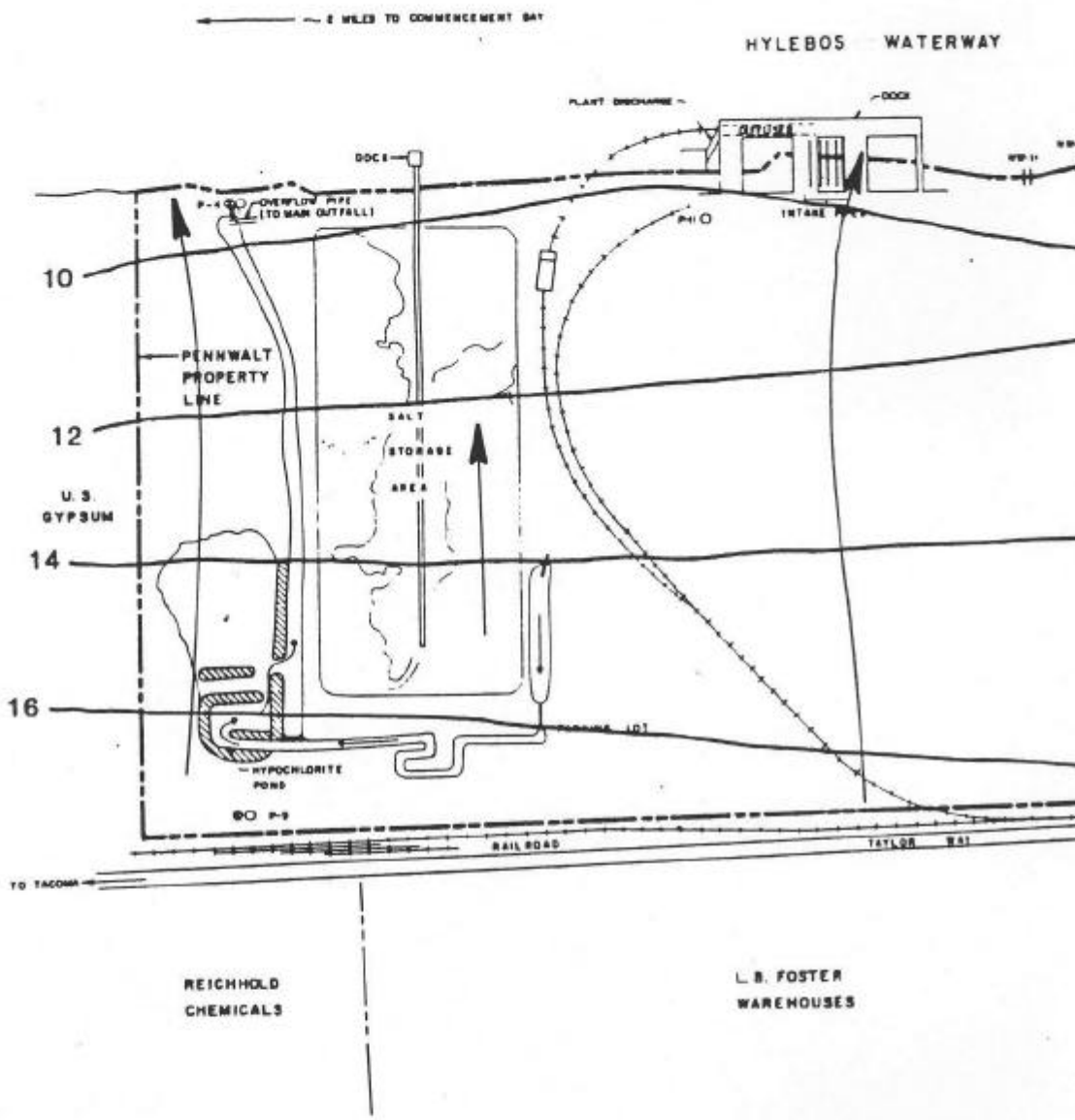
The uppermost, shallow water-bearing zone consists of gray to brown fine to medium-grained, gravelly sand and silty sand which is representative of the artificial fill material. This zone is continuous across the plant site and ranges from 3 to 13 ft in thickness, with an average thickness of about 10 ft. This uppermost zone thickens predominately across the plant site in a west to east direction but thins as it reaches plant boundaries in either direction. The surficial zone is thickest at the northern-most edge of the plant site along the Hylebos Waterway.

Underlying the surficial sand zone is a low permeability brown and gray zone composed of interbedded clayey silt, silt, and fibrous organic peat. Grain size analyses indicate a silt or clayey silt with some sand and a high organic content. These deposits are probably representative of the tidal marsh deposits upon which the fill material was originally placed. This unit ranges in thickness from 3 to 18 ft. Thicknesses of this zone are laterally discontinuous with a distinct trend indicating thinning towards the Hylebos Waterway, especially in the vicinity of monitoring stations P-1, P-2, and P-3.

An intermediate sand zone occurs next in the lithologic profile. As indicated by the borehole logs and the grain-size analyses, this zone consists of a gray, very fine to fine sand with traces of silt. This unit is continuous across the plant site with the thickness varying from 3-15 ft, with an average thickness of about 8.5 ft. This sand unit increases in thickness in the vicinity of monitoring stations P-2 and P-3.

Separating the intermediate and deep sand unit is another low permeability zone comprised of layers of clayey silt and minor amounts of

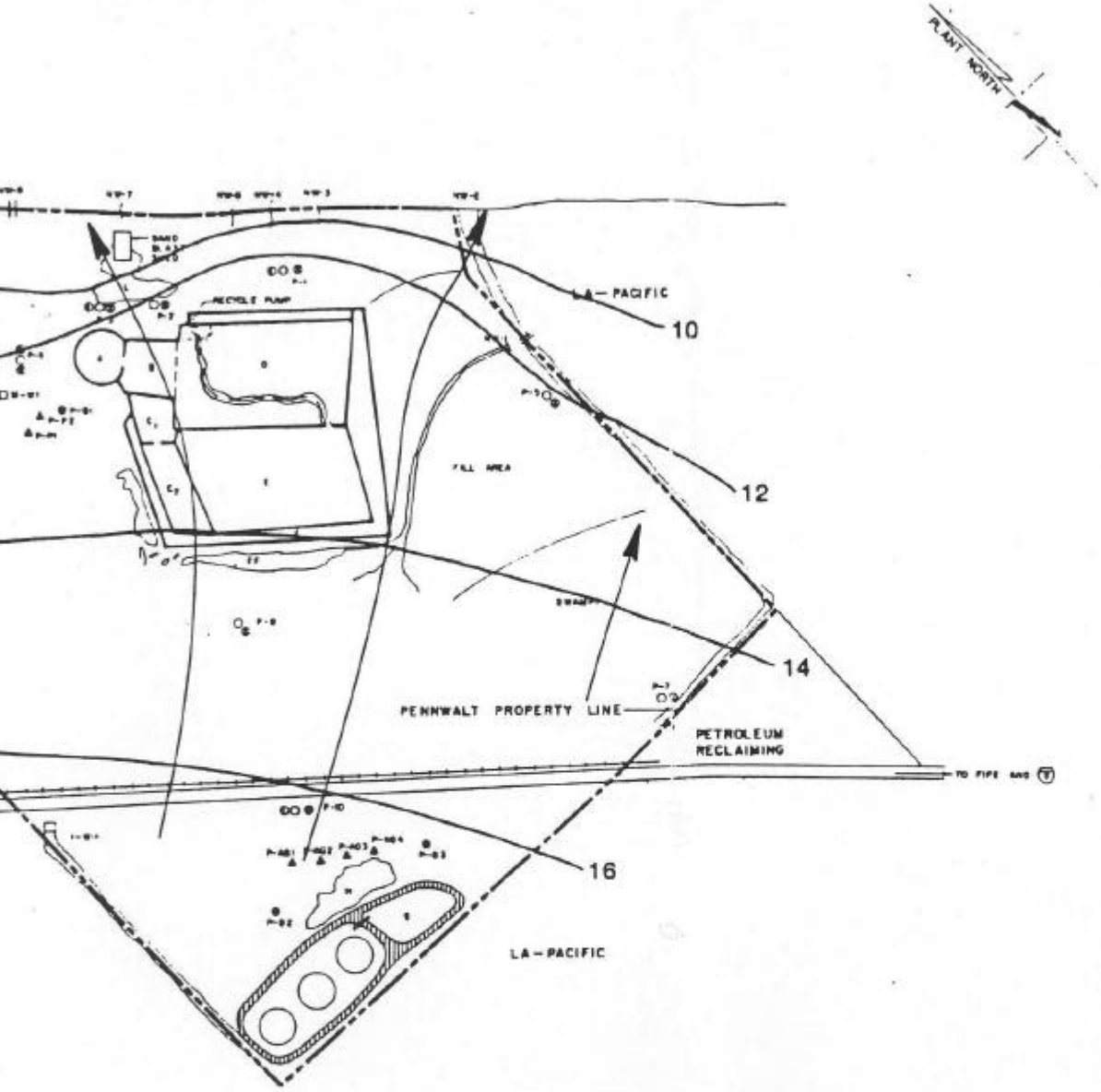


LEGEND

- DEEP
- PIPE
- SHALLOW SURF
- INTERMEDIATE
- DEEP ZONE
- SOIL BORING
- WASTE SAMP
- MANHOLE
- MOUNDS

Lower L

Contour



MONITORING WELL
ITORING WELL
WELL

ide - 7.8feet above MSL datum
20:51, April 30, 1981

val: 2feet
1foot (supplemental contours)

SCALE IN FEET
100 50 0 100

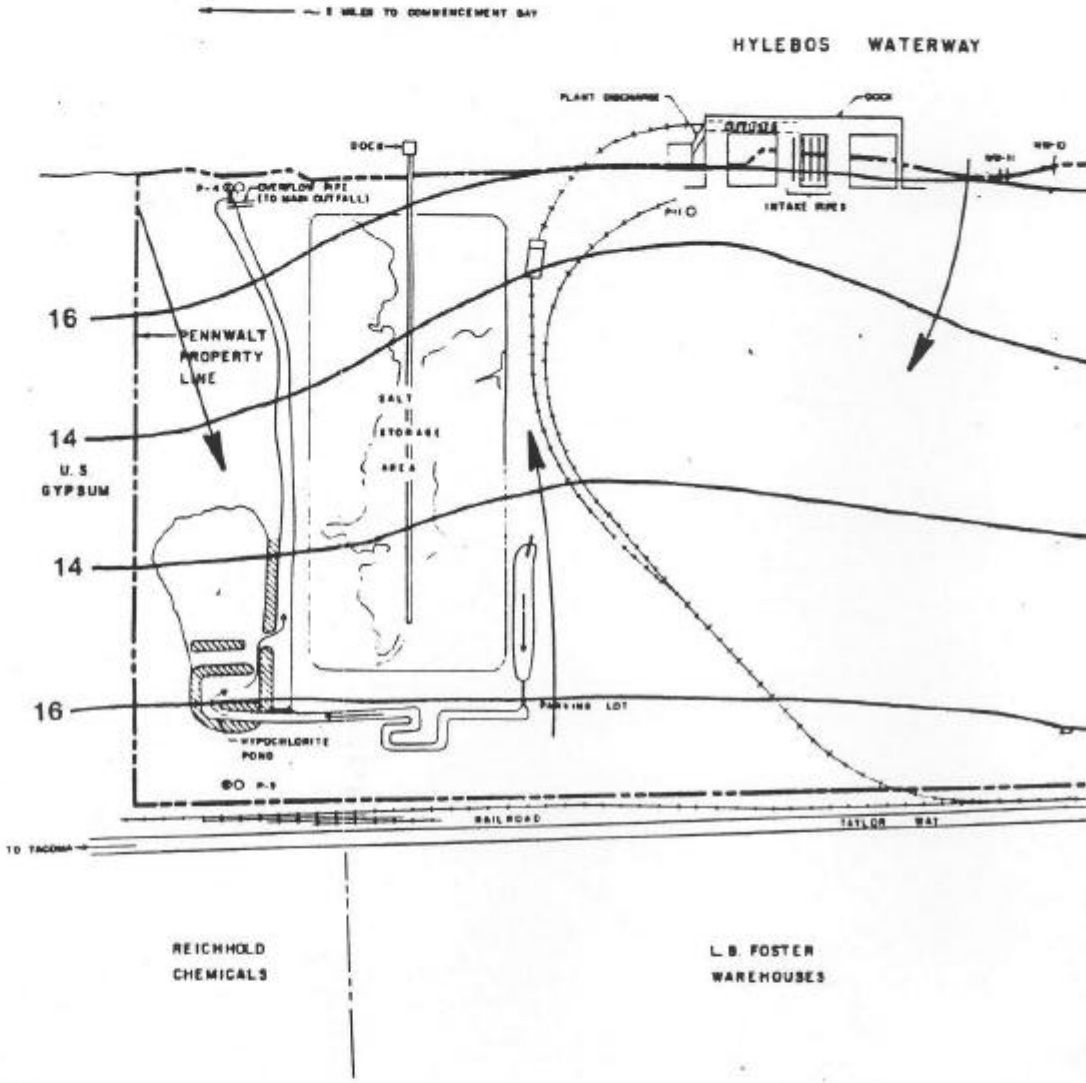
THE AWARE CORPORATION
NASHVILLE, TENNESSEE
HOUSTON, TEXAS

PENNWALT CORP.
Tacoma, Wash.

FIGURE 4.13

INTERMEDIATE ZONE POTENTIOMETRIC SURFACE MAP AT LOWER LOW TIDE, APRIL 30, 1981

ELF000225

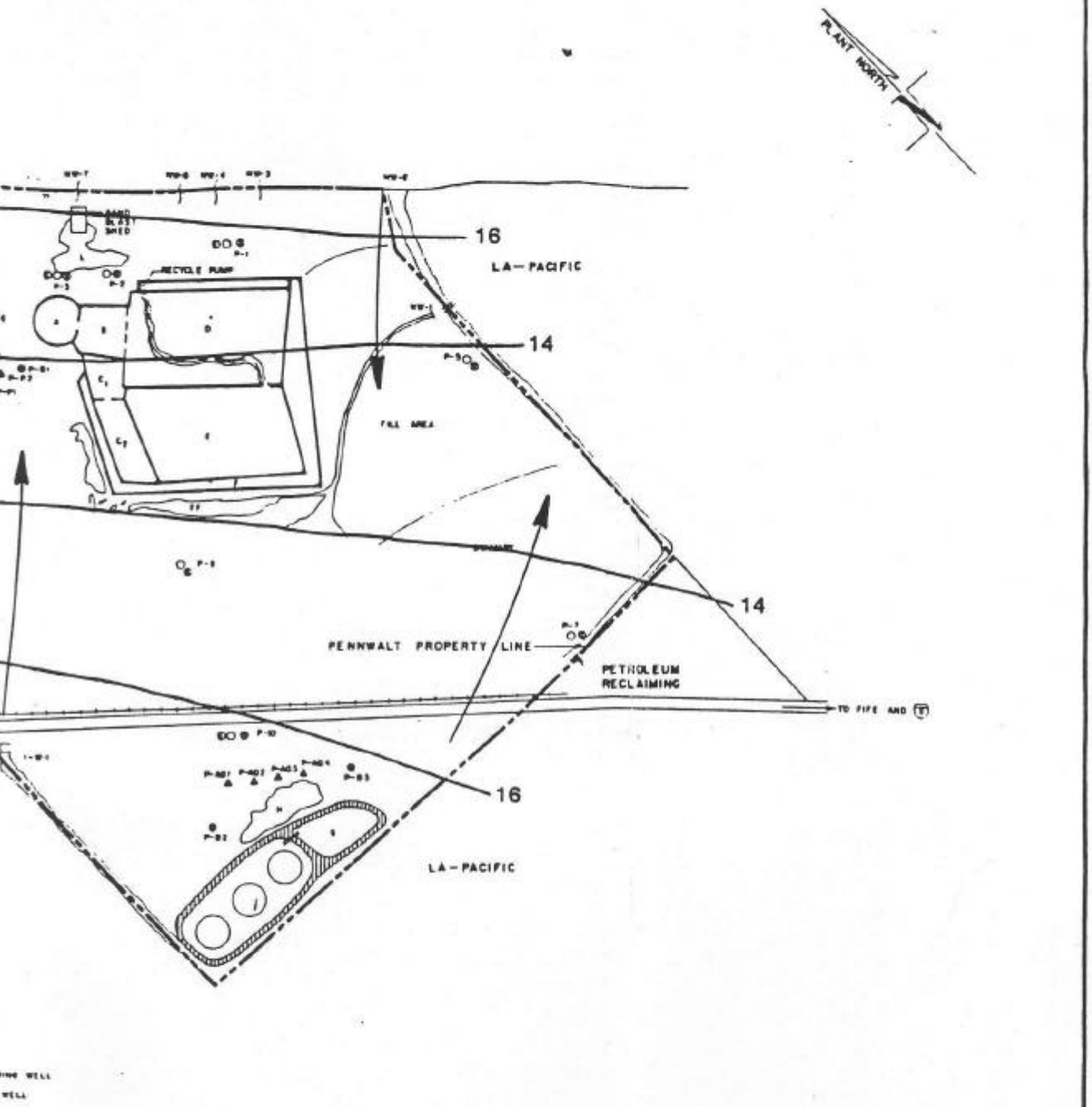


LEGEND

- WELL
- PIPE
- SHALLOW SURFICIAL ZONE
- INTERMEDIATE ZONE
- DEEP ZONE MONITORING
- SOIL BORING
- WASTE SAMPLE
- MANHOLE
- MOUNDS

Higher High

Contour Inte



17.3feet above MSL datum
03:24, May 1, 1981

2feet
1foot supplemental count contours

SCALE IN FEET
100 50 0 100

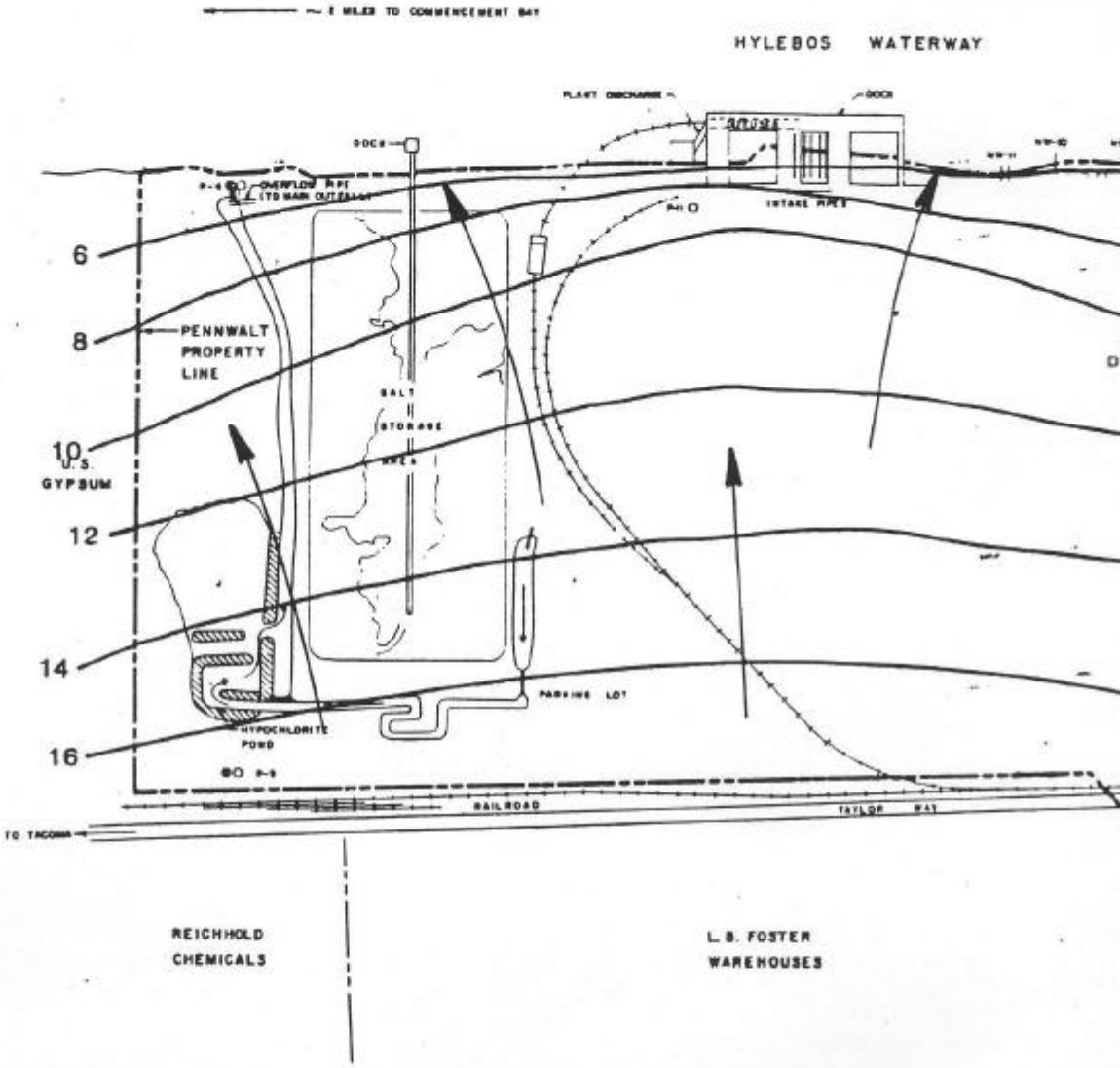
THE AWARE CORPORATION
NASHVILLE, TENNESSEE
HOUSTON, TEXAS

PENNWALT CORP.
Tacoma, Wash.

FIGURE 4.14

INTERMEDIATE ZONE POTENTIOMETRIC SURFACE MAP AT HIGHER HIGH TIDE, MAY 1, 1981

ELF000226



LEGEND

DEEP

PIPE

SHALLOW SURFICAL ZONE MON

INTERMEDIATE ZONE MONITOR

DEEP ZONE MONITORING WEL

SOIL BORING

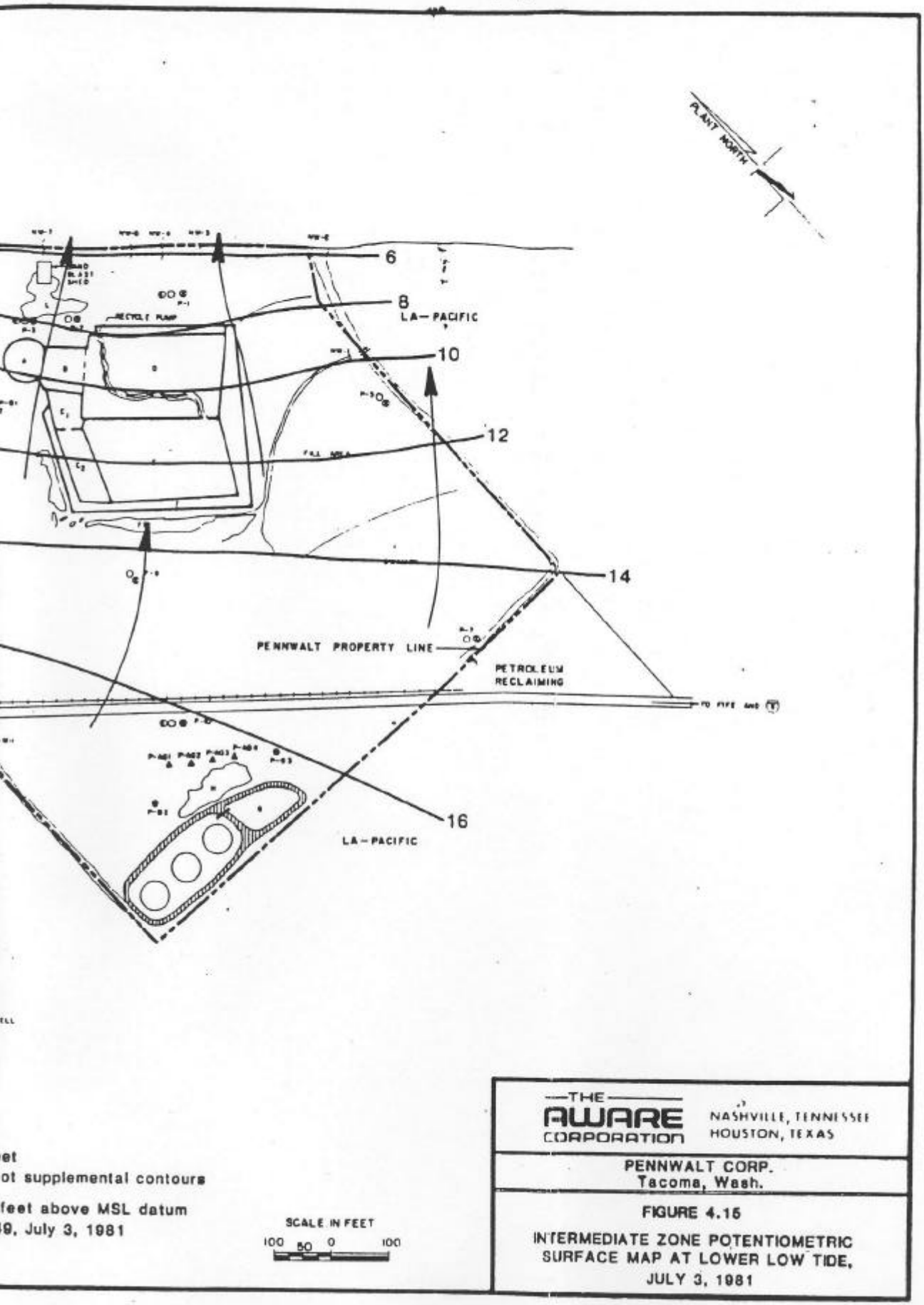
WASTE SAMPLE

MANHOLE

MOUNDS

Contour Interval:

Lower Low Tide



THE AWARE CORPORATION
NASHVILLE, TENNESSEE
HOUSTON, TEXAS

PENNWALT CORP.
Tacoma, Wash.

