Supplemental Investigations and Remedial Alternatives Assessement

for the

Carborundum-Monofrax Refractories Division Falconer, New York Facility

October 1995

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CONSULTANTS

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October 6, 1995

Mr. Nathan I. Bigman
Contracted Remedial Supervisor
Environmental Properties
BP America Inc.
200 Public Square 7-1
Cleveland, Ohio 44114-2375

RE: CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY FACILITY SUPPLEMENTAL INVESTIGATIONS/REMEDIAL ALTERNATIVES ASSESSMENT REPORT

Dear Mr. Bigman:

URS Consultants, Inc. (URS) is pleased to submit three copies of the Supplemental Investigations/Remedial Alternatives Assessment Report for the Carborundum - Monofrax Refractories Division Facility in Falconer, NY. This report provides BP America (BP) with baseline analytical data relating to existing contaminants in soils in the settlement area and sediments in the recirculating/cooling pond and settlement ditch. Additionally, the contaminant levels are assessed relative to NYSDEC regulatory guidelines and human health risk criteria. Various remedial alternatives and conceptual cost estimates are presented in the event that BP chooses to remediate all or part of these areas at the facility.

We have enjoyed working with you on this project and look forward to providing BP with continuing environmental services. Should you have questions or wish to discuss any aspect of this report please call.

Very Truly Yours,

URS CONSULTANTS INC.

Robert R. Henschel

Robert R. Henschel, P.G.
Project Manager

enc.
cc: G. Hribar

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SUPPLEMENTAL INVESTIGATIONS

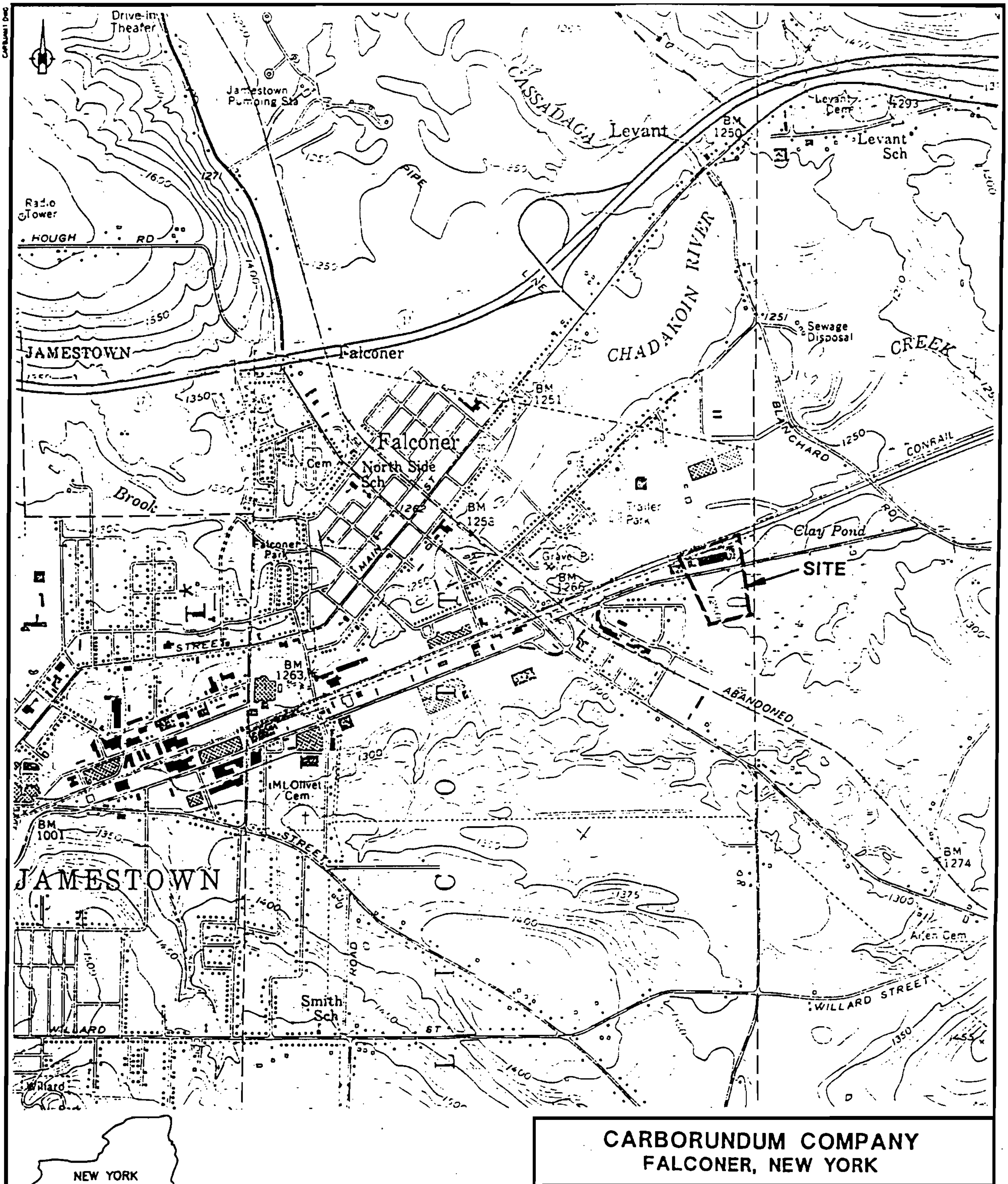
1.0 UNDERSTANDING OF THE SCOPE OF WORK

Based on our discussions of August 1, 1995, it is the understanding of URS Consultants, Inc. (URS) that BP America (BP) is currently negotiating the sale of the Carborundum Company Monofrax Refractories Division Facility (the site) in Falconer, New York (Figure 1-1). As a condition of the sale, BP will retain liability for existing environmental problems at the site as of the date of the sale. Based on previous investigations, potential environmental liabilities associated with the settlement area, settlement ditch and recirculating/cooling pond (R/C) area, which are located south of the main plant (Figure 1-2), were identified. Other potential environmental conditions were also identified at the site, although these are being investigated/remediated by others, and are not part of this scope of work.

The objectives of this project were to conduct a sufficient level of investigation in the settlement area, settlement ditch and R/C pond areas to provide baseline data on current environmental conditions and, to prepare cost estimates for remediation, if necessary. The intent was to provide BP with an estimate of the liability associated with these areas.

To meet these objectives, URS developed a scope of work consisting of several tasks including, but not limited to:

- Site walkover
- Data review
- Development of a work plan
- Supplemental field investigations
- Data evaluation
- Health Risk Assessment
- Identification of remedial alternatives
- Cost estimates for remediation
- Report preparation

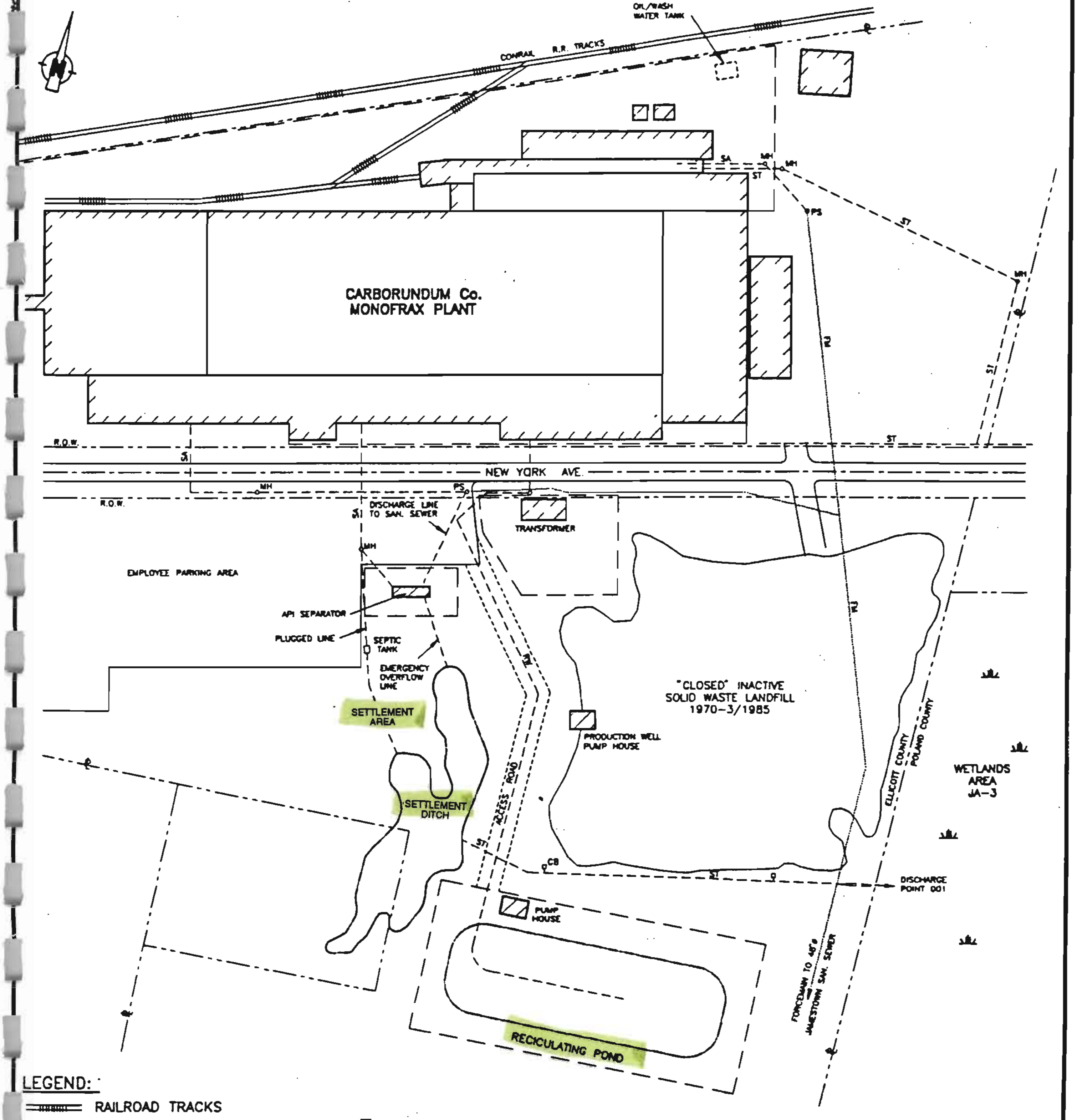


SOURCE:
USGS 7.5 MIN. TOPOGRAPHIC MAPS,
JAMESTOWN, NY (1979) & GERRY, NY (1979)

CARBORUNDUM COMPANY
FALCONER, NEW YORK

FIGURE 1-1

SITE LOCATION MAP



LEGEND:

- RAILROAD TRACKS
- FENCE LINE
- PROPERTY LINE
- ST STORM SEWER LINE
- SA SANITARY SEWER LINE
- FM FORCEMAIN SEWER LINE
- RW RECICULATING WATER LINE

0 50 100 200 FT

GRAPHIC SCALE

CARBORUNDUM COMPANY
FALCONER, NEW YORK

FIGURE 1-2

SITE MAP

As outlined above, URS initially conducted a limited field program to investigate the selected areas at the site and collect samples for analysis. The data from these investigations were subsequently evaluated to assess the degree of contamination present, if any. The detected chemicals were then compared with the New York State Department of Environmental Conservation (NYSDEC) soil and sediment cleanup guidelines to determine if there were any exceedances which might require remediation. Subsequently, URS performed a limited Health Risk Assessment (HRA) for the site to determine the potential human health risk posed by the site. The information from the HRA was utilized to assess whether the site could be left in its current condition with "no further action" required, or whether the site would require remediation.

Based on the results of these assessments, various remedial alternatives were developed which might be implemented if BP America chooses to remediate the site. Cost estimates were also prepared for the various alternatives.

This report presents a summary of the field work performed and the findings of the investigation, discusses the need for remediation, and presents alternatives which might be utilized to remediate the site, as necessary.

2.0 PREVIOUS INVESTIGATIONS

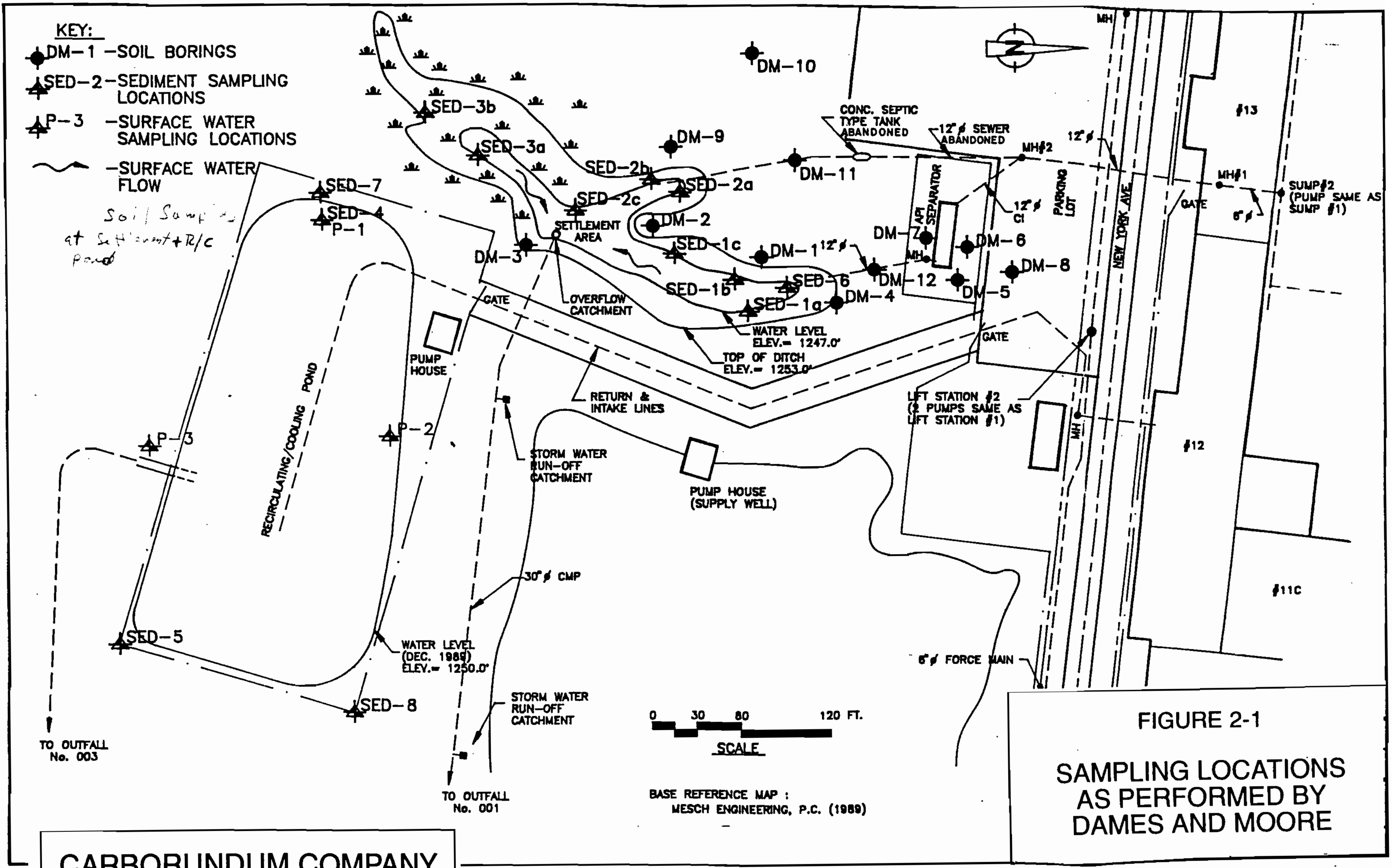
During an inspection of the site conducted by the New York State Department of Environmental Conservation (NYSDEC) Spills Division on September 13, 1989, some oil, sheening, and suspected soil contamination were reported within the confines of the R/C pond embankment. NYSDEC subsequently directed Carborundum to investigate the API separator area, the settlement area and ditch, and the R/C pond area (Figure 1-2) which were suspected sources of the oil. Dow

Dames and Moore conducted a Phase I Investigation in December 1989 and early 1990 which included the advancement of 8 soil borings, and the collection and analysis of 3 surface water, 7 sediment, and 12 soil samples in the settlement and R/C pond areas. The sampling locations are shown on Figure 2-1. All samples were analyzed for TPH. A portion of the samples were additionally analyzed for EPTOX metals and PCBs, and barium, cadmium and chromium. Based on the results of the investigation it was concluded that 1) oil concentration of the pond bank sediment reached levels of 4 percent in two of the samples but were not observed in all sediment samples (six sediment sample locations); 2) oil impacting the sediment at the pond was not identified at depths greater than 18 inches; 3) the settlement area contains industrial waste fill placed over dense clayey-silt tills; 4) oil waste placed on the banks of the settlement ditch and free oil may have contaminated a portion of the fill material in the settlement area; 5) oil had not impacted the clayey-silt till; and, 6) oil-impacted fill in the settlement area extends less than 125 feet west and 60 feet north of the settlement ditch.

Dames and Moore subsequently prepared a work plan for supplemental investigation in the settlement and R/C pond areas dated November 13, 1992 and submitted it to NYSDEC. The plan has not been accepted by NYSDEC.

Pilko & Associates, Inc. (Pilko) conducted a Health, Safety and Environmental Assessment (HSEA) of the site on March 28 and 29, 1994. This HSEA consisted of interviews with site personnel, review of pertinent documents, and visual inspection of the property.

In May 1994, Pilko performed a limited Phase II soil and groundwater assessment at the site. As part of the assessment, soil samples were collected from two soil borings (SB-1 and SB-2) west of the settlement area and five pond sediment sample locations (RC-1 and -2, SP-1, -2, and -3). The



8
7
3
12

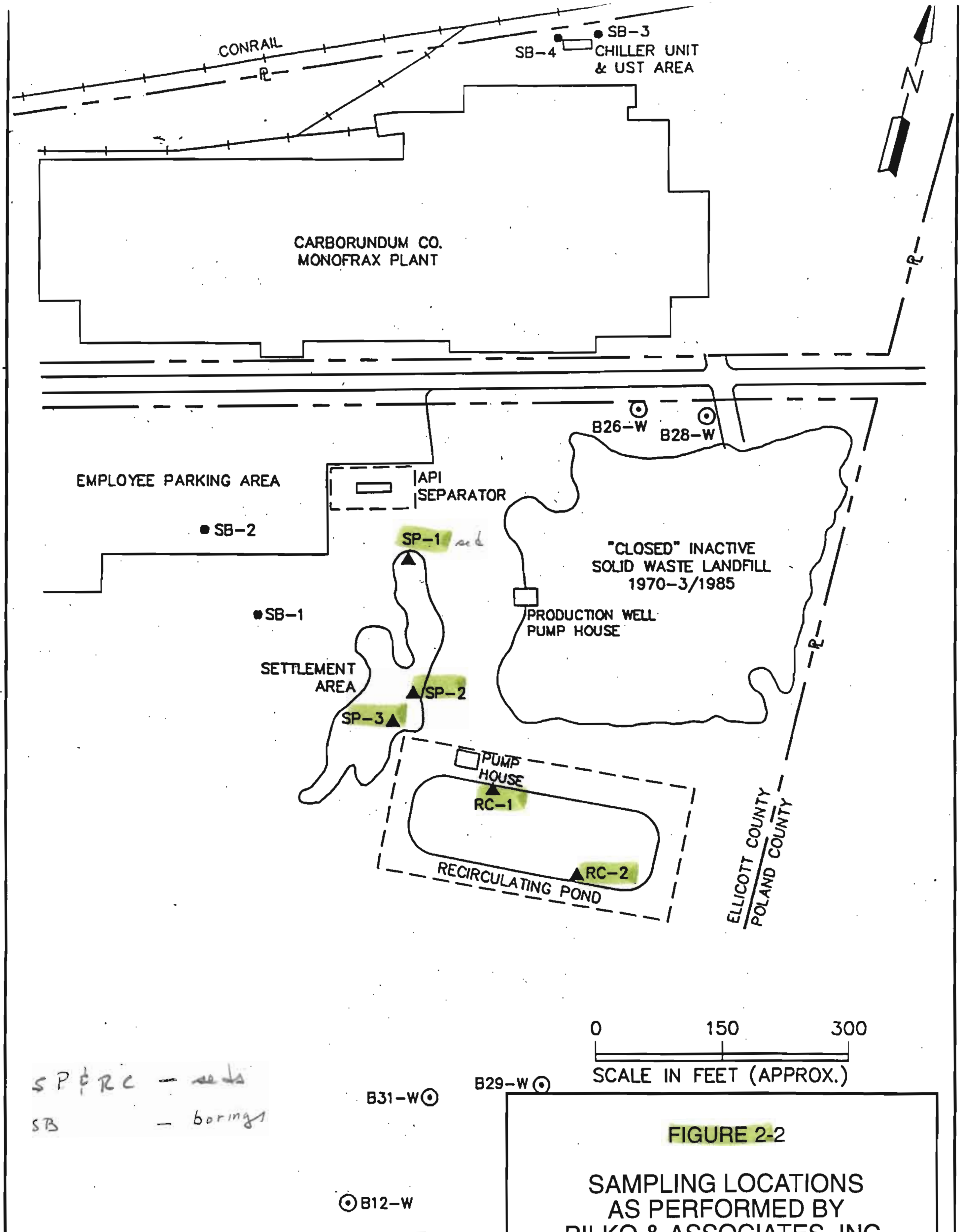
Soil Samples at Settlement + R/C pond

CARBORUNDUM COMPANY
FALCONER, NEW YORK

FIGURE 2-1

SAMPLING LOCATIONS AS PERFORMED BY DAMES AND MOORE approximate locations are shown on Figure 2-2. Groundwater samples were also obtained from five of the existing shallow monitoring wells installed by others as part of a study on the closed landfills. Soil and sediment samples were analyzed by either Toxic Characteristic Leaching Procedure (TCLP), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), RCRA metals, or for benzene, toluene, ethylbenzene, and xylene (BTEX), and total petroleum hydrocarbons as oil and grease. Groundwater samples were analyzed for VOCs and SVOCs. The results of the analyses indicate that oil and grease were present in both the soil and sediment samples at concentrations ranging from 301 to 9,407 mg/kg. TCLP analyses for the soil and sediments indicated no detectable levels of VOCs or SVOCs, and only detected the presence of arsenic at concentrations from non-detect (N.D.) to 0.09 mg/l and barium from N.D. to 2.0 mg/l. These values are well below the RCRA hazardous classification levels. Results of the groundwater analyses indicated no detectable levels of VOCs or SVOCs.

Phase II Results



SP & RC — seds
SB — borings

FIGURE 2-2

SAMPLING LOCATIONS
AS PERFORMED BY
PILKO & ASSOCIATES, INC.

CARBORUNDUM COMPANY
FALCONER, NEW YORK

3.0 IDENTIFIED DATA GAPS

Based on sampling and analysis performed during the above outlined investigations, it was determined that oil contamination is pervasive throughout the sediments in the settlement ditch, the R/C pond sediments, and the industrial fill materials in the settlement area west and north of the settlement ditch. The oils primarily consist of heavy lube oils and cutting oils from various plant operations. It is to be noted, however, that the majority of the analyses were limited to TPH and/or oil and grease. Only a limited number of analyses for TCLP organics and metals were conducted on samples from these areas. Additionally, only one sample was analyzed for EPTOX metals and PCBs.

