HARTCROWSER

Earth and Environmental Technologies

Final Report
Environmental Assessment and Site Characterization Work Plan
Weyerhaeuser Old Machine Shop
Everett Mill E Site
Everett, Washington

Prepared for
Weyerhaeuser Forest Products Company

J-2395-02
May 16, 1989

1910 Fairview Avenue East Seattle, Washington 98102-3699 206.324.9530

CONTENTS

ENVIRONMENTAL ASSESSMENT AND SITE CHARACTERIZATION WORK PLAN WEYERHAEUSER OLD MACHINE SHOP EVERETT MILL E SITE EVERETT, WASHINGTON

I. INTRODUCTION

This report presents the results of our preliminary environmental assessment at the Old Machine Shop on the Everett Mill E site (Figure 1). The purpose of the work was to collect data to assess the existing conditions and develop a plan to more fully characterize the site.

Creosote-contaminated soil was discovered during the removal of four underground petroleum product and waste oil tanks at the old machine shop which was formerly used as a wood treating facility. Weyerhaeuser Company notified the National Response Center and Washington State Department of Ecology (Ecology). Completion of the preliminary environmental assessment and development of a site characterization work plan is in response to this notification.

Our work scope was based upon conversations with Weyerhaeuser Company (John Gross and J.E. "Mick" McCourt; Request for Proposal Environmental Assessment and Investigation Work Plan, Old Machine Shop Everett Mill E and our experience near the Everett Mill E Site).

We completed the following work to make our assessment and develop a site characterization work plan:

- Performed site historical characterization including a file review of the Northwest Regional Office of Ecology and Snohomish County Health Department;
- Performed a site reconnaissance;
- Excavated 15 shallow test pits;
- Collected subsurface soil samples from the test pits and submitted selected samples for laboratory analysis; and
- Analyzed the data and prepared this report.

This work began with an environmental audit of the old machine shop area including the log storage yard, southeast of the old machine shop. The audit revealed potential for environmental concern at the old machine shop and at the log storage yard. Discharges to the soil of Wolman salts, creosote, and petroleum hydrocarbons were suspected at the old machine shop and discharges to the soil of Wolman salts and creosote were suspected at the log storage yard. As a result, preliminary verification and characterization sampling and analyses were performed in these areas.

The additional sampling outlined in the work plan (Section IV) is to obtain additional characterization information to provide a basis to assess site risks and subsequent remediation. This assessment and work plan is organized as follows:

I Introduction
II Summary of Findings
III Site History
IV Existing Conditions
V Model of Site Conditions
VI Site Characterization Work Plan

Two of the attachments that accompany this work plan are guidelines for work specified in the plan.

These attachments are the Field Methods for the Geology and Groundwater Assessments (Attachment A) and Quality Assurance Plan (Attachment B). Attachments C, D, and E are Site Reconnaissance Photographs, Field Exploration Procedures and Results, and Analytical Laboratory Certificates, respectively. A draft health and safety plan has also been prepared and is being reviewed. This plan will easily be incorporated to the overall work plan.

II. SUMMARY OF FINDINGS

- Historic information and site data confirm the presence in soil of wood treating chemicals.

- The area where these chemicals are present is more extensive than indicated by the previous data. Data and analyses completed during this work indicate that the primary area where wood treating chemicals are present is about 2.5 to 3.5 acres in size and lies between the old machine shop and the Snohomish River.

- o Laboratory analyses of soil samples indicate the presence of compounds typical of creosote (PAHs) and pentachlorophenol. The data also indicate the presence in soil of arsenic in concentrations above typical background. This indicates the use of arsenic-based wood preservatives such as Chromated Copper Arsenate (CCA).

- o In addition, smaller areas within the primary area of wood treatment chemical contamination show some petroleum hydrocarbon and PCB contamination.

- o A recent PCB spill occurred during this assessment north of old machine shop (former wood treating facility). Cleanup efforts are currently ongoing.

III. SITE HISTORY

The history of the former wood treatment plant at Weyerhaeuser's Everett Mill E was researched in order to identify potential sources of contamination. Land use activities surrounding the site were also reviewed in order to identify potential impacts on the former wood treatment plant site. We reviewed the following documents: historic fire insurance maps (Sanborn Map Company, 1892, 1893, 1902, 1914, and 1951); topographic maps (U.S. Geological Survey, 1941, 1956, 1968, and 1973); Snohomish County atlases (Anderson Map Company, 1910, and Metsker Map Company, 1927 and 1960); and aerial photographs (U.S. Army Corps of Engineers, 1943; H.G. Chickering, 1961; Pacific Aerial Surveys, 1965; and Washington Department of Natural Resources, 1970). In addition, we reviewed records at the Weyerhaeuser Corporate Archives which consisted of aerial photographs; newspaper and periodical articles; maps; correspondence; and reports. We also interviewed long time Weyerhaeuser employee, Mr. Al Carnes and past Mill E employees, Mr. Ralph Vennes and Mr. Myron Olson.

Historic Site Use

Everett was founded in the late 1800s and immediately became a major center of the forest products industry. The Weyerhaeuser Company established a presence there in 1902 when it purchased the Bell-Nelson Mill on Port Gardner Bay. The site was an undeveloped lowlands of the Snohomish River.

Between 1914 to 1915 Weyerhaeuser constructed Mill B. Due to the swampy nature of the site, sands from the Snohomish River were used as fill material in the site area. The site itself was probably used as a lumber storage yard from 1914 until the wood treatment plant was constructed in 1947. This is evidenced, in part, by 1937 and 1943 aerial photographs which show considerable stacked lumber on and adjacent to the site. This activity was on the extreme south end of the Mill B area.

In November 1936, the American Lumber and Treating Company (AL&TC) proposed to Weyerhaeuser the building of a wood treatment plant containing Wolmanizing and creosoting operations. Shortly thereafter, Weyerhaeuser prepared a cost study, Installation of a Wolmanizing plant at Mill B in Everett. The study was based on AL&TC installing an 8-foot by 100-foot enclosed retort; operating machinery; storage of raw materials including tanks for solution; and railroad siding for bringing in raw materials. Despite this study and the proposal from AL&TC, the plant was not constructed until the late 1940s.

On March 2, 1946, AL&TC entered into agreement with the Weyerhaeuser Company to lease 6.6 acres of land on the southern end of Mill B for 7-1/2 years. AL&TC built a wood treatment plant containing two treatment cylinders, one using Wolman salts and Minalith fire retardant, and the other using creosote and creosote-petroleum mixtures. Weyerhaeuser provided steam and electricity for the plant from their Mill B. Treated wood was dried at Weyerhaeuser's Mill B kilns.

On November 29, 1946, the Civilian Production Administration gave its permission for construction of the treatment plant to begin, and in March 1947, pilings were first driven in as footings for the new $60,000 plant.

Construction of the plant was contracted to the Nelsen Mortensen & Company of Seattle. In late 1947 and early 1948, the treatment cylinders were installed. They were built by the Chicago Bridge & Iron Company. In addition, six tanks were installed to store treatment solutions (creosote, Wolman salts, etc.). A variety of oil and air recovery and blow-off vessels were also installed.

In July 1948, the treatment plant was completed. As reported in the July 1948 issue of the Weyerhaeuser newspaper The Bee and Cee, a typical treatment operation went like this: over one thousand pieces of 2 by 6 lumber were shoved into the cylinder on a narrow gauge railroad track (a Whitcomb gasoline locomotive with five speeds forward and reverse was used). A continuous vacuum was created in the cylinders, during which a Wolman salts solution was admitted. When the cylinder was full of the solution, its pressure was raised to 150 psi, driving the solution into the lumber. When the solution penetrated the wood, excess solution was drawn off. The lumber was run through dry kilns and was ready for sale. A similar process was used to creosote lumber and apply fire retardant. Like all pressure-based wood treatment systems, the AL&TC plant required an extensive piping system. Lines were installed for developing vacuum in the retorts; to carry steam; to carry treating and fire retardant solutions; and to carry compressed air.