FIGURE 4.15

INTERMEDIATE ZONE POTENTIOMETRIC SURFACE MAP AT LOWER LOW TIDE, JULY 3, 1981

ELF000227

fibrous organic peat. This unit was found to vary in thickness from about 5 to 22 ft. An examination of the the lithologic profiles indicate that this unit is continuous across the plant site but tends to thin along a north-south axis through the area bounded by monitoring stations P-2 and P-3.

The deepest unit encountered beneath the plant site was a sand unit comprised of gray to dark gray, slightly silty and silty fine sand with occasional thin, discontinuous lenses of sandy silt. Shell fragments were found abundantly throughout the samples. The thickness of this unit exceeds 20 ft but the base was not established in this study. This deep zone was found to be continuous across the plant site.

4.6 SOIL QUALITY

4.6.1 Sampling Program

In order to determine the concentrations of potential contaminants entrained in the surficial deposits at the facility, split-spoon samples were collected at intervals of 0.0-1.5, 3.0-4.5, and 8.0-9.5 ft in each of ten deep monitoring well borings and in the boring for shallow well P-11. In addition, split-spoon samples were collected at intervals of 0.0-1.5, 3.0-4.5, 8.0-9.5, and 13.0-14.5 ft at test borings P-B1, P-B2, and P-B3 located at the Penite and Agchem sites (reference Plate for locations). A summary of all soil samples collected as part of this initial investigation is included in Table 4-3 with the logs of each boring being included in Appendix B.

ELF000184

TABLE 4-3

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-S-1D-1	4/11/81	4/15/81	0-1.5'	6.75	2-200 g, 1 split sample
P-S-1D-2	4/11/81	4/15/81	3-4.5'	6.50	2-200 g, 2 split samples
P-S-1D-3	4/11/81	4/15/81	8-9.5'	1st 10.95 2nd 9.80	2-200 g, no split samples
P-S-1D-4	4/11/81	4/15/81	13-14.5'	7.55	2 split samples
P-S-1D-5	4/11/81	4/15/81	18-19.5'	7.50	2 split samples
P-S-1D-6	4/11/81	4/15/81	23-24.5'	6.60	2 split samples
P-S-1D-7	4/11/81	4/15/81	28-29.5'	7.15	2 split samples
P-S-1D-8	4/11/81	4/15/81	33-34.5'	6.35	2 split samples
P-S-1D-9	4/11/81	4/15/81	38-39.5'	7.25	2 split samples
P-S-1D-10	4/11/81	4/15/81	43-44.5'	6.55	2 split samples
P-S-1D-11	4/11/81	4/15/81	48-49.5'	6.45	2 split samples
P-S-1D-12	4/11/81	4/15/81	53-54.5'	6.45	2 split samples
P-S-2D-1	4/13/81	4/15/81	0-1.5'	7.30	2-200 g, 2 split samples
P-S-2D-2	4/13/81	4/15/81	3-4.5'	7.45	2-200 g, 2 split samples
P-S-2D-3	4/13/81	4/15/81	8-9.5'	1st 10.55 2nd 10.65	2-200 g, 2 split samples
P-S-2D-4	4/13/81	4/15/81	13-14.5'	6.45	2 split samples
P-S-2D-5	4/13/81	4/15/81	18-19.5'	1st 7.20 2nd 7.15	2 split samples
P-S-2D-6	4/13/81	4/15/81	23-24.5'	1st 8.20 2nd 8.40	2 split samples
P-S-2D-7	4/13/81	4/15/81	28-29.5'	7.05	2 split samples
P-S-2D-8	4/13/81	4/15/81	33-34.5'	6.55	2 split samples
P-S-2D-9	4/13/81	4/15/81	38-39.5'	6.50	2 split samples

TABLE 4-3 (Cont.)

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-S-2D-10	4/13/81	4/15/81	43-44.5'	6.35	2 split samples
P-S-2D-11	4/13/81	4/15/81	48-49.5'	6.80	2 split samples
P-S-2D-12	4/13/81	4/15/81	53-54.5'	6.40	2 split samples
P-S-2D-13	4/13/81	4/15/81	58-59.5'	6.30	2 split samples
P-S-3D-1	4/14/81	4/15/81	0-1.5'	7.30	2-30 g, no split samples
P-S-3D-2	4/14/81	4/15/81	3-4.5'	7.30	2-150 g, no split samples
P-S-3D-3	4/14/81	4/15/81	8-9.5'	10.60	2-200 g, 1 split sample
P-S-3D-4	4/14/81	4/15/81	13-14.5'	6.75	2 split samples
P-S-3D-5	4/14/81	4/15/81	18-19.5'	8.15	2 split samples
P-S-3D-6	4/14/81	4/15/81	23-24.5'	1st 10.20 2nd 9.75	2 split samples
P-S-3D-7	4/14/81	4/15/81	28-29.5'	8.05	2 split samples
P-S-3D-8	4/14/81	4/15/81	33-34.5'	6.75	2 split samples
P-S-3D-9	4/14/81	4/15/81	38-39.5'	7.85	2 split samples
P-S-3D-10	4/14/81	4/15/81	43-44.5'	7.65	2 split samples
P-S-3D-11	4/14/81	4/15/81	48-49.5'	7.65	2 split samples
P-S-3D-12	4/14/81	4/15/81	53-54.5'	8.20	2 split samples
P-S-3D-13	4/14/81	4/15/81	58-59.5'	7.35	2 split samples
P-S-4D-1	4/10/81	4/10/81	0-1.5'	9.15	2-90 g, no split samples
P-S-4D-2	4/10/81	4/10/81	3-4.5'	10.65	2-200 g, 1 sample
P-S-4D-3	4/10/81	4/10/81	8-9.5'	8.65	2-200 g
P-S-4D-4	4/10/81	4/10/81	13-14.5'	7.55	2 split samples
P-S-4D-5	4/10/81	4/10/81	18-19.5'	7.80	2 split samples
P-S-4D-6	4/10/81	4/10/81	23-24.5'	8.60	2 split samples
P-S-4D-7	4/10/81	4/10/81	28-29.5'	7.25	2 split samples

ELF000185

TABLE 4-3 (Cont.)

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-S-4D-8	4/10/81	4/10/81	33-34.5'	7.60	2 split samples
P-S-4D-9	4/10/81	4/10/81	38-39.5'	7.30	2 split samples
P-S-4D-10	4/10/81	4/10/81	43-44.5'	7.65	2 split samples
P-S-4D-11	4/10/81	4/10/81	48-49.5'	8.25	2 split samples
P-S-4D-12	4/10/81	4/10/81	53-54.5'	8.25	2 split samples
P-S-4D-13	4/10/81	4/10/81	58-59.5'	8.15	2 split samples
P-S-4D-14	4/10/81	4/10/81	63-64.5'	8.25	2 split samples
P-S-5D-1	4/9/81	4/10/81	0-1.5'	8.95	2-200 g, 1 sample
P-S-5D-2	4/9/81	4/10/81	3-4.5'	9.25	2-200 g, 2 split samples
P-S-5D-3	4/9/81	4/10/81	8-9.5'	7.70	2-200 g, 2 split samples
P-S-5D-4	4/9/81	4/10/81	13-14.5'	7.55	2 split samples
P-S-5D-5	4/9/81	4/10/81	18-19.5'	7.25	2 split samples
P-S-5D-6	4/9/81	4/10/81	23-24.5'	7.00	2 split samples
P-S-5D-7	4/9/81	4/10/81	28-29.5'	7.25	2 split samples
P-S-5D-8	4/9/81	4/10/81	33-34.5'	7.35	2 split samples
P-S-5D-9	4/9/81	4/10/81	38-39.5	7.15	2 split samples
P-S-5D-10	4/9/81	4/10/81	43-44.5'	7.55	2 split samples
P-S-5D-11	4/9/81	4/10/81	48-49.5'	8.15	2 split samples
P-S-5D-12	4/9/81	4/10/81	53-54.5'	7.95	2 split samples
P-S-5D-13	4/9/81	4/10/81	58-59.5'	8.25	2 split samples
P-S-6D-1	4/15/81	4/15/81	0-1.5'	7.35	2-200 g, 1 split sample
P-S-6D-2	4/15/81	4/15/81	3-4.5'	7.90	2-200 g, 2 split samples
P-S-6D-3	4/15/81	4/15/81	8-9.5'	9.10	2-200 g, 2 split samples
P-S-6D-4	4/15/81	4/15/81	13-14.5'	7.25	2 split samples

ELF000186

TABLE 4-3 (Cont.)

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-S-6D-5	4/15/81	4/15/81	18-19.5'	7.60	2 split samples
P-S-6D-6	4/15/81	4/15/81	23-24.5'	7.75	2 split samples
P-S-6D-7	4/15/81	4/15/81	28-29.5'	7.75	2 split samples
P-S-6D-8	4/15/81	4/15/81	33-34.5'	7.90	2 split samples
P-S-6D-9	4/15/81	4/15/81	38-39.5'	7.40	2 split samples
P-S-6D-10	4/15/81	4/15/81	43-44.5'	7.55	2 split samples
P-S-6D-11	4/15/81	4/15/81	48-49.5'	7.45	2 split samples
P-S-6D-12	4/15/81	4/15/81	53-54.5'	7.35	2 split samples
P-S-6D-13	4/15/81	4/15/81	58-59.5'	7.55	2 split samples
P-S-7D-1	4/6/81	4/8/81	0-1.5'	6.65	2-140 g samples, no split sample
P-S-7D-2	4/6/81	4/8/81	3-4.5'	6.75	2-100 g, 1-25 g sample
P-S-7D-3	4/6/81	4/8/81	8-9.5'	7.20	2-100 g, 2-split samples
P-S-7D-4	4/6/81	4/8/81	13-14.5'	6.85	2 split samples
P-S-7D-5	4/6/81	4/8/81	18-19.5'	7.00	2 split samples
P-S-7D-6	4/6/81	4/8/81	23-24.5'	7.35	1 split sample
P-S-7D-7	4/6/81	4/8/81	28-29.5'	6.65	2 split samples
P-S-7D-8	4/6/81	4/8/81	33-34.5'	6.65	2 split samples
P-S-7D-9	4/6/81	4/8/81	38-39.5'	6.55	2 split samples
P-S-7D-10	4/6/81	4/8/81	43-44.5'	6.30	2 split samples
P-S-7D-11	4/6/81	4/8/81	48-49.5'	6.35	2 split samples
P-S-7D-12	4/6/81	4/8/81	53-54.5'	6.10	2 split samples
P-S-7D-13	4/6/81	4/8/81	58-59.5'	6.20	2 split samples
P-S-7D-14	4/6/81	4/8/81	63-64.5'	6.45	2 split samples

ELF000187

TABLE 4-3 (Cont.)

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-S-8D-1	4/8/81	4/10/81	0-1.5'	6.65	2-100 g, 2 split samples
P-S-8D-2	4/8/81	4/10/81	3-4.5'	7.20	1-200 g, 1-165 g, no split samples
P-S-8D-3	4/8/81	4/10/81	8-9.5'	6.95	2-100 g, 2 split samples
P-S-8D-4	4/8/81	4/10/81	13-14.5'	6.65	2 split samples
P-S-8D-5	4/8/81	4/10/81	18-19.5'	6.65	2 split samples
P-S-8D-6	4/8/81	4/10/81	23-24.5'	6.65	2 split samples
P-S-8D-7	4/8/81	4/10/81	28-29.5'	7.10	2 split samples
P-S-8D-8	4/8/81	4/10/81	33-34.5'	7.10	2 split samples
P-S-8D-9	4/8/81	4/10/81	38-39.5'	6.50	2 split samples
P-S-8D-10	4/8/81	4/10/81	43-44.5'	7.10	2 split samples
P-S-8D-11	4/8/81	4/10/81	48-49.5'	6.40	2 split samples
P-S-8D-12	4/8/81	4/10/81	53-54.5'	7.70	2 split samples
P-S-8D-13	4/8/81	4/10/81	58-59.5'	7.75	2 split samples
P-S-9D-1	4/17/81	4/17/81	0-1.5'	5.95	2-200 g, 2 split samples
P-S-9D-2	4/17/81	4/17/81	3-4.5'	6.15	2-200 g, no split samples
P-S-9D-3	4/17/81	4/17/81	8-9.5'	6.80	2-200 g, 2 split samples
P-S-9D-4	4/17/81	4/17/81	13-14.5'	7.25	2 split samples
P-S-9D-5	4/17/81	4/17/81	18-19.5'	7.20	2 split samples
P-S-9D-6	4/17/81	4/17/81	23-24.5'	7.90	2 split samples
P-S-9D-7	4/17/81	4/17/81	28-29.5'	8.05	2 split samples
P-S-9D-8					No sample
P-S-9D-9	4/17/81	4/17/81	38-39.5'	8.25	2 split samples
P-S-9D-10	4/17/81	4/17/81	43-44.5'	7.75	2 split samples
P-S-9D-11	4/17/81	4/17/81	48-49.5'	8.15	2 split samples
P-S-9D-12	4/17/81	4/17/81	53-54.5'	7.95	2 split samples

TABLE 4-3 (Cont.)

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-S-10D-1	4/16/81	4/17/81	0-1.5'	6.55	2-150 g, no split samples
P-S-10D-2	4/16/81	4/17/81	3-4.5'	7.45	2-200 g, no split samples
P-S-10D-3	4/16/81	4/17/81	8-9.5'	6.95	2-180 g, no split samples
P-S-10D-4	4/16/81	4/17/81	13-14.5'	7.55	2 split samples
P-S-10D-5	4/16/81	4/17/81	18-19.5'	7.95	2 split samples
P-S-10D-6	4/16/81	4/17/81	23-24.5'	6.55	2 split samples
P-S-10D-7	4/16/81	4/17/81	28-29.5'	8.00	2 split samples
P-S-10D-8	4/16/81	4/17/81	33-34.5'	8.05	2 split samples
P-S-10D-9	4/16/81	4/17/81	38-39.5'	8.05	2 split samples
P-S-10D-10	4/16/81	4/17/81	43-44.5'	7.80	2 split samples
P-S-10D-11	4/16/81	4/17/81	48-49.5'	8.20	2 split samples
P-S-10D-12	4/16/81	4/17/81	53-54.5'	8.15	2 split samples
P-S-11-1	4/11/81	4/15/81	0-1.5'	7.60	2-200 g, 1 split sample
P-S-11-2	4/11/81	4/15/81	3-4.5'	7.35	2-36 g, no split samples
P-S-11-3	4/11/81	4/15/81	8-9.5'	6.75	1-200 g, 1-185 g, no split samples
P-S-11-4	4/11/81	4/15/81	13-14.5'	6.60	2 split samples
P-S-11-5	4/11/81	4/15/81	18-19.5'	6.55	2 split samples
P-S-11-6	4/11/81	4/15/81	23-24.5'	6.95	2 split samples
P-S-11-7	4/11/81	4/15/81	28-29.5'	6.80	2 split samples
P-S-11-8	4/11/81	4/15/81	33-34.5'	6.15	2 split samples
P-B1-1	4/16/81	4/17/81	0-1.5'	6.10	2-200 g, 1 split sample
P-B1-2	4/16/81	4/17/81	3-4.5'	7.05	2-155 g, no split samples
P-B1-3	4/16/81	4/17/81	8-9.5'	7.70	2-60 g, no split samples
P-B1-4	4/16/81	4/17/81	13-14.5'	7.50	2-96 g, no split samples

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ELF000190

TABLE 4-3 (Cont.)

SUMMARY OF SOIL SAMPLING AND PH DETERMINATIONS

Sample No.	Collection[a] Date	Delivery[b] Date	Depth	pH[c]	Number of Samples
P-B2-1	4/16/81	4/22/81	0-1.5'	7.95	2-200 g, 1 split sample
P-B2-2	4/16/81	4/22/81	3-4.5'	8.45	2-120 g, no split samples
P-B2-3	4/16/81	4/22/81	8-9.5'	7.45	2-200 g, 2 split samples
P-B2-4	4/16/81	4/22/81	13-14.5'	7.45	2-170 g, no split samples
P-B3-1	4/16/81	4/22/81	0-1.5'	7.15	2-135 g, no split samples
P-B3-2	4/16/81	4/22/81	3-4.5'	7.95	2-200 g, 2 split samples
P-B3-3	4/16/81	4/22/81	8-9.5'	7.25	2-200 g, 1 split sample
P-B3-4	4/16/81	4/22/81	13-14.5'	8.05	
P-AG1-W	4/21/81	4/22/81	10-11.5'	6.85	2-200 g, no split samples
P-AG2-W-1	4/21/81	4/22/81	10-11.5'	6.70	2-170 g, no split samples
P-AG2-W-2	4/21/81	4/22/81	15-16.5'	7.40	2-200 g, 2 split samples
P-AG3-W	4/21/81	4/22/81	15-16.5'	7.55	2-200 g, 2 split samples
P-AG4-W	4/21/81	4/22/81	10-11.5'	7.20	2-200 g, 1 split sample
P-P1-W	4/21/81	4/22/81	15-16.5'	7.70	2-200 g, 2 split samples
P-P2-W	4/21/81	4/22/81	15-16.5'	7.60	2-200 g, 2 split samples

Note:

[a]Samples collected by Shannon & Wilson Inc.

[b]Sample delivered to Laucks Laboratory for chemical analysis.

[c]Determinations made by AWARE, Inc.

All soil samples from the deep monitoring wells and the three test borings were collected by Kring Drilling Company under the direct supervision of a field hydrogeologist from Shannon & Wilson, Inc. Immediately following collection, each split-spoon sample was wrapped in aluminum foil, labeled on the inside and outside, placed in a plastic, zip-lock bag, and kept in a cooler containing dry ice. The soil samples were delivered daily to the Pennwalt laboratory where AWARE personnel determined pH and split each sample for subsequent physical and chemical analyses. All soil samples requiring chemical analysis were subsequently delivered to Laucks Laboratory where simulated leaching tests with analysis of limited parameters.

As part of the overall investigation of waste constituents entrained in the surficial deposits, four supplemental test borings at the Agchem site and two supplemental borings at the Penite site were drilled by Environmental Emergency Services of Portland, Oregon (reference Plate for locations). Direct supervision was provided by an on-site AWARE geologist. The purpose for these supplemental borings was to sample actual waste materials and the geologic materials immediately underlying the waste materials. A summary of these waste and soil samples are provided in Table 4-3 with the logs of the supplemental borings being included in Appendix B.

Each of these borings was completed to a depth ranging from 11.5 to 16.5 ft with samples being collected at approximately 2 to 3 ft intervals depending upon the nature of materials encountered in each boring. The first two samples from each boring were considered to be actual waste

samples with the deepest sample being representative of the underlying geologic materials. Following collection, each split-spoon sample was wrapped in aluminum foil, labeled inside and outside, placed in a plastic zip-lock bag, and kept in a cooler containing dry ice. The upper two waste samples from each boring were subsequently composited by Laucks Laboratory with EP toxicity tests being performed for each composited sample. Those samples collected from beneath the expected waste samples were subsequently split by AWARE personnel with pH measurements being made (Table 4-3). These samples were submitted to Laucks Laboratory for simulated leaching tests with analyses of the limited parameters listed in Table 4-4 being conducted.

Following a review of the physical and chemical data generated from this initial test boring program, it was determined that additional test borings were necessary in the area of the old Penite area in order to more accurately establish the location of the previous disposal sites. Prior to implementing this supplemental drilling program, old aerial photos of the plant site were closely reviewed to permit better placement of proposed borings. Ultimately a total of nine additional test borings were installed in the Penite area by Kring Drilling under the field supervision of a staff hydrogeologist from Shannon & Wilson, Inc. The locations of these borings are depicted in Plate 1 (borings P-B4 through P-B12).

The nine supplemental test borings were completed to depths ranging from 8.5 to 10.0 ft with continuous split-spoon samples being collected between a depth of 2.5 ft and the bottom of the boring. Following collection, each split-spoon sample was properly logged, labeled, wrapped in

TABLE 4-4

SUMMARY OF LIMITED PARAMETER ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS
(in mg/l)

Parameter	Soil Samples								
	P-S-1D-1	P-S-1D-2	P-S-1D-3[a]	P-S-2D-1	P-S-2D-2	P-S-2D-3	P-S-3D-1	P-S-3D-2	P-S-3D-3
pH	7.0	7.1	11.2	7.5	7.8	10.7	7.7	8.4	7.3
Sodium	24	49	500	12	39	680	18	24	16
Magnesium	0.1	0.1	0.1	0.4	0.4	0.2	0.1	0.1	0.1
Calcium	0.2	0.4	0.6	4.8	5.2	0.7	0.6	0.3	0.3
Mercury	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.012
Arsenic	0.02	0.03	0.03	0.04	0.05	0.34	0.39	0.18	0.60
Copper	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.04
Nickel	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Lead	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hexavalent Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	0.02	0.02	0.02	0.04	0.07	2.6	0.04	0.06	0.19
Antimony	0.004	0.002	0.002	0.015	0.014	0.012	0.027	0.009	2.7
Selenium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03
Barium	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Silver	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloride	3	36	470	2	28	460	3	5	1
Total Dissolved Solids	52	170	1,200	57	190	2,000	110	140	130

ELF000193

TABLE 4-4 (Cont'd.)

SUMMARY OF LIMITED PARAMETER ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS
(in mg/l)

Parameter	Soil Samples								
	P-S-4D-1	P-S-4D-2	P-S-4D-3	P-S-5D-1[a]	P-S-5D-2[a]	P-S-5D-3	P-S-6D-1	P-S-6D-2	P-S-6D-3
pH	7.2	11.2	9.3	4.3	9.6	8.3	10.8	7.0	9.6
Sodium	21	140	750	39	570	960	360	23	160
Magnesium	0.3	0.1	1.5	1.0	0.5	4.6	0.1	0.1	0.1
Calcium	13	22	3.4	100	3.0	4.2	0.4	0.4	0.9
Mercury	0.005	0.009	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Arsenic	0.03	0.03	0.04	0.18	0.18	0.02	3.0	10	20
Copper	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.05	0.02
Nickel	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Lead	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hexavalent Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	2.9	0.09	0.08	0.88	0.18	0.09	0.20	0.07	2.9
Antimony	0.009	0.21	0.002	0.008	0.007	0.011	1.8	1.4	1.4
Selenium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Silver	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloride	2	70	1,000	2	460	950	340	2	16
Total Dissolved Solids	140	370	1,800	570	1,200	2,200	1,200	170	340

ELF000194

ELF00195

TABLE 4-4 (Cont'd.)

