



***Annual Monitoring Report  
October 1989 through September 1990  
USX Duluth Works Site***

***Prepared for USX Corporation***

***January 1991***

*Engineering Company*

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ANNUAL MONITORING REPORT  
OCTOBER 1989 - SEPTEMBER 1990  
USS DULUTH WORKS SITE

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1.0 INTRODUCTION

The USS Duluth Works Site (site) is located in the southern portion of the City of Duluth in St. Louis County, Minnesota. The Duluth Works was an integrated steel mill (coke production, steel production and finishing, and material storage) that ended operations in May, 1979.

This site is the subject of a March 26, 1985 Response Order by Consent (Order) between USS, a Division of USX Corporation and the Minnesota Pollution Control Agency (MPCA). In accordance with the Order, the document entitled "Plans Submitted Pursuant to Part IV and Part V, Task A to Exhibit A, March 26, 1985 Response Order by Consent, U.S. Steel Duluth Works Site" was prepared by Barr Engineering Co. and submitted to the MPCA in May 1985. This report described the geologic and hydrogeologic conditions at the site along with the water quality monitoring plan. The monitoring plan was amended and approved by the MPCA based on the recommendations of the October 1986 - September 1987 Annual Monitoring Report. The following sections summarize the results of the water quality monitoring conducted during the period from October, 1989 to September, 1990.

2.0 MONITORING ACTIVITIES

2.1 Water Elevations

Water elevations were measured in each monitoring well prior to purging the well and collection of samples. The groundwater elevations measured at the monitoring wells are listed in Table 1. This data was used to construct the surficial groundwater contours shown on Figure 1.

Groundwater flow under the site is generally east toward the St. Louis river estuary. However, the coke plant settling basin acts as discharge zone for the northern portion of the site.

## 2.2 Water Quality

The procedures specified in the Quality Assurance/Quality Control Plan in the May 1985 report were followed during sample collection. The sampling locations are shown on Figure 2.

Samples were collected quarterly (December, March, June, September) from surface water stations CP-1, CP-2, CP-3, SEEP-1, and WM-1. These samples were analyzed for the "PAH and heterocyclic compounds", "total metals", and "general parameters" listed in Table 2. Samples collected in September from CP-3 and SEEP-1 were also analyzed for the "phenolic compounds" listed in Table 2.

In June, samples were collected from monitoring wells W6, W7, W8, W9, W10, W11, W12, and W13. These samples were analyzed for the "PAH and heterocyclic compounds", "filtered metals", "general parameters", and "annual parameters" listed in Table 2.

Specific conductance, temperature, and pH were measured in the field immediately after collection of each sample.

## 3.0 MONITORING RESULTS

The following sections summarize the analytical results of samples collected from October 1989 to September 1990. Laboratory analytical reports for these samples are in Appendix A.

### 3.1 PAH and Phenolic Compounds

The analytical results of samples analyzed for PAH and phenolic compounds are presents in Table 3. The geographical distribution of PAH compounds at monitoring wells and surface water stations is shown in Figure 3 for the June sampling event. The data for the June sampling event is depicted because it is the most complete data set.

PAH compounds included in the monitoring program are divided into two groups, List 1 and List 2. Suspected carcinogenic PAH compounds are designated as List 1. List 2 PAH compounds are not suspected carcinogens. The highest concentration of List 1 and List 2 PAH compounds were found in monitoring well W6 and surface water stations CP-2, CP-3, SEEP-1, and WM-1. The monitoring well in the vicinity of the demolition landfill (W12) contained no detectable concentration of List 1 PAH compounds, although low concentrations of List 2 PAH compounds were detected(0.027ug/l).

Graphs illustrating the concentration of List 1 and List 2 PAH compounds in the surficial aquifer and surface waters from 1985 to 1990 are shown in Appendix B. There has not been a significant change in concentrations of List 1 and List 2 PAH compounds at the monitoring well stations or surface water stations except CP-2. The concentration of List 1 and List 2 PAH compounds at CP-2 has fluctuated widely over the past year. Discrete sampling events may not be representative of overall trends. Continued monitoring of this station is required to show any trends in PAH concentration.

Phenolic compounds were not detected in either of the samples collected in September from CP-3 and SEEP-1.

### 3.2 General Parameters

General parameters included in the monitoring program are listed in Table 2. The analytical results of samples analyzed for these parameters are shown in Table 4. The geographical distribution of five general parameters (ammonia-nitrogen, total cyanide, thiocyanate, sulfate, total organic carbon) are shown in Figure 4 for the June sampling event. The data for the June sampling event is depicted because it is the most complete data set.

Thiocyanate and sulfate were selected as indicator parameters for purposes of determining changes in contaminant concentrations with time. These parameters are considered possible indicators of groundwater and surface water contamination at the site for the following reasons: 1) the parameters have been consistently detected at elevated levels at the surface stations and monitoring wells at the site, 2) thiocyanate and sulfate were major constituents of the wastes generated at the site. Graphs showing the concentration of sulfate and thiocyanate in the surficial aquifer and surface waters from 1985 to 1990 are shown in Appendix B. The concentration of sulfate in monitoring wells W6, W7, W10, W11, W12, and W13 has shown a slight increase indicated by the June 1990 sampling event. There were no apparent changes in the thiocyanate concentration at the monitoring stations.

### 3.3 Metals

Water samples collected from the surface water stations were analyzed for the total metals listed in Table 2. Water samples collected from the monitoring wells were analyzed for the filtered metals listed in Table 2. The analytical results for these samples are listed in Table 5 and a geographical distribution is shown in Figure 5.



The concentrations of metals in samples collected at the site during the monitoring period were below the maximum acceptable contaminant levels for community water supplies.

#### 4.0 QUALITY CONTROL REVIEW

Quality control procedures used in the collection and analysis of samples are described in the Quality Assurance/Quality Control Plan in the May, 1985 report. A review of the quality control data was conducted to assess the integrity of the of the sampling procedures and analytical results for samples collected from October, 1989 to September, 1990.

##### 4.1 Field Blank Samples

Field blank samples were collected during each sampling event and analyzed for PAH compounds and metals. Results of field blank analysis for PAH compounds and metals are presented in Tables 7 and 8, respectively. Detectable levels were used to identify potential false positive values. Potential false positive values were defined as concentrations equal to or less than the concentration detected in the field blank. Potential false positive values are footnoted with an "s" in the water quality tables.

Field blank samples collected on 12/20/89, 6/19/90, and 9/11/90, indicate all parameters were below the detection limit. Four parameters (2,3-Dihydroindene,Naphthalene,2-Methylnaphthalene,1-Methylnaphthalene) were detected in the 3/28/90 field blank sample.

##### 4.2 Blind Duplicate Samples

A blind duplicate sample was collected at one monitoring station during each sampling event. The duplicate sample was analyzed for the "PAH and heterocyclic compounds", "metals", and "general parameters"

listed in table 2. Tables 9, 10, and 11 show the analytical results of duplicate samples. A coefficient of variation was computed for each duplicate pair. Table 12 lists the coefficients for each sampling event. A coefficient less than 0.25 is generally considered an indication of acceptable reproducibility of analytical results by the laboratory.

The analysis of blind duplicate samples showed acceptable reproducibility except for the March sampling event. The coefficient of variation for this sampling event is high because quinoline, isoquinoline and cyanide were detected in the duplicate sample but were below detection in the original sample.

#### 5.0 RECOMMENDED MONITORING PROGRAM FOR 1991

The Response Action Plan (RAP) is currently being prepared for the USS Duluth Works Site. The long-term monitoring plan will be addressed as part of the RAP. The monitoring plan specified in the May 1985 Barr Engineering Co. report with modifications recommended and approved in the October, 1986 - September, 1987 Annual Monitoring Report will continue to be the routine water quality monitoring plan for the site until the long-term monitoring plan is prepared and approved by the MPCA as part of the RAP for the site.

