Former Fire Stations Groundwater Characterization Work Plan Portland International Airport Portland, Oregon ECSI No. 3324

Prepared for:
Port of Portland

August 15, 2024
32-23006356

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Carmen Owens, P.E.
Associate Engineer

REGISTERED PROFESSIONAL ENGINEER
15,147 PE
OREGON
OCT. 2, 1990
HERBERT F. CLOUGH
EXPIRES: DEC. 31, 2025

Herb Clough, P.E.
Principal Engineer

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1.0 Introduction

This Work Plan for site characterization at the Former Fire Stations (Work Plan) provides the Oregon Department of Environmental Quality (DEQ) with a scope of work to conduct groundwater sampling in the vicinity of the of the two Former Fire Stations (Figures 1 and 2) identified as an area of interest (AOI) in the *Preliminary Assessment: Aqueous Film-Forming Foam Use* (Preliminary Assessment; Apex, 2017). Work at the Site is being conducted with oversight from the Oregon Department of Environmental Quality (DEQ) in accordance with the Voluntary Cleanup Agreement between the DEQ and the Port of Portland (Port) for ECSI No. 3324, dated February 8, 2017.

1.1 Purpose

The purpose of this Work Plan is to describe the scope of work to be completed to define the nature and extent of per- and polyfluoroalkyl substances (PFAS) in groundwater near the Former Fire Stations at the Portland International Airport (PDX). The Former Fire Stations were identified as an AOI because of potential application and use of extinguishing agents containing PFAS.

1.2 Site Description

The Former Fire Stations are located in the northwest portion of PDX (Figure 2). The first fire station was in operation from 1960 to 1972. The second station was located southwest of the original and was in operation from 1972 to 1997. Historical activities included firetruck and equipment storage and associated training (e.g., operation of pumps, loading of concentrate) and equipment maintenance.

1.3 Overview of Hydrogeology

Hydrogeological units present beneath PDX include the overbank deposit (OD) and the Columbia River sand aquifer (CRSA). The OD consists of fine-grained sediments deposited in floodplains adjacent to river channels. In this environment, natural levees are present along the riverbank immediately adjacent to the channel and are thickest at the channel bank and thin toward the floodplain. The OD aquifer is present throughout PDX and is typically between 50 and 60 feet thick, though the overall range is from 20 to 110 feet. Based on the well log for monitoring well TCORE-3, the OD could be as much as 110 feet thick in the vicinity of the former fire stations. Based on results from exploratory borings, the OD consists of soft to stiff, gray (upper portions may be brown) layers of silty clay, silt, silty sand, and sandy silt, with occasional organic or wood debris. Individual layers vary from 5 to 20 feet in thickness. Sandy layers are more likely to be present in the lower portion of this unit, especially where it transitions to the CRSA (if present). Dredge sand fill placed during airport development is present at the ground surface throughout much of PDX.

Groundwater flow has variable direction and hydraulic gradient across the Site, with the dominant groundwater flow direction in the nearby fire training area to the north-northwest (towards the Columbia River). It is expected that groundwater flow at the Former Fire Stations will show a similar gradient.

The CRSA fills a former channel of the ancestral Columbia River, just south of the present-day Columbia River channel. This paleochannel segment has a depth of more than 300 feet, eroded within older sedimentary units such as the Troutdale Gravel Aquifer and Confining Unit 1. The approximate southern extent of this channel generally corresponds to the southern limit of PDX. Where present, the top of the CRSA ranges from 20 to 110 feet below ground surface (bgs). The CRSA is comprised of medium-dense to dense, gray, gray-brown, or black fine- to medium-grained, quartz-rich basaltic sand.

Groundwater flow direction in the CRSA is typically to the north-northeast; however, flow has been observed to the west-southwest when the Columbia River is at flood stage.

2.0 Scope of Work

To date, groundwater reconnaissance monitoring in several existing monitoring wells has verified the presence of PFAS in the OD in the vicinity of the Former Fire Stations. Detected concentrations of PFAS in this vicinity are greater than PFAS concentrations in the nearest Fire Training Facilities monitoring wells, suggesting the potential for source area(s) associated with the Former Fire Stations.

Overbank Deposit. Eight OD monitoring wells will be gauged and sampled. Six of these are existing wells installed for prior investigations of jet fuel releases in the vicinity of Concourse C. Two new OD wells are proposed as shown on Figure 3 (well installation methods are discussed below).

CRSA. Three CRSA monitoring wells will be gauged and sampled. One is an existing well installed for the Terminal Core Redevelopment (TCORE) project. Two new CRSA wells are proposed as shown on Figure 3 (well installation methods are discussed below). The proposed locations of the wells may be adjusted to maintain safe airfield operations.

Well logs for the existing monitoring wells proposed for sampling at the Former Fire Stations area are provided in Appendix A.

3.0 Investigation Activities

The scope of work includes monitoring well installation along with groundwater sampling and analysis. Detailed field and sampling procedures are described in the Sampling and Analysis Plan (SAP) provided in Appendix B.

3.1 Preparatory Activities

Property Access. Apex will provide notification to Port personnel and Port Operations (OPS) to coordinate access to the Site at PDX. The notification will be submitted to OPS one week in advance and include the following:

- Port project manager contact information;
- Apex project manager and PDX field staff contact information;
- Summary of field work;
- Site plan showing work locations;
- Ingress and egress locations for Apex and subcontractors;
- List of subcontractors; and
- Work schedule.

Depending on the location of work, either a Port escort will be provided or badged Apex employees will escort un-badged subcontractor(s). Airside OPS will be notified of the contractors' arrival and departure.

Underground Utility Location. Apex's project manager or designee will mobilize to the Site to mark out the proposed sampling locations with marking paint in order to enable identification of nearby underground utilities by Dig-Alert/Underground Service Alert (USA). Because Dig-Alert does not mark out underground utilities on private property and because the drilling activities will be performed inside the boundaries of the Site, Port personnel will conduct an underground utility locate to mark out underground utilities located within the proximity of each proposed sampling location prior to performing the subsurface work.

If any underground utilities are identified within 5 feet of a proposed sampling location, Apex will adjust the proposed sampling location before drilling commences. Apex will also adjust the proposed drilling location to provide a safety buffer for buildings, heavy traffic areas, overhead utilities, and similar Site features so that sampling can be performed safely and with minimal disruption to existing businesses.

As an additional safety measure, all borings will be hand-cleared using a hand auger, air-knife, or post hole digger to approximately 5 feet bgs.

Site Health and Safety Plan. A Site-specific health and safety plan (HASP) has been prepared for the proposed activities (Appendix C). The HASP was prepared in general accordance with the Occupational Safety and Health Administration (OSHA) and the Oregon Administrative Rules (OAR). A copy of the HASP will be maintained on-site during the field activities.

3.2 Field Activities

Groundwater Levels. Groundwater levels will be measured prior to collecting samples. The wells will be opened to allow water levels to equilibrate before the measurements are recorded. The depth to groundwater, free product, and/or sheen will be measured in each well to the nearest 0.01 foot using an electronic oil-water interface probe.

Groundwater Monitoring. Wells will be sampled using low-flow methods with a peristaltic pump and dedicated PFAS-free tubing. Prior to the collection of groundwater samples, pH, conductivity, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured using a water parameter meter with flow cell connected to the discharge tubing of the sample pump for samples collected from the monitoring wells. Turbidity of the water will be monitored visually, and the color and clarity of the water will be recorded on the sampling data sheet. Purging will be considered complete when the water quality parameters have stabilized to within 10 percent and the water is visually clear for three consecutive three-minute intervals.

Samples will be transferred into laboratory-supplied containers, stored below 6 degrees Celsius (°C), and submitted to Enthalpy Analytical, a state-certified laboratory, under chain-of-custody protocol. Field observations and measurements made during groundwater monitoring will be recorded in field notes. Additional groundwater sampling procedures, sample handling, and quality assurance/quality control (QA/QC) procedures are detailed in the SAP (Appendix B).

Monitoring Well Installation. Four groundwater monitoring wells will be installed in the vicinity of the Former Fire Stations at the locations shown on Figure 3. Two wells (MW-101 and MW-102) will be installed in the OD to an approximate depth of 20 feet bgs based on recent and historical groundwater levels. Two wells (DW-101 and DW-102) will be installed in the upper CRSA to an approximate depth of 80 to 100 feet bgs based on the estimated depth of 70 to 90 feet to the OD/CRSA contact. The final depth of each CRSA well will be determined based on lithologic conditions with the top of the screen approximately 10 feet below the OD/CRSA contact.

The monitoring wells will be installed using sonic drilling methods. They will be constructed of 2-inch diameter, Schedule 40 PVC casing with 10 feet of Schedule 40 PVC screen with 0.010-inch slots. A clean 20/30 silica sand pack will be placed between the boring wall and the PVC screen and riser from the bottom of the well to approximately 1 to 2 feet above the screened interval. A bentonite seal will be placed above the sand pack to within approximately 1 to 2 feet of the ground surface. The bentonite seal will be placed through a side-discharge Tremie pipe to ensure positive placement without bridging or wash-out of previously placed annular materials. The seal will displace standing fluid in the zone and set up without being diluted by formation water. The surface will be completed with a traffic-rated flush-mounted concrete well pad and monument. A watertight locking cap and lock will secure the wellhead, and tamper-resistant bolts will secure the monument cover.

Lithologic descriptions will be prepared for the full length of the borings. Soil cores will be screened for volatile organic compounds (VOCs) using a photoionization detector (PID). Lithologic descriptions will be prepared in general accordance with ASTM 2487/2488. Soil samples will not be collected unless there are field indications of soil impacts.

Additional monitoring well installation procedures are detailed in the SAP (Appendix B).

Handling of Investigation-Derived Waste. Investigation-derived waste (IDW) will consist of purge water, soil, and decontamination water. Purge and decontamination IDW water will be discharged within the containment area of the current Fire Training Facility. The IDW water will not be discharged to the fire training pit if it contains sediment. Soil will be placed in properly labeled Oregon Department of Transportation-approved drums. A sample of the soil will be collected for disposal profiling. The drums will be stored at the designated PDX IDW storage area pending receipt of chemical data. Sampling materials and personal protective equipment will be disposed of as solid waste.

4.0 Analytical Program

Groundwater samples will be analyzed for PFAS by Environmental Protection Agency Method 1663 which includes 40 compounds. This method was finalized for aqueous matrices in July 2023. Samples will be analyzed on a standard turnaround time (approximately 28 days for PFAS). The SAP in Appendix B discusses the analytical program in detail.

QA/QC procedures will be used throughout this project. The SAP in Appendix B describes the QA plan for this project, including sampling and custody procedures, QA sampling analyses, detection limit goals, laboratory QC, and QA reporting.

5.0 Reporting

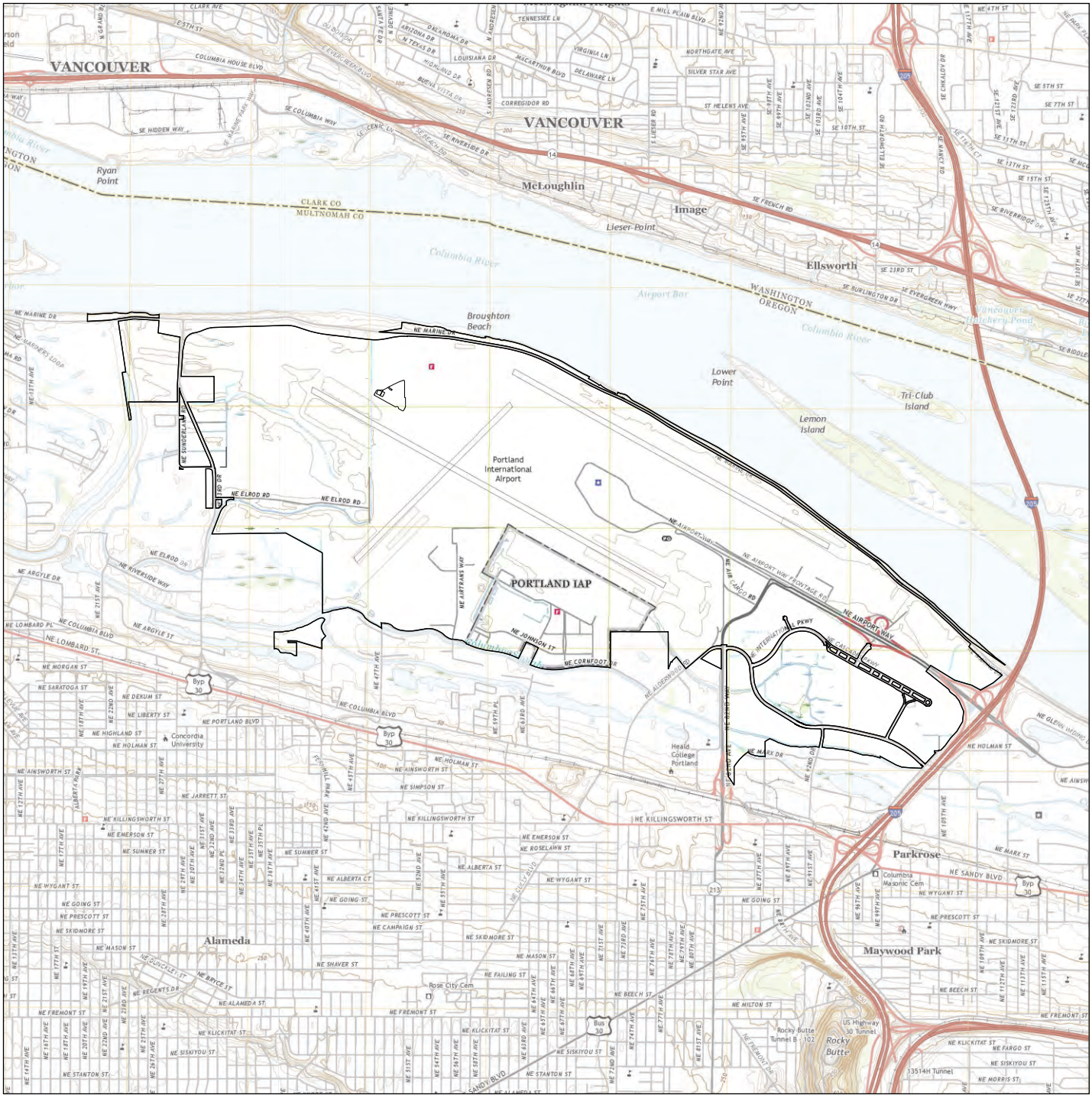
A groundwater data report will be prepared presenting the results of the groundwater monitoring, a screening of chemical results, and recommendations based on those results.

Table 1
Former Fire Stations Site Characterization Plan
Portland International Airport
Portland, Oregon

Water Bearing Zone	Work Phase	Well ID	Well Screen Interval (ft bgs)	Well Log ID
Overbank Deposit (OD)	Existing	MW-1 MW-6 MW-8 MW-11-L58501 MW-12-L58397 MW-14		MULT_111765 MULT_64211 MULT_68450 MULT_68452 MULT_68922 MULT_68924
	Proposed	MW-101 MW-102	-- --	-- --
Columbia River Sand Aquifer (CRSA)	Existing	TCORE-3		MULT_135484
	Proposed	DW-101 DW-102	-- --	-- --

Notes:

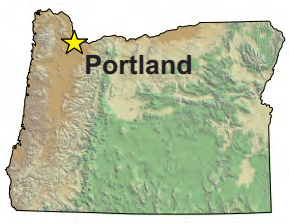
1. TCORE = Terminal Core Redevelopment
2. ft bgs = feet below ground surface



Note: Base map prepared from USGS 7.5-minute quadrangle of Portland and Mount Tabor, WA-OR, dated 2020 as provided by USGS.gov.

0 4,000 8,000

Approximate Scale in Feet



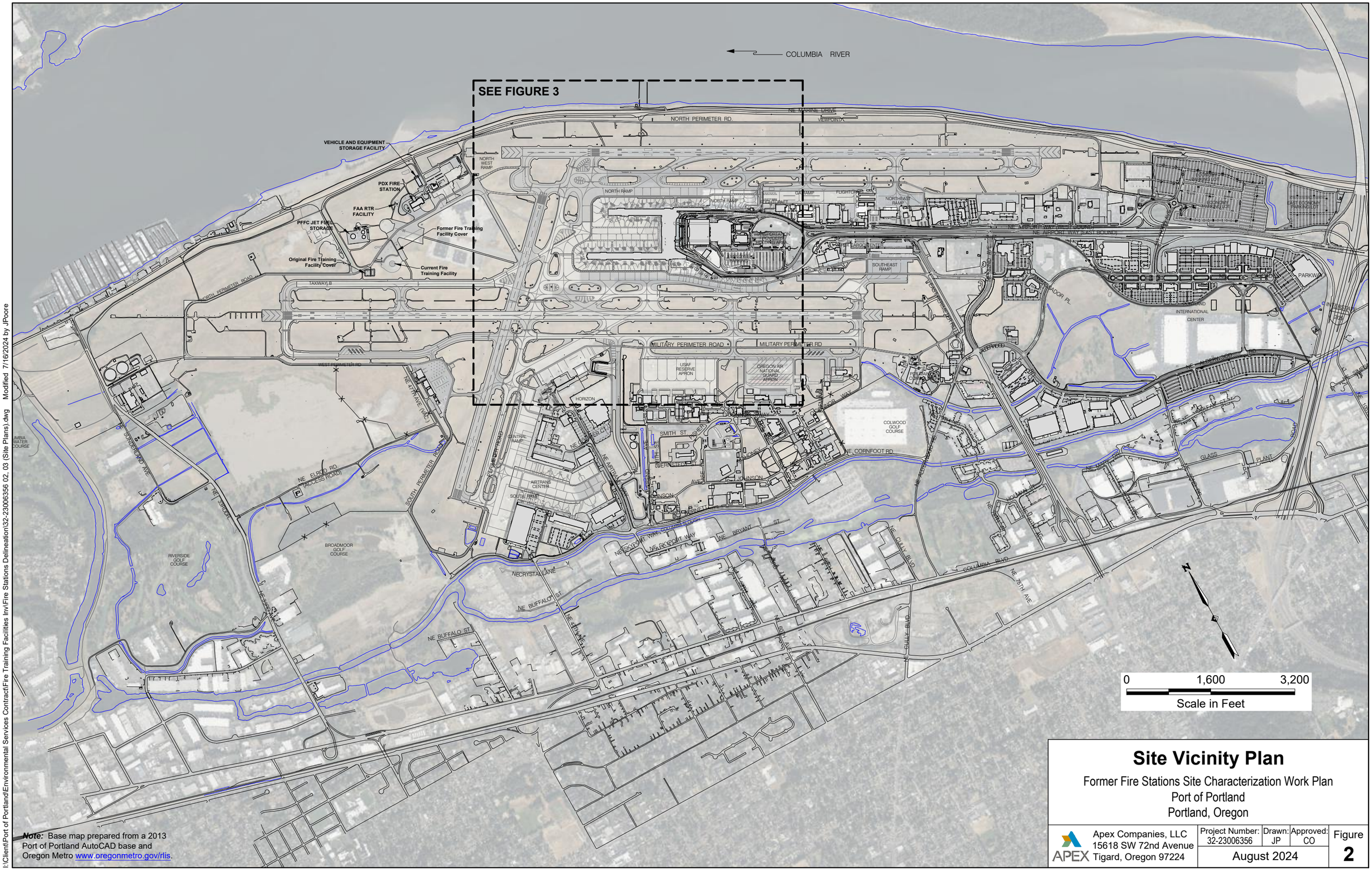
N

Site Location Map

Former Fire Stations Site Characterization Work Plan
Port of Portland
Portland, Oregon

