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ADDITIONAL PERIMETER BORING INVESTIGATION REPORT AND MAINTENANCE FACILITY WORK PLAN

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URS Greiner Woodward Clyde
1501 Fourth Avenue, Suite 1500
Seattle, Washington 98101-1662
(206) 343-7933
9900003

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bgs	below ground surface
DQO	data quality objective
FID	flame ionization detector
NGVD	National Geodetic Vertical Datum
PAH	polynuclear aromatic hydrocarbon
PCMP	Performance and Compliance Monitoring Plan
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SOP	standard operating procedure
TPH	total petroleum hydrocarbons
TWP	treated wood products
VOC	volatile organic compound
WAC	Washington Administrative Code

This Work Plan presents the rationale and approach for additional field investigation on the parcel of land that is adjacent to the former treated wood products (TWP) area at the International Paper facility in Longview, Washington (Figure 1-1). This area is located near the Port of Longview Maintenance Facility and is referred to in this report as the Maintenance Facility area. The parcel is currently owned by the Port of Longview. A summary of investigation work performed in this area, including the most recent investigation work performed in July 1999, is also presented in this Work Plan.

1.1 PROJECT BACKGROUND

The Washington State Department of Ecology (Ecology) noted in a letter dated November 7, 1997, four areas of concern that were identified during subsurface barrier wall construction activities in the fall of 1997. An investigation was performed near the former TWP area in July 1998 to assess soil conditions in the four identified areas. The results of that investigation indicated that soils in the area immediately to the west and northwest of the barrier wall had detectable concentrations of total petroleum hydrocarbons (TPH), and polynuclear aromatic hydrocarbons (PAHs). The impacted soils were found in the area between the TWP area and the Port of Longview Maintenance Facility. Results from this investigation are discussed in *Investigation of Areas of Soil Impact Outside the Containment Area* (URS Greiner Woodward Clyde 1998).

Groundwater samples collected quarterly from some of the Performance and Compliance Monitoring Plan (PCMP) monitoring wells in this area also contained detectable concentrations of TPH as diesel and PAHs, as discussed in the quarterly PCMP groundwater monitoring reports.

Further investigation of the area along the northern and western boundary of the former TWP area was postponed until completion of an investigation of areas of historically ponded water on Port of Longview property. Those areas of historical impoundments were investigated in January 1999, and the results will be discussed in separate reports for the "Eastern Area" and "Western Area".

An investigation of the area to the north and west of the TWP area, representing a logical continuation of the July 1998 investigation further to the north and west, was conducted in July 1999. The investigation was performed in accordance with *Additional Offsite Investigation Work Plan* (URS Greiner Woodward Clyde 1999). The results of this investigation are summarized in this Work Plan. This Work Plan also describes work intended to delineate the boundaries of impacted soil and groundwater in the area north and west of the former TWP area.

1.2 HISTORICAL RESULTS

The most recent field investigation work in the offsite area was performed in July 1999. As discussed in Section 1.1, this work was a continuation of the *Investigation of Areas of Soil Impact Outside the Containment Area* (URS Greiner Woodward Clyde 1998). The work, performed in accordance with the *Additional Offsite Investigation Work Plan* (URS Greiner Woodward Clyde 1999), included collecting soil samples from 29 borings (PB15 to PB43) drilled to the depth of the Upper Silt (Figure 1-1). In addition, 9 of the borings were advanced through the Upper Silt to evaluate the quality of shallow groundwater (Aquifer A). Boring logs are provided in Appendix A.

1.2.1 Soil Results

The results of the analyses of soil samples collected in July 1999 are summarized in Table 1-1 and shown in Figure 1-1. Cross-sections A-A' and B-B' showing the subsurface geology and soil results are provided as Figures 1-2 and 1-3. The results from the previous perimeter boring programs (PB01 to PB14) are also summarized in Table 1-1 and Figure 1-1. Laboratory analysis sheets for the soil and groundwater samples are provided in Appendix B. A quality assurance/quality control review of the data is provided in Appendix C.

Constituent concentrations in soil samples were compared with applicable regulatory criteria. Ecology considers that MTCA Method B criteria are appropriate outside the TWP area, including the area of the Port of Longview Maintenance Facility.

As outlined in the Cleanup Action Plan, the Washington State Model Toxics Control Act (MTCA) Method C industrial soil cleanup levels represent the cleanup goals for soils in the TWP area. Based on the rationale presented in the Cleanup Action Plan, MTCA Method C criteria should also be considered to be the appropriate criteria for soils outside of the TWP area, including the Maintenance Facility area. As discussed in the Cleanup Action Plan, the TWP constituents present in soil within the TWP area do not pose a current or long-term risk to human health or the environment, because of the following factors:

- The chemicals of concern are relatively insoluble and highly sorptive, and therefore largely immobile in subsurface soils and groundwater.
- The hydraulic gradient beneath the TWP area and the Maintenance Facility area is nearly flat, further minimizing the potential for migration of chemicals of concern in groundwater.
- Potential exposure pathways in both areas are incomplete, because the impacted soils in the Maintenance Facility area are overlain by about 3 feet of clean fill and 6 inches of pavement, isolating impacted soils from potential receptors at the surface.
- Both areas will remain industrial in the long-term.
- Practicable removal or treatment options for the chemicals of concern present in subsurface soils in the Maintenance Facility area, including soils below the water table, are unlikely to be effective in achieving MTCA Method B criteria.

Based on the considerations above, MTCA Method C criteria are also the most appropriate criteria for evaluating impacts and remedial alternatives in the Maintenance Facility area. To be conservative, both sets of criteria are discussed in the following sections. For TPH, there are neither MTCA Method B nor Method C criteria. Therfore, to be conservative, comparisons were made with the MTCA Method A criteria for TPH in soils.

Concentrations of TPH as diesel exceeding MTCA Method A for soil were detected in samples from seven borings (PB15, PB18, PB20, PB24, PB26, PB28 and PB31). PAHs were detected at concentrations exceeding MTCA Method B criteria in samples from five locations (PB15, PB18, PB26, PB28, and PB34). Only one of these constituents (benzo(a)anthracene in boring PB18) exceeded MTCA Method C criteria. These detections corresponded with soil samples that exhibited either a sheen or free product in the field. Naphthalene and TPH as diesel were also detected in concentrations exceeding MTCA criteria in soil samples collected from PB11 (drilled in July 1998).

Pentachlorophenol was detected in one soil sample from a single depth interval (7 to 9 feet below ground surface [bgs]) in PB34 at levels greater than the MTCA Method B criterion (but less than the MTCA Method C criterion). No pentachlorophenol was detected above method detection limits in the three other samples tested from this boring or in samples from any other borings.

1.2.2 Groundwater Results

Nine of the 29 borings completed during the July 1999 field investigation were advanced through the Upper Silt into Aquifer A. Water samples were collected through a temporary drive point well screen and analyzed for PAHs and TPH.

Constituent concentrations in groundwater were compared with applicable regulatory criteria. As outlined in the Cleanup Action Plan, the MTCA Method C groundwater cleanup levels represent the long-term cleanup goals for the deed-restricted portion of the TWP area. MTCA Method B groundwater cleanup levels are applicable outside the deed-restricted portion of the TWP area (including the area around the Port of Longview Maintenance Facility). As in the case for soils, there are neither MTCA Method B nor C criteria for TPH in groundwater. Therefore, to be conservative, comparisons were made with the MTCA Method A criterion for TPH in groundwater.

Concentrations of TPH as diesel exceeding the MTCA Method A criterion for groundwater were detected in four borings (PB21, PB31, PB42, and PB43). PAHs were detected at concentrations exceeding MTCA Method B criteria at one location (PB31). These data are summarized in Table 1-2 and shown in Figure 1-4.

TPH as diesel was not detected in three monitoring wells installed around the boundary of the Eastern Area in January 1999 (wells 99EA-1A, 99EA-2A, and 99EA-3A) at concentrations greater than the MTCA Method A criterion for groundwater. Chloroform and arsenic were the only chemicals detected above MTCA Method B criteria in these three wells. Heptachlor was detected in one duplicate groundwater sample collected from well 99EA-3A at a concentration slightly greater than the MTCA Method B criteria. It was not detected in the primary sample. These results are summarized in Table 1-3 and Figure 1-4.

Fifteen PCMP wells were installed in October 1997 and July 1998 to complement two existing wells. Groundwater samples are collected quarterly from these 17 wells and analyzed for TWP indicator parameters (including TPH, pentachlorophenol, and selected PAHs). Results from the August 1999 monitoring round are summarized in Table 1-4 and Figure 1-5. TPH and PAH exceedances of MTCA Method B groundwater criteria have been measured in several wells, including wells 97-5A and 97-6A.

A number of wells were previously installed and sampled in the northern portion of the former TWP area as part of a site groundwater monitoring program. These wells, most of which were abandoned in 1997, are shown in Figure 1-5. In general, groundwater samples were collected quarterly between 1994 and 1996 and analyzed for 10 groundwater protection standard (GWPS) constituents. The results are summarized in Table 1-4 and in Figure 1-5. No constituents were detected at concentrations exceeding MTCA Method B criteria. Based on analytical results from these wells, TWP constituents are not present in groundwater in the area to the north of the barrier wall at concentrations exceeding MTCA Method B criteria.

1.2.3 Groundwater Levels

Depth to groundwater was measured in 34 wells on August 30, 1999, as part of the Third Quarter 1999 groundwater monitoring round. Measurements were collected at 17 wells within the barrier wall (air vent wells and biovent wells) and at 17 wells outside the wall (PCMP wells). The measurements were collected concurrently between 9:04 AM and 9:49 AM. Groundwater elevations from this monitoring round are summarized in Table 1-5.

Groundwater elevations in Aquifer A ranged from a high of 4.6 feet above Mean Sea Level (feet msl) at wells 97-9A and 97-8A in the southern portion of the former TWP area, to a low of 4.28 feet msl at well 97-1A. Groundwater elevations in Aquifer B ranged from a high of 4.42 feet msl at well 97-4B in the southern portion of the former TWP area to a low of 4.19 feet msl at well 97-1B. The general direction of shallow groundwater flow during the August 1999 monitoring event in both Aquifer A and Aquifer B was towards the north-northeast, consistent with the previous groundwater monitoring rounds.

1.3 INVESTIGATION OBJECTIVES

The objectives of the investigation proposed in this Work Plan are to:

- Delineate the boundaries of soil having TWP constituents at concentrations exceeding applicable regulatory criteria, including those specified in the *Cleanup Action Plan, International Paper Facility, Longview, Washington* (Cleanup Action Plan) (Woodward-Clyde 1997).
- Delineate the boundaries of groundwater beneath the Upper Silt (Aquifer A) having TWP constituents at concentrations exceeding applicable regulatory criteria, including those specified in the Cleanup Action Plan.
- Evaluate the feasibility of using oxygen-release compounds (ORC) for mitigating TWP constituents in groundwater.

