11 September, 2003

Mr. Robert Cozzy, P.E.
New York State Department of Environmental Conservation
Bureau of Eastern Remedial Action
Division of Hazardous Waste Remediation
625 Broadway
Albany, NY 12233

Re: Remedial Investigation/Feasability Study Report
BICC Cables Corporation (BICC) Site, Yonkers, NY
NYSDEC Site # 360051
Order on Consent Index No. D-3-0001-00-03

Dear Mr. Cozzy:

Enclosed please find four (4) copies of Volume I of the Remedial Investigation/Feasability Study Report. This report addresses the comments from NYSDEC's 6 September 2002 letter on the draft Remedial Investigation Report originally submitted on 30 April of 2002. A matrix listing each comment and how and where it is adressed in this document will follow under separate cover.

If you have any questions or need additional copies please do not hesitate to call.

Sincerely,

Ernest Rossano, C.P.G.
Senior Project Manager

enclosures

cc: Gary Litwin, NYSDOH (2 copies)
Peter Zinkin, BICC
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Binder 1

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY REPORT

VOLUME I

BICC Cables Corporation
One Point Street
Yonkers, New York

September 2003

Prepared For:

BICC Cables Corporation
254 South Main Street
New City, NY 10956

Prepared by:

Environmental Resources Management
475 Park Avenue South
New York, NY 10016

Roux Associates, Inc.
209 Shafter Street
Islandia, NY 11749

Binder 2

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Binder 3

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY REPORT
VOLUME I Appendices

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1.0 INTRODUCTION

Environmental Resources Management, Inc. (ERM) and Roux Associates, Inc. (Roux) have prepared this Remedial Investigation/Feasibility Study (RI/FS) Work Plan on behalf of Respondent, BICC Cables Corporation (BICC), for the BICC facility in Yonkers, NY (the Site). The RI/FS is being conducted pursuant to Administrative Order on Consent Index No. D-3-0001-00-03 (hereafter referred to as the "Registry Order").

The Site is located at One Point Street in Yonkers, New York. The Site location is presented in Figure 1-1. The Site is bounded by the Hudson River and the EPRI Laboratory building to the west, the Hudson Line of the Metro-North Commuter Railroad to the east, a bus depot and bag factory to the south and the Hudson River to the north. The EPRI Laboratory building, which is located within the BICC facility, is not part of the Registry Site and is, therefore, not included in the Site that is subject to the Registry Order. Additional discussion regarding the delisting of this building is presented in the following section. The location of the EPRI Laboratory and the surrounding properties are shown in Figure 1-2.

The Site has been used for electrical, wire, and cable manufacturing for approximately 100 years. The Site (excluding the EPRI Laboratory building) occupies approximately 13 acres and is designated by the following Block/Lot numbers on the City of Yonkers tax maps: 2114/17, 2114/20-35, 2620/35, 2620/40, 2620/part of 50, 2625/15, 2625/17, 2625/21, 2625/23, 2630/1, 2630/3, and 2630/10. It has approximately 1,800 feet of river frontage and lies within the waterfront described in the Comprehensive Plan for the City of Yonkers (Yonkers, 1990a). This plan includes development plans for the City of Yonkers Local Waterfront Revitalization Program (LWRP).

Figure 1-2 presents a general plan of the Site. The former manufacturing buildings are located on the northern side of the property and the area referred to as "the Yard" is located on the southern side of the property. Excluding the EPRI Laboratory building, the Site is covered by approximately 207,000 square feet of building ground floor space, 300,000 square feet of paved or otherwise covered areas and 80,000 square feet of vegetated areas. A portion of the Site buildings is situated on pilings over the Hudson River.

ERM, on behalf of BICC, conducted a petroleum spills investigation of the Site pursuant to Administrative Order on Consent DC-0001-97-06, dated September 1997, between BICC and the New York State Department of Environmental Conservation (NYSDEC) (hereafter referred to as the "Petroleum Spills Order"). The scope of work for that program was outlined in the February 1997 Site Investigation Work Plan that was reviewed and subsequently approved by NYSDEC on 30 September 1997. The Petroleum Spills Order and the scope of the sampling activities were developed based upon the considerable volume of petroleum products historically used in manufacturing operations at the Site and the assumption that any compounds of concern found at the Site would be related to the use of those products. However, the data collected during the Petroleum Spills Investigation indicated that while petroleum did not present a concern, polychlorinated biphenyls (PCBs) were present in the Site soils. The results of the Petroleum Spills Investigation were subsequently presented to NYSDEC at a meeting in 14 October 1998.

Based upon the data presented to NYSDEC at the 14 October 1998 meeting, NYSDEC listed the Site on the New York State Inactive Hazardous Waste Disposal Site Registry with a classification of 2 and assigned it NYSDEC Site No. 360051. A Registry Order for the Site was executed on 17 March 2000 and the RI/FS Work Plan was approved by the NYSDEC on 20 April 2001.

The objective of the RI is to collect data necessary to adequately characterize a site for the purpose of developing and evaluating effective remedial alternatives. The nature and extent of hazardous substances present have been extensively characterized and are discussed in Sections 2.0 and 3.0 of this report. In addition, the exposure pathways and threat to the public health or environment have been assessed. These assessments are presented in Sections 4.0 through 6.0 of this report.

In accordance with the Registry Order, this RI Report presents the findings of the investigations conducted by BICC in accordance with the Petroleum Spills and Registry Orders. The scope of these investigations are set forth in the Work Plans and Interim Deliverables that were prepared for, and subsequently approved by, NYSDEC under these Orders.

Over the course of the RI, there have been ten Interim Deliverables and two Data Summary Memorandums submitted to NYSDEC. These were:

- Interim Deliverable No. 1: Interior Drain System (Roux, 2001c)[1]
- Interim Deliverable No. 2: Sediment Sampling Plan Addendum (ERM, 2001b)
- Interim Deliverable No. 2, Revision 1: Sediment Sampling Plan Addendum (ERM, 2001e)
- Interim Deliverable No. 3: Additional Interior Characterization – Second Floor (Roux, 2001d)

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[1] A reference identification, such as (Roux, 2001c), is presented after each of the reference documents cited. A full description of each reference document is presented in the References Section.

- Interim Deliverable No. 4: Additional Interior Characterization – Railroad Siding (Roux, 2001e)
- Data Summary Memorandum, Exterior (ERM, 2001d)
- Data Summary Memorandum, Interior (Roux, 2001f)
- Interim Deliverable No. 5: Supplemental RI/FS Sampling (ERM, 2001f)
- Interim Deliverable No. 6: Additional Second Floor Room Cleaning, February 8, 2002 (Roux, 2002)
- Supplement No. 1 to Interim Deliverable No. 6: Scope of Work for the Evaluation of the Potential for Recontamination of Previously Cleaned Areas, October 23, 2002 (Roux, 2002f)
- Supplement No. 1 to Interim Deliverable No. 6, Revision 1 - Scope of Work for Evaluation of the Potential For Recontamination of Previously Cleaned Areas, December 2, 2002 (Roux, 2002f)
- Interim Deliverable No. 7: Investigation of Subsurface Structures Below First Floor, April 17, 2002 (Roux, 2002a)
- Interim Deliverable No. 7, Revision 1: Investigation of Subsurface Structures Below First Floor, May 9, 2002 (Roux, 2002b)
- Interim Deliverable No. 7, Revision 1: Summary of Subsurface Investigations, September 12, 2002 (Roux, 2002g)
- Supplement No. 1 to Interim Deliverable No. 7, Revision 1, Addendum to the Scope of Work for the Investigation of Subsurface Structure Below First Floor, November 22, 2002 (Roux, 2002d)
- Interim Deliverable No. 7 Summary Report, February 28, 2003 (Roux, 2003b)
- Interim Deliverable No. 8: Sediment Sampling Plan Addendum, August 16, 2002 (ERM, 2002a)
- Interim Deliverable No. 8, Revision No. 1: Sediment Sampling Plan Addendum, August 29, 2002 (ERM, 2002b)
- Interim Deliverable No. 8, Revision No. 2: Sediment Sampling Plan Addendum, December 27, 2002 (ERM, 2002c)
- Interim Deliverable No. 9: Additional Subsurface Soil Sampling, September 27, 2002 (Roux, 2002e)
- Interim Deliverable No. 9, Revision No. 1: Additional Subsurface Soil Sampling, October 30, 2002 (Roux, 2002h)
- Supplement No. 1 to Interim Deliverable No. 9, February 27, 2003 (Roux, 2003a)
- Interim Deliverable No. 10: Concrete and Wood Bulk Sampling, March 26, 2003 (Roux, 2003c)

Collectively, the results of the investigations performed under the Petroleum Spills and Registry Orders, which include data from samples collected in the open Site areas [exterior (the Yard)] and within on-Site buildings [interior (the Site buildings)], provide the framework for this RI report.

1.1 SITE BACKGROUND

The primary manufacturing activities that occurred on the Site involved the production of wire and cable. Historic records indicate that wire and cable manufacturing started with the Habirshaw Wire and Cable Company in 1915. This company subsequently became a division of the Phelps Dodge Corporation (Phelps Dodge) in 1930 and this company continued to produce wire and cable until 1984. In 1984, BICC acquired the Site and continued wire and cable production until the plant was closed in 1996. A summary of the ownership history is shown in Table 1-1.

As discussed in further detail in Section 1.3.2.1, a number of chemicals were used over the years of Site operation. Based on the use of petroleum hydrocarbons in manufacturing operations, an environmental investigation began in 1997 at the Site in accordance with the Petroleum Spills Order. The investigation involved collecting environmental media samples from outside (exterior) areas, as well as sample collection from the interior of the on-Site buildings to evaluate whether releases of petroleum had adversely impacted the Site.

Based upon the discovery of PCBs at concentrations above 50 mg/kg in the Yard soils during the Petroleum Spills Investigation, the Site was reclassified under the New York State Inactive Hazardous Waste Disposal

Site Program as a Class 2 Site. Similarly, the results of wipe samples collected within the Site buildings pursuant to the Petroleum Spills Investigation showed that certain areas of the interior portions of the building were impacted by PCBs and lead at concentrations above 1 ug/100cm^2 and 4.3 ug/100cm^2 respectively.

In accordance with the Registry Order, BICC prepared a draft RI/FS Work Plan for the Site. The draft Work Plan was submitted to the NYSDEC in May 2000 (ERM/Roux, 2000). Following receipt of NYSDEC's comments, the revised RI/FS Work Plan was submitted to the NYSDEC on 2 March 2001 (ERM/Roux, 2001) and was approved by the NYSDEC on 20 April 2001.

During the period the RI/FS Work Plan was being prepared, BICC also initiated a pilot program with testing for the purpose of evaluating the effectiveness of cleaning agents and technologies on the interior surfaces of the Site buildings. In connection with this evaluation, cleaning of portions of the building interiors was conducted to accommodate temporary occupancy by tenants engaged in film production. This cleaning, and subsequent approval for occupancy, was performed pursuant to procedures and criteria that comport with the requirements of the RI/FS Work Plan (ERM/Roux, 2001). The NYSDEC and New York State Department of Health (NYSDOH) have overseen cleaning activities at the Site.

BICC commenced the RI field work in late May/early June 2001. The results for the first phase of investigation were summarized in two data summary documents, Data Summary Memorandum, Exterior (ERM, 2001d) and Data Summary Memorandum, Interior (Roux, 2001f). As provided for under the RI/FS Work Plan and as directed by the NYSDEC, data gaps were identified and supplemental investigations were developed and implemented based on the results of the first phase of the RI. The work plan for the supplemental investigation was contained in Interim Deliverable No. 5.

1.2 PURPOSE AND ORGANIZATION OF REPORT

This RI characterizes the nature and extent of hazardous substances at the Site. Together with the accompanying Human Health Risk Assessment (HHRA) and Ecological Risk Assessment, the RI Report provides the basis for subsequent development and evaluation of remedial alternatives in the FS.

The RI Report is organized into seven sections. Following this introduction (i.e., Section 1.0), Section 2.0 presents a summary of the investigations and results regarding environmental media at the Site. The media are soil, fill, ground water and sediment. The evaluation of the nature and extent of the environmental issues is also discussed in this section.

Section 3.0, Building Interiors, presents a summary of the investigations and results of impacts to surface and building structure materials. The environmental condition of the materials is characterized by wipe or bulk samples of concrete and wood, along with samples of debris from the existing trench systems, former process tank wipe samples, and boiler stack samples. The evaluation of the nature and extent of the interior environmental conditions is also discussed in this section.

Section 4.0 presents the HHRA for environmental media for current and future exposure scenarios pertaining to environmental media. Similarly, Section 5.0 is a HHRA for the building materials that evaluates current and future exposure scenarios associated with building materials. Section 6.0 presents the Fish and Wildlife Impact Analysis (FWIA).

The references that were relied upon in the preparation of this RI Report are provided at the end of report in the References Section.

1.3 BACKGROUND INFORMATION

1.3.1 Site Description

Figure 1-2 is a Site plan that shows the boundaries and select features of the Site. The Site is located in a mixed industrial/residential area with multiple and single-family residences to the east, and industrial facilities along the river to the north and south. The Site is bounded by the Hudson River and the EPRI Laboratory building to the west, the Hudson Line of the Metro-North Commuter Railroad to the east, a bus depot and bag factory to the south and the Hudson River to the north. The EPRI Laboratory building, which is located within the BICC facility, is not part of the Registry Site. Additional discussion regarding the delisting of the EPRI Laboratory Building is presented below.

As shown in Figure 1-2, the former manufacturing buildings are located on the northern side of the property. From south to north, these former manufacturing Site Buildings include the East and West warehouses, High Bay Building and the remaining northern former manufacturing areas.

Portions of the Site Buildings are situated on pilings over the river. The approximate location of the shoreline/bulkhead is shown in Figure 1-2. Portions of the Site Buildings, including, but not limited to, the East and

West Warehouses and the High Bay Building, have been cleaned, tested, and as necessary, encapsulated in accordance with RI/FS Work Plan procedures and criteria under the oversight of NYSDEC and NYSDOH. These previously cleaned areas of Site Buildings are currently operated by Hudson River Stage/BICC Cables Corp. Hudson River Stage/BICC Cables Corp. operates under short-term leases with movie production companies for film production, commercials, and for storage uses, both inside and outside the buildings. Occupancy is limited to the previously cleaned areas of the Site Buildings.

A chain link/barbed wire fence surrounds the Site and entry is only through guarded gates at the Babcock and Point Street entrances. Access to the Site is controlled by security guards who are on duty 24 hours a day, seven days a week.

The EPRI Laboratory, which occupies Block 2630/Lot 2, is a freestanding building constructed in or about 1968 on pilings over the Hudson River. This building, which is 35,000 square feet in area and 90 feet tall, was formerly used for cables testing and was not used for any manufacturing operations. This building interior together with other areas of the Site was initially characterized through surface wipe sampling. Results indicated minor chemical concentrations in the surface accumulation. The surface accumulation was later removed through cleaning and the building was retested. All results for the EPRI Laboratory building were below the applicable criteria.

Based on information regarding historic operations conducted in the EPRI Laboratory, a petition was made to delist the EPRI Laboratory from the Registry. On 6 November 2000, NYSDEC approved the petition to remove the EPRI Laboratory from the State Registry (NYSDEC, 2000c).

Therefore, the EPRI Laboratory is not part of the Site Buildings discussed in this RI Report.

To the south of the former manufacturing buildings is an open area that has commonly been referred to as the Yard. The surface of the Yard is covered with either asphalt, ballast, rip rap or concrete or is exposed soil with vegetation. During manufacturing operations, the Yard was used for storage of reels, finished product and raw materials.

As discussed in Section 1.2, this RI presents the results of exterior and building interior investigations. The exterior investigations are made up of environmental media samples (e.g., soil, ground water and Hudson River sediment). This RI presents and evaluates the results of each of these environmental media. For soil, the results are grouped into four data sets. These are designated in Figure 1-2 as: North Yard; South Yard; BICC Parking Lot and Below Buildings. As discussed below in Sections 1.3.2.2 and 1.4, based on available historic records, these four areas coincide with construction and land development milestones at the Site. The demarcation line between the North Yard and South Yard was located based upon:

- Sanborn maps (Figures 1-3 through 1-6),
- aerial photographs (Figures 1-7 through 1-12),
- the anticipated slopeback of the shoreline, and
- the fill quality observed in the North and South Yards (chemical and physical).

As noted in the boring logs (see Appendix A) and further discussed in Section 2.2.1.3, sand, gravel, concrete, brick, coal, ash, metal, wood, scrap metal and rebar were observed in the North Yard fill, South Yard fill and Below Building fill. Review of the Sanborn maps for the Site indicate that the South Yard and the Below Building areas were filled between the 1880s and 1942. In addition to the historic fill materials, the boring logs indicate that the North Yard, which was filled between the 1940s and 1970s contains operational debris.

The building interior investigation is made up of interior building materials samples (concrete wipe samples, concrete bulk samples and wood bulk samples). This RI presents and evaluates the results of each of these building material samples.

1.3.2 Historic Site Operations

The following section briefly describes the prior manufacturing operations and Site usage during its industrial history. More detailed information regarding historic Site operations and chemical usage was previously provided to the NYSDEC in the following deliverables:

- Draft Site Investigation Work Plan, BICC Cable Corporation, Yonkers, New York, prepared by ERM, dated February 19, 1997.
- Initial Submittal, BICC Cables Inc., containing Summary Building Exterior Data Tables and Maps, prepared by ERM, dated March 2000 and Summary Building Interior, Data Tables and Figures, prepared by Roux, dated March 2000, transmitted from DL Rothberg & Associates to the NYSDEC on March 30, 2000.
- Final Remedial Investigation/Feasibility Study Work Plan, BICC Cables Corporation, One Point Street, Yonkers, New York, prepared by ERM, March 2, 2001.
- Site documents made available for NYSDEC review at the offices of DL Rothberg & Associates on December 12 and 18, 2000 – copies of documents requested by NYSDEC from this review were transmitted to the NYSDEC on 28 December 2002.
- Site documents submitted by the Phelps Dodge Corporation to the NYSDEC on August 31, 2001 in response to the NYSDEC's Request for Information.

1.3.2.1 Manufacturing Operations

A summary of the ownership history is shown in Table 1-1.

In 1915, the Harbishaw Wire Company began manufacturing paper-insulated, lead-jacketed cables. These cables were composed of paper insulation that was wound over a conductor, oil impregnated, and covered with a lead sheath jacket. A layer of bitumen was applied to the lead sheath to provide corrosion resistance and the cable was then jacketed with rubber.

At a later time, Habirshaw manufactured a wide range of cable and wire products. Different Habirshaw cable manufacturing lines required different types of equipment and materials. The rubber insulated and jacketed cables required rubber mixing equipment and continuous vulcanizing steam lines. Manufacturing of the armored submarine cable required the use of asphalt and jute to provide water resistance.

After Phelps Dodge acquired the facility in 1930, the product line continued to include various wire and cable production but, by the 1960's, began to focus on paper cable manufacture and included the use of highly refined rosins and later refined hydrocarbon oils as the dielectric fluids to replace the rosins. Rubber cable manufacturing was phased out at the Site by the 1960s. About that time, the manufacturing of armored submarine cable was also discontinued. Higher voltage cables and solid dielectric cable with insulation made of polyethylene (PE) and ethylene propylene rubber (EPR) for medium voltage distribution applications were developed and manufactured at the Site beginning in the 1960s.

Details of the materials used in manufacturing of lead-jacketed, paper-wrapped electrical cable were paper, dielectric fluid (a synthetic hydrocarbon oil) for impregnation of the paper, copper, lead, polyethylene and polyvinylchloride (PVC) were discussed in Appendix A of the RI/FS Work Plan (ERM/Roux, 2001).

After the acquisition of the Yonkers facility by Cablec in 1984 (later merged into BICC Cables Corp.), the product line was narrowed further to focus on the growing electric distribution market for which paper, lead, PE and EPR were used. However, Cablec moved the solid dielectric cable manufacture of PE and EPR to other facilities. Some of the PE and EPR cables that were manufactured at the other BICC factories were shipped to the Site for finishing, such as the application of a lead jacket to provide protection against mechanical abuse and moisture. The principal materials used for cable manufacture after 1984 at the Site were paper, dielectric oil and lead with polyethylene or PVC applied as jackets over the lead. During Cablec operations when the product focus at the Site centered on paper insulated lead jacketed cable, the level of manufacturing activity was significantly reduced.

As a result of a decline in the market for paper insulated lead-jacketed cable, BICC ceased manufacturing operations at the Site in 1996.

1.3.2.2 Site Usage

The Site has been progressively developed over the last 100 years. This has included changes to the Site acreage, topography and number of buildings. Between 1890 and 1916, the first Site buildings were constructed between the Hudson River and the railroad tracks. Although records indicate that S.S. Hepworth & Co. occupied the Site around 1886 (see Table 1-1), facility drawings do not indicate any current Site buildings constructed in that year. Sanborn maps from 1898 and 1917 are provided as Figure 1-3 and 1-4. These figures show the Point Street railroad crossing bridge, as well as the Site buildings and shoreline at that time. As indicated in the 1898 map, the shoreline previously ran adjacent to the rail lines, a yacht club was located in the vicinity of the current High Bay Building and two additional docks were located in the vicinity of the North Yard. The South Yard was fill and then occupied by New York Central freight yard tracks.

As shown in Figure 1-2, today, there is considerable land area to the west of these rail lines. Hence, the exterior Yard area south of these buildings is made-land, resulting from filling that occurred along the shoreline. Filling along the shoreline was a typical practice in this area of the Hudson River. The filling progression can be seen in the Sanborn maps from the years 1898 and 1917 and the additional Sanborn maps from the years 1942 and 1989 (Figures 1-5 and 1-6). It should be noted that the Sanborn map for 1989 mistakenly continues to refer to the South Yard parcel (post-1942) as being occupied by New York Central freight yard tracks. This filling progression is also shown in the aerial photographs discussed below.

In the 1930s and early 1940s, additional buildings were constructed on fill materials and on pilings within the river. These included most of the remaining northern Site buildings and the High Bay building. Figures 1-7 through 1-12 show aerial photographs of the Site spanning the period from 1940 to 1990. Site boundaries, along with key Site features, are noted on each of the aerial photographs. An unidentified feature is located in Figure 1-11 just off the shore to the south of the BICC site. There is no information regarding this feature on the aerial. It is likely the surface water low tide line.

The southern-most manufacturing building in the 1940 aerial photograph is the High Bay Building constructed in 1938. Neither the East nor the West Warehouse had been constructed at the time of this photograph. In fact, the future location of the East Warehouse had not yet been filled. The 1940 shoreline in the future area of these warehouses abuts the railroad tracks. The overlay on this aerial photograph shows the shoreline as it exists today, located much further to the west. Additionally, most of the southern portion of the Yard has already been filled by this time, exhibiting an irregular edge along the Hudson River.

The East Warehouse was constructed by the time of the 1954 aerial photograph. Hence, the former shoreline was filled below this structure by this time. This filling extended to the south, linking the southern Yard landmass to the East Warehouse. In the 1954 aerial photography, the northern part of the Yard appears to be in use for storage of materials. The shoreline of the entire Yard remains irregular along the river. In addition, the photograph shows the presence of a cable manufacturing line, referred to as the Styroflex drawdown line which ran directly from a small shed on pilings at the southern end of the property on a platform over pilings in the river to the current location of the West Warehouse.

By 1976, the filling to create the current shoreline has been completed. The two remaining aerial photographs, covering the period of 1980 and 1990, show that the Styroflex drawdown line is no longer present. Otherwise, the Site surface features remain unchanged, indicating no further filling occurred after 1976.

The Sanborn maps and the aerial photographs demonstrate that the vast majority of the South Yard was filled prior to 1898. The North Yard was then progressively filled in the 1940s and early 1950s with the shoreline filling occurring in the 1970s.

1.4 SUMMARY OF PHYSICAL CHARACTERISTICS

Based on information in the 1940 through 1990 aerial photographs, the exterior soil investigations have been grouped into four groups to represent obvious stages of Site development. The South Yard area is composed of the landmass depicted in the 1940 aerial photograph, extending from the southern boundary of the Site to the point where the shoreline curves eastward to the railroad tracks. The North Yard represents the portion of the Yard that was filled after 1940, including the land below the East Warehouse and the paint shop. As discussed in Section 1.3.1, the demarcation line between the North Yard and South Yard was located based upon:

- Sanborn maps (Figures 1-3 through 1-6),
- aerial photographs (Figures 1-7 through 1-12),
- the anticipated slopeback of the shoreline, and
- the fill quality observed in the North and South Yards (chemical and physical).

Any land beneath the remaining buildings is designated in the Below Buildings group, as this land was part of the earlier known Site construction. The BICC Parking Lot area is separated because it is on the eastern side of the rail lines and direct observations of the subsurface in this area indicate it is composed of different materials than the Yard and beneath building land mass. These four areas are identified in Figure 1-2.

1.4.1 *Topography and Surface Features*

As previously discussed, the Site is covered by buildings, asphalt paving, concrete, ballast, riprap and exposed soil/vegetation. Excluding the EPRI Laboratory, the relative coverage areas are: buildings (35%); asphalt paving, concrete, ballast and riprap (51%) and uncovered vegetated areas (14%). Unpaved, vegetated areas are located: a) within the fenced area on the eastern and western sides of the South Yard; b) immediately east and west of the fence in the North Yard; and, c) east of the access road outside the fenced area. As discussed above, the aerial photographs show that landmass underlying the paved and unpaved portions of the Site consists of fill materials.

1.4.2 *Overburden*

Native overburden material in the Hudson River Valley is a mixture of silt, sand and gravel of glacial, lacustrine and marine origin. These deposits are referred to as the "glacial Lake Hudson deposits".

As the ice sheets continued to retreat northward, water from the Atlantic Ocean entered the Hudson Valley about 12,000 years ago. As part of this marine incursion, coarse sands and gravels ("Basal Sand Deposits") were deposited directly upon the glaciolacustrine silts/clays and interbedded lacustrine-fan sands/gravels. (Stanford 1990) and (Stanford 1991). These marine sands were subsequently overlain by a thick succession of marine silts ("Marine Grey-Silt Unit"). These deposits represent the youngest, naturally occurring geologic unit in the area of the Site.

1.4.3 *Bedrock Geology*

The Site is located in the southern part of Westchester County and this area falls within the Lower Hudson Valley of the New England Physiographic Province. The topography in the area consists of northeast trending ridges separated by rivers that flow southward in valleys. On the eastern bank of the Hudson River the bedrock geology has been mapped as the New York City Group of the Manhattan Prong and on the western bank of the Hudson River is designated the Palisades Ridge. The Manhattan Prong is composed primarily of Grenville age (approximately 1 billion years ago) crystalline metamorphic rocks, consisting of Fordham Gneiss/Inwood Marble/ Manhattan Formation.

The Palisades Ridge on the western bank of the Hudson River is composed primarily of a Triassic-Jurassic age (approximately 200 million years ago) concordant (contacts parallel to bedding) diabase sill that crops out along the river. Triassic shales, sandstones and conglomerates of the Newark Basin underlie the sill. These sedimentary rocks subcrop beneath the Hudson River and are overlain by the more recent overburden deposits described above.

1.4.4 *Surface Water*

The Site lies adjacent to the eastern bank of the Hudson River. No other designated surface water bodies are present in the immediate vicinity of the Site. The topography on the southern side of the Site is relatively flat. On the north end of the Yard, elevations range from a high of approximately 10 feet above mean sea level (msl) on the eastern side of the Site to a low of 0 feet msl on the western side, along the Hudson River. The topography on the south end of the Yard is relatively the same east to west.

Stormwater travels a number of different paths in the Yard. Stormwater recharges through fill material to ground water in unpaved areas (i.e., exposed soil ballast covered and ground covered areas). On-site catch basins in paved areas, which previously discharged to the river, are also present in the Yard. However, these structures have collapsed and no longer function. Consequently, stormwater fills the depressions around the catch basin. Given the presence of an elevated riprap along the shoreline, overland stormwater flow to the river from exposed soil areas is minimal. On the northern side of the Site, the buildings on the pier capture rainwater through a series of roof drains and downspouts and discharge to the Hudson River.

As reported in the RI/FS Work Plan (ERM/Roux, 2001), a study of the Hudson River established a transition zone between fresh and salt water over a 77-mile reach from Turkey Point to Hastings-on-Hudson, just north of the Site. Throughout the tidal reach, the Hudson River is considered a drowned-river estuary with a mean tidal range of 5.5 feet. Within the transition zone under normal inflow and tidal conditions, chloride concentrations range from <25 milligrams per liter (mg/l) at Clinton Point, near New Hamburg to >3,000 mg/l at Hastings-on-Hudson. As such, the tidally influenced portion of the Hudson River extends well to the north of the Site.

1.4.5 Regional Hydrogeology

The main source of ground water in Westchester County is precipitation, which averages 48 inches per year. Runoff averages 22 inches per year and occurs from late winter through the early spring months.

Ground water in the Hudson River Valley occurs in both unconfined and confined conditions within the crystalline, metamorphic bedrock, sedimentary rocks of the Newark Basin and Manhattan Prong, and in the glacial and fluvial unconsolidated sediments that overlie the bedrock units. Ground water recharge generally occurs directly on glacial till or bedrock in the uplands and from there enters the regional system to discharge into local streams and lowland areas.

Glacial outwash deposits, where present, may serve as local aquifers under both confined and unconfined conditions while glacio-lacustrine deposits (e.g., Marine Grey-Silt Unit) generally serve as confining units or aquitards when they directly overlie outwash or pre-glacial fluvial deposits (e.g., Basal Sand Deposits). Because the Hudson River buried valley is filled and capped by the estuarine Marine Grey-Silt Unit, the underlying glacial aquifers are generally confined, and exhibit an upward hydraulic gradient (Stanford 1990a) and (Stanford 1993a).

1.4.6 Site Buildings

As discussed in Section 1.3.2.2, the Site buildings were constructed over a period of approximately 60 years to serve various industrial purposes. Originally, all of the Site buildings were constructed on timber piles driven through soil/fill that was retained by steel sheeting and timber pile bulkheads. The Site buildings were constructed with varying building materials and structural support systems. The majority of the Site buildings have concrete floor slabs supported with concrete or steel frames, while some of the Site buildings are constructed of wood flooring on heavy timber wood framing. The building areas constructed of concrete are typically former manufacturing areas while the areas of wood construction were generally used as office space and light storage.

Although the existing Site buildings were gradually integrated to form a single contiguous building, the varying timeframes of construction and the former usage of each Site building have resulted in distinct structural characteristics in each building and each floor. For instance, the concrete flooring construction is dissimilar from one building to the next and with varying physical properties including thickness, amount of reinforcement, and density. Similarly, the interior wall construction varies from sheet rock to brick and concrete masonry. All of these factors have contributed to the current conditions within the Site buildings in which floor surfaces from one adjoining building to another vary in surface condition and/or stability. Since each of the Site buildings is so unique in its construction, the Site buildings are still referenced by their former Building number designation.

Furthermore, over time, the bulkhead has deteriorated and much of the soil/fill has eroded into the Hudson River. Currently, the soil/fill beneath the West Warehouse, the High Bay Building (Building No. 8), and portions of Building Nos. 7, 9, and 12 has eroded, creating a void space beneath these structures. Due to exposure of the timber support piles through the damaged bulkhead to ice flows and tidal action, deterioration of these support piles has occurred. This has caused visible fracturing and subsidence of several areas of the concrete floor slabs and western dock.

The footprint of each of the four floors also varies as a result of the progressive development of the Site buildings. The footprint of the first floor encompasses approximately 210,000 square feet (SF) while the fourth floor only occupies approximately 16,000 SF. The decreasing area from the first to the fourth floor has resulted, to some extent, in individual roof systems and levels. These roof systems are also of varying age and in differing states of repair. In a number of places, the roof exhibits leaks and allows storm water to enter the Site buildings. Several roof leaks have been identified on each floor of the Site buildings.

At some time following the construction of the Site buildings, a subsurface trench system was constructed in the northern Site buildings. This trench system has concrete walls throughout the length of the system; however, a concrete floor is not present throughout the trench system. Roof drains located in the northern Site buildings tie into portions of the floor trench system, which is routed through the adjacent buildings and conveys storm water to two discharge points. The investigation and cleaning of the trench system is discussed in Section 3.1.2

Based on a review of historical drawings and a geophysical and physical investigation, concrete subsurface structures were identified on the first floor of the Site buildings. According to the historical drawings, these subsurface structures were formerly reel pits and lead press pits. A former reel pit, located in Building No. 2 was investigated and found to contain water and debris. Currently, the remainder of the subsurface structures are filled with soil/fill material and are covered with a concrete slab. A detailed description of the subsurface structure investigation is provided in Section 3.1.5.

2.0 REMEDIAL INVESTIGATION OF ENVIRONMENTAL MEDIA

This section describes the environmental investigation conducted as part of the RI of the Site. The environmental media evaluated during the RI included soil/fill, ground water, and sediment.

2.1 SCOPE OF WORK

As discussed in Section 1.0, an environmental investigation was conducted in 1997 to1998 in accordance with the Petroleum Spills Order for the Site. As part of this investigation, soil/fill and ground water sampling was conducted. The data collected during the Petroleum Spills Investigation provided a general indication of the types and distribution of compounds in the soil/fill and ground water at the Site.

Following the listing of the Site on the Inactive Hazardous Waste Disposal Site Registry, a RI/FS Work Plan (ERM/Roux, 2001) was prepared and approved by NYSDEC. Fieldwork for the RI work scope commenced in late May, early June 2001.

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), after completion of the data validation, a Data Summary Memorandum was prepared and delivered to NYSDEC. The intent of the Data Summary Memorandum was to provide a comprehensive summary of the data to enable ERM, Roux, and NYSDEC/NYSDOH to review that information and make the necessary decisions regarding additional investigation necessary at the Site to complete the RI program. On 5 November 2001, the following documents were delivered to the NYSDEC:

- Data Summary Memorandum (DSM), Exterior (ERM, 2001d); and
- Data Summary Memorandum, Interior (Roux, 2001f).

The DSM, Exterior (ERM, 2001d) contained the results of the Yard soil/fill and ground water sampling activities. The DSM, Interior contained the results of the building surface sampling and the soil/fill sampling conducted below the buildings (Roux 2001f). The building surface results are discussed further in Section 3.0.

Following submittal of these documents to the NYSDEC, a meeting was held on 13 December 2001 to discuss whether data gaps existed and to identify additional sampling needed to complete the RI. On 21 December 2001, ERM submitted Interim Deliverable No. 5, Supplemental RI/FS Sampling (ERM, 2001f), to the NYSDEC. On 3 January 2002, NYSDEC transmitted comments on Interim Deliverable No. 5. Based on this comment letter, additional sampling was included in the interior work scope. The additional interior and exterior sampling commenced on 7 January 2002 and was completed by 22 January 2002. The results of the Site sampling conducted through January 2002 were included in the draft RI report submitted to the NYSDEC on 30 April 2002.

Following submittal of the draft RI report, a meeting was held on 19 June 2002 with NYSDEC and BICC to discuss the draft report. Subsequent to this meeting, the NYSDEC and NYSDOH requested additional sampling be conducted at the Site. This included additional ground water and sediment sampling, soil beneath Site buildings and building interior sampling.

Table 2-1 presents a summary of the RI activities conducted at the Site related to environmental media (i.e., Site soil/fill, groundwater and Hudson River sediment adjacent to the Site). This table identifies the proposed work scope presented in the RI/FS Work Plan (ERM/Roux, 2001), the implemented work scope and the rationale for any changes.

Table 2-2 presents details regarding the exterior work conducted. This table summarizes the pertinent information pertaining to the environmental media samples (designation, laboratory ID, etc.), sampling intervals and corresponding analyses. The building interior samples are discussed in Section 3.0.

This section of the RI separately discusses the investigation of each environmental medium. They are soil/fill (Section 2.2), ground water (Section 2.3) and sediment (Section 2.4). The presentation covers the objectives, field activities and results for each environmental media. Moreover, the discussion of the results includes the data gathered in connection with the Petroleum Spills Investigation. The objectives and procedures for those sampling activities were included in the RI/FS Work Plan (ERM/Roux, 2001). Additional details regarding the sampling and analytical procedures are provided in the Sampling and Analysis Plan (SAP) contained in the RI/FS Work Plan (ERM/Roux, 2001).

Following discussion of the individual media results, Section 2.5 presents a discussion of the data usability. Section 2.6 then presents an evaluation of the nature and extent of environmental media conditions at the Site and their fate and transport.

2.2 *SOIL/FILL INVESTIGATION*

This section discusses the soil/fill investigation objectives, procedures and results. As discussed in Section 1.3.1 and shown in Figure 2-1, the Site soil/fill has been divided into the following four areas:

- North Yard Soil/Fill,
- South Yard Soil/Fill,
- BICC Parking Lot Soil/Fill, and

- Soil/Fill Beneath Buildings.

The sample points included in the North Yard data set occupy the area that was filled after 1940 (see Figures 1-7and 2-1). Consequently, in addition to the soil/fill beneath the paved and unpaved portions of the Yard, the North Yard data set also includes soil/fill from below the East Warehouse and other structures south of the High Bay Building. The Below Buildings soil/fill data includes soil/fill from below all buildings north of the southern wall of the High Bay building. The only soil/fill samples collected in the High Bay building were from the railroad siding area. The remainder of the High Bay building is over water (see Figure 2-1).

As discussed further in Section 2.6, the North Yard, South Yard and landmass below the buildings contain historic fill materials. Historic fill materials are non-indigenous materials deposited to raise the topographic elevation of an area. Historic fill can include, but are not limited to: construction and demolition debris (e.g., concrete, bricks, glass, wood, etc.), cinders, slag and coal, dredge spoils and non-hazardous solid waste. Historic fill was routinely used as fill materials along waterways. The North Yard also contains cable manufacturing waste and scrap debris from former Site operations.

The area beneath the BICC Parking Lot also appears to be composed of fill material (i.e., non-native soil); however, this material is a consistently graded sandy material and is not of the same character or quality as historic fill material. Hereafter, this material will be referred to as soil to distinguish it from the historic fill materials present in the other Site areas.

Section 2.2.1 presents a summary of the soil/fill investigative work conducted in the North Yard, South Yard and the BICC Parking Lot. This work was conducted by ERM. Section 2.2.2 presents a summary of the soil/fill investigative work conducted below the buildings, which was conducted by Roux.

2.2.1 *North Yard, South Yard And BICC Parking Lot*

The North Yard, South Yard and BICC Parking Lot sampling locations are shown in Figure 2-1. An overlay of the soil sampling locations onto the aerial photographs is provided in Figures 1-7 through 1-12.

2.2.1.1 Objectives

Surface Soil/Fill

As shown in Figure 2-1, the majority of the Yard is covered by asphalt pavement, concrete pavement, ballast, gravel, or riprap. Unpaved, vegetated areas are located: a) within the fenced area on the eastern and western sides of the South Yard; b) immediately east and west of the fence in the North Yard; and, c) east of the access road outside the fenced area (see Figure 2-1).

A surface soil/fill sample is designated as one collected from an uncovered surface anywhere within the upper two feet of soil. These intervals were selected to address NYSDEC and NYSDOH requirements. The objective of these samples was to assess the presence of organic compounds and inorganic constituents in surface soil/fill.

Subsurface Soil/Fill

During the Petroleum Spills Investigation, direct observations of subsurface soils indicated that fill materials were present at the Site.

Hence, as part of scoping the RI, a geophysical investigation was performed using metal detection (EM-61) and ground penetrating radar (GPR) surveys to gain more information on the composition of the subsurface in the Yard and better define a sampling strategy. The results of the geophysical investigation were reported in the RI/FS Work Plan (ERM/Roux, 2001).

The objectives of the additional subsurface investigative activities performed during the RI were to:

- determine the extent and quality of fill underlying the Yard;
- determine the depth at which naturally-deposited material is present beneath the Yard;
- evaluate the nature and quality of the naturally-deposited material underlying the Yard;
- investigate anomalies identified during the geophysical investigation (magnetic response and GPR anomalies);
- investigate any anomolies identified during the drain inspection (e.g., the suspected dry well discussed below);
- more accurately delineate the horizontal and vertical extent of PCBs, SVOCs, and inorganic constituents within the fill, soil, and naturally deposited material underlying the Yard;
- determine whether there was a common signature among various environmental media for PCBs;
- determine classification of soil/fill materials as potential waste materials; and
- gather information needed to determine the fate and transport of chemicals in Site soil/fill and to conduct the risk assessment.

Multiple intervals were sampled to assist in the vertical delineation of organic compounds and inorganic constituents in the subsurface. These intervals characterized the unsaturated (above the ground water table) and saturated (below the ground water table) zones in the subsurface.

Based on the information obtained from the earlier Petroleum Spills Investigation, historic Site development and the geophysical investigation, the subsurface sample program was biased toward the North Yard.

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), test pits were incorporated into the investigation to assist in the evaluation of subsurface conditions. These test pits were placed in the North Yard where the geophysical investigation indicated a more concentrated response. The objective of excavating test pits in these selected areas was to allow a more thorough inspection of the fill materials in this portion of the Yard.

Observations of the material encountered during the test pit excavations were carefully noted and field decisions were made for collection of specific samples for laboratory analysis. These test pit samples were intended to provide further characterization of the types of materials that might contribute to organic compounds or inorganic constituents present in environmental media from these materials. The test pit locations are shown on Figure 2-1.

2.2.1.2 Procedures

Surface Soil/Fill Sampling

To evaluate the surface soil/fill quality in the North Yard and South Yard, a total of 23 surface soil samples were collected during this phase of the RI. One surface soil sample is also included in the below building data set.

As mentioned above, surface soil/fill samples were collected anywhere within the upper two feet of soil in uncovered areas. The surface soil/fill sampling procedure is provided in the SAP located in the RI/FS Work Plan (ERM/Roux, 2001).

All surface soil/fill samples were screened in the field using a PID. If elevated concentrations of volatile organic compounds (VOCs) were detected, an additional aliquot of the sample was collected and analyzed for VOCs. Based on the background readings, the field geologist made the decision of whether a PID reading was elevated. Background PID readings generally ranged from zero parts per million by volume (ppmv) to 20 to 25 ppmv.

In general, the PID readings observed during soil/fill sampling were low. Nevertheless, some soil/fill samples were chosen at random for VOC analysis to confirm the PID readings. Surface soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), polychlorinated biphenyls, and/or inorganics. The samples analyzed for VOCs used USEPA Method 8260B. The samples analyzed for SVOCs and PCBs used USEPA Method 8270C and USEPA Method 8081, respectively. Inorganic analyses were performed for Target Analyte List (TAL) constituents using USEPA Methods 6010B and 7470A and cyanide using USEPA Method 9012A. All samples were reported using NYSDEC Analytical Services Protocol (ASP) Category B Deliverables.

A summary of the surface soil/fill samples collected and the analytes for which they were analyzed is shown on Table 2-2. Also included in this table are the PID readings collected during soil/fill sampling.

Subsurface Soil/Fill Sampling

The subsurface soil/fill was investigated by installing borings. Generally, the uppermost soil sample collected from soil borings in unpaved and paved areas was collected for the 0 to 0.5 foot and 1 to 3 foot intervals, respectively. In paved areas, an attempt was made to collect the soil samples as close to the top of the 1 to 3 foot intervals as possible without including asphalt or concrete in the sample.

The Yard borings were extended from the ground surface to the top of the organic silt clay layer wherever the clay was encountered. The depth of this unit was anticipated to be about 15 feet below ground surface (bgs) on the western side of the Yard (adjacent to the Hudson River) and up to 25 feet bgs on the eastern side of the Yard. As discussed below, the boring data indicates that the native silt/clay occurs deeper than anticipated.

The Yard borings were sampled continuously from ground surface to the termination depth to determine the characteristics of the fill material. Guidance regarding sampling depths was provided in the RI/FS Work Plan (ERM/Roux, 2001). However, the sampling intervals were adjusted by the field geologist, as appropriate, based upon field observations.

Borings in the Yard area were installed using a truck-mounted Geoprobe rig and 4-foot long macrocore lined with dedicated acetate liners. Each four-foot core was generally split into two-foot intervals for subsurface sampling purposes. Soil/fill characteristics such as color, moisture content, texture, and lithology were logged in field notebooks. The selected subsurface soil samples were then placed in sample jars for storage and transportation to the laboratory for analysis. Boring logs are presented in Appendix A.

All subsurface soil/fill samples were screened in the field using a PID, and if elevated concentrations of VOCs were detected, an additional volume of the sample was also analyzed for VOCs. The determination of whether or not a reading was elevated and VOC analysis was needed was decided at the discretion of the field geologist based on background PID readings. Subsurface soil/fill samples were analyzed for the same constituents as surface soil/fill samples employing the same analytical methods. In addition, a number of subsurface soil/fill samples were analyzed for specific PCB congeners to determine whether there was a common signature among various environmental media for PCBs, key organic compounds known to be present at the Site.

