EMCON Northwest, Inc.
18912 North Creek Parkway • Suite 100 • Bothell, Washington 98011-8016 • (206) 485-5000 • Fax (206) 486-9766

October 6, 1994
Project 0141-037.63
Privileged and Confidential

Mr. Mark Schneider
Perkins Coie
1201 Third Avenue, 40th Floor
Seattle, Washington 98101-3099

Re: Arsenic Data Review
Weyerhaeuser Everett West Site

Dear Mark:

This report summarizes the available arsenic information developed from environmental investigations in the north Everett area. The purpose of the review is to compare background arsenic concentrations in soil and groundwater to those in the immediate vicinity of the former ASARCO Everett smelter and the Weyerhaeuser Everett West Site. The relative locations of the above-mentioned sites are shown on the site vicinity map (Figure 1).

INTRODUCTION

Various environmental investigations conducted in the north Everett area have evaluated arsenic concentrations in soil and groundwater. Findings of environmental investigations pertaining to the Weyerhaeuser West Site were reported in *Compilation of Assessment Documents for Weyerhaeuser Everett West Site, Volumes 1 through 3* (EMCON, 1994a). The ASARCO Everett smelter investigations include *Hazard Assessment* and *Pre-Remedial Investigation* (SAIC, 1991a, 1991b), and *Everett Smelter Site Remedial Investigation (RI)* (Hydrometrics, 1994). In addition, an environmental assessment for a proposed park along East Marine View Drive was performed by Dames and Moore (1993). References for the reports associated with the above-referenced investigations are attached. Additional investigation of the lowland area downgradient of the former smelter area is proposed by ASARCO, pending access agreements with Burlington Northern Railroad and private individuals.

The sources and distribution of arsenic in the north Everett area have not been fully characterized. However, there is sufficient information to develop a preliminary conceptual model of the local stratigraphy and groundwater flow and the general distribution of arsenic in soil and groundwater in the north Everett area. In general, arsenic concentrations in shallow soil increase near the former ASARCO smelter operations. Maximum groundwater arsenic

concentrations are found downgradient of the former ASARCO smelter and associated slag deposits.

LOCAL TOPOGRAPHY AND GEOLOGY

The topography of the north Everett area consists of an elevated plateau with steep slopes surrounded by tideflats. The geology of the plateau consists primarily of fill and glacial deposits. The tideflats consist of estuarine and fluvial silt and sand overlain by dredge river sand and other fill. For the purpose of this evaluation, the north Everett area was divided into smaller geographical areas based on topography, geology, and former industrial activities (see Figure 1).

The geographic areas are described as follow:

- North Everett Background Area - defined as the area of the Everett plateau with a low potential for smelter-related impacts. Geologic units include 5 to 25 feet of sand and gravel fill, 5 to 60 feet of glacial till, and up to 300 feet of glacial outwash sand. Soil samples associated with past investigations were collected at shallow depths (2 feet or less).

- ASARCO Smelter Peripheral Area - defined as the area upgradient and adjacent to the former ASARCO smelter site. Geologic units are similar to those in the North Everett Background Area, with a general thinning of units towards the edge of the plateau. Soil borings in the area indicate 5 to 25 feet of fill, 5 to 15 feet of till, and at least 30 feet of outwash sand. Soil samples associated with past investigations were collected at depths ranging from the ground surface to 20 feet below ground surface (bgs).

- ASARCO Smelter Area - defined as the former ASARCO smelter operations area on the Everett plateau and the steep eastern slopes facing the Snohomish River. Geologic units and thicknesses are similar to those in the ASARCO Smelter Peripheral Area. Soil samples were collected at depths ranging from the ground surface to 69 feet bgs.

- Snohomish River Tideflat Area - defined as the former Snohomish River tideflats located north and east of the former ASARCO smelter, now covered by up to 10 feet of dredge sand and other fill (the upper sand unit). Approximately 10 feet of organic silt (the upper silt unit) and up to 75 feet of fluvial sand underlie the dredge fill to at least 100 feet bgs. The Weyerhaeuser Everett West and East sites are located in this area.

A generalized geologic map and cross section of the north Everett area are shown in Figures 2 and 3, respectively.

LOCAL HYDROGEOLOGY

Shallow groundwater exists intermittently in sandy fill and sandy lenses within the glacial till on the Everett plateau. Deeper groundwater occurs throughout the plateau in the glacial sand outwash. Water levels were reported at depths of 5 and 47 feet bgs in these glacial units, respectively, indicating a high downward vertical gradient between the two units. Groundwater generally flows radially from the Everett plateau towards the Snohomish River (Figure 2).