## ***Tables***

TABLE 1  
GROUNDWATER ELEVATIONS  
DULUTH WORKS SITE  
(Elevations in Feet MSL)

<u>Location</u>	<u>Elevation 6/18/90</u>
W6	606.35
W7	620.15
W8	618.28
W9	618.59
W10	613.92
W11	614.36
W12	609.12
W13	621.90

TABLE 2  
PARAMETER LISTS

LIST A  
PAH AND HETEROCYCLIC COMPOUNDS

benzo(a)anthracene	anthracene
dibenzo(ah)anthracene	fluoranthene
benzo(b and k)fluoranthene	pyrene
benzo(a)pyrene	benzo(e)pyrene
quinoline	perylene
indeno(1,2,3-dc)pyrene	acridine
chrysene/triphenylene	carbazole
benzo(ghi)perylene	2,3-benzofuran
indene	dibenzofuran
2,3-dihydroindene	benzo(b)thiophene
naphthalene	dibenzothiophene
1-methylnaphthalene	indole
2-methylnaphthalene	3-methylcholanthrene
biphenyl	phenanthridine
acenaphthylene	isoquinoline
acenaphthene	
fluorene	
phenanthrene	

TABLE 2 (continued)

LIST B  
TOTAL METALS

chromium  
lead  
nickel  
zinc  
arsenic

LIST C  
GENERAL PARAMETERS

sulfate  
ammonia  
cyanide  
thiocyanate  
total organic carbon

LIST D  
FILTERED METALS

chromium  
lead  
nickel  
zinc  
arsenic

LIST E  
ANNUAL PARAMETERS

chemical oxygen demand  
total dissolved solids  
cadmium  
chloride

LIST F  
PHENOLIC COMPOUNDS

phenol  
o-cresol  
m-cresol/p-cresol  
2-nitrophenol

4-nitrophenol  
2,4-dinitrophenol  
4,6-dinitro-o-cresol  
2,4-dimethylphenol

TABLE 3

WATER QUALITY MONITORING DATA  
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/L)

	W6	W7	W8	W9	W10	W11	W12	W13
	-----	-----	-----	-----	-----	-----	-----	-----
	06/19/90	06/19/90	06/19/90	06/19/90	06/18/90	06/18/90	06/18/90	06/18/90
Quinoline	<0.016	0.0023	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Benzo(a)anthracene	0.13	<0.0010	0.0078	0.011	<0.0010	<0.0010	<0.0010	<0.0010
Chrysene	0.15 c	<0.0010	0.0089 c	0.012 c	<0.0010	<0.0010	<0.0010	<0.0010
Benzo(b)fluoranthene	0.23 c	<0.0010	0.015 c	0.019 c	<0.0010	<0.0010	<0.0010	<0.0010
Benzo(a)pyrene	0.12	<0.0010	0.0077	0.0073	<0.0010	<0.0010	<0.0010	<0.0010
Indeno(1,2,3,cd)pyrene	0.10	<0.0017	0.010	0.0089	<0.0017	<0.0017	<0.0017	<0.0017
Dibenzo(ah)anthracene	<0.022	<0.0014	0.0021	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
Benzo(ghi)perylene	0.091	<0.0010	0.0088	0.0075	<0.0010	<0.0010	<0.0010	<0.0010
Sum List 1	0.82	0.0023	0.060	0.066	ND	ND	ND	ND
2,3-Benzofuran	DLND	0.0049 s	0.0025 s	0.0022 s	0.0024 s	0.0039 s	0.0021 s	0.0025 s
2,3-Dihydroindene	<0.022	<0.0014	0.0026	<0.0014	0.0016	<0.0014	<0.0014	<0.0014
Indene	<0.016	0.0017	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010
Naphthalene	0.54	0.0042 s	0.0026 s	0.0040 s	0.0053 s	0.0039 s	0.0022 s	0.0047 s
Benzo(b)thiophene	<0.016	<0.0010	<0.0010	<0.0010	<0.0010	0.0057	0.018	<0.0010
Isoquinoline	DLND	DLND	DLND	DLND	DLND	DLND	DLND	DLND
Indole	<0.046	<0.0029	<0.0029	<0.0029	<0.0029	<0.0029	<0.0029	<0.0029
2-Methylnaphthalene	<0.032	0.0022	0.015	<0.0020	0.0026	0.0022	<0.0020	0.0026
1-Methylnaphthalene	<0.016	0.0016	0.010	<0.0010	0.0018	0.0014	0.0011	0.0017
Biphenyl	0.017	<0.0010	0.0019	<0.0010	<0.0010	<0.0010	0.0017	<0.0010
Acenaphthylene	0.049	<0.0010	0.0043	0.0025	<0.0010	<0.0010	<0.0010	<0.0010
Acenaphthene	<0.021	<0.0013	0.0018	<0.0013	<0.0013	<0.0013	<0.0013	<0.0013
Dibenzofuran	0.043	<0.0020	0.0052	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Fluorene	0.11	<0.0014	0.0096	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
Dibenzothiophene	0.040	DLND	0.0019	DLND	DLND	DLND	DLND	DLND
Phenanthrene	0.57	0.0020	0.018	0.0094	0.0020	0.0017	0.0013	0.0020
Anthracene	0.15	0.0021	0.0064	0.0023	<0.0010	<0.0010	<0.0010	<0.0010
Acridine	<0.029	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018
Phenanthridine	<0.022	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
Carbazole	<0.018	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011	<0.0011
Fluoranthene	0.77	0.0011	0.024	0.027	0.0012	<0.0010	<0.0010	0.0012
Pyrene	0.66	0.0036	0.017	0.020	0.0013	<0.0010	<0.0010	0.0013
Triphenylene	0.15 c	<0.0010	0.0089 c	0.012 c	<0.0010	<0.0010	<0.0010	<0.0010
Benzo(k)fluoranthene	0.23 c	<0.0010	0.015 c	0.019 c	<0.0010	<0.0010	<0.0010	<0.0010
7,12-Dimethylbenz(a)anthracene	DLND	DLND	DLND	DLND	DLND	DLND	DLND	DLND
Benzo(e)pyrene	0.084	<0.0010	0.0051	0.0064	<0.0010	<0.0010	<0.0010	<0.0010
Perylene	0.036	<0.0010	0.0025	0.0027	<0.0010	<0.0010	<0.0010	<0.0010
3-Methylcholanthrene	DLND	DLND	DLND	DLND	DLND	DLND	DLND	DLND
Sum List 2	3.1	0.023	0.15	0.076	0.019	0.019	0.027	0.016
Phenol	--	--	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--	--	--
O-Cresol	--	--	--	--	--	--	--	--
M-Cresol	--	--	--	--	--	--	--	--
P-Cresol	--	--	--	--	--	--	--	--

-- Not analyzed.

ND Not detected.

DLND Detection Limit Not Determined.

c Compounds coelute.

j Reported value is less than quantitation limit.

s Potential false positive value based on statistical analysis of blank sample data.

TABLE 3 (cont.)

WATER QUALITY MONITORING DATA  
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/L)