The Work Plan approach described below is designed to meet these objectives. Descriptions of the planned field activities are presented in Sections 2.0 and 3.0. A proposed pilot test for remediation is discussed in Section 4.0. The data evaluation process and schedule for completing the tasks described in this Work Plan are presented in Sections 5.0 and 6.0, respectively. References are provided in Section 7.0.

Table 1-1
PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			98-PB01	98-PB02	98-PB03	98-PB04	98-PB05	98-PB06	98-PB07	98-PB08
Depth (ft bgs)		MTCA C[a]	3-4.5	7.5-9	6-7.5	4.5-6	3-4.5	1.5-3	3-4.5	3-4.5
Date Sampled	MTCA B[a]	Industrial	14-Jul-98	15-Jul-98	15-Jul-98	15-Jul-98	16-Jul-98	16-Jul-98	16-Jul-98	16-Jul-98
TPH (mg/kg)										
diesel range	--	200	**3,300**	**3,300**	**42**	**1,800**	25 U	**54**	**74**	25 U
oil range	--	200	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Semivolatiles (µg/kg)										
naphthalene	3,200,000	140,000,000	**532,000**	**137,000**	**1,160**	**245,000**	**42**	**46**	**12,300**	**24**
acenaphthylene	--	--	**3,250**	1,000 U	100 U	1,000 U	10 U	**21**	**22**	10 U
acenaphthene	4,800,000	210,000,000	**225,000**	**47,500**	**620**	**44,400**	**95**	**308**	**1,030**	**65**
fluorene	3,200,000	140,000,000	**177,000**	**37,000**	**482**	**39,800**	**42**	**108**	**473**	**56**
phenanthrene	--	--	**465,000**	**94,100**	**1,150**	**133,000**	**16**	**60**	**219**	10 U
anthracene	24,000,000	1,050,000,000	**132,000**	**17,500**	**494**	**33,200**	**67**	**33**	**20**	10 U
fluoranthene	3,200,000	140,000,000	**234,000**	**52,300**	**811**	**40,700**	10 U	**60**	**143**	10 U
pyrene	2,400,000	105,000,000	**139,000**	**30,600**	**444**	**24,600**	10 U	**48**	**106**	10 U
benz(a)anthracene	137	18,000	**29,500**	**8,050**	**121**	**6,240**	10 U	**25**	**33**	10 U
chrysene	137	18,000	**26,200**	**7120**	**144**	**5,470**	10 U	**33**	**49**	10 U
benzo(b)fluoranthene	137	18,000	**11,900**	**3,510**	100 U	**2,890**	10 U	**41**	**29**	10 U
benzo(k)fluoranthene	137	18,000	**3,740**	**1,170**	100 U	1,000 U	10 U	**14**	**11**	10 U
benzo(a)pyrene	137	18,000	**6,820**	**1,930**	100 U	**1,670**	10 U	**24**	**15**	10 U
indeno(1,2,3-cd)pyrene	137	18,000	**1,530**	1,000 U	100 U	1,000 U	10 U	**16**	10 U	10 U
dibenz(a,h)anthracene	137	18,000	1,000 U	1,000 U	100 U	1,000 U	10 U	10 U	10 U	10 U
benzo(g,h,i)perylene	--	--	**1,540**	1,000 U	100 U	1,000 U	10 U	**19**	10 U	10 U
pentachlorophenol	8,330	1,090,000	10,000 U	10,000 U	1,000 U	10,000 U	100 U	100 U	100 U	100 U
Total PAHs	--	--	**1988480**	**437780**	**5426.00**	**576970**	**262**	**856**	**14450**	**145**
Total carcinogenic PAHs		18	**79690.0**	**21780.0**	**265.00**	**16270.0**	0.010 U	**153**	**137**	0.010 U

Notes:
bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.
U = below the stated laboratory reporting limit
Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-1

PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			98-PB09	98-PB10	98-PB11		98-PB12		98-PB13	98-PB14
Depth (ft bgs)		MTCA C[a]	3-4.5	3-4.5	6-7.5	9-10.5	7.5-9	9-10.5	7.5-9	7.5-9
Date Sampled	MTCA B[a]	Industrial	16-Jul-98	16-Jul-98	17-Jul-98	17-Jul-98	17-Jul-98	17-Jul-98	17-Jul-98	21-Jul-98
TPH (mg/kg)										
diesel range	--	200	25 U	25 U	**13,000**	**54**	**100**	25 U	25 U	25 U
oil range	--	200	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Semivolatiles (µg/kg)										
naphthalene	3,200,000	140,000,000	**41**	**171**	**4,060,000**	**8,100**	**8,130**	**6,700**	**11,800**	**25**
acenaphthylene	--	--	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
acenaphthene	4,800,000	210,000,000	**50**	**340**	**691,000**	1,000 U	1,000 U	100 U	1,000 U	10 U
fluorene	3,200,000	140,000,000	**47**	**128**	**537,000**	1,000 U	1,000 U	100 U	1,000 U	10 U
phenanthrene	--	--	10 U	10 U	**1,360,000**	1,000 U	1,000 U	100 U	1,000 U	10 U
anthracene	24,000,000	1,050,000,000	10 U	10 U	**161,000**	1,000 U	1,000 U	100 U	1,000 U	10 U
fluoranthene	3,200,000	140,000,000	10 U	10 U	**474,000**	1,000 U	1,000 U	100 U	1,000 U	10 U
pyrene	2,400,000	105,000,000	10 U	10 U	**340,000**	1,000 U	1,000 U	100 U	1,000 U	10 U
benz(a)anthracene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
chrysene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
benzo(b)fluoranthene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
benzo(k)fluoranthene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
benzo(a)pyrene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
indeno(1,2,3-cd)pyrene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
dibenz(a,h)anthracene	137	18,000	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
benzo(g,h,i)perylene	--	--	10 U	10 U	100,000 U	1,000 U	1,000 U	100 U	1,000 U	10 U
pentachlorophenol	8,330	1,090,000	100 U	100 U	1,000,000 U	10,000 U	10,000 U	1,000 U	10,000 U	100 U
Total PAHs	--	--	**138.000**	**649.000**	**7623000**	**8100.00**	**8130**	**6700.00**	**11800**	**25.000**
Total carcinogenic PAHs		18	0.010 U	0.010 U	100 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U

Notes:

bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.

U = below the stated laboratory reporting limit

Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.

Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.

a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-1
PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			PB15		PB17		PB18	PB20	
Depth (ft bgs)		MTCA C[a]	3-5	5-7	3-5	5-7	3-5	3.5-5.5	5.5-7.5
Date Sampled	MTCA B[a]	Industrial	19-Jul-99	19-Jul-99	19-Jul-99	19-Jul-99	19-Jul-99	19-Jul-99	19-Jul-99
TPH (mg/kg)									
diesel range	--	200	**9,600**	**430**	25 U	**75**	**5,000**	**4,600**	**110**
oil range	--	200	500 U	500 U	50 U	50 U	500 U	500 U	**51**
Semivolatiles (µg/kg)									
naphthalene	3,200,000	140,000,000	**4,580,000**	**67,500**	**115**	**969**	**845,000**	**426,000**	**76,900**
acenaphthylene	--	--	200,000 U	1,000 U	10 U	100 U	10,000 U	10,000 U	1,000 U
acenaphthene	4,800,000	210,000,000	**260,000**	**4,430**	**416**	**2,500**	**143,000**	**103,000**	**3,110**
fluorene	3,200,000	140,000,000	200,000 U	**2,370**	**341**	**2,150**	**113,000**	**60,500**	1,000 U
phenanthrene	--	--	**351,000**	**4,270**	**51**	**3,840**	**288,000**	**140,000**	1,000 U
anthracene	24,000,000	1,050,000,000	200,000 U	1,000 U	**80**	**298**	**46,700**	**19,100**	1,000 U
fluoranthene	3,200,000	140,000,000	200,000 U	**1,230**	**311**	**427**	**128,000**	**55,400**	1,000 U
pyrene	2,400,000	105,000,000	200,000 U	1,000 U	**179**	**192**	**76,400**	**35,100**	1,000 U
benz(a)anthracene	137	18,000	200,000 U	1,000 U	**47**	100 U	**20,200**	10,000 U	1,000 U
chrysene	137	18,000	200,000 U	1,000 U	**57**	100 U	**17,100**	10,000 U	1,000 U
benzo(b)fluoranthene	137	18,000	200,000 U	1,000 U	**92**	100 U	**11,900**	10,000 U	1,000 U
benzo(k)fluoranthene	137	18,000	200,000 U	1,000 U	**32**	100 U	10,000 U	10,000 U	1,000 U
benzo(a)pyrene	137	18,000	200,000 U	1,000 U	**71**	100 U	10,000 U	10,000 U	1,000 U
indeno(1,2,3-cd)pyrene	137	18,000	200,000 U	1,000 U	**32**	100 U	10,000 U	10,000 U	1,000 U
dibenz(a,h)anthracene	137	18,000	200,000 U	1,000 U	**11**	100 U	10,000 U	10,000 U	1,000 U
benzo(g,h,i)perylene	--	--	200,000 U	1,000 U	**39**	100 U	10,000 U	10,000 U	1,000 U
pentachlorophenol	8,330	1,090,000	2,000,000 U	10,000 U	100 U	1,000 U	100,000 U	100,000 U	10,000 U
Total PAHs	--	--							
Total carcinogenic PAHs		18							