Apex Companies, LLC 15618 SW 72nd Avenue Tigard, Oregon 97224	Project Number: 32-23006356	Drawn: JP	Approved: CO	Figure 1
	August 2024			

I:\Client\Port of Portland\Environmental Services Contract\Fire Training Facilities Inv\Fire Stations Delineation\32-23006356 01 (Site Location).des



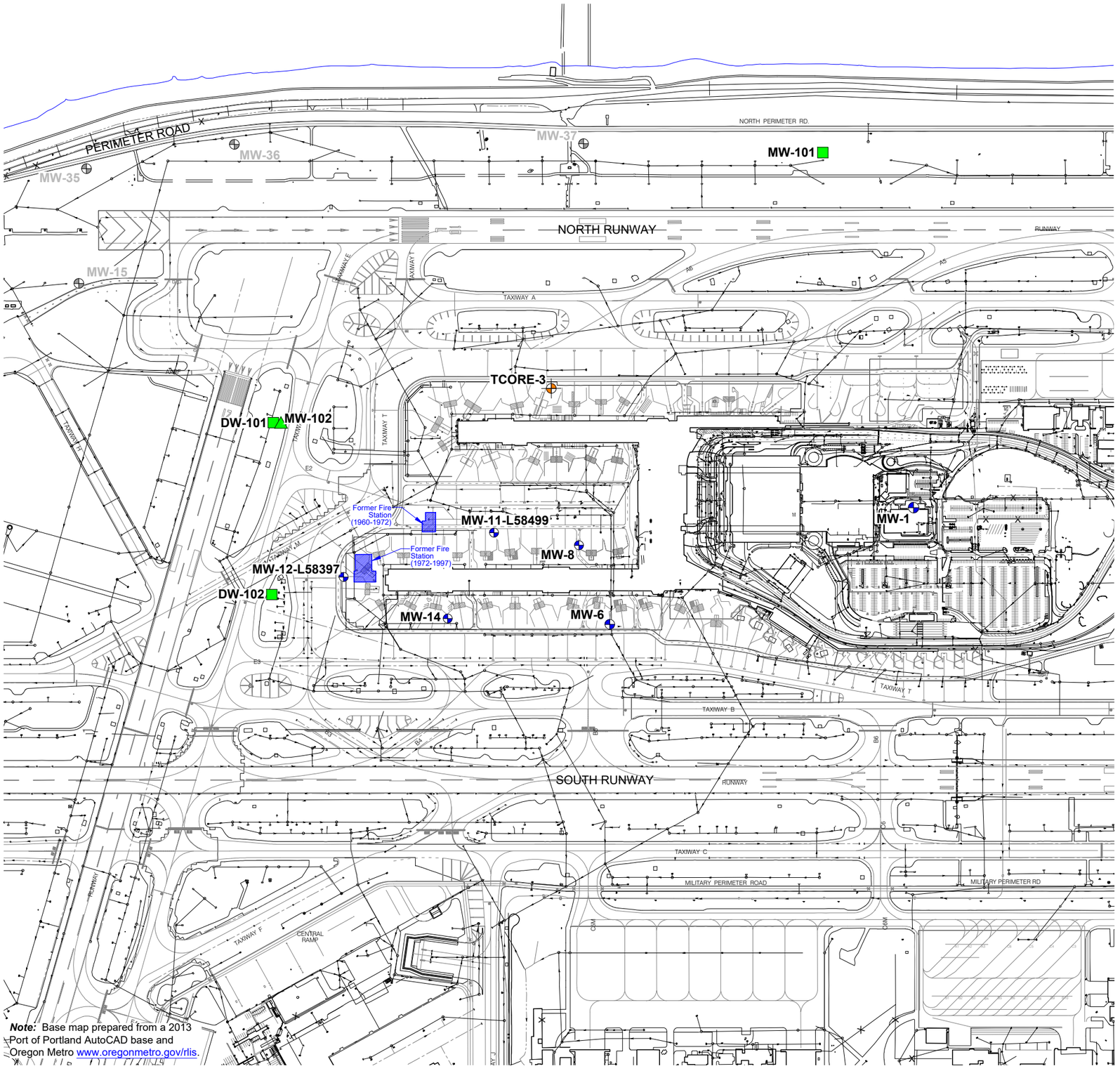
Note: Base map prepared from a 2013 Port of Portland AutoCAD base and Oregon Metro www.oregonmetro.gov/rlis.

Site Vicinity Plan

Former Fire Stations Site Characterization Work Plan
Port of Portland
Portland, Oregon

Apex Companies, LLC 15618 SW 72nd Avenue Tigard, Oregon 97224	Project Number: 32-23006356	Drawn: JP	Approved: CO	Figure 2
	August 2024			

I:\Client\Port of Portland\Environmental Services Contract\Fire Training Facilities Inv\Fire Stations Delineation\32-23006356 02, 03 (Site Plans).dwg Modified 7/16/2024 by JPoore



Note: Base map prepared from a 2013 Port of Portland AutoCAD base and Oregon Metro www.oregonmetro.gov/rlis.

Legend:

- **MW-8** — Existing Overbank Deposit (OD) Monitoring Well Location
- **TCORE-3** — Existing Columbia River Sand Aquifer (CRSA) Monitoring Well Location
- Proposed OD Monitoring Well Location
- Proposed CRSA Monitoring Well Location
- Underground Storm Sewer Pipeline
- Underground Subdrain Sewer Pipeline
- Abandoned Storm Sewer Pipeline
- Catch Basin
- Manhole
- Cleanout

0 600 1,200

Scale in Feet

Former Fire Stations Monitoring Program

Former Fire Stations Site Characterization Work Plan
Port of Portland
Portland, Oregon

Apex Companies, LLC 15618 SW 72nd Avenue Tigard, Oregon 97224	Project Number: 32-23006356	Drawn: JP	Approved: CO	Figure 3
	August 2024			

I:\Client\Port of Portland\Environmental Services Contract\Fire Training Facilities Inv\Fire Stations Delineation\32-23006356 02, 03 (Site Plans).dwg Modified 7/16/2024 by JPoore

Appendix A

Monitoring Well Logs

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OR 690-240-095)

Instructions for completing this report are on the last page of this form.

MULT 64211

RECEIVED
JUN 21 2001
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Start Card # 134984 L43919

(1) OWNER/PROJECT:

WELL NO. MW-6

Name Port of Portland

Address 7000 NE Airport Way

City Portland State OR Zip 97218

(2) TYPE OF WORK:

X New construction | | Alteration (Repair/Recondition)

| | Conversion | | Deepening | | Abandonment

(3) DRILLING METHOD

| | Rotary Air | | Rotary Mud | | Cable

| X | Hollow Stem Auger | | Other

(4) BORE HOLE CONSTRUCTION

Special Standards | | Yes | X No

Depth of completed well 15 ft.

Land surface

Vault 0 ft. TO 1 ft.

Seal 1 ft. TO 4 ft.

Filter pack 4 ft. TO 15 ft.

Water-tight cover

Surface flush vault

Locking cap

Casing diameter 2 in.

material PVC

Welded | | Threaded | X | Glued | |

Liner

diameter ____ in.

material ____

Welded | | Threaded | | Glued | |

Well seal:

Material Bentonite

Amount 2 bags

Grout weight ____

Borehole diameter 10 in.

Bentonite plug at least 3 ft. thick

Screen

material PVC

interval(s):

From 5 To 15

From ____ To ____

Slot size .010 in.

Filter pack:

Material Sand

Size 10-20 in.

(5) WELL TEST:

| | Pump | | Bailer | | Air | | Flowing Artesian

Permeability ____ Yield ____ GPM

Conductivity ____ PH ____

Temperature of water 51 °F/C Depth artesian flow found ____ ft.

Was water analysis done? | X | Yes | | No

By whom? ____

Depth of strata to be analyzed. From ____ ft. to ____ ft.

Remarks: ____

Name of supervising Geologist/Engineer ____

(6) LOCATION OF WELL By legal description

Well Location: County Multnomah

Township 1 (N or S) Range 2 (E or W) Section 8

1. NE 1/4 of NW 1/4 of above section.

2. **Either** Street address of well location Same

or Tax lot number of well location 300

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

10 Ft. below land surface. Date 5/24/01

Artesian Pressure ____ lb/sq. in. Date ____

(8) WATER BEARING ZONES:

Depth at which water was first found 10

From	To	Est. Flow Rate	SWL
10	15		10

(9) WELL LOG:

Ground elevation ____

Material	From	To	SWL
Concrete	0	2	
Gravels	2	5	
Silty Sand	5	15	10

RECEIVED
JUL 03 2001
WATER RESOURCES DEPT
SALEM, OREGON

Date started 5/24/01 Completed 5/24/01

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number 10500

Signed Carlos Anguiano Date 6/19/01

(bonded) Monitor Well Constructor Certification:

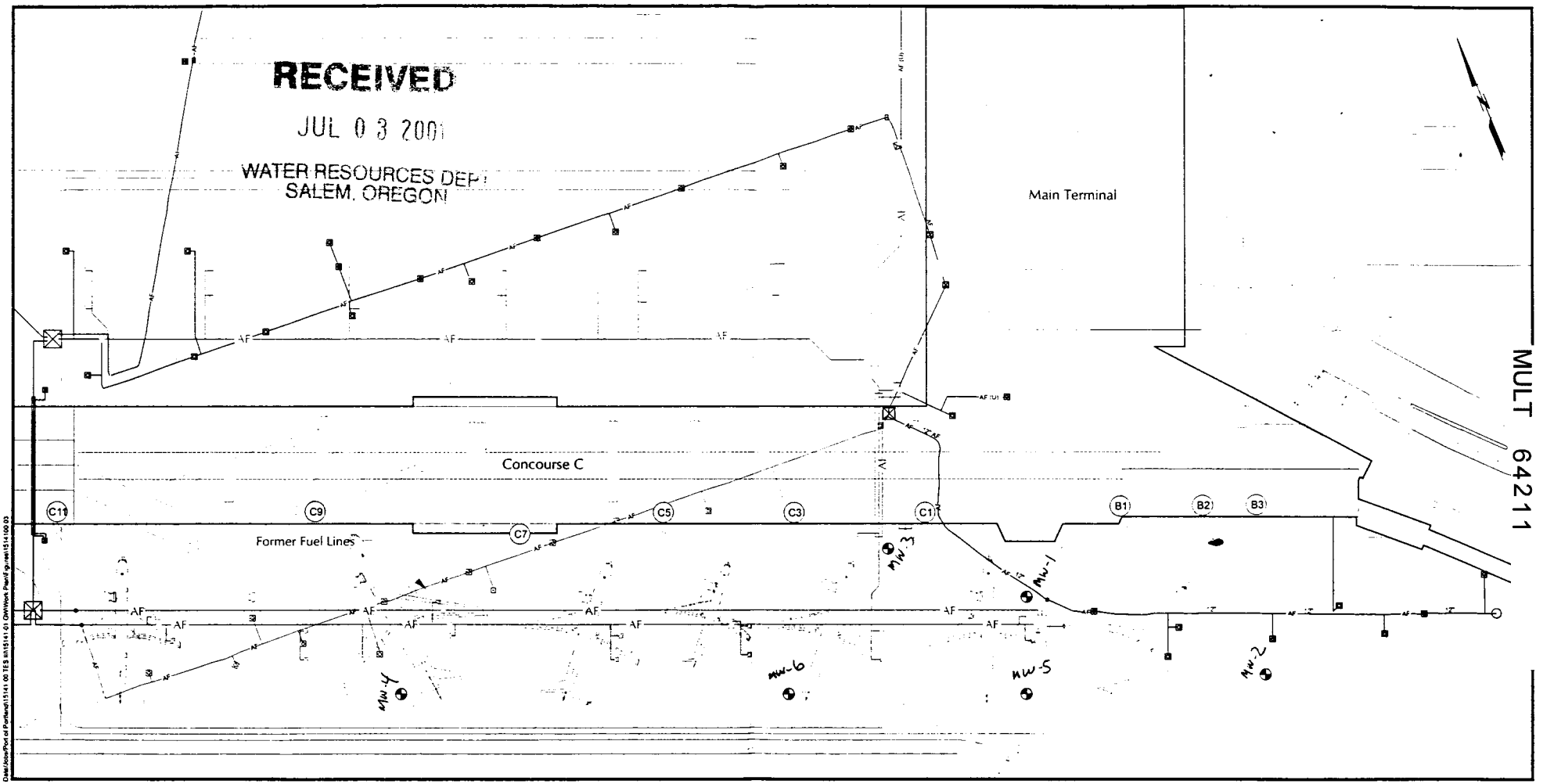
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 1044?

Signed Rick Hatler Date 6/19/01

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

Proposed Monitoring Well Locations
PDX, Terminal Expansion South
Port of Portland



Note: Base map prepared from an AutoCAD map provided by the Port of Portland

Legend:

- MW-T1 — Temporary Well Location and Designation
- B-12 — Boring Location and Designation
- GP-27 — Geoprobe Exploration Location and Designation
- 2,750 (6-8') — Highest TPH-D (Jet Fue) Concentration in Soil in mg/kg (Sample Interval in Feet BGS)
- 13.9 — TPH-D (Jet Fuel) Concentration in Groundwater in mg/L
- B31-51' — Construction Oversight Soil Sample Location and Designation (Sample Locations Without Designation were ND)
- ND — Petroleum Hydrocarbons Not Detected
- Proposed TES Phase II Monitoring Well Location
- —AF— Existing Underground Fuel Line
- — — Former Underground Fuel Line
- —AF— New Underground Fuel Line
- (C9) Gate Number

0 50 100 200
Approximate Scale in Feet

HARTCROWSER
15141-00 4/01
Figure 3

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240 095)

MULT 68450

Instructions for completing this report are on the last page of this form. **Amended Well Report** X

Well ID# L58496

Start Card # 154598

(1) OWNER/PROJECT

WELL NO. MW08

Name Port of Portland

Address 7120 NE Airport Way.

City Portland State OR Zip 97218

(2) TYPE OF WORK

X New construction [ ] Alteration (Repair/Recondition)

[ ] Conversion [ ] Deepening [ ] Abandonment

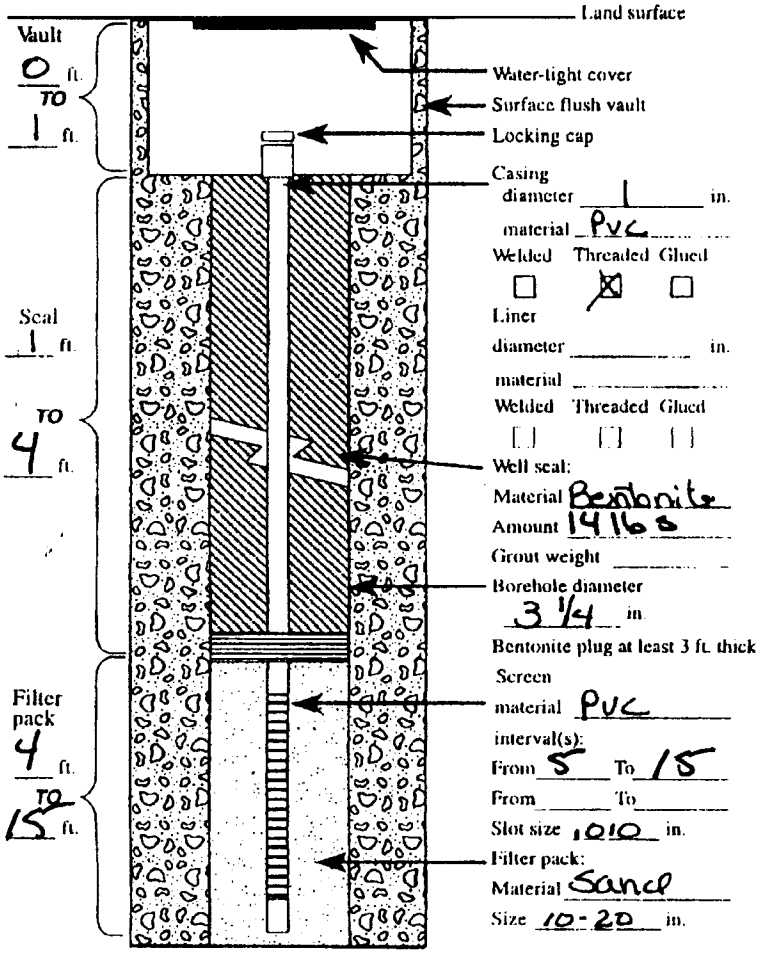
(3) DRILLING METHOD

[ ] Rotary Air [ ] Rotary Mud [ ] Cable

[ ] Hollow Stem Auger X Other Push Probe

(4) BORE HOLE CONSTRUCTION:

Special Standards [ ] Yes [X] No Depth of Completed Well 15 ft.



(5) WELL TESTS:

[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Permeability Yield GPM

Conductivity PH

Temperature of water 54 F/C Depth artesian flow found ft.

Was water analysis done? [ ] Yes X No

By whom?

Depth of strata to be analyzed. From ft. to ft.

Remarks:

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description:

County Multnomah Latitude Longitude

Township 1 (N or S) Range 2 (E or W) Section 8

SE 1/4 of SW 1/4 of above section.

Street address of well location 7120 NE Airport Way

Tax lot number of well location 300

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

9.6 Ft. below land surface. Date 1/7/03

Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found

From	To	Est. Flow Rate	SWL
9.6	15		9.6

(9) WELL LOG:

Ground Elevation

Material	From	To	SWL
Silty Sand	0	15	9.6

JUL 24 2003

RECEIVED

FEB 05 2003

WATER RESOURCES DEPT
SALEM, OREGON

Date started 1/7/03 Completed 1/7/03

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

Signed Brian R. Gallo MWC Number 1044

Date 2/3/03

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed MWC Number 1001

Date 2/3/03

ORIGINAL COPY - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

MULT 68450

Well ID# L58496

Start Card # 154598

Instructions for completing this report are on the last page of this form. Amended Well Report X

(1) OWNER/PROJECT WELL NO. MW 10

Name Port of Portland

Address 7120 NE Airport Way.