Furthermore, select subsurface soil/fill samples were analyzed to ascertain the physical characteristics of soil/fill and to evaluate the classification of the soil/fill as a potential waste material. The physical characteristics analysis involved grain size, bulk density and total organic carbon. The waste classification sampling involved the Resource Conservation Recovery Act (RCRA) toxicity characteristics (TC) using the Toxicity Characteristics Leaching Procedure (TCLP) and the remaining RCRA characteristics (i.e., corrosivity, ignitability and reactivity). The locations of samples analyzed for TCLP and/or RCRA characteristics were within the footprint of the subsurface soils previously identified as containing organic compounds and inorganic constituents.

All boring locations shown in Figure 2-1 were surveyed by a licensed NY State Surveyor or in the field by using a portable Global Positioning System. The U.S. State Plane Coordinates for each location are also included on the boring logs in Appendix A.

All the subsurface soil/fill samples are summarized in Table 2-2. This table also notes all the quality assurance and quality control (QA/QC) samples as recommended in the SAP of the RI/FS Work Plan (ERM/Roux, 2001).

Test Pit Soil/Fill Sampling

The test pits were excavated by a subcontractor using a backhoe under the direction of the field geologist. The dimensions of the pit and the angle of the sidewalls were determined in the field based upon the depth of the excavation, water content, loading and competency of the soil/fill. Each pit was excavated until subsurface obstructions and sidewall competency prevented further excavation. All excavated material was placed on plastic sheeting located to the side of the pit. At the conclusion of inspection and sampling of the pit, the excavated materials were placed back in the pit. Due to compaction limitations, all of the excavation materials could not be returned to the test pits. The excess material was stored, tested, and based on the waste characterization test results, disposed of off-site as a non-hazardous waste. The characterization results and manifests for this waste are provided in Appendix E.

The sidewalls of each test pit were carefully examined by the field geologist from the ground surface to the bottom of the test pit and observations were recorded in the field notebook. Particular attention was paid to the types of fill materials, changes in fill materials in either the horizontal or the vertical direction, color of materials, water content, characteristics of fill, odors and staining. The sidewalls were photographed. Test pit logs and photographs of the test pits are included in Appendix B.

The sampling locations for each test pit were selected in the field based on the type, condition, and location of the materials encountered. In general, one sample was collected from each sidewall and one composite sample was collected from the base of each of the four test pits for a total of 20 samples. All subsurface soil samples from the test pit were screened in the field using a PID. Based on the field screening results, all test pit samples were analyzed for VOCs. Additionally, the test pit samples were analyzed for

SVOCs, PCBs, TAL Inorganics using the previously described USEPA test methods. Additionally, the test pit samples were analyzed using Gas Chromatograph (GC) Flame Ionization Detector (FID) and Gas Chromatograph/Mass Spectroscopy (GC/MS) in the selected ion mode (SIM) for hydrocarbon fingerprinting and PCB congeners, respectively. A list of samples collected and their respective analysis is included on Table 2-2.

During installation of the test pits, a non-aqueous phase liquid (NAPL) layer was observed in TP-1. A NAPL sample was collected from this location and submitted to the laboratory for PCB analysis. The laboratory reported the pattern of hydrocarbons present in the sample to assist in assessing whether the NAPL exhibits a common hydrocarbon signature to other environmental media samples. At some soil boring, test pit and monitoring well locations, evidence of petroleum was noted. For the purpose of this document, "evidence of petroleum" is being defined as soil staining, petroleum-like odors or the visual observation of material resembling product/oil or sheens. In addition to the evidence of petroleum, various unknown colored materials were observed in the subsurface. This particular information is discussed in Section 2.6.

North Yard Drainage System

Cleaning and inspection of the North Yard subsurface structures was conducted during the RI. These structures included two catchbasins (one located in the loading dock to the south of the building in the center of the Yard and one located in the westernmost loading dock along the warehouses), a sump in the eastern loading dock, and surface drains in the vicinity of the eastern loading dock.

Major obstructions were first removed from the catchbasins and the beginning of their piping using a high-pressure water supply and vacuum withdrawal system. This allowed simultaneous cleaning and extraction of the water and sediment. The removed water/sediment mixture was placed in a Frac tank and stored on-site. The water was tested and then discharged to the sanitary sewer system under a permit with Westchester County. The sediment was placed in drums and tested for appropriate disposal off-site.

Once the major obstructions had been removed, transmitters and/or video cameras were placed in the outfall pipe to trace the line. Divers were also stationed in the river to visually identify the discharge location and insert plugs into the lines to minimize sediment discharge to the river. Through video inspection, it was determined that the outfall pipes from the southern and western loading dock catchbasins are collapsed approximately 76 feet and 52 feet, respectively, from their catchbasins. These lines terminate well before they reach the river. At the sump located in the eastern loading dock, two pipes were observed. One pipe was capped. According to BICC personnel, the other pipe was used to transfer supernatant water from the sump to the sanitary sewer system.

Lastly, a camera was inserted into the surface drains located adjacent to the eastern loading dock. This inspection indicated that the trench drains located in the elevated portion of the eastern loading dock discharge into what appears to be a subsurface drainage structure. The top of the drainage structure can be accessed from a surface grating at ground surface. The contractor attempted to remove water from this structure so that they could insert their camera into the structure for inspection. However, water rapidly recharged into the structure making it difficult to see. After reconfiguring their equipment, the contractor was able to simultaneously withdraw water and insert the camera. The characteristics of this structure (i.e., curved side walls) suggest that it is a dry well. Hence, a ground water sample and a sediment sample were collected from this structure and analyzed for VOCs, SVOCs, inorganic constituents and PCBs. The ground water sample is discussed in Section 2.3 and the dry well sediment is discussed below.

The dry well sediment sample was collected using a hand auger. The depth from the top of pavement to the bottom of the dry well is approximately 8.32 feet. Approximately one inch of sediment was present at the bottom of the dry well. A hard surface that the hand auger could not penetrate was located beneath the sediment. The dry well sediment is discussed along with the soil samples, since this media represents soil conditions.

2.2.1.3 Results

The findings of samples collected from North Yard, South Yard and BICC Parking Lot are presented below. Pertinent information regarding the subsurface composition and chemistry are highlighted in tables.

Subsurface Lithology

The observations recorded in logs for the borings installed across the Site provide the basis for cross-sections of the Yard soil/fill. A cross-section key map is presented as Figure 2-2 and four cross-sections (two north-south and two east-west) are provided as Figures 2-3 through 2-6.

As shown in the logs and cross-sections, the South Yard subsurface materials consist of coarse sand and gravel with historic fill materials, while the North Yard contains coarse sand and gravel with historic fill and other materials. The specific materials identified in the North and South Yard fill are:

South Yard	North Yard
Coarse sand and gravel with: Brick fragments, cinders, slag, coal, ash and shells	South Yard materials plus: Wood pieces, resin material, oily residue, rubber, a white chalky resin-like material, wire, cable and plastic

The borings were installed to the underlying silt layer. The silt layer was encountered at depths ranging from 10 to 20 feet below grade. At some boring locations, refusal was encountered before the silt layer could be reached. The location of the silt layer and the depth of each boring are presented in the boring logs.

In addition to the borings in the North and South Yard, borings were also installed in the southeastern unpaved area beyond the fenceline (SB-41, SB-42 and SB-43) and in the BICC Parking Lot (SB-43 and 44). The borings for the southeastern unpaved area beyond the fenceline indicate similar overburden materials to those in the South Yard. Borings SB-41, SB-42 and SB-43 are considered part of the South Yard. Although the boring logs for the BICC Parking Lot also indicate that this area of the Site has been filled, unlike the South Yard, the subsurface of the BICC parking lot is composed of sand with no obviously historic fill. Since this fill is not similar to the fill materials in the Yard, it is evaluated separately.

Soil staining was observed in one boring located in the South Yard (SB-37) and in sixteen borings located in the North Yard (SB-01, 14, 38, 50, 54A, 56, 57, 58, 59, 61, 62, 63, 64, 67, 69 and 79) and in 3 test pits located in the

North Yard (TP-1, TP-2 and TP-4). The depths of soil staining ranged from 3 feet below ground surface in SB-14 (MW-05) to 16 feet below ground surface in SB-57. Figure 2-7 shows the locations of soil staining, odors and sheens in monitoring wells.

Chemistry

Including the Petroleum Spills Investigation, a total of 34 surface soil/fill samples, 199 subsurface soil/fill samples, 20 test pit fill samples and one sediment sample from the drywell were collected in the North Yard, South Yard and BICC Parking Lot.

The samples were analyzed for VOCs, SVOCs, PCBs, inorganic constituents, RCRA characteristics (i.e., toxicity, ignitability, corrosivity and reactivity) and/or physical characteristics. In addition, soil/fill samples collected from the test pits were analyzed to assist in fingerprinting hydrocarbons and for specific PCB congeners. The soil/fill sampling intervals and analytes for the North Yard, South Yard soil are summarized in Table 2-2.

As discussed in Section 2.2, intervals and analytes for fill beneath the buildings is presented in Table 2-3.

As discussed above, a NAPL layer was also observed in the bottom of TP-1 and a sample of this material was collected and analyzed for PCBs and hydrocarbon fingerprinting. The results of the PCB analysis are presented in Table 2-4.

The soil/fill sampling results for the South Yard, North Yard, BICC Parking Lot and dry well sediment are presented in Tables 2-5A through 2-5E, Tables 2-6A through 2-6E, Tables 2-7A through 2-7C and Table 2-9, respectively. Though these results are indicative of fill, the tabular summaries of each organic compound or inorganic constituent also note the corresponding Recommended Soil Cleanup Objective (RSCO) as indicated in NYSDEC Technical Administrative Guidance Memorandum (TAGM) 4046.

For organic constituents, the RSCOs are the lower of the direct contact and impact to ground water cleanup objectives. The RSCOs for inorganic constituents are based on conservative eastern USA background concentrations in native soil. Based upon discussions with Jim Harrington of the NYSDEC, draft RSCOs were used for chromium and cadmium. The draft RSCOs are: 10 milligram per kilogram (mg/kg) for cadmium and 50 mg/kg for chromium.

In addition to the individual SVOC and VOC concentrations, tables containing SVOC and VOC results also contain the total SVOCs and total VOCs for each sample. Along with these results, the maximum soil cleanup objectives for total VOCs and total SVOCs are noted. These maximum cleanup objectives, as set forth in TAGM 4046, are:

- Total VOCs: < 10,000 μg/kg
- Total SVOCs: < 500,000 μg/kg

In addition to these maximum soil cleanup objectives, TAGM 4046 also contains a maximum soil cleanup objective of 50,000 μg/kg for any single SVOC. The RSCOs and categorical limits, as presented in TAGM 4046, are included in the data tables for information and comparison purposes.

In addition to the above totals, the tables containing soil/fill results for SVOCs also contain the values for total benzo(a)pyrene (BaP) equivalents, total carcinogenic polyaromatic hydrocarbons (CaPAHs)[2], total polyaromatic hydrocarbons (PAHs) and total SVOC tentatively identified compounds (TICs). Total benzo(a)pyrene equivalents and total CaPAHs have been presented at the request of the NYSDEC.

The following discusses the soil/fill results for the South Yard, North Yard, Dry Well Sediment and BICC Parking Lot soil/fill samples and the NAPL sample results for TP-1. To complement the tabular summaries and assist in putting the data set into some perspective, the minimum and maximum concentration of VOC, SVOC, CaPAHs, total PCBs, lead and copper, are provided. These parameters represent the organic compounds that were tested for during the RI. Lead and copper represent two inorganic constituents that were most prominent during past Site manufacturing operations.

The minimum and maximum concentrations are accompanied by the one-tailed 95% Upper Confidence Limit (UCL) on the mean (average) concentration for each of the aforementioned parameters. In cases where individual organic compounds or inorganic constituents were reported by the laboratory as not detected, one half of the laboratory detection limit was assumed to be present in the sample when defining the 95% UCL on the mean for that compound. For total values, only detected compounds were included in the totals. The 95% UCL on the mean concentration is intended to represent, with a 95% degree of confidence, the mean of any large group of samples obtained from the designated area. Based on the

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[2] CaPAHs are defined as benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene.

distribution of the soil/fill sampling results, a log normal distribution was assumed when calculating the 95% UCL on the mean.

NAPL Sample

The NAPL sample from TP-1 was analyzed for PCBs. The results, summarized in Table 2-4, indicate that of the PCB Aroclors that were tested, Aroclor 1260 was the only one identified above its detection limit. Aroclor 1260 was reported at a concentration of 99 mg/kg. Since the PCB concentration of the NAPL is above 50 mg/kg, removed NAPL would be classified as both a New York State hazardous waste and a Toxic Substances Control Act (TSCA) PCB waste. Additional discussion regarding the observance of NAPL at the Site is discussed in Section 2.3.3.2.

South Yard

VOCs

Table 2-5A summarizes the VOC analyses for soil/fill in the South Yard. None of the reported VOCs exceeded their respective RSCOs. Furthermore, the total VOCs for these samples were below the maximum soil cleanup objective categorical limits for VOCs.

The minimum, maximum and 95% UCL on the mean concentration for total VOCs are:

Total VOCs South Yard (µg/kg)	
Minimum	ND
Maximum	200
95% UCL Mean	256

SVOCs

Table 2-5B summarizes the SVOC analyses for soil/fill in the South Yard. A number of the reported SVOCs exceeded their respective RSCOs. These SVOCs were typically in the category of PAHs. Exceedances occurred throughout South Yard soil/fill. Total SVOCs are comprised of PAHs, phenols and phthalates; CaPAHs are a subset of PAHs. The South Yard statistics for these parameters are provided below.

As indicated in Table 2-5B, the South Yard soil/fill results did not exceed the maximum soil cleanup objective categorical limit for total SVOCs (i.e., 500,000 μg/kg) or the limit for individual SVOCs (i.e., 50,000 mg/kg).

The minimum, maximum and 95% UCL on the mean concentrations for total SVOCs, total PAHs, total phenols, total phthalates and total CaPAHs in South Yard soil/fill are:

Total SVOCs South Yard (μg/kg)	
Minimum	ND
Maximum	241,710
95% UCL Mean	94,273

Total PAHs South Yard (μg/kg)	
Minimum	ND
Maximum	234,250
95% UCL Mean	76,988

Total Phenols South Yard (μg/kg)	
Minimum	ND
Maximum	65
95% UCL Mean	1.0

Total Phthalates South Yard (μg/kg)	
Minimum	ND
Maximum	47,900
95% UCL Mean	12,158

Total CaPAHs South Yard (μg/kg)	
Minimum	ND
Maximum	94,520
95% UCL Mean	47,202

Inorganics

Table 2-5C summarizes the inorganic constituent analyses for soil/fill in the South Yard. A number of the reported inorganic constituents exceeded the respective RSCOs. The most frequent inorganic constituents that exceeded RSCOs were arsenic, copper, iron, mercury, nickel and zinc. Additionally, lead also exceeded its RSCO in about one-half of the samples.

As described above, copper and lead were key inorganic constituents associated with past manufacturing operations at the Site. Hence, the minimum, maximum and 95% UCL on the mean concentrations for these two constituents in South Yard soil/fill are:

Copper South Yard (mg/kg)	
Minimum	16
Maximum	5,630
95% UCL Mean	288

The highest copper concentration was located in the 0.5 to 2 foot interval at sample location SB-11.

Lead South Yard (mg/kg)	
Minimum	9
Maximum	6,230
95% UCL Mean	778

The highest lead concentration was located in the 3 to 5 foot interval at sample location SB-08.

In response to NYSDEC requests, four additional inorganic constituents, antimony, barium, zinc and mercury, were also reviewed. The minimum, maximum and 95% UCL on the mean concentrations for these four additional inorganic constituents in South Yard soil/fill are:

Antimony South Yard (mg/kg)	
Minimum	1.1
Maximum	152
95% UCL Mean	1.5

Barium South Yard (mg/kg)	
Minimum	34.4
Maximum	4,460
95% UCL Mean	459

Zinc South Yard (mg/kg)	
Minimum	22.1
Maximum	5,220
95% UCL Mean	449

Mercury South Yard (mg/kg)	
Minimum	0.04
Maximum	12.8
95% UCL Mean	1.1

PCBs

Table 2-5D and 2-5E summarize the PCB analyses for surface and subsurface soil/fill, respectively, for the South Yard. As shown in Table 2-5D, 9 out of 23 surface soil samples in the South Yard were found to have PCB concentrations in excess of the surface PCB soil RSCO. In contrast, all of the subsurface soil/fill samples in the South Yard, with the exception of one location, were below the subsurface PCB soil RSCO. The one exception, SB-78, is located close to the shoreline and the PCB finding above the RSCO was in the 19 to 20-foot depth interval. This interval was below two shallower intervals (4 to 8 feet and 12 to 16 feet) in which PCBs were not detected.

The minimum, maximum and 95% UCL mean concentration for total PCBs in South Yard soil/fill is:

Total PCBs South Yard (mg/kg)	
Minimum	ND
Maximum	23
95% UCL Mean	11

North Yard

VOCs

Table 2-6A summarizes the VOC analyses for soil/fill in the North Yard. A total of six North Yard soil/fill samples exhibited VOCs that exceeded their RSCOs. Two of the samples exhibited only minor exceedances of the RSCOs for acetone (SB-62) and methylene chloride (SB-79). The four remaining samples exceeded the RSCOs for benzene, toluene, ethylbenzene and xylene (BTEX). The BTEX exceedances occurred at sample locations SB-61 (west of retaining wall), SB-66 and SB-69 (beneath the High Bay access ramp) and TP-3SW4S (east of the retaining wall). Furthermore, these were also the only samples in which the VOC totals were higher than the maximum soil cleanup objective categorical limits for VOCs. The locations of the RSCO exceedances for individual VOCs are provided in Figure 2-8.

The minimum, maximum and 95% UCL on the mean concentration for total VOCs in North Yard soil/fill is:

Total VOCs North Yard (μg/kg)	
Minimum	ND
Maximum	4,061,703
95% UCL Mean	11,549

SVOCs

Table 2-6B summarizes the SVOC analyses for soil/fill in the North Yard. A number of the reported SVOCs exceeded the respective RSCOs, though the detection limits for many samples were above the individual RSCO for that compound. As in the South Yard, many of the SVOCs were typically in the category of PAHs. However, the CaPAHs in the North Yard were present at higher concentrations than in the South Yard.

Other SVOCs in excess of the RSCOs were related to petroleum and plastic by-products (e.g. phenol, naphthalene and bis-2-ethylhexylphthalate).

A number of the North Yard soil/fill samples also exceeded the maximum soil cleanup objective categorical limits for either the total SVOCs or for any one individual SVOC.

The minimum, maximum and 95% UCL on the mean concentrations for total SVOCs and total CaPAHs in the North Yard soil/fill are:

Total SVOCs North Yard (μg/kg)	
Minimum	ND
Maximum	3,979,350
95% UCL Mean	692,497

Total PAHs North Yard (μg/kg)	
Minimum	ND
Maximum	3,789,300
95% UCL Mean	473,876

Total Phenols North Yard (µg/kg)	
Minimum	ND
Maximum	243,810
95% UCL Mean	6,149

Total Phthalates North Yard (µg/kg)	
Minimum	ND
Maximum	3,700,000
95% UCL Mean	1,667,647

Total CaPAHs North Yard (µg/kg)	
Minimum	ND
Maximum	1,280,100
95% UCL Mean	475,680

Inorganics

Table 2-6C summarizes the inorganic constituent analyses for soil/fill in the North Yard. A number of the reported inorganic constituents exceeded their respective RSCOs. The most frequent inorganic constituents that exceeded RSCOs were arsenic, copper, iron, lead, mercury, nickel and zinc.

As described above, copper and lead were key inorganic constituents associated with past manufacturing operations at the Site. Hence, the minimum, maximum and 95% UCL on the mean concentrations for these two constituents in the North Yard soil/fill are:

Copper North Yard (mg/kg)	
Minimum	10
Maximum	34,800
95% UCL Mean	1,667

The highest copper concentration was located in the 8 to 12-foot interval at sample location SB-79 located beneath the East Warehouse.

Lead North Yard (mg/kg)	
Minimum	6
Maximum	41,900
95% UCL Mean	5,915

The highest lead concentration was located in the 1 to 4-foot interval at sample location SB-70 located beneath the East Warehouse.

In response to NYSDEC requests, four additional inorganic constituents, antimony, barium, zinc and mercury, were also reviewed. The minimum, maximum and 95% UCL on the mean concentrations for these four additional inorganic constituents in the North Yard soil/fill are:

Antimony North Yard (mg/kg)	
Minimum	0.470
Maximum	404
95% UCL Mean	6.6

Barium North Yard (mg/kg)	
Minimum	25
Maximum	18,200
95% UCL Mean	957

Zinc North Yard (mg/kg)	
Minimum	30
Maximum	32,500
95% UCL Mean	2,685

Mercury North Yard (mg/kg)	
Minimum	0.039
Maximum	13.1
95% UCL Mean	1.0

PCBs

Tables 2-6D and 2-6E summarize the PCB analyses for surface and subsurface soil/fill, respectively, for the North Yard. There are limited areas where surface soil is exposed in the North Yard. As shown in Table 2-6D, 5 out of 9 surface soil samples were found in excess the surface PCB soil RSCO (i.e., 1 mg/kg).

In subsurface soil, 35 of 166 soil/fill samples were found to exceed the subsurface PCB soil RSCO (i.e., 10 mg/kg). The subsurface soil/fill sample intervals that exceeded the RSCO extended to a maximum depth of 20 feet below grade.
The minimum, maximum and 95% UCL on the mean concentration for total PCBs in North Yard soil/fill is:

Total PCBs North Yard (mg/kg)	
Minimum	ND
Maximum	97,600
95% UCL Mean	1,246,849

Due to the large standard deviation in the North Yard soil/fill PCB data set, the 95% UCL on the mean PCB concentration is considerably higher than the maximum PCB concentration. The highest concentrations of PCBs were observed at sample locations beneath the ramp to the High Bay building and beneath the East Warehouse (Figure 2-1).

As discussed above, four test pits were installed in the North Yard. At the conclusion of the test pit excavation, the excavated fill materials were placed back into the hole. Due to fluffing, not all of the materials removed from the test pits could be placed back into the hole. The excess material was stored on-site in a roll-off, characterized and disposed of off-Site as a non-hazardous waste. The characterization results and waste manifest for this material are presented in Appendix E.

In addition to these materials, one drum of waste materials was generated during installation of SB-79. Materials included drill cuttings, plastic and personal protective equipment (PPE). The SB-79 soil characterization results (see Table 2-12A) were used to characterize this waste material. Based on the maximum soil concentrations observed in this boring, the waste generated from this location was classified as a TSCA regulation, New York State B007 listed hazardous waste for PCBs. The waste manifest for this drum is included in Appendix E.

Dry Well Sediment

In addition to the above North Yard soil/fill samples, a sediment sample was collected from the bottom of the dry well located in the North Yard. A comparison of the dry well sediment results to the RSCOs is presented in Table 2-9. As shown in that table, there are no exceedances of the RSCOs for VOCs. However, exceedances of the RSCOs occurred for

SVOCs, PCBs and inorganic constituents (i.e., beryllium, chromium, copper, iron, lead, mercury, nickel and zinc).

<u>BICC Parking Lot</u>

Tables 2-7A through 2-7C present the findings of the two subsurface soil/fill samples collected in the BICC Parking Lot. As previously stated, the subsurface soils in the BICC Parking Lot appear to be fill. However, the fill composition is different then encountered in either the South or North Yard. As shown in these tables, none of the samples collected from these two locations in the BICC Parking Lot exceeded the RSCOs for SVOCs or PCBs. Based on the low PID readings observed in this area, soil samples were not submitted for VOC analysis from the BICC Parking Lot. With respect to inorganic constituents, the RSCOs for beryllium, iron, mercury, nickel and zinc were exceeded. Of note, neither the copper nor lead RSCOs, two constituents indicative of past manufacturing operations, were exceeded in these two subsurface soil/fill samples.

2.2.2 *Below Buildings*

The area beneath the Site buildings was investigated separately from other portions of the Yard. This approach was taken because the area beneath the Site buildings is a combination of soil/fill and bulkheading, with large segments directly overlying the shoreline of the Hudson River. Potential releases within the building during historic manufacturing activities could have escaped to the underlying environment through structural features (e.g., trenches, drains, discharge lines, holes, and cracks).

The work to evaluate soil/fill conditions below the buildings was developed and implemented in several phases. The initial scope was set forth in the RI/FS Work Plan (ERM/Roux, 2001). As implementation of the RI/FS Work Plan progressed and new data became available, Interim Deliverable No. 4 (Roux, 2001e) and Interim Deliverable No. 5 (ERM, 2001f) were prepared to develop supplemental data to achieve the project objectives. Additional soil investigation scopes were developed and implemented as Interim Deliverable No. 9 (Roux, 2002e), and Supplement No. 1 to Interim Deliverable No. 9 (Roux, 2003a).

As discussed in Section 1.4, the area beneath the building encompasses the footprint extending from the High Bay building to the older north buildings. It excludes the area beneath the East and West Warehouses and Paint Shop, which were included as part of the North Yard area.

2.2.2.1 Objectives

The objective of the soil/fill investigation below the buildings was to:

- Determine the nature and extent of the impact of historical operations at the Site on subsurface soil/fill conditions.
- evaluate the nature and quality of the material underlying the Site buildings;
- determine classification of the soil/fill as a potential waste material;
- gather information needed to determine the fate and transport of chemicals in Site soil/fill and to conduct the risk assessment; and
- aid in the development of a soil management plan, in the event of future Site development activities.

The investigative scope of work evolved in an iterative fashion, as characterization results became available. The progression of the investigation is documented in the RI/FS Work Plan, Interim Deliverable No. 1, Interim Deliverable No. 4, Interim Deliverable No. 5, Interim Deliverable No. 9, and Supplement No. 1 to Interim Deliverable No. 9.

As part of the RI/FS Work Plan, there were two conditions established to guide soil/fill sampling beneath the building. These conditions were based upon testing results and structural evaluations. The first was linked to a finding of PCBs in the lower increment of concrete core samples of the building floor. The other condition arose from an inspection of the floor trench system (originally designated floor sump system); specifically in the event that materials in the trench were in direct contact with the soil/fill material present below the building. During the course of the RI field activities, additional interior building material cleaning and characterization activities were performed. This cleaning and characterization resulted in an expansion of the subsurface investigation in the area of the building referred to as the railroad siding. Additional scopes were developed in order to further evaluate subsurface conditions in the soil/fill below the northern portion of the Site and to complete PCB delineation in the soil beneath the railroad siding.

2.2.2.2 *Procedures*

Initially, six subsurface soil/fill samples were collected beneath the building floor slab at three locations. These locations were dictated by PCB concentrations in excess of 1 mg/kg in the lower increment of concrete cores at these locations. The results led to the collection of additional soil/fill samples from 19 locations (Interim Deliverable No. 5). The additional samples were intended to characterize and delineate the organic compounds and inorganic constituents that were identified in the initial sampling program.

After the inspection/cleaning of the trench system, eight subsurface soil/fill samples were collected from four locations along the trench system. The analytical results of these eight samples promoted collection of additional soil/fill samples (see Interim Deliverable No. 5) to ensure characterization of organic compounds and inorganic constituents to the top of the ground water table.

In the course of cleaning the area described as the railroad siding (second floor, High Bay), 11 samples within the rail bed were collected (see Figure 2-1). The analytical results of these samples indicated the need for additional characterization. An additional 29 subsurface soil/fill samples were collected for further characterization and delineation of this area (Interim Deliverable No. 5).

Soil/fill sampling was conducted beneath the Site buildings as part of the subsurface anomaly investigation. As discussed in Section 3.2.6, soil/fill samples were collected at locations of suspected anomalies. In total 6 locations were samples. At two of these six locations (SS-245 and SS-246), an intact structure was encountered and the material within the structure sampled. Since these samples characterize the content of the structure, they are not included in the below building database. These sample results are discussed in Section 3.2.6.5. At the remaining four locations (SS-241 through SS-244), a competent structure was not observed. These four locations were therefore incorporated into the below building database.

During the RI, soil/fill samples were also collected below the Site buildings for future soil management purposes. Vertical composite soil/fill samples were collected in accordance with Interim Deliverable No. 9. Delineation samples were also collected as part of this Interim Deliverable. Initially, as part of Interim Deliverable No. 9, :

- 33 composite soil samples were completed to characterize the soil/fill below the concrete slab in the northern portion of the first floor; and

- four discrete soil samples were collected to delineate known areas of elevated PCB concentrations in the soil beneath the railroad siding area of the second floor.

The results of Interim Deliverable No. 9 warranted the collection of 25 discrete delineation soil samples (Supplement No. 1 to Interim Deliverable No. 9). The discrete soil samples are incorporated into the below building database. The composite sample results will be used for soil management purposes and are presented in Section 9.0.

The iterative sequence of investigation of soil/fill beneath the buildings is described in Table 2-1. Geologic logs for each boring are presented in Appendix A. The locations of the borings within the building are shown on Figure 2-1.

In general, soil borings were advanced using the Geoprobe® method from below the concrete floor interval or within the railroad siding to the water table. Soil/fill samples were collected with a Geoprobe® Macro-Core® sampler, split spoon sampler, or a hand auger.

Each interval sampled was initially placed into a plastic bag, sealed and screened for VOCs with a PID. Soil boring logs are provided in Appendix A. Soil/fill samples were selected for laboratory analysis for VOCs, SVOCs, PCBs and inorganic constituents pursuant to the methods described in Section 2.2.1.2.

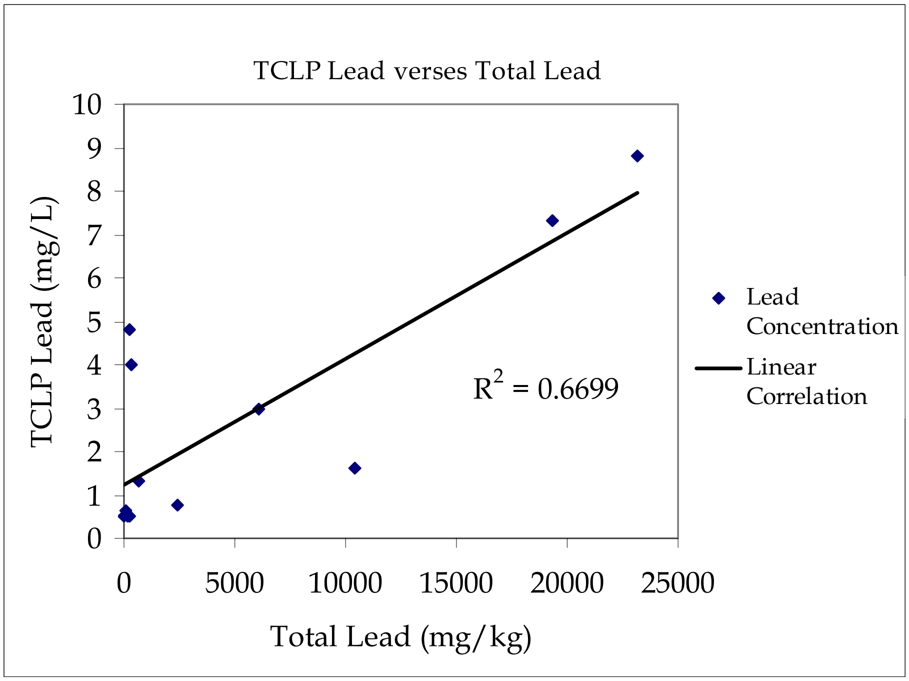
In addition, a sludge sample from the trench system was analyzed for specific PCB congeners. This testing was aimed at determining whether there was a common signature among various environmental media for this particular key organic compound known to be present at the Site. These results are discussed in Section 2.6.

Furthermore, certain subsurface soil/fill samples beneath the building were collected to ascertain the specific physical characteristics and evaluate the classification of the fill material as waste. The physical characteristics testing involved grain size, bulk density, moisture content and total organic carbon. The waste classification sampling involved the testing for the following RCRA waste characteristics: TC using the TCLP, reactivity, corrosivity and ignitability. There were 15 samples collected for waste classification. The locations of samples analyzed for TCLP and/or RCRA characteristics were within the footprint of the subsurface soils previously identified as containing organic compounds and inorganic constituents.

2.2.3 *Subsurface Soil/Fill Physical and Potential Waste Characteristics*

A number of soil/fill samples from the North Yard, South Yard and Below Buildings were collected and analyzed for physical and waste characteristics. The waste classification sampling involved the TCLP and RCRA characteristics. These data are summarized in Table 2-12A and 2-12B as Yard and Below Buildings soil/fill sample results, respectively. As shown in these tables, the only parameter detected above its TCLP limit was lead. This occurred in 4 of the 19 soil boring samples analyzed for TCLP. Two of these soil boring locations were in the North Yard and the remaining two soil boring locations were below the buildings.

Fourteen of the 19 TCLP results, for which total lead results were available, were plotted against total lead values to correlate the corresponding total lead result for a TCLP result of 5 mg/L. Linear regression of this plot is shown below:



Based on this correlation, a total lead value of 15,000 mg/kg is used as an approximate benchmark to correspond with a TCLP lead result above 5 mg/L.

The physical characteristics testing involved grain size, bulk density and total organic carbon. Bulk density and total organic carbon (TOC) results for the Yard fill are presented in Table 2-13. The bulk density of the Yard fill ranged from 0.72 tons/cubic yard to 1.61 tons/cubic yard and the TOC ranged from <1,200 to 461,000 mg/kg. The bulk density of the soil/fill below the buildings ranges from 0.8 tons/cubic yard to 1.43 tons/cubic yard and the TOC ranged from <1,000 to 109,000 mg/kg. The grain size results are presented in Appendix C.

2.3 GROUND WATER INVESTIGATION

This section presents a discussion of the objectives, procedures and results of the ground water investigation for the Site.

2.3.1 Objectives

During the Petroleum Spills Investigation, six monitoring wells were installed at the Site. These were designated as MW-01 through MW-06 (see Figure 2-1). The data from these wells were used to develop a basic understanding of ground water flow and ground water quality at the Site. The initial ground water sampling results suggested that although organic compounds and inorganic constituents were present in Site soil/fill above the RSCOs, these compounds were not leaching into the ground water. As part of the RI/FS Work Plan, four additional wells (MW-7 through MW-10) were scheduled for installation to augment the existing monitoring network.

As previously discussed, NAPL was observed (and sampled) in test pit TP-1 during the RI. To further investigate this condition, an additional well (MW-11) was installed between TP-1 and the Hudson River. In addition, based on the Below Buildings soil/fill sampling results, three ground water monitoring wells were installed within the Site buildings. Two of these monitoring wells were installed downgradient of the portions of the indoor floor trench that did not have a competent bottom and the other well was located at the north end of the buildings downgradient of the soil area containing soil/fill in excess of the RSCOs. These interior wells were located at the request of NYSDEC.

The interior wells have been designated as MWI-01, MWI-02, and MWI-03. In addition to these 14 monitoring wells, ground water was also encountered in the dry well located to the east of the East Warehouse. Based on the recharge rate into this structure, it was assumed that the dry well was in immediate connection with the ground water table. Thus, the shallow ground water quality beneath the Site is described by the temporal testing of the 14 monitoring wells and ground water from the drywell. The location of all of the Site wells and the dry well is shown on Figure 2-1.

There were three ground water sampling events conducted during the RI. The first two events included most of the exterior monitoring wells, specifically those installed as part of the Petroleum Spills Investigation and during the initial phase of post RI/FS Work Plan field activities. The two rounds were intended to verify the results obtained during all the ground water sampling events (i.e. Petroleum Spills Investigation and post RI/FS Work Plan), evaluate any spatial differences in ground water quality (North Yard, South Yard, Below Buildings) and determine whether any fluctuations in ground water quality are due to possible seasonal effects. The third round of analysis was conducted to collect an additional round of sampling from the three interior wells and to confirm the ground water concentrations of PCBs in all Site wells using a lower detection limit as the laboratory detection limits for PCBs were above NYSDEC standards in the initial sampling rounds.

All of the monitoring wells installed at the Site were surveyed to establish elevation reference points. Water level measurements were obtained and converted into ground water elevation data to construct ground water contour maps.

Based on the proximity of the Site to the Hudson River and the fact that the river is tidally influenced at this location, a tidal study was performed. The tidal study considered the effect of tidal cycles in the Hudson River on the on-site monitoring wells and, therefore, ground water flow.

In accordance with the RI/FS Work Plan, activities were conducted to identify the source of the NAPL sheen observed at boring location SB-1 during the Petroleum Spills Investigation. This was accomplished through installation of monitoring well MW-7 in the vicinity of SB-1 and collection of a soil/fill sample at the water table interface immediately adjacent to MW-7 (SB-60) with visual inspection of the interface for the presence of a sheen and analysis of this soil/fill sample for VOCs, SVOCs, PCBs and inorganics. Discussion regarding the soil/fill sample at this location is contained in Section 2.2.

2.3.2 Procedures

This section summarizes the procedures used to assess ground water conditions at the Site and to evaluate the tidal influence at the Site. The specific details of these procedures are set forth in the RI/FS Work Plan (ERM/Roux, 2001).

2.3.2.1 *Monitoring Well Installation and Sampling – Exterior Wells*

Monitoring wells MW-7 through MW-11 were installed with a truck-mounted, hollow stem auger drill rig in accordance with the RI/FS Work Plan (ERM/Roux, 2001). Monitoring well construction logs are included in Appendix A.

In summary, the wells were constructed of four-inch PVC screens and riser. The well screens were generally 10 feet in length and placed to straddle the water table. Soil/fill cuttings generated during installation of the wells were drummed and stored on-site pending receipt of the soil/fill sampling results. Following waste characterization, the drill cuttings were disposed of off-site as non-hazardous waste. The analytical results and waste manifest for this material are presented in Appendix E. Each well was constructed using accepted standards for well construction including sand filter pack and bentonite seals. Tremi-grouting was not required as the tops of the well screens were close to the surface and only concrete was placed above the seal. All new wells, except for MW-10, were completed with a flush-mount, bolt-down cover. MW-10 was installed in a vegetated area and finished with riser and locking protective casing.

All well development was conducted in accordance with the NYSDEC approved Sampling and Analysis Plan. That is, after installation, the newly installed monitoring wells were developed until a ground water turbidity of equal to or less than 50 Nephelometric Turbidity Units (NTUs) was achieved. The water generated during well development and sampling was containerized in 55-gallon drums and tested for hazardous waste characteristics. The development water was subsequently disposed of off site as non-hazardous liquid. The analytical results and waste manifest for this material are presented in Appendix E.

Two rounds of ground water sampling were conducted for each of the exterior monitoring wells, MW-01 through MW-10, and the dry well (PIPE-01). These sampling events occurred in July 2001 and late October/early November 2001. Monitoring well MW-11 was installed during the supplemental sampling and, therefore, was only sampled in January 2002 after its installation. During both rounds of sampling, all wells were sampled and analyzed for VOCs, SVOCs, PCBs and inorganic constituents.

All wells were sampled using a low flow purging technique to minimize the introduction of particulates into the ground water samples. Prior to ground water sampling, the wells were purged with a peristaltic pump at a rate of approximately 0.5 liters per minute. During this time, measurements of the field parameters, such as temperature, pH, conductivity, oxygen-reduction potential, dissolved oxygen, and turbidity were continuously recorded. Once field parameters stabilized to within ten percent and the turbidity was below 50 NTUs, individual water samples were collected into laboratory-supplied containers. Samples were collected directly from dedicated tubing using the low-flow pump except for ground water samples for VOC analysis, which were collected using a bailer. An appropriate type and number of quality control samples were also collected during each round of sampling.

A summary of the ground water samples and the associated quality control samples that were collected are shown in Table 2-2.

2.3.2.2 *Monitoring Well Installation and Sampling – Interior Wells*

As specified in Interim Deliverable No. 5, one ground water monitoring well was installed downgradient of a section of the floor trench system not exhibiting a competent bottom and another well was installed downgradient of the Storage Room/Maintenance Shop. A third monitoring well was installed at the request of NYSDEC downgradient of another portion of the floor trench. The locations of the three monitoring wells are shown in Figure 2-1. Descriptions of the monitoring well installation and sampling activities are provided below.

Monitoring Well Installation

Concrete flooring at each location was first removed using a 12-inch diameter concrete core. Lithology and ground water elevation at each well location was determined by advancing a two-inch diameter by four-foot long sampler to the design depth of the well. A pilot boring was then advanced for each monitoring well using 4.25-inch hollow stem augers. Each pilot borehole was advanced from below the concrete to approximately six-feet below the water table. A wood plug was used at the bottom of the auger during drilling to prevent soil/fill material from entering into the augers. A one-foot sand layer was placed at the bottom of the borehole to allow the well screen to be accurately placed by providing space for the wood plug and the well's bottom cap.

Each monitoring well was constructed with two-inch diameter schedule 40 PVC screen and riser. The well screens were placed to straddle the water table. Wells were completed at the surface with a one-foot bentonite chip layer below a one-foot thick layer of concrete. A thick concrete layer was required due to the volume of traffic anticipated in the well locations. Each monitoring well was finished with a locking cap and an eight-inch diameter road box placed flush with the floor. All soil/fill cuttings and the concrete were placed into 55-gallon drums for characterization and disposal. The material was subsequently disposed of off-site as a non-hazardous waste. The analytical results and waste manifest for this material are presented in Appendix E.

The monitoring wells were developed by surging and pumping to establish a good hydraulic connection between the well and the soil/fill. Approximately 50-gallons of water were removed from each well during development. All development water was containerized into 55-gallon drums for characterization and disposal. The material was subsequently disposed of off-site as a non-hazardous waste. The analytical results and waste manifest for this material are presented in Appendix E.

Following installation, the horizontal and vertical coordinates for each well were determined relative to the North American Datum of 1983 (NAD 83) and the National Geodetic Vertical Datum of 1929 (NGVD 29), respectively.

All wells were sampled using a low flow purging technique to minimize the introduction of particulates into ground water samples. Polyethylene tubing was lowered to a depth approximately six-inches below the water surface in the well. A peristaltic pump was used to purge each well prior to sampling, at a rate of approximately 0.25 gallons per minute. Due to the high turbidity encountered in the wells below the buildings, a lower purge flow rate was used for the interior wells. During the purge time, measurements of the field parameters, such as temperature, pH, conductivity, oxygen-reduction potential, dissolved oxygen, and turbidity were continuously recorded.

Following purging, the polyethylene tubing was removed from the well and discarded. A new, disposable Teflon™ bailer was gently lowered into the well to sample ground water for VOC analysis. Following collection of samples for VOC analysis, new, disposable Teflon™ tubing was lowered to a depth approximately six-inches below the water surface in the well.

Samples of ground water were collected for SVOCs, PCBs, and inorganic constituents analysis using the peristaltic pump to extract the sample at a low flow rate. The pumping rate was adjusted so that it did not exceed 0.13 gallons per minute (0.5 liters per minute) during sampling. Following collection, the ground water samples were labeled and placed in an ice-filled cooler for transport to the laboratory. An appropriate type and number of quality control samples were also collected during each round of sampling.

A summary of the interior ground water samples and the associated quality control samples that were collected are shown in Table 2-3.

2.3.2.3 Ground Water Elevation, Flow, and Tidal Influence

Water Level Measurements

All monitoring wells were surveyed by a New York State licensed surveyor to establish State Plane Coordinates. Additionally, the elevation of the tops of the monitoring well casings were established as a benchmark from which to measure the depth to ground water and thereby calculating the ground water elevation at the point of the monitoring well. These data were used to construct a ground water elevation contour map and establish the ground water flow direction.

After the installation of the interior wells, a round of ground-water measurements was collected on 31 January 2002 that included both the exterior and interior wells. These data from the 14 monitoring wells were used to construct the ground water flow maps.

Hydraulic Conductivity, Gradient, and Flow Velocity

Rising head tests were conducted in three selected monitoring wells, MW-01, MW-07, and MW-10, to determine hydraulic conductivity. The locations of these wells are shown on Figure 2-1. The testing was conducted employing the rising head method. This method is used to estimate hydraulic conductivity in wells in which the screened interval is not fully submerged within the unconfined aquifer. The test was conducted by lowering a properly decontaminated solid slug into the well and allowing the water level to equilibrate to static conditions as monitored by a pressure transducer/recorder system. Once the static water level equilibrium was achieved, the test was initiated by quickly withdrawing the entire slug above the initial static water level. Rapid removal of the slug displaced the column of water into the lower portion of the well, resulting in recharge from the surrounding aquifer. Immediately after removing the slug, the rate of recharge was recorded over time until the water level in the well again achieved static conditions.

