Evaluation Report
SWMU-17, SWMU-20, and AOC-05
Boeing Developmental Center
Tukwila, Washington

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Prepared for

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1.0 INTRODUCTION

This report evaluates current conditions at solid waste management units (SWMUs) SWMU-17 and SWMU-20, and at area of concern (AOC) AOC-05 located at The Boeing Company (Boeing) Developmental Center (BDC) in Tukwila, Washington (Figure 1). The BDC is a Resource Conservation and Recovery Act (RCRA) corrective action site with remedial activities conducted under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). Preparation of this report was authorized under Work Order No. ENV-G-04DC-019.

1.1 BACKGROUND

Under its RCRA corrective action authority, the U.S. Environmental Protection Agency (EPA) conducted a RCRA Facility Assessment (RFA) in 1994 and identified 157 SWMUs and 5 AOCs at the BDC (SAIC 1994). Ecology approved exclusion of most SWMUs and AOCs from further investigation based on the determination that they do not pose a threat to human health or the environment. The status of each SWMU and AOC was documented in a previous summary report (Summary Report) prepared by Landau Associates (Landau Associates 2002a).

Following submittal of the Summary Report (Landau Associates 2002a) to Ecology, only two SWMUs (SWMU-17 and SWMU-20) and three AOCs (AOC-01/02, AOC-03/04, and AOC-5) remained subject to continued monitoring and evaluation. Monitoring was subsequently discontinued at AOC-01/02 and AOC-03/04, in accordance with the Developmental Center Groundwater Monitoring Plan (Boeing 2001), following two consecutive quarters and four consecutive quarters, respectively, during which contaminants of concern were not detected (Boeing 2002, 2003). Based on these monitoring results, no further remedial action is required at AOC-01/02 and AOC-03/04.

At SWMU-20, the pump and treat system was shut down December 14, 2001 and semiannual monitoring was performed through November 2003 to evaluate natural attenuation of volatile organic compounds (VOCs) as a remedial alternative to reach site clean-up concentrations. At AOC-05, Oxygen Release Compound (ORC$^{®}$) was injected during May 2002 to address gasoline-range petroleum hydrocarbons (TPH-G) and benzene, toluene, ethylbenzene, and xylenes (BTEX) present in groundwater. Subsequent to injection, groundwater monitoring at AOC-05 was conducted monthly, then quarterly, then seminannually through November 2003. At SWMU-17, remedial action has consisted of groundwater monitoring only. Figure 2 shows the locations of SWMU-20, AOC-05, and SWMU-17.

1.2 REPORT ORGANIZATION

Following this introductory section, this report is divided into four main sections. Section 2.0 presents evaluation of groundwater monitoring results for SWMU-17. AOC-05 injection of ORC$^{®}$ is described and monitoring results are evaluated in Section 3.0. Section 4.0 presents evaluation of monitoring results for SWMU-20 following shutdown of the pump and treat system in December 2001. A preliminary indoor air evaluation for Buildings 9-101 and 9-90, located in partially in or near SWMU-20, is presented in Section 5.0. Conclusions are summarized in Section 6.0, appropriate use of the report is described in Section 7.0, and references are listed in Section 8.0. A work plan for additional remedial action at SWMU-20 is presented in Appendix A.

2.0 SWMU-17

SWMU-17 is a former 67-gal sump and associated 4,000-gal steel underground storage tank (UST; designated DC-05), located east of the Building 9-75 water tank (Figure 3). Waste oil generated by hydraulic testing shops, automotive maintenance shops, and various other operations at the BDC was poured into the sump and flowed into the UST. Periodically, the waste oil was pumped from the UST for offsite treatment and disposal (SAIC 1994). The sump and UST were installed in 1957 and removed in late March or early April 1986 (Landau Associates 1987).

2.1 REMEDIAL ACTION

Minor amounts of hydrocarbons present in soil samples collected prior to and following UST removal led to the installation of three monitoring wells (BDC-05-1, BDC-05-2, and BDC-05-3) during 1986 (Norton Corrosion Limited, Inc. 1985; Landau Associates 1987). Four additional monitoring wells (BDC-05-2A, BDC-05-4, BDC-05-5, and BDC-05-6) were installed in January 1987 and an additional well, BDC-05-7, was installed in March 1987. In December 1987, Ecology requested that additional groundwater sampling be conducted. Following one to two sampling events at each well for analysis of volatile organic compounds (VOCs) and priority pollutant metals, Ecology stated in August 1988 that no further work was required at this SWMU and that monitoring wells could be abandoned (Ecology 1988). Monitoring wells BDC-05-01 and BDC-05-06 were subsequently abandoned.

From 1996 through 2003, groundwater samples from the five remaining wells (BDC-05-2A, BDC-05-3, BDC-05-4, BDC-05-5, and BDC-05-7) were analyzed on an annual or semiannual basis for VOCs, total petroleum hydrocarbon (TPH), and metals. Split samples collected in December 2001 were sent to Analytical Resources, Inc. (ARI) of Seattle, Washington, as well as to the Boeing laboratory used for analysis of previous samples. Metals concentrations in the ARI samples were significantly lower than the concentrations reported by the Boeing laboratory, indicating that the elevated concentrations of metals in previous samples may have been inaccurate. It was determined that samples submitted to the Boeing laboratory in December 2001 and during previous sampling events had been collected in reused METRO sample bottles that had not been acid washed by the laboratory and were, therefore, a possible source of metals contamination. Groundwater samples have been submitted to ARI since December 2001.

Detected concentrations of arsenic, copper, and tetrachloroethene (PCE) have exceeded the preliminary screening levels. In December 2001, Ecology asked for continued groundwater monitoring at SWMU-17 to evaluate the possible need to pursue more active cleanup (Ecology 2001).

2.2 SAMPLING AND ANALYSIS

Following Ecology's request, groundwater was sampled during four semiannual events during 2002 and 2003 for analysis of VOCs and total and dissolved metals. During these four events, arsenic was analyzed by Method 200.8 (ICP MS) to obtain a lower reporting limit for comparison to the preliminary screening level. Monitoring results through December 2001 were presented in the Summary Report (Landau Associates 2002a) and subsequent monitoring results have been reported in four semiannual groundwater reports (Landau Associates 2002b, 2002c, 2003a, 2003b).

2.3 MONITORING RESULTS

This section discusses the semiannual results for total and dissolved arsenic, total and dissolved copper, and PCE for 2002 and 2003 and compares results to preliminary screening levels established for the BDC in the Summary Report (Landau Associates 2002a). The results for dissolved analysis of arsenic and copper are most applicable for comparison to preliminary screening levels because dissolved results are more representative of concentrations in groundwater given the potential for metals absorbed to particulates in unfiltered samples to affect total metals results. Data for this period are compared to preliminary screening levels in Table 1 and presented below:

- **Dissolved Arsenic:** The only detection of dissolved arsenic during 2002 and 2003 occurred at the reporting limit (0.001 mg/L) at well BDC-05-4 in November 2003. Well BDC-05-4 is located crossgradient of the former UST (Figure 3). Prior to 2002, previous analysis of dissolved arsenic, performed in December 2001 at each of the SWMU-17 wells, resulted in no detections.

- **Dissolved Copper:** Dissolved copper was detected at upgradient well BDC-05-5 and well BDC-05-7 near the former UST during 2002 and 2003. One or more detections during this period exceeded the 0.0034 mg/L preliminary screening level (Method B marine surface water) at wells BDC-05-5 (0.007 mg/L) and BDC-05-7 (0.004-0.005 mg/L), but did not exceed the preliminary screening level for fresh surface water. These concentrations are significantly lower than the maximum historical concentration of dissolved copper of 0.067 mg/L detected at well BDC-05-3 in December 2001. Dissolved copper concentrations for the period of February 1988 to November 2003 are plotted on Figure 4.

- **PCE:** PCE was detected at wells BDC-05-2 (upgradient), BDC-05-3 (downgradient), and BDC-05-7 (near former UST) during 2002 and 2003. Detected concentrations exceeded the 9 μg/L (Method B fresh and marine surface water criteria) preliminary screening level two or more times at wells BDC-05-2 (17 to 23 μg/L) and BDC-05-7 (12 to 20 μg/L). These concentrations are significantly lower than the maximum historical concentration of 79 μg/L measured at well BDC-05-2 in February 1987. Since February 1988, PCE concentrations above the preliminary screening level (9 μg/L) have been measured only at wells BDC-05-2 and BDC-05-7. Since May 1987, PCE concentrations at wells BDC-05-2 and BDC-05-7 have varied above and below the preliminary screening level but have remained consistently within the concentration range of about 5 μg/L to about 20 μg/L; PCE concentrations detected in 2002 and 2003 at these two wells remain consistent with this trend. Breakdown products TCE and cis-1,2-DCE are present in SWMU-17 wells, indicating the occurrence of reductive dechlorination. TCE and cis-1,2-DCE concentrations are below preliminary screening levels. Vinyl chloride has not been historically detected. PCE concentrations for the period of July 1986 to November 2003 are plotted on Figure 5.

2.4 CONCLUSIONS

Based on the recent SWMU-17 monitoring results, we recommend discontinuing metals analysis and continued semiannual monitoring for PCE. Monitoring results for 2002 and 2003 are summarized below:

- Dissolved arsenic was detected at only one well and this detection was at a concentration well below the preliminary screening level.

- Although dissolved copper was detected at low concentrations in wells BDC-05-5 and BDC-05-7, located nearest the former UST, it was not detected in the other three SWMU-17 wells, located upgradient, crossgradient, and downgradient of the former UST. Some of the dissolved copper concentrations at wells BDC-05-5 and BDC-05-7 are above the preliminary screening level for marine surface water, but below the preliminary screening level for fresh surface water; other detections at these two wells have been below both preliminary screening levels.

- PCE was detected at only two wells (BDC-05-2 and BDC-05-7) at concentrations greater than the preliminary screening levels; detected concentrations at these two wells were consistent with previous results since May 1987. Since May 1987, PCE concentrations at wells BDC-05-2 and BDC-05-7 have varied above and below the preliminary screening level but have remained consistently within the concentration range of about 5 µg/L to about 20 µg/L. The presence of TCE and cis-1,2-DCE (Landau Associates 2002a, 2002b, 2002c, 2003a, 2003b) indicates the occurrence of reductive dechlorination. PCE concentrations below the preliminary screening level or below detection limits at the other three SWMU-17 wells, located upgradient, crossgradient, and downgradient of the former UST, indicate PCE contamination is localized. The periodic low-level detections above the screening level at wells BDC-05-2 and BDC-05-7 do not warrant more active cleanup, but do indicate the need for continued monitoring.

3.0 AOC-05

AOC-05 was a 1,000-gal unleaded gasoline steel UST identified as DC-01 and an associated pump island that were located approximately 25 to 30 ft south of the southwest corner of Building 9-61 (Figure 6). The UST was removed in 1985 after it was punctured by a measuring rod and approximately 830 gal of unleaded gasoline was released.

3.1 REMEDIAL ACTION

During UST removal, approximately 500 to 600 gallons of floating product were recovered and additional gasoline was removed with excavated soil (Boeing 2001). Between January and June 2001, groundwater was sampled from twelve soil borings and three remaining monitoring wells (BDC-101, BDC-102, and BDC-103) in the vicinity of the former UST. This groundwater analytical data (IT 2001) indicated that residual gasoline-range petroleum hydrocarbons (TPH-G) and benzene were present at concentrations in excess of preliminary screening levels established for the BDC in the Summary Report (Landau Associates 2002a). Subsequently, groundwater monitoring was performed at the three AOC-05 monitoring wells on a quarterly then semiannual basis.

In November 2001, Ecology and Boeing agreed that ORC® injection and subsequent groundwater monitoring would be performed in AOC-05. Baseline groundwater monitoring and ORC® injection were performed in April and May 2002 in general accordance with the *ORC® Injection Plan: AOC-05* (work plan; Landau Associates 2002d). Subsequent to injection, groundwater sampling was conducted monthly, then quarterly, then seminannually through November 2003. Groundwater data is used to monitor concentrations of TPH-G and benzene in groundwater and to evaluate the effectiveness of the ORC® injection.

3.2 ORC® INJECTION ACTIVITIES

ORC® material was injected into the aquifer in the vicinity of the former UST to promote aerobic biodegradation of petroleum hydrocarbons. ORC® is a powdered magnesium peroxide distributed by Regenesis, Inc. of San Clemente California that slowly releases oxygen to the aquifer when hydrated. On May 6 and 7, 2002, approximately 80 lbs of ORC® were mixed with tap water and injected as a slurry at each injection location (ORC-1 through ORC-13). Direct-push drilling and ORC® injection was performed by Cascade Drilling of Woodinville, Washington. The ORC® slurry was injected through direct-push probe rods over an interval from 10 to 20 ft below ground surface (BGS); depth to water measurements at the three AOC-05 monitoring wells indicated groundwater was at approximately 12 ft

BGS at the time of injection. Following ORC® injection and groundwater sampling, borings were abandoned by backfilling with bentonite chips to the bottom of the pavement and constructing a concrete pavement patch.

A total of 1,060 lbs of ORC® were injected at 13 injection locations in the vicinity of the former UST (Figure 7). Eight of the injection borings are located hydraulically downgradient of the former UST, one is immediately adjacent to the former UST, and four are located hydraulically upgradient. Groundwater flow is westward in the vicinity of AOC-05.

3.3 GROUNDWATER SAMPLING AND ANALYSIS

Groundwater samples were collected for measurement of field parameters and laboratory analysis. Samples were collected prior to ORC® injection to establish baseline conditions and following injection to monitor the effects of the ORC®. Field parameters consisting of dissolved oxygen (DO), oxidation-reduction potential (ORP), conductivity, and pH were measured at each location using a flow through cell and field meters. Groundwater samples were submitted for laboratory analysis of TPH-G by NWTPH-Gx and benzene, toluene, ethylbenzene, and xylene (BTEX) by EPA Method 8021B. Samples collected in November 2003 were also analyzed for redox parameters nitrate, sulfate, and methane by EPA Methods 353.2, 300, and 8015 modified, respectively.

Baseline groundwater monitoring was conducted at three existing wells (BDC-101, BDC-102, and BDC-103); three temporary well points (GS-1, GS-2, and GS-3); and the 13 ORC® injection borings (ORC-1 through ORC-13). Baseline groundwater samples were collected from monitoring wells on April 29, 2002. Baseline groundwater monitoring was performed at the temporary well points and injection borings on May 6 and 7, 2002; at each injection boring, the groundwater sample was collected immediately prior to ORC® injection. Sample locations are shown on Figure 7. Table 2 presents baseline field measurements and laboratory data for the temporary well points and injection borings. Baseline data for the three monitoring wells is presented in Table 3 along with subsequent monitoring data.

Post-injection groundwater monitoring was conducted monthly at the three monitoring wells in June, July, and August 2002, then quarterly in December 2002 through June 2003, with the final sampling conducted in November 2003. Table 3 compares baseline field measurements and analytical results to post-injection results. Table 4 presents the four quarters of data collected prior to baseline sampling for additional comparison. Laboratory reports for data presented in Tables 2, 3, and 4 have been previously submitted to Ecology and quarterly and semiannual groundwater monitoring at AOC-05 has been reported in the Summary Report (Landau Associates 2002a) and in subsequent semiannual groundwater reports (Landau Associates 2002b, 2002c, 2003a, 2003b).

3.4 MONITORING RESULTS

This section discusses the results of baseline and post-injection monitoring and compares these results to four quarters of monitoring data collected prior to baseline sampling.

3.4.1 BASELINE MONITORING

Baseline concentrations of TPH-G exceeded the preliminary screening level at eight of the nineteen groundwater sample locations and benzene concentrations exceeded the preliminary screening level at three of these locations. Groundwater sampled from seven of the thirteen injection borings (ORC-4, ORC-6, ORC-7, ORC-9, ORC-10, ORC-11, and ORC-12) and from monitoring well BDC-103 exceeded the 0.8 mg/L preliminary screening level for TPH-G. Four of these sample locations where TPH-G concentrations exceeded the preliminary screening level are located hydraulically upgradient or crossgradient of the former UST and pump island (ORC-6, ORC-9, ORC-11, and ORC-12). The concentrations of detected TPH-G ranged from 0.27 to 230 mg/L with the maximum concentration occurring at boring ORC-10, located adjacent to the former UST. The 71 μg/L preliminary screening level for benzene was exceeded at injection borings (ORC-7 and ORC-10) and at monitoring well BDC-103. Detected concentrations of benzene ranged from 2.6 to 28,000 μg/L with the maximum detected concentration occurring at ORC-7, located slightly downgradient of the former UST and pump island. Baseline concentrations of TPH-G and benzene are presented on Figure 8. The approximate baseline extent of groundwater with TPH-G and benzene concentrations greater than preliminary screening levels are also shown on Figure 8.

A number of the baseline samples also contained detectable concentrations of toluene, ethylbenzene, and xylenes. The detected concentrations of toluene (1.1 to 47,000 μg/L) and ethylbenzene (1.3 to 5,400 μg/L) were well below the respective preliminary screening levels of 200,000 μg/L and 29,000 μg/L. There is no preliminary screening level established for xylenes; total xylene concentrations ranged from 2.1 to 28,900 μg/L.

Baseline DO concentrations were generally less than 1 mg/L and ORP was generally positive, indicating transitional aquifer redox conditions (i.e., aquifer conditions somewhere between aerobic and anaerobic). Three degrees of aquifer redox conditions are defined as follows (Beil et. al. 2002):

Aerobic	DO > 1 mg/L, ORP > 0 mV
Transitional	DO < 1 mg/L, ORP > 0 mV
Anaerobic and Reducing	DO < 1 mg/L, ORP < 0 mV

Baseline DO concentrations were less than 1 mg/L except at borings ORC-4 (2.64 mg/L) and ORC-8 (3.37 mg/L), and at monitoring well BDC-101 (1.70 mg/L). Baseline ORP was consistently positive and varied from 0.8 to 215 mV.

3.4.2 POST-INJECTION MONITORING

No significant changes were observed in groundwater analytical concentrations or aquifer redox conditions during the seven monitoring events that were conducted following ORC® injection. Post-injection monitoring was conducted at the three monitoring wells for a year and a half between June 2002 and November 2003. Well BDC-103 is located in the release area near the former UST, and wells BDC-101 and BDC-102 are located downgradient (Figure 6). Table 3 compares the results of post-injection monitoring to baseline monitoring data collected from monitoring wells in April 2002. For additional comparison, Table 4 presents the four quarters of monitoring well data collected prior to baseline monitoring (June 2001 and March 2002).

3.4.2.1 Release Area Well BDC-103

At well BDC-103, located near the former UST, post-injection monitoring results were as follows:

- Following injection, TPH-G concentrations varied from 180 to 270 mg/L. These concentrations show no significant change compared to the baseline concentration of 200 mg/L and concentrations that varied from 120 to 200 mg/L during the year prior to baseline sampling and ORC® injection. TPH-G concentrations in groundwater consistently exceeded the 0.8 mg/L preliminary screening level.

- Following injection, benzene concentrations varied from 780 to 4,600 µg/L with a concentration of 850 µg/L measured during the last sampling event in November 2003. These concentrations show no significant change compared to the baseline concentration of 980 µg/L and concentrations that varied from 494 to 5,100 µg/L during the year prior to baseline sampling and ORC® injection. Benzene groundwater concentrations consistently exceeded the 71 µg/L preliminary screening level.

- Concentrations of toluene, ethylbenzene, and xylenes were similar before and after ORC® injection. Concentrations of toluene and ethylbenzene in groundwater were consistently below preliminary screening levels; a preliminary screening level is not established for xylenes.

- DO concentrations stayed below 1 mg/L and ORP was generally positive during post-injection monitoring. DO concentrations ranged from 0.17 to 0.69 mg/L, compared to the 0.21 mg/L baseline concentration. ORP concentrations varied from 4.9 to 143.1 mV, except for negative readings in June 2002 (-110.3 mV) and November 2003 (-74.6 mV). The baseline ORP reading was 44.2 mV.

Figure 9 presents a plot of TPH-G and benzene concentrations at well BDC-103 before and after ORC® injection. Plots of DO concentrations and ORP readings for the three AOC-05 monitoring wells are presented on Figures 10 and 11, respectively.

3.4.2.2 Downgradient Wells BDC-101 and BDC-102

Post-injection monitoring results at downgradient wells BDC-101 and BDC-102 are as described below. November 2003 TPH-G and BTEX results for well BDC-102 are inconsistent with previous results; November 2003 results for BDC-101 are also somewhat inconsistent. These anomalous results may be the result of laboratory error, as reanalysis was required on all three SWMU-17 samples due to laboratory quality control and the results of reanalysis were significantly different for the BDC-102 sample (i.e., TPH-G and BTEX not detected by reanalysis) compared to the original results. The results of the original analyses that resulted in the highest concentrations for the BDC-101 and BDC-102 samples are reported as estimated, but the results are suspect and should be evaluated in light of future sampling results:

- During the six post-injection sampling events prior to November 2003, TPH-G was only detected once at well BDC-101 (0.61 mg/L) and twice at well BDC-102 (0.25 and 0.26 mg/L). Concentrations of 0.42 mg/L (estimated) and 0.99 mg/L (estimated) were reported in November 2003 for wells BDC-101 and BDC-102, respectively. During baseline sampling, TPH-G was not detected at well BDC-101 and was detected at a concentration 0.33 mg/L at well BDC-102. At both wells, baseline and post-injection concentrations were lower than concentrations from the previous year, which ranged from below detection limits to 6.5 mg/L at well BDC-101, and from 0.38 to 1.6 mg/L at well BDC-102.

- During baseline and subsequent sampling, benzene concentrations at BDC-101 and BDC-102 ranged from below detection limits to 4.4 μg/L, with the exception of November 2003 results. In November 2003, concentrations of 13 mg/L (estimated) and 120 mg/L (estimated) were reported for BDC-101 and BDC-102, respectively. With the exception of November 2003 results, baseline and subsequent concentrations are well below the preliminary screening level of 71 μg/L and are lower than benzene concentrations measured during the prior year, which ranged from 1.4 to 95 μg/L at BDC-101 and from 1.3 to 5.33 μg/L at BDC-102.

- With the exception of the ethylbenzene concentration reported for BDC-102 in November 2003, the concentrations of toluene, ethylbenzene, and xylenes corresponding to baseline and post-injection sampling were as low or lower than concentrations detected during the previous year. Groundwater concentrations of toluene and ethylbenzene have consistently been below preliminary screening levels; there is no preliminary screening level established for xylenes.

- DO concentrations occasionally exceeded 1 mg/L at well BDC-101, but not at well BDC-102 and ORP was generally positive at both wells. DO concentrations ranged from 0.35 to 1.89 mg/L at BDC-101, compared to the 1.70 mg/L baseline concentration. DO concentrations at BDC-102 ranged from 0.24 to 1.0 mg/L compared to a baseline concentration of 0.33 mg/L. ORP measurements at the two wells varied from 19.6 to

234.1 mV, except for two negative readings at BDC-102 in June 2002 (-127.2 mV) and November 2003 (-122.2). Baseline ORP readings were 215.3 and 113.5 mV at BDC-101 and BDC-102, respectively.

With the exception of November 2003 results, data shows general decreasing trends in TPH-G and BTEX concentrations at wells BDC-101 and BDC-102. Decreasing trends do not appear attributable to the ORC® injection, as decreasing concentrations were observed prior to baseline sampling and injection. Additionally, consistently low DO and ORP levels indicate that aquifer conditions were not enhanced for aerobic degradation. Figures 12 and 13 present plots of TPH-G and benzene concentrations for wells BDC-101 and BDC-102, respectively. DO concentration and ORP plots for all three monitoring wells are presented on Figures 10 and 11, respectively.

3.5 CONCLUSIONS

Monitoring results indicate that ORC® was ineffective in changing aquifer redox conditions or in significantly decreasing concentrations of TPH-G or benzene. However, generally decreasing downgradient concentrations indicate the plume is not spreading and may be shrinking.

Even at well BDC-103, located just 2.5 ft from boring ORC-10 where 20 pounds of ORC® were injected, no effects of the injection were observed. It appears that released oxygen was quickly consumed by background aquifer demand consisting of organic carbon and/or reduced metals and that little to no oxygen remained to facilitate aerobic degradation of petroleum hydrocarbons. Although total organic carbon (TOC) data has not been collected for AOC-05 soil or groundwater, TOC results for five soil samples collected previously at SWMU-20 indicate elevated concentrations of naturally occurring organic carbon are present in site soil. The SWMU-20 soil samples were collected from depths ranging from 20 to 37.5 ft at wells 14E, 17D, 18D, 18C, and 20D and contained 247 mg/kg to 1,456 mg/kg of TOC (Landau Associates 1992). With the exception of well 14E, these wells are located crossgradient of the former SWMU-20 degreaser and TOC concentrations are unlikely to be the result of an organic carbon release (e.g., TPH) from the degreaser.

In spite of no observable effects of the ORC® injection, baseline and post-injection monitoring results at downgradient wells BDC-101 and BDC-102 show a general decrease in TPH-G and benzene concentrations compared to monitoring results from the previous year (with the exception of November 2003 data). Although injected ORC® was ineffective at reducing concentrations at the release area (BDC-103) and decreasing concentrations at the downgradient wells do not appear to be attributable to ORC® injection, decreasing downgradient concentrations indicate the plume is not spreading and may be shrinking.

Based on downgradient results that indicate the plume is stable or shrinking, we recommend continued semiannual monitoring at wells BDC-101, BDC-102, and BDC-103 to monitor the effectiveness of natural attenuation processes in containing and potentially shrinking the plume. Following four consecutive semiannual monitoring events with results below preliminary screening levels at downgradient wells BDC-101 and BDC-102, we recommend that monitoring be discontinued and that institutional controls be applied to address worker safety and management of AOC-05 groundwater during any excavation activities within the plume.