In light of the previously stated study objectives, the following data gaps were identified:

- In order to establish "baseline" conditions as of the date of sale, it is necessary to know more than just the distribution of TPH and oil and grease at the site. Other contaminants may be present as a result of past practices or unknown incidents at the site.

- There is no documented record of solvent or other VOC usage at the facility with the exception of one 55-gallon drum of Trichloroethane (TCA) which was properly disposed of. The records may not be complete, and solvents historically may have been used at the plant. If historic records are complete and accurate, then no VOC contamination should be present in the soils and sediments. This should be demonstrated as representative of baseline conditions at the site.

- Historically, heavy lube oils contained PCBs to improve their high temperature properties. There is a possibility that the oils used at the facility contained PCBs at some time in the past. Additionally, it was reported that transformers and capacitors at the site previously contained PCB oils which were subsequently disposed of and replaced with non-PCB oils. If PCB oils were properly disposed of, no contamination of the soils or sediments should be present. This should be demonstrated as representative of baseline conditions at the site.

- In general, heavy lube oils contain SVOCs, polynuclear aromatic hydrocarbons (PAHs) in particular, which are generally carcinogenic. To date, no extensive SVOC analyses have been performed at the site. Identifying the presence or absence of PAHs would be important in assessing the potential impact of the site on human health and the environment.

- Most of the samples collected in the R/C pond were apparently from the side slopes, in the vicinity of the water surface. There was no data on the distribution and thickness the sediments, if any, in the bottom areas of the pond. Additionally, these sediments had not been characterized.

- In general, NYSDEC evaluates each site on a case-by-case basis to determine the need for remediation and the cleanup criteria to be used. For soil contamination, the initial evaluation is made by comparing the contaminant levels at the site to guidance values contained in NYSDEC TAGM HWR-94-4046 Determination of Soil Cleanup Objectives and Cleanup Levels (Jan. 1994). In regards to sediments, NYSDEC Division of Fish and Wildlife Technical Guidance for Screening Contaminated Sediments (Nov. 1993) is utilized. Both documents are based on the concentrations of individual organic and inorganic compounds without regard to site-specific uses and conditions. To properly assess the need for and extent of any required remediation, it is necessary to compare analytical data for both organic and inorganic compounds against the guidance values.

- A more appropriate site-specific approach for evaluating the need for remediation at petroleum- contaminated sites is the use of Risk Based Corrective Action (RBCA) assessments. In this process, the potential health risk posed by the site is evaluated based on the type and concentrations of the individual contaminants present, the existing migration pathways, and the potential for exposure. No risk assessment had been performed for the site.

4.0 SCOPE OF WORK

In order to fill the data gaps identified above and assess the need for remediation, URS developed a scope of work consisting of five tasks. These included a site walkover, work plan development, supplemental field investigations, risk-based corrective action assessment, and report preparation. The activities performed during each task are described below.

4.1 Site Walk Over

Prior to initiation of any work on this project, an initial meeting at the site combined with a walkover of the R/C pond and settlement areas was conducted. The intent of this task was to familiarize URS with the site and facility operations, evaluate access for field investigation, and identify any conditions which may impact or limit the project. Additionally, available reports and other relevant materials were obtained.

The objectives of the project were identified and the scope of work discussed with the client.

4.2. Work Plan Development

Under this task, the data and reports obtained in Task 1 were reviewed to determine what work had been completed to date and the findings. Based on this review, data gaps were identified. A supplemental investigation work plan was subsequently developed to obtain the information necessary to address the data gaps. This work plan was submitted to the client for review and comment prior to proceeding with the field work.

4.3 Supplemental Field Investigations

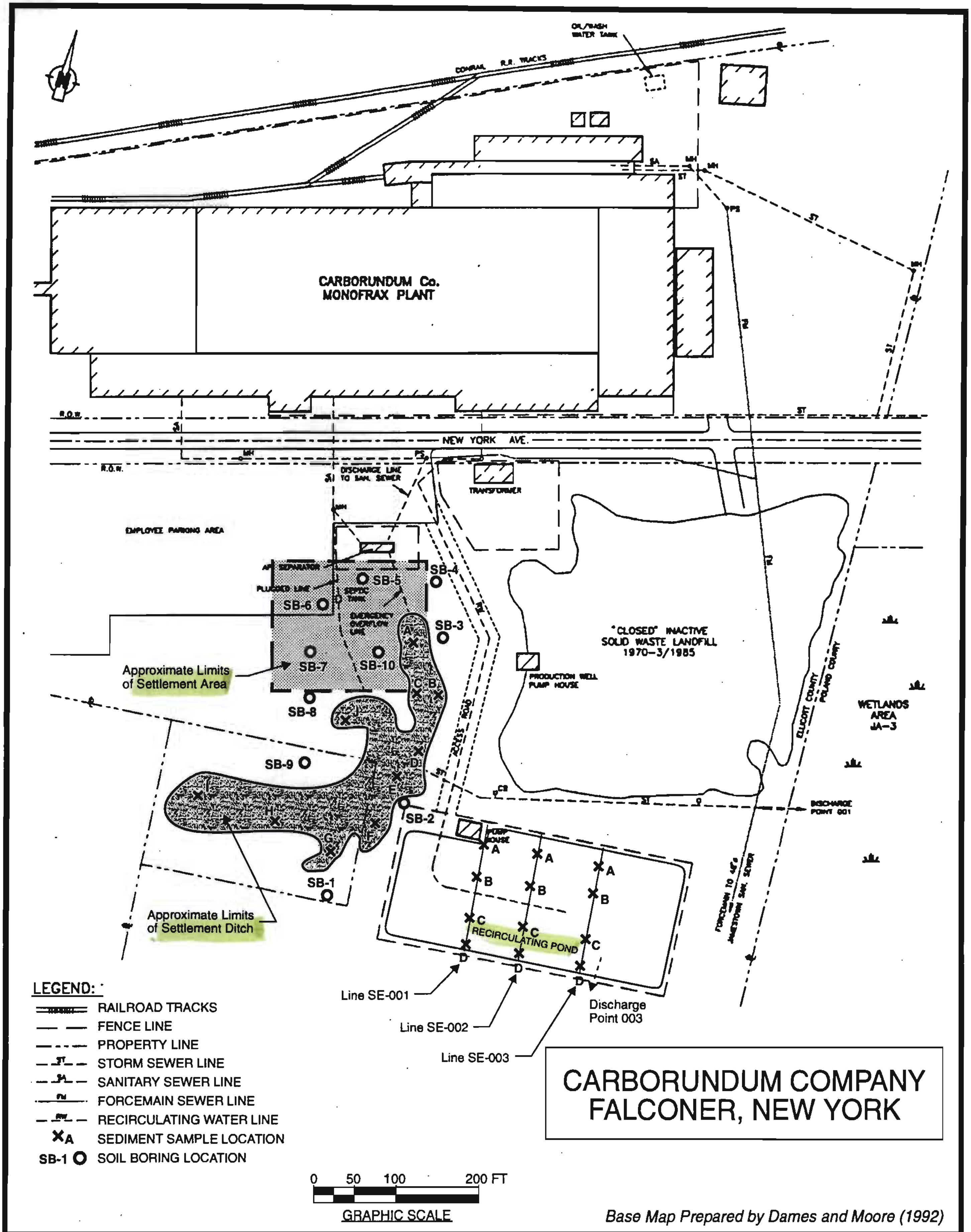
R/C Pond Sampling

Under this task, the relative thickness of sediments and the type and approximate distribution of contaminants present in the sediments was evaluated for the R/C pond area.

To accomplish this, the dimensions of the pond were initially determined, and the pond divided into four roughly equal sections. Three north-south traverse lines (SE-001, -002, and -003) were then completed across the pond at the approximate locations shown on Figure 4-1. A heavy rope was stretched across the pond at each of the traverse locations, and four sampling points marked out along each line. The top of the sediments was estimated by lowering a graduated steel rod from a small boat until it rested on the bottom of the pond at each point along the line. The water surface was utilized as the reference point for all measurements. The thickness of the sediments was then estimated by pushing the steel rod through the sediments until the firmer underlying soils were encountered. The difference between the two measurements was assumed to represent the thickness of the sediments. Although this method does not give an exact determination of the thickness, it provides a reasonably accurate measurement which is suitable for this level of study and the development of potential remedial measures.

Samples of the pond sediments were obtained at four locations (A, B, C, D) along each line (Figure 4-1). A total of 12 samples were collected. The exact locations were adjusted in the field to correspond to areas where a reasonable thickness of sediment was encountered. The samples were collected by pushing a thin-walled, small diameter, split-tube-sampler equipped with clear acatate liners, through the sediments and into the underlying natural soils (where possible). Several attempts were typically required to collect sufficient material at each location. The sediments were composited at each location and placed in the appropriate laboratory sample jars. A portion of each discrete sample was placed in a glass jar to create a composite sample which was subsequently screened with a photo-ionization detector (PID) and flame-ionization device (FID) for VOCs and SVOCs, respectively. The sediment was also screened for TPH and PCBs utilizing immunoassay methods. A summary of the field screening results is presented in Table 4-1.

Additionally, each sample was submitted to the laboratory for analysis of TAL metals and TCL VOCs and SVOCs. Three of the field screened samples were analyzed in the laboratory for confirmatory testing of PCBs and one sample was analyzed for TPH. One sample from each line was also analyzed for total organic carbon (TOC).



CARBORUNDUM COMPANY
FALCONER, NEW YORK

Base Map Prepared by Dames and Moore (1992)

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SUPPLEMENTAL
INVESTIGATIONS LOCATION PLAN

FIGURE 4-1

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TABLE 4-1
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF FIELD IMMUNOASSAY - PCB ANALYSIS
SEDIMENT - R/C POND AND SETTLEMENT DITCH

Sample ID	Optical Density	%Bo	Standards				Estimated PCB Concentration (ppm)
			Negative Control	Calibration 1 1 ppm	Calibration 2 10 ppm	Calibration 3 50 ppm	
R/C POND							
SE-001A	1.44	96.64	1.49	1.38	0.93	0.52	0
SE-001B	0.99	66.44	1.49	1.38	0.93	0.52	1-10
SE-001C	0.82	55.03	1.49	1.38	0.93	0.52	10-50
SE-001D	0.88	59.06	1.49	1.38	0.93	0.52	10-50
SE-002A	1.19	79.87	1.49	1.38	0.93	0.52	1-10
SE-002B	1.28	85.91	1.49	1.38	0.93	0.52	2-20
SE-002C	0.89	59.73	1.49	1.38	0.93	0.52	20-100
SE-002D	0.94	63.09	1.49	1.38	0.93	0.52	1-10
SE-002D	1.00	67.11	1.49	1.38	0.93	0.52	1-10
SE-003A	0.44	23.91	1.84	1.53	1.14	0.6	>50
SE-003B	1.23	66.85	1.84	1.53	1.14	0.6	1-10
SE-003C	1.28	69.57	1.84	1.53	1.14	0.6	1-10
SE-003D	0.92	50.00	1.84	1.53	1.14	0.6	10-50
SETTLEMENT DITCH							
SE-004A	1.61	87.50	1.84	1.53	1.14	0.6	<1
SE-004B	1.44	78.26	1.84	1.53	1.14	0.6	1-10
SE-004C	1.54	83.70	1.84	1.53	1.14	0.6	<1
SE-004D	1.52	82.61	1.84	1.53	1.14	0.6	1-10
SE-004E	1.52	82.61	1.84	1.53	1.14	0.6	1-10
SE-004F	1.76	95.65	1.84	1.53	1.14	0.6	<1
SE-004G	1.36	91.28	1.49	1.30	0.69	0.47	<1
SE-004H	1.34	89.93	1.49	1.30	0.69	0.47	<1
SE-004I	1.12	75.17	1.49	1.30	0.69	0.47	2-20
SE-004J	1.13	75.84	1.49	1.30	0.69	0.47	1-10

%Bo = Optical density/Negative Control multiplied by100.

TABLE 4-1 (cont'd)
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF FIELD IMMUNOASSAY - TPH ANALYSIS
SEDIMENT - R/C POND AND SETTLEMENT DITCH

Sample ID	Optical Density	%Bo	Standards				Estimated TPH Concentration (ppm)
			Negative Control	Calibration 1 5 ppm	Calibration 2 25 ppm	Calibration 3 125 ppm	
R/C POND							
SE-001A	0.80	59.70	1.34	1.07	0.62	0.26	5-25
SE-001B	0.58	43.28	1.34	1.07	0.62	0.26	25-125
SE-001C	0.63	47.01	1.34	1.07	0.62	0.26	5-25
SE-001D	0.63	47.01	1.34	1.07	0.62	0.26	5-25
SE-002A	1.16	86.57	1.34	1.07	0.62	0.26	0
SE-002B	1.07	79.85	1.34	1.07	0.62	0.26	<10
SE-002C	0.47	35.07	1.34	1.07	0.62	0.26	50-250
SE-002D	0.57	42.54	1.34	1.07	0.62	0.26	25-125
SE-002D	0.50	37.31	1.34	1.07	0.62	0.26	25-125
SE-003A	0.57	34.34	1.66	1.49	1.05	0.41	25-125
SE-003B	0.92	55.42	1.66	1.49	1.05	0.41	25-125
SE-003C	0.73	43.98	1.66	1.49	1.05	0.41	25-125
SE-003D	0.55	33.13	1.66	1.49	1.05	0.41	25-125
SETTLEMENT DITCH							
SE-004A	0.57	34.34	1.66	1.49	1.05	0.41	25-125
SE-004B	0.39	23.49	1.66	1.49	1.05	0.41	>125
SE-004C	0.43	25.90	1.66	1.49	1.05	0.41	25-125
SE-004D	0.30	18.07	1.66	1.49	1.05	0.41	>125
SE-004E	0.28	16.87	1.66	1.49	1.05	0.41	>125
SE-004F	0.44	26.51	1.66	1.49	1.05	0.41	50-250
SE-004G	1.18	71.08	1.66	1.49	1.05	0.41	5-25
SE-004H	0.64	38.55	1.66	1.49	1.05	0.41	25-125
SE-004I	0.68	40.96	1.66	1.49	1.05	0.41	50-250
SE-004J	0.46	27.71	1.66	1.49	1.05	0.41	25-125

%Bo = Optical density/Negative Control multiplied by100.

Settlement Ditch Sampling

In order to delineate the extent and thickness of the sediments in the settlement ditch, approximately the same procedures as outlined above for the R/C pond were utilized. However, due to the irregular configuration of the area, the sampling points were selected somewhat randomly in the field based on accessibility. A total of 10 points (SE-004A through J) were sampled to ensure that a good representation of existing conditions was obtained. The approximate locations are shown on Figure 4-1.

Samples of the sediment were also collected by pushing a thin-walled, small diameter, split-tube-sampler equipped with clear acatate liners, through the sediments and into the underlying natural soils (where possible). A summary of the field screening results is presented in Table 4-1.

Additionally, each sample was submitted to the laboratory for analysis of TAL metals and TCL VOCs and SVOCs. One of the field screened samples was analyzed in the laboratory for confirmatory testing of PCBs. Three samples were also analyzed for TOC.

Settlement Area Sampling

As indicated previously, an area extending approximately 125 feet to the west and 60 feet to the north of the settlement ditch was identified as being contaminated with oil. In order to further delineate the extent of the contamination in this area and characterize the contaminated soils, a total of 10 shallow soil borings (SB-1 to -10) were completed around the settlement area at the approximate locations shown on Figure 4-1. These borings were advanced through the industrial fill into the upper portion of the underlying clayey-silt till. In most cases the top of till was encountered at a depth of 6 feet, or less, below ground surface. The maximum depth of the borings was 10 feet.

Soil samples were collected continuously with a split-spoon sampler in accordance with ASTM D-1586 procedures. These samples were visually examined for signs of contamination and field screened with a PID and FID for VOCs and SVOCs, respectively. Additionally, the samples were screened for TPH and PCBs utilizing immunoassay methods. A summary of the field screening results is presented in Table 4-2; and the boring logs are contained in Appendix A.

TABLE 4-2
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF FIELD IMMUNOASSAY - PCB ANALYSIS
SOILS - SETTLEMENT AREA

Sample ID	Interval (ft. bgs)	Optical Density	%Bo	Standards				Estimated PCB Concentration (ppm)
				Negative Control	Calibration 1 1 ppm	Calibration 2 10 ppm	Calibration 3 50 ppm	
SB-01	0-6	1.71	92.93	1.84	1.53	1.14	0.6	<1
SB-02	0-2	1.81	98.37	1.84	1.53	1.14	0.6	<1
	2-4	1.83	99.46	1.84	1.53	1.14	0.6	<1
	4-6	1.84	100.00	1.84	1.53	1.14	0.6	<1
SB-03	0-2	1.81	98.37	1.84	1.53	1.14	0.6	<1
	2-4	1.83	99.46	1.84	1.53	1.14	0.6	<1
	4-6	1.72	93.48	1.84	1.53	1.14	0.6	<1
	6-8	1.75	95.11	1.84	1.53	1.14	0.6	<1
SB-04	0-2	1.37	74.46	1.84	1.53	1.14	0.6	1-10
	2-4	1.51	82.07	1.84	1.53	1.14	0.6	1-10
	4-6	1.74	94.57	1.84	1.53	1.14	0.6	<1
	6-8	–	0.00	1.84	1.53	1.14	0.6	--
SB-05	0-2	1.69	91.85	1.84	1.53	1.14	0.6	<1
	2-4	1.79	97.28	1.84	1.53	1.14	0.6	<1
	4-6	1.77	96.20	1.84	1.53	1.14	0.6	<1
	6-8	--	0.00	1.84	1.53	1.14	0.6	–
SB-06	0-2	1.65	89.67	1.84	1.53	1.14	0.6	<1
	2-4	1.89	102.72	1.84	1.53	1.14	0.6	<1
	4-6	1.76	95.65	1.84	1.53	1.14	0.6	<1
SB-07	0-2	1.64	89.13	1.84	1.53	1.14	0.6	<1
	2-4	1.50	81.52	1.84	1.53	1.14	0.6	1-10
	4-6	1.89	102.72	1.84	1.53	1.14	0.6	<1
SB-08	0-2	1.87	101.63	1.84	1.53	1.14	0.6	<1
	2-4	1.87	101.63	1.84	1.53	1.14	0.6	<1
	4-6	1.86	101.09	1.84	1.53	1.14	0.6	<1
	6-8	1.66	90.22	1.84	1.53	1.14	0.6	<1
SB-09	0-2	1.80	97.83	1.84	1.53	1.14	0.6	<1
	2-4	1.60	86.96	1.84	1.53	1.14	0.6	<1
	4-6	1.79	97.28	1.84	1.53	1.14	0.6	<1
SB-10	0-2	1.59	86.41	1.84	1.53	1.14	0.6	<1
	2-4	1.81	98.37	1.84	1.53	1.14	0.6	<1
	4-6	1.72	93.48	1.84	1.53	1.14	0.6	<1

%Bo = Optical density/Negative Control multiplied by100.

TABLE 4-2 (cont'd)
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF FIELD IMMUNOASSAY - TPH ANALYSIS
SOILS - SETTLEMENT AREA

Sample ID	Interval (ft. bgs)	Optical Density	%Bo	Standards				Estimated TPH Concentration (ppm)
				Negative Control	Calibration 1 5 ppm	Calibration 2 25 ppm	Calibration 3 125 ppm	
SB-01	0-6	0.43	25.90	1.66	1.49	1.05	0.41	25-125
SB-02	0-2	1.35	81.33	1.66	1.49	1.05	0.41	5-25
	2-4	1.39	83.73	1.66	1.49	1.05	0.41	5-25
	4-6	1.09	65.66	1.66	1.49	1.05	0.41	5-25
SB-03	0-2	1.54	92.77	1.66	1.49	1.05	0.41	<5
	2-4	1.56	93.98	1.66	1.49	1.05	0.41	<5
	4-6	0.93	56.02	1.66	1.49	1.05	0.41	25-125
	6-8	1.45	87.35	1.66	1.49	1.05	0.41	5-25
SB-04	0-2	1.42	85.54	1.66	1.49	1.05	0.41	5-25
	2-4	1.11	66.87	1.66	1.49	1.05	0.41	5-25
	4-6	1.11	66.87	1.66	1.49	1.05	0.41	5-25
	6-8	--	0.00	1.66	1.49	1.05	0.41	--
SB-05	0-2	0.74	44.58	1.66	1.49	1.05	0.41	25-125
	2-4	0.96	57.83	1.66	1.49	1.05	0.41	25-125
	4-6	0.89	53.61	1.66	1.49	1.05	0.41	25-125
	6-8	--	0.00	1.66	1.49	1.05	0.41	--
SB-06	0-2	1.08	65.06	1.66	1.49	1.05	0.41	5-25
	2-4	1.33	80.12	1.66	1.49	1.05	0.41	5-25
	4-6	1.15	69.28	1.66	1.49	1.05	0.41	5-25
SB-07	0-2	0.75	45.18	1.66	1.49	1.05	0.41	25-125
	2-4	0.91	54.82	1.66	1.49	1.05	0.41	25-125
	4-6	1.11	66.87	1.66	1.49	1.05	0.41	5-25
SB-08	0-2	1.22	73.49	1.66	1.49	1.05	0.41	5-25
	2-4	0.64	38.55	1.66	1.49	1.05	0.41	25-125
	4-6	0.95	57.23	1.66	1.49	1.05	0.41	25-125
	6-8	0.51	30.72	1.66	1.49	1.05	0.41	25-125
SB-09	0-2	1.09	65.66	1.66	1.49	1.05	0.41	5-25
	2-4	1.06	63.86	1.66	1.49	1.05	0.41	5-25
	4-6	0.74	44.58	1.66	1.49	1.05	0.41	25-125
SB-10	0-2	1.21	72.89	1.66	1.49	1.05	0.41	5-25
	2-4	1.35	81.33	1.66	1.49	1.05	0.41	5-25
	4-6	0.89	53.61	1.66	1.49	1.05	0.41	25-125

%Bo = Optical density/Negative Control multiplied by100.

One of the field screened samples was submitted to the laboratory for confirmatory testing of PCBs and one composite sample from each hole was analyzed for TAL metals. Additionally, the sample which exhibited the highest TPH values in each boring was analyzed for TCL VOCs and SVOCs.

5.0 RESULTS OF INVESTIGATIONS

5.1 R/C Pond

NOT TRUE FOR R/C POND

Yes Table 4-1

As indicated in Table 4-1, the field screening indicated low levels of TPH and PCBs in the sediments throughout the R/C Pond. Measurements of sediment thickness indicate that the side slopes of the pond are relatively devoid of sediments (<0.1 feet), whereas on the bottom of the pond the sediments typically vary from 0.1 to 2.0 feet in thickness, with an average of about 1 feet.