Notes:
bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.
U = below the stated laboratory reporting limit
Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-1
PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			PB21		PB23	PB24	PB26	PB27	
Depth (ft bgs)		MTCA C[a]	3.5-5.5	5.5-7.5	5.5-7.5	3.5-5.5	3.5-5.5	3.5-5.5	5.5-7.5
Date Sampled	MTCA B[a]	Industrial	20-Jul-99	20-Jul-99	20-Jul-99	20-Jul-99	20-Jul-99	20-Jul-99	20-Jul-99
TPH (mg/kg)									
diesel range	--	200	25 U	**38**	25 U	**7,100**	**3,100**	25 U	**39**
oil range	--	200	50 U	50 U	50 U	500 U	500 U	50 U	**52**
Semivolatiles (µg/kg)									
naphthalene	3,200,000	140,000,000	**1,750**	**10,700**	100 U	**697,000**	**73,300**	**220**	**4,460**
acenaphthylene	--	--	100 U	1,000 U	100 U	200,000 U	10,000 U	10 U	100 U
acenaphthene	4,800,000	210,000,000	**128**	1,000 U	**563**	**236,000**	**103,000**	**312**	**339**
fluorene	3,200,000	140,000,000	100 U	1,000 U	**218**	200,000 U	**56,000**	**254**	100 U
phenanthrene	--	--	100 U	1,000 U	100 U	**482,000**	**144,000**	**361**	100 U
anthracene	24,000,000	1,050,000,000	100 U	1,000 U	100 U	200,000 U	**26,600**	**37**	100 U
fluoranthene	3,200,000	140,000,000	100 U	1,000 U	100 U	**220,000**	**73,700**	**56**	100 U
pyrene	2,400,000	105,000,000	100 U	1,000 U	100 U	200,000 U	**48,700**	**35**	100 U
benz(a)anthracene	137	18,000	100 U	1,000 U	100 U	200,000 U	**14,600**	10 U	100 U
chrysene	137	18,000	100 U	1,000 U	100 U	200,000 U	**12,800**	**10**	100 U
benzo(b)fluoranthene	137	18,000	100 U	1,000 U	100 U	200,000 U	**11,200**	**25**	100 U
benzo(k)fluoranthene	137	18,000	100 U	1,000 U	100 U	200,000 U	10,000 U	10 U	100 U
benzo(a)pyrene	137	18,000	100 U	1,000 U	100 U	200,000 U	**12,600**	**20**	100 U
indeno(1,2,3-cd)pyrene	137	18,000	100 U	1,000 U	100 U	200,000 U	10,000 U	**22**	100 U
dibenz(a,h)anthracene	137	18,000	100 U	1,000 U	100 U	200,000 U	10,000 U	10 U	100 U
benzo(g,h,i)perylene	--	--	100 U	1,000 U	100 U	200,000 U	10,000 U	**25**	100 U
pentachlorophenol	8,330	1,090,000	1,000 U	10,000 U	1,000 U	2,000,000 U	100,000 U	100 U	1,000 U
Total PAHs	--	--							
Total carcinogenic PAHs		18							

Notes:
bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.
U = below the stated laboratory reporting limit
Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-1

PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			PB28		PB29	PB31	PB33
Depth (ft bgs)		MTCA C[a]	3.5-5.5	5.5-7.5	5.5-7.5	3.5-5.5	3.5-5.5
Date Sampled	MTCA B[a]	Industrial	21-Jul-99	21-Jul-99	21-Jul-99	21-Jul-99	21-Jul-99
TPH (mg/kg)							
diesel range	--	200	25 U	**26,000**	25 U	**3,200**	25 U
oil range	--	200	50 U	2,500 U	50 U	500 U	50 U
Semivolatiles (µg/kg)							
naphthalene	3,200,000	140,000,000	**2,650**	**3,080,000**	**220**	**242,000**	**30**
acenaphthylene	--	--	**212**	200,000 U	10 U	20,000 U	10 U
acenaphthene	4,800,000	210,000,000	**499**	**576,000**	**412**	**93,900**	**76**
fluorene	3,200,000	140,000,000	**109**	**323,000**	**283**	**42,800**	**13**
phenanthrene	--	--	**215**	**801,000**	**202**	**68,200**	**19**
anthracene	24,000,000	1,050,000,000	**127**	200,000 U	**23**	20,000 U	10 U
fluoranthene	3,200,000	140,000,000	**444**	**308,000**	**30**	**119,000**	**18**
pyrene	2,400,000	105,000,000	**293**	200,000 U	**16**	**80,300**	10 U
benz(a)anthracene	137	18,000	**107**	200,000 U	10 U	20,000 U	10 U
chrysene	137	18,000	**136**	200,000 U	10 U	20,000 U	10 U
benzo(b)fluoranthene	137	18,000	**226**	200,000 U	10 U	20,000 U	10 U
benzo(k)fluoranthene	137	18,000	100 U	200,000 U	10 U	20,000 U	10 U
benzo(a)pyrene	137	18,000	100 U	200,000 U	10 U	20,000 U	10 U
indeno(1,2,3-cd)pyrene	137	18,000	100 U	200,000 U	10 U	20,000 U	10 U
dibenz(a,h)anthracene	137	18,000	100 U	200,000 U	10 U	20,000 U	10 U
benzo(g,h,i)perylene	--	--	100 U	200,000 U	10 U	20,000 U	10 U
pentachlorophenol	8,330	1,090,000	1,000 U	2,000,000 U	100 U	200,000 U	100 U
Total PAHs	--	--					
Total carcinogenic PAHs		18					

Notes:
bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.
U = below the stated laboratory reporting limit
Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-1
PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			PB34				PB35		PB37	PB39
Depth (ft bgs)		MTCA C[a]	5-7	7-9	9-11	11-13	7-9	9-11	5.5-7.5	3.5-5.5
Date Sampled	MTCA B[a]	Industrial	21-Jul-99	21-Jul-99	21-Jul-99	21-Jul-99	2-Aug-99	2-Aug-99	2-Aug-99	2-Aug-99
TPH (mg/kg)										
diesel range	--	200	25 U	**44**	25 UJ	25 UJ	**44**	**39**	25 U	25 U
oil range	--	200	50 U	50 U	50 UJ	50 UJ	50 U	50 U	50 U	50 U
Semivolatiles (µg/kg)										
naphthalene	3,200,000	140,000,000	10 U	**10,500**	**770 J**	10 UJ	10 U	10 U	**40**	**15**
acenaphthylene	--	--	10 U	1,000 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U
acenaphthene	4,800,000	210,000,000	10 U	**1,080**	**12 J**	10 UJ	10 U	10 U	**11**	**24**
fluorene	3,200,000	140,000,000	**38**	**1,810**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
phenanthrene	--	--	**24**	**3,410**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
anthracene	24,000,000	1,050,000,000	10 U	**3,120**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
fluoranthene	3,200,000	140,000,000	**16**	**3,650**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
pyrene	2,400,000	105,000,000	10 U	**3,470**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
benz(a)anthracene	137	18,000	10 U	**3,360**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
chrysene	137	18,000	10 U	**3,950**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
benzo(b)fluoranthene	137	18,000	10 U	**3,440**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
benzo(k)fluoranthene	137	18,000	10 U	**3,670**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
benzo(a)pyrene	137	18,000	10 U	**3,120**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
indeno(1,2,3-cd)pyrene	137	18,000	10 U	**3,580**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
dibenz(a,h)anthracene	137	18,000	10 U	**3,660**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
benzo(g,h,i)perylene	--	--	10 U	**3,670**	10 UJ	10 UJ	10 U	10 U	10 U	10 U
pentachlorophenol	8,330	1,090,000	100 U	**17,300**	100 UJ	100 UJ	100 U	100 U	100 U	100 U
Total PAHs	--	--								
Total carcinogenic PAHs		18								

Notes:
bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.
U = below the stated laboratory reporting limit
Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-1
PERIMETER AND OFFSITE INVESTIGATIONS
SOIL ANALYTICAL RESULTS

Location			PB40	PB41	PB42	PB43
Depth (ft bgs)		MTCA C[a]	5.5-7.5	5.5-7.5	3.5-5.5	3.5-5.5
Date Sampled	MTCA B[a]	Industiral	3-Aug-99	3-Aug-99	3-Aug-99	3-Aug-99
TPH (mg/kg)						
diesel range	--	200	**40**	25 U	**39**	**43**
oil range	--	200	**93**	50 U	50 U	50 U
Semivolatiles (µg/kg)						
naphthalene	3,200,000	140,000,000	**9690**	**41**	10 U	10 U
acenaphthylene	--	--	10 U	10 U	10 U	10 U
acenaphthene	4,800,000	210,000,000	**525**	10 U	10 U	**13**
fluorene	3,200,000	140,000,000	**74**	10 U	10 U	10 U
phenanthrene	--	--	10 U	10 U	10 U	10 U
anthracene	24,000,000	1,050,000,000	10 U	10 U	10 U	10 U
fluoranthene	3,200,000	140,000,000	10 U	10 U	10 U	10 U
pyrene	2,400,000	105,000,000	10 U	10 U	10 U	10 U
benz(a)anthracene	137	18,000	10 U	10 U	10 U	10 U
chrysene	137	18,000	10 U	10 U	10 U	10 U
benzo(b)fluoranthene	137	18,000	10 U	10 U	10 U	10 U
benzo(k)fluoranthene	137	18,000	10 U	10 U	10 U	10 U
benzo(a)pyrene	137	18,000	10 U	10 U	10 U	10 U
indeno(1,2,3-cd)pyrene	137	18,000	10 U	10 U	10 U	10 U
dibenz(a,h)anthracene	137	18,000	10 U	10 U	10 U	10 U
benzo(g,h,i)perylene	--	--	10 U	10 U	10 U	10 U
pentachlorophenol	8,330	1,090,000	100 U	100 U	100 U	100 U
Total PAHs	--	--				
Total carcinogenic PAHs		18				

Notes:
bold and **underlined** results are greater than MTCA Method C for PAHs and MTCA Method A for TPH.
U = below the stated laboratory reporting limit
Samples were analyzed using the following methods: WTPH-D ext.; EPA Method 8270 SIM.
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-2

PERIMETER AND OFFSITE INVESTIGATIONS GROUNDWATER ANALYTICAL RESULTS

LOCATION ID:	MTCA	PB17-GW	PB21-GW	PB23-GW	PB31-GW	PB34-GW	PB35-GW	PB40-GW	PB42-GW	PB43-GW
DATE SAMPLED:	A or B[a]	19-Jul-99	20-Jul-99	20-Jul-99	21-Jul-99	21-Jul-99	2-Aug-99	3-Aug-99	3-Aug-99	3-Aug-99
TPH (mg/L)										
diesel range	1	**0.28**	**1.9**	0.25 U	**39**	**0.69**	0.25 U	**0.98**	**1.4**	**2.0**
oil range	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatiles (µg/L)										
naphthalene	320	**1.0**	**117**	--	**12,900**	**2.1**	0.1 U	**1.1**	**2.5**	**615**
acenaphthylene	--	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	**0.5**	0.1 U
acenaphthene	960	**4.3**	**22**	--	**687**	**0.4**	0.1 U	**13.6**	**62.1**	**73.6**
fluorene	640	**0.8**	**5.9**	--	**337**	**0.3**	0.1 U	**7.0**	**1.4**	**16.2**
phenanthrene	--	**1.1**	**1.8**	--	**543**	**0.3**	0.1 U	**4.6**	**0.3**	0.1 U
anthracene	4,800	**0.1**	1.0 U	--	100 U	0.1 U	0.1 U	**0.3**	**0.2**	0.1 U
fluoranthene	640	**0.3**	1.0 U	--	**206**	**0.1**	0.1 U	0.1 U	0.1 U	0.1 U
pyrene	480	**0.2**	1.0 U	--	**110**	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
benz(a)anthracene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
chrysene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
benzo(b)fluoranthene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
benzo(k)fluoranthene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
benzo(a)pyrene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
indeno(1,2,3-cd)pyrene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
dibenz(a,h)anthracene	0.012	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
benzo(g,h,i)perylene	--	0.1 U	1.0 U	--	100 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pentachlorophenol	0.729	0.5 U	5.0 U	--	500 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Total PAHs		**9**	**158**	--	**1,5083.00**	**4**	**0.5**	**27.6**	**67.7**	**704.8**
Total carcinogenic PAHs		**0.6**	**6.0**	--	**200.00**	**0.4**	0.010 U	**0.6**	**0.5**	0.010 U

Notes:
Bold and **underlined** results are greater than MTCA B.
U = below the stated laboratory reporting limit
Pentachlorophenol is not a PAH. All carcinogenic PAHs have a MTCA Method C value of 18.
a: Cleanup goals and trigger levels are calculated based on provisional oral RfDs cited in EPA Region III RBC table, and MTCA B and C formulas (WAC-173-340-720); except for TPH, which uses the MTCA Method A values.