The test data were used to calculate hydraulic parameter values using the Bouwer and Rice method (Fetter, 1984). The conductivity results were then used in the following equation to estimate the ground water flow velocity:

$Vs = KI/n_e$ (Fetter, 1994)

Where,

Vs = average linear velocity (ft/day)
K = hydraulic conductivity (ft/day)
I = hydraulic gradient (ft/ft)
n_e = effective porosity (dim)

An effective porosity (n_e) of 0. 25 for sand/gravel aquifer was assumed, and the hydraulic gradient was calculated using the measured water table elevations and the measured distance across the Site at selected locations.

Tidal Study

Two separate tidal influence measurements were conducted, one in August 2001 and one in October 2001. The August 2001 tidal study was conducted during a new moon cycle to estimate the maximum tidal influence at the Site. Both the August 2001 and October 2001 tidal measurements were collected during fair weather to minimize the effects of precipitation and large barometric pressure changes.

The August 2001 tidal study included monitoring wells MW-01, MW-03, MW-04, MW-07, and the Hudson River. A pressure transducer (Solinst Levelogger™ LT) was installed in each of the four monitoring wells. A perforated, 4-inch diameter PVC tube was attached to the side of a wooden piling in the River to hold and protect the transducer installed in the River. A measuring point was surveyed and established above the transducer tube in the River so that the water surface elevation of the River could be measured.

The October 2001 tidal study was performed to validate select August 2001 results and to evaluate possible tidal influence on specific conductance in the wells. Changes in specific conductance in the wells over time can be indicative of the mixing of river water and ground water. In this study, In-Situ Troll 4000 Dataloggers were used to continuously record measurements of pressure and specific conductance in monitoring wells MW-01, MW-06, MW-07, MW-08, and the River. In addition, to monitor the impact of mixing on the water quality, water samples were collected from the Hudson River, MW-01 and MW-07 during, or as close to as possible, low tide and high tide. The additional samples were analyzed for inorganic constituents only.

2.3.3 *Results*

2.3.3.1 *Ground Water Flow and Tidal Influence*

Ground Water Flow

Ground water level measurements for the Site monitoring rounds are presented in Table 2-14. Ground water contour maps for the October 2001, January 2002 and July 2002 ground water monitoring rounds are presented in Figures 2-28, 2-29 and 2-30, respectively. As shown in these figures, ground water flow is westerly towards the Hudson River. The hydraulic gradient across the Site is approximately 0.01 feet/feet, with monitoring well MW-04 serving as an apparent upgradient well providing information on the quality of ground water flowing onto the Site. The October 2001 ground water contour map does not include the interior wells installed by Roux (MWI-01, MWI-02, and MWI-03) since these wells had not yet been installed. The interior wells were used on the subsequent two figures. Additionally, monitoring well MW-08 was not used to determine ground water elevation contours. MW-08 has demonstrated anomalous rises and falls in water level. This well is installed at the bottom of a loading ramp and is surrounded by higher ground. MW-08 may be under artesian conditions at times or have an artificially high head due to the pressure of the ground water in the surrounding area.

The three ground water contour maps are generally consistent with each other and depict westward flowing ground water with a ground water high in the vicinity of monitoring wells MW-06 and MW-07. The elevated ground water table in this area is likely due to the topographic high, where ground surface rises from the Yard to the south to ramps leading into the only floor of Building 19, which is at the same level as the second floor of Building 8. Building 8 and the remaining buildings also have a ground floor that is below Building 19. The ground floors or basement floors of the facility effectively create a topographic low immediately north of Building 19. The ground water high in the area of MW-06 and MW-07 is on the order of approximately one foot above the surrounding water table. This high creates a condition where two components of ground water flows southwest and northwest from the MW-06/MW-07 area. Ultimately, however, ground water still flows westward and discharges to the Hudson River.

Slug tests were conducted in three selected monitoring wells, MW-01, MW-07, and MW-10, to determine hydraulic conductivity. The locations of these wells are shown on Figure 2-1. The testing was conducted employing the rising head method to estimate hydraulic conductivity in wells in which the screened interval is not fully submerged within the unconfined aquifer. After the transducers were returned to the office and the data downloaded, it was discovered that one of the transducers used in the test (MW-07) did not properly record data and may have been malfunctioning. Therefore, the data for MW-07 was not used to determine hydraulic conductivity.

Hydraulic conductivity (K) was calculated using an effective porosity (n_e) of 0.25, the effective porosity for a sand/gravel aquifer (Fetter, 1994). Hydraulic conductivity was calculated based on the rising head test data from MW-01 and MW-10. For each well, hydraulic conductivity was calculated using an aquifer thickness of 10 feet, considering the approximate depth of the silt/clay layer, which likely acts as a semi-confining unit, as compared to the average depth to water. The following hydraulic conductivity (K) and average linear velocity (Vs) values were calculated.

Using $Vs = KI/n_e$ (Fetter, 1994)

Where,

V_s = ground water flow rate (ft/day)

K = hydraulic conductivity (ft/day)

I = hydraulic gradient (ft/ft)

n_e = effective porosity (dim)

MW-01:

- MW-01: K = 1.85 ft/day
- MW-01: Vs = 0.07 ft/day

For MW-10:

- MW-10: K= 166 ft/day
- MW-10: Vs = 6.6 ft/day

Tidal Study

During the August 2001 tidal study, a tidal fluctuation of 5 feet was observed in the Hudson River. The river elevation ranged from –2.5 feet below mean sea level to 2.5 feet above mean sea level. Of the four wells tested, only MW-07 appeared to be significantly tidally influenced. The water level in MW-07 fluctuated from 0.7 to 2.3 feet above mean sea level, a tidal fluctuation of 1.6 feet. During this study, tidal fluctuations in MW-01, MW-03, and MW-04 were 0.3, 0.15, and 0.15 feet respectively. The tidal study data are included in Appendix D.

During the October 2001 tidal study, a tidal fluctuation of 3.0 feet was observed in the Hudson River. The river elevation ranged from –1.5 feet below mean sea level to 1.5 feet above mean sea level. MW-06 demonstrated a fairly steady level with approximately 0.1 feet of fluctuation due to tides. MW-08 fluctuated approximately 0.5 feet with a slight lag time behind the tidal cycle. Both MW-07 and MW-01 had an increase in their water levels; however, they did not correlate to a tidal cycle or precipitation event. This may be due to the heterogeneity of the fill materials. The tidal study data, including a hydrograph for the river and each well, are included in Appendix D.

Specific conductance was continually measured in each of the monitoring wells during the October 2000 tidal study. In addition, wells MW-01, MW-07, and the River were sampled at high and low tides for inorganic constituents. These tasks were completed to evaluate whether the tidal influence resulted in any discernable changes to ground water quality. Based on a review of the available data (Appendix D and Tables 2-15 through 2-18) a change in ground water quality was not observed between the tidal cycles.

2.3.3.2 *Ground Water Quality*

NAPL Delineation

As discussed above in Section 2.31, monitoring wells MW-07 and MW-11 were installed to delineate NAPL at the Site. These wells are located to the south of the West Warehouse (see Figure 2-1). MW-07 is located immediately adjacent to SB-01; a sheen was observed in SB-01 during its installation. MW-11 was installed to determine whether NAPL observed in test pit TP-1 was accumulating on the water table and travelling toward the River.

The first round of ground water monitoring was conducted on 17 to 19 July 2001. During that period, an accumulated NAPL layer was not observed in any of the on-site monitoring wells or the suspected dry well. The second round of ground water monitoring was conducted 24 to 26 October 2001 and 6 November 2001. During the second round, additional activities were conducted to determine whether a sheen was present in monitoring well MW-07.

- A NAPL/water interface probe was placed into all ten monitoring wells and the dry well to measure for the presence of both light NAPL and dense NAPL.
- A ground water sample was removed from MW-07, placed in a clear container and observed for a NAPL sheen.

No measurable NAPL layer was detected in MW-07 using the interface probe. However, a visible sheen was observed on the ground water placed in the clear container.

Following installation of MW-11 in January 2002, the well was sampled on 9 January 2002. As with MW-07, a ground water sample was removed from MW-11, placed in a clear container and observed for a NAPL sheen. A visible sheen was observed on the ground water that had been removed.

Sheens were also observed in additional monitoring wells during the July 2002 groundwater sampling activities. Section 2.6.2.2 presents additional discussion regarding the observations of sheens in the Site groundwater monitoring wells and Section 2.6.1.10 presents discussion regarding evidence of petroleum in Site soil/fill. A distinct NAPL layer has not been observed in any of the Site wells.

Ground Water Quality

Over four monitoring events, two complete rounds of ground water sampling were collected for the fourteen (14) on-site monitoring wells and the dry well. The first event took place on 17 to 19 July 2001, the second event was conducted on 24 to 26 October 2001 and 6 November 2001, the third event was conducted on 9 January and 22 January 2002, and the last event was conducted from 28 to 10 July 2002. During the October/

November 2001 ground water monitoring round, the ground water samples were also analyzed for total dissolved solids and chlorides to determine whether the Site ground water would be classified as saline. During the July 2002 monitoring event, all of the Site wells were sampled for PCBs using a lower detection limit.

The ground water sampling results for the 14 ground water monitoring wells and the dry well are summarized in Table 2-15 through 2-18. These tables also present a screening of the ground water sampling results to the NYS Class GA standards. In general, Site ground water exceeded the Class GA standards for iron, lead, magnesium and sodium. Localized exceedances of benzene, tetrachloroethene, xylene, 2-methylphenol, 2,4-dimethylphenol, 3&4-methylphenol, phenol, BEHP, PCB Aroclor 1248, aluminum, barium, iron, lead, magnesium, manganese and sodium were also observed in Site ground water. These results and the locations of NYS Class GA exceedances are discussed further in Section 2.6. A summary of the compounds exceeding their Class GA standards is provided in Table 2-26.

Table 2-19A contains a comparison of the TDS and chloride results to the NYCRR Part 701.17 standards of 2,000 mg/l and 1,000 mg/l, respectively, and is intended to assess the degree of salinity in ground water. This comparison indicated that ground water under the Site is saline.

Table 2-20 contains the field measurements for the October 2001 and January 2002 ground water monitoring event. As shown in Table 2-19, the turbidity in MWI-1 prior to sample collection on 9 January 2002 was greater than 50 NTU. Since turbidity in this well could not be reduced to below 50 NTU, the potential exists for suspended particulate matter being present in the sample. Such material could influence the reported laboratory result for certain parameters. This is evident in the results for

MWI-1, which exhibit anomalous concentrations of less water-soluble organic compounds and inorganic constituents as compared to ground water samples from other Site wells. MWI-01, along with the other interior wells, was resampled in July 2002. An acceptable turbidity was obtained for MWI-01 and the other interior locations. Analytical results are presented in Tables 2-15 through 2-18.

2.4 *SEDIMENT INVESTIGATION*

2.4.1 *Objectives*

During the RI, Hudson River sediment samples were collected from the following four locations:

- Upriver sediment samples to the north of the Site;
- Within the intertidal zone beneath the Site buildings (intertidal building sediment);
- In the subtidal zone adjacent to the Site buildings (subtidal building sediment); and
- Adjacent to the North and South Yards (Yard sediment).

The objectives of the sediment sampling program were to determine whether Site activities impacted Hudson River sediment quality, and, if so, provide the data needed to assess potential effects to any ecological habitats in the study area.

Two sediment sampling events were conducted. The first was conducted in December 2001 and the second was conducted in March 2003. The 2001 sediment sampling locations were identified where potential major discharge locations had been previously located. These included, storm water discharge lines from the Yard and major pipes identified from a survey of the sump/trench and drain system in the buildings. The 2003 sediment sampling locations were selected to provide additional delineation out into the river for select organic compounds and inorganic constituents.

2.4.2 *Procedures*

<u>December 2001 Sampling Event</u>

Sediment sampling locations were identified in areas where potential major discharge locations were identified. These included, storm water discharge lines from the Yard and major pipes identified from a survey of the sump/trench and drain system in the buildings.

Based on these investigative activities, sediment sample locations were identified for:

- Outfall locations of known origin (i.e., stormwater and/or interior drainage system outfalls).
- Areas of potential discharges (i.e., outfalls of unknown origin, broken piping of unknown origin, box structure below Building 8 whose past use is unknown, and sealed holes in the floor and steel plates).
- Areas of debris piles.

The first and second round of sediment sample locations are shown in Figures 2-32 through 2-34. The sampling locations from intertidal and subtidal building areas are shown on Figure 2-33, and the Yard sediment sampling locations are shown in Figure 2-34.

To identify the outfall locations for the stormwater and/or interior drainage systems, these systems first had to be cleaned. During the cleaning and inspection of the piping, washwater and sediment were collected from these pipes and transferred to a Frak tank until disposal. The water and sediment were subsequently analyzed, and the water was discharged into the on-site system that flows to the local Publicly Owned Treatment Works. The water was discharged under a permit with the

Westchester County Department of Environmental Facilities (WCDEF, 2001). The sediment was transferred to four drums and disposed of off-Site as RCRA characteristic hazardous (D008) due to its lead content. The waste characterization testing results and manifest for this material are provided in Appendix E.

In the Hudson River, tracing impacted sediment to the source is complicated by the tidal influence that causes sediment transport in two directions in some areas. Upriver sediment samples were, therefore, collected. Collection of upriver sample information is an important tool in determining whether Site activities have impacted sediment and the upriver information may offer an important perspective as part of assessing the potential effects to any ecological habitats in the study area. The upriver sediment sampling locations are provided in Figure 2-32.

Initially, the goal was to collect upriver samples composed of similar material (i.e., clay and silt) as found below the Site buildings from locations that are least likely to have been impacted by Site operations. Since the Site sediment samples were being collected from within and outside the intertidal zone, two samples were planned at each upriver location (Interim Deliverable No. 2, Revision 1):

- a sample in the inter-tidal zone, which was presumed to contain material similar to the sediments found in the intertidal zone below the buildings; and
- one sample from the subtidal zone, similar to the western area below the buildings that are always submerged.

Upriver samples were collected in the river 500 feet and 800 feet north of the Site, between the Site and the inactive power plant (SEDN-1B and SEDN-2B). However, at both of these locations, the intertidal zone could not be accessed, and the intertidal zone materials at these locations were not comparable to the intertidal zone sediment collected from the Site. As a result, intertidal samples were not collected at these two upriver locations. At the third upriver location, approximately 800 feet north of the abandoned power plant, two upriver sediment samples are designated as SEDN-3A and SEDN-3B, one in the intertidal zone and one in the river. In addition to the upriver locations north of the Site, one downriver sediment sample was collected south of the Site. This sample was collected approximately 800 feet south of the Site, below the low tide line. As with two of the upriver samples, an intertidal zone sediment sample could not be collected at this location. These upriver and downriver sample locations are shown on Figure 2-32.

Additional detail regarding development of the sediment sampling plan conducted in December 2001 is provided in Interim Deliverable No. 2, Revision 1.

Table 2-1 presents a summary of the proposed and actual Site sediment and upriver and downriver sediment sampling locations. During the first round of sediment sampling, sediment samples were collected from two intervals, 0 to 0.5 feet below sediment surface and 0.5 to 1 feet below sediment surface. The round of sediment sampling was conducted by commercial divers under the supervision of the field team leader.

The samples were collected by inserting a pre-labeled, 12-inch core tube into the sediment. After insertion, the top and bottom of the core were each capped with a specific color cap to avoid confusion with the orientation of the sample column. To gather sufficient sediment to fill the containers required by the laboratory, each sampling location required a minimum of 2 cores; each duplicate and matrix spike sample required 2 additional cores. Once topside, the cores were brought from the boat to the staging area. Each core was cut in half into the 0 to 0.5 foot and 0.5 to 1.0-foot samples. Each sample was transferred directly from the core tube into the required laboratory-supplied containers and stored on ice for shipment to the laboratory. The bottle for AVS analysis was filled first and the remaining bottles were filled simultaneously to ensure an even distribution of the sample material in lieu of compositing the samples in a bowl.

At each sediment sample location, observations were made and recorded regarding biological activity and habitat conditions in the sampling area, as well as a description of the sample media itself.

All sediment samples were analyzed for SVOCs, PCBs, TAL inorganic constituents, total organic carbon, acid volatile sulfides, redox potential, grain size distribution, specific gravity, total volatile solids and moisture content. Appropriate sulfur cleanup methods were utilized to address potential sulfur interference. In addition to the above analysis, five sediment samples, SED07-05, SED08W-03, SED09-01, SEDYARD-02, and SEDN-1B were also analyzed for PCB congeners.

Samples were collected from the debris piles observed below the Site buildings. The debris materials sampled included cable, plastic, and slag. Samples were collected using a single-use, dedicated polyethylene trowel and/or clippers as needed. The divers were given disposable gloves, and pre-labeled sealable plastic bags to fill with debris or cable material at each location as needed. Some samples were transferred to laboratory containers for delivery. Others that were too big to fit into the containers were sealed in the plastic bags and delivered with the other samples. Analytical results from these samples are discussed in Section 2.4.3.

All debris samples were analyzed for PCBs and toxicity characteristics by TCLP analysis. Section 2.4.3 discusses the analytical results from these samples. The debris samples were also physically reviewed for characterization purposes.

March 2003 Sampling Event

Based on review of the first round of sediment sampling results, NYSDEC requested in July 2002 that ERM submit a proposed plan for additional sediment delineation for lead, copper and total PCBs. Interim Deliverable No. 8, which contained the proposed sediment sampling plan, was submitted to the NYSDEC on 16 August 2002. Based on NYSDEC comments, revisions to this interim deliverable were submitted to the NYSDEC on 29 October 2002 and 27 December 2002. Revision No. 2 of this document was approved by the NYSDEC on 10 January 2003. Due to ice conditions in the Hudson River, the plan could not be implemented until March 2003.

During a July 2003 meeting, the NYSDEC identified the following potential areas for additional sediment delineation. These areas, which are identified in Figures 2-33 and 2-34 were:

- SEDYARD-05 and SEDYARD-06 (Adjacent to the South Yard);
- SED8W-01 (High Bay Building); and
- SED12-01 and SED12-02 (North Dock).

The sediment sampling included collection of cores in the immediate vicinity of the above samples for collection and analysis of samples, and the collection of samples farther into the river and away from the buildings, which were archived pending analytical results of the first round of sample analysis. This approach was chosen to mitigate the need for additional mobilization to the river to collect additional samples in the future. The criteria for analysis of the archived samples are discussed below.

Sediment Sampling Adjacent to the South Yard

During the first round of sampling, sediment concentrations of lead and copper in excess of the upriver values were observed in sediment samples SEDYARD-05 and SEDYARD-06. Based on this observation, the NYSDEC requested that additional samples be collected and analyzed in the vicinity of these samples for lead and copper. A total of three discrete sediment samples were collected at eight coring locations from the depth intervals of 0 to 6 inches, 6 to 12 inches and 12 to 18 inches below the river bottom. The sample coring locations are shown on Figure 2-34. Samples from the closest six locations (SEDYARD-06-01, SEDYARD-06-02, SEDYARD-06-3, SEDYARD-05-01, SEDYARD-05-02, and SEDYARD-05-03) were analyzed, and the six samples from the remaining two locations farther away from the shoreline (SEDYARD-06-04 and SEDYARD-05-04) were archived pending the analytical results from the first six locations. After the analytical results for the first samples exhibited lead and copper concentrations above the Interim Deliverable No. 8, Revision No. 2 action levels of 80 mg/kg and 60 mg/kg, respectively, the archived samples were analyzed for lead and copper.

Vicinity of the High Bay Building (Building No. 8)

During the December 2001 sampling program, sample SED8W-01 was collected just beyond the western edge of the High Bay building in the vicinity of an outfall pipe (Figure 2-33). This sample exhibited PCB concentrations of 15.8 mg/kg in the 0 to 6-inch sample and 1.1 mg/kg in the 6 to 12-inch sample, respectively. Both sample intervals, therefore, exceeded the NYSDEC delineation limit of 1 mg/kg PCBs in sediment.

Copper was detected at concentrations of 84.9 mg/kg and 124 mg/kg from the 0 to 6-inch and 6 to 12-inch samples, respectively; greater than the action level of 60 mg/kg. Since this was the westernmost sample adjacent to the High bay building, additional delineation sampling was conducted to determine the PCB and copper extent in this area.

A total of 24 discrete samples from the depth intervals 0 to 6 inches, 6 to 12 inches, 12 to 18 inches, and 18 to 24 inches were collected from six new sediment coring locations farther into the river adjacent to sediment sample SED8W-01 (Figure 2-33). Samples from the two coring locations closest to SED8W-01 (SED8W-01-03 and SED8W-01-04) were analyzed immediately, and the remaining 16 samples from four locations (SED8W-01-05, SED8W-01-06, SED8W-01-07, and SED8W-01-08) were archived and submitted for analysis at a later date due to exceedences of lead and copper action level.

Two additional coring locations with four discrete 6-inch sediment samples from 0 to 24-inches deep were collected in the river to the north and south of sample location SED8W-01 (Figure 2-33). At sample location SED8W-01, the PCB concentration in the 6 to 12-inch interval was 1.1 mg/kg, slightly greater than 1 mg/kg. To provide vertical delineation at this location, a core was collected at the SED8W-01 location and samples analyzed from the 12 to 18-inch and 18 to 24–inch intervals.

North Dock

Three sediment samples were collected in the vicinity of the North Dock (SED12-01, SED12-02 and SED12-03) during the December 2001 sampling. Based on the presence of lead and copper at concentrations above upriver concentrations and the presence of PCBs at concentrations greater than 1 mg/kg, additional delineation sampling was deemed necessary in this area.

A total of seven sediment cores were collected outward from SED12-02 and discrete samples were obtained at the depth intervals of 0 to 6 inches, 6 to 12 inches, 12 to18 inches and 18 to 24 inches. Samples from two of these locations (SED12-02-01 and SED12-02-02) were immediately submitted for analysis for PCBs, lead and copper. Samples from the remaining five locations (SED12-02-03, SED12-02-04, SED12-02-05, SED12-02-06, and, SED09-01-04) were archived pending the analytical results from SED12-02-01 and SED12-02-02. Based on presence of lead and copper in these samples at concentrations above upriver concentrations, all five archived samples were subsequently submitted for analysis for lead and copper.

At the request of the NYSDEC, an additional sediment core (SED12-01/03-01) was collected upriver of the sediment sample locations SED12-01 and SED12-03 to further delineate the previously detected concentrations of PCBs, lead and copper. Discrete samples were collected from the 0 to 6-inch, 6 to 12-inch, 12 to18-inch and 18 to 24-inch depth intervals. These samples were submitted for analysis of PCBs, lead and copper.

To provide vertical delineation at SED12-02 and SED12-03, discrete samples were collected from the 12 to 18-inch and 18 to 24-inch intervals at these two locations. These samples were submitted to the laboratory for analysis of PCBs, lead and copper.

In addition to the Building 12 sediment samples, sample location SED09-01 also exhibited total PCB concentrations above 1 mg/kg during the 2001 sampling program. Three additional sediment samples were collected adjacent to this location beneath the EPRI building. Due to access limitations, sediment cores were advanced only one foot at these locations. Sediment samples were collected from the 0 to 6-inch and 6 to 12-inch intervals. The samples were submitted for analysis of PCBs, lead and copper.

Sampling and Analysis

The sediment samples were transferred from the core barrel liner to new, clean-certified, laboratory-supplied containers. All samples were picked up from the Site by a courier and delivered under Chain-of-Custody protocol to Accutest laboratories. All sediment samples were analyzed for TAL metals, total organic carbon (TOC), and grain size distribution and the upper 6-inch interval for AVS-SEM metals and pore-water metals. With the exception of the additional samples adjacent to the South Yard, all of the sediment samples were also being analyzed for PCBs. Sediment samples were collected, handled and analyzed in accordance with the SAP contained in the NYSDEC-approved RI/FS Work Plan for the Site. For analytes having limited holding times, the laboratory conducted the extraction upon receipt of the archived samples so that the holding time was met.

The three sediment-sampling locations located beneath the EPRI laboratory building were accessed by certified divers under the supervision of the ERM field team leader. All three below-building sediment samples were collected using a 12-inch push-core sampler. The core tube was advanced by hand-pressure applied by the diver while bracing against the building piles. After penetrating one foot below grade, the top of the core was capped, effectively creating a vacuum to prevent the core from falling out while being removed from the sediment. After being removed from the sediment, the bottom of the core was capped. Each core was brought topside to ERM personnel after retrieval.

The remaining sediment sampling locations are located in the river beyond the site buildings. These sediment cores were collected using a Vibracore™ with a four-foot long, 4-inch outside diameter core barrel. The Vibracore was mounted on the R.V. Delaware, a research vessel operated by ERM's subcontractor, Aqua Surveys Inc. Coring was conducted at these locations to a depth of four feet into the river bottom, but only the upper two-feet were submitted for laboratory analysis. The core barrel was lined with new, dedicated, rigid plastic core liners. Once the core and liner were removed from the core barrel, the liner was capped and given to ERM personnel. The ERM Field Team Leader accompanied Aqua Survey personnel at all times, and sampling locations were found by using pre-determined coordinates and an on-board Global Positioning System. Cores were kept upright to prevent disturbance or mixing. The cores were transported to the staging area and the liner was carefully cut open.

The cores were laid horizontally on a table to begin core sediment sampling procedures. A tape measure was laid alongside the core to measure the depths from which the sediment was collected. To minimize volatilization of chemicals in the sediment, the samples to be analyzed for AVS SEM analysis were first directly transferred from the core to the sample container. The remainders of each interval sample were transferred to laboratory-supplied containers.

All documentation, sample handling, preservation and transportation was conducted in accordance with the SAP.

2.4.3 *Results*

The sample locations identified in the sediment sampling plan contained in Interim Deliverable No. 2, Revision 1 (ERM, 2001e) and in Interim Deliverable No. 8, Revision 2 (ERM, 2002c) were all collected as planned with the exception of the intertidal zone upriver samples discussed in the previous section and samples from the SED07-01 location (SED07-01 (0-6), SED07-01 (6-12), and SED07-01D). Due to insufficient clearance, the divers could not physically access this location even after numerous attempts. One additional sample location, SED07-06, was collected from above deck, through an access hatchway.

Sediment

During the first round of sediment sampling, the majority of the intertidal and subtidal sediment samples were composed of a gray clay and silt with intermittent brown mottling. The exception was the sediment samples collected at SED19W-03 and SED19W-02. Samples collected from these locations contained sand and fine gravel. This material was also encountered at upgradient sample location SEDN-3A. These three locations are in areas where waves break against riprap or sea walls, thereby dissipating the wave energy and allowing the heavier grains to fall out of suspension.

The sediment samples collected during the second round of sediment sampling were generally similar to the intertidal and subtidal sediment samples collected during the first round of sampling. The second round of sediment samples were composed of gray, silty clay (medium to high plasticity) with black mottling and an organic odor. Some cores contained traces of small gravel, shell fragments (bivalves mainly) or sand. There was generally little visible difference between the intertidal building samples, the subtidal building samples and the samples collected adjacent to the Yard. Logs for the sediment borings are provided in Appendix A.

The sediment sampling results are presented in Tables 2-20 through 2-23. Comparison to the sediment screening criteria is presented in the Fish and

Wildlife Impact Assessment presented in Section 6.0. A summary of the compounds exceeding their sediment screening criteria is provided in Table 2-26.

Organic Compounds

To evaluate whether Site operations have impacted Hudson River sediment quality, the concentration of total SVOCs, and total PAHs and total phthalates, subsets of SVOCs in the three Site sediment areas were compared to upriver sediment concentrations. This comparison is provided below.

Intertidal Buildings

Total SVOCs (μg/kg)				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	2,441	693	2,583	1,101
Maximum	12,907	8,465	48,010	805,857
Mean	6,065	3,977	14,701	92,008

Total PAHs (μg/kg)				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	2,266	440	1,765	698
Maximum	12,232	7,285	45,831	38,172
Mean	5,450	3,202	13,556	5,493

Total Phthalates (µg/kg)				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	175	163	123	55
Maximum	824	1,586	879	801,970
Mean	510	733	631	86,291

The total SVOC, total PAH and total phthalate concentrations in the 0.0 to 0.5-feet interval intertidal building samples are consistent with upriver concentrations. Total SVOCs above upriver concentrations are observed in the 0.5 to 1-foot interval. While the total PAH concentrations in this interval are consistent with upriver concentrations, the total phthalate concentrations are present at concentrations well above upriver concentrations. Most 0.5 to 1-foot intertidal building samples exhibited total phthalate concentrations within an order of magnitude of the upriver concentrations. The exceptions were SED8E-01 and SED8E-02. Total phthalate concentrations in the 0.5 to 1-foot interval are three orders of magnitude higher than upriver concentrations at these two locations.

Subtidal Buildings

Total SVOCs (µg/kg)				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	2,441	2,620	2,583	4,550
Maximum	12,907	10,899	48,010	28,443
Mean	6,065	6,813	14,701	13,041

Total PAHs Subtidal (μ*g/kg)*				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	2,266	2,207	1,765	3,679
Maximum	12,232	10,329	45,831	26,744
Mean	5,450	6,039	13,556	11,833

Total Phthalates (μ*g/kg)*				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	175	381	123	455
Maximum	824	1,518	879	1,050
Mean	510	657	631	834

The total SVOC, total PAH and total phthalate concentrations in the 0.0 to 0.5-feet interval and 0.5 to 1-foot subtidal building samples are consistent with upriver concentrations.

Yard

Total PAHs (μ*g/kg)*				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	2,266	932	1,765	948
Maximum	12,232	3,753	45,831	9,002
Mean	5,450	2,361	13,556	3,127

Total SVOCs (µg/kg)

	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	2,441	1,251	2,583	1,266
Maximum	12,907	7,340	48,010	10,048
Mean	6,065	3,289	14,701	3,801

Total Phthalates (µg/kg)

	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	175	451	123	396
Maximum	824	2,940	879	1,120
Mean	510	1,228	631	746

The total SVOC, total PAH and total phthalate concentrations in the 0.0 to 0.5-feet interval and 0.5 to 1-foot Yard samples are consistent with upriver concentrations.

To evaluate whether Site operations have impacted Hudson River sediment quality, the concentration of total PCBs in the three Site sediment areas were compared to upriver sediment concentrations. This comparison is provided below.

Total PCBs Intertidal Buildings(µg/kg)

	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	44	ND	97	ND
Maximum	840	33,300	890	7,830
Mean	240	2,994	438	1,866

Total PCBs Subtidal Buildings (µg/kg)				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	44	165	97	270
Maximum	840	15,800	890	2,700
Mean	240	2,233	438	922

Total PCBs Subtidal Yard (µg/kg)				
	0 ft. to 0.5 ft.		**0.5 ft. to 1 ft.**	
	Upriver	Result	Upriver	Result
Minimum	44	ND	97	201
Maximum	840	448	890	425
Mean	240	184	438	309

Both the maximum and mean total PCBs in the intertidal and subtidal building samples are higher than upriver values. The statistics for the subtidal Yard samples indicate that their PCB concentrations are consistent with upriver concentrations. Further review of Figure 2-33 indicates that the subtidal building samples exhibiting elevated PCB concentrations are immediately adjacent to the Site buildings.

During the second round of sampling, sediment samples were collected from 12 to 18-inch and 18 to 24-inch intervals at locations having PCB concentrations greater than 1 mg/kg in the 6 to 12-inch interval. These results, which are presented in Figure 2-33, indicate:

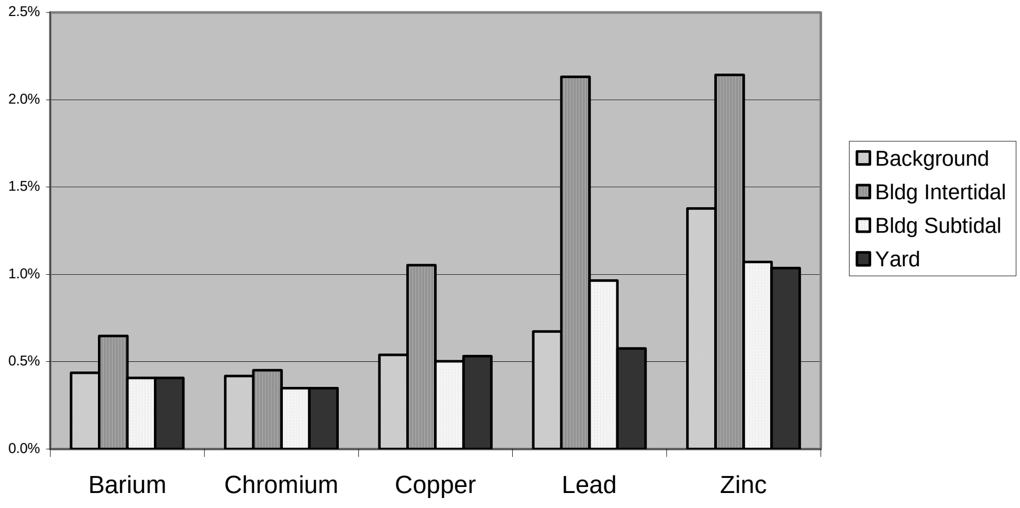
- Vertical delineation to 1 mg/kg (samples SED12-02 and SED8W-01), or
- An increase PCB concentration with depth, indicating that natural recovery is reducing concentrations to an acceptable level.

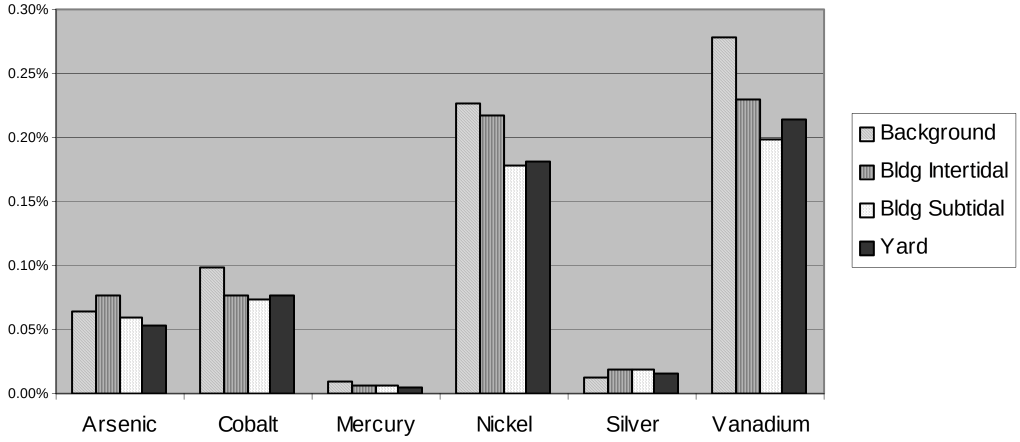
Inorganic Constituents

With regard to inorganic constituents a modified comparison to upriver concentrations was conducted. As discussed in Interim Deliverable No. 8, Revision No. 2, the clay content of the sediment must be taken into account when reviewing sediment data to account for naturally occurring inorganic constituents in the clay. This is done by normalizing the sediment data for aluminum content. This method is widely reported in the scientific literature[i] to account for variability in metals concentrations with the aluminum silicate clay mineral content of soils and sediments (ES&T, 1989). In general, substrates with a higher mineral content have higher aluminum concentrations correlated with higher concentrations of metals. Anomalies from this relationship can be observed as outliers on a plot of the metal to aluminum concentrations, and can be interpreted as indicators of point sources of pollution.

The average normalized inorganic results for these sediment areas are presented below.

Average Metal to Aluminum Ratios in Surface Sediments





As shown in these histograms, the Yard sediment has not been impacted from Site operations (i.e., the average normalized concentrations of all inorganic constituents in this sediment area are consistent with the normalized concentrations of inorganic constituents in upriver sediment). Thus, the Yard sediment has been adequately delineated for inorganic constituents.

In addition, with the exception of lead, the subtidal sediment samples collected adjacent to the buildings have not been impacted from Site operations. Review of the individual lead to aluminum ratios in the subtidal zone indicate that the ratios in excess of upriver values occur at sample locations also containing PCBs in excess of 1 mg/kg.

Finally, this comparison indicates that the intertidal sediment samples collected adjacent to the buildings have been impacted by Site operations for copper, lead, zinc and to a lesser degree, barium.

Miscellaneous Analyses

The sediment samples were also analyzed for a number of general chemistry parameters. These results are summarized in Table 2-23. The impact of these parameters are evaluated in the FWIA (see Section 6.0) and the FS.

Debris

A number of debris piles were observed beneath the High Bay Building and the West Warehouse. The locations of the sediment samples are presented in Figure 2-33. Samples of the debris material located in these piles were collected and tested for PCBs and TCLP. These materials included plastic pellets, slag, rubber and plastic strippings and a variety of cables.

The testing conducted provides a basis for assessing the waste characteristics of the material. The PCB and TCLP results are presented in Table 2-24 and 2-25, respectively. The results show Aroclors 1260, 1248 and 1254 to be present in the debris samples. However, the debris samples were commingled and soiled with sediment. Hence, the results are not a useful indicator of the composition of the debris. Rather, the results are useful in assessing the waste characteristics of the debris material.

One of the eight debris samples (SED08E-04D) exhibited a TCLP lead concentration above the TCLP limit; this debris pile would be classified as a RCRA hazardous waste when removed. The debris pile location SED08E-04D contained a number of cables, some of which appear to be lead jacketed. It is, therefore, likely that sample SED08E-04D exhibited an elevated TCLP lead concentration because it was collected from a lead-jacketed cable present in this debris pile. Based on the TCLP concentrations and PCB concentrations from the remaining debris samples, none of the remaining debris piles would be classified as a RCRA hazardous waste or a TSCA regulated waste.

2.5 ANALYTICAL DATA QUALITY EVALUATION

The SAP included in the RI/FS Work Plan (ERM/Roux, 2001) detailed the Data Quality Objectives (DQOs), analytical requirements and Quality Assurance (QA) protocols for the RI work. As required, the selected analytical laboratories (Accutest Laboratories, Inc. and A.D. Little, Inc.) maintained New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) certification in all categories of Solid and Hazardous Waste analytical testing for the duration of the project. NYSDEC Analytical Services Protocols (ASP) "Category B Deliverables" were provided by the laboratories. A Data Usability Summary Report (DUSR) was prepared for each round of analytical work. A DUSR level of review was approved in an electronic correspondence from NYSDEC to ERM (NYSDEC, 2001d). Twenty (20) DUSRs were prepared for both the exterior and interior environmental media samples. The results of the data review conducted for the/exterior samples are discussed in this section. The DUSRs prepared for the interior environmental media samples are discussed in Section 3.0. Included with each DUSR are the validated and qualified analysis data sheets (Form I) for each sample referenced by the DUSR. These validated Form I results have been transferred to applicable analytical results summary tables.

The following section summarizes the results of the laboratory analysis Quality Assurance (QA). Included in this section is the discussion of the analytical procedures for all exterior environmental media samples, validation, and qualification of the analytical results.

Validation indicated that the data are reliable, however, because of the complex mixture of chemicals present at the site, analytical inconsistencies were identified. For example, data from some soil samples, generated using Method 8270, revealed the presence of polychlorinated biphenyls (PCBs) as tentatively identified compounds (TICs). Analysis of the same samples using Method 8082 (a gas chromatographic method), however, did not confirm the presence of PCBs. A potential cause of this problem is the presence of polychlorinated naphthalenes (PCNs) in the samples that make the gas chromatograms complex. As discussed in the following sections, the impact of PCNs was evaluated and ERM has concluded that PCNs may cause a high bias in some of the reported PCB concentrations, however, impacted areas may still be accurately defined using these data. In addition, results from Method 8082 analyses also revealed the potential presence of Aroclors “greater than 1260,” i.e., contain PCBs that contain a higher degree of chlorination than those present in Aroclor 1260. Method 8082 is not calibrated for these products and the analytical laboratory categorized several of the samples, probably containing these Aroclors as “non-detected” for PCBs. As in the case of samples containing PCNs, ERM has determined that these samples have little impact on the overall quality of the data set and definition of PCB impacts is reliable. The additional analyses and evaluations of the PCB data that were carried out to support ERM’s conclusion that the PCB data reliably define the extent of contamination that requires remediation[3] are presented below.

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[3] ERM attempted to correlate the Method 8270 TIC data with Method 8082 data to be able to use the samples where PCBs in Method 8082 were reported “ND” but contained PCB TICs. The calculated correlation coefficient was approximately 0.6, insufficiently accurate to allow reliable use of estimated data.

2.5.1 *Analytical Procedures*

The environmental samples gathered during the investigation were primarily analyzed by Accutest Laboratories, Inc. (Accutest), located at 2235 Route 130, Fresh Ponds Corporate Village, Building B, Dayton, New Jersey 08810. Accutest is a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) Contract Laboratory Program (CLP) certified laboratory. Accutest meets the requirements for documentation, data reduction and reporting (Lab ID number 10983) and is certified to perform all of the analytical methods used in this investigation. Samples were also submitted to A.D. Little for PCB congener analysis. A.D. Little is also a certified NYSDOH ELAP laboratory.

Accutest analyzed the samples collected at the Site in accordance with "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, USEPA SW-846, Third Edition, September 1986 with revisions". The reported analytical results were consistent with ASP deliverable requirements. The samples collected during the investigation were analyzed using one or more of the following analytical methods. Most samples were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs) plus Tentatively Identified Compounds (TICs) USEPA SW-846 Method 8260B, TCL Semivolatile Organic Compounds (SVOCs) plus TICs by USEPA SW-846 Method 8270C, Polychlorinated Biphenyl Analysis (PCB) by USEPA SW-846 Method 8082 and Target Analyte List (TAL) Inorganics with Mercury analyzed by USEPA SW-846 Method 7471A for soil and sediment samples and USEPA SW-846 Method 7470A for aqueous samples, Cyanide by USEPA SW-846 Method 9012A for aqueous samples and modified for soil and sediment samples and all other metals by USEPA SW-846 Method 6010B. The TCL/TAL is detailed in Exhibit C of the ASP. For the SVOC analysis, 1,2,3-trichlorobenzene and 1,3,5-trichlorobenzene were added as additional target compounds.

Additionally, select samples were analyzed for:

- Total Organic Carbon (TOC) following a modification of "Procedures for Sediment Samples (S1D, S3) from "Procedures for Handling and Chemical Analysis of Sediment and Water Samples," Technical Report EPA/CE-81-1, prepared for the USEPA/Corps of Engineers Technical Committee;
- Toxicity Characteristic Leaching Procedure (TCLP) VOCs, SVOCs and Metals prepared in accordance with USEPA Method 1311 and analyzed by USEPA Methods 8260B, 8270C and 6010B/7410A respectively;
- Reactivity to Sulfide and Cyanide analyzed according to USEPA SW-846 Methods 9034 and 9014 (Chapter Seven) respectively;
- Corrosivity analyzed according to USEPA SW-846 Method 9045C;
- Flammability (Ignitability) analyzed according to USEPA SW-846 Method 1010;
- Chloride analyzed by USEPA Method 300;
- Total Dissolved Solids (TDS) analyzed by USEPA Method 160.1; and
- Salinity analyzed in accordance with the Standards Methods (SM) 18th Edition Method 2520B.

Select samples (as specified in the FSP) were also analyzed for grain size, bulk density, TCLP Pesticides and TCLP Herbicides, Redox potential, specific gravity, acid volatile sulfides and simultaneously extracted metals (AVS-SEM) and total volatile solids. The analytical data from these analyses were not subjected to a formal quality review process because there are no documented data quality review procedures. The results of these analyses were, however, checked for completeness by the validator.

Select samples were also analyzed for PCB congeners using gas chromatography/mass spectrometry in the selected ion-monitoring mode

(GC/MS/SIM). The PCB congener analyses were carried out by A. D. Little (ADL) following the protocols described in ADL's Standard Operating Procedure (SOP) ADL-2845 entitled Determination of PCBs by Gas Chromatography/Mass Spectrometry in the Selected Ion Monitoring Mode (SIM). Before each analytical sequence, the instrument was tuned to maximize sensitivity using perfluorotributlyamine (PFTBA). The initial calibration consisted of five standards containing the target compounds covering the linear range of the method (5 nanograms per milliliter [ng/mL] to 500 ng/mL). Validity of the initial calibration curve was checked by the analysis of an instrumental reference standard (IRM) consisting of a certified solution of key target PCBs (NIST SRM2262). Over the course of the analytical sequence, the stability of the instrument was verified by checking the relative response factors for the mid-level standard (100 ng/mL) against the average relative response factors of the initial calibration. Target compound concentrations were calculated against the internal standard compounds using the relative response factors generated from the initial calibration curve. Quality control samples including a procedural blank, blank spike/blank spike duplicate, matrix/matrix spike duplicate and an instrument reference standard were also analyzed as part of the analytical sequence. Quality assurance audits were performed on all data generated as part of the ADL deliverable. ERM reviewed the ADL PCB congener data for completeness.

