Revised Draft Report

Environmental Evaluation

Shieldalloy Metallurgical Corporation
Newfield, New Jersey

April 1994

TRC

TRC Environmental Corporation

ENVIRONMENTAL EVALUATION

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

April 1994

Submitted by:

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TRC Project No. C7650-S51-40

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EXECUTIVE SUMMARY

Introduction

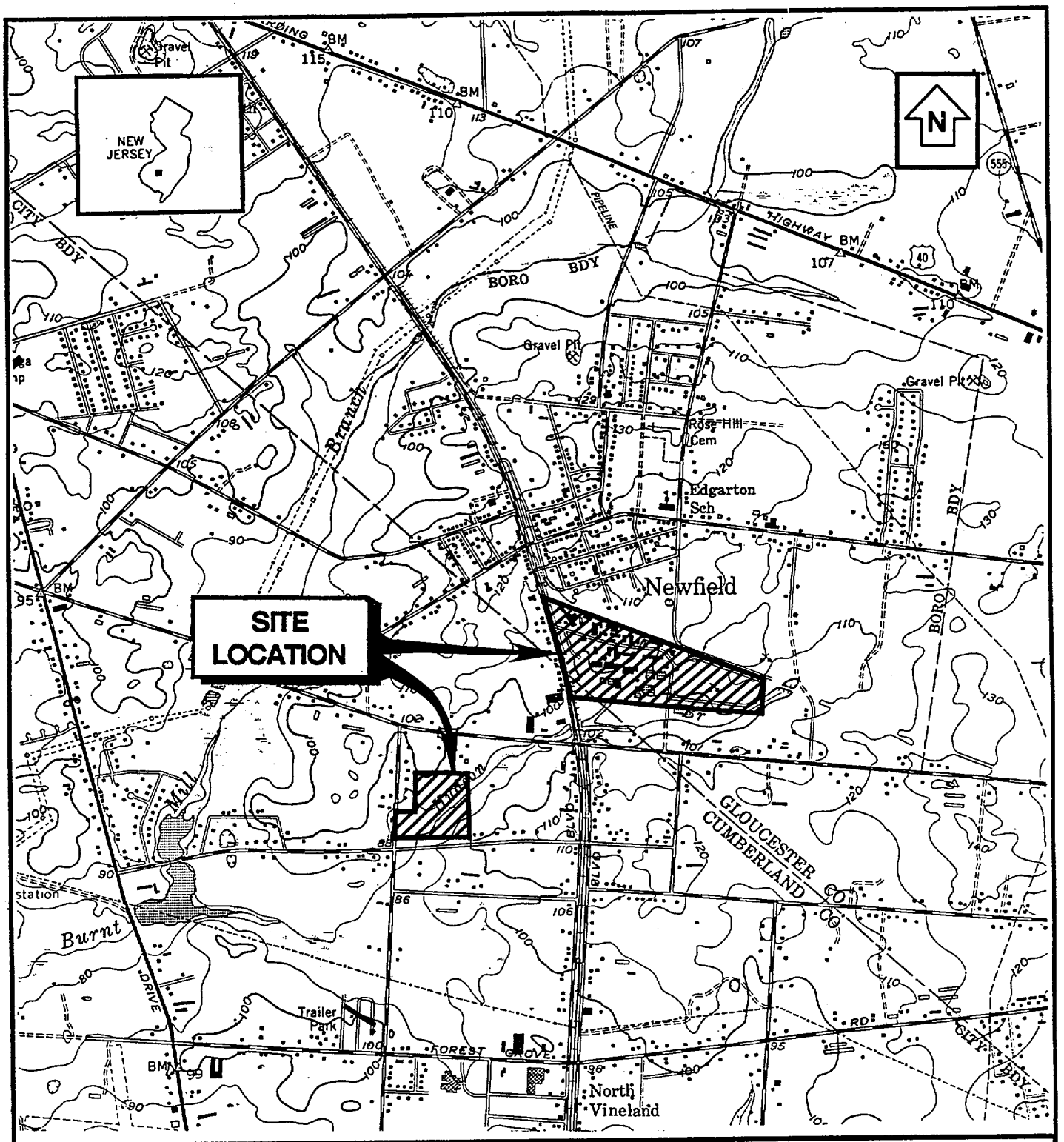
This report provides an Environmental Evaluation (EE) for Shieldalloy Metallurgical Corporation's (SMC) Newfield, New Jersey facility, as required under Administrative Consent Order (1988). The environmental evaluation provides a qualitative assessment of the actual or potential impacts associated with the SMC site in Newfield, New Jersey (see Figure ES-1 for the site location and Figure ES-2 for the site plan), on plants and animals (other than people or domesticated species).

This EE relies upon environmental constituent of concern (COC) data collected during the remedial investigation (TRC, 1992), as well as field observations and biological data specific to the area collected from a variety of sources. The efficacy of specific remedial programs is not included as part of this analysis.

Objectives and Methodology

The primary objectives of this assessment are to identify the ecosystems, habitats, and populations likely to be found at the SMC site and to characterize the constituents, exposure routes and potential impacts on the identified environmental components.

The methodology is structured utilizing the most current methods accepted by USEPA in the Interim Final Risk Assessment Guidance for Superfund, Volume II (Environmental Evaluation Manual) (1989a) and guidance provided by NJDEPE Bureau of Environmental Evaluation and Risk Assessment (1991). Following the guidelines accepted by the USEPA, the basic components of the EE are presented as follows:



0 2000 FT
SCALE

FROM NEWFIELD, NJ 7 1/2' USGS
TOPOGRAPHIC MAP, 1953
PHOTOREVISED 1986

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FIGURE ES-1.
SITE LOCATION

Date: 4/94 | Drawing No. C7650-40

1. Problem Formulation: relate quantitative and spatial extent of constituents to areas of concern (AOC) to determine what types of receptors may be at greatest potential risk; scope the approach for assessing these risks; select the list of COCs for subsequent detailed analysis.

2. Exposure Assessment: determine which pathways are most likely to produce significant exposures to selected indicator species.

3. Stressor-Response Relationships: develop an understanding of COC potency for indicator species via review of pertinent laboratory or field toxicity studies; derive the lowest observable adverse effect level (LOAEL) and no observable adverse effect level (NOAEL) pertinent to indicator species on-site; develop environmental effects levels (EEL) for the level of daily exposure expected to be without adverse effect; obtain water and sediment quality criteria for the protection of aquatic life.

4. Risk Characterization: compare media concentrations to EELs and surface water and sediment criteria.

Resource characterization and risk assessment are addressed for terrestrial and wetland receptors. The terrestrial component divides the site into upland areas of concern as requested by NJDEPE (1994). The wetland receptors are designated as those associated with the Hudson Branch.

Problem Formulation

The background information and site description provided in this report indicate that historical site uses have caused releases of COCs that may create exposures to ecological receptors.

Five industrial Areas of Concern (AOCs), including the Leachate Storage AOC, the Manufacturing AOC, the Chromate Wastewater Spill AOC, the Nuclear Regulatory Commission (NRC) Controlled AOC, and the Railroad Siding AOC were identified for the purposes of the EE. With the exception of the Chromate Wastewater Spill AOC, these areas were previously defined in the RI workplan.

Three additional AOCs were defined from the undeveloped industrial areas currently devoid of buildings and were not previously identified as AOCs in the RI.

Finally, the wetland running along the south edge of the site is divided into three ecological areas of concern (the headwaters for the Hudson Branch, the Hudson Branch ponded region and the Hudson Branch channelized/flood plain region). These industrial, undeveloped, and ecological AOCs are presented in Figure ES-3.

Numerous inorganics were detected in all media and in all AOCs. Volatile organic compounds, semi-volatile organic compounds, and pesticides/PCBs were detected most commonly in the Manufacturing AOC, with a few detected organic compounds in the NRC Controlled AOC, Undeveloped AOC #1, and stream sediments and surface water.

Exposure Assessment

The exposure scenarios developed place indicator species within pathways that are most likely to contribute to exposure. In exposure assessment, the uptake mechanisms for each pathway are described in terms of their relative importance. Receptor contact with affected media can lead to exposure via drinking surface water, ingesting soil or sediment, dermal contact with soil, sediment, or surface water, and ingestion of food resources that are derived from affected media. The significance of these exposure pathways for indicator species and for COCs is discussed.

An extensive list of endangered/threatened animal species was provided for the two counties which border the site. The exposure pathways for these special concern receptors are

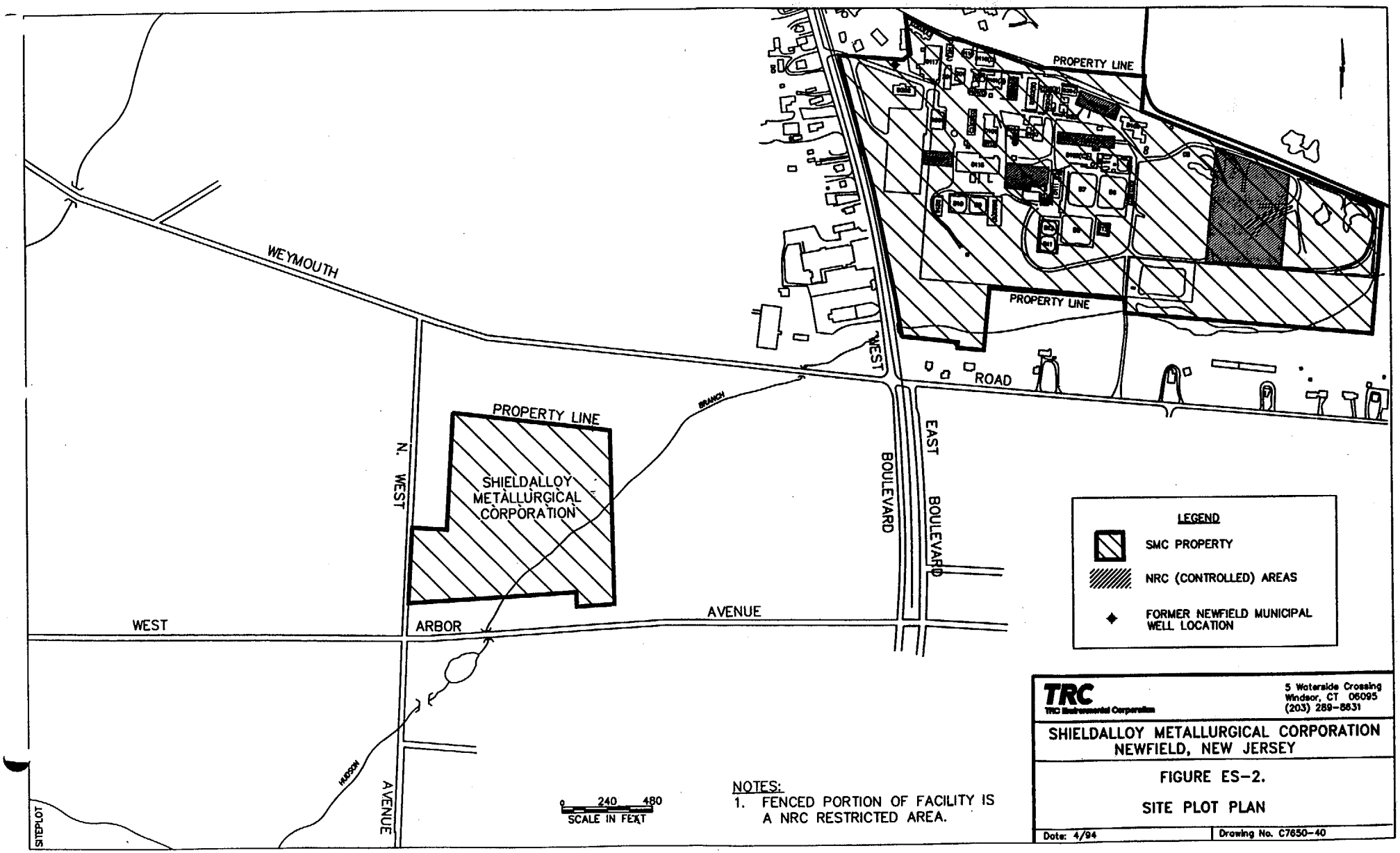
PROPERTY LINE
PROPERTY LINE
WEYMOUTH
WEST
ROAD
PROPERTY LINE
SHIELDALLOY METALLURGICAL CORPORATION
BRANCH
N. WEST
BOULEVARD
EAST
BOULEVARD
WEST
ARBOR
AVENUE
HUDSON
AVENUE
SITEPLOT
LEGEND
SMC PROPERTY
NRC (CONTROLLED) AREAS
FORMER NEWFIELD MUNICIPAL WELL LOCATION
0 240 480
SCALE IN FEET
NOTES:
1. FENCED PORTION OF FACILITY IS A NRC RESTRICTED AREA.
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FIGURE ES-2.
SITE PLOT PLAN
Date: 4/94
Drawing No. C7650-40

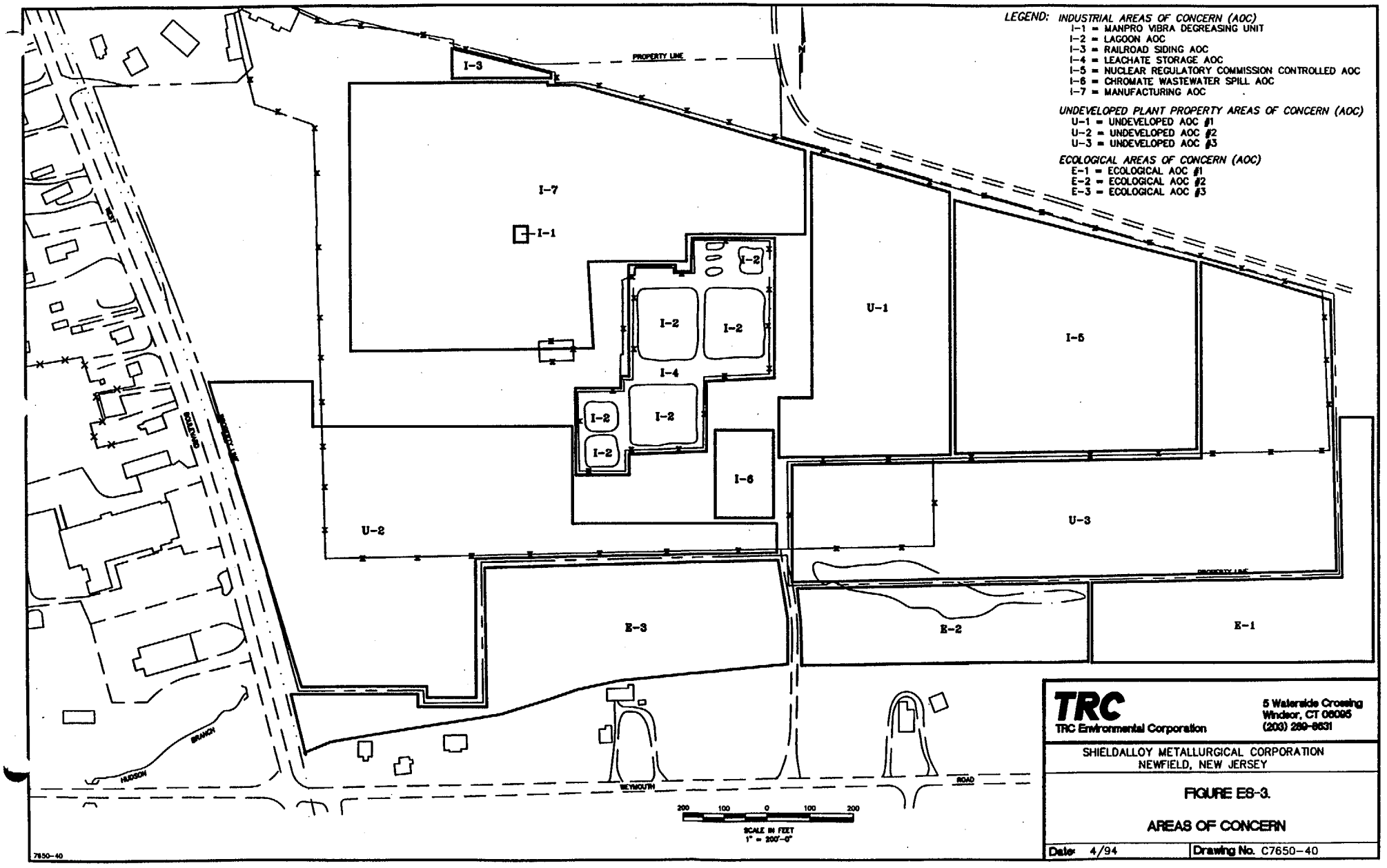

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FIGURE ES-3.

AREAS OF CONCERN

Date: 4/94 | Drawing No. C7650-40

not unlike those described for indicator species. Therefore, the discussion of indicator species potential exposures and risks is also applicable to the phylogenetically similar endangered/threatened species.

Stressor-Response Assessment

Stressor-response relationships for COCs are quantified by single point estimates useful for evaluating exposures to aquatic or terrestrial receptors. These point estimates represent limiting criteria concentrations at which adverse effects are unlikely even if exposure is chronic.

Sediment quality criteria and surface water quality criteria values are used to represent concentrations of constituents in sediment at which adverse effects on benthic and/or aquatic organisms should not occur. For terrestrial species, there are currently no criteria with which to compare surface soil concentrations against in order to assess potential ecological harm to vertebrate terrestrial receptors. However, various literature sources have reported stressor-response data that are useful in generating Environmental Effect Levels (EELs). An EEL is an environmental concentration (in soil or food resources) that should be devoid of toxic effects based upon the no observed adverse effect levels taken from the literature. Environmental concentrations above the EEL may begin to represent an elevated risk.

There are currently no criteria with which to compare surface soil concentrations against in order to assess potential ecological harm to vegetative receptors (plants). However, various literature sources have reported stressor-response data for no observable adverse effect level or phytotoxic levels in plant species and these values are used in this EE.

Risk Characterization

The bases for the current risk characterization are the surface water and sediment criteria for the evaluation of risk to aquatic receptors and for the evaluation of risk to terrestrial and avian species, the EELs and phytotoxic concentration are used. This analysis focuses upon the regions where useable habitat is currently found: Undeveloped AOC #2 and #3, and Ecological AOC #1, #2, and #3.

The EE projects elevated ecological risks for a variety of receptors due to inorganics present in soil, sediment, and surface water. However, uncertainties in this assessment surround the degree of exposure possible for ecoreceptors, the inherent toxicity of detected analytes, and data gaps with respect to media sampling. These uncertainties are highlighted by the fact that the EE prediction of ecological impact is contradicted by field surveys, which to this point have failed to detect indicators of chemical stress. Therefore, the uncertainty analysis is an important component of this EE.

Summary and Conclusions

This EE utilized comparisons of environmental concentrations against sediment and surface water quality criteria, and against environmental effects levels to conclude that stresses are possible to wetland and terrestrial receptors.

Of the five sediment samples collected from the Hudson Branch, sample SD-2 exhibited the largest exceedances of the available sediment criteria. The increase above the sediment criteria in SD-2 ranged from 2-fold for mercury and zinc to 100-fold for chromium. Inorganics which were consistently elevated across the sediment samples include antimony, chromium, and nickel.

A similar trend is evident for the surface water samples collected from the Hudson Branch. Sample SW-2 contained the largest number of COCs for which one or more of the available surface water criteria were exceeded. Further, the largest exceedances of these criteria were also associated with sample SW-2. The increase above the surface water criteria in SW-2 ranged from 5-fold for aluminum and beryllium (as compared to the EPA AWQC) to 3,300-fold for beryllium (as compared to the NJDEPE SWQS). Inorganics for which one or more of the surface water criteria were consistently exceeded across samples include aluminum, chromium, and lead.

Undeveloped AOC #2 and #3 contain open, mowed grassy fields which may form habitat for a limited food web. Undeveloped AOC #1 is an unvegetated area within the industrial site and does not include useable habitat. The COCs in surface soil for Undeveloped AOC #2 and #3 were evaluated with regard to their potential impacts on selected receptors in the terrestrial food chain. Risks from elevated soil concentrations for cadmium and nickel in Undeveloped AOC #2 and manganese in Undeveloped AOC #3 appear to be of greatest concern to local populations of mice and rabbits, with a marginal level of concern for raptors which may sporadically utilize these AOCs.

TABLE OF CONTENTS

SECTION		PAGE
1.0	**INTRODUCTION**	1-1
1.1	Objectives	1-1
1.2	Site Description	1-2
1.2.1	Operations and History	1-3
2.0	**METHODOLOGY**	2-1
2.1	Data Collection	2-3
2.2	Data Evaluation	2-4
2.3	Identification of Ecosystems, Habitats, and Populations	2-6
2.4	Wetlands Delineation Methodology	2-7
3.0	**PROBLEM FORMULATION**	3-1
3.1	Description of Industrial, Undeveloped, and Ecological Areas of Concern (AOCs)	3-1
3.1.1	Industrial AOCs	3-1
3.1.2	Undeveloped AOCs	3-3
3.1.3	Ecological AOCs	3-5
3.1.4	Overview of the Wetland Habitats	3-9
3.2	Field Investigation Summary	3-12
3.3	COC Concentrations in Affected Media	3-13
3.3.1	Sampling Results: Industrial COCs	3-14
3.3.2	Sampling Results: Undeveloped AOCs	3-18
3.3.3	Summary of Ecological AOC Sediment Data	3-22
3.3.4	Summary of Ecological AOC Surface Water Data	3-23
3.3.5	Sampling Results: Ecological AOCs	3-24
3.4	Selection of Constituents of Concern	3-27
3.5	Selection of Indicator Species and Exposure Pathways	3-28
3.5.1	Exposure Scenarios in Upland Industrial Areas	3-29
3.5.2	Exposure Scenarios in Upland Undeveloped Areas	3-30
3.5.3	Exposure Scenarios in Wetland Habitats	3-31
3.6	Endangered Species Search	3-32
3.7	Formulation of the Potential Ecological Problem	3-33
4.0	**EXPOSURE ASSESSMENT**	4-1
4.1	Incorporation of COCs into Plants	4-1
4.2	Incorporation of COCs into Soil/Sediment Organisms	4-3
4.3	Indicator Species Exposure to COCs	4-5
4.4	Potential Exposure to Endangered/Threatened Species	4-10

TABLE OF CONTENTS
(Continued)

SECTION		PAGE
5.0	**STRESSOR-RESPONSE ASSESSMENT**	5-1
5.1	Surface Water and Sediment Criteria	5-1
5.2	Criteria for Terrestrial Species	5-3
5.2.1	Stressor-Response Profiles for Key COCs	5-4
5.3	Phytotoxicity	5-7
6.0	**RISK CHARACTERIZATION**	6-1
6.1	Upland Undeveloped AOCs	6-1
6.2	Wetland Habitats	6-4
6.2.1	Ecological AOC #1	6-5
6.2.2	Ecological AOC #2	6-5
6.2.3	Ecological AOC #3	6-8
6.3	Potential for Phytotoxicity in Undeveloped and Ecological AOCs	6-10
6.3.1	Undeveloped AOC #2	6-11
6.3.2	Undeveloped AOC #3	6-12
6.3.3	Ecological AOC #2	6-13
6.3.4	Ecological AOC #3	6-14
6.4	Uncertainty Analysis	6-15
6.4.1	Uncertainties Surrounding Exposure Assessment	6-15
6.4.2	Uncertainties Surrounding Stressor-Response Assessment	6-16
6.4.3	Uncertainty Arising from Field Evidence	6-17
6.4.4	Uncertainties Due to Data Gaps	6-17
7.0	**CONCLUSIONS AND RECOMMENDATIONS**	7-1
8.0	**REFERENCES**	8-1

APPENDICES

A SURFACE SOIL, SURFACE WATER, AND SEDIMENT DATA

B COMPLETE SPECIES LIST

C ENDANGERED SPECIES DATABASE SEARCH

D GRAIN SIZE ANALYSES FOR SEDIMENT SAMPLES

LIST OF TABLES

TABLE	
2-1	Field Investigation Program Summary
2-2	Hudson Branch Wetland and Upland Species
3-1	Surface Soil Concentration Data for Leachate Storage Area
3-2	Surface Soil Concentration Data for Manufacturing Area
3-3	Surface Soil Concentration Data for Chromate Wastewater Spill Area
3-4	Surface Soil Concentration Data for NRC Controlled Area
3-5	Surface Soil Concentration Data for Railroad Siding Area
3-6	Surface Soil Concentration Data for Undeveloped Area of Concern #1
3-7	Surface Soil Concentration Data for Undeveloped Area of Concern #2
3-8	Surface Soil Concentration Data for Undeveloped Area of Concern #3
3-9	Summary of Sediment Concentration Data
3-10	Summary of Surface Water Concentration Data
3-11	Soil Cleanup Criteria for Selected Constituents
3-12	Constituents of Concern (Industrial AOCs)
3-13	Constituents of Concern (Undeveloped AOCs)
3-14	Constituents of Concern (Ecological AOCs)
3-15	Constituents Excluded from the EE (Industrial AOCs)
3-16	Constituents Excluded from the EE (Undeveloped AOCs)
3-17	Constituents Excluded from the EE (Ecological AOCs)
3-18	Natural Heritage Database Search - Endangered Vertebrates that Exist in Cumberland and Gloucester County

LIST OF TABLES
(Continued)

TABLE

4-1 Major Parameters Governing COC Uptake into the Food Chain

4-2 Physical Characteristics of Wetland Media

4-3 Equations Describing Earthworm Accumulation of COCs

4-4 Accumulation of COCs into Animal Tissues

5-1 Summary of Sediment and Surface Water Criteria

5-2 Mammalian/Avian Environmental Effects Levels

5-3 Screening Concentrations for Exposure of Vegetation to Pollutant Concentrations in Soil and Tissue

LIST OF FIGURES

FIGURE	
1-1	Site Location
1-2	Site Plot Plan
2-1	Areas of Concern
3-1	Delineated Wetland Areas
3-2	Surface Soil Sampling Locations
3-3	Sediment, Surface Water, and Wetland Soil Sampling Locations
3-4	Beryllium Exceedance of Criteria Values
3-5	Chromium Exceedance of Criteria Values
3-6	Nickel Exceedance of Criteria Values
3-7	Vanadium Exceedance of Criteria Values
3-8	Exposure Scenario for Upland Undeveloped Area
3-9	Exposure Scenario for Hudson Branck Wetlands

1.0 INTRODUCTION

1.1 Objectives

This report provides an Environmental Evaluation (EE) for Shieldalloy Metallurgical Corporation's (SMC) Newfield, New Jersey facility, as required under Administrative Consent Order (1988). The environmental evaluation provides a qualitative assessment of the actual or potential impacts associated with the SMC site in Newfield, New Jersey, on plants and animals (other than people or domesticated species). The primary objectives of this assessment are to identify the ecosystems, habitats, and populations likely to be found at the SMC site and to characterize the constituents, exposure routes and potential impacts on the identified environmental components. This evaluation follows guidelines established by USEPA (USEPA, 1989a) and NJDEPE (personal communication, 1991). A human health risk assessment has been submitted to the New Jersey Department of Environmental Protection and Energy (NJDEPE) (TRC, 1994). This EE relies upon environmental constituent of concern (COC) data collected during the remedial investigation (TRC-ECI, 1992), as well as field observations and biological data specific to the area collected from a variety of sources. The efficacy of specific remedial programs is not included as part of this analysis.

Ultimately, the EE presented in this report is expected to be used within a risk management framework. In making decisions concerning what, if anything, should be done at a site (including, for example, the collection of additional data or implementation of a remedial program), the results of the EE should be used in concert with other information generated for the site. The EE discusses the likelihood for significant risk and, where risk is greatest, the EE identifies the COCs and exposure pathways of most concern. This evaluation focuses upon baseline conditions at the site. However, the results of this study will help site managers focus

on the areas, constituents, media, pathways and receptors of greatest concern at the site, thereby helping to identify future remedial alternatives for the site.

1.2 Site Description

The SMC facility consists of approximately 67.5 acres. The manufacturing facilities and support areas are located on approximately 60 acres in Newfield and Vineland, New Jersey, within Gloucester and Cumberland Counties. SMC also owns 7.5 acres of farm lands which are located in Vineland, New Jersey, within Cumberland County. This 7.5 acre parcel is located approximately 2,000 feet southwest of the 60 acre parcel. Figure 1-1 shows the location of the site within the United States Geological Survey (USGS) 7.5 minute series topographic map of the Newfield, New Jersey Quadrangle.

The SMC Newfield property is bounded by a Conrail rail line to the west and to the north. Woods, residential homes, and small businesses are located east of the site. Hudson Branch, a tributary to Burnt Mill Branch, flows along the southern border of the site, just north of residences on Weymouth Road. A large portion of the site is enclosed by a 10-foot steel-wire fence. However, undeveloped portions of the SMC property extend beyond the fenceline. A detailed site map showing site boundaries and cultural features is presented in Figure 1-2.

The SMC property is located in the town of Newfield within New Jersey's Atlantic coastal plain. While not located within the Pine Barrens, the major physical and biological features of this site (sandy, unconsolidated soils, flat to gently sloping terrain, vegetative and wetland types) are strongly influenced by its close proximity to the Pine Barrens.

The SMC property is comprised of 4 major regions: the manufacturing area, the slag storage piles area, the holding ponds, and undeveloped areas (described in Section 3.1). The site

lies upland of the Hudson Branch, whose headwaters form just south of the southeastern corner of the site (Figure 1-2). An extensive wetland is associated with the Hudson Branch as it develops into a ponded area and then follows a stream course along the southern border of the site. The Hudson Branch then crosses West Boulevard as it flows away from the site. Recent data indicates that the Hudsan Branch is a losing stream to a point northeast of Burnt Mill Branch Pond where flow ceases entirely. Technically, the Hudson Branch is within the Maurice River drainage basin. The Maurice River receives the FW2-NT (Category II) classification in its upper reaches, while the classification for the lower portion is FW2-NT (C1) (Category I). If the Hudson Branch flowed into the upper portion of the Maurice River, it would also receive the Category II classification.

1.2.1 Operations and History

SMC (formerly Shieldalloy Corporation) has been operating at the Newfield, NJ facility since 1955. Past production processes include: chromium oxide and chromium metal production, ferrovanadium production, ferrocolumbium and columbium nickel production. A titanium metal degreasing operation was operated from 1965 to 1967. The principal production processes currently employed by SMC include aluminothermic and reduction smelting of ores, which produce purified metal, slags, and various other by-products, co-products, or other materials. Current products include aluminum master alloys, ferroalloys, crushing/grinding metal powders, and pressed metal powder briquettes. Raw materials currently used and stored at the facility include pyrochlore, columbium (niobium), ferroboron, aluminum oxide, titanium oxide, strontium oxide, zirconium oxide, dolomite lime, steel slag, lead, nickel, ferromanganese, silicon, fluoride salts, and oxides of vanadium. The raw materials are distributed to appropriate warehouse or

departments upon arrival. In the past, some raw materials may have been stored throughout the plant. As a result of these current and past manufacturing processes, the facility has generated slag, dross, baghouse dust, and wastewaters. The products and by-products produced by SMC are presented in Table 1 of the RI report (TRC-ECI, 1992).

The SMC facility has grown as manufacturing operations were expanded and new products were manufactured. The expansion of operations required the construction of buildings to house these manufacturing processes. A chronological listing of the various structures built at the SMC facility since 1955 is presented in Table 2 of the RI report (TRC-ECI, 1992).

2.0 METHODOLOGY

The methodology is structured utilizing the most current methods accepted by USEPA in the Interim Final Risk Assessment Guidance for Superfund, Volume II (Environmental Evaluation Manual) (1989a) and guidance provided by NJDEPE Bureau of Environmental Evaluation and Risk Assessment (1991).

Following the guidance accepted by USEPA and NJDEPE, the basic components of the environmental evaluation include:

- Data collection and evaluation.
- Identification of ecosystems, habitats and populations, including those protected, endangered or threatened.
- Wetlands delineation.
- Identification of the constituents of concern, source areas including concentrations, toxicity, and pathways of migration and/or exposure.
- Summarization of potential environmental risk at the site and identification of areas of greatest environmental concern.

Each of these components are discussed in detail in this and following sections.

The EE incorporates the following types of site-specific and constituent-specific data to evaluate the potential for adverse impacts to ecological receptors:

Site-Specific Data Inputs

- concentrations of constituents of potential concern (COCs) found in specific media on-site;
- the spatial relationship between affected media and likely ecologic receptors;
- hydrogeologic features of the site;
- vegetative and habitat types present on-site;
- species anticipated to be resident or actually spotted on-site; and

- protected (endangered, threatened, rare, sensitive, or unique) species and habitats present on-site.

Chemical-Specific Data Inputs

- toxicity to relevant species or suitable surrogates, as described by stressor-response relationships;
- constituent persistence and capacity for environmental transport; and
- bioaccumulation in individual receptors and potential for biomagnification.

Site-specific and constituent-specific inputs were combined in the following 4 stage process in accordance with recent USEPA guidance (USEPA, 1989a; USEPA, 1991c; USEPA, 1992):

1. Problem Formulation: relate quantitative and spatial extent of constituents to areas of concern (AOC) to determine what types of receptors may be at greatest potential risk; scope the approach for assessing these risks; select the list of COCs for subsequent detailed analysis.

2. Exposure Assessment: determine which pathways are most likely to produce significant exposures to selected indicator species.

3. Stressor-Response Relationships: develop an understanding of COC potency for indicator species via review of pertinent laboratory or field toxicity studies; derive the lowest observable adverse effect level (LOAEL) and no observable adverse effect level (NOAEL) pertinent to indicator species on-site; develop environmental effects levels (EEL) for the level of daily exposure expected to be without adverse effect; obtain water and sediment quality criteria for the protection of aquatic life.

4. Risk Characterization: compare media concentrations to EELs and surface water and sediment criteria.

Resource characterization and risk assessment are addressed for terrestrial and wetland receptors. The terrestrial component divides the site into upland areas of concern as requested by NJDEPE (1994). Soils in these upland areas are assessed based on both arithmetic mean and the upper 95th percent confidence limit (95% UCL) of the arithmetic mean surface soil concentration by area of concern. Maximum detect values are also provided and discussed.

The aquatic component analyzes the Hudson Branch as a whole, and as three separate areas. Individual surface water and sediment concentrations are compared directly against NJDEPE Surface Water Quality Standards (SWQS) and/or USEPA ambient water quality criteria (AWQC) or sediment quality criteria (SQC) for the protection of aquatic life. The sources and derivation of these criteria are provided in Section 5.

The following sections provide background regarding sampling of on-site media, methods used to screen and evaluate sampling results for the purpose of the EE, and descriptions of methodologies used for field investigations specific to the EE.

2.1 Data Collection

Key elements of the field investigation program are listed in Table 2-1. The primary goal of the field investigation program was to obtain data to:

- Characterize the hydrogeologic regime in the study area, including hydraulic properties of overburden deposits;
- Characterize the type(s) of contamination present in the study area;
- Determine areal and vertical extent of contamination in the media sampled;
- Identify pathways of constituent migration; and
- Characterize the nature and extent of constituent migration.

The field investigation activities were completed between October 1990 and April 1991. Results of these activities are presented in the Remedial Investigation (RI) Technical Report (TRC-ECI, 1992).

A Radiological Characterization Study required for NRC license renewal has been conducted by SMC for submittal (IT/PS-92-106, April 1992). The purpose of the Radiological

Characterization Study is to determine the extent of radiological contamination at and around the facility. The results of the Radiological Characterization Study and radiological sampling and analyses from wells under the AOC is included in the appendices of the final RI report and in the Feasibility Study for the site.

Identification of contaminant migration pathways is included as part of the fate and transport discussion included in the human health evaluation (TRC, 1994).

2.2 Data Evaluation

As detailed in the RI report (TRC-ECI, 1992), SMC has been operating at the Newfield, NJ facility since 1955. Past raw materials and production processes include: chromium oxide and chromium metal production, vanadium pentoxide and ferrovanadium production, uranium oxide, thorium oxide, and ferrocolumbium and columbium nickel production. Field studies have revealed the presence of numerous organic and inorganic constituents in the soils, surface water, sediments and ground water.

In order to organize the data into a form manageable and appropriate for the baseline health evaluation which is applicable to this EE, the following steps were followed during the data evaluation process as described by USEPA (1989):

1) Gather and sort all data by medium (e.g., surface soil, ground water);
2) Evaluate methods of analysis;
3) Evaluate the sample quantitation limits;
4) Evaluate the data qualifiers and codes;
5) Evaluate blank data;
6) Evaluate tentatively identified compounds (TIC's);

7) Evaluate background data;

8) Develop data sets by medium; and

9) Develop a set of chemicals of potential concern from the entire data set.

Briefly, the specific methods used for the SMC site include the following, which correlate with the previously described steps.

1) All analytical data was initially sorted by media (soil, sediments, and surface water) and by area of concern.

   Note: Surface runoff sample data were not included in the quantitative assessment because the four runoff samples were collected from major drainage pathways (near their off-site discharge points) during a heavy rainfall and, therefore, were not considered to be representative of normal surface water runoff.

2) An evaluation of analytical methods was not considered to be necessary as all data used in the quantitative analysis was analyzed by USEPA's Superfund Contract Laboratory Program (CLP) procedures. Note: Due to a miscommunication with the laboratory performing the total chromium and hexavalent chromium determinations in soil, all samples were extracted using a 24-hour cold water extraction followed by a colorometric analysis, rather than use of the requested alkaline digestion method. A technical agreement was reached between TRC and NJDEPE that only samples with total chromium results greater or equal to 100 mg/kg needed to be reanalyzed using the alkaline digestion method. Thus, the data set for chromium VI consists of alkaline digestion method results, where available, and water leach method results, where alkaline digestion method results are not available.

3) Unusually high sample quantitation limits (SQL's) were not commonly reported in any of the matrices analyzed. This indicates that in most cases, matrix or chemical interferences in the analytical determinations did not cause a loss of sensitivity at this site. One-half of the SQL was used for a non-detectable reading if there was evidence that the chemical is present in that medium. However, for non-detects where it appeared more likely that the chemical could be present at a value greater than 1/2 the SQL, the entire SQL was used. The decision to use the full SQL or 1/2 the SQL was based upon extent and degree of contamination within each medium and potential for migration between media.

4) Data validation qualifiers were assessed during the data evaluation process. As indicated in USEPA guidance (USEPA, 1989), data qualified with U, J or UJ qualifiers were used when appropriate. Not-detect values were not ignored based on the presence of "hits" within the same media.

5) Field and laboratory blanks were used to segregate actual site contamination from cross contamination from field or laboratory procedures. As indicated in USEPA (1989), sample results were considered positive only if concentrations exceeded ten times the concentration of a common laboratory constituent in a blank, or five times the concentration of a chemical that is not considered a common laboratory constituent. (Note: As requested by NJDEPE, an evaluation of the variance between USEPA (1989) and NJDEPE policies with regard to target compounds detected in blank samples has been included in the Uncertainty Assessment of the HHRA (TRC, 1994).

6) Tentatively identified compounds (TICs) were reported infrequently in surface soil samples across the site. Due to the uncertainty associated with the quantitative and qualitative nature of these TICs, they are not included in this evaluation.

7) Background soil sampling locations were identified for this site. Surface soil samples 58, 59, and 60 (RA-58, RA-59 and RA-60) were collected from the northwest portion of the site and used as reference points. Site-specific background levels were not used to eliminate naturally occurring inorganics from the EE. Due to the intermittent nature of the Hudson Branch at upstream locations, it was not possible to accurately determine background or reference points.

8) Datasets were developed by medium, and concentrations of COCs presented as a range (including the maximum detected value), the arithmetic mean, and the 95% upper confidence limit (UCL) on the arithmetic mean (see the human health risk assessment (TRC, 1994) for calculation and discussion of the 95% UCL).

2.3 Identification of Ecosystems, Habitats, and Populations

To characterize the areas that are downgrade of the site, two field surveys were completed. The main objective of the survey was to identify potentially sensitive ecological communities surrounding the site. A second objective was to compile a detailed botanical list of the species in the ecological areas surrounding the site. The descriptions of the ecological areas were also used to research possible animal populations that may be impacted by contaminants on or migrating off of the site. The first survey was conducted on October 17, 1991. The second survey was conducted on April 12 and 13, 1994. From these two searches

a botanical list was compiled for the site and the surrounding properties and is presented in Appendix B.

The method used to compile the botanical list was as follows. The wetland area was broken up into three areas (see Figure 2-1). A vegetation list was compiled for each AOC (see Table 2-2). A vegetation list was also compiled for each wetland delineation sampling point, and each surface water and sediment sampling location. A plant species list was then compiled and is presented in Appendix B.

Because both surveys were conducted during off peak growing season, it was determined by the NJDEPE (1994a) that the survey for stressed vegetation and threatened and endangered species be conducted during the month of June (1994). The results of the stressed, endangered, and threatened vegetation survey will be provided as an addendum along with the changes and conclusions to the revised Environmental Evaluation.

2.4 Wetlands Delineation Methodology

The methods used to delineate wetlands are presented in the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" (Federal Interagency Committee for Wetland Delineation, 1989) and are recognized by the New Jersey Department of Environmental Protection and Energy.

The "three parameter approach" is the methodology most widely used in identifying wetland areas. This technical approach is based on the evaluation of soils, vegetation, and hydrology for the site in question. Wetland areas under normal conditions are characterized by having: A) hydric soils, B) a predominance of hydrophytic vegetation, and C) evidence of wetland hydrology.

A) Hydric Soils - A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part.

B) Hydrophytic Vegetation - Hydrophytic vegetation is defined as macrophytic plant life growing in water, soil, or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

C) Wetland Hydrology - Wetland hydrology is the sum total of wetness characteristics in areas that are inundated or have saturated soils for a sufficient duration to support hydrophytic vegetation.

The delineation was performed using the EPA three-parameter approach. Field investigations were conducted as follows:

A) All existing background data that would aid in understanding and inspecting the site in the field was reviewed prior to and during the delineation. These data included: soils maps, wetlands maps, vegetation maps, and topographic maps.

B) A series of soil borings and excavations were made throughout the site and along the wetland line to identify the extent of the hydric soils on site. The soil investigations were conducted using a 3.25 inch hand auger. Representative soil profiles were recorded at various stations throughout the site.

C) The macrophytic vegetation and plant community composition reflect the hydrological condition of the area; thus, a vegetation inventory was conducted. Plant species were identified, vertically stratified, quantified, and classified according to the wetland indicator system established by the U.S. Fish and Wildlife Service.

D) The current hydrology of the site was reviewed in the field. Any hydrological indicators were observed and taken into consideration during the delineation.

E) The wetland delineation that was conducted in the field was marked by placing numbered "flags" along the upland/wetland boundary throughout the site. The wetland line was plotted on a site plan and can be seen in Figure 3-1.

3.0 PROBLEM FORMULATION

The background information and site description provided in Section 1 indicate that historical site uses have caused releases of COCs that may create exposures to ecological receptors. The following sections describe COC concentrations, media and habitats potentially affected by COCs, and indicator species useful for risk characterization. This portion of the EE results in the formulation of exposure scenarios which become the basis for further analysis.

3.1 Description of Industrial, Undeveloped, and Ecological Areas of Concern (AOCs)

3.1.1 Industrial AOCs

Five industrial AOCs are identified for purposes of the EE. With the exception of the Chromate Wastewater Spill AOC, these areas were previously defined in the RI workplan (ENSR, 1989). As discussed in the RI report (TRC-ECI, 1992), the Chromate Wastewater Spill AOC was investigated during the RI as a result of a 1990 spill which occurred after submittal of the workplan. Two additional industrial AOCs (the Degreasing Unit (Manpro Vibra) AOC and the Lagoon AOC) were identified. However, no surface soil samples were collected in these areas and thus are not included in this EE. Figure 2-1 presents the locations of the five industrial areas of concern.

Leachate Storage AOC

The Leachate Storage AOC is located in the central portion of the SMC facility. Relative to this area, the Manufacturing AOC is located to the northwest, the TR12 Chromate Wastewater Spill AOC to the southeast, and undeveloped facility property to the east and southwest. This area consists of nine lined lagoons used to hold treated wastewater from various processes (i.e.,

pollution control, chrome oxide production). Prior to installation of these lagoons in 1971, a larger unlined lagoon was used in the same area to hold untreated wastewater from these processes. Leaching from this previous lagoon is believed to have occurred. The soils around the lagoons were investigated as a separate area in the RI.

Manufacturing AOC

The Manufacturing AOC occupies much of the northeast portion of the SMC facility. The Railroad Siding AOC is located to the north, the Leachate Storage AOC to the southeast, and undeveloped facility property to the south, east, and west of the Manufacturing AOC. For the most part, this area is covered with buildings and asphalt or concrete drives. Specific areas located within the Manufacturing AOC include the Former Manpro-Vibra Degreasing Unit, the Underground Storage Tank (UST) Area, the Department 106 Area, the Department 102 Area, and the Chromium Button Storage Area. The Former Manpro-Vibra Degreasing Unit was used to remove dirt, fines, and grease from manufactured metals from 1965 to 1967. The USTs contained unleaded gasoline or light diesel fuel. Since the Manufacturing AOC comprises the main facility operations, offices, and loading docks, etc., it was investigated as a separate area in the RI, and is also evaluated separately in the EE.

Chromate Wastewater Spill AOC

The T12 Chromate Wastewater Spill AOC is located in the south central portion of the SMC facility. It is bordered by undeveloped facility property on the south and east, with the Leachate Storage AOC located to the northwest. This area was investigated as a result of a recent (May 1, 1990) spill of chromate wastewater from Tank T-12.

Nuclear Regulatory Commission (NRC) Controlled AOC

The NRC Controlled AOC (also known as the Byproduct Area) is located in the northeast portion of the SMC facility. The area is bordered on the south, east, and west by undeveloped facility property and coincides with the plant boundary on the north. This area is designated as controlled since slags and dusts generated during processing and containing low levels of radioactive isotopes are stored in this portion of the facility, as permitted by NRC license. Per NRC requirements, access to this area is subject to administrative control procedures designed to safeguard operators and the public from excessive radiological risk. For this reason, the NRC Controlled AOC was investigated as a separate area in the RI, and is evaluated separately in the EE.

Railroad Siding AOC

The Railroad Siding AOC is located in the northern portion of the SMC facility. It is a triangular shaped area which is bordered by the property boundary on the north, Manufacturing AOC on the south, and by Building D116(D) on the west. The Railroad Siding AOC was investigated as a separate area in the RI per a request by the NJDEPE, and is therefore also considered separately in the EE.

3.1.2 Undeveloped AOCs

The SMC plant property contains three undeveloped industrial areas that are currently devoid of buildings and which were not identified as Areas of Concern in the remedial investigation (TRC-ECI, 1992). Figure 2-1 presents these Undeveloped AOCs. One area constitutes a rectangular wedge running between the northern and southern fencelines near the

center of the SMC property (Undeveloped AOC #1). This area is essentially unvegetated due to vehicular traffic, such as tractors, used to transport industrial materials across site. This area is also used for the storage of old equipment and debris.

A second area (Undeveloped AOC #2) consists of open fields of maintained grass on the southern and western borders of the site within the fenceline. These areas are surrounded by a border of upland woodlot (see Appendix B for varieties) that occur just over the fenceline but still on the SMC property.

A third undeveloped area (Undeveloped AOC #3) encompasses the southeast corner of the site, and is covered by maintained grasses. This area contains a fence-enclosed "thermo" pond which does not receive any process or treatment waters and whose level is maintained by rainwater and groundwater. The man-made pond has a natural bottom, with emergent grasses evident in the southwest corner at the time of site reconnaissance. Undeveloped AOC #3 also contains an outfall pipe which recirculates remediated groundwater from Hudson Branch wetlands back into the wetland. The point of entry of this drainage into the wetland is near the location of the dirt road which exits the south end of the property. This flow is regularly monitored for a variety of parameters (e.g., chromium, oil and grease, aquatic toxicity testing), and it is a significant source of replenishment to the receiving wetland. The discharged water forms a small pool on-site within Undeveloped AOC #3 that is associated with a small stand of phragmites.

Soil samples from Undeveloped AOC #1 have been analyzed for the full suite of chemical analytes, while soil samples from Undeveloped AOC #2 and #3 have been analyzed for inorganic compounds only. These data are described in Section 3.3. Except for the small pool in Undeveloped AOC #3, all on-site areas are devoid of wetlands and lie upland of the wetland that runs along the southern border of the property.

3.1.3 Ecological AOCs

Wetlands Areas of Concern

The wetland running along the south edge of the SMC property consists of several distinguishable regions. At its easternmost end, an intermittently wet gulley through an oak-pine forest develops into the headwaters for the Hudson Branch (Eastern Upland Woodlot/Headwaters Region). From these headwaters, the Hudson Branch quickly deepens and widens into a large ponded area that is approximately 1 acre and 2-6 feet deep (Hudson Branch-Ponded Region). An unpaved road that leaves the south end of the SMC property forms the western edge of the pond. A culvert directs the Hudson Branch under this unpaved road which on the western side of the unpaved road becomes a somewhat more distinct channelized stream. The stream flows with low velocity through a broad, flat wetland that has abundant riparian vegetation (Hudson Branch-Channelized/Flood Plain Region).

Per NJAC 7:9-4.15, the Maurice River from the boundary of the Union Lake Wildlife Management Area to the confluence with Blackwater Branch (to the south) is classified as a Category I water (FW2-NT(C1)); however, from the source of the Maurice River to the boundary of the section of Union Lake Wildlife Management Area north of Vineland, the Maurice River is classified as FW2-NT (Category II classification). Unnamed or unlisted freshwater streams (such as the Hudson Branch) that flow into streams classified as FW2-NT take the classification of the classified stream they enter. Since the Hudson Branch enters the Maurice River upstream of the boundary of the Union Lake Wildlife Management Area north of Vineland (Newfield Quandrangle, USGS, photorevised 1986), it would also be classified as FW2-NT. It should be noted that based on SMC's recent stream monitoring program, stations with no measured flow

were identified within the Hudson Branch upgradient of the confluence of the Hudson Ranch and Maurice River.

Figure 3-1 presents the wetland delineation developed from the method described in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation, 1989). A complete wetland delineation report will be included as an addendum to this report.

Ecological AOC #1: Eastern Upland Woodlot/Headwaters Region

The headwaters region arises out of a gulley in the center of an oak-pine forest located near the southeastern border of the SMC property. The upland forest is dominated by several oak species (white, red, bear), with pitch pine sporadically mixed in. An understory of highbush blueberry and mountain laurel is well established. This upland forest is of small spatial extent, limited by surrounding human activities (that is, a roadway to the south; the SMC property to the northwest; and agricultural/industrial activities to the east).

A small isolated wetland exists at the southeast corner of the SMC property. This wetland appears to result from a depression in the oak-pine forest, allowing the retention of sufficient surface water to create hydric soils and a limited phragmites stand.

The gulley cuts through the center of the oak-pine forest in an east-to-west direction. It was dry at the time of reconnaissance (October 1991 and April 1994), but during wet periods it serves to replenish the pond. Wetland vegetation is sparse in this headwaters region, as the water flow is intermittent and the oak-pine forest environment is predominant.

Ecological AOC #2: Hudson Branch-Ponded Area

In the westerly direction the gulley leads to shallow pools and backwaters for the larger pond. A broad zone of riparian vegetation becomes established in these shallow pools and along their gradually sloping margins. The overstory in this zone consists primary of red pine in the shallow water or at the water's edge, with a mixture of oak, sassafras, black cherry, eastern cottonwood, willow, pitch pine, and white cedar forming the overstory in the remainder of the wetland soils. Black gum was also found submerged in shallow pools. A variety of wetland understory species were evident at the time of reconnaissance, with the major types including wild rose, high bush blueberry, honeysuckle, and mountain laurel. Phragmites was evident in open areas. A more complete listing of the species found in the various wetland habitats is found in Appendix B.

The ponded area appears to be recharged predominantly from groundwater, although it is possible that the treated groundwater discharge into the wetland backs up into the pond. The northeastern shore of the pond has a shallow upland slope which creates a broad flood plain zone that is replete with riparian vegetation. Progressing westerly, the pond's northern shore takes on a steeper pitch creating a ready demarcation between wetland and upland communities. Wetland fauna consisted of a mixture of red maple, pitch pine, black cherry, white cedar, phragmites, high bush blueberry, wild rose, greenbrier, and rushes. Algae was evident at the surface of the pond in shoreline areas. The upland zone consisted of a top-of-the-slope line of mixed hardwoods (Norway maple, locust, and American elder), with white cedar and pitch pine sporadically present. A mowed grassy area intervened between the upland trees/shrubs and the SMC fenceline.

The pond's southern edge is of gentle slope creating a broad area of wetland/flood plain. A wide variety of wetland vegetation exists in this region, although it is dominated by red maple, phragmites, high bush blueberry, greenbrier, holly and wild rose. Even at this early time of the growing season (April), understory density was sufficient to form thickets in certain locations. The south shoreline features invaginations providing stagnant backwaters with obvious algal growth. The center of the pond was relatively free of vascular or macrophytic vegetation at the surface. Upland (south) of the wetland, the mixed oak-pine forest redeveloped.

Ecological AOC #3: Hudson Branch - Stream Portion

Beginning at the unpaved, north-south road, the Hudson Branch is transformed from a pond to a more channelized stream. The stream does not follow a single, well-defined channel. Rather, there are various splits in the flow with small, vegetated islands regularly occurring. Additionally, the wet area varies in width along the watercourse, with the wetland coming within several yards of the SMC fenceline in places, but then fading from the fenceline at others. An erosional swale area was noticeable emanating from the SMC property into a dried gulley. At this point, the wetland abuts the fenceline. The northside of the watercourse is open and is thus primarily phragmites, although red maple and a variety of understory are intermingled. The south side of the watercourse is substantially shaded by red maple, with very little phragmites present. The stream sediment appeared to be coarse sand, but covered in most places by filamentous algae, detritus, and vascular vegetation. A complex web of roots and stems of old and new vegetative growth covered the substrate near the shoreline. Leaving the south shoreline, the wetland vegetation gave way to upland oak-pine forest, which was limited in extent by houses and a road to the south.

The Hudson Branch flowed at low velocity to the railroad bed and West Road. This juncture marks the western extent of the site. An old stone culvert appeared to be partially blocked as the stream pooled at the foot of the railbed. However, at the outlet of the culvert (west side of West Boulevard) significant flow was detected as the Hudson Branch coursed through a broad flood plain. This region was similar to the hardwood swamp described above, with red maple and phragmites again dominating the overstory and understory. An additional feature was the presence of fallen logs and hummocks, heaped outgrowths of grass or rush vegetation, appearing as islands in the stream. Two emergent species (Duckweed and Marsh Marigold) were growing in the shallow running water area as the Hudson Branch passed under Weymouth Ave. The stream narrowed as it was directed through a culvert under Weymouth Road. On the south side of Weymouth Road, the watercourse quickly broadened. Again red maple and phragmites were the predominant species although a mixture of the other fauna noted above was also present. Fallen logs and hummocks were again major natural features within the watercourse. Several fern species (cinnamon fern, sensitive fern) were found within the wetland. The wetland delineation and reconnaissance went as far west as the SMC groundwater pumping station IW-2.