Table 1-3
EASTERN AREA INVESTIGATION
GROUNDWATER ANALYTICAL RESULTS

SAMPLE ID	MTCA B	99EA 1A	99EA 2A	99EA 3A	99EA 3D
DATE SAMPLED	Groundwater	1/13/99	1/13/99	1/13/99	Dup of 3A
VOC (µg/L)					
Acetone	800	20 U	20 U	20 U	20 U
Chloroform	7.17	5	1 U	9	9
Naphthalene	320	1 U	1 U	4	3
Bromodichloromethane	0.706	1 U	1 U	1 U	1 U
o-Xylene	16000	1 U	1 U	1 U	1 U
Carbon Disulfide	800	1 U	1 U	1 U	1 U
SVOC (µg/L)					
2-Methylnaphthalene	NA	10 U	10 U	193	179
Acenaphthene	960	10 U	10 U	52	53
Fluorene	640	10 U	10 U	10	11
Naphthalene	320	10 U	10 U	15	15
PAHs (µg/L)					
Acenaphthene	960	0.1 U	1.3	34.1	35.6
Fluorene	640	0.1 U	0.1 U	7.6	8.0
Naphthalene	320	0.1 U	0.1 U	10.2	11.2
Phenanthrene	NA	0.1 U	0.1 U	5.8	6.1
2-Methylnaphthalene	NA	10 U	10 U	10 U	10 U
Dibenzofuran		10 U	10 U	10 U	10 U
Anthracene	4800	10 U	10 U	10 U	10 U
TPH (mg/L)					
Diesel Region	1.0	0.25 U	0.25 U	0.87	0.95
PCB/Pesticides (µg/L)					
gamma-BHC (Lindane)	0.0673	0.01 UJ	0.01 UJ	0.01 UJ	0.05 J
Heptachlor	0.0194	0.01 UJ	0.01 UJ	0.01 UJ	0.02 J
Total Metals (mg/L)					
Arsenic	5.8E-05	0.005	0.005	0.001	0.002
Chromium	16 [2]	7E-04	9E-04	6E-04	7E-04
Conventionals (mg/L)					
Alkalinity, Total as CaCO3	NA	100 J	150 J	210 J	220 J
Chloride	250 [1]	2.9	2.9	4.7	4.7
Fluoride	2.0 [1]	0.2	0.2	0.2	0.2
pH (std units)	NA	6.4	6.2	6.3	6.3
Sulfate as SO4	250 [1]	4.9	1.3	7.1	5.2

Notes:
Results above MTCA B Groundwater are underlined
1: Criteria are the Secondary Maximum Contaminant Levels
2: Criterion is for chromium III
--: Not analyzed
NA: Not applicable
U: non-detect
J: estimated value

Table 1-4
TWP AREA AND PCMP MONITORING WELLS GROUNDWATER ANALYTICAL RESULTS

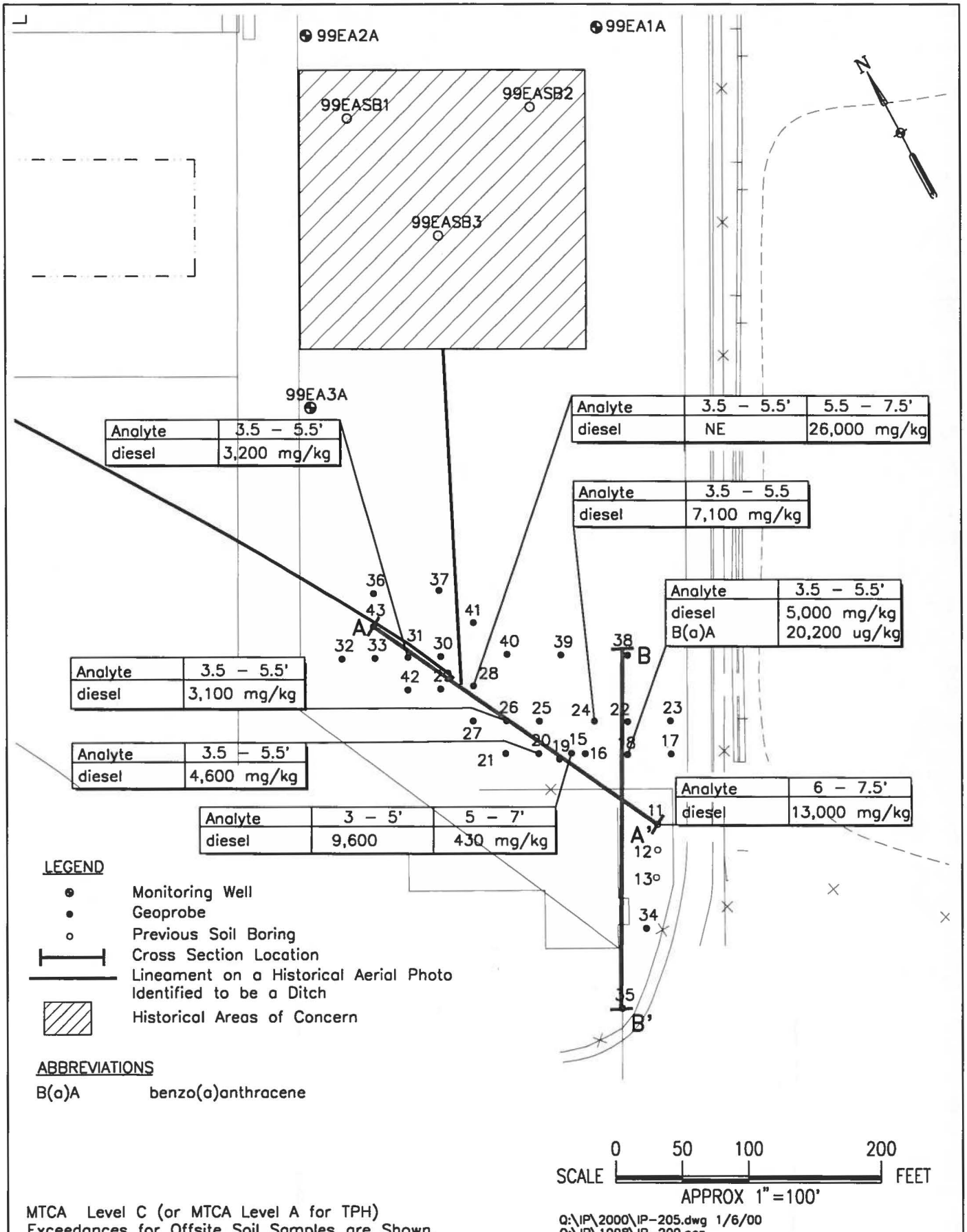
WELL ID	SAMPLING PERIOD	TPH (µg/L)	SEMI-VOLATILES (µg/L)				
		DIESEL	TOLUENE	NAPHTHALENE	BENZO(A) ANTHRACENE	CHRYSENE	PENTACHLORO-PHENOL
Monitoring Wells							
93--1.102	Prior to 1994	--	--	--	--	--	--
	1994	--	4	--	--	--	--
	1995	--	3	--	--	--	--
	1996	--	--	--	--	--	--
93--2.103	Prior to 1994	--	--	--	--	--	--
	1994	--	4	--	--	--	--
	1995	--	55	--	--	--	--
	1996	--	--	--	--	--	--
LL—15.23	Prior to 1994	--	--	--	--	--	--
LL—16.20	Prior to 1994	--	--	--	--	--	--
	1994	--	--	--	--	--	--
	1995	--	--	--	--	--	--
	1996	--	--	--	--	--	--
LL—17.115	Prior to 1994	--	--	--	--	--	--
	1994	--	10	--	--	--	--
	1995	--	7	--	--	--	--
	1996	--	--	--	--	--	--
PCMP Wells[1]							
LL—01.15	Aug 1999	310	--	0.4	--	--	--
LL—18.22	Aug 1999	--	--	--	--	--	--
97--1.A	Aug 1999	--	--	--	--	--	--
97--1.B	Aug 1999	--	--	--	--	--	--
97--2.A	Aug 1999	--	--	--	--	--	--
97--2.B	Aug 1999	--	--	--	--	--	--
97--3.A	Aug 1999	660	--	--	--	--	--
97--4.A	Aug 1999	--	--	--	--	--	--
97--4.B	Aug 1999	320	--	0.2	--	--	--
97--5.A	Aug 1999	**1100**	--	295	--	--	--
97--5.B	Aug 1999	410	--	0.2	--	--	--
97--6.A	Aug 1999	**15000**	--	**11300**	--	--	--
97--6.B	Aug 1999	450	--	0.2	--	--	--
97--7.B	Aug 1999	--	--	--	--	--	--
97--8.A	Aug 1999	--	--	--	--	--	--
97--9.A	Aug 1999	350	--	1.7	--	--	--
97—10.A	Aug 1999	670	--	45.1	--	--	--
MTCA B[2]		1000	1600	320	0.13	0.13	0.729

Notes:
-- not detected
MTCA Method B exceedances are shown in bold.
1 PCMP Wells have been sampled quarterly since March 1998; only results from December 1998, which are considered representative, are shown.
2 In accordance with the Cleanup Action Plan, MTCA Method B (MTCA Method A for TPH) cleanup criteria are applicable for groundwater quality.