Shallow groundwater in the Tideflat Area occurs at depths of 1 to 8 feet bgs in the dredge sand fill (upper sand aquifer), and deeper groundwater occurs in saturated sand (lower sand aquifer) underlying the silt of the former tideflat. The water level in the lower sand aquifer rises to 6 to 8 feet bgs. The vertical gradient between the two units is downward. The lower sand aquifer is tidally influenced near the Snohomish River. In general, groundwater flows towards the Snohomish River shoreline.

Hydraulic connections between the Everett plateau and the Tideflat Area are not well defined, but it is probable that groundwater flows from the outwash sand beneath the plateau to the lower sand aquifer beneath the Tideflat Area. It is possible that groundwater in the shallow deposits on the plateau flows to the upper sand aquifer in the Tideflat Area, however, this determination could not be made with the available data.

SOURCES OF ARSENIC IN SOIL AND GROUNDWATER

Operations at the former ASARCO smelter included lead ore smelting and extraction and processing of arsenic from smelter slag. Wastes from these operations included smelter slag, smelter fluedust (ash), by-products from arsenic processing and rock wool manufacturing, and arsenic-bearing demolition debris (Hydrometrics, 1994). These wastes were deposited at various locations around the former smelter, either transported as windblown particulate, by downslope movement from waste piles, or by man-induced spreading or relocation of wastes (Hydrometrics, 1994). The distribution of waste is not fully documented, but historical records indicate that smelter-related, arsenic-bearing material was probably used as fill for construction of roads, buildings, and railroads and incorporated with dredge fill to the east of the Burlington Northern Railroad on current Weyerhaeuser property (Hydrometrics, 1994). Windblown material is assumed to have been deposited in the directions of prevailing winds, which are to the southeast and the northwest of the former smelter (Hydrometrics, 1994). Based on boring logs in

Hydrometrics (1994), EMCON estimates that at least 5,000 cubic yards of smelter slag were deposited on the slopes and tideflat immediately east of the former smelter site. The slag deposit lies in both the ASARCO Smelter Area and the Tideflat Area. Fragments of slag were noted in sand fill samples from soil borings and test pits at depths from 2 to 60 feet bgs (Hydrometrics, 1994). EMCON personnel observed cinders or slag fragments on the surface at distances up to 400 feet to the northeast of the slag outcrop, and at the Weyerhaeuser Everett East Site (EMCON, 1994b). Cinders or slag have not been observed by EMCON to date in other locations. Concentrations of arsenic in the slag reportedly ranged from 400 to 1,000 mg/kg (Hydrometrics, 1994).

SUMMARY OF FINDINGS

The soil and groundwater data were divided according to the geographical areas. The *Everett Smelter Site RI* soil data were further subdivided according to sample collection depth to evaluate soil arsenic distribution with depth. Groundwater data were subdivided according to hydrostratigraphic zones to compare arsenic concentrations with depth.

Arsenic in Soil

Statistical summaries for each of the geographic areas and different sampling depths are presented in Table 1. The Washington State Department of Ecology (Ecology) statistical software MTCAStat was used to calculate mean arsenic concentrations at the Weyerhaeuser property. Mean arsenic concentrations of the Smelter, Peripheral, and Background Areas were calculated by Hydrometrics (1994) using a simple geometric mean.

The average arsenic concentration in soil in the North Everett Background Area was estimated at 17 mg/kg and is considered to represent natural background conditions. The average arsenic concentration in soil below 2 feet in depth in the ASARCO Smelter Peripheral Area was at or less than the background concentration. Elevated arsenic concentrations in soil were detected above background levels at all soil sample depths (up to 17 feet bgs) in the ASARCO Smelter Area. Maximum arsenic concentrations were detected at and below the former arsenic processing area at the former smelter site (see Table 1). Average arsenic concentrations apparently decrease with soil depth in the ASARCO Smelter Area (Hydrometrics, 1994).

The average arsenic concentration in shallow soil at the Everett West Site in the Tideflat Area was found to be 14.4 mg/kg and is less than the background arsenic concentration.

Arsenic in Groundwater

Monitoring wells in the north Everett area have been sampled quarterly. Average arsenic concentrations were calculated for each region and hydrostratigraphic unit. MTCAStat was used to calculate the average concentrations, which are summarized in Table 2. Total arsenic concentrations are compared in all data sets except for the Everett West Site (dissolved arsenic only). Locations of monitoring wells evaluated for arsenic concentrations are shown on Figure 4.

Shallow Groundwater

No shallow groundwater samples were available from the North Everett Background Area or from the ASARCO Smelter Area. Shallow groundwater was not reportedly encountered during drilling of shallow borings in the ASARCO Smelter Area (Hydrometrics, 1994).