3.1.4 Overview of the Wetland Habitats

The wetlands occurring in association with the Hudson Branch ponded region and stream were found to be mostly undisturbed and in good condition. These habitats present a rich diversity of faunal types over a broad spatial extent, in both the lateral and downstream directions. The majority of wetland habitat can be classified as broadleaf swamp forest, which is one of the major wetlands typical of pinelands (Forman, 1979). This wetland is classically

dominated by red maple, with black gum, sassafras, and a variety of other species potentially contributing to the overstory (Forman, 1979). Pitch pine and cedars are only sporadically present, with highbush blueberry and sweet pepperbush forming the majority of the understory (Forman, 1979). Given that the studied wetland lies outside of the Pine Barrens, it is to be expected that several other species were notable. The presence of the expected species suggests that this wetland is functionally intact. Further, since most specimens noticed were at a mature stage, this wetland appears to be relatively undisturbed or stressed. As further evidence, there were no obvious areas of deficient or missing floral habitat, and in general, floral abundance was prolific. Several areas of disturbance from refuse disposal were noted at the juncture with roadways and behind homes. However, much of the watercourse was free of refuse.

This wetland appears to be sufficient to provide a significant local resource. The succulent vegetation and berries likely provide resource for herbivores such as deer and rabbits. The moist, organified soils provide likely habitat for worms and soil insects, thereby providing a food web base for avian, terrestrial, and amphibian species such as songbirds, woodcock, shrew, and frogs. Predacious raptors such as hawk and owl are not unexpected in this environment. Ducks and geese are likely to find useful habitat in the abundant riparian vegetation that surrounds the Hudson Branch ponded area, using this zone for both shelter and as a food resource.

The numerous backwater areas are likely good breeding grounds for amphibians and aquatic insects. Pine Barrens stream sediments are typically rich in insects (e.g., beetles, chironomids, mosquitos, black flies, dragonflies, damselflies, water bugs) to the general exclusion of other macroinvertebrates (Morgan, 1983; Forman, 1979). This may be due to a combination of water quality (e.g., low pH) and sediment quality (low levels of certain nutrients) features of

Pine Barrens wetlands. Given that the studied wetland shares certain important features with pinelands wetlands, it is anticipated that arthropods are prevalent in comparison to macroinvertebrates such as worms, mollusks, or amphipods). Insectivorous aquatic vegetation (e.g., bladderwort) is also common in Pine Barrens wetlands but these species were not found in the current survey. It is possible that it is too early in the growing season for these to be apparent. Fish are not typically abundant in pinelands watercourses although several varieties (Shad-*Alosa sapidissima*, Chub sucker-*Erimyzon sucetta oblongus*, Iron colored shiner-*Notropsis chalybaeus*, Blue spotted sunfish-*Enneacanthus gloriosus*, Chain pickerel-*Esox reticulatus*, Brook trout-*Salvelinus fontinalis*) are somewhat common. Given the shallowness of the Hudson Branch, and the fact that it is at least partially blocked at the juncture with the railroad bed, it is likely that this portion of the Hudson Branch is depauperate with respect to fish.

Consistent with the above observations, SMC personnel report spotting the following species on the SMC site or in the Hudson Branch wetland: deer, rabbit, chipmunk, hawk, blue heron, turkey vulture, downy woodpecker, chipmunk, turtles, ducks, and geese. Rats also appear to be prevalent since SMC has established trapping locations along the fenceline.

In conclusion, the wetlands areas described represent a functional habitat zone containing flora generally consistent with broad-leafed pinelands wetlands. The slow moving, partially overgrown stream and its associated flood plain/wetlands, and ponded area, provide a significant local resource that appears to be relatively undisturbed. The wetland appears to receive recharge primarily from groundwater and from the outfall from SMC-treated recycled groundwater.

3.2 Field Investigation Summary

The following discussion provides a summary of the field investigation activities which took place between October 1990 and April 1991. Complete details of the field investigation are provided in the Remedial Investigation Technical Report (TRC-ECI, 1992). This section serves only as a summary of these activities. Volatile organic compounds and metals (inorganics) were the primary constituents detected in environmental media at the SMC facility.

In evaluating detected constituent levels in the RI report, they were compared against available regulatory action levels. For soils and sediments, constituent levels were compared to New Jersey Interim Soil Action Levels. For ground water samples, constituent levels were compared to federal and New Jersey Maximum Constituent Levels (MCLs). Surface water constituent levels were compared to New Jersey Water Pollution Control Act (NJWPCA) Maximum Values of Protection of Aquatic Life (Freshwater) and federal MCLs. The Remedial Investigation Technical Report (TRC-ECI, 1992) contains a complete discussion of contamination at the SMC facility.

Ground Water Samples and Air Sampling

A large ground water sampling program was conducted on the SMC property and at various stations along the Hudson Branch downstream of the site. Additionally, 72 air/dust samples were collected during 12 sampling events at the site. These data indicate elevated ground water concentrations of selected inorganic and organic constituents. Air sampling results generally failed to detect elevated constituent levels trapped in airborne dust. The results of sampling in these media are not of use in the EE since environmental receptors are not directly

exposed to ground water and the airborne dust results are not especially relevant to the microenvironment representative of ecological habitats. Sampling results for these media are presented in the RI.

It should be noted that "action levels" provide an initial means for the evaluation of constituent levels and areas of potential concern. It is necessary to evaluate the detected constituent levels and associated potential risks to human health and the environment with respect to site-specific land use conditions and exposure pathways. These activities are conducted in this EE and in the human health evaluation, in accordance with NJDEPE and USEPA guidance.

For each environmental media sampled, a discussion of the constituent types detected, the environmental distribution of constituents, and a comparison of detected levels to regulatory action levels are presented below. Tables 3-1 through 3-10 summarize the analytical data for constituents in surface soil (0-2' depth), surface water and sediments, and a discussion of this data is provided in Section 3.3. This information is presented to provide the reader with an overview of site contamination and to present the calculated representative site exposure point concentrations. Comparisons to site background were also presented when appropriate, and are discussed in Section 3.3 of this report.

3.3 COC Concentrations in Affected Media

The RI report (TRC-ECI, 1992) provides data for SMC surface soils, sediments, subsurface soils, ground water, surface water, and air. Subsurface soil (defined as the soil interval below 2 feet) and ground water data were incorporated into the human health risk assessment (TRC, 1994) because scenarios involving direct human contact with these media were developed. However, ecological receptors are incapable of directly contacting ground water or

subsurface soils, and thus the concentrations found in these media are not relevant to the EE. Subsurface contamination can potentially reach aquatic ecosystems via ground water transport and thus the analysis of surface water and sediment-related risks indirectly incorporates the contribution of subsurface contamination.

The EE terrestrial component focuses upon surface soil COC concentrations (Tables 3-1 through 3-8), while the aquatic component focuses upon surface water and sediment concentrations (Tables 3-9 and 3-10). These tables provide a compilation of data by areas of concern (AOC).

3.3.1 Sampling Results: Industrial COCs

No surface soil sampling data was obtained from the Degreasing Unit (Manpro Vibra) AOC or the Lagoon AOC in the RI. Thus, these areas are not discussed in this EE. Figure 3-2 presents the soil sampling locations with regard to the AOCs.

Leachate Storage AOC

The surface soil dataset for the Leachate Storage AOC is presented in Table 3-1. As shown in this table, 18 inorganics were detected in surface soil at least one time. Of these, aluminum, barium, beryllium, chromium (total), copper, lead, manganese, vanadium, zinc, and titanium were detected at frequencies of 100%. (Note: Titanium was detected in the single soil sample submitted for analysis). These detected inorganics were evaluated with regard to site background concentrations. Results of this comparison indicate that aluminum, antimony, barium, beryllium, cadmium, chromium (total), chromium VI, cobalt, copper, lead, manganese, nickel, selenium, vanadium, and zinc were elevated above site background concentrations. It

should be noted that the arithmetic mean and/or the 95% UCL for antimony, cadmium, cobalt, copper, and selenium fall within or below the range of site-related background concentrations.

There were no samples submitted for analysis for VOCs, SVOCs, pesticides/PCBs in the Leachate Storage AOC.

Manufacturing AOC

The surface soil dataset for the Manufacturing AOC is presented in Table 3-2. As shown in this table, 21 inorganics were detected in surface soil at least one time. Of these, aluminum, barium, chromium (total), copper, lead, manganese, vanadium, zinc, and titanium were detected at frequencies of 100%. [Note: Titanium was analyzed for in five samples rather than 16 samples.] Detected inorganics were evaluated with regard to site background concentrations. Results of this comparison indicate that aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium (total), chromium VI, cobalt, copper, lead, manganese, nickel, selenium, silver, vanadium, zinc, strontium, and titanium may be elevated above site background. It should be noted that the arithmetic mean and/or 95% UCL for antimony, barium, cadmium, cobalt, copper, selenium, and silver are within or below the range of site-related background concentrations.

Ten VOCs were detected in surface soil in the Manufacturing AOC. These include acetone (1/1), carbon disulfide (1/5), 1,2-dichloroethene (1/5), 2-butanone (1/5), trichloroethene (4/5), benzene (1/5), tetrachloroethene (3/5), toluene (3/5), ethylbenzene (1/5), and xylene (total) (1/5). Concentrations of these VOCs range from 0.0015 mg/kg (trichloroethene) to 0.36 mg/kg (xylenes).

Twenty (20) of the 24 SVOCs analyzed for in surface soil were detected at least one time. These detected SVOCs include three phenolic compounds, 12 polycyclic aromatic compounds (PAHs), three phthalates, benzoic acid, and 2,4-dinitrotoluene. Fluoranthene was the most frequently detected SVOC with a detection frequency of 4/5. Concentrations of SVOCs range from 0.042 mg/kg (fluoranthene) to 1.1 mg/kg (benzo(g,h,i)perylene).

Aroclor-1254 was the only pesticide/PCB detected in surface soil in the Manufacturing AOC. This PCB was detected at a frequency of 3/6 and a concentration range of 0.013 to 0.13 mg/kg.

Chromate Wastewater Spill AOC

The surface soil dataset for the Chromate Wastewater Spill AOC is presented in Table 3-3. As shown in this table, 16 inorganics were detected in surface soil at least one time. Of these, aluminum, arsenic, barium, beryllium, chromium (total), copper, lead, manganese, nickel, vanadium, and zinc were detected at a frequency of 100% (in a total of four samples) and chromium VI and titanium were detected at frequencies of 100% (in a total of two samples). Detected inorganics were evaluated with regard to site background concentrations. Results of this comparison indicate that aluminum, arsenic, beryllium, chromium (total), chromium VI, lead, manganese, nickel, vanadium, zinc, and titanium may be elevated above site background. It should be noted that the arithmetic mean for vanadium is within the range of site-related background concentrations.

There were no samples submitted for analysis for VOCs, SVOCs, or pesticides/PCBs in the Chromate Wastewater Spill AOC.

Nuclear Regulatory Commission (NRC) Controlled AOC

The surface soil dataset for the NRC Controlled AOC is presented in Table 3-4. As shown in this table, 19 inorganics were detected in surface soil at least one time. Of these, aluminum, arsenic, barium, beryllium, chromium (total), copper, lead, manganese, nickel, vanadium, zinc, and titanium were detected at frequencies of 100%. Detected inorganics were evaluated with regard to site background concentrations. Results of this comparison indicate that aluminum, antimony, arsenic, barium, beryllium, chromium (total), chromium VI, cobalt, copper, lead, manganese, nickel, vanadium, zinc, boron, niobium, strontium, and titanium may be elevated above site background. It should be noted that the arithmetic mean and/or 95% UCL for antimony, arsenic, cobalt, and copper fall within or below the range of site-related background concentrations.

One VOC (trichloroethene) was detected in surface soil. This VOC was detected in the only sample collected at a concentration of 0.004 mg/kg.

Bis(2-ethylhexyl)-phthalate was the only SVOC detected. Again, this SVOC was detected in the only sample collected at a concentration of 0.085 mg/kg.

Aroclor-1248 and -1254 were the only pesticides/PCBs detected in the single sample submitted for analysis. Aroclor-1248 was detected at a concentration of 1.9 mg/kg while Aroclor-1254 was detected at a concentration of 1.5 mg/kg.

Railroad Siding AOC

The surface soil dataset for the Railroad Siding AOC is presented in Table 3-5. As shown in this table, 16 inorganics were detected in surface soil one time. (Note: One soil sample was collected within the Railroad Siding AOC). These detected inorganics include aluminum, arsenic,

barium, beryllium, cadmium, chromium (total), cobalt, copper, lead, manganese, nickel, selenium, vanadium, zinc, strontium, and titanium. These detected inorganics were evaluated with regard to site background concentrations. Results of this comparison indicate that aluminum, arsenic, barium, beryllium, cadmium, copper, manganese, nickel, vanadium, zinc, strontium, and titanium were elevated above site background concentrations in this single soil sample.

There were no samples submitted for analysis for VOCs, SVOCs, or pesticides/PCBs in the Railroad Siding AOC.

3.3.2 Sampling Results: Undeveloped AOCs

Undeveloped AOC #1

The surface soil dataset for Undeveloped AOC #1 is presented in Table 3-6. As shown in Table 3-16, 22 inorganics were detected in surface soil at least one time. Of these, aluminum, arsenic, barium, beryllium, chromium (total), copper, lead, manganese, nickel, vanadium, zinc, titanium, and zirconium were detected at frequencies of 100%. (Note: Zirconium was detected in the single soil sample submitted for analysis). Detected inorganics were evaluated with regard to site background concentrations. An inorganic constituent was considered to be elevated above site background if more than 5% of the detected soil concentrations exceeded the maximum detected soil concentrations for background. Using this criteria, the following inorganics were considered to be elevated above site background in Undeveloped AOC #1: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium (total), chromium VI, cobalt, copper, lead, manganese, mercury, nickel, silver, vanadium, zinc, boron, niobium, strontium, and titanium. Background values were not available for zirconium. It should be noted that the arithmetic mean

and/or the 95% UCL for antimony, arsenic, cadmium, cobalt, mercury, silver, and niobium fall within or below the range of site-related background concentrations.

Two volatile organic compounds (VOCs) were detected in surface soil in Undeveloped AOC #1. Acetone and 1,1,1-trichloroethane were each detected one time in a single sample (1/1) at low concentrations (0.031 and 0.004 mg/kg, respectively).

Two semi-volatile organic compounds (SVOCs) were detected in surface soil in Undeveloped AOC #1. Di-n-butylphthalate and bis(2-ethylhexylphthalate) were each detected at a frequency of 1/1 at concentrations of 0.21 and 0.085 mg/kg, respectively.

Finally, two PCBs (Aroclor-1248 and Aroclor-1254) were each detected at a frequency of 1/1, at concentrations of 1.9 and 1.5 mg/kg, respectively.

Undeveloped AOC #2

The surface soil dataset for Undeveloped AOC #2 is presented in Table 3-7. Twenty (20) inorganics were detected in surface soil at least one time. Of these, aluminum, barium, chromium (total), copper, lead, manganese, vanadium, and zinc were detected at frequencies of 100%. Detected inorganics were elevated with regard to site background concentrations. Results of this comparison indicate that aluminum, arsenic, barium, beryllium, cadmium, chromium (total), chromium VI, cobalt, copper, lead, manganese, mercury, nickel, vanadium, zinc, niobium, strontium, and titanium may be elevated above site background. It should be noted that the arithmetic mean and/or 95% UCL for arsenic, cadmium, cobalt, mercury, niobium, strontium, and titanium fall within or below the range of site-related background concentrations.

There were no samples submitted for analysis for VOCs, SVOCs, or pesticides/PCBs in Undeveloped AOC #2.

Undeveloped AOC #2 may be considered downgrade from the Manufacturing AOC due to a gentle slope of the site. In order to evaluate potential migration of constituents from the active industrial portion of the facility to this undeveloped area, a comparison of arithmetic mean and 95% UCL concentrations of inorganic constituents between these areas follows. This discussion is limited to those inorganics which may be elevated in the Manufacturing AOC as compared to site background. Arithmetic mean and/or 95% UCL concentrations of aluminum, antimony, arsenic, barium, beryllium, chromium (total), chromium (VI), copper, lead, manganese, selenium, vanadium, zinc, and strontium in the Manufacturing AOC exceeded maximum site background concentrations. Of these elevated inorganics, the arithmetic mean and/or 95% UCL concentrations in Undeveloped AOC #2 also exceeded background for aluminum, arsenic, barium, beryllium, chromium (total), chromium VI, copper, lead, manganese, vanadium, and zinc. Although not elevated above background in the Manufacturing AOC, mercury and nickel were elevated above site background in Undeveloped AOC #2. 95% UCL concentrations for inorganics from the Manufacturing AOC are generally greater than the 95% UCL concentrations in the Undeveloped AOC #2. Thus, there is some indication that migration of inorganic constituents has occurred from the Manufacturing AOC to Undeveloped AOC #2.

Several VOCs and SVOCs were detected in the Manufacturing AOC surface soil samples. These organic compounds were not analyzed for in Undeveloped AOC #2.

Undeveloped AOC #3

The surface soil dataset for Undeveloped AOC #3 is presented in Table 3-8. As shown in this table, 17 inorganics were detected in surface soil at least one time. Of these, aluminum, arsenic, chromium (total), lead, manganese, vanadium, zinc, and titanium were detected at

frequencies of 100%. Detected inorganics were evaluated with regard to site background concentrations. Results of this comparison indicate that aluminum, arsenic, barium, beryllium, chromium (total), lead, manganese, mercury, nickel, silver, vanadium, zinc, and titanium may be elevated above site background. It should be noted that the arithmetic mean and/or the 95% UCL for aluminum, arsenic, barium, beryllium, chromium (total), manganese, mercury, nickel, silver, and titanium fall within or below the range of site-related background concentrations.

There were no samples submitted for analysis for VOCs, SVOCs, or pesticides/PCBs in Undeveloped AOC #3.

Undeveloped AOC #3 may be considered downgrade from the NRC Controlled AOC due to a gentle slope of the site. In order to evaluate potential migration of constituents from the active industrial portion of the facility to this undeveloped area, a comparison of arithmetic mean and 95% UCL concentrations of inorganic constituents between these areas follows. This discussion is limited to those inorganics which may be elevated in the NRC Controlled AOC as compared to site background. Arithmetic mean and/or 95% UCL concentrations of aluminum, barium, beryllium, chromium (total), chromium (VI), lead, manganese, nickel, vanadium, zinc, niobium, strontium, titanium, and zirconium exceeded maximum site background concentrations. Of these elevated inorganics, the arithmetic mean and/or 95% UCL concentrations in Undeveloped AOC #3 also exceeded background for arsenic, barium, lead, manganese, nickel, vanadium, and zinc. Thus, there is some indication that migration of constituents has occurred from the NRC Controlled AOC to Undeveloped AOC #3. 95% UCL concentrations for inorganics from the NRC Controlled AOC are generally greater than the 95% UCL concentrations in Undeveloped AOC #3. One VOC and one SVOC were detected in surface soils from the NRC Controlled AOC. These organic compounds were not analyzed for in AOC #3.

3.3.3 Summary of Ecological AOC Sediment Data

A summary of sediment concentration data is presented in Table 3-9. Sediment samples were collected at five locations of the Hudson Branch as indicated in Figure 3-3. All inorganics listed in Table 3-9 were detected in at least one sediment sampling location. Of these, arsenic, barium, beryllium, chromium, cobalt, copper, lead, magnesium, manganese, nickel, vanadium, zinc, and titanium were detected at all five sampling locations. Antimony and mercury were not detected in SD-1, while niobium was only detected in SD-1. Selenium was detected in SD-1, SD-4, and SD-5.

The Hudson Branch is intermittent in nature such that it is not possible to obtain upstream samples for comparison to samples taken along the facility and downstream. However, an evaluation with regard to inorganic concentrations in sediment versus distance from the facility is presented here. Comparison to sediment criteria is provided in Section 6. In general, inorganic concentrations are greatest at SD-2, which is located south of the Manufacturing AOC but do not diminish in magnitude with increasing distance downstream, indicating potential constituent migration.

Three VOCs (carbon disulfide, 1,2-dichloroethene, and 2-butanone) were detected in stream sediments. Only 2-butanone was detected at all five sampling locations.

Eleven SVOCs were detected in stream sediments. [Note: Samples were submitted for SVOC analysis for SD-1 and SD-4 only.] Phenol, benzoic acid, di-n-butylphthalate, fluoranthene, and bis(2-ethylhexyl)phthalate were detected in both samples while pentachlorophenol, phenanthrene, butylbenzylphthalate, chrysene, and benzo(b)fluoranthene were detected in only one sample.

Four pesticides/PCBs were detected in stream sediments. [Note: Samples were submitted for SVOC analysis for SD-1 and SD-4 only.] All four were detected in both samples and include 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, and Aroclor-1254.

3.3.4 Summary of Ecological AOC Surface Water Data

A summary of surface water concentration data is provided in Table 3-10. Surface water samples were collected at five locations of the Hudson Branch as indicated in Figure 3-3. All inorganics listed in Table 3-10 were detected in at least one surface water sampling location. Of these, aluminum, barium, chromium (total), copper, manganese, nickel, vanadium, zinc, and fluoride were detected at all five sampling locations. Chromium VI was analyzed for (and detected) in a single sample, while boron was analyzed for (and detected) in two samples.

The upper reach of the Hudson Branch is intermittent in nature, such that it is not possible to obtain upstream samples for comparison to samples taken along the facility and downstream. However, an evaluation with regard to inorganic concentrations in surface water versus distance from the facility is provided here. A comparison to NJDEPE SWQS and USEPA AWQC values are provided in Section 6. In general, inorganic concentrations are greatest at SW-2 (south of the Manufacturing AOC) and diminish in magnitude with increasing distance downstream indicating some attenuation with constituent migration.

Three VOCs (chloromethane, 1,2-dichloroethene, and trichloroethene) were detected in SW-4 downstream of the facility.

Two SVOCs (di-n-butylphthalate and bis(2-ethylhexyl)phthalate) were detected in the Hudson Branch surface water. Di-n-butylphthalate was detected in SW-1 and SW-4. Bis(2-ethylhexyl)phthalate was detected once at sampling location SW-4.

3.3.5 Sampling Results: Ecological AOCs

Ecological AOC #1

No sediment or surface water samples were collected from Ecological AOC #1. However, surface soil samples were collected from Undeveloped AOC #3 which is upgrade of this ecological AOC. As discussed previously, comparison of mean concentrations of inorganics to the maximum background concentration indicates that aluminum, barium, beryllium, chromium (total), chromium VI, copper, lead manganese, nickel, vanadium, and zinc may be elevated in surface soils. VOCs, SVOCs, and pesticides/PCBs were not analyzed for Undeveloped AOC #2.

Ecological AOC #2

One sediment sample (SD-1) and one surface water sample (SW-1) were collected within Ecological AOC #2. Of the inorganics submitted for analysis, only antimony and nickel were not detected in the sediment sample (SD-1). In surface water, cadmium, chromium VI, cobalt, cyanide, mercury, selenium, niobium, strontium, and titanium were not detected. In general, concentrations of inorganics in SD-1 and SW-1 are substantially lower than the next downstream sampling location (SD-2, SW-2). Exceptions include lead (364 mg/kg in SD-1 versus 338 mg/kg in SD-2, and 28 µg/kg in SW-1 versus not detected in SW-2); manganese (238 mg/kg in SD-1 versus 227 mg/kg in SD-2); selenium (4.4 mg/kg in SD-1 versus not detected in SD-2); boron (828 µg/kg in SW-1 versus not analyzed for in SW-2); and niobium (173 mg/kg in SD-1 versus not detected in SD-2).

One VOC was detected in SD-1 (2-butanone) while no VOCs were detected in SW-1. Seven SVOCs were detected in SD-1 including phenol, benzoic acid, pentachlorophenol, di-n-

butylphthalate, fluoranthene, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate, and di-n-butylphthalate was the only SVOC detected in SW-1.

Four pesticides/PCBs were detected in SD-1 including 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, and Aroclor-1254. No pesticides/PCBs were detected in SW-1.

Comparison of sediment or surface water concentrations of VOCs, SVOCs, or pesticides/PCBs in SD-1 and SW-1 to SD-2 and SW-2 is not possible as these downstream samples were not submitted for these analyses.

Surface soil samples were collected from the NRC Controlled AOC which is upgrade of Ecological AOC #2.

As discussed previously, comparison of mean concentrations of inorganics to maximum background concentrations indicates that aluminum, barium, beryllium, chromium (total), chromium VI, lead, manganese, nickel, vanadium, zinc, boron, niobium, strontium, and titanium may be elevated in surface soils in the NRC Controlled AOC. Comparison of the maximum concentrations of inorganics in surface soil samples from the NRC Controlled AOC to the concentration in sediments collected at SD-1 indicates a trend of generally lower concentrations in the Hudson Branch. The two exceptions include chromium (1,220 mg/kg in SD-1 versus a maximum concentration of 473 mg/kg in the NRC Controlled AOC) and selenium (4.4 mg/kg in SD-1 versus not detected in the NRC Controlled AOC).

Trichloroethene, bis(2-ethylhexyl)phthalate, Aroclor-1248, and Aroclor-1254 were the only detected organic compounds in the surface soil sample collected in the NRC Controlled AOC.

As discussed previously, comparison of mean concentrations of inorganics to maximum background concentrations indicates that lead, vanadium, and zinc may be elevated in Undeveloped AOC #3. Comparison of the maximum concentrations of inorganics in surface soil

samples from Undeveloped AOC #3 to the concentration in sediments collected at SD-1 indicates a trend of generally higher concentrations in the Hudson Branch. One exception includes zinc which was detected at a concentration of 231 mg/kg in SD-1 versus a maximum concentration of 476 mg/kg in Undeveloped AOC #3.

Organic compounds were either not detected in or not analyzed for in Undeveloped AOC #3.

Ecological AOC #3

Four sediment samples (SD-2, SD-3, SD-4, and SD-5) and four surface water samples (SW-2, SW-3, SW-4, and SW-5) were collected within Ecological AOC #3.

Of the inorganics submitted for analysis from sediment samples, only selenium and niobium were not detected in all four sediment samples. In surface water, aluminum, barium, chromium, copper, manganese, nickel, and vanadium were detected in all four surface water samples.

In general, concentrations of inorganics in SD-2 and SW-2 are greater than the next three downstream samples (SD-3, SD-4, SD-5, and SW-3, SW-4, SW-5). Exceptions include lead (not detected in SW-2 versus a range of 3.8 to 8.45 µg/kg in SW-3, SW-4, and SW-5) and manganese (227 mg/kg in SD-2 versus 336 and 655 mg/kg in SD-4 and SD-5, respectively).

Three VOCs were detected in sediments collected from Ecological AOC #3 including carbon disulfide (SD-5), 1,2-dichloroethene (SD-3 and SD-4) and 2-butanone (SD-2 through SD-5). Three VOCs were detected in surface water samples collected from Ecological AOC #3 including chloromethane (SW-4), 1,2-dichloroethene (SW-4), and trichloroethene (SW-4).

SVOCs and pesticides/PCBs were not detected or not submitted for analysis in SD-2, SD-3, SD-5, SW-2, SW-3, and SW-5. Nine SVOCs were detected in SD-4 including phenol, benzoic acid, phenanthrene, di-n-butylphthalate, fluoranthene, pyrene, chrysene, bis(2-ethylhexyl)phthalate, and benzo(b)fluoranthene.

Two SVOCs were detected in SD-4 including di-n-butylphthalate and bis(2-ethylhexyl)phthalate.

Pesticides/PCBs detected in SD-4 include DDE, DDD, DDT, and Aroclor-1254. No pesticides/PCBs were detected in SW-4.

3.4 Selection of Constituents of Concern

The purpose of the selection process is to identify the site-related constituents which are likely to contribute significantly to the EE. The approach for selection of COCs may involve consideration of a number of factors including (i) detection frequency, (ii) comparison to available background data, (iii) range of detected concentrations, and (iv) essential nutrient status. For the purposes of this EE, constituents were excluded using a tiered approach. First, constituents were excluded from further consideration on the basis of detection frequency. That is, a constituent was excluded if it was not detected in the medium of interest. Constituents were also excluded if found in less than 5% of the samples for that medium. If fewer than 20 samples were collected in a medium, a single detection warranted inclusion as a COC. Second, constituents in surface soil were excluded based on essential nutrient status. Examples of essential nutrients include iron, magnesium, calcium, potassium, and sodium (USEPA, 1989). Third, constituents in surface soil were excluded from consideration if compliance with a soil cleanup standard (Table 3-11) (NJDEPE, 1992) is achieved. That is:

"1. The arithmetic mean of the concentrations of the constituent in all soil samples in an area of concern is less than or equal to the applicable soil cleanup standard for that constituent;

2. No single soil sample exceeds the applicable soil cleanup standard by a factor of more than:

   i. 10 for a soil standard of less than or equal to 10 mg/kg, but not more than 50 mg/kg;

   ii. 5 for a soil standard greater than 10 but less than or equal to 100 mg/kg, but not more than 200 mg/kg; and

   iii. 2 for a soil standard greater than 100 mg/kg; and

3. No more than 10% of the soil samples, or 1 sample if 2 to 10 samples, inclusively, are used, exceed the applicable soil cleanup standard."

Similarly, constituents detected in surface water were excluded if the mean concentrations were below NJDEPE SWQS (NJDEPE, 1992a) or AWQC (USEPA, 1991). If a NJDEPE SWQS or AWQC was not available, the constituent was not excluded as a COC. Constituents in sediments were not excluded from further consideration through comparison to sediment quality criteria or NJDEPE soil cleanup criteria. Constituents and associated concentrations in sediment are discussed with regard to sediment quality criteria in the risk characterization.

Tables 3-12 through 3-14 present the list of COCs for the industrial, undeveloped, and ecological AOCs. Tables 3-15 through 3-17 present the list of constituents excluded from the EE for the industrial, undeveloped, and ecological AOCs and the rationale for exclusion.

3.5 Selection of Indicator Species and Exposure Pathways

The habitat descriptions provided for Industrial, Undeveloped and Ecological AOCs indicate four general exposure environments, as outlined below.

- Upland Industrial Areas: highly industrialized areas devoid of functional habitat due to anthropogenic influences (roads, buildings, storage, debris, slag piles, holding ponds). Industrial AOCs and Undeveloped AOC #1 are included in this category.

- Upland Undeveloped Areas: grassed areas which are regularly mowed and thus have very limited ecosystem potential. Most portions of Undeveloped AOC #2 and #3 fit this description, although each has a small area of relatively undisturbed upland woodlot;

- Wetland Areas Associated with the Hudson Branch: intact wetland ecosystem which contains a wide array of plant and animal life encompassing a variety of trophic levels. The Hudson Branch headwaters region, ponded area, and stream (Ecological AOC #1, #2, and #3, respectively) fit this description.

- Forested Areas Adjacent to Wetlands: small woodlots which border the Hudson Branch wetlands and provide habitat for a variety of terrestrial and avian species.

The EE is subdivided according to upland versus wetland habitat types. Additionally, specific areas within each habitat type (specific AOCs) are addressed separately as appropriate to discuss potential exposures and risks.

3.5.1 Exposure Scenarios in Upland Industrial Areas

Much of the Upland Industrial Area at the SMC site (Industrial AOCs and Undeveloped AOC #1) lacks exposed soil due to the presence of buildings, pavement or holding ponds. Where exposed soil exists, it is generally unvegetated due to being driven upon frequently, or because these areas are used for storage of debris or slag piles. Isolated small patches of grass occur in the manufacturing zone, and trees and shrubs are scarce. Thus these regions are devoid of intact ecosystems, and it is unlikely that populations of ecological receptors can become exposed to analytes detected in industrial soils. Therefore, exposure scenarios are not developed for these regions. Rather than assess the potential for ecological harm, area soil concentrations for

beryllium, chromium, nickel, and vanadium are compared to NJDEPE action levels as presented in the RI and to NJDEPE soil cleanup criteria (for non-residential use) (TRC-ECI, 1992).

3.5.2 Exposure Scenarios in Upland Undeveloped Areas

Upland Undeveloped AOC #2 and #3 are primarily open grassy areas which are bordered on the northern side by the SMC industrial facility and on the southern side by the Hudson Branch wetlands. A fence separates Undeveloped AOC #2 from the wetland, while Undeveloped AOC #3 is not fenced on its southern border and is thus open to the wetland. Additionally, the extreme western side of Undeveloped AOC #2 (across the SMC fence but still on SMC property) and the southeastern edge of Undeveloped AOC #3 are wooded. The vegetative cover at these Undeveloped AOCs and their proximity to wetlands and woodlots provide the opportunity for ecological receptor use and exposure to analytes in soil. These areas are devoid of surface water, although during wet periods runoff and erosion occur in the direction of the wetland.

Soils in this region are sandy, and are likely to contain a variety of insects which, along with vegetation (grass), provide a base for a terrestrial food web. Earthworms may also be present in these soils but they would not be as abundant as in the nearby wetlands, and thus these regions would not be as attractive to small mammal (e.g., shrew) and avian (e.g., woodcock) species which feed upon worms. Figure 3-8 depicts a model of this food web, in which insects and vegetation take up COCs present in soil. Small mammals (mice) can then consume insects/vegetation, while herbivores such as rabbits can also partake of the vegetative cover. Raptors, such as the red-tailed hawk, represent the highest trophic level in this environment, preying upon rodent and rabbit populations.

3.5.3 Exposure Scenarios in Wetland Habitats

The broad-leaf swamp wetland is the major habitat associated with the Hudson Branch in the vicinity of the SMC site. Additionally, a ponded portion of the Hudson Branch near its origin also lies just south of the SMC site. These wetlands potentially provide water and nutritional resource for a variety of species including amphibians (e.g., frogs), reptiles (e.g., turtles, snakes, salamanders), small mammals (e.g., shrew, mouse), herbivores (e.g., rabbits, deer), and avian species (e.g., hawk, woodcock, ducks, geese). Since this aquatic ecosystem is expected to be depauperate with respect to fish, it is unlikely that piscivorous raptors (e.g., kingfisher) would find significant resource here.

Food web exposure scenarios in the aquatic/wetland ecosystem are depicted in Figure 3-9. Indicator species selected for further analysis are highlighted in the figure. At the bottom of the food web are sediment organisms (e.g., aquatic insects and worms) and soil organisms (earthworms, insects). Additionally, the wide variety of succulent plants and fruiting shrubs/vines are an important food web base. Certain small mammals such as shrew can consume large quantities of earthworms, while herbivorous small mammals (mice, rabbits) rely upon the vascular vegetation growing in the wetland. Deer can utilize wetland vegetation and berries, while avian species can be consumers of soil organisms (woodcock), can prey on small rodents (e.g., hawk), or can rely upon riparian vegetation and benthic organisms for shelter and food (ducks, geese). Amphibians and reptiles can consume soil and sediment organisms (worms, insects) and also consume plant matter.

While species other than those shown in Figure 3-9 may also utilize the wetlands, the ones highlighted are useful as indicator species because of their likely presence on-site and their high degree of potential contact with analytes in sediment, soil, or surface water. For example,

the shrew and woodcock's large percentage of diet derived from carnivorous consumption of soil organisms makes these species more likely to receive significant exposure than is the case for species which are also herbivorous and not as ravenous. Within the reptile/amphibian class, frogs are selected as indicator species because of their large consumption of earthworms. The high amounts of soil processed by worms on a daily basis make them a more significant potential exposure source than are insects. Therefore, earthworm-based food webs are of greater potential concern for COC uptake and exposure. The indicator species highlighted are useful for analytical purposes because they likely represent the upper bounds of exposure in this environment.

Forested areas adjacent to Hudson Branch wetlands can provide habitat to a variety of avian, reptilian, and mammalian species. The species types and food web in this region are generally similar to those already described for the wetlands and open field habitats, with soil organisms and vegetation forming the base of the food web. Further, due to the proximity of the wetland, it is likely that a substantial portion of the diet would come from wetland resources for these species. Therefore, the assessment does not define a separate scenario for this habitat. Further, sampling data specific to these areas has not been obtained and so a specific assessment of these areas is not currently possible.

3.6 Endangered Species Search

Endangered Plants

Four vascular plant species were identified in the Natural Heritage Database Search (Appendix C) as existing within the town of Newfield. These include Barratt's Sedge (*Carex barrattii*), Pink Tickseed (*Coreopsis rosea*), Pine Barren Boneset (*Eupatorium resinosum*) and Swamp-pink (*Helonias bullata*). Two of these species (Pink Tickseed and Swamp Pink) seem to

prefer habitat that is similar to wetland areas surrounding the SMC site. All four of these species will be surveyed for during the endangered species search to be completed at the end of June 1994. An Addendum Report will be sent upon completion of the survey.

Endangered Vertebrate Species

No endangered species were identified as living on or near the site. However the Natural Heritage Database did supply information on endangered animal species within the two counties in which the site is located (Glouster and Cumberland). The complete list is contained in Appendix C. The species that are most likely to exist near the site are listed in Table 3-18. These species are identified on the table with a "P" for possibly existing on or near the site.

3.7 Formulation of the Potential Ecological Problem

Data described in Section 3.3 indicate that a variety of metals are present in the wetlands habitat, leading to the possibility that this habitat may be impacted or degraded. This is a locally important functional ecosystem which serves as a resource in terms of food and shelter for a variety of species. Therefore, it is important to analyze the potential stresses placed upon this ecosystem by the analytes detected in wetland soils, sediments and surface water. Other habitats are of lesser resource value (small forested areas, open grassy fields), but are still analyzed within the context of species potentially present and analyte concentrations detected. The industrial AOCs provide no useful habitat and thus they are not analyzed in terms of ecological risk.

4.0 EXPOSURE ASSESSMENT

The exposure scenarios developed place indicator species within pathways that are most likely to contribute to exposure. In exposure assessment, the uptake mechanisms for each pathway are described in terms of their relative importance. Receptor contact with affected media can lead to exposure via drinking surface water, ingesting soil or sediment, dermal contact with soil, sediment, or surface water, and ingestion of food resources that are derived from affected media. The significance of these exposure pathways for indicator species and for COCs is discussed in subsequent sections.

4.1 Incorporation of COCs into Plants

Plant incorporation of organic and inorganic COCs can occur via root uptake. An expression which relates soil concentration (C_s) to concentration in vegetation (C_v) is as follows:

$$C_v = C_s * RUF$$

where: RUF is the root uptake factor.

Root uptake factors for inorganic components have been derived by Baes et al. (1984) based upon an extensive review of the literature, upon modeling approaches, and upon analogy with similar compounds where empirical data were missing. For organic analytes root uptake factors have been described in terms of log K_{ow} values (Travis and Arms, 1988). The strong correlation found between plant uptake and log K_{ow} allows a calculation of RUF from the following equation (Travis and Arms, 1988):

$$\log RUF = 1.588 - (0.578 * \log K_{ow})$$

Table 4-1 presents a listing of RUFs for inorganic and organic COCs based upon Baes et al. and Travis and Arms. It can be seen that for the inorganic analyte of greatest concern at this site,

chromium, a value of 7.5E-03 has been derived. This indicates that vegetative portions of plants are anticipated to contain 2 to 3 orders of magnitude lower chromium concentrations as compared to the surrounding soil. The chromium plant uptake database indicates that uptake is concentration dependent, with substantially less uptake at higher chromium soil concentrations. This pattern is typical of other elements in the Period IV transition series as well (e.g., zinc, iron, manganese). The listed value (7.5E-03) is representative of a soil concentration of 200 mg/kg (Baes et al., 1984).

The small degree of chromium plant uptake under field test conditions may be a result of the complexed nature of chromium in soil. While the conditions of pH and the oxidative state of chromium were not reported by Baes et al., it can be assumed that most of the chromium measured in soil was adsorbed to organic matter as Cr III. This is because Cr VI is readily reduced to Cr III by organic matter and ferrous iron in the soil (Eisler, 1986; USEPA, 1984). In this state, very little chromium would be available for root uptake. It should be noted that the rate of sorption of Cr VI to clays and metal oxides is affected by pH, with acidic pH values favoring adsorption. Very little adsorption was seen on the surfaces tested above pH 8 (Rai et al., 1989). Sediment and wetland soil pH values measured in the April 1994 site reconnaissance indicated Hudson Branch pH values of 4.4 to 7 (Table 4-2). Therefore, it is unlikely that plants are absorbing high levels of chromium.

In relation to chromium, plant uptake of other inorganics is generally greater, with values for other inorganic COCs at this site ranging above unity for boron and strontium (Table 4-1). Key inorganic analytes detected in wetland sediments (nickel, antimony, lead) generally have RUF values surrounding 1E-01, suggesting that wetland plants would have a relatively small degree of uptake. Mercury was detected at one wetland sediment location at a concentration

above 1 mg/kg; mercury vegetative concentrations are expected to be similar to soil concentrations based upon the RUF value shown in Table 4-1.

For organic COCs, low RUF values are derived for analytes with high K_{ow} (e.g., benzo(b)fluoranthene, chrysene, pentachlorophenol) since uptake into plants requires solubilization into pore water, which is inversely proportional to K_{ow}. For more water soluble organic analytes (e.g., phenol, 1,2-dichloroethane), substantial plant uptake is predicted by the RUF values shown in Table 4-1.

4.2 Incorporation of COCs into Soil/Sediment Organisms

Transfer of COCs from soil/sediment into earthworms is based upon the equation shown in Table 4-3 for organic COCs. This transfer is estimated based upon a model developed for earthworms in which non-ionic organic chemicals are partitioned between soil organic carbon and tissue lipids (Markwell et al., 1989; Menzie et al., 1992). As shown in Table 4-3, chemical uptake into earthworms is assumed to be directly related to the ratio of earthworm lipid content (approximately 2%) and the fraction of organic carbon in soil (f_{oc}). A default f_{oc} value of 5% is used (Brady, 1984). Additionally, earthworm concentrations must be converted from a dry weight to a wet weight basis since the quantity of biota ingested is expressed on a wet weight basis.

The earthworm uptake equation shown in Table 4-3 has been empirically-derived and validated for oligochaete and earthworm accumulation of chlorinated organic constituents (i.e., PCBs, DDT) from benthic sediments or soils under steady state conditions (Menzie et al., 1992; Markwell et al., 1989). Since insects process much less soil per body weight than do earthworms, the equilibrium partitioning conditions modeled are less likely to occur in insects.

Therefore, application of the earthworm-based model to insects would likely produce upper-bound estimates of insect uptake.

For inorganic COCs, partitioning based upon lipid solubility is not applicable; thus, uptake into soil invertebrates must be based upon other considerations. For highly soluble inorganic compounds, an equilibrium may be reached between organisms and soil such that the concentrations would be similar between the biotic and abiotic media. However, many inorganics form complexes and sorb onto organic surfaces, which causes biotic concentrations to be well below soil concentrations. For example, studies of chromium, copper, nickel, lead, and zinc uptake into earthworms from sludge or soil indicates concentrations that are 1 to 2 orders of magnitude lower in earthworms than in soil (Hartenstein et al., 1980; Beyer et al., 1985). It should be kept in mind that this comparison is on a dry weight basis. Since earthworms are approximately 80% water, the earthworm wet weight concentration of, for example chromium, would be 200 fold below the respective soil concentration. In contrast, cadmium levels (dry weight basis) in earthworms tended to equal or exceed the respective environmental concentrations. The list of earthworm bioaccumulation factors (BAFs) shown in Table 4-1 reflects these data. BAFs were not derived for numerous inorganics because data were not available. However, it can be assumed that earthworm concentrations of these metals are between 1% and 100% of the soil concentrations based upon the BAFs presented for the other metals.

The earthworm BAF values in Table 4-1 are key indices for potential uptake into the terrestrial food chain. Not only are they relevant for species which heavily utilize earthworms (e.g., woodcock, shrew), but they are also useful as conservative indicators of potential incorporation into the food web of species utilizing soil insects (e.g., mice, frogs). Soil insects

such as certain beetles, larval stages of flies, slugs, and millipedes generally consume less soil than do earthworms and so COC transfer from soil into insects may be somewhat lower than for earthworms. The earthworm BAF values indicate that for chromium and other inorganics complexed or sorbed to soils, uptake into soil organisms is expected to be low. However, given the high concentrations of chromium in wetland sediments and upgradient soils, concentrations could still reach appreciable levels. For organic constituents, soil organism tissue concentrations (wet weight basis) are expected to be approximately 12% of the soil (dry weight) concentration.

4.3 Indicator Species Exposure to COCs

Transfer of COCs from affected media (soil, sediment, surface water, vegetation, soil organisms) into the indicator species depends upon the physical characteristics and dietary habits of these species. The following discussion compares the degree of exposure possible in indicator species based upon these physical characteristics and dietary habits. The most significant environmental medium for exposure would appear to be wetland soils and sediments due to the high concentrations of chromium detected in sediments (Table 3-9), and because the wetland is a rich resource for dietary constituents. Hudson Branch surface waters are considerably less affected by COCs (Table 3-10), and are thus less of a concern in terms of producing COC exposure via surface water consumption. The significance of surface water COC concentrations is evaluated in terms of AWQC and NJDEPE SWQS values in Section 6.

The resource of greatest concern for food chain exposure to COCs is the earthworm. This resource is in intimate contact with soil, and ingests a large amount of soil daily. The potential for COC incorporation into earthworms was discussed in Section 4.2, which indicated that the concentrations of several key inorganics (e.g., chromium, lead, nickel) in earthworms can be 1

to 2 orders of magnitude below the soil concentration (earthworm wet weight to soil dry weight concentrations). Other inorganics (notably cadmium) and organic COCs are expected to attain higher concentration ratios in earthworms. Soil insects are expected to take up less soil-borne COCs than would earthworms, especially for the insects most likely consumed by species utilizing insects together with vegetation (e.g., field mice, amphibians). Rather than being in equilibrium with soil, insect species such as grasshopper, aphids, caterpillars, and spiders which live on vegetative surfaces would likely have tissue concentrations more closely reflecting plant COC concentrations. The generally low RUFs shown in Table 4-1 indicate that plant COC concentrations are likely to be well below soil and earthworm concentrations. Therefore, earthworms are considered a potentially more significant exposure medium than are insects or plant matter.

Benthic macroinvertebrates are another potential food web source of COCs. They can be thought of as in equilibrium with sediment COC concentrations, although for inorganics such as chromium, only a small fraction of that measured in sediment may be available for uptake. The Hudson Branch system does not appear to be an important fish resource, and thus transfer of COCs from benthic species to fish and then to piscivorous raptors does not seem to be a significant concern. However, waterfowl which may use the ponded area could conceivably feed upon benthic resources. This exposure pathway may not be of greatest importance for waterfowl since the diet of ducks and geese is generally more reliant upon riparian vegetation rather than benthic resources (De Graaf, 1983). Therefore this assessment evaluates the significance of sediment COC concentrations in terms of the sediment quality criteria developed in Section 5 rather than in terms of food chain incorporation.

The species expected to obtain the greatest exposure to COCs is the short-tailed shrew. This burrowing mammal is a voracious carnivore, consuming the equivalent of its body weight in earthworms daily (Chapman, 1982). It is anticipated to heavily utilize the wetland because of the abundance of earthworms. Soil ingestion may also be a significant factor due to burrowing activities and since a residue of soil will be associated with ingested earthworms. Soil ingestion can be thought of as occurring at a rate of 2% of dietary consumption for animals consuming resources that are associated with soil. This value is taken from analyses of grazing cattle, in which clumps of soil associated with grass are consumed (Fries and Paustenbach, 1990). Drinking water exposures are expected to be much smaller due to the relatively low concentrations of key COCs in surface water compared to wetland sediments (Tables 3-9 and 3-10). Dermal exposure to adhered soil is a potential contributor to exposure since burrowing activities will likely produce considerable adherence of soil to fur. However, it is likely that COC contact with skin and subsequent transdermal transport would be small, especially since the COCs of greatest environmental concentration in the wetland are inorganics (especially chromium) which are not readily taken up across the skin (Scheuplein, 1965; Wahlberg, 1968; Skog and Wahlberg, 1964).

Five species of amphibians and reptiles were identified in the Natural Heritage Database Search as being in the two counties in which the site is located. The species include the bog and wood turtle, corn snake, tiger salamander, and the Pine Barrens tree frog (see Table 3-18).

Out of the five species listed above, turtles may potentially be the most affected by contamination in and around a wetland. Turtles are found near slow moving waters and move to the surrounding woods to lay eggs and forage. Further, turtles hibernate by burying themselves in sediments and muddy stream banks from October to March. Therefore, turtles

would be dermally exposed to constituents in the water, sediment, and soils that surround a wetland. A large portion of a turtle's diet includes vegetation such as berries, grass, and moss. The remainder of the diet is supplemented with insects, worms, slugs, and frogs. Ingestion exposure to contamination may occur through these food sources originating from contaminated soil. Turtles have a longer life span than other reptiles and amphibians identified in the Natural Heritage Database Search. Therefore, these turtles have a longer time in which to accumulate constituents present in wetlands and surrounding areas.

Because turtles are within close proximity to soils, sediments, and surface water, and food sources are also closely related with the soils and sediments, it is likely that the wood turtle and the bog turtle are receiving the greatest exposure.

Small mammal species that might utilize the wetland such as the southern bog lemming consume a mixed diet of insects and vegetation. While these exposures could be substantial given that chromium concentrations range up to 15,700 mg/kg in wetland sediment, these exposure sources are expected to be considerably less significant than earthworms. For mice which utilize the wetland and nearby upland grassed or wooded areas, direct exposure to affected soils may be the most significant exposure activity. Burrowing activities and inadvertent ingestion of soil along with food resources may produce sufficient soil exposure to outweigh the contribution of dietary COCs.

Raptors such as the red-tailed or broad-winged hawk, or barred owls can utilize this wetland habitat to prey upon small mammals, amphibians and reptiles. These raptors find prey in wooded, swampy, or open field, edge communities. Occupying the highest position in the wetland or field food web, these species can experience a magnified exposure to COCs capable

of bioaccumulating. Aside from food chain exposure, raptors can receive exposure via ingestion of soil/sediment adhered to prey, although this exposure pathway is expected to be minor.

The potential for bioaccumulation in receptors and biomagnification across trophic levels can be evaluated in terms of the chemical-specific biotransfer factor (BTF). As shown in Table 4-4, the BTF is derived from the beef biotransfer factor (BBTF) for which values for inorganics and organic compounds are available (Travis and Arms, 1988; Baes et al., 1984). The BTF is a body weight adjustment of the BBTF such that the bioaccumulation index is no longer dependent upon the body weight of the receptor (cattle in the case of the BBTF). The generalized accumulation factor is a useful index of the potential for tissue accumulation in any given species. However, empirical tissue accumulation data for specific species-COC combinations are needed to verify any the tissue concentrations possible in a given situation.

The BTF is the ratio of tissue concentration to exposure dose (mg/kg/day). As shown in Table 4-1, BTF values vary considerably for both inorganic and organic compounds, ranging between 0.1 and 68. The chromium BTF is intermediate (3.7), and it suggests that chromium tissue residues can be 3 to 4 times greater than the daily ingested dose. This likely reflects poor clearance mechanisms for absorbed chromium. Other inorganics of potential concern in wetland and grassy habitats (e.g., lead, beryllium, antimony, arsenic, vanadium) have generally low BTF values, although nickel and mercury BTF values are substantial. These BTF values indicate the potential for a degree of chromium biomagnification in the raptor food web, although not nearly as much as for large, fat soluble, organic molecules (e.g., Aroclor-1254, benzo(b)fluoranthene) or certain essential minerals (e.g., zinc).

Another factor that must be taken into account when assessing risks to highly mobile receptors such as deer and raptors is the percentage of the dietary intake which is received on-

site. The large home range of deer (approximately 3,000 acres; DeGraaf, 1983), hawk (approximately 250 acres; DeGraaf, 1983), and the barred owl (approximately 60 acres; DeGraaf, 1983) decrease the daily consumption of affected media since a significant portion of the diet, on average, will be derived from unaffected or off-site media.

Other receptors of potential concern in the wetlands and upland grassy areas are worm-eating birds, exemplified by the woodcock, and waterfowl. Woodcock glean the soil surface over fairly limited distances, seeking worms. Their worm consumption can be approximated at 10-15% of body weight, which would provide them with a smaller COC dosage from earthworms than that for shrew. Ducks and geese are expected to utilize riparian vegetation extensively as a source of food and shelter, with benthic resources (vegetation, invertebrates) providing a less significant portion of the diet (DeGraaf, 1983). Therefore, incorporation of COCs into wetland vegetation according to the RUF values shown in Table 4-1 may be particularly relevant for waterfowl.

4.4 Potential Exposure to Endangered/Threatened Species

An extensive list of endangered/threatened animal species was provided for the two counties which border the site. This list is provided through a search of the Natural Heritage Database conducted by NJDEPE and is reproduced as Appendix C. Section 3.6 prioritizes the endangered species search results in terms of species which are most likely to occur on-site or in the wetlands adjacent to the site. The exposure pathways for these special concern receptors are not unlike those described above for indicator species. For example, raptors such as Cooper's hawk, barred owl, and northern harrier will likely receive exposures similar to that described for hawk and owl indicator species, if they occur on-site. Additionally, animals that consume largely

seeds and berries (e.g., bog lemming) would receive less COC exposure than would worm-eating species such as the shrew. Therefore, the discussion of indicator species potential exposures and risks is also applicable to the phylogenetically similar endangered/threatened species.

5.0 STRESSOR-RESPONSE ASSESSMENT

Stressor-response relationships for COCs are quantified by single point estimates useful for evaluating exposures to aquatic or terrestrial receptors. These point estimates represent limiting criteria concentrations at which adverse effects are unlikely even if exposure is chronic. The sources and basis for these values are briefly described below.

5.1 Surface Water and Sediment Criteria

Table 5-1 presents sediment quality criteria values which are used to represent COC concentrations in sediment at which adverse effects on benthic infauna should not occur. The sediment criteria are derived in one of three ways.

The first method used to acquire sediment criteria is to directly use USEPA-derived criterion values. To date, only two on-site COCs (fluoranthene, phenanthrene) have been thoroughly evaluated by the USEPA for the development of sediment criteria, but these criteria are still classified as proposed. The proposed criteria utilize the equilibrium partitioning approach which is based upon the principle that a constituent's toxic potency to water column organisms will be similar to that for benthic organisms, and that effects on benthic organisms only occur after the constituent partitions out of sediment and into pore water (USEPA, 1989).

The second approach is to derive sediment criterion values for phenol and pentachlorophenol for which chronic water quality criteria are available. The method used is the same as that described by USEPA (1988, 1989) in which the sediment quality criteria is derived according to the relationship:

$$SQC = (AWQC)\ (K_{oc})\ (f_{oc})$$

where:

SQC	=	sediment quality criterion (mg/kg)
AWQC	=	chronic ambient water quality criterion
K_{oc}	=	organic carbon/water partition coefficient
f_{oc}	=	fraction of organic carbon present in sediment

Sediment quality criteria values derived in Table 5-1 are based upon an f_{oc} value of 35%. Table 4-2 provides the physical parameters of soil, sediments, and surface water in wetland areas. The pH values were used to indicate the mobility of inorganics in sediments and soils. The total organic carbon (TOC) values were averaged and used to calculate sediment criteria for phenol and pentachlorophenol. Hardness values were used to calculate NJDEPE SWQS for cadmium, copper, lead, nickel, and zinc.