City Portland State OR Zip 97218

(2) TYPE OF WORK

X New construction [ ] Alteration (Repair/Recondition)

[ ] Conversion [ ] Deepening [ ] Abandonment

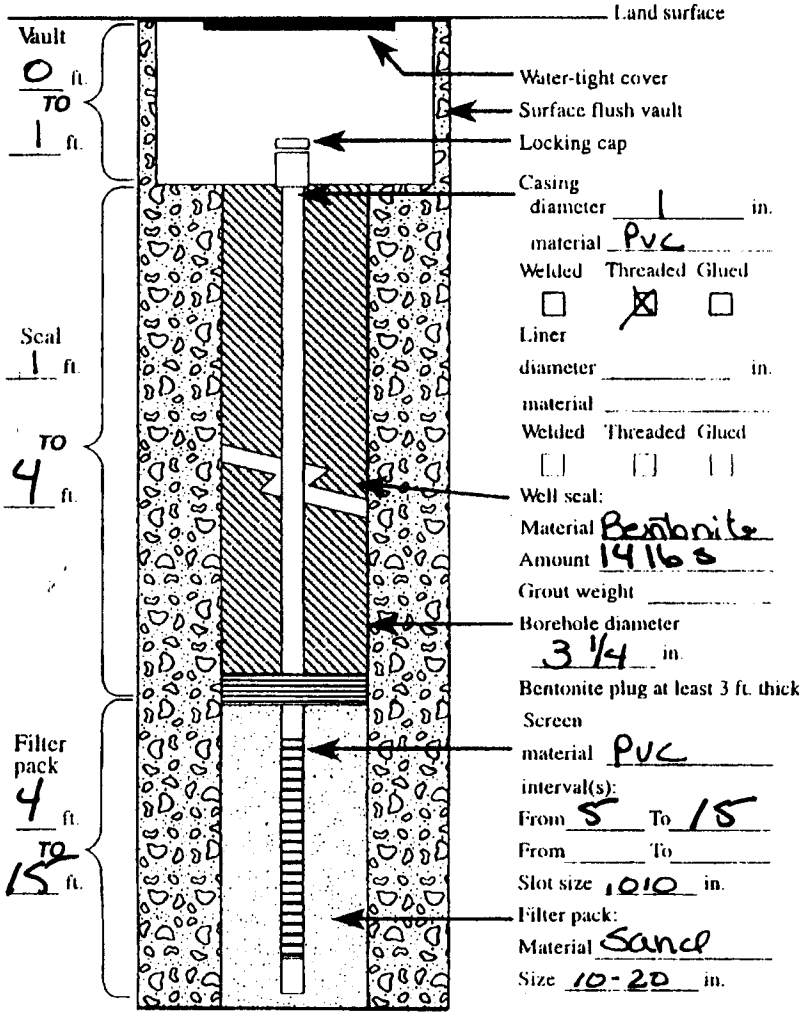
(3) DRILLING METHOD

[ ] Rotary Air [ ] Rotary Mud [ ] Cable

[ ] Hollow Stem Auger X Other Push Probe

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes [ ] No [X] Depth of Completed Well 15 ft.



(5) WELL TESTS:

[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Permeability Yield GPM

Conductivity PH

Temperature of water 54 F/C Depth artesian flow found ft.

Was water analysis done? [ ] Yes X No

By whom?

Depth of strata to be analyzed. From ft. to ft.

Remarks:

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description:

County Multnomah Latitude Longitude

Township 1 (N or S) Range 2 (E or W) Section 8

SE 1/4 of SW 1/4 of above section.

Street address of well location 7120 NE Airport Way

Tax lot number of well location 300

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

9.6 Ft. below land surface. Date 1/7/03

Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found

From	To	Est. Flow Rate	SW
9.6	15		9.6

(9) WELL LOG:

Ground Elevation

Material	From	To	SW
Silty Sand	0	15	9.6

RECEIVED
FEB 05 2003
WATER RESOURCES DEPT
SALEM, OREGON

Date started 1/7/03 Completed 1/7/03

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

Signed Burk R. Gallo MWC Number 1044

Date 2/3/03

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed [illegible] MWC Number 1001

Date 2/3/03

ORIGINAL COPY - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240 095)

MULT 68450

Well ID# L5484946

Start Card # 154598

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT

WELL NO. MW 10

Name Port of Portland

Address 7120 NE Airport Way

City Portland · State OR Zip 97218

(2) TYPE OF WORK

[X] New construction [ ] Alteration (Repair/Recondition)

[ ] Conversion [ ] Deepening [ ] Abandonment

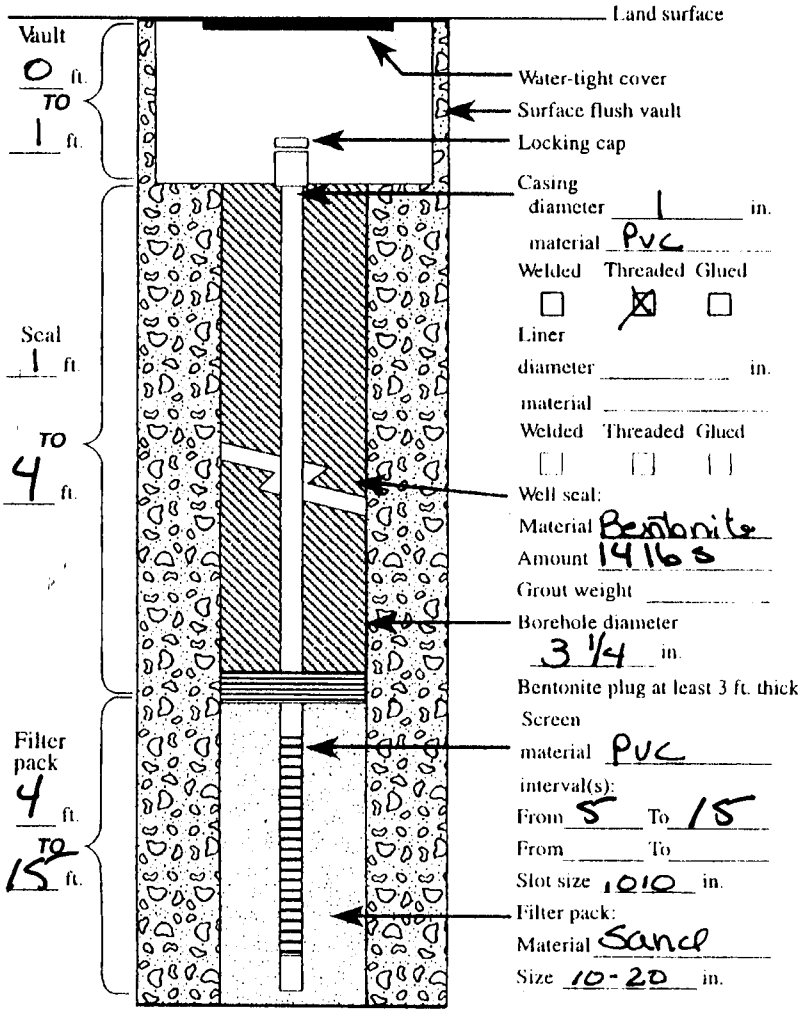
(3) DRILLING METHOD

[ ] Rotary Air [ ] Rotary Mud [ ] Cable

[ ] Hollow Stem Auger [X] Other Push Probe

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes [ ] No [X] Depth of Completed Well 15 ft.



(5) WELL TESTS:

[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian

Permeability Yield GPM

Conductivity PH

Temperature of water 54 F/C Depth artesian flow found ft.

Was water analysis done? [ ] Yes [X] No

By whom?

Depth of strata to be analyzed. From ft. to ft.

Remarks:

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description:

County Multnomah Latitude Longitude

Township 1 (N or S) Range 2 (E or W) Section 8

SE 1/4 of SW 1/4 of above section.

Street address of well location 7120 NE Airport Way

Tax lot number of well location 300

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

9.6 Ft. below land surface. Date 1/7/03

Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found

From	To	Est. Flow Rate	SWL
9.6	15		9.6

(9) WELL LOG:

Ground Elevation

Material	From	To	SWL
Silty Sand	0	15	9.6

RECEIVED
FEB 05 2003
WATER RESOURCES DEPT
SALEM, OREGON

Date started 1/7/03 Completed 1/7/03

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

Signed [signature] MWC Number 1043

Date 2/3/03

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed [signature] MWC Number 1001

Date 2/3/03

ORIGINAL COPY - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER

MULT 68450

MULT 68924
MULT 68924

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

Amended Well Report ☆ Well ID# LS8399

Start Card # 154692

(1) OWNER/PROJECT

WELL NO. MW14

Name Port of Portland

Address 7120 NE Airport Way

City Portland State OR Zip 97218

(2) TYPE OF WORK

☒ New construction ☐ Alteration (Repair/Recondition)

☐ Conversion ☐ Deepening ☐ Abandonment

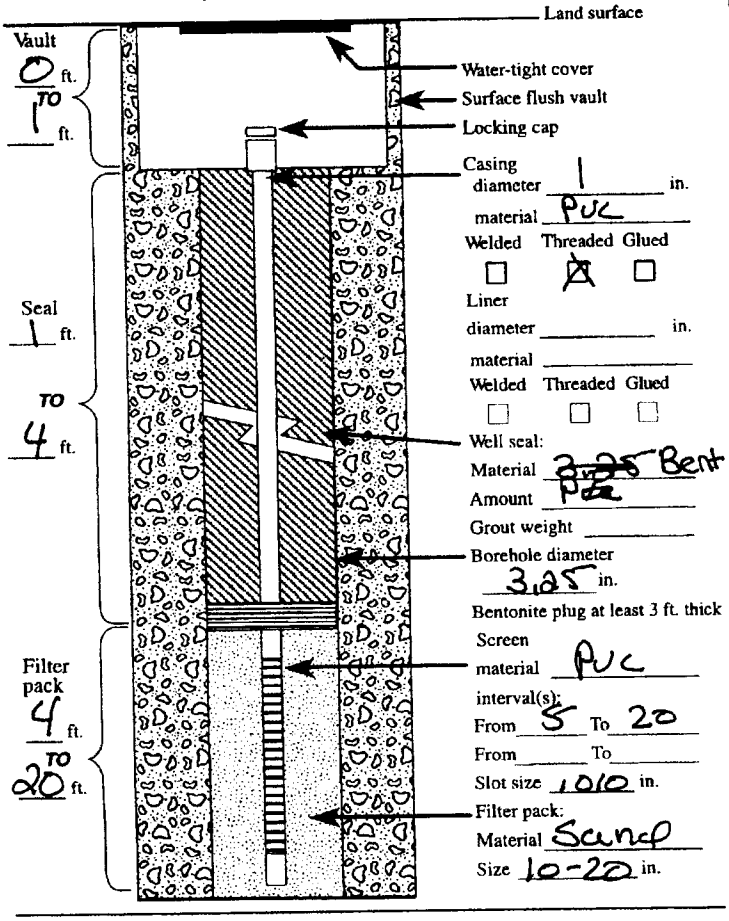
(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable

☐ Hollow Stem Auger ☒ Other Push Probe

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes ☐ No ☒ Depth of Completed Well 20 ft.



(5) WELL TESTS:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ____ Yield ____ GPM

Conductivity ____ PH ____

Temperature of water 54 °F/C Depth artesian flow found ____ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? ____

Depth of strata to be analyzed. From ____ ft. to ____ ft.

Remarks: ____

Name of supervising Geologist/Engineer ____

(6) LOCATION OF WELL By legal description:

County Mult Latitude ____ Longitude ____

Township 1 (N or S) Range 2E (E or W) Section 8

SE 1/4 of NW 1/4 of above section.

Street address of well location 7120 NE Airport Way

Tax lot number of well location 300

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

8.97 Ft. below land surface. Date 2/15/03

Artesian Pressure ____ lb/sq. in. Date ____

(8) WATER BEARING ZONES:

Depth at which water was first found 8.97

From	To	Est. Flow Rate	SWL
8.97	20		8.97

(9) WELL LOG:

Ground Elevation ____

Material	From	To	SWL
Concrete	0	2	
Hard Pack Base	2	9.3	
Med. Brown Sandy Silt	9.3	20	

JUL 24 2003

RECEIVED
MAR 14 2003
WATER RESOURCES DEPT
SALEM, OREGON

Date started 2/14/03 Completed 2/15/03

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

MWC Number 1043

Signed [signature] Date 3/13/03

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 1051

Signed [signature] Date 2/18/03

ORIGINAL COPY – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

STATE OF OREGON MULT 68924

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

Well ID# L58399

Start Card # 154692

(1) OWNER/PROJECT WELL NO. _____

Name Port of Portland

Address 7120 NE Airport Way

City Portland State OR Zip 97218

(2) TYPE OF WORK

☒ New construction ☐ Alteration (Repair/Recondition)

☐ Conversion ☐ Deepening ☐ Abandonment

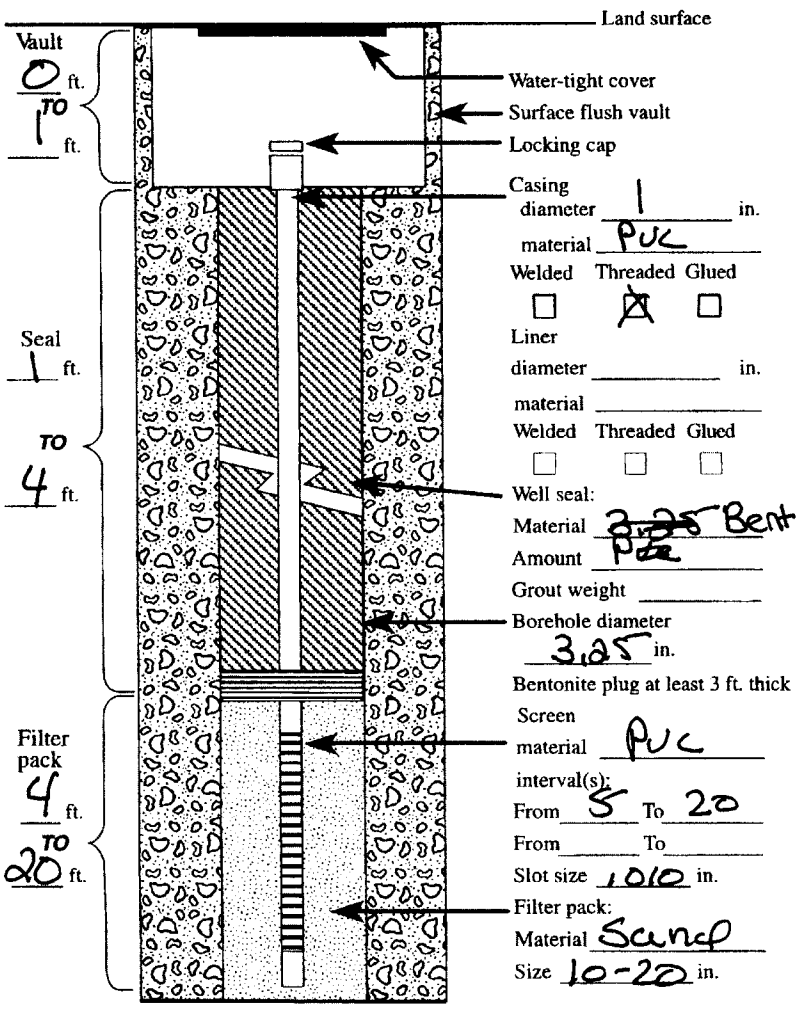
(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable

☐ Hollow Stem Auger ☒ Other Push Probe

(4) BORE HOLE CONSTRUCTION:

Special Standards Yes ☐ No ☒ Depth of Completed Well 20 ft.



(5) WELL TESTS:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability _____ Yield _____ GPM

Conductivity _____ PH _____

Temperature of water 54 °F/C Depth artesian flow found _____ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? _____

Depth of strata to be analyzed. From _____ ft. to _____ ft.

Remarks: _____

Name of supervising Geologist/Engineer _____

(6) LOCATION OF WELL By legal description:

County Mult Latitude _____ Longitude _____

Township 1 (N or S) Range 2 (E or W) Section 8

SE 1/4 of NW 1/4 of above section.

Street address of well location 7120 NE Airport Way

Tax lot number of well location 300

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

8.97 Ft. below land surface. Date 2/15/03

Artesian Pressure _____ lb/sq. in. Date _____

(8) WATER BEARING ZONES:

Depth at which water was first found 8.97

From	To	Est. Flow Rate	SWL
8.97	20		8.97

(9) WELL LOG:

Ground Elevation _____

Material	From	To	SWL
Concrete	0	2	
Hard Packed Base	2	9.3	
Med. Brown Sandy Silt	9.3	20	

RECEIVED
MAR 14 2003
WATER RESOURCES DEPT
SALEM, OREGON

Date started 2/14/03 Completed 2/15/03

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

Signed _____ MWC Number 1043 Date 3/13/03

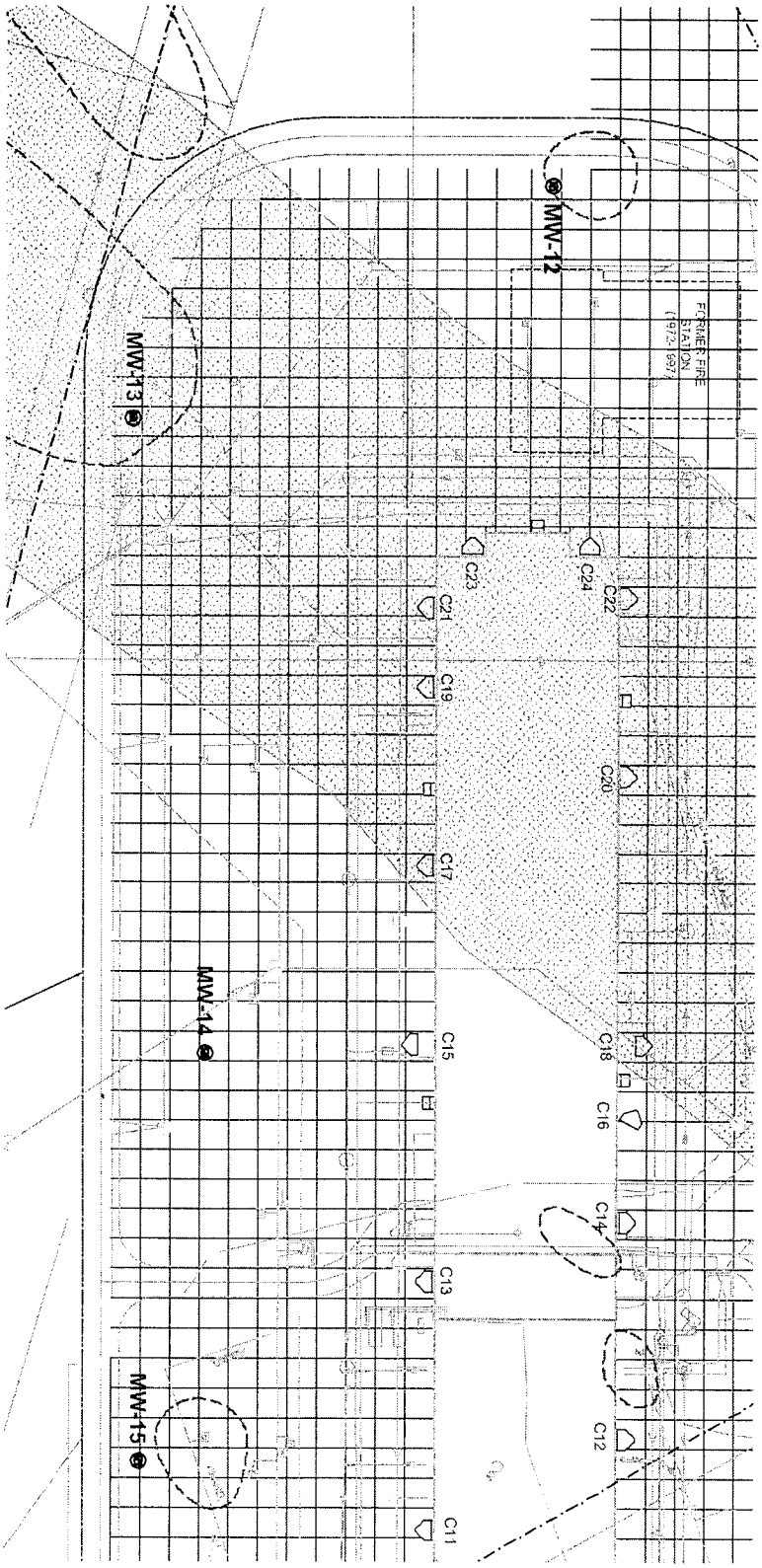
(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