AL&TC operated the wood treatment plant from 1948 until the early 1950s when AL&TC was acquired by Koppers Company. Koppers Company operated the treatment plant until 1963. The treatment plant was converted into a truck maintenance shop. Apparently, when the wood treatment plant was converted into a truck maintenance shop, a pit between the two retorts, which contained piping, was backfilled and a concrete slab was poured. At about the same time an addition was made to the west side of the building and the six chemical storage tanks were removed. Primarily, rolling stock equipment was maintained in the shop. It is reported that oil changes were conducted off the east side of the building, but no documents were found to confirm this.

Historic Use of Adjacent Property

When constructed between 1947 and 1948 the wood treatment plant was located on the southern end of Weyerhaeuser's Mill B, as shown on the 1951 Sanborn map. Major facilities at Mill B included saw, planing, and resaw mills; numerous lumber sheds; and several dry kilns. Previous to Mill B's construction in 1914, the surrounding area was Snohomish River lowlands. As evidenced in aerial photographs, and confirmed by Mr. Al Carnes, the surrounding area was used as a log sort and storage yard until 1971, when Mill E was constructed (Mill B was dismantled in about 1979). The new mill was designed to process small log material (4 to 16 inches in diameter) and construction lumber.

Potential for Contamination

Based on past uses of the site there is a potential for soil and groundwater contamination. The two potential sources of contamination at this site are: the wood treating operation which ran from 1947 until 1963; and the machine shop activities that occurred from 1963 until 1984. Contaminants associated with the wood treating operation are Wolman salts, Milithan fire retardant, creosote, and creosote-petroleum solutions. Aerial photographs from 1965 and 1970 show a large surface area pool to the southeast corner of the former treatment plant. That pooling may have resulted from treatment "blow-off" and may contain residues of the treatment solutions. In addition, petroleum products such as greases and fuel may have leaked or dripped from the locomotive and its flat-cars onto the area leading into the retorts. Contaminants associated with machine shop activities might include cutting and lubricating oils, solvents, metal sweepings, and machine greases. Also, there may be underground storage tanks associated with this operation.

Based on past uses of adjacent property, the potential for migratory contamination appears minimal. The primary source would be underground storage tanks located at Mill B and Mill E operations. As shown on a current facility map of Mill E, there were several large underground storage tanks near the facility.

AGENCY FILE REVIEW

Washington State Department of Ecology

Mary Kautz of Ecology's Northwest Regional Office in Redmond, was contacted for any information the office has relating to the former machine shop. She says they have no specific information relating to the site.

In addition, we contacted Ecology's Underground Storage Tank Office to inquire as to the existence of underground storage tanks on or near the site. Their database lists no tanks for the site or surrounding area.

Snohomish County Health Department

Jeff Defenbach was contacted for any information the county might have in its files relating to the site. There is no pertinent information to their files.

IV. EXISTING CONDITIONS

Our preliminary environmental assessment of the old machine shop (former wood treating facilities) Everett Mill E site indicated areas of soil contamination. The area where contaminants were initially discovered in October 1988 (see Table 1) and the location of a recent PCB spill are shown on Figure 2. The most likely contaminants are creosote, polychlorinated biphenyl, petroleum hydrocarbons, Wolman salts, and possibly pentachlorophenol. These chemicals are the primary contaminants based on chemical analyses of four test pit soil samples, field observations, field screening results, and previous activities at the site.

Figure 3 depicts identified areas of potential contamination:

- A primary area of concern is what appears to be the contamination east of the machine shop. This contamination extends toward the river.

- Another area of concern is what appears to be gasoline contamination. This contamination extends west of the southeast machine shop corner approximately 40 feet.

- o PCB sites were noted on the north end of the old machine shop.

- o Possible pentachlorophenol contamination may exist at two localized areas on the west and east side of the machine shop. Pentachlorophenol was detected in soil samples to the east of the old machine shop.

In addition, a pentachlorophenol dip tank was located near the Snohomish River bank based on conversations with Al Carnes. The specific area where the dip tank was located is vague.

Photograph documentation was made of areas of concern. Photograph locations are indexed on Figure C-1 and a copy of the photographs with captions are included in Attachment C.

Hydrogeology

Our preliminary assessment of the site hydrogeology is based upon data from 15 test pit explorations (Figure 3) and information from the site history.

We understand that dredge sands of the Snohomish River were emplaced over natural wetlands to form a working surface for property development. Subsequently, fill material of gravel, sand, and bark was compacted on top of the dredge sands.

Under these conditions we anticipate a shallow perched groundwater zone to occupy the soils above the natural wetlands soils. The wetlands soils are likely low permeability, organic-rich silts and very fine sands. These materials will likely form an aquitard separating the shallow perched groundwater zone from aquifers below.

We have found that the hydrogeology in the area of our test pits is similar to the system we anticipated. However, because our test pits were shallow, averaging total depths of 5 feet, we were unable to verify the permeability and continuity of the native wetlands soils below the property. Characterization of this soil layer will be accomplished for site characterization.

Soil Stratigraphy

The soil stratigraphy described in 15 test pit explorations, to depths from 4 to 6 feet, indicates the soils to be similar in texture across the property. Discoloring of the soils is common, especially within three feet of the ground surface. This discoloring may have resulted from natural processes, such as groundwater elevation fluctuations, and/or staining from released wastes which have migrated in the soil.

We have identified three principal soil strata that occur across the property based on the test pit data. These strata are the following:

- Grade fill material, occurring between the ground surface and depths of 1 to 3 feet. These soils consist of gravelly sand, crushed rock, and bark;

- Dredge sand, occurring below the grade fill material and continuing to depths of 4 to greater than 6 feet. These soils consist of slightly silty, fine to coarse SAND. Groundwater occurs in these soils generally below a depth of 3 to 4 feet; and

- Native silt, occurring below the dredge sand at depths of 4 to 5 feet and continuing to at least 6 feet. These soils consist of light green, sandy SILT.

We encountered the native silt in only three test pits, TP-6, TP-10, and TP-11 (Figure 3. The other units, grade fill material and dredge sand, were continuous across the property, within the area of our test pit excavations.

Groundwater Occurrence

Groundwater is first encountered within the dredge sand at depths of 2 to 5 feet below ground surface. The mean flow direction, assuming no influence from nearby pumping wells, is anticipated to be toward the Snohomish River. We expect the flow to be tidally influenced for a few hundred yards away from the river.

The dredge sand permeability likely ranges from 10^{-2} to 10^{-4} cm/sec, based on our experience working in similar materials. The saturated thickness is presently unknown, but based on the site history, we expect it to be about 6 to 10 feet.

The dredge sand perched groundwater zone appears to overlie the lower permeability, native silt unit. We expect these low permeability sediments to underlie the entire property. Flow in these soils is likely relatively slow and may be vertically upward.

Test Pit Observations

Fifteen test pits were excavated. Our sampling and test pit exploration procedures are outlined in Attachment D. The site was muddy. Some areas were not accessible with the backhoe due to surface water ponding. Test pit explorations began closest to the machine shop and then moved out toward the river. Each test pit was excavated to a depth ranging from 4-1/2 to 6 feet. Immediately after excavation, the groundwater seeped into the excavated hole.

Strong odors and visible signs of petroleum hydrocarbons were evident in test pits TP-1, TP-11, and TP-15. Oily sheens were noted in each of these test pits as they filled with groundwater. We also noticed an oily sheen on the surface water coming off the stockpiles. A four-inch pipe was encountered while trenching TP-1. It is suspected to be part of the old gasoline tank piping system.

