Dalton, Olmsted & Fuglevand, Inc. *Environmental Consultants*

22125 17th Avenue S.E., Suite 110 • Bothell, Washington 98021
Telephone (206) 486-7905 (FAX 486-7651)

RECEIVED
MAY 17 1990
DEPARTMENT OF ECOLOGY
NORTHWEST REGION

MEMORANDUM

TO: John Gross - Weyerhaeuser Company

FROM: Matthew Dalton

DATE: April 23, 1990

SUBJECT: TECHNICAL MEMORANDUM
INTERIM SITE CHARACTERIZATION REPORT
MILL E SITE, EVERETT, WASHINGTON

PURPOSE

This technical memorandum is an interim site characterization report and briefing on the findings to date of work accomplished by Weyerhaeuser Company and their environmental consultants (Dalton, Olmsted & Fuglevand Inc. and Hart Crowser Inc.) on the Mill E site. Also provided are recommendations for the "path forward."

BACKGROUND

Creosote-contaminated soil was discovered by Weyerhaeuser during the removal of 4 underground petroleum product and waste oil storage tanks at the old machine shop which was formerly used as a wood-treating facility in the area known as "Mill E" on their Everett plant (Figures 1 and 2). Weyerhaeuser Company notified the National Response Center and Washington State Department of Ecology (Ecology) on December 9, 1988.

In response to the discovery of creosote-contaminated soil, the site has been the subject of on-going assessment and site characterization work. Work to date has included: 1) a preliminary assessment for the Old Machine Shop; 2) low-tide sediment sampling surveys made by Weyerhaeuser and 3) site characterization work consisting of hydrologic testing, soil and groundwater sampling and chemical analyses and a preliminary risk assessment.

The site was used primarily as a lumber storage yard from about 1914 until 1947, when a wood treatment plant was constructed. The wood treatment plant was operated until 1963 by the American Lumber and Treating Company (AL&TC) and Koppers Company. Weyerhaeuser leased the property to these companies. In 1963 the plant was converted into a truck maintenance shop (machine shop) by Weyerhaeuser. The machine shop activities continued until 1984. From 1984 to the present Weyerhaeuser is using a portion of the shop building for storage.

Chemicals associated with the wood treating operation are Wolman salts, Milithan fire retardant, creosote, creosote-petroleum solutions and pentachlorophenol. Aerial photographs from 1965 and 1970 show an area of stained soil southeast of the former treatment plant. That staining may have resulted either from disposal of treatment chemicals or from incidental dripping of chemicals from treated wood stored there. This area is not currently exposed because a layer of clean ballast material (crushed rock and bark) has been placed over the site. Boring logs indicate the ballast material is 1 to 3 feet thick. In addition, petroleum products may have leaked from underground storage tanks and greases and fuel may have leaked or dripped from the plant locomotive and its flat-cars onto the area leading into the retorts of the treating plant. Chemicals associated with machine shop activities might include cutting and lubricating oils, solvents, metal sweepings, and machine greases.

On March 29, 1989, during dismantling of switchgear from a transformer substation at the north end of the Old Machine Shop, a release of about 20 pounds of PCBs occurred from the former transformer containment area. The substation had been previously decommissioned, however, two small instrumentation transformers were missed due to their size (18" x 10" x 15"). These instrumentation transformers were accidentally demolished during the dismantling of the switch gear. Within 24 hours of the release of PCB, a PCB spill cleanup was initiated and continued until the PCB spill cleanup criteria in 40 CFR 761.125 was met. Sampling and screening analyses accomplished during subsequent site characterization work discussed below, found no PCB indications in 95 soil samples screened for PCBs. To confirm these results, 13 verification samples were tested. PCBs were not detected in any of the 13 samples above quantification limits. No other PCB removal activities are planned.

The preliminary assessment is documented in a report prepared by Hart Crowser, dated May 16, 1989. The assessment included a historical review of past site use and the excavation of test pits which showed the presence of a perched groundwater zone containing wood treating and fuel chemical residues. This zone was found to overlie a silt layer aquitard underlain by a confined to unconfined saturated sand zone of unknown groundwater quality.

Using this preliminary work as a basis, a site characterization work plan was prepared, approved by Weyerhaeuser, and implemented by their consultants. The site characterization work, which began in June 1989, included additional historical reviews; site reconnaissance; 22 shallow (7- to 12-feet deep) borings and groundwater monitoring wells into the upper perched waterbearing zone; three deeper wells (26- to 27-feet deep) into the semi-confined lower aquifer; soil and water sample chemical analyses; and a preliminary human health and ecologic risk assessment. A site plan showing the well locations is presented as Figure 2.

On May 23 and July 19, 1989, Weyerhaeuser collected two sets of low-tide river sediment samples from various locations adjacent to the site, and at locations across the river and on the west bank of the river, 1 mile upstream of the Mill E site. The sampling locations are shown on Figure 2.

SUMMARY OF FINDINGS AND RECOMMENDATIONS TO DATE

Hydrogeologic Conditions

The soils beneath the site are shown on Figure 3 and consist of three general soil units designated as:

1) **Upper Sand Unit** - consists of about 1 to 3 feet of "grade" fill material over 3 to 6 feet of sand fill. The grade fill was used to create a working surface and is comprised of asphalt, crushed rock ballast, and bark. The sand fill was dredged from the Snohomish River. In situ testing indicates a horizontal hydraulic conductivity of 0.001 to 0.01 cm/sec for the sand fill. The Upper Sand Unit is separated from a Lower Sand Unit by a Silt Unit. Perched groundwater is present within the Upper Sand.

2) **Silt Unit** - The Silt Unit thickness is variable, but is generally 3 to 10 feet. In the vicinity of wells HC-5 and HC-8 this unit was found to be less than 6 inches to non-existent. Laboratory testing of a shelby tube sample of the silt indicates a vertical hydraulic conductivity of 3.3 x 10E7 cm/sec.

3) **Lower Sand Unit** - The thickness of the Lower Sand unit is greater than 16 feet, but the total thickness is unknown. The unit consists of a slightly gravelly to gravelly sand, and is visibly coarser than the sand fill of the Upper Sand Unit. A hydraulic conductivity of 0.01 to 0.1 cm/sec is estimated for the lower unit based on in situ testing and grain size analyses.

Groundwater flow in the Upper Sand and Lower Sand is generally toward the Snohomish River. Tidal fluctuations are not reflected in the water levels in the Upper Sand until the tides reach +2 feet (Mean Sea Level Datum). This elevation corresponds with the approximate elevation of the base of this unit. During high tides some localized flow reversals occur at the river margin (within about 50 feet of the river bulkhead) for short periods of time.

Water level responses during tidal monitoring in the Lower Sand indicate that this unit is hydraulically connected with the Snohomish River. Net groundwater flow is towards the river (Figure 4). A reversal of gradient occurs at the river margins for periods on the order of 6 to 8 hours depending on tidal range.

The geologic borings and hydrologic data (groundwater contours in the Upper Sand unit) infer that a breach or "window" in the Silt Unit may be present in the vicinity of Well HC-5, northwest of the Old Machine Shop (Figures 3 and 4). This window may allow vertical flow between the upper and lower sand zones.