The laboratory analyses detected a limited number of VOCs consisting primarily of acetone, 2-butanone and chlorobenzene. No SVOCs were detected above the PQL, with the exception of di-n-octyl-phthalate. PCBs were detected at low levels in all three samples analyzed, and metals were prevalent in all of the samples. TOC levels ranged from 2.45 to 2.15 percent by dry weight. A summary of the parameters detected and the concentrations is presented in Table 5-1A.

5.2 Settlement Ditch

Field screening of the sediments from this area, as summarized in Table 4-1 indicate low levels of TPH in all of the samples. PCBs were generally below 1.0 ppm. Sampling and measurements indicated that sediment was present throughout the area and ranged from 1.80 to 3.35 feet in thickness, with an average of about 2.5 feet. A summary of the parameters detected and the concentrations is presented in Table 4-1.

The laboratory analyses detected a limited number of VOCs including acetone, 2-butanone, ethylbenzene, toluene, and xylene. Numerous SVOCs were also detected. These consisted primarily of PAHs (carcinogenic and non-carcinogenic) and phthalates. PCBs were not detected in the one sample analyzed. Metals were prevalent in all the samples tested. TOC levels ranged from 3.69 to 13.8 percent by dry weight. A summary of the parameters detected and the concentrations is presented in Table 5-1B.

TABLE 5-1A
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SEDIMENTS - R/C POND

SAMPLE ID DATE SAMPLED PARAMETER DSM	CLASS	UNITS PPB	NYSDEC Sediment Criteria (1)	Background Sediment Levels (3)	SE-001A 08/29/95 Comp.	SE-001B 08/29/95 Comp.	SE-001C 08/29/95 Comp.	SE-001D 08/29/95 Comp.	SE-002A 08/29/95 Comp.	SE-002B 08/29/95 Comp.	SE-002C 08/29/95 Comp.	SE-002D 08/29/95 Comp.	SE-003A 08/30/95 Comp.	SE-003B 08/30/95 Comp.	SE-003C 08/30/95 Comp.	SE-003D 08/30/95 Comp.
ACETONE -	VOC	UG/KG		23	57	330	740	79	39	370	750	110	91	530	1500	85
2-BUTANONE (MEK) -	VOC	UG/KG		23		79				72	340	22		150	170	
CHLOROBENZENE	VOC	UG/KG	3500	3500		24					24		4600	610	61	16
ETHYLBENZENE	VOC	UG/KG		12,900,000												
METHYLENE CHLORIDE	VOC	UG/KG		2000	6.6											
TOLUENE	VOC	UG/KG		2,450,000												
1,1,1-TRICHLOROETHANE	VOC	UG/KG		1,520,000												
O-XYLENE	VOC	UG/KG		100												
M+P-XYLENE	VOC	UG/KG		100												
ANTHRACENE	SVOC	UG/KG		960												
BENZO (A) ANTHRACENE	SVOC	UG/KG		1300												
BENZO (A) PYRENE	SVOC	UG/KG		1600												
BENZO (B) FLUORANTHENE	SVOC	UG/KG		3200												
BENZO (G,H,I) PERYLENE	SVOC	UG/KG		670												
BENZO (K) FLUORANTHENE	SVOC	UG/KG		3200												
BUTYL BENZYL PHTHALATE	SVOC	UG/KG		—												
DI-N-BUTYLPHTHALATE	SVOC	UG/KG		200,000												
CARBAZOLE	SVOC	UG/KG		30												
IDENO (1,2,3-CD) PYRENE	SVOC	UG/KG		600												
CHRYSENE	SVOC	UG/KG		1400												
DIMETHYL PHTHALATE	SVOC	UG/KG		—												
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	UG/KG	200,000	200,000												
FLUORANTHENE	SVOC	UG/KG	1,020,000	1,020,000												
DI-N-OCTYL PHTHALATE -	SVOC	UG/KG		—		12000	12000	4000	670	2200	13000	5700	13000	6000	55000	29000
PHENANTHRENE [illegible]	SVOC	UG/KG		120,000												
PYRENE 1000	SVOC	UG/KG	2600	2600												
PCB 1242 10000	PEST	UG/KG						3200			3100	2700				

Notes: 1) NYSDEC Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment", Nov. 1993.

2) URS Consultants, Inc., "Provisional Sediment Screening Criteria", September 1995.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94-4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background

Shaded Areas - Denote exceedance of NYSDEC and/or Provisional Sediment Screening Criteria.

TABLE 5-1A
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SEDIMENTS - R/C POND

SAMPLE ID			NYSDEC Sediment Criteria	Background Sediment Levels	SE-001A	SE-001B	SE-001C	SE-001D	SE-002A	SE-002B	SE-002C	SE-002D	SE-003A	SE-003B	SE-003C	SE-003D
DATE SAMPLED					08/29/95	08/29/95	08/29/95	08/29/95	08/29/95	08/29/95	08/29/95	08/29/95	08/30/95	08/30/95	08/30/95	08/30/95
PARAMETER DSN	CLASS	UNITS ppm	(1)	(3)	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.	Comp.
ALUMINIUM	METAL	UG/G	—	72,000	8230	10300	12400	6660	8830	9470	19000	6260	7320	13500	16200	7040
ANTIMONY	METAL	UG/G	2	—												
ARSENIC	METAL	UG/G	6	—	3.09	4.83	4.08	4.39	4.24	7.66	6.56	2.46	2.53	7.99	4.53	5.42
BARIUM	METAL	UG/G	0.3/SB	690	94.4	137	181	91.2	142	221	178	75.2	85.6	113	215	108
BERYLLIUM	METAL	UG/G	—	5										0.828		
CADMIUM	METAL	UG/G	0.6	—												
CALCIUM	METAL	UG/G	—	—	4310	42100	49600	21700	17600	38000	49500	17800	36800	35900	45400	38200
CHROMIUM	METAL	UG/G	—	130	10.9	34.8	46.9	14.1	14.4	23.4	60.8	12.0	34.8	39.7	66.9	29.8
COBALT	METAL	UG/G	—	22	10.2	37.4	57.8	14.0	9.57	23.9	71.7	10.7	36.9	23.1	80.3	18.3
COPPER	METAL	UG/G	—	57	23.9	201	298	81.1	62.5	82.5	192	27.2	89.3	55.3	270	109
IRON	METAL	UG/G	2%	—	12000	19100	21000	13700	12600	13400	46800	12900	11700	26600	26200	13800
LEAD	METAL	UG/G	31	—	9.61	14.6	16.5	10.1	9.15	10.8	18.7	7.18	8.26	13.0	18.9	10.0
MAGNESIUM	METAL	UG/G	—	760	1970	4960	4830	2490	2970	3160	9560	3740	4400	8770	5750	3880
MANGANESE	METAL	UG/G	—	—	262	548	682	396	258	558	1240	364	496	579	868	552
MERCURY	METAL	UG/G	0.15	—												
NICKEL	METAL	UG/G	—	95	13.7	25.3	25.4	12.5	17.3	20.5	38.4	13.6	14.1	35.9	30.0	14.3
POTASSIUM	METAL	UG/G	—	—	592	1390	1800	743	873	1000	2870	756	864	2050	2300	888
SELENIUM	METAL	UG/G	1	0.6												
SILVER	METAL	UG/G	1	—												
SODIUM	METAL	UG/G	—	—	66.5	171	278	94.7	92.8		357	93.0	201	189	372	139
THALLIUM	METAL	UG/G	—	—												
VANADIUM	METAL	UG/G	—	130	11.9	15.7	18.2	11.5	14.7	17.6	28.3	10.7	10.3	21.2	23.5	10.2
ZINC	METAL	UG/G	120		89.3	451	520	139	75.6	160	306	85.7	128	151	484	348
PERCENT SOLIDS	MISC	%	—	—	76.9	47.5	32.5	71	60.4	34.2	35.1	73.5	65.1	61.1	35.7	60.0
TOC	MISC	%	—	—			18.1			21.5				2.45		

Notes: 1) NYSDEC Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment", Nov. 1993.

2) URS Consultants, Inc., "Provisional Sediment Screening Criteria", September 1995.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94-4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background

Shaded Areas - Denote exceedance of NYSDEC and/or Background Sediment Levels.

TABLE 5-1B
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SEDIMENTS - SETTLEMENT DITCH

SAMPLE ID DATE SAMPLED PARAMETER DSM	CLASS	UNITS ppb	NYSDEC Sediment Criteria (1)	Background Sediment Levels (3)	SE-004A 08/30/95 Comp.	SE-004B 08/30/95 Comp.	SE-004C 08/30/95 Comp.	SE-004D 08/30/95 Comp.	SE-004E 08/30/95 Comp.	SE-004F 08/30/95 Comp.	SE-004G 08/31/95 Comp.	SE-004H 08/31/95 Comp.	SE-004I 08/31/95 Comp.	SE-004J 08/31/95 Comp.
ACETONE	VOC	UG/KG		23	75	390	590	910	1200	840	1600	800	32	91
2-BUTANONE (MEK)	VOC	UG/KG		23		91	120		170	160	330	51		
CHLOROBENZENE	VOC	UG/KG	3500	3500										
ETHYLBENZENE 100	VOC	UG/KG		12,900,000	8.5									13
METHYLENE CHLORIDE	VOC	UG/KG		2000										
TOLUENE 100	VOC	UG/KG		2,450,000	33	45	90		100			14		46
1,1,1-TRICHLOROETHANE	VOC	UG/KG		1,520,000										
O-XYLENE 100	VOC	UG/KG		100	10									16
M+P-XYLENE 100	VOC	UG/KG		100	26	47	43		92					42
ANTHRACENE	SVOC	UG/KG		960										
BENZO (A) ANTHRACENE .04	SVOC	UG/KG		1300		670								1800
BENZO (A) PYRENE .04	SVOC	UG/KG		1600		810	610	590					1100	1100
BENZO (B) FLUORANTHENE .04	SVOC	UG/KG		3200	870		1500							2500
BENZO (G,H,I) PERYLENE .04	SVOC	UG/KG		670		590								820
BENZO (K) FLUORANTHENE .04	SVOC	UG/KG		3200	1200	2500	1800	2000		1700				3100
BUTYL BENZYL PHTHALATE	SVOC	UG/KG		—										
DI-N-BUTYLPHTHALATE	SVOC	UG/KG		200,000	260		550	350		540	3100	1800	1400	980
CARBAZOLE	SVOC	UG/KG		30										
IDENO (1,2,3-CD) PYRENE	SVOC	UG/KG		600										790
CHRYSENE .04	SVOC	UG/KG		1400		1300		1000						1800
DIMETHYL PHTHALATE	SVOC	UG/KG		—					5300					
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	UG/KG	200,000	200,000	960	1400	2000	1700		1100			490	1700
FLUORANTHENE 1000	SVOC	UG/KG	1,020,000	1,020,000	1200	2300	1900	1800		860	800		310	3400
DI-N-OCTYL PHTHALATE	SVOC	UG/KG		—										
PHENANTHRENE 1000	SVOC	UG/KG		120,000	910	1500	1300	1300					360	2000
PYRENE 1000	SVOC	UG/KG	2600	2600	1100	3200	1800	2000		910	770			2800
PCB 1242 50000	PEST	UG/KG								ND				
				PPM	>2.3	>12.9	>8.9	>8.7		>1.7			>1.1	>19.3

Notes: 1) NYSDEC Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment", Nov. 1993.

2) URS Consultants, Inc. "Provisional Sediment Screening Criteria", September 1995.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94-4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background

Shaded Areas - Denote exceedance of NYSDEC and/or Provisional Sediment Sediment Screening Criteria.

TABLE 5-1B
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SEDIMENTS - SETTLEMENT DITCH

SAMPLE ID DATE SAMPLED PARAMETER	CLASS	UNITS ppm	NYSDEC Sediment Criteria (1)	Background Sediment Levels (3)	SE-004A 08/30/95 Comp.	SE-004B 08/30/95 Comp.	SE-004C 08/30/95 Comp.	SE-004D 08/30/95 Comp.	SE-004E 08/30/95 Comp.	SE-004F 08/30/95 Comp.	SE-004G 08/31/95 Comp.	SE-004H 08/31/95 Comp.	SE-004I 08/31/95 Comp.	SE-004J 08/31/95 Comp.
ALUMINIUM	METAL	UG/G	—	72,000	17500	21900	14900	18200	13200	11700	10100	4350	15500	14200
ANTIMONY	METAL	UG/G	2	—		9.09			9.26					
ARSENIC	METAL	UG/G	6	—		1.12	0.972	1.22	1.13	17.1	10.4	2.27	5.00	1.82
BARIUM	METAL	UG/G	0.3/SB	690	34.9	50.9	45.6	67.0	57.6	222	238	63.4	231	87.5
BERYLLIUM	METAL	UG/G	—	5									0.839	
CADMIUM	METAL	UG/G	0.6	—	0.920	1.05	1.04	1.16	1.54					0.937
CALCIUM	METAL	UG/G	—	—	3130	4060	4160	6000	5410	13400	11500	2960	3580	3590
CHROMIUM	METAL	UG/G	—	130	912	1290	821	1260	1360	19.8	41.0	8.64	215	814
COBALT	METAL	UG/G	—	22	657	419	461	254	440		25.9		17.0	203
COPPER	METAL	UG/G	—	57	276	271	291	335	379	36.1	28.9	8.28	50.9	237
IRON	METAL	UG/G	2%	—	5760	6480	5570	7280	6560	25200	22800	5490	20900	6240
LEAD	METAL	UG/G	31	—	4.20	8.04	6.65	10.7	8.33	33.4	31.1	7.65	17.3	11.0
MAGNESIUM	METAL	UG/G	—	760	1140	1110	852	1140	953	3200	2820	810	3800	1070
MANGANESE	METAL	UG/G	—	—	117	156	135	225	299	2790	1990	182	396	119
MERCURY	METAL	UG/G	0.15	—										
NICKEL	METAL	UG/G	—	95	22.0	33.4	28.6	46.5	39.0	18.7	94.2		39.8	37.6
POTASSIUM	METAL	UG/G	—	—	335	374	317	448	248	1320	1010	296	1120	482
SELENIUM	METAL	UG/G	1	0.6										
SILVER	METAL	UG/G	1	—	4.44	5.96	5.46	6.61	6.66				1.62	4.83
SODIUM	METAL	UG/G	—	—	4000	3520	2690	2710	2210	232	168	189	515	1830
THALLIUM	METAL	UG/G	—	—										
VANADIUM	METAL	UG/G	—	130						19.1	17.4		22.1	
ZINC	METAL	UG/G	120		43.2	69.5	56.6	117	64.0	262	243	47.8	88.6	92.4
PERCENT SOLIDS	MISC	%	—	—	69.1	68.1	66.3	66.5	66.9	28.1	47.9	62.1	68.1	64.9
TOC	MISC	%	—	—	7.24				13.8			3.69		

Notes:
1) NYSDEC Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment", Nov. 1993.
2) URS Consultants, Inc. "Provisional Sediment Screening Criteria", September 1995.
3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968.
4) NYSDEC - Technical and Administrative Guidance Manual HWR-94-4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background

Shaded Areas - Denote exceedance of NYSDEC and/or Background Sediment Levels.

5.3 Settlement Area Soils

Field screening of the soil samples from the borings in this area indicated the presence of TPH in all locations. The levels were typically elevated at the base of the fill material, just above the contact with the underlying silty clay till. PCB levels were generally below 1.0 ppm.

The laboratory analyses detected a limited number of VOCs including acetone, 2-butanone, 1,1,1-trichloroethane, and xylene. These were generally infrequent and at low levels. Numerous SVOCs were also detected, particularly in borings SB-6, -7 and -8. These consisted primarily of PAHs (carcinogenic and non-carcinogenic) and phthalates. PCBs were not detected in the one sample analyzed. Metals were prevalent in all the samples tested. A summary of the parameters detected and the concentrations is presented in Table 5-2.

TABLE 5-2
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SOILS - SETTLEMENT AREA

SAMPLE ID DATE SAMPLED PARAMETER DSM	CLASS	UNITS ppb	NYSDEC Rec. Soil Cleanup Obj. (4) ppb	Eastern USA Soil Background Levels (4)	SB-001 08/30/95 (0'-6')	SB-002 08/30/95 (4'-6')(2'-4')	SB-003 08/30/95 (4'-6')(6'-8')	SB-004 08/30/95 (0'-2')	SB-005 08/30/95 (4'-6')
ACETONE	VOC	UG/KG	~~8000~~ 200	110					
2-BUTANONE (MEK)	VOC	UG/KG	~~4000~~ 300	300					
CHLOROBENZENE	VOC	UG/KG	~~2000~~ 1700	1700					
ETHYLBENZENE	VOC	UG/KG	~~8000~~ 5500	5500					
METHYLENE CHLORIDE	VOC	UG/KG	~~93~~ 100	100					
TOLUENE	VOC	UG/KG	~~20,000~~ 1500	1500					
1,1,1-TRICHLOROETHANE	VOC	UG/KG	~~7000~~ 800	760	7.4				
O-XYLENE	VOC	UG/KG	200,000 ** —	1200 *					
M+P-XYLENE	VOC	UG/KG	200,000 ** 1200	1200 *					6.4
ANTHRACENE	SVOC	UG/KG	~~20,000,000~~ 50K	700,000					
BENZO (A) ANTHRACENE	SVOC	UG/KG	224 ✓	3000					
BENZO (A) PYRENE	SVOC	UG/KG	61 ✓	11,000					
BENZO (B) FLUORANTHENE	SVOC	UG/KG	~~NA~~ 1100	1100					
BENZO (G,H,I) PERYLENE	SVOC	UG/KG	~~NA~~ 50K***	800,000					
BENZO (K) FLUORANTHENE	SVOC	UG/KG	~~NA~~ 1100	1100					
BUTYL BENZYL PHTHALATE	SVOC	UG/KG	~~20,000,00~~ 50K	122,000					
DI-N-BUTYLPHTHALATE	SVOC	UG/KG	8100 ✓	8100	2800	3600	5200	4000	3500
CARBAZOLE	SVOC	UG/KG	—	—					
IDENO (1,2,3-CD) PYRENE	SVOC	UG/KG	NA	3200					
CHRYSENE	SVOC	UG/KG	~~NA~~ 400	400					
DIMETHYL PHTHALATE	SVOC	UG/KG	~~80,000~~ 2000	2000					
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	UG/KG	50,000 ✓	435,000					
FLUORANTHENE 1000	SVOC	UG/KG	~~3,000,000~~ *** 50K	1,900,000	440				580
DI-N-OCTYL PHTHALATE	SVOC	UG/KG	~~2,000,000~~ *** 50K	120,000					
PHENANTHRENE 1000	SVOC	UG/KG	~~NA~~ 50000 ***	220,000	570		1100		
PYRENE 1000	SVOC	UG/KG	~~2,000,000~~ *** 50K	665,000	930				490
PCB 1242 54000	PEST	UG/KG	surface 1000 ✓	10,000					

Notes: 1) NYSDEC - Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment:, Nov. 1993.

2) URS Consultants, Inc. "Provisional Sediment Screening Criteria", September, 1995.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968

Shaded areas - Denote exceedance of NYSDEC Groundwater Protection levels.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94 4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background

* - Total Xylenes not to exceed 1200 ug/kg.

** - Total Xylenes.

*** - Individual SVOCs not to exceed 50,000 ug/kg.

\+ - Stated levels are for soils in the unsaturated zone. For soils near or below the water table, divide by 100.

? ?

TABLE 5-2
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SOILS - SETTLEMENT AREA

ARE THESE #5 CORRECT?

SAMPLE ID DATE SAMPLED PARAMETER DSM	CLASS	UNITS	NYSDEC Rec. Soil Cleanup Obj. (4)	Eastern USA Soil Background Levels (4)	SB-006 08/30/95 (2'-4')(0'-2')	SB-007 08/30/95 (0'-2')	SB-008 08/30/95 (6'-8')	SB-009 08/30/95 (4'-6')	SB-010 08/30/95 (4'-6')
ACETONE	VOC	UG/KG	8000	110	71		130	100	16
2-BUTANONE (MEK)	VOC	UG/KG	4000	300			28		
CHLOROBENZENE	VOC	UG/KG	2000	1700					
ETHYLBENZENE	VOC	UG/KG	8000	5500					
METHYLENE CHLORIDE	VOC	UG/KG	93	100					
TOLUENE	VOC	UG/KG	20,000	1500					
1,1,1-TRICHLOROETHANE	VOC	UG/KG	7000	760					
O-XYLENE	VOC	UG/KG	200,000 **	1200 *					
M+P-XYLENE	VOC	UG/KG	200,000 **	1200 *					
ANTHRACENE	SVOC	UG/KG	20,000,000	700,000		640			
BENZO (A) ANTHRACENE .64	SVOC	UG/KG	224	3000	520	2800			
BENZO (A) PYRENE "	SVOC	UG/KG	61	11,000	690	3800	430		
BENZO (B) FLUORANTHENE "	SVOC	UG/KG	NA	1100	1400	7200	1100		
BENZO (G,H,I) PERYLENE "	SVOC	UG/KG	NA ***	800,000		1200			
BENZO (K) FLUORANTHENE "	SVOC	UG/KG	NA	1100	420	2500			
BUTYL BENZYL PHTHALATE	SVOC	UG/KG	20,000,00 ***	122,000	1100			940	610
DI-N-BUTYLPHTHALATE	SVOC	UG/KG	8100	8100	5800	3000	3400	2100	2400
CARBAZOLE	SVOC	UG/KG	—	—		400			
IDENO (1,2,3-CD) PYRENE .04	SVOC	UG/KG	NA	3200		1200			
CHRYSENE .04	SVOC	UG/KG	NA	400	730	3700	610		
DIMETHYL PHTHALATE	SVOC	UG/KG	80,000	2000					
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	UG/KG	50,000	435,000	470		480	710	
FLUORANTHENE 1000	SVOC	UG/KG	3,000,000 ***	1,900,000	1400	6000	610		
DI-N-OCTYL PHTHALATE '	SVOC	UG/KG	2,000,000 ***	120,000					
PHENANTHRENE 1000	SVOC	UG/KG	NA ***	220,000	810	3200			
PYRENE 1000	SVOC	UG/KG	2,000,000 ***	665,000	2000	8400	770		
PCB 1242	PEST	UG/KG	1000	10,000		ND			

ppm > 7.1 >40.6 >2.1

Notes: 1) NYSDEC - Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment:, Nov. 1993.

2) URS Consultants, Inc. "Provisional Sediment Screening Criteria", September, 1995.

? ? See previous pg.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968

Shaded areas - Denote exceedance of NYSDEC Groundwater Protection levels.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94 4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background
* - Total Xylenes not to exceed 1200 ug/kg.
** - Total Xylenes.
*** - Individual SVOCs not to exceed 50,000 ug/kg.
+ - Stated levels are for soils in the unsaturated zone. For soils near or below the water table, divide by 100.