A creosote odor was noted in most of the remaining test pits (TP-4 through TP-15) but it was strongest at TP-4, TP-5, TP-6, and TP-12. These test pits also showed immediate signs of visible contamination as product flowed into the hole with groundwater following excavation. Faint odors and slight visible signs were noted in the remaining test pits.

A pentachlorophenol odor was most evident in TP-14 but was also noted in pits TP-3 and TP-6. However, testing of a sample from TP-6 did not indicate the presence of PCP above a detection limit of 470 ppb (Table 2).

Oil sheens were noted throughout the site in surface water pooling in tire tracks and other low depressions.

Soil Sample Results

Four soil samples were collected from TP-4, TP-6, TP-12,and TP-15 for analyses. Three of the samples (TP-6, TP-12, and TP-15) were analyzed for volatile organics (EPA Method 8240); semivolatile organics (EPA Method 8270); total arsenic, copper, lead, and zinc (Standard Methods); and GC/FID acid, base, neutral screen (EPA Method 8015 modified) using Laucks Testing Laboratories, Inc., in Seattle, Washington. The one sample collected from TP-4 was analyzed by Weyerhaeuser Analytical and Testing Services in Tacoma, Washington, for total metals, BNAs, and total creosote (estimate based on the results for specific compounds in the BNAs referenced to a creosote standard). The results are summarized in Table 1. Analytical laboratory certificates are presented in Attachment E.

Arsenic concentrations ranged from 20 to 340 ppm. The highest arsenic concentration was detected in TP-12, which was located near the south end of the machine shop. Copper and zinc concentrations ranged from 11 to 37 ppm and 36 to 64 ppm, respectively. Lead was below detection limit (<10 ppm) for the three samples. Lead and zinc analyses were not conducted on the samples collected from TP-4. Chromium concentrations in samples collected from TP-4 ranged from 31 to 37 ppm. Chromium was not analyzed for samples collected in TP-6, TP-12, and TP-15.

Acetone was detected in TP-6 and TP-15 at concentrations of 0.25 and 0.98 ppm, respectively. 2-butanone was also detected in TP-6 at a concentration of 0.46 ppm. Volatile aromatic compounds (including toluene, ethylbenzene, and total xylenes) ranged from not detected to 35 ppm. The highest volatile aromatic concentrations were detected in TP-12. Benzene was not detected in any of the samples. Volatile organics were not analyzed for samples collected from TP-4.

Pentachlorophenol (PCP) was detected in TP-12 at a concentration of 100 ppm. The sample collected from TP-4 had an estimated pentachlorophenol concentration of 2.6 ppm. PCP was not detected in samples collected from TP-6 and TP-15. 2,4-dimethylphenol and 4-methylphenol were detected in TP-6 at concentrations of 0.14 to 0.29 ppm.

4-methylphenol was also detected in TP-15 (0.2 ppm). Polynuclear aromatic hydrocarbon (PAH) concentrations ranged from 0.052 to 1000 ppm. The highest PAH concentrations were detected in TP-12. Total creosote concentration in TP-4 was estimated as 180 ppm.

Other On-site Work

Soil samples were collected and analyzed in 1988 during the removal of two underground storage tanks that were located on the northwest side of the old machine shop. Two waste oil tanks located on the east and southwest side of the machine shop building, respectively, were also removed. Petroleum-contaminated soil discovered during this tank removal was removed and disposed of off-site. Soil samples were collected and analyzed from the east side of the machine shop area. Analytical results indicated creosote contamination at the site as shown on Figure 2 and supporting notes (Table 1).

Chronology of events leading up to the December 9, 1989, notification of the creosote release is described in Table 1. The excavated soil from the pipe bundle found on the east side of the Old Machine Shop (former Wood Treating Facilities) had greater than 1 pound of creosote based on confirmed creosote analyses of 12,200 ppm.

PCB-contaminated hydraulic oil was found in the diesel tank excavation as free phase product (however, no other subsurface location had free phase PCB-contaminated product). On March 29, 1989, a 10 to 20 pound PCB release occurred during the demolition of switchgear that had 2 small instrumentation transformers of about 18" x 10" x 15" dimensions. The spill was discovered on March 30, 1989, and immediately sampled with the suspected PCB spill site secured until cleanup. On March 31, the preliminary sampling results did in fact confirm the presence of a reportable quantity of PCBs. At that time, Olympus Environmental was authorized to proceed with cleanup of the identified areas to 40 CFR 761.125 specifications and wipe samples were taken to certify the spill area asphalt and concrete surfaces as clean (see attached location map and field sketch in Figure 2). Concurrently, spill notification was given by telephone to the Washington State Department of Ecology and EPA

Region X. Certification sampling of PCB spill cleanup and follow-up sampling and cleanup efforts are in progress.

V. MODEL OF SITE CONDITIONS

The available historic, hydrogeologic, and soil quality data were used to develop a model of the site conditions with respect to the nature and extent of contamination and possible migration pathways. This model provides the basis to identify additional data needs and develop a site characterization work plan.

Primary Source Areas - Machine Shop and Blow-out Area

The primary source area based on our historical review is in the vicinity of the old machine shop. This is the area where wood treating occurred and where chemicals used in the treatment process were handled and stored. Fuels stored in underground tanks (now removed) were also located near and adjacent to the machine shop.

A second primary source area is the area where blow-out materials were deposited. Interviews and review of aerial photographs indicate that deposition occurred to the southeast of the old machine shop building, near TP-12.

Secondary Source Areas - Abandoned Rail Track and Log Storage Area

The abandoned rail tracks and treated log storage areas are possible secondary source areas. The dripping of wood preservatives from treated logs could have contaminated near-surface soil. However, the extent and magnitude of contamination in these areas is expected to be much less than in the primary areas.

Chemicals of Concern - Creosote, Pentachlorophenol, PCB, Arsenic, and Fuels

The site history, test pit observations, and soil quality analyses data indicate that several common wood treating chemicals and several fuels (gasoline/diesel) have migrated into site soils. The presence of creosote/diesel fuels are indicated by the semivolatile extractable compounds such as naphthalene, phenanthrene, among others. Leakage of gasoline is indicated by the presence of volatile aromatic compounds (xylenes and ethylbenzene). In addition, acetone and methyl ethyl ketone (MEK) were detected. Acetone and MEK are typically used as solvents. PCB-contaminated hydraulic oil and a recent PCB spill cleanup site are noted on the north end of Old Machine Shop.

Pentachlorophenol was detected in soil samples as was arsenic. The primary concern associated with "penta" is the possible presence of dioxins (especially 2,3,7,8 tetrachlorodibenzo-p-dioxin). The presence of dibenzofurans are also a concern.

Total arsenic concentrations ranged between 35 and 340 mg/kg. While arsenic is a naturally occurring metal, it is a common wood treating compound and was detected at concentrations above typical background for Puget Sound soils (5 to 30 mg/kg).

Migration from Source Areas toward the Snohomish River

The test pit data and position of the site with respect to the Snohomish River indicate that probable migration pathways are eastward toward the Snohomish River. Migration may occur within a shallow groundwater zone composed of dredge fill soils. The bottom of the shallow groundwater zone is composed of low permeability soils typical of tidal flat depositional environments. The low permeability soils likely restrict the downward movement of shallow groundwater and contaminants.

Migration of groundwater into the river may be restricted by bulkheads which are present downgradient of the source areas. Our experience on other sites indicates this to be a common condition in dredge fill coastal areas.

Extent of Primary Contamination - Approximately 2.5 to 3.5 Acres

Our preliminary estimate of the area which may be most contaminated is shown on Figure 3. This estimate is based on observations made in test pit excavations, our interpretation of the site history and hydrogeology, and soil quality analyses. The area includes the known primary source areas (machine shop (former wood treatment facilities) and blow-out areas) and test pits in which free phase product was observed to enter the excavations. We used the following evidence to define the primary area of contamination:

South Boundary. Test pits to the south of the indicated boundary (TP-7 through P-10) showed much less evidence of contamination as compared to those located within the indicated area.