Subsurface Soil Quality

Based upon the initial environmental assessment work, the primary potential contaminants of concern were identified as petroleum fuels, polychlorinated biphenyls (PCBs), and wood treating compounds including creosote, pentachlorophenol (PCP), and CCA (a wood preservative composed primarily of arsenic, copper, and chromium) . 95 soil samples from the borings were screened for volatile organics, polynuclear aromatic hydrocarbons (PAHs), PCP, petroleum hydrocarbons, and PCBs, using a Hart Crowser mobile laboratory.

Verification of the screening analyses was performed by the Weyerhaeuser Analytical Laboratory on split-samples from approximately 10 percent of the soil samples analyzed by the mobile laboratory. Samples were analyzed for PCBs (EPA Method 8080), volatile organic compounds (EPA Method 8240), and semivolatile organic compounds (EPA Method 8270).

The Weyerhaeuser Analytical Laboratory performed metals analyses (EPA Methods 6100 or 7000 series) on 16 soil samples from the borings. They also contracted for dioxin and furan analyses (EPA Method 8280) on 3 soil samples containing high pentachlorophenol concentrations according to the screening analyses.

The key findings of the screening are as follows:

o No PCBs were detected above quantification limits;

o Based on the data collected, the horizontal extent of organic compounds in soil has been delineated. The distribution and concentrations of BTEX compounds detected in the subsurface soils from 2.5 to 12.5 feet in depth are shown on Figure 5. The distribution and concentration of hydrocarbon compounds, indicative of the presence of petroleum products and creosote in soil, and pentachlorophenol (PCP) detections in subsurface soils from 2.5 to 12.5 in depth are shown on Figure 6. The types of petroleum products present are also shown and consist of diesel, gasoline, creosote and hydraulic oil range hydrocarbons. Mill E, which was a saw mill, is the likely source of the hydraulic oil hydrocarbons. The highest concentrations of BTEX compounds, pentachlorophenol, and PAH compounds were detected in the East Shop area in the general area shown on Figure 2;

o Total arsenic, copper, chromium, nickel, and zinc were detected in all of the 16 soil samples analyzed. Highest metal concentrations were typically detected in the immediate vicinity of the machine shop or in the East Shop Area. Arsenic and chromium were most elevated, compared to soil in relatively pristine forest environments of the Cascade Mountain foothills as summarized in Table 1.

Table 1 - Summary of Metal Concentrations in Soil

Parameter	Average Concentration	Maximum Concentration	Background(2)	Number Samples > Background Range
Arsenic	68	295	5 to 30	10 of 16
Chromium	61	479	10 to 70	1 of 16
Copper	21	50	5 to 20	5 of 16
Lead	7.5	35	10 to 60	0 of 16
Mercury	0.09(1)	0.12	0.01 to 0.4	0 of 16
Nickel	28	51	10 to 70	0 of 16
Zinc	44	80	20 to 80	1 of 16

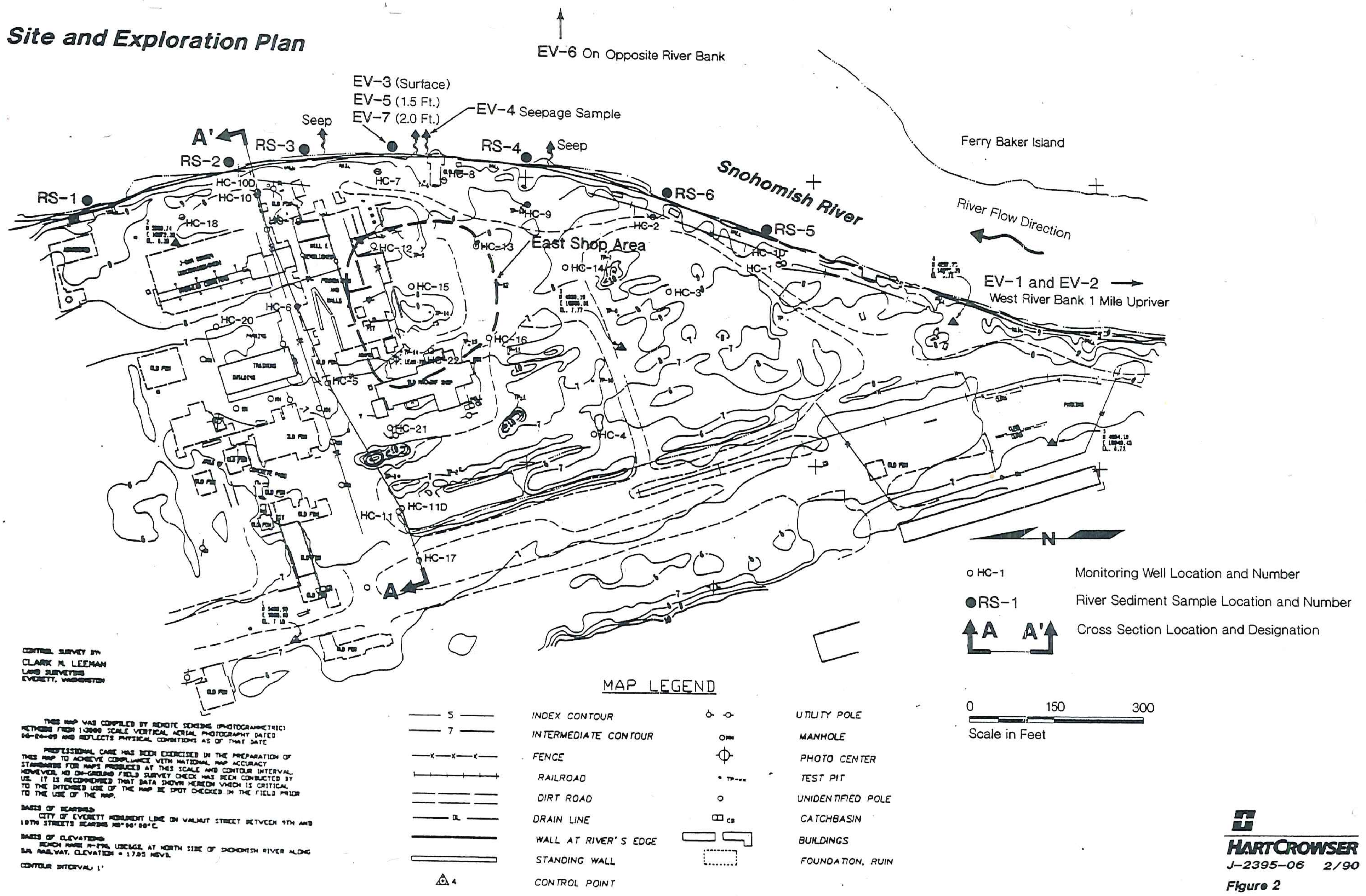
Notes: (1) Mercury was detected in only 2 of 16 samples tested.
(2) Source Metro, 1985.

o Dioxin and furan concentrations in the three samples containing high pentachlorophenol concentrations ranged from less than 0.001 ppm to 0.623 ppm. These compounds are typically formed as by-products during the production of pentachlorophenol. No tetra- or pentachlorodibenzo-p-dioxins were detected. Octachlorodibenzo-p-dioxin accounted for over 80 percent of the dioxins detected in the 3 samples. The highest dioxin and furan concentrations and the highest "TCDD Equivalent" dioxin concentration (0.0049 ppm) were detected in a soil sample (S-1) from a depth of 2.5 to 4 feet in HC-13 in the East Shop Area.

