APPENDIX F.1 DEPTH TO GROUNDWATER INVESTIGATION

Several areas within the City of Portland have known shallow groundwater. Within areas of known or suspected shallow groundwater, additional information about the depth to groundwater (DTW) must be collected to ensure that the proposed underground injection control (UIC) system meets minimum separation distances between the bottom of a UIC and seasonal high groundwater, as required by Oregon Department of Environmental Quality (DEQ) guidelines for private UICs or by the requirements of the water pollution control facility (WPCF) permit for publicly owned UICs that DEQ issued to the City of Portland on June 1, 2005 and modified in 2010. The minimum separation distance between the bottom of the UIC and seasonal high groundwater is 5 feet.

When a public or private[1] UIC is proposed within the regulated area, a site-specific investigation is required to determine the seasonal high depth to groundwater. DTW investigations are required for areas where the estimated depth to seasonal high groundwater contour is less the 50 feet. The City of Portland derived this map from the *Estimation of Depth to Ground Water and Configuration of the Water Table in the Portland, Oregon Area*, prepared by the United States Geological Survey (USGS) (http://pubs.usgs.gov/sir/2008/5059/). This information is available online in two locations:

- Through www.PortlandMaps.com, within the Stormwater Management mapping under the Environmental category for any selected location; and
- Through USGS mapping at http://or.water.usgs.gov/projs_dir/puz/.

Depth to Groundwater Investigation Requirements

The DTW investigation requires sufficient time to plan for and perform the necessary steps to collect a reliable measurement, including obtaining permits, performing utility locates, borings, piezometer/well installation, collection of water level measurements, and decommissioning of the monitoring well. The DTW investigation, including design, installation oversight, water measurements, and decommissioning, must be performed by an Oregon licensed registered geologist (RG), certified engineering geologist (CEG), or professional engineer (PE) with experience in hydrogeologic investigations and well design and installation; the investigation may include either the installation of a temporary piezometer(s) or groundwater monitoring well(s). The qualified professional is responsible for developing an appropriate scope of work to document the DTW, including:

- Determining the number and location(s) of the DTW measurements needed to address project objectives. (It is recommended, but not required, to have each piezometer or well location surveyed to a datum.)

- Determining the appropriate method for obtaining DTW measurements (e.g., piezometer or monitoring well).

[1] The requirements in this document do not apply to UICs specifically excluded by DEQ (e.g., privately owned residential footing and roof drains).

- Determining the appropriate depth of the boring(s). (Boring depth must be a minimum of 20 feet deeper than the proposed UIC depth.)

- Observing and describing soils encountered during drilling.

- Developing an appropriate well or piezometer design.

- Ensuring that construction and abandonment of piezometer or monitoring well complies with Oregon Administration Rules 690-240.

- Obtaining depth to groundwater measurements.[2]

- Estimating the measured DTW to be representative of the "groundwater seasonal high," based on available data and best professional judgment.

- Documenting the procedures used and the results of the DTW investigation.

- Submitting a signed and stamped DTW investigation report.

To the extent practicable, DTW measurements should be obtained in the immediate vicinity (less than or equal to 75 feet) of the proposed UIC. If high-quality shallow groundwater level data is available (e.g., piezometer, monitoring well, drinking water well, irrigation well) within 200 feet of the proposed UIC location, this data may be considered in lieu of site-specific data.

Requirements and Guidelines for Obtaining DTW Measurements

Using the following guidelines to collect and evaluate site-specific groundwater information will ensure that new UICs will meet the vertical separation requirement.

Permitting

Piezometers, monitoring wells, temporary wells, geotechnical holes, and other holes must by drilled, installed, and abandoned in accordance with Oregon Administrative Rules (OAR) 690-240 *Construction, Maintenance, Alteration, Conversion and Abandonment of Monitoring Wells, Geotechnical Holes and Other Holes in Oregon*. These rules require the licensed well constructor to provide notice and pay the associated fee(s) to the Oregon Water Resources Department (OWRD) prior to drilling or abandoning any new monitoring well, piezometer, or geotechnical hole. Additional information is available on OWRD's website: www.wrd.state.or.us.