West Boundary. The west boundary was defined by the historical source area data and our interpretation of groundwater flow being toward the Snohomish River. The area west of TP-2 and TP-3 is upgradient of the source area.

North Boundary. This boundary was defined based on our interpretation of groundwater flow directions from the primary source areas. Additional data are required to refine and confirm the position of this boundary.

East Boundary. The Snohomish River defines the east boundary.

Possible Areas of Secondary Contamination - Caused by Dripping of Wood Preservatives

These areas are those where dripping of wood preservatives from treated logs may have contaminated surficial soils. Treated logs were generally handled in the areas south and southeast of the Old Machine Shop along the former rail area and adjacent log storage areas. Typically, contamination, if present, is localized (spotty) and is lower in concentration as compared to areas where treatment, and chemical handling activities occurred. This interpretation is supported by the test pit data.

VI. ADDITIONAL DATA NEEDS AND RECOMMENDED APPROACH TO DATA COLLECTION TO COMPLETE SITE CHARACTERIZATION (SITE CHARACTERIZATION WORK PLAN)

Geologic Data Need - Refine Soil Strata Sequence and Thickness

The composition and thickness of soil units which underlie the site needs to be further refined. This includes the composition and thickness of the tidal flat and other natural deposits which underlie the fill.

Approach - Drill Shallow and Deep Borings

Shallow Borings. A series of shallow borings should be drilled to the top of the tidal flat deposits in the old machine shop, blow-out, and log handling/storage areas. Sixteen (16) shallow borings drilled to depths up to 15 feet are recommended. Soil samples should be obtained on 2.5-foot-depth intervals and geologic logs should be prepared. These borings should not be drilled through the low permeability deposits especially in the area where most of the contamination is present. Proposed locations are shown on Figure 5.

Deep Borings. Three (3) deeper borings are also recommended to assess the thickness of tidal flat deposits and composition of deeper underlying deposits. Drilling to depths of 25 to 30 feet is recommended. Soil sampling should be conducted on 2.5-foot-depth intervals and geologic logs should be prepared. Shelby tube samples of the low permeability deposits should be collected. These boring should be located outside of the primary area of contamination. Proposed locations are shown on Figure 5.

Products. Fill thickness map and geologic cross sections.

Hydrologic Data Needs - Groundwater Flow Directions and Rates, and Effects of Tides

The direction and hydraulic gradient of groundwater flow toward the Snohomish River needs to be confirmed as does the thickness of the saturated zone within the dredged fill deposits. Site-specific data concerning the hydraulic conductivity of the dredge fill deposits needs to be collected. The effects of tides on the shallow and deep zones should be assessed.

Approach - Install Wells and Conduct Field and Laboratory Testing

Install Wells. Two-inch-diameter wells should be installed in the shallow and deep borings described above. The shallow wells should be screened through the water table and slightly below the top of the tidal flat deposits. The well heads should be surveyed to a common datum.

Assess Tidal Effects on Groundwater Elevations. Continuous recording water level measurement equipment should be installed in 2 to 3 shallow wells, 1 deep well, and in the river. Measurements should be obtained over several tidal cycles. These data will be used to assess how tides effect groundwater elevations and select the time to make water level measurements to assess groundwater flow directions.

Assess Groundwater Flow Directions. Two (2) sets of groundwater level measurements should be made; 1 set during high groundwater elevations and 1 set at low groundwater elevations. These data will be used to evaluate flow directions during low and high elevation conditions. They will also be used to assess the hydraulic connection between the groundwater flow system and the Snohomish River.

Complete Hydraulic Conductivity Testing. *In situ* testing should be conducted in 3 shallow wells and in the 3 deep wells. We recommend that up to 10 grain size analyses be conducted on shallow and deep soil samples to assist us in assessing the variability in site soils and allow us to compare the testing results with data in our files. In addition, laboratory testing should be conducted on 1 of the shelby tube samples of the tidal flat deposits to provide data on vertical hydraulic conductivity.

Assess Groundwater Flow Rates. The groundwater flow direction maps, hydraulic conductivity data and saturated thicknesses will be used to assess the rate and volume of groundwater flowing through the shallow zone. The hydraulic connection between the shallow and deep zones will be estimated.

Products - Water Level and Water Quality Monitoring System

- Groundwater flow directions and rates.
- Influence of tides on groundwater flow directions.
- Analysis of the hydraulic connection between the shallow and deep groundwater zones, and the River.

Soil Quality Data Needs - Determine the Nature and Extent of Soil Contamination and the Need for Soil Remediation.

Soil quality should be examined to determine the distribution of creosote, petroleum compounds, pentachlorophenol, metals, and other compounds identified as potential contaminants at the site. Results of soil chemical analyses will be used to assess environmental risk and the need for soil remediation. If remediation of soils is necessary, we will use the soil quality information generated by this work to discuss the most appropriate remedial options and determine if additional data requirements are necessary to evaluate those options.

Use of the mobile lab will provide rapid analysis of soil samples. Results of these analyses will be used to direct our field exploration program. Screening results will be verified by submitting ten percent of the samples to an analytical laboratory.

Soil Collection. Soil samples will be visually classified and placed in appropriate containers. Soil samples will be screened for the presence of volatile organic compounds using a portable photoionization detector (H-Nu).

Soil Screening. Based on sample depth, odor, visual evidence of contamination, and screening results, approximately four soil samples from each of the 16 shallow borings and six samples from each of the three deep borings will be analyzed by the mobile laboratory. Samples will be screened for the following parameters:

- polychlorinated biphenyl (PCB)
- polynuclear aromatic hydrocarbons (PAH)
- total petroleum hydrocarbons (TPH)
- pentachlorophenol
- volatile organic compounds
- fuel fingerprinting

Since creosote is mainly composed of PAH compounds, PAH screening will provide a quantitative assessment of creosote contamination. TPH screening will provide a quantitative assessment of petroleum fuel content in soils. Volatile organic compound screening will detect compounds typically associated with gasoline and solvents. The fuel fingerprint analysis is a qualitative test designed to identify the type of fuel or creosote present in soil.

Verification Analysis. Ten percent of the soil samples analyzed by the mobile laboratory will be submitted to an analytical laboratory for verification analysis. In addition, ten samples will be submitted for trace metal analysis. Samples will be analyzed for the following parameters:

- PCB (8080
- volatile organic compounds (EPA Method 8240)
- semivolatile organic compounds (EPA Method 8270)
- total and EP toxicity metals (EPA Method 6010 or 7000)

Dioxin and Furan Analysis. Three soil samples will be analyzed for dioxins and furans (EPA Method 8280). Samples containing high PCB and pentachlorophenol concentrations as determined by the screening analysis will be selected for dioxin analysis.

Products. Defined estimate of the nature and extent of contamination.

Groundwater Quality Data Needs - Determine the Nature and Extent of Groundwater Contamination, Flux of Contaminants to the Snohomish River, and Need for Groundwater Remediation.

Groundwater quality should be assessed to determine the distribution of creosote, petroleum compounds, PCB, pentachlorophenol, metals, and other compounds identified as potential contaminants at the site. Results of groundwater chemical analyses will be used to refine our evaluation of the nature and extent of contamination and assess the flux of contaminants and the need for groundwater remediation. If remediation of groundwater is necessary, we will use the groundwater quality information generated by this work to develop suitable remedial options and determine if additional site characterization is necessary to evaluate those options.

Approach. Groundwater samples collected from the sixteen shallow wells and the three deep wells will be submitted to an analytical laboratory for chemical analysis.