TABLE 5-2
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SOILS - SETTLEMENT AREA

SAMPLE ID DATE SAMPLED PARAMETER	CLASS	UNITS	NYSDEC Rec. Soil Cleanup Obj. (4)	Eastern USA Soil Background Levels (4)	SB-001 08/30/95 (0'-6')	SB-002 08/30/95 (0'-6')	SB-003 08/30/95 (0'-6')	SB-004 08/30/95 (0'-6')	SB-005 08/30/95 (0'-8')
ALUMINIUM	METAL	UG/G	SB	33,000	15100	4310	4360	7120	5860
ANTIMONY	METAL	UG/G	SB	NA					
ARSENIC	METAL	UG/G	7.5/SB	3-12	4.57	3.13	1.34	3.87	7.96
BARIUM	METAL	UG/G	300/SB	15-600	197	49.3	24.1	72.0	64.2
BERYLLIUM	METAL	UG/G	0.16/SB	0-1.75	0.877			0.685	
CADMIUM	METAL	UG/G	1/SB	0-1.1				0.666	
CALCIUM	METAL	UG/G	SB	130-35,000	3610	4240	3220	3760	70400
CHROMIUM	METAL	UG/G	10/SB	1.5-40	31.2	10.7	6.99	24.5	17.3
COBALT	METAL	UG/G	30/SB	2.5-60	8.90			7.72	5.99
COPPER	METAL	UG/G	25/SB	1-50	12.9	11.4	6.27	38.5	18.0
IRON	METAL	UG/G	2000/SB	2000-550,000	14500	8150	3080	20100	12500
LEAD	METAL	UG/G	SB	NA*	13.3	8.18	4.34	21.1	14.5
MAGNESIUM	METAL	UG/G	SB	100-5000	2350	1440	457	1580	34800
MANGANESE	METAL	UG/G	SB	50-5000	318	218	68.8	454	762
MERCURY	METAL	UG/G	0.1	0.001-0.2					
NICKEL	METAL	UG/G	13/SB	0.5-25	15.2	7.87		12.9	10.7
POTASSIUM	METAL	UG/G	SB	8500-43,000	1020	420	116	465	668
SELENIUM	METAL	UG/G	1	0.6					
SILVER	METAL	UG/G	SB	NA					
SODIUM	METAL	UG/G	SB	6000-8000	114	85.0	1710	393	77.0
THALLIUM	METAL	UG/G	—	—					
VANADIUM	METAL	UG/G	1-300	1-300	19.4	7.28		14.7	12.6
ZINC	METAL	UG/G	9-50	9-50	73.0	34.8	20.0	129	46.5
PERCENT SOLIDS	MISC	%	—	—	87.6	84.5	89.3	94.0	84.3
TOC	MISC	%	—	—					

Notes: 1) NYSDEC - Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment:, Nov. 1993.

2) URS Consultants, Inc. "Provisional Sediment Screening Criteria", September, 1995.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968

Shaded areas - Denote exceedance of Eastern USA Soil Background Levels.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94 4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background * - Total Xylenes not to exceed 1200 ug/kg.

** - Total Xylenes. *** - Individual SVOCs not to exceed 50,000 ug/kg.

+ - Stated levels are for soils in the unsaturated zone.
For soils near or below the water table, divide by 100.

TABLE 5-2
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION
FALCONER, NEW YORK FACILITY
SUMMARY OF DETECTED PARAMETERS
SOILS - SETTLEMENT AREA

SAMPLE ID DATE SAMPLED PARAMETER	CLASS	UNITS	NYSDEC Rec. Soil Cleanup Obj. (4)	Eastern USA Soil Background Levels (4)	SB-006 08/30/95 (0'-6')	SB-007 08/30/95 (0'-6')	SB-008 08/30/95 (0'-6')	SB-009 08/30/95 (0'-6')	SB-010 08/30/95 (0'-6')
ALUMINIUM	METAL	UG/G	SB	33,000	8680	7540	8900	6700	3350
ANTIMONY	METAL	UG/G	SB	NA					
ARSENIC	METAL	UG/G	7.5/SB	3-12	6.09	5.75	5.86	5.95	3.47
BARIUM	METAL	UG/G	300/SB	15-600	96.8	80.9	148	108	34.4
BERYLLIUM	METAL	UG/G	0.16/SB	0-1.75	0.790		0.649		
CADMIUM	METAL	UG/G	1/SB	0-1.1					
CALCIUM	METAL	UG/G	SB	130-35,000	14500	1920	15600	15900	2760
CHROMIUM	METAL	UG/G	10/SB	1.5-40	25.4	12.1	14.5	55.2	68.2
COBALT	METAL	UG/G	30/SB	2.5-60	7.86		7.51	6.43	17.7
COPPER	METAL	UG/G	25/SB	1-50	24.7	14.9	22.8	29.4	15.3
IRON	METAL	UG/G	2000/SB	2000-550,000	17500	13500	17300	13900	5510
LEAD	METAL	UG/G	SB	NA*	31.8	26.6	41.2	15.7	4.81
MAGNESIUM	METAL	UG/G	SB	100-5000	3660	1070	4660	2750	735
MANGANESE	METAL	UG/G	SB	50-5000	525	171	451	287	171
MERCURY	METAL	UG/G	0.1	0.001-0.2		0.200			
NICKEL	METAL	UG/G	13/SB	0.5-25	16.7	8.35	18.0	16.3	6.16
POTASSIUM	METAL	UG/G	SB	8500-43,000	906	528	1130	787	342
SELENIUM	METAL	UG/G	1	0.6					
SILVER	METAL	UG/G	SB	NA				1.75	
SODIUM	METAL	UG/G	SB	6000-8000		342	133		
THALLIUM	METAL	UG/G	—	—					
VANADIUM	METAL	UG/G	1-300	1-300	14.7	11.8	14.9	12.0	
ZINC	METAL	UG/G	9-50	9-50	81.6	68.6	104	391	23.5
PERCENT SOLIDS	MISC	%	—	—	80.7	85.6	77.4	84.1	79.3
TOC	MISC	%	—	—					

Notes: 1) NYSDEC - Division of Fish and Wildlife, "Technical Guidance for Screening Contaminated Sediment:, Nov. 1993.

2) URS Consultants, Inc. "Provisional Sediment Screening Criteria", September, 1995.

3) Andrew-Jones D.A., "The Application of Geotechnical Techniques to Mineral Exploration", 1968

Shaded areas - Denote exceedance of Eastern USA Soil Background Levels.

4) NYSDEC - Technical and Administrative Guidance Manual HWR-94 4046, "Determination of Soil Clean-up Objectives and Clean-up Levels", January 1994.

SB - Site Background

* - Total Xylenes not to exceed 1200 ug/kg.

** - Total Xylenes.

*** - Individual SVOCs not to exceed 50,000 ug/kg.

+ - Stated levels are for soils in the unsaturated zone. For soils near or below the water table, divide by 100.

6.0 DETERMINATION OF CHEMICALS OF CONCERN

6.1 Sediments

In order to evaluate the potential need for site remediation the concentrations of the parameters detected in the sediments from the R/C Pond and the Settlement Ditch were compared with the available NYSDEC guidance values for sediment. These values are contained in *Technical Guidance for Screening Contaminated Sediment* (NYSDEC, 1993). This document also presents a methodology for deriving sediment quality criteria for those compounds which do not have published values. These criteria do not necessarily represent the final cleanup concentrations that must be achieved during remediation. Rather, they establish sediment screening levels. That is, the criteria are used to identify areas of sediment contamination and make a preliminary assessment of the risk posed by the contamination to human health and the environment.

The NYSDEC published criteria and the methodology for deriving provisional criteria can be applied to some of the parameters detected in the sediment at the site. In those cases where NYSDEC criteria were not available, guidelines, threshold values, or criteria developed by other agencies for each of the parameters were identified. A hierarchy was subsequently established to determine the most appropriate and applicable guidance value for each parameter. NYSDEC's Human Health Bioaccumulation Sediment Criteria are considered inappropriate for the site because human sediment criteria uses drinking water standards for human consumption of contaminated fish. Therefore, these standards are only applicable if human consumption of wildlife living on-site is anticipated, and this is not the case. A detailed description of the methodology used is contained in Appendix B.

The concentrations of the detected parameters were then compared with both the published NYSDEC criteria and the provisional guidance values derived by the methodology (Table 5-1). Any parameter which exceeded the values was considered to be a chemical of concern. For the R/C Pond these included acetone and 2-butanone in most of the samples, and chlorobenzene in SE-003A. There were no exceedances for SVOCs or PCBs. Arsenic, cobalt, copper, magnesium, and zinc exceeded the risk-based criteria for fish and wildlife. In the Settlement Ditch, acetone and 2-butanone exceeded the criteria in most samples and PAHs exceeded the criteria in SE-004B and -004J. Antimony, arsenic, cadmium, chromium, cobalt, copper, lead, magnesium, silver, nickel, and zinc exceeded the risk-based criteria for fish and wildlife.

In addition to the NYSDEC criteria, PCBs are regulated separately under the USEPA Toxic Substances Control Act (TSCA). These regulations establish allowable levels for PCBs in soil/sediment at 25 ppm for non-residential settings and 10 ppm for residential sites (assuming the upper 10 inches of soil is removed and replaced with soil containing less than 1.0 ppm PCBs). Analytical results indicate PCB levels are less than 5 ppm for all sediment samples analyzed, which is below both the criteria. Consequently, under TSCA there would be no requirement to remediate the site.

PCBs may also be regulated under CERCLA in cases where they occur in on-site soils or sediments at concentrations greater than 1.0 ppm, and there is a potential for the soil/sediments to be transported from the site. Whereas this is considered a remote possibility at the site, the R/C Pond contains sediments with PCB levels above 1.0 ppm, and discharges to an on-site channel which ultimately conveys the water to the adjacent off-site wetlands area. Therefore, there is a potential that the sediments in the R/C Pond would have to be remediated under CERCLA.

6.2 Soils

NYSDEC has established guidance values and procedures for determining soil cleanup levels in TAGM-4046 *Determination of Soil Cleanup Objectives and Cleanup Levels* (1994). This document provides soil cleanup objectives for VOCs, SVOCs, PEST/PCBs which are protective of groundwater resources as well as human health. For metals, guidance values are based on levels considered to be protective of human health or equal to background levels at the site.

The concentrations of the detected parameters in soils from the settlement area were compared with the published NYSDEC criteria (Table 5-2). Any parameter which exceeded the guidance values was considered to be a chemical of concern. These included acetone in SB-8 and carcinogenic PAHs in SB-6, -7, and -8. Chromium, magnesium, and zinc were slightly elevated in some of the borings. PCBs did not exceed any of the criteria.

7.0 RISK-BASED CORRECTIVE ACTION ASSESSMENT

The Risk-Based Corrective Action (RBCA) assessment, performed in compliance with the approved Supplemental Investigation Work Plan has been prepared to identify the potential for adverse health effects, if any, resulting from exposure to contaminated soil and sediment at the site. A detailed discussion of the RBCA assessment including the identification of CPCs, screening guidelines, exposure assessment, toxicity assessment and risk characterization is presented in Appendix C. It is important to realize that the RBCA assessment should not be viewed as a substitute for a site-specific quantitation health risk assessment.

The chemical of potential concern (CPCs) identified for soil and sediment at the site initially were compared to risk-based screening concentrations (RBCs) from three different state and federal sources, as identified in Appendix C. The most conservative, or strictest, value of the three sources were then compared to maximum onsite concentrations. CPCs which exceeded the chemical-specific RBC value were retained and quantification of health risks to potential receptors were completed, as detailed in Appendix C.

The exposure assessment consisted of identifying potentially exposed media of concern and exposure pathways. Potential exposed populations include industrial workers under current land use and construction workers under the future land use scenario.

Identified media of concern include soil (surface/subsurface) from the settlement area and sediment from the recirculating pond and settlement ditch. Potential exposure pathways include current industrial workers with exposure via inhalation of soil emissions from the settlement area and future construction workers exposed via direct contact (i.e., ingestion and dermal contact) with soil and sediment.

A toxicity assessment was performed for the CPCs which exceeded RBC values. The CPCs evaluated for potential risks due to soil or sediment exposure include several carcinogenic PAHs, PCBs, arsenic, beryllium, and chromium. The risk characterization demonstrates that under the future land use scenario, noncarcinogenic and carcinogenic health risks are within or below the acceptable USEPA guidelines. The current land use scenario lacked risk evaluation since the inhalation data has not been reported or USEPA-verified for the CPCs identified.

The method of analysis utilized for completing calculations for the carcinogenic and noncarcinogenic risks posed by the site under the future construction scenario followed the USEPA's Risk Assessment Guidelines for Superfund (RAGS) (USEPA 1989a) and is presented in Appendix C. Cancer risk is estimated as the incremental probability of an individual (e.g., construction worker) developing cancer over a lifetime as a result of exposure to a potential carcinogen. A cancer risk of 1 x 10^{-6} indicates that an individual would incur an additional risk of 1 in one million from exposure to that chemical. Noncarcinogenic risk is based on a threshold response theory. This theory is based experimentally on data and is referred to as a No-Observed-Adverse-Effect-Level (NOAEL). Significant noncarcinogenic risks can be observed when the calculated threshold exposure level for a chemical has been exceeded. Calculating noncarcinogenic risks in the risk assessment entails the comparison of these threshold exposure levels to calculated onsite exposure levels and results in hazard quotients, which when summed, equal the hazard index. According to USEPA, the potential for noncarcinogenic adverse health effects exists when the hazard index exceeds unity (1.0). The risk characterization completed for the future construction scenario is discussed below and is presented in detail in Appendix C. The future construction worker's total noncarcinogenic hazard index of 0.3, which is lower than the USEPA level of 1.0, generally indicates that significant adverse health effects due to exposure are lacking. Additionally, the total cancer risk of 1 x 10^{-6}, at the lower end of the USEPA's acceptable range of 1 x 10^{-6} to 1 x 10^{-4}, generally indicates that exposure to onsite CPCs will not pose significant risks to receptors.

The RBCA assessment completed for this site should not be taken as a characterization of absolute risk, or as a fully probable estimate of risk. Rather, it is intended to identify potential levels of risk associated with identified exposure routes at the site.

8.0 REMEDIAL ACTION ALTERNATIVES

Based on the RBCA assessment of contaminants detected at the site it appears that there are no unacceptable risks posed under current or future use scenarios, and therefore no remediation would be required. However, as discussed above, the presence of PCBs at levels above 1.0 ppm in the R/C Pond sediment could represent a potential concern under CERCLA. Additionally, the metals concentrations int he R/C Pond and Settlement Ditch sediments are above the guidance values which are considered protective of fish and wildlife. Depending on the position of NYSDEC regarding these issues, it may be necessary to remediate portions of the site. Consequently, the following section presents a discussion of the potential remedial action alternatives which may be utilized to remediate the site, as necessary.

In developing the remedial alternatives the primary objectives were to reduce or mitigate the regulatory and/or environmental risks associated with contaminants at the site such that BP would have no long-term liabilities.

8.1 General Methods (Remedial Technologies and Process Options)

The purpose of this section is to identify general methods by which a remedial action may be undertaken (e.g. monitoring capping, removal). Remedial alternatives which will be discussed in the following section, may include more than one of these general methods.

The general methods for this site include:

1. No Action - In this method the site would be left in its current condition. This method does not mitigate any environmental contamination or related health risk at the site.

2. Access Restrictions - Access restrictions, in the form of posting and fencing to prohibit access to the site, and deed restrictions against future use of the site would reduce the human health risk by preventing human contact with contaminated soil/sediments. However, total site access restrictions may conflict with the potential future uses of the site.

3. <u>Environmental Monitoring</u> -Monitoring soils and sediments could be used to determine changes in site conditions and risk over time. Monitoring could also be used to evaluate the effectiveness of other remedial measures.

4. <u>Capping</u> - Capping is a commonly accepted method of protection against risk of direct contact with contaminated soils/sediments. Capping of contaminated soils and in the settlement area could be accomplished by placement of 1 to 2 feet of clean fill material over the contaminated soils. A vegetative topsoil cover would also be included. Capping of the sediments in the R/C pond and settlement ditch is also implementable, however, different methods would be utilized. These methods may include placement of granular materials (i.e. sand) through the standing water to form a capping layer or, dewatering of the pond followed by placement of a soil layer over the sediments.

5. <u>Removal</u> - This general method involves the excavation/dredging, transport and disposal of contaminated soils/sediments. The cost effectiveness of this option is generally driven by the disposal fee at the offsite location of choice and the expense of transporting the material there. This site is in close proximity to the Chautauqua County Landfill, a recently constructed state-of-the-art Solid Waste landfill, which is permitted to accept non-hazardous materials such as the contaminated soil/sediments at this site.

6. <u>Treatment</u> - Another option to address the contaminated soils and sediments would be treatment. Treatment technologies can be used to either reduce the levels or the mobility and/or toxicity of the contaminants in the soil/sediment. Technologies that actually reduce or remove the contaminants from the soils/sediment would be preferred over the other treatment options that do not remove the contaminants. Once the contaminants are removed, there is no potential for any future risk.

   Treatment technologies can generally be grouped into thermal, chemical, and biological processes. Each technology has limitations to effectiveness and implementability based on the specific site conditions such as: contaminant levels, desired contaminant removals, soil/sediment characteristics, hydrology, etc. The soil and sediment to be treated contains a wide variety of contaminants including volatile and semivolatile organics, PCBs, and metals. Additionally, it is expected that the sediment from the R/C pond and settlement ditch would have different characteristics than the contaminated soil in the settlement area.

Based on our past experience, URS would expect that either a solidification/stabilization or a biological treatment process would be the most applicable to the soil/sediments present at the site. Biological processes are beneficial in that the contaminants are actually degraded and removed. The drawback to this technology is that it generally does not reduce the metal contaminants. Additionally, some chemical contaminants, particularly PCBs, can also be difficult to effectively degrade. Stabilization processes immobilize the contaminants using chemical additives. This technology is routinely used for the treatment of metal contaminants. However, the effectiveness of this method in reducing the mobility of some of the organics, especially the lower weight volatile organics, is limited. Solidification also generally increases the overall volume of the waste due to the quantity of additives that are required for treatment. It is recommended that further investigation and treatability studies be conducted before implementing any treatment technologies at the site.

For the purpose of this study, it is assumed that solidification/stabilization would be the preferred option due to the concerns over metals and PCBs. Moreover, biological treatment could be utilized if BP desires to reduce the TPH concentrations in the soils/sediments.

8.2 Identification of Remedial Alternatives

The purpose of this section is to develop remedial alternatives that will enable the clean-up objectives to be met for all contaminants of concern at the site which pose a potential health risk. Remedial alternatives may include more than one of the general methods described in the previous section.

Alternative 1 - No Action

Alternative 1 involves no activities at the site. This alternative does not meet remedial response objectives, but is retained as a baseline for comparison with other alternatives.

Alternative 2 - Institutional Action

Alternative 2 includes deed restrictions and environmental monitoring. This alternative would meet the remedial response objectives, but would limit future uses of the site.

Alternative 3 - Capping

Alternative 3 consists of applying 1 to 2 feet of clean fill over the contaminated soils and sediments. The material utilized for underwater application would most likely be a slurry mixture or a granular type soil. This process could be implemented in such a manner that it would not interfere with the daily operation of the facility or the recirculation pond.

Alternative 4 - Excavation and Off-Site Disposal

Alternative 4 consists of excavating contaminated soils in the settlement area and dredging/excavation of sediments from the R/C pond and settlement ditch. In this alternative the settlement ditch area would initially be dewatered and the sediments excavated and disposed offsite. A temporary piping/pumping system would be constructed and integrated into the existing recirculation water system such that the "clean" settlement ditch could be used as a temporary R/C pond. The water from the existing R/C pond would then be pumped to the settlement ditch such that sediments in the pond could be excavated/dredged. Upon completion of removal and disposal of the R/C pond sediments the system would be restored to its original configuration. It is assumed that the excavated materials could be disposed of at the Chautauqua County Landfill (approximately 10 miles from the site).

Alternative 5 - Treatment

For the purpose of this study it is assumed that solidification/stabilization would be the preferred treatment to address the contaminants in the soil/sediments, which include PCB's, metals, PAH's. Given the conditions at the site, it would probably be most cost effective to excavate the soil and sediment and treat the waste in an on-site mixer in which stabilizing/solidifying agents could be added. This method makes for good homogeneity between the stabilizing agent and the contaminated soil. It also offers high control of stabilizing agent loading and other process variables which can effect the quality of the final product.

Solidification/stabilization is an effective process option for PCB's, metals and PAHs, although the feasibility of this option depends greatly on the selection of stabilizing additives for chemical fixing of contaminants.

Because the contaminated soil and sediment occurs in three distinct areas of the site, and each area contains different levels and types of contaminants, it may be more effective to excavate and treat each area separately. Treatability studies prior to treatment would tailor the stabilizing additives to the specific contaminants in each area. These issues would be resolved during the design phase of the project if this technology were to be implemented at the site.

8.3 Estimation Of Remedial Alternative Quantities/Costs

To facilitate evaluation of the alternatives in Section 8.2, conceptual capital costs were developed.

Quantities associated with the remedial activities as they relate to the media of concern were developed initially to serve as the basis for the economic evaluation. A summary of these quantities is presented in Table 8-1 below.

APPENDIX A

SETTLEMENT AREA BORING LOGS

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-1
SHEET NO. 1 **OF** 1
JOB NO.: 0535418.01.00001.000
BORING LOCATION: Falconer, NY
GROUND ELEVATION: N/A
DATE STARTED: 8-30-95
DATE FINISHED: 8-30-95
DRILLER: C. Rengeter
GEOLOGIST: M. Hsieh
REVIEWED BY: DUANE LENHARDT

PROJECT: Carborundum Monofrax Division
CLIENT: BP America
BORING CONTRACTOR: Nature's Way, Inc.
GROUND WATER: Dry @ Complet.