SUMMARY OF LIMITED PARAMETER ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS
(in mg/l)

Parameter	Soil Samples								
	P-S-7D-1	P-S-7D-2	P-S-7D-3	P-S-8D-1	P-S-8D-2	P-S-8D-3	P-S-9D-1	P-S-9D-2	P-S-9D-3
pH	6.5	7.0	7.7	7.0	6.6	6.8	7.0	6.9	7.3
Sodium	5	12	27	35	45	420	330	180	37
Magnesium	0.6	0.2	0.6	1.1	0.6	3.0	3.9	0.6	0.1
Calcium	1.9	1.1	1.1	3.8	0.7	3.0	2.8	0.8	0.4
Mercury	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Arsenic	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.01	12
Copper	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02
Nickel	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Lead	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hexavalent Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	0.02	0.27	1.1	0.05	0.49	3.6	0.04	0.06	0.02
Antimony	0.002	0.002	0.002	0.008	0.006	0.002	0.012	0.006	1.4
Selenium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Silver	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloride	1	4	3	32	33	440	310	92	19
Total Dissolved Solids	80	120	170	140	140	980	710	340	200

EIF00196

TABLE 4-4 (Cont'd.)

SUMMARY OF LIMITED PARAMETER ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS
(in mg/l)

	Soil Samples									
Parameter	P-S-10D-1	P-S-10D-2	P-S-10D-3	P-S-11-1	P-S-11-2	P-S-11-3	P-S-B1-1	P-S-B1-2	P-S-B1-3	P-S-B1-4
pH	7.2	7.7	6.7	8.1	9.6	7.5	6.6	6.8	7.1	6.9
Sodium	9.0	9.0	33	42	34	125	13	21	26	210
Magnesium	0.6	0.6	0.5	0.2	0.2	0.2	0.6	0.1	0.2	0.6
Calcium	20	2.2	1.2	0.7	3.9	1.1	2.7	0.3	0.5	0.9
Mercury	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Arsenic	0.04	0.01	0.05	0.02	0.05	0.04	0.84	2.0	0.01	90
Copper	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.02
Nickel	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Lead	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hexavalent Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	0.02	0.02	0.07	0.02	0.02	0.12	0.02	0.04	0.02	0.12
Antimony	0.008	0.006	0.040	0.005	0.005	0.003	1.8	1.7	0.010	0.045
Selenium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Silver	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloride	1	1	21	6	3	74	3	5	13	76
Total Dissolved Solids	130	61	220	190	170	300	120	150	160	520

ELF00019

TABLE 4-4 (Cont'd.)

SUMMARY OF LIMITED PARAMETER ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS
(in mg/l)

Parameter	Soil Samples							
	P-S-B2-1	P-S-B2-2	P-S-B2-3	P-S-B2-4	P-S-B3-1	P-S-B3-2	P-S-B3-3	P-S-B3-4
pH	6.9	6.7	6.4	6.8	7.1	7.2	7.1	7.2
Sodium	29	19	12	180	21	20	25	20
Magnesium	0.4	0.5	0.5	2.0	0.4	0.2	0.3	0.1
Calcium	0.6	1.1	1.2	1.2	1.4	0.5	0.7	0.4
Mercury	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Arsenic	0.02	0.01	0.04	0.01	0.01	0.04	0.04	0.03
Copper	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Nickel	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Lead	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hexavalent Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	1.9	0.26	0.11	0.05	0.88	0.60	0.50	0.16
Antimony	0.002	0.047	0.005	0.004	0.006	0.014	0.017	0.004
Selenium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Silver	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloride	5	1	1	47	1	3	17	7
Total Dissolved Solids	15,600	98	43	220	72	120	120	5,300

TABLE 4-4 (Cont'd.)

SUMMARY OF LIMITED PARAMETER ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS
(in mg/l)

Parameter	Soil Samples						
	P-P1-W	P-P2-W[a]	P-AG1-W	P-AG2-W-1	P-AG2-W-2	P-AG3-W	P-AG4-W
pH	6.7	7.6	6.4	6.2	7.0	6.7	6.5
Sodium	55	190	26	30	52	49	22
Magnesium	0.5	0.5	0.3	0.2	0.5	0.4	0.8
Calcium	0.7	1.2	1.1	0.5	0.8	0.5	0.8
Mercury	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Arsenic	40	81	0.02	0.03	0.01	0.01	0.02
Copper	0.02	0.02	0.03	0.02	0.02	0.02	0.04
Nickel	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Cadmium	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Lead	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Hexavalent Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Chromium	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Zinc	0.24	0.59	0.23	0.72	0.10	0.26	0.82
Antimony	0.075	0.90	0.006	0.023	0.004	1.3	0.012
Selenium	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Barium	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Silver	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Chloride	30	44	20	19	36	27	1
Total Dissolved Solids	16,000	420	170	150	190	190	5,200

[a]Analyses performed in replicate.

aluminum foil, placed in a plastic bag, and retained for possible future analysis. The logs of these supplemental borings are included in Appendix B.

4.6.2 Analytical Results

The simulated leaching tests performed on the soil samples collected as part of this program involved a procedure identical to the EP toxicity testing method with the exception that the leaching medium was initially adjusted to a pH of 5 with no other pH adjustments being made during the 24-hr mixing period. The pH of 5 was utilized to simulate rainfall conditions at the Pennwalt facility. Natural field leaching is expected to produce lower concentrations than the results from the simulated leaching test due to the complete mixing conditions to which these samples were subjected. The results of these simulated leaching tests are presented in Tables 4-4 and 4-5.

The results of the simulated leaching tests performed on samples from the monitoring wells indicate that very small quantities of the selected parameters are entrained in the surficial deposits which are available for subsequent release to the groundwater system (Table 4-4). The most readily available constituents, as expected, include sodium, magnesium, calcium, and chloride. These parameters were found in higher concentrations than other constituents; however, the concentrations detected in the soil samples were significantly lower than the concentrations found in groundwater samples from the intermediate zone. With the exceptions of arsenic, antimony, and zinc, the concentrations of all other constituents were very low with values being below or very near the detection limits.

TABLE 4-5

SUMMARY OF PESTICIDE ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS

Parameter	Soil Samples								
	P-S-1D-1	P-S-1D-2	P-S-1D-3[c]	P-S-2D-1	P-S-2D-2	P-S-2D-3	P-S-3D-1	P-S-3D-2	P-S-3D-3
Endrin	ND[a]	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	tr[b]	ND	tr	ND	ND	ND	ND	tr	ND
2,4,5-TP (silvex)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ND	ND	ND	ND	ND	ND	ND	ND	ND

	P-S-4D-1	P-S-4D-2	P-S-4D-3	P-S-5D-1[c]	P-S-5D-2[c]	P-S-5D-3	P-S-6D-1	P-S-6D-2	P-S-6D-3
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	tr	tr	ND	tr	ND	ND	tr	ND	ND
2,4,5-TP (silvex)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ND	ND	ND	ND	ND	ND	ND	ND	ND

	P-S-7D-1	P-S-7D-2	P-S-7D-3	P-S-8D-1	P-S-8D-2	P-S-8D-3	P-S-9D-1	P-S-9D-2	P-S-9D-3
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	tr	tr	tr	tr	tr	tr	ND	ND	ND
2,4,5-TP (silvex)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lindane	ND	ND	ND	ND	ND	ND	ND	ND	ND

ELF000200

TABLE 4-5 (Cont'd.)

SUMMARY OF PESTICIDE ANALYSES OF SOIL SAMPLES
SUBJECTED TO SIMULATED LEACHING CONDITIONS

Parameter	Soil Samples									
	P-S-10D-1	P-S-10D-2	P-S-10D-3	P-S-11D-1	P-S-11D-2	P-S-11D-3	P-S-B1-1	P-S-B1-2	P-S-B1-3	P-S-B1-4
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	ND	ND	tr	tr	tr	tr	ND	ND	ND	ND
2,4,5-TP (silvex)	tr	tr	tr	ND	ND	ND	tr	tr	ND	ND
Lindane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

	P-S-B2-1	P-S-B2-2	P-S-B2-3	P-S-B2-4	P-S-B3-1	P-S-B3-2	P-S-B3-3	P-S-B3-4
Endrin	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND
2,4-D	ND	ND	ND	ND	tr	ND	ND	ND
2,4,5-TP (silvex)	tr	tr	ND	tr	tr	tr	tr	tr
Lindane	ND	ND	ND	ND	ND	ND	ND	ND

	P-P1-W	P-P2-W[c]	P-AG1-W	P-AG2-W-1	P-AG2-W-2	P-AG3-W	P-AG4-W
Endrin	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND
2,4-D	ND	ND	ND	ND	ND	ND	ND
2,4,5-TP (silvex)	tr	tr	ND	ND	tr	ND	ND
Lindane	ND	ND	ND	ND	ND	ND	ND

[a]ND = None detected (below LLD - lower limit of detection).

[b]tr = Trace. Some level at or below the limit of quantitation (detection).

[c] [illegible] performed in replicate

Pesticides were not detected in any samples above trace concentrations with the majority of pesticides not being detected in the samples (Table 4-5).

The concentration distribution of antimony in the surficial deposits also reflects the influence of the Penite site with the higher antimony concentrations being found in samples from monitoring wells P-6, P-3 and soil borings P-B1 and P-P2 (Table 4-4). The high antimony concentration in sample P-S-9D-3 is not understood. The elevated zinc concentrations detected in several soil samples did not show a distribution attributable to any definable waste source or any discernable relationship to other parameters analyzed as part of the program.

As expected, the highest concentrations of arsenic were detected in samples from monitoring well P-6D, and in test borings P-B1, P-P1, and P-P2, all of which are located in the area of the Penite disposal site. Concentrations of arsenic at these stations ranged from 0.01 to 90 mg/l. The highest arsenic concentrations were found in samples collected from depths between 13.0 and 16.5 ft. The concentration of arsenic obtained from EP toxicity testing of samples from boring P-P2 was 300 mg/l. All of these values are significantly lower than the arsenic concentrations that have been detected in groundwater samples from monitoring wells downgradient of the Penite area. This would tend to indicate that the arsenic is in a highly soluble form resulting in only small residual concentrations being present in the underlying deposits.

Based upon the physical observations made during the subsequent drilling of the nine supplemental test borings, it appears that approxi-

mately 1.5 ft of gray Penite sludge was encountered in boring B-12 (Plate 1 for location). This gray sludge-like material was encountered between 3.0 and 4.5 ft below ground surface. It is thought that this material represents a residual sludge which accumulated in a small settling pond, approximately 50 ft by 30 ft, which was utilized when the Penite facility was in operation.

Due to the very low and isolated quantitated concentrations of the various parameters detected in the selected soil samples, there appears to be very low quantities of contaminants entrained within the unsaturated zone at the Pennwalt facility. For example, the two highest concentrations of arsenic in samples from the unsaturated zone were only 3 and 10 mg/l in Well P-6D with all other samples having arsenic concentrations less than 2 mg/l.

The probable Penite sludge encountered in boring B-12 is situated in the uppermost part of the saturated zone in the upper surficial fill material. As a result, the leaching of contaminants from this sludge will be controlled by groundwater movement through the material rather than through infiltration. Therefore, due to the thin unsaturated zone and the low concentrations encountered in the unsaturated zone samples, it is expected that only very low concentrations of various constituents would be available for future leaching from infiltration. When compared to concentrations already detected in the groundwater, these values are extremely low and would not be expected to have any appreciable influence on the groundwater system.

4.7 GROUNDWATER CONDITIONS

4.7.1 Regional Conditions

Groundwater in the Puyallup delta region of Tacoma harbor is found under water table, semi-confined, and confined conditions. The delta deposits underlying the area consist of interbedded sands, silts, and clays with laterial lithologic changes. The sand and silty-sand beds are generally the water yielding zones in the delta deposits.

Recharge to the delta groundwater system will occur locally by infiltration of precipitation and from upgradient surface water sources such as the Hylebos River and Puyallup River. The movement of groundwater is from the areas of recharge to discharge areas along the waterways or from deeper zones in the delta directly into Commencement Bay.

Water quality data show the salinity of the groundwater may range up to 10,000 mg/l sodium chloride (NaCl) through most of the depth of delta deposits (Hart and Crowser, 1980). The uppermost deposits have lower salt concentrations, probably from dilution by infiltrating precipitation. The salt concentrations found in the groundwater will also decrease with distance inland from the bay.

High sodium and chloride concentrations found in the groundwater inland from the bay may have been caused by several different mechanisms. Sea water intrusion caused by depletion of the fresh water in the aquifers is not considered a reasonable source because groundwater pumping is not a major water source in the Puyallup delta area. Deposition of wind borne salt on land surface and subsequent flushing into the ground by infiltra-

tion of precipitation could be one source. Flooding of low areas by high tides during storm events could also contribute salt to the groundwater. Leaching of residual salt from dredged material from the waterways utilized as local fill is another potential source for sodium and chloride contributions to the groundwater.

4.7.2 Site Specific Conditions

The groundwater monitoring well drilling program identified three separate water-bearing zones at the Pennwalt facility. These three zones are identified as the shallow surficial zone which occurs under water table conditions, the intermediate zone which occurs under confined conditions and the deep zone which also occurs under confined conditions. Lithologically the water bearing zones are silty fine-sand to coarse-sand units separated by silty clay or organic clay units. The water level elevations measured in the wells screened in the intermediate and deep zones showed the two units to be under confined or artesian conditions. The lithologic sequence found at the site is represented by the uppermost units of the Upper Lithologic zone of the Puyallup River Delta.

Water level measurements in the intermediate and deep zone monitoring wells were made through low and high tidal cycles on April 30 - May 1, 1981 and July 3, 1981 (Tables 4-6 and 4-7). Water level measurement for the shallow surficial monitoring wells and the intermediate zone monitoring wells were made on August 11, 1981 (Table 4-8). Representative hydrographs of the water level measurements from these zones are shown in Figures 4-8 and 4-9.

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TABLE 4-6

WATER LEVEL ELEVATIONS, April 30, 1981 and May 1, 1981

P-1D		P-1S		P-2D		P-2S		P-3D		P-3S		P-4D	
Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation
April 30, 1981													
1914	11.75	1918	14.78	1914	11.84	1917	12.69	1918	11.69	1920	11.68	1926	15.23
1939	11.41	1944	14.37	2000	11.09	2002	12.47	2004	10.97	2006	11.08	2012	12.39
2000	11.09	2001	14.37	2015	10.95	2017	12.42	2019	10.82	2021	10.89	2028	14.51
2015	10.92	2016	14.33	2030	10.82	2032	12.37	2034	10.67	2036	10.79	2043	14.67
2030	10.77	2001	14.23	2045	10.73	2047	12.33	2049	10.56	2051	10.72	2058	12.55
2045	10.72	2046	14.14	2100	10.59	2102	12.23	2104	10.49	2106	10.68	2113	13.18
2100	10.56	2101	13.95	2115	10.63	2117	12.25	2119	10.51	2120	10.62	2135	9.99
2115	10.55	2116	14.15	2130	10.65	2134	12.07	2136	10.54	2138	10.56	2146	9.50
2130	10.59	2131	14.22	2145	10.70	2147	12.00	2150	10.64	2152	10.64	2201	9.52
2145	10.59	2146	14.12	2200	10.74	2202	12.05	2205	10.72	2206	10.67	2212	10.29
2200	10.68	2201	14.14	0030	13.16	0033	11.91	0035	13.43	0038	12.69	0037	12.73
May 1, 1981													
0030	13.28	0031	15.89	0135	14.41	0137	13.19	0141	14.82	0143	13.61	0140	15.79
0135	14.55	0136	16.79	0230	15.20	0232	14.47	0234	15.55	0235	14.42	0231	15.17
0230	15.42	0231	17.43	0245	15.40	0247	14.73	0249	15.76	0250	14.66	0246	15.26
0245	15.60	0246	17.57	0300	15.54	0302	14.87	0304	15.86	0306	14.75	0301	15.17
0300	15.74	0301	17.62	0315	15.63	0317	15.10	0319	15.93	0321	14.92	0316	15.56
0315	15.84	0316	17.69	0330	15.68	0332	15.15	0334	15.98	0336	14.98	0332	15.75
0330	15.90	0331	17.79	0345	15.64	0347	15.35	0349	16.02	0351	15.11	0346	15.62
0345	15.95	0346	17.76	0400	15.74	0402	15.33	0404	16.00	0406	15.14	0401	15.62
0400	15.94	0401	17.76	0416	15.67	0418	15.33	0421	15.88	0422	15.12	0416	15.53
0415	15.91	0416	17.72	0431	15.62	0432	15.31	0434	15.87	0435	15.08	0431	15.45
0431	15.82	0432	17.76										

ELF000207

TABLE 4-6 (Cont.)

WATER LEVEL ELEVATIONS, April 30, 1981 and May 1, 1981

P-4S		P-5D		P-5S		P-6D		P-6S		P-7D		P-7S	
Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation
April 30, 1981													
		1921	11.97	1924	13.00	1921	12.31	1923	12.90	1918	13.37	1920	14.25
2010	9.78	2005	11.65	2006	12.27	2007	11.73	2009	12.25	2010	13.08	2011	14.18
2025	9.63	2020	11.28	2022	12.14	2022	11.53	2024	12.03	2025	13.01	2026	13.31
2040	9.40	2035	11.18	2037	11.95	2037	11.44	2039	11.95	2040	12.97	2041	14.17
2056	9.55	2050	11.09	2052	11.97	2052	11.39	2054	11.86	2055	12.86	2056	14.13
2112	9.31	2105	11.04	2110	12.00	2109	11.30	2111	11.81	2110	12.78	2111	14.13
2128	9.30	2120	10.98	2121	11.86	2123	11.26	2125	11.81	2125	12.75	2126	14.16
2142	9.57	2135	11.01	2136	11.90	2141	11.28	2142	11.75	2140	12.69	2141	14.12
2158	9.36	2150	11.02	2151	11.75	2154	11.33	2155	11.72	2155	12.57	2156	14.07
2213	9.36	2205	11.08	2207	11.83	2209	11.34	2211	11.79	2210	12.60	2211	14.10
0033	13.39	0035	13.08	0036	12.14	0040	13.20	0042	12.44	0022	12.83	0023	14.09
May 1, 1981													
0140	13.86	0140	14.12	0141	12.53	0145	14.27	0147	13.12	0131	13.17	0132	14.14
0230	16.51	0235	14.76	0237	12.84	0237	14.87	0239	13.73	0240	13.58	0241	14.18
0245	16.73	0250	14.93	0251	12.96	0254	14.98	0255	13.90	0255	13.65	0256	14.21
0300	16.86	0305	14.99	0306	13.03	0309	15.15	0310	13.97	0310	13.72	0311	14.21
0315	17.00	0324	15.13	0325	13.13	0323	15.29	0325	14.08	0325	13.84	0326	14.21
0331	17.17	0335	15.14	0336	13.19	0338	15.29	0340	14.19	0340	13.90	0341	14.23
0345	17.10	0350	15.18	0351	13.22	0353	15.39	0355	14.19	0355	13.95	0356	14.26
0400	17.06	0405	15.22	0406	13.27	0408	15.44	0410	13.31	0410	14.01	0411	14.26
0415	16.91	0420	15.13	0421	13.34	0424	15.40	0426	13.32	0425	14.07	0426	14.27
0430	16.83	0436	15.15	0437	13.32	0439	15.36	0441	13.34	0440	14.13	0441	14.27

TABLE 4-6 (Cont.)

WATER LEVEL ELEVATIONS, April 30, 1981 and May 1, 1981

P-8D		P-8S		P-9D		P-9S		P-10D		P-10S		P-11S	
Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation
April 30, 1981													
1914	13.77	1915	14.80	1940	9.47	1935	8.89	1908	15.40	1910	16.42	1920	16.60
2005	13.44	2006	14.73	2001	14.19	2005	17.54	2000	15.20	2001	16.43	1958	16.26
2020	13.31	2021	14.66	2020	14.14	2021	17.56	2015	15.10	2016	16.36	2018	16.26
2035	13.23	2036	14.66	2035	14.02	2038	17.56	2030	15.02	2031	16.38	2033	16.07
2050	13.14	2051	14.65	2051	13.91	2053	17.56	2045	14.97	2046	16.34	2045	16.03
2105	13.07	2106	14.65	2105	13.84	2107	17.55	2100	14.92	2101	16.35	2104	15.76
2120	13.02	2121	14.70	2121	13.82	2124	17.60	2115	14.81	2116	16.34	2119	15.87
2135	12.95	2136	14.69	2133	13.73	2140	17.61	2130	14.80	2131	16.35		
2150	12.91	2151	14.70	2155	13.65	2156	17.55	2145	14.75	2146	16.37	2151	15.86
2205	12.84	2206	14.68	2207	13.64	2208	17.53	2200	14.69	2201	16.38	2204	15.88
0037	13.30	0038	14.70	0027	13.71	0028	17.76	0041	14.83	0042	16.39	0041	17.10
May 1, 1981													
0135	13.72	0136	14.70	0132	14.08	0134	17.65	0140	15.17	0141	16.39	0145	18.03
0235	14.20	0236	14.70	0225	14.40	0226	17.64	0230	15.41	0231	16.39	0235	18.68
0250	14.28	0251	14.75	0240	14.45	0241	17.58	0245	15.49	0246	16.39	0250	18.66
0305	14.37	0306	14.73	0255	14.63	0256	17.63	0300	15.59	0301	16.41	0305	18.86
0320	14.46	0321	14.73	0310	14.64	0311	17.58	0315	15.65	0316	16.40	0322	18.86
0335	14.57	0336	14.74	0326	14.67	0327	17.57	0330	15.74	0331	16.40	0335	19.07
0350	14.63	0351	14.76	0340	14.79	0341	17.61	0345	15.80	0346	16.38	0348	19.04
0405	14.57	0406	14.72	0354	14.81	0355	17.63	0400	15.87	0401	16.40	0405	19.19
0420	14.78	0421	14.71	0410	14.88	0411	17.60	0415	15.93	0416	16.39	0420	18.97
0435	14.79	0436	14.70	0425	14.95	0426	17.60	0430	15.96	0431	16.39	0436	18.98
				0440	15.01	0441	17.61	0501	16.04				

NOTE: Elevation Datum - Mean Sea Level
Lower Low Tide: 7.8 ft at 20:51, April 30, 1981
Higher High Tide: 17.3 ft at 03:24, May 1, 1981

TABLE 4-7

WATER LEVEL ELEVATIONS, July 3, 1981

P-1D		P-1S		P-2D		P-2S		P-3D		P-3S		P-4D	
Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation
1124	8.75	1126	15.40	1155	9.02	1157	8.70	1139	8.02	1140	9.27	1145	6.70
1130	8.53	1132	15.38	1210	8.78	1212	8.53	1150	7.72	1151	9.16	1205	6.36
1145	8.18	1147	15.37	1225	8.49	1227	8.37	1205	7.36	1207	8.90	1220	6.09
1200	7.79	1202	15.27	1240	8.32	1242	8.26	1220	7.12	1222	8.70	1235	5.89
1215	7.31	1217	15.18	1255	8.13	1257	8.27	1235	6.90	1237	8.59	1250	5.65
1230	7.32	1232	15.23	1310	8.12	1313	8.10	1250	6.71	1252	8.50	1305	5.64
1245	7.07	1247	15.18	1325	8.08	1327	8.05	1305	6.67	1307	8.49	1320	5.64
1300	6.97	1302	15.16	1340	8.20	1342	8.16	1320	6.64	1322	8.49	1335	5.71
1315	6.97	1317	15.16	1354	8.34	1357	8.17	1335	6.74	1338	8.57	1350	5.94
1330	6.98	1332	15.15	1628	12.14	1629	10.96	1349	6.89	1351	8.63	1605	10.15
1345	7.10	1347	15.16	1706	13.22	1708	12.36	1624	11.06	1626	10.46	1705	11.90
1559	10.09	1600	15.45	1805	14.69	1806	14.07	1702	12.20	1703	11.22	1805	13.44
1658	12.06	1702	15.80	1925	15.91	1927	15.76	1802	13.79	1803	12.47	1920	15.09
1753	13.49	1755	16.05	1940	15.98	1942	15.89	1920	15.07	1922	13.97	1935	15.40
1915	14.94	1917	16.36	1955	16.14	1957	16.14	1935	15.15	1937	14.14	1950	15.23
1930	14.77	1922	16.11	2010	16.19	2012	16.16	1950	15.28	1952	14.28	2005	15.35
1945	15.21	1937	16.43	2025	16.25	2027	16.22	2005	15.41	2008	14.48	2020	15.33
2000	15.37	2002	16.45	2040	16.36	2042	16.32	2020	15.42	2022	14.52	2035	15.45
2015	15.37	2017	16.46	2055	16.29	2057	16.25	2035	15.53	2037	14.67	2050	15.38
2030	15.52	2032	16.50	2110	16.27	2111	16.27	2050	15.42	2052	14.66	2105	15.39
2045	15.48	2047	16.50	2125	16.20	2127	16.14	2105	15.47	2108	14.70	2120	15.34
2100	15.47	2102	16.51					2119	15.42	2120	14.68		
2115	15.47	2117	16.51										

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TABLE 4-7 (Cont.)