Field Measurements. The following field parameters will be measured during groundwater sampling:

- pH
- specific conductivity
- temperature
- redox potential

Analysis of Samples. Groundwater samples will be submitted to an analytical laboratory and analyzed for the following:

- PCB (8080)
- volatile organic compounds (EPA Method 8240)
- semivolatile organic compounds (EPA Method 8270)
- total and dissolved metals (EPA Method 6010 or 7000)

Products.

- Assessment of groundwater quality conditions
- Data to assess possible contaminate migration into the river.

Free Phase Product Data Needs - Assess the Presence, Composition, and Thickness of Both Floating and Sinking Free Phase Product.

The presence of free phase product needs to be determined. If free phase product is detected, the thickness and composition of the product should be determined. These data will be used to assess whether a product recovery system is needed and will be helpful in the design of the recovery system (if necessary).

Approach. Lower a product well sounder into wells to detect free phase product and determine its thickness. Sample free phase product and submit sample for chemical analysis.

Product Detection. A product well sounder (Flexidip) will be lowered into the monitoring wells to determine if free phase product is present. The product well sounder will also be used to determine the depth of the product/water interface and the apparent product thickness.

Product Sampling. Floating free product will be sampled using a product sampling bailer or a peristaltic pump. Free product which has a density greater than water (sinker) will be sampled using a peristaltic pump or a dual check valve bailer.

Floating Free Product Characterization. Floating free phase product samples will be analyzed for fuel fingerprint analysis. Fuel fingerprint analysis will indicate what type of fuel is present. If gasoline-range hydrocarbons are detected, the sample will also be analyzed for total lead.

Sinking Free Product Characterization. Sinking free product samples will be analyzed for semivolatile organic hydrocarbons (EPA Method 8270) and total metals.

Products.

- Extent of free phase products (both floaters and sinkers)
- Characterization of free phase products
- Recommendations for product recovery

Product of Recommended Investigation

The geologic, hydrologic, and soil/groundwater quality data will be reviewed and analyzed to characterize the site conditions. Our review will include validating the data using EPA data validation guidelines. A soil, groundwater, and free phase product site characterization report will be prepared which will include:

o Site map(s) showing boring/well sampling locations and the areal extent of contamination;

o Geologic sections showing our interpretation of the site subsurface conditions;

o Groundwater flow maps at high and low groundwater elevations, and an assessment of how changing river elevations effect groundwater flow patterns;

o Estimates of the rate of groundwater flow and interconnection between the shallow zone and the deep groundwater zone and river;

o Tabulated soil and groundwater quality data;

o Assessment of the nature and extent of contamination;

- o Identification of possible receptors and need for interim remedial actions necessary to protect human health and the environment; and

- o Appendices which describe our field sampling and analytical procedures.

HART CROWSER, INC.

MATTHEW G. DALTON
Principal Hydrogeologist

SSF:sek/sde
FR239502/JOBS

Table 1 - Chronology of Everett Mill E Cleanup Technical Support Activities

Date	Description of Technical Support Activities
10/18/88	Diesel and gas tank excavated pits show petroleum product. Product is sampled. Waste oil tank also sampled during Crowley Environmental Services cleanup efforts by J. Burnett. Laboratory Request No. 18354 initiated for three samples 1-A, 1-B, and 1-C.
10/21/88	Laboratory test results show no indication of gas or diesel product. Soluble and total lead content high in waste oil sample. Laboratory Request No. 18354 completed.
10/25/88	Hydraulic oil sump was discovered and sampled by J. E. McCourt. Tests were run comparing hydraulic oil to 10/18/88 samples and for specification used oil criteria as well as gross solvent content. Laboratory Request No. 18393 initiated for sample 1-D.
10/31/88	Preliminary results on Request No. 18393 indicated the 10/18/88 petroleum product samples and hydraulic oil were similar. However, the PCB level showed hydraulic oil sump 4.9 ppm, gasoline pit product less than 2.5 ppm, diesel pit product 25 ppm, and waste oil tank (T-3) 17 ppm. These results suggested an off specification used oil spillage.
11/1/88	A composite soil sample was taken at six oil-stained site locations around the machine shop with three surface subsamples taken at each location. The sample was screened for dangerous waste criteria. Laboratory Request No. 18441 initiated for sample 1-E. Preliminary solvent results on 11/4/88 found very little solvent in the soil and the 11/8/88 fish bioassay results suggested that the soil was not a dangerous waste. An aerial photograph of machine shop area from 1940s and early 1950s, prior to its being made into a machine shop, was reviewed. The machine shop was reportedly used for wood treating according to Al Carnes inquiries of retired employees.
11/4/88	Ten 0.5-cubic yard bags of soil excavated from oil-stained areas near motor oil and hydraulic oil bermed areas. Waste oil removed and put into barrels for bermed areas and hydraulic oil sump. Barrels identified as T-6 barrels.

11/11/88 Sampling of temporary recovered oil tank from the skimmer/recovery well and other miscellaneous soils from cleanup was planned for site by J. E. McCourt. Recovered oil was reportedly sampled for analysis by Chem-Pro according to Crowley Environmental Service personnel. Only soil samples were taken from cleanup area. Five underground pipes were found on backside of machine shop near where waste oil tank 2 (tank T-4) was located. A solvent type odor was noted that was not noticed before. Work stopped after determining that the pipes had been cut off or terminated 10 to 15 feet from building. Laboratory Request No. 18513 initiated for sample 4-A composite sample of excavated soil adjacent to underground pipes from bags S-11, S-12, S-13, S-16, and S-17; 4-B composite surface sample from underground pipes area; and 4-C cleanup level surface soil composite sample from side walls and base of excavating adjacent to underground pipe area. Rush analysis was done on Sample 4-B.

11/14/88 Laboratory Request No. 18354 was finished and reported on for waste oil results. It appears that the hydraulic oil and waste oil are off specification used oil due to lead and PCB content. Laboratory Request No. 18519 initiated for 11/4/88 soil excavation for total petroleum hydrocarbon (TPH) and PCBs as well as PCB analyses or miscellaneous hydraulic oil samples.

11/15/88 Preliminary results for soil sample 4-B from the unknown organic contamination at the underground pipe area found the following volatile organics: methylene chloride 120 ppm, acetone 66 ppm, 2-butanone 3.1 ppm, trichloroethane 4.8 ppm, chlorobenzene 2.4 ppm, and part per billion levels of toluene, xylene, and ethylbenzene.

11/18/88 Everett composite soil sample 1-E Laboratory Request No. 18441 was completed and reported the following: the soil was not a dangerous waste for toxicity and persistent, the PCB and solvent were below levels of concern, phenol levels were 1.1 ppm, and the total constituent metal found slightly elevated As, Cr, Cu, and Pb levels. Laboratory Request No. 18519 was finished and reported PCB levels less than 1 ppm for the soil and hydraulic oil samples 4-A through 4-I. The TPH levels were 42,300 ppm for the end berm samples and 22,700 ppm for the mid berm sample. The miscellaneous hydraulic oil appears to be specification used oil and the soil in 0.5-yard bags S-1 to S-10 are problem wastes due to oil contamination.

12/5/88 A review of the results Laboratory Request No. 18513 was begun. In addition to the volatile organics found in the soil from the backside of the machine shop in the cleanup soil, the following was learned: 1) no polychlorinated biphenyl (PCB) or pentachlorophenol (PCP) was found; 2) total petroleum hydrocarbon levels were high for these samples; 3) polynuclear aromatic hydrocarbon (PAH) were elevated compared to the earlier soil 1-E on Request No. 18441; and 4) creosote levels were high in sample 4-B from the pipe area compared to sample 4-A the excavated soil adjacent to the underground pipe area. Characterization work is continuing to confirm the observation of creosote levels.

12/8/88 The recovered oil sampled by Crowley Environmental Service on 10/22/88 from the now abandoned oil recovery well showed no PCB content and total organic halogen levels of 70 ppm. This sample is being retested to confirm this result with regard to the 1232 species of PCB.