Groundwater Quality

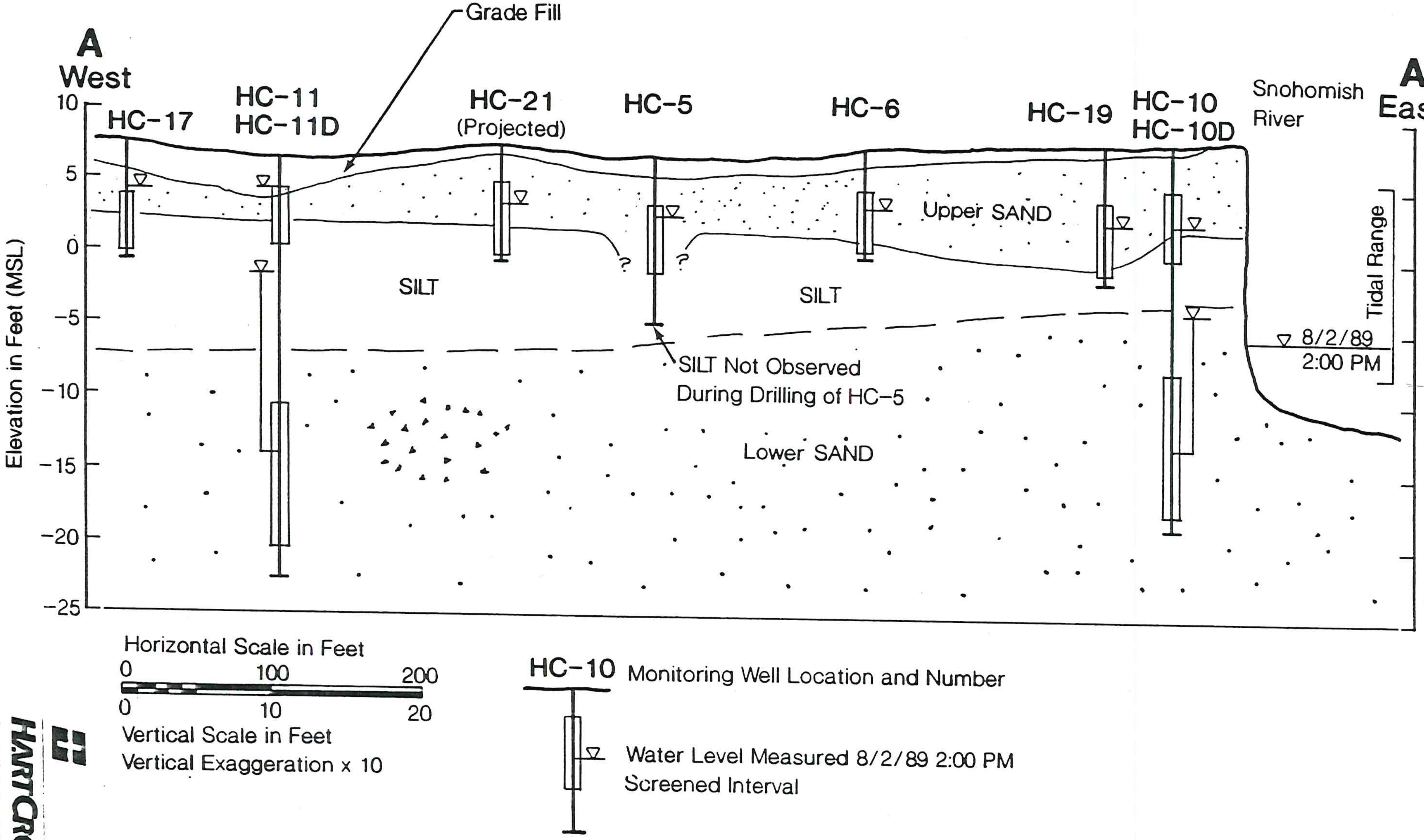
Groundwater samples were collected from 24 monitoring wells. These samples were analyzed by the Weyerhaeuser Analytical Laboratory for metals, volatile and semivolatile organic compounds (EPA Methods 8240 and 8270, respectively), and total and dissolved metals (EPA Method 6010

Site and Exploration Plan



HARTCROWSER
J-2395-06 2/90
Figure 2

Geologic Cross Section A–A'



Tidal Range Measured from July 3 through July 6. 1989

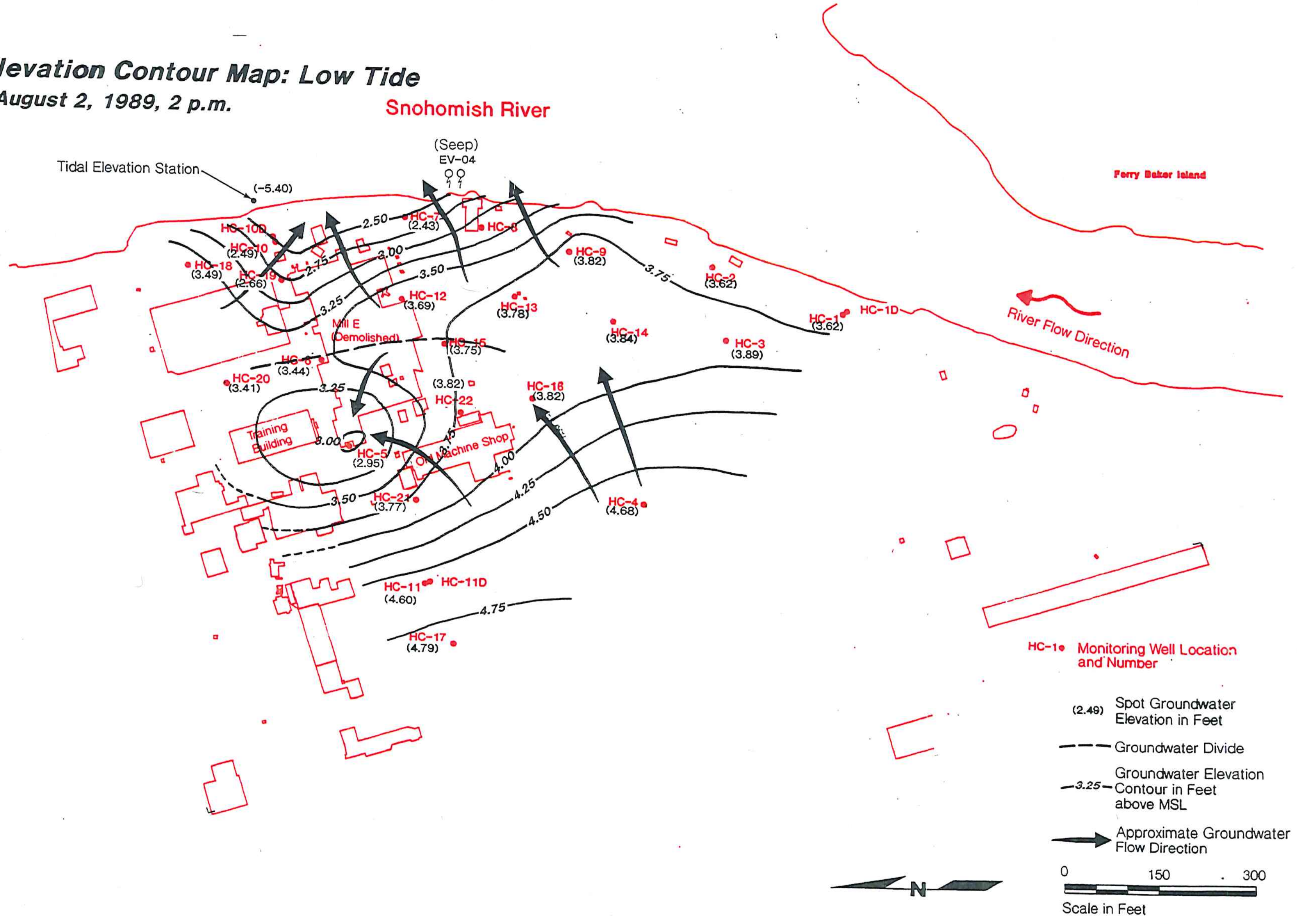
Note: Contacts between soil units are based on interpolation between explorations and represent our interpretation of subface conditions based on currently available data.