WATER LEVEL ELEVATIONS, July 3, 1981

P-4S		P-5D		P-5S		P-6D		P-6S		P-7D		P-7S	
Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation
1147	6.14	1138	9.17	1140	11.66	1133	9.80	1147	11.59	1154	12.24	1156	13.50
1206	5.76	1151	8.90	1153	11.53	1145	9.55	1201	12.30	1208	12.12	1210	14.06
1221	5.53	1206	8.52	1209	11.41	1200	9.21	1217	11.08	1223	11.88	1225	14.06
1236	5.44	1221	8.38	1224	11.29	1215	8.96	1232	10.99	1238	11.73	1240	14.16
1251	5.19	1236	8.21	1239	11.17	1230	8.69	1248	10.95	1253	11.64	1255	14.14
1306	5.17	1251	7.95	1254	11.10	1245	8.48	1302	10.90	1309	11.45	1311	14.01
1321	5.07	1307	7.86	1309	11.01	1300	8.30	1317	10.77	1323	11.42	1325	13.97
1336	5.29	1322	7.91	1324	10.94	1315	8.24	1333	10.76	1338	11.23	1340	14.06
1351	5.42	1337	7.93	1339	10.87	1330	8.16	1347	10.72	1354	11.20	1355	14.08
1607	10.00	1352	8.02	1354	10.80	1345	8.22	1616	10.99	1608	11.13	1610	14.00
1706	12.68	1604	10.39	1607	10.88	1613	10.61	1659	11.45	1708	11.56	1710	14.05
1806	15.74	1706	11.87	1707	11.29	1657	11.72	1800	12.23	1808	12.04	1810	14.06
1921	16.70	1800	12.96	1802	11.78	1757	13.02	1918	14.35	1923	12.61	1925	14.07
1936	16.70	1922	14.12	1924	12.55	1915	14.24	1933	14.07	1938	12.67	1940	14.09
1951	16.98	1937	14.21	1939	12.55	1930	14.38	1947	13.91	1953	12.81	1955	14.17
2006	17.09	1952	14.34	1954	12.63	1945	14.51	2003	13.64	2008	12.97	2010	14.09
2021	17.02	2007	14.36	2009	12.69	2000	14.65	2017	13.60	2024	13.00	2025	14.09
2036	17.26	2022	14.46	2024	12.82	2015	14.70	2033	14.29	2038	13.09	2040	14.12
2051	17.11	2037	14.57	2039	12.90	2030	14.78	2047	13.92	2053	13.17	2055	14.18
2106	17.11	2052	14.54	2054	12.98	2045	14.85	2103	13.98	2108	13.20	2110	14.18
2121	17.06	2107	14.55	2109	12.99	2100	14.83	2116	14.04	2123	13.27	2125	14.18
		2122	14.52	2124	13.03	2115	14.87						

TABLE 4-7 (Cont.)

WATER LEVEL ELEVATIONS, July 3, 1981

P-8D		P-8S		P-9D		P-9S		P-10D		P-10S		P-11S	
Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation	Time	W.L. Elevation
1150	12.51	1152	14.45	1140	13.45	1142	16.80	1145	14.56	1147	16.19	1154	10.42
1203	12.24	1206	14.38	1200	13.19	1200	16.89	1200	14.37	1207	16.12	1211	9.67
1219	12.00	1221	14.33	1215	13.06	1216	16.93	1215	14.22	1217	16.08	1226	9.59
1234	11.87	1236	14.29	1230	12.94	1231	16.92	1230	13.99	1232	16.20	1241	9.58
1244	11.68	1252	14.38	1245	12.61	1246	16.93	1245	13.85	1247	16.01	1256	9.42
1305	11.80			1300	12.53	1301	16.90	1300	13.79	1302	16.13	1310	9.44
1319	11.48	1320	14.51	1315	12.41	1316	16.94	1315	13.66	1316	16.04	1325	9.40
1334	11.22	1336	14.58	1330	12.30	1331	16.92	1330	13.48	1331	16.14	1340	9.57
1349	11.24	1351	14.46	1345	12.16	1346	16.95	1345	13.42	1346	16.14	1355	9.38
1604	11.43	1606	14.39	1600	12.04	1601	17.05	1600	13.19	1602	16.18	1612	10.50
1704	11.94	1706	14.69	1700	12.31	1701	17.07	1700	13.47	1702	16.20	1715	11.92
1805	12.76	1806	14.58	1800	12.72	1801	17.10	1800	13.85	1802	16.21	1810	13.38
1919	13.24	1921	--	1915	13.29	1916	17.13	1915	14.39	1917	16.01	1925	14.71
1934	13.33	1936	14.51	1930	13.39	1931	17.15	1930	14.44	1932	16.22	1940	14.83
1949	13.43	1951	14.46	1945	13.45	1946	17.15	1945	14.55	1947	16.21	1955	15.05
2004	13.61	2006	14.45	2000	13.59	2001	17.15	2000	14.56	2002	16.18	2010	15.13
2019	13.70	2021	14.37	2015	13.70	2016	17.15	2015	14.74	2017	16.10	2025	15.15
2034	14.42	2036	14.45	2030	13.77	2031	17.13	2030	14.81	2032	16.24	2040	15.23
2049	13.76	2051	14.51	2045	13.84	2046	17.14	2045	14.86	2047	16.21	2055	15.29
2104	13.84	2105	14.56	2100	13.93	2101	17.13	2100	14.91	2102	16.03	2110	15.29
2119	13.93	2120	14.64	2115	14.00	2116	17.13	2115	14.97	2116	15.95	2125	15.18

NOTE: Elevation Datum - Mean Sea Level
Lower Low Tide: 8.6 ft at 12:49
Higher High Tide: 18.8 ft at 20:20

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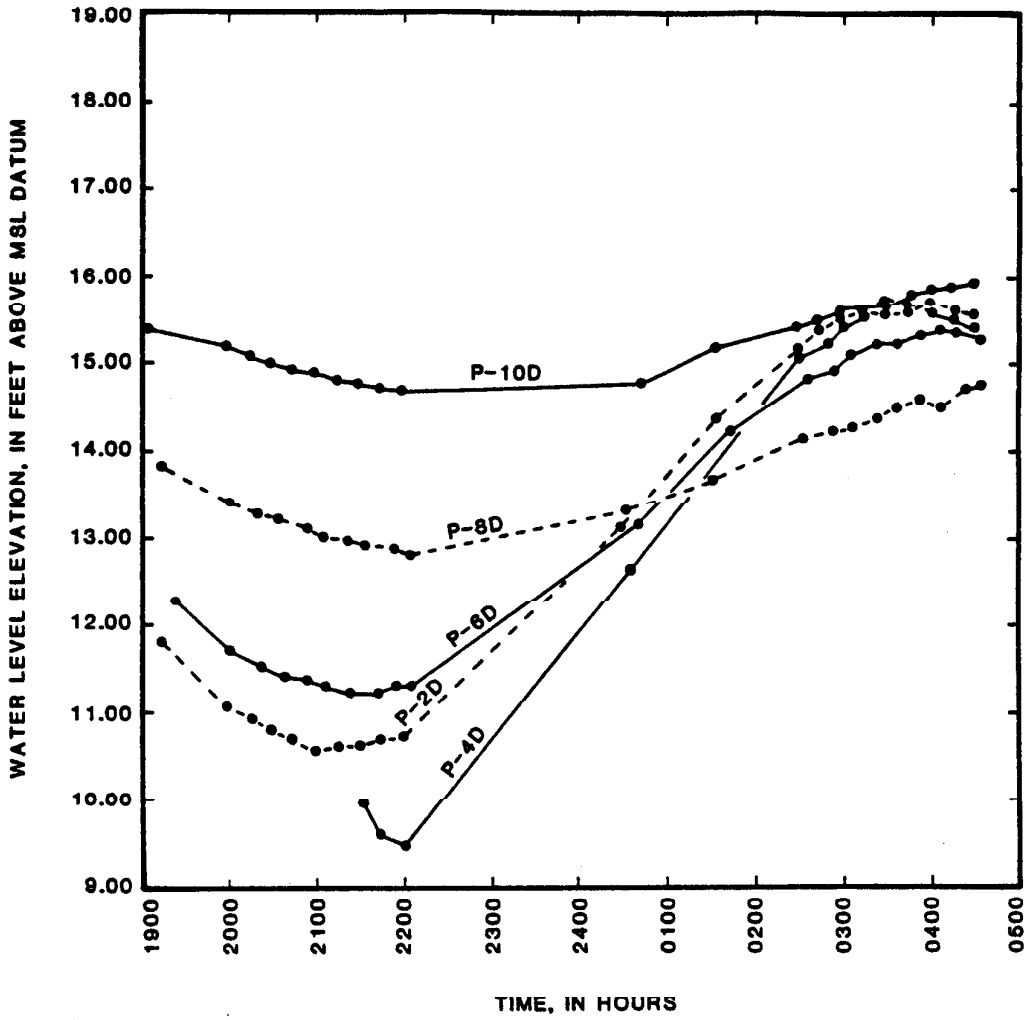
TABLE 4-8

WATER LEVEL ELEVATIONS, August 11, 1981

P-1S		P-1SS		P-3S		P-3SS		P-4S		P-4SS		P-6S		P-6SS		P-10SS	
Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation	Time	Elevation
0800	15.29	0801	16.13	0806	15.13	0807	19.71	0809	8.65	0812	18.21	0810	14.07	0811	19.78	0802	18.07
0815	15.40	0816	15.92	0821	10.99	0822	19.07	0820	8.55	0822	18.21	0825	14.16	0826	19.62	0817	18.07
0830	15.31	0831	15.91	0835	10.40	0836	19.34	0833	8.45	0834	18.21	0840	14.23	0841	19.64	0831	17.97
0845	15.48	0846	16.10	0850	10.96	0851	-18.91	0850	8.35	0851	18.21	0855	14.07	0856	19.80	0846	18.02
0900	15.35	0901	15.95	0905	9.76	0906	19.0	0904	8.04	0905	18.21	0910	14.02	0911	19.59	0901	18.07
0915	15.28	0916	16.14	0920	9.45	0921	19.06	0920	8.35	0920	18.21	0925	14.04	0926	19.54	0916	18.02
0930	15.45	0931	15.91	0935	9.48	0936	18.91	0934	8.34	0935	18.21	0940	13.82	0941	19.54	0931	17.92
0945	15.26	0946	15.91	0950	9.50	0951	18.96	0951	8.41	0951	18.11	0955	13.93	0956	19.49	0946	18.07
1110	15.34	1111	15.87	1105	9.89	1106	18.92	1005	8.59	1006	18.21	1100	13.75	1101	19.58	1001	18.07
1210	15.41	1211	15.98	1205	10.39	1206	18.92	1105	9.15	1106	18.21	1200	13.97	1201	19.57	1100	18.02
1410	15.70	1411	16.04	1405	12.37	1406	18.92	1204	11.45	1205	18.21	1400	12.25	1410	19.55	1200	18.12
1515	15.89	1516	16.04	1410	13.29	1511	18.91	1400	14.45	1401	19.36	1505	12.77	1506	19.55	1355	18.09
1540	15.88	1541	16.10	1535	13.53	1536	18.93	1506	15.69	1507	18.11	1530	12.88	1531	19.64	1503	18.07
1555	15.91	1556	16.09	1550	13.67	1551	18.93	1535	16.09	1536	18.21	1545	13.11	1546	19.65	1531	18.15
1610	15.89	1611	16.11	1605	13.76	1606	18.92	1551	16.18	1552	18.11	1600	13.19	1601	19.53	1547	18.07
1625	15.94	1626	16.09	1620	13.87	1621	19.0	1605	16.27	1606	18.11	1615	13.29	1616	19.55	1601	18.07
1640	16.04	1641	16.23	1635	13.95	1636	19.0	1619	16.38	1619	18.11	1630	13.35	1631	19.53	1616	18.07
1655	16.08	1656	16.16	1650	13.99	1651	19.0	1634	16.38	1635	18.11	1645	13.57	1646	19.66	1630	18.12
1710	16.07	1711	16.13	1705	14.15	1706	19.0	1649	16.38	1649	18.11	1700	13.83	1701	19.57	1646	18.11
1725	16.03	1726	16.11	1720	14.05	1721	19.0	1704	16.35	1705	18.11	1715	13.49	1716	19.56	1701	18.07
								1719	16.30	1721	18.11					1716	18.07

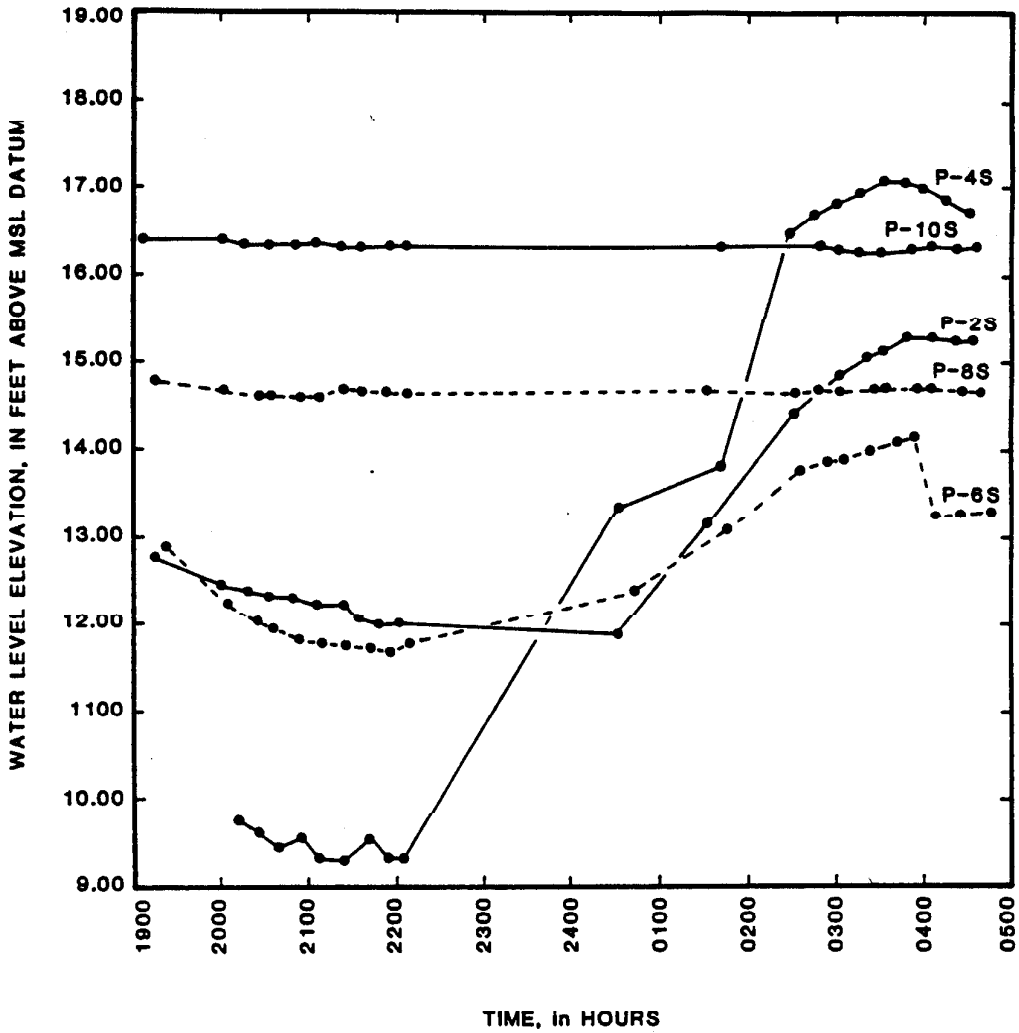
NOTE: Elevation Datum - Mean Sea Level
Low Tide: 6.1 ft @ 09:00
High Tide: 16.3 ft @ 16:44



LOWER LOW TIDE - 7.8 FEET AT 20:51 APRIL 30, 1981
MEAN SEA LEVEL DATUM

HIGHER HIGH TIDE - 17.3 FEET AT 03:24 MAY 1, 1981
MEAN SEA LEVEL DATUM

FIGURE 4.8 DEEP ZONE WATER LEVEL HYDROGRAPHS
APRIL 30, 1981 - MAY 1, 1981



LOWER LOW TIDE - 7.8 FEET AT 20.51 APRIL 30, 1981
MEAN SEA LEVEL DATUM

HIGHER HIGH TIDE - 17.3 FEET AT 03:24 MAY 1, 1981
MEAN SEA LEVEL DATUM

FIGURE 4.9 INTERMEDIATE ZONE WATER LEVEL HYDROGRAPHS
APRIL 30, 1981 - MAY 1, 1981

The hydrograph of the deep zone monitoring well water levels shows the potentiometric change in water elevation caused by low and high tides in the waterway (Figure 4-8). The tidal effect is greatest near the waterway and lessens with increasing distance from the waterway; however, the tidal effect was found to extend across the entire plant site. The water levels measured in the intermediate zone show a tidal response in the wells nearest the waterway but the effect diminishes across the property and is not present in the monitoring wells farthest from the waterway (Figure 4-9). The hydrographs comparing the measured water levels in the shallow surficial zone wells to the water levels in the underlying intermediate zone wells show that no tidal effect occurs in the shallow zone (Figures 4-10 and 4-11). The tidal response in the aquifers will effect the direction and amount of groundwater flow in the different water bearing zones.

4.7.2.1 Shallow Surficial Zone. The shallow surficial water bearing zone consists of fill material dredged from the waterway and obtained from other sources. The fill was placed on top of a salt water marsh area that sloped from Taylor Way towards the waterway and from both the east and west ends of the site towards the area near PW-1 (Figure 4-7).

The elevation of the top of the uppermost confining layer that forms the base of the fill deposits ranges from 16 to 21 ft around the perimeter of the plant property and drops to less than 10 ft in the vicinity of monitoring stations P-1, P-2, and P-3. The configuration of the top of the clay layer resembles a trough with the rim near Taylor Way. The elevation of this rim is high enough to minimize groundwater flow into or away from

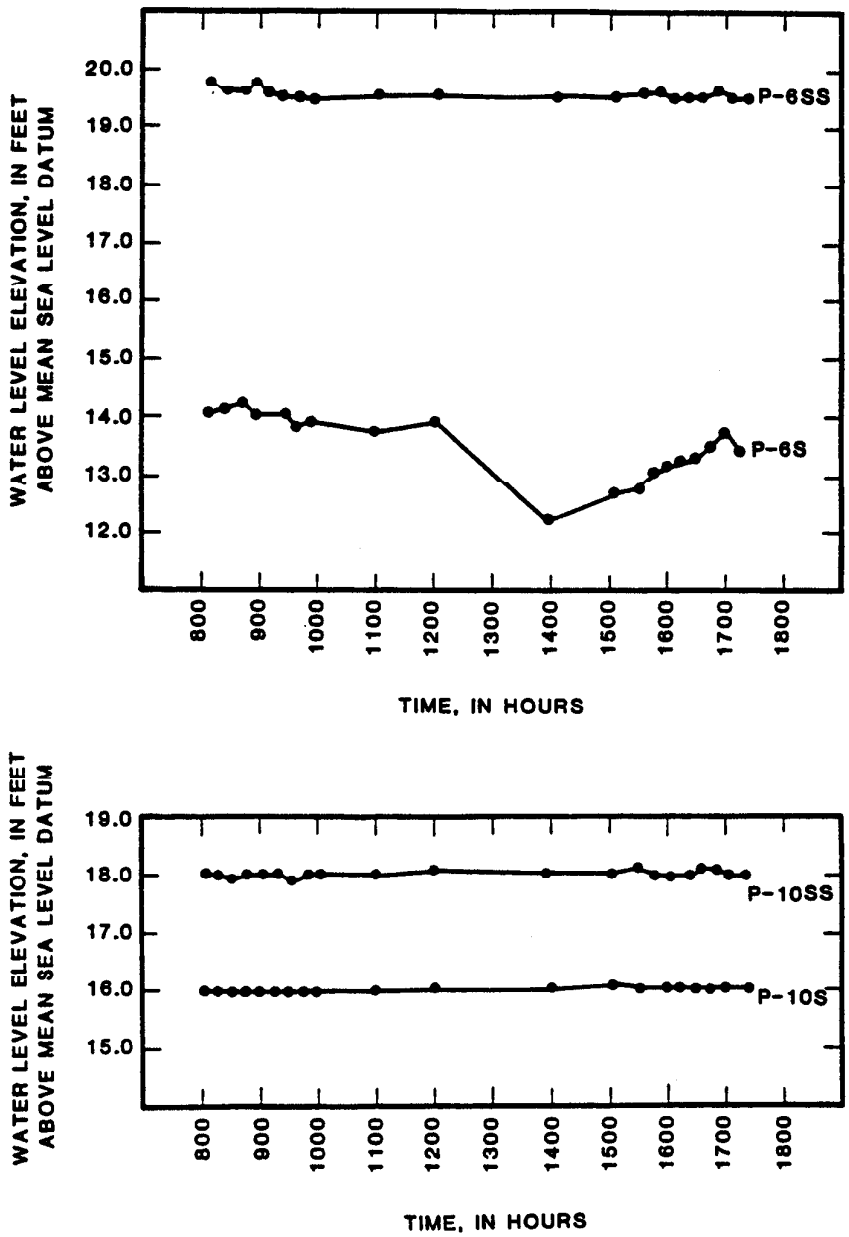
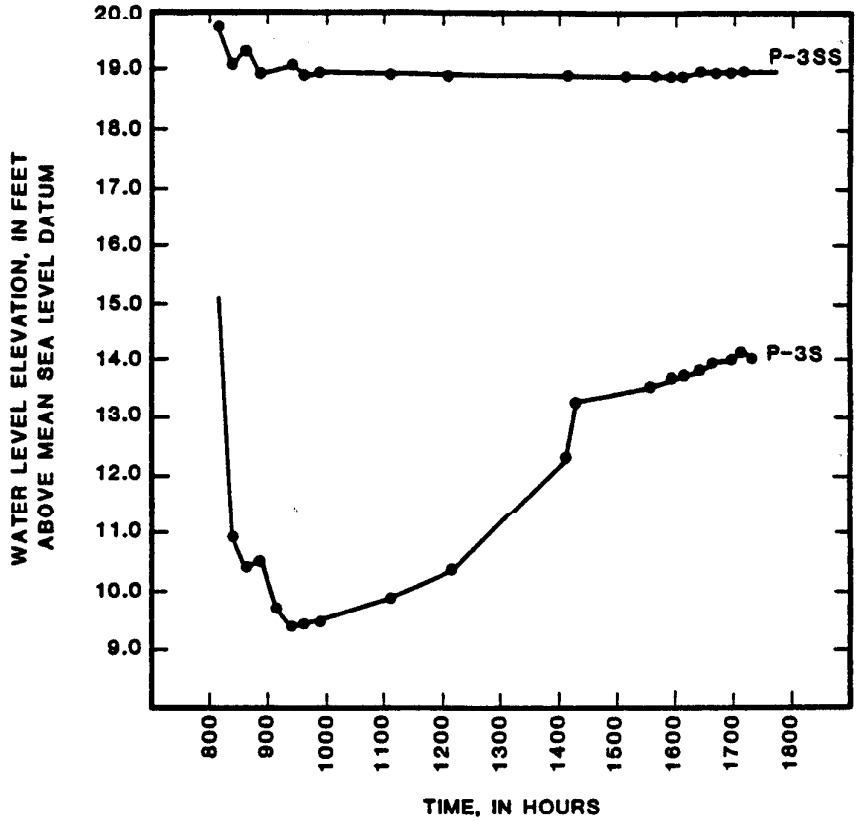