Hydrocarbon profiling of selected samples was conducted by ADL. Sample for hydrocarbon profiling (fingerprinting) were analyzed for:

- target semivolatile saturated hydrocarbons/total petroleum hydrocarbons (SHC/TPH) using gas chromatography/flame ionization detection (GC/FID) and
- polynuclear aromatic hydrocarbons (PAH) by GC/MS/SIM.

Briefly, the procedure employed by ADL included extraction of a representative aliquot of the sample using methylene chloride/acetone following standard SW-846 procedures. Non-target matrix interferences were removed by high-performance liquid chromatography (HPLC) through alumina. The extracts were concentrated, spiked with internal standard and analyzed using with GC/FID or GC/MS/SIM. Quality control samples included method preparation blanks, fortified samples (matrix spikes and blank spikes) and reference material samples.

The GC/FID was calibrated by analyzing five concentrations of normal-(n) C_8 to n-C_{40} hydrocarbons. Midlevel continuing calibration standards were analyzed after every 15 to 18 samples and at the end of the sequence. TPH was calculated from the total area response over the range (nC_8 to the end of the analytical run approximately nC_{45}) using the average response factor (RF) of the even alkanes from the calibration curve. Responses of the internal and surrogate standards were not included in the total response. TPH was also evaluated by summing individual resolved hydrocarbon compounds, i.e., distinct chromatographic peaks detected over the nC_8 to nC_{45} range. The individual resolved peaks were integrated using valley-to-valley baselines on the unresolved complex mixture (UCM).

Samples were analyzed for PAHs and target compounds quantified from the average RF of the calibration curve. Alkalated PAH homologues were quantified from the RF of the parent compound.

Quality control samples for the SHC/TPH and PAH/GC/MS/SIM included a procedural blank, blank spike and blank spike duplicate, matrix spike and matrix spike duplicate, an instrument standard, and an oil reference standard (crude oil). The laboratory performed quality assurance audits and ERM reviewed the data packages for completeness.

2.5.2 *Data Validation*

2.5.2.1 *Objectives*

Data validation is the assessment of data quality with respect to method requirements and technical performance of the analytical laboratory. The objective of the data validation process is to determine the degree of confidence that may be placed on the analytical results. The validation process identifies deviations from the standard method, poor quality control (QC) results, matrix interference, and other analytical problems that may compromise the potential uses of the data. Analytical data packages were examined to ensure that all required laboratory components are included, all QA/QC requirements were performed, and the data use restrictions were well defined. The analytical data were qualified and appropriately flagged by the data validator. This information was taken into account during the interpretation of the data.

2.5.2.2 *Procedures*

Data Usability Summary Reports (DUSRs) were prepared for all data collected during the investigation. The DUSR was prepared according to the guidelines established by the NYSDEC Division of Environmental Remediation Quality Assurance Group and reviewed the following questions:

- Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables?
- Have all holding times been met?
- Do all the QC data: blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?

- Have all of the data been generated using established and agreed upon analytical protocols?
- Does an evaluation of the raw data confirm the results provided in the data summary sheets and qualify control verification forms?
- Have the correct data qualifiers been used?

The data have been evaluated according to the protocols and quality control (QC) requirements of the analytical methods, the Analytical Services Protocols (ASP), the USEPA Contract Laboratory Program (CLP) the National Functional Guidelines for Organic Data Review (October 1999), the National Functional Guidelines for Inorganic Data Review (February 1994), the USEPA Region II Data Review Standard Operating Procedure (SOP) Number HW-24, Revision 1, June 1999: Validating Volatile Organic Compounds by SW-846 Method 8260B, the USEPA Region II Data Review SOP Number HW-22, Revision 2, June 2001: Validating Semivolatile Organic Compounds by SW-846 Method 8270C, the USEPA Region II Data Review SOP Number HW-7, Revision 3, March 1993: TCLP Data Validation, the USEPA Region II Data Review SOP Number HW-2, Revision 11, January 1992: Evaluation of Metals Data for the CLP Program and the reviewer's professional judgment. The order in which the aforementioned guidance documents and/or criteria are listed does not imply any kind of validation hierarchy or particular reliance on a specific guidance document. The most comprehensive reference sources of criteria will be used to perform a complete validation.

A preliminary review of the data was performed to verify that all of the necessary paperwork, such as chains-of-custody, traffic reports, analytical reports, and deliverable packages, were present. A detailed quality assurance review was then performed by a qualified chemist to verify the qualitative and quantitative reliability of the data as it was provided by the laboratory.

The following items/criteria were reviewed for organic compounds:

- Case narrative and deliverables compliance
- Holding times both technical and procedural and sample preservation (including pH and temperature)
- Surrogate Compound recoveries and summaries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) results, recoveries and summaries
- Blank spike (BS) results, recoveries and summaries
- Method blank results and summaries
- Gas Chromatography (GC)/Mass Spectroscopy (MS) tuning and performance
- Initial and continuing calibration summaries and data
- Internal standard areas, retention times, summary and data
- Field and Trip Blank data
- Blind Field Duplicate sample results
- Organic analysis data sheets (Form I)
- GC/MS and GC chromatograms, mass spectra and quantitation reports
- Quantitation/detection limits
- Qualitative and quantitative compound identification

The following items/criteria were reviewed for the Inorganics:

- Case narrative and deliverable requirements
- Holding times and sample preservation
- Detection limits
- Inorganic analysis data sheets (Form I)
- Initial and continuing calibration verifications

- Low Calibration Check Standard Summary
- High Standard Check Summary
- Lab blank data
- Inductively Coupled Plasma Spectroscopy (ICP) interference check sample (ICS) analysis
- Matrix Spike analysis
- Matrix Duplicate analysis
- Laboratory control sample (LCS) results
- ICP serial dilution analysis
- Field Blank results
- Blind Field Duplicate results

Based upon the results of the data review, detailed data validation summary reports were prepared for each laboratory deliverables package. The reports consist of a section that contains an assessment of the deliverables, followed by a section that describes, on an item-by-item basis, the analytical results and any qualifications that should be considered when using the data. The qualifications were made by assessing the results submitted by the laboratory in terms of the technical requirements of the analytical methods (including quality assurance/quality control [QA/QC] criteria) and the data validation requirements. The reports highlight the data results that did not meet QC limits and, therefore, may have required data qualification. The reports also indicate the data qualification actions taken as a result of these criteria.

Qualification of data is made by the use of qualifier codes. These qualifiers serve as an indication of the qualitative and quantitative reliability of the data. The qualifier codes utilized for the most recent sampling events are as follows:

- U – Non Detect. The compound was analyzed for, but not detected. The associated numerical value is the detection limit. The value is usable as a non-detect at the detection limit.
- J - Estimated value. The value was designated as estimated as a result of the data validation criteria. Also used to indicate tentatively identified compounds (TICs) or when an organic compound is present, but the concentration is less than the Contract Required Quantitation Limit (CRQL). The value is usable as an estimated result.
- UJ – The compound was analyzed for, but not detected. The associated numerical value is the detection limit. However, due to a QC exceedance the value is an estimated quantity. The value is usable as a non-detect at the estimated detection limit.
- R - Rejected. Quality control indicates that the data are unusable (compound may or may not be present).
- N - Indicates presumptive evidence of a compound. This flag is used for TICs. Typically a Chemical Abstract Services (CAS) number is reported with the TIC.

2.5.2.3 Results

The analytical results for all samples collected as part of the investigation are valid and usable with qualifications as noted in each DUSR. All data qualifiers were taken into account during the interpretation of the analytical results. Analytical results were simplified for preparation of the analytical results summary tables. Qualifier flags were limited to "U" for non-detects, "J" for estimated values based upon results of the validation, "UJ" for non-detect values that were estimated based on the validation and "R" for values that were deemed as unusable during the validation process based on quality control deficiencies. A limited number of analytical results were rejected based on the data evaluation. The results were rejected due to severe QC deficiencies and/or a method by product as discussed in the validation reports. Overall there was no significant impact regarding the usability of the data set.

The only significant issue regarding overall data quality was identified with respect to the PCB data. Consequently, an "X" qualification was added to select results. The reasons for and implication of the data quality issues with the PCB data are discussed in the following section.

2.5.3 Data Quality Issues – Polychlorinated Biphenyls

PCBs are a class of nonpolar chlorinated hydrocarbons consisting of 209 discrete PCB molecules, called congeners. Each congener consists of a biphenyl nucleus on which from one to ten hydrogen atoms have been replaced by chlorine atoms. The term PCB refers to the entire class or any subset of one or more compounds. The entire set of 209 PCB congeners can be subdivided by the degree of chlorination. The term homolog refers to a subset of PCB congeners that contain the same number of chlorine atoms, e.g., the trichlorobiphenyl homolog that contains three chlorines. PCBs of a particular homolog with differing chlorine substitution patterns are called isomers. For example 2,3,4-trichlorobiphenyl and 3,3',5-trichlorobiphenyl are two of the twelve trichlorobiphenyl isomers.

Commercial PCBs were manufactured and sold as complex mixtures containing multiple isomers with differing degrees of chlorination. Individual PCB congeners are colorless, odorless crystalline compounds. However, commercial mixtures (of congeners) are viscous liquids and the more highly chlorinated the mixture, the more viscous. For example, Aroclor 1260, which contains approximately 60-percent chlorine, is a sticky resin. In the United States, Monsanto was the principal manufacturer of commercial PCB mixtures, which were marketed under the name Aroclor. The Aroclor tradename designated a variety of polychlorinated aromatic mixtures, not just PCBs. As shown in the table below, with the exception of Aroclor 1016, the last two digits of the Aroclor series number correspond to the nominal percent of chlorine in the mixture. (Erikson, 1997)

Composition of Aroclor Mixtures

Aroclor	Average No. of Chlorines/Molecule	Approximate Weight Percent Chlorine	Approximate Molecule Weight
1221	1.15	21	193.7
1232	2	32-33	223.0
1242,1016	3	40-42	257.5
1248	4	48	291.9
1254	5	52-54	326.4
1260	6-6.3	60	366.0
1262	6.8	62	388.4
1268	8.7	68	453.8
1270	10	71	498.6

Source: Erikson, 1997

Commercial PCB mixtures were used in a wide variety of applications including dielectric fluids in capacitors and transformers, heat transfer fluids, hydraulic fluids, lubricating and cutting oils and as additives in pesticides, paints, copy paper (“NCR” paper) adhesives, sealants and plastics. In the period from 1939 to 1997, use of Aroclor in capacitors and transformers accounted from 60 to 70 percent of sales. Aroclors 1260, 1254 and 1242 made up the bulk of production (80 percent between 1957 and 1972 with 1248 and 1016 (after 1971) making up most of the remainder. (Erikson, 1997)

2.5.3.1 *Evaluation of PCB Analyses*

Samples collected during the RI were analyzed for PCBs (as Aroclors) using USEPA SW846 Method 8082, a gas chromatography method. Congener specific analysis was carried out on a limited number of samples using GC/MC/SIM. The former analyses were carried out by Accutest and the latter by ADL. The ADL analyses were conducted in an attempt to develop a signature for Site soil and sediment. According to Sather, et al, "there is a strong correlation between the sum of Aroclors and the total PCBs obtained from full congener analyses" for unweathered samples (Sather, 2001).

Typically, Method 8082 analyses quantify PCBs as Aroclors (**N.B.** Method 8082 can also be used to determine the concentration of PCBs as a series of specific congeners.), with calibration carried out using standard Aroclor solutions containing Aroclors 1016 through 1260. Identification of the Aroclors present in a sample is made by comparing the peak pattern observed (characteristic peaks) in the unknown sample with the peaks present in individual Aroclor standards. Aroclor quantification is carried out using calibration factors (CFs) for up to 5 characteristic peaks (minimum of 3) per Aroclor determined from the standard solutions. Weathering of PCBs in the environment and/or the presence of more than one Aroclor may impact the peak pattern to the point that the characteristics of specific Aroclors are no longer recognizable and identification and quantification are not possible. Aroclor identification may also be complicated, when using Method 8082 by the presence of other chlorinated molecules that have retention times similar to those of the Aroclors.

The Data Utilization review carried out on soil and sediment sampling data identified data quality issues for PCB data. Based on this review, some of the PCB data obtained using Method 8082 were qualified. An "X" qualifier was used to indicate that PCB data qualification was atypical, i.e., data were qualified for a combination (rather than one) of the following reasons:

- The analytical laboratory reported PCBs as "non-detect" (ND) because "Aroclors greater than 1260 were present".
- PCBs were reported as non-detect (ND) in Method 8082 results, however, PCBs were reported as tentatively identified (TICs) in analyses carried out using Method 8270 in the same samples.
- The Aroclors identified in soil and sediment samples using the criteria in Method 8082 may not accurately reflect the Aroclor actually in the sample and other Aroclors may potentially be present.
- Matrix interferences resulted in poor surrogate and spike recoveries. The interferences may have obscured low concentration Aroclor peaks resulting in the misidentification of Aroclors.

Aroclors Greater Than 1260, PCBs Reported as ND in Method 8082 and Presence of Chlorinated Biphenyl Tentatively Identified Compounds

The distribution of homologs in Aroclor mixtures is presented in the table below.

Average Molecular Composition (weight percent) of Aroclors Reported in Method 8082							
Homolog (chlorines)	**Aroclor**						
	1221	**1232**	**1016**	**1242**	**1248**	**1254**	**1260**
0	10						
1	50	26	2	1			
2	35	29	19	13	1		
3	4	24	57	45	22	1	
4	1	15	22	31	49	15	
5				10	27	53	12
6					2	26	42
7						4	38
8							7
9							1

Source: Erikson, 1997

As can be seen in the above table, limited amounts of the 8- and 9-chlorine PCB homologs are likely to be present in the Aroclors typically quantified using Method 8082. The 10-chlorine homolog is also absent from these Aroclors.

For example, the gas chromatograms of soil/fill samples: SB-64 (4-8), SB-64 (17-19.5), SB-65 (16-19), SB-67 (1-4), SB-67 (4-8), SB-67 (8-12), SB-70 (8-12) and SB-73 (8-12) revealed peaks at retention times greater than the characteristic peaks associated with the 8- and 9-chlorine PCB homologs and/or a peak pattern inconsistent with Aroclor 1260. The presence of peaks at retention times greater than peaks associated with Aroclor 1260, the atypical concentrations of what appeared to be 8- and 9-chlorine-containing PCB homologs and peak patterns that appeared to be related to PCBs, led Accutest to conclude that Aroclors "greater than 1260" were present in these samples. Because peak patterns were inconsistent with Aroclor standards, Accutest, therefore, did not quantify the PCBs present in these samples, instead indicating PCBs were ND. Alternatively, as discussed in the following sections, the presence of PCNs, also reported as TICs, could be the reason for the unusual peak patterns observed

As can be seen in Table 2-11A, PCB TICs were identified in soil/fill samples, analyzed using USEPA SW 846 Method 8270. Specifically, while PCBs were reported as ND in soil/fill samples collected at locations SB-50, SB-54, SB-54A, SB-55, SB-56, SB-57, SB-58, SB-64, SB-65, SB-66, SB-67, SB-70 and TP-3, using USEPA Method 8082, PCB TICs containing eight or more chlorine atoms were identified in these samples using Method 8270. The TICs identified included octachloro-1,1′-biphenyl, as well as nona- and decachloro-1,1′-biphenyl. The TICs reported in Method 8270 data, therefore, suggest that chlorinated biphenyls (PCBs) are present in these samples. As stated in Paragraph 1.2 of Method 8082,

> "When samples contain more than one Aroclor, a high level of analyst expertise is required to attain acceptable levels of qualitative and quantitative analysis. The same is true of Aroclors that have been subjected to environmental degradation (weathering) or degradation by treatment technologies. Such weathered multicomponent mixtures may have significant differences in peak pattern than those of Aroclor standards."

In addition to the PCBs identified, the 8270 TIC data also revealed the presence of PCNs in the samples collected from locations SB-50, SB-54, SB-54A, SB-55, SB-56, SB-57, SB-58, SB-64, SB-65, SB-66, SB-67, SB-70 and TP-3. Under the conditions of both Methods 8082 and 8270, PCNs elute ,i.e., have comparable retention times, to PCBs. Similar to PCBs, PCNs are a group of 75 chlorinated naphthalene congeners, containing from 1 to 8 chlorine atoms and are chemically similar to PCBs. Commercial products containing mixtures of PCNs were marketed as Halowax, Nibren Waxes, Seekay Waxes, Cerifal Materials and N-Oil. The commercial formulations exhibit a wide range of patterns from nearly pure mono-chloronaphthalene (Halowax 1031) to nearly pure octa-chloronaphthalene (Halowax 1051). The congener profiles, in weight percent for Halowaxes are presented in the table below.

Composition of Technical Formulations of Halowaxes (in weight percent)

Halowax	Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa
1031	95	5						
1000	60	40						
1001		10	40	40	10			
1099		10	40	40	10			
1013			10	50	40			
1014				20	40	40		
1051							10	90

Because Halowaxes are chemically similar to Aroclors and have complex chromatography patterns, which are observed at retention times similar to those of Aroclor 1260 (Halowax 1013 and 1014), identification and quantification of mixtures of Aroclors 1254 and 1260 with Halowax 1013 and 1014 is complicated. Based on raw materials records, both Halowaxes and Aroclors were used at the Yonkers facility.

Quantification of the samples where PCBs were reported as “ND; Aroclors greater than 1260 potentially present” may provide additional information helpful in delineation of PCBs in soil/fill at the Site. As a result, ERM instructed Accutest to reevaluate the samples where the laboratory had reported the PCB concentration as ND (Method 8082) and that contained PCB TICs (Method 8270).

2.5.3.2 *Samples With Aroclors Greater Than 1260 Reevaluation*

As indicated above, Accutest associated chromatographic peaks detected during the analysis of soil samples collected from the Site as potentially indicative of the presence of Aroclors greater than 1260 or PCNs. Consistent with the calibration requirements of Method 8082, the original gas chromatographic analysis was not calibrated for Aroclors greater than Aroclor 1260. Therefore, the concentrations of Aroclors 1262 and 1268, if present, could not be quantitatively determined. The presence of Halowaxes could also not be qualitatively or quantitatively determined because standard Halowax solutions were not analyzed with the original extracts. An alternative approach was, therefore, developed in an attempt to qualitatively and quantitatively analyze samples, suspected to contain higher molecular weight PCBs and/or PCNs, using the existing laboratory analytical results.

Procedural Discussion and Findings

Polychlorinated Biphenyls. Archived sample extracts were not available and direct reanalysis was therefore not possible. The first step in the attempt to reanalyze the soil samples noted in the original reports as possibly containing higher molecular weight Aroclors was retrieval of the data files from the initial PCB analyses.

Calibration standards for Aroclors 1262 and 1268 were then analyzed and a calibration curve was prepared and response factors calculated. A lower molecular weight Aroclor was analyzed to serve as a retention time reference for determining retention shifts between the original analysis and the Aroclor 1262 and 1268 standards analysis. The response factors of the lower molecular weight Aroclor from the initial analysis and the new analysis were compared to determine if a quantitative bias existed between the two analyses.

Accutest then attempted to identify the presence of Aroclors 1262 and 1268 in this group of samples using a modification of Method 8082 procedures. Specifically, qualifying peaks within the retention windows of the 5 indicator peaks, selected for Aroclors 1262 and 1268, were used for the identification of either of those two Aroclors. If qualified peaks matched the retention times of prominent chromatographic peaks selected in the chromatograms of the Aroclor 1262 and 1268 standards (after adjusting for retention shifts that occurred since the initial analysis), the particular Aroclor was identified as present.

The qualitative review of the existing data files indicated that the peaks present in the original chromatograms were not consistent with Aroclors 1262 and 1268. Specifically, although peaks were observed in the appropriate retention time windows for the Aroclor 1260, the pattern was not sufficiently similar to that of the standard to justify quantitative identification. Therefore, Accutest could not confirm the presence of Aroclors greater than Aroclor 1260 in these samples.

Halowaxes. A high molecular Halowax standard (Halowax-1013) was analyzed for pattern matching and qualitative identification of the late eluting chromatographic peaks in an attempt to confirm the presence of a Halowax mixture(s). As in the case of the Aroclors 1262 and 1268, the pattern of the peaks in the sample chromatogram was not sufficiently similar to those in the standard to confirm the presence of a high molecular weight Halowax.

Analysis of soil sample using GC/MS methodology (Method 8270) indicated the presence of a mixture of high molecular weight PCNs and

PCBs (see Table 2.11A). The GC/MS data suggested that the concentration of the polychlorinated naphthalenes in some samples is greater than the concentration of polychlorinated biphenyls. However, Accutest's attempts to retroactively confirm this mixture of compounds as a commercially prepared PCB and/or Halowax using a modification of Method 8082 were unsuccessful.

The chromatographic patterns of the standards of each product were sufficiently dissimilar from the sample chromatogram and would have resulted in inaccurate and misleading quantitative data had they been used for quantitative purposes. The only conclusions that can be safely drawn from this investigation is that PCNs and/or PCBs from Aroclors greater than 1260 are potentially present in these samples.

A GC/MS method was subsequently developed which specifically targets PCNs . This method has been used on samples collected from the site, to provide qualitative and quantitative information on the PCNs present in the samples. Selected Ion Monitoring (SIM), and representative compounds, selected from each PCN isomer group, were used for calibration purposes. Using the response factors from these isomers, PCNs are reported as total isomer groups (mono through octa chlorinated naphthalenes).

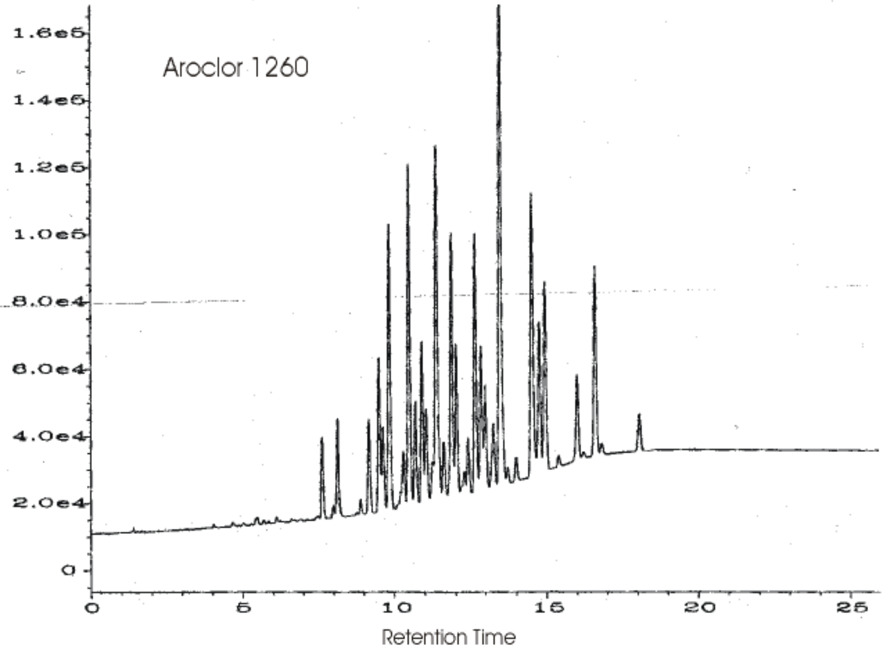
The Aroclors Identified Using Method 8082 May Not Accurately Reflect the Specific Aroclor Present in the Sample

Aroclors were identified in soil and sediment samples using the criteria of Method 8082. The calibration requirements of this method are based on standard solutions containing Aroclors from 1016 to 1260. Halowaxes are quantified using a altogether different method, Method 8081. Monsanto produced additional Aroclors beyond 1260, including Aroclor 1262, Aroclor 1268 and Aroclor 1270. These latter Aroclors were not as widely used as the Aroclors identified in the Method 8082 procedures. Therefore, preparation of calibration standards including these Aroclors is not required.

As shown on the following GCs of Aroclors 1260 and 1262, the GC signatures of these two Aroclors are very similar. Review of the Accutest data revealed that certain samples, identified as containing Aroclor 1260, may, in fact, have contained Aroclor 1262. That is, in the opinion of the ERM data reviewer, the chromatogram more closely resemble Aroclor 1262 than 1260. The misidentification is likely because Method 8082 does not require preparation of a calibration standard for Aroclor 1262. Because the level of data validation performed does not require review of individual chromatograms, the identity of an Aroclor reported as being present may be in error. A bias in the concentration may also exist because a non-specific standard may have been inadvertently used as the basis for the calculation.

PCNs are also likely present in some of the samples collected at the site. Under the conditions of Method 8082, the PCNs presumably used at the site (Halowaxes 1013 and 1014) co-elute (i.e. have similar or the same GC retention times) as Aroclor 1260 and to a lesser extent Aroclor 1254. The presence of PCNs in a sample that is being analyzed for PCBs using Method 8082 therefore complicates the analysis. The chromatographic pattern is more complex, with overlapping peaks. If PCNs are present in a sample and a PCN congener(s), co-elute with a PCB congener(s), the characteristic Aroclor peak pattern can become distorted. The distortion may be so severe that the laboratory cannot confirm the presence of the Aroclor. Co-elution can also increase the area(s) of peaks used to calculate Aroclor concentrations thereby increasing the concentrations of Aroclors reported.

To evaluate the impact of the presence of PCNs, ERM reviewed a number of gas chromatograms to evaluate the significance of the potential presence of "Aroclors greater than 1260 " and of PCNs. Based on this review, ERM has concluded that Aroclor concentrations are likely "biased high" in samples that contain elevated concentrations of PCNs. This high bias affects samples that contain high concentrations of PCBs/PCNs. Samples the low PCB/PCN concentrations are minimally affected and therefore, the PCB data reliably defines the PCB impacts that must be remediated.



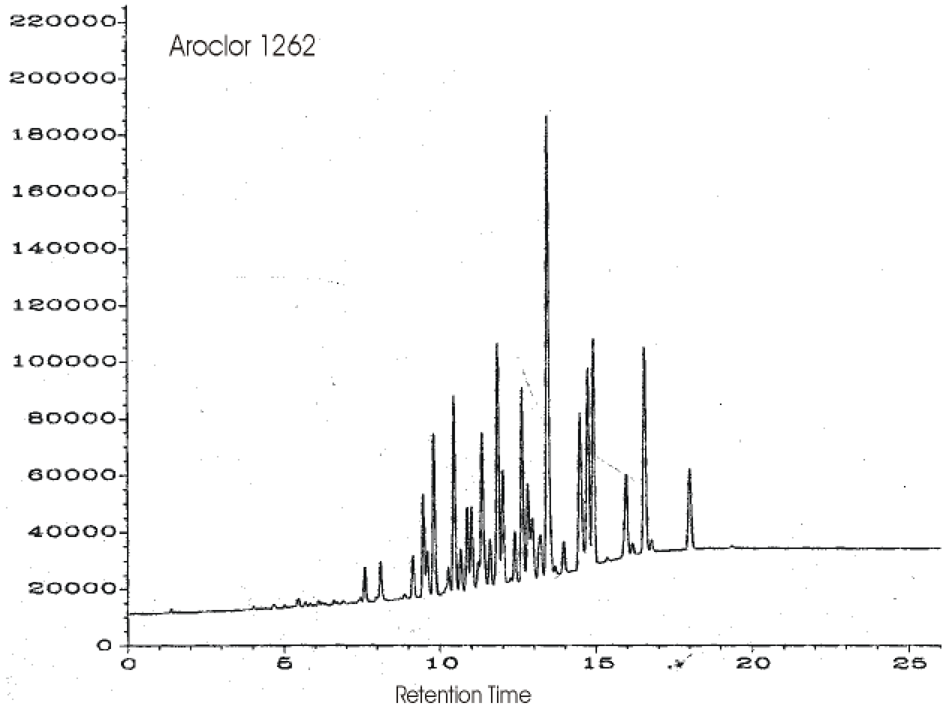


Table 2-11B presents the TICs identified in the Below Buildings soil/fill samples. TICs reported in the Method 8270 analyses for seven below building samples, included chlorinated biphenyls (PCBs). Four of these below building samples also had chloronaphthalenes (PCNs) reported as TICs. Because the laboratory only reports a limited number of TICs, comparison of TIC data from below building samples with TIC data from yard samples is impracticable to evaluate if the contaminants present in both areas are related.

Tables 2-11C through 2-11E present the results of the ADL congener analyses of test pit soil, Sump-1A sediment and river sediment samples, respectively. These data indicate the presence of PCB congeners containing 9 and 10 chlorine atoms.

Matrix Interferences

As indicated in Table 2-11A, numerous soil samples contain concentrations of unidentified TICs and for certain samples, unidentified

TICs represent the major portion of TIC concentrations. The presence of high concentrations of organic material can impact laboratory procedures and lead to elevated detection limits and other quality assurance/quality control problems. In fact, poor surrogate recovery has been identified as a problem with the data and has resulted in qualification of the data from certain samples. The presence of matrix interferences, therefore, may have obscured the presence of low concentration compounds.

2.5.4 Test Pit Hydrocarbon Analyses

In addition to the PCB analyses discussed in Section 2.2.1, the twelve soil samples, collected during the test pit investigation, were also subjected to detailed petroleum hydrocarbon analysis. Specifically, the total petroleum hydrocarbon concentration and the concentration of specific target semi-volatile organic hydrocarbons, ranging from normal (n) C_8 to nC_{40} (aliphatics), were determined by gas chromatography using flame ionization detection (GC/FID). Polyaromatic hydrocarbons (PAHs) contained in the samples were identified using GC/MS/SIM. The objective of these analyses was to determine if there was an identifiable signature (fingerprint) to the hydrocarbons present in test pit soils.

Numerous petroleum products were historically used at the Yonkers facility. These include highly refined oils used as dielectric fluids in cable manufacture (cable oil), quench oils used in cable annealing, lubricating oils used in the extrusion machinery, and dielectric fluids from capacitors and transformers. Although the exact composition of the various petroleum hydrocarbon products used is unknown, it was anticipated that distribution of aliphatics and aromatics, i.e., molecular weight range and fingerprints, observed in the samples would provide a common signature.

All of the twelve samples contained both aliphatic and aromatic hydrocarbons. No discernable pattern was observed that could be used to relate the samples contained in each of the test pits to one another. Based on the molecular weight range of hydrocarbons observed, the hydrocarbons present in the test pit samples are middle to heavy distillate products with a signature clearly distinguishable from the North Slope Crude Oil standard analyzed by the laboratory. Cable oil is a highly refined petroleum product that only contained aliphatic compounds. The PAH pattern in the soil samples TP-1 SW-3E and TP-2 B1 are similar; however, it is not possible to determine if the pattern is due to the presence of similar petroleum products or the presence of fill from related sources.

TP-1 NAPL

The NAPL sample collected from TP-1 was subjected to the same petroleum hydrocarbon analyses used for the soil samples. The NAPL sample contained both aliphatic and aromatic hydrocarbons. The assemblage of aliphatic hydrocarbons was extremely limited and consisted of a generally unresolved "hump" from nC_{24} to nC_{40}. This is the molecular weight range of a heavy distillate; however, the fingerprint does not resemble any of the fingerprints observed in the associated TP 1 soil samples. The PAHs contained in the NAPL are also limited and consisted of predominately naphthalene and substituted naphthalenes, fluorene and substituted fluorenes, and pyrene and substituted fluoranthenes/pyrenes. The PAH pattern also did not resemble any of the soil samples.

In summary, a common petroleum fingerprint was not observed in the test pit soil and NAPL samples.

2.6 EVALUATION OF ENVIRONMENTAL CONDITIONS

The environmental condition is characterized by the extent of Site related organic compounds and inorganic constituents and the physical/chemical relationship between the media that exhibits these chemicals/constituents. Therefore, to properly evaluate the environmental conditions, the organic compounds and inorganic constituents associated with the Site activities need to be determined for each media. Then, the fate and transport characteristics of the Site related constituents can be assessed within and across environmental media.

The environmental media are soil/fill, ground water and sediment. The data, which characterize these media, are presented and summarized in Sections 2.2 through 2.4.

A review of past manufacturing activities indicates that organic compounds and inorganic constituents, particularly certain VOCs, SVOCs, PCBs, and the key inorganic constituents, copper and lead, were used in manufacturing or related operations at the facility. Based upon the data, it appears that many of the chemicals/constituents contained in these analyte groups may have been released to the environment. However, there are also other anthropogenic (man-made) sources of many of the same organic compounds and inorganic constituents that may have also contributed to conditions at the Site. A review of the distribution of the chemical/constituents, together with regional information, was considered to determine whether anthropogenic sources of organic compounds and inorganic constituents are contributing to the environmental conditions at the Site.

2.6.1 Soil/Fill

Historic information documents the filling of major areas of the Site. Fill underlies the South Yard, North Yard and Site buildings. This fill ranges from 10 to 20 feet deep and, based on visual observations during the boring program, is composed of coarse sand and gravel with brick fragments, cinders, slag, coal, ash and shells. Hence, some of the organic compounds and inorganic constituents may have been present in the fill material that was placed on the Site.

Filling was a common activity in many areas along the Hudson River. In fact, there is a nearby property, referred to as the Yonkers Downtown Waterfront Development site (Brownfield site), which has been investigated as part of a brownfield re-development. It is located approximately 0.5 miles south of the Site. The Brownfield site is located within and at the southern end of the Alexander Waterfront Brownfields (ASW) Initiative. It is composed of Parcels A through K. A location map for the Brownfield site is provided in Appendix F.

As part of the ASW initiative, sampling was conducted in 1997 through 1999 on Parcels A, C, E, F, H and I on behalf of the City of Yonkers by AKRF, Inc. Parcel J is a yet to be constructed promenade. The remaining Brownfield Site parcels have not been sampled. The results of these sampling exercises were contained in the following documents:

- Site Investigation Report of "Phase I" Parcels E and F, Yonkers Downtown Waterfront, Yonkers, New York (AKRF, 1998);
- Investigation of "Phase I" Parcels H, I and C, Draft Report, Yonkers Downtown Waterfront, Yonkers, New York (AKRF, 1999); and
- Site Investigation of Parcel A, Yonkers Downtown Waterfront Development, Yonkers, New York (AKRF, 2000).

Sand, gravel, concrete, brick, coal, ash, metal, wood, scrap metal and rebar were observed in the Brownfield parcels. The Sanborn maps for the

Brownfield site indicate that the majority of Parcels A, C, E, F, H and I were filled between 1886 and 1942 (see Appendix F for these maps). The soil/fill at the Brownfield Site parcels was also tested for organic compounds and inorganic constituents. The results are presented in Appendix F. The analytical results for the Brownfield site are consistent with other sites containing historic fill along the Yonkers waterfront. Therefore, the Brownfield site data will hereafter be referred to as the "historic fill data". These data will be used for comparative purposes with the data from the Site.

SVOCs and inorganic constituents are present in the historic fill data set. In fact, many of these chemicals/constituents are present at concentrations above their RSCOs. This is not surprising since the RSCOs, which were developed as screening guidelines for soil, are not appropriately applied to historic fill. In addition, low levels of VOCs and PCBs were also observed in the historic fill data set.

Materials observed in the subsurface soil/fill at the Brownfield site were consistent with the materials observed in the Site soil/fill. That is, sand, gravel, concrete, brick, coal, ash, metal, wood, scrap metal and rebar were observed in the North Yard fill, South Yard fill and Below Building fill. Review of the Sanborn maps for the Site indicate that the South Yard and the Below Building areas were filled between the 1880s and 1942. As noted above, this was the time period that the Brownfield site parcels were filled. In addition to the historic fill materials, the North Yard, which was filled between the 1940s and 1970s, also contains debris from the former manufacturing operations at the Site.

Statistics regarding total SVOCs, PAHs, CaPAHs, phthalates and phenols and individual inorganic constituents for the historic fill data are provided below. This summary is similar to the one for the Site soil/fill data presented in Section 2.2. The minimum, maximum and 95% UCL on the mean concentration for the aforementioned parameters were determined from the historic fill data set. The report on the Brownfield site parcel indicates that remedial action is planned for the area exhibiting TCLP lead in excess of the regulatory limit. So as not to inflate the statistics for the lead concentrations in historic fill, the samples with total lead results that correspond to the TCLP lead in excess of the regulatory limit were not included in the historic fill data set.

Historic Fill Inorganic Data

	Antimony (mg/kg)	Barium (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)
Minimum	1.1	12.4	11	7.6	0.03	21.1
Maximum	8.4	433	9,360	40.5	2.1	3,930
95% UCL on the Mean	1.3	155	629	624	1.1	595

Historic Fill Organic Data

	Total SVOCs (μg/kg)	Total CaPAHs (μg/kg)	Total PAHs (ug/kg)	Total Phenols (ug/kg)	Total Phthalates (ug/kg)	Total PCBs (mg/kg)
Minimum	>190U*	>190U*	>190U*	>190U*	>950U*	>0.035U*
Maximum	991,500	203,600	211,500	695	**980,000**	**5**
95% UCL on the Mean	497,814	92,591	203,153	530	40,401,413	34

*It should be noted that a number of samples exhibited elevated detection limits for compounds within these categories.

Note: Where the 95% UCL on the mean is greater than the maximum concentration, the maximum concentration is highlighted. In these cases, the maximum concentration is used for comparative purposes.

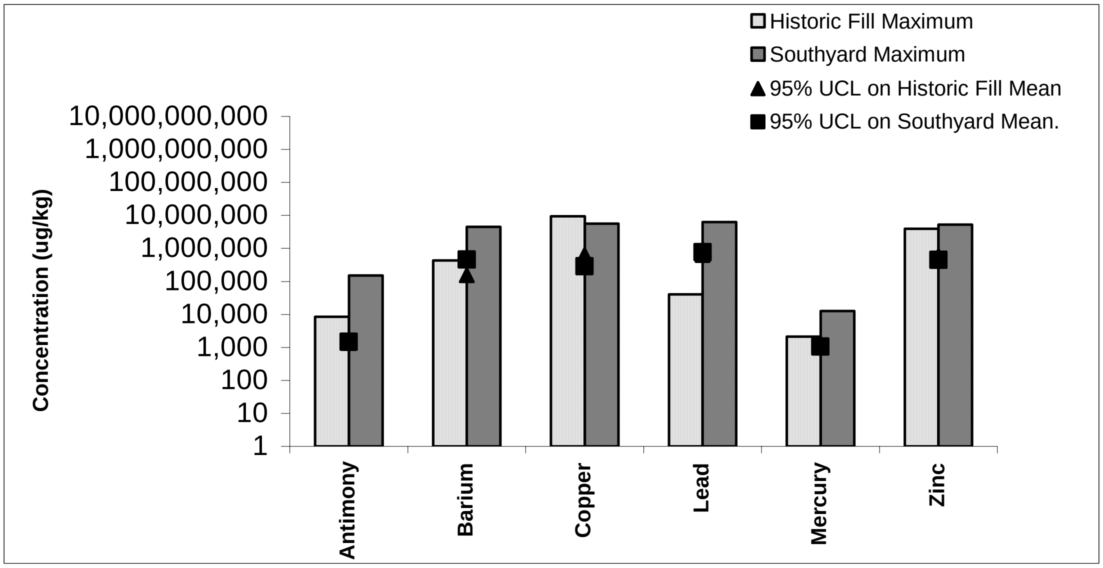
It is evident from the historic fill data that organic compounds and inorganic constituents are present in historic fill at levels in excess of the individual and categorical RSCOs. As noted above, elevated detection limits were also observed in the historic fill data.

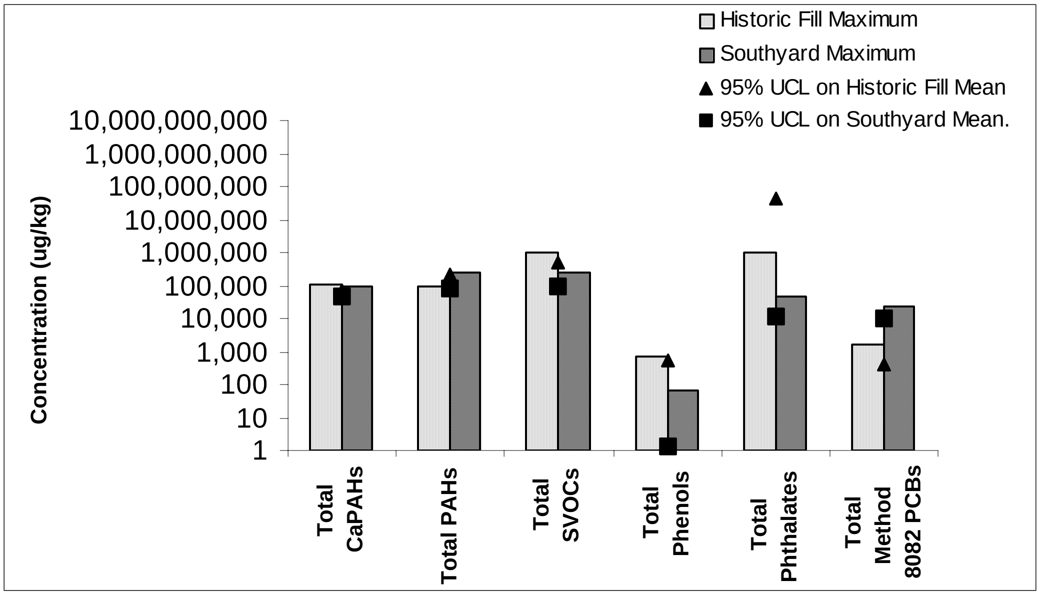
The following subsections present a comparison of the soil/fill quality encountered in the different portions of the Site to these historic fill data. This is followed by a more specific discussion of the results for organic compounds and inorganic constituents and a discussion of the evidence of petroleum and miscellaneous colored materials in the Site soil/fill.

Additional discussion regarding the fate/transport of constituents in soil/fill is presented in Section 2.6.4 and Table 2-10 presents a summary of the organic compounds and inorganic constituents present in Site soil/fill in excess of their screening criteria (i.e., RSCOs).

2.6.1.1 South Yard

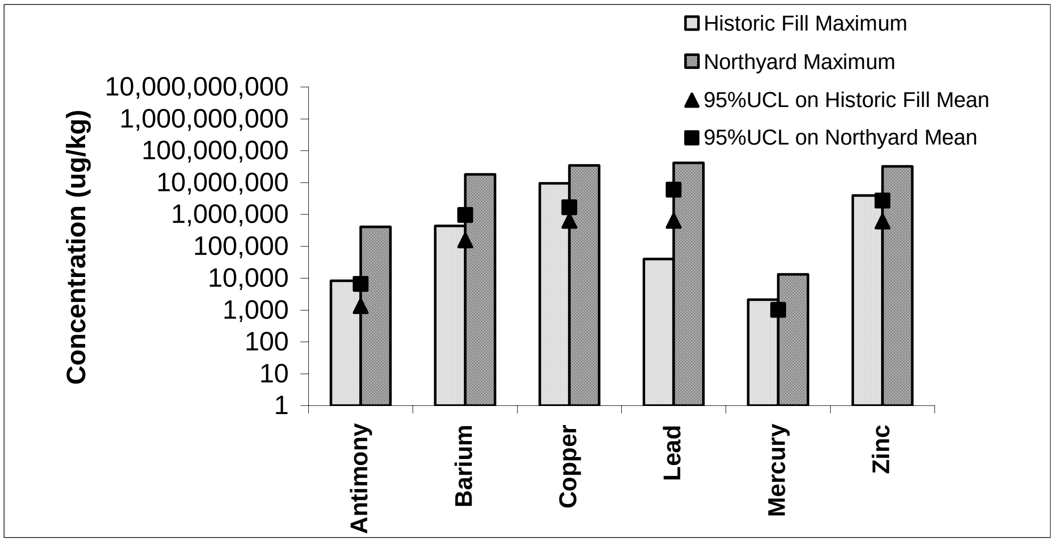
The South Yard fill data is compared to the historic fill data in the following figure. This figure is a histogram showing the range in concentrations of the various analyte groups, and select inorganic constituents for both historic fill and the South Yard. The 95% UCL on the mean is noted on the histograms for each analyte group and the NYSDEC identified inorganic constituents. This comparison indicates that with the exception of PCBs, the South Yard soil/fill is essentially the same or of better quality than the historic fill. Hence, PCBs in the South Yard appear to be related to former Site activities. The difference in total PCBs between South Yard soil/fill and historic fill data is primarily due to the elevated PCB concentrations found in certain exposed surface soil samples and one, isolated subsurface sample collected 20 feet below grade in the South Yard.