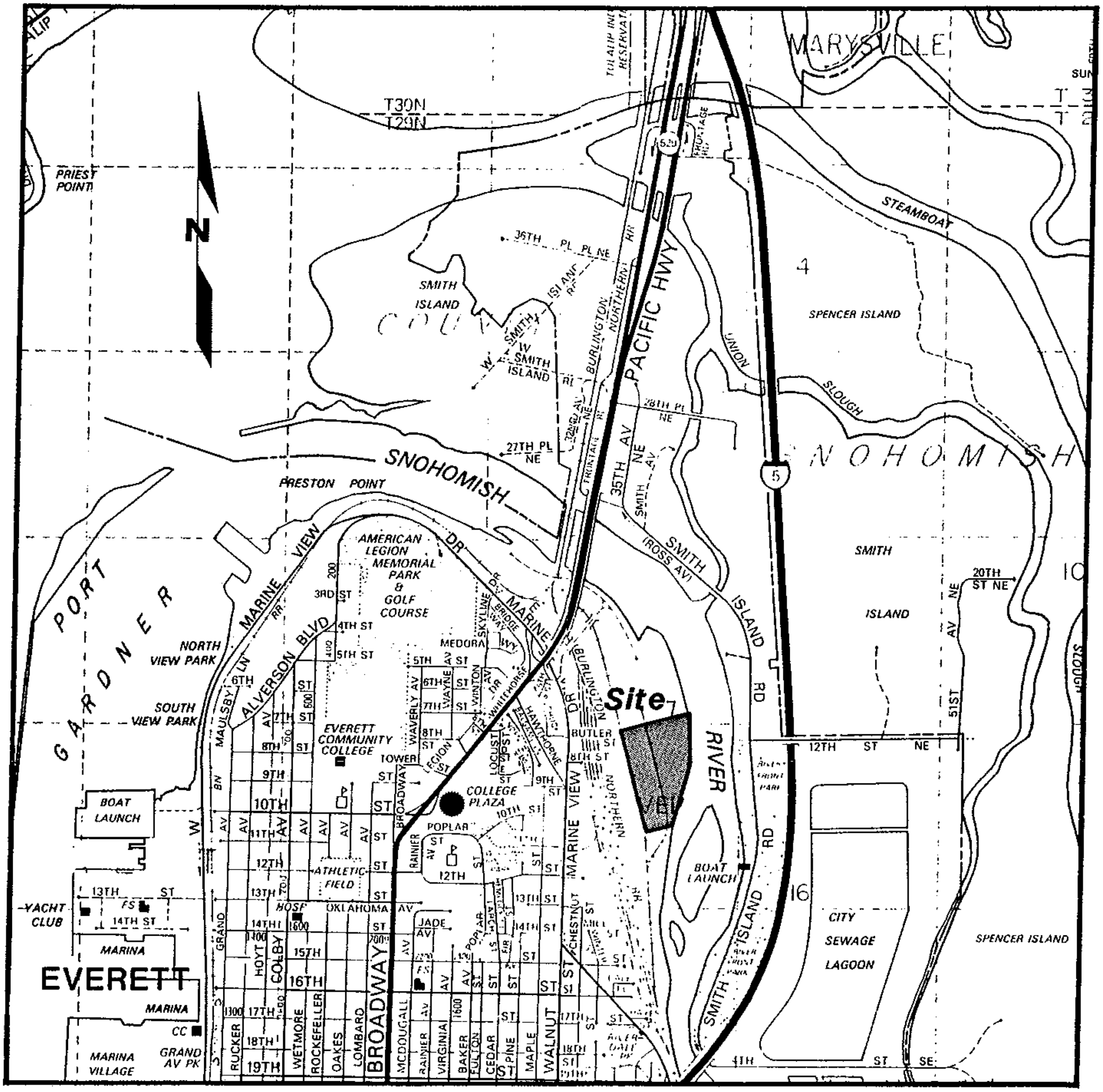
Table 2 - Summary of Preliminary Test Pit Soil Sample Results Weyerhaeuser Everett Mill E Site

ANALYTE	STATION NUMBER / LAB SAMPLE NO.	TP-6 1[a]	TP-12 2[a]	TP-15 3[a]	TP-4 S-2[b]	TP-4 S-2[b] (duplicate)
METALS parts per million (mg/kg), dry basis						
Arsenic		35	340	130	20	20
Copper		37	11	9	16	15
Lead		<10	<10	<10	NA	NA
Zinc		64	47	36	NA	NA
Chromium		NA	NA	NA	31	37
VOLATILE ORGANICS parts per billion (ug/kg), dry basis						
Acetone		250	<6200	98	NA	NA
2-Butanone		46	<3700	<8	NA	NA
Toluene		<3	<1200	9	NA	NA
Ethylbenzene		<3	5800	<3	NA	NA
Total Xylenes		10	35000	130	NA	NA
PHENOLS parts per billion (ug/kg), dry basis						
Pentachlorophenol		<470	100000	<350	2600 J	3300
4-Methylphenol		290	<2500	200	4100 U	330 U
2,4-Dimethylphenol		140	<2500	<35	4100 U	50 J
LOW MOLECULAR WEIGHT PAH parts per billion (ug/kg), dry basis						
Naphthalene		1200	1000000	5300	31000	28000 E
Acenaphthene		<47	230000	660	15000	9000 E
Fluorene		<47	160000	580	9600	5300
Anthracene		<47	82000	270	4200	4400
2-Methylnaphthalene		52	640000	4900	23000	20000
Acenaphthylene		<47	8400	<35	4100 U	330
Phenanthrene		<47	390000	2300	17000	19000 E
HIGH MOLECULAR WEIGHT PAH parts per billion (ug/kg), dry basis						
Fluoranthene		<47	200000	1300	9700	11000 E
Benzo(a)Anthracene		<47	39000	110	1600 J	1400
Benzo(b)Fluoranthene		<94	19000	<71	790 J	650
Benzo(k)Fluoranthene		<94	14000	<71	830 J	710
Benzo(a)Pyrene		<94	16000	<71	610 J	470
Pyrene		<47	150000	780	6400	6400
Chrysene		<94	44000	150	1800 J	1700
Indeno(123-cd)Pyrene		<94	6200	<71	4100 U	150 J
Benzo(ghi)Perlene		<94	5900	<71	4100 U	150 J
bis(2-Ethylhexyl)Phthalate		75	<2500	1200	4100 U	330 U
Dibenzofuran		<47	150000	570	8300	5200
GC/FID SCREEN parts per million (mg/kg), dry basis						
Calculated as Diesel		<1	2300	30	NA	NA
Calculated as Gasoline		<1	<10	7	NA	NA

1. (a) Analyzed by Laucks Testing Laboratories, Inc.. Seattle, Washington.
2. (b) Analyzed by Weyerhaeuser Analytical and Testing Services, Tacoma, Washington.
3. NA indicates parameter or analyte was not measured.
4. U indicates analyte was not detected. Value expressed is the detection limit.
5. J indicates analyte was detected below the established limit of detection.
6. E indicates analyte was detected above the established limit of detection.