The third approach is to rely upon the sediment toxicity database compiled for the National Oceanic and Atmospheric Association (NOAA) by Long and Morgan (1991). This compilation covers a diverse array of chemicals and provides data describing spiked-sediment bioassay results, field observations of chemical concentrations in sediment as compared to effects on benthic macroinvertebrates, and equilibrium-partitioning based criteria values. This database is particularly useful for inorganic constituents since equilibrium partitioning approaches do not apply well to these constituents. The Effects Range-Low (ER-L) and Effects Range-Midway (ER-M) values derived by Long and Morgan are sediment concentrations at the low end and midpoint of the effects range, respectively, such that they are associated with adverse benthic effects in approximately 10% and 50% of the reviewed studies, respectively. The ER-L and ER-M values have been used as a criterion for assessing potential benthic toxicity (USEPA, 1993), and are used as the sediment criterion value for metals in Table 5-1.

Table 5-1 also shows that sediment criteria cannot be derived for a number of metals because ER-L or ER-M values are lacking. In these cases, the potential for adverse aquatic effects is judged strictly against freshwater quality criteria (Table 5-1). Both NJDEPE SWQS (NJDEPE, 1992a) and USEPA AWQC (USEPA, 1991) are presented and used to evaluate constituent concentrations in the Hudson Branch water. This is a reasonable approach since only dissolved forms of metals are available to produce adverse effects, and the water column measurements are suitable indicators of the amount of biologically available metal ions across the aquatic ecosystem. This principle applies to both benthic and water column species, but the possibility exists that sediment pore water concentrations may be higher than those measured higher in the water column.

Certain metals listed as COCs have neither water nor sediment quality criteria values and thus these cannot be quantitatively assessed.

5.2 Criteria for Terrestrial Species

There are currently no criteria with which to compare surface soil concentrations against in order to assess potential ecological harm to vertebrate terrestrial receptors. However, various literature sources have reported stressor-response data that are useful in generating a no observable adverse effect level (NOAEL) in mammalian or avian species. Table 5-2 presents a compilation of these data with appropriate toxicity endpoints and references. Chronic exposure NOAELs in the table were either taken directly from the reported data or were extrapolated from the lowest observable adverse effect level (LOAEL) or a subchronic NOAEL by using 10 fold safety factors.

Table 5-2 also presents the Environmental Effect Level (EEL), which is the environmental concentration that should be devoid of toxic effect based upon the NOAEL (in mg/kg/day) and the ingestion rate of chemical-containing medium in the test. For example, the chromium avian NOAEL of 0.1 mg/kg/day converts to an EEL of 1 mg/kg since the exposed ducks could be assumed to consume the affected feed at a rate of 10% of their body weight per day. Thus, the back-calculated dietary concentration resulting in the chronic NOAEL is 1 mg/kg.

Adverse effects may theoretically begin to occur at concentrations above the EEL. The concept is best applied to media that produce significant ecoreceptor exposure. For example, soil ingestion is a minor exposure pathway for many receptors in comparison to the much larger amount of food ingestion that occurs daily. Therefore, a soil concentration that is above the EEL may still not be a major concern if the food resource (plant, earthworm, insect, mammalian prey) tissue concentrations are below the EEL. Since many inorganic analytes concentrate poorly in plants and soil organisms and do not substantially bioaccumulate, soil concentrations are not the best indicator of the potential for ecological effects.

5.2.1 Stressor-Response Profiles for Key COCs

Chromium

The environmental effects of chromium have been reviewed and research indicates that at high environmental concentrations, chromium is a mutagen, teratogen and carcinogen. While chromium chemistry is not clearly understood, it is generally accepted that some of its chemical forms, primarily hexavalent chromium (Cr VI) and trivalent chromium (Cr III), are toxic. Chromium in biological materials is usually in the +3 (III) form, and is the form that functions as an essential trace element in mammals to regulate glucose, lipid and protein metabolism. In

general, the toxicity of trivalent chromium to mammals is low because its membrane permeability is poor and there is little tendency for Cr III to biomagnify in food chains in the inorganic form. Little information is available on the accumulation tendencies of organo-trivalent chromium compounds. Hexavalent chromium is more toxic than the trivalent form because its oxidizing potential is high and it easily penetrates biological membranes. All toxic effects of Cr VI seem to be related to the strong oxidizing action of chromates, and all biological interactions of chromates result in reduction to the comparatively less toxic trivalent form. Most of the Cr VI found in the environment is a result of domestic and industrial emissions. Review of laboratory animal (rodents, ducks, guinea pigs, dogs, cats, and chickens) studies (Eisler, 1986) have identified sensitive species. For birds, dietary levels of 10 mg Cr III/kg altered growth patterns and decreased survival rates in young black ducks, while levels up to 50 mg/kg had no effect on adult black ducks. The significance of chromium residues is unclear, but available evidence suggests that organs and tissues of wildlife that contain >4.0 mg total Cr/kg dry weight should be viewed as clear presumptive evidence of chromium contamination.

Nickel

Nickel is an essential element required for growth and iron absorption. Data on the toxicity of nickel have shown wide variation in the amount of nickel that produces harmful effects. Environmental studies of exposure to high levels of nickel have indicated adverse effects on the lung, immune system, kidney, and hematological and hematopoietic systems. The toxicity of nickel can be affected by the form of nickel, species, age, reproductive status, duration of administration, and nutrient content of the diet. Review of animal (cattle, chicken, dog, mouse and monkey) studies (NAS, 1980) has identified a mineral tolerance level of 50 mg/kg, based on

the lack of adverse effect with nickel chloride at this level in cattle. Levels of 100 mg/kg nickel as the chloride decreased food intake of calves. In chicks, 500 mg/kg nickel reduced growth and nitrogen retention. In most experiments 1,000 mg/kg had marked adverse effects, including decreased growth rate or weight loss, changes in red blood cell numbers and hemoglobin (both increases and decreases were reported), accumulation of nickel and alterations in tissue concentration of several essential elements. In dogs, 2,500 mg/kg produced emesis, salivation, and gastrointestinal irritation. Monkeys were resistant to adverse effects associated with nickel intake at levels of 250 to 1,000 mg/kg.

Vanadium

Vanadium has been shown to be essential for normal body growth and physiological function in all species. Most of the vanadium found in the environment is the result of industrial contamination of air and water. Numerous reviews on vanadium toxicity in animals (cattle, sheep, chickens, ducks and guinea pigs) have indicated that vanadium appears to exert its toxic effect through inhibition of enzymes (inhibition of NaK-ATPase and activation of cardiac adenylate cyclase) and cell damage from lysis (NAS, 1980). The chick appears to be most susceptible to orally induced vanadium toxicosis since levels of 8-10 mg/kg dietary vanadium were associated with reduced growth in day-old or immature chicks. At levels of 30 mg/kg, depressed egg production and albumin quality were noted in the laying hen. Vanadium given daily at 20 mg/kg of body weight produced diarrhea, emaciation, prostration and increased vanadium in the kidney in calves within 3 days. In growing lambs significant increases in tissue vanadium levels (kidney, bone and liver) occurred with 100 mg/kg dietary intake. Sheep showed a 65 per cent death rate within 80 hours when given 40 mg vanadium per kilogram body weight

as NH_4VO_3. Signs of toxicity in calves and lambs included diarrhea, depressed growth and performance, ataxia and mortality.

Antimony

Antimony has no known essential metabolic function in living organisms, and therefore, is often classified as a non-essential element. Very little antimony occurs free in nature, and most is derived from the principal antimony ore, stibnite (Sb_2S_3), which contains 71-75 percent pure antimony. While antimony chemistry is not clearly understood, it is generally accepted that some of its chemical forms, primarily trivalent antimony (Sb^{+3}) and pentavalent antimony (Sb^{+5}) are toxic. Based on limited evidence in animal (chicken, rabbit, dog and guinea pig) studies (NAS, 1980), a mineral tolerance limit of 70-150 mg/kg in the dry diet is suggested. This value is based upon dietary studies in the rabbit. Rabbits fed 15 mg of potassium antimonyl tartrate per kilogram body weight (5.5 mg/kg antimony) were shown to have increased concentrations of nonprotein nitrogen in blood and urine. After 5 to 20 days, icterus was noted and some individuals showed fatty degeneration and parenchymal necrosis of the liver.

5.3 Phytotoxicity

There are currently no criteria with which to compare surface soil concentrations against in order to assess potential ecological harm to vegetative receptors (plants). However, various literature sources have reported stressor-response data for no observable adverse effect level (NOAEL) or phytotoxic levels in plant species. Table 5-3 presents a compilation of these data with appropriate toxicity endpoints and references.

Aluminum is not an essential nutrient for plants (Brady, 1984). No information was found on the affinity of aluminum for soil, or on the toxicity of aluminum in plants. Based on the low reported ratio of plant tissue to soil concentrations (0.004; Baes et al., 1984), aluminum has a low tendency to accumulate in plant tissue.

Antimony is not an essential nutrient for plants (Brady, 1984). Although antimony has an affinity for clay and organic minerals in soil, the extent to which this affinity reduces the movement of antimony from soils is unknown (USEPA, 1979). No information was found on the toxicity of antimony in plants. Based on the reported ratio of plant tissue to soil concentrations (0.2; Baes et al., 1984), antimony does not readily accumulate in plant tissue.

Arsenic is not an essential nutrient for plants (Brady, 1984). Arsenic has a high affinity for soil colloids, and is not readily accumulated by plants as evidenced by the low ratio of plant tissue to soil concentrations (0.04; Baes et al., 1984). The minimum concentration of arsenic in soil which may be toxic to plants is 3 mg/kg (USEPA, 1980).

Barium is not an essential nutrient in plants (Brady, 1984), and is very insoluble when present in soil. Insoluble barium salts form in soil, thus limiting the downward movement (leaching) of barium in the soil profile. However, barium salts can be solubilized under acidic soil conditions and move downward in the soil profile. The soil pH at the SMC facility is 4.8, which suggests that barium would be moderately solubilized in soil. No information was found on the toxicity of barium in plants. The reported ratio of plant tissue to soil concentrations is 0.15 (Baes et al., 1984), and indicates that barium does not readily accumulate in plant tissue.

Beryllium is not an essential nutrient for plants (Brady, 1984). It is very insoluble in water and is readily absorbed onto soil colloids. No information was found on the toxicity of

beryllium in plants. Based on the reported ratio (0.01) of plant tissue to soil concentrations (Baes et al., 1984), beryllium has a low tendency to accumulate in plant tissue.

Boron is an essential nutrient for plants (Brady, 1984). No information was found on the affinity of boron for soil. The minimum concentration of boron in soil which may be toxic to plants is 0.5 mg/kg (USEPA, 1980). As evidenced by the reported ratio of plant tissue to soil concentrations (4; Baes et al., 1984), boron is one of the few inorganics which readily accumulates in plant tissue.

Cadmium is not considered an essential nutrient for plants (Brady, 1984). Since cadmium is a very soluble inorganic, most of the on-site cadmium is likely to be transported in the dissolved state through surface water runoff or downward leaching of water (USEPA, 1979). Cadmium is not an essential nutrient for the growth of plants. The reported ratio of plant tissue to soil concentrations is 0.55 (Baes et al., 1984), which indicates that cadmium does not readily accumulate in plant tissue The minimum concentration of cadmium in soil which may be toxic to plants is 2.5 mg/kg (USEPA, 1980).

Cobalt is an essential nutrient for plants (Brady, 1984). No information was found on the affinity of cobalt for soil, or on the toxicity of cobalt in plants. Based on the low reported ratio of plant tissue to soil concentrations (0.02; Baes et al., 1984), cobalt has a low tendency to accumulate in plant tissue.

Copper, an essential nutrient for plants (Brady, 1984), is tightly sorbed to iron and manganese oxides, clays, and organic matter (USEPA, 1979). This affinity is strongly affected by soil pH. If soil becomes very acid, copper can be brought into a solution and leached out of the soil. The soil at the SMC facility has a pH of 4.8, which suggests that copper is moderately available for plant uptake. The minimum reported concentration of copper in soil which may be

toxic to plants is 40 mg/kg (USEPA, 1980). Based on the reported ratio of plant tissue to soil concentrations of 0.01 (Baes et al., 1984), copper has a low tendency to accumulate in plant tissue.

Chromium VI transport is controlled by its affinity to organic matter. Chromium III is less mobile than chromium VI due to its affinity for several additional soil colloids including clays and iron oxides. Chromium is not an essential nutrient for plants (Brady, 1984). Since plants concentrate chromium in their tissues at only 0.0075 times the concentration in soil (Baes et al., 1984), the ability of plants to take up chromium from soil to the root system and incorporate it into tissue is very limited. The minimum concentration of chromium (valent state not specified) in soil which may be toxic to plants is 8.4 mg/kg (USEPA, 1980).

Lead is very soluble when bound in a soil matrix, such that it tends to be immobile in soil (Davies, 1988) and is not readily available to plants (Brady, 1984). This is evidenced by the low reported ratio (0.045) of plant tissue to soil concentrations (Baes et al., 1984). Lead is not an essential nutrient for plants (Brady, 1984). The minimum concentration of lead in soil which may be toxic to plants is 1,000 mg/kg (USEPA, 1980).

Manganese is an essential nutrient for plants (Brady, 1984). No information was found on the affinity of manganese for soil. The minimum concentration of manganese in soil which may be toxic to plants is 2.5 mg/kg (USEPA, 1980). As evidenced by the reported ratio of plant tissue to soil concentrations (0.25; Baes et al., 1984), manganese does not readily accumulate in plant tissue.

Mercury is not an essential nutrient for plants (Brady, 1984). The transport of mercury in soil to other media is expected to be limited due to its strong affinity for organic materials (USEPA, 1979). The minimum concentration of mercury in soil which may be toxic to plants

is 455 mg/kg (USEPA, 1980). As indicated by the reported ratio of plant tissue to soil concentrations (0.9; Baes et al., 1984), mercury tends to accumulate in plant tissue at concentrations nearly equal to those in soil.

Nickel is not an essential nutrient for plants (Brady, 1984), and is very mobile as compared with other inorganics detected in on-site soils. Sorption to clays and iron oxides control movement of nickel to a small extent (USEPA, 1979). The minimum concentration of nickel in soil which may be toxic to plants is 500 mg/kg (USEPA, 1980). The ratio of average plant tissue to soil concentrations is 0.06 (Baes et al., 1984), and indicates that nickel has a low tendency to accumulate in plant tissue.

Niobium is not an essential nutrient for plants (Brady, 1984). No information was found on the affinity of niobium for soil, or on the toxicity of niobium in plants. Based on the low reported ratio of plant tissue to soil concentrations (0.02; Baes et al., 1984), niobium has a low tendency to accumulate in plant tissue.

Selenium is readily sorbed to and held tightly by soil colloids (USEPA, 1979). Selenium is not essential for the growth of plants (Brady, 1984). Based on the ratio of average plant tissue to soil concentrations (0.025; Baes et al., 1984), selenium has a low tendency to accumulate in plant tissue. The minimum concentration of selenium in soil which may be toxic to plants is 13 mg/kg (USEPA, 1980).

Silver is not an essential nutrient for plants (Brady, 1984). Silver is tightly bound to soil colloids and also is very insoluble in water. As a result, silver tends to persist in the environment. No information was found on the toxicity of silver in plants. The reported ratio of plant tissue to soil concentrations is 0.4 (Baes et al., 1984), and indicates silver does not readily accumulate in plant tissue.

Strontium is not an essential nutrient for plants (Brady, 1984). No information was found on the affinity of strontium for soil, or on the toxicity of strontium in plants. As evidenced by the reported ratio of plant tissue to soil concentrations (2.5; Baes et al., 1984), strontium is one of the few inorganics which readily accumulates in plant tissue.

Titanium is not an essential nutrient for plants (Brady, 1984). No information was found on the affinity of titanium for soil, or on the toxicity of titanium in plants (Brady, 1984). Based on the low reported ratio of plant tissue to soil concentrations (0.0055; Baes et al., 1984), titanium has a low tendency to accumulate in plant tissue.

Vanadium is not an essential nutrient to plants (Brady, 1984). According to USEPA (1980), the minimum concentration of vanadium in soil which may be toxic to plants is 2.5 mg/kg. Vanadium has a low tendency to accumulate in plant tissue with a ratio of plant tissue to soil concentrations of 0.0055 (Baes et al., 1984).

Zinc, an essential nutrient to plants (Brady, 1984), has a strong affinity to iron oxides and clays, and is very insoluble. These factors greatly restrict the movement of zinc in the soil environment. Although the minimum concentration of zinc in soil which may be toxic to plants is not reported by USEPA (1980), the plant tissue concentration associated with plant damage is 300 mg/kg. In addition, the ratio of plant tissue to soil concentrations is reported as 1.5 (Baes et al., 1984). Based on this ratio, the approximate criterion concentration of zinc in soil is 200 mg/kg. The ratio of plant tissue to soil concentrations further indicates that zinc may accumulate in plant tissue.

Zirconium is not an essential nutrient for plants (Brady, 1984). No information was found on the affinity of zirconium for soil, or on the toxicity of zirconium in plants. Based on the low

reported ratio of plant tissue to soil concentrations (0.002; Baes et al., 1984), zirconium has a low tendency to accumulate in plant tissue.

6.0 RISK CHARACTERIZATION

The basis for the current risk characterization are the surface water and sediment criteria as discussed in Section 5. Additionally, for the evaluation of risk to terrestrial and avian species, the EELs developed in Section 5 are used. The analysis focuses upon the regions where useable habitat is currently found: Undeveloped AOC #2 and #3, and Ecological AOC #1, #2, and #3.

6.1 Upland Undeveloped AOCs

The following discussion evaluates the COCs in surface soil for Undeveloped AOC #2 and #3 with regard to their potential impacts on selected receptors in the terrestrial food chain. As a first tier assessment, the 95% UCL concentrations of the COCs in surface soil are compared to the EELs provided in Table 5-2. For the COCs associated with a 95% UCL surface soil concentration above the EEL, a second tier evaluation is performed by comparing estimated plant tissue and estimated earthworm concentrations against the EEL. Finally, the COCs for which the estimated plant tissue and earthworm concentrations exceed the EEL are further evaluated with regard to the potential for mammalian bioaccumulation. Specifically, the tendency of these COCs to accumulate in mammalian tissue is categorized as follows: low for BTFs less than 1, moderate for BTFs between 1 and 10, and high for BTFs greater than 10.

Undeveloped AOC #2 and #3 contain open, mowed grassy fields which may form habitat for a limited food web. Undeveloped AOC #1 is an unvegetated area within the industrial site and does not include useable habitat. Surface soil COC concentrations in AOC #2 and #3 were presented in Tables 3-7 and 3-8, respectively. The tables indicate that organic COCs were not analyzed for in both Undeveloped AOC #2 and #3.

Concentrations (95% UCL) of inorganic COCs, listed in Table 3-7 for Undeveloped AOC #2, were compared directly against EELs (Table 5-2). This comparison indicates that, with the exception of arsenic and beryllium, Undeveloped AOC #2 soils present a potential ecological risk. (Note: EELs are not available for aluminum, strontium, and titanium.) However, soil exposure is not generally the major exposure pathway for vertebrate terrestrial receptors. Mice and rabbits will be sensitive primarily to vegetative and insect COC concentrations. RUF values (Table 4-1) for these inorganics generally indicate very low plant uptake factors (less than or equal to 1) which is sufficient to decrease the exposure concentration to near or below the EEL for arsenic, chromium, and cobalt.

Vegetative concentrations of cadmium, manganese, and vanadium could potentially exceed the respective EEL. Cadmium was not detected at greatly elevated concentrations in soil (1.6 to 5.3 mg/kg) as compared to background (1 to 1.1 mg/kg), but has a potential for bioaccumulation as indicated by an earthworm BAF range of 1 to 10 (Table 4-1). The BTF for cadmium is low (less than or equal to 1) indicating it does not bioaccumulate in mammals. Manganese was detected in all soil samples and the concentration range (11 to 1,680 mg/kg) exceeded background concentrations (19.4 to 103 mg/kg). The potential for bioaccumulation of manganese is uncertain as an earthworm BAF was not available. The BTF for manganese is low (less than or equal to 1) indicating it does not bioaccumulate in mammals. Vanadium was detected in all samples and at concentrations ranging from 5.4 to 12,100 mg/kg, which exceed background (10.4 to 53.7 mg/kg). The potential for bioaccumulation of vanadium is uncertain as an earthworm BAF was not available. The BTF for vanadium was low (1.7) indicating little bioaccumulation in mammals.

Thus, while soil concentrations appear to be elevated and of potential concern for cadmium, manganese, and vanadium based on comparison to EELs, bioaccumulation in mammalian species and potential transfer to predator species such as raptors is likely to be low. Further, the relatively small size of Undeveloped AOC #2 in relation to the home range of raptors decreases the likelihood of substantial exposure on a regular basis. Thus, it appears that risks from cadmium and nickel are of greatest concern to local populations of mice and rabbits, with a marginal level of concern for raptors which may sporadically utilize Undeveloped AOC #2.

Concentrations (95% UCL) of inorganic COCs, listed in Table 3-8 for Undeveloped AOC #3, were compared directly against EELs. This comparison indicates that Undeveloped AOC #3 soils containing chromium, cobalt, and manganese present a potential ecological risk. (Note: EELs are not available for aluminum or titanium.) However, soil exposure is not generally the major exposure pathway for vertebrate terrestrial receptors. Mice and rabbits will be sensitive primarily to vegetative and insect COC concentrations. RUF values (Table 4-1) for these inorganics generally indicate very low plant uptake factors (less than or equal to 1) which is sufficient to decrease the exposure concentration to near or below the EEL for chromium and cobalt. Vegetative concentrations of manganese could potentially exceed the respective EEL. Manganese was detected in all samples at concentrations ranging from 4.3 to 242 mg/kg, versus background concentrations of 19.4 to 103 mg/kg. The potential for bioaccumulation of manganese is uncertain as an earthworm BAF was not available. The BTF for manganese is low (less than or equal to 1) indicating it does not bioaccumulate in mammals. Thus, while soil concentrations of manganese appear to be elevated based on comparison to EELs, bioaccumulation in mammalian species and potential transfer to predator species such as raptors is likely to be low. Further, the relatively small size of Undeveloped AOC #3 in relation to the

home range of raptors decreases the likelihood of substantial exposure on a regular basis. Thus, it appears that risks from manganese are of greatest concern to local populations of mice and rabbits, with a marginal level of concern for raptors which may sporadically utilize Undeveloped AOC #3.

6.2 Wetland Habitats

A discussion of the entire Hudson Branch as sampled versus water quality and sediment quality criteria is provided here. The potential for risks in Ecological AOC #1 (Upland Woodlot/Hudson Branch Headwaters), #2 (Hudson Branch Ponded Area), and #3 (Hudson Branch - Stream Portion) are discussed below in terms of comparison against surface water and sediment quality criteria. The potential for risks to terrestrial and avian receptors which utilize wetland habitats are discussed in terms of EELs.

Comparison of inorganic concentrations to sediment criteria indicates that chromium and nickel are elevated at all five sampling locations. Antimony concentrations are elevated above sediment criteria at all locations except SD-1. Copper concentrations exceeded criteria at SD-1 and SD-5, while lead, mercury, and zinc concentrations exceeded sediment criteria in SD-1 and/or SD-2. None of the detected VOCs (carbon disulfide, 1,2-dichloroethene, and 2-butanone) or SVOCs (phenol, benzoic acid, di-n-butylphthalate, fluoranthene, bis(2-ethylhexyl)phthalate, pentachlorophenol, phenanthrene, butylbenzylphthalate, chrysene, and benzo(b)fluoranthene) exceed sediment quality criteria. 4,4'-DDE concentrations in SD-1 and 4,4'-DDT concentrations in SD-1 and SD-4 exceed sediment quality criteria.

Comparison of inorganic concentrations to NJDEPE SWQS indicates that aluminum, chromium (total), copper, manganese, and nickel are elevated at all five sampling locations.

Beryllium exceeded the NJDEPE SWQS at all but the furthest downstream location (SW-5), while antimony, cyanide, lead, nickel, and zinc exceeded NJDEPE SWQS at SW-1 and/or SW-2 located alongside the facility. Comparison to AWQC indicates elevations of lead at four of the five sampling locations and copper at the three sampling locations nearest the facility. Antimony, beryllium, cadmium, mercury, nickel, and zinc exceed AWQC at SW-1 and/or SW-2 which are located alongside the facility. Of the three detected VOCs (chloromethane, 1,2-dichloroethene, and trichloroethene), only trichloroethene exceeded the NJDEPE SWQS (but not the AWQC). Neither an AWQC or a NJDEPE SWQS is available for one of the two detected SVOCs (di-n-butylphthalate). Bis(2-ethylhexyl)phthalate exceeded both the AWQC and the NJDEPE SWQS at sampling location SW-4.

6.2.1 Ecological AOC #1

The upland woodlot at the eastern end of the Hudson Branch and the intermittently wet headwaters region have not been sampled. This area lies downgrade from Undeveloped AOC #3, whose surface soils were not highly impacted. Further, the groundwater on-site flows in a southwesterly direction away from this region, suggesting that Ecological AOC #1 is not an area of significant impact.

6.2.2 Ecological AOC #2

Environmental media concentrations at the ponded portion of the Hudson Branch are represented by one sediment (SD-01) and one surface water (SW-01) sample. Comparison of COC concentrations in SD-1 versus the sediment criteria presented in Table 5-1 indicates little ecological impact with the exception of chromium, lead, and nickel. The zinc concentration

exceeded the ER-L, but did not exceed the ER-M. Criteria were not available for barium, beryllium, cobalt, manganese, selenium, vanadium, niobium, and titanium. Chromium was detected at a concentration of 1,220 mg/kg, which exceeds the ER-M by approximately 8-fold. This chromium concentration is lower than detected concentrations in any of the four downstream samples. Lead was detected at a concentration of 364 mg/kg, which exceeds the ER-M by approximately 3-fold. This lead concentration is the highest concentration of lead detected in the Hudson Branch. Finally, nickel was detected at a concentration of 64.1 mg/kg which barely exceeds the ER-M of 50 mg/kg. Similar to chromium, this is the lowest detected concentration of nickel in Hudson Branch sediments.

Several organic compounds (one VOC, seven SVOCs, and four pesticides/PCBs) were detected in SD-1. Sediment criteria are available only for three of the SVOCs and the four pesticides/PCBs. Comparison of these COC concentrations in SD-1 versus the sediment criteria presented in Table 5-1 indicates little ecological impact with the exception of the pesticides/PCBs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and Aroclor-1254). 4,4'-DDE was detected at a concentration of 18 µg/kg which is similar to the ER-M of 15 µg/kg. 4,4'-DDT was detected at a concentration of 33 µg/kg, which exceeds the ER-M by nearly 5-fold. Finally, Aroclor-1254 at a concentration of 160 µg/kg exceeds the ER-L (50 µg/kg) but not the ER-M (400 µg/kg).

Comparison of COC concentrations in SW-1 versus NJDEPE SWQS (Table 5-1) indicates little ecological impact with the exception of aluminum, antimony, chromium, lead, and manganese. Criteria were not available for vanadium and boron. Aluminum was detected at a concentration of 4,610 ug/l, which exceeds the NJDEPE SWQS by approximately 50-fold. While the aluminum concentration at SW-1 is an order of magnitude less than the concentration at SW-2, it is approximately an order of magnitude higher than aluminum concentrations at SW-3, SW-

4, and SW-5. Antimony was detected at a concentration of 44.2 ug/l, which exceeds the NJDEPE SWQS and AWQC by approximately 4- and 1.5 fold, respectively. Antimony was not detected in SW-3, SW-4, or SW-5. Chromium was detected at a concentration of 43.3 ug/l, which exceeds the NJDEPE SWQS by approximately 4-fold. This is the lowest chromium concentration detected in the Hudson Branch water. Lead was detected at a concentration of 28 ug/l, which exceeds the NJDEPE SWQS and AWQC by approximately 45- and 9-fold, respectively. Finally, manganese was detected at a concentration of 622 ug/l, which exceeds the NJDEPE SWQS by approximately 6-fold. Manganese concentrations were lower in SW-3, SW-4, and SW-5. Di-n-butylphthalate was the only detected organic compound in SW-1. NJDEPE SWQS or AWQC are not available for this compound.

Wetland soils immediately adjacent to sediments have not been analyzed. These soils typically lie in the Hudson Branch flood plain, and thus could be expected to be affected by COCs to a degree similar to that seen in SD-1. Therefore, use of the EEL approach for evaluating potential impacts to terrestrial and avian receptors using the wetland can be based upon the analyte concentrations found in sediments. Direct comparison of sediment concentrations against the corresponding EELs reveals that a wide variety of inorganic COCs are present at concentrations of potential concern. Of greatest relevance to waterfowl and herbivores are plant tissue concentrations. Plant tissue concentrations could potentially exceed EELs for barium, chromium, lead, and vanadium by factors of 10- to 20-fold, suggesting an impact to local populations of rabbits and waterfowl which regularly use the area. However, herbivores with a large home range (e.g., deer) may not be greatly affected by these apparent riparian exceedances. In terms of earthworm uptake of COCs, concentrations that exceed the EEL are possible for chromium and lead, although other exceedances are also possible. A lack of earthworm BAF

factors for a variety of analytes limits the analysis. Nevertheless, it would appear that exposure of shrew and woodcock to earthworms associated with affected wetland soils could produce elevated risks. Since chromium bioaccumulates to a degree, it is possible that the elevated risk would be transferred to the upper trophic level (raptors). However, the relatively large home range of these raptors should partially mitigate the exposure and risk.

6.2.3 Ecological AOC #3

Environmental media concentrations along the stream portion of the Hudson Branch are represented by four sediment (SD-2, 3, 4, and 5) and surface water (SW-2, 3, 4, and 5) samples.

Comparison of COC concentrations in SD-2 through SD-5 versus the sediment criteria presented in Table 5-1 indicates a potential for ecological impact associated with SD-2. Specifically, sediment criteria were exceeded for antimony (exceeded the ER-M by approximately 10-fold), chromium (exceeded the ER-M by approximately 100-fold), lead (exceeded the ER-M by approximately 3-fold), mercury (exceeded the ER-M by approximately 2-fold), nickel (exceeded the ER-M by approximately 9-fold), and zinc (exceeded the ER-M by approximately 2-fold). Criteria were not available for barium, beryllium, cobalt, manganese, vanadium, and titanium. Concentrations of inorganics in SD-3, SD-4, and SD-5 are lower than SD-2 with the exception of manganese in SD-4 and SD-5, and selenium in SD-4 and SD-5 (selenium was not detected in SD-2 or SD-3). Sediment quality criteria are exceeded in SD-3, SD-4, and SD-5 for antimony, chromium, and nickel. No other inorganic compounds exceed the sediment criteria in these samples.

Several organic compounds (three VOCs, nine SVOCs, and four pesticides/PCBs) were detected in SD-2 through SD-5. (Note: Only SD-4 was submitted for SVOC and pesticide/PCB

analysis.) There are no sediment quality criteria for the three VOCs detected in sediments. Of the SVOCs detected and for which sediment quality criteria are available (phenol, phenanthrene, fluoranthene, pyrene, and chrysene), none exceeded these criteria. 4,4'-DDT was the only pesticide/PCB which exceeded a sediment quality criteria. This pesticide was detected at a concentration of 28 ug/kg and exceeds the criteria by approximately 4-fold.

Comparison of COC concentrations in SW-2 versus NJDEPE SWQS or AWQC indicates the potential for ecological impact from antimony, aluminum, beryllium, chromium, copper, manganese, mercury, nickel, and zinc. The greatest exceedances were associated with beryllium, copper, mercury, and nickel. The impact associated with beryllium in sediment may be overstated as the basis for the NJDEPE SWQS is human cancer risk. Only a small exceedance of the AWQC is noted for beryllium. Similarly, the exceedances for copper and nickel are substantially less when compared to the AWQC versus the NJDEPE SWQS.

Comparison of COC concentrations in SW-3, SW-4, and SW-5 versus the NJDEPE SWQS or AWQC indicates little ecological impact. Exceedances of NJDEPE SWQS or AWQC occur for aluminum (3- to 6-fold exceedance of the NJDEPE SWQS, but within the AWQC), beryllium (exceeding the NJDEPE SWQS by 100-fold, but within the AWQC), copper (ranging from 3- to 4-fold above the NJDEPE SWQS, but within the AWQC), lead (ranging from 6- to 14-fold above the NJDEPE SWQS, but within the AWQC), and manganese (ranging from 2- to 3-fold above the NJDEPE SWQS).

Three VOCs and two SVOCs were detected in SW-4. (Note: SD-2, SD-3, and SD-5 were not submitted for SVOC analysis.) Of these, bis(2-ethylhexyl)phthalate exceeded the AWQC by nearly 7-fold, but is similar to the NJDEPE SWQS.

As in Ecological AOC #2, wetland soils immediately adjacent to sediments have not been analyzed but can be assumed to be somewhat similar to the adjacent sediment in terms of analyte concentrations. Since SD-2 is considerably more affected than SD-1, it is not surprising that the theoretical plant and earthworm tissue concentrations are particularly elevated at this location relative to EELs. For example, chromium plant concentrations exceed the EEL by a factor of 100, while nickel and vanadium exceedances range between 5 to 27 fold. Mercury and antimony exceedances also become a factor in this region. These results suggest that waterfowl and terrestrial herbivores are at appreciable risk in the vicinity of SD-2. Further, the high concentrations of inorganic analytes may pose a threat to small mammals and raptors which feed off of riparian resources.

Substantial improvement in sediment and surface water was detected between SD-2 and SD-3. However, chromium, nickel, and vanadium concentrations are still sufficiently high to warrant a potential concern for avian and terrestrial receptors due to potentially impacted vegetation and soil/sediment organisms.

With increasing distance from the SMC facility along the Hudson Branch, certain analyte concentrations are reduced in sediment and surface water (e.g., nickel, copper, lead, vanadium). However, chromium levels persist in sediment at concentrations near 2000 mg/kg. These concentrations are sufficient to possibly elevate plant and earthworm concentrations above the EEL suggesting the continuing possibility of ecological harm to wetland species and raptors.

6.3 Potential for Phytotoxicity in Undeveloped and Ecological AOCs

The following discussion evaluates the COCs in surface soil for Undeveloped AOCs #2 and #3, and the COCs in sediment for Ecological AOCs #2 and #3 with regard to their potential

phytotoxicity. As a first tier assessment, the 95% UCL concentrations of the COCs in surface soil (or sediment) are compared to the minimum concentrations in soil which may cause toxic effects in plants as reported in EPA (1980). [Note: As discussed previously, for the ecological AOCs, the wetland soils, which were not sampled, are reasonably assumed to have similar analyte concentrations as the samples collected from the immediately adjacent sediments.] For the COCs with 95% UCLs above these soil criteria, a second tier evaluation is performed by comparing the estimated on-site plant tissue concentrations and those reported by EPA (1980) as being associated with damaged plant tissue. The on-site plant tissue concentrations are estimated by multiplying the on-site soil (or sediment) concentrations by the root uptake factors (RUFs) provided in Baes et al. (1984). Finally, COCs for which the estimated plant tissue concentration exceeds the level associated with plant tissue damage are further evaluated with regard to data uncertainties (e.g., frequency of detection, comparison to background).

6.3.1 Undeveloped AOC #2

Of the 10 COCs identified for Undeveloped AOC #2, three inorganics (chromium (total), manganese and vanadium) are associated with 95% UCL soil concentrations that exceed the reported minimum concentration at which plant toxicity may occur. Of these three inorganics, chromium (total) is the only one for which the estimated plant tissue concentration (1.6 mg/kg) exceeds the criterion level (1 mg/kg) provided by EPA (1980). The estimated plant tissue concentration for manganese (69 mg/kg) does not exceed the criterion level (400 mg/kg) provided by EPA (1980). A plant tissue criterion is not available for vanadium. Chromium (total) was detected in all 31 surface soil samples at concentrations of 1.7 to 5870 mg/kg, with a 95% UCL of 213 mg/kg. Chromium VI was detected in 8/9 surface soil samples at concentrations of 0.15

to 53 mg/kg. The 95% UCL for chromium VI in surface soil is 3483 mg/kg. One or more of the chromium (total) and chromium VI detections and the 95% UCLs exceed the ranges reported as background (2.1 to 18.2 mg/kg for chromium (total) and <0.11 mg/kg for chromium VI). Based on the comparisons to the soil and plant tissue criteria and background, chromium in on-site soil poses a potential concern with regard to phytotoxic effects. Vanadium was detected in all 31 surface soil samples at concentrations of 5.4 to 12100 mg/kg, with a 95% UCL of 2233 mg/kg. One or more of the detections and the 95% UCL for vanadium exceed the range for background (<10.4 to 53.7 mg/kg). Although a plant tissue criterion is not available, the comparisons to the soil criterion and background indicate that vanadium also poses a potential concern with regard to phytotoxic effects. [Note: Soil and plant tissue criterion concentrations are not provided in EPA (1980) for four of the COCs including aluminum, beryllium, strontium, and titanium. With the exception of strontium, these inorganics are associated with RUFs ranging from 0.004 (aluminum) to 0.01 (beryllium) (Baes et al., 1984), and are therefore not likely to readily accumulate in plant tissue. The RUF for strontium is 2.5 indicating that the plant tissue concentrations are typically 2.5 times those detected in the soil.]

6.3.2 Undeveloped AOC #3

Of the five COCs identified for Undeveloped AOC #2, two inorganics (chromium (total) and manganese) are associated with 95% UCL soil concentrations that exceed the reported minimum concentration at which plant toxicity may occur. However, neither of the estimated plant tissue concentrations (0.09 mg/kg for chromium and 59 mg/kg for manganese) exceeds the criterion level (1 mg/kg for chromium and 400 mg/kg for manganese) provided by EPA (1980). Although a soil criterion for cobalt is not provided in EPA (1980), the estimated on-site plant

tissue concentration (0.04 mg/kg) does not exceed the criterion plant tissue concentration (19 mg/kg). Thus, chromium, cobalt, and manganese in soil are unlikely to pose a potential concern with regard to phytotoxic effects. [Note: Soil and plant tissue criterion concentrations are not provided in EPA (1980) for two of the COCs including aluminum and titanium. These inorganics are associated with RUFs of 0.004 and 0.0055, respectively, and are therefore not likely to readily accumulate in plant tissue (Baes et al., 1984).]

6.3.3 Ecological AOC #2

Of the 27 COCs identified for sediment in Ecological AOC #2, four inorganics (arsenic, chromium (total), manganese, and vanadium) are associated with a detected concentration that exceeds the reported minimum concentration at which plant toxicity may occur. [Note: Only a single sediment sample comprises Ecological AOC #2.] Of these four inorganics, chromium (total) is the only one for which the estimated plant tissue concentration (9 mg/kg) exceeds the criterion level (1 mg/kg) provided by EPA (1980). The estimated plant tissue concentrations for arsenic and manganese (0.2 and 60 mg/kg, respectively) do not exceed the criterion levels (0.25 and 400 mg/kg, respectively) provided by EPA (1980). A plant tissue criterion is not available for vanadium. Although soil criteria for cobalt and zinc are not provided in EPA (1980), plant tissue criteria of 19 and 300 mg/kg are available. While the estimated on-site plant tissue concentration for cobalt (0.16 mg/kg) does not appear elevated, the one for zinc (347 mg/kg) exceeds the plant tissue criterion for this inorganic. In the single sediment sample from Ecological AOC #2, chromium, cobalt, and vanadium were detected at concentrations of 1220, 6, and 1890 mg/kg. Background concentrations for these inorganics in sediment are not available. Based on the comparisons to the soil and/or plant tissue criteria, chromium, cobalt,

and vanadium in wetland sediment/soil may pose a potential concern with regard to phytotoxic effects. [Note: Soil and plant tissue criterion concentrations are not provided in EPA (1980) for 17 of the COCs including five inorganics, one VOC, seven SVOCs, and four pesticides/PCBs. With the exception of 2-butanone, benzoic acid, and phenol, these COCs are associated with RUFs less than unity (1) (Baes et al., 1984), and are therefore not likely to readily accumulate in plant tissue. The RUFs for 2-butanone, benzoic acid, and phenols exceed unity (1), ranging from 3.21 (benzoic acid) to 27.4 (2-butanone).]

6.3.4 Ecological AOC #3

Of the 34 COCs identified for sediment in Ecological AOC #3, five inorganics (arsenic, chromium (total), copper, manganese, and vanadium) are associated with detected concentrations that exceed the reported minimum concentration at which plant toxicity may occur. [Note: Due to the small sample size, 95% UCLs are not calculated.] Of these five inorganics, arsenic, chromium, and copper are associated with estimated maximum plant tissue concentrations (0.64, 118, and 3 mg/kg, respectively) that exceed the criterion level (0.25, 1, and 0.73 mg/kg, respectively) provided by EPA (1980). The estimated maximum plant tissue concentration for manganese (164 mg/kg) does not exceed the criterion level (400 mg/kg) provided by EPA (1980). A plant tissue criterion is not available for vanadium. Although soil criteria for cobalt and zinc are not provided in EPA (1980), plant tissue criteria of 19 and 300 mg/kg are available. While the estimated maximum plant tissue concentration for cobalt (0.9 mg/kg) does not appear elevated, the one for zinc (794 mg/kg) exceeds the plant tissue criterion for this inorganic. Although background concentrations for arsenic, chromium, copper, vanadium, and zinc in sediment are not available, these inorganics may pose a potential concern with regard to

phytotoxic effects based on the comparisons to the soil and/or plant tissue criteria. [Note: Soil and plant tissue criterion concentrations are not provided in EPA (1980) for 22 of the COCs including six inorganics, three VOCs, nine SVOCs, and four pesticides/PCBs. With the exception of 2-butanone, carbon disulfide, 1,2-dichloroethane, benzoic acid, and phenol, these COCs are associated with RUFs less than unity (1) (Baes et al., 1984), and are therefore not likely to readily accumulate in plant tissue. The RUFs for 2-butanone, carbon disulfide, 1,2-dichloroethane, benzoic acid, and phenol exceed unity (1), ranging from 2.17 (carbon disulfide) to 27.4 (2-butanone).]

6.4 Uncertainty Analysis

The EE projects elevated ecological risks for a variety of receptors due to inorganics present in soil, sediment, and surface water. However, uncertainties in this assessment surround the degree of exposure possible for ecoreceptors, the inherent toxicity of detected analytes, and data gaps with respect to media sampling. These uncertainties are highlighted by the fact that the EE prediction of ecological impact is contradicted by field surveys, which to this point have failed to detected indicators of chemical stress. Therefore, the uncertainty analysis is an important component of this EE.

6.4.1 Uncertainties Surrounding Exposure Assessment

While elevated COC concentrations have been detected in ecologically significant regions (Hudson Branch wetlands), these detections do not necessarily infer bioavailability and exposure. At greatest issue is the degree of uptake possible for inorganics which are likely to be complexed with organic substrates or sorbed onto soils or sediments. Biotransfer of constituents at the base

of the food web (plants, earthworms, insects, aquatic invertebrates) is assumed to occur according to the RUF value taken from Baes et al. (1984). However, chromium RUF values in wetland soils and sediments may differ significantly from that reported by Baes et al. The highly organified (sediment TOC = 35%) small particle size soils of the wetland flood plain and sediment present a large potential binding capacity (Eisler, 1986; USEPA, 1984; Rai et al., 1989). (Note: Grain size distribution analysis is presented in Appendix D.) It should be noted that stream sediments were covered by a dense layer of vascular vegetation. The high surface area and organic content of this benthic environment may effectively immobilize many inorganic constituents. Further, the relatively acidic pH of these wetland soils and sediments enhances complexation with organic substrates (Rai et al., 1989). Therefore, it is possible that chromium bioavailability in the Ecological AOCs is considerably below that assumed based upon published information. This may also be true for other inorganic analytes detected on-site (e.g., arsenic, antimony, beryllium, and lead) which sorb tightly to soil colloids or organic matter.

6.4.2 Uncertainties Surrounding Stressor-Response Assessment

The major uncertainty associated with applying laboratory-derived toxicity data to environmental receptors is that the indicator species and exposure scenario differ widely between the laboratory and the field. Extrapolations are commonly made from laboratory rodents exposed to chemicals in diet or drinking water to small mammals exposed via earthworms, vegetation, or insects. These exposure differences may lead to large differences in chemical bioavailability, the presence of other interacting analytes (which may increase or decrease toxicity), and altered susceptibility to toxic effects. Extrapolations from waterfowl to raptors and woodcock involves

substantial uncertainty because of differences in dietary composition, chemical handling, and inherent sensitivity.

The environmental effects levels are concentrations above which adverse effects may begin to occur. However, the dose response for these effects is in many cases ill-defined so it is unclear what concentration survival of the individual or ecosystem structure is potentially at risk. Generally, ecosystem effects are most likely in cases where substantial elevations of environmental effects levels occur over a broad region such that entire communities can be impacted. This would appear to be the case in the Hudson Branch wetland since chromium concentrations are a concern over a large portion of Ecological AOC #2 and #3.

6.4.3 Uncertainty Arising from Field Evidence

Site reconnaissance in mid April 1994 found a wetland habitat that is rich in diversity and abundance. It appears to be an intact ecosystem which attracts raptors, blue heron, rabbits, turkey vultures, and a variety of other species. Aquatic vascular vegetation was found to be extensive, and the wetland encompassed a broad plain on either side of the stream. Although a stressed vegetation survey will be formally conducted later in the growing season, this investigation found no evidence consistent with overt phytotoxicity. The nature of the wetlands was as expected based upon that reported for pinelands broad-leafed swamp forests (Forman, 1979).

6.4.4 Uncertainties Due to Data Gaps

Potential impacts to wetland flood plains cannot be directly assessed since these wetland soils have not been analyzed. The current assessment assumed that these analyte concentrations detected in wetland sediments are relevant to these nearby soils since analytes from Hudson

Branch likely wash over and adsorb to these soils during flood periods. However, this has not been verified, and creates a significant uncertainty given the apparent lack of overt impact to these regions.

A degree of uncertainty is also created by the relatively small number of samples taken in wetland sediments. However, the general consistency of results over the sampled reach of Hudson Branch suggests that additional sampling would not necessarily produce results of added significance.

7.0 CONCLUSIONS AND RECOMMENDATIONS

This EE utilized comparisons of environmental concentrations against sediment and NJDEPE SWQS, and against environmental effects levels to conclude that stresses are possible to wetland receptors.

Of the five sediment samples collected from the Hudson Branch, sample SD-2 exhibited the largest exceedances of the available sediment criteria. The increase above the sediment criteria in SD-2 ranged from 2-fold for mercury and zinc to 100-fold for chromium. Inorganics which were consistently elevated across the sediment samples include antimony, chromium, and nickel. The detected concentrations of four organics (4,4'-DDD, 4,4'-DDE, 4,4'-DDT and Aroclor-1254 in samples SD-1 and SD-4) also exceeded one or more of the sediment criteria. A similar trend is evident for the surface water samples collected from the Hudson Branch. Sample SW-2 contained the largest number of COCs for which one or more of the available surface water criteria were exceeded. Further, the largest exceedances of these criteria were also associated with sample SW-2. The increase above the surface water criteria in SW-2 ranged from 5-fold for aluminum and beryllium (as compared to the EPA AWQC) to 3,300-fold for beryllium (as compared to the NJDEPE SWQS). Inorganics for which one or more of the surface water criteria were consistently exceeded across samples include aluminum, chromium, and lead. One organic (bis(2-ethylhexyl)phthalate in SW-4) also exceeded one or more of the surface water criteria. Based on the facility history, the presence of the organics detected in one or more of the sediment and surface water samples is not likely to be site-related.

Undeveloped AOC #2 and #3 contain open, mowed grassy fields which may form habitat for a limited food web. Undeveloped AOC #1 is an unvegetated area within the industrial site and does not include useable habitat. The COCs in surface soil for Undeveloped AOC #2 and

#3 were evaluated with regard to their potential impacts on selected receptors in the terrestrial food chain. Risks from elevated soil concentrations for cadmium and nickel in Undeveloped AOC #2 and manganese in Undeveloped AOC #3 appear to be of greatest concern to local populations of mice and rabbits, with a marginal level of concern for raptors which may sporadically utilize these AOCs.

Field investigations to date do not support this assessment. To improve understanding of the level of ecological risk, some combination of the following additional data gathering may be of use:

- Conduct sediment toxicity studies of sediments taken from several discrete wetland locations. Obtain sediment analyte data from the corresponding locations.
- Conduct toxicity studies of wetland flood plain soils and compare these results to analyte sampling data.
- Assess inorganic analyte concentrations in earthworms, benthic macroinvertebrates, and/or vegetation.

Appropriately designed and conducted studies should help determine whether inorganic analytes are bioavailable and capable of producing adverse effects.

8.0 REFERENCES

Baes, C.F., Sharp, R.D., Sjoreen, A.L., and Shor, R.W. (1984). A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture. Oak Ridge National Labs ORNL-5786.

Beyer, W.N., Pattee, O.H., Sileo, L., Hoffman, D.J., and Mulbern, B.H. (1985). Metal contamination in wildlife living near two zinc smelters. Environ. Pollut. (Series A) 38:63-86.

Brady, Nyle C. (1984). The Nature and Properties of Soils, Ninth Edition, MacMillan Publishing Company, NY.

Chapman, J.A. (1982). Wild Animals of North America; Biology, Management and Economics. Johns Hopkins University Press.

DeGraaf, R.M. (1983). New England Wildlife; Habitat, Natural History and Distribution. U.S. Department of Agriculture, GTR NE-108.

Desbaumes, P., and D. Ramaciotti. (1968). Etude chimique de l'action sur la vegetation d'un effluent gazeux industrial dontenant du chrome hexavalent, Pollut. Atmos. 10:224-226 (as cited in EPA (1980)).

Dvorak, A.J., Lewis, B.G., et al. (1978). Impacts of Coal-Fired Power Plants on Fish, Wildlife, and Their Habitats, U.S. Fish and Wildlife Service Report No. FWS/OBS-78/29, Ann Arbor, Michigan (as cited in EPA (1980)).

Eisler, R. (1986). Chromium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Dept. Interior, Fish & Wildlife Service: Biological Report #85(1.6).

ENSR Consulting and Engineering (ENSR). (1989). Remedial Investigation Workplan, Shieldalloy Metallurgical Corporation, Newfield, New Jersey. December.

Federal Interagency Committee for Wetland Delineation (1989). Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service.

Forman, Richard T.T. (1979). Pine Barrens: Ecosystem and Landscape, Academic Press, New York.

Fries, G. F., and Paustenbach, D.J. (1990). Evaluation of potential transmission of 2,3,7,8-tetrachlorodibenzxo-p-dioxin-contaminated incinerator emissions to humans via foods. Journal of Toxicology and Environmental Health, 29, 1-43.

Hartenstein, R., Neuhauser, E.F., and Collier, J. (1980). Accumulation of heavy metals in the earthworm *Eisenia foetida*. J. Environ. Qual. 9:23-26.

Hobbs, C.H. and R.O. McClellan (1986). Toxic effects of radiation and radioactive materials. In: Casarett and Doull's Toxicology. The Basic Science of Poisons, C.D. Klaasen, M.O. Amdur and J. Doull, Eds., Macmillan Publishing Company, New York, pp. 669-705.

Hurd-Karrer, A.M. (1934-35). Selenium Absorption by Plants and Their Resulting Toxicity to Animals. Smithsonian Institution Annual Report. 35:289 (as cited in EPA (1980)).

Markwell, R.D., Connell, D.W., and Gabric, A.J. (1989). Bioaccumulation of Lipophilic Compounds from Sediments by Oligochaetes. Wat. Res., Vol. 23, 1443-1450.

Menzie, C.A., Burmaster, D., and Freshman, J.S. (1992). Assessment of methods for estimating ecological risk in the terrestrial component. Environ. Toxicol. and Chem. 11, 245–260.

Morgan, M.D., Hastings, R.W., Wolfe, G.W., and Philipp, K.R. A Comparison of Aquatic Species Composition and Diversity in Disturbed and Undisturbed Pinelands Waters. Center for Coastal and Environmental Studies. The State University of New Jersey, New Brunswick, NJ.

National Academy of Sciences (NAS). (1980). Mineral Tolerance of Domestic Animals.

National Research Council (NRC). (1968). Manganese: Medical and Biological Effects of Environmental Pollutants, Committee on Biological Effects of Atmospheric Pollutants, National Academy of Sciences, Washington, D.C. (as cited in EPA (1980)).

New Jersey Department of Environmental Protection and Energy (NJDEPE). (1994). Comments on the Risk Assessment and Human Health Evaluation Addendum, Shieldalloy Metallurgical Corporation, Newfield, New Jersey.

New Jersey Department of Environmental Protection and Energy (NJDEPE). (1992). Proposed New Rule - Cleanup Standards for Contaminated Sites.

New Jersey Department of Environmental Protection and Energy (NJDEPE). (1992a). Proposed Surface Water Quality Standards. N.J.A.C. 7:9B. Also: Basis and Background for the 1992 Proposed Revisions to the Surface Water Quality Standards. October.

New Jersey Department of Environmental Protection and Energy (NJDEPE). (1991). Personal communication.

National Academy of Sciences (NAS). (1980). Mineral Tolerance of Domestic Animals.

National Oceanic and Atmospheric Administration (NOAA) (1991). The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trend Program. NOAA Technical Memorandum NOS OMA 52.

National Technical Information Service (NTIS). (1980). A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals, National Technical Information Service, Rec.

Rai, D., Eary, L.E., and Zachara, J.M. (1989). Environmental Chemistry of Chromium. In: The Science of the Total Environment. Elsevier Science Publishers B.V., Amsterdam.

Scheuplein, R.J. (1965). Mechanism of percutaneous absorption. I. Routes of penetration and the influence of solubility. J. Invest. Dermatol. 45:334-346.

Skog, E. and Wahlberg, J.E. (1964). A comparative investigation of the percutaneous absorption of metal compounds in the guinea pigs by means of the radioactive isotopes: ^{51}Cr, ^{58}Co, ^{65}Zn, ^{110m}Ag, ^{115m}Cd, ^{203}Hg. J. Invest. Dermatol. 43:187-192.

Travis, C.C., and Arms, A.D. (1988). Bioconcentration of organics in beef, milk, and vegetation. Environmental Science and Technology, 22, 271-274.

TRC Environmental Consultants, Inc. (TRC-ECI). (1992). Remedial Investigation Technical Report, Shieldalloy Metallurgical Corporation, Newfield, New Jersey. Final. April.

TRC Environmental Corporation (TRC). (1994). Human Health Risk Assessment, Shieldalloy Metallurgical Corporation, Newfield, New Jersey.

U.S. Environmental Protection Agency (USEPA). (1993). Integrated Risk Information System (IRIS) Database.

U.S. Environmental Protection Agency (USEPA). (1992). Framework for Ecological Risk Assessment. EPA/630/R-91/001.

U.S. Environmental Protection Agency (USEPA). (1991). Water Quality Criteria Summary. Office of Science and Technology. May 1.

U.S. Environmental Protection Agency (USEPA). (1991a). Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene. Office of Science and Technology. PB93-155950. November.