Total arsenic was detected at a maximum of 0.012 mg/L and averaged less than 0.005 mg/L at the only monitoring well (EV-1) installed in the shallow groundwater in the ASARCO Smelter Peripheral Area (Hydrometrics, 1994). Total arsenic in the Tideflat Area immediately downgradient (east) of the slag area and the former smelter ranged from 0.38 to 36 mg/L, and averaged 1.55 mg/L (Hydrometrics, 1994). Arsenic concentrations decreased with distance downgradient of the slag area and former smelter. The total arsenic concentrations in five monitoring wells downgradient of the Everett smelter (Figure 4) ranged from less than 0.005 mg/L to 0.054 mg/L, and averaged less than 0.005 mg/L. These wells may represent background arsenic concentrations for shallow groundwater at the Tideflat Area. Dissolved arsenic concentrations at the Weyerhaeuser Everett West Site ranged from 0.003 to 0.100 mg/L and averaged 0.014 mg/L.

Deep Groundwater

No monitoring wells were installed by ASARCO in the deeper groundwater (outwash sand) in the North Everett Background or ASARCO Smelter Peripheral Areas. Total arsenic was detected at a maximum of 0.012 mg/L in the only monitoring well (EV-3) installed in the ASARCO Smelter Area.

The background arsenic concentrations in the deep groundwater at the former demo landfill in the Tideflat Area may be represented at MW-7 (outwash sand aquifer) or MW-9 (lower sand aquifer), where average arsenic concentrations of 0.011 mg/L and 0.006 mg/L, respectively, were detected.

Total arsenic concentrations in deep groundwater (outwash sand and lower sand aquifer) near the slag deposit in the Tideflat Area ranged from 0.0098 to 14.65 mg/L. Concentrations decreased with distance to 2.7 mg/L at MW-4B (Figure 4). However, further downgradient in the lower sand aquifer, an average dissolved arsenic concentration of 4.46 mg/L was detected in well MW-108D at the Everett East Site (EMCON, 1994c).

SUMMARY AND CONCLUSIONS

Soil. Soil arsenic concentrations of the North Everett Background Area are estimated to be about 17 mg/kg. The average arsenic concentration in soil at the Everett West Site (14.4 mg/kg) is similar to the background area. Elevated arsenic concentrations are found in soil at the ASARCO Smelter and Peripheral Areas. Arsenic concentrations decrease with distance and depth from former smelter operations, although elevated arsenic concentrations are still encountered at 17 feet below ground surface in the ASARCO Smelter Area.

Groundwater. Average total arsenic concentrations at EV-1 (less than 0.005 mg/L) installed upgradient of the Everett smelter site may represent natural background for shallow groundwater of the Everett plateau. No data were available that represent deep (outwash) background groundwater conditions. Background arsenic concentrations (less than 0.005 mg/L) for shallow groundwater at the Tideflat Area may be represented by the five monitoring wells downgradient of the Everett smelter. Background arsenic concentrations in deep groundwater at the Tideflat Area ranged from 0.006 to 0.011 mg/L.

Average arsenic concentrations in shallow and deep groundwater immediately downgradient of the former smelter were significantly greater than background. Average arsenic concentrations in groundwater at the Everett West Site were at least two times greater (0.14 mg/L) than background. The average arsenic concentration in the lower sand aquifer at the Everett West Site was about two times greater than in the overlying upper sand aquifer.

Potential sources of arsenic at the Everett West Site are unknown, but are most likely related to smelter sources because no arsenic-bearing materials reportedly were used in operations at the Everett West site.

LIMITATIONS

Limitations to the services, opinions, and recommendations contained in this report are as specified in the attached statement, which is incorporated herein by reference.

If you have any questions or concerns pertaining to this report, please do not hesitate to contact us at (206) 485-5000.

Sincerely,

EMCON Northwest, Inc.

Steve Nelson, R.G.
Project Hydrogeologist

Linda Dawson
Project Director

Attachments: References
Limitations
Tables 1 and 2
Figures 1, 2, 3, and 4

cc/att: Harold Ruppert; Weyerhaeuser
Stuart Triolo; Weyerhaeuser
John Guenther; EMCON

REFERENCES

Dames & Moore. 1993. Preliminary Results Environmental Audit, Proposed Northeast View Park, Everett, Washington. January 1993.

EMCON Northwest, Inc. 1994a. Compilation of Assessment Documents for Weyerhaeuser, Everett West Site, Volumes 1 through 3.

EMCON Northwest, Inc. 1994b. Draft Remedial Investigation Report for Former Mill E/ Koppers Facility, Everett, Washington. September 1994.

EMCON Northwest, Inc. 1994c. Summary of Weyerhaeuser Everett East Site Soil and Groundwater (in files).

Hydrometrics. 1994. Everett Smelter Site Remedial Investigation, Everett, Washington - Draft. June 1994.

Science Applications International Corporation. 1991a. Final Report for the Everett Slag Site. June 1991.

Science Applications International Corporation. 1991b. Unpublished Data (Pre-Remedial Investigation).