Signed _____ MWC Number 10011 Date 2/18/03

ORIGINAL COPY – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

MULT 68924



MULT 99000

05-08-2009

STATE OF OREGON
MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 87648

START CARD # 1006512

(1) LAND OWNER

Owner Well I.D. #38

First Name _____ Last Name _____

Company PORT OF PORTLAND

Address 121 NW EVERETT ST

City PORTLAND State OR Zip 97208

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☐ Abandonment

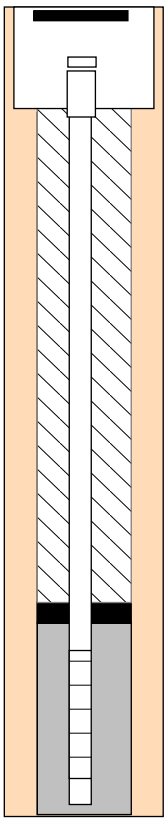
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☒ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☐ Other _____

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 12 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 8.25 From 0 To 12

CASING
Dia. 1 From ☐ 0 To 7
Gauge s80 Wld ☐ Thrd ☒
Material ◯ Steel ◉ Plastic

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld ☐ Thrd ☐
Material ◯ Steel ◯ Plastic

SEAL
From 1 To 5.5
Material Bentonite Grout
Amount 1.00 S Grout weight _____

SCREEN
Casing/Liner Casing Material Plastic
Diameter 1 From 7 To 12
Slot Size .020

FILTER
From 5.5 To 12 Material Silica Sand Size of pack 10/20

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 52 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County **Multnomah** Twp **1.00** N N/S Range **2.00** E E/W WM
Sec **8** **NW** 1/4 of the **SE** 1/4 Tax Lot **0300**
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◯ Nearest address

PORTLAND INTERNATIONAL AIRPORT 7000 NE AIRPORT WAY
PORTLAND, OR 97218 - South Runway

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
Completed Well	04-03-2009		☐	4

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found 6

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
04-03-2009	4	12			☐	4
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
AC/Base Rock	0	1
Sand	1	12

Date Started 04-03-2009 Completed 04-03-2009

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number _____ Date _____

Electronically Submitted
Signed _____

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10563 Date 05-08-2009

Electronically Submitted
Signed FORD STIGALL (E-filed)

Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

MONITORING WELL REPORT - continuation page

MULT 99000

05-08-2009

WELL I.D. # L 87648

START CARD # 1006512

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐
○	○		☐				○	○	☐	☐

SCREENS

Perf/Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	
					☐	

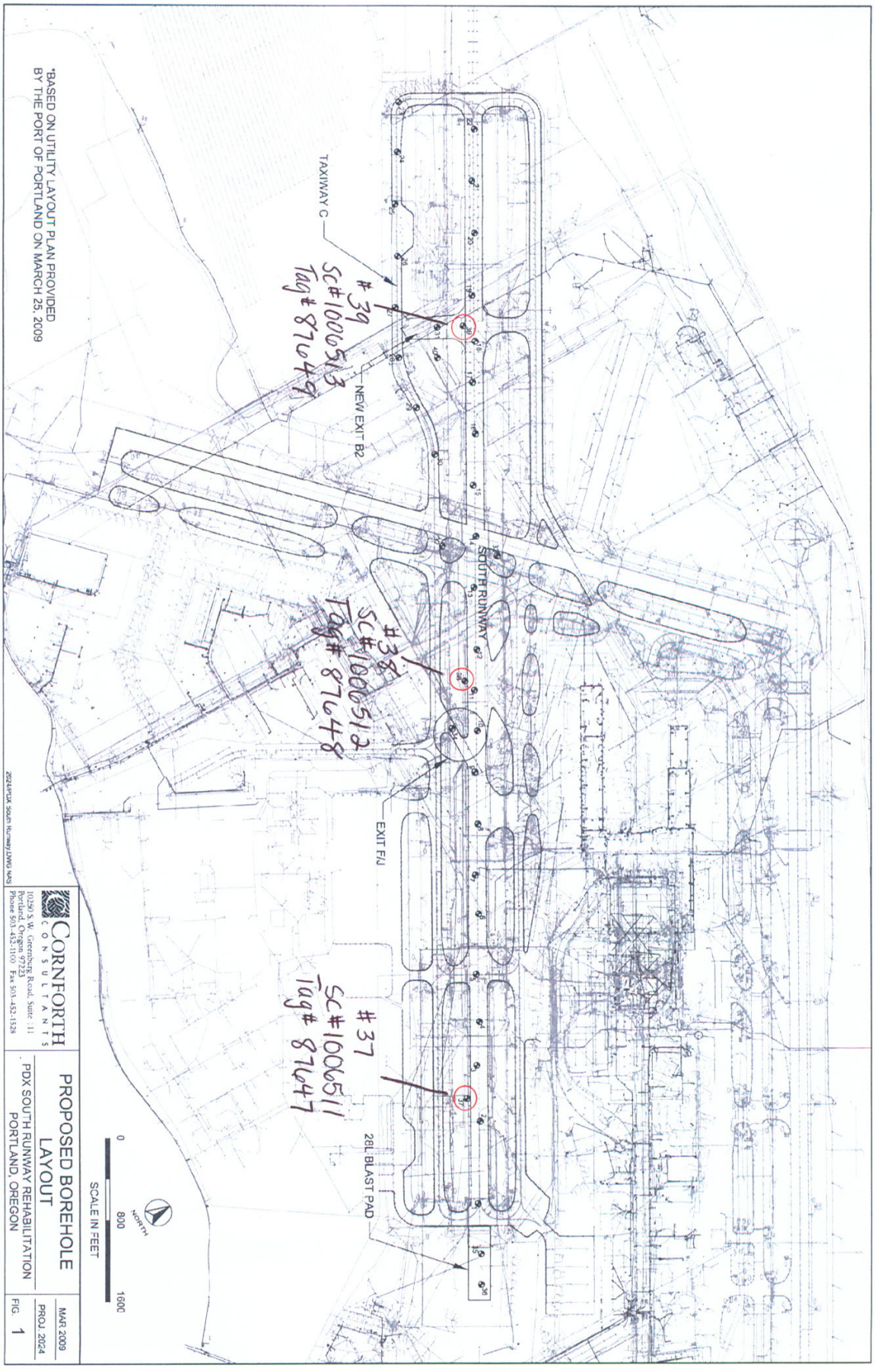
(8) WELL LOG

Material	From	To

Comments/Remarks

Monitoring Well drilled and installed by Richard Wiggins License#1864

Map of well


*BASED ON UTILITY LAYOUT PLAN PROVIDED BY THE PORT OF PORTLAND ON MARCH 25, 2009
TAXIWAY C
NEW EXIT B2
SOUTH RUNWAY
EXIT F/J
28L BLAST PAD
39
SC#1006513
Tag# 87648
38
SC#1006512
Tag# 87648
37
SC#1006511
Tag# 87647
SCALE IN FEET
0
800
1600
NORTH
CORNFORTH CONSULTANTS
PROPOSED BOREHOLE LAYOUT
PDX SOUTH RUNWAY REHABILITATION
PORTLAND, OREGON
MAR 2009
PROJ. 2024
FIG. 1

MULT 135484

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

11/16/2020

WELL I.D. LABEL# L 134816

START CARD # 1049153

(1) LAND OWNER

Owner Well I.D. T-CORE 3

First Name _____ Last Name _____

Company PORT OF PORTLAND

Address PO BOX 3529

City PORTLAND State OR Zip 97208

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☐ Abandonment

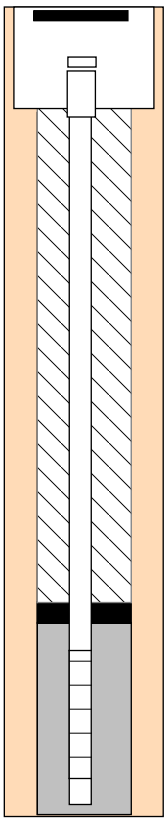
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other SONIC

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 135.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 2.5

BORE HOLE
Diameter 6 From 0 To 135

CASING
Dia. 2 From ☐ 0 To 120
Gauge 40 Wld Thrd
Material ◯ Steel ◉ Plastic ☐ ☒

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯ Steel ◯ Plastic ☐ ☐

SEAL
From 0 To 2.5
Material Cement
Amount 0.5 Sacks Grout weight _____

SCREEN
Casing/Liner Liner Material PVC
Diameter 2 From 117 To 135
Slot Size 0.001

FILTER
From 117 To 135 Material SAND Size of pack 12/20

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 65 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 0 n/a

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 2.00 E E/W WM
Sec 7 SW 1/4 of the SW 1/4 Tax Lot 0400
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◉ Nearest address

7000 NE AIRPORT WAY PORTLAND, OR. 97218

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening			
Completed Well	10/7/2020		119

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found 119.00

SWL Date	From	To	Est Flow	SWL(psi)	+ SWL(ft)

(8) WELL LOG

Ground Elevation _____

Material	From	To
Silty Sands	0	90
Sandy Silts	90	110
Fine grain dark sands	110	135

Date Started 10/7/2020 Completed 10/7/2020

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10578 Date 11/16/2020
Password : (if filing electronically) _____
Signed JEFFREY JOHNSON (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10406 Date 11/16/2020
Password : (if filing electronically) _____
Signed BRIAN GOSE (E-filed)
Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 135484

WELL I.D. LABEL# L 134816

START CARD # 1049153

11/16/2020

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Grout	2.5	117	6	S	

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

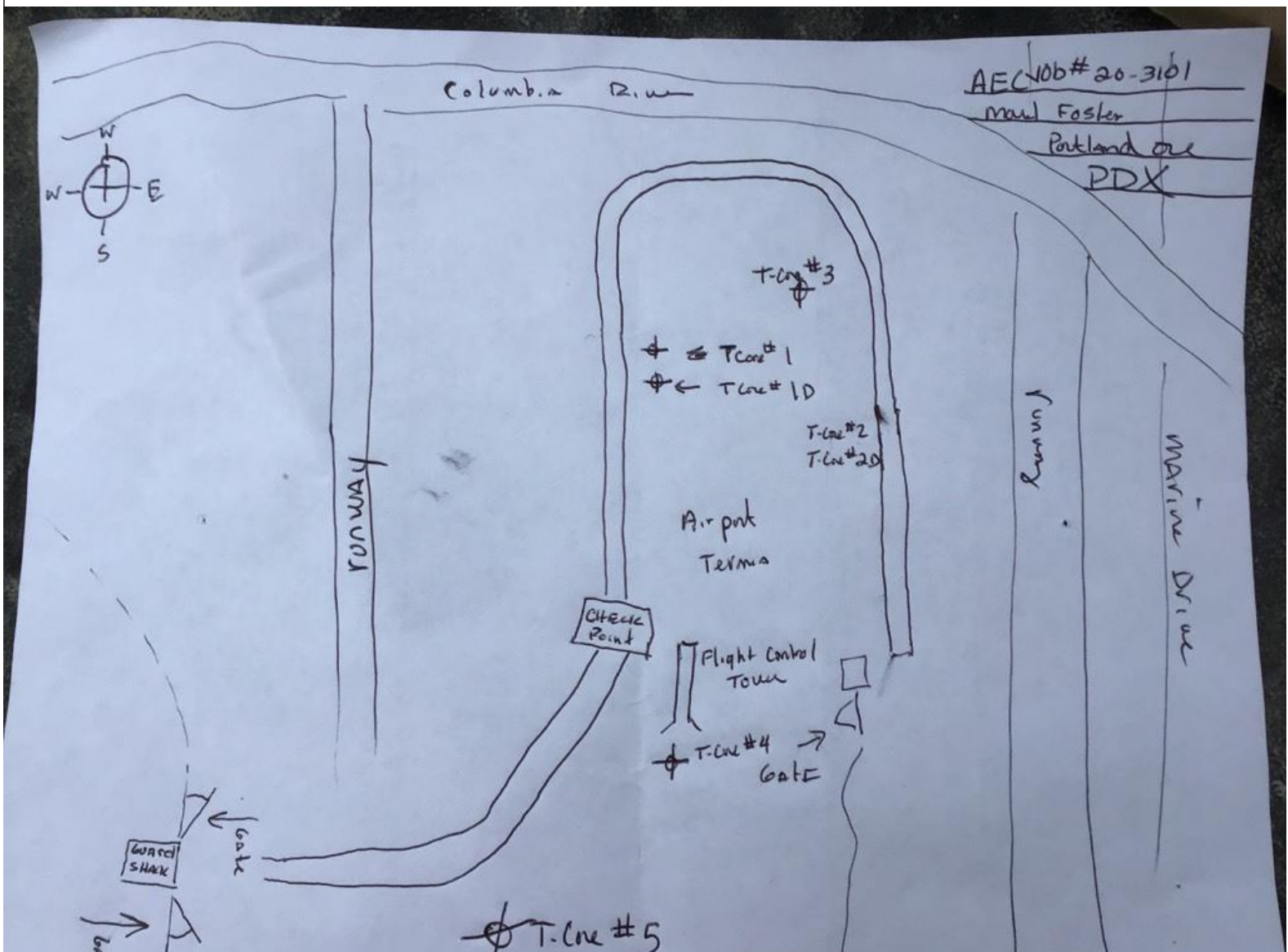
Comments/Remarks

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 135484

11/16/2020

Map of Hole



Appendix B

Sampling and Analysis Plan

1.0 Introduction

This appendix presents the field and sampling procedures and the analytical testing program that will be used to complete the field and analytical work for this project. Quality assurance and quality control (QA/QC) procedures are also discussed in this appendix.

2.0 Field and Sampling Procedures

The project scope of work (SOW) includes collection and chemical analysis of groundwater related to the investigation of the Former Fire Stations at the Portland International Airport (PDX). Data will be used to evaluate current conditions of per- and polyfluoroalkyl substances (PFAS; a component of aqueous film forming foam [AFFF]). The field and sampling procedures include the following:

- Preparatory activities;
- Groundwater elevation measurements;
- Collection of groundwater samples from monitoring wells;
- Soil logging and installation of two overbank deposit (OD) groundwater wells via direct push drilling methods;
- Soil logging and installation of two Columbia River sand aquifer (CRSA) groundwater wells via sonic drilling methods;
- Sample management (i.e., containers, storage, and shipment);
- Decontamination procedures; and
- Handling of investigation-derived waste (IDW).

2.1 Preparatory Activities

Site Health and Safety Plan. A Site-specific health and safety plan (HASP) has been prepared for the proposed activities. The HASP was prepared in general accordance with the Occupational Safety and Health Administration (OSHA) and the Oregon Administrative Rules (OAR). A copy of the HASP will be maintained at the Site during the field activities. Prior to performing any on-site work, Apex will prepare a job safety analysis (JSA) and HASP guiding Site- and project-specific activities, risks, and safety protocols. All field staff and subcontractor personnel supporting the project will be required to review and agree to abide by the HASP. Safety topics will be refreshed daily with the field crew using a daily tailgate safety meeting, to be conducted by Apex's Site Supervisor or Site Safety Officer.

Property Access. Apex will provide notification to Port personnel and Port Operations (OPS). The notification will be submitted to OPS a minimum of one week in advance and include the following:

- Port project manager contact information;
- Apex project manager and field staff contact information;
- Summary of field work;
- Site plan showing work locations;
- Ingress and egress locations for Apex; and
- Work schedule.

Airside OPS will be notified of arrival and departure (Airfield-1 phone is 503-460-4134).

Flagging/Barricading. Portions of the work may be performed within active aircraft operations areas. Work areas and timing will be coordinated with Airside OPS and the Port. Work areas will be designated with cones and vehicles with amber flashing beacons or as required by Airside OPS. Airside OPS will be notified of arrival and departure.

Underground Utility Location. Apex's project manager or designee will mobilize to the Site to mark out the proposed sampling locations with marking paint to enable the identification of nearby underground utilities by Dig-Alert/Underground Service Alert (USA). Because Dig-Alert does not mark out underground utilities on private property and because the drilling activities will be performed inside the boundaries of the Site, Port personnel will conduct an underground utility locate to mark out underground utilities located within the proximity of each proposed sampling location prior to performing the subsurface work.

If any underground utilities are identified within 5 feet of the proposed sampling location, Apex will adjust the proposed sampling location before drilling commences. Apex will also adjust the proposed drilling location to provide a safety buffer for buildings, heavy traffic areas, overhead utilities, and similar Site features so that sampling can be performed safely and with minimal disruption to existing businesses.

As an additional safety measure, all borings will be hand-cleared using a hand auger, air-knife, or post hole digger.

2.2 Groundwater Elevation Measurements

Water level measurements will be collected in general accordance with Apex's Standard Operating Procedure (SOP) 2.16 for water level measurement procedures, provided in this appendix. These measurements will be collected from existing OD and Upper CRSA wells. Well covers and well caps will be opened, and the water level will be allowed to equilibrate under atmospheric conditions for at least five minutes before water level measurements are taken. Depth to water, depth to product, and/or presence of sheen will be recorded in the field notes. Noticeable odors, damage to wells, or other conditions will also be documented in the field notes.

2.3 Collection of Groundwater Samples

Apex will collect groundwater samples in accordance with the low-flow sampling techniques described in SOP 2.5, included in this appendix. Water level monitoring will be attempted during sampling, and pumping drawdown will be restricted to less than 0.3 feet. Groundwater samples collected from OD wells and Upper CRSA wells will be analyzed for PFAS by US Environmental Protection Agency (EPA) Method 1663.

