

TECHNICAL MEMORANDUM

TO: Mavis Kent, Oregon Department of Environmental Quality

cc: Ken Chaput, The Boeing Company
John Cushing, Cascade Corporation
Sarah Prowell, Prowell Environmental

FROM: Christine Kimmel, L.G., Landau Associates *CBK*

DATE: February 7, 2006

RE: **WORK PLAN**
WELL DESIGN AND SCOPE OF WORK
DRILLING AND INSTALLATION OF BOP-70(DS) AND BOP-71(DS)
TROUTDALE SANDSTONE AQUIFER REMEDIAL ACTION

This document presents the scope of work for drilling and installing two new Troutdale Sandstone Aquifer (TSA) groundwater monitoring wells, designated as BOP-70(ds) and BOP-71(ds). The groundwater monitoring wells will be part of the network of wells that were installed under Consent Order No. WMCSR-NWR-96-08 with the Oregon Department of Environmental Quality (DEQ) to remediate trichloroethene (TCE) and other volatile organic compounds (VOCs) in the TSA.

Wells BOP-70(ds) and BOP-71(ds) will be located along the northwestern edge of the observed TCE plume in the TSA, as shown on Figure 1. The planned locations for the two wells are along the City of Gresham right-of-ways of 185th Avenue and NE Sandy Boulevard. The locations of the two wells will allow for the monitoring of TCE concentrations to the west and northwest of existing well BOP-22(ds), where elevated TCE concentrations have historically been observed. In addition, the wells will allow for monitoring of possible short-term loss of hydraulic control of the plume in the TSA during periods of extensive pumping of the Portland Water Bureau well field. The scope of work described in this document includes: drilling, borehole soil and groundwater sampling, installation and development, and well sampling and testing.

GROUNDWATER MONITORING WELL DESIGN

BOP-70(ds) and BOP-71(ds) will be drilled to the base of the TSA sandstone unit (Upper TSA). The Troutdale Gravel Aquifer (TGA) is anticipated to be present at both proposed drilling locations; therefore, a step-down in temporary casing diameters will be required to reduce the possibility of cross-contamination between aquifers. The proposed well design details are summarized below:

- Well Completion Depth. BOP-70(ds) and BOP-71(ds) will be installed to the base of the Upper TSA. The estimated completed depth is about 318 ft below ground surface (BGS), based on the estimated depth of lithologic units from wells BOP-22(dg) and D-18(dg).

- Well Casing Materials. Both wells will be constructed of 2.5-inch (nominal) threaded Schedule 80 PVC well casing. With 20-ft long well screens with a slot size of 0.010. The screen interval will be based on the analytical results from the borehole groundwater samples.
- Filter Pack Specifications. A commercially prepared, presized, and prewashed No. 10-20 Colorado silica sand (or equivalent) filter pack will be installed around the well screen. The filter pack will be presized so that approximately 96 to 100 percent of the sand passes the U.S. Standard No. 8 sieve, and 98 to 100 percent of the material is retained on the U.S. Standard No. 12 sieve.
- Annular Seal. Bentonite chips or pellets will be used as a seal above the filter pack. The annular space from the bentonite seal to the surface will be filled with a bentonite grout having a minimum density of 9.5 lbs/gal. Grout densities will be checked in the field using a mud balance.
- Protective Monument. A lockable, flush-grade security vault will be set in concrete and installed around the well to protect it from unauthorized entry or damage. The vault will be sized to accommodate groundwater extraction equipment and conveyance piping, as appropriate.

DRILLING PROCEDURES

Both BOP-70(ds) and BOP-71(ds) will be drilled and installed using the procedures described in the following sections and in accordance with applicable Oregon Water Resources Department (OWRD) regulations (Oregon Administrative Rules Chapter 690, Division 240, 2003 and subsequent revisions). The drilling will be monitored and recorded by a field engineer or geologist working under the supervision of an Oregon-registered geologist or engineer.

Because drill-drive methods of advancing temporary steel casing through the TSA have been historically unsuccessful, drilling will be accomplished using top-drive air rotary and Tubex-type equipment or other drilling system with similar under-reaming capabilities.

Soil and rock cuttings from well borings will be observed continuously and screened for organic vapors using a photoionization meter (PID). A detailed log will be maintained showing sampling depths, sampling method, soil types, stratification, groundwater conditions, and other pertinent information. Each log will also contain the names of the drilling company and drillers, the type of drill rig, starting and finishing dates for drilling, borehole diameter, boring number, and boring location.

Downhole drilling and sampling equipment will be steam-cleaned before and after drilling of the each well. Air filters will be used to filter the compressed air used during top-drive air rotary drilling.