Sweet-Edwards/EMCON. 1988. Hydrogeologic Investigation Demolition Landfill, Everett Kraft Mill. March 1988.

Sweet-Edwards/EMCON. 1988. Hydrogeologic Investigation Weyerhaeuser Landfill, Everett Draft Mill (Technical Addendum). November 1988.

Sweet-Edwards/EMCON. 1990. Groundwater Monitoring at Weyerhaeuser's Demolition landfill, Everett, Washington - First Quarter 1987 through Fourth Quarter 1989. June 1990.

LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

Table 1

Summary of Arsenic in Soil

Sample Depth	Number of Samples Collected	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average Detection (mg/kg)
North Everett Background Area				
Surface	9	7.3	36.4	17
ASARCO Smelter Peripheral Area				
Surface	78	4.0	525	49
2 feet	55	1.9	730	13
4 feet	30	2	299	8.1
6 feet	3	2.5	13	7.4
All	319	1.9	299	23
ASARCO Smelter Area				
Surface	79	7.2	26,550	436
2 feet	53	2.5	430,000	713
4 feet	22	2.5	150,000	388
6 feet	18	2.5	13,030	565
11 feet	13	2	1,800	101
All	407	2	430,000	426
Tideflat Area - Everett West Site				
0 - 5 feet	13	2.7	70.2	14.4