4.0 SWMU-20

SWMU-20 was a vapor degreaser located in the northwest corner of Building 9-101 (Figure 2). PCE and TCE were reportedly used during operation of the degreaser from about 1956 to 1984. In 1984, the vapor degreaser, associated piping, and other equipment were removed and all openings through the walls and floor were plugged. The concrete-lined degreaser pit and sumps were then backfilled with compacted sand backfill material and capped with a 10-inch thick concrete slab. (Landau Associates 1990). During subsequent soil excavation near the backfilled degreaser pit, groundwater was observed at a depth of 2 to 29 inches above the concrete floor of the degreaser pit.

4.1 REMEDIAL ACTION

Remedial action beginning in 1989 has included removal of contaminated soil, soil and groundwater sampling, monitoring well installation and subsequent monitoring, and operation of a groundwater pump and treat system. Investigations confirmed the presence of PCE, TCE, and breakdown products in groundwater and the solvent release was interpreted to be from the former degreaser pit (SAIC 1994). Benzene and napthalene were also frequently detected in SWMU-20 groundwater samples. The location of SWMU-20, including the former vapor degreaser pit, monitoring wells, and extraction wells, are shown on Figure 14. Remedial action at SWMU-20 is summarized below; a more detailed discussion is contained in Landau Associates (2002a):

- In 1989, approximately 1,400 tons of soil contaminated with PCE and TCE were removed from the area of the former degreaser pit and sumps during a structural upgrade of Building 9-101. Soil and/or water samples were collected before and during excavation for analysis of VOCs, SVOCs, metals, and cyanide.

- During a Phase II investigation performed in August 1989, 65 soil samples were collected from borings and 24 monitoring wells were installed in the vicinity of the former degreaser pit/sump area. Investigation soil samples were analyzed for VOCs, SVOCs, TPH, and polychlorinated biphenyls (PCBs); groundwater samples were analyzed for VOCs and TPH.

- A Phase III investigation was completed in February 1991, which included additional soil sampling and installation of 13 monitoring wells. Soil samples were analyzed for VOCs. Groundwater samples from the 24 existing monitoring wells and 13 new monitoring wells were analyzed for VOCs.

- During the fall of 1993, a groundwater treatment system was installed to remove chlorinated VOCs from groundwater and prevent migration of contaminants. The treatment system consists of two extraction wells (E-1 and E-2), and a sieve tray aerating treatment system. Well E-1 was installed first and operated as the sole extraction well from March 4, 1994 to December 13, 1995. Following installation of a second groundwater extraction well (E-2) in July 1996, groundwater was extracted alternately from the two wells, with E-2 operated most of the time. The groundwater treatment system processed approximately 25,000 gal per day of treated water, which was discharged to a National Pollution Discharge Elimination System (NPDES) permitted stormwater outfall. The treatment system was shutdown December 14, 2001 to allow the groundwater to equilibrate and to evaluate natural attenuation as a remedial alternative to reach site clean-up concentrations.

4.2 MONITORING WELL CONSTRUCTION

Groundwater monitoring wells installed at SWMU-20 and throughout the site have been constructed to allow evaluation of discrete intervals, or horizons, within the aquifer system beneath the site (horizons A, B, C, D, and E). Monitoring wells have been screened as follows:

A Horizon Wells – screen depths ranging from 6.5 to 21.5 ft BGS
B Horizon Wells – screen depths ranging from 22.0 to 27.5 ft BGS
C Horizon Wells – screen depths ranging from 23.5 to 40.5 ft BGS
D Horizon Wells – screen depths ranging from 40.0 to 56.0 ft BGS
E Horizon Wells – screen depths ranging from 77.0 to 82.0 ft BGS.

The A, B, and C Horizon wells are intended to monitor three distinct layers of groundwater located in the shallow, unconfined aquifer. The D Horizon wells are intended to evaluate the semi-confined layer of groundwater present beneath a discontinuous silt aquitard present beneath the unconfined aquifer. The E Horizon well (MW-14E) is intended to monitor the water quality in the fully confined aquifer located below a massive marine silt deposit. The distinction of these horizons has been useful in developing the conceptual groundwater model for the site and important for both the investigation and remediation of SWMU-20.

4.3 SAMPLING AND ANALYSIS

Most of the 35 monitoring wells located a SWMU-20 have been sampled at least semiannually since January 1994 for VOC analysis, with most wells sampled quarterly in 1996 and 1997. Monitoring results through December 2001 were presented in the Summary Report (Landau Associates 2002a) and subsequent monitoring results have been reported in four semiannual groundwater reports (Landau Associates 2002b, 2002c, 2003a, 2003b).

4.4 MONITORING RESULTS

PCE, TCE, dichloroethene (DCE), VC, benzene, and naphthalene have been frequently detected in SWMU-20 since the startup of the groundwater treatment system during the Fall of 1993. A summary of monitoring results from January 1994 through November 2003 is outlined below:

- **Naphthalene:** All detected naphthalene concentrations have been below the preliminary screening level of 4,940 µg/L.

- **Benzene**: Benzene concentrations were initially below the 71 µg/L preliminary screening level at all wells at SWMU-20, and then increased at several wells to a maximum concentration of 230 µg/L measured at well MW-06C in October 1995. Benzene concentrations then dropped below the screening level at all wells by February 1997. Concentrations remained below the preliminary screening levels between February 1997 and December 2001, when the groundwater treatment system was shutdown. Since the system shutdown, concentrations have not rebounded and remain below the preliminary screening levels. Initial increases in concentrations of benzene and the other contaminants discussed below are likely the result of desorption and contaminant mobilization caused by aquifer disturbance at the start of pumping. Benzene concentrations are presented in Table 5 and plotted for select wells on Figure 15.

- **PCE:** PCE was initially detected at 14 wells at concentrations greater than the 9 µg/L preliminary screening level, with the highest concentrations of 420 µg/L and 820 µg/L detected at MW-9A and MW-9B, respectively. During pumping, PCE concentrations increased at four wells to a maximum concentration of 2,568 µg/L at well MW-9A in May 1995. At the time of the system shutdown in December 2001, PCE was detected in only five wells and exceeded the preliminary screening level only at wells MW-9A (16 µg/L) and 10A (11 µg/L). Since the system shutdown, PCE concentrations have rebounded above the preliminary screening level at wells MW-9A (1000 µg/L), MW-9B (250 µg/L), and MW-10A (58 µg/L). These three wells are located in the immediate vicinity of the former degreaser. PCE concentrations are presented in Table 6 and plotted for select wells on Figure 16.

- **TCE:** TCE was initially detected at four wells at concentrations greater than the 81 µg/L preliminary screening level, with the highest concentrations detected at wells MW-9A (500 µg/L) and MW-14A (600 µg/L). During pumping, TCE concentrations increased at six wells to a maximum concentration of 2,318 µg/L at well MW-9A in February 1996. At the time of system shutdown in December 2001, TCE was detected in only five wells and all concentrations were below the preliminary screening level. Since the system shutdown, TCE concentrations have rebounded above the preliminary screening at wells MW-9A (1,500 µg/L) and MW-9B (370 µg/L). These wells are located in the immediate vicinity of the former degreaser. TCE concentrations are presented in Table 7 and plotted for select wells on Figure 17.

- **Cis-1,2-DCE:** Cis-1,2-DCE was initially detected at four wells at concentrations greater than 500 µg/L. No preliminary screening level is established for cis-1,2-DCE and the practical quantitation limit (PQL) is 5 µg/L. The highest initial concentration was 2,500 µg/L at well MW-9A. During pumping, cis-1,2-DCE concentrations increased at four wells to a maximum concentration of 7,484 µg/L detected at well MW-9A in February 1996. At the time of system shutdown in December 2001, the maximum detected concentration of cis-1,2-DCE was 100 µg/L measured at wells MW-9A and MW-9B and detectable concentrations at ten other wells ranged from 1.1 to 36 µg/L. Since the system shutdown, cis-1,2-DCE concentrations have rebounded above 500 µg/L at wells MW-9A (2,300 µg/L) and MW-9B (850 µg/L). These wells are located in the immediate vicinity of the former degreaser. Cis-1,2-DCE concentrations are presented in Table 8 and plotted for select wells on Figure 18.

- **Vinyl chloride:** Vinyl Chloride was initially detected at concentrations greater than the 525 µg/L preliminary screening level at well MW-13C only (760 µg/L). During pumping, vinyl chloride concentrations increased at five wells to a maximum concentration of 1,587 µg/L measured at well MW-14C (October 1995); MW-14 is located downgradient of the former degreaser. At the time of system shutdown in December 2001, vinyl chloride was detected in only seven wells and all concentrations were below the preliminary screening level. Since the system shutdown, vinyl chloride concentrations remain below the preliminary screening level at all at wells, with the highest concentration detected at well MW-14A located approximately 50 ft downgradient of the former degreaser. Vinyl chloride concentrations are presented in Table 9 and plotted for select wells on Figure 19.

Evaluation of groundwater data collected prior to and during operation of the groundwater treatment system, indicated that the rate of concentration reduction was at least as great for most of the constituents of concern under non-pumping conditions as it was under pumping conditions. In fact, the rates of concentration reduction for PCE and TCE were significantly greater under non-pumping conditions. The rates of concentration reduction for cis-1,2-DCE were the same under pumping and non-pumping conditions. Only vinyl chloride exhibited a greater rate of concentration reduction under pumping conditions (Landau Associates 2002a-Appendix B)

Over time, the highest concentrations of PCE, TCE, DCE, have been observed in the A Horizon near the former degreaser pit (MW-9A) with the second highest concentrations observed in the same location in the B Horizon (MW-9B). Concentrations of these compounds decrease in the downgradient direction from monitoring well MW-9A and generally show a decreasing trend with depth. Although some of the highest concentrations of vinyl chloride have been observed at wells MW-9A and MW-9B near the former degreaser, concentrations have also been occasionally high at downgradient wells MW-14A and MW-14C. Near the former degreaser, vinyl chloride concentrations have typically been higher in the A Horizon (MW-9A) than in the B Horizon (MW-9B). Farther downgradient, vinyl chloride concentrations were initially higher in C horizon well MW-14C than in A Horizon well MW-14A (no B Horizon wells were constructed at this location). Beginning in October 1998, higher vinyl chloride concentrations were typically observed at well MW-14A than in MW-14B and this trend continued following the shut down of the groundwater treatment system. Chlorinated hydrocarbons have not been detected in E Horizon well MW-14E since August 1997; earlier detections of cis-1,2-DCE and vinyl chloride at MW-14E were all less than 10 µg/L, well below the preliminary screening levels.

4.5 CONCLUSIONS

We recommend enhanced reductive dechlorination through electron donor amendment to address the rebound in VOC concentrations observed following pump and treat system shutdown. This *in situ* approach is based on previous evaluation indicating that the rate of concentration reduction was at least as great for most constituents of concern under non-pumping conditions as it was under pumping conditions (Landau Associates 2002a-Appendix B). Additionally, the limited number of monitoring wells showing significant rebound in concentrations 2 years after pumping was discontinued does not indicate pumping is needed to hydraulically contain the plume. As indicated in WAC 173-340-360, remedial methods that destroy or reduce the toxicity of hazardous substances, such as enhanced reductive dechlorination, are preferred over methods that transfer contaminants from one medium to another (i.e., groundwater treatment system transfer from groundwater to air). The details of proposed donor injection and monitoring are contained in a work plan presented in Appendix A.

5.0 INDOOR AIR EVALUATIONS

This section describes the indoor air evaluations performed to estimate potential human health risks associated with exposure to indoor air in Buildings 9-90 and 9-101 due to impacts by VOCs in the underlying shallow groundwater. This evaluation is performed because Buildings 9-90 and 9-101 are located in areas that are expected to have a reasonable likelihood of being impacted by contaminated groundwater associated with SWMU-20.

5.1 APPROACH

SWMU-20 is located near the northwest corner of Building 9-101; the building area underlain by SWMU-20 constitutes approximately 0.5 percent of the total building area (Figure 14). Two evaluations were performed for Building 9-101. For an initial conservative evaluation, SWMU-20 groundwater data for shallow A Horizon wells was assumed to be representative of groundwater quality conditions beneath the entire footprint of Building 9-101. This assumption is expected to be very conservative, as SWMU-20 is located on the hydraulic downgradient (west) end of the building structure. Although no groundwater sampling data is available for the Building 9-101 footprint outside of SWMU-20, there are no known or suspected sources of VOCs beneath the building. Except for the 0.5 percent of the Building 9-101 footprint occupied by SWMU-20, groundwater beneath building 9-101 is not expected to be impacted by VOCs. A more realistic evaluation of potential impacts to Building 9-101 indoor air was also performed, assuming that VOCs are not detected in groundwater beneath 99.5 percent of the building footprint.

Building 9-90 is located hydraulically downgradient of SWMU-20 and vinyl chloride is the only VOC detected in groundwater monitoring wells located immediately upgradient. Based on this data, vinyl chloride is considered the only VOC with the potential to impact indoor air in Building 9-90. It is conservatively assumed that vinyl chloride concentrations beneath Building 9-90 are the same as those observed in the A Horizon SWMU-20 monitoring wells. The data set used for evaluation of indoor air at Buildings 9-101 and 9-90 is described in more detail in Section 5.2.

The indoor air evaluation performed for Buildings 9-90 and 9-101 follows EPA guidance for human health risk assessment and indoor air evaluation (EPA 1989, 2000, 2003). A conceptual site model, data evaluation methodology, and the Johnson-Ettinger vapor intrusion modeling process are described below.

5.2 CONCEPTUAL SITE MODEL

The conceptual site model described in this section applies only to the process by which contaminants in SWMU-20 groundwater could impact indoor air. Shallow A Horizon groundwater, encountered between approximately 10 and 21.5 ft BGS, contains VOCs that could potentially volatilize and migrate through void spaces in the unsaturated zone toward the ground surface by diffusion processes. The unsaturated zone at SWMU-20 generally consists of silt, sand, and mixtures thereof (Landau Associates 2002a). Once within the building's zone of influence, migration of volatilized contaminants into the building's indoor air through cracks in the floor slab is controlled by convection processes.

Buildings 9-90 and 9-101 are used for confidential purposes. Building 9-90, used primarily for office space, has a length of 390 ft, width of 175 ft, and an average height of 28 ft. Building 9-101, used primarily for test or development manufacturing, has a length of 950 ft, width of 750 ft, and an average height of 51 ft. If present, contaminants in indoor air could be inhaled by employees working in Buildings 9-90 and 9-101. For the purpose of this evaluation, it was assumed that an adult occupational receptor could be exposed to indoor air for an employment duration of 30 years with a work schedule of 250 days per year.

5.3 DATA EVALUATION

Groundwater samples have been collected from a number of monitoring wells since 1989 to characterize groundwater quality in and around SWMU-20. For the purposes of the indoor air evaluation, data from the two most recent sampling events for A Horizon shallow groundwater monitoring wells were considered to be representative of average groundwater conditions likely to impact indoor air in Buildings 9-90 and 9-101. This data set of two groundwater samples at each of 13 wells is presented in Table 10. VOCs included in the evaluation for Building 9-101 include tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), vinyl chloride, and naphthalene. These are the five VOCs that were detected in at least 5 percent of the samples; VOCs detected in less than 5 percent of the samples were considered to have a *de minimus* effect on potential human health impacts. As described in Section 5.1, vinyl chloride was the only VOC evaluated for Building 9-90.

The 95 percent upper confidence limit (UCL95) of the arithmetic mean of the SWMU-20 Zone A groundwater samples was calculated as an estimate of the upper bounds average groundwater concentration that could contribute to indoor air impacts (Table 10). The calculations presented in Table 10 represent the very conservative assumption that VOC concentrations within the data set of 13 A Horizon wells represent concentrations beneath the entire footprints of Buildings 9-101 and 9-90.

The simulated UCL95 representing the more realistic assumption that groundwater beneath Building 9-101 but outside the footprint of SWMU-20 has not been impacted by VOCs is calculated in Table 11. This simulated UCL95 was calculated by incorporating an additional 5,174 theoretical data points (equivalent to 99.5 percent of the total building data set if the original 26 samples characterize the 0.5 percent area of SWMU-20 beneath Building 9-101) at the most frequently achieved laboratory reporting limit for each VOC (1 µg/L for PCE, TCE, cis-1,2-DCE, and vinyl chloride; 5 µg/L for naphthalene).

5.4 JOHNSON-ETTINGER MODELING

EPA recommends the use of the Johnson-Ettinger model for the prediction of indoor air concentrations based on measured groundwater concentrations (EPA 2003). Version 3.0 of the Johnson-Ettinger advanced model, released in February 2003 and available for free download on EPA's risk assessment web site (http://www.epa.gov/superfund/programs/risk/airmodel/johnson_ettinger.htm), was used to model potential migration of VOCs from shallow groundwater to indoor air and human health impacts associated with the inhalation of impacted indoor air.

Site-specific information regarding the type of soil present between shallow groundwater and ground surface, building dimensions, and average chemical concentrations in groundwater (Sections 5.2 and 5.3) were used in the advanced Johnson-Ettinger model to predict carcinogenic and noncarcinogenic health risks to human receptors exposed to indoor air on a regular occupational basis. Version 3.0 of the Johnson-Ettinger model incorporates toxicity data for each of the chemicals evaluated in this modeling exercise, current as of February 2003. This model does include the provisional toxicity values for TCE that were identified by EPA in 2002. Input parameters and output files from the Johnson-Ettinger are presented in Appendix B.

As defined by MTCA, the acceptable level of excess cancer risk (for carcinogenic effects) is 1×10^{-6} for exposure to individual contaminants (individual excess cancer risk) and 1×10^{-5} for exposure to multiple contaminants (total excess cancer risk). MTCA also defines the acceptable hazard quotient (for noncarcinogenic effects) and hazard index (sum of the individual hazard quotients) as 1.

5.5 EVALUATION RESULTS

This section describes results for two evaluations performed for Building 9-101 and for a single evaluation performed at Building 9-90. Results of the conservative evaluation and the more realistic evaluation performed for Building 9-101 are described in Section 5.5.1. Results of the conservative evaluation performed for Building 9-90 are described in Section 5.5.2.

5.5.1 BUILDING 9-101

The excess cancer risk and hazard quotient for the conservative assumption that all of the groundwater beneath Building 9-101 has been impacted to the same extent as the groundwater at the SWMU-20 A Horizon wells are presented in Table 10. As shown in Table 10, the total excess cancer risk value ($5x10^{-6}$), the maximum hazard quotient ($7x10^{-3}$ for cis-1,2-DCE), and the hazard index ($1x10^{-2}$) associated with inhalation of VOCs in Building 9-101's indoor air are all less than the regulatory criteria. However, the maximum estimated individual excess cancer risk value ($4x10^{-6}$ for TCE) exceeds the regulatory criterion by a factor of 4 for this conservative evaluation.

Evaluation of the more realistic scenario (i.e., groundwater beneath Building 9-101, but outside the footprint of SWMU-20 has not been impacted by VOCs) results in a maximum estimated individual excess cancer risk value of $3x10^{-8}$ (for TCE), which is less than the regulatory criterion. The total excess cancer risk value ($4x10^{-8}$), the maximum hazard quotient ($3x10^{-5}$ for vinyl chloride), and the hazard index ($1x10^{-4}$) are also less than regulatory criteria for this evaluation. The excess cancer risks, hazard quotient, and hazard index for this more realistic evaluation are presented in Table 11.

Although the conservative evaluation shows a potential for a human health risk concern, the more realistic simulation demonstrates that the risk associated with inhalation of indoor air at Building 9-101 is below acceptable levels.

5.5.2 BUILDING 9-90

The estimated excess cancer risk value ($1x10^{-6}$) and the hazard quotient ($4x10^{-3}$) for the conservative evaluation of vinyl chloride in Building 9-90's indoor air are less than or equal to the regulatory criteria. In other words, the evaluation indicates that the risk associated with inhalation of indoor air at Building 9-90 is below acceptable levels.

5.6 CONCLUSIONS

Based on these evaluations, potential impacts to indoor air in Buildings 9-90 and 9-101 associated with contaminated groundwater at SWMU-20 are not expected to result in unacceptable health risks. As described in Section 5.2, these results are specific to the building configurations of Buildings 9-101 and 9-90. Therefore, if future development plans involve the construction of additional buildings in the vicinity of SWMU-20, a supplemental indoor air evaluation to consider potential impacts for the specific building configuration should be performed to confirm protection of human health.

6.0 SUMMARY OF CONCLUSIONS

This section summarizes the conclusions presented in the previous four sections:

- **SWMU-17 Continued Monitoring for PCE:** Based on the monitoring results for 2002 and 2003, we recommend no further action for dissolved arsenic and copper (i.e., discontinuing total and dissolved metals analysis) and continued semiannual monitoring for PCE.

- **AOC-5 Continued Monitoring:** We recommend a monitored natural attenuation approach with continued semiannual monitoring at wells BDC-101, BDC-102, and BDC-103. Following four consecutive monitoring events with results below preliminary screening levels at downgradient wells BDC-101 and BDC-102, we recommend that monitoring be discontinued and institutional controls applied to address worker safety and management of AOC-05 groundwater during any excavation activities within the plume.

- **SWMU-20 Active Remediation:** We recommend injection of electron donor to enhance naturally occurring reductive dechlorination that has been documented at SWMU-20. Previous evaluation of groundwater data from before and during pumping indicated that the rate of concentration reduction was at least as great for most of the constituents of concern under non-pumping conditions as it was under pumping conditions. In fact, the rates of concentration reduction for PCE and TCE were significantly greater under non-pumping conditions. The rates of concentration reduction for cis-1,2-DCE were the same under pumping and non-pumping conditions. Only vinyl chloride exhibited a greater rate of concentration reduction under pumping conditions. Additionally, the limited number of monitoring wells showing rebound in concentrations 2 years after pumping was discontinued does not indicate a need for pumping to hydraulically contain the plume. As indicated in WAC 173-340-360, remedial methods that destroy or reduce the toxicity of hazardous substances, such as enhanced reductive dechlorination, are preferred over methods that transfer contaminants from one medium to another (i.e., pump and treat system transfer from groundwater to air). The details of proposed donor injection and monitoring are contained in a work plan presented in Appendix A.

- **SWMU-20 Indoor Air Evaluation:** Potential impacts to indoor air in Buildings 9-90 and 9-101 associated with contaminated groundwater at SWMU-20 are not expected to result in unacceptable health risks. These results are specific to the building configurations of Buildings 9-101 and 9-90. Therefore, if future development plans involve the construction of additional buildings in the vicinity of SWMU-20, a supplemental indoor air evaluation to consider potential impacts for the specific building configuration should be performed to confirm protection of human health.