The trend of the cross section is shown on figure 2

HARTCROWSER
J-2395-06 2/90
Figure 3

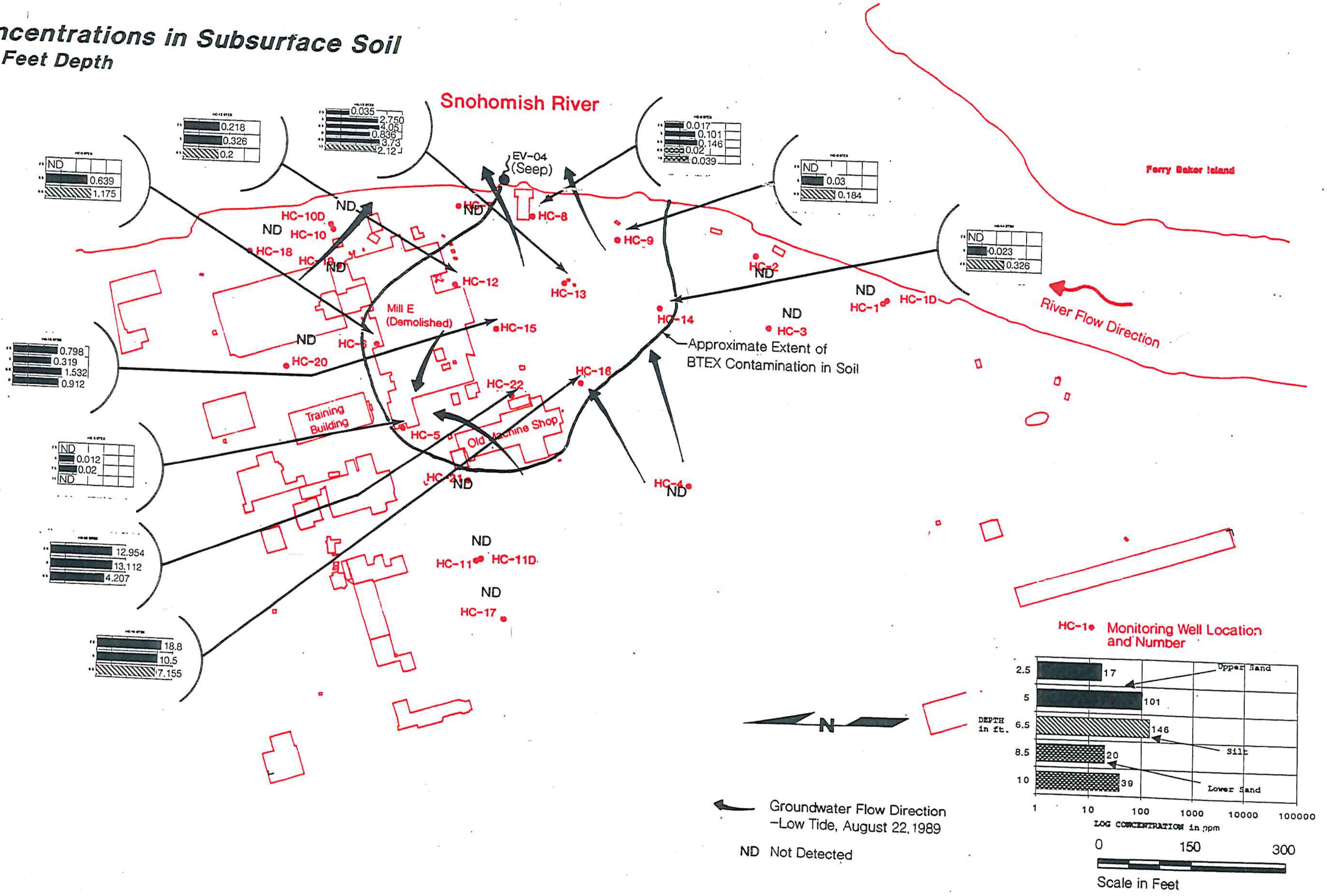
Groundwater Elevation Contour Map: Low Tide

Upper Sand Unit – August 2, 1989, 2 p.m.



HARTCROWSER
J-2395-06 4/90
Figure 4

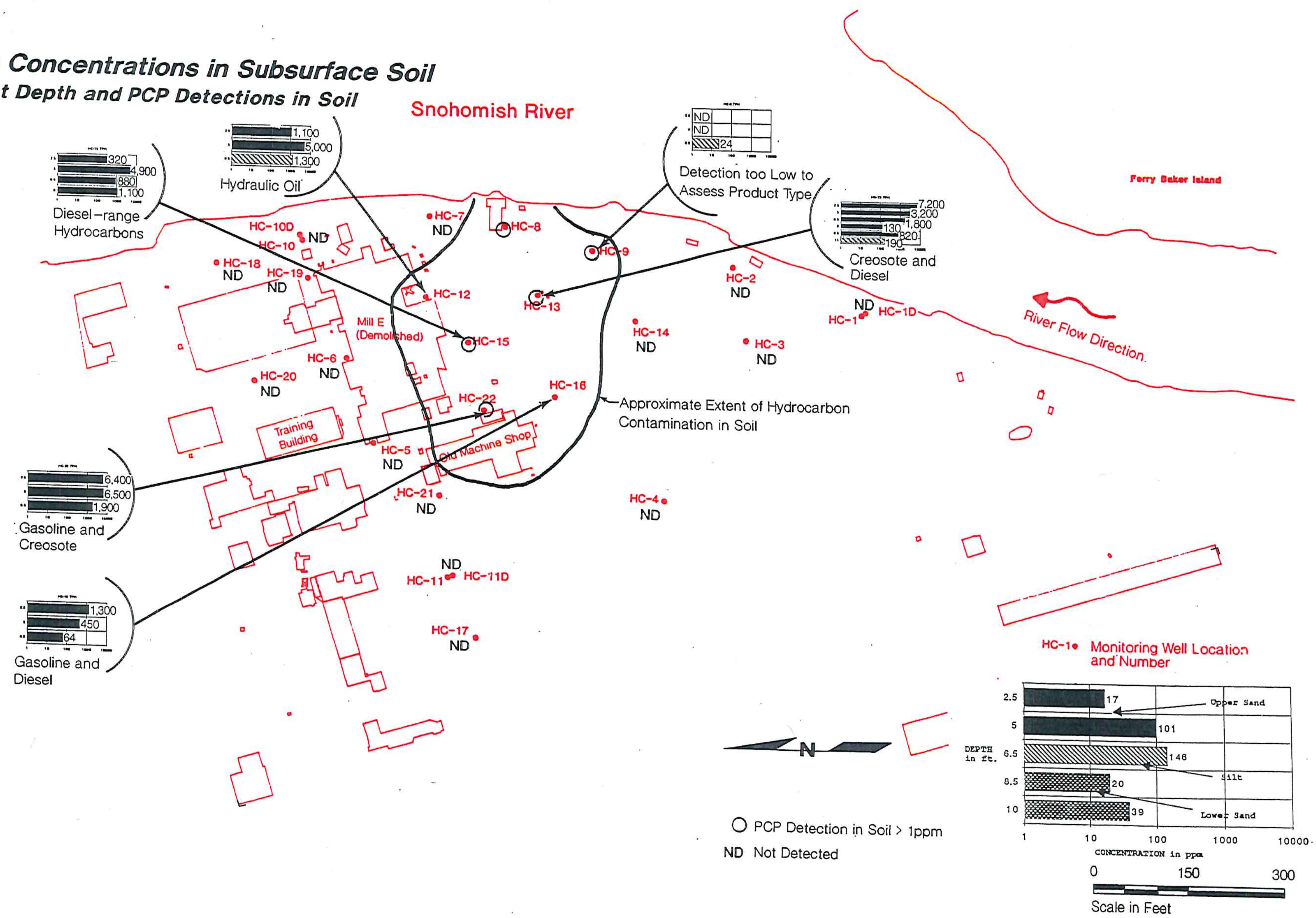
BTEX Concentrations in Subsurface Soil
2.5 to 12.5 Feet Depth