FIGURE 4.10 HYDROGRAPHS OF SHALLOW SURFICIAL WATER LEVELS COMPARED TO INTERMEDIATE ZONE WATER LEVELS, AUGUST 11, 1981



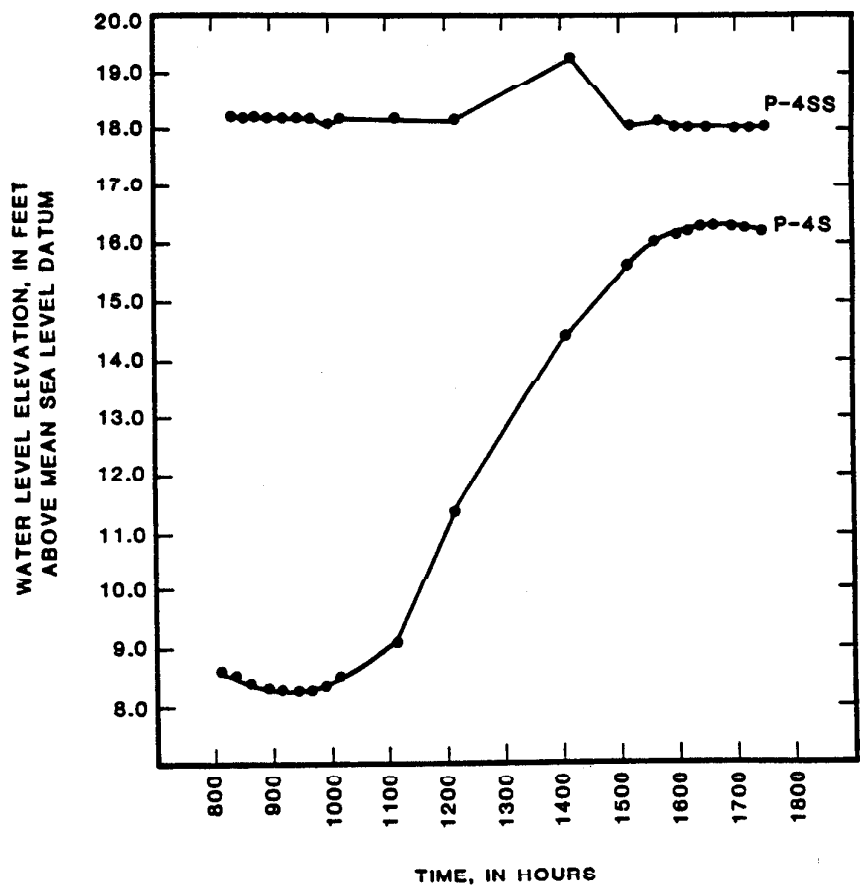


FIGURE 4.11 HYDROGRAPHS OF SHALLOW SURFICIAL WATER LEVELS COMPARED TO INTERMEDIATE ZONE WATER LEVELS, AUGUST 11, 1981

does not prevent actual water movement

the site in the shallow surficial water bearing zone. The groundwater found in this zone is recharged by precipitation on the plant site and seepage or leaks from water-use facilities on the plant site.

Five groundwater monitoring wells were initially installed in the shallow surficial zone to monitor the water table elevation and collect water quality samples. These shallow wells were installed at monitoring stations P-1, P-3, P-4, P-6 and P-10. The initial water level data collected was insufficient to produce a water table map, however, the water table elevation appeared to range between 18 ft and 20 ft elevation with the gradient towards the waterway. There was no readily apparent evidence of mounding in the vicinity of the Taylor Lake area with the highest water-level readings being obtained from the shallow well at monitoring station P-6. It is probable that any groundwater mound that had been developed beneath the Taylor Lake area had dissipated as a result of the discontinuation of discharge to the lagoons.

Following a review of the physical and chemical data obtained from the five initial monitoring wells tapping the surficial zone, it was determined that four additional wells would be needed to adequately monitor and evaluate contaiminant migration through the surficial zone. These four additional wells, P-12SS, P-13SS, P-14SS, and P-15SS, were subsequently installed on September 21, 1981, by Kring Drilling Company under the direct supervision of Shannon & Wilson, Inc. Water level measurements obtained from these and the other five shallow wells indicate a slight mounding in the vicinity of wells P-6SS, P-13SS, and P-14SS (Table 4-9).

TABLE 4-9

WATER LEVEL ELEVATIONS MEASURED IN THE
SHALLOW ZONE MONITORING WELLS
September 24, 1981

Monitoring Well	Time	Water Level Elevation (ft, MSL)
P-1SS	10:20	15.73
	15:15	15.78
P-3SS	09:23	19.01
	14:58	19.05
P-6SS	09:43	19.83
	15:07	19.87
P-12SS	08:51	17.95
	14:29	18.18
P-13SS	09:33	19.53
	14:57	19.50
P-14SS	09:05	19.29
	14:37	19.32
P-15SS	09:15	19.14(?)
	14:45	17.78

NOTE: Lower low tide 5.8 ft(MSL) at 0:853 on 9/24/81.
Higher high tide 17.6 ft(MSL) at 16:09 on 9/24/81.

In order to determine the approximate horizontal hydraulic conductivity of the shallow surficial zone, field slug tests were performed on monitoring wells P-3SS, P-6SS, and P-13SS. These tests were performed by Shannon & Wilson in accordance with methods described by Hvorslev (1951). Since slug tests are subject to error due to such factors as screen blockage, entrained gas bubbles and conduit seepage, the calculated hydraulic conductivities are considered approximate.

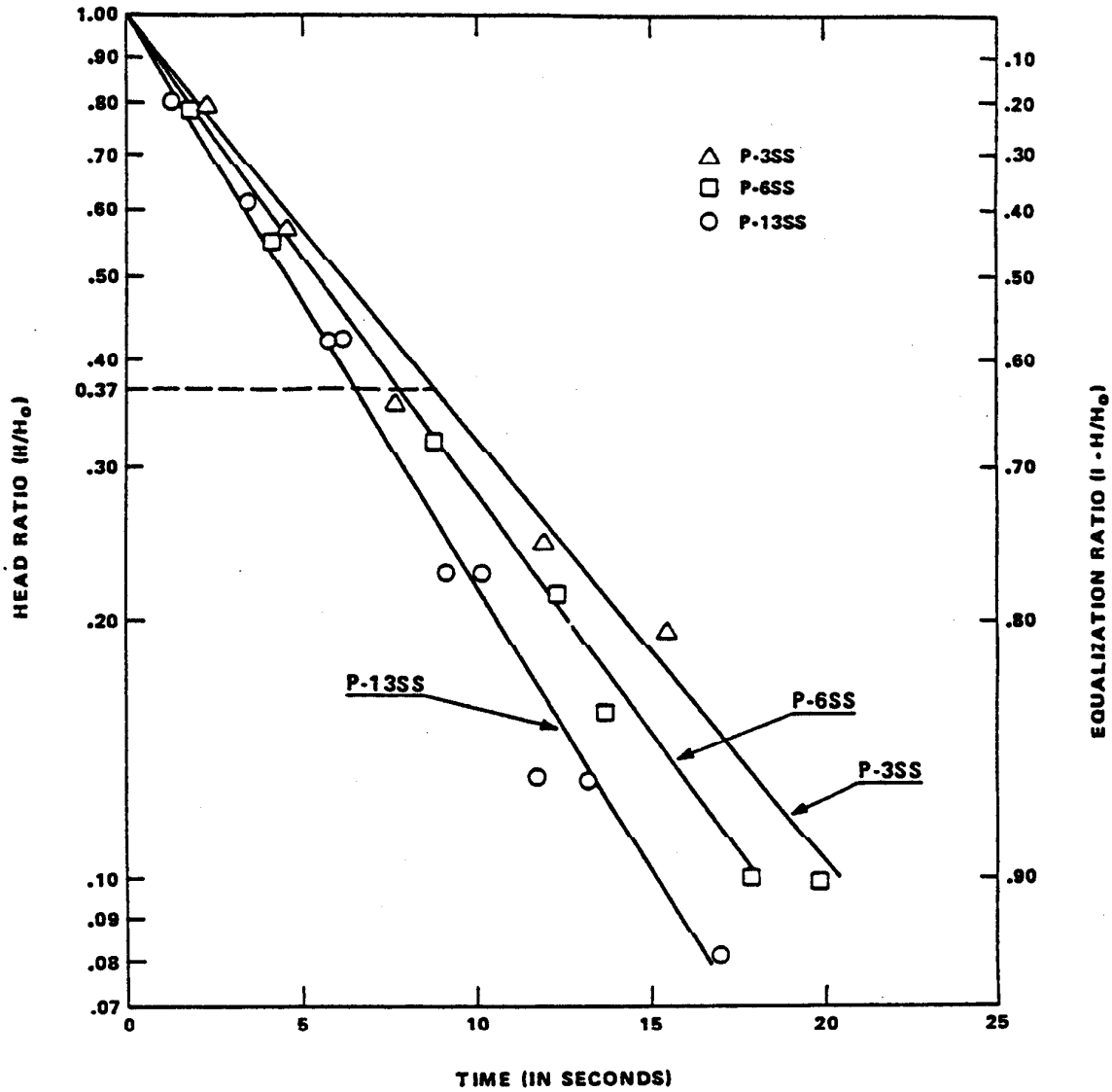
The field observations obtained from the slug tests are summarized in Table 4-10, with the plots of these observations being provided in Figure 4-12. Based upon the measurements obtained from these tests, the hydraulic conductivities calculated for the surficial zone are 55, 62, and 71 gal/day/sq ft for wells P-3SS, P-6SS, and P-13SS, respectively. These calculations are based upon a hydrostatic time lag at 90 percent equilization (T_{90}) as recommended by Hvorslev for practical problems. These values correlate very well with the hydraulic conductivities reported for similar type materials at the nearby Hooker facility.

Field observations made along the waterway bank revealed a white precipitate, probably magnesium hydroxide and calcium carbonate, had deposited above the low tide water line from the dock area to the eastern property boundary. Also observed were several seepage zones as well as water flowing around sewer lines that protrude from the bank. It is probable that the precipitate has plugged the pore spaces between the sand grains near the bank creating a zone of low permeability restricting the discharge of groundwater from the shallow surficial zone into the waterway. The seeps and water flowing around the pipes are probably a result of

TABLE 4-10

SLUG TEST FIELD DATA

Well Number	Depth to Water, H (in ft)	Elapsed Time (sec)
P-3SS	1.00	2.4, 2.4
	2.00	4.6
	3.00	7.7
	3.50	12.0
	3.75	15.4
Initial depth to water (Ho) prior to testing equals 4.65 ft.		
P-6SS	1.00	1.9
	2.00	4.2
	3.00	8.8
	3.50	12.3
	3.75	13.0
	4.00	19.8, 17.8
Initial depth to water (Ho) prior to testing equals 4.44 ft.		
P-13SS	1.00	1.2
	2.00	3.4
	3.00	6.1, 5.8
	4.00	9.1, 10.1
	4.50	13.2, 13.7
	4.75	17.0, 16.7
Initial depth to water prior to testing (Ho) equals 5.17 ft.		



P-3SS	P-6SS	P-13SS
T = 8.8 seconds	T = 7.8 seconds	T = 6.6 seconds
T_{90} = 20.2 seconds	T_{90} = 17.9 seconds	T_{90} = 15.2 seconds

$$K_h = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8LT}$$

$$T_{90} = 2.3T$$

WHERE:

T = BASIC HYDROSTATIC TIME LAG, $\frac{H}{H_o} = 0.37$

T_{90} = TIME LAG AT 90% EQUALIZATION

K_h = HORIZONTAL HYDRAULIC CONDUCTIVITY (cm/sec.)

d = STANDPIPE DIAMETER

D = SCREEN DIAMETER

L = LENGTH OF SCREEN

m = $\left(\frac{K_h}{K_v}\right)^{1/2}$ WHERE Kv IS THE VERTICAL HYDRAULIC CONDUCTIVITY

SOURCE: HVORSLEV (1951)

ELF000222

FIGURE 4.12 SLUG TEST DATA PLOT

preferential routing and discharge from the shallow zone. It is thought at this time that the low permeability zone along the bank has a damming effect which impedes the discharge of groundwater from the shallow surficial zone.

The groundwater flow rate through the surficial zone can be calculated utilizing the fundamental law of saturated fluid flow through a porous medium, Darcy's Law, which can be written in the following form:

$$\frac{Q}{A} = V = -K \frac{\partial h}{\partial l}$$

where:

Q	=	volume rate of flow.
A	=	cross-sectional area.
V	=	specific discharge of Darcy velocity.
K	=	hydraulic conductivity.
$\frac{\partial h}{\partial l}$	=	hydraulic gradient.

The Darcy velocity identified above is not a true velocity of flow in a porous medium, but a superficial velocity. The macroscopic average linear velocity or pore velocity, $\bar{v}$, is defined as:

$$\bar{v} = \frac{Q}{nA} = \frac{v}{n} = \frac{K}{7.48n} \frac{\partial h}{\partial l}$$

where n is the porosity of the medium and 7.48 is a conversion factor from gal to cu ft.

Utilizing the measured field permeability values, a hydraulic gradient of 0.005, and an effective porosity of 0.20, the resulting velocity of groundwater in the shallow zone would be:

$$\bar{v} = \frac{71}{(7.48)(0.2)} \times 0.005$$

$$= 0.18 \text{ ft/day}$$

$$\bar{v} = \frac{71}{(7.48)(0.2)} \times 0.005$$

$$= 0.24 \text{ ft/day}$$

Based upon the above flow velocities, an aquifer width of 2,250 ft, and an average saturated aquifer thickness of eight ft, the total quantity of groundwater discharge from the shallow zone beneath the plant site would be:

$$Q = (0.18)(0.20)(2{,}250 \times 8)$$
$$= 661.7 \text{ cu ft/day}$$
$$= 4{,}950 \text{ gpd}$$
$$Q = (0.24)(0.20)(2{,}250 \times 8)$$
$$= 854.3 \text{ cu ft/day}$$
$$= 6{,}390 \text{ gpd}$$

4.7.2.2 Intermediate Water Bearing Zone. The intermediate water bearing zone is a silty, fine sand bed overlain by an organic, clayey silt that acts as a confining layer. The sand unit ranges from 3 to 15 ft in thickness with an average saturated thickness of 8.5 ft. The elevation of the top of this unit ranges from 7.4 to 16.5 ft above mean sea level. The Hylebos Waterway has been excavated to a depth below this unit providing access for direct discharge of groundwater from the intermediate zone into the waterway.

Potentiometric maps have been constructed for high tide and low tide conditions using the water level data collected for the period April 30 - May 1, 1981 and July 3, 1981 (Figures 4-13, 4-14, and 4-15). The potentiometric surface map at low tide shows a hydraulic gradient sloping to the northeast with groundwater movement into the waterway (Figure 4-13). The high tide potentiometric surface map shows a temporary transient mounding effect along the waterway causing a damming effect on the groundwater flow

(Figure 4-14). The tidal effect may also create a reversal of flow causing the temporary inflow of seawater over short distances into the zone. The seawater that enters the zone during high tide will be flushed out during the next low tide cycle. The tidal effect as seen on the potentiometric surface map extends approximately 400 ft inland from the waterway. The potentiometric surface for the high tidal cycle showed a similar configuration during both the first and second set of measurements.

The potentiometric surface map for the first round of sampling also shows a mounding effect in the vicinity of Taylor Lake caused by inflow from the lagoons into the intermediate water bearing zone. A second groundwater recharge mound is indicated in the vicinity of the salt storage area but the monitoring well spacing is such that insufficient data are available to accurately define flow conditions for the western portion of the property. Use of the lagoons at the Taylor Lake area was discontinued between the first water level measurements of April 30, 1981 and the second set of measurements on July 3, 1981. The potentiometric surface map for low tide on July 3, 1981 shows the absence of a groundwater mound in the Taylor Lake area indicating that recharge from the lagoons has stopped (Figure 4-15).

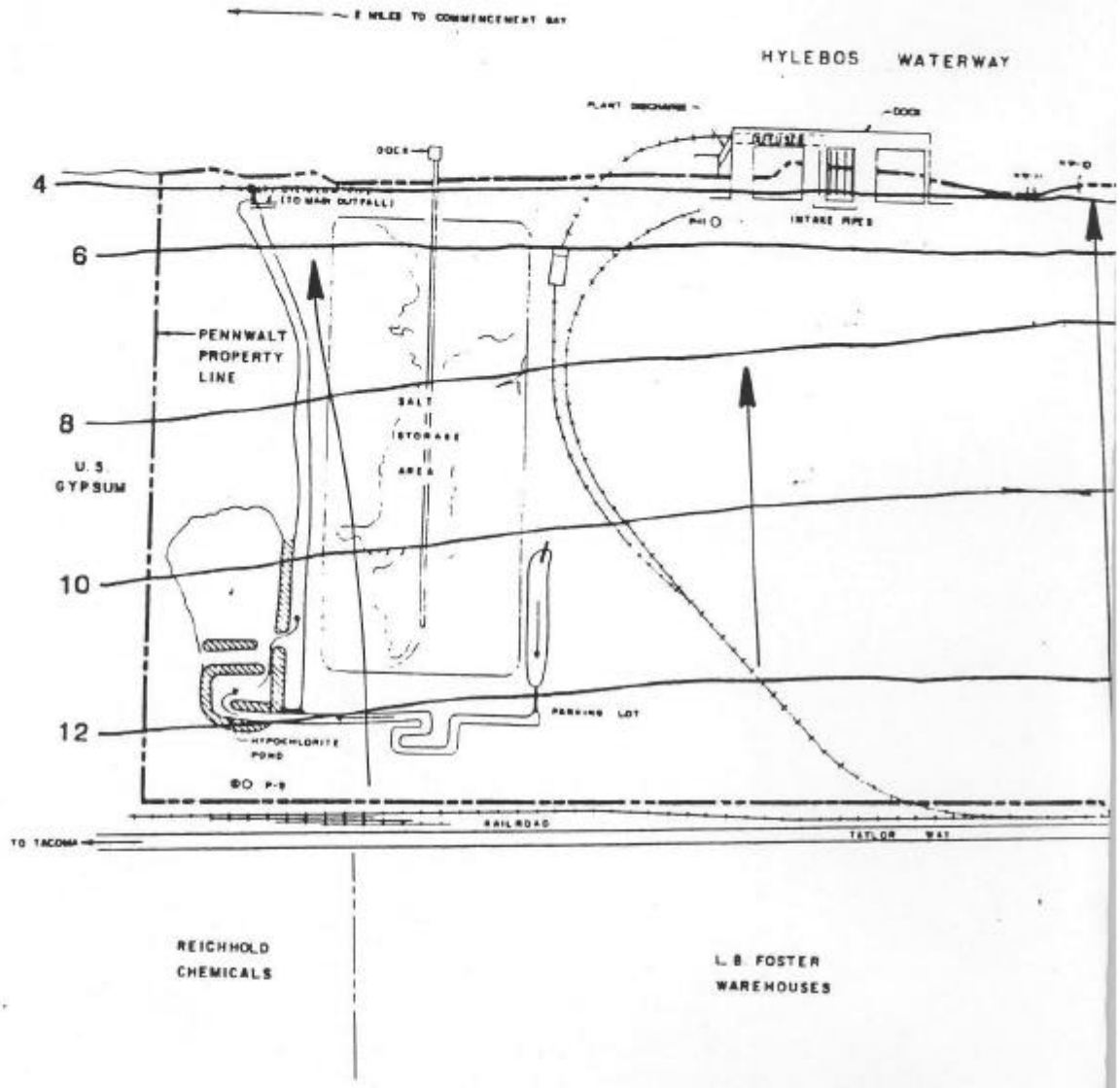
The permeability of the intermediate zone was estimated using the effective grain size of the samples collected during monitoring well construction. The permeabilities were estimated to be in the range from 90 gpd/sq ft to 240 gpd/sq ft. The hydraulic gradient from the south property boundary to the Taylor Lake area is approximately 0.006. The calculated velocity of the groundwater in this area is 0.36 ft/day to

0.96 ft/day. The estimated groundwater flow across the entire site in the intermediate zone is estimated to range from 10,600 gal/day to 28,000 gal/day.

The differences in water level elevations measured in the intermediate zone wells and the shallow surficial zone wells indicate the existence of a downward hydraulic gradient from the shallow surficial zone to the intermediate zone. The greater hydraulic head in the shallow surficial zone has the potential to cause groundwater movement to occur from the shallow zone to the intermediate zone. It is likely that such movement occurs in the vicinity of monitoring stations P-1, P-2 and P-3 where the clay confining layer thins to approximately 4 ft.

4.7.2.3 Deep Water Bearing Zone. The deep water bearing zone is a silty, fine-sand, hydraulically confined by a clayey silt and fibrous organic layer. The confining layer ranges from 5 to 25 ft in thickness across the site. The groundwater monitoring wells were installed in the uppermost 20 ft of the deep zone; however, the total thickness of this zone was not determined. The elevation of the top of the unit is approximately 20 ft below mean sea level. The Hylebos Waterway has been dredged to a depth of 32 ft below MSL and; therefore, intersects the top of the unit.