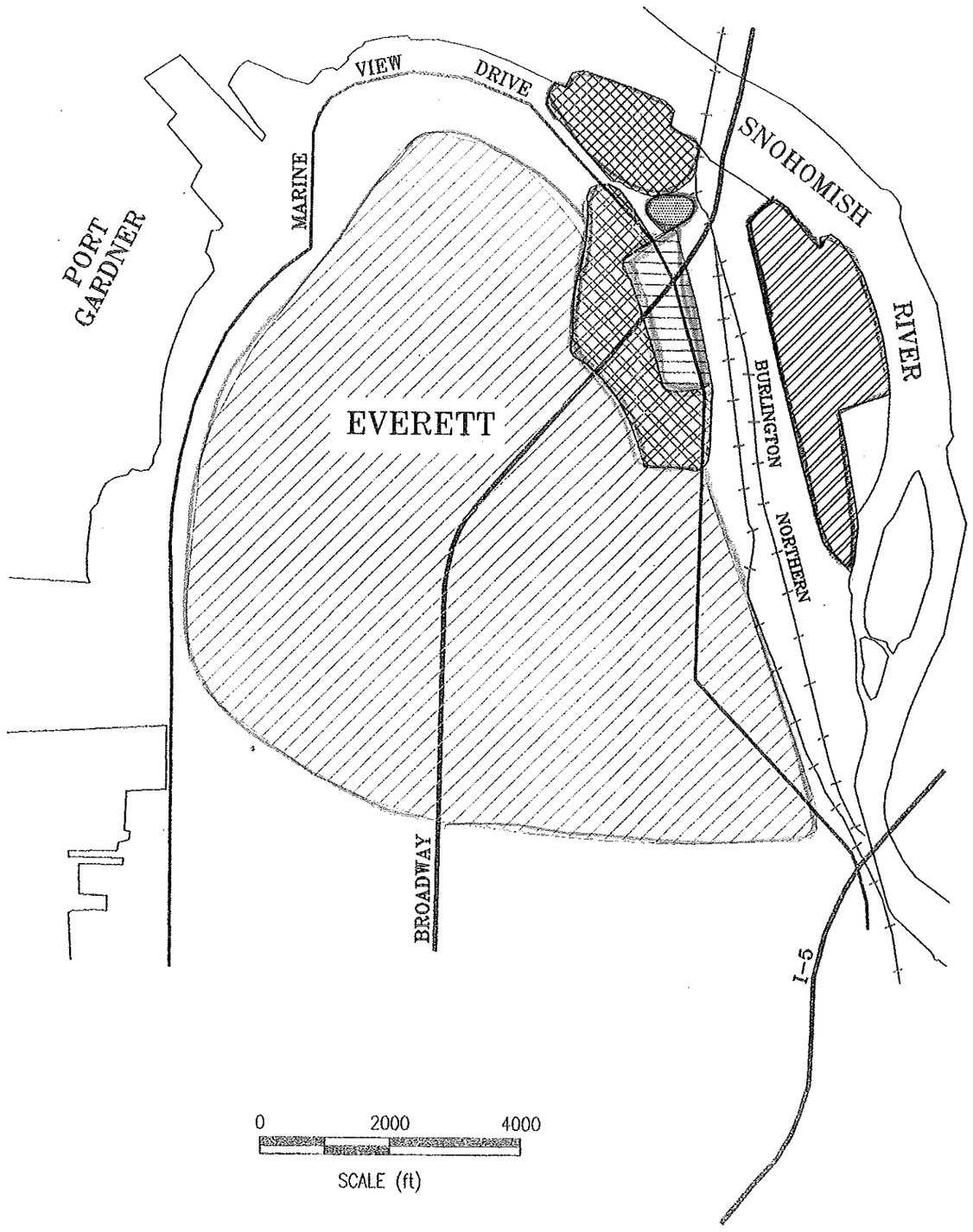
Table 2

Summary of Arsenic in Groundwater
North Everett Area

Area	Number of Wells	Number of Samples	Minimum (mg/L)	Maximum (mg/L)	Average (mg/L)
North Everett Background Area (shallow - fill/till)	0	NA	NA	NA	NA
North Everett Background Area (deep - outwash)	0	NA	NA	NA	NA
Smelter Peripheral Area (shallow - fill/till)[a]	1	4	<0.005	0.012	<0.005
Smelter Peripheral Area (deep - outwash)	0	NA	NA	NA	NA
Everett Smelter Area (shallow - fill/till)	NA	NA	NA	NA	NA
Everett Smelter Area (deep - outwash)[b]	1	5	<0.005	0.012	<0.005
Snohomish Tideflat Area					
Slag area (shallow -fill)[c]	6	16	0.38	36.097	1.55
Slag area (deep - lower sand)[d]	5	13	0.0098	14.65	0.37
Downgradient of smelter area (shallow - upper sand)[e]	5	20	<0.005	0.054	<0.005
Downgradient of smelter area (deep - lower sand)[f]	1	3	2.62	2.78	2.7
Demo Waste Landfill (shallow - fill/upper sand)[g]	1	26	0.002	0.025	0.0074
Demo Waste Landfill (deep - outwash)[h]	1	19	0.001	0.028	0.011
Demo Waste Landfill (deep - Lower Sand)[i]	1	20	<0.003	0.214	0.006
Everett West Site (shallow - Upper Sand)[j]	7	20	0.003	0.100	0.014
Everett West Site (deep - Lower Sand)[k]	5	5	0.011	0.082	0.044

NOTE: See Figure 4 for monitoring well locations.

[a] EV-1
[b] EV-3
[c] EV-4A, EV-6A, EV-7A, EV-8A, EV-9A, WP-1
[d] EV-4B, EV-6B,EV-7B, EV-8B, EV-9B
[e] EV-5, MW-2, MW-3, MW-4A, MW-5
[f] MW-4B
[g] MW-4
[h] MW-7
[i] MW-9
[j] MW-4, MW-1201, MW-1202, MW-1203, MW-1301, MW-1302, MW-1701
[k] SB-1603D, WP-1101D, WP-1601D, WP-1701D, WP-1702D



LEGEND

GEOGRAPHICAL AREAS

- North Everett Background Area
- ASARCO Smelter Peripheral Area
- ASARCO Smelter Area

Snohomish River Tideflat Area

- Weyerhaeuser Everett West Site
- Weyerhaeuser Everett East Site
- Former Demo Landfill

0 2000 4000

SCALE (ft)

EMCON Northwest, Inc.