	CP1				CP2			
	12/20/89	03/28/90	06/19/90	09/11/90	12/20/89	03/28/90	06/19/90	09/11/90
Quinoline	<0.020	<0.0010	<0.0010	<10	<0.0080	4 j	<0.20	<10
Benzo(a)anthracene	<0.020	0.0019	0.0049	<10	0.073	1 j	4.7	<10
Chrysene	<0.020	0.0029 c	0.0072 c	<10	0.061 c	1 jc	5.4 c	<10
Benzo(b)fluoranthene	<0.020	0.0031 c	0.017 c	<10	0.11 c	2 jc	7.3 c	<10
Benzo(a)pyrene	<0.020	0.0013	0.0082	<10	0.054	<6	4.3	<10
Indeno(1,2,3,cd)pyrene	<0.034	<0.0017	0.012	<10	0.033	<6	3.3	<10
Dibenzo(ah)anthracene	<0.028	<0.0014	<0.0014	<10	<0.012	<6	0.93	<10
Benzo(ghi)perylene	<0.020	<0.0010	0.012	<10	0.033	<6	2.4	<10
Sum List 1	ND	0.0092	0.062	ND	0.36	7	28	ND
2,3-Benzofuran	DLND	0.0044	0.0024 s	<10	0.029	<6	DLND	<10
2,3-Dihydroindene	0.13	0.019	0.0038	<10	0.056	<6	<0.28	<10
Indene	0.10	0.0075	0.0032	<10	0.14	5 j	<0.20	<10
Naphthalene	0.20	0.022	0.012 s	<10	0.13	29	<0.38	<10
Benzo(b)thiophene	0.034	0.0030	<0.0010	<10	0.065	1 j	<0.20	<10
Isoquinoline	DLND	DLND	DLND	<10	DLND	2 j	DLND	<10
Indole	<0.058	<0.0029	<0.0029	<10	<0.023	<6	<0.58	<10
2-Methylnaphthalene	<0.040	0.0069	0.014	<10	0.10	2 j	<0.40	<10
1-Methylnaphthalene	<0.020	0.0055	0.0086	<10	0.22	2 j	<0.20	<10
Biphenyl	<0.020	0.0016	<0.0010	<10	0.10	0.6 j	<0.20	<10
Acenaphthylene	<0.020	<0.0010	0.0013	<10	0.43	5 j	0.55	<10
Acenaphthene	<0.026	0.0070	0.0014	<10	0.40	1 j	0.96	<10
Dibenzofuran	<0.040	<0.0020	<0.0020	<10	0.38	2 j	0.65	<10
Fluorene	<0.028	0.0056	0.0015	<10	0.47	3 j	0.94	<10
Dibenzothiophene	DLND	DLND	DLND	<10	0.038	<6	0.33	<10
Phenanthrene	0.024	0.0098	0.0055	<10	0.24	4 j	4.3	2 j
Anthracene	<0.020	<0.0010	0.0010	<10	0.14	0.6 j	2.3	<10
Acridine	0.055	<0.0018	<0.0018	<10	0.029	2 j	<0.36	<10
Phenanthridine	<0.028	<0.0014	<0.0014	<10	0.012	1 j	<0.28	<10
Carbazole	0.046	<0.0011	0.0030	<10	0.29	3 j	<0.22	<10
Fluoranthene	<0.020	0.0063	0.010	<10	0.49	3 j	11	<10
Pyrene	<0.020	0.0053	0.0098	<10	0.34	2 j	7.8	<10
Triphenylene	<0.020	0.0029 c	0.0072 c	<10	0.061 c	1 jc	5.4 c	<10
Benzo(k)fluoranthene	<0.020	0.0031 c	0.017 c	<10	0.11 c	2 jc	7.3 c	<10
7,12-Dimethylbenz(a)anthracene	DLND	DLND	DLND	<10	DLND	<6	DLND	<10
Benzo(e)pyrene	<0.020	0.0016	0.0068	<10	0.032	<6	2.0	<10
Perylene	<0.020	<0.0010	0.0024	<10	0.010	<6	1.1	<10
3-Methylcholanthrene	DLND	DLND	DLND	<10	DLND	<6	DLND	<10
Sum List 2	0.59	0.10	0.087	ND	4.1	40	32	2
Phenol	--	--	--	--	--	--	--	--
2-Chlorophenol	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--	--	--	--	--
Pentachlorophenol	--	--	--	--	--	--	--	--
O-Cresol	--	--	--	--	--	--	--	--
M-Cresol	--	--	--	--	--	--	--	--
P-Cresol	--	--	--	--	--	--	--	--

-- Not analyzed.

ND Not detected.

DLND Detection Limit Not Determined.

c Compounds coelute.

j Reported value is less than quantitation limit.

s Potential false positive value based on statistical analysis of blank sample data.



TABLE 3 (cont.)

WATER QUALITY MONITORING DATA  
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/L)

	CP3				SEEP1			
	12/20/89	03/28/90	06/19/90	09/11/90	12/20/89	03/28/90	06/19/90	09/17/90
Quinoline	<0.060	2 j	<0.010	<10	<0.020	<0.0050	<0.040	<0.0040
Benzo(a)anthracene	<0.060	<6	0.020	<10	<0.020	0.0055	0.077	0.21
Chrysene	<0.060	<6	0.021 c	<10	<0.020	0.014 c	0.15 c	0.55 c
Benzo(b)fluoranthene	<0.060	<6	<0.010	<10	<0.020	<0.0050	0.057 c	0.19 c
Benzo(a)pyrene	<0.060	<6	<0.010	<10	<0.020	<0.0050	0.055	0.14
Indeno(1,2,3,cd)pyrene	<0.10	<6	<0.017	<10	<0.034	<0.0085	<0.068	0.028
Dibenzo(ah)anthracene	<0.084	<6	<0.014	<10	<0.028	<0.0070	<0.056	0.026
Benzo(ghi)perylene	<0.060	<6	<0.010	<10	<0.020	<0.0050	0.051	0.088
Sum List 1	0.10	2	0.041	ND	ND	0.019	0.39	1.2
2,3-Benzofuran	DLND	<6	DLND	<10	DLND	DLND	DLND	0.0058
2,3-Dihydroindene	0.088	<6	<0.014	<10	0.21	0.22	0.26	<0.0056
Indene	0.35	2 j	<0.010	<10	<0.020	<0.0050	<0.040	0.012
Naphthalene	4.4	14	<0.019	<10	<0.038	0.028	<0.076	<0.0076
Benzo(b)thiophene	0.45	<6	0.028	<10	<0.020	<0.0050	<0.040	<0.0040
Isoquinoline	DLND	1 j	0.030	<10	DLND	DLND	DLND	DLND
Indole	0.17	<6	<0.029	<10	<0.058	<0.015	<0.12	<0.012
2-Methylnaphthalene	1.1	1 j	<0.020	<10	<0.040	<0.010	<0.080	<0.0080
1-Methylnaphthalene	0.95	<6	0.014	<10	<0.020	<0.0050	<0.040	<0.0040
Biphenyl	0.53	<6	<0.010	<10	<0.020	<0.0050	<0.040	<0.0040
Acenaphthylene	2.4	3 j	0.062	<10	0.044	0.045	<0.040	0.21
Acenaphthene	1.0	<6	0.13	<10	1.1	0.61	0.94	<0.0052
Dibenzofuran	2.1	1 j	0.12	<10	0.28	0.095	0.22	<0.0080
Fluorene	4.1	2 j	0.13	<10	1.7	0.69	1.2	<0.0056
Dibenzothiophene	0.45	<6	0.024	<10	0.98	0.35	0.74	DLND
Phenanthrene	4.4	2 j	<0.010	<10	<0.020	<0.0050	<0.040	<0.0040
Anthracene	0.65	<6	0.056	<10	0.15	<0.0050	0.12	<0.0040
Acridine	0.34	1 j	0.13	<10	<0.036	0.086	<0.072	<0.0072
Phenanthridine	<0.084	<6	0.029	<10	<0.028	0.13	<0.056	<0.0056
Carbazole	<0.066	2 j	0.037	<10	<0.022	<0.0055	<0.044	<0.0044
Fluoranthene	0.83	1 j	0.59	<10	0.091	0.089	0.19	0.27
Pyrene	0.47	<6	0.33	<10	0.13	0.12	0.38	0.68
Triphenylene	<0.060	<6	0.021 c	<10	<0.020	0.014 c	0.15 c	0.55 c
Benzo(k)fluoranthene	<0.060	<6	<0.010	<10	<0.020	<0.0050	0.057 c	0.19 c
7,12-Dimethylbenz(a)anthracene	DLND	<6	DLND	<10	DLND	DLND	DLND	DLND
Benzo(e)pyrene	<0.060	<6	<0.010	<10	<0.020	<0.0050	0.068	0.21
Perylene	<0.060	<6	<0.010	<10	<0.020	<0.0050	<0.040	0.042
3-Methylcholanthrene	DLND	<6	DLND	<10	DLND	DLND	DLND	DLND
Sum List 2	24	30	1.7	ND	4.6	2.5	4.1	1.4
Phenol	--	--	--	<10	--	--	--	<6
2-Chlorophenol	--	--	--	<10	--	--	--	<6
2-Nitrophenol	--	--	--	<10	--	--	--	<6
2,4-Dimethylphenol	--	--	--	<10	--	--	--	<6
Benzoic Acid	--	--	--	<50	--	--	--	<29
2,4-Dichlorophenol	--	--	--	<10	--	--	--	<6
4-Chloro-3-methylphenol	--	--	--	<10	--	--	--	<6
2,4,6-Trichlorophenol	--	--	--	<10	--	--	--	<6
2,4-Dinitrophenol	--	--	--	<50	--	--	--	<29
4-Nitrophenol	--	--	--	<50	--	--	--	<29
2-Methyl-4,6-dinitrophenol	--	--	--	<50	--	--	--	<29
Pentachlorophenol	--	--	--	<50	--	--	--	2 j
O-Cresol	--	--	--	<10	--	--	--	<6
M-Cresol	--	--	--	--	--	--	--	<6
P-Cresol	--	--	--	<10	--	--	--	<6

-- Not analyzed.

ND Not detected.

DLND Detection Limit Not Determined.

c Compounds coelute.

j Reported value is less than quantitation limit.

s Potential false positive value based on statistical analysis of blank sample data.

TABLE 3 (cont.)