U.S. Environmental Protection Agency (USEPA). (1991b). Proposed Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. Office of Science and Technology. PB93-153880. November.

U.S. Environmental Protection Agency (USEPA). (1991c). ECO Update: Ecological Assessment of Superfund Sites, An Overview. 1(2).

U.S. Environmental Protection Agency (USEPA). (1989). Risk Assessment Guidance for Superfund. Volume I Human Health Evaluation Manual (Part A).

U.S. Environmental Protection Agency (USEPA). (1989a). Risk Assessment Guidance for Superfund. Volume II. Environmental Evaluation Manual.

U.S. Environmental Protection Agency (USEPA). (1980). A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals. PB82-189572.

U.S. Environmental Protection (USEPA). (1979). Water-Related Environmental Fate of 126 Criteria Pollutants. USEPA 440/4-76-029a.

U.S. Environmental Protection Agency (USEPA). (1975). Preliminary Investigation of Effects of Boron, Indium, Nickel, Selenium, Tin, Vanadium, and Their Compounds, Vol. VI, Vanadium, USEPA Report No. EP-560/2-75-005f (as cited in EPA, 1980).

Wahlberg, J.E. (1968). Percutaneous absorption from chromium (^{51}Cr) solutions of different pH, 1.4-12.8. Dermatologica. 137:17-25.

TABLES

TABLE 2-1

FIELD INVESTIGATION PROGRAM SUMMARY

Field Reconnaissance and Instrument Survey
Mobilization
Sampling Grid Layout
Surface Soil Sampling (64 samples)
Test Pit Operations (5 test pits located along former drainage ditch - 5 samples)
Soil Gas Surveys - used to locate 6 soil borings in former product storage areas
Collection of one round of surface water samples from the Hudson Branch, including runoff samples during a rainfall event from major drainage pathways, and one round of sediment samples from the Hudson Branch
Completion of 72 soil borings across the site to characterize soil quality and geology above the water table
Installation of ground water monitoring wells to identify geologic and hydrogeologic conditions; 19 wells installed at 14 locations, including 7 deep and 12 shallow wells
Collection of 2 rounds of ground water samples from on-site and off-site newly installed and existing monitoring wells; initial round (52 monitoring wells sampled) characterized ground water quality and the second round (39 monitoring wells sampled) confirmed first round results and further defined the nature and extent of contamination
Collection of 72 air samples over the course of 12 air sampling events conducted during non-operational periods at the SMC facility

TABLE 2-2

HUDSON BRANCH WETLAND AND UPLAND SPECIES

Species	Eastern Uplands/ Headwaters		Ponded Region		Stream	
	Upland	Wetland	Upland	Wetland	Upland	Wetland
Herbs and Shrubs						
Cattails						✓
Phragmites		✓		✓		✓
Swamp Magnolia						✓
Sensitive Fern				✓		✓
Cinnamon Fern						✓
Soft Rush				✓		✓
Japanese Knotweed					✓	
Sphagnum				✓		
Poison Ivy					✓	
Jewel Weed				✓		✓
Sweep Pepperbush	✓			✓		✓
Blueberry	✓		✓			
Common Elder	✓		✓			
Mountain Laurel	✓				✓	
Green Brier	✓	✓	✓			✓
Multiflora Rose		✓	✓			✓
Duckweed						✓
Marsh Marigold						✓
Honeysuckle					✓	
Crows Foot Club Moss			✓			
Golden Rod Sp.	✓		✓		✓	
Bracken Fern					✓	
Trees						
Black Tupelo		✓				✓
Red Maple			✓	✓		✓
Red Cedar	✓			✓		✓
White Cedar						✓
Willow			✓			
White Oak	✓				✓	
Red Oak	✓				✓	
Bear Oak	✓					
Pitch Pine	✓		✓		✓	
Box Elder				✓	✓	
Black Cherry				✓	✓	
Bigtooth Aspen			✓		✓	
Holly	✓		✓		✓	
Sassafras	✓					
Dogwood			✓			
Staghorn Sumac					✓	
Black Locust			✓			
Norway Maple			✓			

TABLE 3-1
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
LEACHATE STORAGE AOC (a)

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	9/9	2440–8610	5223	7067.6	1840 – 4090	NA
ANTIMONY	1/9	19.8	6.1	8.8	12.3 – <12.8	340
ARSENIC	8/9	0.42–2.1	0.99	1.6	<2.1	2
BARIUM	9/9	12.9–128	43.8	126.1	<40.9 – <42.7	47000
BERYLLIUM	9/9	0.3–19.4	3.9	99.0	<1.0 – <1.1	1
CADMIUM	2/9	0.92–1.2	0.83	0.9	<1.0 – <1.1	100
CHROMIUM (total)	9/9	2.3–1630	226.6	6735.7	2.1 – 18.2	NA
CHROMIUM VI	5/5	0.12–18.1	4.08	4421.7	<0.11	NA
COBALT	8/9	1.3–12.4	4.2	9.2	<10.2 – <10.7	NA
COPPER	9/9	1.8–91.3	15.6	94.2	<5.2 – 20.8	600
LEAD	9/9	4.3–49.1	18.4	48.3	6.7 –17.9	600
MANGANESE	9/9	21.7–627	177.5	923.8	19.4 – 103	NA
MERCURY	2/9	0.09–0.1	0.08	0.1	<0.089 – <.11	270
NICKEL	8/9	3.7–912	175.9	97316.2	<8.3 – 8.3	2400
SELENIUM	2/9	0.42–2	0.59	0.9	<1.0 – <1.1	3100
SILVER	0/9	ND	NA	NA	<2.1	4100
VANADIUM	9/9	29.4–3950	764.0	69935.4	<10.4 – 53.7	7100
ZINC	9/9	3.8–117	35.3	125.1	15.2 – 18.1	1500
CYANIDE	0/8	ND	NA	NA	<1.1	21000
BORON	0/1	ND	NA	NA	<20.9 – <21.4	NA
NIOBIUM	0/1	ND	NA	NA	<40.5 – <42.5	NA
STRONTIUM	0/1	ND	NA	NA	<20.4 – <21.4	NA
TITANIUM	1/1	57.8	57.8	NC	49.3 – 123	NA

(a) – SOIL SAMPLES NOT SUBMITTED FOR VOC, SVOC, AND PESTICIDES/PCB ANALYSIS
ND – NOT DETECTED
NA – NOT AVAILABLE OR NOT APPLICABLE
NC – 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-2
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
THE MANUFACTURING AOC

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	16/16	1770-7685	4917	6231	1840 - 4090	NA
ANTIMONY	4/16	16.8-39.5	9.3	13.5	12.3 - <12.8	340
ARSENIC	15/16	0.53-43.1	3.75	4.96	<2.1	2
BARIUM	16/16	7.5-123	33.3	56.9	<40.9 - <42.7	47000
BERYLLIUM	14/16	0.24-20	3.26	11.58	<1.0 - <1.1	1
CADMIUM	4/16	0.92-1.6	0.93	1.02	<1.0 - <1.1	100
CHROMIUM (total)	16/16	2.3-2280	460.3	16177.2	2.1 - 18.2	NA
CHROMIUM VI	8/12	0.12-18	2.70	30.2	<0.11	NA
COBALT	15/16	1.7-32.8	5.3	7.5	<10.2 - <10.7	NA
COPPER	16/16	1.8-121	14.4	26.5	<5.2 - 20.8	600
LEAD	16/16	2.3-331	40.0	111.9	6.7 -17.9	600
MANGANESE	16/16	22-2380	481	2019	19.4 - 103	NA
MERCURY	3/16	0.1-0.11	0.09	0.10	<0.089 - <.11	270
NICKEL	12/16	3.7-339	46.2	252.7	<8.3 - 8.3	2400
SELENIUM	5/16	0.42-2	0.54	0.63	<1.0 - <1.1	3100
SILVER	3/16	1.15-3.3	1.20	1.49	<2.1	4100
VANADIUM	16/16	8.2-4110	616.9	5214.6	<10.4 - 53.7	7100
ZINC	16/16	3.8-266	63.0	241.8	15.2 - 18.1	1500
CYANIDE	1/12	0.7	0.5	NA	<1.1	21000
BORON	0/2	ND	NA	NA	<20.9 - <21.4	NA
NIOBIUM	0/2	ND	NA	NA	<40.5 - <42.5	NA
STRONTIUM	1/2	46.4	33.40	NC	<20.4 - <21.4	NA
TITANIUM	5/5	81.8-219	143.8	229.1	49.3 - 123	NA
ZIRCONIUM	0/1	ND	NA	NA	NA	NA
VOLATILE ORGANICS						
ACETONE	1/1	0.082	0.08	NC	NA	1000
CARBON DISULFIDE	1/5	0.003	0.003	0.003	NA	NA
1,2-DICHLORETHENE (total)	1/5	0.002	0.002	0.002	NA	1000
2-BUTANONE	1/5	0.008	0.006	0.007	NA	1000
TRICHLOROETHENE	4/5	0.0015-0.003	0.002	0.0029	NA	54
BENZENE	1/5	0.015	0.034	2.878	NA	13
TETRACHLOROETHENE	3/5	0.003	0.003	0.003	NA	6
TOLUENE	3/5	0.002-0.007	0.003	0.006	NA	1000
ETHYLBENZENE	1/5	0.058	0.016	0.140	NA	1000
XYLENE (total)	1/5	0.36	0.076	51.884	NA	1000
BASE NEUTRAL / ACIDS						
PHENOL	2/5	0.046-0.18	0.149	0.410	NA	10000
BENZOIC ACID	3/5	0.088-0.48	0.319	1.427	NA	NA
NAPHTHALENE	1/5	0.13	0.10	0.12	NA	4200
4-NITROPHENOL	1/5	1.0	0.9	1.0	NA	N/A
2,4-DINITROTOLUENE	1/5	0.11	0.09	0.10	NA	N/A
PENTACHLOROPHENOL	3/5	0.11-0.79	0.39	2.63	NA	24
PHENANTHRENE	3/5	0.045-0.13	0.085	0.144	NA	NA
ANTHRACENE	1/5	0.084	0.086	0.088	NA	10000
DI-n-BUTYLPHALATE	1/2	0.12	0.15	NC	NA	10000
FLUORANTHENE	4/5	0.042-0.29	0.138	0.682	NA	10000
PYRENE	1/2	0.046	0.067	NC	NA	10000
BUTYLBENZYLPHTHALATE	1/5	0.12	0.09	0.11	NA	10000
BENZO(a)ANTHRACENE	1/5	0.42	0.22	0.37	NA	4
CHRYSENE	2/5	0.073-0.58	0.235	0.503	NA	40
bis(2-ETHYLHEXYL)PHTHALATE	3/5	0.071-0.25	0.151	0.361	NA	210
BENZO(b)FLUORANTHENE	2/5	0.047-0.35	0.183	0.241	NA	NA
BENZO(k)FLUORANTHENE	1/5	0.16	0.10	0.14	NA	4
BENZO(a)PYRENE	1/5	0.74	0.43	0.66	NA	0.66
INDENO(1,2,3-cd)PYRENE	1/5	0.38	0.22	0.34	NA	4
BENZO(g,h,i)PERYLENE	1/5	1.1	0.5	1.1	NA	NA
PESTICIDES / PCB'S						
AROCLOR-1248	0/6	ND	NA	NA	NA	2
AROCLOR-1254	3/6	0.013-0.13	0.070	0.559	NA	2
AROCLOR-1260	0/6	ND	NA	NA	NA	NA

ND - NOT DETECTED
NA - NOT AVAILABLE OR NOT APPLICABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-3
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
CHROMATE WASTE WATER SPILL AOC (a)

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	4/4	3320-7950	4918	13437	1840 - 4090	NA
ANTIMONY	1/4	6.5	4.8	7.9	12.3 - <12.8	340
ARSENIC	4/4	1.3-4.4	2.2	13.7	<2.1	2
BARIUM	4/4	15.4-29.9	24.1	44.0	<40.9 - <42.7	47000
BERYLLIUM	4/4	0.32-8.9	3.2575	38.92	<1.0 - <1.1	1
CADMIUM	0/4	ND	NA	NA	<1.0 - <1.1	NA
CHROMIUM (total)	4/4	10.9-102	50.0	154.6	2.1 - 18.2	NA
CHROMIUM VI	2/2	0.3-1.32	0.81	NC	<0.11	NA
COBALT	3/4	2-2.9	2.1	2.7	<10.2 - <10.7	NA
COPPER	4/4	2.5-10.9	7.0	13.8	<5.2 - 20.8	600
LEAD	4/4	12-98.9	34.7	102.9	6.7 -17.9	600
MANGANESE	4/4	51.1-408	169.3	430.9	19.4 - 103	NA
MERCURY	0/4	ND	NA	NA	<0.089 - <.11	NA
NICKEL	4/4	5.4-189	74.4	1154.8	<8.3 - 8.3	2400
SELENIUM	0/4	ND	NA	NA	<1.0 - <1.1	NA
SILVER	0/4	ND	NA	NA	<2.1	NA
VANADIUM	4/4	68.3-1810	655.9	7934.2	<10.4 - 53.7	7100
ZINC	4/4	9.6-96	38.7	115.3	15.2 - 18.1	1500
CYANIDE	0/4	ND	NA	NA	<1.1	NA
BORON	0/2	ND	NA	NA	<20.9 - <21.4	NA
NIOBIUM	0/2	ND	NA	NA	<40.5 - <42.5	NA
STRONTIUM	1/2	29.4	25.1	NC	<20.4 - <21.4	NA
TITANIUM	2/2	101-128	115	NC	49.3 - 123	NA

(a) - SOIL SAMPLES NOT SUBMITTED FOR VOC, SVOC, AND PESTICIDES/PCB ANALYSIS
ND - NOT DETECTED
NA - NOT AVAILABLE OR NOT APPLICABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-4
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
THE NUCLEAR REGULATORY COMMISSION CONTROLLED AOC

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	10/10	3570-28700	11038	20837	1840 - 4090	NA
ANTIMONY	3/10	5.9-13.8	6.0	7.7	12.3 - <12.8	340
ARSENIC	10/10	0.6-3.1	1.4	1.9	<2.1	2
BARIUM	10/10	15.7-650	236.6	1137.0	<40.9 - <42.7	47000
BERYLLIUM	10/10	0.68-11.9	4.50	9.33	<1.0 - <1.1	1
CADMIUM	0/10	ND	NA	NA	<1.0 - <1.1	NA
CHROMIUM (total)	10/10	29.25-473	219.45	514.65	2.1 - 18.2	NA
CHROMIUM VI	7/8	1.3-15.69	4.30	64.33	<0.11	NA
COBALT	9/10	1.4-12.2	5.0	9.8	<10.2 - <10.7	NA
COPPER	10/10	2.8-36.5	11.5	20.4	<5.2 - 20.8	600
LEAD	10/10	11.4-556	107.3	393.6	6.7 -17.9	600
MANGANESE	10/10	117.5-890	346.1	591.2	19.4 - 103	NA
MERCURY	0/10	ND	NA	NA	<0.089 - <.11	NA
NICKEL	10/10	10-677	248	1899	<8.3 - 8.3	2400
SELENIUM	0/10	ND	NA	NA	<1.0 - <1.1	NA
SILVER	0/10	ND	NA	NA	<2.1	NA
VANADIUM	10/10	102-2450	880	2077	<10.4 - 53.7	7100
ZINC	10/10	14.7-288	84.8	194.5	15.2 - 18.1	1500
CYANIDE	0/8	ND	NA	NA	<1.1	NA
BORON	4/6	59.5-146	62.4	230.4	<20.9 - <21.4	NA
NIOBIUM	2/6	81.5-845	182.4	2696.7	<40.5 - <42.5	NA
STRONTIUM	4/6	22.8-171	71.6	433.5	<20.4 - <21.4	NA
TITANIUM	6/6	119-305	188	330	49.3 - 123	NA
ZIRCONIUM	1/2	101	70	NC	NA	NA
VOLATILE ORGANICS						
CARBON DISULFIDE	0/1	ND	NA	NA	NA	NA
1,2-DICHLORETHENE (total)	0/1	ND	NA	NA	NA	NA
CHLOROFORM	0/1	ND	NA	NA	NA	NA
2-BUTANONE	0/1	ND	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	0/1	ND	NA	NA	NA	NA
TRICHLOROETHENE	1/1	0.004	0.004	NC	NA	54
BENZENE	0/1	ND	NA	NA	NA	NA
TETRACHLOROETHENE	0/1	ND	NA	NA	NA	NA
TOLUENE	0/1	ND	NA	NA	NA	NA
ETHYLBENZENE	0/1	ND	NA	NA	NA	NA
XYLENE (total)	0/1	ND	NA	NA	NA	NA
BASE NEUTRAL / ACIDS						
PHENOL	0/1	ND	NA	NA	NA	NA
2-CHLOROPHENOL	0/1	ND	NA	NA	NA	NA
BENZOIC ACID	0/1	ND	NA	NA	NA	NA
2,4-DICHLOROPHENOL	0/1	ND	NA	NA	NA	NA
NAPHTHALENE	0/1	ND	NA	NA	NA	NA
4-CHLORO-3-METHYLPHENOL	0/1	ND	NA	NA	NA	NA
2,4,5-TRICHLOROPHENOL	0/1	ND	NA	NA	NA	NA
4-NITROPHENOL	0/1	ND	NA	NA	NA	NA
2,4-DINITROTOLUENE	0/1	ND	NA	NA	NA	NA
PENTACHLOROPHENOL	0/1	ND	NA	NA	NA	NA
PHENANTHRENE	0/1	ND	NA	NA	NA	NA
DI-n-BUTYLPHALATE	0/1	ND	NA	NA	NA	NA
FLUORANTHENE	0/1	ND	NA	NA	NA	NA
PYRENE	0/1	ND	NA	NA	NA	NA
BUTYLBENZYLPHTHALATE	0/1	ND	NA	NA	NA	NA
BENZO(a)ANTHRACENE	0/1	ND	NA	NA	NA	NA
CHRYSENE	0/1	ND	NA	NA	NA	NA
bis(2-ETHYLHEXYL)PHTHALATE	1/1	0.085	0.085	NC	NA	210
BENZO(b)FLUORANTHENE	0/1	ND	NA	NA	NA	NA
BENZO(k)FLUORANTHENE	0/1	ND	NA	NA	NA	NA
BENZO(a)PYRENE	0/1	ND	NA	NA	NA	NA
INDENO(1,2,3-cd)PYRENE	0/1	ND	NA	NA	NA	NA
BENZO(g,h,i)PERYLENE	0/1	ND	NA	NA	NA	NA
PESTICIDES / PCB'S						
4,4-DDT	0/1	ND	NA	NA	NA	NA
AROCLOR-1248	1/1	1.9	1.9	NC	NA	2
AROCLOR-1254	1/1	1.5	1.5	NC	NA	2
AROCLOR-1260	0/1	ND	NA	NA	NA	NA

ND - NOT DETECTED
NA - NOT AVAILABLE OR NOT APPLICABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-5
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
RAILROAD SIDING AOC (a)

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	1/1	7060	7060	NC	1840 – 4090	NA
ANTIMONY	0/1	ND	NA	NC	12.3 – <12.8	340
ARSENIC	1/1	4	4	NC	<2.1	2
BARIUM	1/1	59.9	59.9	NC	<40.9 – <42.7	47000
BERYLLIUM	1/1	20	20	NC	<1.0 – <1.1	1
CADMIUM	1/1	1.5	1.5	NC	<1.0 – <1.1	100
CHROMIUM (total)	1/1	87.3	87.3	NC	2.1 – 18.2	NA
COBALT	1/1	9.5	9.5	NC	<10.2 – <10.7	NA
COPPER	1/1	32.2	32.2	NC	<5.2 – 20.8	600
LEAD	1/1	7.2	7.2	NC	6.7 –17.9	600
MANGANESE	1/1	1810	1810	NC	19.4 – 103	NA
MERCURY	0/1	ND	NA	NC	<0.089 – <.11	NA
NICKEL	1/1	339	339	NC	<8.3 – 8.3	2400
SELENIUM	1/1	0.42	0.42	NC	<1.0 – <1.1	3100
SILVER	0/1	ND	NA	NC	<2.1	NA
VANADIUM	1/1	4110	4110	NC	<10.4 – 53.7	7100
ZINC	1/1	266	266	NC	15.2 – 18.1	1500
BORON	0/1	ND	NA	NC	<20.9 – <21.4	NA
NIOBIUM	0/1	ND	NA	NC	<40.5 – <42.5	NA
STRONTIUM	1/1	46.4	46.4	NC	<20.4 – <21.4	NA
TITANIUM	1/1	219	219	NC	49.3 – 123	NA

(a) – SOIL SAMPLES NOT SUBMITTED FOR VOC, SVOC, AND PESTICIDES/PCB ANALYSIS
ND – NOT DETECTED
NA – NOT AVAILABLE OR NOT APPLICABLE
NC – 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-6
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
UNDEVELOPED AREA OF CONCERN (AOC) # 1

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	15/15	1820-42900	11354	18719.3	1840 - 4090	NA
ANTIMONY	3/15	5.45-13.8	5.2	6.0	12.3 - <12.8	340
ARSENIC	15/15	.61-4.7	1.9	2.6	<2.1	2
BARIUM	15/15	15.9-650	131	323.4	<40.9 - <42.7	47000
BERYLLIUM	15/15	.485-22.5	5.9	17.8	<1.0 - <1.1	1
CADMIUM	3/15	.91-2.8	1.0	1.2	<1.0 - <1.1	100
CHROMIUM (total)	15/15	32.7-469	185	317.2	2.1 - 18.2	NA
CHROMIUM VI	11/13	.66-15.69	2.4	5.5	<0.11	NA
COBALT	14/15	1.19-12.2	6.3	10.7	<10.2 - <10.7	NA
COPPER	15/15	2.8-342	41	116.3	<5.2 - 20.8	600
LEAD	15/15	3.62-142	37	93.2	6.7 -17.9	600
MANGANESE	15/15	46.8-2830	885	2686.3	19.4 - 103	NA
MERCURY	1/15	.125	0.10	NA	<0.089 - <.11	270
NICKEL	15/15	9.4-1110	258	1926.2	<8.3 - 8.3	2400
SILVER	1/15	2.3	1.0	NA	<2.1	4100
VANADIUM	15/15	60.5-4750	1140	4759.3	<10.4 - 53.7	7100
ZINC	15/15	7-286	79	198.6	15.2 - 18.1	1500
BORON	5/12	37.9-146	37	74.0	<20.9 - <21.4	NA
NIOBIUM	2/12	69.7-81.5	37	53.4	<40.5 - <42.5	NA
STRONTIUM	6/12	22.8-171	46	114.1	<20.4 - <21.4	NA
TITANIUM	12/12	89.7-941	213	403.2	49.3 - 123	NA
ZIRCONIUM	1/1	101	101	NC	NA	NA
VOLATILE ORGANICS						
ACETONE	1/1	.031	0.031	NC	NA	1000
1,1,1-TRICHLOROETHANE	1/1	.004	0.004	NC	NA	1000
BASE NEUTRAL / ACIDS						
DI-n-BUTYLPHALATE	1/1	.210	0.21	NC	NA	10000
bis(2-ETHYLHEXYL)PHTHALATE	1/1	.085	0.085	NC	NA	210
PESTICIDES / PCB'S						
AROCLOR-1248	1/1	1.9	1.9	NC	NA	2
AROCLOR-1254	1/1	1.5	1.5	NC	NA	2

ND - NOT DETECTED
NA - NOT AVAILABLE OR NOT APPLICABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-7
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
UNDEVELOPED AREA OF CONCERN (AOC) #2 (a)

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	31/31	1500-37400	5165	6124	1840 - 4090	NA
ANTIMONY	0/31	ND	NA	NA	12.3 - <12.8	340
ARSENIC	30/31	.7-6.2	2.1	2.6	<2.1	2
BARIUM	31/31	6.3-739	51.7	60.1	<40.9 - <42.7	47000
BERYLLIUM	20/31	.17-60.1	3.57	5.2	<1.0 - <1.1	1
BORON	0/25	ND	NA	NA	<20.9 - <21.4	NA
CADMIUM	2/31	1.6-5.3	1.0	1.1	<1.0 - <1.1	100
CHROMIUM (total)	31/31	1.7-5870	223.5	213.0	2.1 - 18.2	NA
CHROMIUM VI	8/9	.15-53	7.42	3483.1	<0.11	NA
COBALT	15/31	1.3-87.1	5.2	4.4	<10.2 - <10.7	NA
COPPER	31/31	1.1-887	36.6	26.0	<5.2 - 20.8	600
CYANIDE	0/29	ND	NA	NA	<1.1	NA
LEAD	31/31	3.4-760	64.4	110.4	6.7 -17.9	600
MANGANESE	31/31	11-1680	186	275.1	19.4 - 103	NA
MERCURY	16/31	.08-.52	0.20	0.2	<0.089 - <.11	270
NICKEL	25/31	2.4-3360	172.7	262.9	<8.3 - 8.3	2400
NIOBIUM	1/25	81.2	36.2	NC	<40.5 - <42.5	NA
SELENIUM	2/31	.44-.51	0.47	0.5	<1.0 - <1.1	3100
SILVER	3/31	1.3-2.05	1.04	1.2	<2.1	4100
STRONTIUM	2/25	29.4-30.2	18.5	24.5	<20.4 - <21.4	NA
TITANIUM	24/25	51.5-200	84.0	120.6	49.3 - 123	NA
VANADIUM	31/31	5.4-12100	694.8	2232.9	<10.4 - 53.7	7100
ZINC	31/31	3.75-1310	78.66	88.2	15.2 - 18.1	1500
ZIRCONIUM	0/1	ND	NA	NA	NA	NA

a) - SOIL SAMPLES NOT SUBMITTED FOR VOC, SVOC, AND PESTICIDE/PCB ANALYSIS
ND - NOT DETECTED
NA - NOT AVAILABLE OR NOT APPLICABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-8
SUMMARY OF SURFACE SOIL CONCENTRATION DATA FOR
UNDEVELOPED AREA OF CONCERN (AOC) #3 (a)

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	ARITHMETIC MEAN (mg/kg)	95% UCL (mg/kg)	SURFACE SOIL BACKGROUND CONCENTRATION (mg/kg)	PROPOSED NEW JERSEY CRITERIA (mg/kg)
INORGANICS						
ALUMINUM	15/15	1060-6400	2490	3332.0	1840 - 4090	NA
ANTIMONY	6/15	5.9-7.3	5.4	5.9	12.3 - <12.8	340
ARSENIC	15/15	.68-6.1	1.81	2.6	<2.1	2
BARIUM	14/15	4.3-53.7	15.3	22.5	<40.9 - <42.7	47000
BERYLLIUM	13/15	.27-1.8	0.52	0.7	<1.0 - <1.1	1
CADMIUM	0/15	ND	NA	NA	<1.0 - <1.1	100
CHROMIUM (total)	15/15	3-24	9	12.3	2.1 - 18.2	NA
COBALT	2/15	2.9-3.6	1.7	2.0	<10.2 - <10.7	NA
COPPER	14/15	1.2-5.3	2.6	3.3	<5.2 - 20.8	600
LEAD	15/15	2.9-91.7	21.3	41.5	6.7 -17.9	600
MANGANESE	15/15	4.3-242	57.4	236.9	19.4 - 103	NA
MERCURY	1/15	.14	0.10	NC	<0.089 - <.11	270
NICKEL	10/15	2.3-39.9	7.9	13.2	<8.3 - 8.3	2400
SELENIUM	4/15	.47-.55	0.45	0.5	<1.0 - <1.1	3100
SILVER	5/15	1.2-2.2	1.1	1.3	<2.1	4100
VANADIUM	15/15	7.4-302	72.3	122.3	<10.4 - 53.7	7100
ZINC	15/15	5.4-476	46.3	71.5	15.2 - 18.1	1500
TITANIUM	14/14	42.5--158	74.9	97.6	49.3 - 123	NA

(a) - SOIL SAMPLES NOT SUBMITTED FOR VOC, SVOC, AND PESTICIDE/PCB ANALYSIS
ND - NOT DETECTED
NA - NOT AVAILABLE OR NOT APPLICABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3

TABLE 3-9
SUMMARY OF SEDIMENT CONCENTRATION DATA

COMPOUND NAME	FREQUENCY OF DETECTION	RANGE OF DETECTION	ARITHMETIC MEAN CONCENTRATION	95% UCL CONCENTRATION	SAMPLE IDENTIFICATION: SD01	SD02	SD03 a	SD04	SD05
INORGANICS (ppm)									
ANTIMONY	4/5	33-270	75.6	1.62E+05	–	270	33	28.7	35.8
ARSENIC	5/5	5.1-16.1	10.2	2.67E+02	5.1	16.1	11.75	8.4	9.8
BARIUM	5/5	129-408	236.1	1.92E+10	129	408	142.5	194	307
BERYLLIUM	5/5	9.1-22.8	9.4	5.09E+01	9.1	22.8	5.55	3.8	5.6
CHROMIUM	5/5	1220-15700	4581	1.58E+19	1220	15700	1865	1770	2350
COBALT	5/5	6-45.3	20.5	2.53E+03	6	45.3	15.65	14.2	21.3
COPPER	5/5	25.3-327	129.8	3.09E+07	25.3	327	82.1	149	65.8
LEAD	5/5	52.8-364	182.9	1.57E+07	364	338	90.7	51.8	69.8
MANGANESE	5/5	216-655	334.4	9.40E+12	238	227	216	336	655
MERCURY	4/5	0.385-1.1	1	1.54E+00	–	2.2	0.385	0.88	1.1
NICKEL	5/5	64.1-423	189.9	3.77E+09	64.1	423	231	135	96.5
SELENIUM	3/5	1.1-4.4	2.7	3.74E+00	4.4	–	–	1.1	1.9
VANADIUM	5/5	647-4850	1853.1	1.54E+15	1890	4850	1078.5	647	800
ZINC	5/5	115-529	240.3	4.46E+09	231	529	151.5	115	175
NIOBIUM	1/2	173	151.5	NC	173	–	–	–	–
TITANIUM	5/5	218-1080	408.1	3.82E+10	279	1080	231.5	218	232
VOLATILES (ppb)									
CARBON DISULFIDE	1/5	4	21.4	3.16E+02	–	–	–	–	4
1,2-DICHLORETHENE (total)	2/5	2-5	21.2	7.45E+02	–	–	2	5	–
2-BUTANONE	5/5	72-130	82.3	8.99E+06	72	130	85.5	55	69
SEMIVOLATILES (ppb)									
PHENOL	2/2	100-520	310	NC	100	N/A	N/A	520	N/A
BENZOIC ACID	2/2	1000-3200	2100	NC	1000	N/A	N/A	3200	N/A
PENTACHLOROPHENOL	1/2	330	2415	NC	330	N/A	N/A	–	N/A
PHENANTHRENE	1/2	110	545	NC	–	N/A	N/A	110	N/A
DI-n-BUTYLPHALATE	2/2	490-580	535	NC	490	N/A	N/A	580	N/A
FLUORANTHENE	2/2	120-210	165	NC	120	N/A	N/A	210	N/A
PYRENE	1/2	130	555	NC	–	N/A	N/A	130	N/A
BUTYLBENZYLPHTHALATE	1/2	140	520	NC	140	N/A	N/A	–	N/A
CHRYSENE	1/2	140	560	NC	–	N/A	N/A	140	N/A
bis(2-ETHYLHEXYL)PHTHALATE	2/2	270-580	425	NC	580	N/A	N/A	270	N/A
BENZO(b)FLUORANTHENE	1/2	110	545	NC	–	N/A	N/A	110	N/A
PESTICIDES/PCB'S (ppb)									
4,4-DDE	2/2	11-18	14.5	NC	18	N/A	N/A	11	N/A
4,4-DDD	2/2	5.3-18	11.7	NC	5.3	N/A	N/A	18	N/A
4,4-DDT	2/2	28-33	30.5	NC	33	N/A	N/A	28	N/A
AROCLOR-1254	2/2	95-160	127.5	NC	160	N/A	N/A	95	N/A

N/A = NOT ANALYZED
NA = NOT AVAILABLE
NC – 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3
a – AVERAGE OF SAMPLE AND ITS RESPECTIVE DUPLICATE (SD10)
BOLDED VALUE – VALUE EXCEEDS EFFECTS RANGE LOWER (ER-L) (NOAA, 1991).
BOLDED AND SHADED – VALUE EXCEEDS EFFECTS RANGE MIDWAY (ER-M) (NOAA, 1991) OR SEDIMENT QUALITY CRITERIA (SQC) (USEPA), AND EFFECTS RANGE LOWER (ER-L) (NOAA, 1991).

TABLE 3-10
SUMMARY OF SURFACE WATER CONCENTRATION DATA
AS COMPARED WITH SURFACE WATER CRITERIA

COMPOUND NAME	FREQUNCY OF DETECTION	RANGE OF DETECTION (ug/L)	ARITHMETIC MEAN CONCENTRATION (ug/L)	95% UCL WATER CONCENTRATION (ug/L)	HUDSON RIVER BRANCH SAMPLES SAMPLE IDENTIFICATION SW1-01	SW2-01	SW3-01	SW4-01	SW5-01
INORGANICS									
ALUMINUM	5/5	224-44800	10089.2	44800.0	**4610**	**44800**	**493**	**319**	**224**
ANTIMONY	2/5	44.2-151	52.2	151.0	**44.2**	**151**	-	-	-
ARSENIC	3/5	2-34.6	8.6	34.6	2	34.6	-	2.4	-
BARIUM	5/5	24.5-292	95.9	292.0	78.2	962	44	40.8	24.5
BERYLLIUM	4/5	1-25.1	5.9	25.1	**1.3**	**25.1**	**1**	**1**	-
CADMIUM	1/5	9	5.0	7.6	-	**9**	-	-	-
CHROMIUM (total)	5/5	43.3-8520	1796.7	8520.0	**43.3**	**8520**	**113**	**208**	**99**
CHROMIUM VI	1/1	0.054	0.1	NC	-	-	-	0.054	-
COBALT	1/5	62.2	18.0	62.2	-	62.2	-	-	-
COPPER	5/5	7.3-432	93.6	432.0	**8**	**432**	**12.75**	**7.7**	**7.3**
LEAD	4/5	3.8-28	22.2	65.0	**28**	-	**8.45**	**3.8**	**5.5**
MANGANESE	5/5	131-2590	780.9	2590.0	622	2590	219	342	131
MERCURY	1/5	21.4	4.4	21.4	-	**21.4**	-	-	-
NICKEL	5/5	17.1-618	141.1	618.0	20.8	**618**	32.05	17.7	17.1
VANADIUM	5/5	246-5700	1362.5	5700.0	272	5700	308.5	246	286
ZINC	5/5	20.8-1070	241.9	1070.0	**56.4**	**1070**	**37.1**	25.4	20.8
CYANIDE	1/5	11	10.2	10.6	-	**11**	-	-	-
BORON	2/2	585-828	706.5	NC	828	N/A	N/A	585	N/A
VOLATILE ORGANICS									
CHLOROMETHANE	1/5	9	5.8	7.7	-	-	-	9	-
1,2-DICHLORETHENE (total)	1/5	2	2.4	2.5	-	-	-	2	-
TRICHLOROETHENE	1/5	3	2.6	2.8	-	-	-	3	-
BASE NEUTRAL / ACIDS									
DI-n-BUTYLPHALATE	2/2	1	1.0	NC	1	N/A	N/A	1	N/A
bis(2-ETHYLHEXYL)PHTHALATE	1/5	2	3.8	2.0	-	N/A	N/A	**2**	N/A

NA - NOT AVAILABLE
NC - 95% UCL NOT CALCULATED BASED ON A SAMPLE SIZE LESS THAN 3
N/A - NOT ANALYZED
SHADED VALUE - VALUE EXCEEDS USEPA SURFACE WATER CRITERIA (USEPA, 1992)
BOLDED VALUE - VALUE EXCEEDS STATE OF NEW JERSEY SURFACE WATER CRITERIA
BOLDED AND SHADED - VALUE EXCEEDS BOTH STATE OF NEW JERSEY AND USEPA SURFACE WATER CRITERIA

TABLE 3-11

SOIL CLEANUP CRITERIA FOR SELECTED CONSTITUENTS[1]
(Continued)

	Soil Cleanup Criteria (mg/kg)	Basis
SVOCs		
Anthracene	1,000	Residential/Non-Residential[5]
Benzoic Acid	NA	
Benzo(a)anthracene	0.9	Residential
Benzo(a)pyrene	0.66	Residential/Non-Residential[6]
Benzo(b)fluoranthene	0.9	Residential
Benzo(g,h,i)perylene	NA	(7)
Benzo(k)fluoranthene	0.9	Residential
Bis(2-ethylhexyl)phthalate	49	Residential
Butylbenzylphthalate	1,100	Residential
Chrysene	0.9	Residential
Di-n-butylphthalate	5,700	Residential
2,4-dinitrotoluene	NA	(8)
Fluoranthene	2,300	Residential
Indeno(1,2,3-cd)pyrene	0.9	Residential
Naphthalene	230	Residential
4-nitrophenol	NA	
Pentachlorophenol	6	Residential
Phenanthrene	NA	
Phenol	10,000	Residential/Non-Residential[5]
Pyrene	1,700	Residential
Pesticides/PCBs		
Aroclor-1248	0.49	Residential[9]
Aroclor-1254	0.49	Residential[9]

(1) Human health-based soil cleanup criteria developed by NJDEPE (1992).
(2) Criterion for nickel as soluble salts.
(3) Default maximum for total VOCs; health-based criterion for this VOC exceeds 1,000 mg/kg.
(4) For cis-1,2-dichloroethene.
(5) Default maximum for total organic constituents; health-based criterion for this organic constituent exceeds 10,000 mg/kg.
(6) Practical quantitation limit; health-based criterion is less than 0.66 mg/kg.
(7) Previous residential (0.66 mg/kg) and non-residential (2.5 mg/kg) criteria withdrawn.
(8) Previous residential (1 mg/kg) and non-residential (4 mg/kg) criteria withdrawn.
(9) Criterion for PCBs.

TABLE 3-12

CONSTITUENTS OF CONCERN
Industrial AOCs

Railroad Siding AOC	Leachate Storage AOC	Nuclear Regulatory Commission (NRC) Controlled AOC	Chromate Wastewater Spill AOC	Manufacturing AOC
<u>Inorganics</u> Aluminum Arsenic Beryllium Cadmium Chromium Cobalt Manganese Nickel Vanadium Strontium Titanium	<u>Inorganics</u> Aluminum Antimony Arsenic Beryllium Cadmium Chromium Cobalt Manganese Mercury Nickel Vanadium Titanium	<u>Inorganics</u> Aluminum Beryllium Chromium Cobalt Lead Manganese Nickel Vanadium Boron Niobium Strontium Titanium Zirconium <u>Pesticides/PCBs</u> Aroclor-1248 Aroclor-1254	<u>Inorganics</u> Aluminum Arsenic Beryllium Chromium Cobalt Manganese Vanadium Strontium Titanium	<u>Inorganics</u> Aluminum Antimony Arsenic Beryllium Cadmium Cobalt Lead Manganese Vanadium Cyanide Strontium Titanium <u>VOCs</u> Carbon Disulfide <u>SVOCs</u> Benzoic Acid 4-Nitrophenol 2,4-Dinitrotoluene Phenanthrene Benzo(g,h,i)perylene

TABLE 3-13

CONSTITUENTS OF CONCERN
Undeveloped AOCs

Undeveloped AOC #1	Undeveloped AOC #2	Undeveloped AOC #3
<u>Inorganics</u> Aluminum Arsenic Beryllium Cadmium Chromium Cobalt Manganese Nickel Vanadium Zinc Boron Niobium Strontium Titanium Zirconium <u>Pesticides/PCBs</u> Aroclor-1248 Aroclor-1254	<u>Inorganics</u> Aluminum Arsenic Beryllium Cadmium Chromium Cobalt Manganese Vanadium Strontium Titanium	<u>Inorganics</u> Aluminum Chromium Cobalt Manganese Titanium

TABLE 3-14

CONSTITUENTS OF CONCERN
Ecological AOCs

Hudson Branch Surface Water	Hudson Branch Sediments	
Inorganics	**Inorganics**	**SVOCs**
Aluminum	Antimony	Phenol
Antimony	Arsenic	Benzoic Acid
Beryllium	Barium	Pentachlorophenol
Chromium	Beryllium	Phenanthrene
Cobalt	Chromium	Di-n-butylphthalate
Copper	Cobalt	Fluoranthene
Cyanide	Copper	Pyrene
Lead	Lead	Butylbenzylphthalate
Magnesium	Manganese	Chrysene
Manganese	Mercury	Bis(2-ethylhexyl)phthalate
Mercury	Nickel	Benzo(b)fluoranthene
Nickel	Selenium	
Vanadium	Vanadium	**Pesticides/PCBs**
Zinc	Zinc	DDE
Boron	Niobium	DDD
	Titanium	DDT
VOCs		Aroclor-1254
Trichloroethene	**VOCs**	
	Carbon Disulfide	
SVOCs	1,2-Dichloroethene	
Bis(2-ethylhexyl)phthalate	2-Butanone	

TABLE 3-15

CONSTITUENTS EXCLUDED FROM THE EE
Industrial AOCs

Railroad Siding AOC		Leachate Storage AOC		Nuclear Regulatory Commission (NRC) Controlled AOC	
Inorganics	**Pesticides/PCBs**	**Inorganics**	**Pesticides/PCBs**	**Inorganics**	**Pesticides/PCBs**
Antimony[1]	4,4-DDT[1]	Barium[3]	4,4-DDT[1]	Antimony[3]	4,4-DDT[1]
Barium[3]	Aroclor-1248[1]	Copper[3]	Aroclor-1248[1]	Arsenic[3]	Aroclor-1260
Copper[3]	Aroclor-1254[1]	Lead[3]	Aroclor-1254[1]	Barium[3]	
Lead[3]	Aroclor-1260	Mercury[3]	Aroclor-1260	Cadmium[1]	**SVOCs**
Mercury[1]		Selenium[3]		Copper[3]	Phenol[1]
Selenium[3]	**SVOCs**	Silver[1]	**SVOCs**	Mercury[1]	2-Chlorophenol[1]
Silver[1]	Phenol[1]	Thallium[1]	Phenol[1]	Selenium[1]	Benzoic Acid[1]
Thallium[1]	2-Chlorophenol[1]	Zinc[3]	2-Chlorophenol[1]	Silver[1]	2,4-Dichlorophenol[1]
Zinc[3]	Benzoic Acid[1]	Cyanide[1]	Benzoic Acid[1]	Thallium[1]	Naphthalene[1]
Cyanide[1]	2,4-Dichlorophenol[1]	Boron[1]	2,4-Dichlorophenol[1]	Zinc[3]	4-Chloro-3-methylphenol[1]
Boron[1]	Naphthalene[1]	Niobium[1]	Naphthalene[1]	Cyanide[1]	2,4,5-Trichlorophenol[1]
Niobium[1]	4-Chloro-3-methylphenol[1]	Strontium[1]	4-Chloro-3-methylphenol[1]	Fluoride[1]	4-Nitrophenol[1]
Zirconium[1]	2,4,5-Trichlorophenol[1]	Zirconium[1]	2,4,5-Trichlorophenol[1]		2,4-Dinitrotoluene[1]
Fluoride[1]	4-Nitrophenol[1]	Fluoride[1]	4-Nitrophenol[1]		Pentachlorophenol[1]
	2,4-Dinitrotoluene[1]		2,4-Dinitrotoluene[1]	**VOCs**	Phenanthrene[1]
	Pentachlorophenol[1]	**VOCs**	Pentachlorophenol[1]	Chloromethane[1]	Anthracene[1]
VOCs	Phenanthrene[1]	Chloromethane[1]	Phenanthrene[1]	Methylene Chloride[1]	Di-n-butylphthalate[1]
Chloromethane[1]	Anthracene[1]	Methylene Chloride[1]	Anthracene[1]	Acetone[1]	Fluoranthene[1]
Methylene Chloride[1]	Di-n-butylphthalate[1]	Acetone[1]	Di-n-butylphthalate[1]	Carbon Disulfide[1]	Pyrene[1]
Acetone[1]	Fluoranthene[1]	Carbon Disulfide[1]	Fluoranthene[1]	1,2-Dichloromethane[1]	Butylbenzylphthalate[1]
Carbon Disulfide[1]	Pyrene[1]	1,2-Dichloromethane[1]	Pyrene[1]	Chloroform[1]	Benzo(a)anthracene[1]
1,2-Dichloromethane[1]	Butylbenzylphthalate[1]	Chloroform[1]	Butylbenzylphthalate[1]	2-Butanone[1]	Chrysene[1]
Chloroform[1]	Benzo(a)anthracene[1]	2-Butanone[1]	Benzo(a)anthracene[1]	1,1,1-Trichloroethane[1]	Bis(2-ethylhexyl)phthalate[3]
2-Butanone[1]	Chrysene[1]	1,1,1-Trichloroethane[1]	Chrysene[1]	Trichloroethene[3]	Benzo(b)fluoranthene[1]
1,1,1-Trichloroethane[1]	Bis(2-ethylhexyl)phthalate[1]	Trichloroethene[1]	Bis(2-ethylhexyl)phthalate[1]	Benzene[1]	Benzo(k)fluoranthene[1]
Trichloroethene[1]	Benzo(b)fluoranthene[1]	Benzene[1]	Benzo(b)fluoranthene[1]	Tetrachloroethene[1]	Benzo(a)pyrene[1]
Benzene[1]	Benzo(k)fluoranthene[1]	Tetrachloroethene[1]	Benzo(k)fluoranthene[1]	Toluene[1]	Indeno(1,2,3-cd)pyrene[1]
Tetrachloroethene[1]	Benzo(a)pyrene[1]	Toluene[1]	Benzo(a)pyrene[1]	Ethylbenzene[1]	Benzo(g,h,i)perylene[1]
Toluene[1]	Indeno(1,2,3-cd)pyrene[1]	Ethylbenzene[1]	Indeno(1,2,3-cd)pyrene[1]	Xylene[1]	
Ethylbenzene[1]	Benzo(g,h,i)perylene[1]	Xylene[1]	Benzo(g,h,i)perylene[1]		
Xylene[1]					

TABLE 3-15

CONSTITUENTS EXCLUDED FROM THE EE
Industrial AOCs
(Continued)

Chromate Wastewater Spill AOC		Manufacturing AOC	
Inorganics	**Pesticides/PCBs**	**Inorganics**	**Pesticides/PCBs**
Antimony[3]	4,4-DDT[1]	Barium[3]	4,4'-DDT[1]
Barium[3]	Aroclor-1248[1]	Copper[3]	Aroclor-1248[1]
Cadmium[1]	Aroclor-1254[1]	Mercury[3]	Aroclor-1254[3]
Copper[3]	Aroclor-1260	Nickel[3]	Aroclor-1260[1]
Lead[3]		Selenium[3]	
Mercury[1]	**SVOCs**	Silver[3]	**SVOCs**
Nickel[3]	Phenol[1]	Thallium[1]	Phenol[3]
Selenium[1]	2-Chlorophenol[1]	Zinc[3]	2-Chlorophenol[1]
Silver[1]	Benzoic Acid[1]	Boron[1]	Naphthalene[3]
Thallium[1]	2,4-Dichlorophenol[1]	Niobium[1]	2,4-Dichlorophenol[1]
Zinc[3]	Naphthalene[1]	Zirconium[1]	4-Chloro-3-methylphenol[1]
Cyanide[1]	4-Chloro-3-methylphenol[1]	Fluoride	2,4,5-Trichlorophenol[1]
Boron	2,4,5-Trichlorophenol[1]		Pentachlorophenol[3]
Niobium	4-Nitrophenol[1]	**VOCs**	Anthracene[3]
Zirconium	2,4-Dinitrotoluene[1]	Chloromethane[1]	Di-n-butylphthalate[3]
Fluoride	Pentachlorophenol[1]	Methylene Chloride[1]	Fluoranthene[3]
	Phenanthrene[1]	Acetone[3]	Pyrene[3]
VOCs	Anthracene[1]	1,2-Dichloroethene[3]	Butylbenzylphthalate[3]
Chloromethane[1]	Di-n-butylphthalate[1]	Chloroform[1]	Benzo(a)anthracene[3]
Methylene Chloride[1]	Fluoranthene[1]	2-Butanone[3]	Chrysene[3]
Acetone[1]	Pyrene[1]	1,1,1-Trichloroethane[1]	Bis(2-ethylhexyl)phthalate[3]
Carbon Disulfide[1]	Butylbenzylphthalate[1]	Trichloroethene[3]	Benzo(b)fluoranthene[3]
1,2-Dichloromethane[1]	Benzo(a)anthracene[1]	Benzene[3]	Benzo(k)fluoranthene[3]
Chloroform[1]	Chrysene[1]	Tetrachloroethene[3]	Benzo(a)pyrene[3]
2-Butanone[1]	Bis(2-ethylhexyl)phthalate[1]	Toluene[3]	Indeno(1,2,3-cd)pyrene[3]
1,1,1-Trichloroethane[1]	Benzo(b)fluoranthene[1]	Ethylbenzene[3]	
Trichloroethene[1]	Benzo(k)fluoranthene[1]	Xylene[3]	
Benzene[1]	Benzo(a)pyrene[1]		
Tetrachloroethene[1]	Indeno(1,2,3-cd)pyrene[1]		
Toluene[1]	Benzo(g,h,i)perylene[1]		
Ethylbenzene[1]			
Xylene[1]			

[1] Either not detected or not analyzed for in surface soil.
[2] Detection frequency less than 5%.
[3] Comparison to NJDEPE soil cleanup criteria (NJDEPE, 19__)

TABLE 3-16

CONSTITUENTS EXCLUDED FROM THE EE
Undeveloped AOCs

Undeveloped AOC #1		Undeveloped AOC #2		Undeveloped AOC #3	
Inorganics	**SVOCs**	**Inorganics**	**Pesticides/PCBs**	**Inorganics**	**Pesticides/PCBs**
Antimony[3]	Phenol[1]	Antimony[1]	4,4-DDT[1]	Antimony[3]	4,4-DDT[1]
Barium[3]	2-Chlorophenol[1]	Barium[3]	Aroclor-1248[1]	Arsenic[3]	Aroclor-1248[1]
Copper[3]	Benzoic Acid[1]	Copper[3]	Aroclor-1254[1]	Barium[3]	Aroclor-1254[1]
Lead[3]	2,4-Dichlorophenol[1]	Lead[3]	Aroclor-1260	Beryllium[3]	Aroclor-1260
Mercury[3]	Naphthalene[1]	Mercury[3]		Cadmium[1]	
Selenium[1]	4-Chloro-3-methylphenol[1]	Nickel[3]	**SVOCs**	Copper[3]	**SVOCs**
Silver[3]	2,4,5-Trichlorophenol[1]	Selenium[3]	Phenol[1]	Lead[3]	Phenol[1]
Thallium[1]	4-Nitrophenol[1]	Silver[3]	2-Chlorophenol[1]	Mercury[3]	2-Chlorophenol[1]
Cyanide[1]	2,4-Dinitrotoluene[1]	Thallium[1]	Benzoic Acid[1]	Nickel[3]	Benzoic Acid[1]
Fluoride[1]	Pentachlorophenol[1]	Zinc[3]	2,4-Dichlorophenol[1]	Selenium[3]	2,4-Dichlorophenol[1]
	Phenanthrene[1]	Cyanide[1]	Naphthalene[1]	Silver[3]	Naphthalene[1]
VOCs	Anthracene[1]	Boron[1]	4-Chloro-3-methylphenol[1]	Thallium[1]	4-Chloro-3-methylphenol[1]
Chloromethane[1]	Di-n-butylphthalate[3]	Niobium[2]	2,4,5-Trichlorophenol[1]	Vanadium[3]	2,4,5-Trichlorophenol[1]
Methylene Chloride[1]	Fluoranthene[1]	Zirconium[1]	4-Nitrophenol[1]	Zinc[3]	4-Nitrophenol[1]
Acetone[3]	Pyrene[1]	Fluoride[1]	2,4-Dinitrotoluene[1]	Cyanide[1]	2,4-Dinitrotoluene[1]
Carbon Disulfide[1]	Butylbenzylphthalate[1]		Pentachlorophenol[1]	Boron[1]	Pentachlorophenol[1]
1,2-Dichloromethane[1]	Benzo(a)anthracene[1]	**VOCs**	Phenanthrene[1]	Niobium[2]	Phenanthrene[1]
Chloroform[1]	Chrysene[1]	Chloromethane[1]	Anthracene[1]	Strontium[1]	Anthracene[1]
2-Butanone[1]	Bis(2-ethylhexyl)phthalate[3]	Methylene Chloride[1]	Di-n-butylphthalate[1]	Zirconium[1]	Di-n-butylphthalate[1]
1,1,1-Trichloroethane[3]	Benzo(b)fluoranthene[1]	Acetone[1]	Fluoranthene[1]	Fluoride[1]	Fluoranthene[1]
Trichloroethene[1]	Benzo(k)fluoranthene[1]	Carbon Disulfide[1]	Pyrene[1]		Pyrene[1]
Benzene[1]	Benzo(a)pyrene[1]	1,2-Dichloromethane[1]	Butylbenzylphthalate[1]	**VOCs**	Butylbenzylphthalate[1]
Tetrachloroethene[1]	Indeno(1,2,3-cd)pyrene[1]	Chloroform[1]	Benzo(a)anthracene[1]	Chloromethane[1]	Benzo(a)anthracene[1]
Toluene[1]	Benzo(g,h,i)perylene[1]	2-Butanone[1]	Chrysene[1]	Methylene Chloride[1]	Chrysene[1]
Ethylbenzene[1]		1,1,1-Trichloroethane[1]	Bis(2-ethylhexyl)phthalate[1]	Acetone[1]	Bis(2-ethylhexyl)phthalate[1]
Xylene[1]		Trichloroethene[1]	Benzo(b)fluoranthene[1]	Carbon Disulfide[1]	Benzo(b)fluoranthene[1]
		Benzene[1]	Benzo(k)fluoranthene[1]	1,2-Dichloromethane[1]	Benzo(k)fluoranthene[1]
Pesticides/PCBs		Tetrachloroethene[1]	Benzo(a)pyrene[1]	Chloroform[1]	Benzo(a)pyrene[1]
4,4-DDT[1]		Toluene[1]	Indeno(1,2,3-cd)pyrene[1]	2-Butanone[1]	Indeno(1,2,3-cd)pyrene[1]
Aroclor-1260		Ethylbenzene[1]	Benzo(g,h,i)perylene[1]	1,1,1-Trichloroethane[1]	Benzo(g,h,i)perylene[1]
		Xylene[1]		Trichloroethene[1]	
				Benzene[1]	
				Tetrachloroethene[1]	
				Toluene[1]	
				Ethylbenzene[1]	
				Xylene[1]	

[1] Either not detected or not analyzed for in surface soil.
[2] Detection frequency less than 5%.
[3] Comparison to NJDEPE soil cleanup criteria (NJDEPE, 19__)

TABLE 3-17

CONSTITUENTS EXCLUDED FROM THE EE
Ecological AOCs

Hudson Branch Surface Water		Hudson Branch Sediments	
Inorganics	SVOCs	Inorganics	SVOCs
Arsenic[2]	Phenol[1]	Silver[1]	2-Chlorophenol[1]
Selenium[1]	2-Chlorophenol[1]	Thallium[1]	2,4-Dichlorophenol[1]
Niobium[1]	Benzoic Acid[1]	Cyanide[1]	Naphthalene[1]
Strontium[1]	2,4-Dichlorophenol[1]	Boron[1]	4-Chloro-3-methylphenol[1]
Titanium[1]	Naphthalene[1]	Strontium[1]	2,4,5-Trichlorophenol[1]
	4-Chloro-3-methylphenol[1]	Zirconium[1]	4-Nitrophenol[1]
VOCs	2,4,5-Trichlorophenol[1]		2,4-Dinitrophenol[1]
Chloromethane[2]	4-Nitrophenol[1]	VOCs	Anthracene[1]
Methylene Chloride[1]	2,4-Dinitrophenol[1]	Chloromethane[1]	Benzo(a)anthracene[1]
Acetone[1]	Pentachlorophenol[1]	Methylene Chloride[1]	Benzo(k)fluoranthene[1]
Carbon Disulfide[1]	Anthracene[1]	Acetone[1]	Benzo(a)pyrene[1]
1,2-Dichloroethene[2]	Di-n-butylphthalate[2]	Chloroform[1]	Indeno(1,2,3-cd)pyrene[1]
Chloroform[1]	Fluoranthene[1]	1,1,1-Trichloroethane[1]	Benzo(g,h,i)perylene
1,1,1-Trichloroethane[1]	Pyrene[1]	Trichloroethene[1]	
Benzene[1]	Butylbenzylphthalate[1]	Benzene[1]	Pesticides/PCBs
Tetrachloroethene[1]	Benzo(a)anthracene[1]	Tetrachloroethene[1]	Aroclor-1248[1]
Toluene[1]	Benzo(b)fluoranthene[1]	Toluene[1]	Aroclor-1260[1]
Ethylbenzene[1]	Benzo(k)fluoranthene[1]	Ethylbenzene[1]	
Xylene[1]	Benzo(a)pyrene[1]	Xylene[1]	
	Indeno(1,2,3-cd)pyrene[1]		
Pesticides/PCBs	Benzo(g,h,i)perylene		
DDT			
Aroclor-1248			
Aroclor-1254			
Aroclor-1260			

[1] Either not detected or not analyzed for in surface soil.
[2] Detection frequency less than 5%.
[3] Comparison to NJDEPE soil cleanup criteria (NJDEPE, 1992)

TABLE 3-18

NATURAL HERITAGE DATABASE SEARCH
ENDANGERED VERTEBRATES THAT EXIST IN CUMBERLAND AND GLOUCESTER COUNTY

Species	Rank[1] Federal	Rank[1] State	Preferred Habitat	On or Near the Site - Possible or Unlikely to be Found
Avian				
Cooper's Hawk		E	Flood Plain Forests and Wooded Swamps	P
Upland Sandpiper		E	Wide Open Pastures and Grassy Fields	U
Henslow's Sparrow	C2	E	Neglected Hay Fields/Weedy Fields	U
Grasshopper Sparrow		T/T	Hay Fields, Sparse Shrub Vegetation	U
Red-Shouldered Hawk		E/T	Wooded Swamps/Wooded Marshes	P
Northern Harrier		E/U	Open Marshes, Swamps, and Bogs	P
Sedge Wren		E	Shallow Sedge Marshes	P
Great Blue Heron		T/S	Wooded Swamps/Streams/Marshes	P
Peregrine Falcon	E/SA	E	Rocky Cliff on Mountains	U
Bald Eagle	LELT	E	Large Water Bodies/Abundant Fish	U
Red-Headed Woodpecker		T/T	Wooded Swamps/Deciduous Woods	P
Osprey		T/T	Large Water Bodies/Abundant Fish	U
Savannah Sparrow		T/T	Grassy Swales/Hay Fields/Meadows/Salt Marsh	U
Vesper Sparrow		E	Short Grass Meadows, Pastures, Hay Fields	U
Least Tern		E	Associated with Shore Communities	U
Barred Owl		T/T	Heavily Wooded Swamps Near Open Field	P
Terrestrial				
Southern Bog Lemming		U	Grassy Meadows	U
Wood Turtle		T	Slow Moving Meandering Streams	P
Bog Turtle	C2	E	Sphagnum Bogs or Wet Meadows	P
Tiger Salamander		E	Wooded Swamps and Wet Areas	P
Timber Rattlesnake		E	Rock Outcroppings on Forested Hillsides	U
Corn Snake		E	Woody Area with Leaf Litter and Barrows	P
Pine Barrens Tree Frog	3C	E	Sphagnum Moss Bogs	U
Pine Snake		T	Open Dry Sandy Fields	U

[1] See Appendix C for federal and state rank code definitions.