7.0 USE OF REPORT

This evaluation report has been prepared for the exclusive use of The Boeing Company for specific application to the Boeing Developmental Center. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Clint Jacob

Clinton L. Jacob, P.E.
Senior Project Engineer

CLJ/tam

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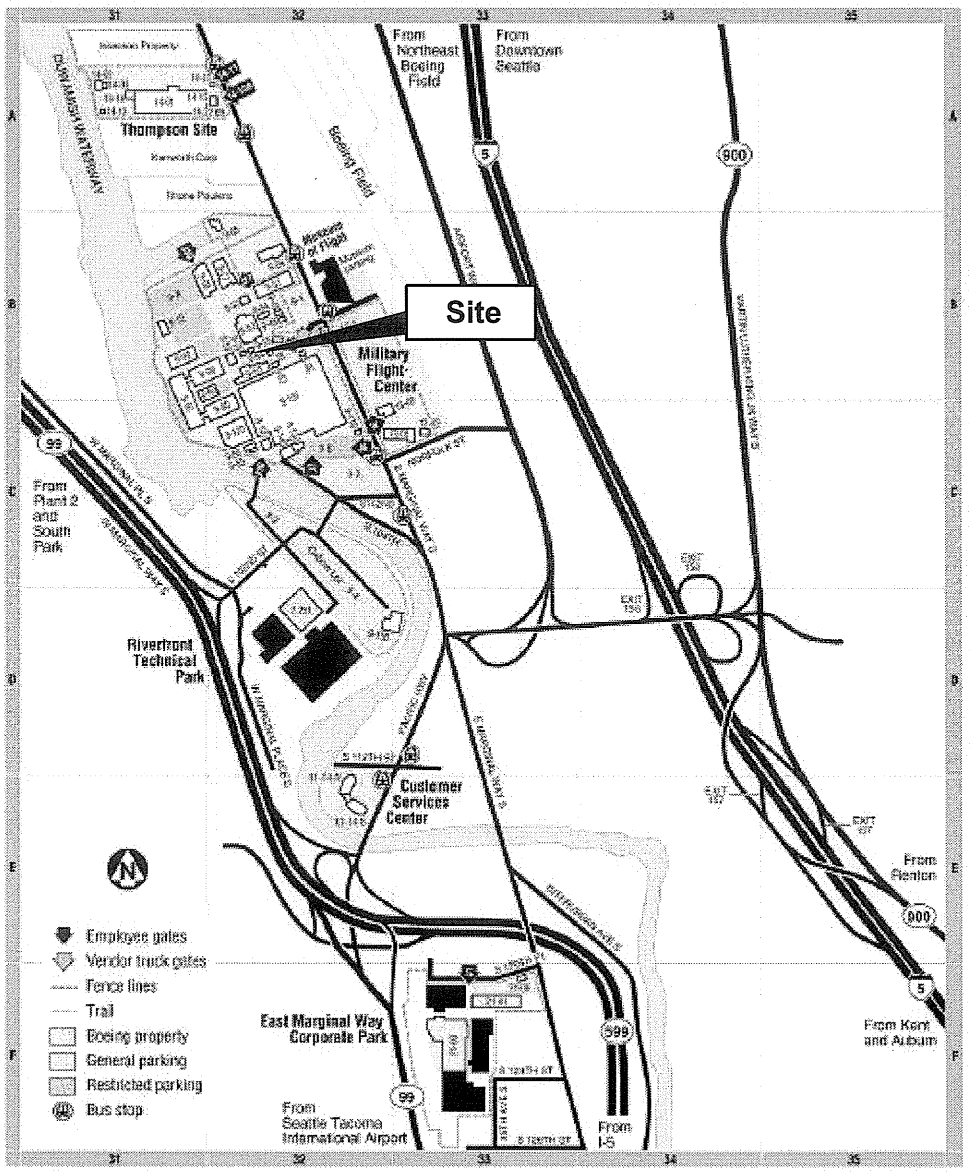

Revised 3-00

Map provided by Boeing, March 2000

Not To Scale

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Tukwila, Washington

Site Location Map

Figure
1

0 200 400

Approximate Scale in Feet

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SWMU & AOC Locations

Figure
2

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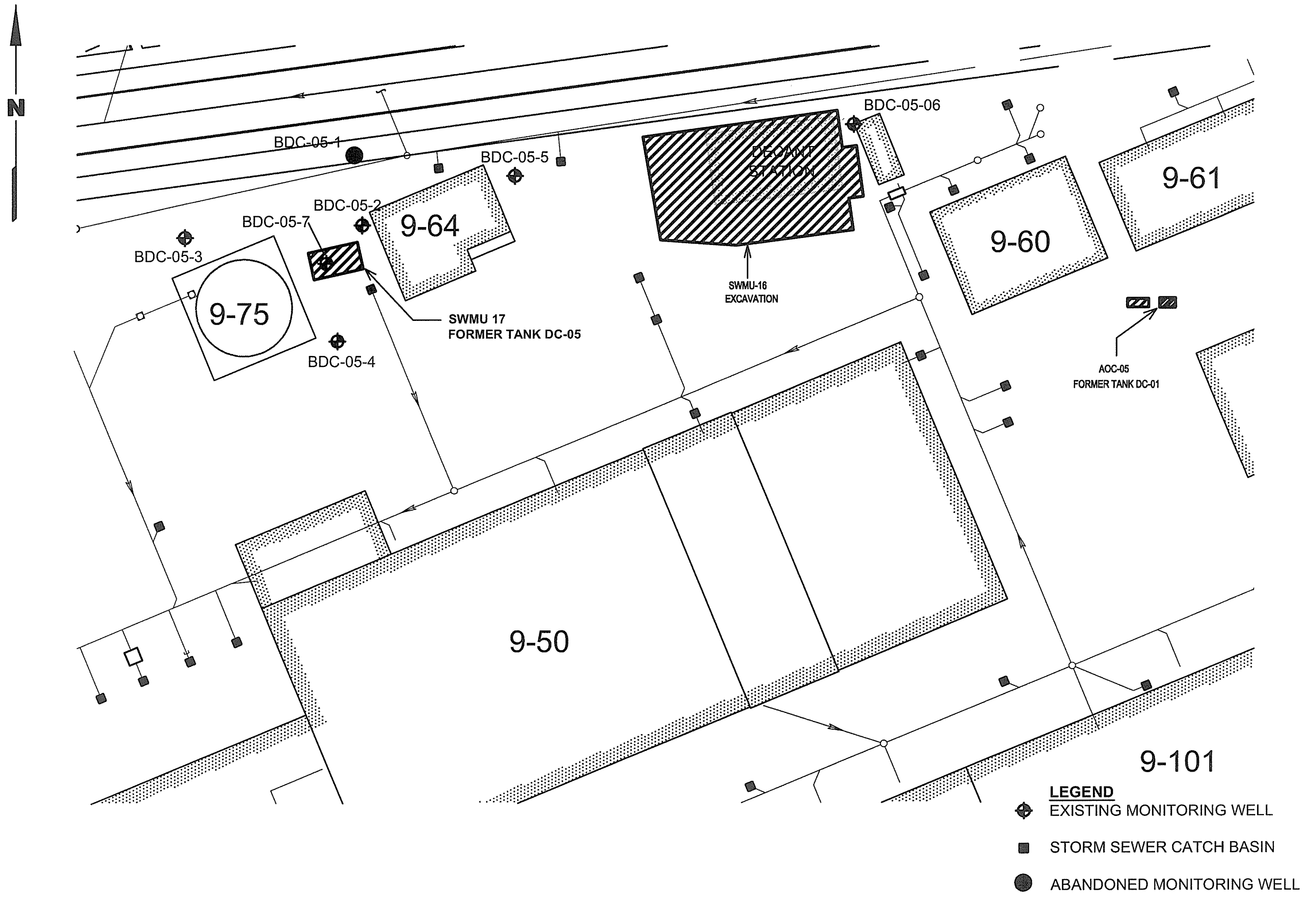

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Scale in Feet

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SWMU-17 Details

Figure
3

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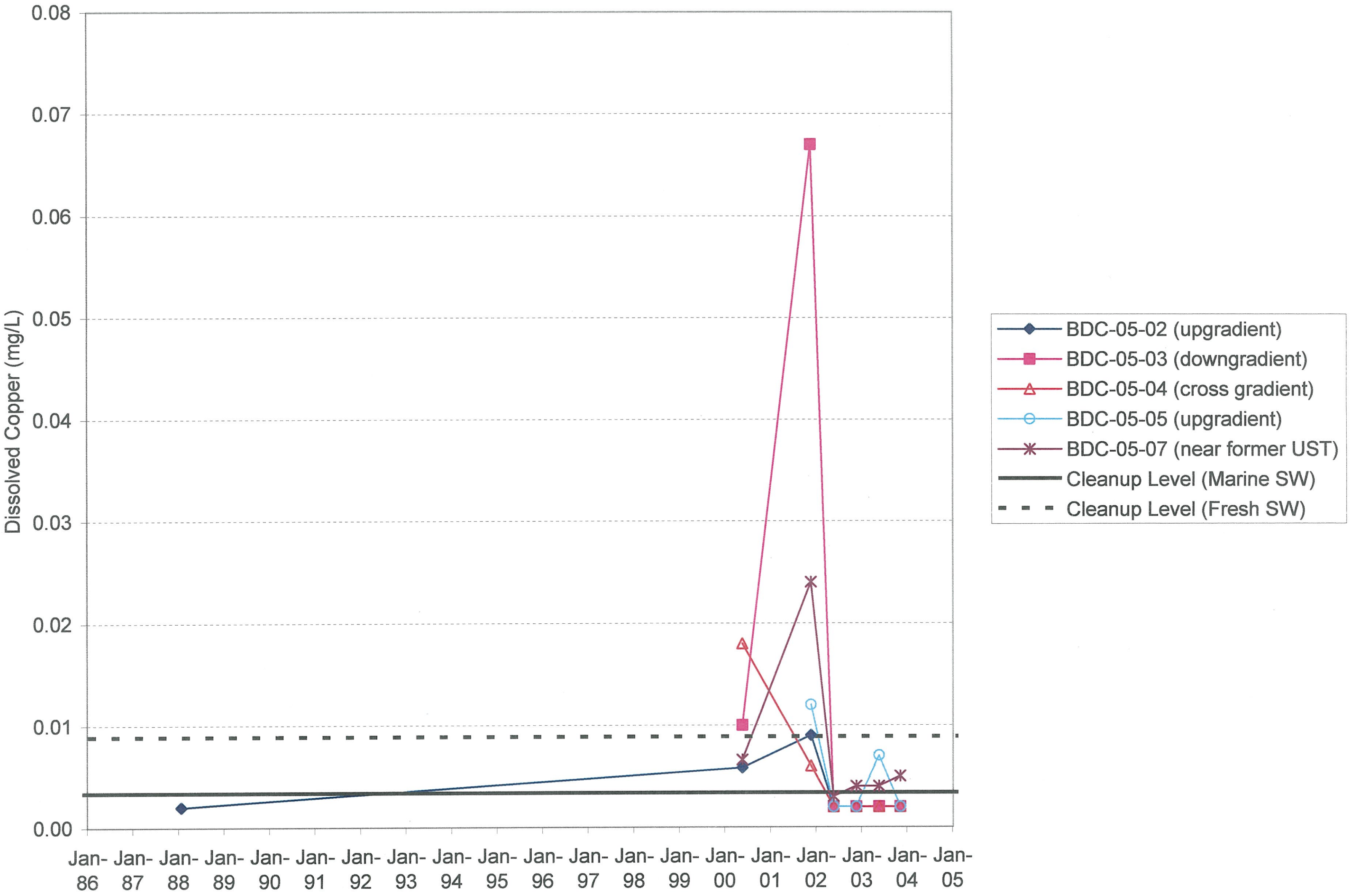

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SWMU-17 Dissolved Copper Concentrations

Figure
4

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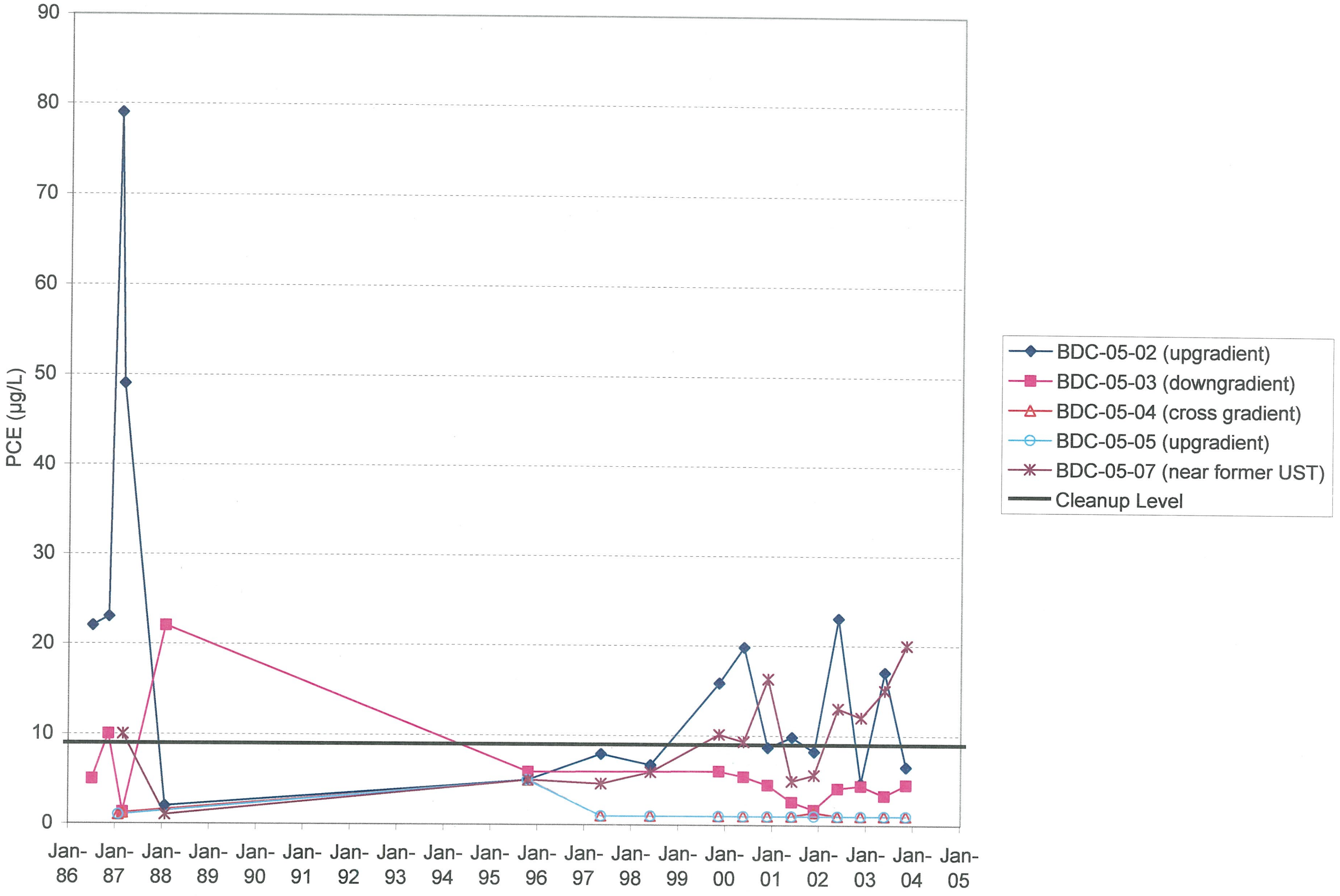

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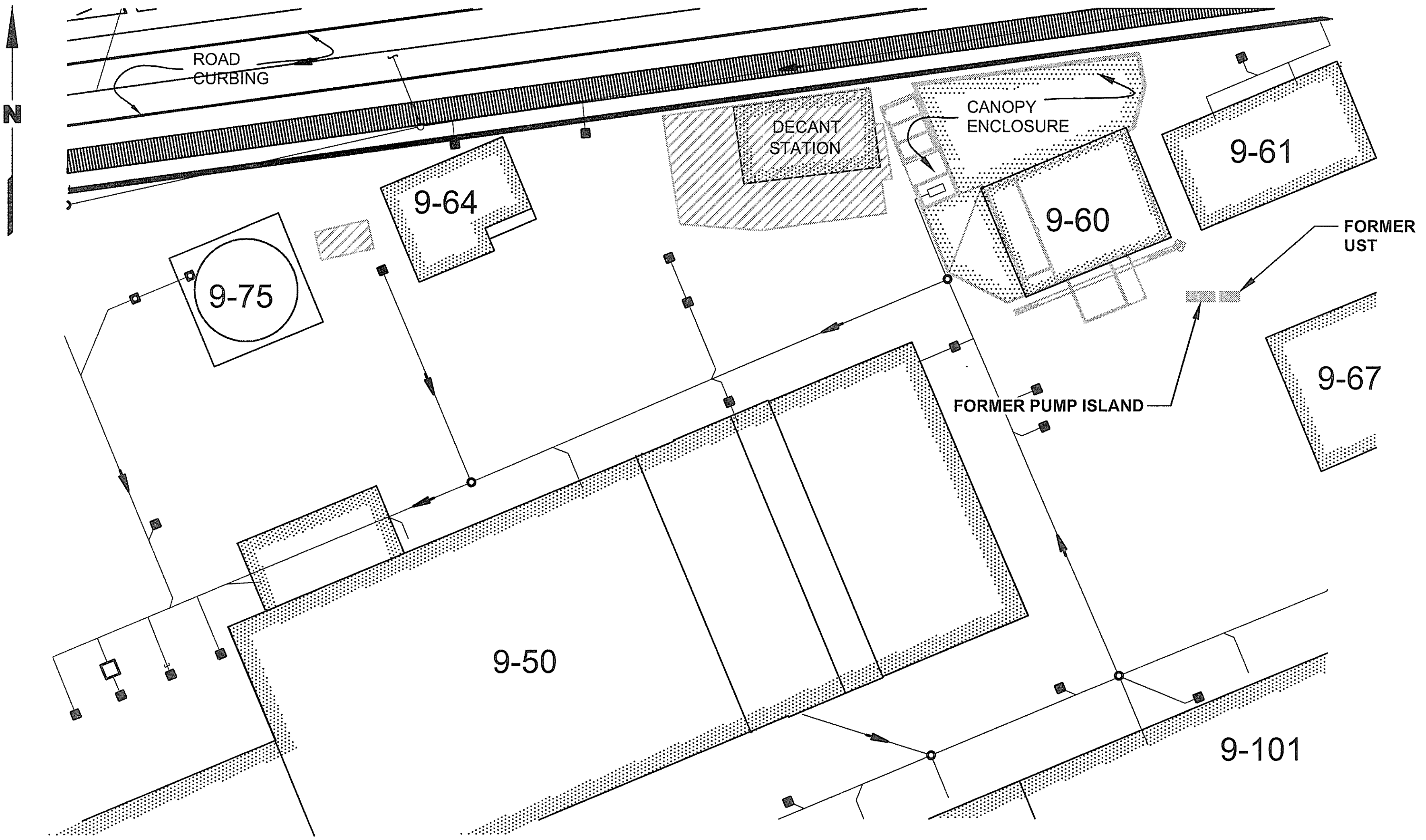
SWMU-17 PCE Concentrations

Figure
5



Legend

■ Storm Sewer Catch Basin

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Tukwila, Washington

AOC-05 Details

Figure 6

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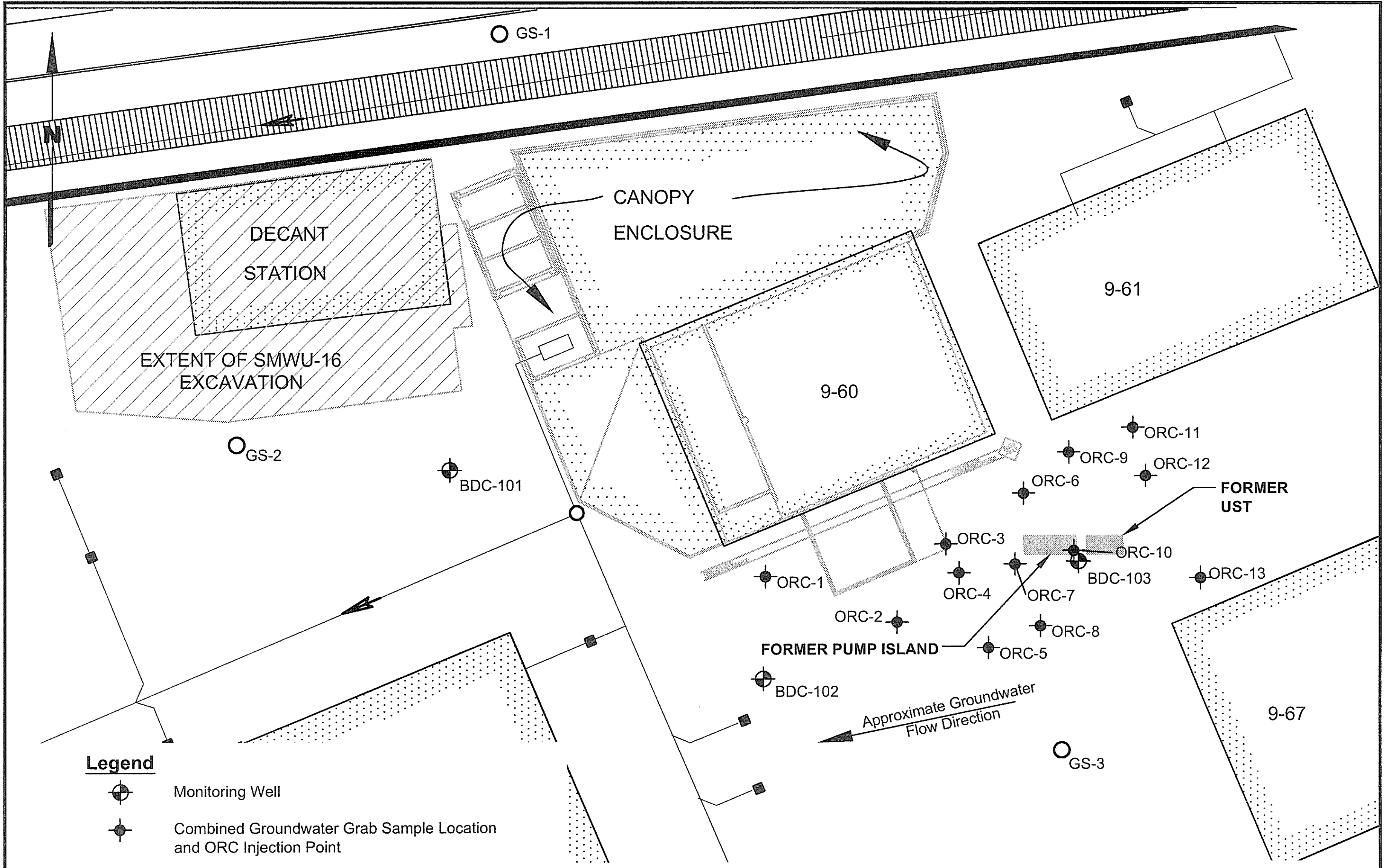

Legend

⊕ Monitoring Well

● Combined Groundwater Grab Sample Location
and ORC Injection Point

○ Groundwater Grab Sample Location

■ Storm Sewer Catch Basin

Note

The locations of ORC injection points are approximate.

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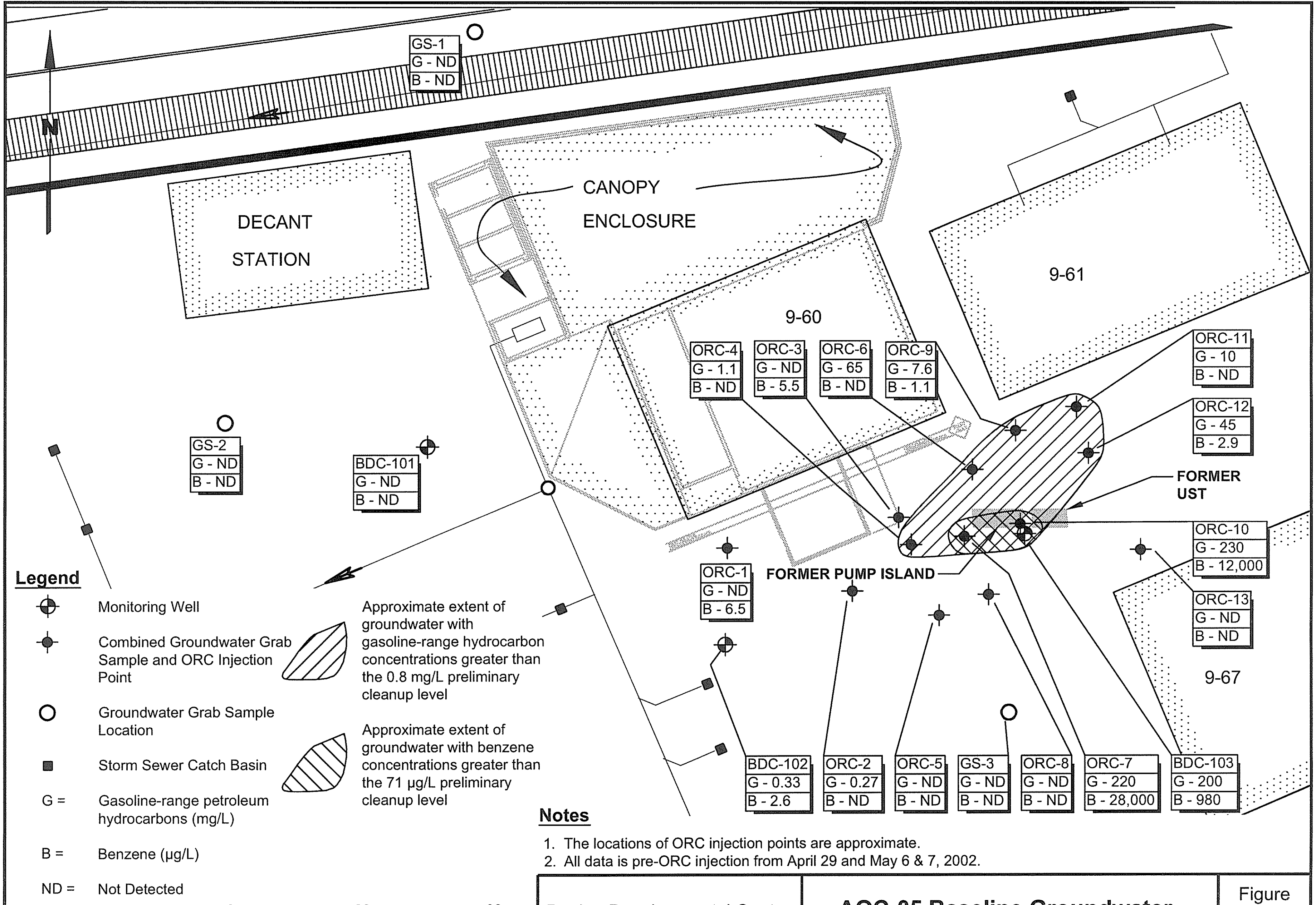
0 30 60
Scale in Feet

Boeing Developmental Center
Tukwila, Washington

**AOC-05 ORC Injection and
Groundwater Sample Locations**

Figure
7

Boeing/Developmental Center/Evaluation Report | T:\025\093\040\Evaluation Report\Fig8.dwg (A) "Figure 8" 2/27/2004



Notes

1. The locations of ORC injection points are approximate.
2. All data is pre-ORC injection from April 29 and May 6 & 7, 2002.