WATER QUALITY MONITORING DATA  
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/L)

	WM1			
	12/20/89	03/28/90	06/19/90	09/11/90
Quinoline	<0.010	<0.0050	<0.0010	<10
Benzo(a)anthracene	<0.010	0.0084	0.0031	<10
Chrysene	0.012 c	0.019 c	0.0084 c	<10
Benzo(b)fluoranthene	<0.010	0.019 c	0.0036 c	<10
Benzo(a)pyrene	<0.010	<0.0050	0.0012	<10
Indeno(1,2,3,cd)pyrene	<0.017	<0.0085	<0.0017	<10
Dibenzo(ah)anthracene	<0.014	<0.0070	<0.0014	<10
Benzo(ghi)perylene	<0.010	<0.0050	<0.0010	<10
Sum List 1	0.012	0.046	0.016	ND
2,3-Benzofuran	DLND	DLND	0.013 s	<10
2,3-Dihydroindene	0.20	0.15	0.023	<10
Indene	0.061	0.094	0.060	<10
Naphthalene	0.059	0.044	0.071	<10
Benzo(b)thiophene	0.034	0.031	0.0086	<10
Isoquinoline	DLND	DLND	DLND	<10
Indole	<0.029	<0.015	<0.0029	<10
2-Methylnaphthalene	<0.020	<0.010	0.0028	<10
1-Methylnaphthalene	0.065	0.038	0.0047	<10
Biphenyl	0.025	0.014	<0.0010	<10
Acenaphthylene	0.047	0.045	0.0065	<10
Acenaphthene	1.0	0.90	0.088	<10
Dibenzofuran	0.25	0.24	0.031	<10
Fluorene	0.38	0.50	0.079	<10
Dibenzothiophene	0.022	0.041	0.013	<10
Phenanthrene	0.027	0.099	0.035	<10
Anthracene	0.024	0.018	0.0071	<10
Acridine	<0.018	<0.0090	0.011	<10
Phenanthridine	<0.014	<0.0070	<0.0014	<10
Carbazole	0.33	0.33	0.024	<10
Fluoranthene	0.13	0.15	0.077	<10
Pyrene	0.078	0.066	0.038	<10
Triphenylene	0.012 c	0.019 c	0.0084 c	<10
Benzo(k)fluoranthene	<0.010	0.019 c	0.0036 c	<10
7,12-Dimethylbenz(a)anthracene	DLND	DLND	DLND	<10
Benzo(e)pyrene	<0.010	<0.0050	0.0021	<10
Perylene	<0.010	<0.0050	<0.0010	<10
3-Methylcholanthrene	DLND	DLND	DLND	<10
Sum List 2	2.8	2.7	0.59	ND
Phenol	--	--	--	--
2-Chlorophenol	--	--	--	--
2-Nitrophenol	--	--	--	--
2,4-Dimethylphenol	--	--	--	--
Benzoic Acid	--	--	--	--
2,4-Dichlorophenol	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--
2,4,6-Trichlorophenol	--	--	--	--
2,4-Dinitrophenol	--	--	--	--
4-Nitrophenol	--	--	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--
Pentachlorophenol	--	--	--	--
O-Cresol	--	--	--	--
M-Cresol	--	--	--	--
P-Cresol	--	--	--	--

-- Not analyzed.

ND Not detected.

DLND Detection Limit Not Determined.

c Compounds coelute.

j Reported value is less than quantitation limit.

s Potential false positive value based on statistical analysis of blank sample data.

TABLE 4

WATER QUALITY MONITORING DATA  
GENERAL PARAMETERS

(concentrations in mg/L)

	CP1				CP2			
	12/19/89	03/28/90	06/19/90	09/11/90	12/19/89	03/28/90	06/19/90	09/11/90
Total Organic Carbon	5.4	15	8.9	7.1	6.5	14	7.7	7.7
Ammonia Nitrogen	5.3	<0.1	<0.1	<0.1	0.3	0.3	0.2	0.3
Sulfate	85	69	52	21	80	80	61	49
Cyanide, total	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.03
Thiocyanate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

	CP3				SEEP1			
	12/19/89	03/28/90	06/19/90	09/11/90	12/19/89	03/28/90	06/19/90	09/11/90
Total Organic Carbon	9.0	15	7.3	8.0	6.1	8.0	12	4.6
Ammonia Nitrogen	0.9	0.3	0.2	0.2	0.2	<0.1	0.2	0.4
Sulfate	170	78	61	58	150	170	170	210
Cyanide, total	0.08	0.01	0.03	0.02	<0.01	<0.01	<0.01	<0.01
Thiocyanate	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

	WM1			
	12/19/89	03/28/90	06/19/90	09/11/90
Total Organic Carbon	7.6	6.4	8.7	7.8
Ammonia Nitrogen	0.2	0.2	0.1	0.3
Sulfate	360	290	230	110
Cyanide, total	<0.01	<0.01	<0.01	<0.01
Thiocyanate	<1.0	<1.0	<1.0	<1.0

-----  
 -- Not analyzed.

.014

TABLE 4 (cont.)

WATER QUALITY MONITORING DATA  
GENERAL PARAMETERS

(concentrations in mg/L)

	W6 ----- 06/19/90	W7 ----- 06/19/90	W8 ----- 06/19/90	W9 ----- 06/19/90
Biochemical Oxygen Demand	--	--	--	--
Chemical Oxygen Demand	--	--	--	--
Chloride	--	--	--	--
Cyanide, total	0.04	--	<0.01	<0.01
Ammonia Nitrogen	0.1	0.6	1.3	0.2
Total Dissolved Solids	--	--	--	--
Sulfate	460	870	<1	98
Thiocyanate	<1.0	1.0	<1.0	<1.0
Total Organic Carbon	7.1	5.2	20	3.9
	W10 ----- 06/18/90	W11 ----- 06/18/90	W12 ----- 06/18/90	W13 ----- 06/18/90
Biochemical Oxygen Demand	--	--	--	--
Chemical Oxygen Demand	--	5	15	9
Chloride	--	4	7	9
Cyanide, total	<0.01	<0.01	0.01	<0.01
Ammonia Nitrogen	<0.1	<0.1	<0.1	0.2
Total Dissolved Solids	--	860	1400	620
Sulfate	380	610	1300	320
Thiocyanate	<1.0	<1.0	<1.0	<1.0
Total Organic Carbon	4.1	4.1	3.6	6.9

-----  
-- Not analyzed.

.023

TABLE 5

WATER QUALITY MONITORING DATA  
METALS

(concentrations in ug/L, unless noted otherwise)

	CP1				CP2			
	12/19/89	03/28/90	06/19/90	09/11/90	12/19/89	03/28/90	06/19/90	09/11/90
Arsenic	<25	<10	<2	<2	<25	<10	<2	<2
Cadmium	--	--	<10	--	--	--	<10	--
Chromium, total	<5	<5	<100	<1	<5	<5	<100	<1
Lead	<5	<5	<100	<1	<5	13	<100	<1
Nickel	<50	<25	<50	<50	<50	<25	<50	<50
Zinc, mg/L	<0.01	<0.10	0.21	<0.01	<0.01	<0.10	<0.10	<0.01

	CP3				SEEP1			
	12/19/89	03/28/90	06/19/90	09/11/90	12/19/89	03/28/90	06/19/90	09/11/90
Arsenic	<25	<10	<2	<2	<25	<10	<2	<2
Cadmium	--	--	<10	--	--	--	<10	--
Chromium, total	<5	<5	<100	<1	<5	<5	<100	<1
Lead	<5	<5	<100	<1	<5	<5	<100	<1
Nickel	<50	<25	<50	<50	<50	<25	<50	<50
Zinc, mg/L	<0.01	<0.10	<0.10	<0.01	<0.01	<0.10	<0.10	<0.01

	WM1			
	12/19/89	03/28/90	06/19/90	09/11/90
Arsenic	<25	<10	<2	<2
Cadmium	--	--	<10	--
Chromium, total	<5	<5	<100	3
Lead	<5	<5	<100	5
Nickel	<50	<25	60	<50
Zinc, mg/L	0.06	0.16	0.18	0.08

-----  
-- Not analyzed.

.022

TABLE 5 (cont.)