Potentiometric maps have been developed for lower low tide and higher high tide conditions for the water level elevations measured on April 30, 1981 and May 1, 1981 (Figures 4-16 and 4-17). These figures show the potentiometric surface to have a gradient to the northeast with resulting groundwater movement in that direction and discharge to the Hylebos Waterway. The hydraulic gradient is constant towards the northeast at low



LEGEND

SEEP

PIPE

SHALLOW SURFICIAL ZONE

INTERMEDIATE ZONE

DEEP ZONE

SOIL BORING

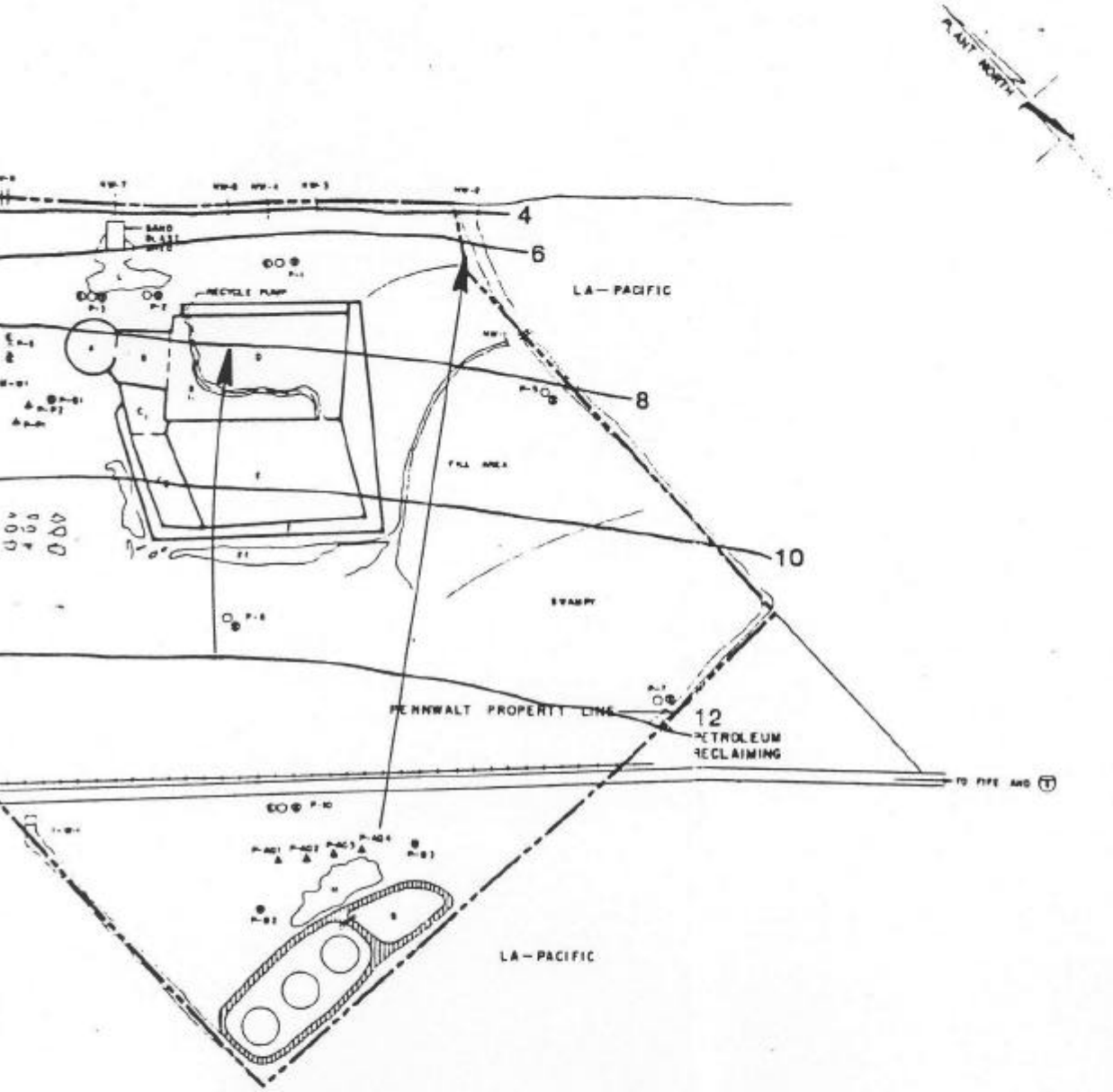
WASTE SAMPLE

MANHOLE

MOUNDS

Contour Interv

Lower Low Ti



: 2feet
1foot supplemental contours

: 2.8feet above MSL datum
at 1249, July 3, 1981

SCALE IN FEET
100 50 0 100

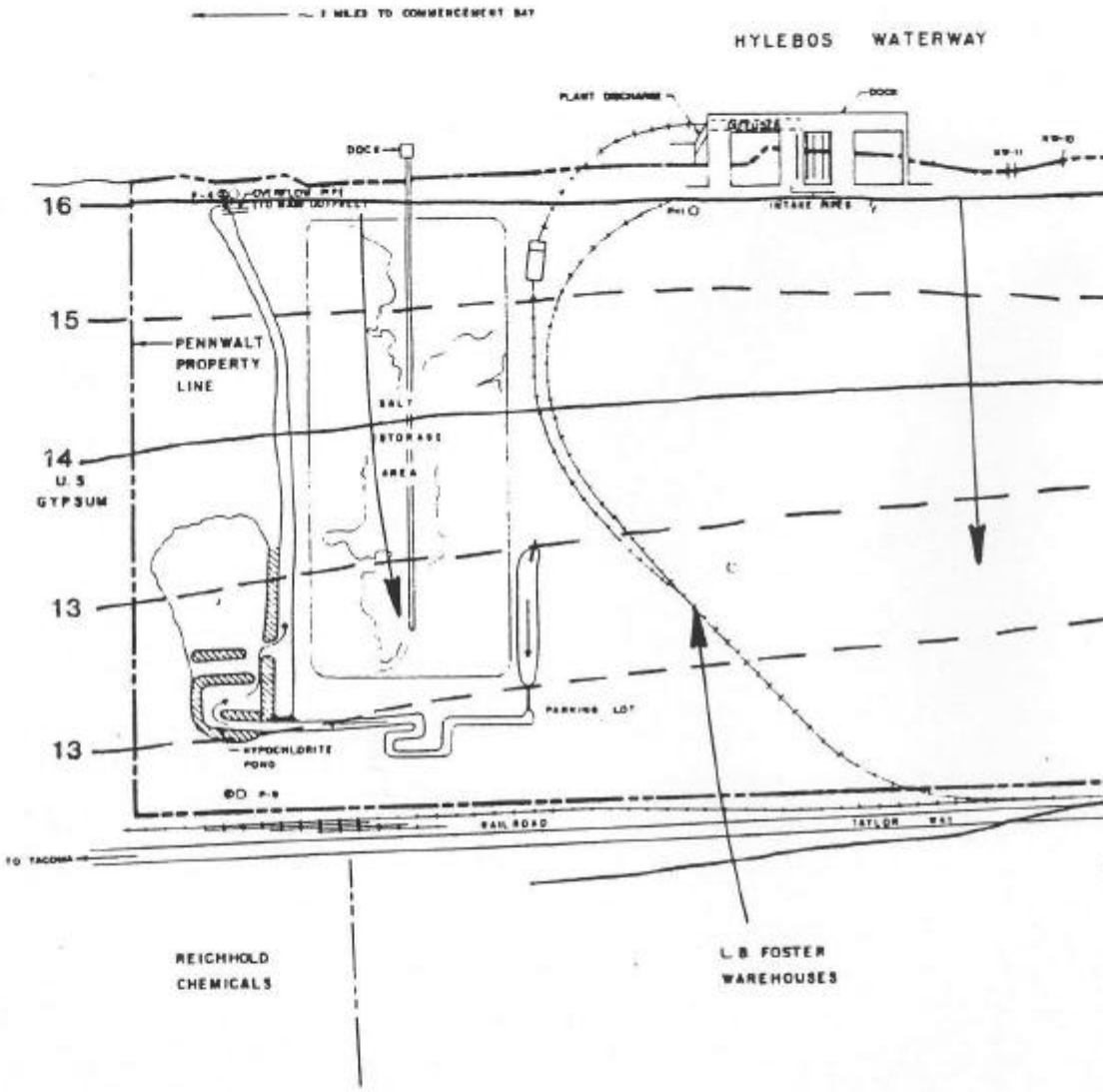
THE AWARE CORPORATION
NASHVILLE, TENNESSEE
HOUSTON, TEXAS

PENNWALT CORP.
Tacoma, Wash.

FIGURE 4.16

DEEP ZONE POTENTIOMETRIC SURFACE MAP AT LOWER LOW TIDE, JULY 3, 1981

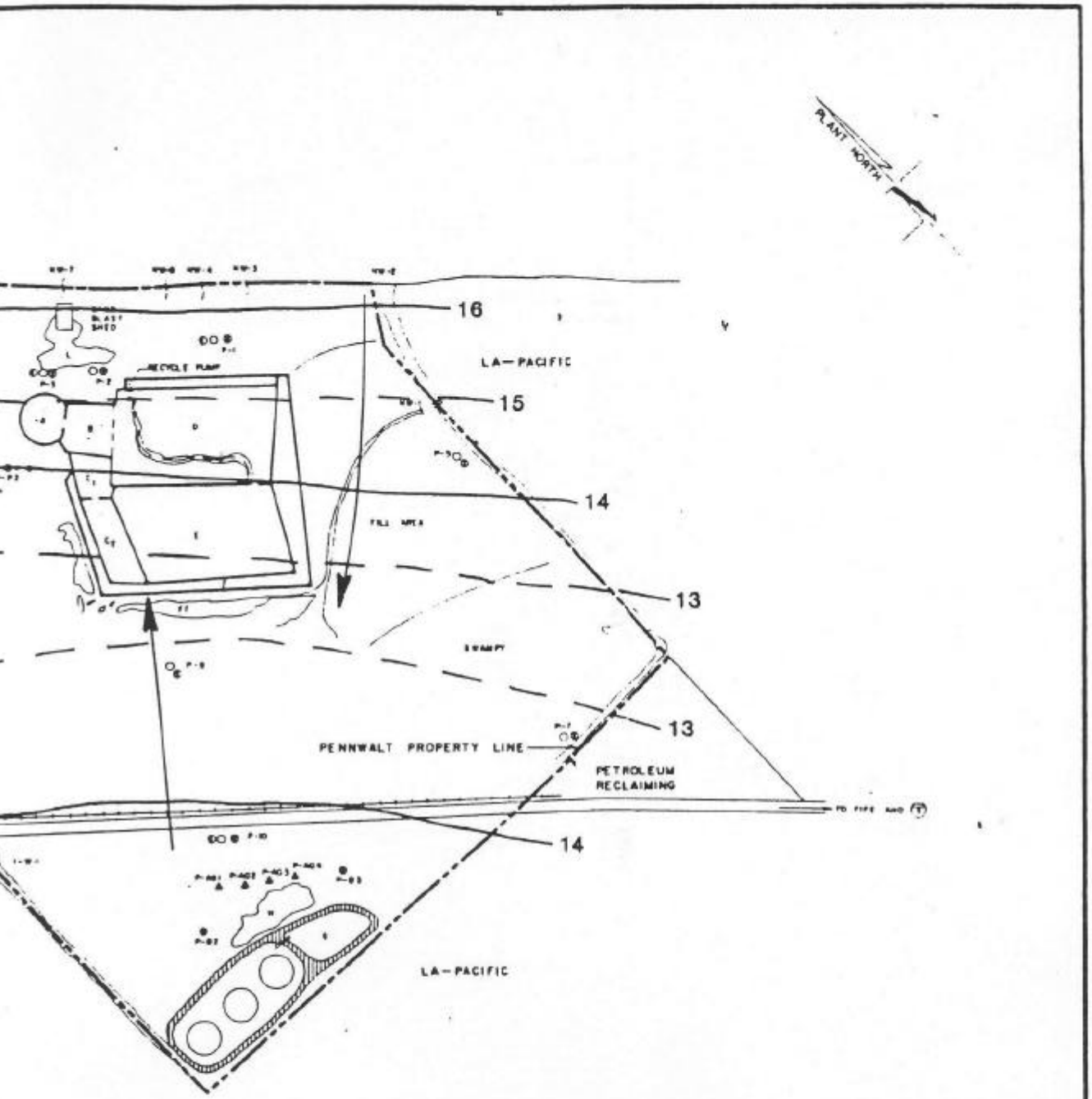
ELF000230



LEGEND

Contour Inte

Higher High



2feet
1foot supplememtal contour

18.8feet above MSL datum
at 2020, July 3, 1981

SCALE IN FEET
100 50 0 100

THE AWARE CORPORATION
NASHVILLE, TENNESSEE
HOUSTON, TEXAS

PENNWALT CORP.
Tacoma, Wash.

FIGURE 4.17

DEEP ZONE POTENTIOMETRIC SURFACE
MAP AT HIGHER HIGH TIDE,
JULY 3, 1981

ELF000231

tide, but high tide causes a mounding and damming effect along the waterway boundary. The high tide effect causes a temporary reversal of the hydraulic gradient along the waterway and an increase in elevation of the potentiometric surface under the site. The reversal of the gradient extends inland about 500 ft from the waterway. The increase in elevation of the potentiometric surface continues, and decreases in magnitude, from the reversal interface to the south.

At lower low tide on April 30, 1981, the potentiometric surface of the deep zone had a hydraulic gradient of approximately 0.0096. The permeability of the deep zone was estimated, using the effective grain size of the samples collected during monitoring well construction, to range from 90 gpd/ft^2 to 230 gpd/ft^2. The resulting calculated rate of groundwater velocity ranges from 0.58 ft/day to 1.48 ft/day. The estimated groundwater flow under the Pennwalt facility ranges from 37,400 gal/day to 95,700 gal/day through the upper 20 ft of the deep aquifer.

The difference in potentiometric head between the intermediate and deep zones generally shows the existence of a downward hydraulic gradient from the intermediate to deep zone. There is a potential for groundwater movement from the intermediate zone through the confining zone to the deep zone. The potentiometric surface maps and groundwater quality data do not indicate a significant flow in this direction, however, it might occur through areas of greater permeability in the confining zone.

4.8 GROUNDWATER QUALITY

4.8.1 Monitoring Network

In order to assess the vertical and areal distribution of potential contaminants in the groundwater system beneath the Pennwalt facility, a total of 21 monitoring wells were initially installed at 11 stations across the plant site (Plate 1). With the exception of monitoring station P-11, all monitoring stations consisted of a shallow well approximately 24 to 34 ft deep and a deep well approximately 55 to 65 ft deep. Only a shallow monitoring well was installed at monitoring station P-11. The shallow wells at each monitoring station were completed into the intermediate water-bearing zone beneath the site with the deep wells tapping the deep water-bearing zone. The shallow well at station P-1 was inadvertently screened in both the shallow surficial zone and the intermediate water-bearing zone. Following the first two sampling rounds, this monitoring well was subsequently pulled and the borehole was backfilled from a depth of 23 ft to the ground surface with a cement-bentonite grout to prevent cross contamination between the shallow and intermediate zones. The geologic logs and as-built drawings for each of these monitoring wells are provided in Appendix A.

As a result of information generated during the installation and sampling of these initial 21 monitoring wells, it was determined that five additional shallow monitoring wells would be needed to obtain information on contaminant migration through the uppermost surficial fill deposits at the Pennwalt facility. The five additional shallow monitoring wells were

installed at stations P-1, P-3, P-4, P-6, and P-10 with these wells being installed to depths ranging from 6 to 13 ft (Plate 1). The geologic logs and as-built drawings for each of the supplemental wells are provided in Appendix A.

Following the review and evaluation of data obtained from the five shallow wells tapping the surficial fill deposits, it was again determined that supplemental shallow wells would be warranted in order to more clearly define and evaluate contaminant migration through the surficial zone and subsequent discharge to the waterway. Therefore, four additional shallow wells, P-12SS, P-13SS, P-14SS, and P-15SS, were installed downgradient of the Penite area (Plate 1). These wells ranged in depth from 9.4 to 12.2 ft. The geologic logs and as-built drawings for each of the four additional shallow wells are included in Appendix A.

All groundwater monitoring wells installed as part of this project were drilled and constructed by the Kring Drilling Company under the direct field supervision of a staff hydrogeologist from Shannon and Wilson, Inc. Overall supervision and responsibility for the monitoring program was by AWARE, Inc. Each of the monitoring wells was drilled utilizing a modified Mobile B-61 drill rig equipped with 4-in I.D. hollow-stem auger. All of the initial monitoring wells were constructed of 1.5-in I.D. threaded PVC casing equipped with a 10-ft section of No. 10 slot PVC screen. A 5-ft blank section of PVC casing was placed at the bottom of each well to serve as a silt trap. A 5-ft section of 4-in I.D. steel casing equipped with a threaded steal cap was installed at the surface for protective purposes. The nine additional shallow wells were also constructed of 1.5-in I.D.

threaded PVC casing; however, these wells were equipped with only 5-ft or 3-ft (P-10) sections of No. 10 slot PVC screen. These wells were not equipped with silt traps, and 4-in I.D. PVC pipe equipped with a slip-on cap was utilized for the outer protective casing at the surface. Details of monitoring well construction are provided in Appendix A.

In order to minimize the potential cross-contamination during the drilling operation, all auger flights were properly cleaned following the drilling of each well. The monitoring wells were installed in sequence beginning in areas of least expected contamination and proceeding to areas of highest expected contamination. Following completion of all wells, each of the initial 21 monitoring wells were pumped for a minimum of 2 hr by means of a centrifugal pump in order to develop the wells and to remove any contaminants introduced during the drilling and installation process. With the exception of wells P-5S, P-6S, and P-9S, all wells yielded sediment-free water. However, the discharge from these wells was sediment free during the subsequent sampling programs. The nine supplemental shallow monitoring wells were developed for a minimum of 30 minutes with a centrifugal pump. At the end of this development period, each of these wells, with the exception of P-10SS, yielded sediment-free water.

4.8.2 Sampling Frequency and Methods

In order to establish an adequate data base upon which to conduct subsequent evaluations, two seperate sampling rounds were conducted for the initial 21 monitoring wells with two additional sampling round being conducted for the supplemental shallow zone wells. The first round of groundwater samples was collected on April 29-30, 1981, with individual

samples being collected from both the intermediate zone and deep zone monitoring wells at high and low tides. In addition to the high and low tide samples collected from each well during the first round, a single composite sample was collected from each of the eleven montioring stations for subsequent priority pollutant analysis. The second round of groundwater samples from the initial 21 monitoring wells was collected on July 2, 1981, with individual samples being collected from both the intermediate zone and deep zone wells at high and low tides. The sampling of the initial five shallow wells was conducted on August 13, 1981, with individual samples being collected from these wells at high and low tides. The final round of groundwater samples was collected on September 24, 1981, with samples being collected from the four supplemental shallow wells and shallow wells P-1SS, P-3SS, and P-6SS.

Prior to the collection of groundwater samples during each sampling round, all monitoring wells, with the exception of well P-10SS, were purged of at least three volumes of standing water. During the first, second, and fourth sampling rounds, a centrifugal pump was utilized to evacuate each well the day prior to sampling; whereas, during the third sampling round a peristaltic pump was utilized to purge the wells immediately prior to sampling. Separate intake hoses were used for the centrifugal pump in purging the intermediate zone and deep zone monitoring wells with the hoses being thouroughly rinsed after pumping each well. During the third sampling round, a separate piece of tygon tubing was utilized for purging each monitoring well. The purging of wells prior to collection of each round of samples was conducted by personnel from Shannon and Wilson, Inc.

The first and second rounds of groundwater samples were collected by personnel from AWARE, Inc. and Shannon and Wilson, Inc. The third and fourth rounds of samples were collected by personnel for Shannon and Wilson, Inc. Collection of groundwater samples during the first and second rounds was initiated approximately one and one-half hours prior to the high or low of the tidal cycle and was completed approximately one hour following the high or low tide. Sampling during the third and fourth round began about one hour prior to the high or low of the tidal cycle and was completed about one hour after the high or low tide.

All groundwater samples collected as part of this program were obtained utilizing a Cole Parmer, electric, peristaltic pump equipped with tygon tubing. A separate piece of tygon tubing was utilized for each monitoring well sampled. All samples were collected in appropriate containers provided by Laucks Laboratory (first round) and Am Test, Inc. (second, third, and fourth rounds). Immediately following collection, each sample was placed in wet ice for subsequent shipment to the laboratory. All samples were delivered to the laboratory within 24-hr of collection of the final sample. Individual sample collection data sheets are provided in Appendix C which summarize all pertinent sampling information for each groundwater sample collected as part of this program.

4.8.3 Analytical Parameters

In order to properly determine and evaluate the chemical characteristics of the groundwater underlying the Pennwalt facility, analytical parameters for the first round groundwater samples included both priority pollutants as well as a reduced list of 17 inorganic parameters and five

organic parameters (Table 4-11). The analyses for priority pollutants were performed on composited first round samples from high/high and low/low tide from the deep and intermediate wells at each monitoring station. The priority pollutant analyses performed on these composited samples were utilized as a screening mechanism to determine the presence or absence of various potential contaminants. The reduced list of parameters was analyzed for each individual sample collected at high/high and low/low tides from the shallow and deep wells at each monitoring station. The parameters included in this reduced list were selected based upon known or expected waste constituents as well as contaminants indentified in previous sampling surveys conducted by NOAA. The analytical results for the first round groundwater samples are summarized in Tables 4-12, 4-13 and 4-14.

Based upon the analytical results of the first round groundwater samples, a total of five inorganic parameters and three organic parameters were selected for the second round sampling program (Table 4-15). These parameters included pH, arsenic, hexavalent chromium, total chromium, total cyanide, chloroform, carbon tetrachloride, and tetrachloroethylene. These parameters were determined to be the contaminants of concern at the Pennwalt facility based upon a review meeting of Pennwalt, Washington DOE, Pierce County Health Department, U.S. EPA, and AWARE. In addition to the three organic parameters, it was agreed that chlorinated ethanes would be analyzed for all samples from monitoring station PW-1. The third round of groundwater samples collected from the shallow zone at monitoring stations P-1, P-3, P-4, P-6, and P-10 were analyzed for the same limited parameters

TABLE 4-11

FIRST ROUND ANALYTICAL PARAMETERS

Priority Pollutants	Chromium, Total
Antimony	Chromium, Hexavalent
Arsenic	Chloride
Barium	Sodium
Copper	Magnesium
Nickel	Calcium
Cadmium	Chloroform
Lead	Dichlorobromomethane
Zinc	Dibromochloromethane
Silver	Bromoform
Mercury	Carbon Tetrachloride
Selenium	

TABLE 4-12

FIRST ROUND ANALYTICAL RESULTS FOR INTERMEDIATE ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in parts per million)									
	Sb	As	Ba	Cu	Ni	Cd	Pb	Zn	Ag	Hg
PW-1S-HT[a]-1	< 0.01	0.07	< 0.1	0.019	0.019	<0.002	< 0.005	0.002	0.003	< 0.002
PW-2S-HT-1	< 0.01	0.24	< 0.1	0.023	0.032	<0.002	< 0.005	0.032	0.004	< 0.002
PW-3S-HT-1	< 0.01	0.08	0.4	0.014	0.010	<0.002	< 0.005	0.006	0.002	< 0.002
PW-4S-HT-1	< 0.01	<0.01	0.8	0.016	0.014	<0.002	< 0.005	0.010	0.002	< 0.002
PW-5S-HT-1	< 0.01	0.04	< 0.1	0.015	0.027	<0.002	< 0.005	< 0.002	<0.002	< 0.002
PW-6S-HT-1	0.05	0.10	0.3	0.016	0.023	0.007	< 0.005	< 0.002	<0.002	< 0.002
PW-7S-HT-1	< 0.01	<0.01	< 0.1	0.001	< 0.005	<0.002	< 0.005	0.002	<0.002	0.007
PW-8S-HT-1	< 0.01	<0.01	< 0.1	0.011	< 0.005	<0.002	< 0.005	0.008	<0.002	0.006
PW-9S-HT-1	< 0.01	<0.01	< 0.1	0.013	0.020	0.011	< 0.005	0.010	<0.002	0.002
PW-10S-HT-1	< 0.01	<0.01	< 0.1	0.006	0.008	<0.002	< 0.005	0.004	<0.002	0.004
PW-11S-HT-1	< 0.01	<0.01	0.8	0.031	< 0.005	<0.002	< 0.005	0.002	<0.002	< 0.002
PW-1S-LT[b]-1	< 0.01	0.02	< 0.1	0.018	< 0.005	0.006	< 0.005	0.007	<0.002	< 0.002
PW-2S-LT-1	< 0.01	0.44	< 0.1	0.029	0.009	<0.002	< 0.005	< 0.002	0.005	< 0.002
PW-3S-LT-1	< 0.01	0.06	0.9	0.017	0.006	<0.002	0.005	0.012	<0.002	< 0.002
PW-4S-LT-1	< 0.01	<0.01	0.8	<0.002	0.009	<0.002	< 0.005	0.030	<0.002	< 0.002
PW-5S-LT-1	< 0.01	0.04	< 0.1	0.004	0.031	<0.002	< 0.005	< 0.002	<0.002	< 0.002
PW-6S-LT-1	0.03	0.52	< 0.1	<0.002	< 0.005	<0.002	< 0.005	0.009	<0.002	< 0.002
PW-7S-LT-1	< 0.01	<0.01	< 0.1	<0.002	< 0.005	<0.002	< 0.005	0.016	<0.002	0.008
PW-8S-LT-1	< 0.01	<0.01	0.3	<0.002	< 0.005	<0.002	< 0.005	0.013	<0.002	< 0.002
PW-9S-LT-1	< 0.01	<0.01	< 0.1	<0.002	0.025	<0.002	< 0.005	0.015	<0.002	< 0.002
PW-10S-LT-1	< 0.01	<0.01	< 0.1	<0.002	< 0.005	<0.002	< 0.005	0.003	<0.002	< 0.002
PW-11S-LT-1	< 0.01	<0.01	1.1	<0.002	< 0.005	0.002	< 0.005	0.009	<0.002	< 0.002