Site Vicinity Map

Weyerhaeuser Company, Everett, WA



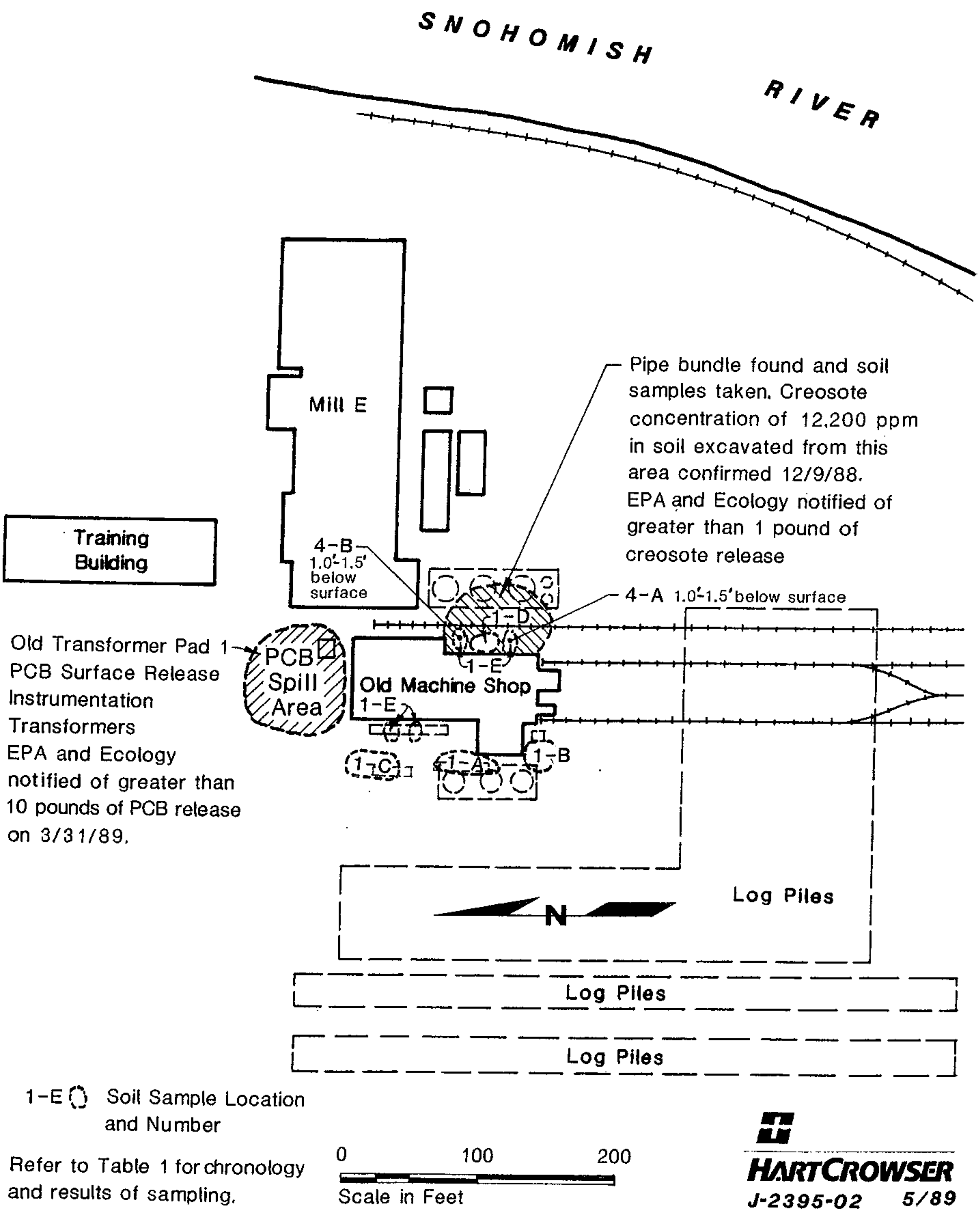
HARTCROWSER

J-2395-02 4/89

Figure 1

Previous On-site Work and Recent PCB Spill Area

Weyerhaeuser Company, Everett, WA



Refer to Table 1 for chronology and results of sampling.

HARTCROWSER
J-2395-02 5/89
Figure 2

Site Features and Test Pit Location Plan

Weyerhaeuser Company, Everett, WA

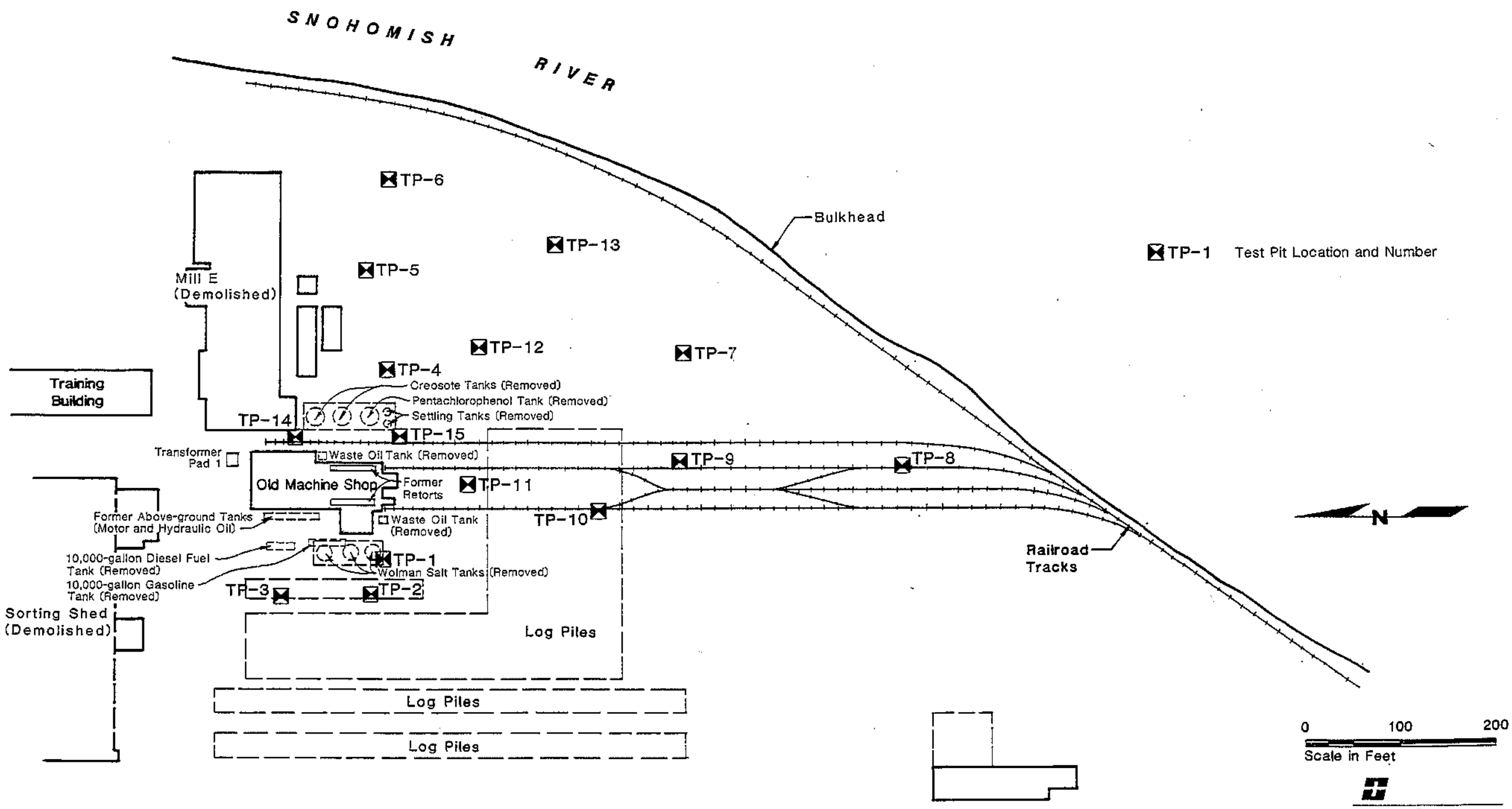
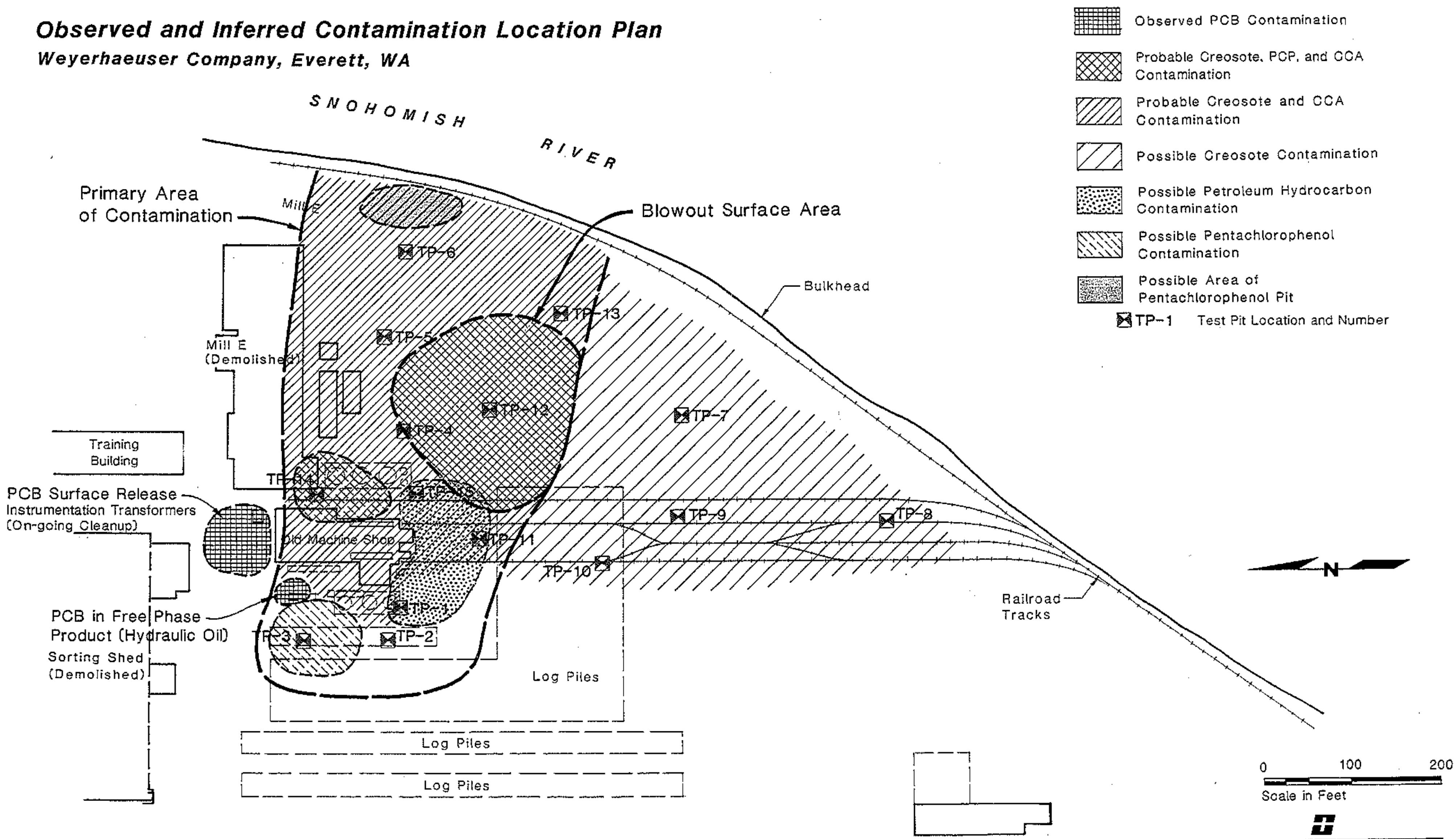