WATER QUALITY MONITORING DATA  
METALS

(concentrations in ug/L, unless noted otherwise)

	W6 ----- 06/19/90	W7 ----- 06/19/90	W8 ----- 06/19/90	W9 ----- 06/19/90
Arsenic, filtered	5	<2	<2	3
Cadmium, filtered	<0.1	<0.1	<0.1	<0.1
Chromium, filtered	3	14	<1	5
Lead, filtered	<10	<10	<10	<10
Nickel, filtered	<50	<50	<50	<50
Zinc, filtered, mg/L	<0.01	<0.01	0.01	<0.01

	W10 ----- 06/18/90	W11 ----- 06/18/90	W12 ----- 06/18/90	W13 ----- 06/18/90
Arsenic, filtered	<2	<2	<2	<2
Cadmium, filtered	<0.1	0.2	<0.1	<0.1
Chromium, filtered	1	<1	3	3
Lead, filtered	<10	<10	<10	<10
Nickel, filtered	<50	60	<50	<50
Zinc, filtered, mg/L	0.02	<0.01	<0.01	<0.01

TABLE 6

WATER QUALITY MONITORING DATA  
FIELD PARAMETERS

	W7	W8	W9	W10	W11	W12	W13
	-----	-----	-----	-----	-----	-----	-----
	06/19/90	06/19/90	06/19/90	06/18/90	06/18/90	06/18/90	06/18/90
Temperature, oC	10	11	10	17	20	14	16
Specific Conductance, @ 25oC	1400	1400	560	1100	1100	1600	950
pH, standard units	7.1	7.0	7.3	7.1	7.1	6.9	7.3

	CP1				CP2			
	-----	-----	-----	-----	-----	-----	-----	-----
	12/19/89	03/28/90	06/19/90	09/11/90	12/19/89	03/28/90	06/19/90	09/11/90
Temperature, oC	1.0	2.0	14	17	1.0	1.0	14	17
Specific Conductance, @ 25oC	710	450	420	420	68	630	500	510
pH, standard units	8.5	7.7	7.5	7.1	8.0	7.8	7.5	7.1

	CP3				SEEP1			
	-----	-----	-----	-----	-----	-----	-----	-----
	12/19/89	03/28/90	06/19/90	09/11/90	12/19/89	03/28/90	06/19/90	09/11/90
Temperature, oC	1.0	2.0	15	20	5.0	5.0	12	14
Specific Conductance, @ 25oC	85	730	520	510	770	920	1100	850
pH, standard units	7.9	7.7	7.8	7.2	7.9	7.9	7.5	7.0

	WM1			
	-----	-----	-----	-----
	12/19/89	03/28/90	06/19/90	09/11/90
Temperature, oC	1.0	4.0	15	18
Specific Conductance, @ 25oC	850	950	950	550
pH, standard units	7.4	7.4	7.8	7.3

TABLE 7

QUALITY CONTROL DATA  
FIELD BLANK SAMPLES  
FAH COMPOUNDS

(concentrations in ug/L)

FIELD BLANKS				
	12/20/89	03/28/90	06/19/90	09/11/90
Quinoline	<0.0010	<0.0010	<0.0010	<10
Benzo(a)anthracene	<0.0010	<0.0010	<0.0010	<10
Chrysene	<0.0010	<0.0010	<0.0010	<10
Benzo(b)fluoranthene	<0.0010	<0.0010	<0.0010	<10
Benzo(a)pyrene	<0.0010	<0.0010	<0.0010	<10
Indeno(1,2,3,cd)pyrene	<0.0017	<0.0017	<0.0017	<10
Dibenzo(ah)anthracene	<0.0014	<0.0014	<0.0014	<10
Benzo(ghi)perylene	<0.0010	<0.0010	<0.0010	<10
2,3-Benzofuran	<0.0055	DLND	DLND	<10
2,3-Dihydroindene	<0.0048	0.0051	<0.0014	<10
Indene	<0.018	<0.0010	<0.0010	<10
Naphthalene	<0.0036	0.0071	<0.0019	<10
Benzo(b)thiophene	<0.0010	<0.0010	<0.0010	<10
Isoquinoline	DLND	DLND	DLND	<10
Indole	<0.0029	<0.0029	<0.0029	<10
2-Methylnaphthalene	<0.0020	0.0040	<0.0020	<10
1-Methylnaphthalene	<0.0010	0.0019	<0.0010	<10
Biphenyl	<0.0010	<0.0010	<0.0010	<10
Acenaphthylene	<0.0010	<0.0010	<0.0010	<10
Acenaphthene	<0.0013	<0.0013	<0.0013	<10
Dibenzofuran	<0.0020	<0.0020	<0.0020	<10
Fluorene	<0.0014	<0.0014	<0.0014	<10
Dibenzothiophene	DLND	DLND	DLND	<10
Phenanthrene	<0.0010	<0.0010	<0.0010	<10
Anthracene	<0.0010	<0.0010	<0.0010	<10
Acridine	<0.0018	<0.0018	<0.0018	<10
Phenanthridine	<0.0014	<0.0014	<0.0014	<10
Carbazole	<0.0011	<0.0011	<0.0011	<10
Fluoranthene	<0.0010	<0.0010	<0.0010	<10
Pyrene	<0.0010	<0.0010	<0.0010	<10
Triphenylene	<0.0010	<0.0010	<0.0010	<10
Benzo(k)fluoranthene	<0.0010	<0.0010	<0.0010	<10
7,12-Dimethylbenz(a)anthracene	DLND	DLND	DLND	<10
Benzo(e)pyrene	<0.0010	<0.0010	<0.0010	<10
Perylene	<0.0010	<0.0010	<0.0010	<10
3-Methylcholanthrene	DLND	DLND	DLND	<10

-----  
DLND Detection Limit Not Determined.



TABLE 8  
QUALITY CONTROL DATA  
FIELD BLANK SAMPLES  
METALS

	FIELD BLANKS	
	12/19/89	09/11/90
Arsenic, ug/L	<25	<2
Chromium, total, ug/L	<5	<1
Lead, ug/L	<5	<1
Nickel, ug/L	<50	<50
Zinc, mg/L	<0.01	<0.01

.....  
.019

TABLE 9

QUALITY CONTROL DATA  
BLIND DUPLICATE SAMPLES  
PAH COMPOUNDS

(concentrations in ug/L)

	WM1		WM1		CP3		WM1	
	12/20/89 Sample	12/20/89 Duplicate	03/28/90 Sample	03/28/90 Duplicate	06/19/90 Sample	06/19/90 Duplicate	09/11/90 Sample	09/11/90 Duplicate
Quinoline	<0.010	<0.0080	<0.0050	0.040	<0.010	<0.010	<10	<10
Benzo(a)anthracene	<0.010	<0.0080	0.0084	0.010	0.020	0.016	<10	<10
Chrysene	0.012 c	<0.0080	0.019 c	0.023 c	0.021 c	0.018 c	<10	<10
Benzo(b)fluoranthene	<0.010	<0.0080	0.019 c	0.017 c	<0.010	<0.010	<10	<10
Benzo(a)pyrene	<0.010	<0.0080	<0.0050	<0.0050	<0.010	<0.010	<10	<10
Indeno(1,2,3,cd)pyrene	<0.017	<0.014	<0.0085	<0.0085	<0.017	<0.017	<10	<10
Dibenzo(ah)anthracene	<0.014	<0.012	<0.0070	<0.0070	<0.014	<0.014	<10	<10
Benzo(ghi)perylene	<0.010	<0.0080	<0.0050	<0.0050	<0.010	<0.010	<10	<10
Sum List 1	0.012	ND	0.046	0.090	0.041	0.034	ND	ND
2,3-Benzofuran	DLND	DLND	DLND	DLND	DLND	DLND	<10	<10
2,3-Dihydroindene	0.20	0.13	0.15	0.18	<0.014	<0.014	<10	<10
Indene	0.061	0.041	0.094	0.092	<0.010	<0.010	<10	<10
Naphthalene	0.059	0.043	0.044	0.042	<0.019	<0.019	<10	<10
Benzo(b)thiophene	0.034	0.027	0.031	0.030	0.028	0.025	<10	<10
Isoquinoline	DLND	DLND	DLND	0.021	0.030	0.022	<10	<10
Indole	<0.029	<0.023	<0.015	<0.015	<0.029	<0.029	<10	<10
2-Methylnaphthalene	<0.020	<0.016	<0.010	<0.010	<0.020	<0.020	<10	<10
1-Methylnaphthalene	0.065	0.044	0.038	0.053	0.014	0.011	<10	<10
Biphenyl	0.025	0.015	0.014	0.018	<0.010	<0.010	<10	<10
Acenaphthylene	0.047	0.029	0.045	0.049	0.062	0.051	<10	<10
Acenaphthene	1.0	0.65	0.90	1.1	0.13	0.10	<10	<10
Dibenzofuran	0.25	0.16	0.24	0.31	0.12	0.089	<10	<10
Fluorene	0.38	0.21	0.50	0.55	0.13	0.10	<10	<10
Dibenzothiophene	0.022	0.015	0.041	0.050	0.024	0.021	<10	<10
Phenanthrene	0.027	0.015	0.099	0.10	<0.010	<0.010	<10	<10
Anthracene	0.024	0.012	0.018	0.019	0.056	0.048	<10	<10
Acridine	<0.018	<0.014	<0.0090	<0.0090	0.13	0.11	<10	<10
Phenanthridine	<0.014	<0.012	<0.0070	<0.0070	0.029	0.025	<10	<10
Carbazole	0.33	0.15	0.33	0.42	0.037	0.032	<10	<10
Fluoranthene	0.13	0.062	0.15	0.17	0.59	0.56	<10	<10
Pyrene	0.078	0.039	0.066	0.086	0.33	0.32	<10	<10
Triphenylene	0.012 c	<0.0080	0.019 c	0.023 c	0.021 c	0.018 c	<10	<10
Benzo(k)fluoranthene	<0.010	<0.0080	0.019 c	0.017 c	<0.010	<0.010	<10	<10
7,12-Dimethylbenz(a)anthracene	DLND	DLND	DLND	DLND	DLND	DLND	<10	<10
Benzo(e)pyrene	<0.010	<0.0080	<0.0050	<0.0050	<0.010	<0.010	<10	<10
Perylene	<0.010	<0.0080	<0.0050	<0.0050	<0.010	<0.010	<10	<10
3-Methylcholanthrene	DLND	DLND	DLND	DLND	DLND	DLND	<10	<10
Sum List 2	2.8	1.6	2.7	3.3	1.7	1.5	ND	ND