TABLE 4-12 (Cont'd)

FIRST ROUND ANALYTICAL RESULTS FOR INTERMEDIATE ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in parts per million)						
	Se	Cr	Cr^{+6}	Cl	Na	Mg	Ca
PW-1S-HT-1	< 0.01	0.044	0.04	22,500	11,000	12	20
PW-2S-HT-1	< 0.01	< 0.005	< 0.01	13,600	7,900	10	40
PW-3S-HT-1	< 0.01	0.009	< 0.01	7,600	2,100	270	160
PW-4S-HT-1	< 0.01	< 0.005	< 0.01	27,300	11,600	480	190
PW-5S-HT-1	< 0.01	0.013	< 0.01	34,300	15,100	750	430
PW-6S-HT-1	< 0.01	< 0.005	< 0.01	8,200	4,400	480	290
PW-7S-HT-1	< 0.01	< 0.005	< 0.01	2,500	860	150	200
PW-8S-HT-1	< 0.01	0.018	< 0.01	3,500	1,500	150	100
PW-9S-HT-1	< 0.01	0.008	< 0.01	1,400	800	87	140
PW-10S-HT-1	< 0.01	0.012	< 0.01	1,300	760	65	64
PW-11S-HT-1	< 0.01	< 0.005	< 0.01	35,000	14,000	450	330
PW-1S-LT-1	< 0.01	1.1	< 0.01	11,500	7,700	7	30
PW-2S-LT-1	< 0.01	0.012	< 0.01	12,900	8,600	410	180
PW-3S-LT-1	< 0.01	< 0.005	< 0.01	8,000	4,300	470	260
PW-4S-LT-1	< 0.01	< 0.005	< 0.01	17,900	36,000	810	460
PW-5S-LT-1	< 0.01	0.016	< 0.01	36,500	5,300	310	310
PW-6S-LT-1	< 0.01	< 0.005	< 0.01	6,600	2,900	440	250
PW-7S-LT-1	< 0.01	< 0.005	< 0.01	2,600	770	160	220
PW-8S-LT-1	< 0.01	0.006	< 0.01	3,900	1,400	160	110
PW-9S-LT-1	< 0.01	< 0.005	< 0.01	1,300	680	80	135
PW-10S-LT-1	< 0.01	0.007	< 0.01	1,300	760	70	66
PW-11S-LT-1	< 0.01	< 0.005	< 0.01	33,000	12,300	410	320

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TABLE 4-12 (Cont'd)

FIRST ROUND ANALYTICAL RESULTS FOR INTERMEDIATE ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)				
	Chloroform	Dichloro-bromomethane	Dibromo-chloromethane	Bromoform	Carbon Tetrachloride
PW-1S-HT-1	14.000	0.020	0.016	ND[c]	0.830
PW-2S-HT-1	10.000	ND	ND	ND	0.013
PW-3S-HT-1	0.830	ND	ND	ND	ND
PW-4S-HT-1	0.230	ND	ND	ND	ND
PW-5S-HT-1	0.012	ND	ND	ND	ND
PW-6S-HT-1	tr[d]	ND	ND	ND	ND
PW-7S-HT-1	ND	ND	ND	ND	ND
PW-8S-HT-1	tr	ND	ND	ND	ND
PW-9S-HT-1	tr	ND	ND	ND	ND
PW-10S-HT-1	0.015	tr	tr	ND	ND
PW-11S-HT-1	tr	ND	ND	ND	ND
PW-1S-LT-1	5.400	0.070	0.100	ND	1.200
PW-2S-LT-1	5.700	ND	ND	ND	ND
PW-3S-LT-1	0.470	ND	ND	ND	ND
PW-4S-LT-1	0.160	ND	ND	ND	ND
PW-5S-LT-1	tr	tr	ND	ND	ND
PW-6S-LT-1	0.010	ND	ND	ND	ND
PW-7S-LT-1	0.010	tr	ND	ND	ND
PW-8S-LT-1	0.011	tr	ND	ND	ND
PW-9S-LT-1	0.010	ND	ND	ND	ND
PW-10S-LT-1	tr	tr	ND	ND	ND
PW-11S-LT-1	0.011	tr	ND	ND	ND

[a]HT denotes high tide sample collected in April

[b]LT denotes low tide sample collected in April

[c]ND = None Detected (less than 1 mg/l)

[d]tr = trace (less than 10 mg/l)

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TABLE 4-13

FIRST ROUND ANALYTICAL RESULTS FOR DEEP ZONE MONITORING WELLS
AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in parts per million)									
	Sb	As	Ba	Cu	Ni	Cd	Pb	Zn	Ag	Hg
PW-1D-HT[a]-1	< 0.01	<0.01	< 0.1	< 0.002	< 0.005	0.007	< 0.005	<0.002	< 0.002	0.004
PW-2D-HT-1	< 0.01	<0.01	< 0.1	< 0.002	< 0.005	<0.002	< 0.005	<0.002	< 0.002	< 0.002
PW-3D-HT-1	< 0.01	<0.01	< 0.1	< 0.002	< 0.005	<0.002	< 0.005	<0.002	< 0.002	< 0.002
PW-4D-HT-1	< 0.01	<0.01	0.4	< 0.002	0.005	<0.002	< 0.005	<0.002	< 0.002	< 0.002
PW-5D-HT-1	< 0.01	<0.01	< 0.1	< 0.002	< 0.005	<0.002	< 0.005	<0.002	< 0.002	< 0.002
PW-6D-HT-1	0.02	0.42	< 0.1	< 0.002	< 0.005	<0.002	0.005	<0.002	0.003	0.003
PW-7D-HT-1	< 0.01	<0.01	< 0.1	< 0.002	0.010	<0.002	< 0.005	<0.002	< 0.002	< 0.002
PW-8D-HT-1	< 0.01	<0.01	< 0.1	< 0.002	< 0.005	<0.002	< 0.005	<0.002	< 0.002	< 0.002
PW-9D-HT-1	< 0.01	0.03	< 0.1	0.024	0.006	0.010	0.007	0.010	< 0.002	< 0.002
PW-10D-HT-1	< 0.01	<0.01	< 0.1	0.015	< 0.005	0.013	0.005	0.005	0.005	< 0.002
PW-1D-LT[b]-1	< 0.01	<0.01	< 0.1	0.008	< 0.005	<0.002	< 0.005	<0.002	< 0.002	0.004
PW-2D-LT-1	< 0.01	<0.01	< 0.1	0.011	0.008	<0.002	< 0.005	0.003	< 0.002	< 0.002
PW-3D-LT-1	< 0.01	<0.01	< 0.1	0.012	0.008	<0.002	< 0.005	0.011	< 0.002	0.002
PW-4D-LT-1	< 0.01	<0.01	< 0.1	0.044	0.005	<0.002	0.010	<0.002	< 0.002	< 0.002
PW-5D-LT-1	< 0.01	<0.01	< 0.1	0.014	0.005	0.011	< 0.005	0.005	< 0.002	< 0.002
PW-6D-LT-1	0.05	0.80	< 0.1	0.022	0.009	<0.002	0.012	0.021	< 0.002	0.007
PW-7D-LT-1	< 0.01	<0.01	< 0.1	0.007	< 0.005	0.015	< 0.005	0.005	< 0.002	< 0.002
PW-8D-LT-1	< 0.01	<0.01	< 0.1	0.009	< 0.005	<0.002	< 0.005	0.003	< 0.002	0.003
PW-9D-LT-1	< 0.01	<0.01	< 0.1	0.008	< 0.005	<0.002	< 0.005	0.003	0.002	< 0.002
PW-10D-LT-1	< 0.01	<0.01	< 0.1	0.009	< 0.005	0.006	0.005	0.012	< 0.002	< 0.002

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TABLE 4-13 (Cont'd)

FIRST ROUND ANALYTICAL RESULTS FOR DEEP ZONE MONITORING WELLS
AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in parts per million)						
	Se	Cr	Cr^{+6}	Cl	Na	Mg	Ca
PW-1D-HT-1	< 0.01	0.022	< 0.01	210	59	26	47
PW-2D-HT-1	< 0.01	0.011	< 0.01	26	35	15	29
PW-3D-HT-1	< 0.01	0.005	< 0.01	10	31	17	27
PW-4D-HT-1	< 0.01	0.005	< 0.01	30,600	12,000	480	380
PW-5D-HT-1	< 0.01	0.009	< 0.01	210	98	12	25
PW-6D-HT-1	< 0.01	< 0.005	< 0.01	460	77	26	43
PW-7D-HT-1	< 0.01	< 0.005	< 0.01	66	37	28	24
PW-8D-HT-1	< 0.01	< 0.005	< 0.01	84	79	20	23
PW-9D-HT-1	< 0.01	0.031	0.01	86	62	18	19
PW-10D-HT-1	< 0.01	0.005	< 0.01	89	63	22	21
PW-1D-LT-1	< 0.01	< 0.005	< 0.01	210	90	26	44
PW-2D-LT-1	< 0.01	< 0.005	< 0.01	57	39	16	28
PW-3D-LT-1	< 0.01	0.006	< 0.01	150	93	19	29
PW-4D-LT-1	< 0.01	0.019	< 0.01	47,000	14,700	460	400
PW-5D-LT-1	< 0.01	0.011	< 0.01	47	35	11	28
PW-6D-LT-1	< 0.01	0.005	< 0.01	140	83	25	43
PW-7D-LT-1	< 0.01	< 0.005	< 0.01	55	35	27	24
PW-8D-LT-1	< 0.01	0.005	< 0.01	91	86	20	25
PW-9D-LT-1	< 0.01	0.016	< 0.01	99	71	22	20
PW-10D-LT-1	< 0.01	0.005	< 0.01	80	56	22	22

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TABLE 4-13 (Cont'd)

FIRST ROUND ANALYTICAL RESULTS FOR DEEP ZONE MONITORING WELLS
AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)				
	Chloroform	Dichloro-bromomethane	Dibromo-chloromethane	Bromoform	Carbon Tetrachloride
PW-1D-HT-1	0.053	ND[c]	ND	ND	ND
PW-2D-HT-1	tr	ND	tr[d]	ND	ND
PW-3D-HT-1	ND	ND	ND	ND	ND
PW-4D-HT-1	0.073	ND	tr	tr	ND
PW-5D-HT-1	tr	ND	tr	tr	ND
PW-6D-HT-1	tr	ND	ND	ND	ND
PW-7D-HT-1	tr	ND	ND	ND	ND
PW-8D-HT-1	0.012	tr	tr	ND	ND
PW-9D-HT-1	0.017	ND	ND	ND	ND
PW-10D-HT-1	0.018	tr	ND	ND	ND
PW-1D-LT-1	0.065	ND	ND	ND	ND
PW-2D-LT-1	tr	ND	ND	ND	ND
PW-3D-LT-1	tr	tr	ND	ND	ND
PW-4D-LT-1	0.170	tr	tr	tr	ND
PW-5D-LT-1	tr	ND	ND	ND	ND
PW-6D-LT-1	tr	tr	ND	ND	ND
PW-7D-LT-1	tr	ND	ND	ND	ND
PW-8D-LT-1	tr	ND	ND	ND	ND
PW-9D-LT-1	tr	ND	ND	ND	ND
PW-10D-LT-1	0.015	ND	ND	ND	ND

[a]HT denotes high tide sample collected in April

[b]LT denotes low tide sample collected in April

[c]ND = None Detected (less than 1 mg/l)

[d]tr = trace (less than 10 mg/l)

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TABLE 4-14

ANALYTICAL RESULTS FOR PRIORITY POLLUTANTS FROM COMPOSITED GROUNDWATER SAMPLES
(Results in µg/l)

Monitoring Well Parameter	PW-1C	PW-2C	PW-3C	PW-4C	PW-5C	PW-6C	PW-7C	PW-8C	PW-9C	PW-10C	PW-11C
Acenaphthene	ND[a]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acrolein	ND*[b]	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Acrylonitrile	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	tr[c]	tr	tr	tr	tr	tr	tr	tr	tr	ND
1, 2, 4-trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 2-dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 1, 1-trichloroethane	1,300	16	tr	11	tr	ND	tr	ND	ND	ND	ND
Hexachloroethane	360	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 1-dichloroethane	12	130	tr	ND	ND	ND	ND	ND	ND	ND	ND
1, 1, 2-trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 1, 2, 2-tetrachloroethane	ND	ND	tr	tr	tr	tr	tr	tr	tr	tr	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis (chloromethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis (2-chloroethyl) ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethyl vinyl ether (mixed)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2, 4, 6-trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Parachlorometa cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform (trichloromethane)	1,300	1,800	170	160	tr	tr	tr	tr	tr	tr	tr
2-chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 2-dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 3-dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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TABLE 4-14 (Cont.)

ANALYTICAL RESULTS FOR PRIORITY POLLUTANTS FROM COMPOSITED GROUNDWATER SAMPLES
(Results in µg/l)

Monitoring Well Parameter	PW-1C	PW-2C	PW-3C	PW-4C	PW-5C	PW-6C	PW-7C	PW-8C	PW-9C	PW-10C	PW-11C
1, 4-dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3, 3-dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 1-dichloroethylene	tr	tr	ND	ND	tr	ND	ND	ND	ND	ND	ND
1, 2-trans-dichloroethylene	ND	tr	ND	ND	ND	ND	ND	ND	ND	ND	ND
2, 4-dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 2-dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 2-dichloropropylene (1, 3-dichloropropene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2, 4-dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2, 4-dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2, 6-dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1, 2-diphenylhydrazine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	tr	tr	tr	tr	tr	tr	tr	tr	tr	ND	tr
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-chlorophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-bromophenyl phenyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis (2-chloroisopropyl) ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis (2-chloroethoxy) methane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride (Dichloromethane)	90	230	38	28	60	62	56	54	58	18	24
Methyl chloride (Chloromethane)	12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl bromide (Bromomethane)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform (Tribromomethane)	tr	tr	ND	tr	ND	ND	ND	ND	ND	ND	ND

ELF000247

TABLE 4-14 (Cont.)

ANALYTICAL RESULTS FOR PRIORITY POLLUTANTS FROM COMPOSITED GROUNDWATER SAMPLES
(Results in µg/l)

Monitoring Well Parameter	PW-1C	PW-2C	PW-3C	PW-4C	PW-5C	PW-6C	PW-7C	PW-8C	PW-9C	PW-10C	PW-11C
Dichlorobromomethane	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorodibromomethane	10	tr	ND	tr	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2, 4-dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4, 6-dinitro-o-cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodimethylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodiphenylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodi-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	29	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	tr	tr	tr	17	ND	tr	ND	tr	ND	ND	ND
Bis (2-ethylhexyl) phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butyl benzyl phthalate	ND	tr	tr	tr	tr	tr	ND	tr	ND	ND	ND
Di-n-butyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethyl phthalate											

ELF000248

TABLE 4-14 (Cont.)

ANALYTICAL RESULTS FOR PRIORITY POLLUTANTS FROM COMPOSITED GROUNDWATER SAMPLES
(Results in µg/l)

Monitoring Well Parameter	PW-1C	PW-2C	PW-3C	PW-4C	PW-5C	PW-6C	PW-7C	PW-8C	PW-9C	PW-10C	PW-11C
Dimethyl phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (a) anthracene (1, 2-benzanthracene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene (3, 4-benzopyrene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3, 4-benzofluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (k) flouranthane (11, 12-benzofluoranthene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (ghi) perylene (1, 12-benzoperylene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene (1, 2, 5, 6-dibenzanthracene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno (1, 2, 3-cd) pyrene (1, 2-o-phenylenepyrene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	430	380	20	10	tr	tr	tr	ND	ND	ND	ND
Toluene	26	tr	tr	tr	tr	tr	tr	tr	ND	tr	tr
Trichloroethylene	tr	tr	ND	ND	tr	ND	ND	ND	ND	ND	ND
Vinyl Chloride (Chloroethylene)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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TABLE 4-14 (Cont.)

ANALYTICAL RESULTS FOR PRIORITY POLLUTANTS FROM COMPOSITED GROUNDWATER SAMPLES
(Results in µg/l)

Monitoring Well Parameter	PW-1C	PW-2C	PW-3C	PW-4C	PW-5C	PW-6C	PW-7C	PW-8C	PW-9C	PW-10C	PW-11C
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4, 4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4, 4'-DDE (p, p'-DDX)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4, 4'-DDD (p, p'-TDE)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a-endosulfan-Alpha	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
b-endosulfan-Beta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a-BHC-Alpha	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
b-BHC-Beta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
r-BHC(lindane)-Gamma	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
g-BHC-Delta	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1242 (Arochlor 1242)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1254 (Arochlor 1254)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1221 (Arochlor 1221)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1232 (Arochlor 1232)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1248 (Arochlor 1248)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1260 (Arochlor 1260)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1016 (Arochlor 1016)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Antimony (total)	<5	< 5	<5	<5	< 5	28	<5	< 5	< 5	< 5	< 5

ELF00025

TABLE 4-14 (Cont.)

ANALYTICAL RESULTS FOR PRIORITY POLLUTANTS FROM COMPOSITED GROUNDWATER SAMPLES
(Results in µg/l)

Monitoring Well Parameter	PW-1C	PW-2C	PW-3C	PW-4C	PW-5C	PW-6C	PW-7C	PW-8C	PW-9C	PW-10C	PW-11C
Arsenic (total)	44	470	69	< 5	37	220	< 5	30	20	6	26
Beryllium (total)	< 5	<5	< 5	< 5	<5	<5	< 5	<5	< 5	< 5	< 5
Cadmium (total)	< 2	<2	< 2	< 2	<2	<2	< 2	<2	< 2	< 2	< 2
Chromium (total)	680	76	20	23	75	16	< 5	14	15	10	19
Copper (total)	< 2	<2	< 2	< 2	<2	<2	< 2	<2	< 2	< 2	< 2
Cyanide (total)	250	38	< 10	260	110	39	58	45	450	77	54
Lead (total)	< 5	<5	< 5	< 5	<5	<5	< 5	<5	< 5	< 5	< 5
Mercury (total)	< 2	<2	< 2	< 2	<2	2	< 2	<2	< 2	2	< 2
Nickel (total)	< 5	7	< 5	< 5	14	<5	< 5	<5	10	< 5	< 5
Selenium (total)	< 5	<5	< 5	< 5	<5	<5	< 5	<5	< 5	< 5	< 5
Silver (total)	< 2	<2	< 2	< 2	7	<2	< 2	<2	< 2	< 2	< 2
Thallium (total)	< 10	<10	< 10	< 10	<10	< 10	< 10	<10	< 10	< 10	< 10
Zinc (total)	3	41	5	8	8	10	3	9	7	4	6
2, 3, 7, 8-tetrachloro-dibenzo-p-dioxin (TCDD)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a]ND = None detected (<1 µg/l)

[b]ND* = None detected (<100 µg/l)

[c]tr = trace (1-10 µg/l)

ELF000251

TABLE 4-15

SECOND ROUND ANALYTICAL PARAMETERS

pH
Arsenic
Chromium, Hexavalent
Chromium, Total
Cyanide, Total
Chloroform
Carbon Tetrachloride
Tetrachloroethylene

Additional Analyses for Station PW-1

1,1 Dichloroethane
1,2 Dichloroethane
1,1,1 Trichloroethane
1,1,2 Trichloroethane
Tetrachloroethane
1,1,2,2 Tetrachloroethane

as the second round samples with chlorinated ethanes being analyzed for samples from monitoring stations P-1 and P-3. The final round of samples were analyzed only for arsenic. The analytical results for the second round samples are summarized in Tables 4-16 and 4-17 with analytical results for the third round samples being provided in Table 4-18, and result for the fourth round samples provided in Table 4-19.

All laboratory analyses were performed in accordance with approved or recommended EPA methods, where available. In order to provide quality control for laboratory analyses, replicate samples were collected during the first and second sampling rounds from monitoring stations P-3 and P-1, respectively. In addition, in-house laboratory replicate measurements were made for selected parameters on selected samples. The results of these quality control measurements are included in Tables 4-20, 4-21, 4-22, 4-23, and 4-24.

4.8.4 First Round Results (Priority Pollutants)

The analytical results of priority pollutant analyses performed on the composited groundwater samples from the eleven separate monitoring stations revealed a total of only 20 parameters with quantitated concentrations. A summary of the priority pollutant parameters with quantitated concentrations is provided in Table 4-25. These analytical results can only be utilized as indications of the presence or absence of individual parameters and do not allow evaluation of the vertical or areal distribution of contaminants or changes in concentrations with tidal fluctuations. As can be seen from Table 4-25, ten of the parameters with quantitated concentrations were detected at only a single monitoring sta-

TABLE 4-16

SECOND ROUND ANALYTICAL RESULTS FOR
INTERMEDIATE ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)				
	pH	Arsenic	Hexavalent Chromium	Total Chromium	Total Cyanide
PW-1S-LT-2	12.20	0.03	0.327	1.19	0.041
PW-1S-HT-2	12.25	< 0.03	1.11	1.34	0.037
PW-2S-LT-2	11.45	7.3	0.016	0.29	< 0.003
PW-2S-HT-2	11.50	2.3	0.007	0.089	0.005
PW-3S-LT-2	9.40	0.06	< 0.010	0.020	< 0.003
PW-3S-HT-2	8.10	0.03	< 0.010	0.015	< 0.003
PW-4S-LT-2	7.00	0.04	< 0.010	0.016	0.025
PW-4S-HT-2	7.00	0.04	< 0.010	0.016	0.024
PW-5S-LT-2	7.20	0.08	< 0.010	<0.010	0.012
PW-5S-HT-2	7.20	0.07	< 0.010	0.043	0.008
PW-6S-LT-2	7.65	0.22	< 0.010	<0.010	0.005
PW-6S-HT-2	8.35	0.20	< 0.010	<0.010	< 0.003
PW-7S-LT-2	7.00	< 0.03	< 0.010	0.022	0.011
PW-7S-HT-2	6.90	< 0.03	< 0.010	<0.010	0.008
PW-8S-LT-2	6.60	0.06	< 0.010	0.015	0.099
PW-8S-HT-2	6.65	0.03	< 0.010	0.015	0.017
PW-9S-LT-2	7.20	< 0.03	< 0.010	0.010	0.947
PW-9S-HT-2	7.15	< 0.03	< 0.010	0.034	1.37
PW-10S-LT-2	7.35	< 0.03	< 0.010	0.049	0.011
PW-10S-HT-2	7.30	< 0.03	< 0.010	0.021	0.033
PW-11S-LT-2	7.60	< 0.03	< 0.010	0.010	< 0.003
PW-11S-HT-2	7.45	0.03	< 0.010	<0.010	0.005
PW-12S-LT-2	12.20	< 0.03	0.97	1.05	0.033

ELF00254

TABLE 4-16 (Cont'd)

SECOND ROUND ANALYTICAL RESULTS FOR
INTERMEDIATE ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)				
	Chloro-form	Carbon Tetra-chloride	Tetrachloro-ethylene	1,1 Dichloro-ethane	1,2 Dichloro-ethane
PW-1S-LT-2	3.050	0.045	--	0.0065	0.0002
PW-1S-HT-2	0.570	0.026	--	0.0036	0.0008
PW-2S-LT-2	2.700	0.005	0.860		
PW-2S-HT-2	5.840	0.062	0.180		
PW-3S-LT-2	0.390	< 0.00001	< 0.00001		
PW-3S-HT-2	0.160	< 0.00001	0.0004		
PW-4S-LT-2	0.009	< 0.00001	< 0.00001		
PW-4S-HT-2	0.043	< 0.00001	< 0.00001		
PW-5S-LT-2	0.003	< 0.00001	< 0.00001		
PW-5S-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-6S-LT-2	0.004	< 0.00001	< 0.00001		
PW-6S-HT-2	< 0.002	< 0.00001	0.00001		
PW-7S-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-7S-HT-2	0.002	< 0.00001	0.00001		
PW-8S-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-8S-HT-2	< 0.002	< 0.00001	0.0025		
PW-9S-LT-2	< 0.002	< 0.00001	0.00001		
PW-9S-HT-2	< 0.002	< 0.00001	0.001		
PW-10S-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-10S-HT-2	< 0.002	0.00001	0.0004		
PW-11S-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-11S-HT-2	< 0.002	< 0.00001	0.0004		