HARTCROWSER
J-2395-06 4/90

Hydrocarbon Concentrations in Subsurface Soil

2.5 to 12.5 Feet Depth and PCP Detections in Soil



HARTCROWSER

J-2395-06 4/90

or 7000). In addition, 6 samples were analyzed for PCBs (EPA Method 8080). The key findings are as follows:

o No free product was detected in the wells;

o No PCBs were detected in groundwater;

o No organic chemicals were detected in the three lower sand wells. Upgradient and downgradient dissolved metal concentrations were similar in this lower unit. Additional wells located more downgradient of the machine shop area are recommended to confirm this finding.

o The distribution of concentrations of metals and organic chemicals in upper sand groundwater is generally consistent with the site history and soil quality data. The highest concentrations of metals (e.g. arsenic) and wood treating compounds (as indicated by PAH concentrations) are in the East Shop Area generally centered on well HC-13 as shown on Figures 7 and 8. This is the area where aerial photographs showed soil staining and where the highest concentrations of wood treating soil contaminants were found in soil;

o The highest concentrations of BTEX compounds were in well HC-16 which is located south of HC-13 (Figure 9). The primary source of these compounds were several underground fuel storage tanks which were removed in the fall of 1988.

o Groundwater discharge from the Upper Sand is towards the Snohomish River or into the underlying sand. A sample (EV-04) from a seep which discharges into the river, at a point downgradient of the East Shop area (Figure 4), contains detectable concentrations of BTEX (0.42 ppm) and PAH compounds (2.87 ppm). Benzene and total xylenes were detected in the seepage at 0.10 and 0.20 ppm respectively, while most of the PAH compounds consist of naphthalene which was detected at 2.3 ppm. Arsenic and several other metals were also detected in the seep water. Total arsenic was detected at a concentration of 0.115 ppm.

o Relatively high arsenic concentrations were also detected in upgradient shallow wells as shown on Figure 7. Concentrations of more than 0.50 ppm were detected. The concentrations of arsenic in upgradient wells does not appear to be directly related to former wood treating operations. Additional sampling work is recommended to determine the source of this arsenic.

Preliminary Risk Assessment

The preliminary risk assessment indicates that site risks to public health are mostly related to potential skin (dermal) contact or soil ingestion. As long as site access is restricted, these risks are negligible. This same risk assessment indicates that the calculated impacts of the Mill E discharges into the river system are negligible because of dispersion and dilution. No interim remedial actions, other than what Weyerhaeuser has already implemented (discussed under Interim Remedial Action), are indicated based on the preliminary risk assessment.

Public Health: To arrive at these findings the preliminary assessment estimated risks for four exposure pathways:

o Soil ingestion by on-site adult workers;

o Dermal (skin) exposure by on-site adult workers;

o Inhalation of dusts and vapors by off-site residents; and

o Consumption of fish and shellfish by off-site residents.

Exposure assumptions and chemical toxicity values recommended by EPA Region X were used in making the assessment. The EPA assumptions, by assuming unrestricted site access, generally result in over estimation of the exposures and risks.

Nearly all the potential non-carcinogenic risks are attributable to dermal contact or soil ingestion exposures to TCDD-equivalents present in on-site soils. In reality, the risks due to direct dermal contact or soil ingestion are negligible because contaminated soil is covered with ballast and site access in the East Shop Area is restricted.

Cumulative cancer risks due to lifetime exposures, expressed as the possibility of additional cancer risks per a unit population, were estimated to be between 0 and 1 additional cases in 20,000 for the average condition and between 0 and 1 additional cases in 3,000 for the probabilistic upper bound condition. To provide perspective on these risk levels, consumption of charcoal broiled steak (two servings per week) is associated with a calculated cancer risk of 1 in 14,000. Nearly all the calculated risks are due to arsenic, PAH, and TCDD-equivalent exposures. However, more than 98 percent of the total estimated potential risk is attributable to dermal contact and soil ingestion exposures. As with the non-carcinogenic risks, the current risks are negligible because the contaminated soil is covered with ballast and the site is restricted.

Ecological Assessment: Potential ecological risks to the Snohomish River estuary from water discharges into the river were assessed for water and sediment.

Groundwater and/or seep (EV-4) concentrations of arsenic, acenaphthene, naphthalene, and pentachlorophenol exceed marine chronic or acute marine ambient water quality criteria as summarized in Table 2. The limited available data indicates that seep-water concentrations are lower by a factor ranging from 2 to 35 times the average groundwater concentrations detected in the upper sand zone. Further dilution would occur in the river. A groundwater budget analysis of the possible range of groundwater flow volumes into the river indicate dilutions between

1,000,000:1 to 2,800,000:1. Such dilutions substantially reduce "contact" concentrations in the river, and indicate that only a small nearshore area would exceed the criteria.

Table 2 - Comparison of Water Quality with Ambient Criteria

Parameter (conc. in ppm)	Average GW Concentration*	EV-4 Seep Concentration	Chronic Marine Criteria	Acute Marine Criteria
Arsenic	4.1	0.115	0.013	2.3
Acenaphthene	0.755	0.120	0.710	0.970
Naphthalene	5.6	2.3	0.62	2.4
Pentachlorophenol	9.2	NA	0.008	0.013

Note: * GW = groundwater

Sediment Quality Comparisons

Many of the chemicals identified at the Mill E site have a tendency to adsorb to sediments after discharge to receiving waters. Sediment quality has received much attention and sediment standards have been developed for the Puget Sound Region. Apparent Effects Thresholds (AETs) are sediment concentrations which, if exceeded, may result in biological impacts to at least some sensitive marine species. The AETs are subdivided into LAETs and HAETs. The LAETs represent toxicity thresholds for the most sensitive species tested, while HAETs represent a level above which biological effects may be noted for a variety of components of the ecological community.