c compounds coelute.

ND Not Detected.

DLND Detection Limit Not Determined.

TABLE 10

QUALITY CONTROL DATA  
BLIND DUPLICATE SAMPLES  
GENERAL PARAMETERS

(concentrations in mg/L)

	WM1		WM1	
	12/19/89 Sample	12/19/89 Duplicate	03/28/90 Sample	03/28/90 Duplicate
Total Organic Carbon	7.6	7.7	6.4	2.0
Ammonia Nitrogen	0.2	0.2	0.2	0.2
Sulfate	360	360	290	280
Cyanide, total	<0.01	<0.01	<0.01	0.01
Thiocyanate	<1.0	<1.0	<1.0	<1.0

	CP3		WM1	
	06/19/90 Sample	06/19/90 Duplicate	09/11/90 Sample	09/11/90 Duplicate
Total Organic Carbon	7.3	7.2	7.8	7.3
Ammonia Nitrogen	0.2	0.2	0.3	<0.1
Sulfate	61	60	110	120
Cyanide, total	0.03	0.02	<0.01	<0.01
Thiocyanate	<1.0	<1.0	<1.0	<1.0

--- Not analyzed.

.017

TABLE 11

QUALITY CONTROL DATA  
BLIND DUPLICATE SAMPLES  
METALS

	WM1		WM1	
	12/19/89 Sample	12/19/89 Duplicate	03/28/90 Sample	03/28/90 Duplicate
Arsenic, ug/L	<25	<25	<10	<10
Cadmium, ug/L	--	--	--	--
Chromium, total, ug/L	<5	<5	<5	<5
Lead, ug/L	<5	<5	<5	<5
Nickel, ug/L	<50	<50	<25	<25
Zinc, mg/L	0.06	0.05	0.16	0.15

	CP3		WM1	
	06/19/90 Sample	06/19/90 Duplicate	09/11/90 Sample	09/11/90 Duplicate
Arsenic, ug/L	<2	<2	<2	<2
Cadmium, ug/L	<10	10	--	--
Chromium, total, ug/L	<100	<100	3	3
Lead, ug/L	<100	<100	5	4
Nickel, ug/L	<50	<50	<50	<50
Zinc, mg/L	<0.10	<0.10	0.08	0.07

-----  
-- Not analyzed.

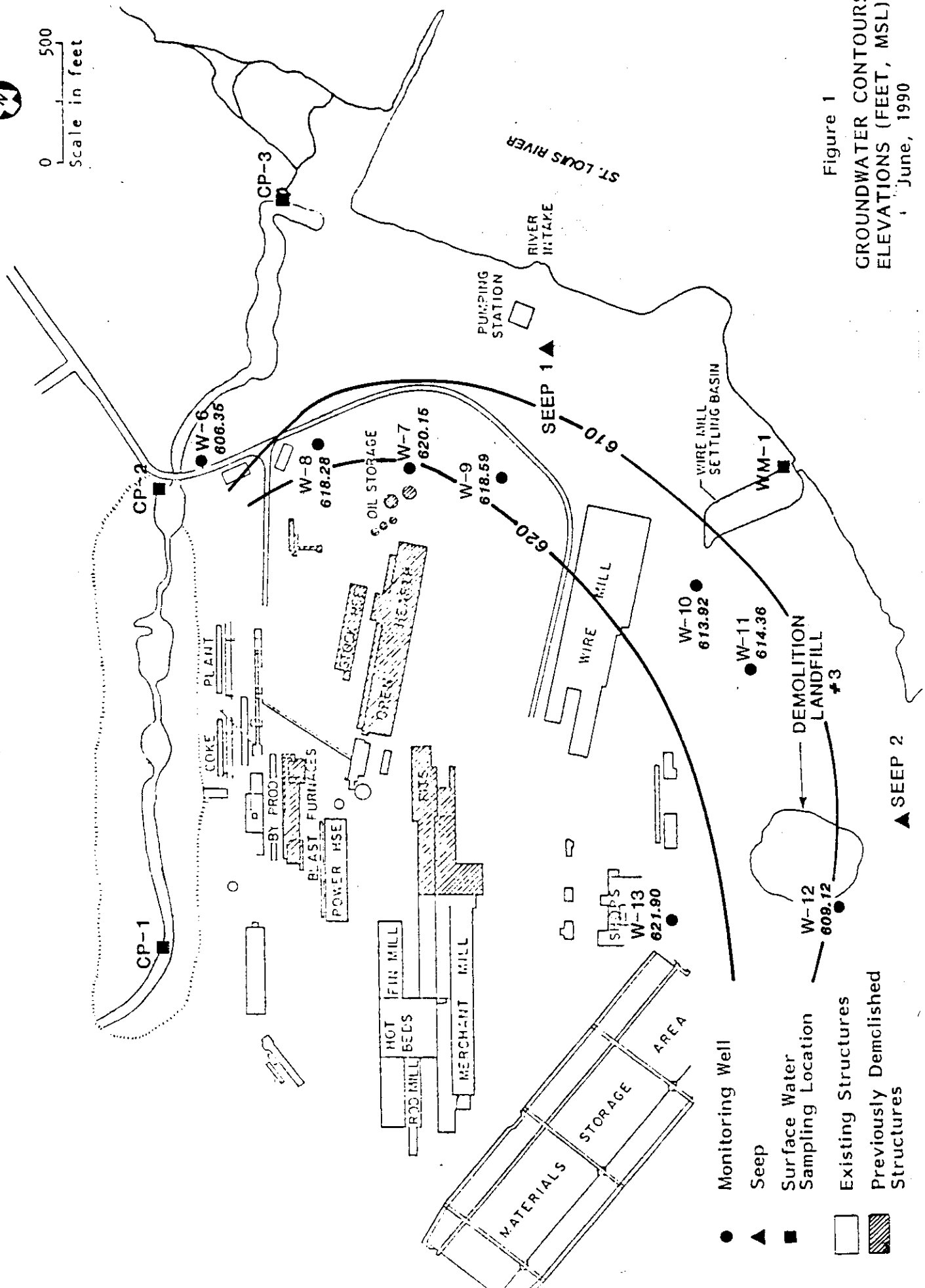
TABLE 12  
QUALITY CONTROL DATA  
BLIND DUPLICATE SAMPLES

<u>Station</u>	<u>Date Collected</u>	<u>Coefficient of Variation</u>
WM-1	12/20/89	0.24
WM-1	03/28/90	0.44
CP-3	06/19/90	0.12
WM-1	09/11/90	0.15

## *Figures*



0 500  
Scale in feet



- Monitoring Well
- ▲ Seep
- Surface Water Sampling Location
- Existing Structures
- ▨ Previously Demolished Structures