TABLE 1-5
GROUNDWATER ELEVATIONS ON AUGUST 30, 1999

WELL ID	NORTHING[1]	EASTING[1]	MP ELEV.[2] (FT)	DEPTH TO WATER[2] (FT)	WATER TABLE[3] ELEV. (FT MSL)	TIME OF MEASUREMENT
97-1.A	292150.8315	1018918.056	13.98	9.7	4.28	9:27
97-1.B	292154.9102	1018917.089	14.97	10.78	4.19	9:29
97-2.A	291953.978	1019048.945	14.42	10.06	4.36	9:25
97-2.B	291952.0735	1019055.011	14.24	9.96	4.28	9:23
97-3.A	291633.1211	1018963.562	17.36	12.84	4.52	9:11
97.4.A	291746.0127	1018690.205	15.5	10.97	4.53	9:06
97-4.B	291750.8815	1018688.102	16.36	11.94	4.42	9:04
97-5.A	291919.9106	1018625.959	15.93	11.44	4.49	9:08
97-5.B	291924.448	1018628.642	15.59	11.27	4.32	9:09
97-6.A	292074.508	1018738.74	13.06	8.66	4.4	9:17
97-6.B	292079.3105	1018740.424	12.97	8.72	4.25	9:15
LL 18.22	291736.28	1019056.22	12.22	7.87	4.35	9:21
97-7.B	291736.1302	1019056.506	13.87	9.48	4.39	9:19
97-8.A	291555.8046	1019071.599	15.58	10.98	4.6	9:16
LL 01.15	291381.21	1018980.33	13.79	9.26	4.53	9:14
97-9.A	291523.0044	1018820.598	14.24	9.64	4.6	9:09
97-10.A	291997.5279	1018692.204	12.57	8.15	4.42	9:11
av-01	292043.1000	1018777.810	17.53	13.14	4.39	9:42
av-02	291881.9200	1018793.360	22.47	18.09	4.38	9:38
av-03	291822.4000	1018772.660	21.65	17.29	4.36	9:12
av-04	291847.1900	1018703.300	19.46	14.93	4.53	9:27
av-05	291789.5900	1018729.830	18.75	14.41	4.34	9:17
av-07	291883.9300	1018753.010	21.24	16.87	4.37	9:36
av-08	291892.8400	1018698.220	18.31	13.94	4.37	9:34
99EA-1A	292673.3874	1018982.0303	13.43	9.28	4.4	9:24
99EA-2A	292779.9570	1018787.3927	13.71	9.85	4.3	9:24
99EA-3A	292357.0016	1018649.4197	14.79	10.62	4.43	9:19

Notes:
[1] Relative to State Planar Coordinate System
[2] MP elevation and depth to water expressed in feet below MP.
[3] Water table elevations in feet above MSL.
MP - Measuring Point
MSL - Mean Sea Level



MTCA Level C (or MTCA Level A for TPH) Exceedances for Offsite Soil Samples are Shown.

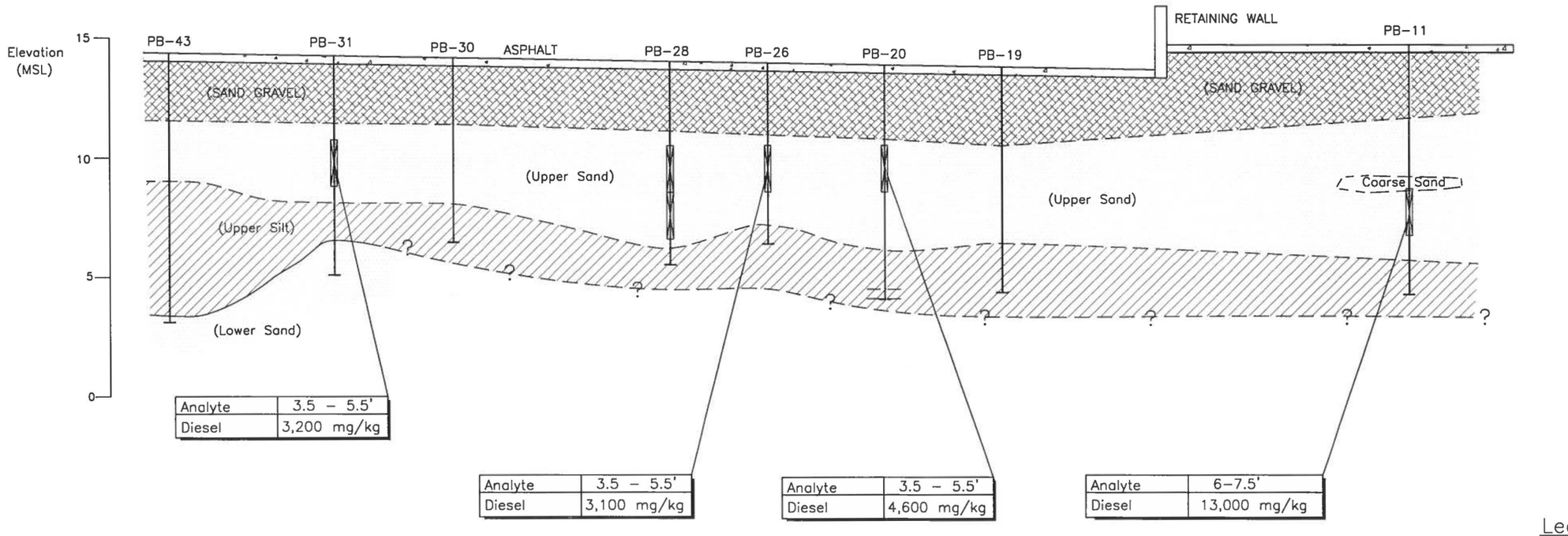
Q:\IP\2000\IP-205.dwg 1/6/00
Q:\IP\1998\IP-200.pcp

International Paper Longview, Washington	Project No. 91C0796B	Additional Perimeter Boring Investigation Geoprobe Locations	Figure 1-1
URS Greiner Woodward Clyde			

Looking East

A (North)

A' (South)



Analyte	3.5 – 5.5'
Diesel	3,200 mg/kg

Analyte	3.5 – 5.5'
Diesel	3,100 mg/kg

Analyte	3.5 – 5.5'
Diesel	4,600 mg/kg

Analyte	6–7.5'
Diesel	13,000 mg/kg

Legend

Soil Sample Interval

Exceedances of MTCA C criteria (or MTCA A for TPH) for offsite soils are shown

SCALE 0 5 FEET
Vertical Scale

SCALE 0 25 FEET
Horizontal Scale

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11x17-STD.pcp

International Paper Longview, WA	Project No. 5409900003.10
URS Greiner Woodward Clyde	

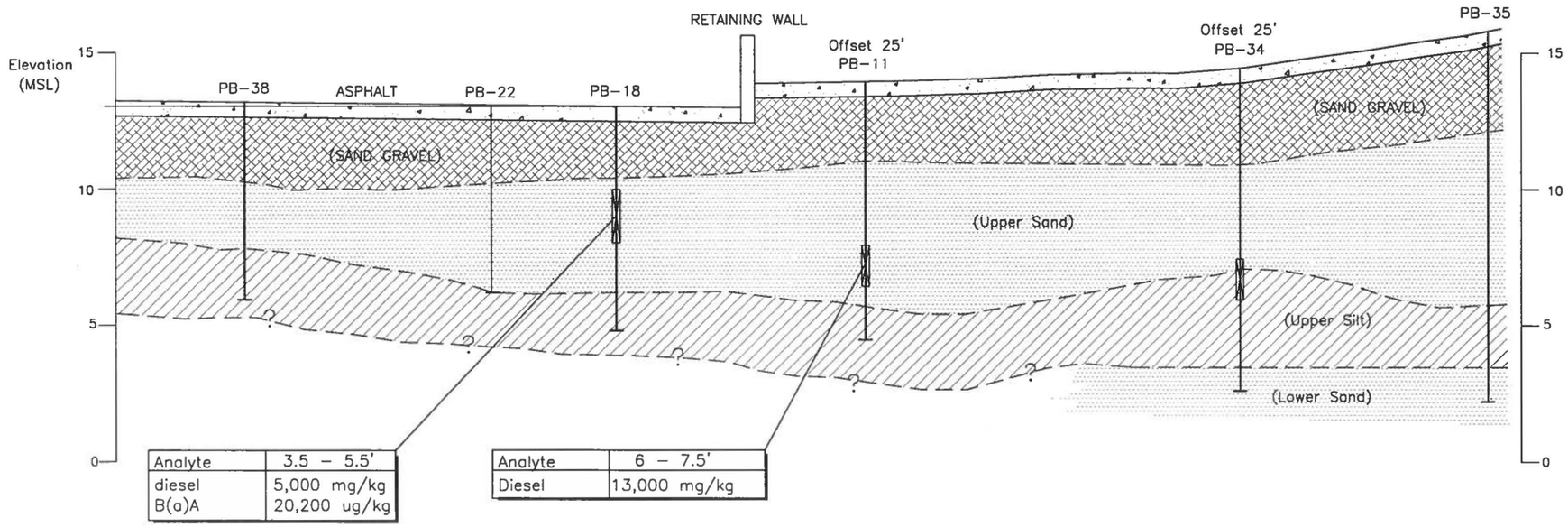
Additional Perimeter Boring Investigation
Cross Section A–A'

Figure 1–2

B
(Northeast)

Looking Southeast

B'
(Southwest)