DATE	TIME	LEV	TYPE

	CAS.	SAMP	CORE	TUBE
TYPE		SS (SPLIT-SPOON)		
DIA.		2"		
WT.		140#		
FALL		30"		

* POCKET PENETROMETER READING

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"		RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
		1	SS	12	7	40	Yellow	Med. Dense	Yellow silty sand to gray med. sand w/ depth, 25~35% gravel, 1" max.	SM	grass roots
2				8	11		Gray				
		2	SS	7	5	50		Med. Stiff	Gray clayey silt, 10~25% gravel, ½" max	ML/CL	
				4	5						
5		3	SS	3	3	10					
6				2	3				Bottom of Boring @ 6.0 ft		
10											
15											
20											SPT Flows
25											
30											
35											

SPT Flows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01
BORING NO. SB-1

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-2

PROJECT: Carborundum Monofrax Division	**SHEET NO.** 1 **OF** 1
CLIENT: BP America	**JOB NO. :** 0535418.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.	**BORING LOCATION:** Falconer, NY
GROUND WATER: Dry @ Complet.	**GROUND ELEVATION:** N/A
	DATE STARTED: 8-30-95
	DATE FINISHED: 8-30-95
	DRILLER: C. Rengeter
	GEOLOGIST: M. Hsieh
	REVIEWED BY: DUANE LENHARDT

DATE	**TIME**	**LEV**	**TYPE**		**CAS.**	**SAMP**	**CORE**	**TUBE**
				TYPE		SS (SPLIT-SPOON)		
				DIA.		2"		
				WT.		140#		
				FALL		30"		
				* POCKET PENETROMETER READING				

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"		RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
		1	SS	31	28	75	Yellow	Hard	Yellow clayey Silt	ML/CL	
1.5				17	42		Gray	Dense	Gray med. to coarse Sand w/ 25~35% gravel, 1½" max	SM	• Very moist
2.5		2	SS	38	17	65	↓	MEDIUM STIFF	Gray clayey silt w/ 10~25% gravel 3/8" max, low plasticity.	ML/CL	• moist
				22	17						
5		3	SS	5	4	10		↓			
6				3	4		↓				
									Bottom of Boring @ 6.0 ft		
10											
15											
20											
25											
30											
35											

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-2

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-3

PROJECT: Carborundum Monofrax Division								**SHEET NO.** 1 **OF** 1	
CLIENT: BP America								**JOB NO.:** 0535418.01.00001.000	
BORING CONTRACTOR: Nature's Way, Inc.								**BORING LOCATION:** Falconer, NY	
GROUND WATER: Dry @ Complet					**CAS.**	**SAMP**	**CORE**	**TUBE**	**GROUND ELEVATION:** N/A
DATE	**TIME**	**LEV**	**TYPE**	**TYPE**		SS (SPLIT-SPOON)			**DATE STARTED:** 8-30-95
				DIA.		2"			**DATE FINISHED:** 8-30-95
				WT.		140#			**DRILLER:** C. Rengeter
				FALL		30"			**GEOLOGIST:** M. Hsieh
				* POCKET PENETROMETER READING					**REVIEWED BY:** DUANE LENHARDT

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"		RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
		1	SS	12	7	50	Gray/	Med.	med. to coarse sand		
				5	7			Dense	w/ 15~30% gravel		
		2	SS	4	3	30	Dark	Loose	1½" max. moist	SM	
				2	3		↓	↓	to very moist.		
5		3	SS	4	2	20					∘ wood debris
				2	2						
7		4	SS	2	1	50	Gray	Soft			
8	SS			1	2				clayey silt wet, fibrous, med. plasticity	ML/CL	
									Bottom of Boring @ 8.0 ft		
10											
15											
20											
25											SPT Blows
30											
35											

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-3

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-4

PROJECT: Carborundum Monofrax Division	**SHEET NO.** 1 **OF** 1
CLIENT: BP America	**JOB NO. :** 05354118.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.	**BORING LOCATION:** Falconer, NY
GROUND WATER: Dry @ Complet	**GROUND ELEVATION:** N/A

DATE	TIME	LEV	TYPE		CAS.	SAMP	CORE	TUBE
				TYPE		SS (SPLIT-	SPOON)	
				DIA.		2"		
				WT.		140#		
				FALL		30"		
				* POCKET PENETROMETER READING				

DATE STARTED:	8-30-95
DATE FINISHED:	8-30-95
DRILLER:	C. Rengeter
GEOLOGIST:	M. Hsieh
REVIEWED BY:	DUANE LENHARDT

DEPTH FT	STRATA	SAMPLE NO.	TYPE	BLOWS PER 6"		RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
1	S∴S	1	SS	20 25	28 25	75	Yellow White	Very Dense	Silty sand w/ 15~25% gravel, 1" max	SM	
	S C	2	SS	50/5"		10		Med.			
5	S S	3	SS	8 4	2 8	5	dark	Stiff	clayey silt, moist	ML	· grass roots
8	S S S	4	SS	6 10	10 17	0		↓			
10	SS SS	5	SS	10 8	10 14	5	Yellow Gray	Very Stiff	Silty clay, moist med. plasticity	ML/CL	
									Bottom of Boring @ 10.0 ft		
15											
20											SPT Blows
25											
30											
35											

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-4

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-5

PROJECT: Carborundum Monofrax Division	**SHEET NO.** 1 **OF** 1
CLIENT: BP America	**JOB NO. :** 0535418.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.	**BORING LOCATION:** Falconer, NY
GROUND WATER: Dry @ Complet	**GROUND ELEVATION:** N/A
	DATE STARTED: 8-30-95
	DATE FINISHED: 8-30-95
	DRILLER: C. Rengeter
	GEOLOGIST: M. Hsieh
	REVIEWED BY: DUANE LENHARDT

DATE	TIME	LEV	TYPE		CAS.	SAMP	CORE	TUBE
				TYPE		SS (SPLIT-SPOON)		
				DIA.		2"		
				WT.		140#		
				FALL		30"		
				* POCKET PENETROMETER READING				

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6"		SAMPLE RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
		1	SS	10 25	19 28	55	Yellow Gray	Very Dense	Silty sand w/ 25~50% gravel, 1" max. moist to wet.	SM	
		2	SS	17 12	12 13	20	Yellow	Dense			
5 6		3	SS	6 6	5 7	10	dark				
8		4	SS	4 10	6 14	60	Yw/Gray ↓	VERY STIFF	clayey silt w/ 15~30% gravel, ½" max.	ML/CL	
									Bottom of Boring @ 8.0 ft		
10											
15											
20											SPT Blows
25											
30											
35											

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-5

URS CONSULTANTS, Inc.

TEST BORING LOG **BORING NO.** SB-6							
PROJECT: Carborundum Monofrax Division							**SHEET NO.** 1 **OF** 1
CLIENT: BP America							**JOB NO. :** 0535418.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.							**BORING LOCATION:** Falconer, NY
GROUND WATER: Dry @ Complet				**CAS.**	**SAMP**	**CORE** / **TUBE**	**GROUND ELEVATION:** N/A
DATE	**TIME**	**LEV**	**TYPE**	**TYPE**	SS (SPLIT-SPOON)		**DATE STARTED:** 8-30-95
				DIA.	2"		**DATE FINISHED:** 8-30-95
				WT.	140#		**DRILLER:** C. Rengeter
				FALL	30"		**GEOLOGIST:** M. Hsieh
				* POCKET PENETROMETER READING			**REVIEWED BY:** DUANE LENHARDT

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"	BLOWS PER 6"	RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
1		1	SS	13	23	90	Yellow	Dense	Silty sand	SM	
				13	16		Gray	Soft	Sandy silt to clayey silt w/ depth, moist to very moist	ML/CL	
		2	SS	2	2	25					
				2	2						
5		3	SS	2	2	40					
6				5	3			Med. Stiff			• slightly moist 5.5~6.0ft.
10									Bottom of Boring @ 6.0 ft		
15											
20											
25											SPT Blows
30											
35											

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-6

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-7

PROJECT: Carborundum Monofrax Division	**SHEET NO.** 1 **OF** 1
CLIENT: BP America	**JOB NO.:** 0535418.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.	**BORING LOCATION:** Falconer, NY
GROUND WATER: Dry @ Comple	**GROUND ELEVATION:** N/A
	DATE STARTED: 8-30-95
	DATE FINISHED: 8-30-95
	DRILLER: C. Rengeter
	GEOLOGIST: M. Hsieh
	REVIEWED BY: DUANE LENHARDT

DATE	TIME	LEV	TYPE		CAS.	SAMP	CORE	TUBE
				TYPE		SS (SPLIT-SPOON)		
				DIA.		2"		
				WT.		140#		
				FALL		30"		
				* POCKET PENETROMETER READING				

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6"		SAMPLE RECOVERY RQD %	DESCRIPTION COLOR	DESCRIPTION CONSISTENCY HARDNESS	DESCRIPTION MATERIAL DESCRIPTION	DESCRIPTION CLASS USCS	REMARKS
		1	SS	10 14	24 7	75	Yellow Gray	Dense	Silty sand w/ 10~25% gravel, ½" max	SM	
		2	SS	2 2	2 3	5	Dark ↓	Loose V. Loose			
5 6		3	SS	1 2	1 4	30	Gray	SOFT	clayey silt, moist, low ~ med. plasticity	ML/CL	
10									Bottom of Boring @ 6.0 ft		
15											
20											SPT Blows
25											
30											
35											

SPT Blows

1	2
3	4

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-7

A-3205

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-8
SHEET NO. 1 **OF** 1
JOB NO. : 0535418.01.00001.000
BORING LOCATION: Falconer, NY
GROUND ELEVATION: N/A
DATE STARTED: 8-30-95
DATE FINISHED: 8-30-95
DRILLER: C. Rengeter
GEOLOGIST: M. Hsieh
REVIEWED BY: DUANE LENHART

PROJECT: Carborundum Monofrax Division
CLIENT: BP America
BORING CONTRACTOR: Nature's Way, Inc.
GROUND WATER: Dry @ Complet

DATE	TIME	LEV	TYPE

	CAS.	SAMP	CORE	TUBE
TYPE		SS (SPLIT-SPOON)		
DIA.		2"		
WT.		140#		
FALL		30"		

* POCKET PENETROMETER READING

DEPTH FT	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"	RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
2	1	SS	17 23 16 17	70	Yellow	Dense	Silty sand w/ 25~40% gravel, 1" max.	SM	
	2	SS	9 7 7 6	50	Gray ↓	Stiff → Med. Stiff		ML/CL	
5	3	SS	2 2 1 2	90	Dark Gray	Soft	clayey silt moist To V. moist		• Dark sand seam 5.5~6.0ft.
7	4	SS	1 2 2 5	45	↓				
8						LOOSE	med. sand, Wet	SM	
10							Bottom of Boring @ 8.0ft		
15									
20									SPT Blows
25									
30									
35									

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-8

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-9

PROJECT: Carborundum Monofrax Division								**SHEET NO.** 1 **OF** 1
CLIENT: BP America								**JOB NO. :** 0535418.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.								**BORING LOCATION:** Falconer, NY
GROUND WATER: Dry @ Comple.					**CAS.**	**SAMP**	**CORE** **TUBE**	**GROUND ELEVATION:** N/A
DATE	**TIME**	**LEV**	**TYPE**	**TYPE**		SS (SPLIT SPOON)		**DATE STARTED:** 8-30-95
				DIA.		2"		**DATE FINISHED:** 8-30-95
				WT.		140#		**DRILLER:** C. Rengeter
				FALL		30"		**GEOLOGIST:** M. Hsieh
				* POCKET PENETROMETER READING				**REVIEWED BY:** DUANE LENHARDT

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"		RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
	S	1	SS	11	11	60	Yellow Gray	Med. Dense	Silty sand w/ 25~40% gravel, 1/2" max.	SM	
	S S			12	14						
3	S	2	SS	11	12	40					
4	S S			50/0"				STIFF	Clayey silt w/ 10~25% gravel, 1/2" max, moist	ML	
5		3	SS	9	9	60		Med. Dense	Med. sand, wet	SM	
6				5	3						
									Bottom of Boring @ 6.0 ft		
10											
15											
20											SPT Blows
25											
30											
35											

SPT Blows

1	2
3	4

COMMENTS Mobile Drill ATV Rig, 3 1/4" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-9

A-3205

URS CONSULTANTS, Inc.

TEST BORING LOG
BORING NO. SB-10

PROJECT: Carborundum Monofrax Division	**SHEET NO.** 1 **OF** 1
CLIENT: BP America	**JOB NO.:** 0535418.01.00001.000
BORING CONTRACTOR: Nature's Way, Inc.	**BORING LOCATION:** Falconer, NY

GROUND WATER: Dry @ Complet.					**CAS.**	**SAMP**	**CORE**	**TUBE**	**GROUND ELEVATION:** N/A
DATE	**TIME**	**LEV**	**TYPE**	**TYPE**		SS (SPLIT-SPOON)			**DATE STARTED:** 8-30-95
				DIA.		2"			**DATE FINISHED:** 8-30-95
				WT.		140#			**DRILLER:** C. Rengeter
				FALL		30"			**GEOLOGIST:** M. Hsieh
				* POCKET PENETROMETER READING					**REVIEWED BY:** DUANE LENHARDT

DEPTH FT	STRATA	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6"		RECOVERY RQD %	COLOR	CONSISTENCY HARDNESS	MATERIAL DESCRIPTION	CLASS USCS	REMARKS
		1	SS	10 17	14 17	90	Yellow Gray	Dense To	Silty sand to sand w/ depth		
		2	SS	10 5	7 4	75	White	Med.	moist to wet	SM	
5 6		3	SS	2 1	2 2	90	Gray ↓	Dense Loose	w/ depth 15~30% gravel 1" max		◦ clay seam @ 5.0 ft
10									Bottom of Boring @ 6.0 ft		
15											
20											
25											SPT Blows
30											
35											

SPT Blows

1	2
3	4

A-3205

COMMENTS Mobile Drill ATV Rig, 3¼" HSA

PROJECT NO. 0535418.01.
BORING NO. SB-10

APPENDIX B

SEDIMENT CRITERIA EVALUATION

TABLE OF CONTENTS

B1.0 INTRODUCTION

URS Consultants, Inc. (URS) developed criteria to be utilized in assessing whether pond sediment should be considered contaminated. To date, the New York State Department of Environmental Conservation (NYSDEC) has published sediment quality criteria for 64 chemicals. Constituents identified in sediment samples however, include compounds for which NYSDEC has no published sediment quality criteria. For these compounds, the NYSDEC has outlined methods to derive sediment quality criteria in *Technical Guidance for Screening Contaminated Sediment* (1993). This document outlines methodology used by the New York Division of Fish and Wildlife and the Division of Marine Resources for establishing sediment criteria for the purpose of identifying contaminated sediments. These criteria do not necessarily represent the final cleanup concentrations that must be achieved during remediation. Rather they establish sediment screening levels. That is, the criteria are used to identify areas of sediment contamination and make a preliminary assessment of the risk posed by the contamination to human health and the environment. Criteria are developed for two classes of chemicals -- non-polar organic constituents and metals.

The NYSDEC-published criteria and the methodology for deriving provisional criteria can be applied to many of the constituents detected in sediments. In those cases where NYSDEC criteria were not available, guidelines, threshold values, or criteria developed by other agencies were identified for each of the constituents; a hierarchy to determine the most appropriate and applicable for each constituent was established; and, a summary table of the various sources was constructed (Table 2). The specifics of this hierarchy and a description of each source are outlined in Section 2.0. Section 3.0 identifies constituents which lacked sufficient information to derive sediment potential cleanup levels, and provides recommendations for interim potential cleanup levels for these latter constituents.

B2.0 HIERARCHY OF SOURCES FOR DETERMINING POTENTIAL SEDIMENT CRITERIA

A number of sources of sediment criteria exist, and these sources may vary in strength with regard to the availability of supportive evidence. A protocol was established for defining a hierarchy of sources to be consulted. Sediment criteria were obtained with reference to the following hierarchy of sources:

1) NYSDEC's *Technical Guidance for Screening Contaminated Sediments,* 1993a
2) U.S.EPA's *Proposed Sediment Quality Criteria for the Protection of Benthic Organisms,* 1991c
3) Provisional NYSDEC and U.S. EPA Sediment Criteria
4) Potential Sediment Criteria proposed in *Criteria for Contaminated Soil/Sediment Cleanup,* 1989
5) U.S. EPA's *National Perspective on Sediment Quality*, 1985; and
6) Background Concentrations as Appropriate Criteria for Inorganic Constituents

If no value was available in the primary source the next source on the hierarchical scale was consulted, and so on and so forth. Each of these sources is discussed in the following text. If NYSDEC's *Technical Guidance for Screening Contaminated Sediments* or *Criteria for Contaminated Soil/Sediment Cleanup* have more than one criteria available for a single constituent of concern; then the one which is most protective of aquatic life is used as the recommended sediment criteria.

NYSDEC's *Technical Guidance for Screening Contaminated Sediment*

As outlined in *Technical Guidance for Screening Contaminated Sediments* (1993), NYSDEC has developed sediment criteria for two classes of contaminants -- non-polar organic contaminants and metals. Non-polar organic contaminants are derived using the EPA-endorsed equilibrium partitioning approach. Metal criteria are derived from Ministry of Ontario guidelines and National Oceanographic and Atmospheric Administration (NOAA) data that make use of the screening-level approach. As the site is located in New York, these criteria precede any other criteria available for possible consideration as potential sediment criteria. Accordingly, freshwater sediment criteria applicable to the site are sediment criteria based on aquatic toxicity, wildlife residue, and sediment criteria for metals, and are listed in Table 2. The most restrictive of these three criteria was selected as the potential sediment criteria. NYSDEC's Human Health Bioaccumulation Sediment Criteria are considered inappropriate for the site because human sediment criteria uses drinking water standards to determine a standard for human consumption of contaminated fish; therefore, these standards are only applicable if human consumption of wildlife living on-site is anticipated; therefore inappropriate criteria for this site.

U.S. EPA's *Proposed Sediment Quality Criteria for the Protection of Benthic Organisms*

Under the mandate of the Clean Water Act, EPA is currently pursuing efforts to develop and publish sediment quality criteria for some of the 65 pollutants or pollutant categories designated as toxic under Section 307(a) of the CWA. As part of this effort, draft documents which derive chemical-specific Sediment Quality Criteria are currently under EPA review, and were obtained from Mary Reiley at EPA's Office of Water. However, the constituents that exist at the site and for which draft proposed Sediment Quality Criteria are currently under review are limited to phenanthrene and fluoranthene. The proposed sediment quality criteria for each of these constituents are listed on Table 2 and considered to be second in the hierarchy of selection of potential sediment criteria for the site.

Provisional NYSDEC and U.S. EPA Sediment Criteria

The methodology selected by EPA and NYSDEC for determination of Sediment Quality Criteria (and generally regarded as technically sound) is the "equilibrium partitioning", or EP, approach (U.S. EPA, 1989; NYSDEC, 1993). In such an approach, a Sediment Quality Criteria is back calculated from an acceptable pore water concentration, using a simple partitioning model based primarily on the concentration of organic carbon in the sediment, and the affinity of the constituent for organic carbon in the sediment. The calculation is as follows:

$$SQC = K_{ow} * WQC * Cf$$

Where:

SQC	-	Sediment Quality Criterion (μg/kg sediment)
K_{ow}	-	partition coefficient (ℓ/kg sediment)
WQC	-	chemical-specific Water Quality Criteria (μg/ℓ)
Cf	-	conversion factor (1 kg/1,000 gOC)

NYSDEC methodology was utilized to determine provisional sediment criteria for those organic constituents for which no proposed Sediment Quality Criteria were available. As mentioned before, human health criteria should not be utilized in developing criteria for aquatic organism's and wildlife's exposure to sediment; on the contrary, only criteria established for environmental receptors are appropriate. Therefore, NYSDEC (October, 1993) Ambient Water Quality Standards/Guidance Values (AWQS/GV) and EPA (1986) Chronic Ambient Water Quality Criteria were utilized for the Protection of Freshwater Aquatic Organisms (AWQC) as the WQCs in the previously-listed equation. There are no partition coefficients for inorganics. Table 3 presents the provisional potential criteria for sediment based on NYSDEC's AWQS/GV and EPA's AWQCs, and the parameter values, such as K_{ow} utilized to calculate these criteria.

Sediment criteria utilizing either published criteria or the above-mentioned NYSDEC methodology for deriving provisional values were applicable to 36 of the 39 constituents existing at the site (Table 1). Whenever there was a NYSDEC criteria available, it was utilized. However, in the absence of NYSDEC or EPA criteria (EPA being considered second in the hierarchy of sources), a selection of appropriate sediment criteria was made from other reliable sources subsequently described.

Potential Sediment Criteria Proposed in *Criteria for Contaminated Soil/Sediment Cleanup*

Criteria for Contaminated Soil/Sediment Cleanup, Chapter 3 (Fitchko, 1989) provides an extensive review of various governmental sediment criteria and methodologies. The Apparent Effects Threshold (AET) approach was selected as the most applicable values for the site. An apparent Effects Threshold is a constituent's concentration in sediment above which statistically significant biological effects (BE) (i.e., mortality, decreased fecundity, population decreases) would always be expected. The AET concentrations are empirically derived from corresponding field data for sediment chemistry. AETs are presented in Table 2 for amphipods (BE - mortality), oyster larvae (BE - abnormality), benthic infaunal analysis (BE - significant depression of total abundance), and Microtox (BE - decrease in luminescence). AETs were established for a wide range of constituent classes including volatiles, semivolatiles, metals, and pesticides.

U.S. EPA's *National Perspective on Sediment Quality*

In 1986, the U.S. EPA attempted to provide assistance in focusing sediment criteria development efforts. Threshold concentrations for 48 constituents in 7 chemical categories were established. In general, these values have been updated with more current information; however, these concentrations can be utilized as potential sediment criteria when no other data are available for a particular chemical.

Background Concentrations as Appropriate Criteria for Inorganic Constituents

For many inorganic constituents, there are no published sediment criteria available. In the absence of representation of "acceptable" sediment conditions, or criteria, a substitute criteria is necessary. One indicator of generally-acceptable sediment conditions is published average concentrations of various constituents in sediment. Average concentrations are available for a wide range of naturally-occurring constituents, are generally representative of well-functioning ecosystems, and automatically incorporate naturally-occurring levels of various constituents such as inorganics and polynuclear aromatic hydrocarbons. These published concentrations are, therefore, used as provisional criteria by which to derive potential sediment criteria for inorganic constituents. National background concentrations obtained from Andrews-Jones (1968) and EPA (1985) were utilized as action levels for inorganics. If a chemical is detected at a concentration that is below the naturally-occurring concentration in sediments, then the chemical can be eliminated from further consideration as recommended in EPA's risk assessment guidance. Furthermore, according to EPA, a party can not be expected to clean up a site to levels less than those which occur naturally. Therefore, if there are sediment criteria available for given constituents but these criteria represent concentrations below naturally-occurring background concentrations, then background concentrations are the most applicable.

B3.0 CONSTITUENTS WITH INSUFFICIENT INFORMATION TO DERIVE A PRELIMINARY REMEDIATION GOAL

Three constituents detected in sediment data from the site did not have enough information on their physical, chemical, and toxicological properties to develop a realistic potential sediment criteria. These constituents include acetone, 2-butanone (MEK), and carbazole. However, other constituents exist for which data are available to apply the principles of structural activity relationships (SAR). That is, these constituents are closely related in structure and toxicological effect to other constituents for which information on sediment criteria is available. In order to provide a usable criteria until more properties of these constituents are known, a provisional sediment criteria (Table 4) was derived by substituting a promulgated criteria of a similar compound.

A relationship between chemical structure and physiologic/pharmacologic activity is a well-established axiom of toxicology. Indeed, the structure-activity relationship (SAR) is a proven basis for new drug development. In the absence of any dose-response data for a given chemical, it is accepted procedure to apply SAR principles to derive provisional toxicity benchmarks.

In the course of developing sediment criteria for various chemicals, no ecotoxicologic data were available for 2-butanone. In order to develop provisional sediment criteria in the absence of relevant toxicity data, principles of SAR were applied and a search was undertaken to ascertain whether chemically related compounds for which criteria have been established by NYSDEC exist.

2-Butanone is highly water soluble and is not very toxic. No chemical on the NYSDEC sediment criteria list really resembles 2-butanone. A low molecular weight ketone or alcohol would fulfill the criteria of appropriate SAR. However, no information on sediment criteria for ketones or alcohols are available. Nonchlorinated phenols represent the closest SAR fit. Phenol is fairly water soluble and probably much more toxic than MEK or 2-butanone, and is therefore an appropriate basis for ascribing a safe provisional sediment criterion for 2-butanone.