Groundwater samples will be collected using dedicated PFAS-free tubing (e.g., high-density polyethylene [HDPE]) and a peristaltic pump. Existing Site monitoring wells typically include a 10-foot screen interval. During sample collection, the tubing will be placed in the middle of the screened interval. Groundwater will be purged prior to sampling. During purging, groundwater field parameters (pH, oxidation-reduction potential [ORP], dissolved oxygen [DO], specific conductivity, and temperature) will be measured using a flow cell connected to the discharge tubing of the sample pump. Turbidity of the water will be monitored visually with color and clarity being recorded on the sampling data sheet. Purging will be considered complete when the water quality parameters have stabilized to within 10 percent and the water is visually clear for three consecutive three-minute intervals. Sample containers will be provided by the laboratory ready for sample collection. Table B-1 lists sample container requirements.

To avoid PFAS contamination of the groundwater samples, sampling personnel will avoid using items containing polytetrafluoroethylene (PTFE, also known as Teflon), low-density polyethylene (LDPE), or polypropylene as well as other items that contain PFAS, such as aluminum foil, Post-It notes, waterproof field books, markers, chemical ice packs (e.g. blue ice), certain decontamination soaps, and certain product packaging (e.g. such as that found on pre-wrapped foods and snacks). Similarly, many clothing items contain PFAS, such as those coated with Teflon or incorporating a Gore-Tex membrane. Clothing items will only be worn if they have been washed at least six times, and known PFAS-containing products will be avoided during sample collection. Field personnel will avoid the use of cosmetics, moisturizers, and hand cream. Insect repellant and sunscreen will be avoided, and alternative skin barriers (e.g., long sleeve clothing, wide-brimmed hats, etc.) will be used. PFAS contamination prevention protocols will be reviewed with personnel daily during the field activities. Before any samples are collected, the sample handler will wash their hands and wear nitrile gloves while collecting and sealing sample containers.

2.4 Groundwater Monitoring Well Installation

OD Well Installation. Two groundwater monitoring wells will be installed using a Geoprobe direct push drill rig to an approximate depth of 15 to 20 feet bgs (Figure 3) based on recent and historical groundwater levels. They will be located west and northeast of the Former Fire Stations.

The OD monitoring wells will be installed and constructed of 2-inch diameter, Schedule 40 polyvinyl chloride (PVC) casing with 10 feet of Schedule 40 0.010-inch slot PVC screen. A clean 20/30 silica sand filter pack will be placed between the boring wall and the PVC screen and riser from the bottom of the well to

approximately 1 to 2 feet above the screened interval. A bentonite seal will be placed above the sand filter pack to within approximately 1 to 2 feet of the ground surface. The bentonite seal will be placed through a side-discharge Tremie pipe to ensure positive placement without bridging or wash-out of previously placed annular materials. The seal will displace standing fluid in the zone being sealed and will be set without being diluted by groundwater. The surface will be completed with a traffic-rated flush-mounted concrete well pad and monument. A watertight locking cap and lock will secure the wellhead, and tamper-resistant bolts will secure the monument cover.

CRSA Well Installation. Two CRSA groundwater monitoring wells will be installed using a sonic rig to an approximate depth of 80-100 feet bgs, though the final depth will be determined based on actual lithological conditions (Figure 3). Sonic drilling will be conducted using an inner 4-inch diameter casing followed by an outer 6-inch diameter casing that sleeves over the inner casing. Sonic drilling technology combines harmonics (vibration) and rotation as the basis for tool advancement and reduces the volume of IDW created. The sonic drilling technique will also substantially reduce or eliminate communication between strata of different elevations. The inner core barrel will be advanced 10 feet into the subsurface followed by the outer casing. The core barrel will then be removed from the borehole, and the soil will be logged and sampled. Then the core barrel will be returned to the encased borehole and pushed another 10 feet. An additional 10-foot length of casing will be added to the outer casing and advanced to meet the bottom of the core barrel. This process will continue until the total depth is reached.

The CRSA monitoring wells will be installed and constructed of 2-inch diameter, Schedule 40 PVC casing with 10 feet of Schedule 40 PVC screen with 0.010-inch slots. A clean 20/30 silica sand pack will be placed between the boring wall and the PVC screen and riser from the bottom of the well to approximately 1 to 2 feet above the screened interval. A bentonite seal will be placed above the sand pack to within approximately 1 to 2 feet of the ground surface. The bentonite seal will be placed through a side-discharge Tremie pipe to ensure positive placement without bridging or wash-out of previously placed annular materials. The seal will displace standing fluid in the zone being sealed and set up without being diluted by formation water. The surface will be completed with a traffic-rated flush-mounted concrete well pad and monument. A watertight locking cap and lock will secure the wellhead, and tamper-resistant bolts will secure the monument cover.

Lithologic Descriptions. Soil sampling for lithologic descriptions will be conducted for the full length of the borings for OD and CRSA wells. Soil cores will be screened for volatile organic compounds using a photoionization detector (PID), and lithologic descriptions will be made in general accordance with American Society for Testing Materials Standard 2487/2488. If adding water to a boring becomes necessary to prevent or minimize sand heaving during well installation, significantly more water will be removed during well development to confirm removal of added water prior to groundwater sampling. This will ensure collected samples are representative of subsurface conditions.

Documentation. The field geologist will document the well installation and construction activities. Details to be noted include the following:

- Length of well components;
- Measurements of bentonite, sand, and concrete depths;
- Types, brands, weights, and amounts of materials used;
- Documentation of decontamination; and
- Any deviation from standard procedures or problems encountered during the well installation activities.

The drilling contractor will be responsible for conforming to all applicable regulations pertaining to well construction.

Monitoring Well Development. The OD and CRSA wells will be developed to establish a connection with the aquifer. Well development will occur approximately 24 hours after well installation is completed. The wells will be developed by surging and purging a minimum of five casing volumes of water from the well using a downhole pump. Field parameters will be collected during development and include temperature, pH, ORP, DO, and conductivity. Development will be considered complete when the water is visually clear and field parameters have stabilized to within 5 percent of the previous measurement for three consecutive borehole volumes. Purge water will be drummed and handled in accordance with Section 2.6. The top of inner well casing elevation, as well as the x and y location coordinates for the newly-installed wells, will also be recorded by an Oregon licensed surveyor following well installation activities.

2.4 Sample Management

Containers. Clean sample containers will be provided by the analytical laboratory ready for sample collection (container requirements are listed in Table B-1). For samples collected for PFAS analysis, sample containers (including lids) will be HDPE or polypropylene and will not contain PTFE (Teflon).

Labeling Requirements. A sample label will be affixed to each sample container before sample collection. Containers will be marked with the project name, sample I.D. (unique I.D. for each sample location), date and time stamp (military time) of collection, sampler's initials, and the type of analysis.

Sample Storage and Shipment. Water samples will be stored in a cooler chilled with ice to below six degrees Celsius (°C). The cooler lid will be sealed with chain-of-custody seals. Samples will be sent via overnight courier to the analytical laboratory for chemical analysis. Chain-of-custody will be maintained and documented at all times.

2.5 Decontamination Procedures

Personnel Decontamination. Personnel decontamination procedures depend on the level of protection specified for a given activity. The HASP identifies the appropriate level of protection for the type of work and expected field conditions associated with this project. In general, clothing and other protective equipment can be removed from the investigation area. Field personnel will thoroughly wash their hands and faces at the end of each day and before taking any work breaks.

Sampling Equipment Decontamination. To prevent cross-contamination between samples, clean, dedicated sampling equipment (e.g., groundwater sampling tubing) will be used for each sample and will be discarded after use. Cleaning of non-disposable items (i.e., field meter, telescoping swing sampler, and water level probe) will consist of washing in a detergent (Alconox®) solution, rinsing with tap water, and rinsing with de-ionized (DI; laboratory-supplied and certified PFAS-free) water. Decontamination water will be collected and handled in accordance with Section 2.6.

2.6 Handling of Investigation-Derived Waste

IDW will consist of purge water, soil, decontamination water, and recoverable separate-phase petroleum hydrocarbons (SPH). Purge and decontamination IDW water will be land applied within the capped area of the current Fire Training Facility. The IDW water will not be discharged to the fire training pit if it contains sediment or SPH. Soil and recoverable SPH will be placed in properly labeled Oregon Department of Transportation-approved drums. The SPH drum will be transferred to the designated PDX IDW storage area pending receipt of chemical data. Sampling materials and personal protective equipment will be disposed of as solid waste.

3.0 Analytical Testing Program

Analytical laboratory QA/QC procedures are discussed in Section 5 of this appendix.

Tables B-1 through B-3 provide the proposed analytical method, the laboratory reporting limits, and the anticipated number of samples to be collected. Samples will be collected and handled using methods described in Section 2 of this appendix. Specific container and storage requirements for samples will be discussed with the analytical laboratory prior to sample collection and will be in accordance with the container requirements presented in Table B-1.

The contaminants of interest (COI) for this project are PFAS by EPA Method 1663 which utilizes isotope dilution and solid phase extraction in a manner similar to the former Isotope Dilution Method and the Department of Defense Quality Systems Manual 5.3 method. EPA Method 1633 is the first isotope dilution method with solid-phase extraction for non-drinking water, solid, and tissue matrices and includes a list of 40 PFAS. Reported PFAS will include the method list of 40 compounds (see Table B-2).

4.0 Field Quality Assurance Program

Table B-3 provides a summary of anticipated field QA/QC samples.

Field Chain-of-Custody. A chain-of-custody form will be used to record possession of a sample and to document analyses requested. Each time the sample bottles or samples are transferred between individuals, both the sender and receiver will sign and date the chain-of-custody form. When a sample shipment is transported to the laboratory, a copy of the chain-of-custody form will be included in the transport container (e.g. ice chest).

Field Duplicate Samples. One field duplicate sample will be collected to achieve a 10 percent ratio of duplicate to primary samples. The duplicate sample will be analyzed for PFAS. A field duplicate consists of two samples collected sequentially from one sample location to assess data variability. The field duplicate will be analyzed by the same analytical methods used for primary samples. Relative percent difference (RPD) for the field duplicate will be calculated to assess the data precision and accuracy as well as the potential variability caused by sample handling.

Equipment Rinse Blanks. An equipment blank will be collected and analyzed for PFAS compounds along with the field samples. The blank will be collected using laboratory-supplied and verified PFAS-free water. An equipment blank is analyzed to determine the success of equipment decontamination and can also show laboratory sources of contamination.

5.0 Quality Assurance Plan

The purpose of the Quality Assurance Plan (QAP) is to specify procedures and methods for office and field documentation, sample handling and custody, recordkeeping, equipment handling, and laboratory analyses that will be used during sampling and analysis.

5.1 Quality Assurance Objectives for Data Management

The general QA objectives for this project are to develop and implement procedures for obtaining and evaluating data of acceptable quality. To collect such information, analytical data must have an appropriate degree of accuracy and reproducibility, samples collected must be representative of actual field conditions, and samples must be collected and analyzed using unbroken chain-of-custody procedures.
Specific QA objectives are as follows.

1. Establish sampling techniques that will produce analytical data representative of the media being measured.

2. Collect and analyze a sufficient number of field duplicate samples to establish sampling precision. Laboratory duplicates of the same sample will provide a measure of precision within the sample (sample homogeneity).
3. Analyze a sufficient number of analytical duplicate samples to assess the performance of the analytical laboratory.
4. Analyze a sufficient number of blank, standard, duplicate, spiked, and check samples within the laboratory to evaluate results against numerical QA goals established for precision and accuracy.

Precision, accuracy, representativeness, completeness, and comparability parameters used to indicate data quality are defined below.

5.1.1 Precision

Precision is a measure of the reproducibility of data under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. For duplicate measurements, precision can be expressed as the RPD. Analysis of field duplicate samples will serve to measure the precision of sampling. Laboratory duplicate measurements will be carried out with at least a 5 percent frequency for each sample matrix.

5.1.2 Accuracy

Accuracy is the measure of error between the reported test results and the true sample concentration. True sample concentration is never known due to analytical limitations and error. Consequently, accuracy is inferred from the recovery data from spiked samples.

Because of difficulties with spiking samples in the field, the laboratory will spike samples. The laboratory will perform sufficient spike samples of a similar matrix (water or soil) to allow the computation of the accuracy.

Perfect accuracy is a 100 percent recovery.

5.1.3 Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration of the chemical parameters in the medium sampled.

Sampling procedures, as well as sample-handling protocols for storage, preservation, and transportation, are designed to preserve the representativeness of the samples collected. Proper documentation will confirm that protocols are followed. This helps to assure the sample identification and integrity.

Laboratory method blanks will be run in accordance with established laboratory protocols.

5.1.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially that a sufficient amount of valid data be generated to allow for the evaluation of site cleanup.

5.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The objective of this QAP is to assure that data developed during the sampling are comparable to other data from projects with the same media and sampling techniques. Comparability of the data will be assured by using EPA-defined procedures which specify sample collection, handling, and analytical methods.

5.1.6 Documentation

EPA Level III documentation will be generated during sampling/analysis. This level of documentation is generally considered legally defensible and consists of the following:

- Chain-of-custody;
- Holding times;
- Laboratory method blank data;
- Sample data;
- Shipping receipts;
- Laboratory notes;
- Raw data validation;
- Matrix/surrogate spike data; and
- Duplicate sample data.

5.2 Sampling Protocols

5.2.1 Methods

Sampling methods are presented in Section 2. These procedures are designed to ensure that:

- Samples collected are consistent with project objectives; and
- Samples are identified, handled, and transported in a manner that does not alter the representativeness of the data from the actual site conditions.

QA objectives for sample collection will be accomplished by a combination of the following items.

- **Standardized Procedures.** Standardized procedures will be followed and documented.
- **Laboratory QA.** Laboratory duplicate measurements will be carried out on at least 5 percent of laboratory samples. Analytical procedures will be evaluated using the protocols of the analytical laboratory. These protocols can be submitted upon request.
- **Chain-of-Custody.** Procedures for chain-of-custody are described in Section 5.3.

5.3 Sample and Document Custody Procedures

The various methods used to document field sample collection and laboratory operation are presented below.

5.3.1 Field Chain-of-Custody Procedures

Sample chain-of-custody refers to the process of tracking the possession of a sample from the time it is collected in the field through the laboratory analysis. A sample is considered to be under a person's custody if:

- It is in a person's physical possession;
- It is in view of the person after possession has been taken; or
- It is secured by that person so that no one can tamper with the sample or secured by that person in an area which is restricted to authorized personnel.

A chain-of-custody form is used to record possession of a sample and to document analyses requested. Each time the sample bottles or samples are transferred between individuals, both the sender and receiver will sign and date the chain of custody form. When a sample shipment is transported to the laboratory, a copy of the chain of custody form will be included in the transport container (i.e. ice chest).

The chain-of-custody forms are used to record the following information:

- Sample identification number;
- Sample collector's signature;
- Date and time of collection;
- Description of sample;
- Analyses requested;
- Shipper's name and address;
- Receiver's name and address; and
- Signatures of persons involved in chain-of-custody.

Procedures for the handling, documenting, and shipping of samples are described in Section 2.

5.3.2 Laboratory Operations

The analytical laboratory has a system in place for documenting the following laboratory information:

- Calibration procedures;
- Analytical procedures;
- Computational procedures;
- Quality control procedures;
- Bench data;
- Operating procedures or any changes to these procedures; and
- Laboratory notebook policy.

Laboratory chain-of-custody procedures provide the following:

- Identification of the responsible party (sample custodian) authorized to sign for incoming field samples;
- A log consisting of sequential lab-tracking numbers; and
- Specification of laboratory sample custody procedures for sample handling, storage, and internal distribution for analysis.

5.3.3 Corrections to Documentation

Original data are recorded in field notes and on chain-of-custody forms using indelible ink. Documents will be retained even if they are illegible or contain inaccuracies that require correction.

If an error is made on a document, the individual making the entry will correct the document by crossing a line through the error, entering the correct information, and initialing and dating the correction. Any subsequent error discovered on a document is corrected, initialed, and dated by the person who made the entry.

5.4 Equipment Calibration Procedures and Frequency

Instruments and equipment used during this project will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by laboratory personnel fully trained in these procedures.

For PFAS analysis, the instrumentation will be tuned once per week and calibrated with a minimum of five standards resulting in a linear calibration (r^2>0.985). A second source check standard will be analyzed with every batch and must be ±15 percent of the average response of the mid-point calibration standard. Sample concentrations should be within bracketing calibration standards. If not, samples must be diluted to be within the calibration range.

5.5 Analytical Procedures

Samples will be analyzed using SW 846 analytical protocols and EPA methodology.

Analytical instrumentation used for quantitation of PFAS must be free of PTFE transfer lines and frits to avoid elevated background levels. Only polypropylene containers will be used in the sample, standard, and extraction procedures due to potential adsorption of analytes onto glass. Laboratory reagent blanks (LRB) will be used to monitor interferences and should be less than one-third the minimum reporting limit (MRL) for each method analyte.

The limit of detection (LOD) for PFAS will be defined using the method blank and is three times the peak-to-peak amplitude of the baseline noise near the target peak. The limit of quantitation (LOQ), or MRL, is defined as five times the LOD for a specific analyte and is the lowest point of calibration. The LOD and LOQ are determined semiannually.

High-quality PFAS standards will be used to quantitate both branched and linear isomers. Documentation of these standards will be available from the analytical laboratory upon request.

5.6 Data Reduction, Validation, and Reporting

Reports generated in the field and laboratory will be included with project reports.

The project manager will assure the validation of the analytical data. The laboratory generating analytical data for this project will be required to submit results that are supported by sufficient backup and QA/QC data to enable the reviewer to determine the quality of the data. The validity of the laboratory data will be determined based on the objectives outlined in Section 5.1 and Section 5.8. Data validity will also be determined based on the sampling procedures and documentation outlined in Sections 5.2 and 5.3. Upon completion of the review, the Project Manager will be responsible for assuring the development of a QA/QC report on the analytical data. Data will be stored and maintained according to the standard procedures of the laboratory. The method of data reduction will be described in the final report.

5.7 Performance Audits

Performance audits are an integral part of an analytical laboratory's standard operating procedures and are available upon request.

5.8 Data Measurement Assessment Procedures

The quality of the data will be assessed based on precision, accuracy, and completeness. Procedures to compute each are discussed below.

5.8.1 Precision

The RPD is used to assess the precision of the analytical method and is calculated using the following equation:

(1) $$RPD = \frac{X_s - X_d}{(X_s + X_d)/2} \times 100\%$$

where:

X_s = analytical result of the sample

X_d = analytical result of the duplicate sample

5.8.2 Accuracy

The accuracy of the data set is determined from the analysis of spiked samples. The accuracy is calculated using the following equation.

(2) $$A = \frac{(X_{ss} - X_s)}{T} \times 100\%$$

where:

A = accuracy

X_{ss} = analytical result obtained from the spiked sample

X_s = analytical result obtained from the sample

T = true value of the added spike

The overall accuracy is the arithmetic mean of the spiked samples.