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AOC-05 Baseline Groundwater Concentrations

Figure
8

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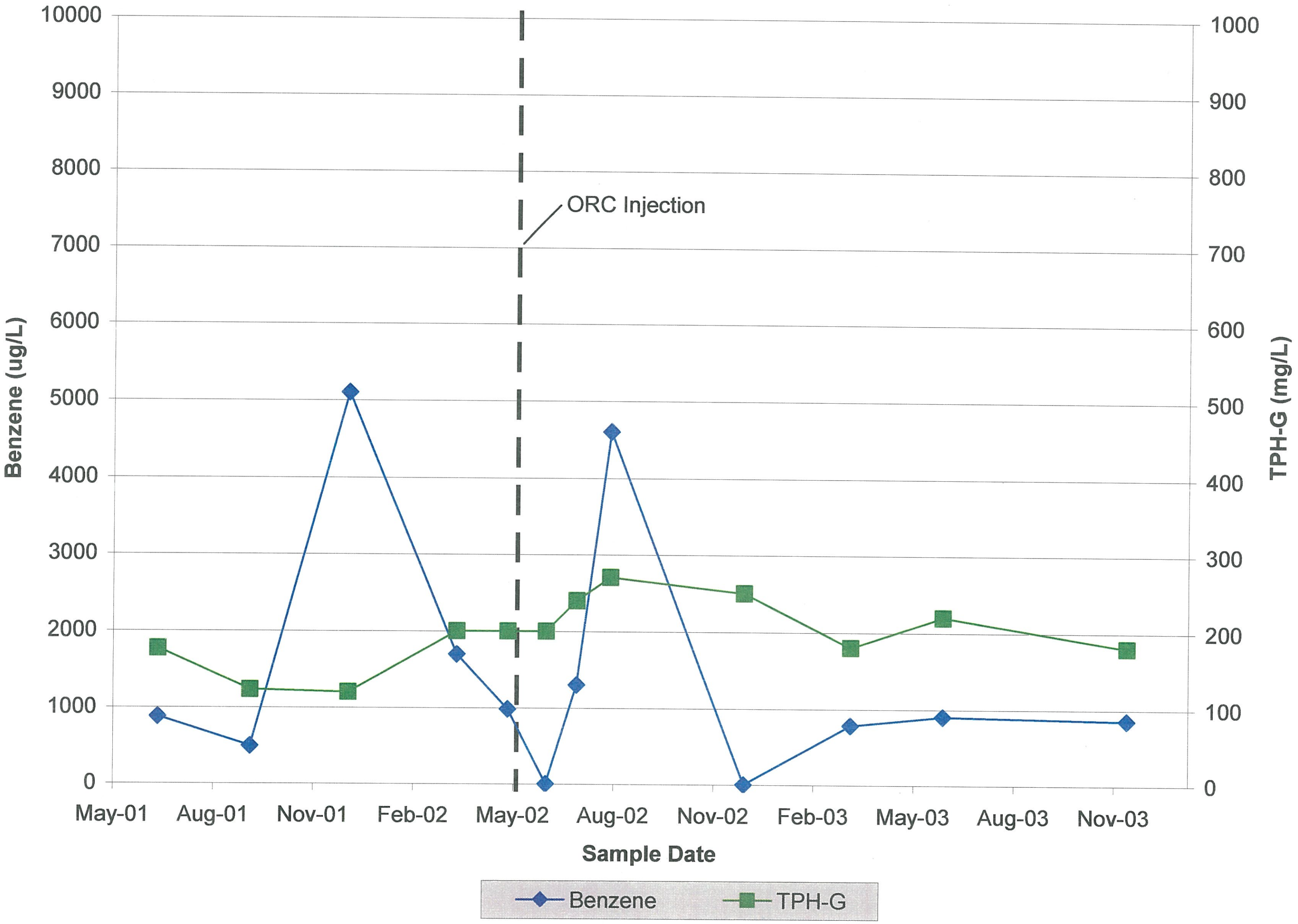

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Well BDC-103
TPH-G and Benzene Concentrations

Figure
9

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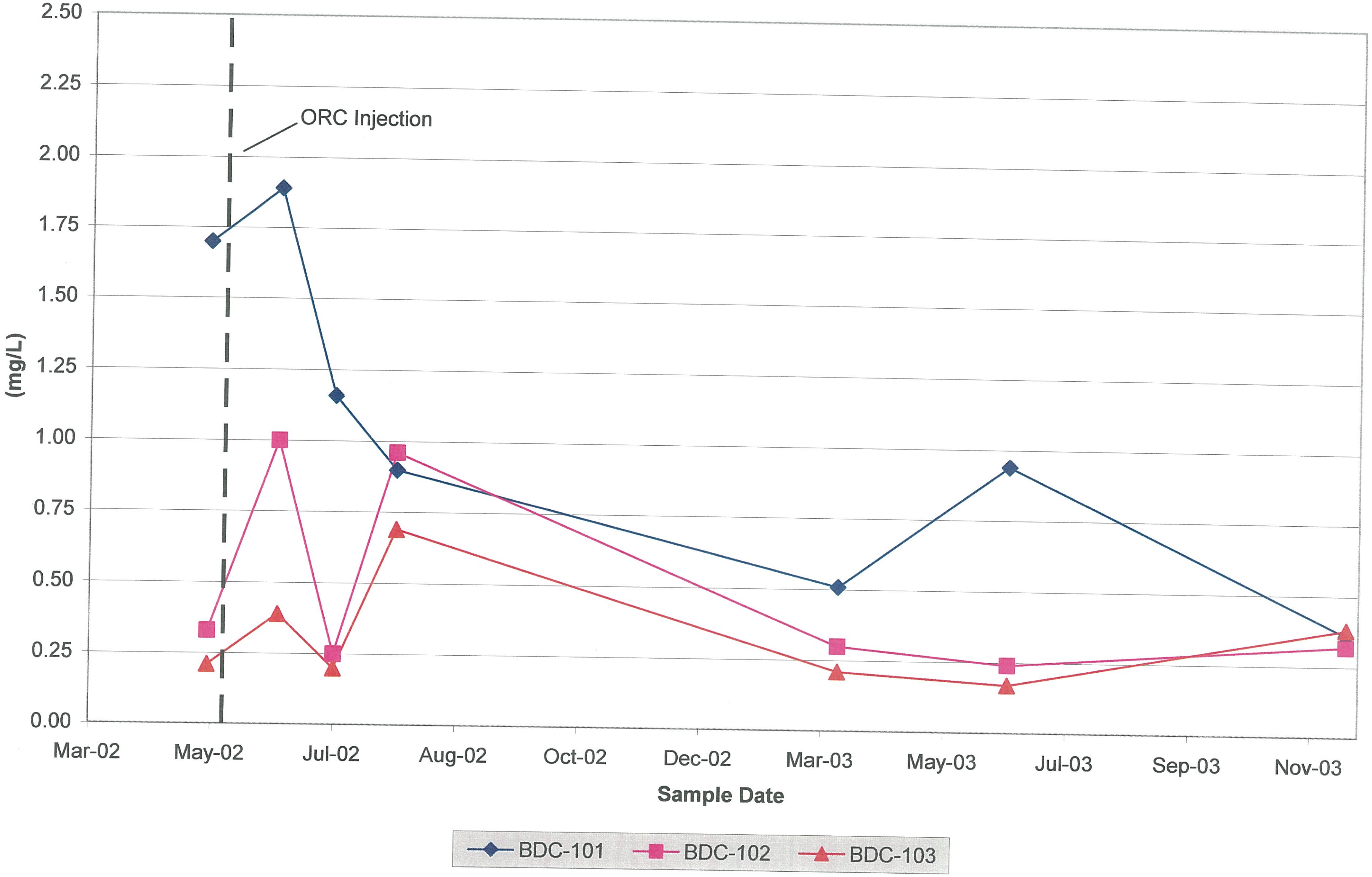

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AOC-05
Dissolved Oxygen Concentrations

Figure
10

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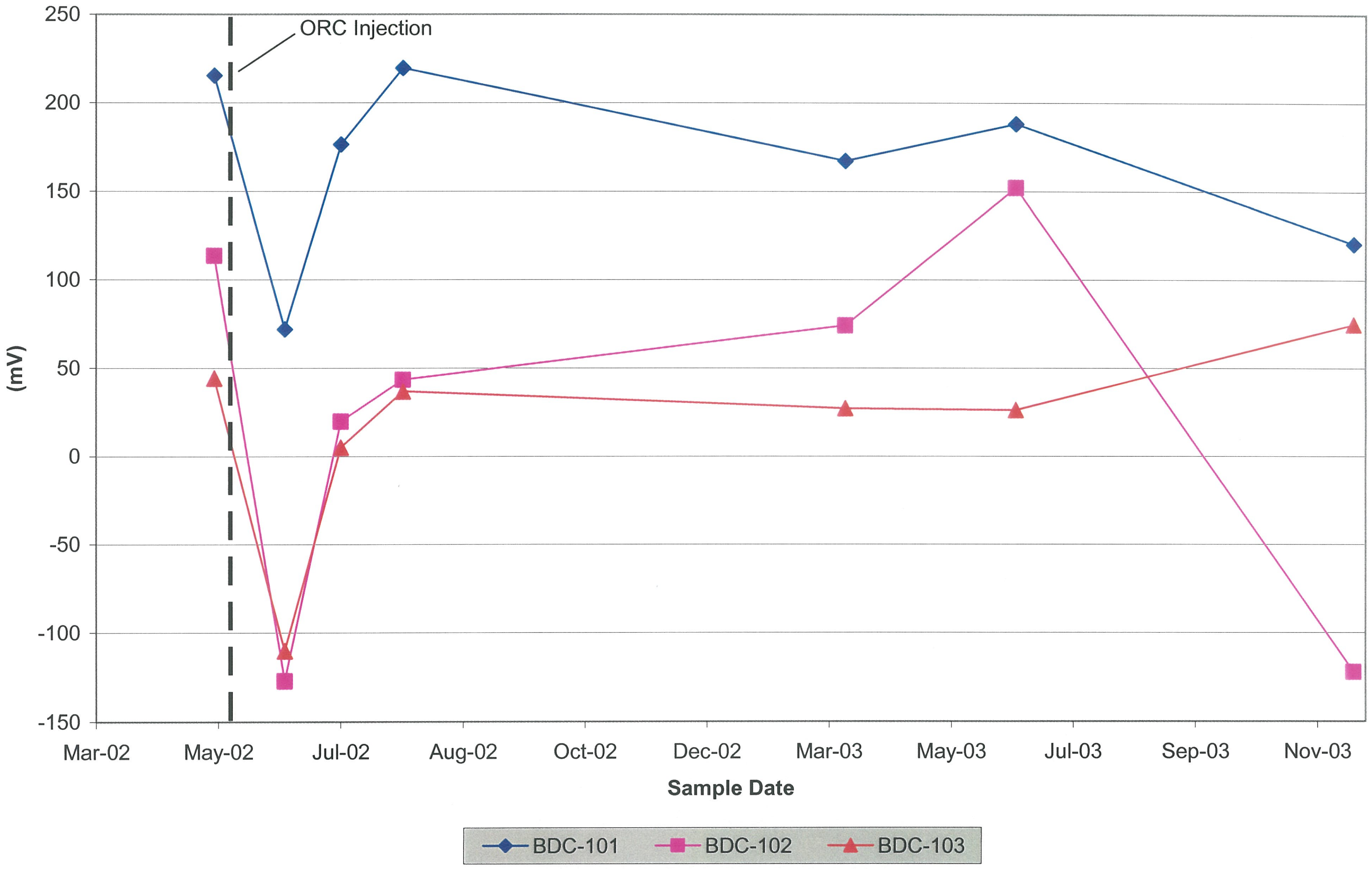

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Boeing Developmental Center Tukwila, Washington	**AOC-05** **ORP Readings**	Figure 11

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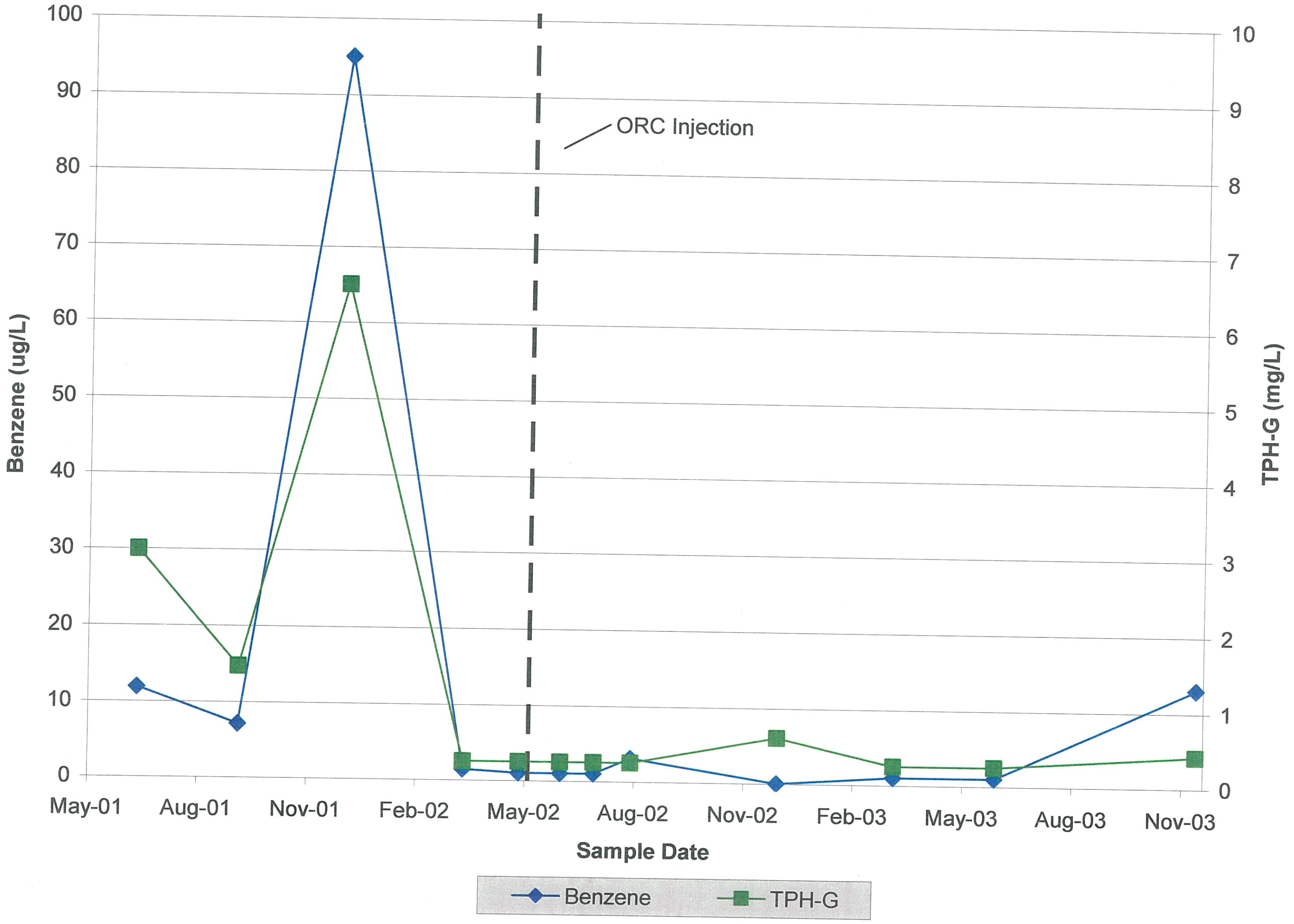

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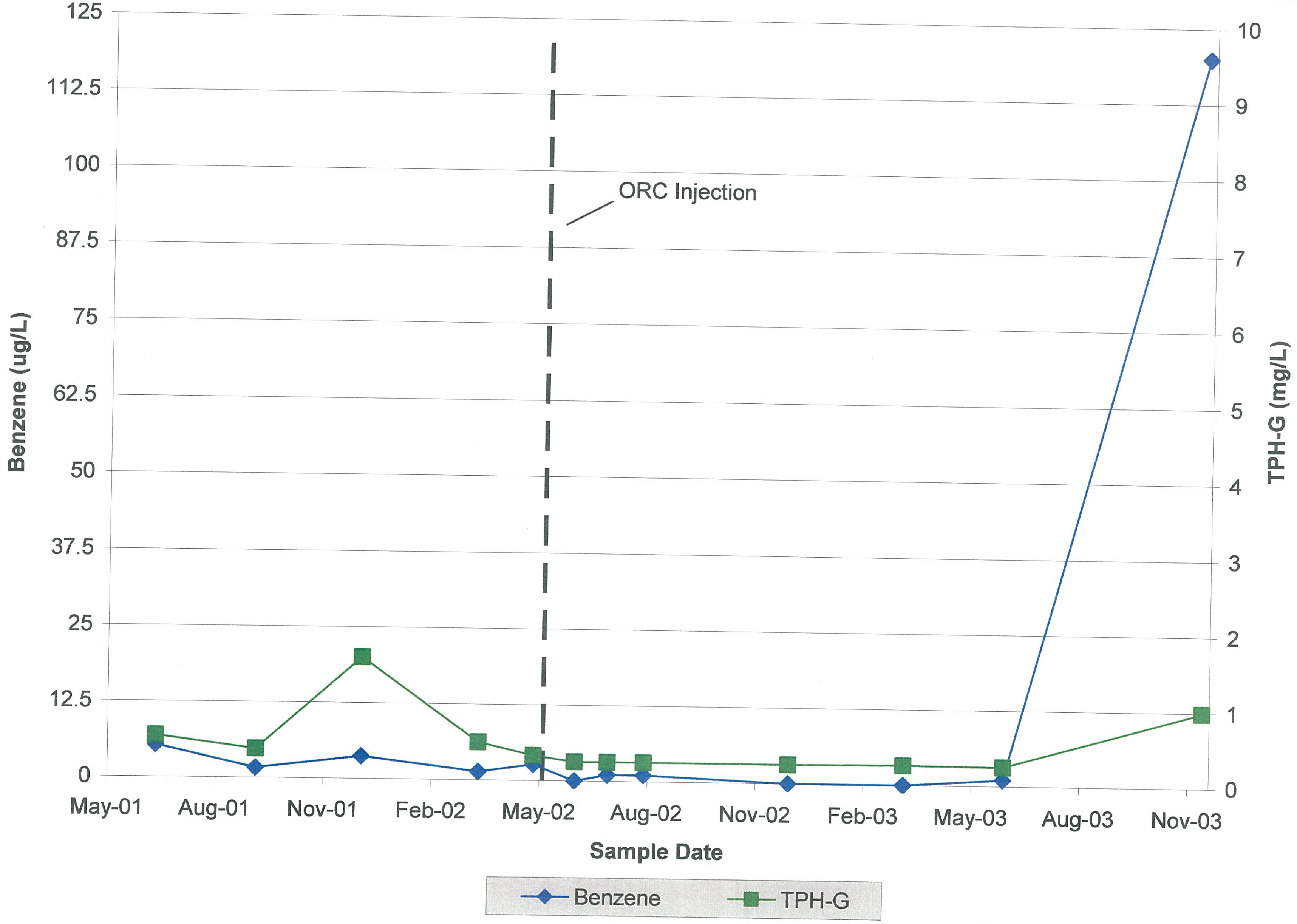
Tukwila, Washington

Well BDC-101
TPH-G and Benzene Concentrations

Figure
12

Source: S:\Wproc\025\093\040\ORC Inj Eval Rpt GW Tbs.xls BDC-102



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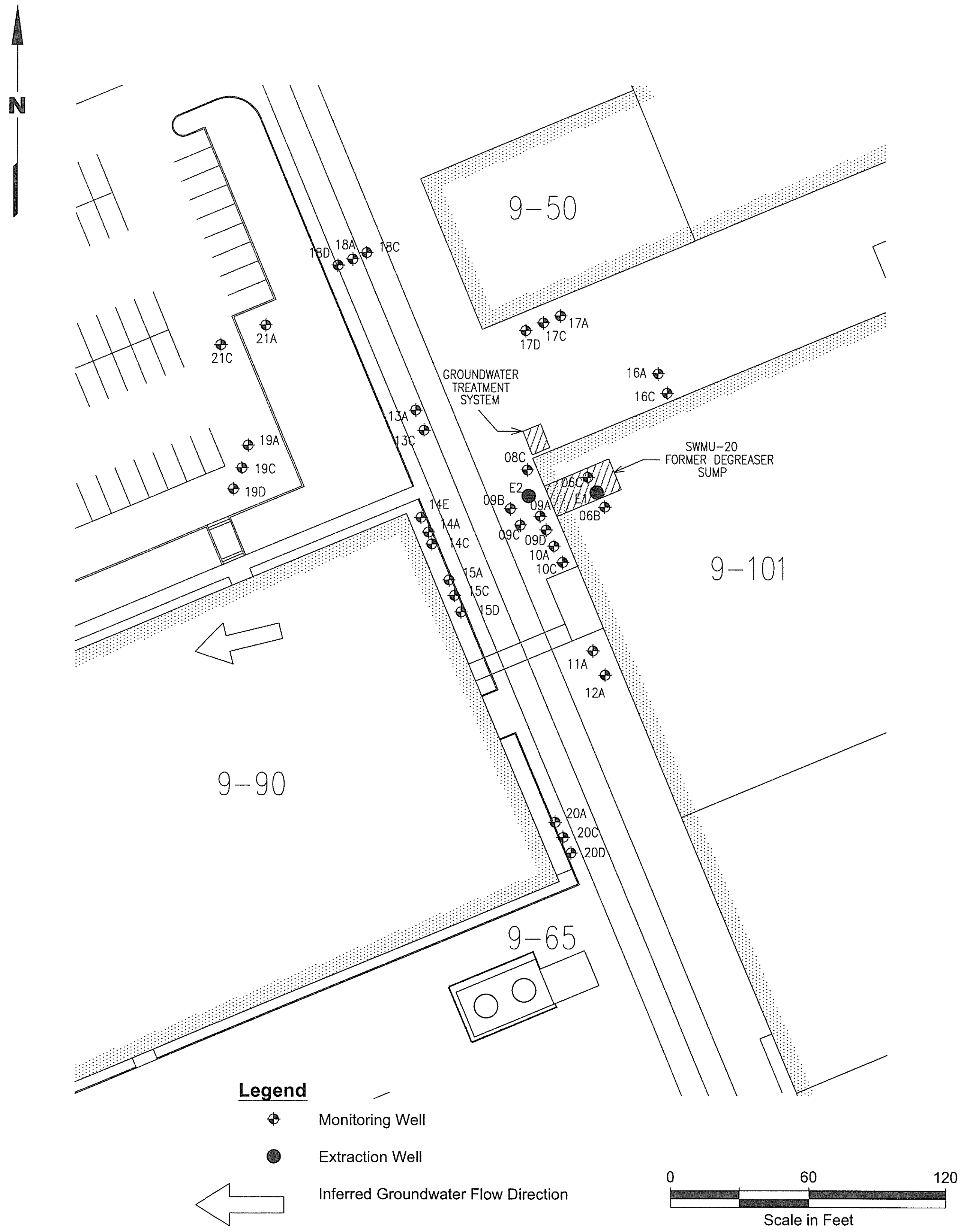
Boeing Developmental Center
Tukwila, Washington

Well BDC-102
TPH-G and Benzene Concentrations

Figure
13

Boeing/Developmental Center/Evaluation Report | T:\025\093\040\Evaluation Report\Fig14.dwg (A) "Figure 14" 2/27/2004