B4.0 CONCLUSIONS

Because NYSDEC Sediment Criteria are ARARs or To Be Considered (TBCs) criteria, NYSDEC's values and approach took precedence and were used to the maximum extent that was practicable. However, in the absence of promulgated or provisionally derived NYSDEC criteria, criteria from other sources were utilized. In selecting or developing sediment criteria when NYSDEC values were not available, as many documents containing sediment criteria as could be located were obtained. Most criteria are based on the equilibrium partitioning (EP) approach adopted by NYSDEC which applies aquatic toxicity data to the interstitial pore space water or studies on naturally-occurring levels. This may be overly conservative, as the most sensitive aquatic life may not inhabit interstitial pore-space water (i.e., benthic organisms found in this pore space may not be the most sensitive aquatic organisms upon which aquatic toxicity criteria are based). Furthermore, development of sediment criteria depends on freshwater toxicity information. There is a long list of constituents of concern at the site, some of which simply have no aquatic toxicological data.

In summary, based on the above analysis of available sources, Table 1 summarizes the sediment criteria which are considered applicable screening-level values for determining if sediments at the site are contaminated. It should be emphasized that these criteria do not represent final cleanup concentrations; instead, they should be used to make a preliminary, screening-level assessment of the constituents present in pond sediments at the site.

TABLES

TABLE 1

RECOMMENDATIONS FOR MOST APPROPRIATE SEDIMENT CRITERIA AT A SITE IN NEW YORK STATE

Chemicals	**Recommendation for Most Appropriate Sediment PRG**
Volatiles (ug/gOC)	
1,1,1-Trichloroethane	1.52E +03
2-Butanone	NA*
Acetone	NA*
Chlorobenzene	3.50E + 00
Di-n-butylphthalate (1)	2.00E + 03
Ethylbenzene	1.29E + 04
Methylene chloride (1)	2.00E + 00
Toluene	2.45E + 03
Xylene (Total) (1)	1.00E - 01
Semivolatiles (ug/gOC)	
Anthracene (1)	9.60E-01
Benzo(a)anthracene (1)	1.30E + 00
Benzo(a)pyrene (1)	1.60E + 00
Benzo(b)fluoranthene (1)	3.20E + 00
Benzo(g,h,i)perylene (1)	6.70E-01
Benzo(k)fluoranthene (1)	3.20E + 00
Bis(2-ethylhexyl)phthalate	2.00E + 02
Carbazole	NA*
Chrysene (1)	1.40E + 00
Fluoranthene	1.02E + 03
Indeno(1,2,3-cd)pyrene (1)	6.00E-01
Phenanthrene	1.20E + 02
Pyrene (1)	2.60E + 00
Inorganics (mg/kg)	
Aluminum	7.20E + 04
Antimony	2.00E + 00
Arsenic	6.00E + 00
Barium	6.90E + 02
Beryllium	5.00E + 00
Cadmium	6.00E-01
Chromium	1.30E + 02
Cobalt	2.20E + 01
Copper	5.70E + 01
Iron	2.00E-02
Lead	3.10E + 01
Manganese	7.60E + 02
Mercury	1.50E-01
Nickel	9.50E + 01
Silver	1.00E + 00
Selenium	6.00E-01
Vanadium	1.30E + 02
Zinc	1.20E + 02

(1)	Units in mg/kg
NA	Not enough information available to establish sediment criteria
*	See Section 3.0 in text.

TABLE 2

SEDIMENT CRITERIA FROM VARIOUS SOURCES

Chemicals	NYSDEC Sediment Criteria (2)			U.S. EPA Sediment Criteria (3) ug/gOC	Provisional Criteria Based on NYS AWQS/GV (4) ug/gOC	Provisional Criteria Based on EPA AWQC (5) ug/gOC
	Table 1		Table 2			
	Aquatic Toxicity Basis ug/gOC	Wildlife Residue Basis ug/gOC	Criteria for Metals mg/kg			
Volatiles						
1,1,1-Trichloroethane						1.52E + 03
2-Butanone						
Acetone						
Benzene						2.05E + 02
Chlorobenzene	3.5					
Di-n-butylphthalate						
Ethylbenzene						1.29E + 04
Methylene chloride						
Toluene						2.45E + 03
Xylene (Total)						
Semivolatiles						
Anthracene						
Benzo(a)anthracene						
Benzo(a)pyrene						
Benzo(b)fluoranthene						
Benzo(g,h,i)perylene						
Benzo(k)fluoranthene						
Bis(2-ethylhexyl)phthalate	199.5					
Carbazole						
Chrysene						
Fluoranthene	1020			620		
Indeno(1,2,3-cd)pyrene	5570	12				2.43E + 05
Phenanthrene	120			180		
Pyrene						
Inorganics						
Aluminum (1)						
Antimony			2			
Arsenic			6			
Barium						
Beryllium						
Cadmium			0.6			
Chromium			26			
Cobalt						
Copper			16			

TABLE 2 (Cont.)

Chemicals	**NYSDEC Sediment Criteria (2)**			**U.S. EPA Sediment Criteria (3) ug/gOC**	**Provisional Criteria Based on NYS AWQS/GV (4) ug/gOC**	**Provisional Criteria Based on EPA AWQC (5) ug/gOC**
	Table 1		**Table 2**			
	Aquatic Toxicity Basis ug/gOC	**Wildlife Residue Basis ug/gOC**	**Criteria for Metals mg/kg**			
Iron Lead Manganese			2% 31 460			
Mercury Nickel Silver			0.15 16 1			
Selenium Vanadium						
Zinc			120			

(1) No sediment background concentration was available - the average soil background concentration reported in Shacklette, et al., 1984
(2) NYSDEC, 1993b
(3) U.S. EPA, 1993a,b,c,d,e
(4) NYSDEC, 1993a
(5) U.S. EPA, 1986
(6) Fitchko, 1989
(7) U.S. EPA, 1985
(8) Andrews-Jones, 1968

TABLE 2 (Cont.)

Chemicals	**Apparent Effects Threshold Sediment Values (6)**				**Sediment Threshold Concentrations (7) mg/kg**	**Background Sediment Criteria (8) mg/kg**
	Amphipod AET mg/kg	**Oyster AET mg/kg**	**Benthic AET mg/kg**	**Microtox AET mg/kg**		
Volatiles						
1,1,1-Trichloroethane						
2-Butanone						
Acetone						
Benzene					1.36	
Chlorobenzene						
Di-n-butylphthalate					2000	
Ethylbenzene	0.05	0.037	0.037	0.033	5.6	
Methylene chloride					2	
Toluene					10	
Xylene (Total)	0.16	0.12	0.12	0.1		
Semivolatiles						
Anthracene	0.96	0.96	1.3	0.96	44	
Benzo(a)anthracene	1.6	1.6	4.5	1.3	220	
Benzo(a)pyrene	2.4	1.6	6.8	1.6	1800	
Benzo(b)fluoranthene	3.7	3.6	8	3.2		
Benzo(g,h,i)perylene	0.74	0.72	5.4	0.67		
Benzo(k)fluoranthene	3.7	3.6	8	3.2	5000	
Bis(2-ethylhexyl)phthalate	3.1	1.9	1.9	1.9		
Carbazole						
Chrysene	2.8	2.8	6.7	1.4	460	
Fluoranthene	3.9	2.5	6.3	1.7		
Indeno(1,2,3-cd)pyrene	0.69	0.69	5.2	0.6	24000	
Phenanthrene	2.1	1.5	3.2	1.5	56	
Pyrene	4.3	3.3	7.3	2.6	198	
Inorganics						
Aluminum (1)						72000
Antimony	5.3	26	3.2	26		
Arsenic	93	700	85	700	33	6.6
Barium						690
Beryllium	0.5	0.45	0.5	0.36		5
Cadmium	6.7	9.6	5.8	9.6	31	0.5
Chromium	130	37	59	27	25	130
Cobalt						22
Copper	800	390	310	390	136	57

TABLE 2 (Cont.)

Chemicals	**Apparent Effects Threshold Sediment Values (6)**				**Sediment Threshold Concentrations (7) mg/kg**	**Background Sediment Criteria (8) mg/kg**
	Amphipod AET mg/kg	**Oyster AET mg/kg**	**Benthic AET mg/kg**	**Microtox AET mg/kg**		
Iron	27000	37000	37000	37000		
Lead	700	660	300	530	132	20
Manganese	230	480	1000	480		760
Mercury	2.1	0.59	0.88	0.41	0.8	0.04
Nickel	120	39	49	28	20	95
Silver	3.7	0.56	5.2	0.58		0.5
Selenium	1		63			0.6
Vanadium						130
Zinc	870	1600	260	1600	760	80
Cyanide					0.1	

(1) No sediment background concentration was available - the average soil background concentration reported in Shacklette, et al., 1984
(2) NYSDEC, 1993b
(3) U.S. EPA, 1993a,b,c,d,e
(4) NYSDEC 1993a
(5) U.S. EPA, 1986
(6) Fitchko, 1989
(7) U.S. EPA, 1985
(8) Andrews-Jones, 1968

TABLE 3

CALCULATIONS OF PROVISIONAL SEDIMENT CRITERIA BASED ON EPA AND NYSDEC WATER QUALITY CRITERIA

Chemical	**Kow**	**Reference**	**NYSDEC**		**U.S. EPA**	
			AWQC/GV ug/L	**Provisional Sediment Criteria ug/gOC**	**AWQC ug/L**	**Provisional Sediment Criteria ug/gOC**
Volatiles						
1,1,1-Trichloroethane	2.95E + 02	RCRA			5.15E + 03	1.52E + 03
2-Butanone (MEK)	1.82E + 00	RCRA				
Acetone	5.75E-01	RCRA				
Chlorobenzene	6.92E + 02	RCRA	5.00E + 00	ND		
Di-n-butylphthalate	1.58E + 05	RCRA				
Ethylbenzene	1.41E + 03	RCRA			9.15E + 03	1.29E + 04
Methylene Chloride	1.78E + 01	RCRA				
Toluene	4.90E + 02	RCRA			5.01E + 03	2.45E + 03
Xylene (Total)						
Semivolatiles						
Anthracene	2.82E + 04	RCRA				
Benzo(a)anthracene	4.07E + 05	RCRA				
Benzo(a)pyrene	9.55E + 05	RCRA				
Benzo(b)fluoranthene	3.72E + 06	RCRA				
Benzo(g,h,i)perylene	1.70E + 07	RCRA				
Benzo(k)fluoranthene	6.92E + 06	RCRA				
bis(2-Ethylhexyl)phthalate	2.00E + 05	RCRA	6.00E-01	ND	3.60E + 02	ND
Carbazole						
Chrysene	4.10E + 05					
Fluoranthene	2.14E + 05	RCRA			1.14E + 03	2.43E + 05
Indeno(1,2,3-cd)pyrene	4.57E + 07	RCRA				
Phenanthrene	2.88E + 04	RCRA			6.30E + 00	ND
Pyrene	1.51E + 05	RCRA				
Inorganics						
Aluminum	NA		1.00E + 02			
Antimony	NA				3.00E + 01	
Arsenic	NA		1.90E + 02		1.90E + 02	
Barium	NA					
Beryllium	NA		1.10E + 03		5.30E + 00	
Cadmium	NA		7.70E + 00		1.10E + 03	
Cobalt	NA				2.10E + 02	
Copper	NA		5.00E + 00			
Iron	NA		2.90E + 00		1.20E + 01	
Lead	NA		3.00E + 02		1.00E + 03	
Manganese	NA		8.60E + 00		3.20E + 00	
Mercury	NA					
Nickel	NA		7.10E + 00		1.20E-02	
Selenium	NA		1.00E + 00		1.60E + 02	
Silver	NA		1.00E-01		5.00E + 00	
Vanadium	NA		1.90E + 02			
Zinc	NA		1.70E + 02		1.10E + 02	

TABLE 3 (Cont.)

RCRA - U.S. EPA, 1992
PCGEMS - U.S. EPA, 1988
N/A - no available data
ND - no provisional criteria was derived as a NYSDEC sediment criteria exists
* - Insufficient data to develop criteria. Value presented is the Lowest Observed Effect (LOEL)
** - Hardness dependent criteria (100mg/L CaCO3 used)
pr - Provisional Chronic Criteria generated from chronic/acute ratio
P - Proposed Criterion
Carbon Disulfide

TABLE 4

DERIVATION OF PROVISIONAL SEDIMENT CRITERIA FOR CONSTITUENTS LACKING TOXICOLOGICAL SEDIMENT DATA

Chemical	Substitute Compound	Substitute Compound's Potential Sediment Criteria (mg/kg)
2-Butanone	Phenols (unchlorinated)	0.023 (1)
Acetone	Phenols (unchlorinated)	0.023 (1)
Carbazole	Aniline	0.030 (2)

(1) NYSDEC, 1993
(2) NYSDEC, 1991

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BIBLIOGRAPHY

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APPENDIX C

RISK BASED CORRECTIVE ACTION ASSESSMENT

APPENDIX C

RISK-BASED CORRECTIVE ACTION ASSESSMENT

APPENDIX C - RISK-BASED CORRECTIVE ACTION ASSESSMENT

C.1 Objectives and Scope

The Risk Based Corrective Action (RBCA) assessment presented in this section is a preliminary identification of the potential for adverse health effects, if any, resulting from exposure to contaminated sediment and soil at the Carborundum-Monofrax Refractories Division, Falconer, NY site. This RBCA assessment was performed in accordance with the approved supplemental investigations Work Plan to address the human health risks posed by current and potential future site conditions. It uses data and information collected during the field investigation to assess human health risk in the immediate and surrounding areas.

This RBCA assessment for the site follows the general procedures set forth in the American Society for Testing of Materials (ASTM) "Emergency Standard Guidance for Risk-Based Corrective Action Applied at Petroleum Release Sites", ES38-94, 1994 and USEPA's *Risk Assessment Guidance for Superfund (RAGS)* (USEPA 1989). As such, it includes the following four components:

Identification of Chemicals of Potential Concern
Exposure Assessment
Toxicity Assessment
Risk Characterization

These components are presented in the following subsections.

C.2 Identification of Chemicals of Potential Concern

The data presented in Section 5.0 of this report were used to identify chemicals of potential concern at the site. A screening process was used for determining chemicals of potential concern (CPC). If a chemical or metal was detected at least once in a particular medium, then that chemical or metal was identified as a CPC and retained. The next step of the screening process was to determine if the maximum concentration detected exceeded risk-based screening concentrations (RBCs). Tables 1 and

2 present RBCs for the inhalation and ingestion routes of exposure. Values used in these tables were taken from three (3) different sources:

- USEPA Soil Screening Guidance, December 1994
- USEPA Region III, Risk-Based Concentration Table, March 1995
- NYSDEC TAGM 4046

In general, RBCs are chemical concentrations in a particular medium that represent a level of contamination below which there is no concern under CERCLA, provided conditions associated with RBCs are met. Some of the references provide for conditions to be residential, others are industrial. In all cases the most conservative scenarios were used. (It is important to realize that the RBCs do not constitute regulation or guidance, and should not be viewed as a substitute for a site-specific quantitative risk assessment).

The strictest, or most conservative, value was chosen from the three sources. This value was then compared to the maximum concentration detected for the particular area (e.g., fill area). Tables 3 through 6 summarize this comparison and identify when there was an RBC exceedance. Exceedances were retained in the RBCA assessment, and quantification of the health risks to the receptors is discussed in Section C.5.

Five inorganic analytes, calcium, magnesium, iron, sodium, and potassium, were not included in the RBCA assessment, in as much as it is reasonable to assume that these chemicals would not pose significant risks to receptors studied in this assessment. In accordance with *RAGS* "chemicals that are (1) essential human nutrients, (2) present at low concentrations (i.e., only slightly elevated above naturally occurring levels), and (3) toxic only at very high doses (i.e., much higher than those that could be associated with contact at the site) need not be considered further in the quantitative risk assessment." (USEPA 1989).

C.3 Exposure Assessment

The purpose of this exposure assessment is to identify: potentially exposed populations; media of concern; and potential routes of exposure. Table 7 presents a summary of exposure pathways assessed for the site. The following subsections discuss the rationale for identification of completed exposure pathways.

C.3.1 Identification of Potentially Exposed Populations

Potentially exposed populations were identified for current land use conditions at the site, as shown in Table 7. Currently, the area is industrial, with the nearest residential structure located approximately 50 feet across New York Avenue to the south, upgradient of this site. Therefore, the only receptors that might potentially come in contact with contaminated media at the site are the industrial workers employed at the facility (there is no evidence or observation of any trespassing, and hence no recreational activities are expected to take place under the current land use scenario).

It was assumed that in the future, land use would remain industrial, with possible construction activities taking place (e.g., draining of recirculating pond or underground pipe installation). Therefore, a construction worker is identified as a population of concern in the future.

C.3.2 Identification of Media of Concern

Under the current land use scenario the soil (surface and subsurface) from the settlement area is identified as a medium of concern. Volatilization from the fill area may potentially expose industrial workers to CPCs in soil via the inhalation route. Sediment from the R/C pond or settlement ditch is not identified as a medium of concern under current land use, since the potential for direct contact (i.e. ingestion or dermal contact) does not exist. Surface water was not collected during field activities. However, previous investigations at the site have demonstrated this medium to be contaminant-free. In addition, NYSDEC has ceased monitoring of the surface water; it is not identified as a medium of concern. Groundwater is not currently used as a potable water supply. Groundwater onsite is supplied from a municipal source. Since an exposure route (e.g. ingestion or inhalation) for groundwater does not exist, it is not identified as a medium of concern.

Under the potential future use scenario, soil from the fill area and sediment from the recirculating pond and settlement area have been identified as media of concern. Since intrusive activities (i.e., construction activities) and potential draining of pond and settlement areas may occur, the construction workers may be exposed to these media via direct contact (i.e. ingestion and dermal contact). For similar reasons discussed under the current land use scenario, surface water and groundwater are not identified as media of concern for the future land use scenario.

C.3.3 Identification of Potential Routes of Exposure

Potential routes of exposure for the Carborundum site have been developed for current and potential future land use scenarios. As shown on Table 7, given current conditions, industrial workers' exposure to site-related CPCs could occur through inhalation of soil emissions from the fill area. Direct contact is not identified as a complete exposure pathway, since workers do not access this area of the site.

Potential exposure pathways for construction workers in the future use scenario are summarized on Table 7 and include incidental ingestion of soil from the fill area as well as sediment from both the recirculating pond and the settlement area. Exposure to sediment is based on future construction plans including possible drainage of these areas. Although dermal contact is a complete exposure pathway for soil and sediment, it is quantitatively assessed for the sediments located in the settlement area exclusively. This is due to the lack of published absorption factors required to calculate intake values for all CPCs other than PCBs (Aroclor-1242) which were detected in sediment at the settlement area.

C.3.4 Estimation of Chemical Intake and Exposure Parameters

The exposure dose, or intake, is defined as the mass of a substance in contact with an organism's exchange boundary (e.g., lungs) per unit body weight per unit time. Units for exposure intake are typically milligrams per kilogram-day (mg/kg-day). Exposure dose is calculated by dividing the total mass (mg) of a substance to which an organism is exposed by body weight (kg) and exposure time (days).

The exposure dose is calculated on the basis of the chemical's concentration in the environmental medium of concern, the relative absorption factor of the chemical, and a number of intake variables expressing the frequency, duration, and magnitude of exposure. These intake variables are selected conservatively, so that, in combination, they produce an estimate of the reasonable maximum exposure for each particular exposure pathway.

The following discussion indicates how exposure dose (or intake) has been calculated for each exposure pathway at the Carborundum site. Chronic (lifetime) exposure is determined by calculating an average daily exposure dose for each receptor. Subchronic (short-term) exposure is assessed for the construction worker. Chronic exposure doses are used to quantify carcinogenic health effects, whereas both chronic and subchronic doses are considered in evaluating noncarcinogenic health effects.

Intake equations for each exposure pathway were taken from RAGS (USEPA 1989a) and are presented below. The exposure parameters used in each intake equation and the intake calculated for each exposure pathway are presented in Tables 8 through 14.

1. Ingestion of Soil/Sediment

Equation:

$$Intake\ (mg/kg\text{-}day) = \frac{CS\ x\ IR\ x\ CF\ x\ FI\ x\ EF\ x\ ED}{BW\ x\ AT}$$

Where:

CS = Chemical concentration in surface/subsurface soil/sediment (i.e., or the maximum detected concentration - mg/kg)

IR = Ingestion rate (mg soil or sediment/day)

CF = Conversion factor (10-6 kg/mg)

FI = Fraction ingested from contaminated source (unitless)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged, in days)

2. Dermal Contact with Sediment

Equation:

$$Absorbed\ Dose\ (mg/kg\text{-}day) = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical concentration in sediment (i.e., the maximum detected concentration - mg/kg)

CF = Conversion factor (10-6 kg/mg)

SA = Surface area available for contact (cm2/event)

AF = Sediment to skin adherence factor (mg/cm2)

ABS = Absorption factor (unitless)

EF = Exposure frequency (events/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (period over which exposure is averaged, in days)

In general, the exposure parameters used in this RBCA assessment were taken from USEPA risk assessment guidance documents such as RAGS (USEPA 1989a), the USEPA supplemental guidance memorandum entitled "Standard Default Exposure Factors" (USEPA 1991d), the Exposure Factors Handbook (USEPA 1989b), and the Dermal Exposure Assessment: Principles and Applications (USEPA

1992a). The exposure parameters used are presented in Tables 8 through 14. Exposure parameters that differ from the default values presented in these documents are discussed below.

All Routes of Exposure

The exposure frequency proposed for the future use construction worker is based on the assumption that these receptors would be exposed to surface/subsurface soil and sediment four months of the year (i.e., May - August). Cold weather and snow (ground cover) would inhibit exposure to these media. Therefore, an exposure frequency value of 85 days/year was used for these receptors (17 weeks x 5 days/week).

An exposure duration of 4 months (i.e., 0.33 years) was used for the construction worker in the future. This is based on the assumption that construction activities would be completed in four months.

Ingestion of Soil/Sediment

The fraction ingested is based on the presumption of reasonable maximum exposure.

Dermal Contact with Sediment

The skin surface area available for contact for future use construction workers is the sum of the surface area of the hands and arms (USEPA 1989a). The value reported in RAGS for a male adult is 3,120 cm2.

The dermal absorption values were taken from Dermal Exposure Assessment: Principles and Applications (USEPA 1992a). Verified absorption values are available only for cadmium and PCB (i.e., 0.01 and 0.06, respectively), (Mr. Mark Maddaloni USEPA, Region II telephone conversation - February 1994). Therefore, PCBs are the only chemicals in sediment that will be evaluated for this route of exposure.

C.4 Toxicity Assessment

Toxicity information for the CPCs which had RBC exceedances identified in Section 7.2 are categorized by their relative health risks. Risks are divided into carcinogenic and noncarcinogenic effects, with noncarcinogenic chemicals further subdivided into chronic and subchronic categories. Toxicological profiles for the chemicals with RBC exceedances are provided in Attachment 1.