Figure 1  
GROUNDWATER CONTOURS  
ELEVATIONS (FEET, MSL)  
June, 1990

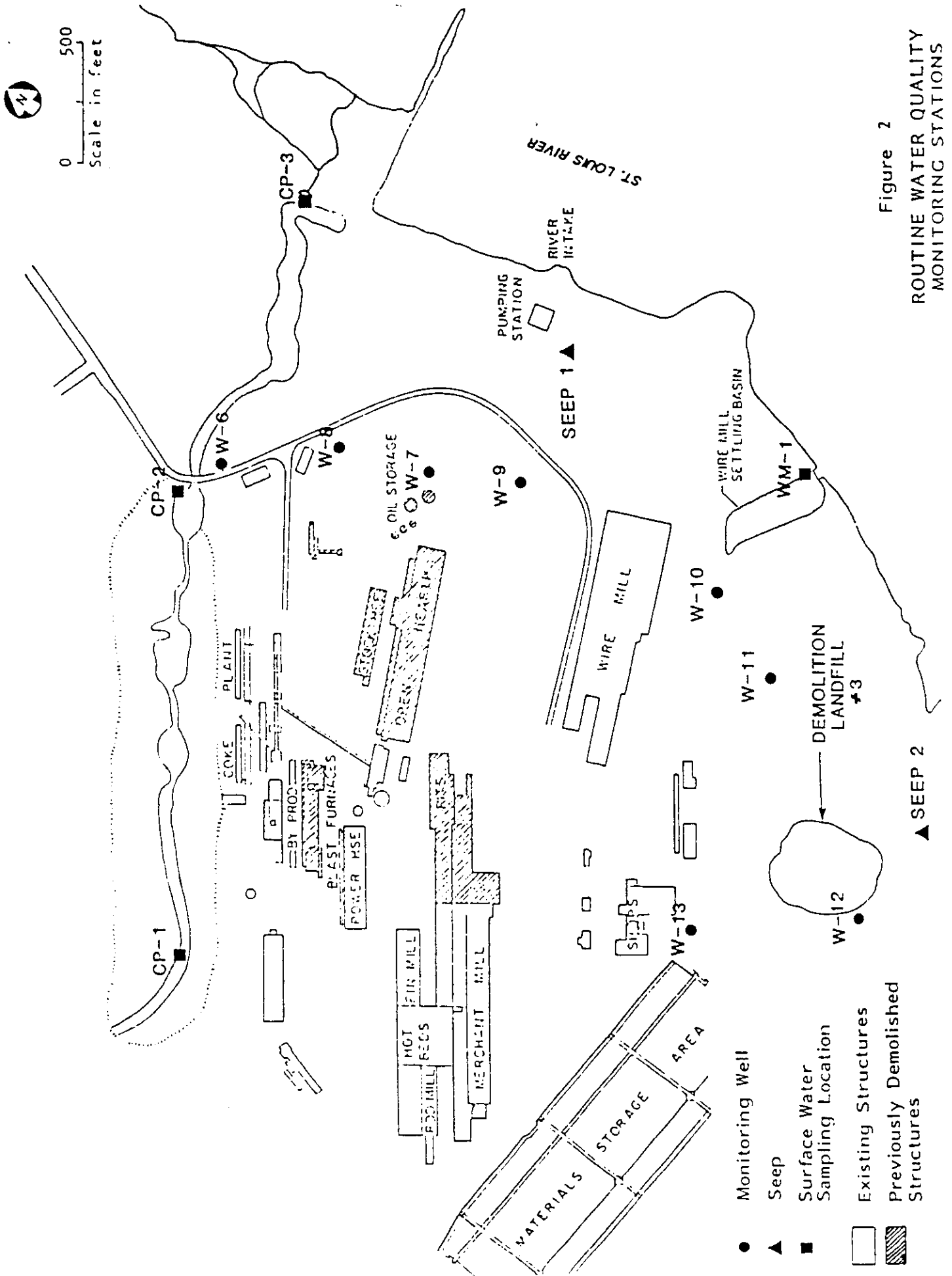
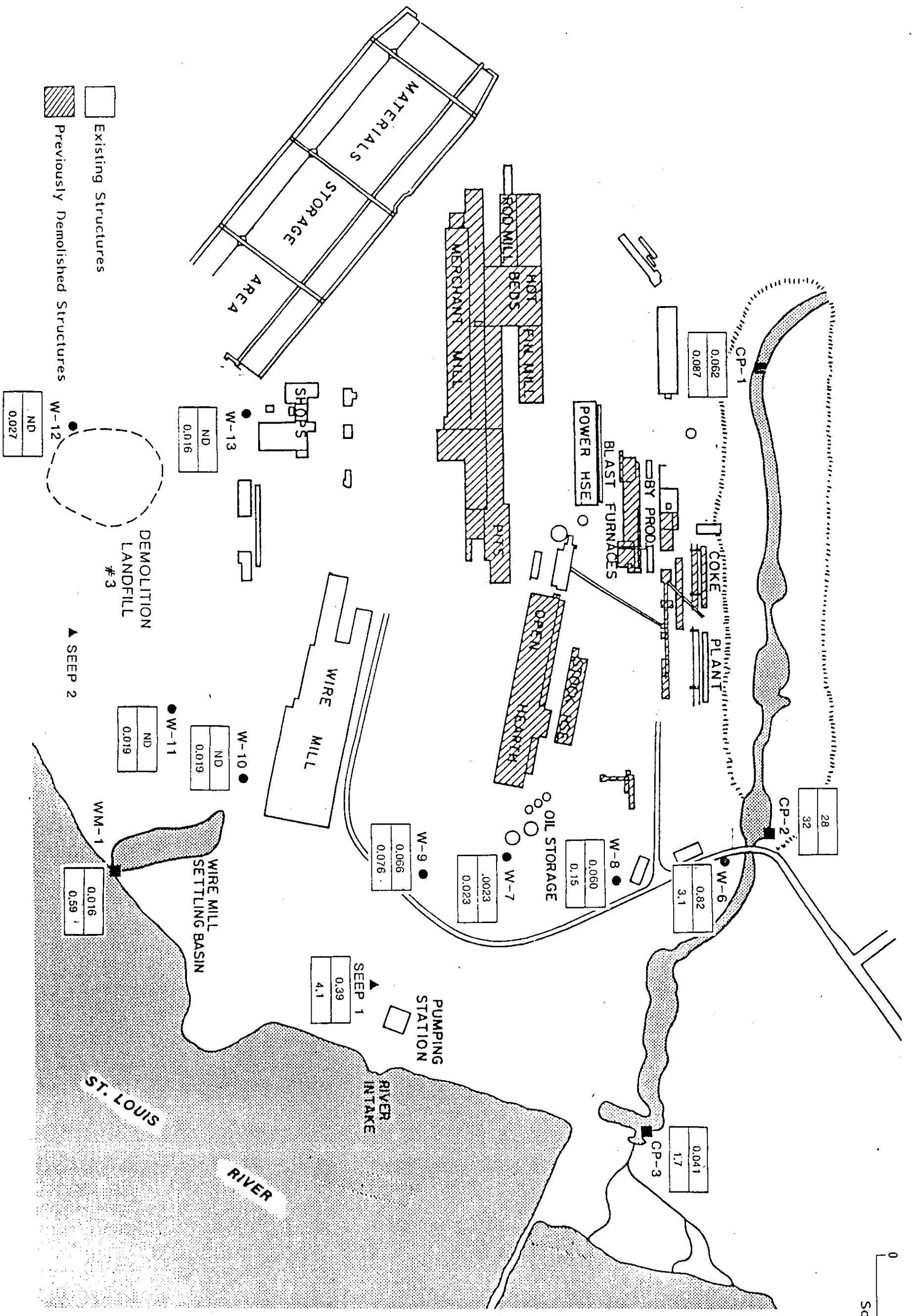
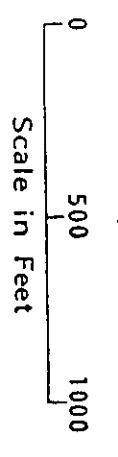