ELF000255

TABLE 4-16 (Cont'd)

SECOND ROUND ANALYTICAL RESULTS FOR
INTERMEDIATE ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)			
	1,1,1 Tri-chloroethane	1,1,2 Tri-chloroethane	Tetrachloro-ethane	1,1,2,2 Tetra-chloroethane
PW-1S-LT-2	0.0098	0.0012	1.090	0.0006
PW-1S-HT-2	0.0042	< 0.00001	0.270	< 0.00001
PW-2S-LT-2				
PW-2S-HT-2				
PW-3S-LT-2				
PW-3S-HT-2				
PW-4S-LT-2				
PW-4S-HT-2				
PW-5S-LT-2				
PW-5S-HT-2				
PW-6S-LT-2				
PW-6S-HT-2				
PW-7S-LT-2				
PW-7S-HT-2				
PW-8S-LT-2				
PW-8S-HT-2				
PW-9S-LT-2				
PW-9S-HT-2				
PW-10S-LT-2				
PW-10S-HT-2				
PW-11S-LT-2				
PW-11S-HT-2				
PW-12S-HT-2	0.00031	0.00018	0.011	0.0010

ELF000256

TABLE 4-17

SECOND ROUND ANALYTICAL RESULTS FOR
DEEP ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)				
	pH	Arsenic	Hexavalent Chromium	Total Chromium	Total Cyanide
PW-1D-LT-2	7.85	< 0.03	<0.010	< 0.010	< 0.003
PW-1D-HT-2	7.90	< 0.03	<0.010	< 0.010	0.008
PW-2D-LT-2	7.55	< 0.03	<0.010	< 0.010	< 0.003
PW-2D-HT-2	7.55	< 0.03	<0.010	< 0.010	< 0.003
PW-3D-LT-2	7.35	< 0.03	<0.010	< 0.010	0.004
PW-3D-HT-2	7.25	< 0.03	<0.010	< 0.010	< 0.003
PW-4D-LT-2	9.95	< 0.03	<0.010	0.013	0.005
PW-4D-HT-2	9.85	0.03	<0.010	0.013	0.005
PW-5D-LT-2	8.70	< 0.03	<0.010	< 0.010	< 0.003
PW-5D-HT-2	8.15	< 0.03	<0.010	< 0.010	0.004
PW-6D-LT-2	7.85	0.27	<0.010	< 0.010	< 0.003
PW-6D-HT-2	8.20	0.19	<0.010	< 0.010	< 0.003
PW-7D-LT-2	7.75	< 0.03	<0.010	< 0.010	< 0.003
PW-7D-HT-2	8.00	0.04	<0.010	0.017	< 0.003
PW-8D-LT-2	8.30	< 0.03	<0.010	< 0.010	0.005
PW-8D-HT-2	8.35	< 0.03	<0.010	0.011	0.005
PW-9D-LT-2	7.75	< 0.03	<0.010	0.010	< 0.003
PW-9D-HT-2	8.00	< 0.03	<0.010	0.035	< 0.003
PW-10D-LT-2	7.60	< 0.03	<0.010	< 0.010	< 0.003
PW-10D-HT-2	8.10	0.10	<0.010	< 0.010	0.004
PW-12D-LT-2	7.85	< 0.03	<0.010	< 0.010	0.003

ELF000257

TABLE 4-17 (Cont'd)

SECOND ROUND ANALYTICAL RESULTS FOR
DEEP ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)				
	Chloro-form	Carbon Tetra-chloride	Tetrachloro-ethylene	1,1 Dichloro-ethane	1,2 Dichloro-ethane
PW-1D-LT-2	0.019	< 0.00001	--	<0.00001	<0.00001
PW-1D-HT-2	0.0079	< 0.00001	--	<0.00001	<0.00001
PW-2D-LT-2	< 0.002	< 0.00001	0.0009		
PW-2D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-3D-LT-2	< 0.002	< 0.00001	0.0003		
PW-3D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-4D-LT-2	0.310	< 0.00001	0.0001		
PW-4D-HT-2	0.068	< 0.00001	< 0.00001		
PW-5D-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-5D-HT-2	0.003	< 0.00001	0.00001		
PW-6D-LT-2	< 0.002	< 0.00001	0.00001		
PW-6D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-7D-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-7D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-8D-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-8D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-9D-LT-2	< 0.002	< 0.00001	< 0.00001		
PW-9D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-10D-LT-2	0.002	< 0.00001	< 0.00001		
PW-10D-HT-2	< 0.002	< 0.00001	< 0.00001		
PW-12D-HT-2	0.008	< 0.00001	0.0180	0.0076	0.0014

ELF000258

TABLE 4-17 (Cont'd)

SECOND ROUND ANALYTICAL RESULTS FOR
DEEP ZONE MONITORING WELLS AT HIGH AND LOW TIDES

Monitoring Well	Parameter (in mg/l)			
	1,1,1 Tri-chloroethane	1,1,2 Tri-chloroethane	Tetrachloro-ethane	1,1,2,2 Tetra-chloroethane
PW-1D-LT-2	<0.00001	0.0001	0.014	< 0.00001
PW-1D-HT-2	0.00001	0.00001	0.0054	< 0.00001
PW-2D-LT-2				
PW-2D-HT-2				
PW-3D-LT-2				
PW-3D-HT-2				
PW-4D-LT-2				
PW-4D-HT-2				
PW-5D-LT-2				
PW-5D-HT-2				
PW-6D-LT-2				
PW-6D-HT-2				
PW-7D-LT-2				
PW-7D-HT-2				
PW-8D-LT-2				
PW-9D-HT-2				
PW-10D-LT-2				
PW-10D-HT-2				
PW-12D-HT-2	0.026	0.0044	0.490	0.0004

ELF000259

TABLE 4-18

ANALYTICAL RESULTS FOR SHALLOW ZONE
MONITORING WELLS AT HIGH TIDE AND LOW TIDE,
August 14, 1981

	PW-1SS-HT[a]	PW-1SS-LT[b]	PW-3SS-HT	PW-3SS-LT	PW-4SS-HT	PW-4SS-LT	PW-6SS-HT	PW-6SS-LT	PW-10SS-HT	PW-10SS-LT
pH	9.7	9.9	11.5	11.5	8.0	8.2	10.7	10.7	NS[c]	7.4
As (mg/L)	< 0.03	0.39	1,680	1,010	< 0.03	<0.03	2,450	3,670	NS	0.33
Cr (mg/l)	1.60	1.70	1.9	2.7	0.125	0.130	0.008	< 0.005	NS	< 0.005
Cr^{+6} (mg/l)	1.54	0.33	< 0.3[d]	< 0.3[d]	0.063	0.080	< 0.005	< 0.005	NS	< 0.005
CN (mg/l)	0.069	0.079	0.118	0.124	0.023	0.030	0.054	0.112	<0.003	< 0.003
Chloroform (mg/l)	3.180	1.210	0.034	0.077	0.996	0.408	0.840	0.835	NS	0.016
Carbon Tetrachloride (mg/l)	0.106	< 0.00001	<0.00001	< 0.00001	0.002	< 0.00001	<0.00001	<0.00001	NS	<0.00001
1,1 Dichloroethane (mg/l)	0.018	0.002	<0.00001	< 0.00001	e	e	e	e	NS	e
1,2 Dichloroethane (mg/l)	0.004	0.001	<0.00001	< 0.00001	e	e	e	e	NS	e
1,1,1 Trichloroethane (mg/l)	0.011	< 0.00001	<0.00001	< 0.00001	e	e	e	e	NS	e
1,1,2 Trichloroethane (mg/l)	<0.00001	< 0.00001	<0.00001	< 0.00001	e	e	e	e	NS	e
Tetrachloroethane (mg/l)	5.630	0.234	0.003	< 0.00001	e	e	e	e	NS	e
1,1,2,2, Tetrachloroethane (mg/l)	0.002	< 0.00001	<0.00001	< 0.00001	e	e	e	e	NS	e
Tetrachloroethylene (mg/l)	e	e	e	e	<0.00001	< 0.00001	0.020	0.01	NS	0.0006

[a]High Tide

[b]Low Tide

[c]NS - insufficient sample

[d]High detection limit due to interference by an emulsion formation.

[e]Parameter not analyzed.

ELF000260

TABLE 4-19

ANALYTICAL RESULTS FOR ARSENIC SAMPLING OF
SHALLOW ZONE MONITORING WELLS
September 24, 1981

Monitoring Well Sample	Arsenic (mg/l)
PW-1SS-LT	0.19
PW-1SS-HT	0.22
PW-3SS-LT	886
PW-3SS-HT	914
PW-6SS-LT	2,800/2,170[a]
PW-6SS-HT	3,190
PW-12SS-LT	100
PW-12SS-HT	123
PW-13SS-LT	286
PW-13SS-HT	234
PW-14SS-LT	340
PW-14SS-HT	235
PW-15SS-LT	10.0
PW-15SS-HT	11.7

[a]Laboratory replicate analysis.

TABLE 4-20

ANALYTICAL RESULTS FOR FIRST ROUND LABORATORY
REPLICATE SAMPLES

	Results in mg/l						
	PW-1D-HT-1	PW-4D-HT-1	PW-9D-HT-1	PW-10D-HT-1	PW-12D-HT-1	PW-7S-HT-1	PW-9S-HT-1
Antimony			< 0.01/< 0.01			< 0.01/< 0.01	
Arsenic	< 0.01/< 0.01[a]			< 0.01/< 0.01			< 0.01/< 0.01
Barium		0.3/.4			0.1/ 0.1		
Beryllium							
Cadmium	0.007/< 0.002		0.010/ 0.008			< 0.002/< 0.002	
Calcium				21/ 21			140/ 140
Chromium			0.031/ 0.030			< 0.005/< 0.005	
Copper	< 0.002/< 0.002		0.024/ 0.020			0.011/ 0.013	
Lead	< 0.005/< 0.005		0.007/ 0.008			< 0.005/< 0.005	
Magnesium				22/ 22			87/ 86
Mercury							
Nickel	< 0.005/< 0.005		0.006/ 0.005			< 0.005/< 0.005	
Selenium							
Silver	< 0.002/< 0.002		< 0.002/< 0.002			< 0.002/< 0.002	
Sodium				63/ 57			800/ 810
Thallium							
Zinc	< 0.002/< 0.002		0.010/ 0.004			0.002/ 0.002	

	Results in mg/l
Bromoform	ND/ ND[b]
Carbon Tetrachloride	ND/ ND
Chloroform	0.017/0.017
Dibromochloromethane	ND/ ND
Dichlorobromonethane	ND/ ND

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TABLE 4-20 (Cont'd)

ANALYTICAL RESULTS FOR FIRST ROUND LABORATORY
REPLICATE SAMPLES

	Results in mg/l						
	PW-10S-HT-1	PW-5D-LT-1	PW-6D-LT-1	PW-10D-LT-1	PW-3S-LT-1	PW-4S-LT-1	PW-12S-LT-1
Antimony		<0.01/<0.01			<0.01/<0.01		<0.01/ <0.01
Arsenic			0.80/0.80			<0.01/<0.01	
Barium	<0.1/<0.1			<0.1/<0.1			0.4/ 0.4
Beryllium							
Cadmium							
Calcium							180/ 180
Chromium							<0.005/<0.005
Copper							
Lead							
Magnesium							430/ 430
Mercury							
Nickel							
Selenium							
Silver							
Sodium							3,600/3,700
Thallium							
Zinc							

	Results in mg/l
Bromoform	
Carbon Tetrachloride	
Chloroform	
Dibromochloromethane	
Dichlorobromomethane	

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TABLE 4- 20(Cont'd)

ANALYTICAL RESULTS FOR FIRST ROUND LABORATORY
REPLICATE SAMPLES

	Results in mg/l						
	PW-3S-HT-1	PW-4D-LT-1	PW-1S-LT-1	PW-2S-LT-1	PW-11S-LT-1	PW-7D-LT-1	PW-5S-LT-1
Antimony							
Arsenic							
Barium							
Beryllium							
Cadmium		< 0.002/< 0.002		< 0.002/< 0.002			
Calcium						24/24	310/ 310
Chromium		0.019/ 0.020		0.012/ 0.018			
Copper		0.044/ 0.038		0.029/ 0.022			
Lead		0.010/ 0.011		< 0.005/ 0.003			
Magnesium						27/26	310/ 310
Mercury							
Nickel		0.005/< 0.005		0.009/ 0.014			
Selenium							
Silver		< 0.002/< 0.002		0.005/< 0.002			
Sodium						35/32	5,300/5,300
Thallium							
Zinc		< 0.002/ 0.007		< 0.002/ 0.020			

	Results in mg/l				
Bromoform	ND/ND	tr[c]/ND	ND/0.030	ND/ND	ND/ND
Carbon Tetrachloride	ND/ND	ND/ND	1.200/0.820	ND/ND	ND/ND
Chloroform	0.830/0.480	0.170/0.160	5.400/4.400	5.700/5.800	0.011/tr
Dibromochloromethane	ND/ND	tr/tr	0.100/0.060	ND/ND	ND/ND
Dichlorobromomethane	ND/ND	tr/tr	0.070/0.040	ND/ND	ND/ND

ELF00264

TABLE 4-20 (Cont'd)

ANALYTICAL RESULTS FOR FIRST ROUND LABORATORY
REPLICATE SAMPLES

	Results in mg/l						
	PW-2C	PW-3C	PW-4C	PW-5C	PW-9C	PW-10C	PW-11C
Antimony	<0.005/<0.005						<0.005/<0.005
Arsenic					0.020/0.017	0.006/0.005	
Barium							
Beryllium			<0.005/<0.005				
Cadmium							
Calcium							
Chromium			0.023/ 0.021				
Copper							
Lead							
Magnesium							
Mercury		<0.002/<0.002					<0.002/<0.002
Nickel							
Selenium							<0.005/<0.005
Silver							
Sodium							
Thallium				<0.01/<0.01			<0.01/ <0.01
Zinc							

	Results in mg/l
Bromoform	
Carbon Tetrachloride	
Chloroform	
Dibromochloromethane	
Dichlorobromonethane	

[a]Original Sample Results/Laboratory Replicate Results
[b]ND = None Detected (less than 0.001 mg/l)
[c]tr = Trace (less than 0.010 mg/l)

ELF00265

TABLE 4-21

ANALYTICAL RESULTS FOR FIELD
REPLICATE SAMPLES

	Results in mg/l							
	PW-3S LT-1	PW-12S LT-1	PW-3S HT-1	PW-12S HT-1	PW-3D LT-1	PW-12D LT-1	PW-3D HT-1	PW-12D HT-1
Antimony	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	< 0.01
Arsenic	0.06	0.04	0.08	0.06	< 0.01	<0.01	<0.01	< 0.01
Barium	0.9	0.4	0.4	0.4	< 0.1	<0.1	<0.1	< 0.1
Cadmium	< 0.002	< 0.002	< 0.002	<0.002	<0.002	0.006	< 0.002	< 0.002
Calcium	260	180	160	160	29	40	27	26
Chloride	8,000	8,200	7,600	8,000	150	280	10	12
Chromium (Total)	< 0.005	< 0.005	0.009	0.018	0.006	0.006	0.005	< 0.005
Chromium (Hexavalent)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	< 0.01
Copper	0.017	< 0.002	0.014	0.012	0.012	0.009	0.002	0.013
Lead	< 0.005	< 0.005	< 0.005	<0.005	<0.005	< 0.005	< 0.005	< 0.005
Magnesium	470	430	270	260	19	10	17	16
Mercury	< 0.002	< 0.002	< 0.002	<0.002	<0.002	< 0.002	< 0.002	< 0.002
Nickel	0.006	< 0.005	0.010	0.005	0.008	< 0.005	< 0.005	0.011
Silver	< 0.002	< 0.002	0.002	<0.002	<0.002	< 0.002	< 0.002	< 0.002
Sodium	4,300	3,600	2,100	2,200	93	7,100	31	27
Zinc	0.012	0.003	0.006	<0.002	0.011	0.11	< 0.002	0.003
	Results in mg/l							
Bromoform	ND[a]	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	0.470	0.490	0.530	0.440	tr[b]	tr	ND	tr
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorobromomethane	ND	ND	ND	ND	tr	ND	ND	ND

[a]ND = none detected (less than 0.001 mg/l)

[b]tr = trace (less than 0.010 mg/l)

ELF000266

TABLE 4-22

ANALYTICAL RESULTS FOR SECOND ROUND LABORATORY REPLICATE SAMPLES

Well No./Parameter	Arsenic (mg/l)	Total Chromium (mg/l)	Hexavalent Chromium (mg/l)	Total Cyanide (mg/l)
PW-1D-LT[a]	<0.03/<0.03			
PW-2D-HT[b]	<0.03/<0.03		< 0.01/<0.01	
PW-3D-HT		<0.01/<0.01		
PW-5D-LT			< 0.01/<0.01	
PW-5D-HT		<0.01/<0.01		
PW-6S-LT		<0.01/<0.01		
PW-6D-LT	0.27/0.20			
PW-6D-HT	0.19/0.18			
PW-8S-LT		0.015/0.017		
PW-9S-HT			< 0.01/<0.01	1.37/1.42
PW-9D-LT	<0.03/<0.03			
PW-9D-HT				< 0.03/<0.03
PW-10S-HT		0.021/0.014		
PW-12D/LT			< 0.01/<0.01	

[a]Low tide.

[b]High tide.

ELF000267

TABLE 4-23

ANALYTICAL RESULTS FROM SECOND ROUND FIELD REPLICATE SAMPLES

	PW-1S HT[a]	PW-12S HT	PW-1S LT[b]	PW-12S LT	PW-1D HT	PW-12D HT	PW-1D LT	PW-12D LT
pH	12.25		12.20	12.20	7.90		7.85	7.85
As (mg/l)	< 0.03		0.03	< 0.03	< 0.03		< 0.03	< 0.03
Cr (mg/l)	1.34		1.19	1.05	< 0.01		< 0.01	< 0.01
Cr^{+6} (mg/l)	1.11		0.327	0.97	< 0.01		< 0.01	< 0.01
Cyanide (mg/l)	0.037		0.041	0.033	0.008		< 0.003	0.003
1,1Dichloroethane (mg/l)	0.0036		0.0065	0.0076	< 0.00001		< 0.00001	0.00023
1,2 Dichloroethane (mg/l)	0.0008		0.002	0.00014	< 0.00001		< 0.00001	0.00019
Chloroform (mg/l)	0.57	0.59	3.05	0.69	0.0079	0.008	0.019	0.008
1,1,1 Trichloroethane (mg/l)	0.0042		0.0098	0.026	< 0.00001		< 0.00001	0.00031
1,1,2 Trichloroethane (mg/l)								
Carbon Tetrachloride (mg/l)		0.039				< 0.00001		
Tetrachloroethylene (mg/l)								
1,1,2,2 Tetrachloro-ethylene (mg/l)		0.34				0.018		

[a]High tide.

[b]Low tide.

ELF00268

TABLE 4-24

RESULTS OF LABORATORY REPLICATE
ANALYSES OF SHALLOW ZONE SAMPLES

	Arsenic (mg/l)	Cr (mg/l)	Cr^{+6} (mg/l)	CN (mg/l)
PW-1SS-HT	<0.003/<0.003	1.60/ 1.63		
PW-3SS-HT				
PW-4SS-HT	<0.003/<0.003	0.130/ 0.125		
PW-6SS-HT				
PW-10SS-HT				
PW-1SS-LT			0.33/0.34	
PW-3SS-LT				
PW-4SS-LT				
PW-6SS-LT				
PW-10SS-LT		<0.005/<0.005		

TABLE 4-25 From compiled gw sampl

SUMMARY OF PRIORITY POLLUTANT ANALYSES FOR PARAMETERS WITH QUANTITATED CONCENTRATIONS

Parameter	Samples with Quantitated Concentrations	Concentration (in mg/l)	Remarks
Carbon Tetrachloride	PW-1C	0.039	No known specific source. Might be a byproduct along with chloroform generated in old graphite cells by the reaction of linseed oil and chlorine. Not considered to be a problem.
Chlorinated Ethanes			
1,1,1-trichloroethane	PW-1C	1.30	No known specific source of this group of compounds. Not considered to be a significant problem.
	PW-2C	0.016	
	PW-4C	0.011	
Hexachloroethane	PW-1C	0.360	
1,1-dichloroethane	PW-1C	0.012	
	PW-2C	0.130	
Halomethanes			
Chloroform	PW-1C	1.300	Trace concentrations in all other samples. Concentrations in the vicinity of the lagoons can be attributed to past waste generation and disposal practices. Lower concentrations of chloroform detected in other wells might be the result of the chemical reaction between free chlorine and buried naturally-occurring organic materials.
	PW-2C	1.800	
	PW-3C	0.170	
	PW-4C	0.160	

ELF000270

TABLE 4-25 (Cont'd)

SUMMARY OF PRIORITY POLLUTANT ANALYSES FOR PARAMETERS WITH QUANTITATED CONCENTRATIONS

Parameter	Samples with Quantitated Concentrations	Concentration (in mg/l)	Remarks
Zinc, continued	PW-6C	0.010	
	PW-7C	0.003	
	PW-8C	0.009	
	PW-9C	0.007	
	PW-10C	0.004	
	PW-11C	0.006	

ELF000271

TABLE 4-25 (Cont'd)

SUMMARY OF PRIORITY POLLUTANT ANALYSES FOR PARAMETERS WITH QUANTITATED CONCENTRATIONS

Parameter	Samples with Quantitated Concentrations	Concentration (in mg/l)	Remarks
Chromium (Total), continued	PW-6C	0.016	
	PW-8C	0.014	
	PW-9C	0.015	
	PW-10C	0.010	
	PW-11C	0.019	
Cyanide (Total)	PW-1C	0.250	Maximum detected concentration was found in sample PW-9C which suggests an off-site source of cyanide. Concentration distribution does not indicate on-site sources.
	PW-2C	0.038	
	PW-4C	0.260	
	PW-5C	0.110	
	PW-6C	0.039	
	PW-7C	0.058	
	PW-8C	0.045	
	PW-9C	0.450	
	PW-10C	0.077	
	PW-11C	0.054	
Nickel	PW-2C	0.007	Random and isolated low concentration values. Not considered to be a problem.
	PW-5C	0.014	
	PW-9C	0.010	
Zinc	PW-1C	0.003	No significant concentration distribution to indicate an on-site source. Not considered to be a problem.
	PW-2C	0.041	
	PW-3C	0.005	
	PW-4C	0.008	
	PW-5C	0.008	

ELF000272

TABLE 4-25 (Cont'd)

SUMMARY OF PRIORITY POLLUTANT ANALYSES FOR PARAMETERS WITH QUANTITATED CONCENTRATIONS

Parameter	Samples with Quantitated Concentrations	Concentration (in mg/l)	Remarks
Tetrachloroethylene	PW-1C PW-2C PW-3C PW-4C	0.430 0.380 0.020 0.010	No known specific source. Might be a byproduct along with chloroform generated in old graphite cells by the reaction of linseed oil and chlorine. Not considered to be a significant problem.
Toluene	PW-1C	0.026	Trace concentrations in all other samples except PW-9C. No known specific source. Not considered to be a problem.
Antimony	PW-6C	0.028	Antimony was in raw materials for Penite production. Not considered to be a significant problem.
Arsenic	PW-1C PW-2C PW-3C PW-5C PW-6C PW-8C PW-9C PW-10C PW-11C	0.044 0.470 0.069 0.037 0.220 0.030 0.020 0.006 0.026	Concentration distribution indicates that ASARCO sands as well as the old Penite area are contributors of arsenic. Not considered to be a significant problem.
Chromium (Total)	PW-1C PW-2C PW-3C PW-4C PW-5C	0.680 0.076 0.020 0.023 0.075	Minor amounts of chromium were discharged to lagoons between 1978 and 1979 from chlorate production. Not considered to be a significant problem.

ELF000273