TABLE 4-1

MAJOR PARAMETERS GOVERNING COC UPTAKE INTO THE FOOD CHAIN

COC	RUF[1]	Earthworm BAF[2]	Mammal BTF[3]
Inorganics			
Aluminum	4E-03	NA	1.02
Antimony	0.2	NA	0.68
Arsenic	4E-02	NA	1.36
Barium	0.15	NA	0.102
Beryllium	1E-02	NA	0.68
Cadmium	0.55	1-10	0.374
Chromium	7.5E-03	2.5E-02	3.74
Cobalt	2E-02	NA	13.6
Copper	1E-02	0.14	6.8
Lead	4.5E-02	5E-02	0.204
Manganese	0.25		0.272
Mercury	0.9		10.2
Nickel	6E-02	2E-02	4.08
Silver	0.4	0.2	2.04
Vanadium	5.5E-03	NA	1.7
Zinc	1.5	0.1	68
Boron	4	NA	0.544
Niobium	2E-02	NA	170
Strontium	2.5E+00	NA	0.204
Titanium	5.5E-03	NA	20.4
Zirconium	2E-03	NA	3.74
Volatiles			
Carbon Disulfide	2.17	0.60	0.002
1,2-Dichloroethane	5.62	0.60	4.8E-04
2-Butanone	27.40	0.60	3.11E-05
Semi-Volatiles			
Phenol	5.55	0.60	5E-04
Benzoic Acid	3.21	0.60	1.3E-03
Pentachlorophenol	4.9E-02	0.60	1.75
Phenanthrene	0.102	0.60	0.493
Di-n-butylphthalate	3.8E-02	0.60	2.71
Fluoranthene	3.2E-02	0.60	3.65
Pyrene	3.9E-02	0.60	2.59
Butylbenzylphthalate	6.7E-02	0.60	1.03
Chrysene	2.2E-02	0.60	6.96
DEHP	0.144	0.60	0.271
Benzo(b)fluoranthene	6E-03	0.60	63.46
Pesticides/PCBs			
4,4'-DDE	2E-02	0.60	8.37
4,4'-DDD	1.3E-02	0.60	16.69
4,4'-DDT	1E-02	0.60	26.46
Aroclor-1254	7E-03	0.60	50.41

(1) RUF = Root Uptake Factor, which is the ratio of the concentration in vegetation to the concentration in soil.

(2) BAF = Bioaccumulation Factor, applicable to earthworms. It is the ratio of the concentration in earthworms to the concentration in soil (dry weight to dry weight basis).

(3) BTF = Biotransfer Factor, applicable to terrestrial and amphibian species. It is the ratio of the concentration in animal tissue to the daily dose in mg/kg/day.

TABLE 4-2

PHYSICAL CHARACTERISTICS OF WETLAND MEDIA

Sample Location	pH	Total Organic Matter	Hardness
SD-1	5.36	25.8	NA
SD-2	7.05	49.4	NA
SD-3	6.96	9.06	NA
SD-4	6.40	64.8	NA
SD-5	5.68	27.2	NA
SW-1	6.90	NA	41.2
SW-2	8.14	NA	18.8
SW-3	7.90	NA	20.0
SW-4	7.63	NA	22.8
SW-5	7.50	NA	34.4
SOL-1	4.39	NA	NA
SOL-2	5.38	NA	NA

SD = Sediment Sample (see Figure 3-3)
SW = Surface Water Sample (see Figure 3-3)
SOL = Soil Sample (see Figure 3-3)
NA = Not Analyzed

TABLE 4-3

EQUATIONS DESCRIBING EARTHWORM ACCUMULATION OF COCs

C_{EW} = C_S * BAF * m

where:

C_{EW} = concentration of COC in earthworm (mg/kg)

C_S = concentration of COC in soil or sediment (mg/kg)

BAF = $Y_L/0.66\ f_{oc}$

where:

BAF = soil-to-insect bioaccumulation factor (dry weight to dry weight)

Y_L = lipid content of insect = 0.02

f_{oc} = organic content of soil = 0.05

m = dry weight to wet weight insect conversion factor = 0.2

TABLE 4-4

ACCUMULATION OF COCs INTO ANIMAL TISSUES

C_T = ED * BTF

where:

C_T = tissue concentration of COCs
ED = dose from all exposure pathways combined
BTF = biotransfer factor relating tissue concentration to daily dose (d)

where: BTF is derived from Beef Biotransfer Factors (BBTF) (day/kg) in which:

BTF(d) = BBTF (day/kg) * BW_C (kg)

where:

BBTF = Beef Biotransfer Factor, as derived by Travis and Arms (1988), Baes (1984), or Vreman (1986)

BW_C = body weight of cattle = 680 kg

TABLE 5-1

SUMMARY OF SEDIMENT AND SURFACE WATER CRITERIA

Constituent	Ambient Water Quality Criteria (AWQC)[1] (ug/l)	NJ Surface Water Quality Standards[2] (ug/l)	SQC[3]*	ER-L[4]*	ER-M[4]*
Inorganics					
Aluminum	NA	87	NA	NA	NA
Antimony	30	12.2	NA	2	25
Arsenic	190	190	NA	33	85
Barium	NA	2,000	NA	NA	NA
Beryllium	5.3	0.00767	NA	NA	NA
Cadmium	1.1	0.41	NA	NA	NA
Chromium (total)	NA	11	NA	80	145
Chromium VI	11	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA
Copper	12	3.9	NA	70	390
Lead	3.2	0.61	NA	35	110
Magnesium	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA
Mercury	0.012	0.012	NA	0.15	1.3
Nickel	160	52.7	NA	30	50
Selenium	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA
Zinc	110	35.4	NA	120	270
Niobium	NA	NA	NA	NA	NA
Titanium	NA	NA	NA	NA	NA
Cyanide	5.2	5.2	NA	NA	NA
Boron	NA	NA	NA	NA	NA
Fluoride	NA	NA	NA	NA	NA
Volatile Organics					
Carbon Disulfide	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA
1,2-Dichloroethene (total)	20,000	592	NA	NA	NA
2-Butanone	NA	NA	NA	NA	NA
Trichloroethene	21,900	1.09	NA	NA	NA

TABLE 5-1

SUMMARY OF SEDIMENT AND SURFACE WATER CRITERIA
(Continued)

Constituent	Ambient Water Quality Criteria (AWQC)[1] (ug/l)	NJ Surface Water Quality Standards[2] (ug/l)	SQC[3]*	ER-L[4]*	ER-M[4]*
Semi-Volatile Organics					
Phenol	NA	NA	12,723	NA	NA
Benzoic Acid	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	241,150	NA	NA
Phenanthrene	NA	NA	123	NA	NA
Di-n-butylphthalate	NA	NA	NA	NA	NA
Fluoranthene	NA	NA	1,022	NA	NA
Pyrene	NA	NA	NA	350	2,200
Butylbenzylphthalate	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	400	2,800
Bis(2-ethylhexyl)phthalate	0.3	1.76	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA
Pesticides/PCBs					
4,4'-DDE	NA	NA	NA	2	15
4,4'-DDD	NA	NA	NA	2	20
4,4'-DDT	NA	NA	NA	1	7
Aroclor-1254	NA	NA	NA	50	400

(1) USEPA, 1991
(2) Based on 1992 proposed category II stream criteria (NJDEPE, 1992a).
(3) USEPA, 1991a,b
(4) NOAA, 1991

* The units for inorganic constituents are in mg/kg; the units for organic constituents are in µg/kg.

TABLE 5-2

MAMMALIAN/AVIAN ENVIRONMENTAL EFFECTS LEVELS

COC	Receptor	Sensitive Toxic Effect	Chronic NOAEL (mg/kg/d)	Environmental Effect Level (mg/kg)	References
Metals					
Aluminum					
Antimony	Mammalian	Decreased longevity, altered blood chemistry	0.035	0.35	USEPA, 1993
Arsenic	Avian	Neuromuscular effects	1	10.0	Eisler, 1988
	Mammalian	Developmental	0.05	0.5	Eisler, 1988a
Barium	Avian/Mammalian	Peripheral nervous system	0.2	2.0	NAS, 1980
Beryllium	Avian/Mammalian	None Observed	0.5	5.0	USEPA, 1992
Cadmium	Avian	Developmental	0.04	0.4	Eisler, 1985
	Mammalian	Blood Pressure	0.004	0.04	ATSDR, 1988
Chromium	Avian	Altered growth/survival	0.1	1.0	Eisler, 1986
	Mammalian	Developmental	0.35	3.5	ATSDR, 1991
Cobalt	Avian/Mammalian	Peripheral nervous system; hematopoietic system	0.1	1.0	NAS, 1980
Copper	Avian/Mammalian	Hepatitis, hemolysis	0.25	2.5	NAS, 1980
Lead	Avian	Neurotoxicity	0.28	2.8	Eisler, 1988
	Mammalian	Developmental	0.07	0.7	ATSDR, 1991
Manganese	Mammalian	Biochemical changes in brain	4	40	USEPA, 1993
Mercury	Avian	Neuromuscular effects	0.02	0.2	NAS, 1980
	Mammalian	Developmental	0.04	1.0	ATSDR, 1993
Nickel	Avian/Mammalian	Liver, kidney, red blood cells	0.5	5.0	NAS, 1980
Selenium	Avian	Reproductive	0.1	1.0	Eisler, 1985
	Mammalian	Liver enzyme changes	0.035	0.35	Eisler, 1985
Silver					
Vanadium	Avian/Mammalian	Depressed growth	0.1	1.0	NAS, 1980
Zinc	Mammalian	Anemia	0.1	1.0	USEPA, 1993
Niobium			NA	NA	
Strontium			NA	NA	
Titanium			NA	NA	

TABLE 5-2

MAMMALIAN/AVIAN ENVIRONMENTAL EFFECTS LEVELS
(Continued)

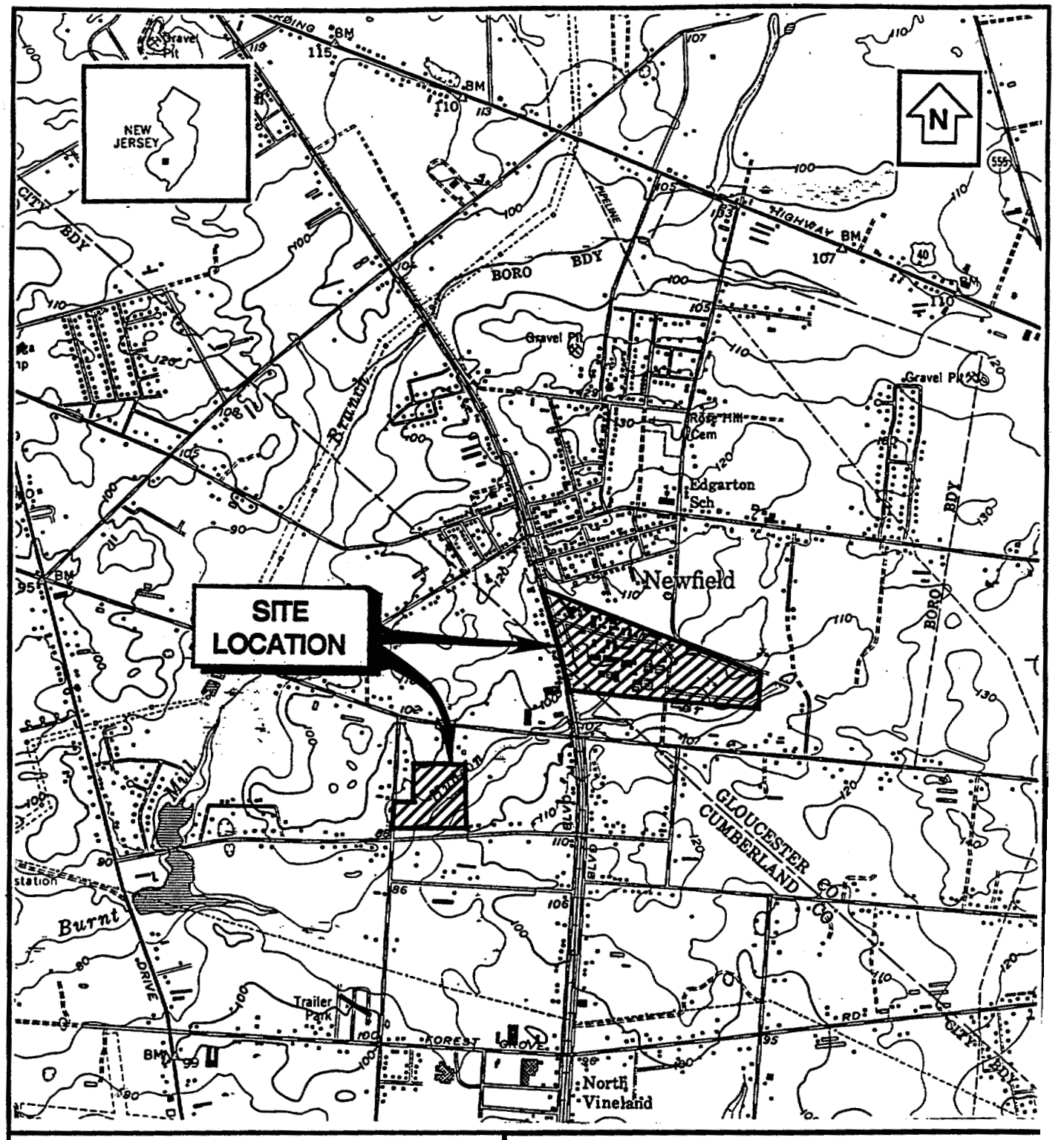
COC	Receptor	Sensitive Toxic Effect	Chronic NOAEL (mg/kg/d)	Environmental Effect Level (mg/kg)	References
VOCs					
Benzene	Avian/Mammalian	Bone marrow toxicity	1	10	ATSDR, 1988
Ethylbenzene	Avian/Mammalian	Liver/kidney toxicity	100	1,000	USEPA, 1992
Toluene	Avian/Mammalian	Liver/kidney weights	20	200	USEPA, 1992
Xylene	Avian/Mammalian	CNS hyperactivity	250	2,500	USEPA, 1992
SVOCs					
Benzoic Acid	Mammalian	Decreased stress resistance	4	40	USEPA, 1993
PAHs	Avian	Liver enlargement	4	40	Eisler, 1987
	Mammalian	Developmental	10	100	ATSDR, 1990
Pentachlorophenol	Mammalian	Liver/kidney toxicity	3	30	USEPA, 1993
Phenol	Mammalian	Developmental	60	600	USEPA, 1993
Phthalates	Mammalian	Increased liver weight	1.9	19	USEPA, 1993
Pesticides/PCBs					
DDT	Avian	Reproduction	0.07	0.7	Newell, 1987
	Mammalian	Tumors	0.03	0.3	ATSDR,
Aroclor-1254	Avian	Chicken reproduction	0.1	1.0	Eisler, 1986
	Mammalian	Porphyria,liver damage; immune suppression	0.01	0.1	Eisler, 1986

TABLE 5-3

SCREENING CONCENTRATIONS FOR EXPOSURE OF VEGETATION TO POLLUTANT CONCENTRATIONS IN SOIL AND TISSUE

	Concentration (mg/kg)		Reference
	Soil	Plant Tissue	
Arsenic	3	0.25	Dvorak et al., 1978
Boron	0.5	11	Dvorak et al., 1978
Cadmium	2.5	3	Dvorak et al., 1978
Chromium	8.4	1	Dvorak et al., 1978; Desbaumes and Ramaciotti, 1968
Cobalt	--	19	Dvorak et al., 1978
Copper	40	0.73	Dvorak et al., 1978
Fluoride	400	310	Dvorak et al., 1978
Lead	1,000	126	Dvorak et al., 1978
Manganese	2.5	400	Dvorak et al., 1978; National Research Council, 1973
Mercury	455	--	Dvorak et al., 1978
Nickel	500	60	Dvorak et al., 1978
Selenium	13	100	Dvorak et al., 1978; Hurd-Karrer, 1934-35
Vanadium	2.5	--	USEPA, 1975
Zinc	--	300	Dvorak et al., 1978

FIGURES



0 2000 FT

SCALE

FROM NEWFIELD, NJ 7 1/2' USGS
TOPOGRAPHIC MAP, 1953
PHOTOREVISED 1986

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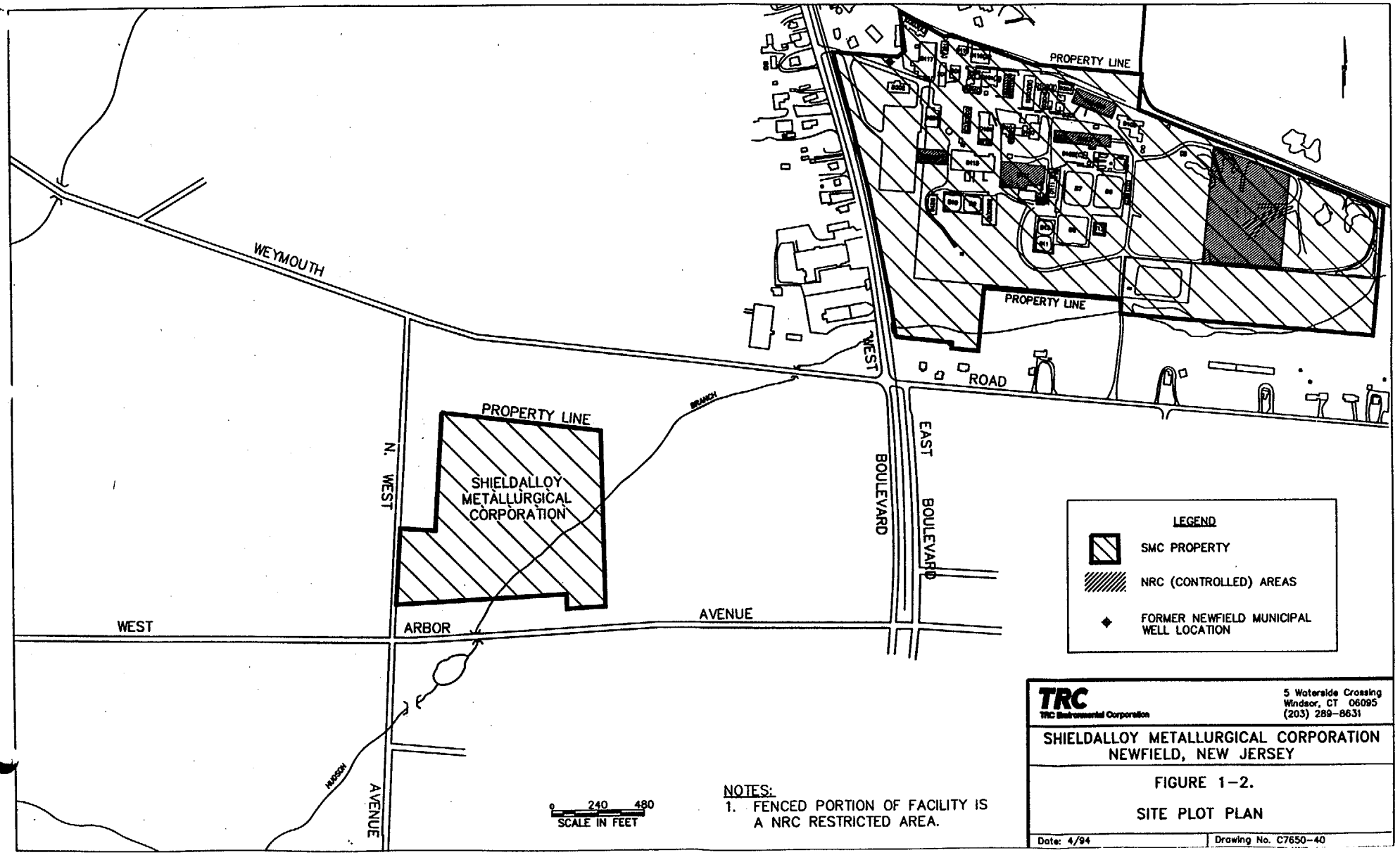
Windsor, CT 06095
(203) 289-8631

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

FIGURE 1-1.

SITE LOCATION

Date: 4/94 | Drawing No. C7650-40



NOTES:
1. FENCED PORTION OF FACILITY IS A NRC RESTRICTED AREA.

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FIGURE 1-2.

SITE PLOT PLAN

Date: 4/94 | Drawing No. C7650-40

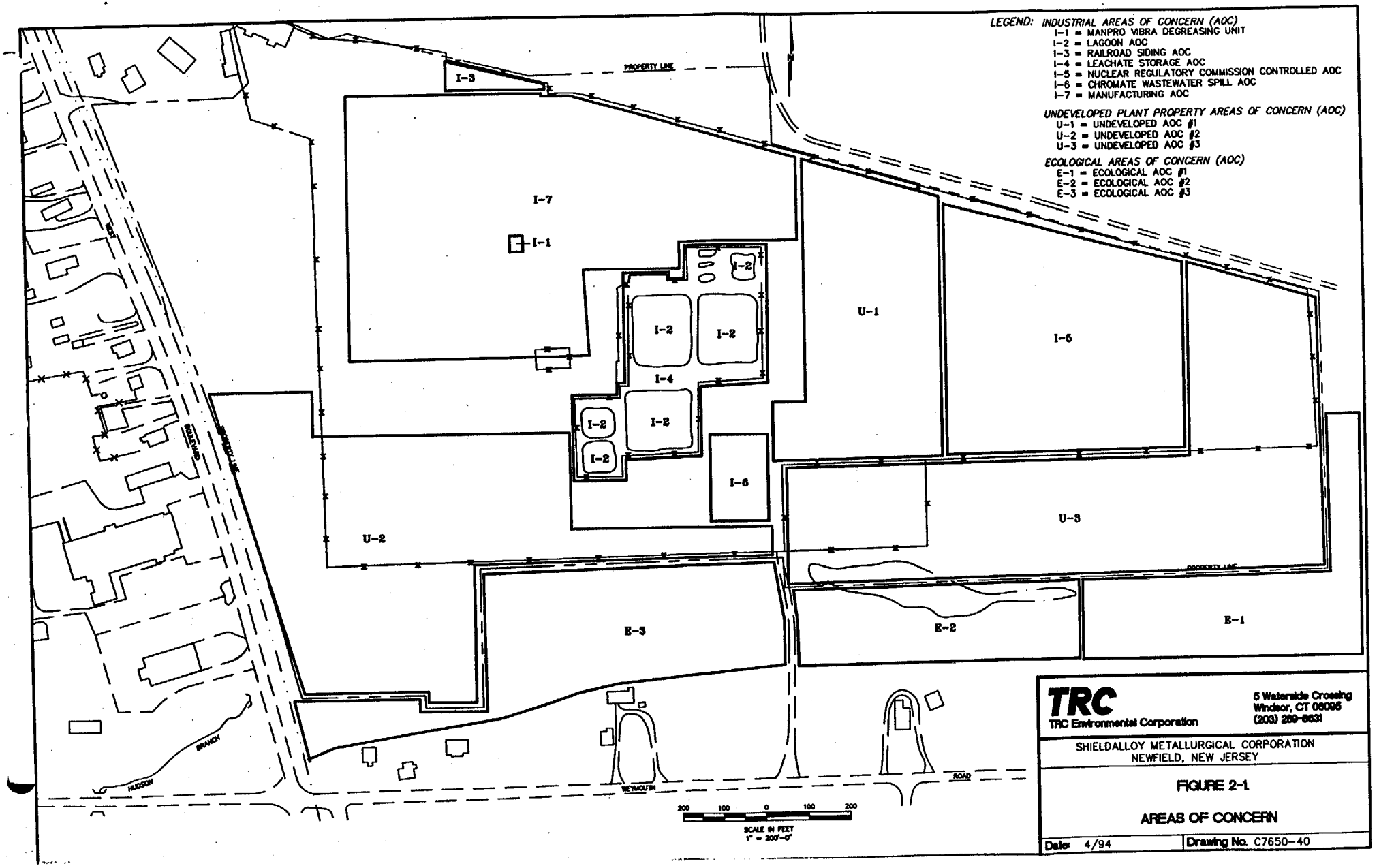
LEGEND: INDUSTRIAL AREAS OF CONCERN (AOC)
I-1 = MANPRO VIBRA DEGREASING UNIT
I-2 = LAGOON AOC
I-3 = RAILROAD SIDING AOC
I-4 = LEACHATE STORAGE AOC
I-5 = NUCLEAR REGULATORY COMMISSION CONTROLLED AOC
I-6 = CHROMATE WASTEWATER SPILL AOC
I-7 = MANUFACTURING AOC
UNDEVELOPED PLANT PROPERTY AREAS OF CONCERN (AOC)
U-1 = UNDEVELOPED AOC #1
U-2 = UNDEVELOPED AOC #2
U-3 = UNDEVELOPED AOC #3
ECOLOGICAL AREAS OF CONCERN (AOC)
E-1 = ECOLOGICAL AOC #1
E-2 = ECOLOGICAL AOC #2
E-3 = ECOLOGICAL AOC #3
PROPERTY LINE
I-3
I-7
I-1
I-2
I-4
I-6
I-5
U-1
U-2
U-3
E-1
E-2
E-3
HUDSON
BRANCH
WEYMOUTH
ROAD
200 100 0 100 200
SCALE IN FEET
1" = 200'-0"
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FIGURE 2-1
AREAS OF CONCERN
Date: 4/94
Drawing No. C7650-40

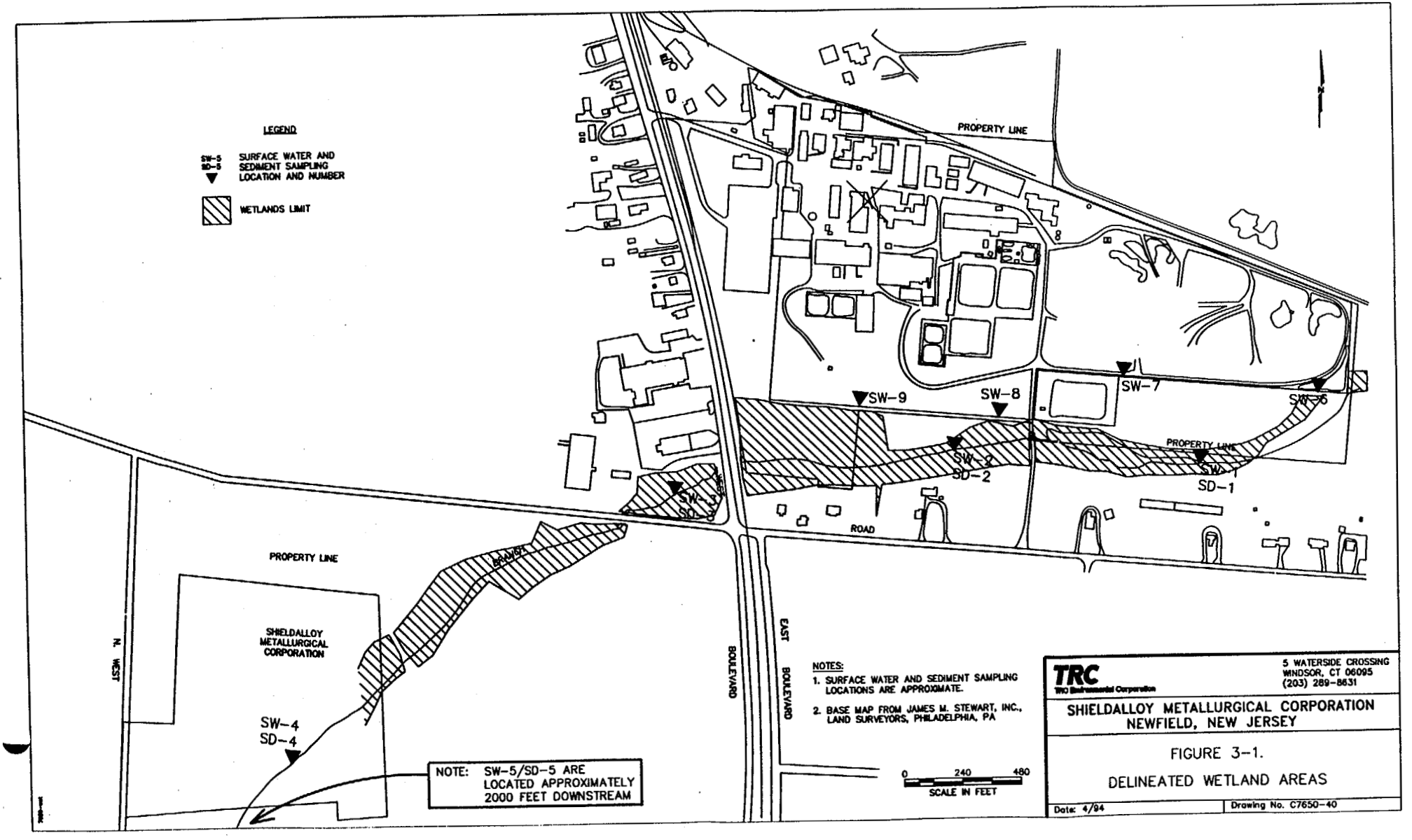
LEGEND
SW-5 SD-5 SURFACE WATER AND SEDIMENT SAMPLING LOCATION AND NUMBER
WETLANDS LIMIT
PROPERTY LINE
SW-9
SW-8
SW-7
SW-6
SW-2
SD-2
SW-1
SD-1
ROAD
PROPERTY LINE
SHIELDALLOY METALLURGICAL CORPORATION
SW-4
SD-4
NOTE: SW-5/SD-5 ARE LOCATED APPROXIMATELY 2000 FEET DOWNSTREAM
N. WEST
BOULEVARD
EAST BOULEVARD
NOTES:
1. SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS ARE APPROXIMATE.
2. BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA
0 240 480
SCALE IN FEET
TRC
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FIGURE 3-1.
DELINEATED WETLAND AREAS
Date: 4/94
Drawing No. C7650-40

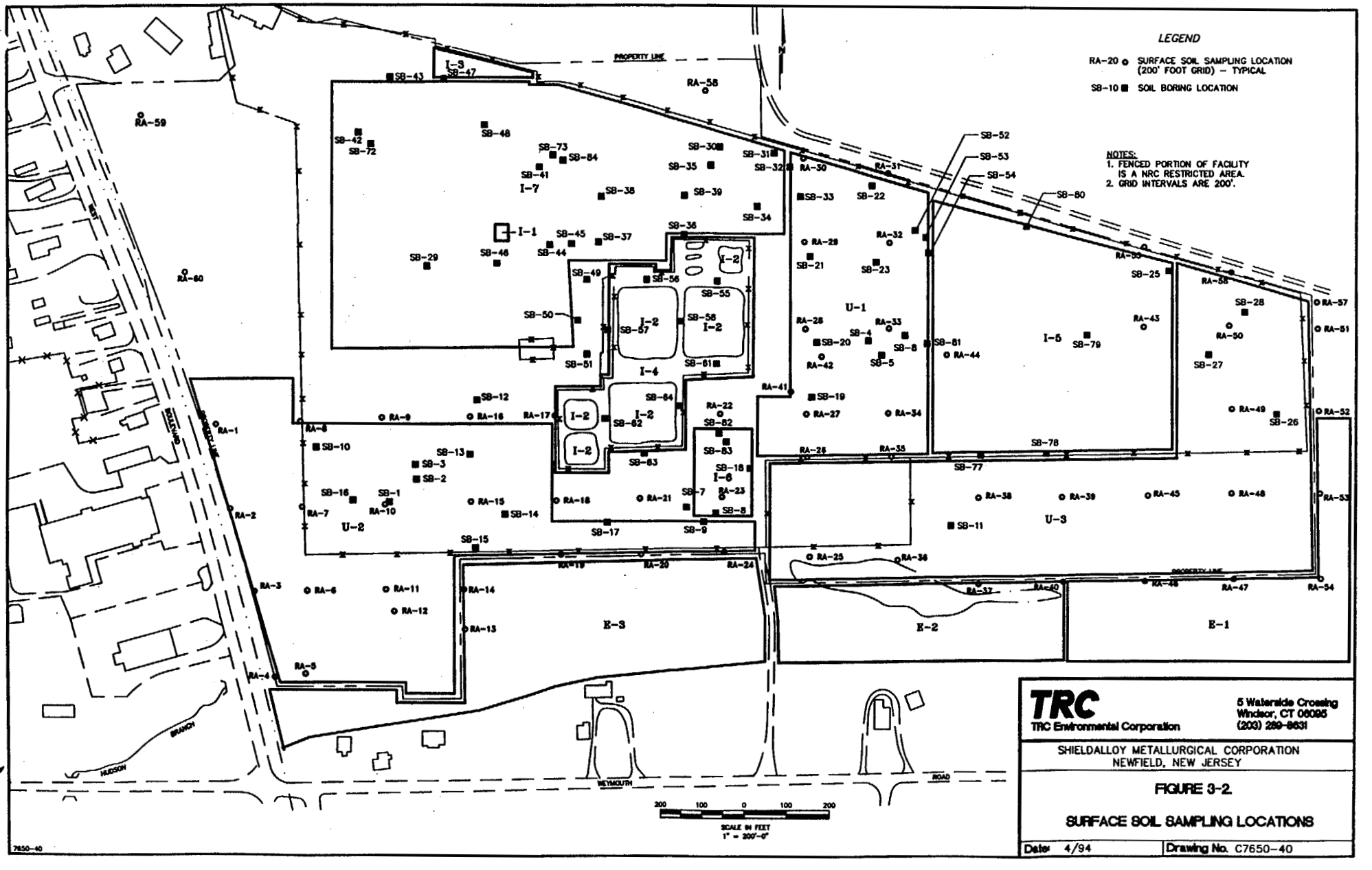

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FIGURE 3-2.

SURFACE SOIL SAMPLING LOCATIONS

Date: 4/94 | Drawing No. C7650-40

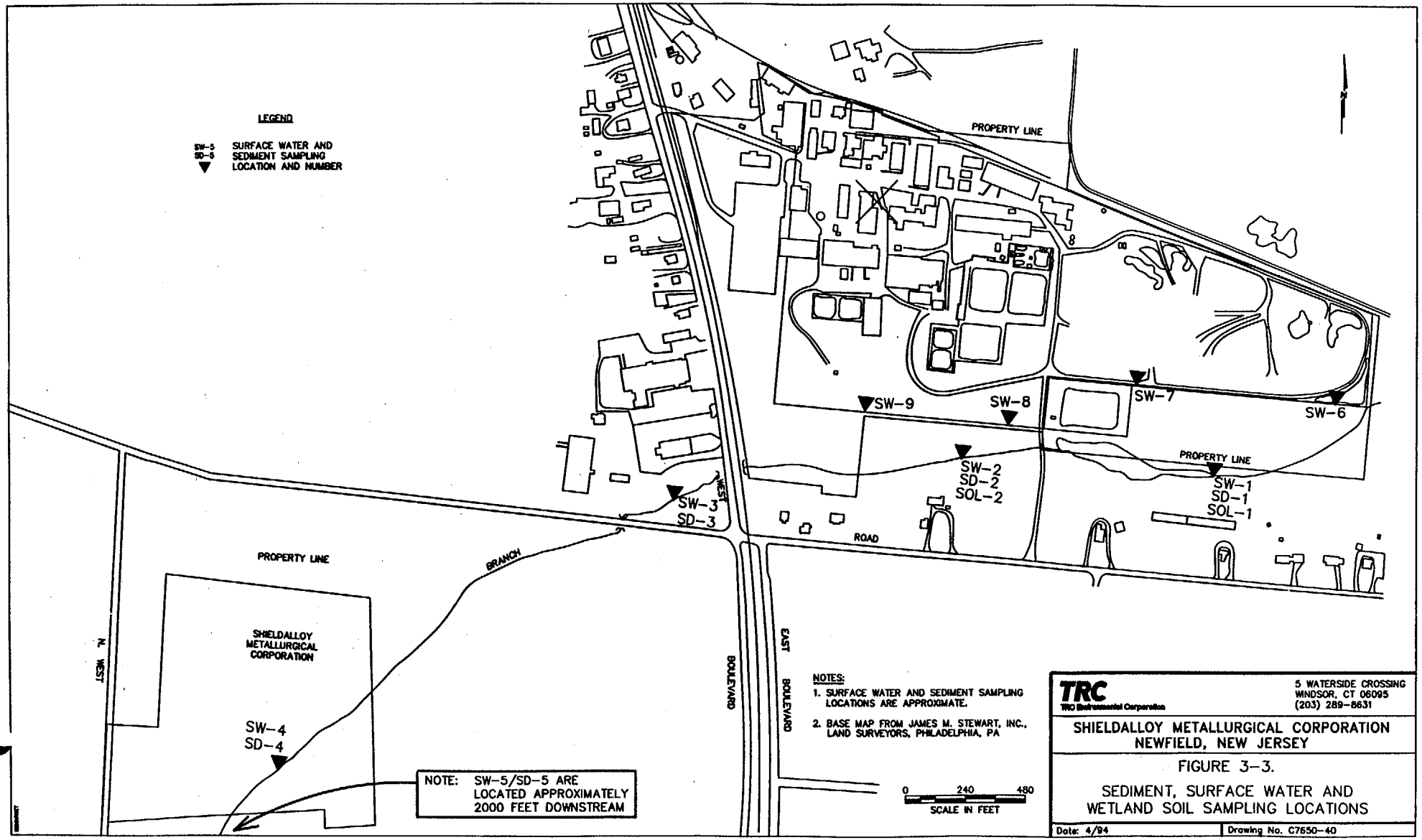
LEGEND
SW-5 SD-5 SURFACE WATER AND SEDIMENT SAMPLING LOCATION AND NUMBER
PROPERTY LINE
SW-9
SW-8
SW-7
SW-6
SW-2
SD-2
SOL-2
SW-1
SD-1
SOL-1
SW-3
SD-3
WEST BRANCH
ROAD
PROPERTY LINE
SHIELDALLOY METALLURGICAL CORPORATION
SW-4
SD-4
N. WEST BOULEVARD
EAST BOULEVARD
NOTE: SW-5/SD-5 ARE LOCATED APPROXIMATELY 2000 FEET DOWNSTREAM
NOTES:
1. SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS ARE APPROXIMATE.
2. BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA
0 240 480
SCALE IN FEET
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FIGURE 3-3.
SEDIMENT, SURFACE WATER AND WETLAND SOIL SAMPLING LOCATIONS
Date: 4/94
Drawing No. C7550-40

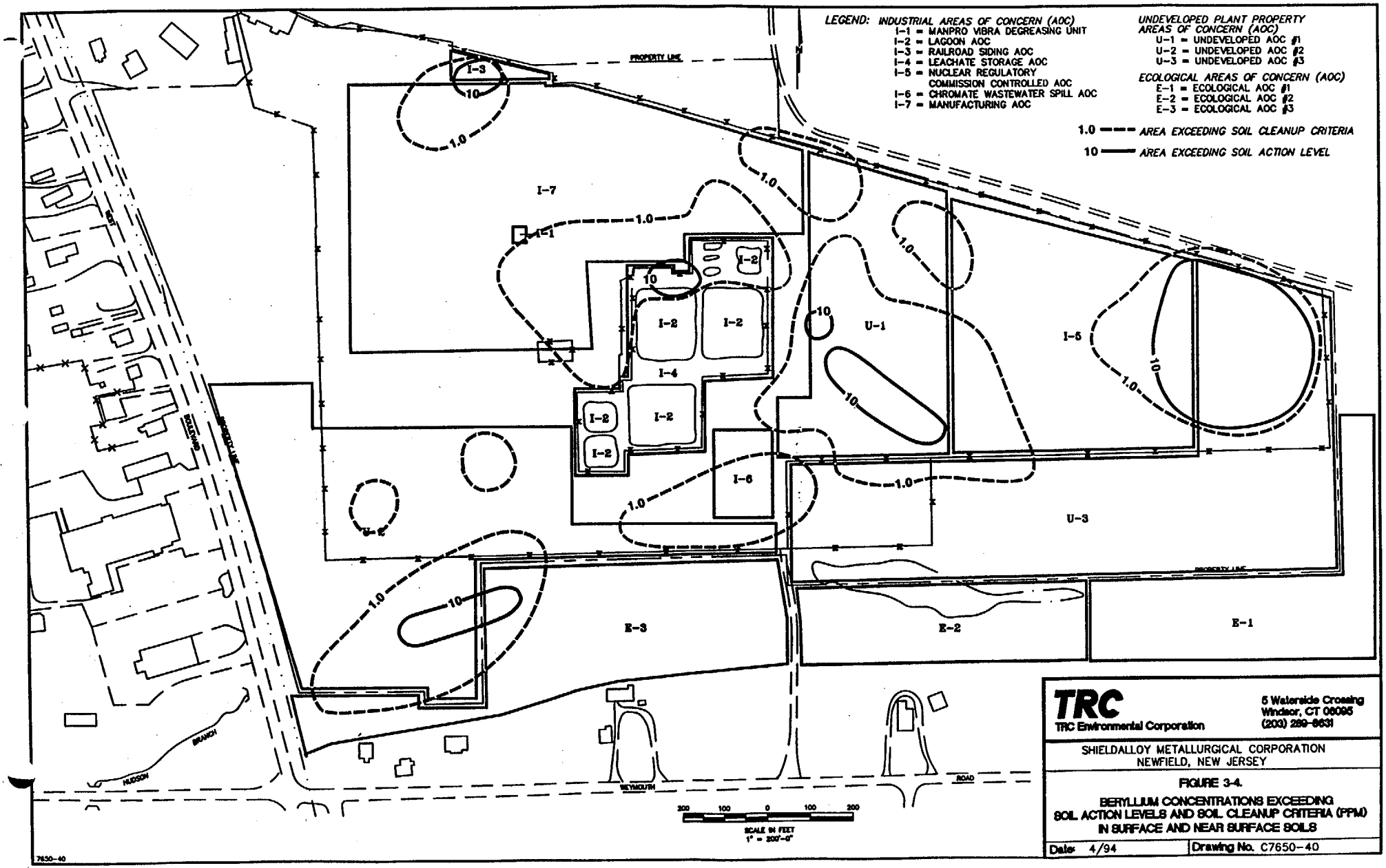

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FIGURE 3-4.
BERYLLIUM CONCENTRATIONS EXCEEDING SOIL ACTION LEVELS AND SOIL CLEANUP CRITERIA (PPM) IN SURFACE AND NEAR SURFACE SOILS

Date: 4/94 | Drawing No. C7650-40

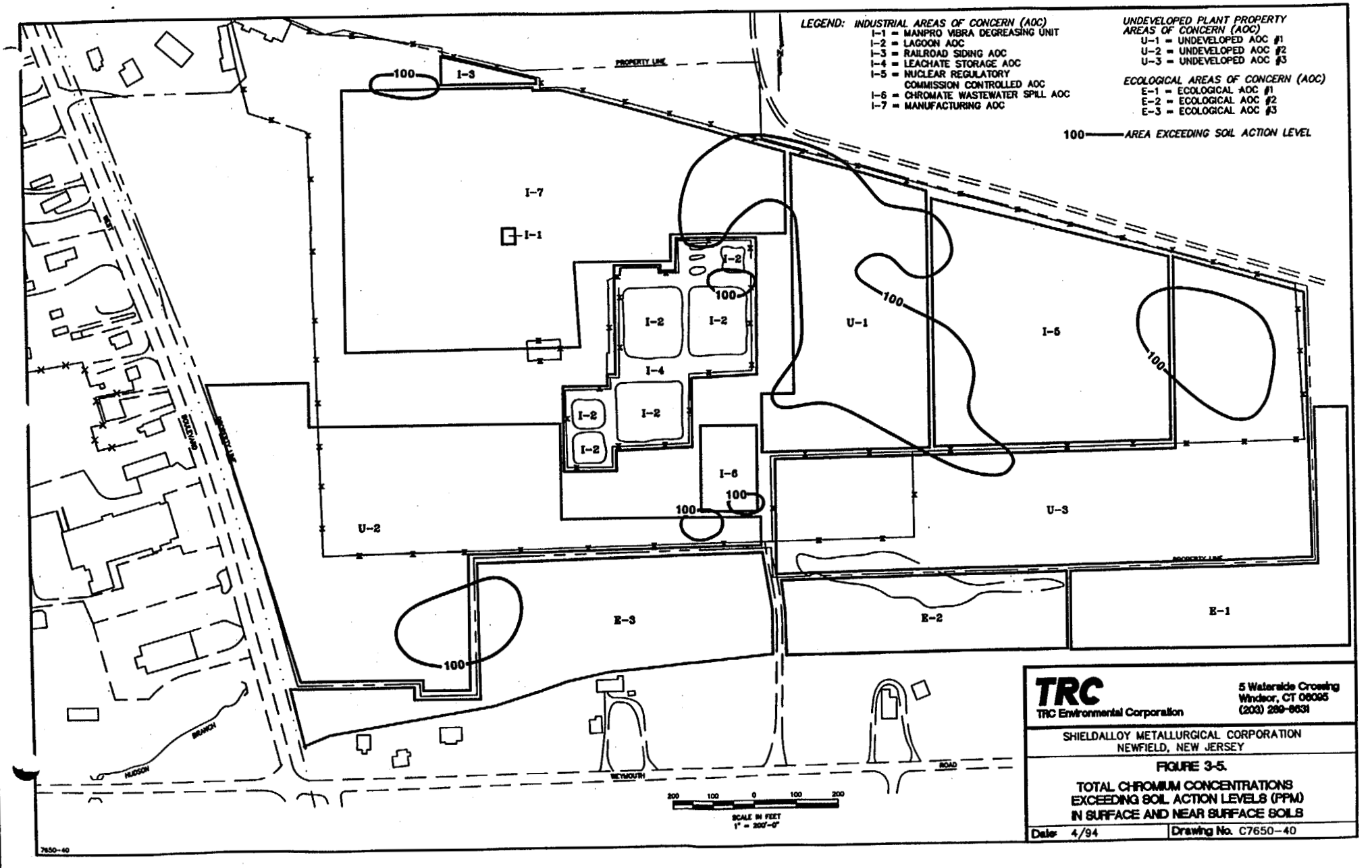

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FIGURE 3-5.

TOTAL CHROMIUM CONCENTRATIONS EXCEEDING SOIL ACTION LEVELS (PPM) IN SURFACE AND NEAR SURFACE SOILS

Date: 4/94 | Drawing No. C7650-40

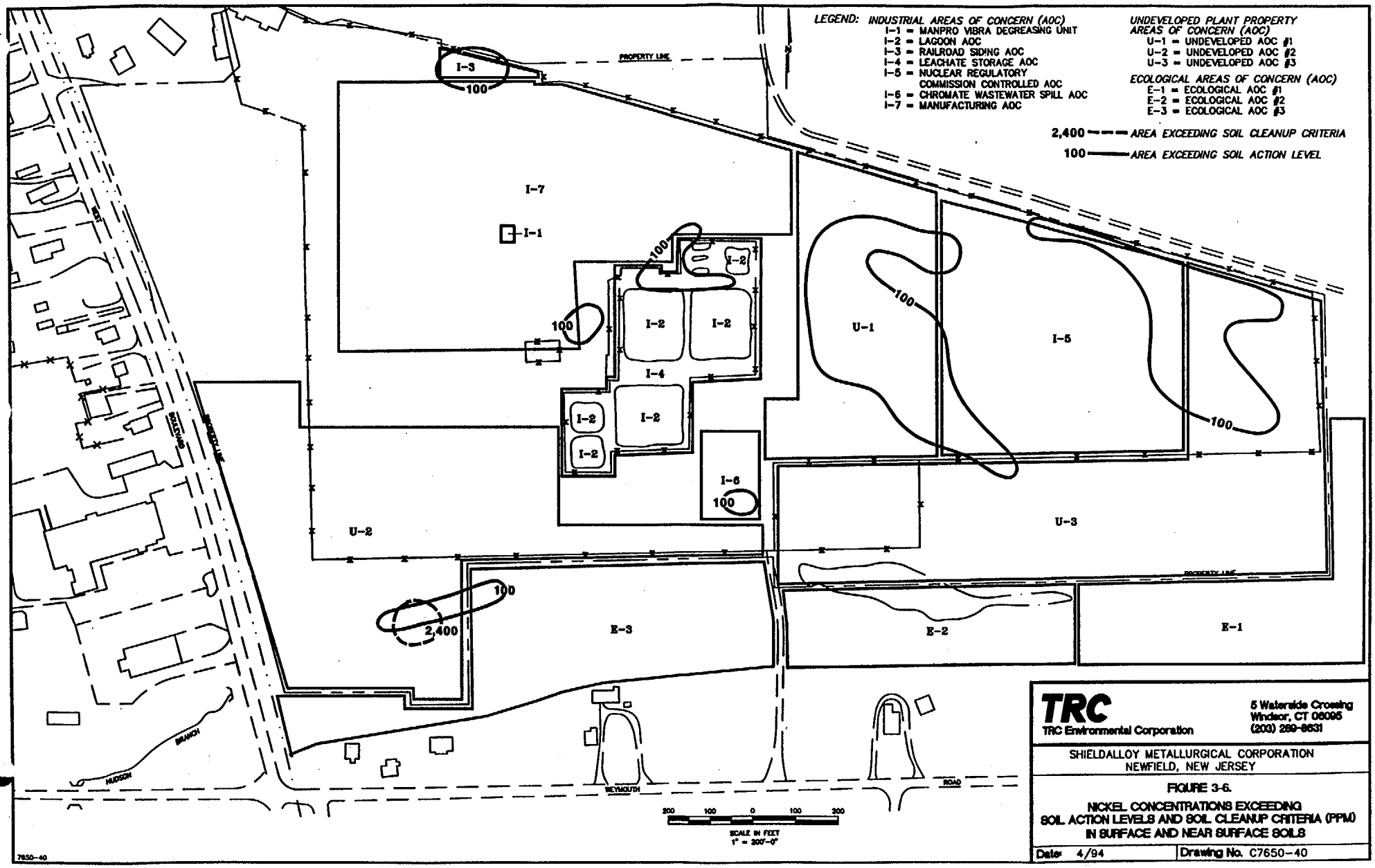

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FIGURE 3-6.