5.8.3 Completeness

Completeness (percent complete) of the data is determined by the following equation.

(3) $$PC = \frac{\text{Number of samples with acceptable data}}{\text{Number of samples collected}} \times 100\%$$

5.9 Corrective Actions

If the quality control audit detects unacceptable conditions or data, the project manager will be responsible for developing and initiating corrective action. Corrective action may include the following:

- Reanalyzing the samples, if holding time criteria permit;
- Resampling and analyzing;
- Evaluating and amending sampling and analytical procedures; and
- Accepting data and acknowledging the level of uncertainty or inaccuracy by flagging the data.

5.10 Quality Assurance Reports

A quality assurance review will be conducted that presents a QA/QC evaluation of the data collected during the sampling activities for inclusion in the final report. In addition to an opinion regarding the validity of the data, the QA/QC evaluation will address the following:

- Any adverse conditions or deviations from the Sampling and Analysis Plan;
- Assessment of analytical data for precision, accuracy, and completeness;
- Significant QA problems and recommended solutions; and
- Corrective actions taken for any problems previously identified.

Table B-1
Analytical Methods - Sample Container Requirements
Former Fire Stations
Port of Portland

Analyte and Method	Lab	Matrix	Container	Preservative	Storage Temperature	Holding Time	
						Sampling to Preparation	Preparation to Analysis
PFAS by EPA Method 1663	Enthalpy Analytical	Groundwater Soil	2 x 500 mL HDPE 1 x 6 ounce HDPE	None	4±2°C	28 days	28 days

Notes:

1. PFAS = Per-and polyfluoroalkyl substances.
2. HDPE containers for PFAS analysis must be PFAS-free and not have Teflon-lined lids.
3. Holding time determined from the most recent EPA method for analysis of PFAS in water matrices (draft EPA method 1633).
4. mL = Milliliter.
5. °C = Degrees Celsius.

Table B-2
Analytical Methods, Anticipated Sample Number, and Laboratory Reporting Limit
Former Fire Stations
Port of Portland

Analyte	Acronym	Method	Groundwater		Soil	
			Anticipated Number of Samples/Event	Laboratory Reporting Limit (ng/L)	Anticipated Number of Samples/Event	Laboratory Reporting Limit (ng/g)
Perfluorobutanoic acid	PFBA	EPA Method 1663	12	6.40	1	0.5
Perfluoro-3-methoxypropanoic acid	PFMPA	EPA Method 1663	12	3.20	1	0.5
3-Perfluoropropyl Propanoic acid	3:3 FTCA	EPA Method 1663	12	8.00	1	15
Perfluoropentanoic acid	PFPeA	EPA Method 1663	12	3.20	1	0.5
Perfluoro(4-methoxybutanoic) acid	PFMBA	EPA Method 1663	12	3.20	1	0.5
Fluorotelomer sulfonate	4:2 FTS	EPA Method 1663	12	6.00	1	0.5
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	EPA Method 1663	12	3.20	1	0.5
Perfluorobutane sulfonic acid	PFBS	EPA Method 1663	12	1.42	1	0.5
Perfluorohexanoic acid	PFHxA	EPA Method 1663	12	1.60	1	0.5
Hexafluoropropylene oxide-dimer acid (GenX)	HFPO-DA	EPA Method 1663	12	6.68	1	0.5
5:3 Fluorotelomer carboxylic acid	5:3 FTCA	EPA Method 1663	12	40.0	1	15
Perfluoro(2-ethoxyethane)sulphonic acid	PFEESA	EPA Method 1663	12	2.85	1	0.5
Perfluoroheptanoic acid	PFHpA	EPA Method 1663	12	1.60	1	0.5
Perfluoropentane sulfonic acid	PFPeS	EPA Method 1663	12	1.50	1	0.5
4,8-Dioxa-3H-perfluorononanoate	ADONA	EPA Method 1663	12	6.32	1	0.5
Fluorotelomer sulfonate	6:2 FTS	EPA Method 1663	12	6.07	1	0.5
Perfluorooctanoic acid	PFOA	EPA Method 1663	12	2.00	1	0.5
Perfluorohexane sulfonic acid	PFHxS	EPA Method 1663	12	1.60	1	0.5
7:3 Fluorotelomer carboxylic acid	7:3 FTCA	EPA Method 1663	12	40.0	1	15
Perfluorononaoic acid	PFNA	EPA Method 1663	12	1.60	1	0.5
Perfluoroheptane sulfonic acid	PFHpS	EPA Method 1663	12	1.52	1	0.5
Fluorotelomer sulfonate	8:2 FTS	EPA Method 1663	12	6.14	1	0.5
Perfluorodecanoic acid	PFDA	EPA Method 1663	12	1.60	1	0.5
Methyl perfluorooctanesulfonamidoacetic acid	MeFOSAA	EPA Method 1663	12	1.60	1	0.5
Perfluorooctane sulfonic acid	PFOS	EPA Method 1663	12	1.49	1	0.5
Ethyl perfluorooctanesulfonamidoacetic acid	EtFOSAA	EPA Method 1663	12	1.60	1	0.5
Perfluoroundecanoic acid	PFUnA	EPA Method 1663	12	1.60	1	0.5
9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	EPA Method 1663	12	6.24	1	0.5
Perfluorononane sulfonic acid	PFNS	EPA Method 1663	12	1.54	1	0.5
Perfluorooctane sulfonamide	PFOSA	EPA Method 1663	12	1.60	1	0.5
Perfluorododecanoic acid	PFDoA	EPA Method 1663	12	1.60	1	0.5
Perfluorodecane sulfonic acid	PFDS	EPA Method 1663	12	1.54	1	0.5
Perfluorotridecanoic acid	PFTrDA	EPA Method 1663	12	1.60	1	0.5
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	EPA Method 1663	12	6.00	1	0.5
Perfluorotetradecanoic acid	PFTeDA	EPA Method 1663	12	1.60	1	0.5
Perfluorodecane Sulfonic Acid	PFDoS	EPA Method 1663	12	1.55	1	0.5
Methylperfluorooctanesulfonamidoethanol	MeFOSE	EPA Method 1663	12	16.0	1	0.5
Methylperfluorooctanesulfonamide	MeFOSA	EPA Method 1663	12	1.60	1	0.5
Ethyl perfluorooctane sulfonamido ethanol	EtFOSE	EPA Method 1663	12	16.0	1	0.5
Ethylperfluorooctanesulfonamide	EtFOSA	EPA Method 1663	12	1.60	1	0.5

Notes:
ng/L = nanograms per Liter
ng/g = nanograms per gram
EPA = US Environmental Protection Agency

Table B-3
Quality Assurance Samples
Former Fire Stations
Port of Portland

QA Sample Matrix	QA Sample Type	Analyses Requested	Anticipated Number of Samples
Groundwater	Field Duplicate	PFAS	1
	Equipment Blank	PFAS	1

Notes:

1. QA = Quality assurance.
2. PFAS = Per- and polyfluoroalkyl substances.
3. QA samples are per groundwater sampling event.

Apex Standard Operating Procedures

SOP 2.5 – Low Flow Groundwater Sampling Procedures for PFAS
SOP 2.16 – Water Level Measurement Procedures

1. Purpose

This Standard Operating Procedure (SOP) describes the methods for collection of groundwater samples for per- and polyfluorinated alkyl substances (PFAS) from monitoring wells applying low flow protocols. Low flow sampling is a method of collecting samples that does not require the removal of large volumes of water and therefore does not overly agitate the water, suspend particles, or potentially aspirate volatile organic compounds (VOCs). Typical flow rates for low flow sampling range from 0.1 liters per minute (L/min) to 0.5 L/min depending on site characteristics. Low-flow purge methods are the preferred sampling method for PFAS based on their chemical characteristics, to ensure the most representative groundwater sample is collected. The groundwater monitoring activities will consist of measuring water levels, purging and sampling groundwater, and measuring groundwater field parameters. This procedure is applicable during Apex Companies low flow groundwater sampling activities where the analytical program includes PFAS compounds. The procedures in this SOP are consistent with low flow sampling for non-PFAS compounds and include protocols to address potential for cross-contamination from materials containing PFAS.

2. Scope

This SOP applies to all Apex field events where low flow methods will be used to collect groundwater samples for analysis of PFAS.

3. Equipment and Materials

The following materials are necessary for this procedure:

- Traffic cones, tools, keys, and buckets/drums.
- Water quality meter with calibration solutions (record daily calibration/calibration check in field notes).
- Sampling equipment including a PFAS-free water level probe, PFAS-free pumps, PFAS-free tubing (high-density polyethylene [HDPE] or silicone tubing), and laboratory-supplied PFAS-free (HDPE) sample containers. Sample containers should not have Teflon®-lined lids. PFAS may adsorb to glass containers; therefore, glass should be avoided for water samples.
- Field documentation materials.
- PFAS-free decontamination materials that do not contain fluorosurfactants.
- Personal protective equipment (as required by project Health and Safety Plan).

Prior to conducting the sampling event, a materials screening should be performed to identify field equipment and personal protective equipment (PPE) that are PFAS-free to reduce the risk of cross-contamination. The materials screening should include a review of safety data sheets (SDS) and ingredient lists (in personal care products, sunscreens, insect repellants, etc.). Additional details regarding which materials are allowed and which are prohibited are provided below.

The following PFAS-containing equipment and materials are PROHIBITED and should be avoided when sampling soil for PFAS:

- Teflon®-containing materials (polytetrafluoroethylene [PTFE]) (e.g. sample containers, tubing, bailers, tape, plumbing paste). In cases where Teflon®-containing materials are unavoidable, ensure adequate purging is performed prior to sampling and equipment blanks are collected prior to sampling.
- Low-density polyethylene (LDPE)-containing materials (e.g. disposable plastic storage bags, or containers used to transport samples, tubing). In cases where LDPE-containing materials are unavoidable, an equipment blank can be collected to ensure the LDPE is PFAS-free. LDPE does not typically contain PFAS in the raw materials; however, LDPE products are often cross-contaminated with PFAS during manufacturing.
- Materials containing polyvinylidene fluoride (PVDF; Kynar®), which can be found in tubing, films/coatings on aluminum, lithium-ion batteries, and wire insulators.
- Materials containing polychlorotrifluoroethylene (PCTFE; Neoflon®), which can be found on food packaging, valves, seals, and gaskets.
- Materials containing ethylene-tetrafluoroethylene (ETFE; Tefzel®), which can be found on wire insulation, pipe liners, and cable tie wraps.
- Materials containing fluorinated ethylene propylene (FEP; Teflon®; Hostaflon®; Neoflon®), which can be found in labware, wire insulation, and pipe linings.
- Paper products such as waterproof field books (e.g. Rite-in-the-Rain), plastic clipboards, binders, spiral hard cover notebooks, sticky notes, or glue materials.
- Markers.
- Chemical (blue) ice packs.
- Latex gloves.
- Coated materials, including aluminum foil.
- Decontamination soaps containing fluorosurfactants such as Decon 90.
- Water that is not verified to be "PFAS-free" by the laboratory to be used for trip, equipment, and decontamination blanks and decontamination processes.

- Water resistant, waterproof, stain-treated clothing or shoes, including Gore-Tex™ and Tyvek® materials. If PFAS-free shoes cannot be used, PFAS-free over-boots may be worn and donned in the staging area prior to sampling.

Additionally, there is documentation that some personal care products, as well as food and drinks, may introduce PFAS contaminants to the samples. Therefore, these additional precautions should be taken during the sampling event:

- Many personal care products, such as cosmetics, moisturizers, and hand creams, contain PFAS. These products should be avoided during sampling events and 24 hours prior to sampling. Please note that many products marketed as 'natural' or 'organic' contain PFAS. If personal care products must be used, the ingredient list should be checked for PFAS.
- Many manufactured sunblocks and insect repellents contain PFAS. Only PFAS-free sunblock and insect repellent should be used during sampling events. If sunscreens or insect repellants are used during a PFAS sampling event, the product(s) should be applied in the staging area. After application, hands should be washed, and new nitrile gloves used.
- Many food and drink wrappers and containers, paper plates, aluminum foil, and paper towels contain PFAS. Food containers and related items should be kept out of the sampling area. Samplers should wash hands thoroughly with PFAS-free water and soap after handling food wrappers and containers.

The following equipment and materials are typically PFAS-free and recommended for use when collecting samples for PFAS analysis:

- HDPE, polypropylene, acetate, nylon, polyvinyl chloride (PVC), cotton, stainless steel, natural rubber, and silicone materials (e.g. tubing, bailers, tape, plumbing paste).
- Nitrile gloves that are frequently changed.
- Loose paper with Masonite or aluminum clipboards.
- Bags of ice.
- Alconox® or Liquinox®.
- Laboratory-supplied and verified PFAS-free water to be used for trip, equipment, and decontamination blanks and decontamination processes.
- Cotton textiles are recommended for field clothing and should be laundered a minimum of 6 times from time of purchase due to possible PFAS-related treatments. Fabric softener must be avoided. Rain gear should be made from polyurethane, PVC, and/or wax-coated materials.

There is some documentation that field vehicles could have seats treated with stain resistant products and could represent a source of cross-contamination. If possible, cover treated vehicle seats with a well-laundered cotton blanket or sheet. Do not handle sample containers on the vehicle seats. Always change gloves after exiting the vehicle.

4. Methodology

Field Preparation:

Prior to sampling, set up separate eating, staging, and sampling areas to help avoid PFAS cross-contamination. Due to the high risk of cross-contamination, any visitors to the site should remain at a distance from the sampling area. A sequence should be set up prior to sampling. Water sample collection should start with wells suspected to be least contaminated and end with wells suspected to be most contaminated.

Water Levels:

Water levels in the wells will be measured and recorded for the purpose of determining groundwater elevations and gradient. The wells will be opened and the water level allowed to equilibrate before the measurements are taken. When opening monitoring wells, take precautions to prevent injury from the well-cap in the event the well is over-pressured. Measurements of the depth to water will be made to the nearest 0.01 foot using an electronic probe.

Purging:

Purge using low-flow sampling equipment (e.g., peristaltic pump or bladder pump) at a low-flow rate to limit water table drawdown. Unless specified otherwise in the project-specific sampling and analysis plan (SAP), the sample tubing/pump will be lowered to the middle of the saturated screened interval. To assess the effectiveness of purging, groundwater field parameters (pH, dissolved oxygen [DO], oxidation-reduction potential [ORP], electrical conductivity, and temperature) will be measured using a flow cell connected to the discharge tubing of the sample pump. Purging will generally be considered complete when the water quality parameters (i.e., pH, temperature, DO, ORP, and specific conductance) stabilize within 10 percent for three consecutive 3-minute intervals. Consult the project-specific SAP for additional parameters, stabilization criteria, and required pump depth, as these parameters may vary based on project site and local requirements and guidance. Purge water will be placed in Department of Transportation (DOT)-approved drums or ground-applied based on client preferences and/or local regulations and guidance.

Sample Collection:

After the purging of each well is complete, collect groundwater samples for chemical analyses using the same pump used for the well purging. Place collected samples into cooler(s) kept at temperatures that do not exceed 6 degrees Celsius (°C). Chemical/blue ice packs should not be used to keep PFAS samples chilled. The samples and regular ice should be double bagged using bags made of non-PFAS materials.

Low Yield Sampling Procedure:

If drawdown of the water table is unavoidable and a well pumps dry during purging, discontinue measurement of water quality parameters. Collect groundwater samples once the water level recovers to 90 percent of the pre-purge water column. Contact project manager in the event of slow recharge conditions.

Decontamination Procedures:

Field sampling equipment, including water level indicators, oil/water interface meters, pumps, and other non-dedicated equipment, should be decontaminated before first use and in between sampling each well location. The SDS of detergents or soaps used for decontamination procedures should be reviewed to ensure that fluorosurfactants are not listed as ingredients. Laboratory-certified PFAS-free water should be used for the final rinse during decontamination of sampling equipment. When possible, equipment should also be rinsed with PFAS-free water immediately prior to first use. Sampling equipment can be scrubbed with a polyethylene or PVC brush as needed to remove particulates.

5. References

California State Water Quality Control Board, Division of Water Quality, 2020. Per-and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines for Non-Drinking Water. September 2020.

Massachusetts Department of Environmental Protection, 2019. Fact Sheet, Interim Guidance on Sampling and Analysis for PFAS at Disposal Sites Regulated under the Massachusetts Contingency Plan. June 19, 2018. Updated December 27, 2019.

Michigan Department of Environmental Quality, 2018. General PFAS Sampling Guidance. October 16, 2018.

New Hampshire Department of Environmental Services, 2019. Per- and Polyfluoroalkyl Substances (PFAS) Sample Collection Guidance. May 2019.

New York Department of Environmental Conservation, 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS). January 2021.

1. PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) describes procedures for the collection of groundwater level measurements and separate phase hydrocarbon (SPH) measurements. Measurements may be collected as an independent event or in conjunction with groundwater sampling or SPH removal. This SOP is applicable for Apex Companies, LLC (Apex) sites and projects.

2. EQUIPMENT AND MATERIALS

The following materials are necessary for this procedure:

- Water level or oil/water interface probe (as appropriate);
- Field documentation materials;
- Decontamination materials;
- Bailers or tape/paste (to confirm unusual SPH detections) and
- Personal protective equipment (PPE; as required by project Health and Safety Plan).

3. METHODOLOGY

Preparation. Obtain and review table of well construction details and historical groundwater and SPH levels/thicknesses. Bring tables into the field for ready reference.

Field Procedure. Water level and SPH measurements should be collected upon arrival at the site. Appropriate PPE (as required by the project-specific Health and Safety Plan) should be worn during measurement activities. During groundwater sampling events, measurements should be collected (1) prior to, during, and after purging and sampling. Water level measurements during low-flow sampling are conducted to ensure that drawdown is not occurring during purging/sampling. Low-flow sampling methods are described in SOP 2.5. The following procedures should be followed when collecting groundwater level and SPH measurements from wells:

No SPH in monitoring well

1. The electronic probe should be tested to ensure proper instrument response. If response is inadequate, replace batteries or repair probe as needed.
2. Well covers and caps will be opened and the water level allowed to equilibrate under atmospheric conditions. Observe for indications that water levels may not be at equilibrium such as:
    a. Escaping air upon loosening of well cap; or
    b. Water level above the top of the well screen.