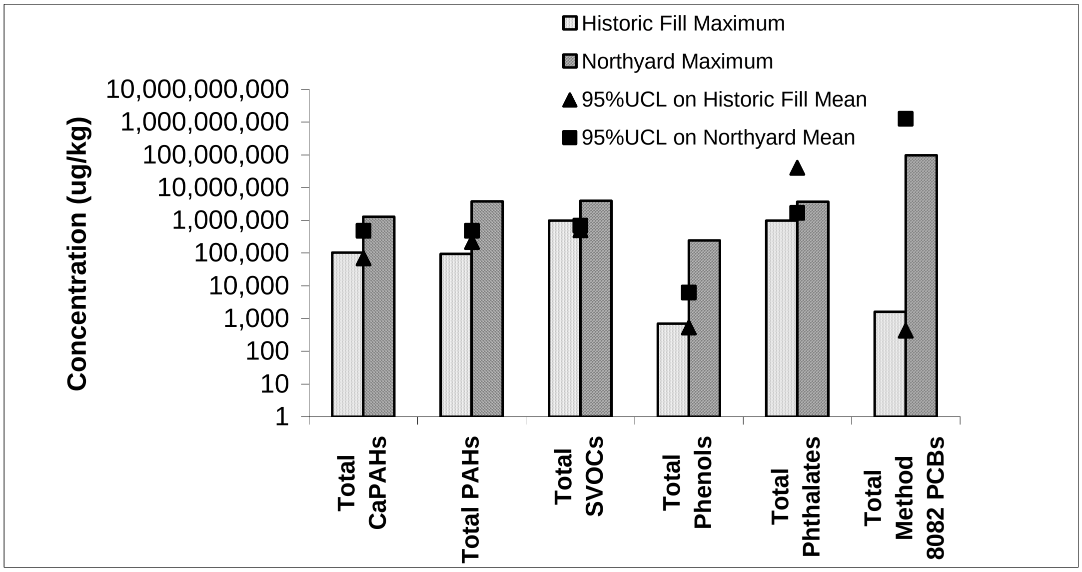




2.6.1.2 *North Yard*

A comparison of the North Yard soil/fill data to the historic fill data is depicted below. This figure is a histogram showing a comparison of the historic fill data and the North Yard data. This comparison indicates that the North Yard soil/fill contains organic compounds and inorganic constituents at levels above those found in the historic fill.



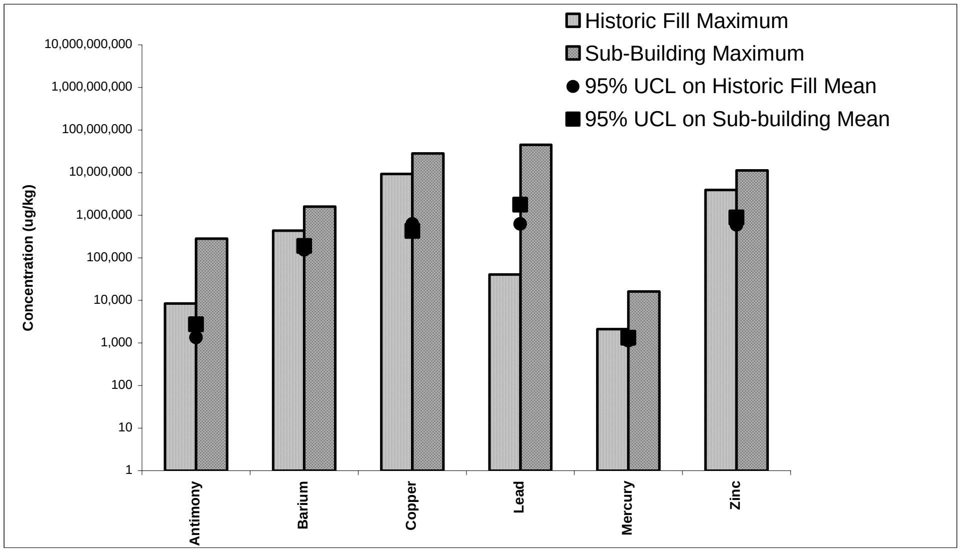


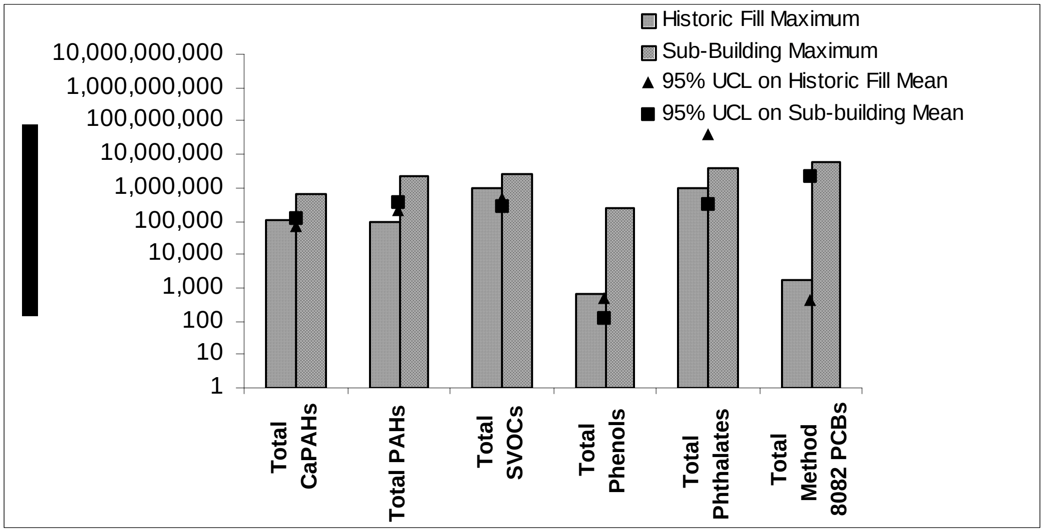
The antimony, mercury, total SVOC, total PAH and total phthalate 95% UCL on the mean concentrations in the North Yard soil/fill samples are generally within an order of magnitude of the 95% UCL on the mean concentrations historic fill data. The barium, copper, lead, zinc, total CaPAH and total phenol 95% UCL on the mean concentrations for the North Yard soil/fill samples are generally an order of magnitude greater than the 95% UCL on the mean concentrations for the historic fill data. The largest disparity between the North Yard data and the historic fill data is associated the total PCB concentrations. The maximum PCB concentration for the North Yard soil/fill (which is lower than the 95% UCL on the mean) is four orders of magnitude greater than the maximum PCB concentration in the historic fill data.

In conclusion, the comparison indicates that Site related activities in the North Yard area have contributed barium, copper, zinc, CaPAHs, phenols, lead and particularly PCBs, to the environmental media at the Site. In addition, VOCs are also present in the North Yard area at concentrations above RSCOs.

2.6.1.3 *Below Buildings*

A comparison of the Below Buildings soil/fill data to the historic fill data is depicted below. This comparison indicates that the soil/fill below the building predominantly contains lead, total PCBs and total phenols at levels that are higher than those found in historic fill data.





The below building soil/fill 95% UCL on the mean concentration for antimony, barium, copper, mercury, zinc, total PAHs, total SVOCs, total phthalates and total phenols are less than or the same order of magnitude as the historic fill data. The lead and total CaPAHs results, a subset of total SVOCs, are an order of magnitude higher than the historic fill data. The largest disparity between the below buildings soil/data and the historic fill data is associated with the total PCB concentrations. The 95% UCL on the mean PCB concentration is four orders of magnitude greater than the historic fill data. The comparison indicates that Site related activities in this area have contributed PCBs, and to a lesser degree lead and CaPAHs to the environmental media.

2.6.1.4 *BICC Parking Lot*

Two samples, SB-44 and SB-45, were collected from beneath the asphalt in the BICC Parking Lot. As shown in Table 2-7A, none of the results from these samples exceeded the RSCOs for organic compounds. Minor and often sporadic occurrences of the inorganic constituents above RSCOs, which are based on eastern USA background concentrations, were observed for iron, mercury, nickel and zinc. Since the BICC parking lot soil is not historic fill, the results for this area were not compared to the historic fill data.

Based on the results shown in Table 2-7A - C, the environmental condition of subsurface soil in the BICC Parking Lot has not been impacted from Site activities.

2.6.1.5 VOCs

The areal distribution of VOCs at the Site is shown in Figure 2-8. The figure also shows the outline of the buildings and indicates, based upon the data, a separation of the North and South Yard fill areas.

Intervals exhibiting VOC concentrations in excess of their RSCOs are presented in Figure 2-8. This figure also notes where evidence of petroleum occurred at locations of VOC RSCO exceedances. Additional discussion regarding evidence of petroleum is provided in Section 2.6.1.10. Finally, Table 2-10 contains a summary of the number of Site soil/fill samples exhibiting exceedances of their VOC RSCOs. As shown in Figure 2-8, there is a limited soil area where VOCs exceed the RSCOs. The fate and transport of these VOCs is discussed in Section 2.6.4.1.

2.6.1.6 PCBs

The areal distribution of PCBs in surface and subsurface soil/fill throughout the entire Yard is presented in Figure 2-9. The figure also shows the outline of the buildings and indicates a boundary of the North and South Yard fill areas.

Only sample points of exposed soil/fill are designated as surface locations in Figure 2-9. Each sample point is colored to denote whether it is above or below the surface PCB RSCO. Figure 2-9 indicates the exposed surface soil areas that exceed the RSCO for PCBs are limited to eastern Site areas adjacent to the rail tracks and a localized area in the southwestern portion of the Site near the Hudson River.

The subsurface soil/fill sample locations are similarly colored to denote whether the results were above or below the subsurface PCB RSCO. If any vertical sample interval at a location exhibited PCBs in excess of the subsurface RSCO, it is noted as exceeding this criterion on the figure.
It is evident from Figure 2-9 that a number of subsurface soil/fill samples in the North Yard exhibit concentrations of PCBs above the RSCO. These locations are beneath the East Warehouse, the loading ramp and to the east and west of the retaining wall. The samples with PCBs above RSCOs tend to extend to the southern boundary of the area filled after 1940. PCB concentrations above the RSCOs were observed as deep as to 20 feet below grade in the North Yard, well below the water table. A decreasing trend in PCB concentrations was not consistently observed with depth below grade. At some sample locations, the shallow samples exhibited lower concentrations than the deeper samples.

All the subsurface soil/fill samples in the South Yard, except one isolated sample, exhibit concentrations of PCBs that are less than the subsurface PCB RSCO. The one sample above this criterion is located along the shoreline in the southwestern portion of the Site. The sample interval from 19 to 20 feet below grade at this location (SB-78) had a PCB concentration of 23.3 mg/kg.

Figure 2-10 is an isometric cross-section posting all the soil/fill samples. This figure notes each interval that was sampled. The samples are color coded to indicate whether they are above or below the PCB RSCO. Incremental increases above the RSCOs are also color coded to show the distribution of PCBs. This figure provides a perspective of all surface and subsurface samples that exceed the PCB RSCO in the North Yard and Below Buildings. It also shows the position of the one lone subsurface soil/fill result above the PCB RSCO in the South Yard. The sample interval (19 to 20 feet) of this isolated subsurface sample in the South Yard with PCBs above the RSCO is in the saturated zone, considerably below the ground water surface. In both the North and South Yards and Below the Buildings, the area of soil/fill exceeding the PCB RSCOs is sufficiently delineated for the RI/FS.

Table 2-10 contains a summary of the number of Site soil/fill samples exhibiting exceedances of their PCB RSCOs. The fate and transport of PCBs in soil/fill at the site is discussed in Section 2.6.4.

2.6.1.7 SVOCs

The areal and cross-section distributions of total SVOCs, total CaPAHs, PAHs, phthalates and phenols in soil/fill throughout the entire Yard are presented in Figures 2-11 through 2-18. These figures also show the outline of the buildings and note the separation of the North and South Yard fill areas. These areal and cross-section figures utilize categorical RSCOs (where available) and historic fill 95% UCL on the mean concentrations for comparative purposes. These areal and cross-section figures also indicate the total CaPAHs that are greater than 10 mg/kg, a level that has been used for screening purposes for these constituents in a manner similar to the categorical RSCOs.

When the historical fill data are considered together with the Site, it appears that Site activities may have contributed some of these organic compounds to the environmental condition in the North Yard based on the greater concentration range in the North Yard soil/fill samples. In the case of the South Yard and Below Buildings soil/fill samples, the range and 95% UCL on the mean concentrations for SVOCs are more closely linked to the historic fill as described by the historic fill data. The fate and transport of the SVOC compounds are discussed in Section 2.6.4.

2.6.1.8 *Inorganic Constituents*

As discussed in Section 2.2.1.3, the following inorganic constituents were selected to evaluate potential Site related soil/fill impacts: antimony, barium, copper, lead, mercury and zinc. The areal and cross-sectional distribution of these select inorganic constituents are shown in Figures 2-17 and 2-19 through 2-27. These figures also show the outline of the buildings and the separation of the North and South Yard fill areas. The sample points in this figure are colored to denote how the result for any interval within the sample compares to the historic fill data and their RSCOs.

As shown in these figures, the concentrations of barium, copper, lead and zinc in the North Yard soil/fill samples are generally an order of magnitude higher than the 95% UCL on the mean concentrations for the historic fill data. Antimony concentrations are generally below the eastern USA background concentrations and the 95% UCL on the mean concentrations for the historic fill. Mercury concentrations are generally below the 95% UCL on the mean concentrations for the historic fill.

2.6.1.9 *Evidence of Petroleum and Miscellaneous Colored Materials in Soil/Fill*

Evidence of petroleum was noted at some soil boring, test pit and monitoring well locations. For the purpose of this document, "evidence of petroleum" has been defined as soil staining, petroleum-like odors or the visual observation of material resembling product/oil or sheens. In addition to the evidence of petroleum, various unknown colored materials were also observed in the subsurface soil/fill. The locations of these observations are summarized in the Table 2-10 and presented in Figure 2-7. This information was obtained from the soil boring logs, monitoring well logs, groundwater sampling event logs and field notebooks presented in Appendix A.

In total, a visible sheen or product was observed in 15 of the 60 North Yard soil boring locations and three of the four North Yard test pit locations. In addition, odors, unknown colored materials and/or soil staining were also noted at a portion of the soil borings/test pits listed above and in an additional eight soil borings and one North Yard test pit location.

In contrast to the North Yard, the South Yard and Below Building areas at the Site appear to be minimally impacted by these materials (i.e., evidence of petroleum and unknown colored materials). That is, a sheen was only noted at one soil boring location in the South Yard and at no soil boring locations in the Below Building area, and odors, stains, and/or unknown colored materials were identified in three additional borings in the South Yard and two borings in the Below Building area.

Although evidence of petroleum was observed in a number of soil borings and test pits at the site, as discussed in Section 2.6.2.2, a NAPL layer has not been observed in any of the Site groundwater monitoring wells. Discussion regarding the fate and transport of the evidence of petroleum and unknown colored materials is presented in Section 2.6.4.

2.6.2 *Ground Water*

2.6.2.1 Ground Water Elevation and Flow

Ground water flow from the Site is southwesterly towards the Hudson River. Ground water elevation measurements for the exterior and interior wells are presented in Table 2-19 and ground water contour maps for the October 2001, January 2002 and July 2002 monitoring rounds are presented in Figures 2-28, 2-29 and 2-30.

The average depth of ground water in contact with Site fill is approximately ten feet. Using this value to determine the conductivity measurements from the slug testing, the ground water velocity from the Site was estimated to range from 0.7 to 6.6 feet per day.

2.6.2.2 Ground Water Quality

The ground water results from the July 2001, October 2001, November 2001, January 2002 and July 2002 groundwater sampling events were previously presented in Tables 2-15 through 2-18. The results of these sampling events are comparable to one another. Table 2-10 presents a summary of the organic compounds and inorganic constituents present in Site groundwater in excess of their screening criteria (i.e., Class GA standards).

The Class GA ground water quality standards were also provided in the aforementioned tables, though the shallow ground water in the soil/fill exhibits dissolved solids that do not meet the threshold for the Class GA classification. Ground water samples from MW-03, MW-06 and MW-08 met or exceeded the limits for saline water classification (NYCRR Part

Section 701.17). As such, the Site ground water would not be suitable as a potable ground water drinking water supply and Class GA standards would not apply. Also, there are no potable wells at the Site or within a one-half mile radius of the Site.

MW-04 and MW-05 are hydraulically upgradient wells. MW-01 through MW-03 and MW06 through MW-11 are Site wells. Following is a comparison of the Site groundwater concentrations to upgradient concentrations and a discussion of chemicals exceeding the groundwater screening criteria.

VOCs

Benzene, xylenes and tetrachloroethene were the only VOCs measured at concentrations in excess of the Class GA standards. Benzene and xylenes are aromatic hydrocarbons; common in petroleum related products. The occurrence of benzene and xylenes is fairly localized in wells MW-6 and MW-7, corresponding to the area in the North Yard where soil/fill also exhibited these constituents. Neither benzene nor xylene was detected in the upgradient wells.

The origin of the tetrachloroethene identified in Site ground water at the suspected dry well (i.e., PIPE-01) appears to be an off-site, upgradient area. Tetrachloroethene was also detected in MW-5, an upgradient well.

Additional discussion regarding the fate and transport of these chemicals in ground water is presented in Section 2.6.4.

SVOCs

The primary SVOCs that were detected in ground water in excess of the screening criteria were benzo(a)pyrene (BaP), 2-methylphenol, 2,4-dimethylphenol, 3&4-methylphenol, phenol and bis (2-ethylhexyl) phthalate (BEHP).

The origin of the BaP identified in ground water below the buildings appears to be correlated with the condition of the sample. BaP was only detected once at levels above standards. This was in the well MWI-01, which is located within the building, during the January 2002 monitoring event. As previously discussed, the turbidity of this well could not be brought below 50 NTUs, a goal of low flow sampling. Hence, particulates suspended in the ground water sample were present in the aqueous sample. Since the laboratory method involves digesting the entire aliquot of sample as part of the testing, any suspended particulate in the aqueous sample would have been captured in the digestion. The result of the analysis would, therefore, be a combination of what was dissolved in the ground water and what was suspended, and subsequently digested, in the aqueous sample as part of the testing methodology. Therefore, the BaP result is considered not representative of ground water quality beneath the Site. The subsequent groundwater sample from this well, collected in July 2002, did not exhibit groundwater concentrations of BaP above the Class GA standards. BaP was not detected in either of the upgradient wells.

BEHP was detected in low concentrations in an upgradient well; however, neither 2-methylphenol, 2,4-dimethylphenol, 3&4-methylphenol nor phenol were detected in the upgradient wells. Additional discussion regarding the potential for soil to be a source for these chemicals and the fate and transport of these chemicals is presented in Section 2.6.4.

PCBs

There was only one occurrence of PCBs in excess of standards in a ground water sample. This was the ground water sample from MW-07, which was collected in October 2001. During the initial ground water sample collection, a NAPL sheen was observed on the sample from MW-07. This sheen undoubtedly skewed the RI ground water sample result for this well. It is likely that this sheen was present when MW-07 was sampled in July 2001; however, it could not be seen on the small sample volume collected at that time. The presence of a sheen would, therefore, have impacted the ground water sampling results for this well. This was confirmed during the subsequent sample collection (October 2001). There were no PCBs reported in ground water, including MW-7, in the most recent round of testing. Therefore, although the data indicate that PCBs may be present in pockets of residual NAPL contained in the pores of soil/fill in the North Yard, they are not dissolved in ground water.

Inorganic Constituents

Overall, the pattern of inorganic constituents in ground water is consistent with their occurrence in soil/fill of the same composition as the Historic fill data. Also, many of the dissolved solids are related to saline character of ground water in certain areas of the Site. Additional discussion regarding the fate and transport of inorganic constituents is presented in Section 2.6.4.

2.6.2.3 *Evidence of Petroleum in Ground Water*

In addition to assessing groundwater quality, an objective of the RI was to delineate NAPL layers present at the Site. The need for this investigation was spurred by the observation of a NAPL sheen in a soil boring during the Petroleum Spills Investigation.

A summary of the evidence of petroleum observed in the monitoring wells is presented in Table 2-26 and Figure 2-7. As noted in this table, slight sheens were observed in a number of the site wells during groundwater sampling events. Sheens were observed in six of the eight North Yard ground water monitoring wells (i.e., MW-01, MW-02, MW-04, MW-06, MW-07 and MW-11), two of the three South Yard monitoring wells (MW-09 and MW-10) and one of the three interior monitoring wells (MWI-02). Although NAPL sheens were observed in most of the Site wells, a distinct NAPL layer has not been observed in any of the Site wells. As a result, a distinct NAPL layer is not indicated to be present at the Site. Instead, small areas of residual NAPL appear to be present within the fill materials. The impact of these areas on the Site groundwater quality is discussed in Section 2.6.4.

2.6.3 *Sediment*

2.6.3.1 *Sediment Quality*

As discussed in Section 2.4, sediment samples were collected from the following four locations:

- Upriver sediment samples to the north of the Site;
- Within the intertidal zone beneath the Site buildings;
- In the subtidal zone adjacent to the Site buildings; and
- Adjacent to the North and South Yards.

Table 2-26 presents a summary of the organic compounds and inorganic constituents present in sediment in excess of their screening criteria (i.e., NYSDEC sediment screening criteria).

Sediment samples were collected from these locations from 0.0 to 0.5-feet, 0.5 to 1-foot, 1.0 to 1.5-feet and 1.5 to 2-feet intervals. Results for the above sediment samples were summarized in Tables 2-19 to 2-21. The total PCB, total PAH total SVOC, lead and copper results and are posted in Figures 2-32 to 2-34. The upriver sample results are posted in Figure 2-32. The sediment sample results from below the buildings and adjacent to the Yard are posted in Figure 2-33 and 2-34, respectively.

Summary statistics of the sediment results were previously presented in Section 2.4. These summary statistics illustrate the relationship between the samples collected from these three distinct areas and provide a basis for evaluating the environmental condition in this medium and potential impacts from Site activities.

As discussed in Section 2.4.3, with the exception of the 0.5 to 1-foot intertidal building intervals, the concentrations of SVOCs in all other Site related sediment samples (i.e., 0.5 to 1-foot intertidal building, all subtidal building and all Yard samples) were consistent with upriver SVOC concentrations. The 0.5 to 1-foot sample intervals for the intertidal building samples exhibited higher total SVOC concentrations than the same interval in the upriver locations. Review of the SVOC data indicates that this is attributable to high phthalate concentrations in Building 8E intertidal samples.

With regard to total PCBs, the total PCB results for the Yard sediment samples exhibit a good correlation with the upriver samples. The range and mean total PCB concentrations in both sample intervals from these locations are in the same order of magnitude, slightly below 1 mg/kg. In contrast, the intertidal and subtidal building samples exhibit a greater range and mean total PCB concentration than the upriver locations. Subtidal building samples containing PCBs at concentrations above upriver concentrations are located immediately adjacent to the Site buildings (see Figure 2-33). Also, there are PCB Aroclors present in these samples that were not routinely seen in media samples from Site soil/fill areas. Based on the summary of PCB sediment statistics, the total PCB concentrations decrease rapidly in the 0.5 to 1-foot sample interval.

As discussed in Section 2.4.3, normalization of the inorganic constituent results to aluminum indicate that the Yard and subtidal sediment samples not immediately adjacent the Site buildings are consistent with upriver concentrations. Subtidal sediment immediately adjacent to Site buildings indicates an impact for lead and intertidal building samples appear to have been impacted by barium, chromium, copper, lead and zinc.

A comparison of the sediment sampling results to the NYSDEC sediment screening criteria is presented in the ecological assessment in Section 6.0. As discussed in the previous section, Site ground water is not adversely impacting river water quality and consequently, sediment quality.

Additional discussion regarding the fate/transport of constituents in sediment is presented in Section 2.6.4.

2.6.4 *Fate and Transport of Environmental Media*

As discussed above, three environmental media are present at the Site: soil/fill, groundwater and Hudson River sediment. The fate and transport of these environmental media are discussed below.

2.6.4.1 *Soil/Fill*

Potential environmental fate and transport mechanisms for site soil/fill include:

- erosion of soil/fill to the Hudson via overland stormwater flow from unpaved areas;
- erosion of soil/fill to the Hudson via sloughing of fill from areas where the bulkhead has lost its integrity; and
- leaching of chemicals in Site soil/fill to groundwater.

Potential human health fate and transport mechanisms are discussed in the Risk Assessment, Section 4.0.

Erosion via Stormwater Flow

Portions of the North Yard and South Yard soil/fill are currently unpaved. Consequently, there is potential for Site soil/fill from these areas to be transported to the river as surface water runoff. The elevated riprap along the shoreline prevents gross fill erosion into the river via this transport mechanism. In addition, the upward slope of the land in this area plus the riprap minimizes surface soil migration to the river.

Erosion along Shoreline

Soil/fill underlies the North Yard, South Yard and Site buildings. Soil/fill in the Yard areas is sloped back and stabilized with riprap. Subsidence in the fill has not been observed along the shoreline adjacent to the Yard, and the shoreline in this area of the Site appears to be stable.

Soil/fill is also present below the west warehouse and the northern Site buildings. It is also suspected that soil/fill was also previously located below the High Bay building. The soil/fill below the west warehouse is sloped back and appears to be stable. There is no riprap covering this fill material.

The fill beneath the northern Site buildings is currently bulkheaded. However, the bulkhead beneath these buildings is in poor condition. As discussed in Section 3.2.6.2, the geophysical surveys conducted beneath the buildings indicated erosion of the fill has occurred. This erosion of fill material has resulted in subsidence of some of the dock structures and building floors in the north end of the buildings. The High Bay building was bulkheaded when it was constructed. The condition of this bulkhead is very poor and river water penetrates the bulkheaded area below the building. There appears to have been significant erosion of fill materials from beneath this building. This has caused a structural subsidence evident in Building No. 7 which was previously repaired. Based upon observed conditions under the Site Buildings and the constituents contained in the sediments, erosion of fill from areas where the bulkhead is in poor condition is an environmental fate and transport mechanism at the Site.

Leaching to Ground Water

As discussed above, a number of organic compounds and inorganic constituents are present in Site soil/fill. The primary factors that influence leaching to groundwater are aqueous solubility and adsorption.

Aqueous solubility defines an organic compound or inorganic constituent's ability to dissolve in ground water. Measured in mass of chemical per volume of water (e.g. mg/l), it provides insight into the potential for migration from the soil/fill medium to ground water and then to the Hudson River.

Adsorption describes the binding relationship of an organic compound or inorganic constituents and a solid matrix. At the Site, the solid matrix is the soil/fill, which contains organic carbon (see Table 2-13). The sorptive characteristic of organic compounds is assessed by its organic carbon partition coefficient (K_{oc}). This value has no units and is indicative of the ability to adsorb to the organic carbon in the soil/fill. Many inorganic constituents are part of the mineral composition of a solid matrix. When inorganic constituents are released to the environment they tend to also adsorb onto the soil/fill.

The Site contains a total of 14 ground water monitoring wells and one dry well (Figure 2-1). Four wells are located in the South Yard, six wells and a dry well are located in the North Yard, a dry well and four wells are located within the Site buildings. Monitoring wells MW-04 and MW-05 are considered to be upgradient wells. Accordingly, there are 12 Site wells and 2 upgradient wells.

Inorganic Constituents

As shown in Figure 2-31, ground water concentrations in all 12 Site wells and the dry well exceeded their screening criteria for three or more of the following inorganic constituents: aluminum, iron, lead, magnesium, manganese and sodium. Elevated aluminum, sodium and manganese concentrations appear to be due to the influence of the Hudson River on the Site groundwater. The concentrations of these constituents in the Hudson River are generally considerably higher than the Site groundwater concentrations of these inorganic constituents. River concentrations adjacent to the site are provided in Table 2-27.

Leaching to groundwater appears to be occurring for iron, lead and manganese. Higher groundwater concentrations of these constituents are observed in the Site wells than in the upgradient wells (MW-04 and MW-05). Exceedances of the upgradient iron concentrations and iron screening criteria were observed in the majority of the Site wells. Exceedances of the upgradient manganese concentrations and manganese screening criteria were less prevalent and the exceedances of the upgradient concentrations were minor. Finally, exceedance of the lead screening criteria occurred in one-half of the Site wells and the dry well. Groundwater concentrations of lead in these wells were slightly above the screening criteria. In addition to the above noted inorganic constituents, the screening criteria for barium was also exceeded. This occurred in two of the twelve Site wells: MW-06 and MW-07. This exceedance is considered to be isolated. As discussed below, these wells are in an area of soil staining (see Figure 2-7).

VOCs

Exceedances of the groundwater screening criteria were observed in North Yard wells and building wells for tetrachloroethene, benzene and xylene.

VOCs tend to exhibit higher aqueous solubilities than other organic compounds and inorganic constituents. The aqueous solubilities, at 20° C, of benzene and xylenes are 1,780mg/l and 198 mg/l, respectively. In contrast, the solubility of PCB Aroclor 1260 at 25° C is 0.0027 mg/l.

In contrast, VOCs have low organic carbon adsorption coefficients (K_{oc}). The K_{oc} for benzene and xylenes is 65 and 240 as compared to PCB Aroclor 1260, which is 6,700,000.

Therefore, the occurrence of benzene and xylenes in the soil/fill at elevated levels in the North Yard, coupled with the factors that influence fate and transport suggest that these organic compounds can move from soil/fill to ground water. The occurrence of these two VOCs in ground water in monitoring wells located in the North Yard support this conclusion.

In comparison, the soil screening criteria (i.e., RSCOs) were exceeded at four North Yard (SB-61, SB-62, SB-69 and TP-1) and three below building soil boring locations (RSB-2, RSB-3 and TS-3) for one or more of the following VOCs: acetone, benzene, ethylbenzene, toluene and xylene (see Figure 2-8). Monitoring well MW-11 is located downgradient of three of these four soil boring locations (SB-61, SB-62 and TP-1) and downgradient of the NAPL sheen observed in TP-1. However, exceedances of the groundwater screening criteria were not observed for any of these VOCs in MW-11. Therefore, the soil exceedances at these three soil borings (SB-61, SB-62 and TP-1) and the sheen in TP-1 are not leaching unacceptable concentrations to Site groundwater.

MW-06 and MW-07 are located downgradient of the remaining soil boring exhibiting VOC TAGM exceedances (SB-69). Soil staining (see Figure 2-7) was also observed in the vicinity of this soil boring and beneath the east warehouse. These data suggests that the soil/fill in the vicinity and upgradient of MW-06 and MW-07 is leaching VOCs to Site groundwater resulting in exceedances of the groundwater screening criteria. Leaching of VOCs from soils is an environmental fate and transport mechanism at the Site. The impact of the chemicals that have leached to groundwater are discussed below in the potential fate and transport mechanism for Site groundwater.

Tetrachloroethene in excess of the screening criteria was observed in one North Yard well, MW-06, one building well, MW-05 and the dry well. The source of the tetrachloroethene in groundwater appears to be an upgradient source. North Yard soil/fill concentrations of tetrachloroethene are well below the soil screening criteria (i.e., RSCOs) and MW-05 is an upgradient well.

SVOCs and PCBs

Exceedances of the groundwater screening criteria for SVOCs were observed in two North Yard wells, MW-7 and MW-11. Exceedances occurred in these wells for one or more of the following parameters: phenol, BEHP, 2,4-dimethylphenol, 3,4-methylphenol and 2-methylphenol. SVOCs generally tend to exhibit lower aqueous solubilities than VOCs. BEHP has an aqueous solubility 0.04 mg/l. In comparison to VOCs, this organic compound also has a relatively higher K_{oc}. The K_{oc} of BEHP is 794,330, respectively. In contrast, phenol has an aqueous solubility of 93,000 mg/l and a K_{oc} of 14.

Low estimated concentrations of phenol were observed in two North Yard wells, MW-11 and MW-07, during their first rounds of sampling. These minor exceedances of the screening criteria were not observed during subsequent monitoring rounds. Elevated soil concentrations of phenol were not observed in the soil borings in the vicinity of these wells.

Exceedances of the screening criteria for BEHP, 2-methylphenol and 3,4-methylphenol were limited to MW-07. Low estimated concentrations of 2-methylphenol were observed during the first round of sampling. This minor exceedance of the screening criteria was not observed during subsequent monitoring round. In addition, elevated soil concentrations of 2-methylphenol and 3,4-methylphenol were not observed in the soil borings in the vicinity of this well. Although elevated BEHP concentrations were only observed in one of the two monitoring rounds, elevated concentrations of BEHP were observed in the soil borings in the vicinity of MW-07. Finally, evidence of petroleum and colored materials were observed in the vicinity of MW-07 (see Figure 2-7).

In conclusion, it appears that barium, iron, lead, manganese, benzene, xylene and BEHP may be leaching from Site soil/fill and from the stained areas identified in Figure 2-7 resulting in exceedances of the ground water screening criteria. Leaching of chemicals from soils is an environmental fate and transport mechanism at the Site. The impact of the chemicals that have leached to groundwater are discussed below in the potential fate and transport mechanism for Site ground water. The other SVOCs and PCBs detected in Site soil/fill in excess of the RSCOs are not leaching to ground water at a level that is impacting Site ground water.

2.6.4.2 *Ground Water*

Potential environmental fate and transport mechanisms for Site ground water include:

- discharge of dissolved constituents in groundwater to the Hudson; and
- discharge of free phase NAPL to the Hudson River.

Potential human health fate and transport mechanisms associated with Site ground water are discussed in the Risk Assessment, Section 4.0.

<u>Discharge of Dissolved and Colloidal Constituents in Ground Water to the Hudson River</u>

As discussed in Section 2.3.3.1, Site groundwater discharges to the Hudson River. To estimate the volume of Site ground water discharging to the Hudson River, the total length of the ground water front leaving the Site was first estimated. The length of the ground water front entering the river was conservatively estimated to be the distance along the shoreline adjacent to the Yard plus the length along the fill below the buildings and the bulkheads. This assumption is conservative since it assumes that ground water is discharging along all the bulkhead areas at the velocity measured for the Yard. The total length is approximately 2,333 linear feet (lf). This is longer than the north-south length of the Site as measured along the shoreline (i.e., 1,800 lf) since the east-west lengths along the bulkheads were also included in the total.

The total ground water flow rate from the Site to the Hudson River was then estimated using the following equation:

$$Q_{gw} = VsLD \times CF$$

Where,

Q_{gw} = ground water flow rate (liters/day)
Vs = ground water flow rate (ft/day)
L = length of ground water discharge front (ft)
D = depth of the aquifer in contact with fill (ft)
CF = conversion factor, 28.317 liters/day per cubic ft/day

Using a Vs range from 0.7 to 6.6 ft/day, a L of 2,333 ft and a D of 10 feet, the ground water flow rate to the Hudson River would range from 48,887 liters/day to 4,386,620 liters/day. The average ground water flow rate from the Site into the River would, therefore, be 2,193,310 liters/day.

To evaluate the resulting concentration of Site ground water after it is discharged to the Hudson River, it is important to know the degree to which the Site ground water is diluted when it discharges to the Hudson River. This value is estimated using the following equation:

$$\text{Dilution Factor} = Q_{\text{Hudson River}}/Q_{gw}$$

Where,

Q_{gw} = ground water flow rate (liters/day)

$Q_{\text{Hudson River}}$ = low flow in the Hudson River (liters/day)

The low flow in the Hudson River was conservatively assumed to be the lowest monthly net fresh-water discharge at Poughkeepsie as provided by the U.S. Geological Survey for the period 1947 to 2000 (USGS, 2001). This value is overly conservative since: (1) only 82% of the drainage area was gauged to arrive at that value; and (2) significant additional surface and ground water discharges contribute to flow in the Hudson River between Poughkeepsie and Yonkers. The lowest monthly flow at Poughkeepsie, 3,030 cf/sec (or 7.41×10^9 liters/day), occurred in September 1964. The USGS 7Q10 flow was not used since the nearest flow gauging station is located north of Poughkeepsie at Green Island in a non-tidal portion of the river. The USGS has been unable to collect gauging information from this station for a number of years due to construction activities.

Assuming the average ground water flow rate into the River, the resulting conservative dilution factor for Site ground water discharge to the Hudson River would be 3,380. The actual dilution factor is likely much higher.

A comparison of the projected ground water concentrations in the Hudson River to the NYS surface water standards and criteria is presented in Section 4.0 for human exposures to surface water and Section 6.0 for aquatic exposures to surface water. This comparison, along with actual River concentrations of inorganic constituents (see Table 2-27) indicate that Site ground water is not adversely impacting river water quality.

Discharge of Free Phase NAPL to the Hudson River

As discussed in Section 2.6.1.9, evidence of petroleum (i.e., sheens, staining and odors) has been observed in the North Yard and below the Site buildings. However, free phase NAPL has not been observed in any of the Site wells. Rather, NAPL is present in pockets within the fill and in residual saturation at some locations and is not mobile. NAPL seeps have not been observed in the River. Due to the nature of the Site fill and the absence of a distinct NAPL layer, there is no potential for transport of NAPL to the Hudson River.

2.6.4.3 *Hudson River Sediment*

Other than the soil/fill transport mechanisms discussed above that are associated with Hudson River sediment (i.e., erosion of soil/fill to the Hudson via overland stormwater flow from unpaved areas and erosion of soil/fill to the Hudson via sloughing of non-bulkheaded filled areas), there are two additional potential sources for continued chemical discharge to Hudson River sediment. They are:

- continued discharge of chemicals through the discharge of stormwater to previous process drain systems – it appears that previous discharges to the floor drains at the Site contributed to sediment concentrations in the River; and
- leaching of chemicals from debris piles underlying the Site buildings to Hudson River sediment.

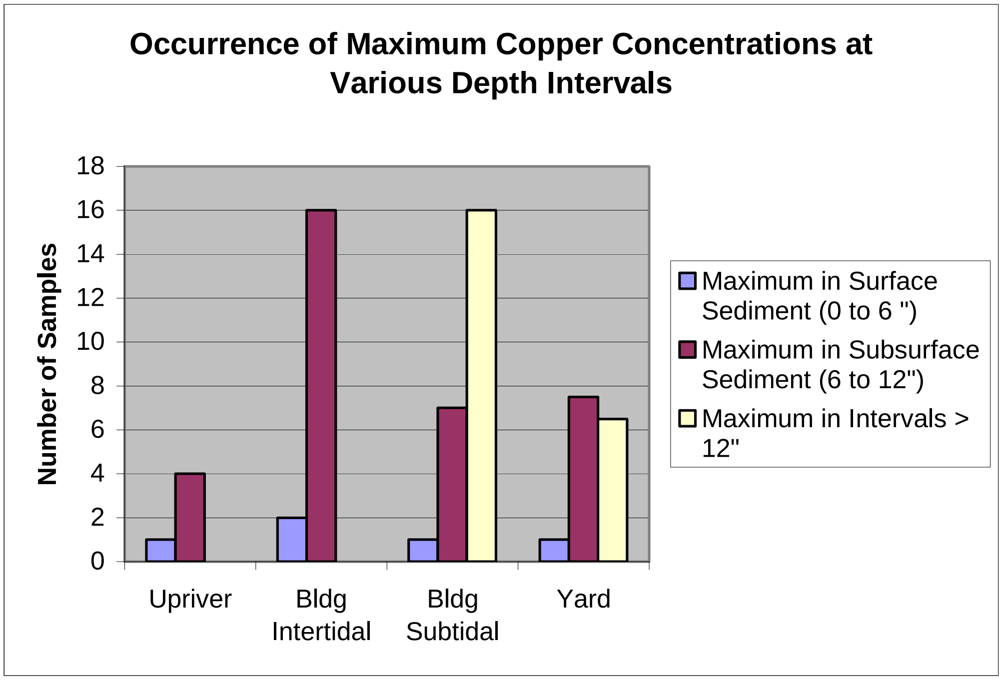
As discussed in Section 3.2.6, sediment/sludge are present in the Site's former process drainage systems and these materials contain PCBs, SVOCs and inorganic constituents (see Tables 3-8A through 3-8C). A portion of this former drainage system was cleaned out during the RI; however, residual materials remain in the system (see Figure 2-1). The stormwater drainage system for the Site is interconnected to the former process drainage system at certain locations. As such, there is continued potential for chemicals contained in the sediment/sludge within this drainage system to discharge to the Hudson River along with stormwater flow.

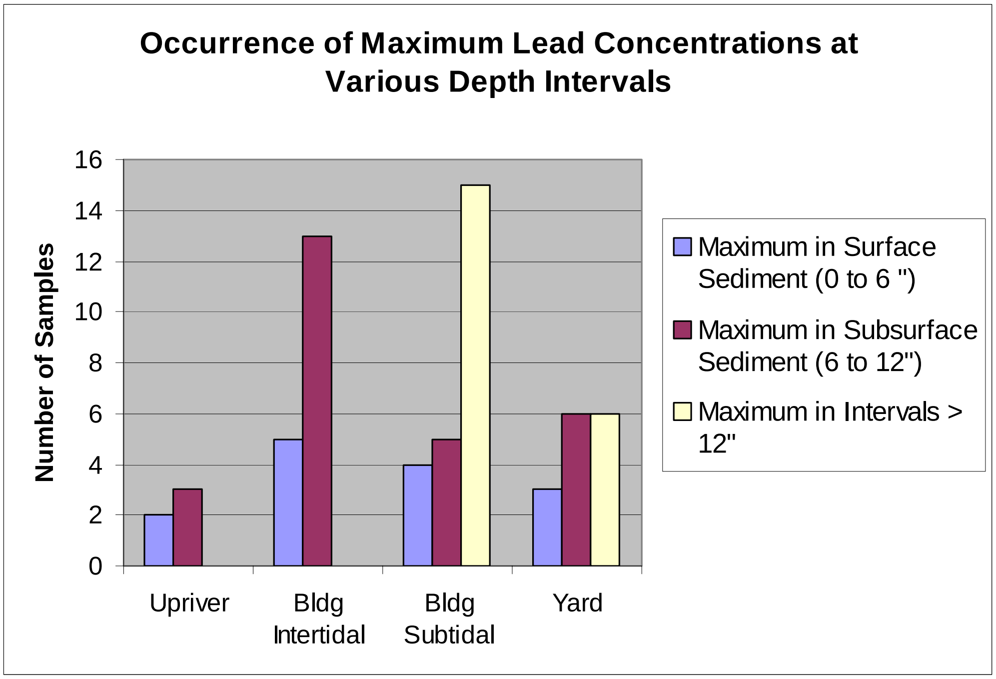
Waste characterization sampling of the debris located beneath the Site was conducted during the RI. The results for this sampling were provided in Tables 2-24 and 2-25. As shown in these tables, the debris appears to contain measurable concentrations of PCBs and inorganic constituents. These concentrations may be associated with the debris or the sediment that has adhered to the debris.

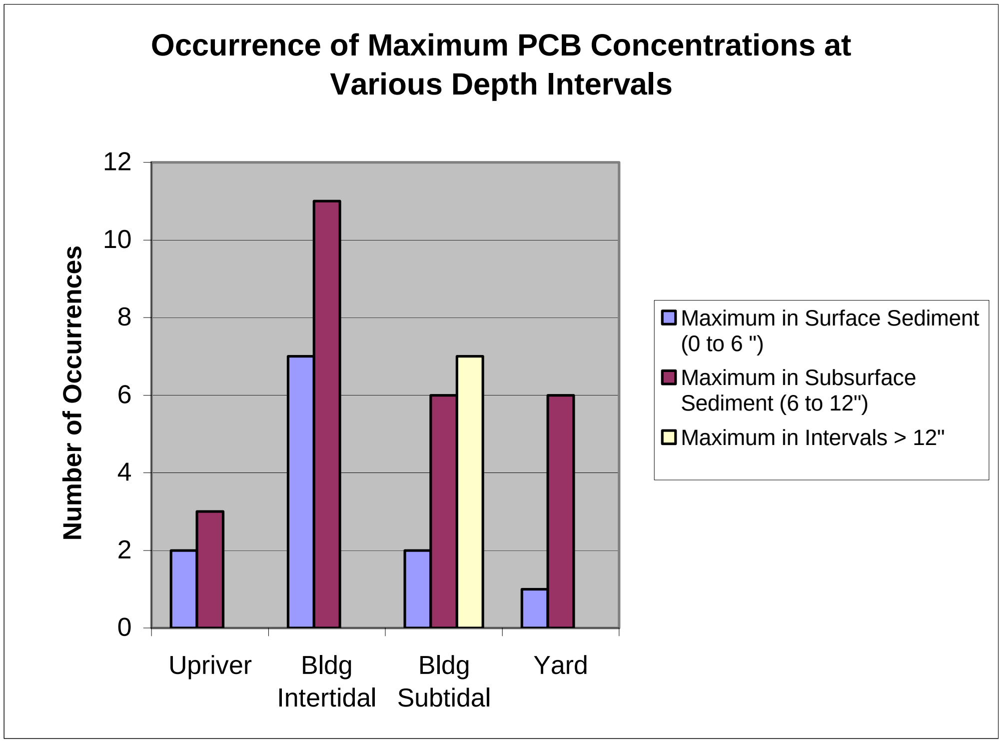
Potential environmental fate and transport mechanisms for Hudson River sediment in the vicinity of the Site include:

- Partitioning of contaminants to solid and liquid (i.e., porewater) phases;
- Uptake into the food chain (bioaccumulation and biomagnification);
- Sediment particle transport and burial; and
- Persistence and weathering.