Table 3 summarizes the sediment quality data that was collected as part of this work and compares this data with the LAETs and the HAETs. None of the concentrations exceed the HAETs but five chemicals, at one location (samples EV-3 and EV-5 - Figure 2), exceed the LAETs including acenaphthene, fluorene, 2-methylnaphthalene, naphthalene and dibenzofurans. Arsenic exceeds the LAET at one location (RS-6). Based on these data, possible sediment toxicity caused by site discharges is limited to small, localized areas, near seep EV-4 and sediment sampling location RS-6. Samples taken upstream and downstream of each of these locations (Figure 2) did not detect these compounds except at RS-4 where fluorene was detected at 1.7 ppm well below the LAET of 23 ppm. This finding is also supported by sediment data obtained from the main Snohomish River channel.

Recent studies by EPA showed that there are no regional sediment quality concerns near the Mill E site. As part of the overall evaluation of sediment contamination and toxicity in the greater Everett Harbor area, EPA collected sediment samples in the main river channel both upstream and downstream of the Mill E site. Two samples were obtained upstream SR-01 and SR-02 (Figure

1) and a sample was taken downstream (SR-03). Arsenic, acenaphthene, naphthlene, and dibenzofurans were detected at both the upstream and downstream locations at concentrations below the LAETs. Although several of the six chemicals discussed above were detected in the main channel sediments, none of the concentrations exceeded LAETs as summarized in Table 4.

Table 4 - Summary of EPA Sediment Data

PARAMETER	UPSTREAM LOCATION SR-01	UPSTREAM LOCATION SR-02	DOWNSTREAM LOCATION SR-03
Arsenic (ppm)	8.0	7.8	8.9
Acenaphthene (ppb)	2	2	9
Fluorene (ppb)	10u	10u	10u
2-Methylnaphthalene (ppb)	10u	6	12
Naphthalene (ppb)	11	14	35
Total Dibenzofuran (ppb)	10u	3	10

Note: Units in mg/kg (ppm) or ug/kg (ppb) - dry weight
Source: EPA, 1988, Puget Sound Estuary Program Everett Harbor Action Program: Analysis of Toxic Program Areas. PTI Environmental Services and Tetra Tech, Inc. Final Report, Septmeber, 1988.

RECOMMENDED INTERIM REMEDIAL ACTIONS

Based upon the preliminary risk assessment, the following interim remedial actions are recommended for the Mill E site:

o **Site Access Restrictions.** Existing site access restrictions should be maintained. The Mill E site is already closed to unauthorized personnel.

o **Soil Disturbance.** Since the preliminary risk assessment indicates the predominant site risks are associated with possible dermal contact with soil or ingestion of soil within the Old Machine Shop area, the cover and underlying soils should not be disturbed without proper health and safety precautions to mitigate these risks.

ADDITIONAL DATA COLLECTION AND EVALUATIONS

To complete the site characterization, some additional data collection efforts are recommended. The recommended activities are outlined below.

o Soil and Facilities

- Sampling of Soils Beneath Foundations. No soil samples have yet been taken from under or immediately adjacent to existing foundations of the machine shop where the wood treating process was conducted. Additional soil samples should be obtained and analyzed.

o Groundwater

- Identify and Sample Possible Additional Seeps. One seep has been sampled to date. Other seeps should be identified and sampled to assess seasonal variability and refine the assessment of possible impacts to the river.

- Additional Sampling of Existing Wells. In order to assess seasonal variability in groundwater concentrations and flow patterns, additional sampling of the existing wells is required.

- Historical Review of Upgradient Activities. Historical activities that occurred upgradient from Mill E should be identified to assess the possible cause of relatively high arsenic concentrations in the upgradient Wells HC-11 and HC-17.

- Installation of Additional Upgradient Wells. Additional monitoring wells should be installed in the Upper Sand to assess arsenic groundwater concentrations upgradient of Mill E. The location of wells should be based on the results of the historical review.

- Install Monitoring Wells into Lower Sand. Monitoring wells should be installed into the Lower Sand to assess the vertical and horizontal extent of contamination, if any, between the Old Machine Shop and the Snohomish River.

Table 3 - Summary of Snohomish River Sediment Data and Comparison to Apparent Effects Threshold Values

	UPSTREAM		NEAR HC-01	50 ft SOUTH OF HC-02	20 ft SOUTH OF HC-09	ACROSS RIVER	NEAR HC-7		NEAR HC-07	5 ft NORTH OF HC-10	200 ft NORTH OF HC-10	APPARENT EFFECTS THRESHOLDS	
							Surface	1.5 Ft.					
PARAMETER	EV-1	EV-2	RS-5	RS-6	RS-4	EV-6	EV-3	EV-5	RS-3	RS-2	RS-1	LAET	HAET
Percent Solids	79.0%	55.7%	83.0%	47.8%	46.5%	74.9%	60.5%	40.5%	56.7%	66.2%	76.8%		
TOC (% dry wt)	4.4% (a)	4.4% (a)	4.4% (a)	4.4% (a)	4.4% (a)	4.4% (a	3.6%	4.0%	4.4% (a)	4.4% (a)	4.4% (a)		
METALS (mg/kg dry wt.):													
Arsenic	20.0 U	10.0 U	20.0 U	460.0	20.0 U	10.0 U	10.0	21.0	20.0 U	20.0 U	20.0 U	57.0	700.0
Chromium	58.0	33.0	35.0	58.0	60.0	23.0	36.0	42.0	47.0	38.0	30.0	260.0	270.0
VOLATILES (mg/kg TOC):													
Benzene	0.1 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.2 U	0.2	0.2 U	0.2 U	0.1 U	-	-
Toluene	0.1 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.2 U	0.2	0.2 U	0.2 U	0.1 U	20.0 (a	470.0
Ethylbenzene	0.1 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.2 U	0.7	0.2 U	0.2 U	0.1 U	2.4 (a	>3.8
Total xylenes	0.1 U	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.2 U	2.1	0.2 U	0.2 U	0.1 U	12.0 (a	>12
LPAHs (mg/kg TOC):													
Acenaphthene	8.3 U	16.7 U	7.5 U	15.2 U	15.6 U	9.2 U	50.5	67.9	16.1 U	11.8 U	8.8 U	16.0	200.0
Fluorene	8.3 U	16.7 U	7.5 U	15.2 U	1.7	9.2 U	16.5	29.6	16.1 U	11.8 U	8.8 U	23.0	360.0
2-Methylnaphthalene	8.3 U	16.7 U	7.5 U	15.2 U	15.6 U	9.2 U	68.9	80.2	16.1 U	11.8 U	8.8 U	64.0	>120
Naphthalene	8.3 U	16.7 U	7.5 U	15.2 U	15.6 U	9.2 U	220.4	166.7	16.1 U	11.8 U	8.8 U	99.0	220.0
Phenanthrene	8.3 U	16.7 U	7.5 U	15.2 U	8.3	9.2 U	17.9	34.0	16.1 U	11.8 U	8.8 U	120.0	690.0
HPAHs (mg/kg TOC):													
Benzo(a)anthracene	8.3 U	16.7 U	7.5 U	15.2 U	2.3	9.2 U	21.1 U	20.3 U	16.1 U	11.8 U	8.8 U	110.0	650.0
Benzo(b)fluoranthene	8.3 U	16.7 U	7.5 U	15.2 U	2.7	9.2 U	21.1 U	20.3 U	16.1 U	11.8 U	8.8 U	230.0	1,500.0
Chrysene	8.3 U	16.7 U	7.5 U	15.2 U	3.2	9.2 U	21.1 U	20.3 U	16.1 U	11.8 U	8.8 U	110.0	850.0
Fluoranthene	8.3 U	16.7 U	1.8	15.2 U	13.7	9.2 U	21.1 U	20.3 U	16.1 U	11.8 U	8.8 U	160.0	3,000.0
Pyrene	8.3 U	16.7 U	1.6	15.2 U	7.9	9.2 U	21.1 U	20.3 U	16.1 U	11.8 U	8.8 U	1,000.0	1,400.0
PENTACHLOROPHENOL (mg/kg dry weight basis)	1.9 U	2.7 U	1.8 U	3.1 U	3.2 U	2.0 U	2.5 U	4.0 U	2.8 U	2.4 U	2.1 U	0.36	0.69
MISCELLANEOUS (mg/kg TOC):													
Bis(2-EH)phthalate	8.3 U	16.7 U	1.5	22.7 U	2.2	9.2 U	21.1 U	38.1 U	1.7 (e)	1.4 (e)	8.8 U	47.0	78.0
Total Dibenzofuran	8.3 U	16.7 U	7.5 U	22.7 U	24.0 U	9.2 U	18.8	32.1	16.1 U	11.8 U	8.8 U	15.0	>170