BOP-70(ds) and BOP-71(ds) will be installed at the base of the Upper TSA, as described previously. The TGA and the CU1 separating the TGA and TSA are anticipated to be encountered during drilling at each location. Therefore, step-down drilling will be implemented to minimize the potential for cross-contamination between the TGA and TSA. The step-down techniques are summarized below:

1. Drilling will begin in the TGA using a 12-inch diameter temporary steel casing to the top of CU1. The temporary casing will be advanced, without additional drilling, until refusal or no more than 2 ft into CU1. The borehole will not be advanced beyond the casing at this stage.
2. The lower portion of the borehole will be sealed with at least 3 ft of bentonite chips. The bentonite chips will be allowed to hydrate for at least 12 hours, or until the integrity of the bentonite seal is determined to be adequate based on site conditions.
3. An 8-inch steel casing will be lowered inside the 12-inch casing to the bottom of the hole. Drilling will proceed through the Upper TSA and to the top of the Lower TSA.

Waste Management

During drilling, cuttings and water will be separated in an open-topped skid. Cuttings will be placed in 10 yd³ rolloff containers; solid residuals (e.g., Tyvek gloves) will be contained in 55-gallon drums or other covered containers, identified with the date of collection, origin (i.e., location and depth), and a brief description of the contents. Containerized waste will be transferred to a designated storage area on the Boeing facility and stored until characterized and classified. After characterization and classification, the waste will be managed consistent with applicable state and federal regulations. Water generated during drilling and development will be handled as described in the “Discharged Water Management” section of this technical memorandum.

BOREHOLE SAMPLING

Geologic sampling and logging will be performed at a maximum interval of about 5 ft during drilling of BOP-70(ds) and BOP-71(ds). Grab soil samples will be collected from the drill rig cyclone and will be described consistent with American Society of Testing and Materials procedures and recorded on a field boring log with other relevant drilling information.

Three borehole groundwater samples will be collected from each boring throughout the Upper TSA interval to evaluate possible vertical profiles of VOC concentrations. Borehole groundwater samples will be collected from three intervals of the Upper TSA; the upper 20 ft, estimated central 20 ft; and the bottom 20 ft. Borehole groundwater samples will be collected using a submersible pump (i.e. Grunfos pump) and pressurized packers to isolate the target sampling interval. Prior to sample collection, water will be purged until suspended solids have been reduced. Borehole samples will be submitted to a testing facility for VOC analysis on a requested 24 hour turn-around-time. The final well screen placement for the well will be based on the analytical results of the borehole samples.

WELL INSTALLATION AND DEVELOPMENT

Well Installation

All well casing material will be steam-cleaned before installation in the boring if factory decontamination procedures cannot be determined. Well installation procedures are provided below:

- **Well Casing and Screen Installation.** BOP-70(ds) and BOP-71(ds) will be installed with 2.5-inch diameter, Schedule 80 PVC casing. Centralizers will be installed above and below the screen and near the top of the well casing. Once the well casing and screen are installed, the total length of the well will be verified and documented by lowering a weighted tape to the bottom of the well.
- **Filter Pack Installation.** The annular well space between the boring walls and well screen will be packed with No. 10-20 Colorado sand (filter pack) to about 3 ft above the well screen. The filter pack will be installed through a tremie pipe, or carefully poured down the annulus between the well casing and the temporary casing as the temporary casing is slowly withdrawn. To ensure complete settlement of the filter pack material, the well will be surged with a surge block each time 10 ft of filter pack is placed.
- **Annular Bentonite Seal.** A 5-ft bentonite chip or pellet seal will be placed above the filter pack. The annular space from the bentonite seal to the surface seal will be filled with bentonite grout. The bentonite grout will be installed through a tremie pipe between the well casing and the temporary casing as the temporary casing is slowly withdrawn. The tremie pipe will have side discharges to help prevent grout from disturbing the bentonite seal and filter pack. Grout densities will be checked in the field using a mud balance.

WELL DEVELOPMENT

BOP-70(ds) and BOP-71(ds) will be developed by surging and pumping, or other suitable methods, after the grout has set in the well annulus for a minimum of 24 hours. Development will remove soil introduced during installation activities and establish hydraulic continuity between the filter pack and the soil formation. Development will continue until at least five well volumes of water are removed, soil is reasonably cleared from the wells, and the turbidity of the water is low. No groundwater sampling will be performed for at least 2 days following development.

Topographic Survey

A vertical and horizontal survey will be conducted by a licensed land surveyor to document the location of the wells and to establish a reference point elevation for groundwater level measurements. The same datum used in previous site investigations will be used and the work will be consistent with the regional surveys conducted in May 1991 and November 1994 by Chase Jones and Associates.