Current sediment burial (i.e., deposition) was evaluated by determining at which sampling interval the maximum chemical concentrations of lead, copper and PCBs occurred. This evaluation is presented in the following histograms for the upriver, intertidal building, subtidal building and Yard sediment data.


Occurrence of Maximum Copper Concentrations at Various Depth Intervals
Number of Samples
18
16
14
12
10
8
6
4
2
0
Upriver
Bldg Intertidal
Bldg Subtidal
Yard
Maximum in Surface Sediment (0 to 6 ")
Maximum in Subsurface Sediment (6 to 12")
Maximum in Intervals > 12"


Occurrence of Maximum Lead Concentrations at Various Depth Intervals
Number of Samples
16
14
12
10
8
6
4
2
0
Upriver
Bldg Intertidal
Bldg Subtidal
Yard
Maximum in Surface Sediment (0 to 6 ")
Maximum in Subsurface Sediment (6 to 12")
Maximum in Intervals > 12"



As shown in these histograms, the majority of the maximum concentrations are occurring at deeper intervals. This indicates that sediment deposition is occurring at these locations. It should be noted that samples greater than 12 inches were not collected at the upriver locations or beneath the Site buildings. Access restrictions prevented collection of the latter samples.

Additional discussions regarding these fate and transport mechanisms are evaluated in Section 6.0.

Potential human health fate and transport mechanisms associated with Hudson River sediment adjacent to the Site are discussed in the Risk Assessment, Section 4.0.

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[i] Windom, H.L., S.J. Schropp, F.D. Calder, J.D. Ryan, R.G. Smith, Jr., L.C. Burney, F.G. Lewis, and C.H. Rawlinson. 1989. Natural trace metal concentrations in estuarine and coastal marine sediments of the southeastern United States. Environmental Science and Technology 23:314-320.

3.0 REMEDIAL INVESTIGATION OF BUILDING INTERIORS

A Remedial Investigation was performed to characterize the environmental conditions of the Site building interiors. The data collected have been utilized to evaluate risks to temporary and longer-term occupants of the Site buildings. This section presents the scope of building interior RI work and results of this investigation.

3.1 INTERIOR REMEDIAL INVESTIGATION SCOPE OF WORK

The following section presents the building interior RI work scope.

The RI/FS Work Plan (ERM/Roux, 2001)[1] incorporated and built upon interior sampling data that were collected during the following previous investigative activities: Petroleum Spills Investigation; pilot studies conducted to evaluate cleaning technologies; and building surface cleaning operations. Data developed prior to and following submittal of the RI/FS Work Plan (ERM/Roux, 2001) were screened against interim Site-specific criteria for PCBs and lead established by the NYSDEC and NYSDOH for temporary occupancy of the building as a movie studio (NYSDOH, 2000). The interim occupancy criteria for PCBs and lead are 10 µg/wipe and 400 µg/wipe, respectively. As portions of the buildings (i.e., floors and, in some instances walls) were cleaned and the post-cleaning sampling verified compliance with the NYSDEC/NYSDOH interim occupancy criteria, areas of the Site buildings were made available for tenant occupancy. Cleaning methods included one or more of the following technologies:

- pressure washing;
- physical scrubbing;

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[1] A reference identification, such as (ERM/Roux, 2001), is presented after each of the reference documents cited. A full description of each reference document is presented in the References Section.

- shot blasting; and
- scarifying.

Building surfaces that could not be cleaned using these methods to meet the interim occupancy criteria were encapsulated to prevent direct human contact with the contaminated building surface. Portions of the buildings that have not been cleaned are restricted to tenant occupancy through physical barriers (i.e., fencing, locked doors, etc.) and signage; and access to these areas by facility workers is subject to certain precautions (i.e., protective shoe covers).

Accordingly, the building areas can be divided into three groups:

- Cleaned areas that meet the interim occupancy criteria for both lead and PCBs or areas that do not meet the interim occupancy criteria for either lead or PCBs, but are encapsulated;
- Cleaned areas that do not meet the interim occupancy criteria for either lead or PCBs; and
- Areas not yet cleaned that do not meet the interim occupancy criteria for either lead or PCBs.

Details regarding cleaning operations were summarized in the following documents:

- August 7, 2000 Letter of Transmittal from Roux Associates to Ms. Sally W.W. Dewes (Roux, 2000a)
- October 13, 2000 letter from Roux Associates to Ms. Sally W. W. Dewes (Roux, 2000b);
- October 25, 2000 letter from Roux Associates to Ms. Sally W. W. Dewes (Roux, 2000c); and
- February 28, 2001 letter from Roux Associates to Ms. Sally W. W. Dewes (Roux, 2001b).

A review of the operational history of the Site buildings and pre-RI/FS Work Plan data indicated that the primary constituents of concern within the Site buildings were PCBs and lead.

Following the submittal of the RI/FS Work Plan (ERM/ Roux, 2001), it was determined that additional building areas not currently in use required additional testing. The areas requiring additional testing were identified based on historical use (i.e., former storage areas, former locations of transformers or capacitors and maintenance activities) and NYSDEC requests for additional sampling.

To characterize environmental conditions within the Site buildings and to determine the presence of lead and PCBs on and within the building materials themselves, a variety of media were sampled. Wipe samples were collected to characterize surface concentrations for occupancy purposes. Concrete core and wood samples were collected to evaluate remedial and disposal options for building materials. The concrete core and wood samples were collected in areas where the potential exists for future building demolition and in areas where there are existing transformers, or where there was knowledge of former electrical equipment, (e.g., former annealing line capacitors). Additionally, concrete core samples were collected based on the wipe sample concentrations to determine whether the chemical concentrations extend at depth into the concrete materials.

Prior to the RI/FS associated building interior work tasks, select sampling was performed from 1997 through 2000 by ERM and Roux Associates. A complete copy of the Summary Building Interior Data Tables and Figures report (Roux, 2000) is included in Appendix G. The data are summarized as follows:

- Historic sample data collected by ERM from the first, second and third floors; and
- Historic sample data collected by Roux Associates from the first, second and third floors

Historic Sample Data Collected by ERM from the First, Second and Third Floors

A total of six sediment samples were collected from sumps located on the first floor by ERM on November 6, 1997. These samples were submitted for analysis for VOCs, SVOCs, pesticides, PCBs, and inorganic constituents.

The following samples were collected on the first floor by ERM in November 1997, March 1998, and April 1998. A total of 26 wipe samples were collected from floor surfaces throughout the first floor. Thirteen wipe samples were submitted for analysis for SVOCs, pesticides, PCBs and inorganic constituents, one sample was submitted for analysis for SVOCs, pesticides and PCBs, and 12 samples were submitted for analysis for PCBs only.

A total of 14 wipe samples were collected from wall surfaces throughout the first floor. Eleven wipe samples were submitted for analysis for SVOCs, pesticides, PCBs and inorganic constituents, and three samples were submitted for analysis for PCBs only.

Three wipe samples were collected from columns in the first floor High Bay area. One sample was submitted for analysis for SVOCs, PCBs and inorganic constituents, and two samples were submitted for analysis for PCBs only.

Two additional wipe samples were collected from the two 25,000 gallon aboveground storage tanks and submitted for analysis for SVOCs, pesticides, PCBs, and inorganic constituents.

In addition, 10 concrete chip samples were collected throughout the first floor, from five locations. Two samples were submitted for analysis for SVOCs, pesticides, PCBs, and inorganic constituents, two samples were submitted for analysis for SVOCs, PCBs, and metals, and six samples had analyses for PCBs only. Oil samples were collected from three transformers on the first floor and submitted for analysis for PCBs.

The following samples were collected on the second floor by ERM in November 1997 and March 1998. A total of 15 wipe samples were collected from floor surfaces on the second floor. Five wipe samples were collected for SVOCs, pesticides, PCBs, and inorganic constituents analysis, three wipe samples were collected for SVOCs, PCBs, and inorganic constituents analysis, and six wipe samples were collected for PCB analysis only.

A total of six wipe samples were collected from wall surfaces on the second floor. Two wipe samples were submitted for analysis for SVOCs, pesticides, PCBs, and inorganic constituents, two wipe samples were submitted for analysis for SVOCs, PCBs, and inorganic constituents, and two wipe samples were submitted for analysis for PCBs only.

Three concrete chip samples were collected from two locations. Two concrete chip samples were submitted for analysis for SVOCs, PCBs, and metals, and one concrete chip samples was submitted for analysis for PCBs only.

The following samples were collected on the third floor by ERM in November 1997 and March 1998. Seven wipe samples were collected from floor surfaces. Two wipe samples were collected for SVOCs and PCB analysis, and five wipe samples were collected for PCB analysis only. Four wipe samples were collected from wall surface on the third floor and submitted for analysis for PCBs only. Four concrete chip samples were collected from two locations and submitted for analysis for SVOCs, PCBs, and inorganic constituents.

In addition, TCLP VOCs, TCLP SVOCs, TCLP pesticides, and TCLP inorganic constituent data was collected in November 1997 for a sample of residual oil, a boiler stack sample, a sump composite sample, a sample from the lead extrusion pit, and a sample from the sand surrounding the two 25,000 gallon aboveground storage tanks.

Historic Sample Data Collected by Roux Associates from the First, Second and Third floors

As part of the first floor pilot study conducted by Roux Associates, wipe samples were collected for PCB analysis at ten locations on the first floor, one location on the second floor, and two locations on the third floor. Wipe samples were collected following physical cleaning of the samples locations, and following cleaning of the sample location using a decontamination product (i.e., Power Cleaner 155®, TechXtract™ or Biosolve™).

In October 1999, concrete chip samples were collected at 10 locations (2 floor samples and 8 wall samples) from within the lead extrusion pit, located in the second floor High Bay. Samples were submitted for analysis for total lead and TCLP lead.

As part of the second floor High Bay lead pilot study, a total of fifty wipe samples were collected in October 1999. These wipe samples were collected from rafter and girder surfaces and were submitted for analysis for lead. Two wipe samples were collected from each location, one sample was collected prior to surface cleaning, and one sample was collected following physical scrubbing using a cleaning product.

RI – Related Sampling

The building interior RI work tasks commenced on 24 May 2001. During implementation of the RI/FS Work Plan (ERM/ Roux, 2001), additional sampling was conducted on the second floor of the facility. This sampling was not included in the RI/FS Work Plan (ERM/ Roux, 2001). The results of this additional sampling were therefore included in Interim Deliverable No. 3 (Roux, 2001d), which was submitted to the NYSDEC on 28 September 2001.

In accordance with the RI/FS Work Plan (ERM/Roux 2001), after completion of the data validation, a Data Summary Memorandum (DSM) was prepared and delivered to NYSDEC. The intent of the Data Summary Memorandum was to provide a comprehensive summary of the data to enable a review of the information and make the necessary decisions regarding additional investigation necessary at the Site to complete the RI program. The DSM, Interior (Roux, 2001f) was delivered to the NYSDEC on 5 November 2001. The DSM, Interior (Roux, 2001f) contained the results of the building surface sampling and the soil/fill sampling conducted below the buildings.

Following the submittal of the DSM, Interior (Roux, 2001f) and the DSM, Exterior (ERM, 2001d), a meeting was held on 13 December 2001 to discuss whether data gaps existed and to identify additional sampling needed to complete the RI. On 21 December 2001, ERM submitted Interim Deliverable No. 5, Supplemental RI/FS Sampling (ERM, 2001f), to the NYSDEC. On 3 January 2002, NYSDEC transmitted comments on Interim Deliverable No. 5. Based on this comment letter, additional sampling was included in the building interior work scope. The additional interior and exterior sampling commenced on 7 January 2002 and was completed by 22 January 2002.

The collection of additional wipe samples in the Railroad Siding Platform area was requested by the NYSDEC and NYSDOH in May 2002. Split sampling with the NYSDEC and NYSDOH was performed in May 2002. The results of this sampling were included in Supplement No. 1 to Interim Deliverable No. 6, Revision 1 (Roux, 2002f), submitted to the NYSDEC on 2 December 2002.

In an effort to evaluate the potential for recontamination and to provide additional background data for the existing conditions in previously cleaned areas, post-clean wipe and concrete core sampling was performed in October 2002. This sampling was performed in accordance with the Supplement No. 1 to Interim Deliverable No. 6, Revision 1 (Roux, 2002f) scope of work. This sampling was performed in the Railroad Siding Platform, the encapsulated areas on the first and second floor, and previously cleaned areas in Building Nos. 2 and 8 on the first and second floors.

Additional confirmatory wipe sampling was requested by the NYSDEC and NYSDOH prior to a short-term tenant occupancy to commence in November 2002. The post-clean wipe samples were collected in October 2002 in accordance with the scope of work provided in correspondence to the NYSDEC, dated 21 October 2002 (Roux, 2002c).

Supplemental post-clean wipe samples and concrete core and wood bulk sampling was performed on each floor of the Site buildings (first floor through fourth floor) in March and May 2003 in accordance with the scope of work provided in Interim Deliverable No. 10 (Roux 2003c), submitted to the NYSDEC on 28 March 2003 and Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003d), submitted to the NYSDEC 12 May 2003, respectively. This sampling was performed to provide a vertical profiling of PCB contamination within the building material. For treatability purposes, the concrete core samples were collected in 0.5-inch intervals. Post-clean wipe samples were collected to supplement the data received from the corresponding bulk sample.

In response to finding a subsurface concrete vault below the concrete floor slab in Building 2 during interior sampling activities in January 2002, a subsurface structure investigation was conducted at the Site to identify any additional subsurface structures below the concrete slab, and to characterize these subsurface structures and their contents. This investigation was performed using geophysical methods followed by intrusive inspection of suspected structures (i.e., drilling of inspection holes). The subsurface structure investigation was performed in October 2002 in accordance with the scope of work provided in Interim Deliverable No. 7, Revision No. 1, submitted to the NYSDEC 9 May 2002 and supplement No. 1 to Interim Deliverable No. 7, submitted to the NYSDEC on 25 November 2002.

Table 3-1 presents a summary of the RI activities conducted at the Site related to interior building materials. This table identifies the proposed work scope presented in the RI/FS Work Plan (ERM/Roux, 2001) and Interim Deliverables, the implemented work scope and the rationale for any changes. Table 3-2 presents details regarding the building interior work that was conducted. This table summarizes the pertinent information relating to the building interior samples (designation, laboratory ID, etc.) and corresponding analyses.

This section of the RI (Section 3.0) discusses the objectives, field activities and results for the building interiors. This discussion is divided into the following areas:

- Building Materials
- Sumps/Drain Pipes
- Boiler Stack
- Process Tanks
- Concrete Structures

Moreover, the discussion of the results also includes the data gathered prior to the finalization of the RI/FS Work Plan (ERM/Roux, 2001). The objectives and procedures for those sampling activities were included in the Site Background section of the RI/FS Work Plan (ERM/Roux, 2001). Additional details regarding the sampling and analytical procedures are described in the Sampling and Analysis Plan (SAP) contained in the RI/FS Work Plan (ERM/Roux, 2001). A data usability discussion is included along with the discussion of the results.

All sampling and analysis was conducted in accordance with the SAP provided in the RI/FS Work Plan (ERM/Roux, 2001). In addition, all interior work was conducted in accordance with the Health and Safety Plan included in the RI/FS Work Plan (ERM/Roux, 2001).

3.1.1 Building Materials

The RI/FS Work Plan (ERM/Roux, 2001) specified procedures for the collection of building wipe and concrete samples. Additional sampling, which was discussed in Interim Deliverable No. 4, was later conducted for wood flooring. Following submittal of the DSM, Interior (Roux, 2001f), additional sampling of building materials (i.e., concrete and wood) was deemed necessary by the NYSDEC. This additional sampling was specified in Interim Deliverable No. 5 (ERM, 2001f).

Additional post-clean wipe and concrete core sampling were performed to evaluate potential recontamination of previously cleaned areas. This sampling was specified in Supplement No. 1 to Interim Deliverable No. 6 (Roux, 2002f).

Confirmatory wipe sampling was requested by the NYSDEC and NYSDOH prior to a short-term lease in November 2002. This sampling was performed in previously cleaned areas of the first and second floors and in accordance with the scope of work provided in correspondence to the NYSDEC on 21 October 2002 (Roux 2002c).

Supplemental post-clean wipe and concrete core and wood bulk sampling was performed on each floor of the Site buildings. This sampling was specified in Interim Deliverable No. 10 (Roux 2003c) and Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003d).

The objectives of the concrete and wood wipe, concrete core and wood bulk sampling effort were to determine:

- the concentration of lead and/or PCBs remaining on the building materials after the removal of surface accumulation to determine occupancy conditions;
- the efficacy of potential building material cleaning processes; and
- the extent of lead and PCBs within the building materials.

With the exception of the wipe samples collected to determine the efficacy of potential building material cleaning processes, all wipe sample were collected from previously cleaned areas or the sample area was cleaned in accordance with 40 CFR Part 761.375 prior to sample collection. For the samples collected to determine cleaning efficacy, a sample of the surface accumulation (either wipe or bulk) was collected before the sample area was cleaned and the post-clean wipe sample was collected.

All building material wipe samples were collected using a standard 100 cm^2 size template (10 cm by 10 cm) and a laboratory prepared deionized water-soaked gauze pad (lead) or a hexane-soaked gauze pad (PCBs). Samples were collected by placing a new, disposable template at the sampling location and then wiping the entire template area once in the horizontal direction and once in the vertical direction with the gauze pad using moderate pressure. After the template area was wiped in both directions, the gauze pad or filter paper was returned to the glass container, which was then labeled and placed in an ice-filled cooler for transport to the laboratory. For sampling locations where both lead and PCB wipe samples were collected, a new template was used for each wipe sample, the templates were non-overlapping, and the lead sample was collected first. All sampling was performed using clean, disposable gloves. The PCB samples were analyzed using USEPA Method 8082 and the lead samples were analyzed using USEPA Method 6010. All sample results were reported using NYSDEC ASP Category B Deliverables.

The cleaning procedure prior to collecting wipe samples was performed in accordance with the Code of Federal Regulations (CFR) Title 40 Part 761.375. Before collecting a post-clean wipe sample, an area of approximately one square foot was pressure washed and the resulting wash water contained through the use of a wet/dry vacuum cleaner. After applying a detergent on the targeted area, the wet surface was scrubbed with a brush for at least one minute. Following scrubbing, the area was rinsed with at least one gallon of water through pressure washing for at least one minute. A wet/dry vacuum cleaner was then used to contain the wash water and dry the area. The same wash and rinse procedure was repeated once more prior to collecting the wipe sample. The brush used for scrubbing the area was decontaminated prior to each reuse and the wash water was contained for disposal. Following this cleaning procedure, the area was ready for post-cleaning wipe sample collection.

Concrete samples of the floor slabs were collected using an electric concrete core machine. The concrete was cored in 6-inch intervals and examined for visual indications of impacts. The concrete core was then divided into 0.5-inch or 2-inch sections for analysis, depending on the scope of work. After sectioning, the concrete was crushed, placed in a laboratory-supplied glass container, which was then labeled and placed in an ice-filled cooler for transport to the laboratory. Select concrete cores were composited (entire 6-inch interval) and analyzed for lead, PCBs, TCLP VOCs, TCLP SVOCs, TCLP inorganic constituents, and waste characteristics of ignitability, corrosivity, and reactivity. All coring, cutting, and crushing equipment that came into contact with a concrete sample was decontaminated following use with a laboratory grade soap wash and potable water rinse. All sampling was performed using clean, disposable gloves. Concrete core samples were analyzed for PCBs and/or lead using USEPA Methods 8082 and 6010, respectively. All sample results were reported using NYSDEC ASP Category B Deliverables.

Wood sampling was conducted to determine concentrations of lead and/or PCBs in the wood flooring located in the northern portion of the second and third floors and throughout the fourth floor. Wood samples were collected as bulk samples or using an electric drill and wood drill bit. Bulk samples or drill cuttings were collected and placed in a glass container, which was then labeled and placed in an ice-filled cooler for transport to the laboratory. Samples were analyzed for PCBs and lead using USEPA Methods 8082 and 6010, respectively. Select wood samples were also analyzed for TCLP VOCs, TCLP SVOCs, TCLP inorganic constituents, and waste characteristics of ignitability, corrosivity, and reactivity. All sampling equipment was decontaminated following use with a laboratory grade soap wash and potable water rinse. All sample results were reported using NYSDEC ASP Category B Deliverables.

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), building material wipe and concrete core sampling was conducted in the storage room (Building No. 4), spray paint booth, known or potential PCB-containing equipment areas, former lead storage and manufacturing areas, and former maintenance and storage areas. Additional wipe and concrete core sampling was then conducted, in accordance with Interim Deliverable No. 5 (ERM, 2001f), to: confirm the adequacy of room cleaning in previously cleaned areas; characterize environmental conditions on building surfaces in portions of the building that had not been sampled previously; and evaluate building material cleaning technologies in uncleaned areas. Subsequent wipe, concrete core, and wood sampling was performed to identify potential areas of recontamination and evaluate remedial technologies to address PCB contamination within the building material in accordance with Interim Deliverable Nos. 6 and 10, respectively. Sampling locations for the fourth, third, second and first floors are shown on Figure 3-1, Figure 3-2 and Figure 3-3, and Figure 3-4, respectively.

Previously Cleaned Areas - Building Surface Concentrations

To confirm the adequacy of cleaning in areas previously cleaned, post-cleaning wipe samples were collected from 11 locations (S-87, S-109 through S-113, S-158 through S-160, S-165, and S-166) for PCBs analysis and 10 locations (S-128 through S-135, S-149, and S-150) for lead analysis.

In addition, post-clean wipe samples were collected from the rafters of the second floor of the High Bay Building (HB-16 through HB-25) for lead analysis (Figure 3-3).

At the request of the NYSDEC and NYSDOH, confirmatory wipe samples were collected in previously cleaned areas to identify any areas of potential recontamination. Wipe samples were collected from 6 locations (S-87, S-88, S-95, S-189, S-190 and S-191) in the Railroad Siding Platform Area for PCB analysis (Figure 3-3). Subsequently, wipe samples were collected from 21 locations (CWS-1 through CWS-21) on the first and second floors for PCB and lead analysis.

Uncleaned Areas - Building Surface Concentrations and Efficacy of Cleaning Technologies

To determine the efficacy of building material surface cleaning technologies, sampling was conducted prior to and after the use of the following two technologies:

- hand scraping, detergent/pressure wash combination (i.e., pressure washing the area, applying Simple Green™ and Biosolve™ cleaners with spray bottles, scrubbing the area with a steel brush, and pressure washing the area again - approximately one to two minutes was spent cleaning at each location); and
- shot blasting.

Fifty-two locations were selected to evaluate detergent/pressure wash combination cleaning. Pre and post-cleaning wipe samples for both lead and PCBs were collected from sample locations S-99 through S-108, S-115, S-117, S-119, S-121 to S-127, S-136, S-137, S-145 to S-148, S-151, S-152, S-154, S-156, S-157, and S-167 to S-187 (Figures 3-2 through 3-4). At one additional location (S-155), a pre-cleaning sample was collected for lead analysis and post-cleaning samples were collected for lead and PCB analysis. The post-cleaning sample for PCBs was not part of the scope of work and was collected due to field error. In addition, wipe samples were collected from the petroleum residue identified on a wall in two areas of the first floor in Building No. 2A (see Figure 3-4).

To evaluate the efficacy of shot blasting, two portions of the Site building that had previously been cleaned using the detergent/pressure wash combination, but continued to exceed the lead interim occupancy criteria were sampled, shot blasted and sampled again. These areas were four encapsulated floor areas located on the second floor of the High Bay building and a portion of Building No. 10 south of the drying ovens that exceeded the interim occupancy criteria for lead (i.e., sample location S-60). The work in the lead exceedance areas was intended primarily as a surface preparation for re-encapsulation, but was also designed to evaluate shot blasting as a technology to address areas exceeding the interim occupancy criteria for lead that could not be remediated by pressure washing alone. In addition, shot blasting was also conducted in the Railroad Siding Platform Area and the room immediately north of the Railroad Siding Platform (Building No. 5) on the second floor.

Prior to cleaning and shot blasting, samples of the surface accumulation were collected from the Railroad Siding Platform area and submitted for analysis for PCBs and lead. Due to the significant amount of surface accumulation (up to several inches) on top of the concrete flooring along the railroad siding platform, samples of the accumulated material were collected in lieu of wipe samples. Representative samples of the surface accumulation were placed in a laboratory supplied glass container, which was then labeled and placed in an ice-filled cooler for transport to the laboratory. The samples were submitted for analysis for PCBs and lead.

One location (S-95) did not have a significant surface accumulation present. Accordingly a wipe sample (designated S-95A) was collected at that location which was representative of the pre-clean conditions.

Following shot blasting, wipe samples were collected for lead analyses at locations S-89 through S-94 and S-97 through S-98 (second floor, High Bay) and S-96B (Building No. 10) and for lead and PCB analysis at locations S-84 through S-88 and S-95 (Railroad Siding Platform Area and the room immediately north of the Railroad Siding Platform (Building No. 5) see Figure 3-11).

On January 8, 2002, additional cleaning of the area between samples S-86 and S-88 was performed by American Environmental Assessment Corporation (AEAC) personnel under the supervision of Roux Associates. The additional cleaning was required to remove remaining surface accumulation, based on the results of the initial post-decontamination sampling. Additional detail regarding the cleaning conducted in the second floor of the High Bay building, Railroad Siding Platform Area and the room immediately north of the Railroad Siding Platform (Building No. 5) on the second floor is provided in Interim Deliverable No. 6 (Roux, 2002).

Building Material Disposal Requirements

Concrete samples were collected to determine disposal requirements for building materials and to evaluate the extent to which PCBs and lead had permeated into the concrete. The latter item will be used to determine remedial technologies for PCBs and lead within the concrete. Concrete samples were collected using a two-inch diameter or four-inch diameter concrete core on an electric drill. Sample collection procedures are the same as those discussed above.

A total of 22 locations were cored during this phase of sampling. Zero to six-inch composite samples were collected from five locations (S-129, S-135, S-184, S-187, and S-188) to evaluate potential waste disposal requirements. These composite samples were analyzed for lead, PCBs, TCLP VOCs, TCLP SVOCs, TCLP inorganic constituents, and waste characteristics of ignitability, corrosivity, and reactivity.

Two-inch concrete core intervals were collected at 14 locations (S-53, CS-53B, CS-54B, S-138 to S-144, and S-161 to S-164) for use in evaluating potential remedial technologies (Figure 3-4). Concrete interval samples were collected from the zero to two-inch, two to four-inch, and four to six-inch intervals at 11 of these 14 locations. Concrete samples were collected at location S-53 from the two to four-inch interval, at location CS-53B from the zero to two-inch interval, and at location CS-54B from the two to four-inch and four to six-inch intervals only. The selected intervals at locations S-53, CS-53B and CS-54B were designed to provide supplemental data for samples for which the laboratory data had been deemed unusable during data validation. All concrete core interval samples were submitted for analysis for PCBs only.

Zero to six-inch concrete composite samples were also collected at locations S-52 and S-55 to determine waste disposal requirements. Samples from these two locations were analyzed for lead, PCBs, TCLP VOCs, TCLP SVOCs, TCLP inorganic constituents, and waste characteristics of ignitability, corrosivity, and reactivity. The two-inch interval samples from these two locations were analyzed for PCBs. In addition, concrete samples were collected at location S-52 from the two to four-inch interval and at location S-55 from the two to four-inch and four to six-inch intervals and were analyzed for PCBs only. The selected intervals at these locations were designed to provide supplemental data for samples for which the laboratory data had been deemed unusable during data validation.

Additional concrete samples were collected to provide horizontal and vertical delineation of PCBs within the building material on each floor of the Site buildings. A total of 115 concrete cores were collected to a depth of 6 inches and analyzed for PCBs in 0.5-inch intervals to a depth of 1.5-inches. Select concrete cores were analyzed to deeper intervals to provide further vertical delineation. This concrete sampling was performed in accordance with the scope of work provided in Interim Deliverable No. 10 (Roux 2003c) and Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003d).

Wood Sampling

In May 2001, the wood flooring located on the second floor was sampled to determine surface concentrations of lead and PCBs (Figure 3-3). This area, which is located immediately north of the second floor office area and was previously cleaned, is primarily composed of wood that is partially covered with metal (diamond plate). Concrete flooring covers a smaller portion of the area. A total of eight wipe samples (2N-1 to 2N-8) were collected for PCB and lead analysis. In addition, two bulk wood samples (from locations 2N-1 and 2N-3 in the wood floor area) were collected and analyzed for PCBs and lead analysis. Additional discussion regarding this sampling is presented in Interim Deliverable No. 1 (Roux, 2001c).

Additional wood sampling was conducted during the supplemental sampling to characterize concentrations of lead and/or PCBs in the wood floor for potential disposal purposes. Wood samples were collected using an electric drill and wood drill bit. Sampling locations are shown on

Figure 3-3. At each sampling location, multiple holes were drilled into the wood floor surface being sampled. Multiple holes were required to obtain the necessary volume for laboratory analysis. Each hole was advanced through the entire surface being sampled. Drill cuttings were collected by hand and placed in a glass container, which was then labeled and placed in an ice-filled cooler for transport to the laboratory. The drill bit was decontaminated following use with a laboratory grade soap wash and potable water rinse. All sampling was performed using clean, disposable gloves. Wood samples were submitted for analysis for PCBs and lead. In addition, four wood samples (S-117, S-120, S-123, and S-127) were submitted for analysis for TCLP VOCs, SVOCs and inorganic constituents.

Eleven wood samples were collected on the second floor of the building. Eight grab samples were collected from a single wood floor. In several areas an older wood floor had been covered by one-inch of concrete that in turn had been covered by another wood floor. Three composite wood samples (S-122, S-123, and S-124) were collected from these locations by collecting drill cuttings from the first floor, removing the first floor, breaking and removing the concrete, and then compositing the drill cuttings from the second, lower wood floor.

As part of the Interim Deliverable No. 10 bulk sampling investigation, a total of 30 wood samples were collected from the fourth, third, and second floors of the Site buildings; locations are shown on Figures 3-1, 3-2, and 3-3, respectively.

3.1.2 *Sumps/Drain Pipes*

The first investigative task conducted following approval of the RI/FS Work Plan (ERM/Roux, 2001) was tracing/surveying the first floor process and storm-water drainage system. Following inspection of the system, it was apparent that the proposed scope of work (i.e., cleaning and testing the integrity of the trench at each access location) was not adequate and the scope of work was modified accordingly. As discussed in Interim Deliverable No. 1 (Roux, 2001c), the drainage system consists of a network of below floor trenches and piping as shown in Figure 3-4. Access to the drainage system was limited to several points covered by steel plates. Sludge accumulations were observed throughout the system. Additional cleaning was therefore conducted to determine the construction and integrity of this system.

As discussed in Interim Deliverable No. 1 (Roux, 2001c), The following scope of work was implemented:

- Sludge samples were collected from three locations (Sump-1, Sump-2, and Sump-3 - the most down-gradient access locations identified in each segment of the system) and were submitted for analysis for PCBs, SVOCs, and inorganic constituents in accordance with the Work Plan (see Figure 3-4).
- An additional sludge sample was collected from the access point located south of the Sump-1 location (designated Sump-1A), which was not cleaned as part of the trench system. The sample was submitted for analysis for PCBs to confirm the detection in the sample from Sump-1.
- The trench portion of the system was cleaned to the extent possible by AEAC of Wyandanch, New York, utilizing a high vacuum Guzzler truck. Additional access points were created as necessary to accomplish this task.
- National Water Main Cleaning Company (NWMCC) of Newark, New Jersey then cleaned and mapped the inaccessible/unknown portions of the system utilizing a reverse water jetting method to advance an electronic probe. The electronic probe was used to determine if discharge points were located over the river.

All waste materials generated during the above cleaning procedures were contained in a vacuum truck, sampled for disposal parameters, and later removed from the Site for proper disposal. Waste characterization testing results and manifests are provided in Appendix E.

The results of the cleaning and inspection of the drainage system indicated that while concrete walls are present throughout the trench system, concrete floors were present only in limited areas. Accordingly, process water and storm water were in direct contact with the fill material present below the floor. Further, access points did not indicate sump locations.

Piping found at two of the three down-gradient access points (Sump-1A and Sump-3) was ultimately traced to discharge points that were in contact with the river (see Figure 3-4). At the third down-gradient access point (Sump-2), an approximately 18-inch long section of the 10-inch diameter pipe appeared to be purposely broken to allow water to enter the pipe, indicating that drainage may not have been the original purpose. As shown on Figure 3-4, this pipe could not be traced to a river discharge location. The results of this investigation were incorporated into the sediment sampling plan.

3.1.3 Boiler Stack

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), samples were collected of the stack ash and stack construction materials to evaluate disposal options for stack debris. These samples were collected prior to the finalization of the RI/FS Work Plan (ERM/Roux, 2001) since demolition of the stack was necessary due to structural concerns. NYSDEC was notified of the expedited sampling in a Memorandum from Roux Associates to Ms. Sally W. W. Dewes dated February 22, 2001 (Roux, 2001a).

One sample (Stack-1) of the residual ash/cinders was collected from the boiler stack at the second floor access door and submitted for SVOC and metal analysis by TCLP. Additionally, two samples (Brick-1 and Brick-2) of the boiler stack brick were collected for metal analysis by TCLP and one sample (Stack Liner) of a concrete-like liner material was collected for PLM bulk asbestos analysis by ELAP Method 198.1/198.4. The location of the former stack is shown on Figure 3-4.

3.1.4 *Process and Fuel Oil Tanks*

Eleven former process oil tanks are currently located in the ceiling of the second floor. Process oil tanks 1 through 8 are suspended in the ceiling of the Railroad Siding Area and process oil tanks 9 through 11 are located in Building 8 (High Bay Building). Each of these tanks has been emptied of their contents. In accordance with the RI/FS Work Plan (ERM/Roux, 2001), wipe samples were collected from Tanks 1, 2, 3, and 4 and the combined discharge from Tanks 5 and 6, Tanks 7 and 8, and Tanks 9 through 11 were submitted for analysis for PCBs. Wipe samples Tank 1 through Tank 4 were collected from the interior surface of cut pipes immediately below each tank. Due to the inaccessibility of Tanks 5 through 11, and with NYSDEC's verbal concurrence, wipe samples were collected from the combined discharge ports of Tanks 7 and 8 and Tanks 9 through 11. A liquid (oil) sample was available and collected from the combined discharge port of Tanks 5 and 6 in lieu of wipes. All samples were collected on June 19 and 20, 2001 for PCB analysis by USEPA Method 8082.

Based on the wipe sample results collected in June 2001 for the manifold piping leading from Tank 7 and Tank 8 (9 µg/wipe), additional steps were taken to collect individual samples from these tanks. Individual wipe samples were collected from piping located immediately below each of the two tanks. In addition, Tank 3 was resampled to obtain usable data after the previous sample results were deemed unusable by the data validator. These samples were collected on January 7, 2002 and analyzed for PCBs by USEPA Method 8082.

Formerly, two waste oil tanks were located on the first floor of Building No. 2. These tanks were installed in 1976 and stored waste oil that was produced from the oil used in the cable reel cleaning process. The oil was temporary stored in these tanks prior to off-site disposal. The capacities of these tanks are unknown. According to BICC, these tanks were removed in 1993.

Additionally, two aboveground tanks are located on the first floor, just north of Building No. 9 and west of the Compressor Room. These two tanks are situated next to each other and have an approximate capacity of 25,000 gallons each. These tanks store #6 fuel oil for use in the two boilers located in Building No. 11. These tanks are located in an enclosed vault, approximately 40 feet long by 30 feet wide. The only access to these tanks is from outside the building through a small hatch, located above each of the tanks. According to historic Site drawing and Site personnel, the vault containing these two tanks is filled with sand.

3.1.5 Concrete Structure Evaluation

At the request of the NYSDEC, the integrity and contents of concrete structures located within Building No. 4 (i.e., Storage Room) were inspected as part of the implementation of Interim Deliverable No. 5. Inspection included moving/removing a small amount of debris within several of the structures to locate the bottom, confirming the integrity of the structures and identifying the nature of the material within the structures.

A subsurface structure investigation was conducted on the first floor of the Site buildings in October 2002. This investigation was prompted by the discovery of a subsurface concrete vault located below the concrete floor in Building No. 2. The objectives of this investigation were to locate any additional subsurface structures, visually inspect any identified structures, and characterize the contents of the subsurface structures. This investigation used geophysical methods (i.e., Microgravity and ground penetrating radar) to identify potential structures below the concrete floor slab. Any anomalies identified by the geophysical survey were further investigated by coring inspection holes through the concrete slab in an effort to visually inspect the potential structures. Soil/fill samples were collected from within identified concrete structures. This sampling is further discussed in Section 3.2.6.

3.1.6 Lead-Based Paint Survey

To supplement the November 1997 lead paint survey discussed in the RI/FS Work Plan (ERM/Roux, 2001), an expanded survey of painted surfaces within the building was conducted by J.C. Broderick & Associates, Inc. between 18 November 2001 and 5 December 2001. This recent survey was conducted to confirm and expand upon the 1997 survey. The supplemental testing was performed on materials potentially representing an exposure scenario due to the poor condition of the paint (i.e., peeling, oxidizing), or materials in high traffic areas. Testing was also performed on materials that could be affected during future renovation or demolition activities and thus present a future exposure.

3.2 BUILDING INTERIOR RESULTS

As discussed above, the objectives of the building interior investigation were as follows:

<u>Building materials (e.g., concrete, steel and wood</u>)

- To determine the concentration of lead and/or PCBs remaining on the building materials after the removal of surface accumulation so that occupancy use decisions could be made;
- To determine the efficacy of potential building material cleaning processes;
- To determine the disposal requirements for building materials.

Sections 3.2.2, 3.2.3, 3.2.4, and 3.2.5 present the results for the building materials sampling. This includes the analytical results for pre- and post-clean wipe samples, concrete core samples and wood samples collected on the fourth floor, third floor, second floor and first floor of the building.

For areas currently cleaned to the interim occupancy criteria, only the post-clean sampling results are presented in the figures. These data are representative of the present environmental conditions and are therefore presented in the figures discussed in this section and used in the HHRA presented in Section 5.0. Pre-clean data and interim post-clean data (i.e., not final) for the previously cleaned areas identified in the RI/FS Work Plan were provided in the RI/FS Work Plan (ERM/Roux, 2001). This information, which is useful in evaluating the efficacy of the cleaning methods employed, will be used in the Feasibility Study evaluations.

After preparation of the RI/FS Work Plan (ERM/Roux, 2001), additional building areas have been cleaned, tested and confirmed to have building surface concentrations below the interim occupancy criteria. Therefore, the data tables have been organized to provide pre-clean, final post-clean, and interim wipe sample results for areas cleaned after submittal of the RI/FS Work Plan (ERM/Roux, 2001). Since the interim cleaning wipe sample results are not relevant to the evaluation of the current conditions in the building interiors, they are not referenced in the subsequent figures.

- In portions of the building that have not yet been cleaned,
- pre-clean samples are considered to be representative of current conditions; and
- post-clean samples collected in accordance with 40 CFR Part 761.375 (i.e., surface accumulation first removed) are considered to be representative of conditions following cleaning.

In areas of the building that were cleaned and then encapsulated, the samples collected after cleaning and prior to encapsulation are considered representative. In some instances where either lead or PCBs exceeded the interim occupancy criteria, only the compound exceeding the criteria was sampled after cleaning.

It is important to note that for presentation purposes on the figures and for discussion purposes below, no distinction is made between samples collected subsequent to cleaning of a room and samples collected in accordance with 40 CFR Part 761.375 when referring to post-clean samples. Concrete core samples and bulk wood samples were collected after cleaning of the sampling location, either by cleaning the entire room or in accordance with 40 CFR Part 761.375. The level of cleaning performed at each building interior sampling location is noted in Table 3-2.

As a preliminary screening, the analytical results for building surface wipes were compared to the NYSDEC/NYSDOH interim occupancy criteria for total PCBs of 10 micrograms per 100 square centimeters ($\mu g/100cm^2$), hereafter referred to as micrograms per wipe sample (μg/wipe) and 400 μg/wipe for lead. Analytical results for building surface wipes are further evaluated as part of the Risk Assessment presented in Section 5.0.

Initially, 6-inch concrete cores were collected and split into 3 individual 2-inch interval concrete core samples. This sampling interval was conducted at the request of the NYSDEC to evaluate wicking. Subsequent to the initial concrete core sampling, more comprehensive concrete core sampling was performed. These core samples were submitted for analysis in 0.5-inch intervals. The 0.5-inch and 2-inch increment sample results will be evaluated in the FS to identify remedial needs for concrete media.

3.2.1 Data Usability

A Data Usability Summary Report (DUSR) level of data validation was performed by Data Validation Services, North Creek, New York. Use of a DUSR level of review was approved in an electronic correspondence from Ms. Sally W. W. Dewes of the NYSDEC to Ms. Carla Weinpahl of ERM dated September 25, 2001 (NYSDEC, 2001d). The data review performed as part of the DUSR validation was completed in accordance with the USEPA Region II validation standard operating procedures, the USEPA National Functional Guidelines for Data Review, and the NYSDEC DUSR guidelines (revised 1997). Each DUSR includes a data review of the raw data and the quality control parameters. The quality control parameters include custody documentation, holding times, surrogate and matrix spike recoveries, duplicate correlation, calibration standard/blank performance, instrument performance, blank contamination, matrix interference, and method compliance. Additionally, the precision, accuracy and completeness of the data were evaluated.

Twelve separate DUSRs were prepared for the interior work performed as part of the RI and subsequent phases of work. The twelve reports were completed for the following sampling:

- DUSR dated October 29, 2001 for wipe, concrete, wood and soil samples collected as part of the RI, Interim Deliverable No. 1 and Interim Deliverable No. 3, completed prior to October 2001;
- DUSR dated December 28, 2001 for soil samples collected as part of Interim Deliverable No. 4, completed on October 18, 2001; and
- DUSR dated February 27, 2002 for wipe, concrete, wood, soil and ground water samples collected as part of Interim Deliverable No. 5, completed in December and January 2002.
- DUSR dated June 28, 2002 for wipe samples collected at the request of the NYSDEC/NYSDOH on May 31, 2002.
- DUSR dated July 17, 2002 for wipe samples collected at the request of the NYSDEC on June 21, 2002.
- DUSR dated January 9, 2003 for wipe samples completed as part of Interim Deliverable No. 6, and as part of a confirmatory sampling round in previously cleaned portions of the building, completed in October 2002.
- DUSR dated January 10, 2003 for product and water samples collected as part of Interim Deliverable No. 7, completed in October 2002.
- DUSR dated February 17, 2003 for concrete samples collected as part of Interim Deliverable No. 6, completed in November 2002.
- DUSR dated May 6, 2003 for wipe, concrete and wood samples collected as part of Interim Deliverable No. 10, completed in March 2003.
- DUSR dated June 12, 2003 for soil samples collected as part of Supplement No. 1 to Interim Deliverable No. 9, completed in March 2003.
- DUSR dated June 24, 2003 for wipe, concrete and wood samples collected as part of Supplement No. 1 to Interim Deliverable No. 10, completed in May 2003.

All data tables were amended to reflect changes made to concentrations or qualifiers during data validation. Those values or qualifiers that were changed are noted with a "V". Provided below are brief discussions of the individual DUSRs.

In addition to building interior results, the fill sampling results beneath the buildings and the interior ground water samples are also included in these reports.

DUSR Dated October 29, 2001

The DUSR indicates that most analyte values and reporting limits were usable as reported by the laboratory, with edits or qualifications as estimated due to typical matrix effects or processing. However, PCB results that were reported as non-detect are not usable due to matrix interference or to the interpretation of the data to include non-target analyte Aroclor mixtures. These samples included: S-55/2-4, S-55/4-6, S-52/2-4, CS-53B/0-2, TS-6/0-1, SUMP-2, S-53/2-4, CS-54B/2-4, CS-54B/4-6, SS-50/1-3 and Tank-3. All samples were recollected as part of Interim Deliverable No. 5 to obtain usable data. Resampling at these locations produced usable data.