Figure 2  
 ROUTINE WATER QUALITY  
 MONITORING STATIONS



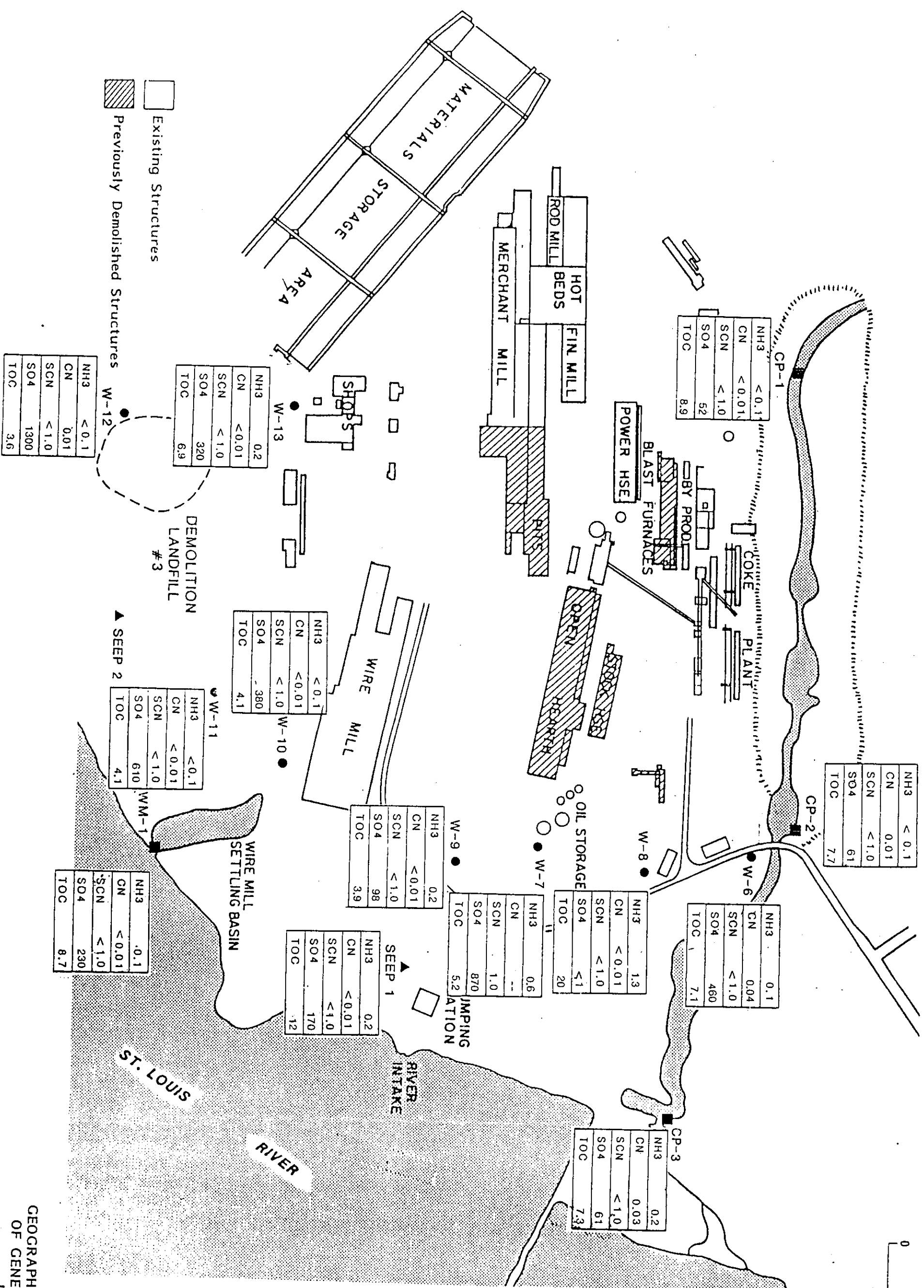


Sum List 1 Compounds (ug/l)  
 Sum List 2 Compounds (ug/l)  
 ND Not Detected

Figure 3  
 GEOGRAPHICAL DISTRIBUTION  
 OF PAH COMPOUNDS  
 June, 1990



Scale in Feet  
0 500 1000



NH3 = Ammonia-Nitrogen  
CN = Total Cyanide  
SCN = Thiocyanate  
SO4 = Sulfate  
TOC = Total Organic Carbon  
Concentration in mg/l

Figure 4  
GEOGRAPHICAL DISTRIBUTION  
OF GENERAL PARAMETERS  
June, 1990

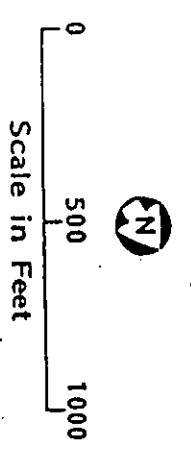
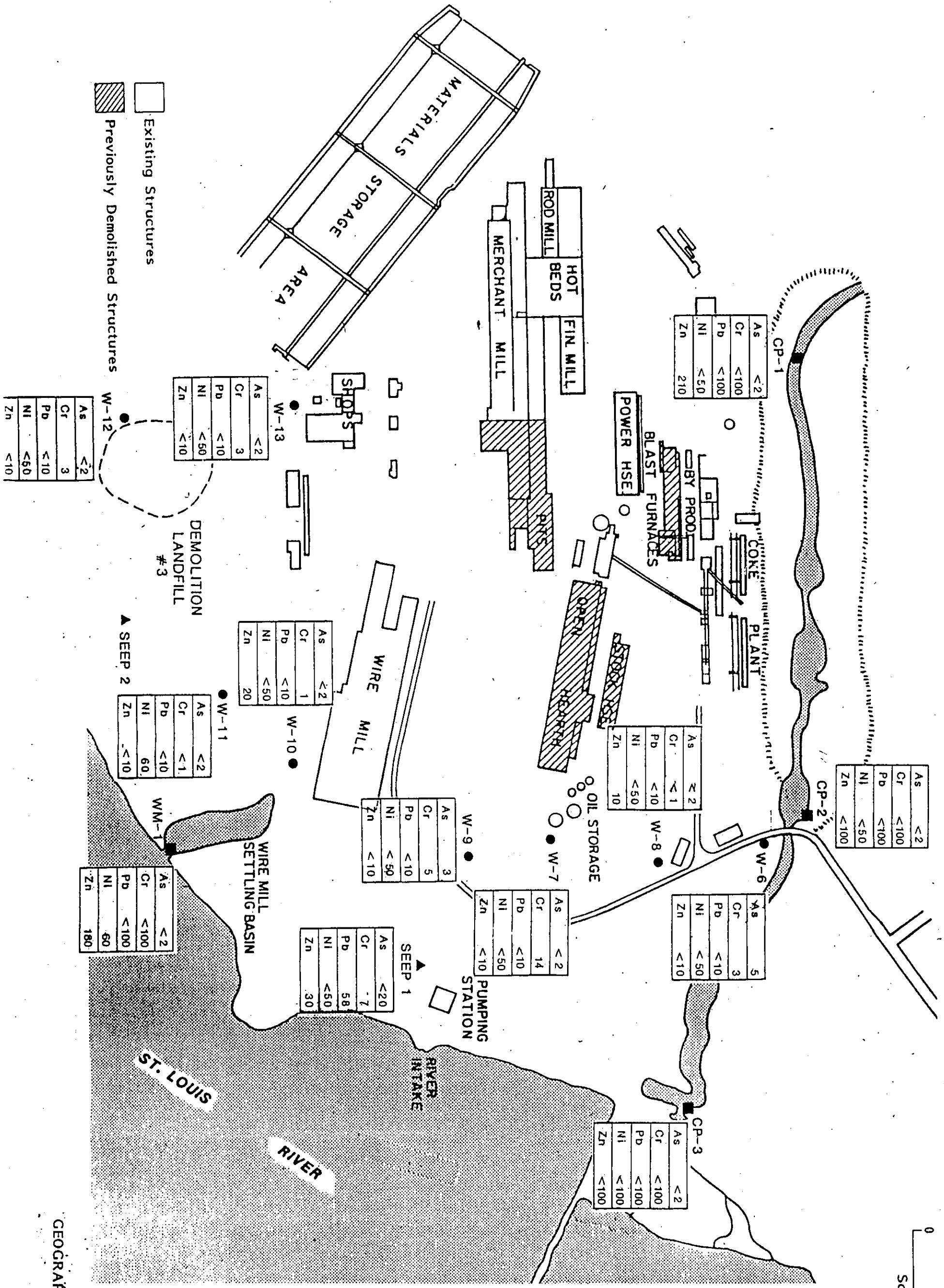


Figure 5  
GEOGRAPHICAL DISTRIBUTION  
OF METALS  
June, 1990