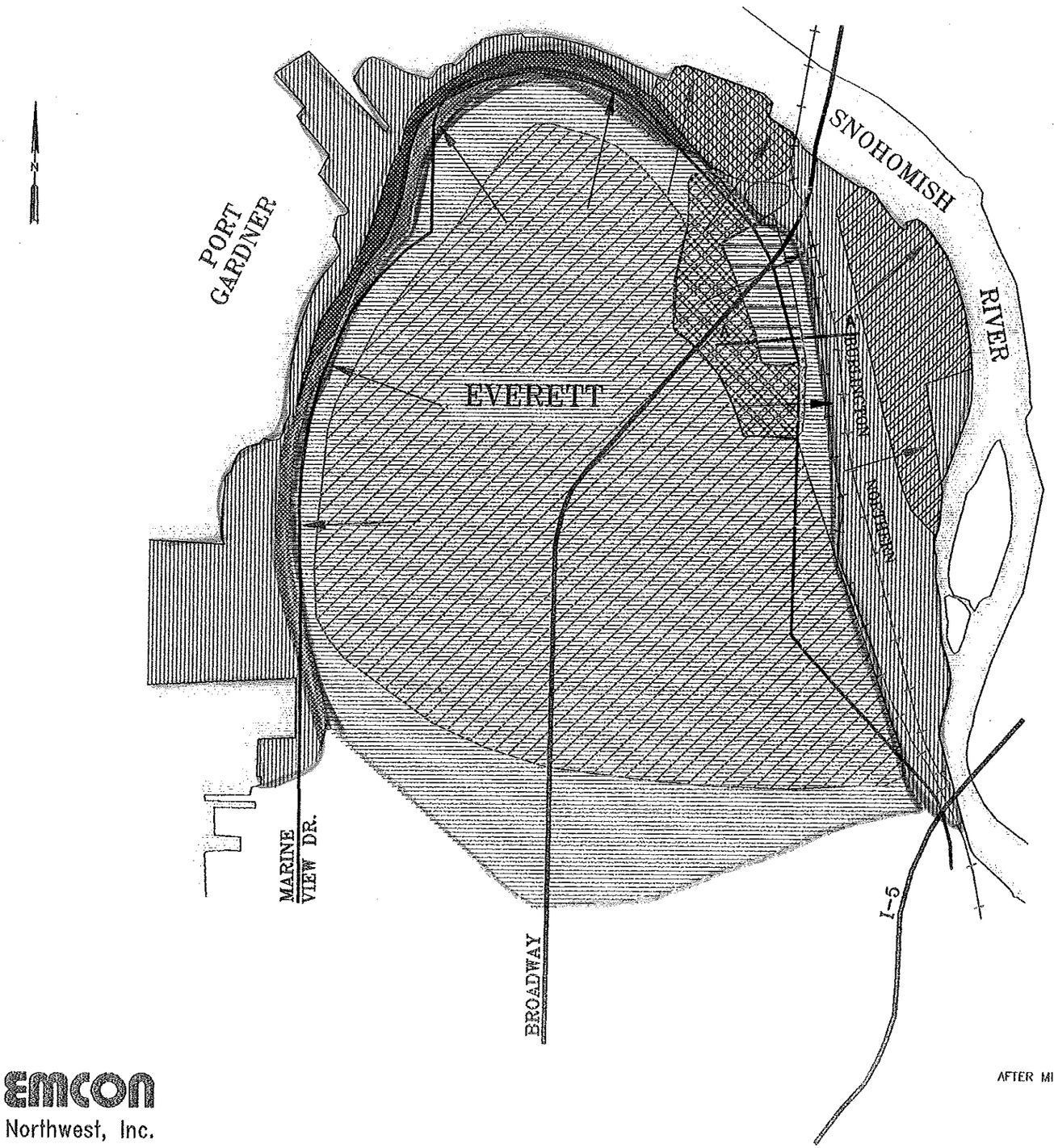
DATE	9-94
DWN.	EJB
REV.	
APPR.	
PROJECT NO.	0141-037.63

FIGURE 1

GEOGRAPHICAL AREAS

WEYERHAEUSER, EVERETT
ARSENIC DATA REVIEW

1=750 10-06-94 G:\DWG\0141\037\63BLC07



LEGEND

GEOGRAPHICAL AREAS:

- North Everett Background Area
- ASARCO Smelter Peripheral Area
- ASARCO Smelter Area

Tideflat Area

- Weyerhaeuser Everett West Site
- Weyerhaeuser Everett East Site
- Former Demo Landfill

GEOLOGIC UNITS

- Fill – Dredge Sand (Upper Sand)
- Vashon Till and Fill
- Vashon Advance Outwash Sand
- Pre–Vashon Silt and Sand
- Generalized Groundwater Flow Direction
- A A' Cross Section Location

0 2000 4000

SCALE (ft)