NICKEL CONCENTRATIONS EXCEEDING SOIL ACTION LEVELS AND SOIL CLEANUP CRITERIA (PPM) IN SURFACE AND NEAR SURFACE SOILS

Date: 4/94 | Drawing No. C7650-40

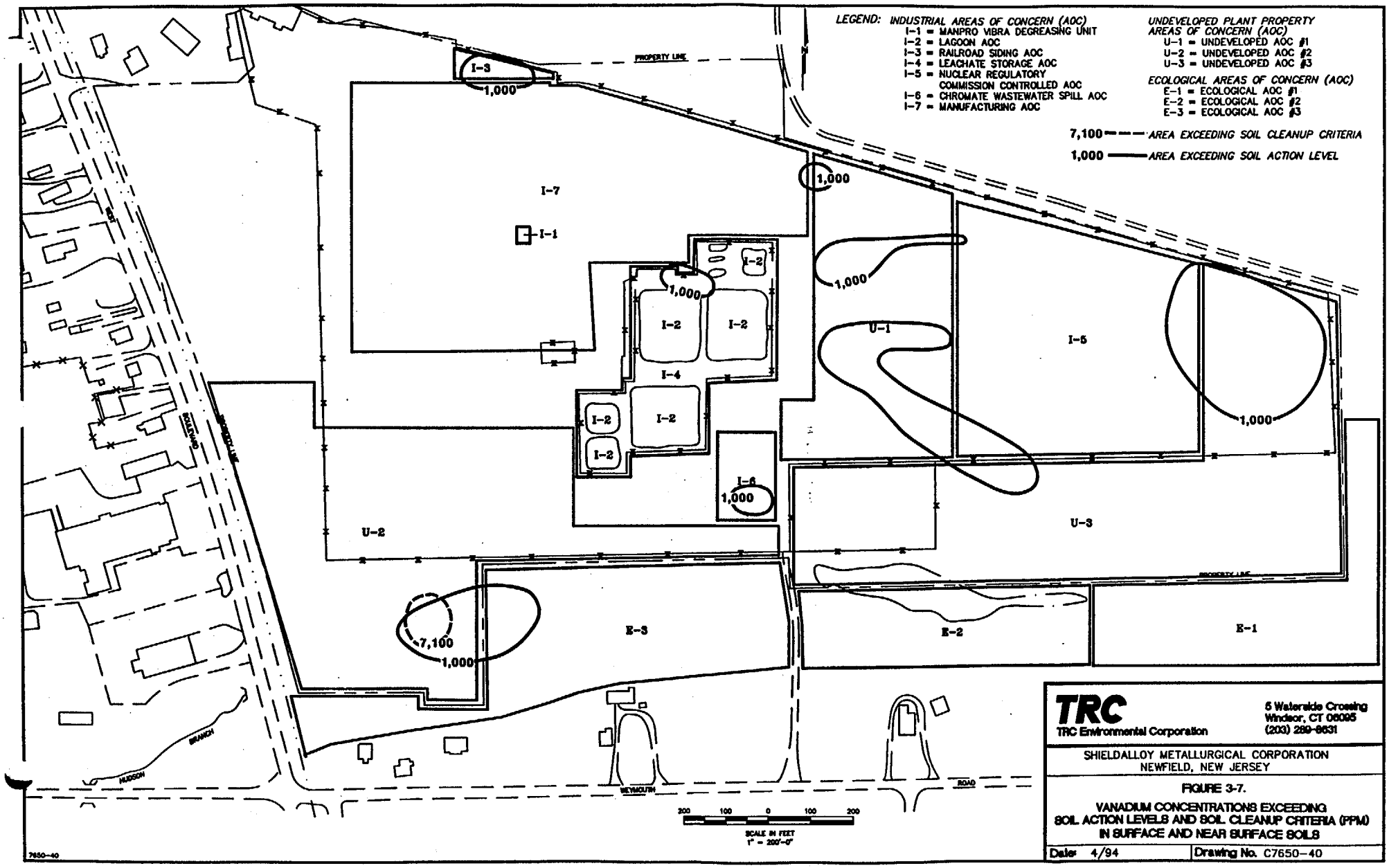

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FIGURE 3-7.

VANADIUM CONCENTRATIONS EXCEEDING SOIL ACTION LEVELS AND SOIL CLEANUP CRITERIA (PPM) IN SURFACE AND NEAR SURFACE SOILS

Date: 4/94 | Drawing No. C7650-40

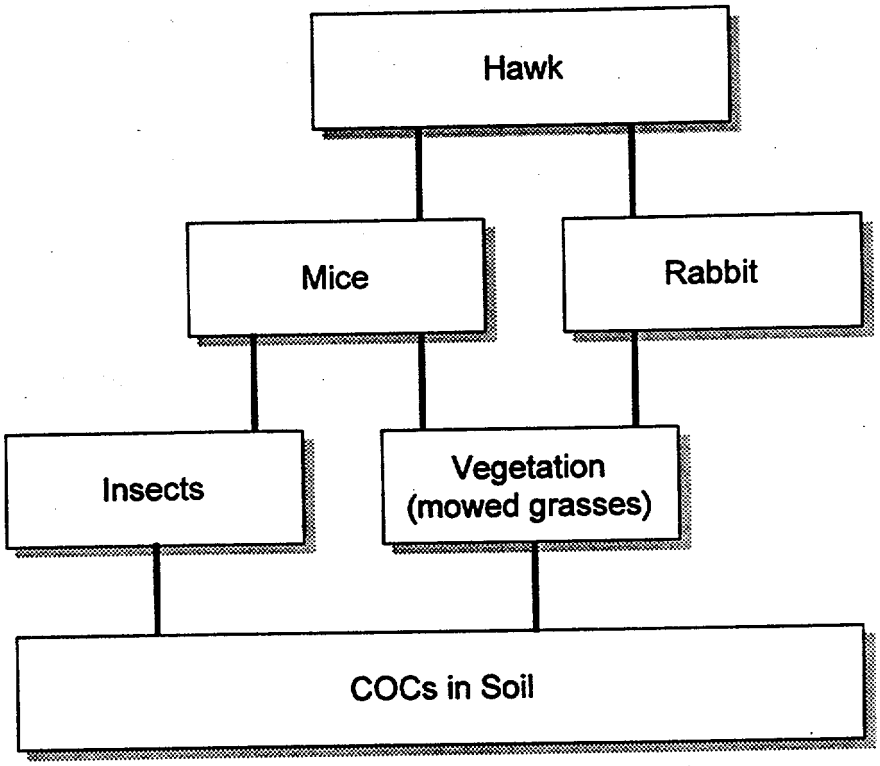

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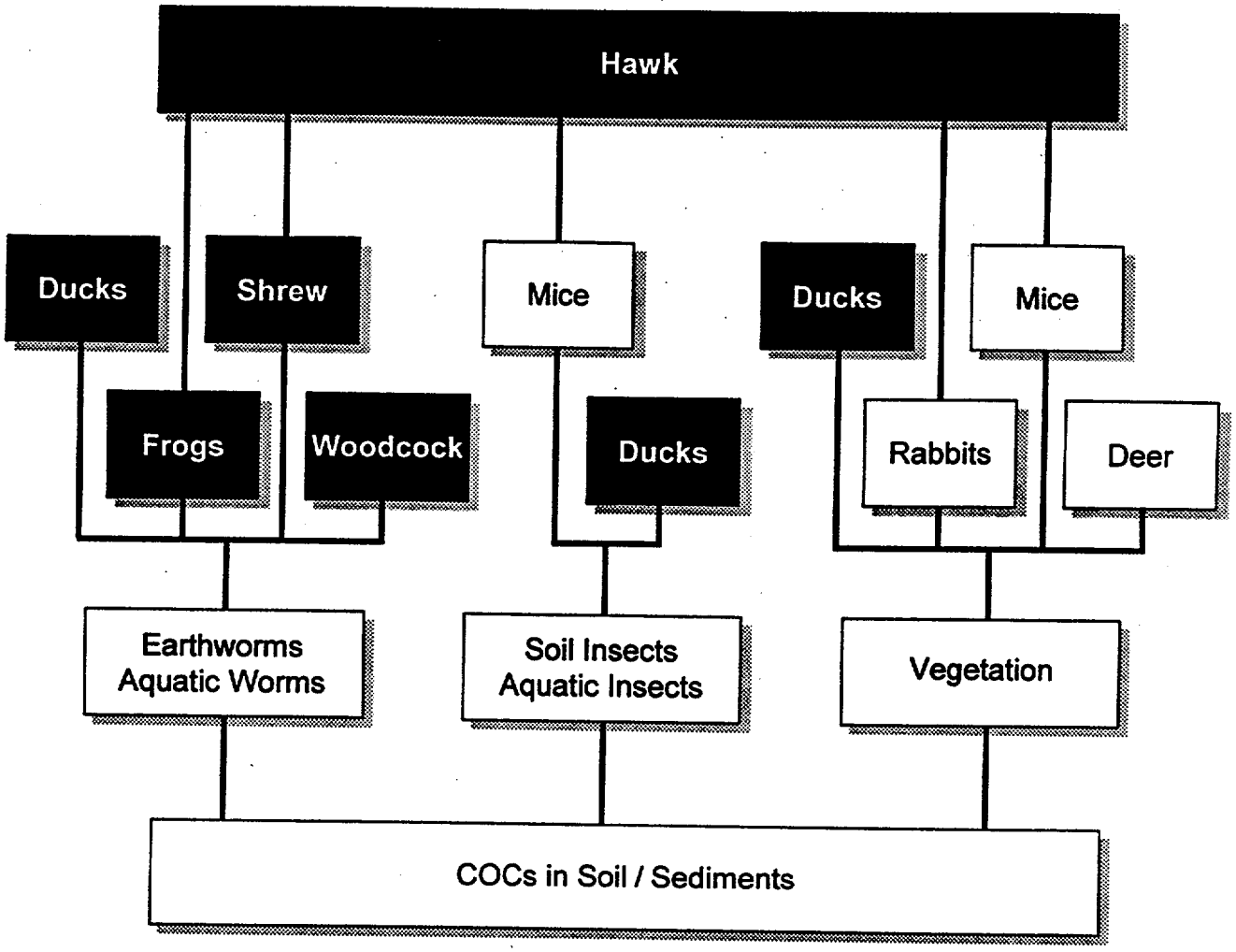
FIGURE 3-8.
EXPOSURE SCENARIO FOR UPLAND UNDEVELOPED AREAS (UNDEVELOPED AOCs 2 & 3)

Date: 4/94 | Drawing No. C7650-40

C7650-40



Reversed boxes have been selected as indicator species.

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FIGURE 3-9.
EXPOSURE SCENARIOS IN HUDSON BRANCH WETLANDS

Date: 4/94 | Drawing No. C7650-40

C7650-40

APPENDIX A

SURFACE SOIL, SURFACE WATER, AND SEDIMENT DATA

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN SURFACE WATER SAMPLES

SAMPLE IDENTIFICATION:	SW1-01	SW2-01	SW3-01	SW10-01	SW4-01	SW5-01	SW6-01	SW7-01	SW8-01	SW9-01
VOLATILE ORGANICS (ppb)										
CHLOROMETHANE	-	-	-	-	9 J	-	-	-	-	-
BROMOMETHANE	-	-	-	-	-	-	-	-	-	-
VINLY CHLORIDE	-	-	-	-	-	-	-	-	-	-
CHLOROETHANE	-	-	-	-	-	-	-	-	-	-
METHYLENE CHLORIDE	19 R*	17 R*	18 R*	18 R*	10 BJ*	10 BJ*	41 R*	36 R*	35 R*	19 R*
ACETONE	12 BJ*	6 JB	6 JB	5 JB	7 JB	7 JB	6 N*	10 N*	9 N*	4 N*
CARBON DISULFIDE	-	-	-	-	-	-	2 N*	2 N*	2 N*	2 N*
1,1-DICHLORETHENE	-	-	-	-	-	-	-	-	-	-
1,1-DICHLORETHANE	-	-	-	-	-	-	-	-	-	-
1,2-DICHLORETHENE (total)	-	-	-	-	2 J	-	-	-	-	-
CHLOROFORM	-	-	-	-	-	-	-	-	-	-
1,2-DICHLORETHANE	-	-	-	-	-	-	-	-	-	-
2-BUTANONE	-	-	-	-	-	-	-	-	-	-
1,1,1-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	-
CARBON TETRACHLORIDE	-	-	-	-	-	-	-	-	-	-
VINYL ACETATE	-	-	-	-	-	-	-	-	-	-
BROMODICHLOROMETHANE	-	-	-	-	-	-	-	-	-	-
1,2-DICHLOROPROPANE	-	-	-	-	-	-	-	-	-	-
cis-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-
TRICHLOROETHENE	-	-	-	-	3 J	-	-	-	-	-
DIBROMOCHLOROMETHANE	-	-	-	-	-	-	-	-	-	-
1,1,2-TRICHLOROETHANE	-	-	-	-	-	-	-	-	-	-
BENZENE	-	-	-	-	-	-	-	-	-	-
trans-1,3-DICHLOROPROPENE	-	-	-	-	-	-	-	-	-	-
BROMOFORM	-	-	-	-	-	-	-	-	-	-
4-METHYL1-2-PENTANONE	-	-	-	-	-	-	-	-	-	-
2-HEXANONE	-	-	-	-	-	-	-	-	-	-
TETRACHLOROETHENE	-	-	-	-	-	-	-	-	-	-
1,1,2,2-TETRACHLOROETHANE	-	-	-	-	-	-	-	-	-	-
TOLUENE	-	-	-	-	-	-	-	-	-	-
CHLOROBENZENE	-	-	-	-	-	-	-	-	-	-
ETHYLBENZENE	-	-	-	-	-	-	-	-	-	-
STYRENE	-	-	-	-	-	-	-	-	-	-
XYLENE (total)	-	-	-	-	-	-	-	-	-	-
TOTAL VOCs	12	6	6	5	31	17	8	0	0	0

B - QUALIFIER USED WHEN THE ANALYTE IS FOUND IN THE ASSOCIATED METHOD BLANK AS WELL AS IN THE SAMPLE. IT INDICATES POSSIBLE / PROBABLE CONTAMINATION.

J - QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS ESTIMATED.

N - QUALIFIER INDICATES THE CONCENTRATION FOUND IN THE SAMPLE IS LESS THAN THREE TIMES THE CONCENTRATION FOUND IN THE ASSOCIATED BLANKS. THE PRESENCE OF THE ANALYTE IS NEGATED DUE TO LABORATORY CONTAMINATION.

R - DATA IS REJECTED DUE TO HOLDING TIME EXCEEDED, BLANK CONTAMINATION, INSTRUMENT CALIBRATION ERROR, OR OTHER MAJOR CONTROLLING LIMITS ARE EXCEEDED.

* - INDICATES QUALIFIER PLACED BY TRC-ECI.

N/A - NOT ANALYZED FOR THIS COMPOUND

'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF SEMI-VOLATILE ORGANIC COMPOUNDS DETECTED IN SURFACE WATER SAMPLES

SAMPLE IDENTIFICATION:	SW1-01	SW2-01	SW3-01	SW10-01	SW4-01	SW5-01	SW6-01	SW7-01	SW8-01	SW9-01
BASE NEUTRAL / ACIDS (ppb)										
PHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
bis(2-CHLOROETHYL)ETHER	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2-CHLOROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
1,3-DICHLOROBENZENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
1,4-DICHLORBENZENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZYL ALCOHOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
1,2-DICHLOROBENZENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
bis(2-CHLOROISOPROPYL)ETHER	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
N-NITROSO-DI-N-PROPYLAMINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
HEXACHLOROETHANE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
NITROBENZENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ISOPHORONE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2-NITROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2,4-DIMETHYLPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZOIC ACID	-	N/A	N/A	N/A	-	N/A	-	-	-	-
bis(2-CHLOROETHOXY)METHANE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2,4-DICHLOROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
1,2,4-TRICHLOROBENZENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
NAPHTHALENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-CHLOROANILINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
HEXACHLOROBUTADIENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-CHLORO-3-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2-METHYLNAPHTHALENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
HEXACHLOROCYCLOPENTADIENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2,4,6-TRICHLOROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2,4,5-TRICHLOROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2-CHLORONAPHTHALENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2-NITROANILINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DIMETHYLPHTHALATE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ACENAPHTHYLENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2,6-DINITROTOLUENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF SEMI-VOLATILE ORGANIC COMPOUNDS DETECTED IN SURFACE WATER SAMPLES

SAMPLE IDENTIFICATION:	SW1-01	SW2-01	SW3-01	SW10-01	SW4-01	SW5-01	SW6-01	SW7-01	SW8-01	SW9-01
BASE NEUTRAL / ACIDS (ppb) (continued)										
3-NITROANILINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ACENAPHTHENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
1,4-DINITROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-NITROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DIBENZOFURAN	-	N/A	N/A	N/A	-	N/A	-	-	-	-
2,4-DINITROTOLUENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DIETHYLPHTHALATE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-CHLOROPHENYL-PHENYLETHER	-	N/A	N/A	N/A	-	N/A	-	-	-	-
FLUORENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-NITROANILINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4,6-DINITRO-2-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
N-NITROSODIPHENYLAMINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4-BROMOPHENYL-PHENYLETHER	-	N/A	N/A	N/A	-	N/A	-	-	-	-
HEXACHLOROBENZENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
PENTACHLOROPHENOL	-	N/A	N/A	N/A	-	N/A	-	-	-	-
PHENANTHRENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ANTHRACENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DI-n-BUTYLPHALATE	1 J	N/A	N/A	N/A	1 J	N/A	-	2 J	2 J	1 J
FLUORANTHENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
PYRENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BUTYLBENZYLPHTHALATE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
3,3'-DICHLOROBENZIDINE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZO(a)ANTHRACENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
CHRYSENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
bis(2-ETHYLHEXYL)PHTHALATE	-	N/A	N/A	N/A	2 J	N/A	-	-	-	-
DI-n-OCTYL PHTHALATE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZO(b)FLUORANTHENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZO(k)FLUORANTHENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZO(a)PYRENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
INDENO(1,2,3-cd)PYRENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DIBENZO(A,H)ANTHRACENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BENZO(g,h,i)PERYLENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
TOTAL caPAH	0	N/A	N/A	N/A	0	N/A	0	0	0	0

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF PESTICIDE/PCB COMPOUNDS DETECTED
IN SURFACE WATER SAMPLES

SAMPLE IDENTIFICATION:	SW1-01	SW2-01	SW3-01	SW10-01	SW4-01	SW5-01	SW6-01	SW7-01	SW8-01	SW9-01
PESTICIDES/PCB'S (ppb)										
ALPHA-BHC	-	N/A	N/A	N/A	-	N/A	-	-	-	-
BETA-BHC	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DELTA-BHC	-	N/A	N/A	N/A	-	N/A	-	-	-	-
GAMMA-BHC(LINDANE)	-	N/A	N/A	N/A	-	N/A	-	-	-	-
HEPTACHLOR	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ALDRIN	-	N/A	N/A	N/A	-	N/A	-	-	-	-
HEPTACHLOR EPOXIDE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ENDOSULFAN I	-	N/A	N/A	N/A	-	N/A	-	-	-	-
DIELDRIN	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4,4-DDE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ENDRIN	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ENDOSULFAN II	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4,4-DDD	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ENDOSULFAN SULFATE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
4,4-DDT	-	N/A	N/A	N/A	-	N/A	-	-	-	-
METHOXYCHLOR	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ENDRIN KETONE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
ALPHA-CHLORDANE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
GAMMA-CHLORDANE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
TOXAPHENE	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1016	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1221	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1232	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1242	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1248	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1254	-	N/A	N/A	N/A	-	N/A	-	-	-	-
AROCLOR-1260	-	N/A	N/A	N/A	-	N/A	-	-	-	-

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF INORGANIC COMPOUNDS DETECTED
IN SURFACE WATER SAMPLES

SAMPLE IDENTIFICATION:	SW1-01	SW2-01	SW3-01	SW10-01	SW4-01	SW5-01	SW6-01	SW7-01	SW8-01	SW9-01
INORGANICS (ppb)										
ALUMINUM	4610	44800	544	442	319	224	3450	48100	12800	9300
ANTIMONY	44.2 B	151	–	–	–	–	–	–	–	–
ARSENIC	2.0 B	34.6	–	–	2.4 B	–	–	116	2.4 B	2.2 B
BARIUM	78.2 B	962	44.4 B	43.6 B	40.8 B	24.5 B	205	400	65.1 B	160 B
BERYLLIUM	1.3 B	25.1	1.0 B	1.0 B	1.0 B	–	–	468	15.4	37.2
CADMIUM	–	9.0	–	–	–	–	–	5.2	–	–
CALCIUM	5480	18100	4040 B	3960 B	4600 B	4940 B	9200	30300	13300	11000
CHROMIUM	43.3	8520	120	106	208	99.0	29.6	313	91.4	283
CHROMIUM VI	–	–	–	–	0.054	–	0.031	0.057	0.028	0.14
COBALT	–	62.2	–	–	–	–	–	13.1 B	–	–
COPPER	8.0 B	432	13.7 B	11.8 B	7.7 B	7.3 B	6.3 B	64.2	16.3 B	23.2 B
CYANIDE, TOTAL (UG/L)	–	11.0J*	–	–	–	–	–	94.4	–	12.3
IRON	4660	71000	1210	1020	933	697	128	13900	14200	6820
LEAD	28.0	–	7.6	9.3	3.8 B	5.5 B	8	1240	1050	170
MAGNESIUM	9250	5670	1700 B	1690 B	2060 B	2400 B	16500	63200	12000	27800
MANGANESE	622	2590	220	219	342	131	10.7 B	1160	223	500
MERCURY	–	21.4	–	–	–	–	–	–	–	–
NICKEL	20.6 B	618	29.6 B	34.5 B	17.7 B	17.1 B	–	415	49.2	242
POTASSIUM	8670	4870 B	1610 B	1890 B	4310 B	4490 B	9300	171000	6890	14400
SELENIUM	–	–	–	–	–	–	–	29 B	–	2.1 B
SILVER	–	–	–	–	–	–	–	–	–	–
SODIUM	25900	20300	24400	23900	107000	65200	64900	90100	23800	80700
THALLIUM	–	–	–	–	–	–	–	–	–	–
VANADIUM	272	5700	310	307	246	286	1410	8650	3380	8350
ZINC	56.4	1070	41.8	32.4	25.4	20.8	58.6	942	108	234
BORON	828	N/A	N/A	N/A	585	N/A	14100	4960	286	320
NIOBIUM	–	N/A	N/A	N/A	–	N/A	–	527	–	–
STRONTIUM	–	N/A	N/A	N/A	–	N/A	221	–	–	–
TITANIUM	–	N/A	N/A	N/A	–	N/A	–	443	193	143
ZIRCONIUM	–	N/A	N/A	N/A	–	N/A	N/A	N/A	N/A	N/A
FLUORIDE	0.87	0.92	1.1	1.1	0.84	0.97	N/A	N/A	N/A	N/A
SULPHATE	68.7	25.8	12.2	11.7	139	80.2	N/A	N/A	N/A	N/A

B – INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL

J – QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS ESTIMATED.

* – INDICATES QUALIFIER PLACED BY TRC–ECI.

N/A – NOT ANALYZED FOR THIS COMPOUND

'–' – NOT DETECTED TO THE REPORTED DETECTION LIMIT

CRDL – CONTRACT REQUIRED DETECTION LIMITS.

IDL – INSTRUMENT DETECTION LIMITS.

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF VOLATILE ORGANIC CONSTITUENTS DETECTED IN STREAM SEDIMENTS

SAMPLE IDENTIFICATION *DUPE if Duplicate*	SD01-01	SD02-01	SD03-01	SD3-01 DUPE	SD04-01	SD05-01
VOLATILE ORGANICS (PPB)						
CHLOROMETHANE	-	-	-	-	-	-
BROMOMETHANE	-	-	-	-	-	-
VINLY CHLORIDE	-	-	-	-	-	-
CHLOROETHANE	-	-	-	-	-	-
METHYLENE CHLORIDE	100 R*	870 R*	110 R*	75 R*	98 R*	130 R*
ACETONE	330 BJ*	430 BJ*	360 BJ*	190 BJ*	290 BJ*	220 BJ*
CARBON DISULFIDE	-	-	-	-	-	4 J
1,1-DICHLORETHENE	-	-	-	-	-	-
1,1-DICHLORETHANE	-	-	-	-	-	-
1,2-DICHLORETHENE (total)	-	-	2 J	-	5 J	-
CHLOROFORM	-	-	-	-	-	-
1,2-DICHLORETHANE	-	-	-	-	-	-
2-BUTANONE	72	130 J	120	51	55	69
1,1,1-TRICHLOROETHANE	-	-	-	-	-	-
CARBON TETRACHLORIDE	-	-	-	-	-	-
VINYL ACETATE	-	-	-	-	-	-
BROMODICHLOROMETHANE	-	-	-	-	-	-
1,2-DICHLOROPROPANE	-	-	-	-	-	-
cis-1,3-DICHLOROPROPENE	-	-	-	-	-	-
TRICHLOROETHENE	-	-	-	-	-	7 J
DIBROMOCHLOROMETHANE	-	-	-	-	-	-
1,1,2-TRICHLOROETHANE	-	-	-	-	-	-
BENZENE	-	-	-	-	-	-
trans-1,3-DICHLOROPROPENE	-	-	-	-	-	-
BROMOFORM	-	-	-	-	-	-
4-METHYL1-2-PENTANONE	-	-	-	-	-	-
2-HEXANONE	-	-	-	-	-	-
TETRACHLOROETHENE	-	-	-	-	-	-
1,1,2,2-TETRACHLOROETHANE	-	-	-	-	-	-
TOLUENE	-	-	-	-	-	-
CHLOROBENZENE	-	-	-	-	-	-
ETHYLBENZENE	-	-	-	-	-	-
STYRENE	-	-	-	-	-	-
XYLENE (total)	-	-	-	-	-	-
TOTAL VOCs	402	560	482	241	350	300

B - QUALIFIER USED WHEN THE ANALYTE IS FOUND IN THE ASSOCIATED METHOD BLANK AS WELL AS IN THE SAMPLE. IT INDICATES POSSIBLE / PROBABLE CONTAMINATION.

J - QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS ESTIMATED.

N - QUALIFIER INDICATES THE CONCENTRATION FOUND IN THE SAMPLE IS LESS THAN THREE TIMES THE CONCENTRATION FOUND IN THE ASSOCIATED BLANKS. THE PRESENCE OF THE ANALYTE IS NEGATED DUE TO LABORATORY CONTAMINATION

R - DATA IS REJECTED DUE TO HOLDING TIME EXCEEDED, BLANK CONTAMINATION, INSTRUMENT CALIBRATION ERROR, OR OTHER MAJOR CONTROLLING LIMITS ARE EXCEEDED.

* - INDICATES QUALIFIERS PLACED BY TRC-ECI.

N/A - NOT ANALYZED FOR THIS COMPOUND.

'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT.

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF SEMI-VOLATILE CONSTIUENTS DETECTED IN STREAM SEDIMENTS

SAMPLE IDENTIFICATION: *DUPE if Duplicate*	SD01-01	SD02-01	SD03-01	SD3-01 DUPE	SD04-01	SD05-01
BASE NEUTRAL / ACIDS (PPB)						
PHENOL	100 J	N/A	N/A	N/A	520 J	N/A
bis(2-CHLOROETHYL)ETHER	-	N/A	N/A	N/A	-	N/A
2-CHLOROPHENOL	-	N/A	N/A	N/A	-	N/A
1,3-DICHLOROBENZENE	-	N/A	N/A	N/A	-	N/A
1,4-DICHLORBENZENE	-	N/A	N/A	N/A	-	N/A
BENZYL ALCOHOL	-	N/A	N/A	N/A	-	N/A
1,2-DICHLOROBENZENE	-	N/A	N/A	N/A	-	N/A
2-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A
bis(2-CHLOROISOPROPYL)ETHER	-	N/A	N/A	N/A	-	N/A
4-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A
N-NITROSO-DI-N-PROPYLAMINE	-	N/A	N/A	N/A	-	N/A
HEXACHLOROETHANE	-	N/A	N/A	N/A	-	N/A
NITROBENZENE	-	N/A	N/A	N/A	-	N/A
ISOPHORONE	-	N/A	N/A	N/A	-	N/A
2-NITROPHENOL	-	N/A	N/A	N/A	-	N/A
2,4-DIMETHYLPHENOL	-	N/A	N/A	N/A	-	N/A
BENZOIC ACID	1000 J	N/A	N/A	N/A	3200 J	N/A
bis(2-CHLOROETHOXY)METHANE	-	N/A	N/A	N/A	-	N/A
2,4-DICHLOROPHENOL	-	N/A	N/A	N/A	-	N/A
1,2,4-TRICHLOROBENZENE	-	N/A	N/A	N/A	-	N/A
NAPHTHALENE	-	N/A	N/A	N/A	-	N/A
4-CHLOROANILINE	-	N/A	N/A	N/A	-	N/A
HEXACHLOROBUTADIENE	-	N/A	N/A	N/A	-	N/A
4-CHLORO-3-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A
2-METHYLNAPHTHALENE	-	N/A	N/A	N/A	-	N/A
HEXACHLOROCYCLOPENTADIENE	-	N/A	N/A	N/A	-	N/A
2,4,6-TRICHLOROPHENOL	-	N/A	N/A	N/A	-	N/A
2,4,5-TRICHLOROPHENOL	-	N/A	N/A	N/A	-	N/A
2-CHLORONAPHTHALENE	-	N/A	N/A	N/A	-	N/A
2-NITROANILINE	-	N/A	N/A	N/A	-	N/A
DIMETHYLPHTHALATE	-	N/A	N/A	N/A	-	N/A
ACENAPHTHYLENE	-	N/A	N/A	N/A	-	N/A
2,6-DINITROTOLUENE	-	N/A	N/A	N/A	-	N/A
3-NITROANILINE	-	N/A	N/A	N/A	-	N/A

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF SEMI-VOLATILE CONSTIUENTS DETECTED IN STREAM SEDIMENTS

SAMPLE IDENTIFICATION. *DUPE if Duplicate*	SD01-01	SD02-01	SD03-01	SD3-01 DUPE	SD04-01	SD05-01
BASE NEUTRAL / ACIDS (PPB) (continued)						
ACENAPHTHENE	-	N/A	N/A	N/A	-	N/A
1,4-DINITROPHENOL	-	N/A	N/A	N/A	-	N/A
4-NITROPHENOL	-	N/A	N/A	N/A	-	N/A
DIBENZOFURAN	-	N/A	N/A	N/A	-	N/A
2,4-DINITROTOLUENE	-	N/A	N/A	N/A	-	N/A
DIETHYLPHTHALATE	-	N/A	N/A	N/A	-	N/A
4-CHLOROPHENYL-PHENYLETHER	-	N/A	N/A	N/A	-	N/A
FLUORENE	-	N/A	N/A	N/A	-	N/A
4-NITROANILINE	-	N/A	N/A	N/A	-	N/A
4,6-DINITRO-2-METHYLPHENOL	-	N/A	N/A	N/A	-	N/A
N-NITROSODIPHENYLAMINE	-	N/A	N/A	N/A	-	N/A
4-BROMOPHENYL-PHENYLETHER	-	N/A	N/A	N/A	-	N/A
HEXACHLOROBENZENE	-	N/A	N/A	N/A	-	N/A
PENTACHLOROPHENOL	330 J	N/A	N/A	N/A	-	N/A
PHENANTHRENE	-	N/A	N/A	N/A	110 J	N/A
ANTHRACENE	-	N/A	N/A	N/A	-	N/A
DI-n-BUTYLPHALATE	490 JB	N/A	N/A	N/A	580 JB	N/A
FLUORANTHENE	120 J	N/A	N/A	N/A	210 J	N/A
PYRENE	-	N/A	N/A	N/A	130 J	N/A
BUTYLBENZYLPHTHALATE	140 J	N/A	N/A	N/A	-	N/A
3,3'-DICHLOROBENZIDINE	-	N/A	N/A	N/A	-	N/A
BENZO(a)ANTHRACENE	-	N/A	N/A	N/A	-	N/A
CHRYSENE	-	N/A	N/A	N/A	140 J	N/A
bis(2-ETHYLHEXYL)PHTHALATE	580 J	N/A	N/A	N/A	270 J	N/A
DI-n-OCTYLPHTHALATE	-	N/A	N/A	N/A	-	N/A
BENZO(b)FLUORANTHENE	-	N/A	N/A	N/A	110 J	N/A
BENZO(k)FLUORANTHENE	-	N/A	N/A	N/A	-	N/A
BENZO(a)PYRENE	-	N/A	N/A	N/A	-	N/A
INDENO(1,2,3-cd)PYRENE	-	N/A	N/A	N/A	-	N/A
DIBENZO(A,H)ANTHRACENE	-	N/A	N/A	N/A	-	N/A
BENZO(g,h,i)PERYLENE	-	N/A	N/A	N/A	-	N/A
TOTAL cePAH	0	N/A	N/A	N/A	250	N/A

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF PESTICIDE/PCB CONSTITUENTS DECTECTED IN STREAM SEDIMENTS

SAMPLE IDENTIFICATION: *DUPE if Duplicate*	SD01-01	SD02-01	SD03-01	SD3-01 DUPE	SD04-01	SD05-01
PESTICIDES/PCB'S (PPB)						
ALPHA-BHC	-	N/A	N/A	N/A	-	N/A
BETA-BHC	-	N/A	N/A	N/A	-	N/A
DELTA-BHC	-	N/A	N/A	N/A	-	N/A
GAMMA-BHC(LINDANE)	-	N/A	N/A	N/A	-	N/A
HEPTACHLOR	-	N/A	N/A	N/A	-	N/A
ALDRIN	-	N/A	N/A	N/A	-	N/A
HEPTACHLOR EPOXIDE	-	N/A	N/A	N/A	-	N/A
ENDOSULFAN I	-	N/A	N/A	N/A	-	N/A
DIELDRIN	-	N/A	N/A	N/A	-	N/A
4,4-DDE	18 J	N/A	N/A	N/A	11 J	N/A
ENDRIN	-	N/A	N/A	N/A	-	N/A
ENDOSULFAN II	-	N/A	N/A	N/A	-	N/A
4,4-DDD	5.3 J	N/A	N/A	N/A	18 J	N/A
ENDOSULFAN SULFATE	-	N/A	N/A	N/A	-	N/A
4,4-DDT	33 J	N/A	N/A	N/A	28 J	N/A
METHOXYCHLOR	-	N/A	N/A	N/A	-	N/A
ENDRIN KETONE	-	N/A	N/A	N/A	-	N/A
ALPHA-CHLORDANE	-	N/A	N/A	N/A	-	N/A
GAMMA-CHLORDANE	-	N/A	N/A	N/A	-	N/A
TOXAPHENE	-	N/A	N/A	N/A	-	N/A
AROCLOR-1016	-	N/A	N/A	N/A	-	N/A
AROCLOR-1221	-	N/A	N/A	N/A	-	N/A
AROCLOR-1232	-	N/A	N/A	N/A	-	N/A
AROCLOR-1242	-	N/A	N/A	N/A	-	N/A
AROCLOR-1248	-	N/A	N/A	N/A	-	N/A
AROCLOR-1254	160 J	N/A	N/A	N/A	95 J	N/A
AROCLOR-1260	-	N/A	N/A	N/A	-	N/A

APPENDIX A
SHIELDALLOY METALLURGICAL CORPORATION
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN STREAM SEDIMENTS
PAGE 5 of 5

SAMPLE IDENTIFICATION: *DUPE if Duplicate*	SD01-01	SD02-01	SD03-01	SD3-01 DUPE	SD04-01	SD05-01	
** INORGANICS (ppm) **							
ANTIMONY	-	270	36.3	29.7	28.7	35.8 B	
ARSENIC	5.1	16.1 B	12.3	11.2	8.4	9.8	
BARIUM	129	408 B	146	139	194	307	
BERYLLIUM	9.1	22.8	5.9	5.2	3.8	5.6	
CADMIUM	-	-	-	-	-	-	
CALCIUM	2960	3790 B	1210 B	1060 B	1500 B	3470	*
CHROMIUM	1220	15700	1960	1780	1770	2350	
CHROMIUM VI (1)	-	-	-	-	-	-	
COBALT	6.0 B	45.3 B	16.5 B	14.8 B	14.2 B	21.3 B	
COPPER	25.3	327	93.0	71.1	149	65.8	
CYANIDE	-	-	-	-	-	-	
CYANIDE, TOTAL	-	-	-	-	-	-	
IRON	13600	17800	8500	7450	8300	10400	
LEAD	364	338	104	77.4	51.8	69.8	
MAGNESIUM	868 B	1300 B	507 B	436 B	447 B	745 B	
MANGANESE	238	227	227	205	336	655	
MERCURY	-	2.2	0.16	0.61	0.68	1.1	
NICKEL	64.1	423	257	205	135	96.5	
POTASSIUM	597 B	-	471 B	357 B	-	-	
SELENIUM	4.4	-	-	-	1.1 B	1.9 B	
SILVER	-	-	-	-	-	-	
SODIUM	199 B	860 B	553 B	556 B	257 B	554 B	
THALLIUM	-	-	-	-	-	-	
VANADIUM	1890	4850	1160	997	647	800	
ZINC	231	529	164	139	115	175	
BORON	-	-	-	-	-	-	
NIOBIUM	173	-	-	-	-	-	
STRONTIUM	-	-	-	-	-	-	
TITANIUM	279	1080	254	209	218	232	
ZIRCONIUM	-	N/A	N/A	N/A	-	N/A	
FLUORIDE	50.1	150	17.4	17.2	34.1	43.4	
SULFATE	464	1420	719	748	414	783	

B - INDICATES THAT THE REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL
J - QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS ESTIMATED.
N - QUALIFIER INDICATES THE CONCENTRATION FOUND IN THE SAMPLE IS LESS THAN THREE TIMES THE CONCENTRATION FOUND IN THE ASSOCIATED BLANKS. THE PRESENCE OF THE ANALYTE IS NEGATED DUE TO LABORATORY CONTAMINATION
R - DATA IS REJECTED DUE TO HOLDING TIME EXCEEDED, BLANK CONTAMINATION, INSTRUMENT CALIBRATION ERROR, OR OTHER MAJOR CONTROLLING LIMITS ARE EXCEEDED.
* - INDICATES QUALIFIERS PLACED BY TRC-ECI.
N/A - NOT ANALYZED FOR THIS COMPOUND.
'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT.
CRDL - CONTRACT REQUIRED DETECTION LIMITS.
IDL - INSTRUMENT DETECTION LIMITS.
(1) - SAMPLES FOR CHROMIUM VI ANALYSIS COLLECTED IN DECEMBER 1990.

APPENDIX A

SUMMARY OF VOLATILE CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA34-01
SAMPLE DEPTH BELOW GRADE (INCHES):	0-6
VOLATILE ORGANICS (PPB)	
CHLOROETHANE	-
BROMOMETHANE	-
VINLY CHLORIDE	-
CHLOROETHANE	-
METHYLENE CHLORIDE	71 R*
ACETONE	31 BJ*
CARBON DISULFIDE	-
1,1-DICHLORETHENE	-
1,1-DICHLORETHANE	-
1,2-DICHLORETHENE (total)	-
CHLOROFORM	-
1,2-DICHLORETHANE	-
2-BUTANONE	-
1,1,1-TRICHLOROETHANE	-
CARBON TETRACHLORIDE	-
VINYL ACETATE	-
BROMODICHLOROMETHANE	-
1,2-DICHLOROPROPANE	-
cis-1,3-DICHLOROPROPENE	-
TRICHLOROETHENE	4 J
DIBROMOCHLOROMETHANE	-
1,1,2-TRICHLOROETHANE	-
BENZENE	-
trans-1,3-DICHLOROPROPENE	-
BROMOFORM	-
4-METHYL1-2-PENTANONE	-
2-HEXANONE	-
TETRACHLOROETHENE	-
1,1,2,2-TETRACHLOROETHANE	-
TOLUENE	-
CHLOROBENZENE	-
ETHYLBENZENE	-
STYRENE	-
XYLENE (total)	-
Total VOCs	35

B - QUALIFIER USED WHEN ANALYTE IS FOUND IN ASSOCIATED METHOD BLANK AS WELL AS IN SAMPLE. IT INDICATES POSSIBLE/PROBABLE CONTAMINATION.

J - QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. CONCENTRATION IS QUANTITATIVELY QUALIFIED AND FINAL RESULT REPORTED IS ESTIMATED.

R - DATA IS REJECTED DUE TO HOLDING TIME EXCEEDED, BLANK CONTAMINATION, INSTRUMENT CALIBRATION ERROR, OR OTHER MAJOR CONTROLLING LIMITS ARE EXCEEDED.

'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT.

APPENDIX A

SUMMARY OF SEMI-VOLATILE CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA34-01
SAMPLE DEPTH BELOW GRADE (INCHES):	0-6
BASE NEUTRAL / ACIDS (PPB)	
PHENOL	-
bis(2-CHLOROETHYL)ETHER	-
2-CHLOROPHENOL	-
1,3-DICHLOROBENZENE	-
1,4-DICHLORBENZENE	-
BENZYL ALCOHOL	-
1,2-DICHLOROBENZENE	-
2-METHYLPHENOL	-
bis(2-CHLOROISOPROPYL)ETHER	-
4-METHYLPHENOL	-
N-NITROSO-DI-N-PROPYLAMINE	-
HEXACHLOROETHANE	-
NITROBENZENE	-
ISOPHORONE	-
2-NITROPHENOL	-
2,4-DIMETHYLPHENOL	-
BENZOIC ACID	-
bis(2-CHLOROETHOXY)METHANE	-
2,4-DICHLOROPHENOL	-
1,2,4-TRICHLOROBENZENE	-
NAPHTHALENE	-
4-CHLOROANILINE	-
HEXACHLOROBUTADIENE	-
4-CHLORO-3-METHYLPHENOL	-
2-METHYLNAPHTHALENE	-
HEXACHLOROCYCLOPENTADIENE	-
2,4,6-TRICHLOROPHENOL	-
2,4,5-TRICHLOROPHENOL	-
2-CHLORONAPHTHALENE	-
2-NITROANILINE	-
DIMETHYLPHTHALATE	-
ACENAPHTHYLENE	-
2,6-DINITROTOLUENE	-

'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT.

APPENDIX A
SUMMARY OF SEMI-VOLATILE CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA34-01
SAMPLE DEPTH BELOW GRADE (INCHES):	0-6
BASE NEUTRAL / ACIDS (PPB) (continued)	
ACENAPHTHENE	-
1,4-DINITROPHENOL	-
4-NITROPHENOL	-
DIBENZOFURAN	-
2,4-DINITROTOLUENE	-
DIETHYLPHTHALATE	-
4-CHLOROPHENYL-PHENYLETHER	-
FLUORENE	-
4-NITROANILINE	-
4,6-DINITRO-2-METHYLPHENOL	-
N-NITROSODIPHENYLAMINE	-
4-BROMOPHENYL-PHENYLETHER	-
HEXACHLOROBENZENE	-
PENTACHLOROPHENOL	-
PHENANTHRENE	-
ANTHRACENE	-
DI-n-BUTYLPHALATE	210 JB
FLUORANTHENE	-
PYRENE	-
BUTYLBENZYLPHTHALATE	-
3,3'-DICHLOROBENZIDINE	-
BENZO(a)ANTHRACENE	-
CHRYSENE	-
bis(2-ETHYLHEXYL)PHTHALATE	85 J
DI-n-OCTYL PHTHALATE	-
BENZO(b)FLUORANTHENE	-
BENZO(k)FLUORANTHENE	-
BENZO(a)PYRENE	-
INDENO(1,2,3-cd)PYRENE	-
DIBENZO(A,H)ANTHRACENE	-
BENZO(g,h,i)PERYLENE	-
TOTAL caPAHs	0

B - QUALIFIER USED WHEN ANALYTE IS FOUND IN ASSOCIATED METHOD BLANK AS WELL AS IN SAMPLE. IT INDICATES POSSIBLE/PROBABLE CONTAMINATION.

J - QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. CONCENTRATION IS QUANTITATIVELY QUALIFIED AND FINAL RESULT REPORTED IS ESTIMATED.

'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT.

APPENDIX A

SUMMARY OF PESTICIDE/PCB CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA34-01
SAMPLE DEPTH BELOW GRADE (INCHES):	0-6
PESTICIDES/PCB'S (PPB)	
ALPHA-BHC	-
BETA-BHC	-
DELTA-BHC	-
GAMMA-BHC(LINDANE)	-
HEPTACHLOR	-
ALDRIN	-
HEPTACHLOR EPOXIDE	-
ENDOSULFAN I	-
DIELDRIN	-
4,4-DDE	-
ENDRIN	-
ENDOSULFAN II	-
4,4-DDD	-
ENDOSULFAN SULFATE	-
4,4-DDT	-
METHOXYCHLOR	-
ENDRIN KETONE	-
ALPHA-CHLORDANE	-
GAMMA-CHLORDANE	-
TOXAPHENE	-
AROCLOR-1016	-
AROCLOR-1221	-
AROCLOR-1232	-
AROCLOR-1242	-
AROCLOR-1248	1900
AROCLOR-1254	1500 J
AROCLOR-1260	-

J - QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. CONCENTRATION IS QUANTITATIVELY QUALIFIED AND FINAL RESULT REPORTED IS ESTIMATED.

'-' - NOT DETECTED TO THE REPORTED DETECTION LIMIT.

APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION: SAMPLE DEPTH BELOW GRADE (Inches)	RA01-01 0-6	RA02-01 0-6	RA03-01 0-6	RA04-01 0-6	RA05-01 0-6	RA06-01 0-6	RA07-01 0-6	RA08-01 0-6	RA09-01 0-6
INORGANICS (PPM)									
ALUMINUM	3080	3120	3760	3920	7260	1500	4130	3140	3230
ANTIMONY	–	–	–	–	–	–	–	–	–
ARSENIC	1.8 B	1.6 B	3.1	2.7	4.5	1 B	1.7 B	1.8	1.6 B
BARIUM	16.6 B	12.4 B	19.9 B	24.3 B	57.8	15.2 B	14.6 B	15.1 B	11.9 B
BERYLLIUM	–	–	–	–	1.4	–	–	0.27 B	0.72 B
CADMIUM	–	–	–	–	–	–	–	–	–
CALCIUM	121 B	66.2 B	210 B	186 B	750 B	431 B	166 B	826 B	394 B
CHROMIUM	2.1 B	2.6 B	5.1	12.2	29.7	36.2	54.7	11.6	5.7
CHROMIUM VI	–	–	–	–	–	–	–	–	–
COBALT	–	–	–	–	1.7 B	–	–	–	1.8 B
COPPER	17.2	6.1	39.5	19.7	8.6	5.5 B	2.8 B	4.0 B	5.1 B
IRON	5340	4080	7290	8010	10300	1790	3630	4050	6160
LEAD	15.1	11.3	49.2	93	76.4	49.4	8.7	20.3	10.4
MAGNESIUM	135 B	115 B	114 B	221 B	572 B	202 B	188 B	392 B	251 B
MANGANESE	68.4	41.3	24.1	37	26.6	102	54.8	214	49.3
MERCURY	–	0.52	0.24	0.23	0.27	0.52	0.29	0.45	0.11
NICKEL	–	–	3.9 B	7.5 B	26.9	9.0 B	2.4 B	5.9 B	6.7 B
POTASSIUM	–	–	–	–	516 B	–	294 B	218 B	262 B
SELENIUM	–	–	–	0.44 B	–	–	–	–	–
SILVER	–	–	–	–	–	–	–	–	–
SODIUM	29.8 B	43.4 B	42.4 B	50.6 B	171 B	36.9 B	42.9 B	73.8 B	82.1 B
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	6.2 B	5.4 B	12.7	38.8	203	36.4	20	34.5	124
ZINC	13.7	24.9	20.4	27.8	31.1	22.5	13.5	28.1	17.1
CYANIDE	–	–	–	–	–	–	–	–	–
BORON	–	–	–	–	–	–	–	–	–
NIOBIUM	–	–	–	–	–	–	–	–	–
STRONTIUM	–	–	–	–	–	–	–	–	–
TITANIUM	79.3	73.9	106	127	159	78.1	88.6	99.6	112
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

B – INDICATES REPORTED VALUE IS LESS THAN CRDL BUT GREATER THAN IDL.
N/A – NOT ANALYZED FOR THIS COMPOUND
'–' – NOT DETECTED TO REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMIT
IDL – INSTRUMENT DETECTION LIMIT

APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA10-01	RA11-01	RA12-01	RA13-01	RA14-01	RA15-01	RA16-01	RA17-01	RA18-01
SAMPLE DEPTH BELOW GRADE (Inches)	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6
INORGANICS (PPM)									
ALUMINUM	2410	2300	37400	7120	8720	1550	4940	4340	4950
ANTIMONY	–	–	–	–	–	–	–	–	–
ARSENIC	1.7 B	3.1	4	6.2	4.2 B	0.67 B	1.1 B	2.1	3.1 B
BARIUM	9.6 B	44.2 B	739	56.3 B	182	6.3 B	15.1 B	8.6 B	11.5 B
BERYLLIUM	0.17 B	2.1	60.1	6.8	12.8	–	0.89 B	0.40 B	0.39 B
CADMIUM	–	–	5.3	–	1.6	–	–	–	–
CALCIUM	164 B	1400 B	7320	3130	3670	90.7 B	923 B	127 B	106 B
CHROMIUM	38	45.1	5870	123	218	6.1	8.2	18.7	3.1
CHROMIUM VI	–	–	– I*	0.38 I*	– I*	–	–	0.12	0.33
COBALT	–	–	87.1	3.1 B	19.5	–	2.1 B	1.3 B	2.1 B
COPPER	2.0 B	5.5 B	887	17.6	33.6	1.1 B	3.0 B	1.4 B	1.5 B
IRON	2530	5750	32300	12000	9050	1890	7790	9230	13900
LEAD	11.3	40.8	760	319	257	3.5 B	9.8	6.4	8
MAGNESIUM	155 B	1720	4380	2980	3680	111 B	454 B	168 B	139 B
MANGANESE	62	71	1680	354	1110	36.8	106	21.7	19
MERCURY	0.26	–	0.51	0.44	0.17	–	–	–	–
NICKEL	3.7 B	17.8	3360	90.4	1290	3.8 B	15.7	5.1 B	6 B
POTASSIUM	208 B	480 B	1040 B	845 B	257 B	–	305 B	–	245 B
SELENIUM	–	–	–	–	0.51 B	–	–	–	–
SILVER	–	–	–	–	–	–	–	–	–
SODIUM	29.3 B	184 B	349 B	218 B	163 B	17.8 B	33.1 B	34.8 B	24.6 B
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	21.6	403	12100	1360	2560	24.2	131	34.4	20.8
ZINC	9.9	56.5	1310	87	355	4.3	14.3	18.4	6.1
CYANIDE	–	–	–	–	–	–	–	–	–
BORON	–	–	N/A	–	–	N/A	–	–	–
NIOBIUM	–	–	N/A	–	81.2	N/A	–	–	–
STRONTIUM	–	–	N/A	–	30.2	N/A	–	–	–
TITANIUM	70.3	51.5	N/A	197	197	N/A	103	57.8	61.8
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

B – INDICATES REPORTED VALUE IS LESS THAN CRDL BUT GREATER THAN IDL.
N/A – NOT ANALYZED FOR THIS COMPOUND
'–' – NOT DETECTED TO REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMIT
IDL – INSTRUMENT DETECTION LIMIT
* – INDICATES QUALIFIER PLACED BY TRC-ECI.
'I' – CHROMIUM +6 VALUE IS THE RESULT OF WATER LEACH METHOD

APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA19-01	RA20-01	RA21-01	RA22-01	RA23-01	RA24-01	RA25-01	RA26-01	RA27-01
SAMPLE DEPTH BELOW GRADE (Inches)	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6
INORGANICS (PPM)									
ALUMINUM	2430	1970	3430	3740	7950	2260	2710	4170	5360
ANTIMONY	–	–	–	–	–	–	–	–	–
ARSENIC	1.9 B	1.2 B	1.5 B	1.3 B	4.4	1.1 B	1.1 B	5	1.3
BARIUM	10.2 B	11.2 B	11.7 B	26.8 B	24.4 B	9.6 B	18.5 B	25.5 B	26.5 B
BERYLLIUM	–	–	0.95	3.3	8.9	–	0.46 B	1.8	2.3
CADMIUM	–	–	–	–	–	–	–	–	–
CALCIUM	594 B	996 B	616 B	1440	8650	402 B	828 B	563 B	574 B
CHROMIUM, TOTAL	6.6	3.8	8.9	51.4	102	7.6	8.1	16.3	57.6
CHROMIUM VI	–	–	–	0.30	0.96 I*	–	–	–	–
COBALT	–	–	1.3 B	2.1 B	2.9 B	–	–	3.6 B	3.4 B
COPPER	3.9 B	6.2	4.1 B	10.9	9.1	3 B	2.5 B	5.3	12.2
IRON	2860	2150	4400	4650	3890	2620	3570	12300	6620
LEAD	26.5 B	9.8	8.7	12	98.9	10.3	26.1	15 B	19.3 B
MAGNESIUM	111 B	150 B	1890	1090	14900	171 B	361 B	484 B	454 B
MANGANESE	42.9	47.4	39.3	408	100	77.9	123	164	591
MERCURY	0.09	0.41	–	–	–	0.12	0.14	–	–
NICKEL	–	–	8.3	91.5	189	3.5 B	9.1	29.9	42.1
POTASSIUM	–	–	316 B	180 B	388 B	–	–	223 B	577 B
SELENIUM	–	–	–	–	–	–	–	–	–
SILVER	–	–	–	–	–	–	–	2.2	–
SODIUM	37.4 B	36.6 B	150 B	434 B	264 B	23.6 B	23.8 B	189 B	59.6 B
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	14.4	11.5	175	654	1810	21.1	61.8	280	453
ZINC	24.3	26.9	25.9	28	96	21.4	18.8	79.4	30.5
CYANIDE	–	–	–	–	–	–	–	–	–
BORON	–	–	–	–	–	–	–	–	–
NIOBIUM	–	–	–	–	–	–	–	N/A	–
STRONTIUM	–	–	–	–	29.4	–	–	–	–
TITANIUM	65.3	51.9	96.6	128	101	61.5	94.4	121	142
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

B – INDICATES REPORTED VALUE IS LESS THAN CRDL BUT GREATER THAN IDL.
N/A – NOT ANALYZED FOR THIS COMPOUND
'–' – NOT DETECTED TO REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMIT
IDL – INSTRUMENT DETECTION LIMIT
* – INDICATES QUALIFIER PLACED BY TRC-ECI.
'I' – CHROMIUM +6 VALUE IS THE RESULT OF WATER LEACH METHOD

APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA28-01	RA29-01	RA30-01	RA31-01	RA32-01	RA33-01	RA34-01	RA35-01	RA36-01
SAMPLE DEPTH BELOW GRADE (Inches)	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6	0-6
INORGANICS (PPM)									
ALUMINUM	42900	7940	3710	4060	11000	13100	28700	3700	1660
ANTIMONY	–	–	–	5.9 B	13.8	–	–	–	6.2 B
ARSENIC	2.7	1.2 B	4.2	1.6 B	1.6 B	1.1 B	3.1	6.1	0.74 B
BARIUM	166	77.2	26.1 B	23.3 B	149	650	400	53.7	6.5 B
BERYLLIUM	22.5	6.3	2.1	0.68 B	1.9	7.1	11.9	1.8	0.30 B
CADMIUM	0.91	2.8	–	–	–	–	–	–	–
CALCIUM	49500	4960	639 B	231 B	8410	7050	71900	840 B	107 B
CHROMIUM	368	130	421	67.2	469	113	148	24.0	3.0
CHROMIUM VI	0.46 I*	0.82 I*	1.6 I*	–	2.7 I*	0.19 I*	–	–	–
COBALT	19	8.0 B	3.9 B	2.2 B	3.5 B	12.2	6.1 B	2.9 B	–
COPPER	47.5	21.9	6.4	2.8 B	10.8	8.5	16.3	4.5 B	1.2 B
IRON	27100	16500	8400	6060	9070	2460	5100	8530	2540
LEAD	43.2	80	25.6	11.4	46.0	34.4	142	91.7	2.9 B
MAGNESIUM	26000	4620	477 B	–	50500	8290	33800	1150	190 B
MANGANESE	2830	1540	701	332	241	269	543	242	37.5
MERCURY	–	–	–	–	–	–	–	–	–
NICKEL	1110	239	78	10.0	356	534	299	39.9	4.1 B
POTASSIUM	342 B	169 B	–	–	1110	305 B	741 B	–	–
SELENIUM	–	–	–	–	–	–	–	–	–
SILVER	–	–	–	–	–	–	–	–	–
SODIUM	217 B	171 B	69.1 B	159 B	629 B	618 B	1520	219 B	160 B
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	4750	1270	390	102	436	1510	2450	302	35.9
ZINC	110	148	29	110	41.6	28.9	209	476	10.0
CYANIDE	–	–	–	–	–	–	N/A	–	–
BORON	102	37.9	–	–	146	64.1	59.5	–	–
NIOBIUM	–	–	–	–	–	81.5	–	–	–
STRONTIUM	117	–	–	–	22.8	127	171	–	–
TITANIUM	941	416	151	119	154	204	256	158	55.2
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	101	N/A	N/A

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N/A – NOT ANALYZED FOR THIS COMPOUND
'–' – NOT DETECTED TO REPORTED DETECTION LIMIT
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APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA37-01	RA38-01	RA39-01	RA71-01	RA40-01	RA41-01	RA42-01	RA43-01	RA44-01
SAMPLE DEPTH BELOW GRADE (Inches)	0-6	0-6	0-6	DUPE RA39-01	0-6	0-6	0-6	0-6	0-6
INORGANICS (PPM)									
ALUMINUM	1180	2350	3510	4530	2020	1820	17900	66900	6480
ANTIMONY	7.0 B	–	7.3 B	–	–	–	–	–	8.8 B
ARSENIC	0.95 B	0.68 B	1.5 B	1.6 B	1.7 B	1.0 B	2.0 B	2.9 B	1.3 B
BARIUM	8.0 B	9.1 B	18.4 B	22.8 B	11.6 B	15.9 B	121	394	455
BERYLLIUM	0.36 B	0.37 B	0.38 B	0.39 B	0.34 B	5.5	13.0	26.6	4.3
CADMIUM	–	–	–	–	–	–	–	–	–
CALCIUM	111 B	198 B	257 B	243 B	219 B	612 B	13300	81800	8680
CHROMIUM	16.3	3.6	5.6	5.8	10.7	147	295	121	144
CHROMIUM VI	–	–	–	–	–	0.14 I*	0.34 I*	– I*	0.70 I*
COBALT	–	–	–	–	–	–	8.0 B	4.9 B	–
COPPER	2.8 B	1.3 B	1.5 B	2.9 B	3.3 B	5.1	73.7	21.9	36.5
IRON	1530	2260	4260	5300	2400	1760	25400	3120	3850
LEAD	11.2	4.4	4.9	5.7	16.8	11.2	41.4	203	556
MAGNESIUM	146 B	212 B	367 B	412 B	193 B	239 B	6650	42000	27600
MANGANESE	47.9	36.8	53.5	52.6	101	137	1060	370	890
MERCURY	–	–	–	–	–	–	–	0.11	–
NICKEL	4.2 B	3.9 B	5.5 B	4.8 B	5.6 B	32.7	326	306	65.5
POTASSIUM	–	–	–	–	–	–	–	–	2830
SELENIUM	–	–	–	0.52 B	–	–	–	–	–
SILVER	–	–	–	1.5 B	–	–	–	–	–
SODIUM	250 B	166 B	162 B	156 B	222 B	354 B	253 B	473 B	31300
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	65.3	43.6	39.7	36.2	47.7	715	1770	3780	551
ZINC	10.4	13.3	9.2	8.6	21.4	13.0	72.0	192	288
CYANIDE	–	–	–	–	–	–	–	0.52R*	–
BORON	–	–	–	–	–	–	–	69.5	65.3
NIOBIUM	–	–	–	–	–	–	69.7	104	845
STRONTIUM	–	–	–	–	–	–	26.5	139	68.5
TITANIUM	53.6	60.6	110	142	66.2	89.7	246	216	305
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION:	RA45-01	RA46-01	RA47-01	RA48-01	RA49-01	RA70-01	RA50-01	RA51-01	RA52-01
SAMPLE DEPTH BELOW GRADE (Inches)	0-6	0-6	0-6	0-6	0-6	DUPE RA49-01	0-6	0-6	0-6
INORGANICS (PPM)									
ALUMINUM	1420	1710	2220	1230	74300	60100	91300	1580	952
ANTIMONY	–	–	7.3 B	–	–	–	–	–	–
ARSENIC	1.5 B	2.1 B	1.8 B	0.93 B	3.1	2.6	3.1 B	1.5 B	0.79 B
BARIUM	11.3	7.1 B	7.7 B	4.3 B	248	177	683	10.9 B	9.3 B
BERYLLIUM	0.31 B	0.34 B	0.32 B	–	29.3	41.7	18.8	0.28 B	–
CADMIUM	–	–	–	–	–	–	–	–	–
CALCIUM	43.9 B	43.3 B	31.8 B	40.6 B	87100	70500	103000	73.0 B	58.3 B
CHROMIUM	7.3	9.1	6.1	5.4	114	201	176	12.5	2.4
CHROMIUM VI	–	–	–	–	– I*	–	– I*	–	–
COBALT	–	–	–	–	6.7 B	7.9 B	4.3 B	–	–
COPPER	2.0 B	2.5 B	1.8 B	2.4 B	14.7	49.5	14.3	2.6 B	1.7 B
IRON	3030	3610	3690	1430	3740	9480	4280	3480	1610
LEAD	10.4	19.8	52.0	7.2	74.2	66.0	96.7	8.2 B	4.6
MAGNESIUM	–	–	131 B	117 B	36400	26000	45800	181 B	107 B
MANGANESE	7.3	7.0	5.6	4.3	562	255	337	10	6.3
MERCURY	–	–	–	–	–	–	–	–	–
NICKEL	–	–	–	–	530	660	144	3.3 B	2.2 B
POTASSIUM	–	–	–	–	–	–	–	–	–
SELENIUM	–	–	–	0.47 B	–	–	–	0.42 B	–
SILVER	–	–	–	1.5 B	–	–	–	–	–
SODIUM	173 B	195 B	180 B	174 B	521 B	393 B	546 B	116 B	122 B
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	34.3	40.5	29.6	31.0	3990	5760	2660	36.0	15.0
ZINC	8.9	10.6	7.6	6.3	59.4	41.3	89.0	6.9	6.0
CYANIDE	-R*	-R*	-R*	-R*	0.615R*	–	–	–	–
BORON	–	–	–	–	104	239	208	–	–
NIOBIUM	–	–	–	–	52.1	–	52	–	–
STRONTIUM	–	–	–	–	118	101	228	–	–
TITANIUM	66.9	76.7	70.3	42.5	165	135	190	78.3	52.2
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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APPENDIX A
SUMMARY OF INORGANIC CONSTITUENTS DETECTED IN SURFACE SOIL SAMPLES

SAMPLE IDENTIFICATION: SAMPLE DEPTH BELOW GRADE (Inches)	RA53-01 0-6	RA54-01 0-6	RA55-01 0-6	RA56-01 0-6	RA57-01 0-6	RA58-01 6-12	RA72-01 DUPE RA58-01	RA58-02 42-48	RA59-01 6-12
INORGANICS (PPM)									
ALUMINUM	1500	1060	4770	6120	4350	4090	4720	4070	2820
ANTIMONY	6.5 B	5.9 B	5.2 B	–	–	–	6.1 B	–	4.7 B
ARSENIC	1.3 B	1.1 B	1.5 B	1.3 B	–	1.6 B	1.7 B	1.4 B	1.2 B
BARIUM	11.7 B	5.6 B	19.8 B	51.2	–	26.0 B	22 B	22 B	21.2 B
BERYLLIUM	0.27 B	0.33 B	0.60 B	1.8	–	0.5 B	.4 B	.23 B	–
CADMIUM	–	–	–	–	–	–	–	–	–
CALCIUM	38.4 B	39.1 B	556 B	1960	–	247 B	186 B	92.6 B	133 B
CHROMIUM	9.1	4.6	9.0	39.2	11.3	18.2	11.8	6.1	2.1 B
CHROMIUM VI	–	–	–	–	–	–	–	–	–
COBALT	–	–	2.3 B	4.0 B	–	2.7 B	1.9 B	1.9 B	–
COPPER	3.8 B	2.3 B	3.9 B	7.4	7.5	20.7	12.5	4.3 B	3.2 B
IRON	2830	2380	7680	7410	7500	8230	6560	4820	3630
LEAD	41.6	9.7 B	13.4	58.4	21.5	17.9 B	19.2	6.6	8.6
MAGNESIUM	136 B	111 B	411 B	989 B	148	251 B	238 B	151 B	164 B
MANGANESE	5.8	5.3	69.1	222	–	103	62.8	38.4	19.2
MERCURY	–	–	–	–	–	–	–	–	–
NICKEL	2.3 B	–	7.1 B	28.1	–	8.3	4.7 B	4.5 B	3.4 B
POTASSIUM	–	–	227 B	208 B	–	241 B	–	–	–
SELENIUM	0.51 B	–	–	–	–	–	–	–	0.49 B
SILVER	1.4 B	1.4 B	–	–	–	–	–	–	0.37 B
SODIUM	188 B	180 B	132 B	152 B	–	130 B	122 B	114 B	112 B
THALLIUM	–	–	–	–	–	–	–	–	–
VANADIUM	31.6	36.5	59.9	208	49.4	53.8	38.6	19.5	8.1 B
ZINC	10.7	6.2	155	335	112	18.1	7.4	7.6	16.7
CYANIDE	–R*	–R*	–	–	N/A	–	–	–	–
BORON	–	–	–	–	–	–	–	–	–
NIOBIUM	–	–	–	–	–	–	–	–	–
STRONTIUM	–	–	–	–	–	–	–	–	–
TITANIUM	70.9	61.9	125	150	142	123	116	91.6	59.1
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	–	–	–	–

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N/A – NOT ANALYZED FOR THIS COMPOUND
'–' – NOT DETECTED TO REPORTED DETECTION LIMIT
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* – INDICATES QUALIFIER PLACED BY TRC–ECI.

SAMPLE IDENTIFICATION: SAMPLE DEPTH BELOW GRADE (Inches)	RA59-02 42-46	RA60-01 0-6	RA60-02 42-48	RA64-01 0-6
INORGANICS (PPM)				
ALUMINUM	2890	1840	2520	4660
ANTIMONY	–	–	–	11.2 B
ARSENIC	1.1 B	1.2 B	1.9 B	69.8
BARIUM	8.9 B	17.7 B	17.5 B	370
BERYLLIUM	0.29 B	–	–	0.57 B
CADMIUM	–	–	–	1 B
CALCIUM	49.9 B	220 B	127 B	49300
CHROMIUM	–	1.6 B	1.5 B	801
CHROMIUM VI	–	–	–	201 I*
COBALT	1.6 B	–	1.5 B	4 B
COPPER	3.2 B	2.7 B	3.2 B	21.4
IRON	10700	3220	6620	10300
LEAD	3.8 B	6.7	7.8	101
MAGNESIUM	96.9 B	170 B	190 B	2250
MANGANESE	22.6	35.7	31.8	110
MERCURY	–	–	–	0.05
NICKEL	2.4 B	2.5 B	2.2 B	6.3 B
POTASSIUM	–	–	–	678 B
SELENIUM	–	–	–	4
SILVER	–	–	–	4.4
SODIUM	102 B	113 B	112 B	353 B
THALLIUM	–	–	–	–
VANADIUM	12.3	8.0 B	9.0 B	67
ZINC	12.3	15.2	10.4	248
CYANIDE	–	–	–	N/A
BORON	–	–	–	N/A
NIOBIUM	–	–	–	N/A
STRONTIUM	–	–	–	N/A
TITANIUM	62.3	49.3	78.6	N/A
ZIRCONIUM	–	–	–	N/A

B – INDICATES REPORTED VALUE IS LESS THAN CRDL BUT GREATER THAN IDL.
N/A – NOT ANALYZED FOR THIS COMPOUND
'–' – NOT DETECTED TO REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMIT
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APPENDIX A
SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL BORING SAMPLES (0–2 FEET)

SAMPLE IDENTIFICATION:	SB29–01	SB29–01	SB42–01	SB44–01	SB46–01	SB72–01
SAMPLE DEPTH BELOW GRADE (FT):	0–2	DUPE	0–2	0–2	0–2	0–2
VOLATILE ORGANICS (PPB)						
CHLOROMETHANE	–	–	–	–	–	–
BROMOMETHANE	–	–	–	–	–	–
VINLY CHLORIDE	–	–	–	–	–	–
CHLOROETHANE	–	–	–	–	–	–
METHYLENE CHLORIDE	43 BJ*	36 R*	34 BJ*	47 R*	30 R*	44 B
ACETONE	82 BJ*	73 BJ*	98 BJ*	3900 R*	23 BJ*	57 R*
CARBON DISULFIDE	–	–	–	3 J	–	–
1,1–DICHLOROETHENE	–	–	–	–	–	–
1,1–DICHLOROETHANE	–	–	–	–	–	–
1,2–DICHLOROETHENE (total)	–	–	–	2 J	–	–
CHLOROFORM	–	–	–	–	–	–
1,2–DICHLOROETHANE	–	–	–	–	–	–
2–BUTANONE	8 J	9 JB	–	–	–	–
1,1,1–TRICHLOROETHANE	–	–	–	–	–	–
CARBON TETRACHLORIDE	–	–	–	–	–	–
VINYL ACETATE	–	–	–	–	–	–
BROMODICHLOROMETHANE	–	–	–	–	–	–
1,2–DICHLOROPROPANE	–	–	–	–	–	–
cis–1,3–DICHLOROPROPENE	–	–	–	–	–	–
TRICHLOROETHENE	2 J	1 J	3 J	2 J	–	2 J
DIBROMOCHLOROMETHANE	–	–	–	–	–	–
1,1,2–TRICHLOROETHANE	–	–	–	–	–	–
BENZENE	–	–	–	150	–	–
trans–1,3–DICHLOROPROPENE	–	–	–	–	–	–
BROMOFORM	–	–	–	–	–	–
4–METHYL1–2–PENTANONE	–	–	–	–	–	–
2–HEXANONE	–	–	–	–	–	–
TETRACHLOROETHENE	–	–	3 J	3 J	–	3 J
1,1,2,2–TETRACHLOROETHANE	–	–	–	–	–	–
TOLUENE	–	–	2 J	7	–	2 J
CHLOROBENZENE	–	–	–	–	–	–
ETHYLBENZENE	–	–	–	58	–	–
STYRENE	–	–	–	–	–	–
XYLENE (total)	–	–	–	360	–	–
DIETHYL ETHER	–	–	–	–	–	–
TPH	N/A	N/A	4500	N/A	N/A	18000
TOTAL VOCs	135	83	140	585	23	51

B – ANALYTE IS FOUND IN THE ASSOCIATED METHOD BLANK AS WELL AS IN THE SAMPLE. IT INDICATES POSSIBLE / PROBABLE CONTAMINATION.

J – USED TO INDICATE AN ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS ESTIMATED.

N – QUALIFIER INDICATES THE CONCENTRATION FOUND IN THE SAMPLE IS LESS THAN THREE TIMES THE CONCENTRATION FOUND IN THE ASSOCIATED BLANKS. THE PRESENCE OF THE ANALYTE IS NEGATED DUE TO LABORATORY CONTAMINATION.

R – DATA IS REJECTED DUE TO HOLDING TIMES EXCEEDED, BLANK CONTAMINATION, INSTRUMENT CALIBRATION ERROR, OR OTHER MAJOR CONTROLLING LIMITS ARE EXCEEDED.

* – INDICATES QUALIFIER PLACED BY TRC–ECI.

N/A – NOT ANALYZED FOR THIS COMPOUND

'–' – NOT DETECTED TO THE REPORTED DETECTION LIMIT

TPH – TOTAL PETROLEUM HYDROCARBONS

APPENDIX A
SUMMARY OF SEMI-VOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL BORING SAMPLES (0-2 FEET)

SAMPLE IDENTIFICATION:	SB29-01	SB29-01	SB42-01	SB44-01	SB46-01	SB72-01
SAMPLE DEPTH BELOW GRADE (FT):	0-2	DUPE	0-2	0-2	0-2	0-2
BASE NEUTRAL / ACIDS (PPB)						
PHENOL	–	190 JB	–	46 J	–	–
bis(2-CHLOROETHYL)ETHER	–	–	–	–	–	–
2-CHLOROPHENOL	–	–	–	–	–	–
1,3-DICHLOROBENZENE	–	–	–	–	–	–
1,4-DICHLORBENZENE	–	–	–	–	–	–
BENZYL ALCOHOL	–	–	–	–	–	–
1,2-DICHLOROBENZENE	–	–	–	–	–	–
2-METHYLPHENOL	–	–	–	–	–	–
bis(2-CHLOROISOPROPYL)ETHER	–	–	–	–	–	–
4-METHYLPHENOL	–	–	–	–	–	–
N-NITROSO-DI-N-PROPYLAMINE	–	–	–	–	–	–
HEXACHLOROETHANE	–	–	–	–	–	–
NITROBENZENE	–	–	–	–	–	–
ISOPHORONE	–	–	–	–	–	–
2-NITROPHENOL	–	–	–	–	–	–
2,4-DIMETHYLPHENOL	–	–	–	–	–	–
BENZOIC ACID	–	59 J	150 J	88 J	–	–
bis(2-CHLOROETHOXY)METHANE	–	–	–	–	–	–
2,4-DICHLOROPHENOL	–	–	–	–	–	–
1,2,4-TRICHLOROBENZENE	–	–	–	–	–	–
NAPHTHALENE	–	–	–	130 J	–	–
4-CHLOROANILINE	–	–	–	–	–	–
HEXACHLOROBUTADIENE	–	–	–	–	–	–
4-CHLORO-3-METHYLPHENOL	–	–	–	–	–	–
2,4,6-TRICHLOROPHENOL	–	–	–	–	–	–
2,4,5-TRICHLOROPHENOL	–	–	–	–	–	–
2-CHLORONAPHTHALENE	–	–	–	–	–	–
2-NITROANILINE	–	–	–	–	–	–
DIMETHYLPHTHALATE	–	–	–	–	–	–
ACENAPHTHYLENE	–	–	–	–	–	–
2,6-DINITROTOLUENE	–	–	–	–	–	–
3-NITROANILINE	–	–	–	–	–	–
ACENAPHTHENE	–	–	–	–	–	–
2,4-DINITROPHENOL	–	–	–	–	–	–
4-NITROPHENOL	–	–	–	1000 J	–	–
DIBENZOFURAN	–	–	–	–	–	–
2,4-DINITROTOLUENE	–	–	–	110 J	–	–
DIETHYLPHTHALATE	–	–	–	–	–	–
4-CHLOROPHENYL-PHENYLETHER	–	–	–	–	–	–
FLUORENE	–	–	–	–	–	–
4-NITROANILINE	–	–	–	–	–	–
4,6-DINITRO-2-METHYLPHENOL	–	–	–	–	–	–
N-NITROSODIPHENYLAMINE	–	–	–	–	–	–
4-BROMOPHENYL-PHENYLETHER	–	–	–	–	–	–
HEXACHLOROBENZENE	–	–	–	–	–	–
PENTACHLOROPHENOL	130 J	140 J	–	790 J	110 J	–
PHENANTHRENE	–	–	–	130 J	45 J	77 J
ANTHRACENE	–	–	–	84 J	–	–
DI-N-BUTYLPHTHALATE	110 J	130 J	200 JB	300 JB	120 JB	–
FLUORANTHENE	44 J	40 J	–	290 J	71 J	110 J
PYRENE	50 J	42 J	–	350 JB	100 JB	140 JB
BUTYLBENZYLPHTHALATE	–	–	–	120 J	–	–
BENZO(a)ANTHRACENE	–	–	–	420	–	–
CHRYSENE	–	–	–	580	–	73 J
bis(2-ETHYLHEXYL)PHTHALATE	62 J	110 J	–	250 J	71 J	–
BENZO(b)FLUORANTHENE	–	–	–	350 J	–	47 J
BENZO(k)FLUORANTHENE	–	–	–	160 J	–	–
BENZO(a)PYRENE	–	–	–	740	–	–
INDENO(1,2,3-cd)PYRENE	–	–	–	380 J	–	–
BENZO(g,h,i)PERYLENE	–	–	–	1100	–	–
TOTAL caPAH	0	0	0	2630	0	120

B – QUALIFIER USED WHEN THE ANALYTE IS FOUND IN THE ASSOCIATED METHOD BLANK AS WELL AS IN THE SAMPLE. IT INDICATESPOSSIBLE / PROBABLE CONTAMINATION.

J – QUALIFIER USED TO INDICATE AN ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS AN ESTIMATE.

N – QUALIFIER INDICATES THE CONCENTRATION FOUND IN THE SAMPLE IS LESS THAN THREE TIMES THE CONCENTRATION FOUND IN THE ASSOCIATED BLANKS. THE PRESENCE OF THE ANALYTE IS NEGATED DUE TO LABORATORY CONTAMINATION.

R – DATA IS REJECTED DUE TO HOLDING TIMES EXCEEDED, BLANK CONTAMINATION, INSTRUMENT CALIBRATION ERROR, OR OTHER MAJOR CONTROLLING LIMITS ARE EXCEEDE

• – INDICATES QUALIFIER PLACED BY TRC-ECI.

N/A – NOT ANALYZED FOR THIS COMPOUND

'–' – NOT DETECTED TO THE REPORTED DETECTION LIMIT

APPENDIX A
SUMMARY OF PESTICIDE/PCBs
DETECTED IN SOIL BORING SAMPLES (0–2 FEET)

SAMPLE IDENTIFICATION:	SB20–01	SB30–01	SB31–01	SB32–01	SB33–01	SB34–01	SB35–01
SAMPLE DEPTH BELOW GRADE:	0–2	0–2	0–2	0–2	0–2	0–2	0–2
PESTICIDES/PCB'S (PPB)							
ALPHA–BHC	NA	NA	NA	NA	NA	NA	NA
BETA–BHC	NA	NA	NA	NA	NA	NA	NA
DELTA–BHC	NA	NA	NA	NA	NA	NA	NA
GAMMA–BHC (LINDANE)	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR	NA	NA	NA	NA	NA	NA	NA
ALDRIN	NA	NA	NA	NA	NA	NA	NA
HEPTACHLOR EPOXIDE	NA	NA	NA	NA	NA	NA	NA
ENDOSULFAN I	NA	NA	NA	NA	NA	NA	NA
DIELDRIN	NA	NA	NA	NA	NA	NA	NA
4,4–DDE	NA	NA	NA	NA	NA	NA	NA
ENDRIN	NA	NA	NA	NA	NA	NA	NA
ENDOSULFAN II	NA	NA	NA	NA	NA	NA	NA
4,4–DDD	NA	NA	NA	NA	NA	NA	NA
ENDOSULFAN SULFATE	NA	NA	NA	NA	NA	NA	NA
4,4–DDT	NA	NA	NA	NA	NA	NA	NA
METHOXYCHLOR	NA	NA	NA	NA	NA	NA	NA
ENDRIN KETONE	NA	NA	NA	NA	NA	NA	NA
ALPHA–CHLORDANE	NA	NA	NA	NA	NA	NA	NA
GAMMA–CHLORDANE	NA	NA	NA	NA	NA	NA	NA
TOXAPHENE	NA	NA	NA	NA	NA	NA	NA
AROCLOR–1016	–	–	–	–	–	–	–
AROCLOR–1221	–	–	–	–	–	–	–
AROCLOR–1232	–	–	–	–	–	–	–
AROCLOR–1242	–	–	–	–	–	–	–
AROCLOR–1248	–	–	–	–	–	–	–
AROCLOR–1254	–	–	13 J	130	16 J	–	–
AROCLOR–1260	22 J	–	–	–	–	–	–

J – ESTIMATED VALUE. THE CONCENTRATION IS QUANTITATIVELY QUALIFIED AND THE FINAL RESULT REPORTED IS AN ESTIMATE.

NA – NOT ANALYZED

'–' – NOT DETECTED TO THE REPORTED DETECTION LIMIT

APPENDIX A
SUMMARY OF COMPOUNDS DETECTED IN
SOIL BORING SAMPLES (0–2 feet)

SAMPLE IDENTIFICATION:	SB07-01	SB08-01	SB08-01	SB09-01	SB10-01	SB11-01	SB13-01	SB14-01	SB14-01	SB15-01
SAMPLE DEPTH BELOW GRADE (FT)	0–2	0–2	DUPE	0–2	0–2	0–2	0–2	0–2	DUPE	0–2
INORGANICS (PPM)										
SILVER, TOTAL	–	–	–	–	2 B	–	–	–	2.1	–
ALUMINUM, TOTAL	2090	5360	3220	4550	4360	6400	9000	2290	3140	5190
ARSENIC, TOTAL	–	1.4 B	0.87 B	0.7 B	0.78 B	0.71 B	1.5 B	1.1 B	0.75 B	1.7 B
BARIUM, TOTAL	9.1 B	13 B	18.4 B	19.4 B	14.7 B	27.9 B	110	6.9 B	6.4 B	39.6 B
BERYLLIUM, TOTAL	0.68 B	2.1	3.2	1.8	–	–	2	0.25 B	0.25 B	1 [illegible]
CALCIUM, TOTAL	65.7 B	4950	1270	95.5 B	84.8 B	129 B	2560	80.2 B	55.9 B	706 B
CADMIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
COBALT, TOTAL	–	–	1.7 B	1.7 B	1.5 B	–	4.7 B	–	–	2.5 B
CHROMIUM, TOTAL	3.3	30.8	27.7	178	3.9	5.2	32.4	2.3	1.1 B	29.7
CHROMIUM VI	0.15	–	–	22.6 +	–	–	–	–	–	–
COPPER, TOTAL	1.7 B	2.3 B	5.2	3.1 B	2.1 B	–	12.2	2.4 B	2.9 B	7.5
CYANIDE, TOTAL	–R*	–	–	–	–	–	–R*	–	–	–
IRON, TOTAL	2460	2200	5180	4440	4330	6000	8170	7400	10600	7030
MERCURY, TOTAL	–	–	–	–	–	–	–	–	–	–
POTASSIUM, TOTAL	235 B	–	–	655 B	291 B	–	230 B	–	–	325 B
MAGNESIUM, TOTAL	305 B	2440	1440	554 B	178 B	421 B	1090	134 B	134 B	654 B
MANGANESE, TOTAL	11	92.9	142	36.8	22.7	20.2	547	24.5	20.3	56.5
SODIUM, TOTAL	44.5	103 B	142 B	188 B	185 B	–	76.1 B	86.2 B	101 B	159 B
NICKEL, TOTAL	–	11.6	73.7	11	–	2.8 B	94.4	3 B	–	13.6
LEAD, TOTAL	3.5	9.3	14.9	3.4	4.5	5.6	2.04	4.8	3.2	14.8
ANTIMONY, TOTAL	–	–	–	–	–	–	–	–	–	–
SELENIUM, TOTAL	–	–	–	–	–	0.55 B	–	–	–	0.51 B
THALLIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
VANADIUM, TOTAL	128	435	472	324	10.2 B	7.4 B	417	19.2	9.1 B	139
ZINC, TOTAL	7.7	9.2	20.2	8.7	8.8	5.4	75	3.8 B	3.7 B	49.6
BORON	–	–	–	–	N/A	N/A	–	N/A	N/A	N/A
NIOBIUM	–	–	–	–	N/A	N/A	–	N/A	N/A	N/A
STRONTIUM	–	–	–	–	N/A	N/A	22.5	N/A	N/A	N/A
TITANIUM	85.2	85.2	94.5	121	N/A	N/A	200	N/A	N/A	N/A
ZIRCONIUM	N/A	–	–	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SULFATE	N/A	N/A	N/A	N/A	N/A	51.7	N/A	N/A	N/A	N/A

B – REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.
J – ANALYZED DURING THE TEN DAY HOLDING TIME BUFFER PERIOD.
R – QUALIFIER INDICATES THAT THE HOLDING TIME WAS EXCEEDED.
* – INDICATES QUALIFIER PLACED BY TRC–ECI.
+ – INDICATES Cr+6 DATA BY LEACH METHOD
N/A – NOT ANALYZED
'–' – PARAMETER WAS NOT DETECTED TO THE REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMITS.
IDL – INSTRUMENT DETECTION LIMIT.

APPENDIX A
SUMMARY OF COMPOUNDS DETECTED IN SOIL BORING SAMPLES (0–2 feet)

SAMPLE IDENTIFICATION:	SB17–01	SB18–01	SB19–01	SB20–01	SB21–01	SB22–01	SB23–01	SB23–01	SB25–01	SB25–01
SAMPLE DEPTH BELOW GRADE (FT)	0–2	0–2	DUPE	0–2	0–2	0–2	0–2	DUPE	0–2	DUPE
INORGANICS (PPM)										
SILVER, TOTAL	1.3 B	2.2	1.9 B	–	–	–	–	–	–	–
ALUMINUM, TOTAL	1720	7440	6750	7950	10400	6030	3050	6000	24400	2000
ARSENIC, TOTAL	1.6 B	1.3 B	1.5 B	4.7	1.2 B	1.1 B	0.57 B	0.65 B	–	0.51 B
BARIUM, TOTAL	8.1 B	37.3 B	113	152	71.8	44.4	21.5 B	16.5 B	86.7	4.7 B
BERYLLIUM, TOTAL	1	0.38 B	3.5	5.7	7.7	0.59 B	0.66 B	0.29 B	14	0.11 B
CALCIUM, TOTAL	297 B	81.6 B	4350	13100	7890	269 B	268 B	145 B	25000	37.6 B
CADMIUM, TOTAL	–	–	–	1.7	–	–	–	–	–	–
COBALT, TOTAL	–	1.9 B	2.4 B	9.7 B	10 B	2.6 B	–	1.45	–	–
CHROMIUM, TOTAL	11.5	7.2	29.3	143	162	32.7	31.4	51	48.9	1.2 B
CHROMIUM VI	–	0.27	–	0.15 +	0.84 +	0.66	3	–	–	–
COPPER, TOTAL	4.8 B	4.2 B	11.1	342	49.4	3.6 B	3 B	3.4 B	12.2	–
CYANIDE, TOTAL	–	–	–	–R*	–	–R*	–	–	–	–
IRON, TOTAL	2200	7620	8580	18900	15000	7610	7390	6700	3340	4520
MERCURY, TOTAL	0.08	–	–	–	–	–	0.09	–	0.12	0.1
POTASSIUM, TOTAL	220 B	1180	382 B	556 B	389 B	375 B	320 B	499 B	–	–
MAGNESIUM, TOTAL	1200	533 B	4210	4070	6330	840 B	547 B	672 B	10600	32.2 B
MANGANESE, TOTAL	62.3	24.2	342	1510	3150	85.7	62.4	31.2	49.1	6.8
SODIUM, TOTAL	223 B	479 B	264 B	206 B	195 B	332 B	284 B	295 B	–	–
NICKEL, TOTAL	13.4	3.8 B	64.2	322	463	11.4	12.5	6.3 B	210	–
LEAD, TOTAL	25.9	4.6	55.8	3.62	68.3	4.1	8.4 B	12.9	68.7	2.7
ANTIMONY, TOTAL	–	–	–	–	–	–	–	6.7 B	–	–
SELENIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
THALLIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
VANADIUM, TOTAL	153	24.8	517	1160	1810	82.9	93.8	27.2	2780	–
ZINC, TOTAL	25.5	5.7	53.7	59.6	286	23.7	9	5	20.4	3.9 B
BORON	N/A	N/A	N/A	–	N/A	–	N/A	N/A	N/A	N/A
NIOBIUM	N/A	N/A	N/A	–	N/A	–	N/A	N/A	N/A	N/A
STRONTIUM	N/A	N/A	N/A	110	N/A	–	N/A	N/A	N/A	N/A
TITANIUM	N/A	N/A	N/A	341	N/A	133	N/A	N/A	N/A	N/A
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SULFATE	N/A	N/A	N/A	N/A	N/A	55.7	N/A	N/A	N/A	N/A

B – REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.
J – ANALYZED DURING THE TEN DAY HOLDING TIME BUFFER PERIOD.
R – QUALIFIER INDICATES THAT THE HOLDING TIME WAS EXCEEDED.
* – INDICATES QUALIFIER PLACED BY TRC–ECI.
+ – INDICATES Cr+6 DATA BY LEACH METHOD
N/A – NOT ANALYZED
'–' – PARAMETER WAS NOT DETECTED TO THE REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMITS.
IDL – INSTRUMENT DETECTION LIMIT.

APPENDIX A
SUMMARY OF COMPOUNDS DETECTED IN SOIL BORING SAMPLES (0–2 feet)

SAMPLE IDENTIFICATION:	SB26–01	SB28–01	SB29–01	SB29–01	SB30–01	SB31–01	SB32–01	SB33–01	SB34–01	SB35–01
SAMPLE DEPTH BELOW GRADE (FT)	0–2	0–2	0–2	DUPE	0–2	0–2	0–2	0–2	0–2	0–2
INORGANICS (PPM)										
SILVER, TOTAL	–	–	–	1.5 B	–	–	–	2.3	–	–
ALUMINUM, TOTAL	6040	104000	8980	6390	6900	8620	3890	4910	4470	3040
ARSENIC, TOTAL	1.1 B	2.6 B	0.58 B	0.92 B	1 B	0.86 B	1.1 B	1.1 B	1.2 B	0.6 B
BARIUM, TOTAL	28.4 B	228	12.4 B	10.9 B	39.9 B	26.1 B	30.8 B	26.3 B	33.7 B	7.5 B
BERYLLIUM, TOTAL	0.25 B	19.2	0.59 B	0.41 B	1.4	0.68 B	7.8	1.1	–	0.24 B
CALCIUM, TOTAL	1830	115000	680 B	1370	1690	1670	1010 B	891 B	1250	1610
CADMIUM, TOTAL	–	–	–	–	0.92 B	–	–	–	–	–
COBALT, TOTAL	–	3.3 B	5.2 B	2 B	5.7 B	3.2 B	3.3 B	3.3 B	1.7 B	3.1 B
CHROMIUM, TOTAL	10.1	127	13	7.2	2280	783	1100	180	14.8	762
CHROMIUM VI	–	– +	N/A	N/A	1.3 +	0.64 +	0.79 +	– +	–	0.19 +
COPPER, TOTAL	1.5 B	33.6	7.5	6.9	10.8	6.7	13.1	5.1 B	3.1 B	2.6 B
CYANIDE, TOTAL	–	–	–	–	–	–	–	–	–	–
IRON, TOTAL	5410	1670	26400	11600	13400	10900	8210	8480	6770	7490
MERCURY, TOTAL	–	–	–	–	–	–	–	–	0.1	–
POTASSIUM, TOTAL	206 B	–	773 B	561 B	426 B	653 B	285 B	191 B	464 B	322 B
MAGNESIUM, TOTAL	754 B	43000	296 B	360 B	720 B	572 B	707 B	683 B	201 B	219 B
MANGANESE, TOTAL	25.3	113	120	107	1240	163	565	236	44.6	56.3
SODIUM, TOTAL	505 B	1020	26.3 B	102 B	96.1 B	101 B	268 B	187 B	152 B	56.1 B
NICKEL, TOTAL	2.0 B	469	5.1 B	4.5 B	24	7.4 B	108	36.4	–	–
LEAD, TOTAL	6	70.4	11.3	8.6	43	57.2	331	15.4	9.4	2.5
ANTIMONY, TOTAL	–	–	–	–	39.5	16.8	–	–	–	17.9
SELENIUM, TOTAL	–	5.1	–	–	–	–	–	–	–	–
THALLIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
VANADIUM, TOTAL	14.1	3630	48.9	28.7	282	109	1190	145	8.2 B	28.2
ZINC, TOTAL	9.7	49.1	10.8	5.8	75	30.5	243	14.2	11.4	6.7
BORON	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NIOBIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STRONTIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TITANIUM	N/A	N/A	160	113	N/A	N/A	N/A	N/A	N/A	N/A
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SULFATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

B – REPORTED VALUE IS LESS THAN THE CRDL BUT GREATER THAN THE IDL.
J – ANALYZED DURING THE TEN DAY HOLDING TIME BUFFER PERIOD.
R – QUALIFIER INDICATES THAT THE HOLDING TIME WAS EXCEEDED.
* – INDICATES QUALIFIER PLACED BY TRC–ECI.
+ – INDICATES Cr+6 DATA BY LEACH METHOD
N/A – NOT ANALYZED
'–' – PARAMETER WAS NOT DETECTED TO THE REPORTED DETECTION LIMIT
CRDL – CONTRACT REQUIRED DETECTION LIMITS.
IDL – INSTRUMENT DETECTION LIMIT.

APPENDIX A
SUMMARY OF COMPOUNDS DETECTED IN
SOIL BORING SAMPLES (0–2 feet)

SAMPLE IDENTIFICATION:	SB36–01	SB37–01	SB38–01	SB39–01	SB43–01	SB44–01	SB46–01	SB47–01	SB48–01	SB49–01
SAMPLE DEPTH BELOW GRADE (FT)	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2
INORGANICS (PPM)										
SILVER, TOTAL	–	–	–	–	3.3	–	–	–	–	–
ALUMINUM, TOTAL	5290	5660	3550	1990	4010	6760	1770	7060	10900	3140
ARSENIC, TOTAL	1.2 B	0.76 B	0.65 B	0.53 B	43.1	1.7 B	1 B	4	2.5	0.97 B
BARIUM, TOTAL	99.6	8.3 B	9.2 B	16.7 B	123	15.8 B	8.7 B	59.9	39.6 B	44.2
BERYLLIUM, TOTAL	6.3	2.7	–	1.6	0.91 B	6.6	1.6	20	0.46 B	3.6
CALCIUM, TOTAL	4790	1310	222 B	341 B	1740	2340	1710	8460	384 B	266 B
CADMIUM, TOTAL	0.92 B	–	–	–	1.6	–	–	1.5	–	–
COBALT, TOTAL	3.7 B	2.5 B	1.7 B	2.2 B	32.6	5 B	–	9.5 B	4.5 B	3 B
CHROMIUM, TOTAL	1630	32.7	17.4	101	260	97.5	6.6	87.3	7.6	7.1
CHROMIUM VI	5.6 +	0.18	–	0.22 +	N/A +	N/A	N/A	N/A	N/A	0.32
COPPER, TOTAL	10.6	4.1 B	2.5 B	3.4 B	121	4.4 B	2.3 B	32.2	5.3 B	3.6 B
CYANIDE, TOTAL	–	–	–	–R*	0.7	–R*	–R*	–R*	–	–
IRON, TOTAL	5010	8020	5250	3840	31100	21000	2610	9810	13800	6320
MERCURY, TOTAL	0.1	–	–	–	0.11	–	–	–	–	–
POTASSIUM, TOTAL	422 B	301 B	–	–	248 B	467 B	213 B	–	493 B	235 B
MAGNESIUM, TOTAL	2180	548 B	275 B	254 B	639 B	1130	844 B	3510	1010 B	496 B
MANGANESE, TOTAL	158	33.7	37.5	192	2380	612	22	1810	72	70.6
SODIUM, TOTAL	137 B	66.5 B	32.2 B	30.2 B	192 B	66.3 B	35.4 B	410 B	64.2 B	214 B
NICKEL, TOTAL	116	–	–	25.4	41.9	5.9 B	19	339	4.2 B	11.3
LEAD, TOTAL	20.6	12.4 B	4.6	5.5	105	9 B	2.3	7.2	4.2	6.6
ANTIMONY, TOTAL	19.6	–	–	–	–	–	–	–	–	–
SELENIUM, TOTAL	2	0.47 B	–	–	0.75 B	–	–	0.42 B	0.65 B	–
THALLIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
VANADIUM, TOTAL	1250	594	13.4	328	176	1280	308	4110	35.5	826
ZINC, TOTAL	117	7.6	4.9	40.1	159	13.7	6	266	18.7	8.5
BORON	N/A	N/A	N/A	–	N/A	N/A	N/A	–	N/A	N/A
NIOBIUM	N/A	N/A	N/A	–	N/A	N/A	N/A	–	N/A	N/A
STRONTIUM	N/A	N/A	N/A	–	N/A	N/A	N/A	46.4	N/A	N/A
TITANIUM	N/A	N/A	N/A	102	N/A	156	61.6	219	N/A	N/A
ZIRCONIUM	N/A	N/A	N/A	–	N/A	N/A	N/A	N/A	N/A	N/A
SULFATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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APPENDIX A
SUMMARY OF COMPOUNDS DETECTED IN SOIL BORING SAMPLES (0–2 feet)

SAMPLE IDENTIFICATION:	SB50–01	SB51–01	SB52–01	SB53–01	SB54–01	SB55–01	SB56–01	SB57–01	SB61–01	SB62–01
SAMPLE DEPTH BELOW GRADE (FT)	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2
INORGANICS (PPM)										
SILVER, TOTAL	–	–	–	–	–	–	–	–	–	–
ALUMINUM, TOTAL	4480	4010	19600	3570	15000	8610	3650	8420	5250	3940
ARSENIC, TOTAL	1.2B	1.2B	1.5B	0.88B	0.6B	0.74B	1.4B	1.1B	0.83B	0.42B
BARIUM, TOTAL	15.5B	14.9B	119	160	178	36.2B	53.2	128	22.9B	12.9B
BERYLLIUM, TOTAL	4.2	2.1	3.8	7.6	2.2	3.5	18.4	4.1	0.31B	0.42B
CALCIUM, TOTAL	372B	149B	21500	1180	11700	1890	1050B	5430	84.3B	94.9B
CADMIUM, TOTAL	–	–	–	–	–	1.2	–	–	–	–
COBALT, TOTAL	6.1B	2.4B	1.4B	10.3	6.3B	8.2B	12.4	3.4B	3.3B	1.5B
CHROMIUM, TOTAL	6.4	5.8	206	473	334	158	67.6	61.8	33	50.7
CHROMIUM VI	0.58	0.35	0.38 +	1.3 +	4.8 +	0.89 +	0.34	0.43	–	–
COPPER, TOTAL	3.3B	3B	6.1	9.9	7.1	91.3	15.1	9.9	4.9B	1.9B
CYANIDE, TOTAL	–	–	–	–	–	–R*	–	–	–	–
IRON, TOTAL	8610	5570	3380	4140	2300	23200	6960	6210	12000	7270
MERCURY, TOTAL	–	–	–	–	–	–	0.09	–	–	–
POTASSIUM, TOTAL	253B	839B	–	–	–	–	–	–	405B	–
MAGNESIUM, TOTAL	528B	504B	9260	2060	5580	1460	3320	3260	271B	155B
MANGANESE, TOTAL	26.1	55	128	233	150	371	627	129	78.9	48.4
SODIUM, TOTAL	110B	56.3B	892B	557B	1030B	188B	174B	153B	210B	–
NICKEL, TOTAL	221	3.8B	43.3	275	677	176	912	345	10.9	–
LEAD, TOTAL	4.4B	21B	30.8	34.8	40.5	9B	46.1	49.1	10.7	6.4
ANTIMONY, TOTAL	–	–	–	–	–	–	–	–	–	–
SELENIUM, TOTAL	0.53B	–	–	–	–	–	–	–	–	–
THALLIUM, TOTAL	–	–	–	–	–	–	–	–	–	–
VANADIUM, TOTAL	928	488	742	1510	433	671	3950	802	29.4	55.4
ZINC, TOTAL	16.3	7.4	28.9	30.6	48.3	48.9	50.9	33.3	17.3	11.2
BORON	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NIOBIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STRONTIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TITANIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SULFATE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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APPENDIX A
SUMMARY OF COMPOUNDS DETECTED IN
SOIL BORING SAMPLES (0–2 feet)

SAMPLE IDENTIFICATION:	SB63–01	SB64–01	SB77–01	SB78–01	SB79–01	SB80–01	SB81–01	SB82–01	SB83–01
SAMPLE DEPTH BELOW GRADE (FT)	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2	0–2
INORGANICS (PPM)									
SILVER, TOTAL	–	–	–	–	–	–	–	–	–
ALUMINUM, TOTAL	2440	5070	17100	4080	6320	6970	4580	3320	4660
ARSENIC, TOTAL	0.66 B	–	0.96 B	1.3 B	–	0.66 B	1.3 B	1.5 B	1.4 B
BARIUM, TOTAL	17.5 B	15.5 B	138	74.5	29.0 B	102	216	15.4 B	29.9 B
BERYLLIUM, TOTAL	0.3 B	0.35 B	8.3	0.38 B	1.4	6	2.8	0.32 B	0.51 B
CALCIUM, TOTAL	597 B	86.6 B	10300	295	315 B	785 B	1190	235 B	618 B
CADMIUM, TOTAL	–	–	–	–	0.62	–	–	–	–
COBALT, TOTAL	–	2.2 B	5 B	–	2.7 B	9.3 B	4.5 B	–	2 B
CHROMIUM, TOTAL	17	2.3	135	16.1	49.3	86.2	211	10.9	35.5
CHROMIUM VI	–	–	0.48 +	0.37	0.48	–	0.17 +	–	–
COPPER, TOTAL	3.8 B	1.8 B	14.1	3.7 B	3.4 B	8.7	13	2.5 B	5.4
CYANIDE, TOTAL	–	–	–	–	–	–	–	–	–
IRON, TOTAL	2780	11500	14400	4540	8160	10300	7590	3720	8300
MERCURY, TOTAL	–	–	–	0.14	0.04	0.07	–	–	–
POTASSIUM, TOTAL	318 B	–	1240	620 B	1000	283 B	335 B	349 B	307 B
MAGNESIUM, TOTAL	252 B	226 B	9590	2080	399 B	3210	1180	311 B	415 B
MANGANESE, TOTAL	133	30.3	1480	47.9	26.2	299	557	51.1	118
SODIUM, TOTAL	38.6	–	5400	315 B	772 B	129 B	292 B	75.3 B	59.8 B
NICKEL, TOTAL	6.2 B	3.7 B	115	7.7 B	4.0 B	617	176	5.4 B	11.7
LEAD, TOTAL	12.8	4.3	124	63.2	23.6	102	165	13	14.7
ANTIMONY, TOTAL	–	–	–	5.7 B	–	–	–	6.5 B	–
SELENIUM, TOTAL	–	0.42 B	1.1	–	–	–	–	–	–
THALLIUM, TOTAL	–	–	–	–	–	–	–	–	–
VANADIUM, TOTAL	54.1	29.5	1760	52.8	209	1120	612	68.3	91.2
ZINC, TOTAL	17.2	3.8 B	72.8	37.5	9.3	95.2	48	9.6	21
BORON	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NIOBIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
STRONTIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TITANIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ZIRCONIUM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SULFATE	N/A	N/A	–	N/A	N/A	N/A	N/A	N/A	N/A

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APPENDIX B

COMPLETE SPECIES LIST

APPENDIX B

PLANT SPECIES LIST

Common Name	Scientific Name
Herbs	
Cattail	*Typha latifolia*
Giant Reed	*Phragmites australis*
Sensitive Fern	*Onoclea sensibilis*
Cinnamon Fern	*Osmunda cinnamomea*
Soft Rush	*Juncus effusus*
Japanese Knotweed	*Polygonum cuspidatum*
Sphagnum Moss	*Sphagnum spp.*
Poison Ivy	*Rhus radicans*
Jewel Weed	*Impatiens capensis*
Common Elder	*Sambucus canadensis*
Duckweed	*Lemna spp.*
Marsh Marigold	*Caltha palustris*
Goldenrod	*Salidago spp.*
Bracken Fern	*Pteridium aquilinum*
Crows Foot Club Moss	*Lycopodium*
Shrubs	
Swamp Magnolia	*Magnolia virginiana*
Sweet Pepperbush	*Clethra alnifolia*
Blueberry	*Vaccinium spp.*
Mountain Laurel	*Kalmia latifolia*
Greenbrier	*Smilax spp.*
Multiflora Rose	*Rosa multiflora*
Honeysuckle	*Lonicera spp.*
Bear Oak	*Quercus ilicifolia*
Holly	*Ilex opaca*
Staghorn Sumac	*Rhus typhina*
Trees	
Black Tupelo	*Nyssa sylvatica*
Red Maple	*Acer rubrum*
Atlantic Eastern Red Cedar	*Juniperus virginiana*
Atlantic White Cedar	*Chamaecyparis thyoides*
Willow	*Salix spp.*
White Oak	*Quercus alba*
Northern Red Oak	*Quercus rubra*
Pitch Pine	*Pinus rigida*
Box Elder	*Acer negundo*
Black Cherry	*Prunus serotina*
Bigtooth Aspen	*Populus grandidentata*
Sassafras	*Sassafras albidum*
Flowering Dogwood	*Cornus florida*
Norway Maple	*Acer platanoides*
Black Locust	*Robinia pseudoacacia*

APPENDIX C

ENDANGERED SPECIES DATABASE SEARCH

State of New Jersey
Department of Environmental Protection and Energy
Division of Parks and Forestry
Office of Natural Lands Management
CN 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

Robert C. Shinn, Jr.
Commissioner

Thomas F. Hampton
Administrator

April 19, 1994

Sean Hayden
TRC Environmental Corporation
5 Waterside Crossing
Windsor, Ct 06095

Re: Shieldalloy Metallurgical Corp.

Dear Mr. Hayden:

Thank you for your data request regarding rare species information for the above referenced project site in the City of Millville, Cumberland County.

The Natural Heritage Data Base has records for *Carex barrattii*, *Coreopsis rosea*, *Eupatorium resinosum* and *Helonias bullata* occurrences which may have been collected on or within the immediate vicinity of the project site. If suitable habitat is present, these species may be found on the site. A survey would be needed to determine if these species are present on the site. The attached list provides additional information about these occurrences.

Also attached are lists of rare species and natural communities which have been documented from Cumberland and Gloucester Counties. If suitable habitat is present at the project site, these species would have potential to be present. If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend you contact the Division of Fish, Game and Wildlife; Endangered and Nongame Species Program.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Thomas F. Breden
Coordinator/Ecologist
Natural Heritage Program

cc: Larry Niles
Thomas Hampton
NHP File No. 94-3907531

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NATURAL LANDS MANAGEMENT

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the data base. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEPE Land Use Regulation Program, CN 401, Trenton, NJ 08625-0401.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

18 APR 1994

ON OR IN THE IMMEDIATE VICINITY OF PROJECT SITE
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK	DATE OBSERVED	IDENT.	LOCATION
*** Vascular plants									
CAREX BARRATTII	BARRATT'S SEDGE	3C		LP	G4	S4	1873-05-??	Y	NEWFIELD.
COREOPSIS ROSEA	PINK TICKSEED			LP	G3	S2	1899-08-??	Y	NEWFIELD.
EUPATORIUM RESINOSUM	PINE BARREN BONESET	C2	E	LP	G2	S2	1899-08	Y	NEWFIELD.
HELONIAS BULLATA	SWAMP-PINK	LT	E	LP	G3	S3	1902-04-??	Y	NEWFIELD BOG.

4 Records Processed

EXPLANATIONS OF CODES USED IN NATURAL HERITAGE REPORTS

FEDERAL STATUS CODES

The following U.S. Fish and Wildlife Service categories and their definitions of endangered and threatened plants and animals have been modified from the U.S. Fish and Wildlife Service (F.R. Vol. 50 No. 188; Vol. 55, No. 35; F.R. 50 CFR 17.11 and 17.12). Federal Status codes reported for species follow the most recent listing.

LE Taxa formally listed as endangered.

LT Taxa formally listed as threatened.

PE Taxa already proposed to be formally listed as endangered.

PT Taxa already proposed to be formally listed as threatened.

C1 Taxa for which the Service currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.

C1* Taxa which may be possibly extinct (although persuasive documentation of extinction has not been made--compare to 3A status).

C2 Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules.

C3 Taxa that are no longer being considered for listing as threatened or endangered species. Such taxa are further coded to indicate three subcategories, depending on the reason(s) for removal from consideration.

3A Taxa for which the Service has persuasive evidence of extinction.

3B Names that, on the basis of current taxonomic understanding, do not represent taxa meeting the Act's definition of "species".

3C Taxa that have proven to be more abundant or widespread than was previously believed

and/or those that are not subject to any identifiable threat.

S/A Similarity of appearance species.

STATE STATUS CODES

Two animal lists provide state status codes after the Endangered and Nongame Species Conservation Act of 1973 (NSSA 23:2A-13 et. seq.): the list of endangered species (N.J.A.C. 7:25-4.13) and the list defining status of indigenous, nongame wildlife species of New Jersey (N.J.A.C. 7:25-4.17(a)). The status of animal species is determined by the Nongame and Endangered Species Program (ENSP). The state status codes and definitions provided reflect the most recent lists that were revised in the New Jersey Register, Monday, June 3, 1991.

D Declining species-a species which has exhibited a continued decline in population numbers over the years.

E Endangered species-an endangered species is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow.

EX Extirpated species-a species that formerly occurred in New Jersey, but is not now known to exist within the state.

I Introduced species-a species not native to New Jersey that could not have established itself here without the assistance of man.

INC Increasing species-a species whose population has exhibited a significant increase, beyond the normal range of its life cycle, over a long term period.

T Threatened species-a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate.

P Peripheral species-a species whose occurrence in New Jersey is at the extreme edge of its present natural range.

S Stable species-a species whose population is not undergoing any long-term increase/decrease within its natural cycle.

U Undetermined species-a species about which there is not enough information available to determine the status.

Status for animals separated by a slash(/) indicate a duel status. First status refers to the state breeding population, and the second status refers to the migratory or winter population.

Plant taxa listed as endangered are from New Jersey's official Endangered Plant Species List N.J.S.A. 131B-15.151 et seq.

E Native New Jersey plant species whose survival in the State or nation is in jeopardy.

REGIONAL STATUS CODES FOR PLANTS

LP Indicates taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program. A complete list of endangered and threatened Pineland species is included in the New Jersey Pinelands Comprehensive Management Plan.

EXPLANATION OF GLOBAL AND STATE ELEMENT RANKS

The Nature Conservancy has developed a ranking system for use in identifying elements (rare species and natural communities) of natural diversity most endangered with extinction. Each element is ranked according to its global, national, and state (or subnational in other countries) rarity. These ranks are used to prioritize conservation work so that the most endangered elements receive attention first. Definitions for element ranks are after The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3).

GLOBAL ELEMENT RANKS

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout it's range; with the number of occurrences in the range of 21 to 100.