Toxicity data used in this HRA were collected following the hierarchy recommended by USEPA. First, Integrated Risk Information System (IRIS) (USEPA 1995a) was consulted through an on-line computer linkage. Second, when the information sought was not available on IRIS, the Health Effects Assessment Summary Tables (HEAST) (USEPA 1994a) was consulted for values. Table 15 identifies the sources for each value and the date of the referenced value.

C.4.1 Carcinogenic Effects

For evaluation of carcinogenic risk from exposure to contaminants, USEPA has established slope factors (SFs). A SF is a measure of toxicity that defines quantitatively the correlation between dose and response. The SF is used in a quantitative risk assessment to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a known or potential carcinogen. SFs are developed for oral intake and for inhalation routes of exposure.

When assessing potential cancer risk posed by exposure to carcinogenic PAHs other than benzo(a)pyrene, the following approach was used after consulting USEPA Region II. The slope factor for benzo(a)pyrene was used to evaluate all carcinogenic PAHs; however, the concentration of each PAH is adjusted by an "estimated order of potential potency," in accordance with Provisional Guidance for Quantitative Risk Assessment of Polycyclic Hydrocarbons (USEPA 1993a). These relative potency factors were applied to Table 12.

Table 15 presents toxicity information for known or potential carcinogens that were detected in one or more of the environmental media that had RBC exceedances at the Carborundum site.

Included in this table is the weight-of-evidence, tumor site and references for which this information was derived.

a. Slope Factor, representing a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. Slope factors are expressed as inverse units of dose, i.e., $(mg/kg\text{-}day)^{-1}$. This slope factor allows calculation of incremental lifetime cancer risk associated with exposure to the chemical at a known or estimated dosage. Table 15 provides separate slope factors, where applicable and available, for oral and inhalation routes of exposure.

For the inhalation route of exposure, the toxicity values for carcinogenic effects can be expressed in terms of risk per unit concentration, (i.e., $[\mu g/m^3]^{-1}$). The following equation, as recommended in RAGS (USEPA 1989a), was utilized to convert the risk per unit concentration values to slope factors (i.e., $[mg/kg\text{-}day]^{-1}$):

Equation:

$$Slope\ Factor = \frac{Unit\ Risk\ (\mu g/m^3)^{-1}\ x\ 70\ kg}{20\ m^3/day\ x\ 0.001\ mg/\mu g}$$

Where:

70 kg = body weight default value
20 m^3/day = inhalation rate default value
0.001 mg/μg = conversion factor

b. Weight-of-Evidence for carcinogenicity, expressing the degree of confidence relating to the likelihood that exposure to a given chemical causes cancer in humans. This weight-of-evidence is based upon the following USEPA classification system:

Group A--Human Carcinogen - This category indicates that there is sufficient evidence from epidemiological studies to support a casual association between an agent and cancer in humans.

Group B--Probable Human Carcinogen - This category indicates that there is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or that, in the absence of positive data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

Group C--Possible Human Carcinogen - This category indicates that there is limited evidence of carcinogenicity in animals and inadequate or lack of human data.

Group D--Not Classified - This category indicates that there were no data to evaluate or that the evidence for carcinogenicity in humans and in animals was inadequate.

Group E--No Evidence of Carcinogenicity to Humans - This category indicates that there is no evidence of carcinogenicity in at least two adequate animal tests in different species or in both epidemiological and animal studies.

c. Tumor site, i.e., physiological location of cancer upon which the slope factor and weight-of-evidence are based.

d References, including sources(s) and date(s), are provided to indicate the basis for identified slope factors. Chemicals for which a slope factor was not available (indicated by "ND") a reference was not listed in this column. Both sources: IRIS and HEAST were consulted prior to reporting an "ND" on Table 15.

C.4.2 Noncarcinogenic Effects

For evaluating noncarcinogenic effects from exposure to contaminants, the quantitative measures of toxicity used are the reference dose (RfD), when the exposure route is via ingestion or dermal contact, and the reference concentration (RfC), when the pathway is inhalation. Specific values have been developed for chronic and subchronic RfDs and RfCs.

Chronic RfDs are derived from the No-Observed-Adverse-Effect-Level (NOAEL) for the critical toxic effect. They are modified by application of uncertainty factors reflecting the type of study on which the values are based. Chronic RfCs are derived in a similar fashion but are based upon studies of inhalation exposure. For this reason, calculation of RfCs is more complex, and RfCs are therefore available for fewer chemicals.

Subchronic values for RfDs and RfCs are derived in the same fashion as the chronic values when suitable less-than-lifetime studies are available. Subchronic RfDs and RfCs should be used to evaluate noncarcinogenic effects over exposure periods of two weeks to seven years.

Table 15 summarizes toxicity information on the noncarcinogenic effects observed from exposure to CPCs that were identified at the Carborundum site. For each CPC the following information is provided:

a. Reference Doses, expressed in mg/kg-day, generally identify an estimate of the average daily exposure level below which significant adverse noncarcinogenic health effects are not expected.

The published chronic and subchronic inhalation toxicity values are reported as reference concentrations (RfC) and in the units of mg/m^3. The published RfCs were converted to RfDs, expressed in units of mg/kg-day, using the following equation as given in RAGS (USEPA 1989a):

Equation:

$$\text{Reference Dose (RfD)} = \frac{RfC\ (mg/m^3)\ x\ 20\ m^3/day}{70\ kg}$$

Where:

70 kg = body weight default value
20 m^3/day = inhalation rate default value

In accordance with RAGS (USEPA 1989a), if subchronic data are missing and a chronic RfD derived from chronic data exists, the chronic RfD is adopted as the subchronic RfD. Table 15 identifies when chronic RfDs were used as surrogate values for subchronic RfDs.

b. Critical Effects, expressing the toxic end point(s) of adverse response (e.g., liver damage) associated with the exposure to noncarcinogenic chemicals.

c. Source(s) and date(s) of dose-response data. For chemicals lacking reference doses indicated by "ND", a reference was not listed in the appropriate column on Table 15.

C.4.3 Chemicals Lacking Toxicity Values

The following CPCs with RBC exceedances have been detected in environmental samples from the Carborundum site but lack published qualitative toxicity values. These chemicals include 4 carcinogens and 6 noncarcinogens. The carcinogens are: benzo(a)anthracene, chrysene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene. As stated earlier, the slope factor for benzo(a)pyrene was utilized with potential potency factors for each of these carcinogenic PAHs. The noncarcinogens which lack toxicity data are: benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and Aroclor-1242 (it should be noted that even though these chemicals could not be evaluated for noncarcinogenic effects, all of them are classified as carcinogens and were evaluated for cancer risks).

C.5 Risk Characterization

Health risk is a function of both human exposure and chemical toxicity. The risk characterization is the process by which the exposure assessment (Section C.3 is integrated with the toxicity assessment (Section C.4) to estimate present and potential threats to human health posed by contamination at the site.

The results of the risk characterization are presented on Table 16. Under the current land use scenario, the industrial worker may be exposed to chemicals volatilizing from soils in the settlement area via the inhalation pathway. For the three carcinogenic PAHs identified as CPCs because of RBC exceedances, inhalation toxicity values are not reported by the USEPA. Therefore, the total noncarcinogenic hazard index and total cancer risk could not be calculated for the current land use.

As shown on Table 16, under the future land use scenario, four exposure pathways were used to determine the total risk (noncarcinogenic subchronic and carcinogenic) for the construction worker. The risks incurred by the construction workers were combined to estimate the total risk. The total subchronic (short-term) hazard index for the construction worker is 0.3 which is below the USEPA acceptable value of 1. The ingestion of sediment from the settlement ditch, at a hazard index of 0.2, contributes 67% to the total hazard index for the construction worker.

The total cancer risk for the construction worker, as presented on Table 16, is 1×10^{-6} which is at the lower end of the USEPA acceptable cancer risk range of 1×10^{-6} to 1×10^{-4}. Incidental ingestion of soil from the settlement area and sediment from the R/C pond and the settlement ditch contribute nearly equal risks to the total cancer risk for this future use receptor.

TABLE 1

SUMMARY OF RISK-BASED SCREENING CONCENTRATIONS
INHALATION PATHWAY - VOLATILIZATION FROM SOIL
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL OF POTENTIAL CONCERN	CLASS	Region III RBCs (mg/kg)	USEPA SSLs (mg/kg)	TAGM 4046 Health Based Levels (mg/kg)	Risk-Based Concentration (RBC) (mg/kg)
ACETONE	VOC	62000	62000	8000	8000
2-BUTANONE (MEK)	VOC	—	—	4000	4000
1,1,1-TRICHLOROETHANE	VOC	980	980	7000	980
M+P-XYLENE	VOC	1950	320	200000	320
ANTHRACENE	SVOC	6.8	—	20000	6.8
BENZO (A) ANTHRACENE	SVOC	27	—	0.224	0.224
BENZO (A) PYRENE	SVOC	11	—	0.0609	0.0609
BENZO (B) FLUORANTHENE	SVOC	23	—	—	23
BENZO (G,H,I) PERYLENE	SVOC	—	—	—	—
BENZO (K) FLUORANTHENE	SVOC	—	—	—	—
BUTYL BENZYL PHTHALATE	SVOC	530	530	20000	530
DI-N-BUTYLPHTHALATE	SVOC	100	100	8000	100
CARBAZOLE	SVOC	11	—	—	11
INDENO (1,2,3-CD) PYRENE	SVOC	280	—	—	280
CHRYSENE	SVOC	3.6	—	—	3.6
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	210	210	50	50
FLUORANTHENE	SVOC	68	—	3000	68
PHENANTHRENE	SVOC	—	—	—	
PYRENE	SVOC	56	—	2000	56
ALUMINIUM	METAL	—	—	—	—
ARSENIC	METAL	380	380	—	380
BARIUM	METAL	350000	350000	—	350000
BERYLLIUM	METAL	690	690	—	690
CADMIUM	METAL	920	920	—	920
CALCIUM	METAL	—	—	—	—
CHROMIUM	METAL	140	140	—	140
COBALT	METAL	—	—	—	—
COPPER	METAL	—	—	—	—
IRON	METAL	—	—	—	—
LEAD	METAL	—	—	—	—
MAGNESIUM	METAL	—	—	—	—
MANGANESE	METAL	—	—	—	—
MERCURY	METAL	7	7	—	7
NICKEL	METAL	6900	6900	—	6900
POTASSIUM	METAL	—	—	—	—
SILVER	METAL	—	—	—	—
SODIUM	METAL	—	—	—	—
VANADIUM	METAL	—	—	—	—
ZINC	METAL	—	—	—	—

NOTE

— - Denotes no value reported for that parameter.

TABLE 2

SUMMARY OF RISK-BASED SCREENING CONCENTRATIONS
INGESTION PATHWAY - DIRECT CONTACT WITH SOIL
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL OF POTENTIAL CONCERN	CLASS	Region III RBCs (mg/kg)	ESEPA SSLs (mg/kg)	TAGM 4046 Health Based Level (mg/kg)	Risk-Based Concentration (RBC) (mg/kg)
ACETONE	VOC	200000	7800	8000	7800
2-BUTANONE (MEK)	VOC	1000000	—	4000	4000
CHLOROBENZENE	VOC	41000	1600	2000	1600
ETHYLBENZENE	VOC	200000	7800	8000	7800
METHYLENE CHLORIDE	VOC	760	85	93	85
TOLUENE	VOC	410000	16000	20000	16000
1,1,1-TRICHLOROETHANE	VOC	180000	—	7000	7000
O-XYLENE	VOC	1000000	160000	200000	160000
M+P-XYLENE	VOC	2000000	160000	200000	160000
ANTHRACENE	SVOC	610000	23000	20000	20000
BENZO (A) ANTHRACENE	SVOC	7.8	0.9	0.224	0.224
BENZO (A) PYRENE	SVOC	0.78	0.09	0.0609	0.0609
BENZO (B) FLUORANTHENE	SVOC	7.8	0.9	—	0.9
BENZO (G,H,I) PERYLENE	SVOC	—	—	—	—
BENZO (K) FLUORANTHENE	SVOC	78	9	—	9
BUTYL BENZYL PHTHALATE	SVOC	410000	16000	20000	16000
DI-N-BUTYLPHTHALATE	SVOC	200000	7800	8000	7800
CARBAZOLE	SVOC	290	32	—	32
INDENO (1,2,3-CD) PYRENE	SVOC	7.8	0.9	—	0.9
CHRYSENE	SVOC	780	88	—	88
DIMETHYL PHTHALATE	SVOC	1000000	780000	80000	80000
BIS (2-ETHYLHEXYL) PHTHALAT	SVOC	410	46	50	46
FLUORANTHENE	SVOC	82000	3100	3000	3000
DI-N-OCTYL PHTHALATE	SVOC	41000	1600	2000	1600
PHENANTHRENE	SVOC	—	—	—	—
PYRENE	SVOC	61000	2300	2000	2000
PCB 1242	PCB	0.74	1	1	0.74
ALUMINIUM	METAL	1000000	—	—	1000000
ANTIMONY	METAL	820	31	—	31
ARSENIC	METAL	3.3	0.4	—	0.4
BARIUM	METAL	140000	5500	—	5500
BERYLLIUM	METAL	1.3	0.1	—	0.1
CADMIUM	METAL	1000	39	—	39
CALCIUM	METAL	—	—	—	—
CHROMIUM	METAL	10000	390	—	390
COBALT	METAL	120000	—	—	120000
COPPER	METAL	76000	—	—	76000
IRON	METAL	—	—	—	—
LEAD	METAL	—	400	—	400
MAGNESIUM	METAL	—	—	—	—
MANGANESE	METAL	10000	—	—	10000
MERCURY	METAL	610	23	—	23
NICKEL	METAL	41000	1600	—	1600
POTASSIUM	METAL	—	—	—	—
SILVER	METAL	10000	390	—	390
SODIUM	METAL	—	—	—	—
VANADIUM	METAL	14000	550	—	550
ZINC	METAL	610000	23000	—	23000

NOTE

— - Denotes no value reported for that parameter.

TABLE 3

IDENTIFICATION OF RBC EXCEEDANCES - CURRENT USE INHALATION OF CHEMICALS VOLATILIZING FROM SOIL - SETTLEMENT AREA CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL OF POTENTIAL CONCERN	CLASS	Risk-Based Concentration (mg/kg)	Maximum Onsite Concentration (mg/kg)	Exceedance (YES/NO)
ACETONE	VOC	8000	0.13	NO
2-BUTANONE (MEK)	VOC	4000	0.028	NO
1,1,1-TRICHLOROETHANE	VOC	980	0.0074	NO
M+P-XYLENE	VOC	320	0.0064	NO
ANTHRACENE	SVOC	6.8	0.64	NO
BENZO (A) ANTHRACENE	SVOC	0.224	2.8	YES
BENZO (A) PYRENE	SVOC	0.0609	3.8	YES
BENZO (B) FLUORANTHENE	SVOC	23	7.2	NO
BENZO (G,H,I) PERYLENE	SVOC	—	1.2	—
BENZO (K) FLUORANTHENE	SVOC	—	2.5	—
BUTYL BENZYL PHTHALATE	SVOC	530	1.1	NO
DI-N-BUTYLPHTHALATE	SVOC	100	5.8	NO
CARBAZOLE	SVOC	11	0.4	NO
INDENO (1,2,3-CD) PYRENE	SVOC	280	1.2	NO
CHRYSENE	SVOC	3.6	3.7	YES
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	50	0.71	NO
FLUORANTHENE	SVOC	68	6	NO
PHENANTHRENE	SVOC	—	3.2	—
PYRENE	SVOC	56	8.4	NO
ALUMINIUM	METAL	—	15100	—
ARSENIC	METAL	380	7.96	NO
BARIUM	METAL	350000	197	NO
BERYLLIUM	METAL	690	0.877	NO
CADMIUM	METAL	920	0.666	NO
CALCIUM	METAL	—	70400	—
CHROMIUM	METAL	140	68.2	NO
COBALT	METAL	—	17.7	—
COPPER	METAL	—	38.5	—
IRON	METAL	—	20100	—
LEAD	METAL	—	41.2	—
MAGNESIUM	METAL	—	34800	—
MANGANESE	METAL	—	762	—
MERCURY	METAL	7	0.2	NO
NICKEL	METAL	6900	18	NO
POTASSIUM	METAL	—	1130	—
SILVER	METAL	—	1.75	—
SODIUM	METAL	—	1710	—
VANADIUM	METAL	—	19.4	—
ZINC	METAL	—	391	—

NOTE

— - Denotes no value reported for that parameter.

TABLE 4

IDENTIFICATION OF RBC EXCEEDANCES - FUTURE USE
DIRECT CONTACT (INGESTION) WITH SEDIMENT-SETTLEMENT DITCH
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL OF POTENTIAL CONCERN	CLASS	Risk-Based Concentration (mg/kg)	Maximum Onsite Concentration (mg/kg)	Exceedance (YES/NO)
ACETONE	VOC	7800	1.6	NO
2-BUTANONE (MEK)	VOC	4000	0.33	NO
ETHYLBENZENE	VOC	7800	0.013	NO
TOLUENE	VOC	16000	0.1	NO
O-XYLENE	VOC	160000	0.016	NO
M+P-XYLENE	VOC	160000	0.092	NO
BENZO (A) ANTHRACENE	SVOC	0.224	1.8	YES
BENZO (A) PYRENE	SVOC	0.0609	1.1	YES
BENZO (B) FLUORANTHENE	SVOC	0.9	2.5	YES
BENZO (G,H,I) PERYLENE	SVOC	—	0.82	—
BENZO (K) FLUORANTHENE	SVOC	9	3.1	NO
DI-N-BUTYLPHTHALATE	SVOC	7800	3.1	NO
INDENO (1,2,3-CD) PYRENE	SVOC	0.9	0.79	NO
CHRYSENE	SVOC	88	1.6	NO
DIMETHYL PHTHALATE	SVOC	80000	5.3	NO
BIS (2-ETHYLHEXYL) PHTHAL	SVOC	46	2	NO
FLUORANTHENE	SVOC	3000	3.4	NO
PHENANTHRENE	SVOC	—	2	—
PYRENE	SVOC	2000	3.2	NO
ALUMINIUM	METAL	1000000	21900	NO
ANTIMONY	METAL	31	9.26	NO
ARSENIC	METAL	0.4	17.1	YES
BARIUM	METAL	5500	238	NO
BERYLLIUM	METAL	0.1	0.839	YES
CADMIUM	METAL	39	1.54	NO
CALCIUM	METAL	—	13400	—
CHROMIUM	METAL	390	1360	YES
COBALT	METAL	120000	657	NO
COPPER	METAL	76000	379	NO
IRON	METAL	—	25200	—
LEAD	METAL	400	33.4	NO
MAGNESIUM	METAL	—	3800	—
MANGANESE	METAL	10000	2790	NO
NICKEL	METAL	1600	94.2	NO
POTASSIUM	METAL	—	1320	—
SILVER	METAL	390	6.66	NO
SODIUM	METAL	—	4000	—
VANADIUM	METAL	550	22.1	NO
ZINC	METAL	23000	262	NO

NOTE

— - Denotes no value reported for that parameter.

TABLE 5

IDENTIFICATION OF RBC EXCEEDANCES - FUTURE USE DIRECT CONTACT (INGESTION) WITH SOIL - SETTLEMENT AREA CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL OF POTENTIAL CONCERN	CLASS	Risk-Based Concentration (mg/kg)	Maximum Onsite Concentration (mg/kg)	Exceedance (YES/NO)
ACETONE	VOC	7800	0.13	NO
2-BUTANONE (MEK)	VOC	4000	0.028	NO
1,1,1-TRICHLOROETHANE	VOC	7000	0.0074	NO
M+P-XYLENE	VOC	160000	0.0064	NO
ANTHRACENE	SVOC	20000	0.64	NO
BENZO (A) ANTHRACENE	SVOC	0.224	2.8	YES
BENZO (A) PYRENE	SVOC	0.0609	3.8	YES
BENZO (B) FLUORANTHENE	SVOC	0.9	7.2	YES
BENZO (G,H,I) PERYLENE	SVOC	—	1.2	—
BENZO (K) FLUORANTHENE	SVOC	9	2.5	NO
BUTYL BENZYL PHTHALATE	SVOC	16000	1.1	NO
DI-N-BUTYLPHTHALATE	SVOC	7800	5.8	NO
CARBAZOLE	SVOC	32	0.4	NO
INDENO (1,2,3-CD) PYRENE	SVOC	0.9	1.2	YES
CHRYSENE	SVOC	88	3.7	NO
BIS (2-ETHYLHEXYL) PHTHALATE	SVOC	46	0.71	NO
FLUORANTHENE	SVOC	3000	6	NO
PHENANTHRENE	SVOC	—	3.2	—
PYRENE	SVOC	2000	8.4	NO
ALUMINIUM	METAL	1000000	15100	NO
ARSENIC	METAL	0.4	7.96	YES
BARIUM	METAL	5500	197	NO
BERYLLIUM	METAL	0.1	0.877	YES
CADMIUM	METAL	39	0.666	NO
CALCIUM	METAL	—	70400	—
CHROMIUM	METAL	390	68.2	NO
COBALT	METAL	120000	17.7	NO
COPPER	METAL	76000	38.5	NO
IRON	METAL	—	20100	—
LEAD	METAL	400	41.2	NO
MAGNESIUM	METAL	—	34800	—
MANGANESE	METAL	10000	762	NO
MERCURY	METAL	23	0.2	NO
NICKEL	METAL	1600	18	NO
POTASSIUM	METAL	—	1130	—
SILVER	METAL	390	1.75	NO
SODIUM	METAL	—	1710	—
VANADIUM	METAL	550	19.4	NO
ZINC	METAL	23000	391	NO

NOTE

— - Denotes no value reported for that parameter.

TABLE 6

IDENTIFICATION OF RBC EXCEEDANCES - FUTURE USE DIRECT CONTACT (INGESTION) WITH SEDIMENT-RECIRCULATING POND CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL OF POTENTIAL CONCERN	CLASS	Risk-Based Concentration (mg/kg)	Maximum Onsite Concentration (mg/kg)	Exceedance (YES/NO)
ACETONE	VOC	7800	1.5	NO
2-BUTANONE (MEK)	VOC	4000	0.34	NO
CHLOROBENZENE	VOC	1600	4.6	NO
METHYLENE CHLORIDE	VOC	85	0.0066	NO
DI-N-OCTYL PHTHALATE	SVOC	1600	55	NO
PCB 1242	PCB	0.74	3.2	YES
ALUMINIUM	METAL	1000000	19000	NO
ARSENIC	METAL	0.4	7.99	YES
BARIUM	METAL	5500	221	NO
BERYLLIUM	METAL	0.1	0.828	YES
CALCIUM	METAL	—	49600	—
CHROMIUM	METAL	390	66.9	NO
COBALT	METAL	120000	80.3	NO
COPPER	METAL	76000	298	NO
IRON	METAL	—	46800	—
LEAD	METAL	400	18.9	NO
MAGNESIUM	METAL	—	9560	—
MANGANESE	METAL	10000	1240	NO
NICKEL	METAL	1600	38.4	NO
POTASSIUM	METAL	—	2870	—
SODIUM	METAL	—	372	—
VANADIUM	METAL	550	28.3	NO
ZINC	METAL	23000	520	NO

NOTE

— - Denotes no value reported for that parameter.