AFTER MINARD, 1983

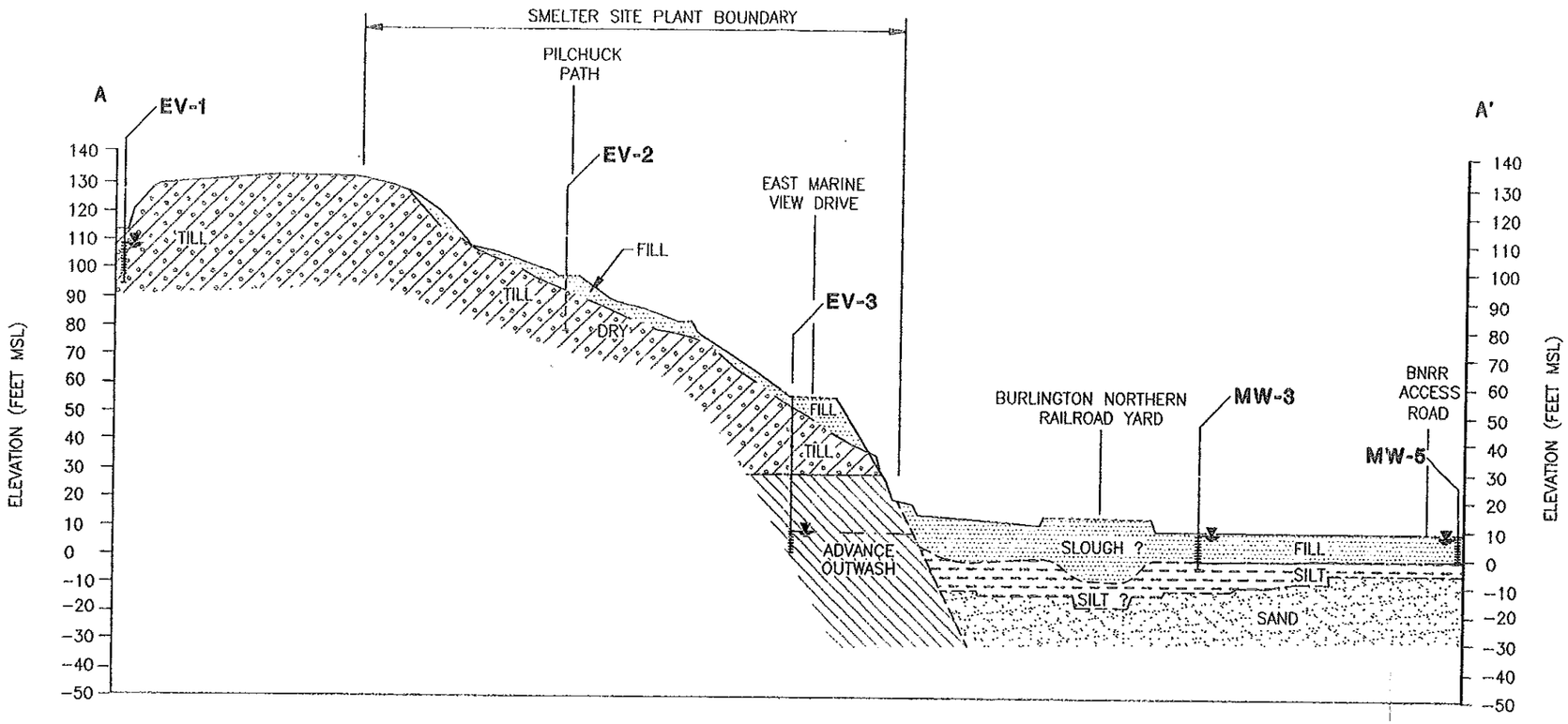
EMCON Northwest, Inc.

DATE	9–94
DWN.	MLP
REV.	
APPR.	
PROJECT NO.	0141–037.63

FIGURE 2
GENERALIZED GEOLOGIC MAP

WEYERHAEUSER EVERETT
ARSENIC DATA REVIEW

1=750 10–6–94 G:\DWG\0141\037\63BLC06



LEGEND:

EXISTING TOPOGRAPHY

GEOLOGIC CONTACT (DASHED WHERE INFERRED)

ROAD

RAILROAD TRACKS

INFERRED POTENTIOMETRIC SURFACE FOR DEEP GROUNDWATER SYSTEM

Well Number — EV-3

Water Level in Well

Screened Interval of Well

MONITORING WELL

UPLAND STRATIGRAPHIC UNITS

FILL

TILL

ADVANCE OUTWASH

LOWLAND STRATIGRAPHIC UNITS

DREDGE FILL – UPPER SAND UNIT

SILT – UPPER SILT UNIT

SAND – LOWER SAND UNIT

0 200 400

HORIZ. SCALE (ft)

2:1 VERTICAL EXAGGERATION

EMCON Northwest, Inc.