G4 Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU Possibly in peril range-wide but status uncertain; more information needed.

GX Believed to be extinct throughout range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? Species has not yet been ranked.

STATE ELEMENT RANKS

S1 Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical

area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.

S2 Imperiled in New Jersey because of rarity (6 to 20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.

S3 Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.

S4 Apparently secure in state, with many occurrences.

S5 Demonstrably secure in state and essentially ineradicable under present conditions.

SA Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded; examples include european strays or western birds on the East Coast and visa-versa.

SE Elements that are clearly exotic in New Jersey including those taxa not native to North America (introduced taxa) or taxa deliberately or accidentally introduced into the State from other parts of North America (adventive taxa). Taxa ranked SE are not a conservation priority (viable introduced occurrences of G1 or G2 elements may be exceptions).

SH Elements of historical occurrence in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work.

SN Regularly occurring, usually migratory and typically nonbreeding species for which no significant or effective habitat conservation measures can be taken in the state; this category includes migratory birds, bats, sea turtles, and cetaceans which do not breed in the state but pass through twice a year or may remain in the winter (or, in a few cases, the summer); included also are certain lepidoptera which regularly migrate to a state where they reproduce, but then completely die out every year with no return migration. Species in this category are so widely and unreliably distributed during migration or in winter that no small set of sites could be set aside with the hope of significantly furthering their conservation. Other nonbreeding, high globally-ranked species (such as the bald eagle, whooping crane or some seal species) which regularly spend some portion of the year at definite localities (and therefore have a valid conservation need in the state) are not ranked SN but rather S1, S2, etc.

SR Elements reported from New Jersey, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. In some instances documentation may exist, but as of yet, its source or location has not been determined.

SRF Elements erroneously reported from New Jersey, but this error persists in the literature.

SU Elements believed to be in peril but the degree of rarity uncertain. Also included are rare taxa of uncertain taxonomical standing. More information is needed to resolve rank.

SX Elements that have been determined or are presumed to be extirpated from New Jersey. All historical occurrences have been searched and a reasonable search of potential habitat has been completed. Extirpated taxa are not a current conservation priority.

SXC Elements presumed extirpated from New Jersey, but native populations collected from the wild exist in cultivation.

T Element ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species. For example *Stachys palustris* var. *homotricha* is ranked "G5T? SH" meaning the full species is globally secure but the global rarity of the var. *homotricha* has not been determined; in New Jersey the variety is ranked historic.

Q Elements containing a "Q" in the global portion of its rank indicates that the taxon is of questionable, or uncertain taxonomical standing, e.g., some authors regard it as a full species, while others treat it at the subspecific level.

.1 Elements documented from a single location.

Note: To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).

IDENTIFICATION CODES

These codes refer to whether the identification of the species or community has been checked by a reliable individual and is indicative of significant habitat.

Y	Identification has been verified and is indicative of significant habitat.
BLANK	Identification has not been verified but there is no reason to believe it is not indicative of significant habitat.
?	Either it has not been determined if the record is indicative of significant habitat or the identification of the species or community may be confusing or disputed.

Revised September 1991

FEB 1994

GLOUCESTER COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

	NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
* Vertebrates							
	AMBYSTOMA TIGRINUM	TIGER SALAMANDER		E		G5	S2
	AMMODRAMUS HENSLOWII	HENSLOW'S SPARROW	C2	E		G4	S1
	ARDEA HERODIAS	GREAT BLUE HERON		T/S		G5	S2
	BARTRAMIA LONGICAUDA	UPLAND SANDPIPER		E		G5	S1
	BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2
	CLEMMYS INSCULPTA	WOOD TURTLE		T		G4	S3
	CLEMMYS MUHLENBERGII	BOG TURTLE	C2	E		G3	S2
	FALCO PEREGRINUS	PEREGRINE FALCON	E/SA	E		G3	S1
	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	LELT	E		G4	S1
	HYLA ANDERSONII	PINE BARRENS TREEFROG	3C	E		G4	S3
	PITUOPHIS MELANOLEUCUS	PINE SNAKE		T		G5	S3
	POOECETES GRAMINEUS	VESPER SPARROW		E		G5	S2
	STRIX VARIA	BARRED OWL		T/T		G5	S3
* Ecosystems							
	FRESHWATER TIDAL MARSH COMPLEX	FRESHWATER TIDAL MARSH COMPLEX				G4?	S3?
* Invertebrates							
	CATOCALA PRETIOSA PRETIOSA	A PRECIOUS UNDERWING	C2			G4T2T3	S2S3
	CELITHEMIS MARTHA	MARTHA'S PENNANT				G4	S3S4
	ENALLAGMA PICTUM	SCARLET BLUET				G4	S3?
	LIBELLULA AURIPENNIS	GOLDEN-WINGED SKIMMER				G5	S1?
	LIGUMIA NASUTA	EASTERN PONDMUSSEL				G4	SH
	NICROPHORUS AMERICANUS	AMERICAN BURYING BEETLE	LE	E		G1	SH

* Other types

FEB 1994

GLOUCESTER COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
BALD EAGLE WINTERING SITE	BALD EAGLE WINTERING SITE				G?	S?
* Vascular plants						
AESCHYNOMENE VIRGINICA	SENSITIVE JOINT-VETCH	LT	E	LP	G2	S1
AGASTACHE NEPETOIDES	YELLOW GIANT HYSSOP				G5	S2
AMIANTHIUM MUSCITOXICUM	FLY POISON				G4G5	S2
ANEMONE CANADENSIS	CANADA ANEMONE				G5	SX
APLECTRUM HYEMALE	PUTTYROOT		E		G5	S1
ASCLEPIAS RUBRA	RED MILKWEED			LP	G4G5	S2
ASIMINA TRILOBA	PAWPAW		E		G5	S1
ASTER RADULA	LOW ROUGH ASTER		E		G5	S1
BIDENS BIDENTOIDES	BUR-MARIGOLD	C23C			G3	S2
CACALIA ATRIPLICIFOLIA	PALE INDIAN PLANTAIN		E		G4G5	S1
CALLITRICHE VERNA	SPRING WATER STARWORT				G5	S2
CARDAMINE LONGII	LONG'S BITTER CRESS	3C	E		G3G4Q	SH
CAREX BARRATTII	BARRATT'S SEDGE	3C		LP	G4	S4
CAREX FRANKII	FRANK'S SEDGE				G5	S2
CAREX LIMOSA	MUD SEDGE		E		G5	S1
CAREX POLYMORPHA	VARIABLE SEDGE	C2	E		G2	S1
CAREX ROSTRATA	BEAKED SEDGE				G5	S2
CASTANEA PUMILA	ALLEGHENY CHINQUAPIN		E		G5	S1
CORALLORRHIZA WISTERIANA	SPRING CORAL-ROOT				G5	SX.1
COREOPSIS ROSEA	PINK TICKSEED			LP	G3	S2
CROTONOPSIS ELLIPTICA	ELLIPTICAL RUSHFOIL			LP	G5	S2
CYPERUS ENGELMANNII	ENGELMANN'S FLATSEDGE		E		G4Q	S2
CYPERUS LANCASTRIENSIS	LANCASTER FLATSEDGE		E		G5	S2
CYPERUS RETROFRACTUS	ROUGH FLATSEDGE		E		G5	SH

FEB 1994

GLOUCESTER COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

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DALIBARDA REPENS	ROBIN-RUN-AWAY		E		G5	SH.1
DESMODIUM LAEVIGATUM	SMOOTH TICK-TREFOIL				G5	S3
DESMODIUM STRICTUM	PINELAND TICK-TREFOIL			LP	G4	S2
DRABA REPTANS	CAROLINA WHITLOW-GRASS		E		G5	SH
ELEOCHARIS EQUISETOIDES	KNOTTED SPIKERUSH		E	LP	G4	SH
ELEOCHARIS TORTILIS	TWISTED SPIKERUSH		E		G5	S1
ELEPHANTOPUS CAROLINIANUS	ELEPHANT'S FOOT		E		G5	SH
ERIOCAULON PARKERI	PARKER'S PIPEWORT	3C			G3	S2
ERIOPHORUM GRACILE	SLENDER COTTONGRASS		E		G5	SH
ERIOPHORUM TENELLUM	ROUGH COTTONGRASS		E		G5	S1
EUPATORIUM RESINOSUM	PINE BARREN BONESET	C2	E	LP	G2	S2
GLYCERIA LAXA	NORTHERN MANNAGRASS				G5	S2
GYMNOPOGON BREVIFOLIUS	SHORT-LEAVED SKELETON GRASS		E		G5	S1
HELONIAS BULLATA	SWAMP-PINK	LT	E	LP	G3	S3
HETERANTHERA MULTIFLORA	MUD PLANTAIN				G4	S2
LUZULA ACUMINATA	HAIRY WOODRUSH		E		G5	S1
MELANTHIUM VIRGINICUM	VIRGINIA BUNCHFLOWER		E		G5	S1
MICRANTHEMUM MICRANTHEMOIDES	NUTTALL'S MUDWORT	C2*	E		GH	SH
MUHLENBERGIA CAPILLARIS	LONG-AWNED SMOKE GRASS		E		G5	S1
MUHLENBERGIA TORREYANA	PINE BARREN SMOKE GRASS	3C		LP	G3	S3
NYMPHOIDES CORDATA	FLOATING HEART			LP	G5	S3
ONOSMODIUM VIRGINIANUM	VIRGINIA FALSE-GROMWELL		E		G4	S1
PANICUM ACICULARE	BRISTLING PANIC GRASS		E		G4G5	S1
PENSTEMON LAEVIGATUS	SMOOTH BEARD TONGUE		E		G5	S1
PHASEOLUS POLYSTACHIOS	WILD KIDNEY BEAN				G4	S2
POLYGALA INCARNATA	PINK MILKWORT		E		G5	SH
POLYGONUM OPELOUSANUM	NORTHEASTERN SMARTWEED				G5	S2

FEB 1994

GLOUCESTER COUNTY
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NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
PRUNUS ANGUSTIFOLIA	CHICKASAW PLUM		E		G5	S1
PYCNANTHEMUM TORREI	TORREY'S MOUNTAIN MINT		E		G2	S1
QUERCUS IMBRICARIA	SHINGLE OAK		E		G5	S1.1
RHYNCHOSPORA GLOBULARIS	GRASS-LIKE BEAKED RUSH		E		G5	S1
RHYNCHOSPORA PALLIDA	PALE BEAK RUSH				G3?	S3
RHYNCHOSPORA SCIRPOIDES	LONGBEAKED BALDRUSH				G4	S2
SCHEUCHZERIA PALUSTRIS	ARROW-GRASS		E		G5	SH
SCHIZAEA PUSILLA	CURLY GRASS FERN	3C		LP	G3	S3
SPIRANTHES LACINIATA	LACE-LIP LADIES'-TRESSES		E		G4G5	S1
SPIRANTHES ODORATA	FRAGRANT LADIES'-TRESSES				G5	S2
THASPIUM BARBINODE	HAIRY-JOINTED MEADOW-PARSNIP				G5	SX.1
TIPULARIA DISCOLOR	CRANEFLY ORCHID				G4G5	S3
UTRICULARIA BIFLORA	TWO-FLOWERED BLADDERWORT		E		G5	S1
VALERIANELLA RADIATA	BEAKED CORN-SALAD		E		G5	S1
VERBENA SIMPLEX	NARROW-LEAVED VERVAIN		E		G5	SH
VERNONIA GLAUCA	BROAD-LEAVED IRONWEED		E		G5	S1
VULPIA ELLIOTEA	SQUIRREL FESCUE		E		G5	SH

Records Processed

FEB 1994

CUMBERLAND COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

	NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
Vertebrates							
	ACCIPITER COOPERII	COOPER'S HAWK		E		G4	S2
	AMBYSTOMA TIGRINUM	TIGER SALAMANDER		E		G5	S2
	AMMODRAMUS HENSLOWII	HENSLOW'S SPARROW	C2	E		G4	S1
	AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW		T/T		G4	S2
	ARDEA HERODIAS	GREAT BLUE HERON		T/S		G5	S2
	BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T		G5	S2
	CIRCUS CYANEUS	NORTHERN HARRIER		E/U		G5	S2
	CISTOTHORUS PLATENSIS	SEDGE WREN		E		G5	S1
	CROTALUS HORRIDUS	TIMBER RATTLESNAKE		E		G5	S2
	ELAPHE GUTTATA	CORN SNAKE		E		G5	S1
	FALCO PEREGRINUS	PEREGRINE FALCON	E/SA	E		G3	S1
	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	LELT	E		G4	S1
	HYLA ANDERSONII	PINE BARRENS TREEFROG	3C	E		G4	S3
	HYLA CHRYSOSCELIS	COPE'S GRAY TREEFROG		E		G5	S2
	MELANERPES ERYTHROCEPHALUS	RED-HEADED WOODPECKER		T/T		G5	S3
	PANDION HALIAETUS	OSPREY		T/T		G5	S3
	PASSERCULUS SANDWICHENSIS	SAVANNAH SPARROW		T/T		G5	S2
	PITUOPHIS MELANOLEUCUS	PINE SNAKE		T		G5	S3
	POOECETES GRAMINEUS	VESPER SPARROW		E		G5	S2
	STERNA ANTILLARUM	LEAST TERN		E		G4	S2
	STRIX VARIA	BARRED OWL		T/T		G5	S3
	SYNAPTOMYS COOPERI	SOUTHERN BOG LEMMING		U		G5	S2
Ecosystems							
	BRACKISH TIDAL MARSH COMPLEX	BRACKISH TIDAL MARSH COMPLEX				G4	S2?

CUMBERLAND COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
COASTAL PLAIN INTERMITTENT POND	VERNAL POND				G3?	S2S3
FRESHWATER TIDAL MARSH COMPLEX	FRESHWATER TIDAL MARSH COMPLEX				G4?	S3?
Invertebrates						
ANAX LONGIPES	COMET DARNER				G5	S2?
APAMEA APAMIFORMIS	A NOCTUID MOTH				G4	SU
APAMEA INEBRIATA	A NOCTUID MOTH				G3G4	S2S4
CATOCALA CONSORS SORSCONI	THE CONSORT, OR CONSORS UNDERWING				G4TU	S1S3
CATOCALA PRETIOSA PRETIOSA	A PRECIOUS UNDERWING	C2			G4T2T3	S2S3
CELITHEMIS MARTHA	MARTHA'S PENNANT				G4	S3S4
CELITHEMIS VERNA	DOUBLE-RINGED PENNANT				G5	S1?
CHLOROPTERYX TEPPERARIA	ANGLE WINGED EMERALD MOTH				G4	SU
CISTHENE PLUMBEA	LEAD-COLORED LICHEN MOTH				G5	S3
ENALLAGMA PICTUM	SCARLET BLUET				G4	S3?
ENALLAGMA RECURVATUM	PINE BARRENS BLUET	3C			G3	S3
IDAEA OBFUSARIA	RIPPLED WAVE				G4G5	S2S4
IDAEA VIOLACEARIA	A GEOMETRID MOTH				G4	S1S3
INCISALIA IRUS	FROSTED ELFIN				G4	SU
LIBELLULA AURIPENNIS	GOLDEN-WINGED SKIMMER				G5	S1?
LIBELLULA AXILENA	BAR-WINGED SKIMMER				G5	S1?
LITHOPHANE LEMMERI	LEMMER'S PINION MOTH	3C			G3G4	S2
LITHOPHANE LEPIDA ADIPEL	A NOCTUID MOTH				G4T3T4	S3S4
MACROCHILO HYPOCRITALIS	A NOCTUID MOTH				G4	S2S3
MACROCHILO SP 1	A NOCTUID MOTH				G3Q	S3
MITOURA HESSELI	HESSEL'S HAIRSTREAK	3C			G3G4	S3S4

FEB 1994

CUMBERLAND COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

	NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
	PAPAIPEMA STENOCELIS	CHAIN FERN BORER MOTH				G4	S3
	PROBLEMA BULENTA	THE RARE SKIPPER	C2			G2G3	S2
	SOMATOCHLORA PROVOCANS	TREETOP EMERALD				G3G4	S2S4
	SYMPETRUM AMBIGUUM	BLUE-FACED MEADOWFLY				G5	S1?
Other types							
	BALD EAGLE WINTERING SITE	BALD EAGLE WINTERING SITE				G?	S?
	MIGRATORY SHOREBIRD	MIGRATORY SHOREBIRD				G?	S?
	CONCENTRATION SITE	CONCENTRATION SITE					
	PRIMEVAL FOREST	PRIMEVAL FOREST				G3?	S1
Vascular plants							
	AESCHYNOMENE VIRGINICA	SENSITIVE JOINT-VETCH	LT	E	LP	G2	S1
	AGASTACHE SCROPHULARIIFOLIA	PURPLE GIANT HYSSOP				G4	S2
	ARETHUSA BULBOSA	DRAGON MOUTH				G4	S2
	ASCLEPIAS RUBRA	RED MILKWEED			LP	G4G5	S2
	ASCLEPIAS VARIEGATA	WHITE MILKWEED				G5	S2
	BIDENS BIDENTOIDES	BUR-MARIGOLD	C23C			G3	S2
	BOLTONIA ASTEROIDES VAR GLASTIFOLIA	BOLTONIA		E		G5T?	S1
	CALYSTEGIA SPITHAMAEA	ERECT BINDWEED		E		G4G5	S1
	CAREX BARRATTII	BARRATT'S SEDGE	3C		LP	G4	S4
	CAREX MITCHELLIANA	MITCHELL'S SEDGE				G3G4	S2
	CAREX ROSTRATA	BEAKED SEDGE				G5	S2
	CAREX TYPHINA	CAT-TAIL SEDGE				G5	S2
	CLITORIA MARIANA	BUTTERFLY PEA		E		G5	S1
	COREOPSIS ROSEA	PINK TICKSEED			LP	G3	S2

FEB 1994

CUMBERLAND COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
CUSCUTA CORYLI	HAZEL DODDER				G5	S2
CUSCUTA POLYGONORUM	SMARTWEED DODDER		E		G5	S2
CYPERUS ENGELMANNII	ENGELMANN'S FLATSEDGE		E		G4Q	S2
CYPERUS POLYSTACHYOS	COAST FLATSEDGE		E		G5	S1
DESMODIUM LAEVIGATUM	SMOOTH TICK-TREFOIL				G5	S3
DESMODIUM STRICTUM	PINELAND TICK-TREFOIL			LP	G4	S2
DESMODIUM VIRIDIFLORUM	VELVETY TICK-TREFOIL				G5?	S2
DIOSCOREA VILLOSA VAR HIRTICAULIS	HAIRY-STEMMED WILD YAM				G5T2T3Q	SU
ELEOCHARIS MELANOCARPA	BLACK-FRUITED SPIKERUSH		E		G4	S1
ELEOCHARIS TORTILIS	TWISTED SPIKERUSH		E		G5	S1
ERIOCAULON PARKERI	PARKER'S PIPEWORT	3C			G3	S2
ERIOPHORUM TENELLUM	ROUGH COTTONGRASS		E		G5	S1
EUPATORIUM RESINOSUM	PINE BARREN BONESET	C2	E	LP	G2	S2
GALACTIA VOLUBILIS	DOWNY MILK-PEA		E		G5	SH
GENTIANA AUTUMNALIS	PINE BARREN GENTIAN	3C		LP	G3	S3
GENTIANA VILLOSA	STRIPED GENTIAN				G4	SX.1
HELONIAS BULLATA	SWAMP-PINK	LT	E	LP	G3	S3
HYPERICUM GYMNANTHUM	CLASPING-LEAVED ST. JOHN'S-WORT				G4?	S2
JUNCUS CAESARIENSIS	NEW JERSEY RUSH	C2	E	LP	G2	S2
LESPEDEZA STUEVEI	TALL BUSH-CLOVER				G4?	S2
MUHLENBERGIA TORREYANA	PINE BARREN SMOKE GRASS	3C		LP	G3	S3
MYRIOPHYLLUM PINNATUM	CUT-LEAVED WATER-MILFOIL		E		G5	SH
MYRIOPHYLLUM VERTICILLATUM	WHORLED WATER-MILFOIL		E		G5	SH
NUPHAR MICROPHYLLUM	SMALL YELLOW POND LILY		E		G5	SH
ONOSMODIUM VIRGINIANUM	VIRGINIA FALSE-GROMWELL		E		G4	S1

CUMBERLAND COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	REGIONAL STATUS	GRANK	SRANK
OPHIOGLOSSUM VULGATUM VAR PYCNOSTICHUM	SHEATHED ADDER'S-TONGUE		E		G5TU	SH
PASPALUM DISSECTUM	MUDBANK PASPALUM				G3G4	S2
PENSTEMON LAEVIGATUS	SMOOTH BEARD TONGUE		E		G5	S1
PHORADENDRON SEROTINUM	MISTLETOE			LP	G5	S2
PINUS TAEDA	LOBLOLLY PINE				G5	S2
PLATANTHERA CILIARIS	YELLOW-FRINGED ORCHID			LP	G5	S2
POLYGALA INCARNATA	PINK MILKWORT		E		G5	SH
POLYGALA POLYGAMA	RACEMED MILKWORT				G5	S2
POLYGONUM DENSIFLORUM	STOUT SMARTWEED		E		G5	S1
PRUNUS ANGUSTIFOLIA	CHICKASAW PLUM		E		G5	S1
PYRUS ANGUSTIFOLIA	NARROW-LEAVED WILD CRABAPPLE				G5?	S2
QUERCUS NIGRA	WATER OAK		E		G5	S1
RHODODENDRON ATLANTICUM	DWARF AZALEA		E		G4G5	S1
RHYNCHOSPORA MICROCEPHALA	SMALL-HEADED BEAKED RUSH		E		G?	S1
RHYNCHOSPORA NITENS	SHORT-BEAKED BALDRUSH				G4	S2
RHYNCHOSPORA PALLIDA	PALE BEAK RUSH				G3?	S3
RUELLIA CAROLINIENSIS	CAROLINA PETUNIA		E		G5	SH
SCHIZAEA PUSILLA	CURLY GRASS FERN	3C		LP	G3	S3
SCHWALBEA AMERICANA	CHAFFSEED	LE	E	LP	G2	S1
SCIRPUS MARITIMUS	SALT MARSH BULRUSH		E		G5	SH
SCLERIA MINOR	SLENDER NUT RUSH			LP	G4	S4
SPIRANTHES ODORATA	FRAGRANT LADIES'-TRESSES				G5	S2
STACHYS HYSSOPIFOLIA	HYSSOP HEDGE-NETTLE				G5	S2
STYLOSANTHES BIFLORA	PENCIL FLOWER				G5	S3
VERNONIA GLAUCA	BROAD-LEAVED IRONWEED		E		G5	S1

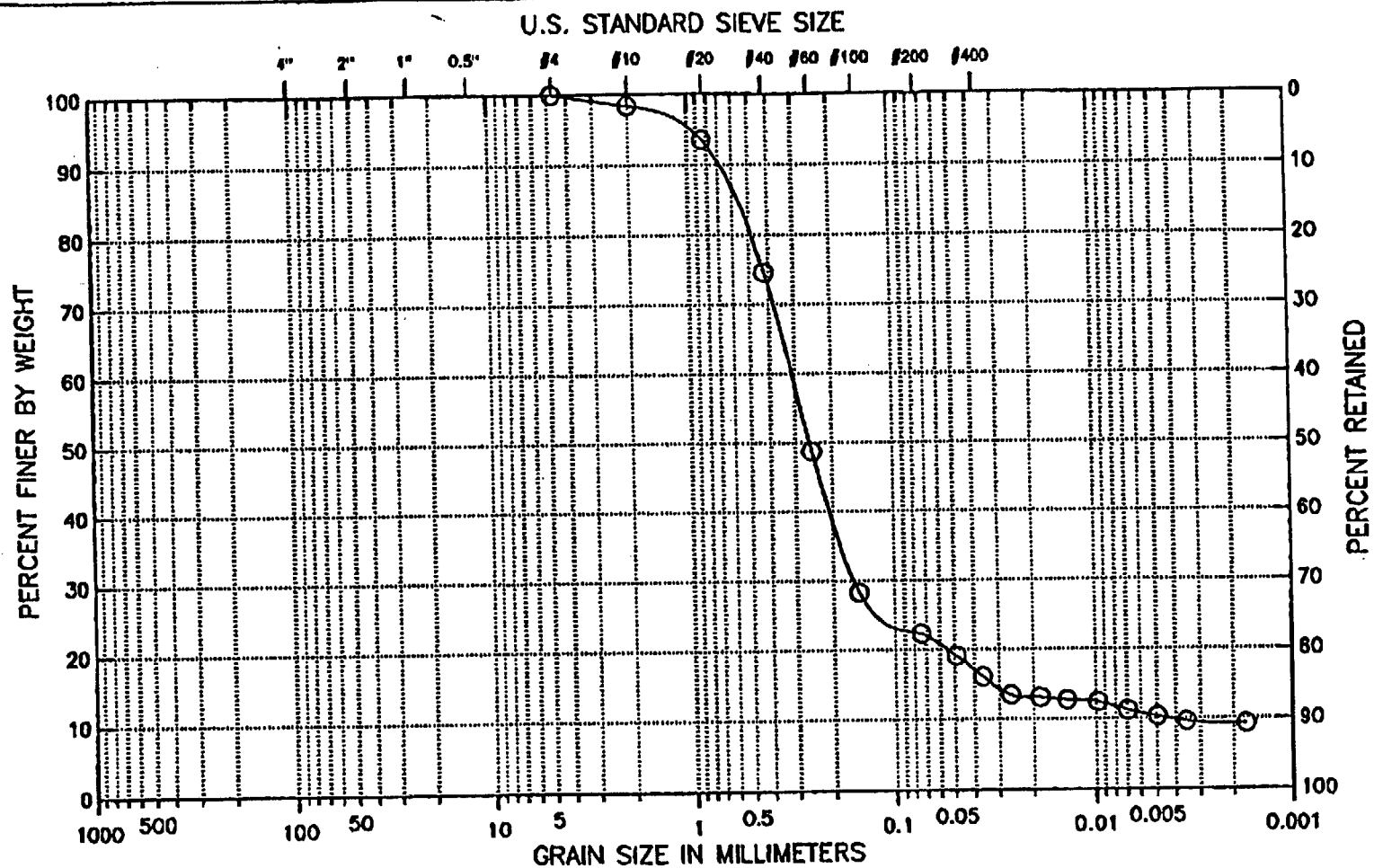
APPENDIX D

GRAIN SIZE ANALYSES FOR SEDIMENT SAMPLES

GeoTesting Express
Concord, MA

Boring No. : ---
Sample No: Sed-1
Tested by : cnr
Filename : SED1

Project : Shieldalloy Metallurgical
Project No.: GTX-463
Location: Cambridge, MA
Date : Thu Apr 28 1994



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Classification :

Remarks :
Head Waters Area

Visual Description :
Wet, black silty sand with organics, roots

Figure 1

GEOTECHNICAL LABORATORY TEST DATA

Project : Shieldalloy Metallurgical
Project No. : GTX-463
Boring No. : ---
Sample No. : Sed-1
Location : Cambridge, MA
Soil Description : Wet, black silty sand with organics, roots
Remarks : Head Waters Area

Depth : ---
Test Date : 04/25/94
Test Method : ASTM D422

Filename : SED1
Elevation : ---
Tested by : cnr
Checked by : gtt

HYDROMETER

Hydrometer ID : hyl-2
Weight of air-dried soil = 160 gm
Specific Gravity = 2.65

Hydroscopic Moisture Content :
Weight of Wet Soil = 0 gm
Weight of Dry Soil = 0 gm
Moisture Content = 0

Elapsed Time (min)	Reading	Temperature (deg. C)	Corrected Reading	Particle Size (mm)	Percent Finer (%)	Adjusted Particle Size
1.00	31.00	14.30	31.00	0.049	19	0.049
2.00	26.10	14.30	26.10	0.036	16	0.036
4.00	21.80	14.30	21.80	0.026	13	0.026
8.00	21.20	14.30	21.20	0.019	13	0.019
15.00	20.60	14.30	20.60	0.014	13	0.014
30.00	20.10	14.30	20.10	0.010	12	0.010
60.00	18.10	14.40	18.10	0.007	11	0.007
120.00	16.70	14.40	16.70	0.005	10	0.005
240.00	15.50	14.30	15.50	0.004	10	0.004
1006.00	15.00	14.10	15.00	0.002	9	0.002

FINE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
#4	0.187	4.75	0.00	0.00	100
#10	0.079	2.00	0.82	0.82	98
#20	0.033	0.84	2.50	3.32	94
#40	0.017	0.42	9.78	13.10	75
#60	0.010	0.25	13.36	26.46	49
#100	0.006	0.15	10.55	37.01	28
#200	0.003	0.07	3.08	40.09	22
Pan			11.51	51.60	0

Total Dry Weight of Sample = 59.6

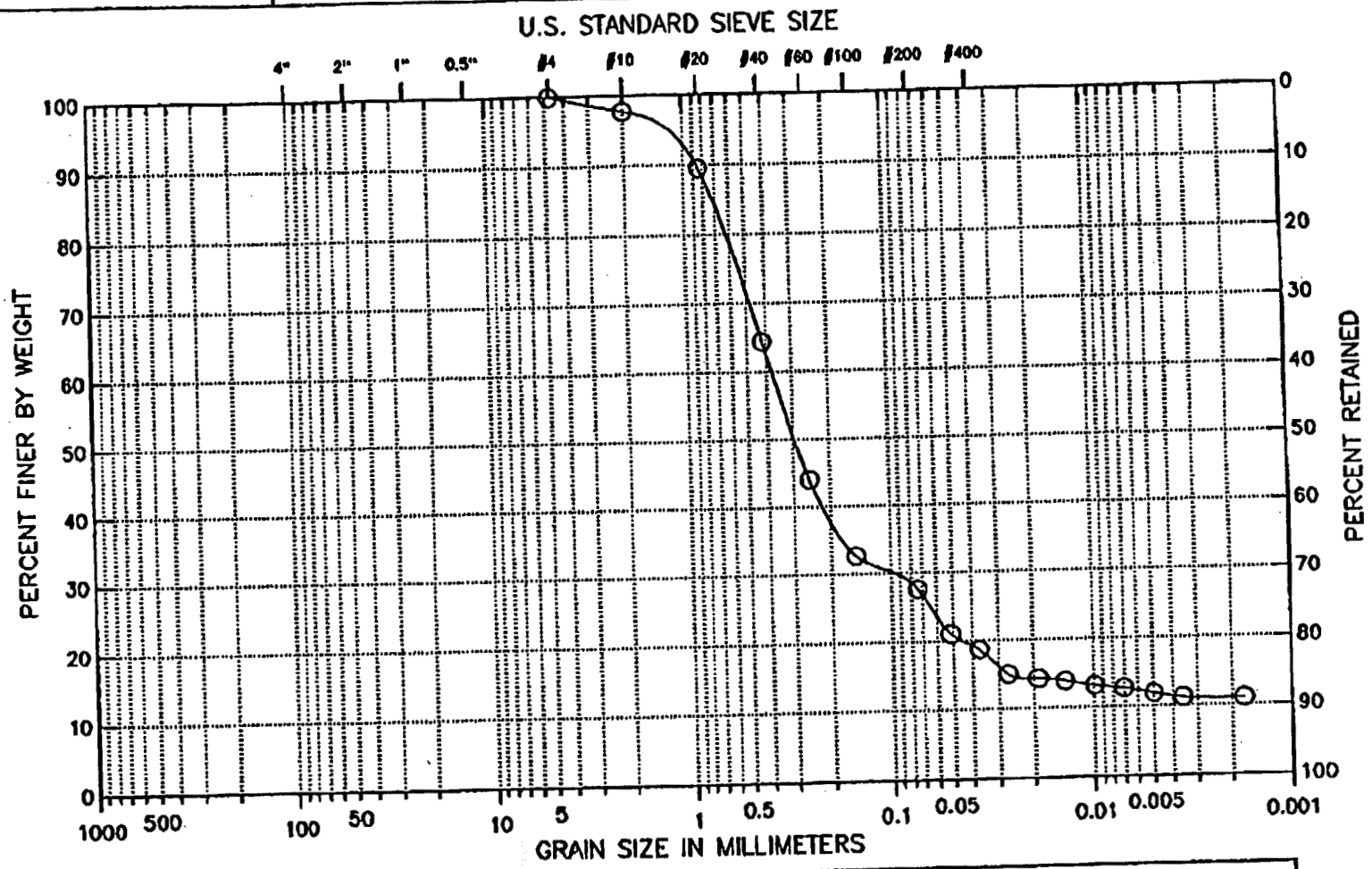
D85 : 0.6145 mm
D60 : 0.3134 mm
D50 : 0.2565 mm
D30 : 0.1556 mm
D15 : 0.0318 mm
D10 : 0.0043 mm

Soil Classification
ASTM Group Symbol : N/A
ASTM Group Name : N/A
AASHTO Group Symbol : A-2-4(0)
AASHTO Group Name : Silty Gravel and Sand

GeoTesting Express
Concord, MA

Boring No. : ---
Sample No: Sed-2
Tested by : cnr
Filename : SED2

Project : Shieldalloy Metallurgical
Project No.: GTX-463
Location: Cambridge, MA
Date : Thu Apr 28 1994



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Classification :

Remarks :
Area Below Outfall

Visual Description :
Wet, black silty sand with organics, roots

Figure 2

GEOTECHNICAL LABORATORY TEST DATA

Project : Shieldalloy Metallurgical
Project No. : GTX-463
Boring No. : ---
Sample No. : Sed-2
Location : Cambridge, MA
Soil Description : Wet, black silty sand with organics, roots
Remarks : Area Below Outfall

Depth : ---
Test Date : 04/25/94
Test Method : ASTM D422

Filename : SED2
Elevation : ---
Tested by : cmr
Checked by : gtt

HYDROMETER

Hydrometer ID : hy1-2
Weight of air-dried soil = 121 gm
Specific Gravity = 2.65

Hydroscopic Moisture Content :
Weight of Wet Soil = 0 gm
Weight of Dry Soil = 0 gm
Moisture Content = 0

Elapsed Time (min)	Reading	Temperature (deg. C)	Corrected Reading	Particle Size (mm)	Percent Finer (%)	Adjusted Particle Size
1.00	26.00	14.40	26.00	0.051	21	0.051
2.00	23.10	14.40	23.10	0.037	19	0.037
4.00	18.50	14.40	18.50	0.027	15	0.027
8.00	17.60	14.40	17.60	0.019	14	0.019
15.00	17.10	14.40	17.10	0.014	14	0.014
30.00	16.20	14.40	16.20	0.010	13	0.010
60.00	15.60	14.40	15.60	0.007	13	0.007
120.00	14.60	14.70	14.60	0.005	12	0.005
240.00	13.80	14.60	13.80	0.004	11	0.004
1006.00	13.60	14.20	13.60	0.002	11	0.002

FINE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
#4	0.187	4.75	0.01	0.01	100
#10	0.079	2.00	1.02	1.03	98
#20	0.033	0.84	3.72	4.75	90
#40	0.017	0.42	11.41	16.16	64
#60	0.010	0.25	9.26	25.42	44
#100	0.006	0.15	5.16	30.58	33
#200	0.003	0.07	2.30	32.88	28
Pan			12.51	45.39	0

Total Dry Weight of Sample = 53.28

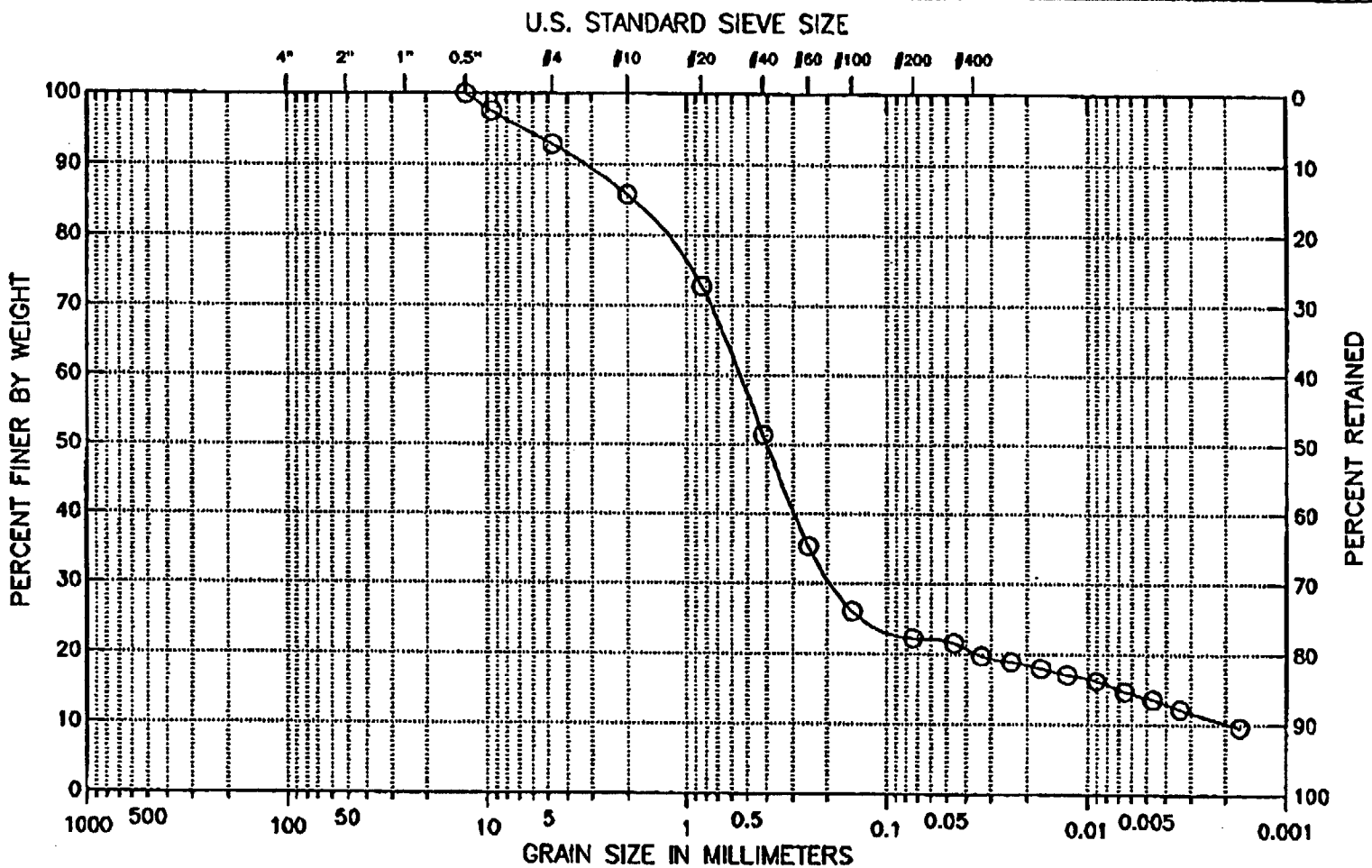
D85 : 0.7420 mm
D60 : 0.3756 mm
D50 : 0.2912 mm
D30 : 0.1036 mm
D15 : 0.0269 mm
D10 : 0.0000 mm

Soil Classification
ASTM Group Symbol : N/A
ASTM Group Name : N/A
AASHTO Group Symbol : A-2-4(0)
AASHTO Group Name : Silty Gravel and Sand

GeoTesting Express
Concord, MA

Boring No. : ---
Sample No: Sed-3
Tested by : cnr
Filename : SED3

Project : Shieldalloy Metallurgical
Project No.: GTX-463
Location: Cambridge, MA
Date : Thu Apr 28 1994



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Classification :

Visual Description :
Wet, black silty sand with organics

Remarks :
Weymouth Road/W. Blvd.

Figure 3

GEOTECHNICAL LABORATORY TEST DATA

Project : Shieldalloy Metallurgical
Project No. : GTX-463
Boring No. : ---
Sample No. : Sed-3
Location : Cambridge, MA
Soil Description : Wet, black silty sand with organics
Remarks : Weymouth Road/W. Blvd.

Depth : ---
Test Date : 04/25/94
Test Method : ASTM D422

Filename : SED3
Elevation : ---
Tested by : cnr
Checked by : gtt

HYDROMETER

Hydrometer ID : hy1-2
Weight of air-dried soil = 159.1 gm
Specific Gravity = 2.65

Hydroscopic Moisture Content :
Weight of Wet Soil = 0 gm
Weight of Dry Soil = 0 gm
Moisture Content = 0

Elapsed Time (min)	Reading	Temperature (deg. C)	Corrected Reading	Particle Size (mm)	Percent Finer (%)	Adjusted Particle Size
1.00	40.00	14.40	40.00	0.046	22	0.046
2.00	36.50	14.40	36.50	0.033	20	0.033
4.00	35.00	14.40	35.00	0.024	19	0.024
8.00	33.30	14.40	33.30	0.017	18	0.017
15.00	31.60	14.40	31.60	0.013	17	0.013
30.00	30.00	14.40	30.00	0.009	16	0.009
60.00	27.20	14.40	27.20	0.007	15	0.007
120.00	25.10	14.60	25.10	0.005	14	0.005
236.00	22.50	14.40	22.50	0.003	12	0.003
1006.00	17.80	14.10	17.80	0.002	10	0.002

FINE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
0.5"	0.500	12.70	0.00	0.00	100
0.375"	0.374	9.51	2.29	2.29	98
#4	0.187	4.75	4.40	6.69	93
#10	0.079	2.00	6.78	13.47	86
#20	0.033	0.84	12.30	25.77	73
#40	0.017	0.42	20.22	45.99	51
#60	0.010	0.25	15.23	61.22	35
#100	0.006	0.15	8.81	70.03	26
#200	0.003	0.07	3.58	73.61	22
Pan			21.09	94.70	0

Total Dry Weight of Sample = 98.83

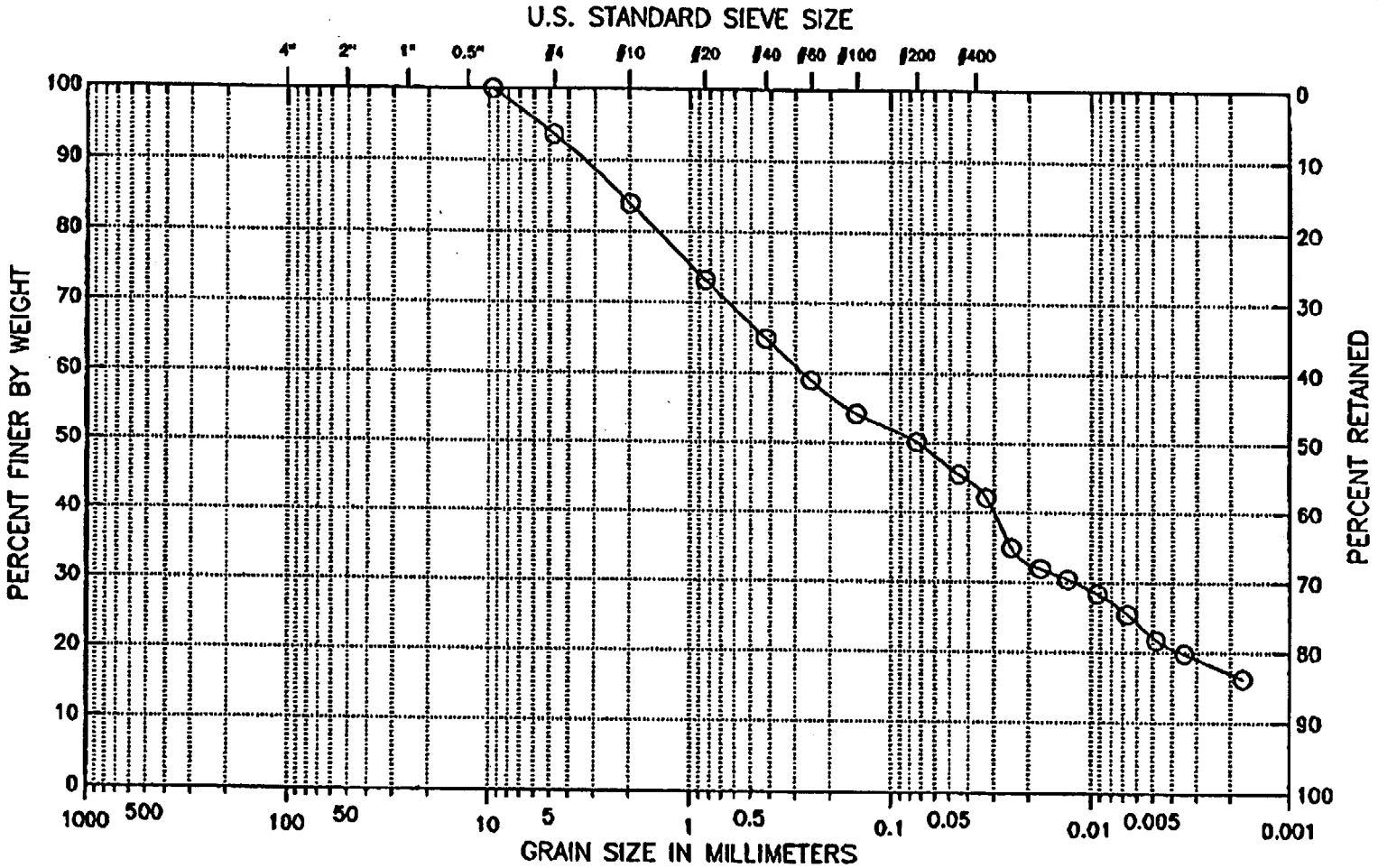
D85 : 1.8991 mm
D60 : 0.5549 mm
D50 : 0.4010 mm
D30 : 0.1856 mm
D15 : 0.0070 mm
D10 : 0.0019 mm

Soil Classification
ASTM Group Symbol : N/A
ASTM Group Name : N/A
AASHTO Group Symbol : A-2-4(0)
AASHTO Group Name : Silty Gravel and Sand

GeoTesting Express
Concord, MA

Boring No. : ---
Sample No: Sed-4
Tested by : cnr
Filename : SED4

Project : Shieldalloy Metallurgical
Project No.: GTX-463
Location: Cambridge, MA
Date : Thu Apr 28 1994



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Classification :

Visual Description :
Wet, black sandy silt with organics

Remarks :
Property West of Main Site

Figure 4

GEOTECHNICAL LABORATORY TEST DATA

Project : Shieldalloy Metallurgical
Project No. : GTX-463
Boring No. : ---
Sample No. : Sed-4
Location : Cambridge, MA
Soil Description : Wet, black sandy silt with organics
Remarks : Property West of Main Site

Depth : ---
Test Date : 04/25/94
Test Method : ASTM D422

Filename : SED4
Elevation : ---
Tested by : cnr
Checked by : gtt

HYDROMETER

Hydrometer ID : hy1-2
Weight of air-dried soil = 77.6 gm
Specific Gravity = 2.65

Hydroscopic Moisture Content :
Weight of Wet Soil = 0 gm
Weight of Dry Soil = 0 gm
Moisture Content = 0

Elapsed Time (min)	Reading	Temperature (deg. C)	Corrected Reading	Particle Size (mm)	Percent Finer (%)	Adjusted Particle Size
1.00	42.00	14.40	42.00	0.045	45	0.045
2.00	38.90	14.40	38.90	0.033	42	0.033
4.00	32.20	14.40	32.20	0.024	35	0.024
8.00	29.50	14.40	29.50	0.018	32	0.018
15.00	28.10	14.40	28.10	0.013	30	0.013
30.00	26.20	14.40	26.20	0.009	28	0.009
60.00	23.50	14.60	23.50	0.007	25	0.007
120.00	20.10	14.80	20.10	0.005	22	0.005
240.00	18.30	14.30	18.30	0.003	20	0.003
1005.00	15.00	14.10	15.00	0.002	16	0.002

FINE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
0.375"	0.374	9.51	0.00	0.00	100
#4	0.187	4.75	2.07	2.07	94
#10	0.079	2.00	3.18	5.25	84
#20	0.033	0.84	3.51	8.76	73
#40	0.017	0.42	2.71	11.47	65
#60	0.010	0.25	1.94	13.41	59
#100	0.006	0.15	1.57	14.98	54
#200	0.003	0.07	1.32	16.30	50
Pan			16.39	32.69	0

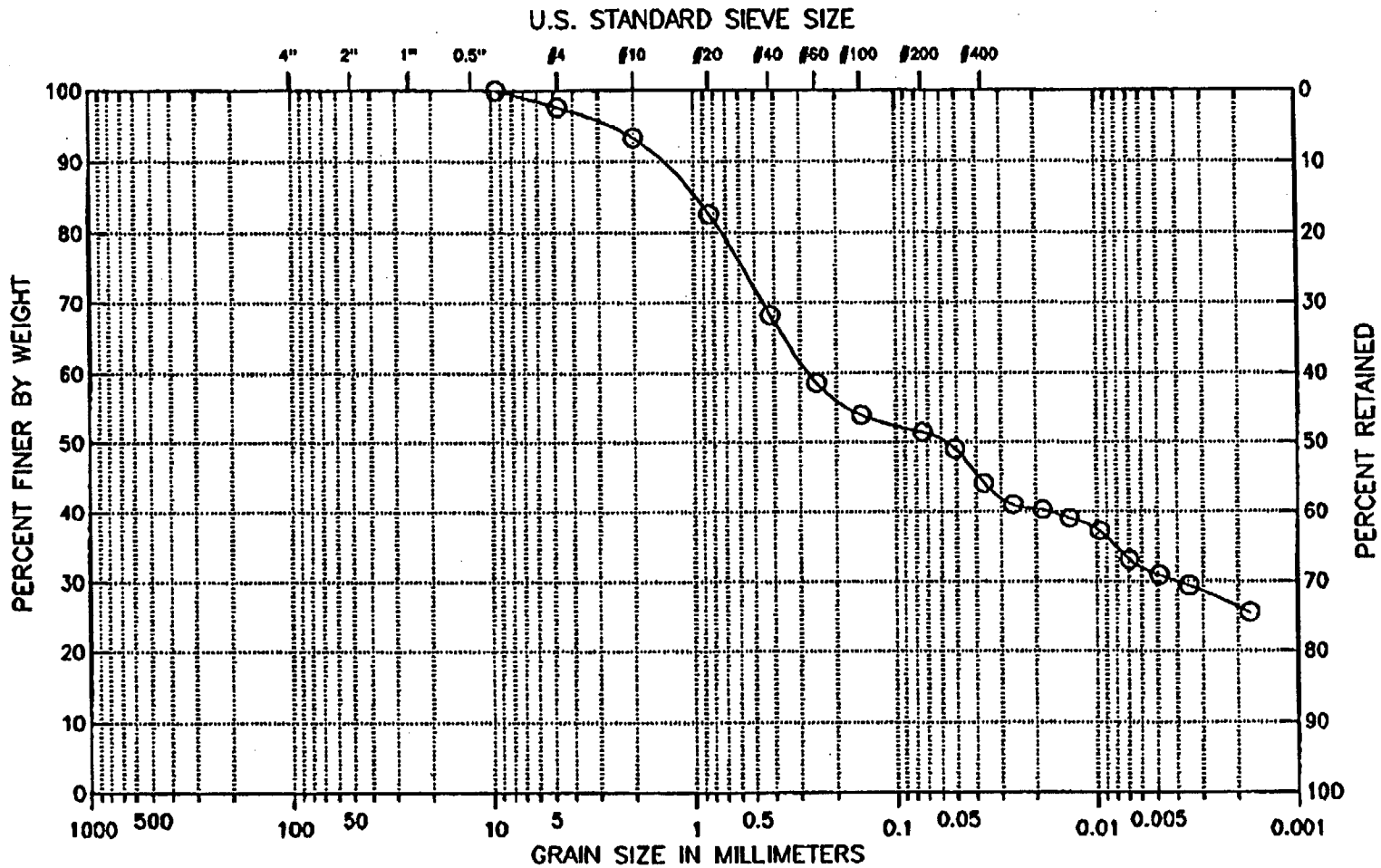
Total Dry Weight of Sample = 40.72

D85 : 2.1977 mm
D60 : 0.2734 mm
D50 : 0.0729 mm
D30 : 0.0121 mm
D15 : N/A
D10 : N/A

Soil Classification
ASTM Group Symbol : N/A
ASTM Group Name : N/A
AASHTO Group Symbol : A-4(0)
AASHTO Group Name : Silty Soils

GeoTesting Express
Concord, MA

Boring No. : ---	Project : Shieldalloy Metallurgical
Sample No: Sed-5	Project No.: GTX-463
Tested by : cnr	Location: Cambridge, MA
Filename : SED5	Date : Thu Apr 28 1994



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Classification :

Remarks :
New Burnt Moll Branch

Visual Description :
Wet, black sandy silt with organics, roots

Figure 5

GEOTECHNICAL LABORATORY TEST DATA

Project : Shieldalloy Metallurgical
Project No. : GTX-463
Boring No. : ---
Sample No. : Sed-5
Location : Cambridge, MA
Soil Description : Wet, black sandy silt with organics, roots
Remarks : New Burnt Moll Branch

Depth : ---
Test Date : 04/25/94
Test Method : ASTM D422

Filename : SED5
Elevation : ---
Tested by : cnr
Checked by : gtt

HYDROMETER

Hydrometer ID : hyl-2
Weight of air-dried soil = 51.6 gm
Specific Gravity = 2.65

Hydroscopic Moisture Content :
Weight of Wet Soil = 0 gm
Weight of Dry Soil = 0 gm
Moisture Content = 0

Elapsed Time (min)	Reading	Temperature (deg. C)	Corrected Reading	Particle Size (mm)	Percent Finer (%)	Adjusted Particle Size
1.00	27.00	14.40	27.00	0.051	49	0.051
2.00	24.30	14.40	24.30	0.037	44	0.037
4.00	22.60	14.40	22.60	0.026	41	0.026
8.00	22.20	14.40	22.20	0.019	40	0.019
15.00	21.50	14.40	21.50	0.014	39	0.014
30.00	20.50	14.40	20.50	0.010	37	0.010
60.00	18.20	14.50	18.20	0.007	33	0.007
120.00	17.00	14.50	17.00	0.005	31	0.005
240.00	16.20	14.50	16.20	0.004	29	0.004
1005.00	14.10	14.20	14.10	0.002	26	0.002

FINE SIEVE SET

Sieve Mesh	Sieve Openings Inches	Millimeters	Weight Retained (gm)	Cumulative Weight Retained (gm)	Percent Finer (%)
0.375"	0.374	9.51	0.00	0.00	100
#4	0.187	4.75	1.86	1.86	98
#10	0.079	2.00	3.45	5.31	93
#20	0.033	0.84	8.59	13.90	83
#40	0.017	0.42	11.46	25.36	68
#60	0.010	0.25	7.66	33.02	59
#100	0.006	0.15	3.73	36.75	54
#200	0.003	0.07	2.03	38.78	51
Pan			40.99	79.77	0

Total Dry Weight of Sample = 83.43

D85 : 1.0222 mm
D60 : 0.2696 mm
D50 : 0.0594 mm
D30 : 0.0040 mm
D15 : N/A
D10 : N/A

Soil Classification
ASTM Group Symbol : N/A
ASTM Group Name : N/A
AASHTO Group Symbol : A-4(0)
AASHTO Group Name : Silty Soils