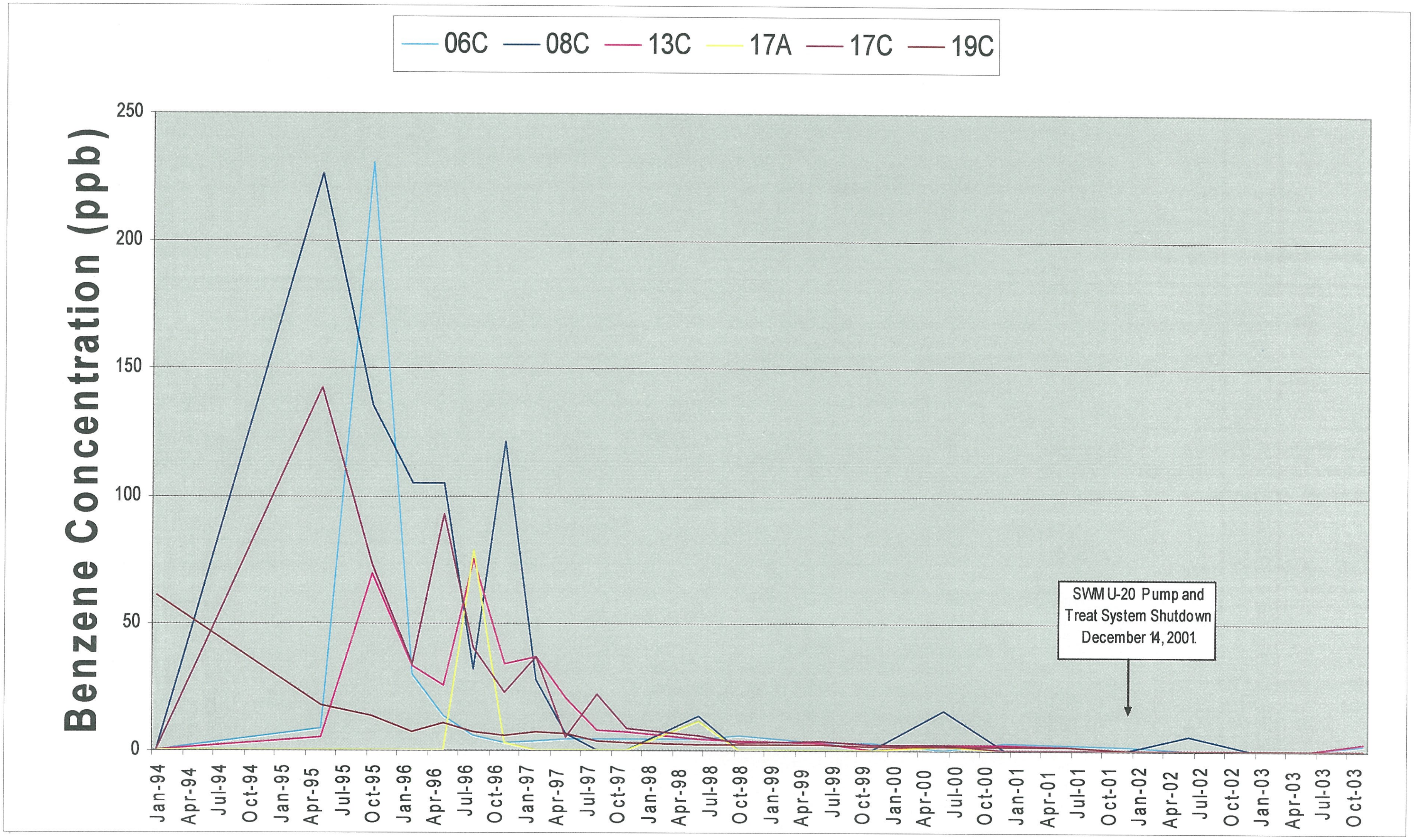
Landau Associates

Boeing Developmental Center
Tukwila, Washington

SWMU-20 Details

Figure
14

Source: S:\Sharedoc\025\093\Nov03 Semiannual Rpt Benzene Chart

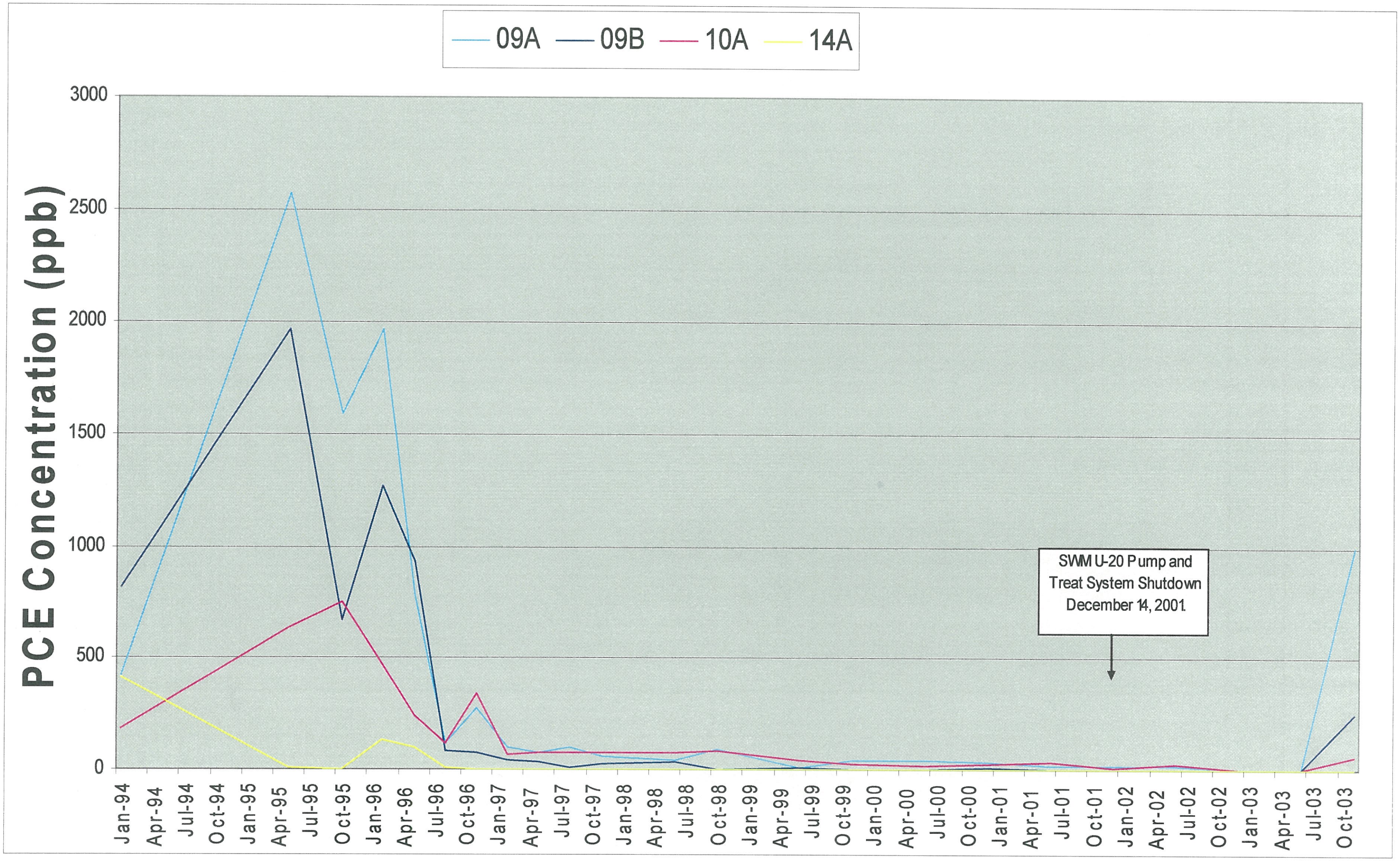


SWMU-20 Pump and Treat System Shutdown December 14, 2001.

LANDAU ASSOCIATES

Boeing Developmental Center Tukwila, Washington	**SWMU-20 Benzene Concentrations**	Figure 15

Source: S:\Sharedoc\025\093\Nov03 Semiannual Rpt PCE Chart



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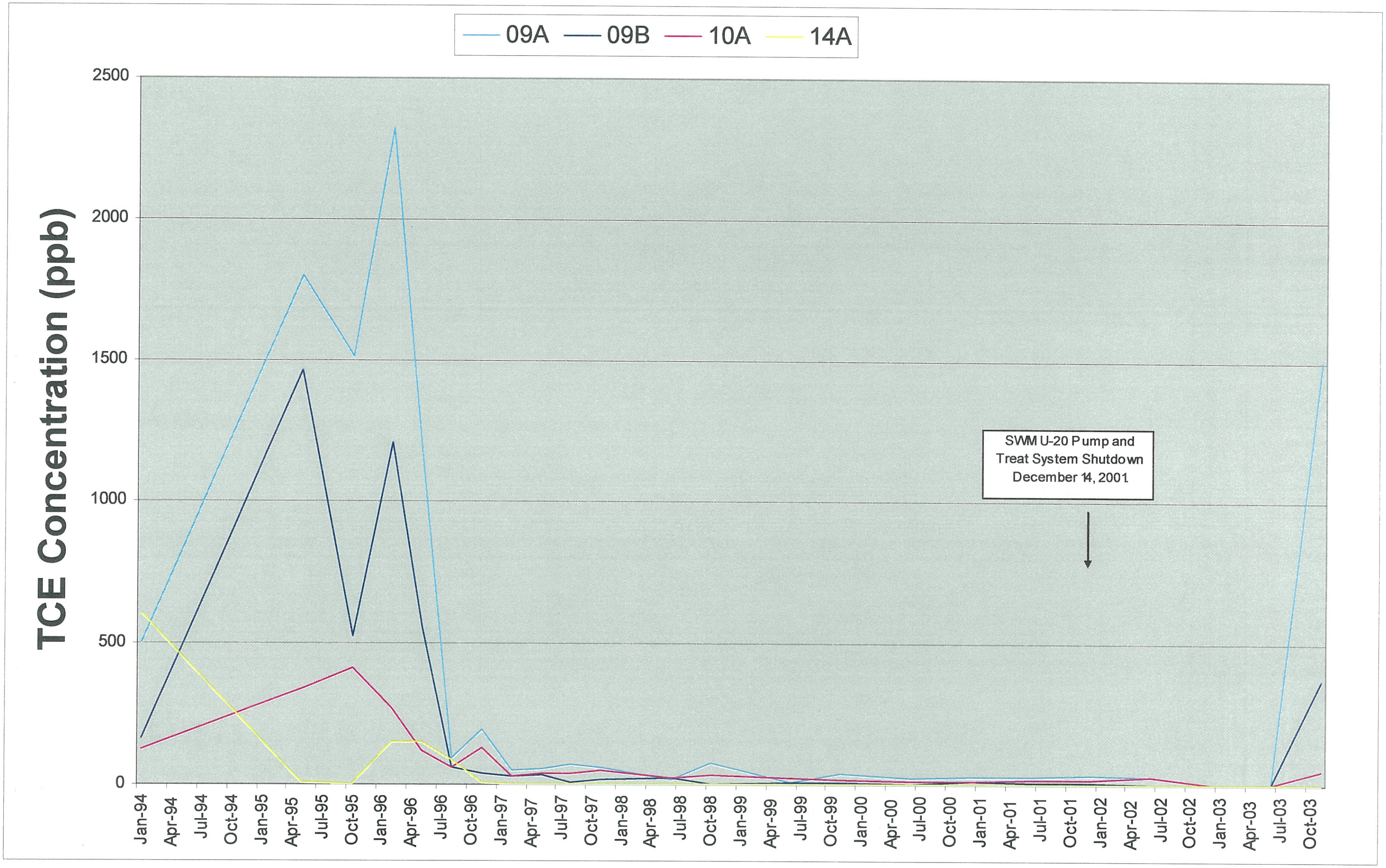
Boeing Developmental Center Tukwila, Washington	**SWMU-20 PCE Concentrations**	Figure 16

Source: S:\Sharedoc\025\093\Nov03 Semiannual Rpt TCE Chart



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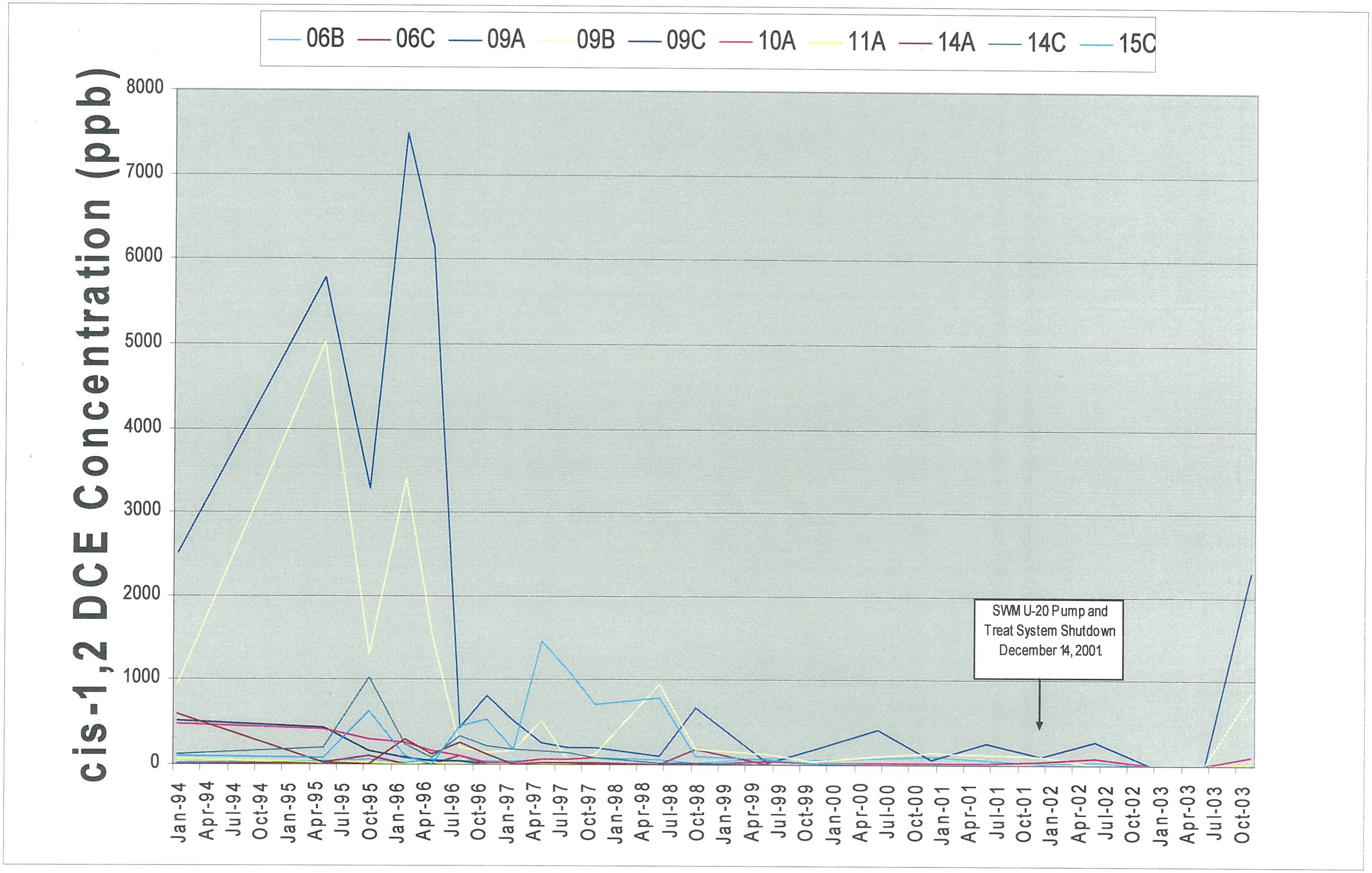
Tukwila, Washington

SWMU-20 TCE Concentrations

Figure
17

Source: S:\Sharedoc\025\093\Nov03 Semiannual Rpt Cis-1,-DCE Chart



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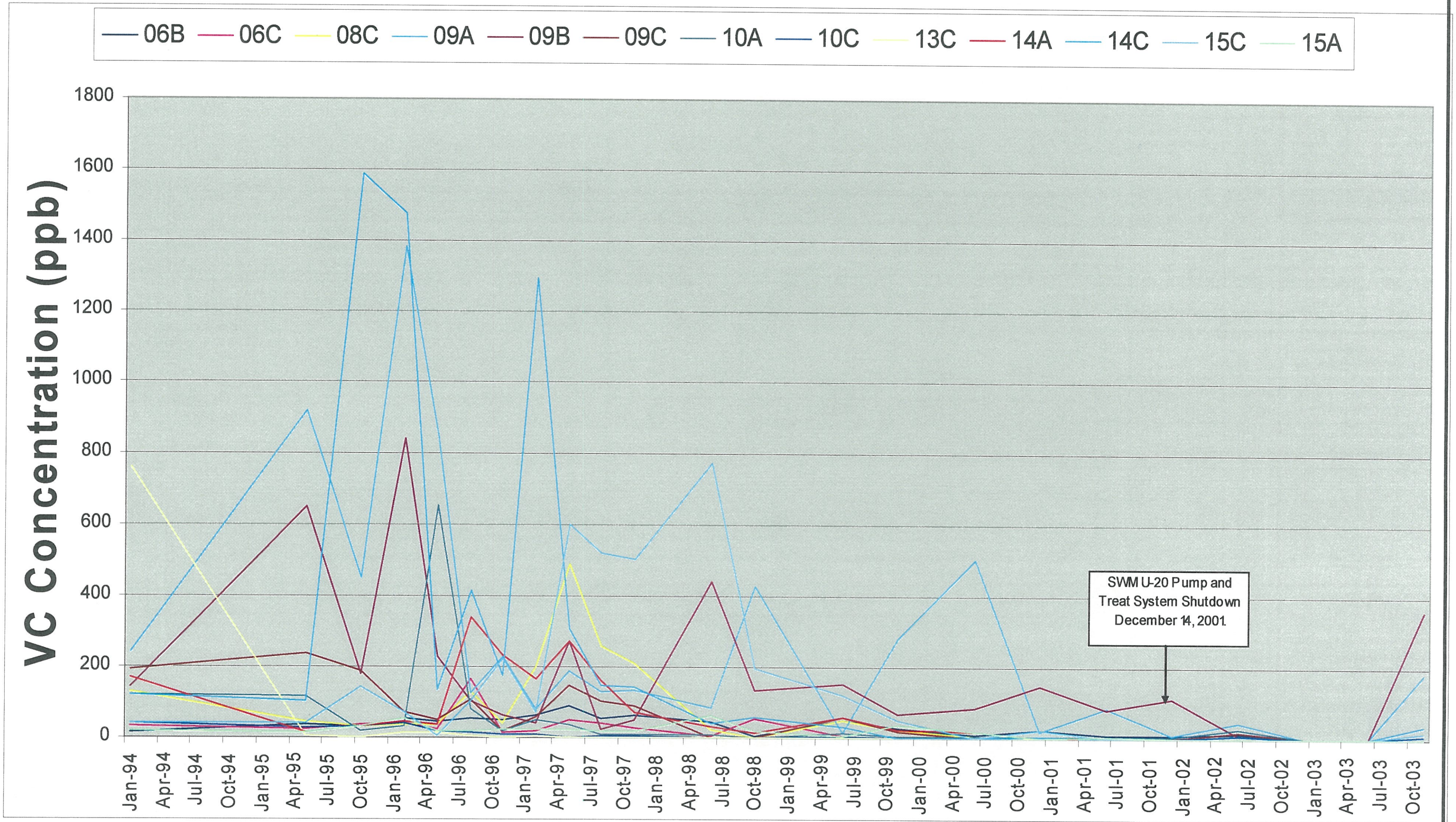
Boeing Developmental Center Tukwila, Washington	**SWMU-20 Cis-1,2-DCE Concentrations**	Figure 18

Source: S:\Sharedoc\025\093\Nov03 Semiannual Rpt VCChart



SWMU-20 Pump and Treat System Shutdown December 14, 2001.

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Tukwila, Washington

SWMU-20 Vinyl Chloride Concentrations

Figure
19

TABLE 1
SWMU-17 SUMMARY OF MONITORING WELLS

	Method B Preliminary Screening Level Marine Surface Water	Method B Preliminary Screening Level Fresh Surface Water	Jun-02	Dec-02	Jun-03	Nov-03
TOTAL ARSENIC (mg/L)	0.005	0.005				
BDC-05-2			0.05 U	0.05 U	0.001 U	0.001 U
BDC-05-3			0.05 U	0.05 U	**0.004**	0.001 U
BDC-05-4			0.05 U	0.05 U	$\boxed{\mathbf{0.011}}$	$\boxed{\mathbf{0.018}}$
BDC-05-5			0.05 U	0.05 U	**0.002**	**0.001**
BDC-05-7			0.05 U	0.05 U	**0.002**	0.001 U
DISSOLVED ARSENIC (mg/L)	0.005	0.005				
BDC-05-2			0.05 U	0.05 U	0.001 U	0.001 U
BDC-05-3			0.05 U	0.05 U	0.001 U	0.001 U
BDC-05-4			0.05 U	0.05 U	0.001 U	**0.001**
BDC-05-5			0.05 U	0.05 U	0.001 U	0.001 U
BDC-05-7			0.05 U	0.05 U	0.001 U	0.001 U
TOTAL COPPER (mg/L)	0.0034	0.0089				
BDC-05-2			0.002 U	**0.002**	**0.002**	0.002 U
BDC-05-3			0.002 U	**0.003**	$\boxed{\mathbf{0.004}}$	**0.002**
BDC-05-4			0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-5			**0.003**	$\boxed{\mathbf{0.004}}$	$\boxed{\mathbf{0.004}}$	**0.003**
BDC-05-7			$\boxed{\mathbf{0.004}}$	$\boxed{\mathbf{0.007}}$	$\boxed{\mathbf{0.008}}$	$\boxed{\mathbf{0.011}}$
DISSOLVED COPPER (mg/L)	0.0034	0.0089 (a)				
BDC-05-2			0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-3			0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-4			0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-5			0.002 U	**0.002**	$\boxed{\mathbf{0.007}}$	0.002 U
BDC-05-7			**0.003**	$\boxed{\mathbf{0.004}}$	$\boxed{\mathbf{0.004}}$	$\boxed{\mathbf{0.005}}$
TETRACHLOROETHENE (μg/L)	9	9				
BDC-05-2			$\boxed{\mathbf{23}}$	**4.7**	$\boxed{\mathbf{17}}$	**6.5**
BDC-05-3			**4.1**	**4.4**	**3.3**	**4.5**
BDC-05-4			1.0 U	1.0 U	1.0 U	1.0 U
BDC-05-5			1.0 U	1.0 U	1.0 U	1.0 U
BDC-05-7			$\boxed{\mathbf{13}}$	$\boxed{\mathbf{12}}$	$\boxed{\mathbf{15}}$	$\boxed{\mathbf{20}}$

(a) Hardness dependent; hardness assumed to be 75.4 mg/L.
U = Indicates compound was analyzed for, but was not detected at the reported sample detection limit.
Box indicates exceedance of screening level.

TABLE 2
AOC-05 BASELINE GROUNDWATER DATA
TEMPORARY WELLPOINTS AND INJECTION BORINGS

	Preliminary Cleanup Levels	GS1-15 EI66H 5/6/2002	GS2-15 EI66P 5/7/2002	GS3-15 EI66O 5/7/2002	ORC1-15 EI66A 5/6/2002	ORC2-15 EI66B 5/6/2002	ORC3-15 EI66L 5/7/2002	ORC4-15 EI66C 5/6/2002	ORC5-15 EI66D 5/6/2002
Total Petroleum Hydrocarbons (mg/L)									
Gasoline	0.8	0.25 U	0.25 U	0.25 U	0.25 U	0.27	0.25 U	1.1	0.25 U
BTEX (µg/L)									
Benzene	71	1 U	1 U	1 U	6.5	1 U	5.5	1 U	1 U
Toluene	200,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	29,000	1 U	1 U	1 U	1 U	1 U	1 U	1.3	1 U
m,p-Xylene	NA	1 U	1 U	1 U	1 U	13	2.2	1 U	1 U
o-Xylene	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	NA	2 U	2 U	2 U	2 U	14	3.2	2 U	2 U
Field Parameters									
Dissolved Oxygen (mg/L)	NA	0	0	0	--	0.99	0	2.64	0
ORP (mV)	NA	0.8	25.5	26	14.6	35.7	52.8	34.6	32.3
Conductivity (uS/cm)	NA	118	481	968	--	424	244	367	490
pH	NA	6.91	6.56	6.6	6.64	6.31	6.18	6.33	6.36

TABLE 2
AOC-05 BASELINE GROUNDWATER DATA
TEMPORARY WELLPOINTS AND INJECTION BORINGS

	Preliminary Cleanup Levels	ORC6-15 EI66M 5/7/2002	ORC7-15 EI66E 5/6/2002	ORC8-15 EI66F 5/6/2002	ORC9-15 EI66N 5/7/2002	ORC10-15 EI66K 5/7/2002	ORC11-15 EI66G 5/6/2002	ORC12-15 EI66I 5/7/2002	ORC13-15 EI66J 5/7/2002
Total Petroleum Hydrocarbons (mg/L)									
Gasoline	0.8	65	220	0.25 U	7.6	230	10	45	0.25 U
BTEX (µg/L)									
Benzene	71	2 U	28,000	1 U	1.1	12,000	2 U	2.9	1 U
Toluene	200,000	440	47,000	1 U	2.1	42,000	22	1.1	1 U
Ethylbenzene	29,000	2,300	3,200	1 U	64	3,700	370	350	1 U
m,p-Xylene	NA	7,800	11,000	1 U	63	12,000	1,300	2,600	1 U
o-Xylene	NA	2,700	5,300	1 U	21	5,800	440	55	1 U
Total Xylenes	NA	10500	16300	2 U	84	17800	1740	2655	2 U
Field Parameters									
Dissolved Oxygen (mg/L)	NA	0	--	3.37	0	--	0	0	0.98
ORP (mV)	NA	26.7	--	13	16.7	--	9.1	32.9	48.4
Conductivity (uS/cm)	NA	218	--	1450	243	--	275	212	0.126
pH	NA	6.72	--	6.69	6.96	--	6.78	6.88	6.36

NA = no preliminary cleanup level available.
U = compound was not detected at given detection limit.
Boxed value indicates concentration above preliminary cleanup level.