Figure 3

Observed and Inferred Contamination Location Plan

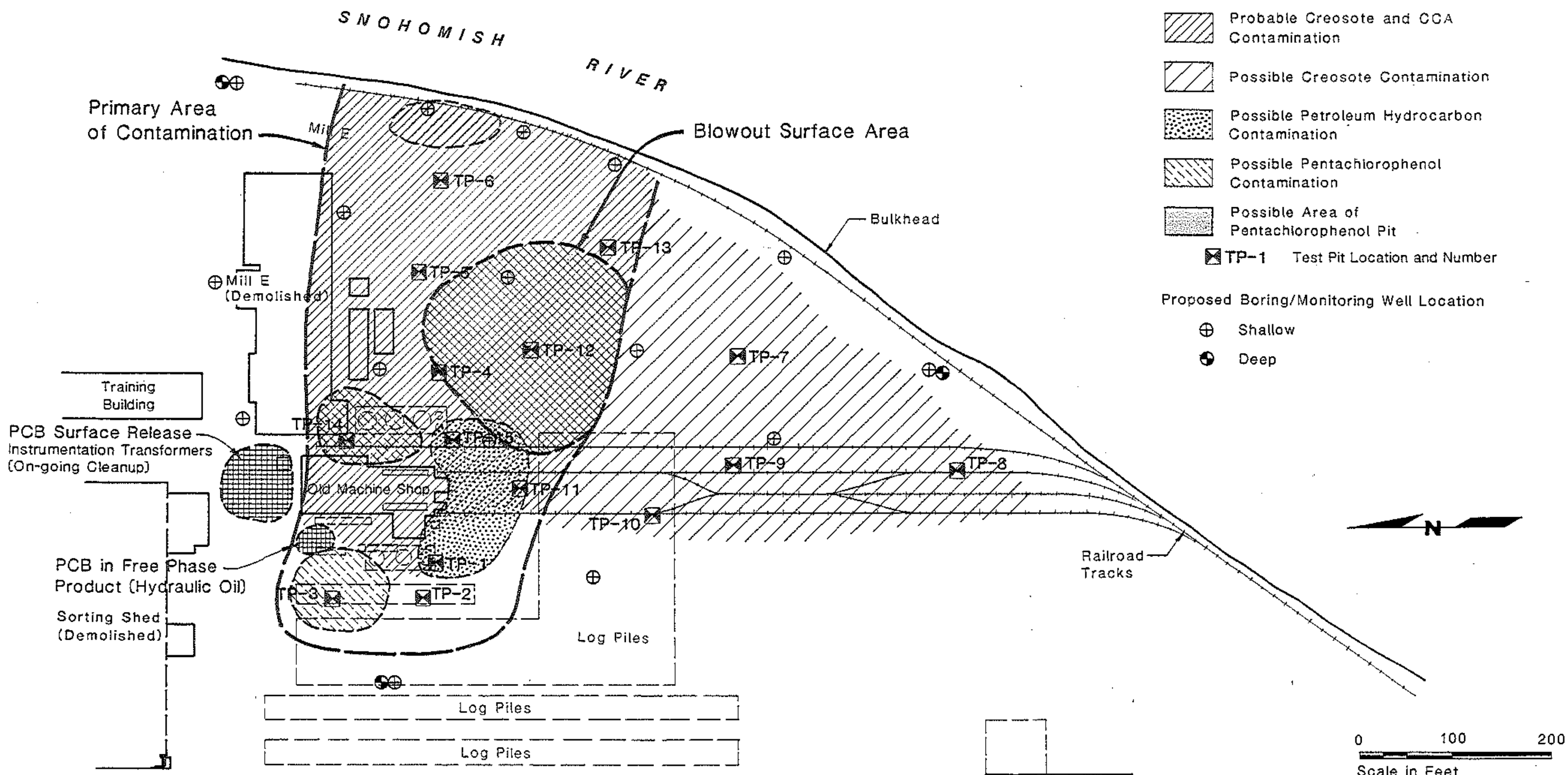
Weyerhaeuser Company, Everett, WA



HARTCROWSER
J-2395-02 5/89
Figure 4

Proposed Exploration Plan

Weyerhaeuser Company, Everett, WA



HARTCROWSER

J-2395-02 5/89

Figure 5