Analyte	3.5 – 5.5'
diesel	5,000 mg/kg
B(a)A	20,200 ug/kg

Analyte	6 – 7.5'
Diesel	13,000 mg/kg

Legend

Sample Interval

Abbreviations

B(a)A benzo(a)anthracene

Exceedances of MTCA C criteria
(or MTCA A for TPH) for offsite soils are shown

SCALE 0 5 FEET
Vertical Scale

SCALE 0 25 FEET
Horizontal Scale

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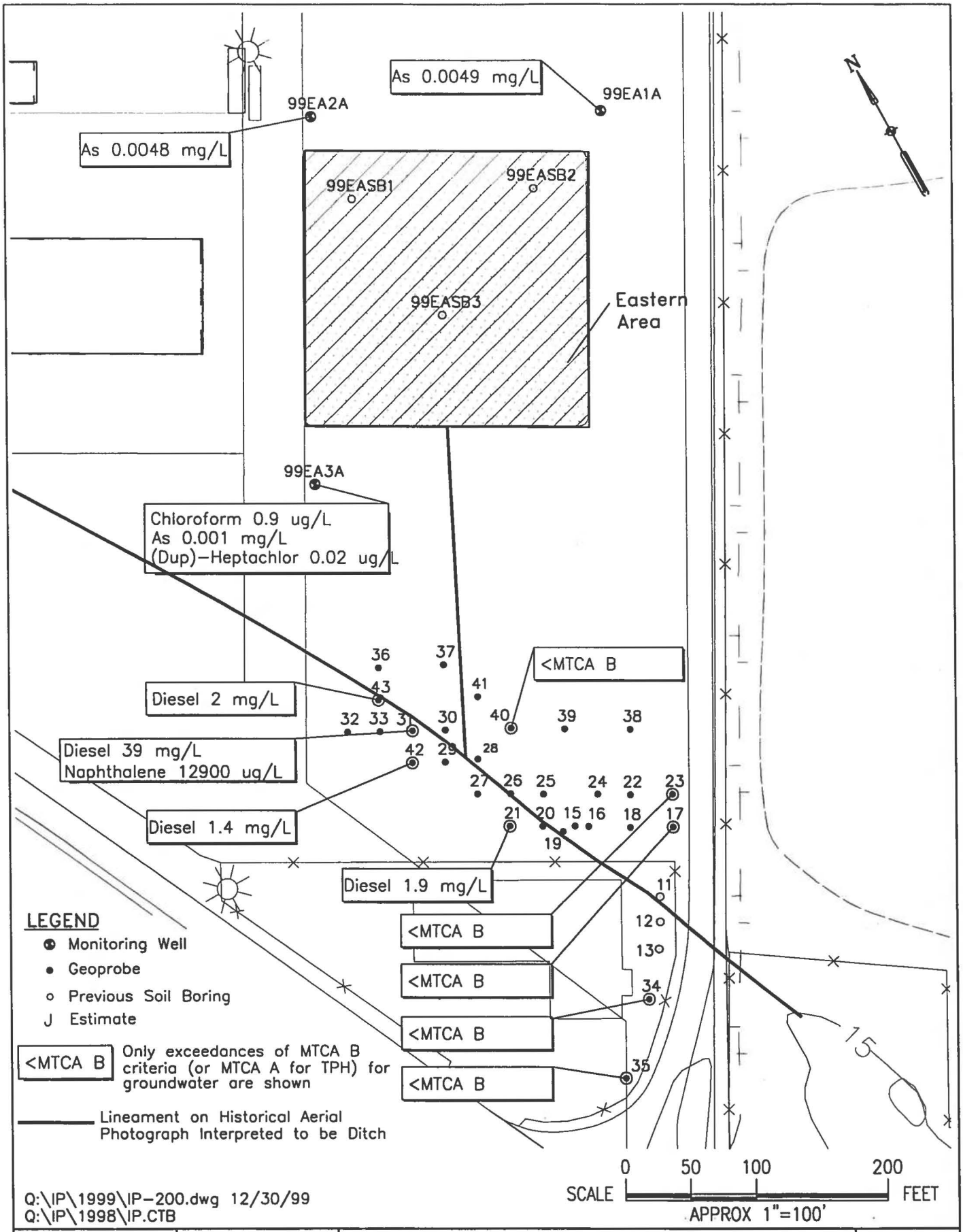
11x17–STD.pcp

International Paper Longview, WA	Project No. 5409900003.10
URS Greiner Woodward Clyde	

Additional Perimeter Boring Investigation
Cross Section B–B'
Showing Soil Sample Results

Figure 1–3



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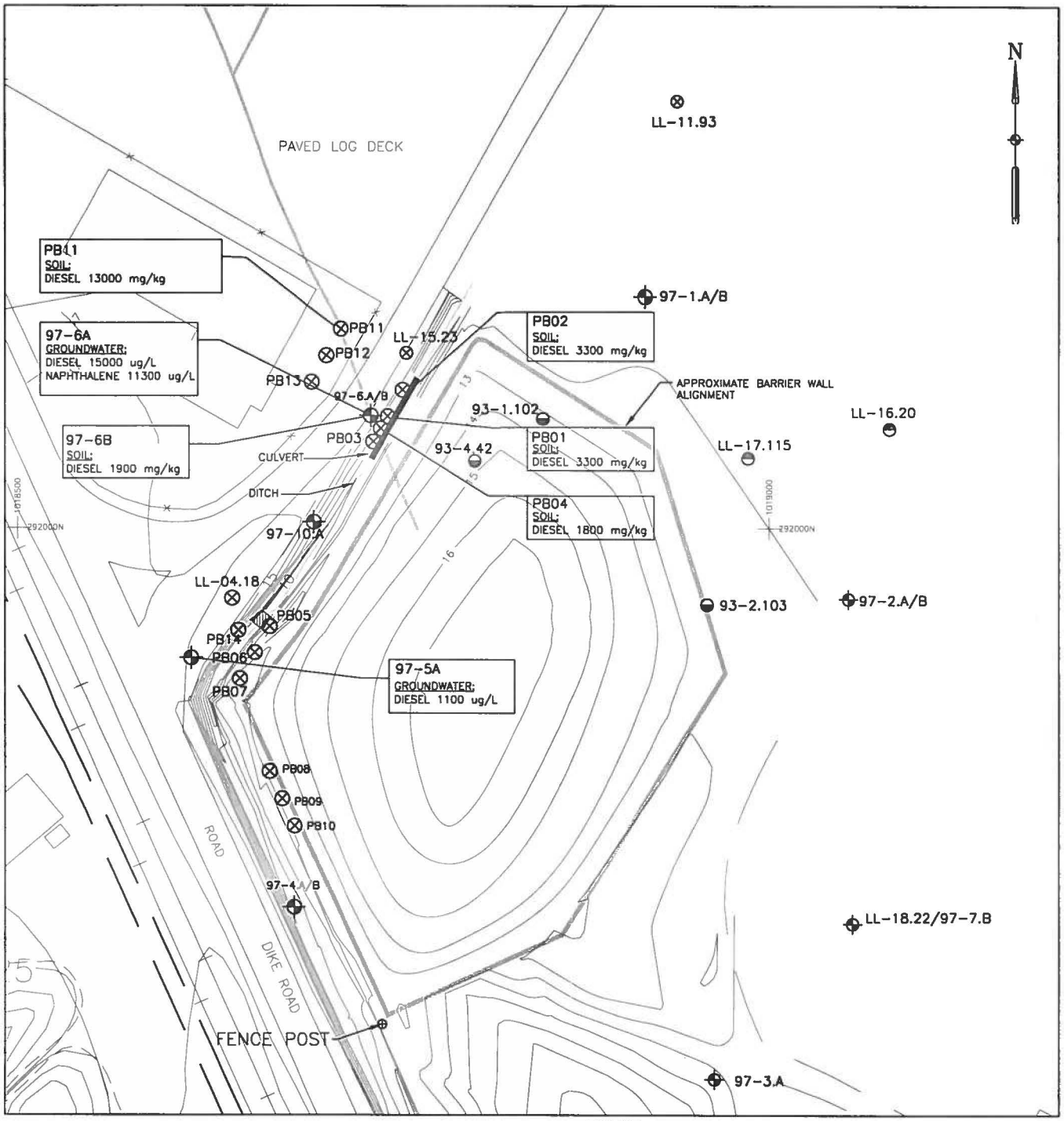
International Paper Longview, Washington	Project No. 91C0796B	Additional Perimeter Boring Investigation Groundwater Analytical Results	Figure 1–4
URS Greiner Woodward Clyde			



LEGEND

- PCMP Wells With August 1999 Groundwater Analytical Results Shown.
- Previous Borehole Locations With Analytical Results From July 1998 Investigation Shown.
- 1995 Boring and Monitoring Well Locations
- 1993 Boring and Monitoring Well Locations
- Lineament on historical aerial photo interpreted to be ditch

NOTES

1. MTCA Level C Exceedances For Soil Samples Are Shown.
2. MTCA Level B Exceedances For Groundwater Samples Are Shown.

SCALE 0 50 100 200 FEET
APPROX 1"=100'

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International Paper Longview, Washington	Project No. 91C0796B	Historical Soil and Groundwater Results	Figure 1-5
URS Greiner Woodward Clyde			

The results of the July 1999 investigation of the area north and west of the TWP area served to characterize the extent of soil and groundwater impacted by TWP constituents outside of the TWP area, with the exception of:

- the extent of PAH and TPH compounds under the Port of Longview Maintenance Building and in one area north of the Maintenance Building
- the extent of pentachlorophenol at one location along the eastern side of the Port of Longview Maintenance Building
- delineation of TPH as diesel in groundwater.

As stated in Section 1.0, the objectives of the Work Plan are to complete the site characterization work and to evaluate the potential feasibility of using ORC for mitigation of chemicals in groundwater. The approach to achieving the project objectives includes drilling exploratory geoprobes, and collecting and analyzing soil and groundwater samples in the vicinity the Port of Longview Maintenance Facility. These sampling locations were selected to refine the delineation of areas where constituents were detected at concentrations exceeding applicable criteria in soil and groundwater during the previous investigation, as discussed in Section 1.3. Locations selected for additional investigation (Figure 2-1) represent areas that are logical extensions of the previous investigations in nearby areas.

In particular, constituents, including pentachlorophenol, were found at concentrations exceeding MTCA Method B criteria at one location (PB34) and at one specific depth interval (7 to 9 feet bgs) along the eastern side of the Port of Longview Maintenance Facility. A series of four geoprobe locations will be placed 10 feet radially outward from PB34. Additional contingency borings are also shown in Figure 2-1, and include three borings that progressively "step" to the west, around the footprint of the building.

Three additional borings are proposed to refine the delineation of groundwater containing concentrations of TPH as diesel at concentrations exceeding applicable criteria. Proposed locations for these borings are approximately 25 feet west of PB21, PB42, and PB43 respectively, as shown in Figure 2-1.

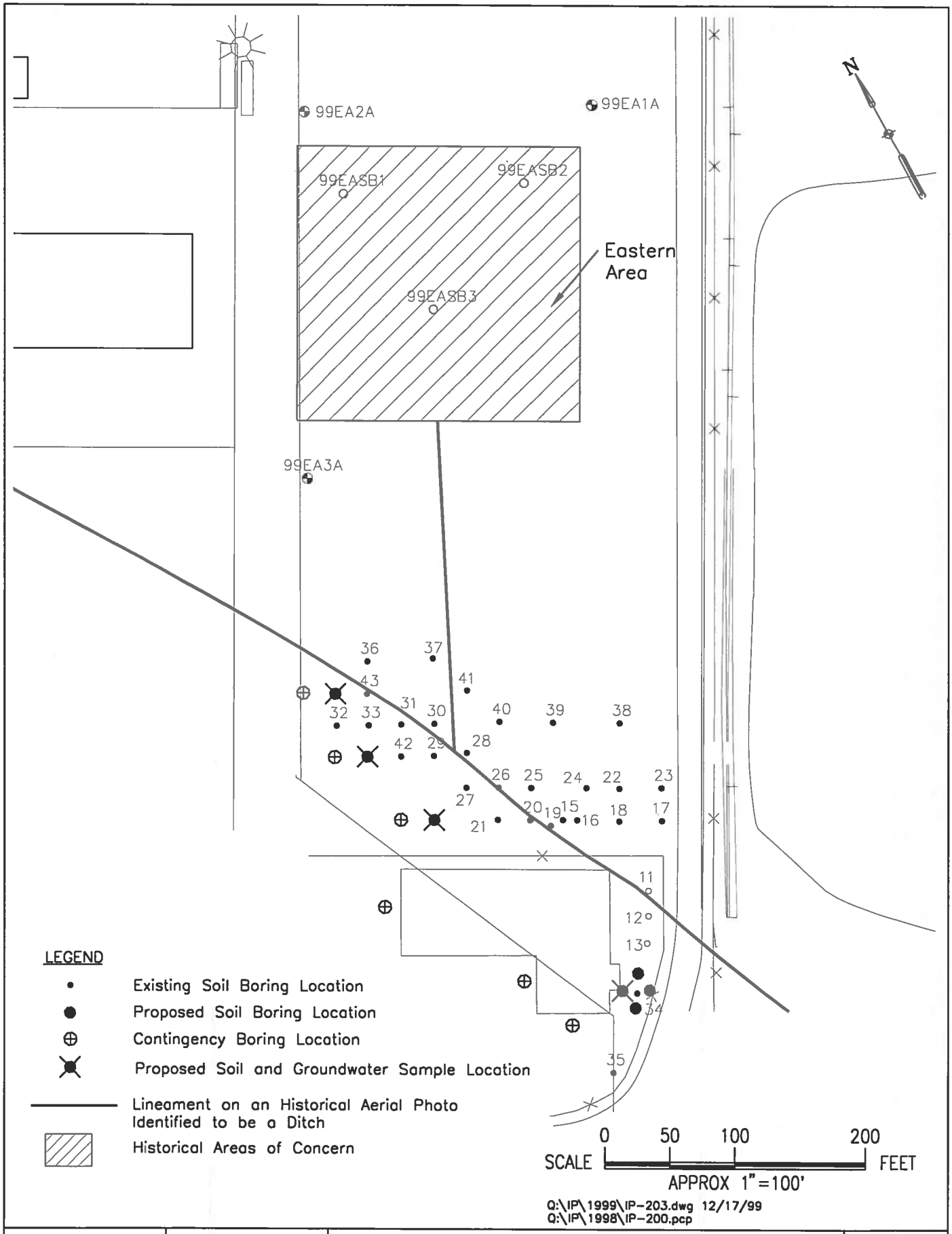
Depending on the results obtained in the field, additional locations may be "stepped out" further to the north and west with the geoprobe rig. Decisions regarding sampling locations, depths, and methods will be made in the field in conjunction with Ecology and Port of Longview personnel.