TABLE 3
AOC-05 BASELINE AND POST-INJECTION GROUNDWATER DATA
MONITORING WELLS

	Preliminary Cleanup Levels	Pre-ORC Injection	Post ORC Injection						
		BDC-101 4/29/2002 EH92A	BDC-101 6/3/2002 EK68A	BDC-101 7/1/2002 EN04A	BDC-101 8/1/2002 EP36A	BDC-101 12/2/2002 FA41A	BDC-101 3/10/2003 FH27A	BDC-101 6/3/2003 FN40A	BDC-101 11/19/2003 GB17B
Total Petroleum Hydrocarbons (mg/L)									
Gasoline	0.8	0.25 U	0.25 U	0.25 U	0.25 U	0.61	0.25 U	0.25 U	0.42 J
BTEX (µg/L)									
Benzene	71	1 U	1	1 U	3.1	4.3	1	1 U	13 J
Toluene	200,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ
Ethylbenzene	29,000	2.2	1 U	1 U	2.4	21	4.5	1 U	15 J
m,p-Xylene	NA	1 U	1 U	1 U	1 U	27	3.2	1 U	35 J
o-Xylene	NA	1 U	1 U	1 U	1 U	6.4	1 U	1 U	1 UJ
Total Xylenes	NA	2 U	2 U	2 U	2 U	33.4	4.2	2 U	36 J
Conventional Parameters									
N-Nitrate (mg-NL)		--	--	--	--	--	--	--	1.1
Sulfate (mg/L)		--	--	--	--	--	--	--	16
Methane (µg/L)		--	--	--	--	--	--	--	240
Field Parameters									
Dissolved Oxygen (mg/L)	NA	1.70	1.89	1.16	0.9	0.35	0.51	0.94	0.36
ORP (mV)	NA	215.3	71.8	176.3	219.5	234.1	167	188	120.3
Conductivity (uS/cm)	NA	406	441	466	432	437	433	431	398
pH	NA	6.66	7.09	6.74	6.67	6.66	6.89	6.59	6.01
Iron(II) (mg/L)		--	--	--	--	--	--	--	0.2

TABLE 3
AOC-05 BASELINE AND POST-INJECTION GROUNDWATER DATA
MONITORING WELLS

		Pre-ORC Injection	Post ORC Injection						
	Preliminary Cleanup Levels	BDC-102 4/29/2002 EH92B	BDC-102 6/3/2002 EK68B	BDC-102 7/1/2002 EN04B	BDC-102 8/1/2002 EP36B	BDC-102 12/2/2002 FA41B	BDC-102 3/10/2003 FH27B	BDC-102 6/3/2003 FN40B	BDC-102 11/19/2003 GB17C
Total Petroleum Hydrocarbons (mg/L)									
Gasoline	0.8	0.33	0.25 U	0.25	0.25 U	0.25 U	0.26	0.25 U	0.99 J
BTEX (µg/L)									
Benzene	71	2.6	4.4	1 U	1 U	1 U	1 U	1 U	120 J
Toluene	200,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ
Ethylbenzene	29,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	8.5 J
m,p-Xylene	NA	1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ
o-Xylene	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ
Total Xylenes	NA	2.1	2 U	2 U	2 U	2 U	2 U	2 U	2 UJ
Conventional Parameters									
N-Nitrate (mg-NL)		--	--	--	--	--	--	--	0.19
Sulfate (mg/L)		--	--	--	--	--	--	--	46
Methane (µg/L)		--	--	--	--	--	--	--	1100
Field Parameters									
Dissolved Oxygen (mg/L)	NA	0.33	1.00	0.25	0.96	0.35	0.3	0.24	0.32
ORP (mV)	NA	113.5	-127.2	19.6	43.3	188.6	74	152	-122.2
Conductivity (uS/cm)	NA	814	834	757	783	895	759	931	714
pH	NA	6.70	6.85	6.73	6.79	6.89	6.88	6.61	6.16
Iron(II) (mg/L)		--	--	--	--	--	--	--	5.5

TABLE 3
AOC-05 BASELINE AND POST-INJECTION GROUNDWATER DATA
MONITORING WELLS

	Preliminary Cleanup Levels	Pre-ORC Injection	Post ORC Injection						
		BDC-103 4/29/2002 EH92C	BDC-103 6/3/2002 EK68C	BDC-103 7/1/2002 EN04C	BDC-103 8/1/2002 EP36C	BDC-103 12/2/2002 FA41C	BDC-103 3/10/2003 FH27C	BDC-103 6/3/2003 FN40C	BDC-103 11/19/2003 GB17D
Total Petroleum Hydrocarbons (mg/L)									
Gasoline	0.8	200	200	240	270	250	180	220	180
BTEX (µg/L)									
Benzene	71	980	960	1,300	4,600	1,400	780	900	850 J
Toluene	200,000	16,000	17,000	16,000	18,000	15,000	13,000	10,000	8,300 J
Ethylbenzene	29,000	5,400	5,100	5,200	5,200	5,000	5,200	5,000	4,500 J
m,p-Xylene	NA	20,000	20,000	20,000	19,000	22,000	20,000	20,000	18,000 J
o-Xylene	NA	7,000	7,100	6,800	6,600	6,900	6,700	6,600	5,500 J
Total Xylenes	NA	27,000	27,100	26,800	25,600	28,900	26,700	26,600	23,500 J
Conventional Parameters									
N-Nitrate (mg-NL)			--	--	--	--	--	--	0.012
Sulfate (mg/L)			--	--	--	--	--	--	53
Methane (µg/L)			--	--	--	--	--	--	630
Field Parameters									
Dissolved Oxygen (mg/L)	NA	0.21	0.39	0.20	0.69	0.33	0.21	0.17	0.38
ORP (mV)	NA	44.2	-110.3	4.9	36.7	143.1	27	26	-74.6
Conductivity (uS/cm)	NA	333	315	343	506	573	320	315	496
pH	NA	6.75	6.77	6.66	6.65	6.74	6.85	6.59	6.05
Iron(II) (mg/L)			--	--	--	--	--	--	5.5

NA = no preliminary cleanup level available.

U = compound was not detected at given detection limit.

J = indicates the analyte was positively identified, and the concentration listed is an estimate.

-- = Not Measured.
Boxed value indicates concentration above preliminary cleanup level.

TABLE 4
AOC-05 PREVIOUS QUARTERLY GROUNDWATER DATA
MONITORING WELLS

	Preliminary Cleanup Levels	Previous Data BDC-101 6/11/2001	BDC-101 9/4/2001	BDC-101 12/3/2001	BDC-101 3/13/2002
Total Petroleum Hydrocarbons (mg/L)					
Gasoline	0.8	3	5	6.5	0.25 U
BTEX (µg/L)					
Benzene	71	11.9	7.13 J	95	1.4
Toluene	200,000	1 U	10.7	1.6	1 U
Ethylbenzene	29,000	113.1	50.4	750	4.4
Total Xylenes	NA	109.2	53.8	650	2 U

TABLE 4
AOC-05 PREVIOUS QUARTERLY GROUNDWATER DATA
MONITORING WELLS

	Preliminary Cleanup Levels	Previous Data			
		BDC-102 6/11/2001	BDC-102 9/4/2001	BDC-102 12/3/2001	BDC-102 3/13/2002
Total Petroleum Hydrocarbons (mg/L)					
Gasoline	0.8	0.55	0.38	1.6	0.5
BTEX (μg/L)					
Benzene	71	5.33 J	1.61 J	3.7	1.3
Toluene	200,000	1 U	1.89 J	1 U	1 U
Ethylbenzene	29,000	1 U	1 U	1 U	1 U
Total Xylenes	NA	2 U	1.87 J	3.49 J	1 U

TABLE 4
AOC-05 PREVIOUS QUARTERLY GROUNDWATER DATA
MONITORING WELLS

	Preliminary Cleanup Levels	Previous Data BDC-103 6/11/2001	 BDC-103 9/4/2001	 BDC-103 12/3/2001	 BDC-103 3/13/2002
Total Petroleum Hydrocarbons (mg/L)					
Gasoline	0.8	177	123	120	200
BTEX (µg/L)					
Benzene	71	875 J	494 J	5,100	1,700
Toluene	200,000	12,010	3,760	2,300,000	17,000
Ethylbenzene	29,000	1,985 J	419 J	10,000	4,900
Total Xylenes	NA	11,430	2,636	3,400,000	26,400

NA = no preliminary cleanup level available.
U = compound was not detected at given detection limit.
J = indicates the analyte was positively identified, and the concentration listed is an estimate.
Boxed value indicates concentration above preliminary cleanup level.

TABLE 5
SWMU-20 CUMULATIVE BENZENE CONCENTRATIONS
(Preliminary Screening Level = 71 μg/L)

	Jan-94	May-95	Oct-95	Feb-96	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Jun-98	Oct-98	Jun-99	Nov-99	Jun-00	Dec-00	Jun-01	Dec-01	Jun-02	Dec-02	Jun-03	Nov-03
06B	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**1.3**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
06C	ND	**8.64**	**230.09**	**29.96**	**13.7**	**5.6**	**2.9**	**3.4**	**4.6**	**4.1**	**4.2**	**4.2**	**5.7**	**2.8**	**2.7**	<1.00	**2.76**	**1.94**	**1.7**	<1.0	<1.0	<1.0	**2.2**
08C	ND	**225.74**	**135.58**	**104.73**	**104.6**	**31.8**	**121**	**27.5**	**6.1**	<4.00	<4.00	13.6	<5.00	<1.00	<2.00	**15.8**	<2.00	<1.00	<1.0	**5.4**	**4.4**	<3.0	<5.0
09A	ND	<1.00	<5.00	<500.00	<50.00	<3.33	<10.00	<4.00	<5.00	<1.00	<4.00	<1.00	<10.00	<1.00	<10.00	<10.00	<5.00	<1.00	<1.0	<1.0	<1.0	<15	<20
09B	ND	**19.76**	<33.30	<50.00	<10.00	**2.5**	<1.00	<1.00	**7.5**	**3.1**	**3.3**	<3.33	<10.00	<2.00	<2.00	<2.00	<2.00	<1.00	**1.2**	<1.0	<1.0	<1.0	<1.0
09C	ND	<1.00	<5.00	<10.00	<1.00	**9.6**	**2.4**	**6.3**	**9.3**	**4.8**	**3.6**	**1.7**	**2.5**	**1.7**	<1.00	**1.5**	**1.36**	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
09D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
10A	ND	<1.00	<5.00	<50.00	<10.00	<1.00	<3.33	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
10C	ND	1.15	<5.00	<5.00	**1.33**	**1.4**	**1.4**	**1.5**	**1.4**	**1.2**	**1.3**	**1.3**	**1.1**	**1.1**	<1.00	**1.4**	**1.23**	<1.00	**1.3**	<1.0	<1.0	<1.0	<1.0
11A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
12A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13C	ND	**4.88**	**69.66**	**33.56**	**25.76**	**75**	**34.1**	**36.5**	**20.5**	**7.6**	**6.8**	**3.9**	**3.3**	**3**	<1.00	**2**	**2.31**	**1.16**	<1.0	<1.0	**3.6**	**6.9**	**2.7**
14A	ND	<1.00	<5.00	<20.00	<1.00	<10.00	<5.00	<4.00	<2.00	<2.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14C	ND	<1.00	<5.00	<5.00	**26.44**	**22**	**11.7**	<10.00	<10.00	<10.00	**4.3**	**2.8**	**4.64**	**2.5**	**1.2**	**1.4**	**1.33**	<1.00	<1.0	<1.0	**1.1**	<1.0	<1.0
14E	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15A	ND	<1.00	<5.00	<5.00	<5.00	<2.00	<1.00	<4.00	<2.00	<1.00	<2.00	<3.33	<10.00	<1.00	<10.00	<10.00	<10.00	<1.00	<1.0	<1.0	<1.0	<5.0	<5.0
15C	ND	<1.00	<33.30	<5.00	<1.00	<3.33	<1.00	<2.00	<10.00	<10.00	<10.00	<3.33	**5.2**	**5.2**	**5.4**	<1.00	**4.28**	**2.92**	**3.2**	<1.0	<1.0	<1.0	<1.0
15D	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
16A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**2**	<1.00	**10.9**	**49.8**	**1.6**	**46.03**	**33.88**	**15**	<1.0	<1.0	<1.0	<1.0
16C	ND	<1.00	<5.00	<10.00	<1.00	**3.3**	**31.2**	**11.3**	**14.4**	**18.8**	**1.7**	**15**	**8.3**	**10**	**6.4**	**7.8**	**4.33**	**4.99**	**4.5**	**1.7**	**2.6**	**1.2**	**2.8**
17A	ND	<1.00	<5.00	<5.00	<1.00	**78.8**	**2.7**	<1.00	<1.00	<1.00	<1.00	**11.2**	<1.00	<1.00	<1.00	**1.5**	<1.00	NT	<1.0	<1.0	<1.0	<1.0	<1.0
17C	ND	**142.64**	**73.23**	**34.26**	**92.46**	**40.6**	**22.5**	**36.6**	**4.7**	**21.8**	**8.53**	**5.6**	**2.7**	**3.7**	**2.4**	**2.1**	NT	<1.00	NT	NT	NT	NT	NT
17D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
18A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
18C	**14**	**8.77**	**5.28 J**	<5.00	**5.79**	**5.4**	**3.1**	**3.6**	**4**	**2.9**	**2.7**	**1.5**	**1.4**	**1.5**	<1.00	**1.1**	**1.26**	<1.00	<1.0	<1.0	<1.0	**2.2**	<1.0
18D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19A	**1.1**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19C	**61**	**17.57**	**13.44**	**7.14 J**	**10.46**	**6.8**	**5.6**	**6.8**	**6.2**	**3.4**	**2.9**	**2.2**	**1.8**	**1.8**	**1.3**	**1.2**	**1.43**	**1.3**	<1.0	<1.0	<1.0	<1.0	<1.0
19D	**3.9**	**3.60**	<5.00	<5.00	**2.42**	**2.2**	**1.6**	**1.9**	**1.7**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20C	ND	<1.00	<5.00	<5.00	<1.00	**1.1**	<1.00	**1.1**	**1.1**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	**1.1**	<1.0
20D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
21A	NT	NT	NT	NT	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	NT	NT
21C	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.0	<1.0	<1.0	NT	NT

NT = Not Tested.

ND = Not Detected.

J = Indicates the analyte was positively identified, and the concentration listed is an estimate.

Source: S:|Sharedoc\025\093\Nov03 Semiannual Rpt\swmu20_nov03_sum Summary.

TABLE 6
SWMU-20 CUMULATIVE TETRACHLOROETHENE CONCENTRATIONS
(Preliminary Screening Level = 9 μg/L)

	Jan-94	May-95	Oct-95	Feb-96	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Jun-98	Oct-98	Jun-99	Nov-99	Jun-00	Dec-00	Jun-01	Dec-01	Jun-02	Dec-02	Jun-03	Nov-03
06B	**27**	**5.87**	**14.4**	**9.62 J**	**26.18**	**13.7**	**14.3**	**21.5**	**21.3**	**17**	**16.9**	**18.9**	**16.3**	**22.6**	**2.3**	**6**	**10.19**	**2.6**	**2.4**	**10**	**10**	**7.9**	**3.9**
06C	**22**	<1.00	<10.00	<10.00	<1.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
08C	**16**	<1.00	<5.00	<5.00	<3.33	<10.00	**13.5**	<5.00	<4.00	<4.00	<4.00	**7.8**	<5.00	<1.00	<2.00	<2.00	<2.00	<1.00	<1.0	<1.0	<1.0	<3.0	<5.0
09A	**420**	**2568.3**	**1589**	**1970**	**785.7**	**114**	**272**	**98**	**76**	**96.9**	**56.6**	**39.4**	**94**	**5.1**	**38**	**40**	**36.6**	**12.65**	**16**	**14**	**540**	**1800**	**1000**
09B	**820**	**1972.7**	**668.1**	**1266**	**934.6**	**78.9**	**75.9**	**44.3**	**35**	**10.9**	**21.5**	**31.3**	<10.00	**6.74**	**3.6**	<2.00	**6.62**	**1.18**	**2.1**	<1.0	<1.0	**1.0**	**250**
09C	ND	**11.32**	<5.00	<10.00	**1.24**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
09D	**8.8**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
10A	**180**	**635.8**	**754 E**	**468.85**	**242.1**	**114**	**342**	**67.5**	**77.8**	**76.5**	**70.3**	**72.5**	**86.4**	**38**	**21.5**	**16.6**	**21.63**	**30.3**	**11**	**24**	**24**	**34**	**58**
10C	**6.9**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
11A	**5.2**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
12A	**3.9**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13A	**10**	**4.17**	<5.00	<5.00	**6.82**	**3**	**2.1**	**3.2**	**2.1**	**1.7**	**1.5**	**1.6**	**1.3**	<1.00	<1.00	**1.2**	<1.00	<1.00	**1.6**	**2.7**	**2.4**	**3.4**	**3.0**
13C	**5.1**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14A	**410**	**4.42**	<5.00	**133.57**	**96.06**	**11.2**	<5.00	<4.00	<2.00	<2.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14C	**7.2**	**9.02**	**10.53**	**8.64 J**	**5.44**	**6.1**	<1.00	<10.00	<10.00	<10.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14E	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15A	**11**	<1.00	<5.00	<5.00	<5.00	<2.00	<1.00	<4.00	<2.00	<1.00	<2.00	<3.33	<10.00	<1.00	<10.00	<10.00	<10.00	<1.00	<1.0	<1.0	<1.0	<5.0	<5.0
15C	**13**	<1.00	<33.30	<5.00	<1.00	**1.1**	<1.00	<2.00	<10.00	<10.00	<10.00	<3.33	<1.00	<2.00	<2.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15D	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
16A	**1.6**	**1.10**	<5.00	<5.00	<1.00	**1.7**	<1.00	**1.1**	<1.00	<1.00	<1.00	**1.64**	**1.03**	**1.3**	**2.3**	**2.2**	<1.00	<1.00	<1.0	<1.0	**1.2**	**1.2**	**1.1**
16C	ND	<1.00	<5.00	<10.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
17A	**36**	1.39	<5.00	<5.00	**1.55**	<1.00	**1.3**	**2.7**	**1.90 J**	**2.2**	<1.00	**2.6**	**2.4**	**2.5**	**2.1**	**2.6**	**4.15**	NT	<1.0	**3.8**	**4.6**	**4.6**	**4.8**
17C	**36**	<1.00	<5.00	<5.00	<1.00	**1.6**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
17D	**46**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
18A	**5.4**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
18C	**4.6**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
18D	**4.6**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19A	**6**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19C	**6.5**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
19D	**9.5**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20A	**3.4**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20C	**3.9**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
20D	**4.3**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
21A	NT	NT	NT	NT	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	NT	NT
21C	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.0	<1.0	<1.0	NT	NT

NT = Not Tested.

ND = Not Detected.

J = Indicates the analyte was positively identified, and the concentration listed is an estimate.

Source: S:|Sharedoc\025\093\Nov03 Semiannual Rpt\swmu20_nov03_sum Summary.

TABLE 7
SWMU-20 CUMULATIVE TRICHLOROETHENE CONCENTRATIONS
(Preliminary Screening Level = 81 μg/L)

	Jan-94	May-95	Oct-95	Feb-96	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Jun-98	Oct-98	Jun-99	Nov-99	Jun-00	Dec-00	Jun-01	Dec-01	Jun-02	Dec-02	Jun-03	Nov-03
06B	**4.2**	**3.57**	**6.00 J**	<5.00	**7.37**	**3.5**	**2.5**	**4.9**	**4.7**	**4.6**	**6.5**	**3.5**	**2.6**	**4.54**	**2.2**	**4.7**	**8.71**	**5.83**	**4.7**	**5.9**	**4.5**	**2.9**	**1.0**
06C	**1.6**	<1.00	**31.36**	<10.00	<1.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**91.6**	<2.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
08C	**21**	**3.16**	<5.00	<5.00	<3.33	<10.00	**26.2**	<5.00	<4.00	<4.00	<4.00	**26.6**	<5.00	<1.00	<2.00	<2.00	<2.00	<1.00	<1.0	<1.0	<1.0	<3.0	<5.0
09A	**500**	**1796.5**	**1507**	**2318**	**1160**	**90.8**	**191**	**49.3**	**51.1**	**69.2**	**56.4**	**15.4**	**77**	**3.5**	**35**	**23**	**24.3**	**25.21**	**32**	**24**	**580**	**990**	**1500**
09B	**160**	**1463**	**524.7**	**1206**	**554**	**58.6**	**35.2**	**28.7**	**31.5**	**4.9**	**15.4**	**20.65**	<10.00	**7.5**	**4.8**	**2.6**	**11.2**	**5.79**	**4.8**	**2.5**	**12**	**9.7**	**370**
09C	ND	**19.41**	<5.00	<10.00	**3.54**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
09D	**2.2**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
10A	**120**	**333.23**	**411 E**	**268.41**	**115.3**	**56.7**	**128**	**28.4**	**38.2**	**36.6**	**48.8**	**23.8**	**33.9**	**19.2**	**14**	**8.3**	**13.11**	**17.02**	**18**	**24**	**29**	**32**	**49**
10C	**3.9**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
11A	**7**	**2.41**	<5.00	<5.00	**2.54**	**1.9**	**1**	<1.00	<1.00	**1.2**	**1.6**	<1.00	**1.03**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	**1.9**	**2.2**	**2.2**	**2.8**
12A	**5.5**	**1.13**	<5.00	<5.00	<1.00	**1.7**	**1.2**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13A	**31**	**12.23**	<5.00	**9.57 J**	**16.52**	**3.4**	**3.4**	**2**	**1.5**	**2.9**	**3**	**1.1**	**1.7**	**1.8**	**2.3**	**2.4**	**2.12**	**1.28**	<1.0	**3.4**	**3.3**	**3.9**	**3.8**
13C	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14A	**600**	**6.25**	<5.00	**151.58**	**146.72**	**84.1**	**2.8**	<4.00	<2.00	<2.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14C	**6.6**	**14.41**	**21.93**	**13.33**	**7.61**	**12.5**	<1.00	<10.00	<10.00	<10.00	<2.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
14E	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15A	**7.5**	<1.00	<5.00	<5.00	<5.00	<2.00	<1.00	<4.00	<2.00	<1.00	<2.00	<3.33	<10.00	<1.00	<10.00	<10.00	<10.00	<1.00	<1.0	<1.0	<1.0	<5.0	<5.0
15C	**12**	<1.00	<33.30	<5.00	<1.00	**7.5**	<1.00	<2.00	**12**	<10.00	<10.00	<3.33	<1.00	<2.00	<2.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15D	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
16A	**4.4**	**5.02**	<5.00	<5.00	**2.57**	**4**	**2.1**	**2.6**	**2**	**1.9**	<1.00	<1.00	<1.00	**1.01**	**1.4**	**1.2**	**1.08**	<1.00	<1.0	<1.0	**1.5**	**1.3**	**1.2**
16C	ND	<1.00	<5.00	<10.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
17A	**7.2**	**17.42**	**17.04**	<5.00	**7.28**	<1.00	**9.8**	**17.5**	**4.9**	**18**	**2**	<1.00	**12.4**	**11.1**	**11.5**	**6.6**	**13.99**	nt	**5.9**	**7.4**	**7.5**	**7.4**	**7.9**
17C	**2.1**	<1.00	<5.00	<5.00	<1.00	**14.1**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
17D	**2.3**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
18A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
18C	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
18D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19A	**1.5**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19C	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
19D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20A	**1.1**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20C	**1.8**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
20D	**1.5**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
21A	NT	NT	NT	NT	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	NT	NT
21C	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.0	<1.0	<1.0	NT	NT

NT = Not Tested.

ND = Not Detected.

J = Indicates the analyte was positively identified, and the concentration listed is an estimate.

Source: S:|Sharedoc\025\093\Nov03 Semiannual Rpt\swmu20_nov03_sum Summary.

TABLE 8
SWMU-20 CUMULATIVE CIS-1,2-DICHLOROETHENE CONCENTRATIONS
(No Preliminary Screening Level)

	Jan-94	May-95	Oct-95	Feb-96	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Jun-98	Oct-98	Jun-99	Nov-99	Jun-00	Dec-00	Jun-01	Dec-01	Jun-02	Dec-02	Jun-03	Nov-03
06B	**23**	**43.71**	**53.75**	**29.45**	**58.31**	**46.3**	**30.5**	**37.4**	**60.9**	**61.8**	**76.4**	**66.7**	**9.9**	**70.1**	**49.7**	**71.5**	**91.77**	**63.94**	**27**	**40**	**23**	**13**	**11**
06C	**7.9**	**14.57**	**99.09**	<10.00	**1.01**	**107**	**1.9**	**3.1**	**22.1**	**28.3**	**12.3**	**1.1**	**181 E**	<2.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
08C	**44**	**14.95**	<5.00	**5.55 J**	**8**	**1.1**	**37.6**	<5.00	**37.3**	**46.1**	**42.3**	**38.4**	<5.00	**1.1**	<2.00	**3.2**	<2.00	<1.00	<1.0	<1.0	<1.0	<3.0	<5.0
09A	**2500**	**5790.9**	**3286**	**7484**	**6143**	**443**	**816**	**520**	**258**	**206.E**	**199**	**94.3**	**680**	**15.5**	**187**	**421**	**60.75**	**266.6**	**100**	**280**	**1600**	**2300**	**2300**
09B	**940**	**5010.4**	**1307 E**	**3407 E**	**1521**	**207**	**142**	**164 E**	**510**	**35.1**	**111**	**939 E**	**178**	**122.04**	**41.2**	**102.4**	**135.2**	**112.3**	**100**	<180	**180**	**140**	**850**
09C	**520**	**431.66**	**159.69**	**70**	**33.67**	**29.8**	**1.6**	**4.6**	**2.6**	**2**	**1.7**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**1.1**	**6.7**	**2.7**	**4.1**	**8.9**
09D	**5.1**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
10A	**470**	**421.26**	**297 E**	**249.16**	**159.2**	**90.1**	**17.8**	**29**	**66.1**	**58.5**	**74.1**	**29.3**	**6.9**	**33.3**	**20.6**	**10.6**	**14.14**	**14.09**	**36**	**80**	**110**	**88**	**98**
10C	**14**	**1.93**	<5.00	<5.00	**1.01**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	**3.7**	**3.3**	**14**	**6.2**
11A	**54**	**15.86**	**10.82**	**7.17 J**	**10.27**	**9.3**	**6.4**	**4.9**	**6.6**	**6.1**	**4.2**	**2.8**	**2.3**	**2.1**	**1.1**	**1.5**	**1.55**	**1.27**	**2.1**	**6.0**	**12**	**17**	**18**
12A	**20**	**2.30**	**17.5**	<5.00	**1.09**	**9.5**	**6.6**	<1.00	**6.1**	**3.7**	**3**	**1.7**	**1.7**	**1.8**	**1.03**	**1.9**	**2.07**	**1.46**	**2.2**	**1.8**	**3.3**	**1.4**	**4**
13A	**8.2**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	**1.6**	<1.00	<1.00	**1.2**	**1.3**	**1.2**	**1.2**	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13C	**16**	**1.14**	<5.00	<5.00	<1.00	**1.3**	<1.00	**1.3**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	**1.4**	**<1.0**
14A	**590**	**15.50**	**9.83 J**	**294.36**	**115.94**	**249**	**114**	**6.4**	**24.2**	**18.3**	**9.5**	**4.9**	**3.7**	**7**	**3.2**	**3.8**	<1.00	<1.00	<1.0	<1.0	**7.2**	**23**	**170**
14C	**110**	**187.91**	**1017.8**	**237.4**	**70.06**	**326**	**211**	**183**	**163**	**136**	**82.7**	**25.6**	**21.7**	**6.2**	<1.00	**1.2**	**2.83**	**1.64**	<1.0	**1.5**	**2.4**	**31**	**13**
14E	**1.1**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15A	**9.1**	**3.29**	<5.00	<5.00	<5.00	**3.6**	**3.5**	**4.5**	**5**	**5.5**	**5.5**	**15.65**	<10.00	<1.00	<10.00	<10.00	<10.00	**4.99**	**4.9**	**2.8**	**2.8**	<5.0	<5.0
15C	**92**	**69.14**	**640.52**	**93.62**	**1.47**	**463**	**532**	**187**	**1470**	**1100**	**719**	**785 E**	**90.5**	**53.2**	**28.4**	**1.01**	**2.53**	<1.00	**1.1**	<1.0	<1.0	**2.9**	**5.7**
15D	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
16A	**5.5**	**12.63**	**5.38 J**	<5.00	**25.39**	**12**	**3.2**	**6.2**	**2.4**	**1.7**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	**1.76**	**1.82**	**2.6**	<1.0	**1.2**	**2.4**	**1.3**
16C	**14**	**11.83**	**6.24 J**	<10.00	**5.66**	**2.6**	**1.6**	**1.6**	**1.13**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
17A	**4.3**	**1.38**	<5.00	<5.00	**1.09**	<1.00	**1.4**	**1.2**	**2.90 J**	**4.13**	<1.00	**2.3**	**3.8**	**4.1**	**4.3**	**2.3**	**2.1**	NT	**2**	<1.0	**1.0**	**1.4**	**1.6**
17C	**5.3**	<1.00	<5.00	<5.00	**1.19**	**1.6**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
17D	**1.8**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
18A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
18C	**1.3**	**2.02**	<5.00	<5.00	<1.00	**1**	<1.00	<1.00	<1.00	<1.00	**1.1**	**1.8**	**2.8**	**1.9**	**2.1**	**1.3**	**1.59**	**1.42**	<1.0	<1.0	<1.0	**1.7**	**<1.0**
18D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19A	**2.4**	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19C	**1.7**	**1.17**	<5.00	<5.00	**1.37**	**1.3**	<1.00	<1.00	**1.2**	**1.2**	**1.2**	**2**	**1.2**	**1.4**	<1.00	**1.03**	<1.00	**1.01**	<1.0	<1.0	<1.0	<1.0	1
19D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20C	**16**	**7.34**	**6.06 J**	<5.00	**2.46**	**2.5**	**2.1**	**1.9**	**1.6**	<1.00	<1.00	<1.00	**1.5**	<1.00	<1.00	**1.3**	<1.00	**1.09**	**1.1**	<1.0	**1.3**	**2.1**	**1.6**
20D	**1.8**	**2.22**	<5.00	<5.00	**46.38**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
21A	NT	NT	NT	NT	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	NT	NT
21C	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.0	<1.0	**1.3**	NT	NT

NT = Not Tested.