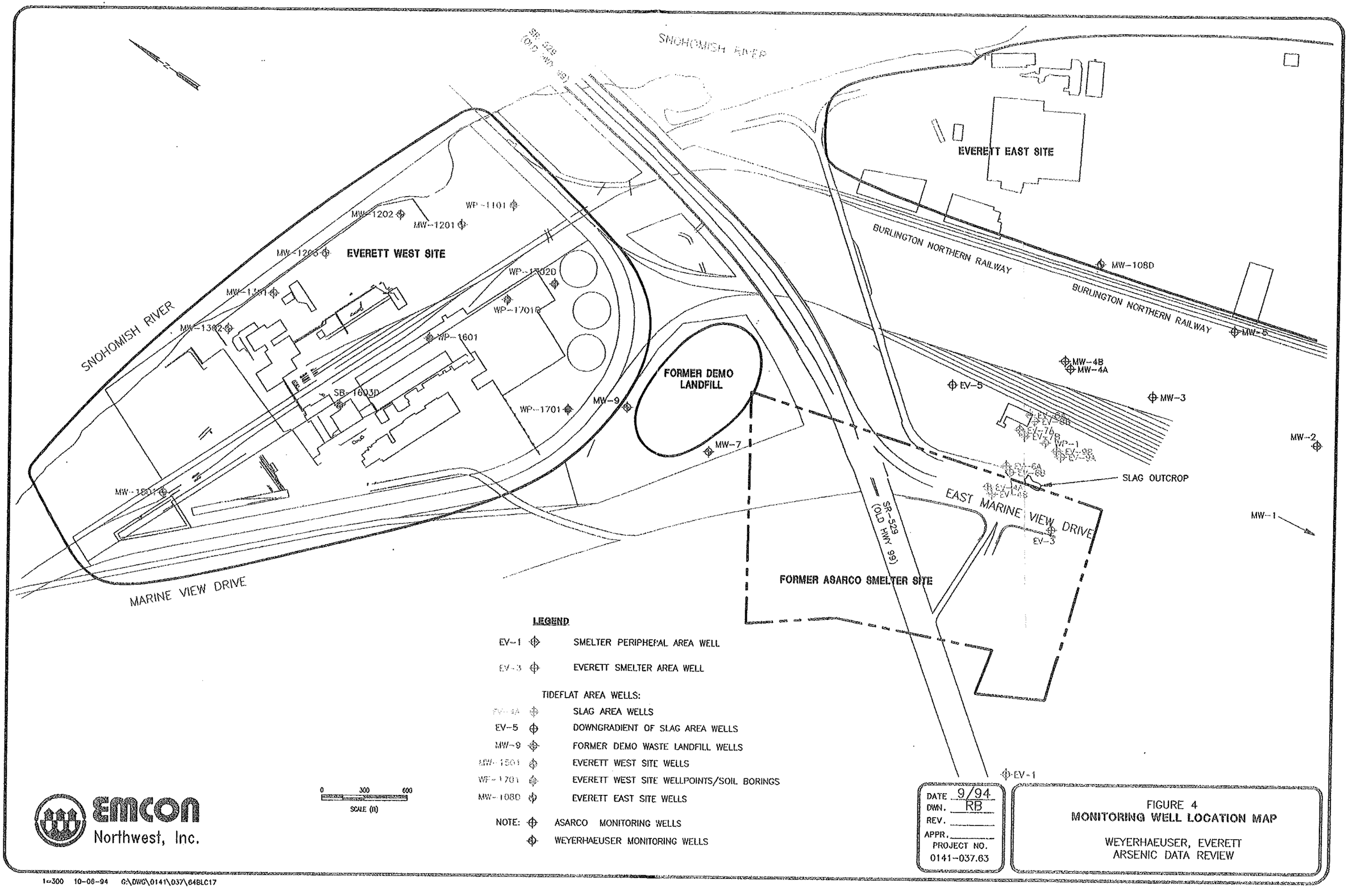
After Hydrometrics (1994)

DATE 9-94
DWN. MLP
REV.
APPR.
PROJECT NO. 0141-037.63

Figure 3
WEYERHAEUSER EVERETT
NORTH EVERETT AREA

GENERALIZED CROSS SECTION

SCALE 1=2 10-6-94 G:\DWG\0141\037\63BLC08


SNOHOMISH RIVER
SR-529 (OLD HWY 99)
SNOHOMISH RIVER
EVERETT EAST SITE
EVERETT WEST SITE
BURLINGTON NORTHERN RAILWAY
BURLINGTON NORTHERN RAILWAY
MW-108D
MW-5
MW-4B
MW-4A
EV-5
MW-3
MW-2
MW-1
MW-1202
WP-1101
MW-1201
MW-1205
MW-1302
WP-1702D
WP-1701D
WP-1601
SB-1603D
WP-1701
MW-9
MW-1501
FORMER DEMO LANDFILL
MW-7
EV-6A
EV-6B
EV-7A
EV-7B
WP-1
EV-9B
EV-9A
SLAG OUTCROP
EAST MARINE VIEW DRIVE
EV-3
SR-529 (OLD HWY 99)
MARINE VIEW DRIVE
FORMER ASARCO SMELTER SITE
EV-1
LEGEND
EV-1 SMELTER PERIPHERAL AREA WELL
EV-3 EVERETT SMELTER AREA WELL
TIDEFLAT AREA WELLS:
EV-4A SLAG AREA WELLS
EV-5 DOWNGRADIENT OF SLAG AREA WELLS
MW-9 FORMER DEMO WASTE LANDFILL WELLS
MW-1501 EVERETT WEST SITE WELLS
WP-1701 EVERETT WEST SITE WELLPOINTS/SOIL BORINGS
MW-1080 EVERETT EAST SITE WELLS
NOTE: ASARCO MONITORING WELLS
WEYERHAEUSER MONITORING WELLS
0 300 600
SCALE (ft)
DATE 9/94
DWN. RB
REV.
APPR.
PROJECT NO.
0141-037.63
FIGURE 4
MONITORING WELL LOCATION MAP
WEYERHAEUSER, EVERETT
ARSENIC DATA REVIEW
Emcon
Northwest, Inc.
1=300 10-06-94 G:\DWG\0141\037\64BLC17