WELL SAMPLING AND TESTING

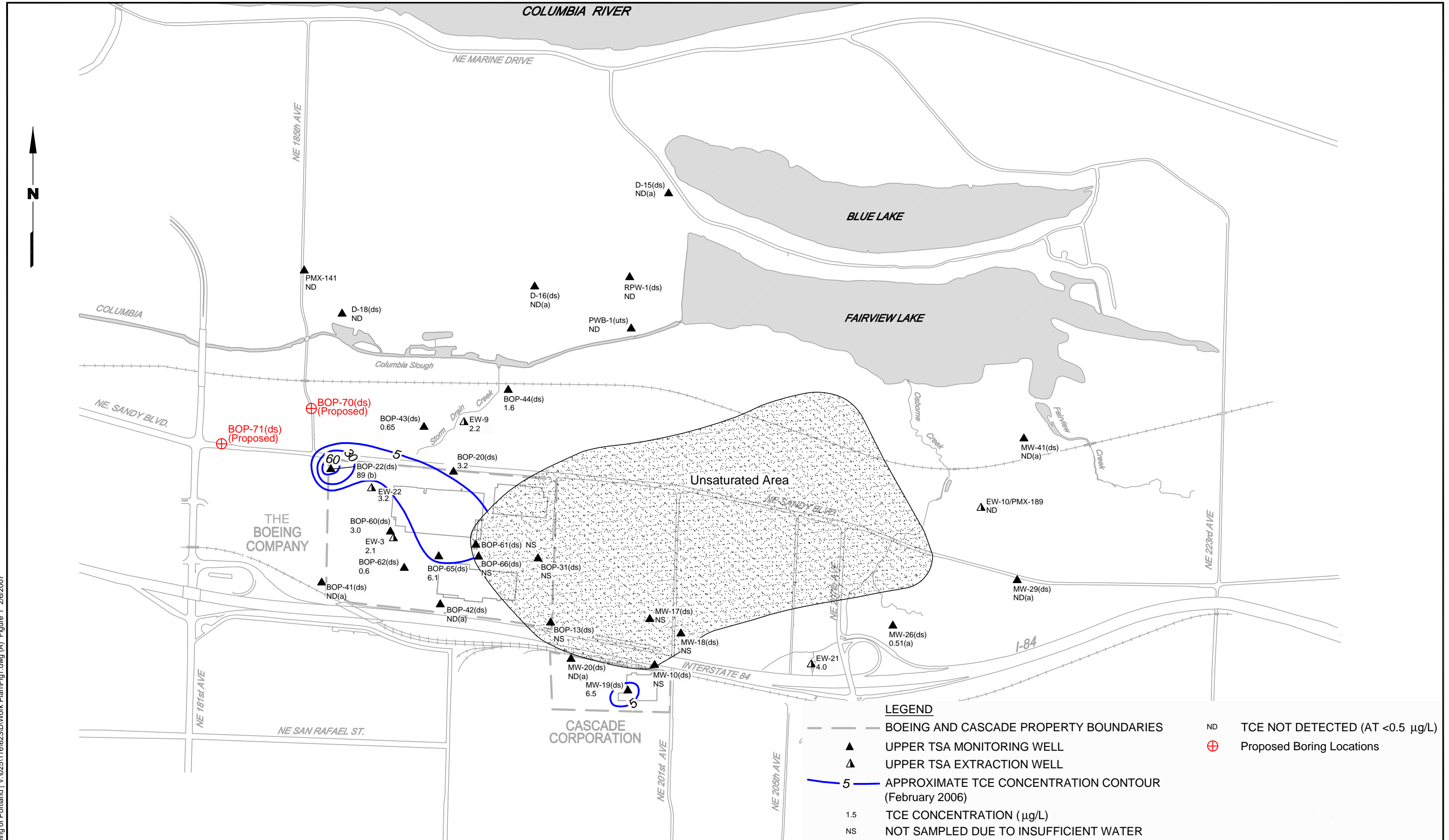
Groundwater elevations will be monitored at BOP-70(ds) and BOP-71(ds) using dataloggers. Manual water level data will be used to calibrate the dataloggers and to provide a backup data set if the dataloggers should fail.

Wells BOP-70(ds) and BOP-71(ds) will be added to the TSA remedial action monitoring program. Groundwater samples will be collected on a quarterly monitoring program and analyzed for VOCs using diffusion bag samplers (DBS). Groundwater analytical results will be included in the quarterly and annual reporting requirements for the existing remedial action.

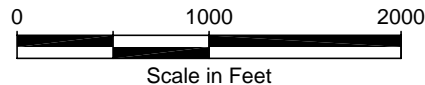
SUMMARY

The proposed actions will support the TSA remedy and assist with evaluation of monitoring any potential loss of hydraulic control during extensive periods of PWB pumping from the well field. Based on the information presented in this plan, we seek DEQ's approval to implement the well installation activities scope of work.

Attachment



Boeing of Portland | V:\025116\023D\Work Plan\Fig1.dwg (A) *Figure 1* 2/6/2007



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TSA Remedial Action
East Multnomah County,
Oregon

Proposed New Well Locations

Figure
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