ND = Not Detected.

J = Indicates the analyte was positively identified, and the concentration listed is an estimate.

Source: S:|Sharedoc\025\093\Nov03 Semiannual Rpt\swmu20_nov03_sum Summary.

TABLE 9
SWMU-30 CUMULATIVE VINYL CHLORIDE CONCENTRATIONS
(Preliminary Screening Level = 525 μg/L)

	Jan-94	May-95	Oct-95	Feb-96	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Jun-98	Oct-98	Jun-99	Nov-99	Jun-00	Dec-00	Jun-01	Dec-01	Jun-02	Dec-02	Jun-03	Nov-03
06B	13	36.53	31.8	52.29	44.78	54.5	49.4	63.7	88.7	55	62.7	46.3	4.2	48.4	25.9	8	21.58	10.62	8.9	12	11	8.4	17
06C	30	20.89	34.09	38.34	22.06	164	12	18.3	50.3	39.5	26.1	6	54.6	4.4	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
08C	130	42.13	32.69	35.33	35.96	129	41.2	201	488	256	210	20.6	<5.00	49.7	21.4	2.4	<2.00	<1.00	<1.0	<1.0	<1.0	<3.0	<5.0
09A	240	917.05	449	1385	844.9	124	228	80.9	185	127	135	83.8	425	14	278	499	17.95	86.44	7.8	46	150	120	180
09B	140	648.6	175.6	836	228.2	104	62.6	41.7	270	20.9	50.7	439.56	132	152.36	66.6	82.6	146.7	78.9	110	7.6	27	19	360
09C	190	233.79	185 E	71.74	50.13	106	19.4	59.8	147	102.5	87.8	1.1	<1.00	59	16.4	<1.00	<1.00	<1.00	<1.0	18	8.6	5.6	8.0
09D	ND	1.37	<5.00	<5.00	<1.00	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
10A	120	116.25	16.12	31.6	651.2	80.9	16.7	48.2	33.4	9.8	8.8	8.7	1.3	12.1	3.5	3	3.32	3.32	2.9	28	54	36	9.1
10C	39	28.29	33.16	40.41	18.69	11.6	10.1	9	<1.00	4.3	3.8	1.7	1.6	2.8	1.4	2.1	<1.00	<1.00	<1.0	8.4	15	15	8.8
11A	39	26.80	8.37 J	12.14	14.04	3.8	1.8	<1.00	<1.00	<1.00	3.4	<1.00	<1.00	1.1	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
12A	14	<1.00	17.16	<5.00	<1.00	2.9	8.6	<1.00	9.4	6.7	1.1	1.3	<1.00	2.7	1.06	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13A	12	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
13C	760	3.03	<5.00	15.24	11.48	3.6	1.9	2.5	2.2	<1.00	<1.00	1	1.6	1.8	<1.00	<1.00	<1.00	<1.00	<1.0	1.6	3.3	4.9	2.2
14A	170	11.38	30.32	44.4	36.4	339	232	162	270	158	70	29.1	13.74	58.2	20.9	19.7	<1.00	<1.00	<1.0	<1.0	69	28	240
14C	120	103.49	1587.3	1477	134.78	414	175	1296	307	148	144	39.4	56.4	30.2	<1.00	<1.00	4.67	1.21	<1.0	<1.0	4.4	50	35
14E	10	1.43	<5.00	<5.00	<1.00	1.3	<1.00	<1.00	1.3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
15A	16	13.84	31.2	54.62	19.45	19.4	23	20.4	23.5	17.4	18.6	61.61	17.2	2.9	37	16	<10.00	3.86	1.8	2.0	3.3	<5.0	<5.0
15C	38	38.79	142.38	69.81	5.12	104	220	69	598	519	500	772 E	194 E	121.2	49.2	1.4	21.32	<1.00	1.5	<1.0	1.3	5.6	16
15D	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	8.6	5.2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
16A	6	9.18	<5.00	<5.00	8.42	4.4	<1.00	<1.00	2.2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
16C	15	23.46	38.59	45.16	31.71	20.8	11.8	11.3	9.1	3	<1.00	1.4	<1.00	1.9	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	1.4	3.8	2.6
17A	ND	<1.00	<5.00	<5.00	<1.00	1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.0	<1.0	<1.0	<1.0	<1.0
17C	10	2.32	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
17D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	<1.00	NT	NT	NT	NT	NT
18A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
18C	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1.1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
18D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
19C	5.5	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	<1.0	<1.0
19D	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20A	ND	<1.00	<5.00	<5.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
20C	47	20.12	12.63	13.77	8.32	6.7	3.4	3.3	3.4	<1.00	<1.00	1.6	1.8	<1.00	1.9	<1.00	1.06	<1.00	<1.0	1.4	2.7	4.0	3.1
20D	ND	6.98	<5.00	<5.00	31.12	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	NT	NT	NT	NT	NT
21A	NT	NT	NT	NT	<1.00		<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.0	<1.0	<1.0	NT	NT
21C	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.00	<1.0	<1.0	<1.0	nt	nt

NT = Not Tested.

ND = Not Detected.

J = Indicates the analyte was positively identified, and the concentration listed is an estimate.

Source: S:|Sharedoc\025\093\Nov03 Semiannual Rpt\swmu20_nov03_sum Summary.

TABLE 10
VAPOR INTRUSION MODELING RESULTS BASED ON CONSERVATIVE ASSUMPTIONS FOR BUILDINGS 9-90 AND 9-101 BOEING DEVELOPMENTAL CENTER

Groundwater Concentrations (ug/L)

Location	Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Naphthalene
09A	Jun-03	**1800**	**990**	**2300**	**120**	75 U
09A	Nov-03	**1000**	**1500**	**2300**	**180**	1 U
10A	Jun-03	**34**	**32**	**88**	**36**	5 U
10A	Nov-03	**58**	**49**	**98**	**9.1**	5 U
11A	Jun-03	1 U	**2.2**	**17**	1 U	5 U
11A	Nov-03	1 U	**2.8**	**18**	1 U	5 U
12A	Jun-03	1 U	1 U	**1.4**	1 U	5 U
12A	Nov-03	1 U	1 U	**4**	1 U	5 U
13A	Jun-03	**3.4**	**3.9**	1 U	1 U	5 U
13A	Nov-03	**3**	**3.8**	1 U	1 U	5 U
14A	Jun-03	1 U	1 U	**23**	**28**	5 U
14A	Nov-03	1 U	1 U	**170**	**240**	5 U
15A	Jun-03	5 U	5 U	5 U	5 U	**370**
15A	Nov-03	5 U	5 U	5 U	5 U	**490**
16A	Jun-03	**1.2**	**1.3**	**2.4**	1 U	5 U
16A	Nov-03	**1.1**	**1.2**	**1.3**	1 U	5 U
17A	Jun-03	**4.6**	**7.4**	**1.4**	1 U	5 U
17A	Nov-03	**4.8**	**7.9**	**1.6**	1 U	5 U
18A	Jun-01	1 U	1 U	1 U	1 U	1 U
18A	Dec-01	1 U	1 U	1 U	1 U	1 U
19A	Jun-01	1 U	1 U	1 U	1 U	**1.54**
19A	Dec-01	1 U	1 U	1 U	1 U	1 U
20A	Jun-01	1 U	1 U	1 U	1 U	**5.48**
20A	Dec-01	1 U	1 U	1 U	1 U	1 U
21A	Jun-02	1 U	1 U	1 U	1 U	5 U
21A	Dec-02	1 U	1 U	1 U	1 U	5 U

	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Naphthalene	Cumulative Health Risk Indices
Distribution (assumed):	Lognormal	Lognormal	Lognormal	Lognormal	Lognormal	
Number of Samples:	26	26	26	26	26	
Frequency of Detection:	38%	46%	54%	23%	15%	
Maximum Detection:	1800	1500	2300	240	490	
Mean:	112.85	100.90	194.08	24.66	39.50	
Standard Deviation:	395.65	344.62	621.23	60.27	117.05	
Mean (log-transformed data):	1.19	1.30	1.75	1.07	1.70	
Std Deviation (log-transformed data):	2.09	2.03	2.39	1.84	1.56	
Geometric Mean:	3.28	3.67	5.74	2.91	5.50	
t-statistic (normal dist only) :						
H-statistic:	4.11	4.03	4.60	3.71	3.29	
UCL95:	161	148	894	61	52	
Exposure Point Concentration:	161	148	894	61	52	
Building 9-90 Risk Summary:						
Indoor Air Excess Cancer Risk:	--	--	--	1E-06	--	1E-06
Indoor Air Hazard Quotient:	--	--	--	4E-03	--	4E-03
Building 9-101 Risk Summary:						
Indoor Air Excess Cancer Risk:	2E-07	4E-06	--	6E-07	--	5E-06
Indoor Air Hazard Quotient:	--	2E-03	7E-03	2E-03	5E-04	1E-02

U = compound was not detected at given detection limit.

-- = Not Measured.

Notes:

1. Groundwater concentrations shown in bold are those that were detected at or above the laboratory reporting limit.
2. Shaded cells identify carcinogenic risk exceeding acceptable levels for a single substance (1E-06) or multiple substances (1E-05) or noncarcinogenic risk exceeding acceptable levels for a single substance (hazard quotient less than or equal to 1) or multiple substances (hazard index less than or equal to 1).
3. Groundwater concentrations represented in this table include Zone A data collected from the most recent available year of sampling events. In most cases, this data was collected in June and November of 2003. In some cases (i.e., wells 18A, 19A, 20A, and 21A), semiannual sampling has been discontinued due to a history of nondetect sample results. The most recent year of available data (i.e., semiannual data from 2001 or 2002) was used to characterize groundwater quality at these wells.
4. Vapor intrusion modeling for Building 9-90 evaluated for vinyl choride only based on lack of detection of other VOCs at monitoring wells adjacent to Building 9-90.

TABLE 11
SIMULATED VAPOR INTRUSION MODELING RESULTS BASED ON MORE REALISTIC ASSUMPTIONS FOR BUILDING 9-101
BOEING DEVELOPMENTAL CENTER

		Groundwater Concentrations (ug/L)				
Location	Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Naphthalene
09A	Jun-03	**1800**	**990**	**2300**	**120**	75 U
09A	Nov-03	**1000**	**1500**	**2300**	**180**	1 U
10A	Jun-03	**34**	**32**	**88**	**36**	5 U
10A	Nov-03	**58**	**49**	**98**	**9.1**	5 U
11A	Jun-03	1 U	**2.2**	**17**	1 U	5 U
11A	Nov-03	1 U	**2.8**	**18**	1 U	5 U
12A	Jun-03	1 U	1 U	**1.4**	1 U	5 U
12A	Nov-03	1 U	1 U	**4**	1 U	5 U
13A	Jun-03	**3.4**	**3.9**	1 U	1 U	5 U
13A	Nov-03	**3**	**3.8**	1 U	1 U	5 U
14A	Jun-03	1 U	1 U	**23**	**28**	5 U
14A	Nov-03	1 U	1 U	**170**	**240**	5 U
15A	Jun-03	5 U	5 U	5 U	5 U	**370**
15A	Nov-03	5 U	5 U	5 U	5 U	**490**
16A	Jun-03	**1.2**	**1.3**	**2.4**	1 U	5 U
16A	Nov-03	**1.1**	**1.2**	**1.3**	1 U	5 U
17A	Jun-03	**4.6**	**7.4**	**1.4**	1 U	5 U
17A	Nov-03	**4.8**	**7.9**	**1.6**	1 U	5 U
18A	Jun-01	1 U	1 U	1 U	1 U	1 U
18A	Dec-01	1 U	1 U	1 U	1 U	1 U
19A	Jun-01	1 U	1 U	1 U	1 U	**1.54**
19A	Dec-01	1 U	1 U	1 U	1 U	1 U
20A	Jun-01	1 U	1 U	1 U	1 U	**5.48**
20A	Dec-01	1 U	1 U	1 U	1 U	1 U
21A	Jun-02	1 U	1 U	1 U	1 U	5 U
21A	Dec-02	1 U	1 U	1 U	1 U	5 U
Theoretical	Theoretical	1 U	1 U	1 U	1 U	5 U

Distribution (assumed):	Lognormal	Lognormal	Lognormal	Lognormal	Lognormal
Number of Samples:	5200	5200	5200	5200	5200
Frequency of Detection:	0.19%	0.23%	0.27%	0.12%	0.08%
Maximum Detection:	1800	1500	2300	240	490
Mean:	1.56	1.50	1.97	1.12	5.17
Standard Deviation:	28.55	24.91	45.18	4.50	8.47
Mean (log-transformed data):	0.01	0.01	0.01	0.01	1.61
Std Deviation (log-transformed data):	0.17	0.17	0.21	0.15	0.11
Geometric Mean:	1.01	1.01	1.01	1.01	5.00
t-statistic (normal dist only) :					
H-statistic:	1.69	1.69	1.70	1.68	1.67
UCL95:	1.02	1.02	1.04	1.02	5.04
Exposure Point Concentration:	1.02	1.02	1.04	1.02	5.04

						Cumulative Health Risk Indices
Building 9-101 Risk Summary:						
Indoor Air Excess Cancer Risk:	1E-09	3E-08	--	1E-08	--	4E-08
Indoor Air Hazard Quotient:	--	2E-05	8E-06	3E-05	5E-05	1E-04

U = compound was not detected at given detection limit.

-- = Not Measured.

Notes:
1. Groundwater concentrations shown in bold are those that were detected at or above the laboratory reporting limit.
2. Shaded cells identify carcinogenic risk exceeding acceptable levels for a single substance (1E-06) or multiple substances (1E-05) or noncarcinogenic risk exceeding acceptable levels for a single substance (hazard quotient less than or equal to 1) or multiple substances (hazard index less than or equal to 1).
3. Groundwater concentrations represented in this table include Zone A data collected from the most recent available year of sampling events. In most cases, this data was collected in June and November of 2003. In some cases (i.e., wells 18A, 19A, 20A, and 21A), semiannual sampling has been discontinued due to a history of nondetect sample results. The most recent year of available data (i.e., semiannual data from 2001 or 2002) was used to characterize groundwater quality at these wells.
4. 2,173 iterations of identical theoretical data for assumed clean areas beneath Building 9-101 are hidden from this table for viewing clarity.

APPENDIX A

SWMU-20 Electron Door Amendment Work Plan

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1.0 INTRODUCTION

This document presents a work plan to conduct active remediation at Solid Waste Management Unit (SWMU) -20 at the Boeing Developmental Center in Tukwila, Washington. The BDC is a Resource Conservation and Recovery Act (RCRA) corrective action site with remedial activities conducted under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). Preparation of this work plan was authorized under Work Order No. ENV-G-04DC-019.

Groundwater at SWMU-20 contains the dissolved volatile organic compounds (VOCs) tetrachloroethene (PCE), trichloroethene (TCE), and breakdown products cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride. PCE and TCE were released from a former vapor degreaser located in Building 9-101 (Figure A-1) (Landau Associates 2002). A groundwater treatment system was operated at SWMU-20 between Fall 1993 and December 14, 2001, when the system was shut down to evaluate natural attenuation as a remedial alternative to achieve cleanup objectives. Based on rebound of VOC concentrations in a number of monitoring wells that are located in the immediate vicinity of the former vapor degreaser, Boeing has proposed active remediation by enhanced *in situ* reductive dechlorination through electron donor amendment (Landau Associates 2003). This work plan describes injection of electron donors sodium lactate and vegetable (soybean) oil emulsion and outlines groundwater monitoring to be performed before and after injection.

2.0 ELECTRON DONOR AMENDMENT

This section describes the general objectives of electron donor amendment, evaluates existing reductive dechlorination and redox conditions in SWMU-20, and describes proposed injection at SWMU-20.

2.1 GENERAL OBJECTIVES

Electron donor amendment is designed to enhance and maintain the reducing aquifer conditions required for reductive dechlorination of PCE, TCE, and associated breakdown products. Electron donor amendment stimulates reducing aquifer conditions that are required for reductive dechlorination, and provides organic carbon needed for bacterial growth. Hydrogen provided by fermentation of organic carbon reduces aquifer conditions. Hydrogen is the electron used to replace chlorine atoms on the chlorinated hydrocarbon compound through reductive dechlorination. Following donor amendment to an aquifer, ubiquitous aerobic and anaerobic bacteria utilize the hydrogen to consume any electron acceptors that may be present in the aquifer, including dissolved oxygen (DO), nitrate, manganese (IV), iron (III), sulfate, and CO_2. These electron acceptors are consumed in sequentially-occurring redox processes (chemical or biochemical processes in which electrons are transferred) known as oxygen reduction, nitrate reduction (denitrification), iron reduction, sulfate reduction, and CO_2 reduction (methanogenesis). Electron acceptors are consumed in this order because the use of each successive electron acceptor releases less energy, and bacteria preferentially use electron acceptors that provide the greatest energy return. Upon depletion of dissolved oxygen, an aquifer is anaerobic and becomes more reducing with the depletion of each successive electron acceptor.

Chlorinated compounds (e.g., PCE, TCE, cis-1,2-DCE, and vinyl chloride) are electron acceptors in the process known as reductive dechlorination. In successive steps of reductive dechlorination, individual chlorine atoms on the chlorinated hydrocarbon compound are replaced with hydrogen from the electron donor. Through reductive dechlorination, PCE is reduced to sequential breakdown products TCE, cis-1,2-DCE, vinyl chloride, ethene, and ethane, which ultimately degrades to CO_2 and water. Each sequential breakdown step requires more highly reducing conditions than the previous step (i.e., cis-1,2-DCE reduction to vinyl chloride requires more reducing conditions than TCE reduction to cis-1,2-DCE). PCE and TCE are highly oxidized (chlorinated) compounds that can be degraded under slightly reducing conditions (nitrate and iron reducing conditions), while reductive dechlorination of less oxidized breakdown products cis-1,2-DCE and vinyl chloride, requires sulfate-reducing to methanogenic conditions (Lu et al. 2001, ITRC 1998).

2.2 EXISTING CONDITIONS AT SWMU-20

Naturally-occurring reductive dechlorination processes are ongoing at SWMU-20, as evidenced by the incidence of PCE and TCE breakdown products cis-1,2-DCE and vinyl chloride (Landau Associates 2002, 2003). Observed reductive dechlorination indicates an existing source of organic carbon, sulfate-reducing to methanogenic aquifer redox conditions, and the presence of bacteria required for complete reductive dechlorination.

Reductive dechlorination in SWMU-20 is currently supported by naturally-occurring organic carbon. Total organic carbon (TOC) concentrations of 247 mg/kg to 1,456 mg/kg were measured in soil samples collected previously during the installation of five SWMU-20 monitoring wells. These soil samples were collected at depths ranging from 20 to 37.5 ft below ground surface (BGS) within Duwamish River alluvium (Landau Associates 1992).

The occurrence of vinyl chloride at SWMU-20 indicates sulfate-reducing to methanogenic redox conditions and the presence of bacteria required for complete reductive dechlorination. Reductive dechlorination of cis-1,2-DCE to vinyl chloride requires sulfate reducing to methanogenic conditions (Lu et al. 2001, ITRC 1998). While bacteria capable of reductive dechlorination of PCE and TCE are ubiquitous and varied in the environment, *Dehalococcoides* bacteria capable of cis-1,2-DCE dechlorination to vinyl chloride are less commonly occurring (Ellis et al. 2000). An extensive survey of *Dehalococcoides* at multiple contaminated sites indicated that the bacterium was present at all sites where complete reductive dechlorination of TCE occurred and, conversely, the survey did not find *Dehalococcoides* at any sites where reductive dechlorination was stalled at cis-1,2-DCE (Major et al. 2003).

Donor injection has significantly enhanced reductive dechlorination at a similar site where naturally-occurring organic carbon is present and reductive dechlorination was previously occurring. A pilot test injection of sodium lactate enhanced reductive dechlorination at the nearby former Boeing Electronics Manufacturing Facility (EMF) within Boeing Plant 2, where baseline sampling indicated sulfate-reducing to methanogenic redox conditions and production of ethene. Over the four-month period following sodium lactate injection, total VOC concentrations decreased 85 to 92 percent at three injection wells, and decreased 94 percent at a monitoring well located 75 ft downgradient. The cell density of *Dehalococcoides* bacteria also increased two to four orders of magnitude compared to baseline (PPC 2004).

2.3 INJECTION AT SWMU-20

Electron donor consisting of food-grade sodium lactate and vegetable oil emulsion will be injected at wells in the immediate vicinity of the former vapor degreaser. The combined application of soluble (fast-release) sodium lactate and relatively insoluble (slow-release) vegetable oil is designed to address both downgradient impacts and residual source material in the release area.

Sodium lactate and vegetable oil emulsion will be mixed with groundwater pumped from extraction wells E1 and E2 (Figure A-1) to form dilute solutions for injection at wells MW-9A, MW-9B, MW-9C, MW-6B, MW-6C, and a new A-Horizon well to be installed near MW-6B and MW-6C. In accordance with Washington Administrative Code (WAC 173-218) the site will be registered with Ecology's Underground Injection Control (UIC) program. Given the large volume injections described in the following section, groundwater pumped from E1 and E2 is preferred over tap water to avoid dilution and/or dispersion of the plume, and to avoid the introduction of highly oxygenated water. United Stated Environmental Protection Agency (EPA) policy allows for reinjection of groundwater extracted from a contaminated area, provided groundwater is treated to substantially reduce hazardous constituents prior to reinjection, with reduction of hazardous constituents occurring prior to or following injection (EPA 2000).

2.3.1 SODIUM LACTATE INJECTION

Sodium lactate is an innocuous, food-grade amendment that has been widely used as an electron donor for injection to groundwater. Sodium lactate is the salt of lactic acid. Lactate occurs naturally in milk, and is used by the dairy industry during fermentation processes used to manufacture buttermilk, yogurt, and other dairy products. Sodium lactate is completely soluble in groundwater causing it to move with the flow of groundwater. Although the advance of lactate is somewhat retarded due to consumption, any retardation is expected to be less than of the VOC compounds targeted for remediation. Lactate is fermented to hydrogen and intermediates, including propionate and pyruvate, which also ferment to hydrogen.

Groundwater pumped from extraction well E2 will be used to dilute sodium lactate for injection into monitoring wells MW-9A, MW-9B, and MW-9C (Figure A-1). Approximately 5000 gallons of groundwater will be mixed with 550 gallons (10 drums) of 60 percent sodium lactate solution to create a 6 percent solution for injection. Monitoring wells MW-9A, MW-9B, and MW-9C are screened from 11 to 21.5 ft, 22 to 27 ft, and 29 to 39.5 ft, respectively (Figure A-2). Due to an observed decrease in concentration with depth (Landau Associates 2002, 2003), 50 percent of the solution (3025 gallons) will be injected at well MW-9A and 25 percent (1512 gallons) will be injected at each of wells MW-9B, and MW-9C.

2.3.2 VEGETABLE OIL INJECTION

Vegetable oil is an innocuous, food-grade amendment that has been widely used as an electron donor for injection to groundwater. Soybean oil is typically used because of its low cost relative to other vegetable oils. The concentrated emulsion to be used at SWMU-20 is composed of soybean oil (50 percent by volume), lactic acid (4 percent by volume), water, and food-grade emulsifying agents. The emulsion has a reported oil droplet size of 0.5 micron, which will allow the oil droplets to pass through pore spaces in the aquifer and move out radially from the injection points. These very small oil droplets will adsorb to soil particles as they move with groundwater flow, forming a permeable barrier of vegetable oil at residual saturation within the aquifer. Over time, oil will break down to hydrogen and intermediate volatile organic acids that will move downgradient with groundwater flow for stimulation of reductive dechlorination.