NOTES:

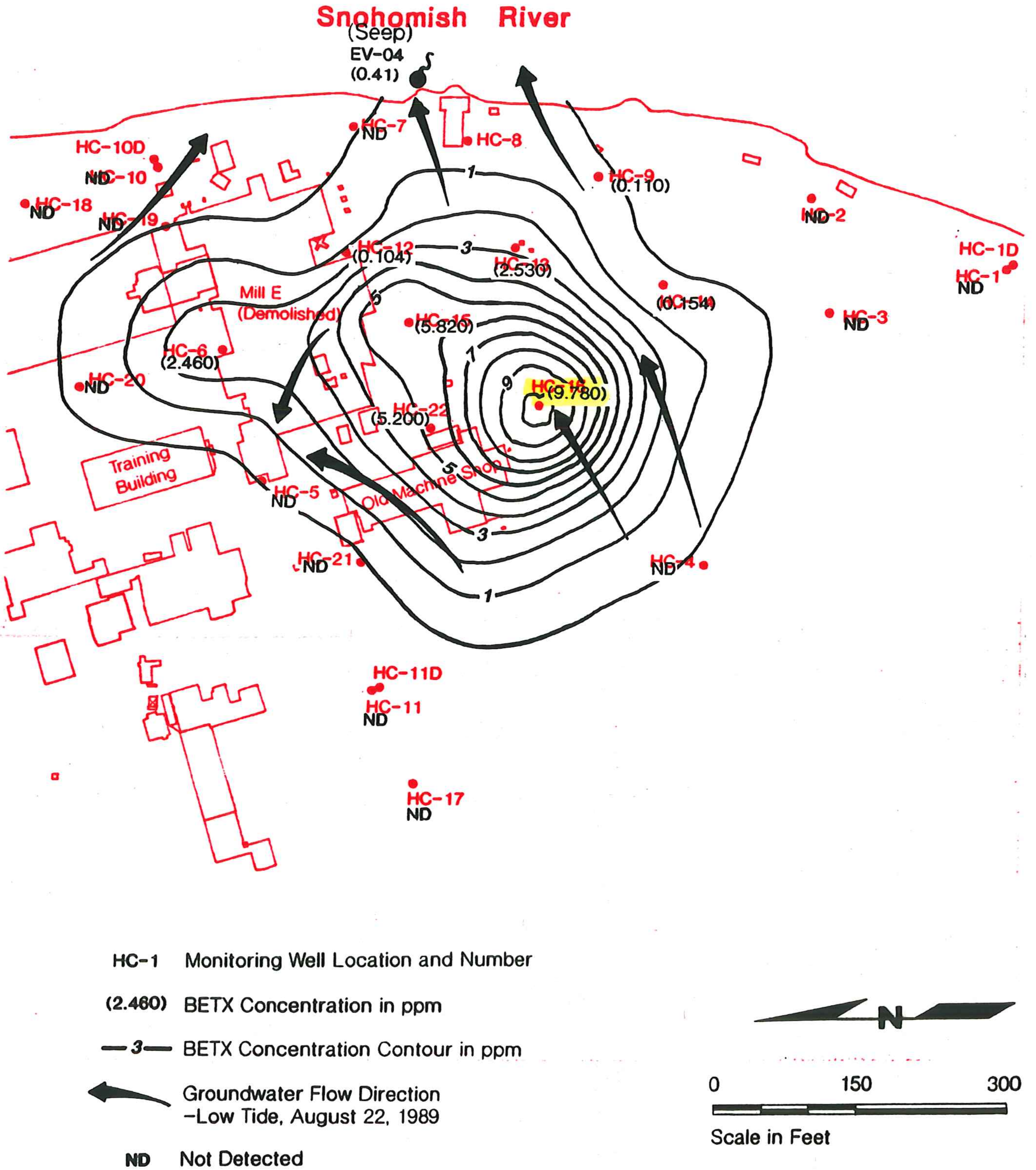
(a) Values presented represent estimates based on data collected in similar environments.

(b) See Figure 2 for sediment sample locations.

(c) U indicates not detected above detection limit.