TABLE 7

EXPOSURE PATHWAYS
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

	CURRENT USE	FUTURE USE
EXPOSURE PATHWAY	INDUSTRIAL WORKER	CONSTRUCTION WORKER
INHALATION OF CHEMICALS VOLATILIZING FROM SOIL*	X	—
DERMAL CONTACT WITH SEDIMENT OR SOIL	—	X
INGESTION OF SEDIMENT OR SOIL	—	X

NOTES:
* - Consists of surface and subsurface soil.
X - Indicates a complete exposure pathway.
— - No pathway exists.

TABLE 8

INGESTION OF CARCINOGENIC CHEMICALS IN SOIL - SETTLEMENT AREA
FUTURE USE - CANCER RISK
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	POTENTIAL POTENCY FACTOR (unitless)	EXPOSURE CONCENTRATION IN SOIL (CS) (mg/kg)	INTAKE (mg/kg-day)	SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK
			CONSTRUCTION WORKER	ORAL	CONSTRUCTION WORKER
Benzo(a)anthracene	0.1	2.80E+00	2.11E-09	7.30E+00	1.54E-08
Benzo(b)fluoranthene	0.1	7.20E+00	5.42E-09	7.30E+00	3.96E-08
Benzo(a)pyrene	1.0	3.80E+00	2.86E-08	7.30E+00	2.09E-07
Indeno(1,2,3-cd)pyrene	0.1	1.20E+00	9.03E-10	7.30E+00	6.59E-09
Arsenic	—	7.96E+00	5.99E-08	1.75E+00	1.05E-07
Beryllium	—	8.77E-01	6.60E-09	4.30E+00	2.84E-08

TOTAL CANCER RISK	4E-07

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Ingestion rate	IR	mg/day	480
Conversion factor	CF	kg/mg	1.00E-06
Fraction ingested from contaminated source	FI	unitless	1
Exposure frequency	EF	days/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	25550

NOTES:

NV - No Value

EQUATIONS:

Intake = [(CS × IR × CF × FI × EF × ED) / (BW × AT)] x Potency Factor

Cancer Risk = (Intake) × (Slope Factor)

TABLE 9

INGESTION OF NONCARCINOGENIC CHEMICALS IN SOIL - SETTLEMENT AREA FUTURE USE - HAZARD INDEX CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	EXPOSURE CONCENTRATION IN SOIL (CS) (mg/kg)	INTAKE (mg/kg-day) CONSTRUCTION WORKER	REFERENCE DOSE ORAL RfD (mg/kg-day) SUBCHRONIC	HAZARD QUOTIENT (unitless) CONSTRUCTION WORKER
Benzo(a)anthracene	2.80E+00	4.41E-06	NV	NV
Benzo(b)fluoranthene	7.20E+00	1.14E-05	NV	NV
Benzo(a)pyrene	3.80E+00	5.99E-06	NV	NV
Indeno(1,2,3-cd)pyrene	1.20E+00	1.89E-06	NV	NV
Arsenic	7.96E+00	1.25E-05	3.00E-04	4.18E-02
Beryllium	8.77E-01	1.38E-06	5.00E-03	2.77E-04
			TOTAL HAZARD INDEX	**4E-02**

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Ingestion rate	IR	mg/day	480
Conversion factor	CF	kg/mg	1.00E-06
Fraction ingested from contaminated source	FI	unitless	1
Exposure frequency	EF	days/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	122

NOTES:

NV - No Value

EQUATIONS:

Intake = (CS × IR × CF × FI × EF × ED) / (BW × AT)

Hazard Quotient = (Intake) / (Reference Dose)

TABLE 10

INGESTION OF CARCINOGENIC CHEMICALS IN SEDIMENT - RECIRCULATING POND FUTURE USE - CANCER RISK CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	POTENTIAL POTENCY FACTOR (unitless)	EXPOSURE CONCENTRATION IN SEDIMENT (CS) (mg/kg)	INTAKE (mg/kg-day)	SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK (unitless)
			CONSTRUCTION WORKER	ORAL	CONSTRUCTION WORKER
Aroclor-1242	—	3.20E+00	2.41E-08	7.70E+00	1.85E-07
Arsenic	—	7.99E+00	6.01E-08	1.75E+00	1.05E-07
Beryllium	—	8.28E-01	6.23E-09	4.30E+00	2.68E-08
			TOTAL CANCER RISK		3E-07

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Ingestion rate	IR	mg/day	480
Conversion factor	CF	kg/mg	1.00E-06
Fraction ingested from contaminated source	FI	unitless	1
Exposure frequency	EF	days/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	25550

NOTES:

NV - No Value

EQUATIONS:

Intake = [(CS × IR × CF × FI × EF × ED) / (BW × AT)] x Potency Factor

Cancer Risk = (Intake) × (Slope Factor)

TABLE 11

INGESTION OF NONCARCINOGENIC CHEMICALS IN SEDIMENT - RECIRCULATING POND FUTURE USE - HAZARD INDEX CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	EXPOSURE CONCENTRATION IN SEDIMENT (CS) (mg/kg)	INTAKE (mg/kg-day) CONSTRUCTION WORKER	REFERENCE DOSE ORAL RfD (mg/kg-day) SUBCHRONIC	HAZARD QUOTIENT (unitless) CONSTRUCTION WORKER
Aroclor-1242	3.20E+00	5.05E-06	NV	NV
Arsenic	7.99E+00	1.26E-05	3.00E-04	4.20E-02
Beryllium	8.28E-01	1.31E-06	5.00E-03	2.61E-04
			TOTAL HAZARD INDEX	4E-02

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Ingestion rate	IR	mg/day	480
Conversion factor	CF	kg/mg	1.00E-06
Fraction ingested from contaminated source	FI	unitless	1
Exposure frequency	EF	days/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	122

NOTES:

NV - No Value

EQUATIONS:

Intake = (CS × IR × CF × FI × EF × ED) / (BW × AT)

Hazard Quotient = (Intake) / (Reference Dose)

TABLE 12

DERMAL CONTACT WITH CARCINOGENIC CHEMICALS IN SEDIMENT - RECIRCULATING POND
FUTURE USE - CANCER RISK
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	EXPOSURE CONCENTRATION IN SEDIMENT (CS) (mg/kg)	ABSORPTION FACTOR (ABS) (unitless)	ABSORBED DOSE (mg/kg-day)	SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK (unitless)
			CONSTRUCTION WORKER	ORAL	CONSTRUCTION WORKER
Aroclor-1242	3.20E+00	0.06	9.40E-09	7.70E+00	7.23E-08

TOTAL CANCER RISK	7E-08

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Conversion factor	CF	kg/mg	1.00E-06
Skin surface area available for contact	SA	cm^2/event	3120
Soil to skin adherence factor	AF	mg/cm^2	1
Exposure frequency	EF	events/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	25550

NOTES:

NV - No Value

EQUATIONS:

Absorbed Dose = (CS × CF × SA × AF × ABS × EF × ED) / (BW × AT)

Cancer Risk = (Absorbed Dose) × (Slope Factor)

TABLE 13

INGESTION OF CARCINOGENIC CHEMICALS IN SEDIMENT - SETTLEMENT DITCH FUTURE USE - CANCER RISK CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	POTENTIAL POTENCY FACTOR (unitless)	EXPOSURE CONCENTRATION IN SEDIMENT (CS) (mg/kg)	INTAKE (mg/kg-day)	SLOPE FACTOR (mg/kg-day)^-1	CANCER RISK (unitless)
			CONSTRUCTION WORKER	ORAL	CONSTRUCTION WORKER
Benzo(a)anthracene	0.1	1.80E+00	1.36E-09	7.30E+00	9.89E-09
Benzo(b)fluoranthene	0.1	2.50E+00	1.88E-09	7.30E+00	1.37E-08
Benzo(a)pyrene	1.0	1.10E+00	8.28E-09	7.30E+00	6.05E-08
Arsenic	—	1.71E+01	1.29E-07	1.75E+00	2.25E-07
Beryllium	—	8.39E-01	6.32E-09	4.30E+00	2.72E-08
Chromium	—	1.36E+03	1.02E-05	NV	NV

TOTAL CANCER RISK	3E-07

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Ingestion rate	IR	mg/day	480
Conversion factor	CF	kg/mg	1.00E-06
Fraction ingested from contaminated source	FI	unitless	1
Exposure frequency	EF	days/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	25550

NOTES:

NV - No Value

EQUATIONS:

Intake = [(CS × IR × CF × FI × EF × ED) / (BW × AT)] x Potency Factor

Cancer Risk = (Intake) × (Slope Factor)

TABLE 14

INGESTION OF NONCARCINOGENIC CHEMICALS IN SEDIMENT - SETTLEMENT DITCH FUTURE USE - HAZARD INDEX CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

CHEMICAL	EXPOSURE CONCENTRATION IN SEDIMENT (CS) (mg/kg)	INTAKE (mg/kg-day)	REFERENCE DOSE ORAL RfD (mg/kg-day)	HAZARD QUOTIENT (unitless)
		CONSTRUCTION WORKER	SUBCHRONIC	CONSTRUCTION WORKER
Benzo(a)anthracene	1.80E+00	2.84E-06	NV	NV
Benzo(b)fluoranthene	2.50E+00	3.94E-06	NV	NV
Benzo(a)pyrene	1.10E+00	1.73E-06	NV	NV
Arsenic	1.71E+01	2.70E-05	3.00E-04	8.99E-02
Beryllium	8.39E-01	1.32E-06	5.00E-03	2.65E-04
Chromium	1.36E+03	2.14E-03	2.00E-02	1.07E-01
			TOTAL HAZARD INDEX	2E-01

PARAMETER	SYMBOL	UNITS	CONSTRUCTION WORKER
Ingestion rate	IR	mg/day	480
Conversion factor	CF	kg/mg	1.00E-06
Fraction ingested from contaminated source	FI	unitless	1
Exposure frequency	EF	days/year	85
Exposure duration	ED	years	0.33
Body weight	BW	kg	70
Averaging time	AT	days	122

NOTES:

NV - No Value

EQUATIONS:

Intake = (CS × IR × CF × FI × EF × ED) / (BW × AT)

Hazard Quotient = (Intake) / (Reference Dose)

TABLE 15
TOXICITY VALUES
CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE
POTENTIAL NONCARCINOGENIC EFFECTS

	Reference Dose (mg/kg-day)				Critical Effect				Reference-Date			
	Subchronic		Chronic		Subchronic		Chronic		Subchronic		Chronic	
Chemical	Inhalation RfD	Oral RfD	Inhalation RfD	Oral RfD	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	Inhalation	Oral
Benzo(a)anthracene	ND	ND	ND	ND	--	--	--	--	--	--	--	--
Chrysene	ND	ND	ND	ND	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	ND	ND	ND	ND	--	--	--	--	--	--	--	--
Benzo(a)pyrene	ND	ND	ND	ND	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ND	ND	ND	ND	--	--	--	--	--	--	--	--
Aroclor-1242	ND	ND	ND	ND	--	--	--	--	--	--	--	--
Arsenic	ND	3.00E-04	ND	3.00E-04	--	Keratosis	--	Keratosis	--	HEAST-FY94	--	IRIS-6/95
Beryllium	ND	5.00E-03*	ND	5.00E-03	—	No adverse effects	—	No adverse effects	—	—	—	IRIS-9/95
Chromium (III)	ND	1.00E+00	ND	1.00E+00	--	No effects observed	--	No effects observed	--	HEAST-FY94	--	IRIS-6/95
Chromium(VI)	ND	2.00E-02	ND	2.00E-02	--	No effects observed	--	No effects observed	--	HEAST-FY94	--	IRIS-6/95

IRIS - Integrated Risk Information System. Date indicates access to IRIS.
HEAST - Health Effects Assessment Summary Tables. Date indicates the fiscal year they were published.
RfD - Reference Dose
ND - Not Determined
* - In the absence of established subchronic RfD values, chronic RfD values are utilized.

POTENTIAL CARCINOGENIC EFFECTS

	Slope Factor (mg/kg-day)^-1		Weight-of-Evidence	Tumor Site		Reference-Date	
Chemical	Inhalation	Oral	Classification	Inhalation	Oral	Inhalation	Oral
Benzo(a)anthracene	ND	ND	B2	—	—	—	—
Chrysene	ND	ND	B2	—	—	—	—
Benzo(b)fluoranthene	ND	ND	B2	—	—	—	—
Benzo(a)pyrene	ND	7.30E+00	B2	—	Forestomach, larynx	—	IRIS-6/95
Indeno(1,2,3-c,d)pyrene	ND	ND	B2	—	—	—	—
Aroclor-1242	ND	7.70E+00	B2	—	Liver	—	IRIS-6/95
Arsenic	1.50E+01	1.75E+00	A	Lung, skin	Lung, skin	IRIS-6/95	IRIS-6/95
Beryllium	8.40E+00	4.30E+00	B2	Lung, osteosarcom	Lung, osteosarcomas	IRIS-9/95	IRIS-9/95
Chromium(VI)	4.20E+01	ND	A	Lung	--	IRIS-6/95	--

IRIS- Integrated Risk Information System. Date indicates access to IRIS.
ND - Not determined
▨ - Arsenic value based on exposure in drinking water with a unit risk of 5E-5 µg/l derived from IRIS-(6/94).

TABLE 16

CANCER RISKS AND HAZARD INDICES FOR MULTIPLE EXPOSURE PATHWAYS CARBORUNDUM - MONOFRAX REFRACTORIES DIVISION, FALCONER, NY SITE

EXPOSURE PATHWAY	FUTURE USE CONSTRUCTION WORKER	
	CANCER RISK	HAZARD INDEX SUBCHRONIC
Dermal Contact with Sediment-Recirculating Pond	7E-08	NV
Ingestion of Sediment-Recirculating Pond	3E-07	4E-02
Ingestion of Sediment-Settlement Ditch	3E-07	2E-01
Ingestion of Soil-Settlement Area	4E-07	4E-02
TOTAL EXPOSURE CANCER RISK	**1E-06**	▨
TOTAL EXPOSURE HAZARD INDEX	▨	**3E-01**

NOTE:

NV - Data inadequate to calculate risks.

ATTACHMENT 1

TOXICOLOGICAL PROFILES

TOXICOLOGICAL PROFILES
CARBORUNDUM-MONOFRAX REFRACTORIES DIVISION
FALCONER, NY SITE

ARSENIC

Arsenic exists to a small extent in the elemental form but is usually present in various chemical states. Inorganic arsenic usually refers to tri- or pentavalent arsenic combined with oxygen, sulfur or chlorine. Organic arsenic refers to arsenic combined with carbon and hydrogen groups; an example is methylated arsenic as found in herbicides.

Of an estimated total release of approximately 10,000 short tons annually in the United States, smelter activity accounts for about 50%, biocide (pesticide, herbicide, fungicide) used contributes 32%, and glass production contributes about 7%, with the remaining amount being released from various other sources. One of these minor sources is incineration of municipal waste.

Arsenic toxicity varies with its valency and the chemical form of the compound. Inorganic trivalent compounds are more acutely toxic than pentavalent compounds, both of which are more toxic than organic arsenic compounds. No reports have been found showing that metallic arsenic exhibits acute toxicity to organisms.

Qualitative data on toxic levels of arsenic from inhalation exposure indicate that high levels may be associated with severe irritation of the nasal mucosa, larynx, and bronchi. Inorganic arsenic exposure has been related to reversible effects on the nervous and hematopoietic systems.

Acute arsenic poisoning in adults is associated with relatively large doses (>70 to 180 mg). Symptoms of arsenic toxicity include fever, anorexia, melanosis, and cardiac arrhythmia, which may be followed by cardiovascular failure. Other symptoms include severe gastrointestinal damage, shock, and coma. Direct toxic effects on the liver, hematopoietic, nervous, and cardiovascular systems may also occur. Some effects are reversible while others are not.

In man, chronic oral exposure to arsenic may induce a sequence of changes in the skin, proceeding from hyperpigmentation to hyperkeratosis and leading in some cases to skin cancers, which are characterized as either squamous carcinomas in the keratotic areas or basal cell carcinomas. Respiratory cancer is associated with inhalation exposure to arsenic, as indicated by studies of smelter workers and workers engaged in the production and use of arsenical pesticides.

BENZO(a)ANTHRACENE

Benzo(a)anthracene produced tumors in mice exposed by gavage, intraperitoneal, subcutaneous or intramuscular injection and topical application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. Although there are no human data that specifically link exposure to benzo[a]-anthracene to human cancers, benzo(a)anthracene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke.

Benzo(a)anthracene is a polycyclic aromatic hydrocarbon (PAH) compound. Because it is formed when gasoline, garbage, or any animal or plant material burns, it is usually found in smoke or soot. This chemical combines with dust particles in the air and is carried into water and soil and onto crops. Benzo(a)anthracene is found in coal tar pitch used by industry as an adhesive.

BENZO(b)FLUORANTHENE

There are no data available to assess significant exposure levels of benzo(b)fluoranthene alone for humans. Reports of adverse health effects such as carcinogenicity by the inhalation and dermal routes of exposure do exist for mixtures that include benzo(b)fluoranthene thus providing some information to qualitatively assess its role as a human carcinogen. It is a carcinogen via various routes; a poison to rats via subcutaneous route; a contaminant in food, water, and smoke; and an experimental teratogen, neoplastic agent, and mutagen.

Benzo(b)fluoranthene, in its pure form, is a colorless crystalline solid. It is a polycyclic aromatic hydrocarbon that is formed during combustion of fossil fuels and organic material.

BENZO(a)PYRENE

Short term and intermediate oral exposure to very high levels of benzo(a)pyrene resulted in death in experimental animals. The induction of cancer is the key endpoint of toxicity following chronic exposures to lower doses of benzo(a)pyrene in the diet. Lethal effect from high doses of benzo(a)pyrene were caused by bone marrow depression. There is no information available for the potential human carcinogenicity following oral benzo(a)pyrene exposure. Studies with experimental animals have produced leukemia and tumors of the forestomach and lung following intermediate exposure in mice.

No short term or intermediate inhalation exposure effects are available for benzo(a)pyrene. The induction of cancer is the key long term effect. Benzo(a)pyrene is a moderately potent experimental carcinogen in many species by many routes of exposure. There are no reports directly correlating human benzo(a)pyrene exposure and tumor development, although humans are likely to be exposed by all routes.

Benzo(a)pyrene is a polycyclic aromatic hydrocarbon (PAH) compound. It is formed when any organic material burns and is usually found in smoke and soot as a combustion by-product. Benzo(a)pyrene is found in coal tar pitch used by the industry, and is found in creosote. People may be exposed to benzo(a)pyrene from environmental sources such as air, water, and soil, and from tobacco smoke and overcooked food. Typical exposure are not usually to benzo(a)pyrene alone, but to a mixture of similar chemicals.

BERYLLIUM

Beryllium, is a gray metal that combines the properties of light weight and high tensile strength. Beryllium is used as a neutron reflector and neutron moderator in nuclear reactors. It is also used in the manufacture of beryllium alloys, namely beryllium copper and beryllium aluminum. Beryllium is also used for radio components, in aerospace structures, and inertial guidance systems.

Death may result from short exposure to very low concentrations of beryllium and its salts (Merck 1989). Contact dermatitis, chemical conjunctivitis, corneal burns, nonhealing ulceration at site of injury, and subcutaneous nodules may occur following exposure to this element. Acute effects include pneumonitis, which may result from a single exposure to beryllium and is occasionally fatal. Pulmonary granulomatens disease may appear in three months to 15 years, often after short exposure. The death rate is approximately 25 percent.

Studies of workers at a beryllium processing plant reported significant increases of lung cancer. There is evidence for induction of tumors by a variety of beryllium compounds via inhalation and intratracheal instillation and the induction of osteosarcomas in rabbits by intravenous or intramedullary injection in multiple studies (IRIS 1995).

CHROMIUM

Hexavalent chromium is more toxic than trivalent chromium. Inhalation causes the greatest effects. The effects of inhalation exposure to hexavalent chromium include ulcers of the upper respiratory tract, nasal inflammation, perforation of the nasal septa and lung cancer. Hexavalent chromium is mutagenic in bacteria and mammalian cells and causes chromosomal effects in mammalian cells. Most trivalent chromium compounds are inactive in short-term genotoxicity assays. Chromium salts are teratogenic in animals by the intraperitoneal and intravenous routes. No information on the developmental or reproductive effects of ingested or inhaled chromium were found in the available literature.

CHRYSENE

Chrysene produced carcinomas and malignant lymphoma in mice after intraperitoneal injection and skin carcinomas in mice following dermal exposure. In mouse skin painting assays, chrysene tested positive in both initiation and complete carcinogen studies. Chrysene produced chromosomal abnormalities in hamsters and mouse germ cells after gavage exposure, positive responses in bacterial gene mutation assays, and transformed mammalian cells exposed in culture. It was shown to be a complete carcinogen. Chrysene has produced positive results for initiating activity in several mouse strains when applied in combination with various promoting agents producing skin papillomas and carcinomas. Although there are no human data that specifically link exposure to chrysene to human cancers, chrysene is a component of mixtures that have been associated with human cancer. These include coal, tar, soots, coke oven emissions and cigarette smoke.

Chrysene is a polycyclic aromatic hydrocarbon (PAH) compound. Because it is formed when gasoline, garbage, or any animal or plant material burns, it is usually found in smoke and soot. This chemical combines with dust particles in the air and is carried into water and onto soil and crops.

Chrysene is found in coal tar pitch used by the industry as an adhesive. People may be exposed to chrysene from environmental sources such as air, water, and soil, and from tobacco smoke and overcooked food. Typical exposure are not usually to chrysene alone, but to a mixture of similar compounds.

INDENO (1,2,3-c,d)PYRENE

Indeno(1,2,3-c,d) pyrene is a polycyclic aromatic hydrocarbon (PAH) compound. Because it is formed when fossil fuels, garbage, or any animal or plant material burns, it is usually found in smoke and soot. This chemical combines with dust particles in the air and is carried into water and onto soil and crops. Indeno(1,2,3-c,d) pyrene is found in coal tar pitch used by the industry as an adhesive.

There are animal data that specifically link exposure to indeno (1,2,3-c,d) pyrene with human cancers. It produced tumors in mice following lung implants, subcutaneous injection and dermal exposure. Indeno(1,2,3-c,d) pyrene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, overcooked food and tobacco smoke.

POLYCHLORINATED BIPHENYLS (PCBs) - AROCLOR 1242

Polychlorinated biphenyls (PCBs) are complex mixtures containing isomers of chlorobiphenyls with different chlorine content. There are 209 possible compounds obtainable by substituting chlorine for hydrogen on different positions of the biphenyl ring system. It should also be noted that PCB commercial mixtures have been shown to contain other classes of chlorinated derivatives. PCBs are used in electrical capacitors, electrical transformers, vacuum pumps, and gas-transmission pumps. They are also used in hydraulic fluids, plasticizers, adhesives, fire retardants, wax extenders, inks, lubricants, and oils.

Aroclor-1242 is moderately toxic via oral and dermal routes. It is an experimental carcinogen.