It is anticipated that any soil with elevated constituent concentrations will occur primarily above the Upper Silt layer. Therefore, at a minimum, the geoprobes will be advanced to the top of the Upper Silt layer at each location. If the Upper Silt is not present, the geoprobes will be advanced to the water table. If field measurements or observations indicate the presence of obvious chemical impact in any interval above the Upper Silt, the drilling will be discontinued to avoid carry-down. Groundwater sampling will then be performed at an adjacent location.

Soil samples will be collected for field screening and laboratory analysis at each location. The soil samples will be collected from depth intervals judged most likely to have elevated constituent concentrations, including the vadose zone-water table interface and the Upper Sand-Upper Silt interface. Field measurements will include visual observation, screening for volatiles with a flame ionization detector (FID), and TPH analysis using a Hanby test kit. Worst-case soil samples (i.e., samples characterized by the presence of a sheen or free product, or yielding the

highest FID or Hanby test kit readings) will be selected for laboratory analysis. Collecting soil samples from intervals where constituents are likely to have accumulated, in presumed worst-case locations, maximizes the chances that potentially impacted areas will be detected in the field.

Care will be taken to avoid disturbing potential confining layers, primarily the Upper Silt, that may serve as a barrier to contaminant migration. Groundwater samples will be collected using a peristaltic pump. The pump tubing will be lowered through the geoprobe pipes into the water. The soil and groundwater samples will be submitted to the laboratory for analysis of constituents of concern at the former TWP area, including TPH, pentachlorophenol, and PAHs.



International Paper Longview, Washington	Project No. 91C0796B	Additional Perimeter Boring Investigation Proposed Geoprobe Sample Locations	Figure 2-1
URS Greiner Woodward Clyde			

The Quality Assurance Project Plan (QAPP) prepared for the PCMP (Woodward-Clyde 1997) gives a detailed description of the project data quality objectives (DQOs) that will be followed for this Work Plan. Completion of the work will follow the standard operating procedures (SOPs) included in the project SOP binder (PTI 1996).

The geoprobes will be drilled and sampled according to SOP 44, using a modified geoprobe rig. They will be advanced to the depth of the top of the Upper Silt (estimated to be 8 to 10 feet bgs), or into the water table if the Upper Silt is not present.

Selected geoprobes will be advanced through the Upper Silt to collect groundwater samples from Aquifer A (i.e., the Lower Sand unit). These will be placed in areas where there is no evidence of impact above the Upper Silt as determined by the field test kits and visual observations.

It is anticipated that a minimum of seven geoprobes will be required to delineate the horizontal extent of potentially affected soil and groundwater. Depending on results obtained from these geoprobes, additional contingency borings may be drilled and sampled. Proposed locations for the geoprobes are shown in Figure 2-1. Prior to the advancement of the probes, an underground utility contractor will locate any subsurface utilities.

3.1 GEOPROBE SOIL SAMPLING

Soil samples will be collected from each geoprobe boring to obtain detailed information on the soil stratigraphy and constituent concentrations in soil. Soil samples will be obtained using standard penetration test procedures. Samples will be collected continuously (i.e., at 2-foot intervals) from each of the geoprobes. An effort will be made to collect samples from the interval intersecting the top of the Upper Silt and the water table.

The geoprobes will be logged by a qualified URS Greiner Woodward Clyde geologist or engineer. A qualified staff technician will assist and perform field screening. Soil descriptions, soil conditions, the presence or absence of odors, and any other evidence of contamination will be recorded in the field log, according to SOPs 48 and 49.

Soil samples will be collected for headspace analysis, field screening, and off-site laboratory analysis. Approximately five soil samples will be collected from each of the borings. Each of the samples will be screened for headspace analysis. A small amount of soil will be placed into a plastic ziplock bag and allowed to volatilize in a warm area for approximately 15 minutes. The headspace in the bag will be screened with a portable FID to measure the concentration of total organic vapors. Headspace readings will be recorded in the field logbook. Soil used for headspace analysis will subsequently be used for testing with the Hanby TPH test kit but not included with any laboratory samples.

Up to five soil samples from each boring will be retained for field TPH analyses using a portable Hanby TPH test kit. In general, two samples from each boring, based upon visual observation, FID headspace analysis, and field screening data, will be submitted to the laboratory for analysis. Additional samples may be collected and submitted for laboratory analysis if visual observation and field screening measurements suggest that constituent concentrations may significantly exceed those noted in other samples from that borehole.

The soil samples will be submitted for analysis of chemicals of concern from the former TWP area, including TPH, pentachlorophenol, and PAHs. If sufficient sample material is not collected

for these analyses, additional boreholes will be driven within 5 feet of the original borehole location to collect additional sample material.

The soil samples collected for laboratory analysis will be homogenized in the field by mixing with a stainless-steel spatula and bowl. Any sample intervals characterized by screening evidence of field contamination, or containing changes in lithology, will be homogenized separately for laboratory analysis; otherwise, the full soil interval will be used for homogenizing.

Table 3-1 lists the laboratory methods to be used as well as sample containers, preservation methods, and holding times. All sampling, field testing, and laboratory testing will be performed in accordance with the applicable SOPs indicated in Table 3-2.

The location and ground surface elevation of each boring will be surveyed by a registered land surveyor following completion of the field program. The vertical datum for the survey will be National Geodetic Vertical Datum (NGVD). The datum for the planar coordinates will be the State Planar Coordinate System.

Drums will be utilized to contain cuttings generated during the drilling investigation. The drummed soil cuttings will be transported to the former TWP area, stored under cover, labeled, and designated for proper off-site disposal. All probe locations will be backfilled according to the requirements of Washington Administrative Code (WAC) 173-160-560 for abandonment of resource protection wells, and the sites restored as closely as practicable to their previous condition. The geoprobe operator will file a notice of intent with Ecology's Southwest Regional Office in accordance with WAC 173-160-420(9) and pay any fees prior to fieldwork.

3.2 GEOPROBE GROUNDWATER SAMPLING

If feasible, groundwater samples will be collected from selected geoprobe locations using a peristaltic pump or a bailer. Locations are shown in Figure 2-1. If sufficient water cannot be obtained within 1 hour, the groundwater sampling at that location will be discontinued. The intended groundwater sampling locations include the three locations from the geoprobe transect north of the Port Maintenance Facility, and one of the geoprobe locations located to the east of the Maintenance Facility. Decisions will be made in concert with Ecology and the Port of Longview in the field regarding potential locations for the groundwater samples.

The groundwater samples will be collected from the saturated zone beneath the Upper Silt (i.e., Aquifer A), where feasible. Table 3-1 lists the laboratory methods to be used as well as sample containers, preservation methods, and holding times. All sampling, field testing, and laboratory testing will be performed in accordance with the applicable SOPs indicated in Table 3-2. All water generated will be contained in labeled drums and stored under cover on the former TWP area until proper off-site disposal is arranged. Each groundwater sample will be submitted to the laboratory for analysis of TPH, pentachlorophenol, and PAHs.

Table 3-1
SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES

PARAMETER	METHOD NUMBER	CONTAINER	PRESERVATION METHODS	HOLDING TIME
SOIL				
PAHs (low level)	EPA 8270 SIM	8-oz. WM jar	cool to 4° C	14 days (extraction)
pentachlorophenol	EPA 8270 SIM	use PAH jar	cool to 4° C	14 days (extraction)
diesel range hydrocarbons	NWTPH-Dx	use PAH jar	cool to 4° C	14 days (extraction)
WATER				
PAHs (low level)	EPA 8270 SIM	1 – 1 L amber glass	cool to 4° C	7 days (extraction)
pentachlorophenol	EPA 8270 SIM	use PAH jar	cool to 4° C	14 days (extraction)
diesel range hydrocarbons	NWTPH-Dx	1 – 1 L amber glass	cool to 4° C	7 days (extraction)

Notes:
EPA: Environmental Protection Agency
PAH: polynuclear aromatic hydrocarbon
WM: wide mouth

Table 3-2
PROJECT STANDARD OPERATING PROCEDURES

SOP	TITLE
2	Sample Packaging and Shipping
3	Equipment Decontamination for Soil and Water Sampling
4	Field Documentation
5	Sample Custody
6A	Preparation of Field Quality Control Samples - Water
6B	Preparation of Field Quality Control Samples - Sediment
44	Installation and Sampling of Probe Holes with Geoprobe System
48	Logging of Soil Boreholes
49	Field Classification of Soil

Source: PTI (1996)

A pilot test will be performed to evaluate the feasibility and effectiveness of remediating impacted groundwater through the use of oxygen release compounds (ORCs). Details of the pilot test will be established after reviewing the results from the geoprobe sampling, and described in a Work Plan letter report.

ORC is a proprietary formula of magnesium peroxide, or oxygenated magnesia, that was invented, and is distributed, by Regenesis, Inc. of San Clemente, California. Successful results have been achieved at many sites in accelerating *in situ* bioremediation of organic chemicals in groundwater and the saturated zone above the groundwater table. In general, the compound works by slowly releasing oxygen into groundwater, thus, increasing the rate of microbial degradation of contaminants. As groundwater flows past the compound, oxygen is released and the environment switches from an anaerobic to an aerobic state. With increased oxygen available, the bacterial and fungal populations that degrade petroleum compounds are greatly enhanced and contaminants are converted to non-toxic compounds.