BETX Concentrations in Groundwater Contour Map

Upper SAND Unit



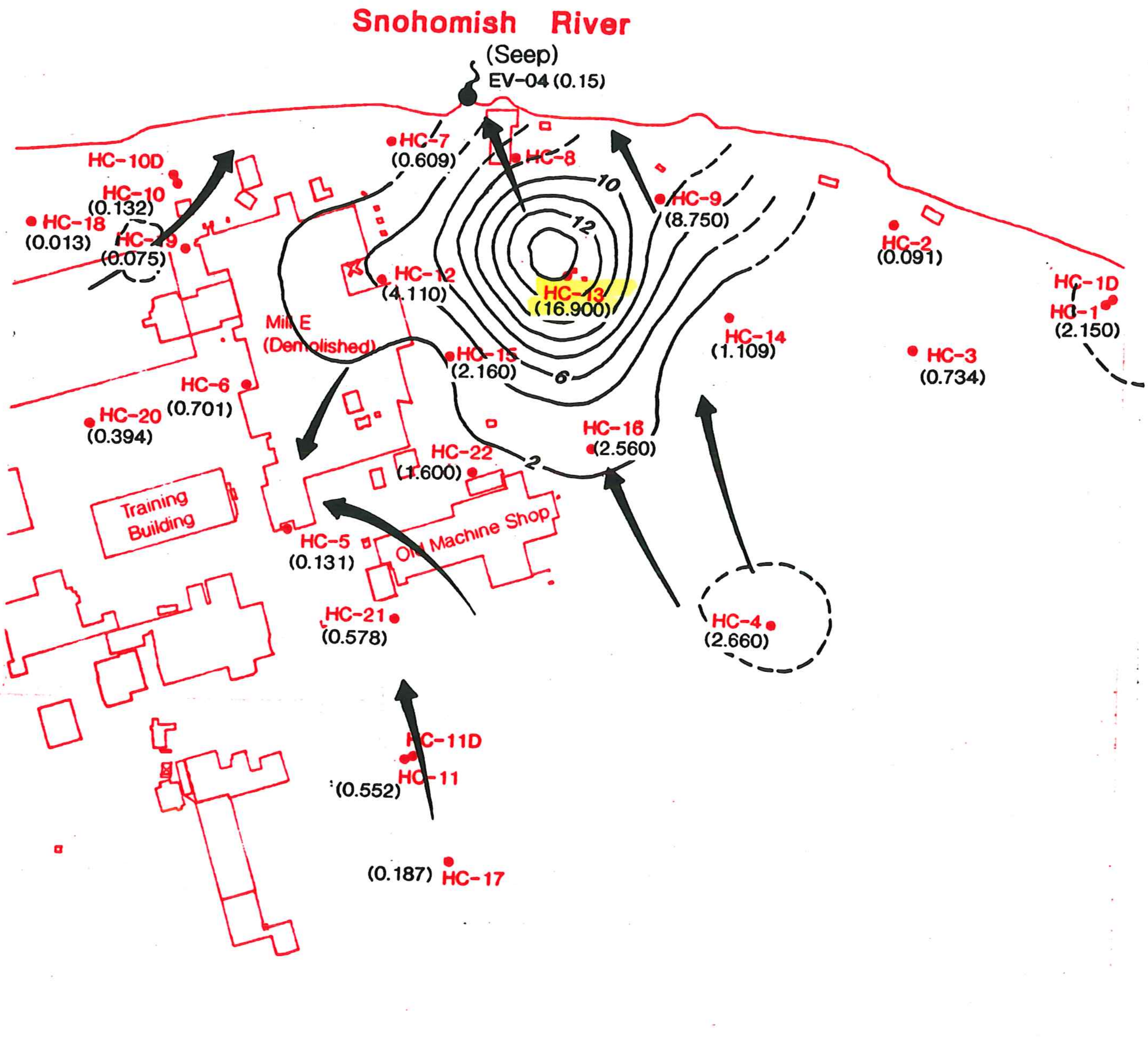
HARTCROWSER

J-2395-06 4/90

Figure 9

Dissolved Arsenic Concentrations in Groundwater Contour Map

Upper SAND Unit



N

0 150 300

Scale in Feet

● HC-1 Monitoring Well Location and Number

(0.701) Dissolved Arsenic Concentration in ppm

— 10 — Dissolved Arsenic Concentration Contour in ppm

Groundwater Flow Direction –Low Tide, August 22, 1989.

ND Not Detected

Contour Interval 2 ppm

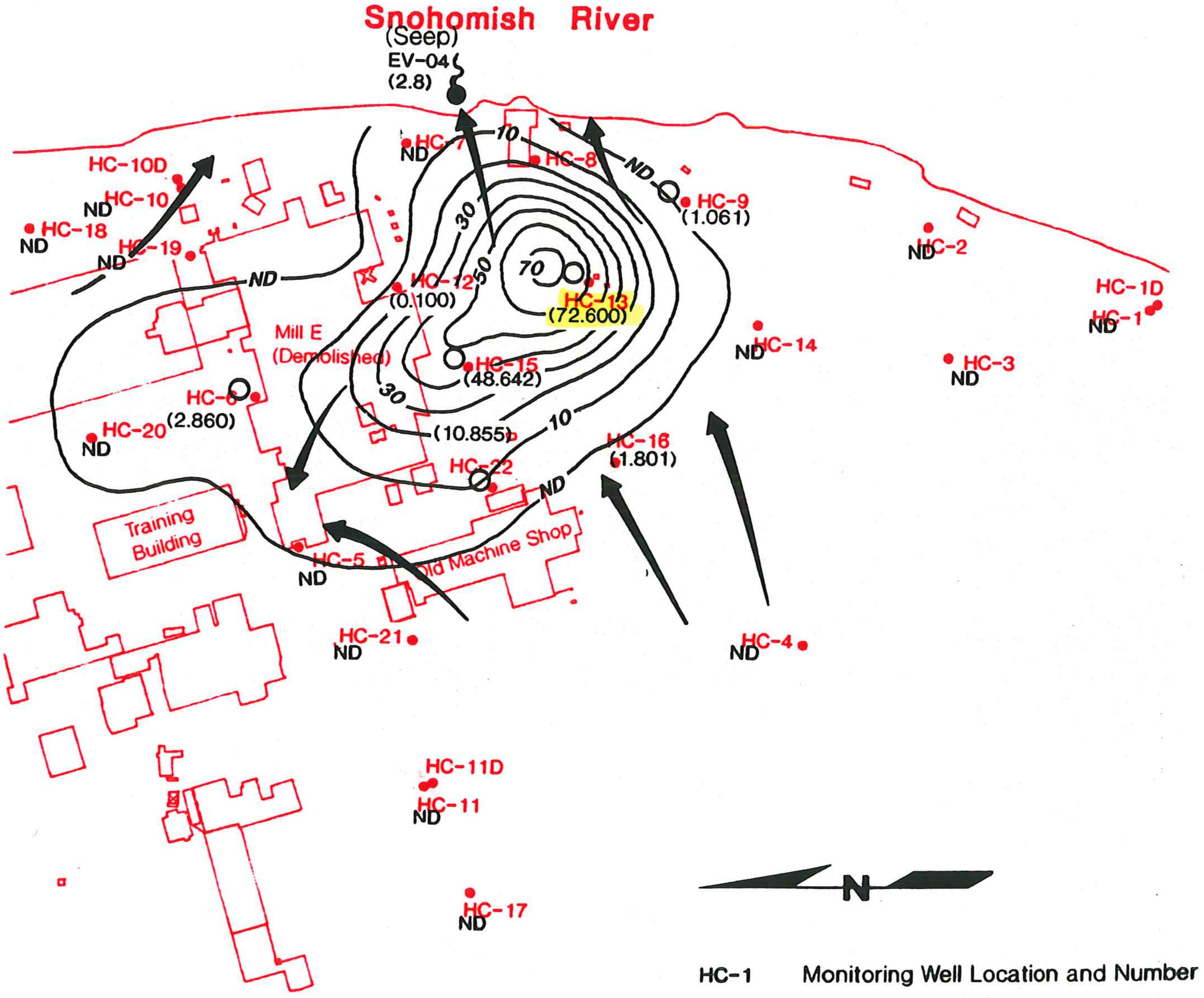
HARTCROWSER

J-2395-06 4/90

Figure 7

PAH Concentration in Groundwater Contour Map

Upper SAND Unit



HC-1	Monitoring Well Location and Number
(2.860)	PAH Concentration in ppm
—10—	PAH Concentration Contour in ppm
ND	Not Detected
	Contour Interval in 10 ppm
←	Groundwater Flow Direction – Low Tide, August 22, 1989.

0 150 300

Scale in Feet

Wells with PCP Detections

Well	PCP Concentration in ppm
HC-6	0.015J
HC-9	4.4J
HC-13	60J
HC-15	2.1
HC-22	0.036J

J = Estimated Concentration

Groundwater Flow Direction
–Low Tide, August 22, 1989.

HARTCROWSER

J-2395-06 4/90

Figure 8