   For either of these conditions, equilibrium should be verified by repeating water level measurements over five-minute intervals until successive equal measurements are obtained. Otherwise allow water levels to equilibrate for a minimum of five minutes before measurements are taken. Unless otherwise indicated in the work scope of site-specific sampling plan, water level measurements should be taken from the least contaminated wells first to avoid cross-contamination.
3. Locate the reference point on the well riser pipe.
4. Slowly lower the probe until the probe signal indicates that water has been contacted.
5. Record the depth-to-water (DTW) probe reading at the reference point. Measurements should be collected to the nearest 0.01 foot.
6. Withdraw the probe and repeat steps 5 and 6. Measurements should agree within a precision of 0.01 feet. Repeat if needed until a precision of 0.01 feet is obtained.
7. If the work scope or site specific sampling plan requires that the depth-to-bottom (DTB) of monitoring wells is measured, then the probe should be lowered to the bottom of the well and the DTB reading at the reference point should be measured to the nearest 0.01 foot.
8. Remove probe and decontaminate the tape using alcohol wipes then wash the tape and probe in a detergent (Alconox®) solution, rinse with tap water, and a final deionized water rinse. DO NOT USE ALCOHOL WIPES ON THE PROBE TIP. Describe in field notes unusual characteristics of SPH that may bias thickness readings (e.g. unusually viscous product).

SPH in monitoring well

1. Repeat above steps 1 through 5.
2. Slowly lower the oil/water interface probe until the signal indicates that SPH has been contacted (generally a steady tone and signal light).
3. Record the depth-to-product (DTP) probe reading at the reference point. Measurements should be collected to the nearest 0.01 foot.
4. Continue lowering the probe until the signal indicates that water has been contacted (generally an intermittent tone and signal light).
5. Record the DTW probe reading at the reference point. Measurements should be collected to the nearest 0.01 foot.
6. Withdraw the probe and repeat steps 5 and 6. Measurements should agree within a precision of 0.01 feet. Repeat if needed until a precision of 0.01 feet is obtained.
7. Remove probe and initially decontaminate the tape using alcohol wipes then wash/scrub the tape and probe in a detergent (Alconox®) solution, rinse with tap water, and a final deionized water rinse. DO NOT USE ALCOHOL WIPES ON THE PROBE TIP. Describe in field notes unusual characteristics of SPH that may bias thickness readings (e.g. unusually viscous product).
8. If unusual SPH thicknesses are detected (e.g. SPH is detected in well with no prior history of SPH or thicknesses are greater than prior detections), verify presence/thickness using alternative technique (e.g. bailer, tape and water/petroleum colorimetric paste).

Appendix C

Health and Safety Plan

This Level 2 HASP is intended to provide health and safety guidelines for project field work meeting the following criteria:

- **Short-duration work not exceeding 30 consecutive days**
- **"Buddy System" in use (or communication plan implemented for "lone worker"**
- **Some likelihood of chemical and/or physical hazard exposure**
- **Limited number of job tasks (5 or less)**
- **No supplied-air respirator use**
- **Limited number of subcontractors involved (3 or less)**

The Project Manager should review this Health and Safety Plan with all Apex project personnel. A copy of the HASP must be kept in the field with the project team as well as maintained in project files.

Administrative Information **This document is valid for a maximum time period of one year after initial completion and must be re-evaluated by the project team at that time.** **A minimum of two persons with appropriate training and medical surveillance must be onsite or an appropriate communication plan must be implemented. A mix of Apex and other personnel can satisfy this requirement.**	Site Name and Location Portland Internation Airport, Portland, Oregon	
	Client Contact David Breen	
	Project Name PDX Former Fire Stations	
	Health & Safety Plan Date 6/19/2024	Revision Number and Date
	Field Work Start Date TBD	Anticipated Field Work End Date TBD
	Project Manager (*responsible for implementing the site health and safety program on this project*) Carmen Owens	Site Safety Officer (SSO) (*responsible for overall site health and safety performance on this project).* Chris Weer

Project Background and Scope of Work

Include numbered list of tasks to be completed by Apex personnel during this project, and a separate list of tasks to be completed by any subcontractors at the site.

JSAs are to be prepared for each task listed. Subcontractors are responsible for preparing JSAs for their activities.

Apex Scope of Work:

1. Gauge groundwater monitoring wells for depth to water.
2. Sample groundwater at Site monitoring wells.
3. Oversee the installation of 2 shallow groundwater monitoring wells via Geoprobe.
4. Oversee the installation of 2 deep groundwater monitoring wells via Sonic Rig.
5. Log soil lithology and conduct field screening.
6. Develop and sample groundwater monitoring wells.
7. Sample Management/COC

Subcontractor Scope of Work: One Call will be conducted more than 48 hours before fieldwork begins. The Port of Portland will provide private utility location services. Drilling subcontractor will operate a direct push probe unit and a sonic drill rig. As an additional safety measure, all wells will be hand-cleared using a hand auger, air-knife, or post hole digger. Holes will be cleared to 5 feet using an air-knife and vacuum truck or with hand auger.

Site/Project General Information

An asterisk (*) indicates that additional checklists or permits are required and must be completed and attached to this document.

A double asterisk (**) indicates that a Risk Review performed by a member of the Corporate Safety Committee must take place prior to beginning fieldwork on the project.

Site Type (check all applicable boxes)

☒ Active Facility	☐ Remote Facility	☐ Inactive Facility	☐ Residential
☐ Mine	☐ Railroad	☐ Industrial	☒ Secured
☐ Uncontrolled	☒ Other (specify)	Active facility with multiple forms of transportation.	

Main Site Hazards (check all applicable boxes)

☒ Slip/Trip/Fall	☐ Cold Stress	☐ Heat Stress	☐ Extreme Weather
☒ Biological	☒ Organic/Inorganic Chemicals	☒ High Noise	☐ Construction Traffic
☒ Vehicular Traffic	☒ Respirable Particles	☐ Excavations	☒ Buried/Overhead Utilities
☐ Non-Ionizing Radiation	☒ Security	☐ ASTs/USTs	☐ Manlift/Cherry Picker Use
☐ Work Over 6' High*	☒ Hand/Portable Power Tools	☐ Oxygen Deficiency	☐ Construction
☐ Blasting Agents	☐ Confined Spaces	☐ Welding or Hot Work	☐ Lockout/Tagout*
☐ Lockout/Tagout	☐ Forklift Use	☐ Chemical Mixing**	☒ Commercial Vehicle
☐ Scaffold Use	☐ Portable Ladders	☐ Other (*specify*)	

Chemical Products Apex will Use or Store Onsite

For each chemical product identified, an SDS must be attached to this HASP

- ☒ Alconox or Liquinox
- ☒ Hydrochloric acid (HCl)*
- ☒ Nitric acid (HNO_3)*
- ☐ Sodium hydroxide (NaOH)*
- ☐ Calibration gas (Methane)
- ☐ Calibration gas (Isobutylene)
- ☐ Calibration gas (Pentane)
- ☐ Calibration gas (4-gas mixture)
- ☐ Other (specify)
- ☐ Isopropyl Alcohol
- ☐ Household bleach (NaOCl)*
- ☒ Sulfuric acid (H_2SO_4)*
- ☐ Hexane
- ☐ Other (specify)

***NOTE: Eyewash solution shall be readily available on ALL projects where corrosive materials are used or stored, including sample preservatives.**

Safe Work Practices

Place a checkmark by applicable SWPs and attach to this document

For hazards not covered by SWPs listed in this section, ensure the hazard is addressed in the JSA for that task. Otherwise, the JSA may reference the SWP for that hazard.

SWPs Applicable To This Project (check all applicable boxes)

☒ Hazard Communication	☒ Medical Services and First Aid	☒ Airborne Contaminants	☐ Heat Stress
☐ Cold Stress	☒ Natural Hazards	☒ Personal Protective Equipment	☒ Respiratory Protection
☐ Confined Space Entry	☒ Drum Handling	☐ Excavation	☐ Fall Protection and Prevention
☐ Forklift and Truck Operations	☒ Hand/Power Tool Use	☒ Heavy and Material Handling Equipment	☐ Ladder Safety
☐ **Other Task (specify)**	☐ **Other Task (specify)**	☒ **Other Task (specify) Traffic awareness/delineation**	☐ **Other Task (specify)**
☐ **Other Task (specify)**	☐ **Other Task (specify)**	☐ **Other Task (specify)**	☐ **Other Task (specify)**

Levels of Protection Required for each Task

Signature of the SSO on page 1 of this document signifies certification of PPE Hazard Assessment

Task Description	Level			
	A	B	C	D
Supervision of well installations.	☐	☐	☐	☒
Groundwater sampling and gauging.	☐	☐	☐	☒
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐

Personal Protective Equipment	Equipment	Req	Rec	NA	Equipment	Req	Rec	NA
Req=Required Rec=Recommended An asterisk (*) indicates that employees must be a participant in the respiratory program, including, annual training and fit testing.	Steel Toe Boots	☒	☐	☐	Tyvek Suit	☐	☐	☐
	Safety Glasses Shields	☒	☐	☐	Outer Disposable Boots	☐	☐	☐
	Hi Vis Vest (Specify Class 2/3)	☒	☐	☐	Indirect Vented Goggles	☐	☐	☐
	Hi Vis Shirt	☐	☐	☐	Poly-Coated Tyvek	☐	☐	☐
	Hard Hat	☒	☐	☐	Dust Mask*	☐	☐	☐
	Fire Resistant Clothing (FRC)	☐	☐	☐	Full-Face Respirator*	☐	☐	☐
	Hearing Protection	☒	☐	☐	Half-Face Respirator*	☐	☒	☐
	Work Gloves – Type: Nitrile	☐	☒	☐	Inner Chemical Gloves	☐	☐	☐
	Outer Chemical Gloves	☒	☐	☐	Other (specify)	☐	☐	☐
Training and Medical Surveillance Req=Required Rec=Recommended	**Training**	**Req**	**Rec**	**NA**	**Medical Surveillance**	**Req**	**Rec**	**NA**
	40 Hour HAZWOPER	☒	☐	☐	Medical Clearance (fit for duty)	☒	☐	☐
	Current 8 Hour HAZWOPER	☒	☐	☐	Respirator Clearance	☒	☐	☐
	8 Hour HAZWOPER Supervisor	☐	☐	☐	Blood Lead and ZPP	☐	☐	☐
	24Hour HAZWOPER	☐	☐	☐	Other (specify)	☐	☐	☐
	Current CPR and First Aid	☒	☐	☐	Other (specify)	☐	☐	☐
	10 Hour Construction	☐	☐	☐	Other (specify)	☐	☐	☐
	Other (specify)	☐	☐	☐	Other (specify)	☐	☐	☐
	Other (specify)	☐	☐	☐	Other (specify)	☐	☐	☐
	Other (specify)	☐	☐	☐	Other (specify)	☐	☐	☐
Safety Supplies Req=Required Rec=Recommended	**Supplies**	**Req**	**Rec**	**NA**	**Supplies**	**Req**	**Rec**	**NA**
	First Aid Kit	☒	☐	☐	Fire Extinguisher	☒	☐	☐
	Eyewash Solution	☒	☐	☐	Water/Sports Drink	☐	☒	☐
	Air Horn	☐	☐	☐	Oral Thermometer (heat monitoring)	☐	☐	☐
	Noise Meter (Dosimeter)	☐	☐	☐	Decontamination Supplies	☒	☐	☐

Work Zones **If exclusion zones are necessary because of chemical OR equipment hazards, describe the plan**	Exclusion Zone: The work area should be surrounded by multiple traffic cones so that the work area is highly visible to traffic. Portions of the work may be performed during nighttime hours. Work areas will be designated with cones, lights, vehicles with amber flashing beacons, and the drilling subcontractor will adhere a flag to the drill rig mast. Airside Ops will be notified of the contractors arrival and departure. Additional exclusion zone requirements may be implemented based on correspondence with PDX Airside Operations Planner during portions of the field activities near or adjacent to runways or taxiways.
	Contamination Reduction Zone:
	Support Zone:

Site Access/Control **How do we limit unauthorized entry to the site itself?**	Access Control Procedures: The facility is fenced and to enter you must pass through a guarded gate.
DECON Procedures	Decontamination Procedures: Follow Level D PPE decontamination procedures.

Communication Plan **In the event work must be completed alone by an Apex employee or work is performed in a rural area with limited communication, this Communication Plan must be completed.**	The purpose of the communication plan is to provide a "What to Do" if the project manager/supervisor cannot contact field personnel. The field team and PM must coordinate a call in time daily. The check-in intervals will depend on the project setting and hazards. More importantly, if the field team does not check in, what is the requirement or actions of the PM.			
	Daily Check in Time	Responsible Person	Daily Check In Time	Responsible person
	1400	Chris Weer		
	Plan of Action (in the event of no communication): If no communication, project manager or safety officer will attempt to call responsible person or other on-site field staff. If no one is reachable, a message will be left and a second contact attempt will be made in 10 minutes. If no communication is made after 30 minutes, then the facility manager will be contacted directly. Alternatively, a representative from the Apex office may be sent to the terminal directly to communicate with field staff. The terminal is approximately a 40 minute drive from the Apex office.			

Chemicals of Concern

In the section to the right, check any chemicals present onsite in any media (air, soil water).

In the table below, list chemicals suspected or confirmed to be onsite, and provide requested information.

☐ Friable Asbestos	☐ alpha-Napthylamine	☐ Methyl chromoethyl ether
☐ 3,3'-Dichlorobenzidine	☐ bis-Chloromethyl ether	☐ beta-Napthylamine
☐ Benzidine	☐ 4-Aminodiphenyl	☐ Ethyleneimine
☐ beta-Propiolactone	☐ 2-Acetylaminoflourene	☐ 4-Dimethylaminoazobenzene
☐ N-Nitrosomethylamine	☐ Vinyl chloride	☐ Inorganic arsenic
☐ Lead	☐ Chromium (VI)	☐ Cadmium
☒ Benzene	☐ Coke oven emissions	☐ 1,2-Dibromo-3-chloropropane
☐ Acrylonitrile	☐ Ethylene oxide	☐ Formaldehyde
☐ Methylenedianiline	☐ 1,3-Butadiene	☐ Methylene chloride
☒ Other_____	☒ **No Apex exposure to these**	☒ Sub Slab VOCs

Materials Present or Suspected at Site	Highest Reported Concentration (specify units and sample medium)	Exposure Limit (specify ppm or mg/m³)	IDLH Level (specify ppm or mg/m³)	Primary Hazards of the Material (explosive, flammable, corrosive, toxic, volatile, radioactive, biohazard, oxidizer, or other)	Symptoms and Effects of Acute Exposure	Ionization Potential (eV)
Petroleum Hydrocarbons		PEL = 500 REL = 350 TLV = Skin Hazard ☐	1,100ppm	Flammable	Fatigue, headache, nausea, dizziness. Exposure to high levels can lead to coma or death.	
Benzene		PEL = 1 ppm REL = 0.1 ppm TLV = Skin Hazard ☐	500 ppm	Flammable	Drowsiness, dizziness, rapid heart rate, headache, tremors, confusion, and unconsciousness. Exposure to very high levels can lead to death.	
PCB's		PEL = 0.5 mg/m3 REL = TLV = Skin Hazard ☐	5 mg/m3	Strong oxidizers	irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen	
Toluene		PEL = 200 ppm REL = 100 ppm TLV = Skin Hazard ☐	500 ppm	Flammable	Causes mild to moderate skin irritation. Inhalation or ingestion may cause nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness	

PEL = OSHA Permissible Exposure Limit
REL = NIOSH Recommended Exposure Limit
TLV = ACGIH Threshold Limit Value
IDLH = Immediately Dangerous to Life or Health

Monitoring Equipment: All monitoring equipment on site must be calibrated before and after each use and results recorded.				
Instrument (Check all required)	**Task**	**Instrument Reading**	**Action Guideline**	**Comments**
☐ Combustible gas indicator model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	0 to 10% LEL	Monitor; evacuate if confined space	
		10 to 25% LEL	Potential explosion hazard	
		>25% LEL	Explosion hazard; interrupt task; evacuate site	
☐ Oxygen meter model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	>23.5% Oxygen	Potential fire hazard; evacuate site	
		23.5 to 19.5% Oxygen	Oxygen level normal	
		<19.5% Oxygen	Oxygen deficiency; interrupt task; evacuate site	
☐ Radiation survey meter model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Normal background	Proceed	Annual exposure not to exceed 1,250 mrem per quarter Background reading must be taken in an area known to be free of radiation sources
		Two to three times background	Notify SSO	
		>Three times background	Radiological hazard; interrupt task; evacuate site	
☐ Photoionization detector model: ☐ 11.7 eV ☒ 10.6 eV ☐ 10.2 eV ☐ 9.8 eV ☐ _____ eV	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Any response above background to 5 ppm above background	Level D is acceptable	Action levels must be determined based on the COCs and concentrations identified in the media sampled. If no COC conentrations are known, then use 5 ppm sustained within the breathing zone as your action level until the contaminants are identified.
		ppm above background	Level C (not anticipated)	
		ppm above background	Discontinue work	
☐ Flame ionization detector model:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Any response above background to ppm above background	Level C is acceptable Level B is recommended	Action levels must be determined based on the COCs and concentrations identified in the media sampled. If no COC conentrations are known, then use 5 ppm sustained within the breathing zone as your action level until the contaminants are identified.
		ppm above background	Level B	
		above background	Level A	
☐ Detector tube models:	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Specify:	Specify:	The action level for upgrading the level of protection is one-half of the contaminant's PEL. If the PEL is reached, evacuate the site and notify a safety specialist.
☐ Other (specify):	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5	Specify:	Specify:	

Emergency Response Planning	
In the pre-work briefing and Daily Tailgate Safety meetings, all onsite employees will be trained in the provisions of emergency response planning, site communication systems, and site evacuation routes. **Signal a site emergency or medical emergency with three blasts of a loud horn (car horn, fog horn, or similar device).** **To complete this section, attach a hospital route map to the HASP.**	**All work-related incidents must be reported. For all medical emergencies, call 911 or the local emergency number. For non-emergency incidents, you must:** • Give appropriate first aid care to the injured or ill individual and secure the scene. • Immediately call WorkCare at (888) 449-7787 (available 24 hours/7 days per week) if the injured person is an Apex employee. • Notify the Project Manager and/or SSO after calling WorkCare. • Enter the safety incident into the Apex Incident Report and submit to incidents@apexcos.com within 24 hours. **In the event of an emergency that necessitates evacuation of the work task area or the site as a whole, the following procedures shall occur:** • The Apex site supervisor or Project Manager will contact all nearby personnel using the onsite communications system to advise of the emergency. • Personnel will proceed along site roads to a safe distance upwind from the hazard source to a pre-determined assembly area. • Call 911 • Personnel will remain in that area until the site supervisor or Project Manager or other authorized individual provides further instruction. **In the event of a severe spill or leak, site personnel will follow the procedures listed below:** • Evacuate the affected area and relocate personnel to an upwind, pre-determined assembly area. • Inform the Apex site supervisor or Project Manager, an Apex office, and a site representative immediately. • Locate the source of the spill or leak and stop the source if it is safe to do so until appropriately trained personnel are onsite to do so. • Begin containment and recovery of spilled or leaked materials. • Notify appropriate local, state, and federal agencies after obtaining client consent to do so. **In the event of severe weather, site personnel will follow the procedures listed below:** • Site work shall not be conducted during severe weather, including high winds and lightning. • In the event of severe weather, stop work, lower any equipment (drill rigs), and evacuate the affected area. • Monitor internet or other sources for sever weather alerts before resuming work. • In the event of lightning, outdoor work must be halted for a minimum of 30 minutes from the last lightning observation.