After the contaminant concentrations are decreased or eliminated, the ORC byproduct remaining in soil and groundwater is a cement-like material with the chemical make up of ordinary milk of magnesia. A very small amount of free magnesium is left in an insoluble form and small amounts, if any, of residual free phosphates are left as monopotassium and dipotassium phosphate, better known as meat moisturizer and-baby food additive.

A phenomenon associated with ORC, referred to as biosurfactant desorption, typically occurs between two weeks and one month after application. With enhanced bacterial populations and activity, contaminants sorbed to soil particles in the saturated zone are stripped by the bacteria and are released into groundwater. Shortly thereafter, the contaminants are degraded and an overall decrease in total concentrations is observed. Although the temporary rise in groundwater concentrations is disconcerting, the desorption is a necessary component of the remediation process.

In general, it is anticipated that a 1 3/4-inch nominal diameter boring will be advanced in the vicinity of PCMP well 97-6A (Figure 1-5). Based on monitoring results from well 97-6A, groundwater in this vicinity has been impacted by TPH and PAHs. The boring will be advanced approximately 1 foot into the Lower Sand (Aquifer A). The ORC will be injected under pressure through the geoprobe drill stem into the saturated zone. After injection, the drill stem will be withdrawn and the boring sealed to the surface with cement-bentonite grout. The intent is that ORCs in the sealed boring will gradually dissolve and disperse into groundwater and facilitate degradation of dissolved chemicals.

Two separate 2-inch diameter PVC monitoring wells will be installed approximately 10 to 15 feet from the injection boring. One of the monitoring wells will be installed downgradient from the injection boring. The second monitoring well will be installed cross-gradient. Water quality parameters, including pH, temperature, dissolved oxygen, specific conductance, and eH, will be measured in each monitoring well in the field prior to injection of ORC in the nearby boring. Water samples will also be collected from each monitoring well once prior to ORC injection, and approximately every two weeks after injection. The groundwater samples will be analyzed in the laboratory for TPH and PAHs. It is anticipated that the groundwater sampling will be continued for a period of about 3 months.

The analytical results will be plotted with time to evaluate the effectiveness and kinetics of ORC in facilitating degradation of TPH and PAHs dissolved in groundwater. The effective radius of

the treatment will also be estimated. The results and data evaluation will be provided in a letter report, as described in Section 5.0.

A quality assurance/quality control (QA/QC) review of the laboratory analytical results from the investigation activities and the pilot test will be performed as part of the data evaluation.

The field and chemical data will initially be transmitted to Ecology as stand-alone data tables. The appropriate document for reporting results from the investigation will be discussed with Ecology after review of the data tables.

The final report will meet applicable MTCA requirements and will include a description of the field work conducted, boring logs, sample descriptions, summaries of all chemical and field observation data collected, the results of the QA/QC review of the analytical data, a discussion of the results of the investigations and pilot test, and a discussion of the necessity and feasibility of remediation.

The field investigations described in Section 3.0 are scheduled to begin before February 14, 2000. We anticipate that the investigation work will be completed within 2 working days. An estimated six weeks are required for receipt and validation of laboratory data. Therefore, it is anticipated that chemical data summary tables can be prepared and transmitted to Ecology by March 31, 2000.

As discussed in Section 5.0, depending on the results of the investigation, the data will initially be transmitted to Ecology as stand-alone data tables. The appropriate final document for reporting results from the investigation will be discussed with Ecology.

It is anticipated that fieldwork for the pilot test can be started in March-April 2000, after review of the data from the analytical program and preparation of a Work Plan letter report. The injection boring and monitoring wells can be installed in one day. Groundwater sampling will be performed over the following two months. A letter report containing the results from the pilot testing program and evaluating the feasibility of this method can be provided in June 2000.

PTI Environmental Services. 1996. *Standard Operating Procedures, Quality Assurance Project Plan, health and Safety Plan, International Paper Company facility, Longview, Washington.*

URS Greiner Woodward Clyde. 1999. *Additional Offsite Investigation Work Plan, International Paper Facility, Longview, Washington.*

_____. 1998. *Investigation of Areas of soil Impact Outside the Containment Area, International Paper Longview.*

Washington State Department of Ecology. 1996. Model Toxics Control Act Cleanup Levels and Risk Calculations (CLARCII). Update.

Woodward-Clyde. 1997. *Corrective Action Performance and Compliance Monitoring Plan. International Paper Facility, Longview, Washington.*

————. 1997. *Cleanup Action Plan, International Paper Facility, Longview, Washington.*

————. 1998. *Off Site Investigation Work Plan, International Paper Facility, Longview, Washington.*

Appendix C
Quality Assurance/Quality Control Review

The analytical results for nine water and thirty-one soil samples collected in July and August, 1999 were subject to a QA/QC review including the following:

- Chain of custody and holding times
- Blank review
- Surrogate review
- Matrix/blank spike review
- Duplicate review
- Reporting limits

Samples were collected by URS Greiner Woodward Clyde and analyzed by Oregon Analytical Laboratory of Beaverton, Oregon. Samples were submitted to the laboratory between July 19 and August 3, 1999. Samples were analyzed for the following: diesel range hydrocarbons by NWTPH-Dx, and low level polynuclear aromatic hydrocarbons (PAH's) by EPA method 8270 SIM.

SUMMARY

All analytical data are acceptable for project uses. The PAH and NWTPH-Dx data for two samples were qualified as estimated (J) due to missed holding times. The method blanks were free of contaminants. No data were qualified due to surrogate or spike percent recoveries. Laboratory duplicate results were comparable. The laboratory reporting limits are acceptable.

Chain of Custody and Holding Times

The chain of custody forms indicate that samples were maintained under chain of custody, the forms were signed during release and receipt, and that the samples were chilled and appropriately preserved. The laboratory report is complete. The holding times were met with two exceptions. Samples PB34-9-11 and PB34-11-13 were extracted for PAHs and NWTPH-Dx one day past the 14 day holding time. The non-compliant results were qualified as estimated (J).

Review of Blanks

The laboratory analyzed one batch method blank for each method. The method blanks did not have detectable levels of any analyte. No data were qualified due to these results.

Surrogate Recovery Review

Each sample was spiked with a surrogate (system monitoring compound) for applicable analyses. The surrogate percent recoveries were within the control limits with the following exceptions. The PAH surrogate percent recoveries for samples PB15-3-5, PB18-3-5, PB20-3.5-5.5, PB24-3.5-5.5, PB26-3.5-5.5, PB28-5.5-7.5, PB31-3.5-5.5, and PB31-GW were not recovered due to high analyte concentration. Associated quality control data were within the control limits; therefore no data were qualified. One of the two NWTPH-Dx surrogate percent recoveries for samples PB15-3-5, PB24-3.5-5.5, PB26-3.5-5.5, PB28-5.5-7.5, PB31-3.5-5.5, and PB31-GW were not recovered due to high analyte concentration. Associated quality control data were

within the control limits; therefore no data were qualified. One of the six PAH surrogate percent recoveries for sample PB34-7-9 was not recovered due to matrix interference. Associated quality control data were within the control limits; therefore no data were qualified.

Matrix Spike/Matrix Spike Duplicate Review

The laboratory analyzed a matrix spike/matrix spike duplicate or a blank spike/blank spike duplicate for all analyses. The percent recoveries and duplicate RPD's were within the control limits with the exceptions listed below.

- Soil NWTPH-Dx matrix spike for batches L12254 and L12282: the percent recoveries were not recovered due to high analyte concentration. No data were qualified.

Duplicate Review

No field duplicates were collected during this sampling round. Laboratory duplicates were performed for the following analyses: NWTPH-Dx. Duplicate results greater than five times the reporting limit, were within the control limits with the following exceptions. The L12254 laboratory duplicate RPD (44%) was above the control limits. Associated quality control data were within the control limits; therefore no data were qualified.

Reporting Limits

The reporting limits are summarized in the table below. Many of the samples required dilution due to high analyte concentration; however, reporting limits meet the project needs.

ANALYTE	WATER REPORTING LIMIT mg/l	SOIL REPORTING LIMIT mg/kg
diesel	0.25	25
oil	0.50	50 to 2500
PAH's	0.1 to 100 µg/L	10 to 200000µg/kg
pentachlorophenol	0.5 to 500 µg/L	100 to 2000000 µg/kg

Completeness

The laboratory reported all requested analyses and the laboratory report is complete. Based on the QA/QC review, some data were qualified as estimated (J). The following table summarizes the sample IDs and qualified results for all samples covered by this review:

SAMPLE ID	LABORATORY SAMPLE ID	ANALYTE	QUALIFIER
PB15-3-5	L12254-1	none	
PB15-5-7	L12254-2	none	
PB17-3-5	L12254-8	none	
PB17-5-7	L12254-9	none	
PB18-3-5	L12254-13	none	
PB20-3.5-5.5	L12254-19	none	
PB20-5.5-7.5	L12254-20	none	
PB21-3.5-5.5	L12254-22	none	
PB21-5.5-7.5	L12254-23	none	
PB17-GW	L12254-12	none	
PB21-GW	L12254-26	none	
PB23-5.5-7.5	L12282-4	none	
PB24-3.5-5.5	L12282-8	none	
PB26-3.5-5.5	L12282-12	none	
PB27-3.5-5.5	L12282-15	none	
PB27-5.5-7.5	L12282-16	none	
PB23-GW	L12282-7	none	
PB28-3.5-5.5	L12297-1	none	
PB28-5.5-7.5	L12297-2	none	
PB29-5.5-7.5	L12297-5	none	
PB31-3.5-5.5	L12297-8	none	
PB33-3.5-5.5	L12297-13	none	
PB34-5-7	L12297-16	none	
PB34-7-9	L12297-17	none	
PB34-9-11	L12297-18	PAHs	J or UJ
		NWTPH-Dx	J or UJ
PB34-11-13	L12297-19	PAHs	J or UJ
		NWTPH-Dx	J or UJ

SAMPLE ID	LABORATORY SAMPLE ID	ANALYTE	QUALIFIER
PB34-GW	L12297-20	none	
PB31-GW	L12297-21	none	
PB35-7-9	L12475-2	none	
PB35-9-11	L12475-3	none	
PB37-5.5-7.5	L12475-11	none	
PB39-3.5-5.5	L12475-14	none	
PB40-5.5-7.5	L12475-17	none	
PB41-5.5-7.5	L12475-21	none	
PB42-3.5-5.5	L12475-22	none	
PB43-3.5-5.5	L12475-26	none	
PB35-GW	L12475-6	none	
PB40-GW	L12475-19	none	
PB42-GW	L12475-25	none	
PB43-GW	L12475-29	none	