DUSR Dated December 28, 2001

The DUSR indicates that several qualifications to reported results as estimated were required due to matrix interference of the samples. In addition, results for two volatile samples were qualified due to holding time exceedance.

DUSR Dated February 27, 2002

The DUSR indicates that most analyte values and reporting limits were usable as reported by the laboratory, with edits or qualifications as estimated due to typical matrix effects or processing. However, PCB results for two samples (M-1 and RSB-9/1-3) are not usable due to matrix interference in the samples. Locations that were resampled based on the

DUSR dated October 29, 2001, produced usable data for those locations during the Interim Deliverable No. 5 sampling.

DUSR Dated June 28, 2002

The DUSR indicates that all analyte values and reporting limits were usable as reported by the laboratory, with the exception of a minor edit to the reporting limits of the non-detected Aroclors in one sample.

DUSR Dated July 17, 2002

The DUSR indicates that all results and reporting limits are usable, with the exception of increasing the reporting limits of the non-detected Aroclors in one sample.

DUSR Dated December 20, 2002

The DUSR indicates that most analyte values and reporting limits were usable as reported by the laboratory, with edits or qualifications as estimated due to typical matrix effects or processing. The reporting limits were increased for non-detected Aroclors in select samples submitted for PCB analysis that required dilution due to high concentrations.

DUSR Dated January 9, 2003

The DUSR indicates that all sample results for lead wipes are usable as reported, and sample results for PCB wipes are usable as reported, or with minor qualifications as estimated due to typical processing or matrix effects. The reporting limits for non-detected Aroclors in select PCB wipes have been increased due to required dilution.

DUSR Dated January 10, 2003

The DUSR indicates that most sample analyte values and reporting limits are usable as reported, or with minor edits or qualifications. Due to matrix interference, select SVOC and inorganic constituent results were qualified as estimated. Due to lack of recovery in the matrix spike, the Sulfide Reactivity result for the product sample was declared unusable.

DUSR Dated February 17, 2003

The DUSR indicates that 18 of the total 64 concrete samples showed usable results as reported from the laboratory, or required minor qualification. The remaining 46 concrete samples were held and extracted beyond there allowable holding time. Due to the extended time between sample collection and extraction, the reporting limits for these samples were increased to compensate for possible losses. In addition, the reporting limits were increased for non-detected Aroclors in select concrete samples, which required dilution due to high concentrations.

DUSR Dated May 6, 2003

The DUSR indicates that results are usable as reported from the laboratory, or due to matrix effect, samples are usable with minor qualifications. Due to a lack of surrogate recovery, the results for one PCB wipe sample were determined to be unusable. In addition, the reporting limits were increased for non-detected Aroclors in select samples that required dilution due to high concentrations.

DUSR Dated June 12, 2003

The DUSR indicates that SVOC and inorganic constituent analyte values and reporting limits are usable as reported, or with minor qualification due to typical processing or matrix effects. Several samples analyzed for PCBs have results reported as non-detect. According to the DUSR, several of these samples show evidence of the presence of PCB congeners, and due to interference from sample matrix, the match to Method 8082 Aroclor mixtures is poor. In order to compensate, the reporting limits have been increased, and results were qualified with an "X", indicating chlorinated biphenyls are possibly present in the sample, however, no distinct Aroclor pattern has been identified. In addition, the reporting limits were increased for non-detected Aroclors in select samples that required dilution due to high concentrations.

DUSR Dated June 24, 2003

The DUSR indicates that the reported results for the samples are usable as reported, usable with qualification as estimated, or usable with elevated reporting limits. Reporting limits have been elevated in select PCB samples with non-detect results due to matrix interference. In addition, the reporting limits were increased for non-detected Aroclors in select samples that required dilution due to high concentrations found in other Aroclors.

3.2.2 Fourth Floor Sampling Results

As shown on Figure 3-1, the northern portion of the fourth floor has been renovated and is currently occupied by carpeted and painted offices. The remainder of this floor is unrenovated and has not yet been cleaned. The entire fourth floor consists of wood construction. This subsection presents the wipe and bulk wood sampling results for the fourth floor.

3.2.2.1 *Wipe Sample Results*

Post-clean samples were collected from the fourth floor and submitted for analysis for PCBs and lead. Figure 3-5 presents the post-clean sample locations and results. A tabular summary of the post-clean wipe sampling results is presented in Table 3-4. Wipe samples collected from the renovated office space on this floor were collected from the wood floor under the existing carpeting and in accordance with the scope of work provided in Interim Deliverable No. 10 (Roux 2003c).

Post-clean PCB Samples

Sixteen post clean wipe samples were collected in March 2003 for PCB analysis from the fourth floor building surfaces (Figure 3-5). Six of the sixteen wipe samples were collected from the renovated portion of the fourth floor. The remainder of the samples was collected from the uncleaned areas of this floor. PCB concentrations were detected in two of the sixteen wipe samples collected. PCBs were detected in samples S-299 and S-300 with total concentrations of 1.6 µg/wipe and 9.2 µg/wipe, respectively. These two samples are located in the unrenovated portion of the fourth floor. All post-clean samples were less than the interim occupancy criteria.

Post-Clean Lead Samples

Sixteen post clean wipes were collected in March 2003 for lead analysis from the fourth floor building surfaces (Figure 3-5). Total lead concentrations ranged from 0.52 µg/wipe at sample location S-300 to

62.4 µg/wipe at sample location S-290. All sixteen of the lead wipe samples were significantly less than the interim occupancy criteria.

Conclusion

In conclusion, all post-clean wipe samples collected from the fourth floor wood building surfaces were below the interim occupancy criteria for PCBs and lead.

3.2.2.2 *Wood Bulk Sample Results*

Wood bulk samples were collected to determine if PCBs extend into the wood building material. Figure 3-6 presents the results for wood bulk samples collected on the fourth floor. A tabular summary of wood bulk sample results for PCBs is presented in Table 3-7A. Each wood bulk sample was collected in the location of the post-clean wipe samples discussed above.

PCB Samples

Sixteen wood samples were collected on the fourth floor in March 2003 in accordance with the scope of work provided in Interim Deliverable No. 10 (Roux 2003c). Six of the sixteen wood samples were collected from the renovated office space and from below the existing carpeting. The remainder of the wood samples was collected from the renovated portion of this floor. Concentrations ranged from 0.123 mg/kg at sample location S-301 to 8.393 mg/kg at sample location S-300.

Conclusion

Detectable levels of PCBs were identified in all sixteen samples collected from the fourth floor.

3.2.3 *Third Floor Sampling Results*

As shown in Figure 3-2, the northern portion of the third floor was historically used as office space (Building Nos. 1 and 16 and a portion of Building No. 2) has been renovated (i.e., painted and carpeted). Offices currently occupy this portion of the third floor. The remainder of the third floor has not yet been cleaned. This subsection presents the wipe, concrete core, and wood bulk sampling results for the third floor.

3.2.3.1 *Wipe Sample Results*

Pre-clean and post-clean wipe samples were collected from the third floor and submitted for analysis for PCBs and lead. Figures 3-7 and 3-8 present the pre-clean and post-clean sample locations and results, respectively, with a comparison to the interim occupancy criteria for lead and PCBs. Tabular summaries of all pre-clean and post-clean wipe sampling results are presented in Tables 3-3 through 3-5. With the exception of pre-clean wipe samples Trans W-1 and Trans W-2, which were collected from wall surfaces, all building surface samples were collected from floor surfaces.

Pre- and Post-Clean PCB Samples

Thirteen pre-clean wipe samples were collected for PCB analysis from the third floor building surfaces (Figure 3-7). Five pre-clean wipe samples were collected in November 1997, two wipe samples were collected in March 1998, four wipe samples were collected in January 2002, and two wipe samples were collected in June 2002. PCBs were detected in twelve of the thirteen pre-clean wipe samples. Total PCB concentrations ranged in concentration from 2 μg/wipe at location W-2 to 2,060 μg/wipe at location Trans#4 and the interim occupancy criteria was exceeded in eleven of the thirteen sample locations as shown on Figure 3-7. A tabular summary of the analytical data is provided in Table 3-3A.

Nine post-clean wipe samples were collected and submitted for analysis for PCBs. Five wipe samples were collected in July 1998 and four samples were collected in January 2002. Post-clean PCB concentrations ranged from 0.023 μg/wipe at location S-31 to 354 μg/wipe at location S-100B as shown on Figure 3-8. A tabular summary of the analytical data is provided in Table 3-4A.

Of the 13 pre-clean samples collected, corresponding post-clean samples were collected for 6 of these samples: S-99 through S-102 (where pre-clean samples are designated with an "A" and post-clean with a "B"), Trans#2 and Trans#4 (where PSW-15A and PSW-14A are the respective post-clean samples). At these 6 locations, the interim occupancy was met at only 2 of the 6 post-clean locations, PSW-15A and PSW-14A. Post-clean PCB wipe concentrations at sample locations S-99B through S-102B continue to exceed the interim occupancy criteria.

In addition to the 6 post-clean samples that were collected from the pre-clean sample locations, discussed above, another five post-clean samples were collected for PCBs from the third floor. Two of these samples were collected from the uncleaned areas (S-32 and S-33) and one of these samples was collected from the renovated area (S-31); all were below the interim occupancy criteria for PCBs.

At two of the post-clean locations (S-100B and S-102B), PCB concentrations increased from the pre-cleaning results. Both of these samples, which were collected from separate rooms, were collected from painted floor areas. As shown in Table 3-2, these sample locations were cleaned using physical scrubbing and pressure washing prior to sampling. This cleaning process removed some of the old paint from the sampled surfaces, thus exposing the underlying concrete. It is assumed that these samples are representative of the condition of the concrete underlying the painted surfaces in these areas.

In addition to these two rooms, several additional rooms on the third floor have painted floors. These rooms are identified on Figures 3-7 and 3-8. Post-clean wipe samples were collected from the painted floor areas in two of these seven rooms. In one room, represented by post-clean sample S-101, the paint was removed during sampling. While the PCB concentration of this sample was above the interim occupancy criteria, the post-clean results did not increase above the pre-clean value. In another room, represented by post-clean sample PSW-14A, the interim occupancy criteria was met; however, it is not known whether the paint was removed during cleaning. The remaining post-clean wipe samples on the third floor were collected in areas that had non-painted concrete surfaces or were collected from flooring material such as linoleum tile. It should be noted that while sample S-99 was collected from a room where the majority of the floor is coated, the sample was collected from a petroleum stained, unpainted floor location.

Subsequent post clean sampling was performed on the third floor in March and May 2003. This supplemental post-clean sampling was specified in Interim Deliverable No. 10 (Roux, 2003c) and Supplement No. 1 to Interim Deliverable No. 10 (Roux, 2003d). A total of 35 samples were collected from both the renovated and uncleaned portions of the third floor (Figure 3-8). Total PCB concentrations ranged from non-detect at sample locations S-274 and S-275 to 681 µg/wipe at sample location S-339. In total, 28 of the 35 post clean wipe samples collected on the third floor exceeded the interim occupancy criteria. Each sample that exceeded the interim occupancy criteria is located in the uncleaned portion of the third floor.

<u>Pre- and Post-Clean Lead Samples</u>

Six pre-clean wipe samples (S-99A through S-102A, S-192A and S-193A) were collected for lead analysis from the uncleaned portion of the third floor. Lead concentrations ranged from 56.7 µg/wipe at location S-102A to 338 µg/wipe at location S-99A as shown in Figure 3-7. None of the results exceeded the interim occupancy criteria. A tabular summary of the analytical data is provided in Table 3-3B.

Of the four pre-clean samples, all four had corresponding post-clean samples (S-99B through S-102B). Lead concentrations in the post-clean samples ranged from non-detect at location S-102B to 56.4 µg/wipe at location S-100B (see Table 3–4B). Each post-clean sample was below the interim occupancy criteria for lead.

Subsequently, a total of 35 post-clean samples were collected in March 2003 and May 2003 from both the renovated office space and the uncleaned portion of the third floor and analyzed for lead. As discussed above, this sampling was specified in Interim Deliverable No. 10 and Supplement No. 1 to Interim Deliverable No. 10. The lead concentrations ranged from 0.36 µg/wipe at location S-273 to 601 µg/wipe at location S-341. Sample S-341 (601 µg/wipe) was the only wipe sample collected during this investigation to exceed the interim occupancy criteria.

Conclusion

In conclusion, the localized floor cleaning conducted at the sample locations in the uncleaned portion of third floor had limited effectiveness in reducing the PCB concentrations on the floor surfaces to below the interim occupancy criteria. In addition, in areas with painted floor surfaces, the floor cleaning that was conducted resulted in an increase in the surface concentration of PCBs in concrete through removal of the overlying paint layer. In contrast, lead concentrations were reduced in the painted floor area (S-100B and 102B) and at locations S-99B and S-101B through cleaning.

Wipe sampling results for PCBs do, however, demonstrate that PCB concentrations are below the interim occupancy criteria in the renovated portion of the third floor. A total of 44 post-clean wipe samples were collected and submitted for analysis for PCBs. Thirty-two of these samples exceeded the interim occupancy criteria. Each of the samples that exceeded the interim occupancy criteria is located in the uncleaned portion of the third floor.

A total of 39 post clean wipe samples were collected and submitted for analysis for lead. Only one wipe sample exceeded the interim occupancy criteria. This sample location (S-341) is located in the uncleaned portion of the third floor.

3.2.3.2 *Concrete Sample Results*

As discussed above, concrete core samples were collected in areas where there are existing transformers, or where there was knowledge of former transformers and electrical equipment. Additionally concrete core samples were collected based on the wipe sample concentrations to determine whether PCB and lead concentrations extend into the concrete building material.

PCB Samples

Initially, 30 concrete samples were collected in March 2003 from 10 concrete core locations in the uncleaned portion of the third floor. Each sample was collected to a depth of 6-inches. The concrete cores were divided into 0.5-inch increments and analyzed to a depth of 1.5-inches for PCBs. In May 2003, an additional 63 concrete samples were collected from 21 core locations. These cores were also analyzed in 0.5-increments to a depth of 1.5-inches. Additionally, 6 sample locations were selected from the March 2003 sampling for vertical delineation. Two 0.5-inch samples (1.5-2.0-inches and 2.0-2.5-inches) from each core were sent for analysis. A total of 105 samples were submitted for analysis for PCBs.

Concrete sample concentrations ranged from non-detect at sample locations S-320 and S-322 in the 0.5 to 1 inch interval, and at locations S-281, S-320, S-322, and S-325 in the 1 to 1.5 inch intervals to 3,905 mg/kg at sample location S-338 in the 0 to 0.5-inch interval.

Conclusions

PCBs were detected in 99 of the 105 samples collected from the uncleaned portion of the third floor. Therefore, the data demonstrate that PCBs have permeated into the concrete building material.

3.2.3.3 *Wood Sample Results*

The northern portion of the third floor, which has been renovated and is comprised of office space, is constructed of wood. Wood bulk samples were collected from the wood flooring below the existing carpet and vinyl tiling.

PCB Samples

Bulk wood samples were collected in March 2003 from 4 locations in the renovated portion of the third floor and submitted for analysis for PCBs. This sampling was performed in accordance with the Interim Deliverable No. 10 scope of work (Roux 2003). Analytical data for the wood samples are summarized in Table 3-7A. The sampling locations are presented on Figure 3-9.

PCBs were detected in all four samples. PCB concentrations ranged from 0.27 mg/kg at sample location S-275 to 4.33 mg/kg at sample location S-276.

Conclusions

Each of the samples was collected from renovated offices in the northern portion of the third floor. Detectable levels of PCBs are present in the wood building material, currently under the existing carpeting or tiled flooring.

3.2.4 *Second Floor Sampling Results*

As shown in Figure 3-3, the southern portion of the second floor (i.e., High Bay Building and Building No. 2) and a portion of the northeastern area of the second floor (i.e., Building Nos. 2A and 5 and a portion of Building No. 1) were previously cleaned. The remainder of the northern portion of the second floor has not yet been cleaned. This subsection presents the results of the wipe, surface accumulation, concrete core and wood bulk samples collected from the second floor. All building surface samples were collected from floor surfaces, with the exception of post-clean samples S-80 and S-82, which were collected from wall surfaces, post-clean samples HB-16 through HB-25, which were collected from the rafters in the High Bay Building, and pre-clean sample S-190, which was collected from the railroad siding wall.

3.2.4.1 *Wipe Sample Results*

Pre-clean and post-clean wipe samples were collected from the second floor of the buildings and were submitted for analysis for PCBs, lead and mercury during the interior investigation. Figures 3-10 and 3-11 present the pre-clean and post-clean results, respectively, with a comparison to the interim occupancy criteria for lead and PCBs.

Pre- and Post-Clean PCB Samples

Twenty-eight pre-clean wipe samples were collected from the second floor of the building and were submitted for analysis for PCBs (see Table 3-3A). One pre-clean sample was collected in December 2000, six samples were collected in May 2001, sixteen samples were collected in January 2002, two samples were collected with the NYSDEC and NYSDOH in May 2002, and three samples were collected in May 2003. All 26 pre-clean samples were collected in areas of the second floor that have not yet been cleaned. However, review of Figure 3-10 suggests that two pre-clean sample locations, S-95A and S-105A, are located in cleaned areas. Sample S-95A was collected just prior to the cleaning conducted in the railroad platform area. Sample S-105A was collected from a raised platform above the floor of the cleaned passageway. The cleaned passageway floor, which is coincident with the second floor of the High Bay, is reflected in

Figure 3-10. One sample, (S-190) collected during a split sampling investigation with the NYSDEC and NYSDOH in May 2002, was collected from the wall of the Railroad Siding Platform. The remainder of the pre-clean samples was collected from floor surfaces.

Total PCB concentrations in the pre-clean samples ranged from non-detect at seven locations to 37.1 µg/wipe at location S-119A. The interim occupancy criterion for PCBs was exceeded in four of the 28 pre-clean samples (2N-3, S-95A, S-117A, and S-119A). These locations are shown in Figure 3-10.

Of the 28 pre-clean samples collected, corresponding post-clean samples are available for 20 of these samples: S-95, S-103 through S-108, S-115, S-117, S-119, S-121 through S-127, and S-314 through S-316 (where pre-clean samples are designated with an "A" and post-clean with a "B"). At all of these 20 locations, the interim occupancy criteria for PCBs were met after cleaning. Figure 3-11 illustrates the post-clean wipe sample locations.

Including the 20 post-clean wipe samples discussed above, a total of 47 post-clean wipe samples were collected for PCBs (see Table 3-4A). Five wipe samples were collected in July 1998, 13 wipe samples were collected in June 2001, eight samples were collected in December 2001, and 21 samples were collected in January 2002. The samples were collected in both the previously cleaned and uncleaned areas of the second floor. PCBs were detected in 18 of the 47 post-clean wipe samples. Total PCB concentrations ranged from non-detect at 29 locations to 9.5 µg/wipe at location PSW-13A.

In May 2002, at the request of the NYSDEC and NYSDOH, split confirmatory wipe samples were collected in the previously cleaned

Railroad Siding Platform to identify potential areas of recontamination. Six post-clean wipe samples were collected from four locations (S-87, S-88, S-95 and S-189). Four of the six samples were collected at S-87 and S-88. Since pre- and post-vacuum samples were collected at these locations, a total of four samples were collected (S-87D, S-87 E, S-88B, and S-88C). Five of the six samples collected from the Railroad Siding Platform exceeded the interim occupancy criteria. The concentration of PCBs in these samples ranged from 11.9 µg/wipe at S-88C to 547 µg/wipe at S-189A.

Additional wipe sampling was performed in the previously cleaned portions of the second floor to identify potential areas of recontamination in October 2002. Eight post-clean wipe samples were collected in accordance with the scope of work provided in Supplement No. 1 to Interim Deliverable No. 6, Revision 1 (Roux, 2002f). The sample locations are presented on Figure 3-11. Five of the eight samples were collected in the Railroad Siding Platform to confirm the results of the sampling performed in May 2002. The remaining three wipe samples were collected in the High Bay Building (Building 8). One of the three wipe samples collected in the High Bay Building was collected from the encapsulated former transformer area (HBC-1). The concentrations of PCBs in these samples ranged from non-detect at sample HBC-1B to 530 µg/wipe at sample S-189B. The interim occupancy criterion for PCBs was exceeded in three of the eight wipe samples, each located on the Railroad Siding Platform (S-87F, S-88D, and S-189B).

Prior to a short-term tenant occupancy in November 2002, the NYSDEC and NYSDOH requested supplemental confirmatory sampling of the previously cleaned areas of the second floor. This sampling was performed in accordance with the scope of work provided in correspondence to the NYSDEC dated October 21, 2002 (Roux 2002c). Therefore, seven confirmatory post-clean wipe samples (CWS-15 through CWS-21) were collected from Building No. 1 and Building No. 2 in October 2002. Detectable PCB concentrations were identified in each sample, however, the interim occupancy criteria for PCBs was not exceeded in any of the samples. The PCB concentrations in these samples ranged from 0.59PJ µg/wipe at sample location CWS-17 to 3.4PJ µg/wipe at sample location CWS-16.

Due to potential laboratory error associated with the two sampling investigations performed in October 2002, additional wipe samples were collected to confirm the results provided from the initial sampling. However, the laboratory error was resolved and therefore, only the initial sampling results are provided. The laboratory error was due to a mathematical miscalculation and, once detected, the correctly calculated data were reported. Since the confirmation sampling does not provide any additional information and was not collected in the presence of NYSDEC and NYSDOH (for samples CWS-15 through CWS-21), these results have been excluded from this report.

Post-clean wipe samples were collected prior to the concrete core and wood bulk sampling performed for Interim Deliverable No. 10 (Roux 2003c) and Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003d). Twenty-seven post clean wipe samples were collected for PCB analysis in March 2003. An additional 14 post clean wipe samples were collected from the second floor in May 2003. A total of 41 post-clean wipe samples were collected. No samples exceeded the interim occupancy criteria. PCB concentrations ranged from non-detect at 25 sample locations to 8.1 µg/wipe at sample location S-336, located in the High Bay Building.

In summary, post-clean wipe samples were collected for PCB analysis over the course of the investigation. Eight of the 109 post-clean samples exceeded the interim occupancy criterion for PCBs. Each of the eight samples is located in the Railroad Siding Platform.

Pre- and Post-Clean Lead Wipe Samples

Twenty-six pre-clean wipe samples were collected from the second floor and submitted for analysis for lead (see Table 3-3B). Six wipe samples were collected in May 2001, one sample was collected in December 2001, sixteen samples were collected in January 2002, and three samples were collected in May 2003. All of the pre-clean samples were collected in areas of the second floor that have not yet been cleaned (see Figure 3-10). However, review of Figure 3-10 suggests that two pre-clean sample locations, S-95A and S-105A, are located in cleaned areas. Sample S-95A was collected immediately prior to the cleaning conducted in the Railroad Siding Area. Sample S-105A was collected from a raised platform above the floor of the cleaned passageway. The cleaned passageway floor, which is coincident with the second floor of the High Bay, is reflected in Figure 3-10.

Lead concentrations in these 26 pre-clean samples ranged from 16.8 µg/wipe at location S-125A to 4,140 µg/wipe at location S-119A. The interim occupancy criterion was exceeded in twelve of the 26 sample locations (2N-2, 2N-6, S-103A, S-105A, S-107A, S-108A, S-115A, S-117A, S-119A, S-121A, S-122A, and S-316B). Figure 3-10 illustrates the pre-clean wipe sample locations where the interim occupancy criterion was exceeded.

Of the 26 pre-clean samples collected, corresponding post-clean samples are available for 20 of these samples: S-95, S-103 through S-108, S-115, S-117, S-119, S-121 through S-127, and S-314 through S-316 (where pre-clean samples are designated with an "A" and post-clean with a "B"). At all of these 20 locations, the interim occupancy criterion for lead was met after cleaning. Figure 3-11 illustrates the post-clean wipe sample locations.

Including the 20 post-clean samples discussed above, 52 post-clean building surface wipe samples were collected from the second floor and submitted for analysis for lead. Twenty-six post-clean samples were collected in July 2000, four samples were collected in June 2001, six samples were collected in December 2001, and sixteen samples were collected in January 2002. The post-clean samples were collected in both the cleaned and the uncleaned areas of the second floor, as shown in Figure 3-11. In addition to the building surface wipe samples, ten samples (S-89, S-90, S-91, S-92, S-92B, S-93, S-94, S-97, S-97B, and S-98) were collected in December 2001 from four encapsulated areas of the High Bay building after the encapsulating material had been removed and the floor shot blasted (see Figure 3-11). As previously discussed, these areas had been encapsulated due to lead concentrations above the interim occupancy criteria.

Ten post-clean wipe samples were collected from the building rafters on the second floor (HB-16, HB-17-2, HB-18 through HB-25) in July 2000 and submitted for analysis for lead. For clarity, the discussion of lead post-clean wipe sampling results has been divided into the following three areas: building surface wipe samples, encapsulated areas, and rafter wipe samples.

Additional wipe sampling was performed in previously cleaned portions of the second floor to identify potential areas of recontamination in October 2002. Eight post-clean wipe samples (S-78B, S-87F, S-88D, S-109C, S-189B, S-194A, S-195A, and HBC-1) were collected in accordance with the scope of work provided in Supplement No. 1 to Interim Deliverable No. 6, Revision 1 (Roux 2002f). These sample locations are presented on Figure 3-11.

Prior to a short-term tenant occupancy in November 2002, the NYSDEC and NYSDOH requested supplemental confirmatory sampling of the previously cleaned areas of the second floor. This sampling was performed in accordance with the scope of work provided in correspondence to the NYSDEC dated October 21, 2002 (Roux 2002c). Seven confirmatory post-clean wipe samples (CWS-15 through CWS-21) were collected from Building No. 1 and Building No. 2 in October 2002.

As specified in the Interim Deliverable No. 10 and Supplement No. 1 to Interim Deliverable No. 10 scopes of work, post clean wipe samples were collected prior to the collection of the concrete core and wood bulk samples. Twenty-seven post clean wipe samples were collected in March 2003. An additional 14 post clean wipe samples were collected in May 2003. Sampling locations are presented on Figure 3-11.

Post-Clean Building Surface Wipe Samples

Lead was detected in all fifty-two post-clean wipes samples collected as part of the RI Work Plan, and ranged in concentration from 0.41 µg/wipe at location S-115B to 382 µg/wipe at location S-98. The interim occupancy criterion for lead was not exceeded at any of the fifty-two post-clean sample locations.

Detectable levels of lead were identified in each of the samples collected as part of Interim Deliverable No. 6. Two samples (S-88D and S-109C) exceeded the interim occupancy criteria. The lead concentrations ranged from 50.6 µg/wipe at sample S-87F to 896 µg/wipe at sample S-88D.

Lead was detected in each of the confirmatory samples that were requested by the NYSDEC and NYSDOH. The interim occupancy criterion was not exceeded in any of these samples. The lead concentrations for these samples ranged from 74.4 µg/wipe at sample CWS-18 to 379 µg/wipe at sample CWS-20.

The interim occupancy criterion for lead was not exceeded in any of the Interim Deliverable No. 10 samples collected in March 2003 and May 2003. Lead concentrations ranged from non-detect at sample location S-246 to 14.6 µg/wipe at sample location S-307.

In summary, 108 post-clean wipe samples were collected on the second floor. Two floor wipe samples exceeded the interim occupancy criteria for lead. Figure 3-11 illustrates the wipe sample locations for each of the samples discussed above.

Encapsulated Area Samples

Four floor areas located in the second floor of the High Bay were encapsulated to address exceedances of the interim occupancy criteria for lead. Eight samples were collected from these areas and submitted for analysis for lead after the encapsulant material had been removed by shot blasting the floor. Lead concentrations in the initial wipe samples collected after shot blasting ranged from 4.8 µg/wipe at location S-93, to a high of 3,520 µg/wipe at location S-97. With the exception of samples S-92 and S-97, all samples were below the interim occupancy criteria for lead. The lead concentrations at locations S-92 and S-97 were suspected to be caused by incomplete collection of the shot-blasting debris.

Following receipt of the initial post-clean sampling results, the formerly encapsulated areas represented by samples S-92 and S-97 were additionally cleaned using additional vacuuming. Analytical results for wipe samples collected after the additional cleaning (S-92B and S-97B) ranged from 9.5 µg/wipe and 15.5 µg/wipe, respectively, below the interim occupancy criteria for lead. All four areas previously encapsulated for lead exceedances have therefore been cleaned to the interim occupancy criteria for lead.

Rafter Wipe Samples

Lead concentrations in the rafter samples ranged from 20.8 µg/wipe at location HB-16 to 946 µg/wipe at location HB-19. Only one of the rafter samples (HB-19) exceeded the interim occupancy criteria. This rafter is located more than 20 feet above the floor and would be relatively inaccessible to temporary occupants or Site workers.

Post-Clean Mercury Samples

Four post-clean wipe samples were collected in June 2001 for mercury analysis from the former Paint Shop. Mercury was not detected in any of the four post-clean wipe samples collected (S-80 through S-83). A tabular summary of the data is presented in Table 3-5.

Conclusion

Following are the conclusions from the second floor wipe sampling:

- A total of 109 post-clean samples were collected for PCB analysis. Eight samples exceeded the interim occupancy criterion for PCBs. These eight samples were collected from the Railroad Siding Platform subsequent to cleaning.

- Over the course of the investigation, 108 post-clean samples have been collected for lead analysis from both the previously cleaned areas and the uncleaned portion of the second floor. Two samples collected from previously cleaned areas of the second floor exceeded the interim occupancy criterion for lead. Lead was detected in all samples, with the exception of S-246.
- The floor surfaces previously encapsulated for lead in the second floor of the High Bay (i.e., Building No. 8) were cleaned using shot blasting. Confirmatory sampling performed after the shot blasting indicated that lead concentrations were reduced to below the interim occupancy criteria for lead in all samples. The encapsulated area for PCBs on the second floor will remain encapsulated pending further evaluation in the FS.
- One of the ten High Bay (Building No. 8) rafter samples exhibited lead concentrations above the interim occupancy criteria for lead. However, this sample location is isolated.

3.2.4.2 *Surface Accumulation Results*

As previously discussed, five samples of surface accumulation were collected from the Railroad Siding Platform prior to cleaning activities in December 2001. The locations of these samples are presented in Figure 3-3 and the analytical results for these samples are presented in Table 3-6A through 3-6C. These samples were collected to characterize the materials from this area since wipe samples could not be conducted. This information was also used for waste disposal characterization.

As shown in these tables, total PCB concentrations in the surface accumulation ranged from 1.3 to 145 mg/kg; the PCB results from one sample, M-1, were rejected. Aroclor-1254 was detected in all of the remaining four samples and Aroclor-1260 was detected in one of the four samples. SVOCs and inorganic constituents were also present in these samples. Lead concentrations ranged from 14,000 to 44,000 mg/kg.

During cleaning, these materials were removed from the floor using scraping, shot blasting and pressure washing and containerized for disposal. Seven drums of solid waste material were generated during this activity. In addition, approximately 700 gallons of wash water were generated during these cleaning activities. Composite samples were collected for waste characterization. Results are provided in Appendix E. Based on the PCB concentration of the solid waste composite sample (53 mg/kg), the 7 drums of solid materials were classified and disposed as a TSCA waste and NYS B007 listed hazardous waste (Manifest # NYG3228138). Based on the results for the wash water composite sample, the wash water was classified and disposed as a non-hazardous waste. The waste characterization testing results and manifest are provided in Appendix E.

3.2.4.3 Concrete Samples Results

As discussed above, concrete core samples were collected in areas where there are existing transformers or where there was knowledge of former PCB-containing equipment (i.e., former annealing line capacitors). Additionally, concrete core samples were collected based on the wipe sample concentrations to determine whether the PCB and lead concentrations extend into the concrete materials. Sampling Locations are presented on Figure 3-12. Analytical data for the concrete core samples submitted for PCB and lead analysis are presented in Tables 3-7A and 3-7B.

<u>PCB Samples</u>

Initially, concrete core samples were collected from four locations on the second floor of the High Bay (Building No. 8) for PCB analysis

(Figure 3-12). Concrete cores at S-69, S-71, and S-81 were collected in June 2001 and extended to a depth of 6 inches below the top of the concrete slab. These cores were divided into three, 2-inch sample intervals. Sample HBC-1 was collected in July 2000 and extended to a depth of 2.5 inches below the top of the concrete slab. This core was divided into one, 0.5-inch interval followed by two, 1-0 inch intervals. Thus, twelve discrete interval concrete core samples were collected on the second floor and analyzed for PCBs. PCBs were detected in 5 of the 12 concrete core samples. One sample, HBC-1 0-0.5-inch interval, was identified as unusable during data validation. Concentrations of PCBs ranged from non-detect to 5.5 mg/kg in sample HBC-1 in the 0.5-1.5-inch interval.

One of four locations, HBC-1, exhibited elevated PCB concentrations in concrete core samples. Although the wipe samples from this localized area did not exceed the interim occupancy criteria for PCBs, the concrete surface at this location was encapsulated to address the concern raised by NYSDEC regarding potential wicking of the PCBs from within the concrete to the concrete surface. These concerns were raised by NYSDEC in letters to Roux (NYSDEC, 2000a)(NYSDEC, 2000b) and during a 7 July 2000 conference call. An epoxy coating was applied to this area to address any wicking concerns.

Five concrete cores were collected in October 2002 as part of the Interim Deliverable No. 6 scope of work (Figure 3-12). Three of the five concrete cores were collected from the Railroad Siding Platform. The remaining two concrete core samples were collected in the High Bay Building (Building 8). Each core was collected at the same location of post-clean wipe samples in an effort to evaluate the potential for recontamination in these previously cleaned areas. Each core was collected to a depth of

6 inches and divided into 0.5-inch intervals. Initially, the top one-inch (0-0.5-inch interval and 0.5-1.0-inch interval) was submitted for analysis. The remainder of the core was submitted for analysis, if PCBs were detected in the top one-inch. A total of 35 concrete core samples were submitted for analysis for PCBs. PCB concentrations ranged from non-detect in eight samples to 1,670 mg/kg at sample S-87F in the 0.5-1-inch interval.

Sixty concrete samples were collected from 20 core locations on the second floor in March 2003, as specified in Interim Deliverable No. 10 (Roux 2003c). An additional 33 concrete samples were collected from 11 locations on the second floor in May 2003, as specified in Supplement No. 1 to Interim Deliverable No. 10(Roux 2003d). All sample locations are presented on Figure 3-12. Concrete core samples were collected to a depth of 6-inches. Each core was divided into 0.5-inch intervals and analyzed to a depth of 1.5 inches. Four sample locations were selected from the March 2003 sampling for vertical delineation. Two 0.5-inch samples (1.5-2.0-inches and 2.0-2.5-inches) from each core were submitted for analysis. A total of 101 samples were submitted for analysis for PCBs.

Concentrations for PCBs ranged from non-detect at twenty-five locations to 16 mg/kg at sample location S-337 in the 0 to 0.5 inch interval. PCB concentrations were detected in 76 of the 101 samples collected in March and May 2003.

Lead Samples

Twelve discrete interval concrete core samples were collected on the second floor of the High Bay Building (Building No. 8) and submitted for analysis for lead (Figure 3-12). Analytical data for the individual increments sampled is summarized in Table 3-7B. Lead was detected in all twelve concrete samples and ranged in concentration from 1.6 mg/kg at sample location S-68 in the 4-6-inch interval to 303 mg/kg at sample location S-68 in the 0-2-inch interval.

Conclusions

The following are the conclusions from the second floor concrete core sampling:

- A total of 148 concrete core samples were collected from 40 locations. PCB concentrations ranged from non-detect to 1,670 mg/kg in S-87F in the 0.5-1.0-inch interval.
- With the exception of three concrete cores, the concrete cores collected from the second floor were located in previously cleaned areas. PCB concentrations were detected in 99 of 148 concrete samples. This indicates that detectable concentrations of PCBs extend into the concrete building material on the second floor.
- Lead was detected in each of the 12 concrete core samples.

3.2.4.4 *Wood Bulk Sample Results*

As discussed above, wood bulk samples were collected in areas of wood construction to determine whether PCB and lead concentrations extend into the wood building material. Analytical data for the wood samples are summarized in Table 3-7A through Table 3-7F. The locations of the wood bulk samples and analytical results are shown on Figure 3-12.

PCB Samples

Bulk wood samples were collected from 14 sample locations on the second floor (Buildings Nos. 1, 4, 6 and 15) and submitted for analysis for PCBs. All of the wood samples specified in the RI/FS Work Plan were collected in January 2002, with the exception of samples 2N-1 Bulk and 2N-3 Bulk, which were collected in May 2001. Analytical data for the PCB analysis is summarized in Table 3-7A. PCB concentrations in wood on the second floor ranged from 370 µg/kg at sample location S-124 to 36,400 µg/kg at sample location 2N-3.

In March 2003, seven wood samples were collected, in accordance with Interim Deliverable No. 10 (Roux 2003c). An additional three wood samples were collected in May 2003, in accordance with Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003d). All ten wood samples were collected from the northern portion of the Site buildings, which has not yet been cleaned. PCBs were detected in each of the wood samples. Total PCB concentrations for the 10 wood samples ranged from 0.254 mg/kg at sample location S-249 to 16.3 mg/kg at sample location S-248.

Lead Samples

Bulk wood samples were collected from 13 sample locations on the second floor and analyzed for lead. All of the wood samples specified in the RI/FS Work Plan were collected in January 2002, with the exception of samples 2N-1 Bulk and 2N-3 Bulk, which were collected in May 2001. Analytical data for the lead analysis are summarized in Table 3-7B. Total lead concentrations in wood on the second floor ranged in concentration from 3.7J mg/kg at S-126 to 2,680J mg/kg at S-119. In addition to total lead analysis, TCLP metals analysis was conducted on four wood samples (S-117, S-120, S-123 and S-127). As discussed below, the TCLP lead concentration at location S-120, the sample location nearest to the wood sample exhibiting the highest total lead concentration (S-119), was 0.79 mg/l.

TCLP Samples

Four bulk wood samples were collected from sample locations S-117, S-120, S-123 and S-127 and submitted for analysis for TCLP VOCs, TCLP SVOCs, TCLP metals and the RCRA characteristics (i.e., ignitability, corrosivity and reactivity). Results of these analyses are presented in Tables 3-7C, 3-7D, 3-7E and 3-7F, respectively. As shown in these tables, TCLP VOCs, TCLP SVOCs and TCLP metals results for the wood samples are all well below their TCLP regulatory limits. The highest TCLP lead concentration was 2.6 mg/l at sample location S-117 and the TCLP lead concentration corresponding to the highest total lead concentration is 0.79 mg/l at sample location S-120. The corrosivity, reactivity and ignitability results are all well below their RCRA characteristic limits.

Conclusion

The following conclusions can be reached based on the wood sampling performed on the second floor:

- PCBs were detected in each of the wood samples collected on the second floor. Each sample was collected from the northern portion of the second floor, which has not yet been cleaned. The data demonstrate that PCBs extend into the wood building material in this portion of the Site buildings.
- Lead was detected in each of the wood samples collected from the second floor. Each sample was collected from the northern portion of the second floor, which has not yet been cleaned. The data demonstrates that lead extends into the wood building material in this portion of the Site buildings.
- No samples exceeded the TCLP VOC, TCLP SVOC, TCLP metals, and RCRA characteristics regulatory requirements.

3.2.5 *First Floor Sampling Results*

As shown in Figure 3-4, the southern portion of the first floor (Buildings Nos. 2, 8, 19 and portions of Building Nos. 1, 7 and 10) has been cleaned and the northern portion of the first floor has not yet been cleaned. This subsection presents the results of the wipe and concrete core samples collected from the first floor.

3.2.5.1 *Wipe Sample Results*

Pre-clean and post-clean wipe samples were collected from the first floor of the building and were submitted for analysis for PCBs and lead during the interior investigation. Figures 3-13 and 3-14 present the pre-clean and post-clean results, respectively, with a comparison to the interim occupancy criteria for lead and PCBs. With the exception of pre-clean samples SR-1W through SR-3W, WS-1 and WS-2, which were collected from wall surfaces, all building surface samples were collected from floor surfaces.

<u>Pre- and Post-Clean PCB Samples</u>

Forty-six pre-clean wipe samples were collected from the first floor and were submitted for analysis for PCBs (see Table 3–3A). Eleven pre-clean wipe samples were collected in November 1997 and thirty-five samples were collected in January 2002. The pre-clean samples were collected in areas of the first floor that have not yet been cleaned.

PCBs were detected in forty-five of the forty-six pre-clean wipe samples. Total PCB concentrations ranged from non-detect at one location (S-148A) to 3,300 μg/wipe at location SR-3F. The interim occupancy criteria was exceeded at thirty-four of the sample locations. These locations are shown in Figure 3-13.

Of the 46 pre-clean samples collected, corresponding post-clean samples are available for the following 38 pre-clean sample locations:

- S-136, S137, S-145 through S-148, S-151 through S-154, S-156, S-157, S-167 through S-187 (where pre-clean samples are designated with an "A" and post-clean with a "B"); and
- SR-1F, SR-2W, SR-3F, SR-3W, and SR-4F (where PSW-10A, PSW-9A, PSW-11A, PSW-8A, and PSW-12A, respectively, are the post-clean sample designations).

At 35 of these 38 locations, the interim occupancy criteria for PCBs were met after cleaning. The interim occupancy criterion for PCBs was exceeded in the post-clean samples at S-174, S-176 and S-187. Figure 3-14 illustrates the post-clean wipe sample locations.

Including the 38 post-clean wipe samples discussed above, one hundred and seventy-five post-clean wipe samples were collected in accordance with the RI/FS Work Plan and submitted for analysis for PCBs (see Table 3–4A). Seventeen samples were collected in July 1998, twenty samples were collected in August 1999, three samples were collected in October 1999, twelve samples were collected in February 2000, twelve samples were collected in July 2000, three samples were collected in August 2000, five samples were collected in September 2000, forty-eight samples were collected in January 2001, fifteen samples were collected in June 2001, and forty samples were collected in January 2001 for PCB analysis. The samples were collected in both the previously cleaned and uncleaned areas of the first floor. PCBs were detected in 138 of the 175 post-clean wipe samples, and ranged in concentration from non-detect at thirty-eight locations to 9,800 µg/wipe at location S-41. Twenty-seven of the 175 post-clean samples exceeded the interim occupancy criteria for

PCBs on the first floor. Figure 3-14 presents the post-clean wipe sample PCB results.

These exceedances of PCB levels can be grouped into the following four general areas of the first floor: 1) the annealing line transformer area; 2) Transformer #14 area; 3) the Pipe Shop/Store Room; and 4) five scattered areas in the northern one-third of the first floor. To address the exceedances in the floor areas of the annealing line transformer area, Transformer #14 area, and the Pipe Shop/Store Room and allow occupancy in the first floor of the High Bay and the Pipe Shop, these floor areas were encapsulated. Encapsulation prevents direct contact of these surfaces by building tenants and facility personnel. The encapsulated floor areas surrounding the annealing line transformer area and Transformer #14 area are also fenced off to preserve the condition of the floor covering.

Additional wipe sampling was performed in the previously cleaned portions of the first floor to identify potential areas of recontamination in October 2002 (Interim Deliverable No. 6). Nine post-clean wipe samples were collected on the first floor. Five of the nine wipe samples (S-41B, S-139B, S-143B, S-163B, and CS-54C) were collected in areas that have been encapsulated to evaluate the potential for cross-contamination from areas not yet cleaned. PCB concentrations were detected in seven of the nine wipe samples. Two samples, S-41B and S-184C, exceeded the interim occupancy criteria. These samples were collected from the encapsulated Annealing Line Area in the High Bay Building (Building No. 8) and Building No. 12, respectively. The PCB concentrations ranged from non-detect at sample HB1-3B to 720 µg/wipe at sample S-184C.

Prior to a short-term tenant lease in November 2002, the NYSDEC and NYSDOH requested supplemental confirmatory sampling of the previously cleaned areas of the first floor. This sampling was performed in accordance with the scope of work provided in correspondence to the NYSDEC dated October 21, 2002 (Roux 2002f). A total of 14 post-clean wipe samples (CWS-1 through CWS-14) were collected from the High Voltage Lab (Building No. 7), Stairwells No. 2 and No. 3, and the West and East Warehouses. PCB concentrations were detected in 13 of the 14 wipe samples. The interim occupancy criterion was exceeded in 4 of the 14 wipe samples. Three of the samples that exceeded the interim occupancy criteria were located in the High Voltage Lab (CWS-1 through CWS-3). The fourth sample that exceeded the interim occupancy criteria was located in the East Warehouse. The concentrations of PCBs ranged from non-detect at sample CWS-7 to 820 µg/wipe at sample CWS-3.