Emergency Contacts	Name	Location	Phone	Cell Phone
Hospital (attach map)	Providence Portland Medical Center	4805 NE Glisan St. Portland, OR	503-215-5526	
Police	911		911	
Fire	911		911	
Project Manager	Carmen Owens	Portland, OR	503-924-4704	319-360-4128
Field Manager (if not PM)	Chris Weer	Portland, OR	503-924-4704	971-806-1637
Site Safety Officer (if not PM)	Chris Weer		503-924-4704	
Division H&S Contact	Lauren Bellinger	Portland, OR	503-924-4704	
Corporate H&S Contact	Josh House	Rockville, MD	301-417-0200	
Incident Intervention	WorkCare	NA	888-449-7787	
Subcontractor Safety Contact				
Subcontractor Safety Contact				

Acknowledgement	***I have read, understood, and agree with the information set forth in this Health & Safety Plan, and will follow guidance in the plan and in the Apex Corporate Health and Safety Manual. I understand the training and medical monitoring requirements for conducting activities covered by this HASP and have met these requirements.*** ***Apex has prepared this plan solely for the purpose of protecting the health and safety of Apex employees. Subcontractors, visitors, and others at the site are required to follow provisions in this document at a minimum, but must refer to their organization's health and safety program for their protection.***		
Printed Name	Signature	Organization	Date

Approval Signatures

Signatures in this section indicate the signing employee will comply with and enforce this HASP, as well as procedures and guidelines established in the Apex Corporate H&S Manual. Signatures in this section also indicate that any subcontractors performing work under contract to Apex agree to comply with this HASP.

YOUR TRIP TO:

Providence Portland Medical Center

14 MIN | 9.7 MI

Est. fuel cost: $1.05

Trip time based on traffic conditions as of 2:28 PM on March 6, 2017. Current Traffic: Light

Start of next leg of route

1. Start out going **northwest** on NE Airport Way.

Then 0.11 miles — 0.11 total miles

2. Take NE Airport Way toward **Departures/Ticketing/Check-In/Valet Parking**.

Then 0.18 miles — 0.28 total miles

3. Keep **left** at the fork to continue on NE Airport Way.

Then 2.37 miles — 2.65 total miles

4. Merge onto I-205 S/Veterans Memorial Fwy S/E Portland Fwy S toward **I-84/Portland/Salem**.

Then 3.07 miles — 5.73 total miles

5. Merge onto I-84 W/US-30 W via EXIT 21B toward **Portland**.

Then 2.86 miles — 8.59 total miles

6. Take EXIT 2 toward **43rd Ave**.

Then 0.37 miles — 8.96 total miles

7. Turn **right** onto NE Halsey St.

Then 0.20 miles — 9.16 total miles

8. Take the 3rd **right** onto NE 47th Ave.

If you reach NE 48th Ave you've gone a little too far.

Then 0.51 miles — 9.66 total miles

9. Turn **left** onto NE Glisan St.

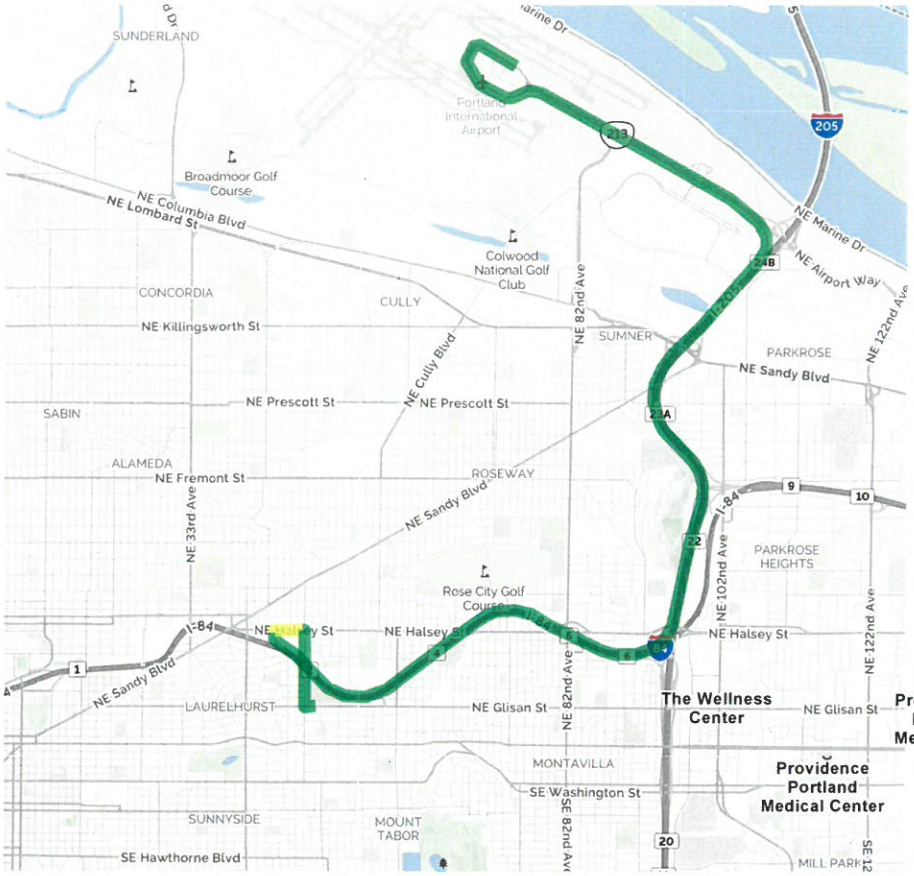
NE Glisan St is just past NE Hoyt St.

If you reach NE Flanders St you've gone a little too far.

Then 0.07 miles — 9.74 total miles

10. Providence Portland Medical Center, 4805 NE GLISAN ST.

If you reach NE 49th Ave you've gone a little too far.



Vibra Specialty Hospital of Portland

VA East Portland Clinic

APEX

Groundwater Sampling
Job Safety Analysis (JSA)

Project Number:	**32-23006356**	Project/Client Name:	**Port of Portland**
Project Manager:	**Carmen Owens**	Project Location:	**PDX**

Specific Task:	**Collect samples from monitoring wells**

Minimum Required PPE for Task:

- ☑ Hard Hat
- ☑ Safety Toed Boots
- ☑ Safety Glasses
- ☑ Hearing Protection
- ☐ Long Sleeved Shirt
- ☐ Fire Resistant Clothing
- ☐ Hi-Vis Shirt
- ☑ Hi-Vis Vests Class 2
- ☐ Hi-Vis Vests Class 3
- ☐ Coverall
- ☑ Gloves <type>
- ☐ Respirator <type and cartridge>
- ☐ Face Shield
- ☐ Other (specify): <enter additional PPE here>

Additional Task-Step Specific PPE: (as indicated below under controls)	**NA**	**Equipment/Tools Required:**	**Peristaltic pump, hand tools**
Training Required for this Task:	**HAZWOPER40**	**Permits Required for this Task: (e.g. confined space, LOTO)**	**NA**
Forms Associated with this Task:	**HASP, Daily Tailgate Meeting form, monitoring and gauging forms.**		

JSA Developed/Reviewed By:			**Date and Revision Number:**	6/19/2024
Employee Name/Job Title	Employee Name/Job Title	Employee Name/Job Title	H&S Team Leader to ensure all personnel performing this task have reviewed JSA and agree to follow it. Site specific changes to this JSA have been made as warranted based on this review. H&S Team Leader Signature/Date:	
Carmen Owens				

Task Steps	Potential Hazards and Consequences	Likelihood	Severity	Risk	Controls to Eliminated/Reduce Risks
1. Pre-Field Safety Meeting	N/A			0	All employees will attend a pre-field meeting which will include the pertinent SOPs, client-specific Job Safety Analysis, Permit(s) to Work (if required), Subsurface Investigation Procedures, potential hazards, and actual hazards present and controls for those hazards
2. Travelling to/from the Site	2a. Traffic accident - Injury	3	3	9	Follow posted speed limits and traffic signs. Stay alert to to other vehicles, cyclists, pedestrians and be a defensive driver by maintaining a safe distance with other vehicles on the road.
	2b. Improperly secured load - Accident or injury	2	3	6	Maintain good housekeeping to securely load vehicles and ensure that loose or light items that may shift during travel are secured. Use ratcheting straps, covers, etc to secure loads.
3. Loading and Unloading Equipment	3a. Moving equipment - back or muscle strain	2	3	6	Ensure proper lifing techniques. Do not attempt to bodily move large equipment. Use the buddy lift to move heavy objects.
	3b. Slip/trips/falls - Injury	2	3	6	Maintain good housekeeping. Inspect the area of tripping hazards. If grass or vegetation is tall, objects may be obscured. Ensure good footing in the work area. Sturdy work boot required
4. Calibration of equipment	Skin or eye contact with calibration chemicals	2	2	4	Wear disposable gloves and safety glasses, avoid direct contact with calibration solutions. Properly dispose of calibration solution waste.

APEX

Groundwater Sampling Job Safety Analysis (JSA)			
Project Number:	**32-23006356**	Project/Client Name:	**Port of Portland**
Project Manager:	**Carmen Owens**	Project Location:	**PDX**

Specific Task:	**Collect samples from monitoring wells**				
Task Steps	**Potential Hazards and Consequences**	**Likelihood**	**Severity**	**Risk**	**Controls to Eliminated/Reduce Risks**
5. Setup and installation of low-flow pump	5a. Potential hand injuries during pump setup.	2	2	**4**	Wear gloves when preparing pump and equipment for sampling
	5b. Traffic consideration - Injury	3	3	**9**	Some well are located adjacent to roadways in the right-of-way. Maintain a well delineated work area using cones, field vehicle, or other barricades to avoid hazards from vehicular traffic.
	5c. Slip/trips/falls - Injury	2	3	**6**	Maintain good housekeeping. Inspect the area of tripping hazards. If grass or vegetation is tall, objects may be obscured. Ensure good footing in the work area. Sturdy work boot required
	5d. Lifting or moving equipment - Injury	2	3	**6**	Ensure proper lifing techniques. Do not attempt to bodily move large equipment. Use the buddy lift to move heavy objects.
	5e. Unexpected release of pressure from compressor - Injury	2	2	**4**	Check compressor and air plines for damange to avoid unexpected pressure release. Maintain recommended pressure.
6. Sample Collection	6a. Contact with potentially contaminated groundwater - Exposure	2	2	**4**	Wear disposable goves and safety glasses when collecting samples to minimize contact with contaminated media.
	6b. Contact with acids from sample preservation.	2	2	**4**	Wear disposable gloves and safety glasses or goggles when handling acids. Quantites handled are generally very small, so large spills are unlikely. In the event of contact with acid, wash area thoroughly with fresh water.
	6c. Slip/trips/falls - Injury	2	3	**6**	Maintain good housekeeping. Inspect the area of tripping hazards. Sturdy work boot required. Maintain 3-points of contact when using stairways.
	6d. Sample mangement - Injury from damaged glassware	2	2	**4**	Inspect bottles before use. Wear gloves and use care when handling glass sampling containers to avoid hand lacerations.
	6e. Moving equipment or full sample coolers - Back or muscle injury.	2	3	**6**	Ensure proper lifing techniques. Do not attempt to bodily move large equipment. Use the buddy lift to move heavy coolers.
	6f. Cutting or Disconnecting sample tubing - Hand injury	2	3	**6**	Wear leather gloves (or similar) when using cutting tools to cut and/or disconnect tubing.
7. Cleanup and movement between sample locations.	7a. Visitor mishaps resulting in bodily harm.	3	3	**9**	Pay attention to visitors approaching work area. When necessary, setup traffic cones and/or other traffic barriers to keep vehicles and visitors out of the work area. Use caution tape if available

APEX

Groundwater Sampling Job Safety Analysis (JSA)			
Project Number:	**32-23006356**	Project/Client Name:	**Port of Portland**
Project Manager:	**Carmen Owens**	Project Location:	**PDX**

Specific Task:	**Collect samples from monitoring wells**				
Task Steps	**Potential Hazards and Consequences**	**Likelihood**	**Severity**	**Risk**	**Controls to Eliminated/Reduce Risks**
	7b. Tripping over equipment as it is taken apart and laying on ground before being loaded.	3	2	**6**	All personnel should be constantly watching for trip hazards such as uneven terrain, holes, ditches, stretched wires or ropes, or any other materials or pieces of equipment in their path
	7c. Hurting back trying to lift heavy objects.	3	3	**9**	Use proper lifting techniques to avoid back strain. Get help if the object is too heavy by yourself.
8. Management of Investigation Derived Waste	8a. Slip/trips/falls - Injury	2	3	**6**	Maintain good housekeeping. Inspect the area of tripping hazards. Sturdy work boot required. Maintain 3-points of contact when using stairways.
	8b. Potential hand injuries while opening/closing accumulation drum	2	3	**6**	Wear leather (or similar) work gloves and hand tools when opening and closing the lids to accumulation storage drums to avoid pinching hand in the ring or cutting hand on the drum or lid..
	8c. Spill - Environmental impact	2	2	**4**	Have absorbant pads and/or rags available in the event of a spill. Wear gloves when handling pads or potentially contaminated material.
9. Site wide Activities	9a. Slip/trips/falls - Injury	2	3	**6**	Maintain good housekeeping. Inspect the area of tripping hazards. Sturdy work boot required. Maintain 3-points of contact when using stairways.
	9b. Traffic considerations - Injury	2	3	**6**	Some wells are located in active traffic areas for terminal operation. Maintain a well delineated work area using cones, field vehicle, or other barricades to avoid hazards from vehicular traffic.

			Hazard Severity				
			1	2	3	4	5
			INSIGNIFICANT negligible or no injury could result	**MINOR** minor injury requiring only first aid	**MODERATE** injury resulting in lost time could occure	**HIGH** serious injury or death could occur	**VERY HIGH** multiple deaths could occur
Likelihood	1	VERY UNLIKELY	1	2	3	4	5
	2	UNLIKELY	2	4	6	8	10
	3	POSSIBLE	3	6	9	12	15
	4	LIKELY	4	8	12	16	20
	5	VERY LIKELY	5	10	15	20	25

APEX

Airside Construction
Job Safety Analysis (JSA)

Project Number:	**32-23006356**	Project/Client Name:	**Port of Portland**
Project Manager:	**Carmen Owens**	Project Location:	**PDX**

Specific Task:	**Arrival at PDX and travel and setup for drilling.**

Minimum Required PPE for Task:

- ☑ Hard Hat
- ☑ Safety Toed Boots
- ☑ Safety Glasses
- ☑ Hearing Protection
- ☐ Long Sleeved Shirt
- ☐ Fire Resistant Clothing
- ☐ Hi-Vis Shirt
- ☑ Hi-Vis Vests Class 2
- ☐ Hi-Vis Vests Class 3
- ☐ Coverall
- ☑ Gloves
- ☑ Respirator
- ☐ Face Shield <type>
- <type and cartridge>
- ☐ Other (specify): <enter additional PPE here>

Additional Task-Step Specific PPE: (as indicated below under controls)	**NA**	**Equipment/Tools Required:**	**Drill rig**
Training Required for this Task:	**HAZWOPER40, Port security badge**	**Permits Required for this Task: (e.g. confined space, LOTO)**	**NA**
Forms Associated with this Task:	**HASP, Daily Tailgate Meeting form, field log, lithologic log, and sampling sheets**		

JSA Developed/Reviewed By:			**Date and Revision Number:** 6/19/2024
Employee Name/Job Title	Employee Name/Job Title	Employee Name/Job Title	H&S Team Leader to ensure all personnel performing this task have reviewed JSA and agree to follow it. Site specific changes to this JSA have been made as warranted based on this review. H&S Team Leader Signature/Date:
Carmen Owens			

Task Steps	Potential Hazards and Consequences	Likelihood	Severity	Risk	Controls to Eliminated/Reduce Risks
1. Pre-Field Safety Meeting	N/A				All employees will attend a pre-field meeting which will include the pertinent SOPs, client-specific Job Safety Analysis, Permit(s) to Work (if required), Subsurface Investigation Procedures, potential hazards, and actual hazards present and controls for those hazards.
2. Arrival at gate of Airfield.	Dangerous to travel to site, planes or other heavy traffic.	1	4	**4**	Call Operations at gate to inform of arrival and make sure it is clear to travel to sample locations.
3. Travel to work area.	Plane traffic and other vehicle traffic in the area.	1	4	**4**	Use route that has been determined as safest, stay on roadway and use flashers on vehicle when on airfield. Obey posted speed limits. Make sure drill crew is escorted to site. Follow Port rules.
4. Set up work area	4a. Not being visible to planes and other vehicles .	2	4	**8**	Use cones and signage to deliniate the work area and that operations knows where you are going to be located.

APEX

Airside Construction **Job Safety Analysis (JSA)**			
Project Number:	**32-23006356**	Project/Client Name:	**Port of Portland**
Project Manager:	**Carmen Owens**	Project Location:	**PDX**

Specific Task:	**Arrival at PDX and travel and setup for drilling.**

Task Steps	Potential Hazards and Consequences	Likelihood	Severity	Risk	Controls to Eliminated/Reduce Risks
	4b. Drill mast not being visible to low flying aircraft.	2	4	**8**	Secure all material inside of vehicles, be aware of FOD (Foreign Object Debris). Practice good houskeeping.
	4c. Working at night near runway, not being visible.	2	4	**8**	Set up lights to see and be seen, work with Airport OPS for permission when we can mobilize to location.
5. Perform work at site	Material not secured and blowing around could get sucked into aircraft engines.	1	4	**4**	Secure all material inside of vehicles, be aware of FOD (Foreign Object Debris). Practice good houskeeping.
6. Clean up site	6a. Material left behind and blowing onto runway. Debris on tires.	1	4	**4**	Check work area to make sure nothing is left behind. Check tires for FOD. Use GOAL (Get out and look). Call Operations to check if site inspection is required and let them know you aretravelling to the gate. Practice good housekeeping.
7. Travel from work area.	Plane traffic and other vehicle traffic in the area.	1	4		Use route that has been determined as safest, stay on roadway and use flashers on vehicle when on airfield. Obey posted speed limits. Make sure drill crew is escorted from site. Follow Port rules.
8. Arrival at gate of Airfield.	N/A				Call Operations at gate to inform of departure of airfield.

			Hazard Severity				
			1	2	3	4	5
			INSIGNIFICANT negligible or no injury could result	**MINOR** minor injury requiring only first aid	**MODERATE** injury resulting in lost time could occure	**HIGH** serious injury or death could occur	**VERY HIGH** multiple deaths could occur
Likelihood	1	VERY UNLIKELY	1	2	3	4	5
	2	UNLIKELY	2	4	6	8	10
	3	POSSIBLE	3	6	9	12	15
	4	LIKELY	4	8	12	16	20
	5	VERY LIKELY	5	10	15	20	25