Utility Clearance

Boring locations must be checked for underground utilities prior to any drilling activity. The Oregon Utility Notification Center's (OUNC) one-call number provides a free service to home owners, contractors, and other excavators, informing them of any buried facilities in the area

[2] If groundwater is not encountered (e.g., saturated conditions are not observed, no water seeps are observed) within 20 feet of the proposed bottom of the UIC, a piezometer or monitoring well does not need to be installed.

where they are planning to dig. The OUNC must be called two business days prior to digging. To request locates for proposed excavation, call the One-Call Center at 1-800-332-2344.

Piezometer/Well Design

The piezometer or well design should include the following, where necessary:

- Total boring depth.
- Appropriate well screen interval.
- Piezometer or well materials (e.g., well screen, filter pack, casing). Factory-fabricated prepacked wells screens may be used. New or reused equipment must be thoroughly decontaminated by steam cleaning or high-pressure hot water washing unless delivered in packaging with documentation of proper decontamination.
- Appropriate annular seal.
- Appropriate surface seal and security casing.

Piezometer/Well Borehole Drilling and Installation

Continuous soil sampling is recommended to allow detailed characterization of subsurface soil and identification of groundwater depth. The RG, CEG, or PE must prepare and submit a detailed boring log of subsurface conditions. Soil boring logs should be in accordance with the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* (ASTM D2488-00). Borings must be advanced to the groundwater level, or to a minimum of 20 feet below the proposed total depth of the UIC or 10 feet below a proposed UIC of 5 feet or less. If water is encountered in the boring, it must be noted on the drilling log.

The appropriate drilling method should be selected by the RG, CEG, or PE in conjunction with the driller, based on anticipated site-specific geologic and hydrogeologic conditions, anticipated boring depth, site accessibility, availability of equipment, and piezometer/well design. All equipment placed into the boreholes must be properly decontaminated prior to use.

Any investigation-derived material (e.g., soil cutting, water, personal protective gear) generated during drilling activities must be properly contained, characterized, and disposed in accordance with applicable state and federal regulations. Soil and water disposal must be documented.

Depth to Water Measurements

Following piezometer/well installation, water levels must be allowed to equilibrate for a minimum of 24 hours in fine-grained soils. After the water level has stabilized, an electronic water level indicator or a weighed tape should be used to measure the depth to water. Measurements should be made relative to ground surface and to the nearest 1/8 inch (~0.01 feet). The observer must make at a minimum two measurements over a period of about 15 minutes to show the results are static.

Estimating Depth to Seasonal High Groundwater

The site-specific DTW measurement must be used to estimate the depth to seasonal high groundwater. Seasonal water-table fluctuations were evaluated in the draft *Estimation of Depth to Ground Water and Configuration of the Water Table in the Portland, Oregon Area* report, prepared by the USGS and used to determine the seasonal correction factor (SCF). The SCF represents a long-term measurement of the seasonal water-table fluctuations. The SCF was set at

6 feet, using the USGS estimated mean of observed seasonal water table fluctuations for the unconsolidated sedimentary aquifer. To correct for seasonal variation, the SCF used to estimate depth to seasonal high groundwater is applied during periods of seasonal groundwater lows (late fall) and water level transition (summer and winter months). In March through May (seasonal high groundwater), no correction is added.

To correct site-specific DTW measurements to seasonal high DTW estimates, the following correction should be made:

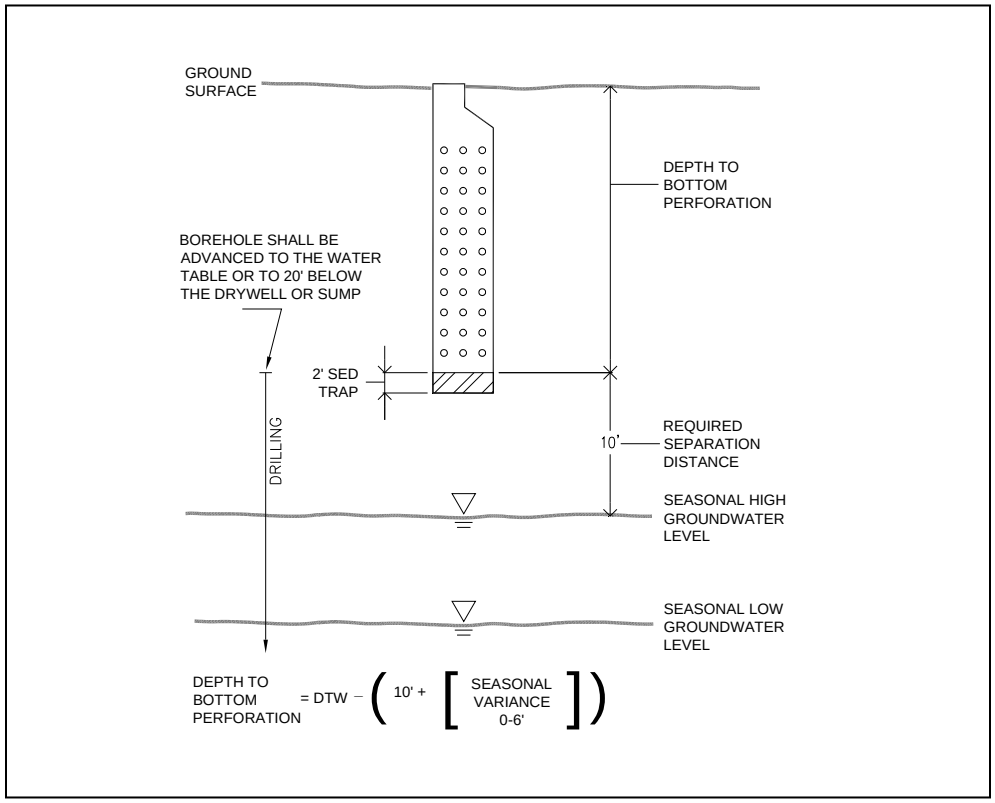
$$DTW_{SH} = DTW_{SS} - SCF$$

Where: DTW_{SH} = Estimated seasonal high depth to groundwater (feet)
DTW_{SS} = Measured site-specific depth to groundwater (time specific)
SCF = Seasonal correction factor
6 feet for measurements June through February
0 feet for measurements in March through May

If water is not encountered in the soil boring, advanced 20 feet below the proposed UIC completion depth, it must be documented on the boring log and in the investigation report. In this case, the depth to water is assumed to be outside the range of seasonal fluctuation; the minimum required separation distance for the proposed bottom of the UIC to seasonal high groundwater is therefore met by default. The borehole may be decommissioned immediately, in accordance with OAR 690-240.

Exhibit F.1-2 illustrates the depth to groundwater investigation.

Exhibit F.1 -2: Depth to Groundwater Investigation



Decommissioning

Borings, piezometers, temporary wells, and wells must be abandoned in accordance with OAR 690-240. Specific decommissioning procedures must be determined by a licensed driller and the registered geologist or professional engineer.

Minimum Requirements for DTW Investigation Report

The DTW Investigation report must contain, but is not limited to:

- A copy of the State of Oregon Monitoring Well Log Report or Geotechnical Hole Report, as appropriate.
- A map showing the final location of each well or piezometer and tax lot boundaries.
- Latitude and longitude of each well or piezometer.
- Description of field procedures (drilling method, sampling method, development method, depth to groundwater measurements, etc.).
- Measured water level to the nearest hundredth of a foot.
- Detailed soils log prepared by, or under the direct supervision of, the RG, CEG, or PE.
- Construction diagram for each well/piezometer.
- Summary of groundwater depth measurements (depth measured, elevation, date, time).
- Discussion/basis for estimation of seasonal high depth to groundwater measurement.
- Construction and investigation reports stamped and signed by the RG, CEG, or PE.

Depth to Groundwater Investigation Report Submittal and Usage

Two copies of the OWRD well or piezometer construction report and the signed and stamped DTW investigation report must be submitted with the development permit application to the City and to DEQ with the UIC rule authorization application, which can be obtained at http://www.deq.state.or.us/wq/uic/forms.htm.

The corrected site-specific depth to seasonal high groundwater must be used to verify that the proposed UIC will meet the separation distances set by DEQ to obtain rule authorization for private UICs or ensure compliance under the City's WPCF permit. If separation distances cannot be met, an alternative design must be developed that meets separation distance requirements.