Groundwater pumped from extraction well E1 will be used to dilute the vegetable oil emulsion for injection into monitoring wells MW-6B, MW-6C, and a new A-Horizon well to be installed just upgradient (east) of the former vapor degreaser (Figure A-1). As an A-Horizon monitoring well is not present near wells MW-6B and MW-6C, we propose to construct a new well screened from 10 to 20 ft BGS for injection and monitoring (Figure A-2). The new well will allow donor injection to the A Horizon beneath the former vapor degreaser. Although the depth to groundwater was approximately 13 ft BGS near the former degreaser in November 2003, groundwater has been observed in the past at depths above the base of the former degreaser, indicating seasonal saturation of underlying soil (Landau Associates 2002). Existing monitoring wells MW-6B and MW-6C are screened below the A Horizon at depths of 22 to 27.5 ft and 30 to 40.5 ft, respectively (Figure A-2). Approximately 4750 gallons of groundwater will be mixed with 257 gallons of concentrated emulsion (50 percent oil) to create an injection solution containing 2.5 percent oil. Due to an observed decrease in VOC concentrations with depth (Landau Associates 2002, 2003), 50 percent of the solution (2500 gallons) will be injected at the new A-horizon well and 25 percent (1250 gallons) will be injected at each of wells MW-6B, and MW-6C. The created permeable barrier of vegetable oil is designed to provide a steady supply of hydrogen to potential source material beneath the former degreaser and to the area near wells MW-9A and MW-9B, where some of the highest VOC concentrations have been observed.

The new A-Horizon well (to be identified as MW-6A) will be located inside Building 9-101 near the east end of the former vapor degreaser. Well MW-6A will be constructed of threaded 2-inch diameter schedule PVC casing and screen. The screen (0.010-in slot size) will extend from 10 to 20 ft BGS, and a sandpack consisting of 10/20 sand will extend from 8 to 20 ft BGS. An annular seal will be constructed of hydrated bentonite chips from 1.5 to 8 ft BGS, and the well will be completed with a flush-mount monument.

3.0 GROUNDWATER MONITORING

Groundwater monitoring will be performed at SWMU-20 wells to evaluate the effects of donor injection and to evaluate the need for subsequent donor amendment. Prior to injection, groundwater monitoring will be performed at regularly sampled SWMU-20 wells and new well MW-6A to establish baseline conditions. Subsequent to donor injection, regular semiannual monitoring will be performed and select SWMU-20 wells will also be sampled quarterly.

Groundwater monitoring will consist of groundwater sampling for measurement of field parameters and laboratory analysis. Oxidation reduction potential (ORP), pH, DO, and dissolved ferrous iron (iron II) will be measured in the field. Samples will also be submitted for laboratory analyses of VOCs, total organic carbon (TOC), sulfate, ethene, ethane, and methane. Field and laboratory methods are listed for each parameter in Table A-1, along with a brief description of the information obtained from each parameter. Analytical Resources Inc. (ARI) of Seattle, Washington will perform or subcontract the remaining analyses under their existing contract with Boeing.

3.1 BASELINE MONITORING

The purpose of baseline monitoring is to evaluate VOC concentrations and aquifer redox conditions prior to donor amendment. Baseline monitoring will be performed at regularly sampled SWMU-20 wells and new well MW-6A during the next semiannual sampling event scheduled for June 2004.

3.2 FOLLOWING ELECTRON DONOR AMENDMENT

Following electron donor injection, monitoring will be conducted at SWMU-20 wells to evaluate the effectiveness of injected donor at stimulating more reduced aquifer redox conditions and enhanced reductive dechlorination. Monitoring results will also be used to evaluate the need for subsequent injections of vegetable oil and/or sodium lactate electron donor. Regular semiannual monitoring will be performed at SWMU-20 wells. Quarterly monitoring will be performed at the six injection wells (the new A-Horizon well MW-6A, MW-6B, MW-6C, MW-9A, MW-9B, and MW-9C) and at downgradient well MW-14A and crossgradient well MW-10A, where rebound of one or more VOCs has been observed since shutdown of the groundwater treatment system.

4.0 DATA EVALUATION

The primary measure of enhanced reductive dechlorination will be an ultimate decrease in the concentrations of PCE, TCE and breakdown products cis-1,2-DCE and vinyl chloride. The rate and effectiveness of enhanced reductive dechlorination will be assessed through changes in concentrations of PCE, TCE and breakdown products. PCE breakdown products TCE, cis-1,2-DCE, and vinyl chloride may initially increase, then decrease in concentration.

Aquifer redox conditions will be evaluated based on ORP, and concentrations of DO, iron II, sulfate, and methane. Three degrees of aquifer redox (aerobic, transitional, and anaerobic and reducing) will be evaluated as follows (Beil et al. 2002):

Aerobic	DO > 1 mg/L, ORP > 0 mV
Transitional	DO < 1 mg/L, ORP > 0 mV
Anaerobic and Reducing	DO < 1 mg/L, ORP < 0 mV

As described in Section 2.2, current conditions appear to be sulfate-reducing to methanogenic, which is considered anaerobic and reducing. DO and ORP are often less-than-reliable indicators of redox conditions as they are difficult to measure consistently and accurately. Therefore, aquifer redox conditions will also be evaluated based on observed iron-reducing conditions (increasing concentrations of iron II), sulfate-reducing conditions (decreasing concentrations of sulfate), and methanogenesis (increasing concentrations of methane).

Increasing TOC concentrations are considered the most reliable indicators of the downgradient extent of electron donor. Observed changes in other parameters may result from aquifer changes that occurred upgradient and were carried by groundwater flow to downgradient monitoring locations. Concentrations of TOC above background indicate the presence of volatile organic acids with hydrogen available to enhance reductive dechlorination at the monitoring location. TOC groundwater concentrations of less than 10 mg/L are considered to be TOC depleted (Maierle and Cota 2001).

5.0 SCHEDULE

We propose to install the new A-Horizon well (MW-6A) during May 2004 so it can be included in baseline sampling to be conducted during semiannual monitoring in June 2004. Following collection of baseline data, donor injection will be completed in June or July 2004. Regular semiannual monitoring will continue to be performed in December and June. Select wells will also be monitored quarterly in September and March (Section 3.2). Based on monitoring data, subsequent injections of electron donor may be required, which would need two to four days for each event.

6.0 REPORTING

Monitoring results will be provided in semiannual groundwater monitoring reports regularly prepared for the Developmental Center.

7.0 USE OF THIS REPORT

This Work Plan has been prepared for the exclusive use of the Boeing Company for specific application to SWMU-20 at the Boeing Developmental Center. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Clint Jacob

Clinton L. Jacob, P.E.
Senior Project Engineer

CLJ/JRN/tam/pcs

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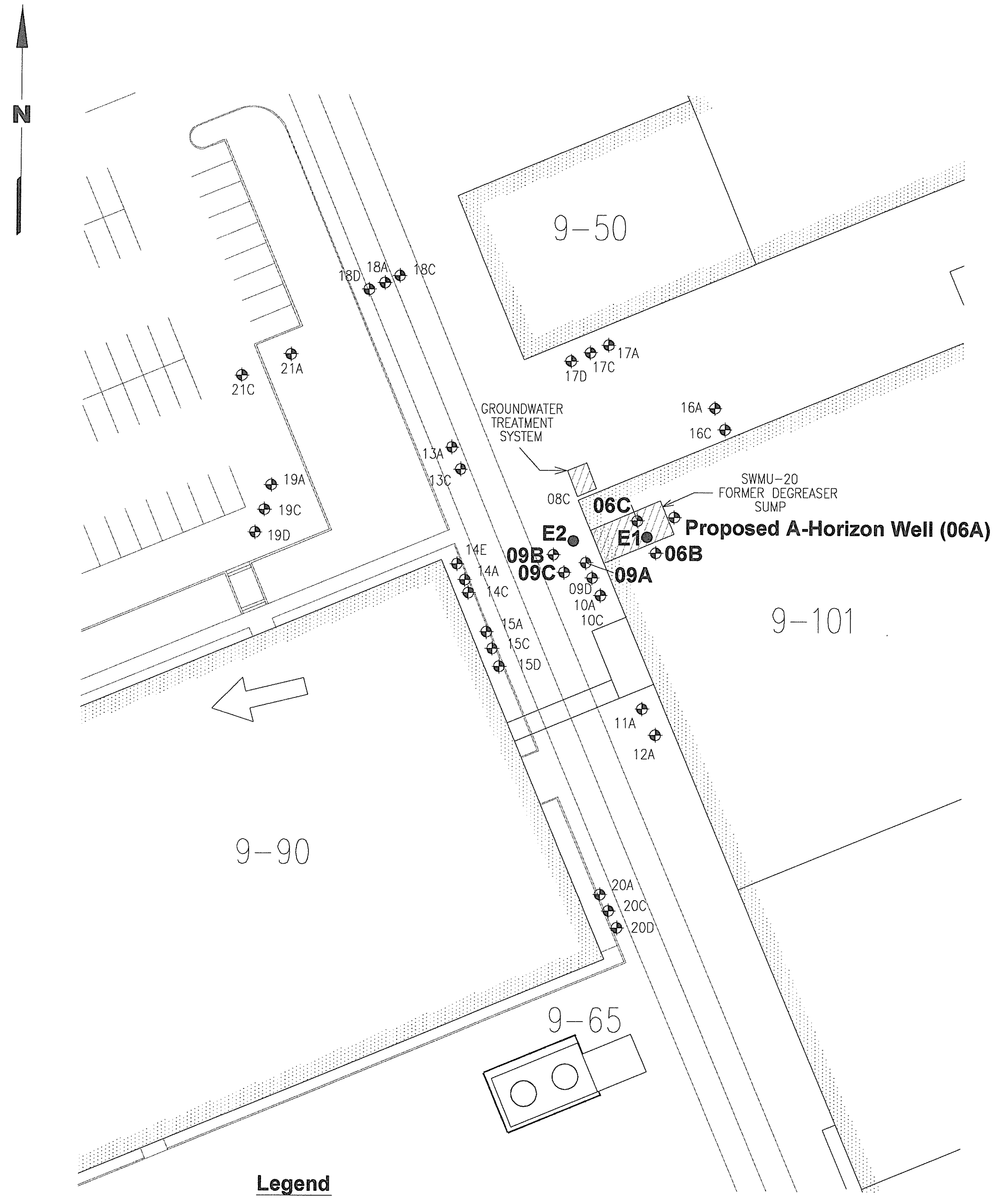
Boeing/Developmental Center/Rmd Action Workplan | T:\025\093\040\Rmd Action Workplan\FigA-1.dwg (A) "Figure A-1" 3/10/2004



Note

Extraction and injection wells are bolded

Legend

⊕	Monitoring Well
●	Extraction Well
⇦	Inferred Groundwater Flow Direction

0 60 120

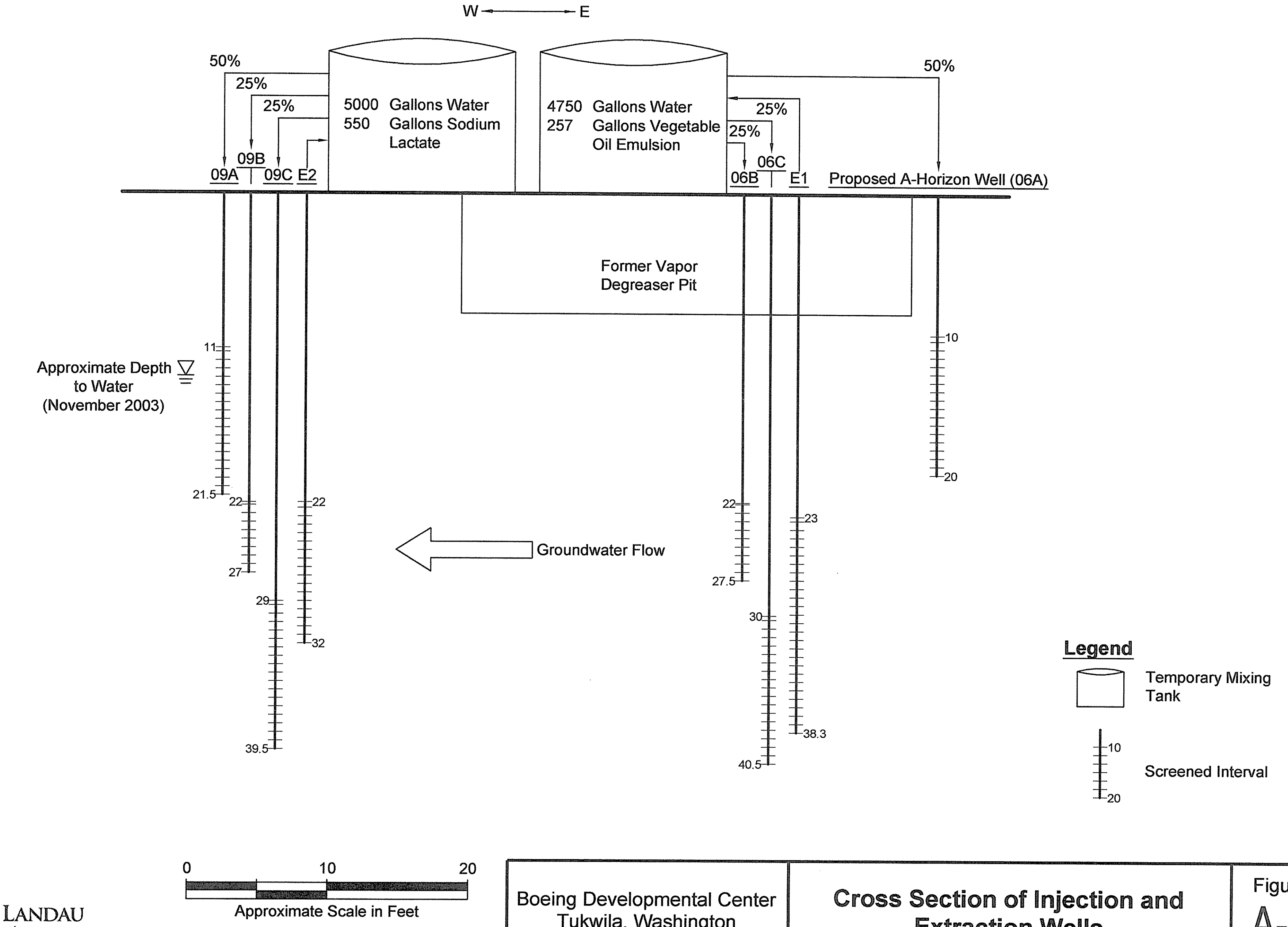
Scale in Feet

LANDAU ASSOCIATES

Boeing Developmental Center
Tukwila, Washington

SWMU-20

Figure
A-1



LANDAU ASSOCIATES

Boeing Developmental Center
Tukwila, Washington

Cross Section of Injection and Extraction Wells

Figure
A-2

TABLE A-1
BOEING DEVELOPMENT CENTER SWMU-20
GROUNDWATER MONITORING PARAMETERS

Field Parameters	Information Provided
Dissolved Oxygen (DO) [field meter and single-use reactive ampoules] (a)	Aquifer is considered anaerobic at DO concentrations less than 1.0 mg/L.
Oxidation Reduction Potential (Redox) [field meter] (a)	Negative values indicate reducing conditions.
pH [field meter] (a)	May decrease due to injected donor. Ideal for reductive dechlorination in the range of 6 to 8.
Iron(II) [Hach test kit]	Concentrations above background indicate iron reducing conditions.

Laboratory Analyses	Information Provided
Volatile Organic Compounds (VOCs) [Method 8260] [3-40 ml VOA-HCl] (b)	Concentrations of chlorinated VOCs and breakdown products are indicative of reductive dechlorination and pathways.
Total Organic Carbon (TOC) [Method 415.1][250 ml Amber-H2SO4]	Will increase due to arrival of volatile fatty acids released from injected sodium lactate and vegetable oil.
Sulfate [IC Method E300][500 ml poly]	Decreasing concentrations indicate sulfate reducing conditions.
Ethene/Ethane/Methane [Method 8015 Mod] [3-40 ml VOA] (b)	Concentrations of ethene and ethane are indicative of reductive dechlorination and pathways. Increasing methane concentrations indicate methanogenic conditions.

Notes:
(a) Measured using a flow-through cell.
(b) Care to be taken during sample collection to minimize aeration and volatilization.

APPENDIX B

Johnson-Ettinger Input Parameters and Output Files

Building 9-90

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
127184	1.61E+02	Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-90

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	2.00E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.1E-07	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
79016	1.48E+02	Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-90

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
9.4E-06	5.0E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
156592	8.94E+02	cis-1,2-Dichloroethylene

MORE ↓

ENTER	ENTER	ENTER	ENTER	ENTER	ENTER	ENTER	ENTER	ENTER		ENTER
			Totals must add up to value of L_{WT} (cell G28)							
Average soil/ groundwater temperature, T_S (°C)	Depth below grade to bottom of enclosed space floor, L_F (cm)	Depth below grade to water table, L_{WT} (cm)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	Soil stratum directly above water table, (Enter A, B, or C)	SCS soil type directly above water table	Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

RESULTS SHEET - BUILDING 9-90

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	3.50E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.5E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75014	6.12E+01	Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
127184	1.61E+02	Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S ($^{\circ}$C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75014	6.12E+01	Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

RESULTS SHEET - BUILDING 9-90

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.4E-06	3.8E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-90

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
91203	5.20E+01	Naphthalene

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**		**ENTER**
			Totals must add up to value of L_{WT} (cell G28)							
Average soil/ groundwater temperature, T_S (°C)	Depth below grade to bottom of enclosed space floor, L_F (cm)	Depth below grade to water table, L_{WT} (cm)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	Soil stratum directly above water table, (Enter A, B, or C)	SCS soil type directly above water table	Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	12000	5300	850	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

RESULTS SHEET - BUILDING 9-90

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.10E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.2E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

Building 9-101

DATA ENTRY SHEET - BUILDING 9-101

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
127184	1.61E+02	Tetrachloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type (Lookup Soil Parameters)	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type (Lookup Soil Parameters)	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-101

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	2.00E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.9E-07	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)		Chemical
79016	1.48E+02		Trichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)		**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5		

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

RESULTS SHEET - BUILDING 9-101

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.3E-06	2.3E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
156592	8.94E+02	cis-1,2-Dichloroethylene

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**		**ENTER**
			Totals must add up to value of L_{WT} (cell G28)							
Average soil/ groundwater temperature, T_S (°C)	Depth below grade to bottom of enclosed space floor, L_F (cm)	Depth below grade to water table, L_{WT} (cm)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	Soil stratum directly above water table, (Enter A, B, or C)	SCS soil type directly above water table	Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Stratum A SCS soil type Lookup Soil Parameters	Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	Stratum A soil total porosity, n^A (unitless)	Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	Stratum B SCS soil type Lookup Soil Parameters	Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	Stratum B soil total porosity, n^B (unitless)	Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	Stratum C SCS soil type Lookup Soil Parameters	Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	Stratum C soil total porosity, n^C (unitless)	Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**		**ENTER**
Enclosed space floor thickness, L_{crack} (cm)	Soil-bldg. pressure differential, ΔP (g/cm-s^2)	Enclosed space floor length, L_B (cm)	Enclosed space floor width, W_B (cm)	Enclosed space height, H_B (cm)	Floor-wall seam crack width, w (cm)	Indoor air exchange rate, ER (1/h)		Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5		

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Averaging time for carcinogens, AT_C (yrs)	Averaging time for noncarcinogens, AT_{NC} (yrs)	Exposure duration, ED (yrs)	Exposure frequency, EF (days/yr)	Target risk for carcinogens, TR (unitless)	Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-101

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.50E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	6.7E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75014	6.12E+01	Vinyl chloride (chloroethene)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

RESULTS SHEET - BUILDING 9-101

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
6.2E-07	1.6E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
91203	5.20E+01	Naphthalene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, $\rho_b{}^A$ (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, $\theta_w{}^A$ (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, $\rho_b{}^B$ (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, $\theta_w{}^B$ (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, $\rho_b{}^C$ (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, $\theta_w{}^C$ (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-101

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	3.10E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	4.8E-04

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

Building 9-101 Simulation

DATA ENTRY SHEET - BUILDING 9-101 SIMULATED

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W ($\mu g/L$)	Chemical
127184	1.02E+00	Tetrachloroethylene

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**		**ENTER**
			Totals must add up to value of L_{WT} (cell G28)							
Average soil/ groundwater temperature, T_S (°C)	Depth below grade to bottom of enclosed space floor, L_F (cm)	Depth below grade to water table, L_{WT} (cm)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	Soil stratum directly above water table, (Enter A, B, or C)	SCS soil type directly above water table	Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-101 SIMULATED

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	2.00E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.2E-09	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101 SIMULATED

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
79016	1.02E+00	Trichloroethylene

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**		**ENTER**
			Totals must add up to value of L_{WT} (cell G28)							
Average soil/ groundwater temperature, T_S (°C)	Depth below grade to bottom of enclosed space floor, L_F (cm)	Depth below grade to water table, L_{WT} (cm)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	Soil stratum directly above water table, (Enter A, B, or C)	SCS soil type directly above water table	Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Stratum A SCS soil type Lookup Soil Parameters	Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	Stratum A soil total porosity, n^A (unitless)	Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	Stratum B SCS soil type Lookup Soil Parameters	Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	Stratum B soil total porosity, n^B (unitless)	Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	Stratum C SCS soil type Lookup Soil Parameters	Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	Stratum C soil total porosity, n^C (unitless)	Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Enclosed space floor thickness, L_{crack} (cm)	Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	Enclosed space floor length, L_B (cm)	Enclosed space floor width, W_B (cm)	Enclosed space height, H_B (cm)	Floor-wall seam crack width, w (cm)	Indoor air exchange rate, ER (1/h)	Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Averaging time for carcinogens, AT_C (yrs)	Averaging time for noncarcinogens, AT_{NC} (yrs)	Exposure duration, ED (yrs)	Exposure frequency, EF (days/yr)	Target risk for carcinogens, TR (unitless)	Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

RESULTS SHEET - BUILDING 9-101 SIMULATED

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	1.47E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.9E-08	1.6E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101 SIMULATED

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒ X

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
156592	1.04E+00	cis-1,2-Dichloroethylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Totals must add up to value of L_{WT} (cell G28) Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type Lookup Soil Parameters	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type Lookup Soil Parameters	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-101 SIMULATED

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.50E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	7.8E-06

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101 SIMULATED

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75014	1.02E+00	Vinyl chloride (chloroethene)

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**		**ENTER**
			Totals must add up to value of L_{WT} (cell G28)							
Average soil/ groundwater temperature, T_S (°C)	Depth below grade to bottom of enclosed space floor, L_F (cm)	Depth below grade to water table, L_{WT} (cm)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	Soil stratum directly above water table, (Enter A, B, or C)	SCS soil type directly above water table	Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Stratum A SCS soil type Lookup Soil Parameters	Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	Stratum A soil total porosity, n^A (unitless)	Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	Stratum B SCS soil type Lookup Soil Parameters	Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	Stratum B soil total porosity, n^B (unitless)	Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	Stratum C SCS soil type Lookup Soil Parameters	Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	Stratum C soil total porosity, n^C (unitless)	Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Enclosed space floor thickness, L_{crack} (cm)	Soil-bldg. pressure differential, ΔP (g/cm-s^2)	Enclosed space floor length, L_B (cm)	Enclosed space floor width, W_B (cm)	Enclosed space height, H_B (cm)	Floor-wall seam crack width, w (cm)	Indoor air exchange rate, ER (1/h)	Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER	**ENTER**	**ENTER**	**ENTER**	**ENTER**	**ENTER**
Averaging time for carcinogens, AT_C (yrs)	Averaging time for noncarcinogens, AT_{NC} (yrs)	Exposure duration, ED (yrs)	Exposure frequency, EF (days/yr)	Target risk for carcinogens, TR (unitless)	Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET - BUILDING 9-101 SIMULATED

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (μg/L)	Indoor exposure groundwater conc., noncarcinogen (μg/L)	Risk-based indoor exposure groundwater conc., (μg/L)	Pure component water solubility, S (μg/L)	Final indoor exposure groundwater conc., (μg/L)
NA	NA	NA	8.80E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.0E-08	2.7E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET - BUILDING 9-101 SIMULATED

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES ☐

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES ☒

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
91203	5.04E+00	Naphthalene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	**ENTER** Depth below grade to bottom of enclosed space floor, L_F (cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** Thickness of soil stratum A, h_A (cm)	**ENTER** Thickness of soil stratum B, (Enter value or 0) h_B (cm)	**ENTER** Thickness of soil stratum C, (Enter value or 0) h_C (cm)	**ENTER** Soil stratum directly above water table, (Enter A, B, or C)	**ENTER** SCS soil type directly above water table	**ENTER** Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined stratum A soil vapor permeability, k_v (cm^2)
10	15	300	125	175	0	B	SI	S		

Totals must add up to value of L_{WT} (cell G28)

MORE ↓

ENTER Stratum A SCS soil type	**ENTER** Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	**ENTER** Stratum A soil total porosity, n^A (unitless)	**ENTER** Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	**ENTER** Stratum B SCS soil type	**ENTER** Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	**ENTER** Stratum B soil total porosity, n^B (unitless)	**ENTER** Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	**ENTER** Stratum C SCS soil type	**ENTER** Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	**ENTER** Stratum C soil total porosity, n^C (unitless)	**ENTER** Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
Lookup Soil Parameters				Lookup Soil Parameters				Lookup Soil Parameters			
S	1.66	0.375	0.054	SI	1.35	0.489	0.167		Error	Error	Error

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	**ENTER** Soil-bldg. pressure differential, ΔP (g/cm-s^2)	**ENTER** Enclosed space floor length, L_B (cm)	**ENTER** Enclosed space floor width, W_B (cm)	**ENTER** Enclosed space height, H_B (cm)	**ENTER** Floor-wall seam crack width, w (cm)	**ENTER** Indoor air exchange rate, ER (1/h)	**ENTER** Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
15	40	29000	23000	1550	0.1	0.5	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	250	1.0E-06	1

Used to calculate risk-based groundwater concentration.

MORE ↓

END

RESULTS SHEET - BUILDING 9-101 SIMULATED

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.10E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	4.7E-05

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END