Due to potential laboratory error associated with the sampling investigations performed in October 2002, additional wipe samples were collected to confirm the results provided from the initial sampling. However, the laboratory error was resolved and, therefore, only the initial sampling results are provided. The laboratory error was due to a mathematical miscalculation and, once detected, the correctly calculated data were reported. Since the confirmation sampling does not provide any additional information and was not collected in the presence of NYSDEC and NYSDOH (for samples CWS-1 through CWS-14), these results have been excluded from this report.

Post clean wipe samples were collected prior to the concrete core and wood bulk sampling performed for Interim Deliverable No. 10 (Roux 2003c) and Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003d). Fifty post clean wipe samples were collected in March 2003 and 3 post clean wipe samples were collected in May 2003. Four of the 53 wipe samples exceeded the interim occupancy criteria. The PCB concentrations ranged from non-detect at 16 locations to 33 µg/wipe at sample location S-230.

Pre- and Post-Clean Lead Samples

Forty-six pre-clean wipe samples were collected from the first floor (Buildings Nos. 2, 2A, 5, 6, 7, 8, 9, 10, 10A, 12, 12A, 12B, 14 and 15) and submitted for analysis for lead (see Table 3–3B). Eleven samples were collected in November 1997 and 35 samples were collected in January 2002. The pre-clean samples were collected in the areas of the first floor that have not been cleaned.

Lead was detected in all forty-six pre-clean wipe samples, and ranged in concentration from 67.5 µg/wipe at location S-178A to 9,690 µg/wipe at location S-146A. The interim occupancy criterion was exceeded in thirty of the forty-six sample locations. Figure 3-13 illustrates the pre-clean wipe sample locations where the interim occupancy criterion was exceeded.

Of the 46 pre-clean samples collected, corresponding post-clean samples are available for 35 of these samples. All pre-clean samples are designated with an “A” and all post-clean samples are the same number with a “B”. At all locations, the interim occupancy criterion for lead was met after cleaning. The remaining 11 pre-clean wipe samples were collected prior the RI/FS Work Plan and are included only to provide additional pre-clean data coverage. Figure 3-14 illustrates the post-clean wipe sample locations.

Including the 35 post-clean samples discussed in the previous paragraph, a total of 85 post-clean samples were collected for lead analysis. Four samples were collected in July 2000, eight samples were collected in

August 2000, twelve samples were collected in January 2001, sixteen samples were collected in June 2001, one sample was collected in December 2001, and forty-four samples were collected in January 2002. Lead concentrations ranged from 0.37 µg/wipe at location S-133B to 192 µg/wipe at location TL-2. None of these samples exceeded the interim occupancy criteria for lead

The Data Summary Memorandum, Interior (Roux, 2001f) indicated one sample location, S-60, as exceeding the interim occupancy criteria for lead. Since preparation of the Data Summary Memorandum, Interior (Roux, 2001f), this area of Building No. 10 has been cleaned by shot blasting. Additional detail regarding that cleaning activity was presented in Interim Deliverable No. 6 (Roux, 2002). Sample S-60 is, therefore, no longer representative of the lead surface concentration in this area. The concentration of lead detected in the post-cleaning sample collected subsequent to that cleaning (S-96B) was below the interim occupancy criteria for lead.

Additional wipe sampling was performed in previously cleaned portions of the first floor to identify areas of recontamination in October 2002 (Interim Deliverable No. 6, [Roux 2002]). Nine post-clean samples (S-41B, S-139B, SW-143B, S-163B, S-184C, HB1-3B, PSW-20C, PWC-12B and CS-54C) were collected from the first floor concrete floor surface. These sample locations are presented on Figure 3-14. The lead concentrations ranged from 77 µg/wipe at sample PWC-12B to 970 µg/wipe at sample S-163B. The interim occupancy criterion for lead was exceeded in two samples (S-163B and S-184C).

Prior to a short-term tenant lease in November 2002, the NYSDEC and NYSDOH requested supplemental confirmatory sampling of the previously cleaned areas of the first floor. This sampling was performed in accordance with the scope of work provided in correspondence to the NYSDEC dated October 21, 2002 (Roux 2002f). Fourteen confirmatory post-clean wipe samples (CWS-1 through CWS-14) were collected from the High Voltage Lab, Stairwells No. 2 and No. 3, and the West and East Warehouses. The lead concentrations for these samples ranged from 8.5 µg/wipe at sample CWS-5 to 523 µg/wipe at sample CWS-3. The interim occupancy criterion for lead was exceeded in two samples (CWS-1 and CWS-3).

Supplemental post-clean wipe samples were collected in March 2003 and May 2003 in accordance with the Interim Deliverable No. 10 (Roux 2003) and Supplement No. 1 to Interim Deliverable No. 10 (Roux 2003) scopes of work. These wipe samples were collected prior to the collection of concrete core and wood bulk samples. Fifty wipe samples were collected in March 2003 and three wipe samples were collected in May 2003. Two of the 53 wipe samples exceeded the interim occupancy for lead (S-199 and S-204). The lead concentrations ranged from non-detect at two locations to 1,320 µg/wipe at sample location S-204.

Conclusions

Following are the conclusions from the first floor wipe sampling:

- The pre-clean sample data demonstrates exceedances of the interim occupancy criteria for PCBs in the portion of the first floor that has not yet been cleaned. The interim occupancy criteria for PCBs was exceeded in 30 of 46 pre-clean wipe samples collected for PCBs from the uncleaned areas.
- Over the course of the investigation, 251 post-clean samples were collected from both the previously cleaned and the uncleaned areas and submitted for analysis for PCBs. Thirty-seven of the 251 samples exceed the interim occupancy. However, 20 of these samples that exceed the interim occupancy are sample locations that have since been encapsulated.

- A total of 161 post-clean wipe samples were collected and analyzed for lead in both the previously cleaned and the uncleaned areas of the first floor. Six of these samples exceeded the interim occupancy criteria for lead.
- Encapsulated areas on the first floor will remain in place pending further evaluation as part of the FS.

3.2.5.2 *Concrete Sample Results*

As discussed above, concrete core samples were collected in areas where there are existing transformers, or where there was knowledge of former PCB-containing equipment (i.e., former annealing line capacitors). Additionally, concrete core samples were collected based on the wipe sample concentrations to determine whether PCB and lead concentrations extend into the concrete materials. Analytical data for the concrete core samples are provided in Tables 3-7A through 3-7F. Sample locations and analytical results are presented on Figure 3-15.

<u>PCB Samples</u>

Concrete core samples were collected from 31 locations on the first floor for PCB analysis (Figure 3-15). Two concrete cores were collected in July 1998, four concrete cores were collected in January 2001, eight concrete cores were collected in June 2001, and seventeen concrete cores were collected in January 2002. Of these samples, 26 of the cores were split into 3, 2-inch lengths for analysis. Five of the cores (S-129, S-135, S-184, S-187 and S-188) were analyzed as a 0 to 6-inch composite only. In total, ninety-four concrete core samples were collected on the first floor and submitted for analysis for PCBs. Duplicate samples were collected of the 0 to 6-inch composite interval at locations S-52, S-184, and S-188. PCB results for the individual increments are presented in Table 3-7A.

PCB concentrations in the concrete core samples ranged from non-detect in 15 locations to 6,300 mg/kg at sample location S-41. Detectable PCB concentrations were identified in 79 of the 94 concrete core samples.

The areas where PCBs were detected can be grouped into four general areas: 1) the former annealing line (High Bay – Building No. 8); 2) the Transformer 14 area (High Bay – Building No. 8); 3) the Pipe Shop (a portion of Building No. 1); and 4) the northern uncleaned portion of the first floor. The former annealing line, the transformer area and the Pipe Shop are located in previously cleaned areas and the floor areas covering these concrete areas are encapsulated.

Four additional concrete cores were collected in October 2002, as specified in Supplement No. 1 to Interim Deliverable No. 6, Revision 1 (Roux 2002f). Three of these cores were collected from the High Bay Building (Building 8) and one was collected from the uncleaned portion of the first floor (Figure 3-15). Each core was collected at the same location of post-clean wipe samples in an effort to evaluate the potential for recontamination in these previously cleaned areas. Each core was collected to a depth of 6 inches and divided into 0.5-inch intervals. Initially, the top one-inch (0-0.5-inch interval and 0.5-1.0-inch interval) was submitted for analysis. The remainder of the core was submitted for analysis if PCBs were detected in the top one-inch. A total of 29 concrete core samples were submitted for analysis for PCBs. PCB concentrations ranged from non-detect at 15 locations to 296 mg/kg at S-184C in the 0.5-1.0-inch interval.

As part of Interim Deliverable No. 10 scope of work (Roux 2003c), 150 concrete core samples were collected from 50 locations on the first floor for PCB analysis. An additional 26 concrete samples were collected from 16 locations on the first floor (Figure 3-15). Concrete core samples were collected to a depth of 6-inches. Each core was divided into 0.5-inch intervals and analyzed to a depth of 1.5 inches. Three sample locations were selected from the March 2003 sampling for vertical delineation. A total of 193 samples were submitted for analysis for PCBs. The PCB concentrations ranged from non-detect in 57 locations to 246 mg/kg in the top 0.5-inch increment at sample location S-208, located in the uncleaned portion of the first floor. PCB concentrations were detected in 136 concrete core samples.

Lead Samples

Thirty-one discrete interval concrete core samples were collected on the first floor and submitted for analysis for lead (Figure 3-15). Twenty-one concrete core samples were collected in June 2001 and ten concrete core samples were collected in January 2002. Duplicate samples were collected at locations S-52, S-184, and S-188. Analytical data for the individual increments sampled is summarized in Table 3-7B. The lead concentrations ranged from non-detect at two locations to 118 mg/kg at sample S-67 in the 2-4-inch interval.

In addition to total lead analysis, TCLP metals analysis was conducted on seven concrete samples. As discussed below, all TCLP lead concentrations were well below the TCLP limit.

TCLP Samples

Seven concrete core samples (S-52, S-55, S-129, S-135, S-184, S-187 and S-188) were submitted for analysis for TCLP VOCs, TCLP SVOCs, TCLP metals and the RCRA characteristics (i.e., ignitability, corrosivity and reactivity). Results of these analyses are presented in Tables 3-7C, 3-7D, 3-7E and 3-7F, respectively. As shown in these tables, TCLP VOCs, TCLP

SVOCs and TCLP metals results for the concrete samples are all well below their TCLP regulatory limits. The highest TCLP lead concentration was 2.6 mg/l at sample location S-117. The reactivity and ignitability results are all well below their RCRA characteristic limits. Corrosivity (i.e., pH) results for first floor concrete samples ranged from 12.52 to 12.66 SU. Although a pH of higher than 12.5 SU is considered to be a RCRA characteristic waste for corrosivity, due to its composition, concrete itself generally exhibits a pH ranging from 12 to 13 SU (Concrete, 1999). Although the pH at the surface of the concrete may decrease with time, the concrete below the surface, which is not in contact with air, would retain its initial pH.

Conclusion

- A total of 316 concrete core samples were collected from previously cleaned, currently encapsulated, and uncleaned areas of the first floor. PCB concentrations were detected in 229 of the 316 concrete core samples. The concrete core sample data demonstrates that PCBs have permeated within the concrete building material.
- Detectable lead concentrations were identified in 29 of 31 concrete core samples.
- No samples exceeded the TCLP VOC, TCLP SVOC, TCLP metals, and RCRA characteristics regulatory requirements.

3.2.6 *Subsurface Structure Evaluation*

The objectives of this task were:

- to determine the structure and integrity of the concrete floor structures in the Building No. 4;
- to locate and inspect potential subsurface structures below the concrete slab on grade; and
- characterize any contents contained within the identified subsurface structures.

3.2.6.1 *Building No. 4 Concrete Structures*

As discussed above, an inspection of the concrete structures within Building No. 4 was conducted. The location of these structures is provided on Figure 3-4. After the debris was moved to allow for inspection of the walls and floor of two of the structures, it was determined that the structures were approximately three feet in depth and had competent concrete bottoms. Fill in the structures consisted of concrete and other miscellaneous construction debris and did not exhibit any staining or odors. With concurrence from the on-site NYSDEC representative, the fill within the structures was not removed from any of the structures. The former usage of these structures is unknown.

3.2.6.2 *Geophysical Investigation*

Geophysical methods were used to assess for the presence of subsurface structures within the survey area. Enviroscan, Inc. (Enviroscan) conducted this investigation under the supervision of Roux Associates. This investigation was conducted from June 18, 2002 to June 21, 2002 using both ground penetrating radar (GPR), and microgravity technologies. GPR, which uses radar pulses to detect material with different dielectric properties, is very effective in distinguishing metallic tanks and pipes from soil and fill materials, except where reinforcing steel in overlying concrete slabs is spaced too closely or where thick concrete slabs are present. Microgravity technology, which measures gravitational acceleration under a certain point to determine if a void is present, is capable of penetrating through areas with dense concrete reinforcing.

A total of 22 anomalous areas were detected in the geophysical investigation. All anomalies are presented on Figure 3-16. A complete description of the geophysical activities and results was provided to the NYSDEC in the Interim Deliverable No. 7 Summary Report (Roux, 2003) and is provided as Appendix H. In addition to the anomalies found by the geophysical investigation, three potential subsurface structures were identified from historic Site drawings. Two of these potential structures are located in Building No. 5, and the remaining potential structure is located in Building 4.

3.2.6.3 *Subsurface Anomaly Inspection*

The subsurface anomaly inspection was conducted from October 7 through October 10 and October 16, 2002. All 22 anomalies detected by Enviroscan were inspected during this task. Anomaly inspection was performed by coring 4-inch diameter inspection holes through the concrete floor slab. These inspection holes were designed to provide additional information regarding the subsurface conditions below the floor slab. Larger openings were made in the floor for a more complete inspection of the subsurface anomalies. The location of each inspection hole is shown in Figure 3-16. Detailed results for the subsurface anomaly inspection task are provided in the Interim Deliverable No. 7 Summary Report (Roux 2003), which is provided as Appendix H.

3.2.6.4 *Subsurface Vault Sampling and Pump Out*

The subsurface vault located in Building No. 2 contained approximately 250 gallons of NAPL and 40,000 gallons of water below the NAPL layer. On October 8, 2002 a sample of the NAPL and a sample of the underlying water was collected. The NAPL sample (designated VP-1) and the water sample (designated VL-1) were both submitted for analysis for TCL VOCs, TCL SVOCs, TAL metals, PCBs, and RCRA disposal characteristics. The

NAPL sample was also submitted for analysis for TCLP metals and petroleum fingerprint analysis. Analytical results for these samples are presented in Tables 3-11A through 3-11F. The petroleum fingerprint analysis analytical report is provided in Appendix H.

Under the supervision of Roux Associates, AEAC pumped off the layer of NAPL using a vacuum truck. A total of 10,131 gallons of water and 250 gallons of NAPL were removed and disposed off-site. Copies of completed waste manifests are included in Appendix E. No recharging of water was observed within the subsurface vault. Approximately 30,000 gallons of non-hazardous water remained in this structure. The remaining water and any debris within the subsurface vault will be addressed with the selected interior remedy.

3.2.6.5 *Subsurface Anomaly Fill Sample Results*

This section discusses the results of the fill sampling conducted as part of Interim Deliverable No. 7. The scope of this fill sampling investigation is outlined in Supplement No. 1 to Interim Deliverable No. 7, Revision 1 (Roux, 2002d). Based on observations made during the subsurface anomaly inspection task, it was determined that most of the identified anomalies were areas of soil/fill covered by the concrete floor slab, rather than subsurface voids. The soil/fill material observed in these areas appeared to be typical of the soil/fill located beneath the majority of the building and in the South Yard. Most of these areas did not exhibit evidence of being a subsurface void, or vault, and it was determined, with the concurrence of the on-site NYSDEC representative, that most of these areas did not require further investigation (i.e., sampling).

Six of the 22 anomalous areas did, however, show evidence of being a subsurface structure that may have been filled in and covered with a concrete slab. These areas included the two anomalies located in Building No. 2 (Anomalies 2 and 3), the anomaly located in the southwest portion of the Pipe Shop (Anomaly 5), the anomaly located in the northern portion of the Pipe Shop (Anomaly 9), the "L" shaped anomaly located in Building No. 15 (Anomaly 16), and the anomaly located in the eastern portion of Building No. 4 (Anomaly 22). Soil borings SS-241 to SS-246 were completed in these areas. All anomalies are shown on Figure 3-16.

In accordance with the Supplement No. 1 to Interim Deliverable No. 7, Revision 1 scope of work, soil borings were completed using a track-mounted Geoprobe rig. Samples were collected in 4-foot macrocore samples lined with dedicated acetate liners. Soil borings were advanced until either a solid concrete bottom was reached, or to a depth of 6 feet bls, whichever was encountered first. Soil samples were logged for lithology and samples were collected in two-foot intervals, and submitted for analysis for SVOCs, PCBs, inorganic constituents, and RCRA disposal characteristics. In addition, samples were submitted for analysis for VOCs only if field PID screening results exceeded 10 ppm. Soil boring logs are provided in Appendix A.

Samples SS-241 through SS-246 were collected from anomalous areas that, upon inspection, indicated that a subsurface structure might exist at that location below the concrete slab.

Samples SS-245 and SS-246 were collected from within solid bottomed subsurface structures. These results are discussed below.

However, samples SS-241 through SS-244 were collected in anomalous areas that were not subsurface structures. For this reason, these samples were included in the Below Building soil/fill dataset presented in Tables 2-8A through 2-8D and are discussed along with the other Below Building samples in Section 2.0. All samples collected from SS-241 through SS-244 were within the historic fill range for SVOCs and inorganic constituents and below the PCB RSCO.

In addition to these anomaly locations, a subsurface structure was also identified during the Interim Deliverable No. 9 sampling. This subsurface structure was identified by borings SS-224 and SS-255, where both of these borings encountered a solid bottom at a depth of 4 feet. These samples, SS-224, SS-224A, and SS-255, are discussed below along with the subsurface structure samples. The locations of borings completed within subsurface structures are shown on Figure 3-16.

<u>Results for Subsurface Structure Samples (SS-245, SS-246, SS-224 and SS-255)</u>

VOCs

None of the fill samples collected from subsurface structures in this investigation had PID field screening values in excess of 10 ppm, therefore no samples were submitted for VOC analysis.

SVOCs

A total of six fill samples were collected from subsurface structures and submitted for analysis for SVOCs. Table 3-12A presents these analytical results. Five of the six samples contained at least one SVOC compound in excess of its respective RSCO. The majority of the compounds that exceeded the RSCO criteria were PAHs. Specific samples that exceeded the RSCO in at least one sample included Benzo[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Bis(2-ethylhexyl)phthalate, Chrysene, and Dibenzo[a,h]anthracene. The concentrations of SVOCs at these locations are however within the range of historic fill.

Inorganic Constituents

A total of six fill samples were collected from subsurface structures and submitted for analysis for inorganic constituents. Table 3-12B presents analytical results for inorganic constituents. Each of the samples contains inorganic constituents in excess of their respective RSCO. Iron, mercury and zinc exceeded the RSCO criterion in each of the six samples.

PCBs

A total of six fill samples were collected from subsurface structures and submitted for analysis for PCBs. Table 3-12C presents the results for PCBs. All six of the samples submitted for analysis had detectable PCB concentrations. Concentrations ranged from 1.279 mg/kg to 1,800 mg/kg at locations SS-255 and SS-246, respectively. Two of the six samples contained PCBs at concentrations in excess of the subsurface RSCO for PCBs.

Subsurface Anomaly Fill Waste Characteristics

A total of three fill samples were collected from subsurface vaults and submitted for analysis for RCRA disposal characteristics. Table 3-12D presents these results. None of the samples collected exceeded the USEPA characteristics for hazardous waste.

Conclusion

In conclusion, based on the findings of this investigation, the areas identified as subsurface structures were the subsurface vault in Building No. 2 south of the Pipe Shop, the subsurface anomaly located in the southeastern portion of Building No. 4 and the two potential structures found based on a review of a historical drawing in Building No. 5. Analytical results for these structures indicate that the fill material found in all of the identified structures contain SVOC, inorganic constituents and PCB compound in excess of the RSCO criteria. The fill material found in the anomaly located in the southeast portion of Building No. 4 contains PCBs at concentrations significantly above the RSCO criteria (1,800 mg/kg).

3.2.7 *Interior Floor Trench System Sampling Results*

The objectives of the interior floor trench investigation were:

- To determine the structure and integrity of the floor drainage system and its outfall locations;
- Determine areas where potential impacts to materials underlying the trenches may have occurred; and
- To characterize materials within the system.

The configuration of the floor trench system is reflected in Figure 2-1. This figure also shows locations where a bottom was not encountered in the floor trench. Prior to the collection of soil samples below the bottomless portion of the trenches (see Section 2.2 for further discussion), sludge samples were collected from the floor trenches and the floor trenches were cleaned. Three samples of the floor trench sludge were collected and submitted for analysis for SVOCs and metals (SUMP-1, SUMP-2, and SUMP-3) and four samples of the sludge were collected and analyzed for

PCB analysis (SUMP-1, SUMP-2, SUMP-3, and SUMP-1A). The analytical results for the sludge samples are summarized in Table 3-8A through 3-8C. Each analyte group is discussed below. These data were not intended to be used to evaluate potential occupancy requirements and therefore are not compared to any regulatory criteria for this report. In addition, the majority of this material was removed during the inspection of the trench system.

Twenty individual SVOCs were detected at various concentrations in all sludge samples collected. Most of the compounds detected are PAHs. Analytical results are summarized in Table 3-8A. Total SVOC concentrations ranged from 7,551 µg/kg in sample Sump-2 to 58,371 µg/kg in sample Sump-3.

Three sludge samples (SUMP-1, SUMP-2, and SUMP-3) were submitted for analysis for inorganic constituents (see Table 3–8B). With the exception of two inorganic constituents (i.e., sodium and thallium), the remaining twenty-one metals were all detected at or above their respective method detection limits. Concentrations of copper and lead, which are considered to be key constituents associated with past operations at the Site, ranged from 584 mg/kg (Sump-1) to 3,460 mg/kg and from 6,920 mg/kg (Sump-1) to 68,800 mg/kg (Sump-3), respectively.

PCBs Aroclor 1248 and Aroclor 1260 were detected in three of the floor trench samples (SUMP-1, SUMP-1A, and SUMP-3). Aroclor 1248 was detected at a concentration of 3,320,000 µg/kg in sample SUMP-1A and Aroclor 1260 was detected in SUMP-1, SUMP-1A, and SUMP-3, at concentrations of 47,900 µg/kg, 10,800,000 µg/kg, and 3,860J µg/kg, respectively. The PCB analytical results are summarized in Table 3-8C.

Based on the above analytical results and the absence of floors in certain sections of the trench system, additional cleaning of the floor trenches was conducted and soil samples were collected from beneath the bottomless portions of the trench. In addition, ground water monitoring wells were also installed downgradient of the portion of the floor trench that did not have a competent bottom. Section 2.2 presents the soil sampling results beneath the trenches and Section 2.3 presents the ground water sampling results. The waste manifest for disposal of the removed sludge is provided in Appendix E.

3.2.8 Process Tank Sampling Results

The objective of this task was to determine whether process oil tanks contained any PCBs. Nine wipe samples were collected from the process tank interiors and submitted for analysis for PCBs. A second sample was collected from Tank 3 since the results from the first sample were deemed unusable. In addition, separate wipe samples were collected from Tank 7 and Tank 8 based on the results of a composite sample for Tanks 7 and 8. Table 3-9 presents the PCB results for the tank wipe samples. Aroclor-1254 was detected in Tanks 3, 4 and 7 at 1.8, 0.83, and 2.7 μg/wipe, respectively. Composite sample Tank 7-8 showed a higher PCB concentration (9 μg/wipe). After further investigation and analysis of discrete samples Tank-7 and Tank-8, the PCBs detected in the composite sample from Tanks 7 and 8 appear to have originated from Tank 7. Composite samples are typically regarded as diluted. However, in this instance, the composite sample (Tank 7-8) was at a higher concentration than the discrete sample (Tank 7).

An oil sample was also collected from the combined discharge piping from Tank 5 and Tank 6 and submitted for analysis for PCBs. PCBs were not detected at a method detection limit of 20,000 μg/kg. The high method detection limits for this sample are likely the result of matrix interference.

A brief summary of sample results is listed below:

Sample Designation	Total PCB Result	Aroclor
TANK-1	0 µg/wipe	NA
TANK-2	0 µg/wipe	NA
TANK-3	1.8 µg/wipe	Aroclor-1254
TANK-4	0.83 µg/wipe	Aroclor-1254
TANK 5-6 (Oil)	0 µg/kg	NA
TANK 7-8	9 µg/wipe	Aroclor-1260
TANK-7	2.7 µg/wipe	Aroclor-1254
TANK-8	0 µg/wipe	NA
TANK 9-11	0 µg/wipe	NA

These data were not intended to be used to evaluate potential occupancy requirements and therefore are not compared to any regulatory criteria for this report. However, the data are relevant to understanding process operations at the Site. An evaluation of these data will be performed as part of the FS. Any additional sampling needs will be determined depending upon whether the tanks remain or are removed as part of the interior remedial alternatives.

3.2.9 *Boiler Stack Results*

As discussed in Section 3.1.1.3, samples were collected of the stack ash and stack construction materials to evaluate disposal options for stack debris. Analytical results for the three samples are presented in Table 3-10. All ash TCLP concentrations were below their respective USEPA Toxicity Characteristic criteria for each metal detected. In addition, the sample of the concrete-like stack liner material collected (Stack Liner) did not contain asbestos.

3.2.10 *Lead-Based Paint Survey*

As discussed above, a lead paint survey of the Site buildings was conducted. This survey was conducted using an in-field LPA-1 Lead Paint Analyzer. The LPA-1 Lead Paint Analyzer utilizes X-Ray Fluorescent (XRF) technology to determine whether a painted surface contains greater than 1.0 mg of lead in a square centimeter (cm^2) of painted surface (1.0 mg/cm^2) and therefore is classified by the U.S. Department of Housing and Urban Development (HUD) as a lead-based paint in a residential setting. Although not applicable in commercial/industrial settings, the HUD criterion was used as a screening tool to evaluate painted building surfaces at the Site. The results of the survey are contained in the *Pre-Construction Lead Based Paint Survey*, prepared by J.C. Broderick & Associates, Inc., dated November 2001 (see Appendix I).

As shown in this report, the in-field measurements are reported as either positive (i.e., the material is a lead-based paint) or negative (i.e., the material is not a lead-based paint). A total of 1,525 measurements were collected throughout the Site buildings. Of these 1,525 locations, 191 locations tested positive as lead-based paint. The report provides tabular summaries of the in-field measurements, as well as building diagrams indicating the room numbers referenced in the report.

A general discussion of the results for each floor is provided below. An evaluation of the survey results is provided in Section 5.3.2. Maps identifying the locations of the rooms noted below are provided in the *Pre-Construction Lead Based Paint Survey* (see Appendix I).

First Floor

Lead-based paint is present in previously cleaned and uncleaned areas of the first floor. Lead-based paint was identified in a total of four previously cleaned first-floor rooms (Room Nos. 1028, 1034, 1037 and 1038). Paint in all four of these rooms is peeling. Peeling lead-based paint is present on the walls, columns and beams in Room Nos. 1028 and 1034. Peeling lead-based paint in Room Nos. 1037 and 1038 is limited to an unused, restricted steel staircase and yellow-colored aisle marking paint on the floor, respectively. With the exception of the yellow aisle marking, there is no lead-based paint on the floors in these previously cleaned rooms. None of the other first floor previously cleaned rooms contain any lead-based paint.

The floors and walls in the four first floor rooms containing peeling lead-based paint discussed above were previously cleaned to remove surface accumulations from building material surfaces. Floors in these rooms were cleaned using a combination of pressure washing and shot blasting and walls were cleaned using pressure washing. In addition to removing surface accumulations, this cleaning also removed some of the peeling paint from the floor and wall surfaces and the paint chips that had already fallen to the floor from overhead painted surfaces. Although the stairway was not cleaned, it is located in a restricted access hallway.

Lead-based paint was detected in 13 first floor rooms that were not previously cleaned (Room Nos. 1001, 1003, 1007, 1008,1014, 1015, 1016, 1019, 1020, 1021, 1023, 1024, 1026, 1040, 1041, 1042 and 1043). Peeling lead-based paint was identified in 4 of these 13 rooms (Room Nos. 1015, 1021, 1023 and 1024). Lead-based painted surfaces in these four rooms include: walls, metal stairs, boilers and/or doors. In the remaining

11 rooms that do not contain peeling paint, lead-based paint was identified on the walls, floors and/or doors.

Second Floor

Lead-based paint is present in previously cleaned and uncleaned areas of the second floor. Lead-based paint is present in five previously cleaned rooms (Room Nos. 2007, 2008, 2012, 2013 and 2014) and three stairwells located on the second floor. Four of these five rooms (Room Nos. 2007, 2008, 2012 and 2013) and stairwells contain peeling lead-based paint. Painted surfaces in these areas include: floors, walls, columns and railings.

The floors, ceilings and walls/columns in these four rooms and three stairwells containing peeling lead-based paint were previously cleaned to remove surface accumulations from building material surfaces. Floors in these rooms were cleaned using a combination of pressure washing and shot blasting and walls were cleaned using pressure washing. In addition to removing surface accumulations, this cleaning also removed some of the peeling paint from the floor and wall surfaces and the paint chips that had already fallen to the floor from overhead painted surfaces. Due to the presence of lead in the collected cleaning material, some of the cleaning materials were classified as characteristic hazardous wastes for lead. Analytical results and waste manifests for these materials are provided in Appendix E.

The remaining previously cleaned room containing lead-based painted surfaces is Room No. 2014. The lead-based paint in this room is not currently peeling. Painted surfaces in this room include only the walls.

Lead-based paint is also located in the portions of the second floor that have not yet been cleaned. Lead-based paint was detected in four uncleaned second-floor rooms (Room Nos. 2026, 2027, 2029 and 2032). Of these four rooms, two uncleaned second floor rooms (Room Nos. 2026 and 2027) contain peeling lead-based paint. Lead-based painted surfaces in these two rooms include: walls, floors and columns. Lead-based paint not presently in a peeling condition was identified on the walls in Room Nos. 2029 and 2032.

Third Floor

Lead-based paint is present in previously cleaned and uncleaned areas of the third floor. Lead-based paint is present in 15 previously cleaned rooms located on the third floor. Peeling lead-based paint is present in four of these 15 previously cleaned rooms (Room Nos. 3013, 3018, 3036 and 3037) and three stairwells. The only lead-based painted surfaces in these rooms are the walls. Lead-based paint that is not currently peeling was identified on walls in previously cleaned Room Nos. 3006, 3010, 3011, 3012, 3015, 3016, 3017, 3018, 3026, 3028 and 3035, and a door in Room No. 3038.

Lead-based paint is present in nine uncleaned rooms located on the third floor. Peeling lead-based paint is present in 3 of these 9 uncleaned rooms (i.e., Room Nos. 3040, 3049 and 3058). Lead-based painted surfaces in these three rooms include: walls, cabinets and doors. Lead-based paint that is not currently peeling was identified on walls and cabinets in Room Nos. 3043, 3045, 3047, 3060, 3062A and 3057.

Fourth Floor

Lead-based paint is present on the walls (including a window) and a door in five rooms (Room Nos. 4003, 4004, 4007, 4008 and 4010) and in three stairwells located on the fourth floor. The lead-based paint identified in four of the five rooms (Room Nos. 4003, 4004, 4007 and 4008) and in all three stairwells is peeling. Currently, access to the unrenovated portion of the fourth floor is prohibited due to structural concerns.

3.2.11 Fate and Transport of Contaminants Associated with Interior Building Material

This section discusses the potential fate and transport of PCB and lead contamination associated with the interior building material if no further remedial action is taken at the Site buildings. As described in Section 3.1, interior building material encompasses primarily the concrete and wood bulk building material associated with the interior portions of the building, but it also includes the interior subsurface floor trench system, process oil and fuel oil storage tanks, subsurface concrete structures and any associated contents, and lead-based painted surfaces.

3.2.11.1 Concrete and Wood Building Material

Three potential environmental fate and transport mechanisms exist for contamination associated with the concrete and wood building material. These potential mechanisms include:

- Transport of chemicals (including lead-containing dust) from uncleaned areas of the Site to previously cleaned interior areas of the Site, or to the exterior environment;
- Transport of chemicals to the surrounding environment due to deteriorating building conditions;
- Potential recontamination (i.e. wicking) of PCBs to the surface of previously cleaned concrete.

Fate and transport mechanisms associated with the protection of human health are discussed in Section 5, The Baseline Human Health Risk Assessment of Building Materials.

Transport of Chemicals from Uncleaned to Previously Cleaned Areas

Portions of the first and second floors were previously cleaned using a combination of hand scraping, pressure washing, and shot blasting to be compliant with the Site-specific interim occupancy criteria (IOC), as presented on Figures 3-14 and 3-11, respectively. In addition, portions of the third and fourth floors were renovated to allow compliance with the IOC, as shown on Figures 3-8 and 3-5, respectively. The proximity of these previously cleaned or renovated areas to the uncleaned areas offers the potential for PCB or lead contamination to be carried into previously cleaned areas. Cross-contamination could be caused by on-Site activity in the Site buildings, such as walking, or forklift traffic as a result of maintenance activity, or indoor air currents caused by the ventilation system or open bay doors and windows. The potential for contamination to be carried outside of the building, to the surrounding environment also exists. Contamination could be carried outdoors on the shoes, or clothing of personnel, on equipment, or airborne contaminants could be carried outside the building via indoor air currents. Currently, the effects of these transport mechanisms are minimized through the use of disposable shoes covers when personnel are in uncleaned areas of the Site buildings, and the practice of decontaminating equipment after use in uncleaned areas of the Site buildings.

Transport of Chemicals to the Surrounding Environment Due to Deteriorating Building Conditions

As previously discussed in Section 1.4.6, portions of the concrete and wood building material in the Site buildings, especially the older northern buildings, are deteriorating due to age and tidal affects from the Hudson River. The poor condition of the Site buildings increases the risk of contaminated media to migrate from the buildings interior to the surrounding environment. Due to the deteriorating condition of the buildings roof, especially in the northern Site buildings, stormwater enters the building during times of precipitation. The poor condition of the floor in the northern part of the second floor (Building No. 4), and the fact that most of the northern buildings are only one story, cause most of the stormwater that enters the building to accumulate on the first floor. This stormwater creates the potential for migration of contamination into the surrounding environment. Routes of migration to the surrounding environment may be through the subsurface trench system or through cracks and openings in the concrete floor slab, ultimately leading to discharge to the Hudson River or to the below building soil/fill. In addition to accelerating chemical migration, stormwater that enters the Site buildings will cause further deterioration of the physical structure of the buildings.

Potential Recontamination of Previously Cleaned Concrete Areas

As described above, portions of the Site have been cleaned in an effort to be in compliance with the IOC. PCBs have penetrated the surface of the concrete, and are found at depth in portions of the first, second and third floors, as shown on Figures 3-15, 3-12, and 3-9, respectively. It is possible that sections of the Site buildings that were previously cleaned still have residual concentrations of PCBs within the concrete floor slab. In areas where PCBs have permeated into the concrete floor slab, it is possible that recontamination, or wicking of PCBs to the surface may take place. If this process is occurring, then it is possible that over time previously cleaned areas may become recontaminated.

3.2.11.2 *Interior Subsurface Floor Trench System*

As described in Section 3.1.2, an extensive subsurface floor trench system exists below the first floor in the northern Site buildings. This system consists of a series of trenches and pipes that currently collect and discharge stormwater. Portions of this trench do not have a competent concrete bottom. Initially, a considerable quantity of sludge was located in this trench. As part of Interim Deliverable No. 1 (Roux, 2001c) the trench system was cleaned, and the trench sludge was removed to the extent possible. Currently, residual sludge is still in place in portions of this trench system.

As presented in Tables 3-8A through 3-8C, both organic compounds and inorganic constituents are present in the residual trench sludge. This floor trench system acts as a direct conduit to the below building soil/fill and to the Hudson River. Due to stormwater entering this trench, a potential transport mechanism exists for chemicals found in the trench sludge to leach into the subsurface soil/fill located below the trench sludge, or for chemicals to leach directly into the Hudson River. Furthermore, as discussed above, any additional chemicals entering this trench system due to deteriorating building conditions contribute to this transport mechanism.

3.2.11.3 *Process Oil and Fuel Oil Storage Tanks*

As described in Section 3.1.4, eleven process oil aboveground storage tanks are located in the ceiling or on the walls of the second floor. Also, two aboveground fuel oil storage tanks are located on the first floor, within a concrete vault with no access. All of the process oil tanks located on the second floor have been emptied. Only residual product is located in these process oil tanks and piping associated with these tanks. The fuel oil tanks located on the first floor are still active and contain an unknown quantity of No. 6 fuel oil.

The process oil tanks in the ceiling and on the walls of the second floor contain little residual product and offer a relatively small risk of transport of contaminants. Human contact with residual product in these tanks would be the most common transport mechanism, and due to the remote locations of these tanks, this is not likely.

There is minimal potential for the remaining product associated with the two active fuel oil tanks on the first floor to be transported to the underlying soil/fill. These fuel oil tanks are enclosed in a concrete vault, and encased in sand. If a release occurred, it is most likely that product would impact the surrounding sand, and be contained in the concrete vault. Furthermore, there has been no evidence of petroleum-impacted soil/fill in borings completed in the vicinity of these tanks.

3.2.11.4 *Subsurface Concrete Structures*

A subsurface structures investigation was completed as part of Interim Deliverable No. 7 (Roux 2002b). The findings of this investigation are summarized in Section 3.2.5. It was determined that four potential subsurface structures exist below the first floor slab. Based on this investigation, three structures contained fill, and one structure contained a mixture of product and water. Analytical data from the fill containing structures is presented on Tables 3-12A through 3-12D, and analytical data for the product and liquid filled structure is presented on Tables 3-11A through 3-11F.

Based on the presence of contaminants in these structures, a potential for leaching to the surrounding soil/fill exists. This potential transport mechanism is mitigated based on the fact that each structure appears to have competent concrete walls and a bottom, and is covered by the concrete floor slab. Also, based on fill samples collected during the subsurface anomaly investigation, it does not appear the groundwater is entering any of the structures.

3.2.11.5 Lead Based Painted Surfaces

As described in Section 3.2.10, portions of the interior building material are painted with lead based paint. The condition of this lead based paint varies, depending on age and location. In several areas of the Site buildings, the condition of the paint is considered to be poor, or peeling. All four floors contain areas where lead based paint is peeling. Deteriorating paint can be removed from the building surfaces with relative ease. Lead containing dust associated with this paint can be transported throughout the interior and exterior portions of the Site, and potentially off-Site. The main transport mechanism for lead based paint would be from on-Site activity, (i.e. walking, maintenance activity, fork-lift traffic, etc.). Dust can be transported off-Site by personnel on clothing, shoes, equipment, etc.

4.0 BASELINE HUMAN HEALTH RISK ASSESSMENT OF ENVIRONMENTAL MEDIA

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), a baseline Human Health Risk Assessment (HHRA) was completed for the Site environmental media (i.e., soil, ground water and sediment). This HHRA has been conducted in accordance with work scope provided in the RI/FS Work Plan (ERM/Roux, 2001) and the procedures identified in the *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual, Part A* (USEPA, 1989).

The HHRA estimates excess carcinogenic lifetime risks that may be associated with certain exposures at the Site. For noncarcinogenic chemicals/constituents, the HHRA weighs whether or not the specified exposures are likely to represent an appreciable risk of significant adverse effects to humans. These risks are considered for both current and future use scenarios at the Site.

The HHRA is divided into a series of steps. These are:

Step 1: Potential exposure pathways are identified (Section 4.1).
Step 2: Chemicals of potential concern (COPCs) are selected for each pathway identified in Step 1 (Section 4.2).
Step 3: Exposure assumptions and exposure point concentrations are used to estimate chemical intakes for the COPCs for each pathway identified (Section 4.3).
Step 4: A toxicity assessment is conducted for the COPCs (Section 4.4).
Step 5: The risks to human health are characterized based on the calculated chemical intakes (Section 4.5).

The steps culminate in risk characterization (Step 5), which is a synthesis and summary of information about the degree of potential hazards that may exist at the Site under certain use scenarios. The risk characterization is used to understand the types of exposures and risks that may result from the Site. It is a prelude to decision making on how to mitigate (e.g. reduce or eliminate) the hazard or exposure.

The conclusions of the HHRA are summarized in Section 4.6.

4.1 IDENTIFICATION OF POTENTIAL EXPOSURE PATHWAYS

A general Site description is provided in Section 1.3.1. As discussed in that section, the Site, which is located in a mixed industrial/residential area, is bordered by the Hudson River.

As discussed in Section 1.3.1, the Site soil/fill has been divided into four areas: North Yard, South Yard, BICC Parking Lot, and Below Buildings (see Figure 1-2). The Yard is located on the southern side of the property, and is divided into the North Yard and the South Yard based on historic fill patterns. The existing buildings and thus the Below Building soil/fill are located on the northern side of the property. The BICC Parking Lot is located to the east of the existing buildings on the opposite side of the railroad tracks. There are no surface water bodies on the Site itself. Site access is restricted by fencing and full-time security guards.

Environmental media at the Site include soil/fill, ground water, and Hudson River sediment. Characterization of these media was discussed in Section 2.0. Identification of exposure pathways for these environmental media takes into consideration human receptors at the Site under both the current and future Site use. Current and future human receptors at the Site include the following:

- Facility workers – On-Site workers who maintain the property, grounds and buildings (current and future use).
- Short-term Site tenants - Parties that occupy the Site for less than six months per year under a short-term lease. These are generally film companies engaged in pre-production, production and post-production filming operations (current and potential future use).

- Residents and construction workers (future use).

Due to access restrictions, trespassers, as current or future receptors, are not considered an exposed population in this assessment.

The following summarizes the current and anticipated future use of the Site.

Current Site Uses

The South Yard, as defined in Section 1.4 (see Figure 2-1), consists of covered and uncovered areas. Areas are covered with asphalt pavement, concrete pavement, ballast, or rip rap. The asphalt-covered portions are currently used for storage of truck trailers. The South Yard can be accessed by facility workers and short-term Site tenants.

The North Yard, as defined in Section 1.4 (see Figure 2-1), consists of covered and uncovered areas. Areas are covered with asphalt pavement, concrete pavement, ballast, rip rap and buildings (i.e., guard house, East and West Warehouses, and Paint Shop). The paved portions of the North Yard are currently used for parking by facility workers and short-term Site tenants and the East and West Warehouses are accessible to both facility workers and short-term Site tenants.

The BICC Parking Lot, as defined in Section 1.4 (see Figure 2-1), is fully paved and has been used for parking by facility workers and short-term Site tenants.

Buildings cover the remainder of the Site. All existing Site buildings are accessible to facility workers. Unrestricted areas of these buildings are used by the short-term Site tenants. Evaluation of the potential human health risks posed by the building interiors is presented in Section 5.0.

There is no current use of Site ground water or exposure to Hudson River sediment by any Site occupants.

<u>Future Anticipated Use</u>

Although development plans are evolving, residential units are currently being planned in the area that is now the North and South Yard. As part of this construction, there is a possibility that the East and West Warehouses and the Paint Shop (which overlay North Yard soil/fill) may be demolished. Hence, potential future human receptors for these soil/fill areas (i.e., North Yard and South Yard) would, therefore, be construction workers and residents.

In the future, Site buildings could remain and be used as a film studio or for other commercial purposes, though the structures would have to be renovated to accommodate these uses. If the buildings were demolished, the existing slabs/ foundations may remain as a construction base upon which future construction could commence. Therefore, potential future human receptors for this soil/fill area (i.e., Below Buildings) are considered to be construction workers, facility workers and short-term Site tenants. The BICC Parking Lot would be used as a parking lot under the future use scenario. Potential future human receptors for this soil area (i.e., BICC Parking Lot) would be facility workers and short-term Site tenants.

There is no future use anticipated for Site ground water by any Site occupants. Future construction workers may, however, be exposed to ground water during construction activities.

Significant human contact with Hudson River sediment in the vicinity of the Site (i.e., below building and Yard sediment) is not expected to occur in the future. Limited sediment contact by construction workers may, however, occur in the future. Under one possible future use, a marina may be constructed adjacent to the Yard and new buildings would be constructed over the river in the area of the West Warehouse after existing buildings are demolished. Construction workers installing pilings for the marina and buildings may, therefore, come into contact with sediment in these areas.

Potential exposure pathways for soil/fill in each of the four Site soil/fill areas, Site ground water and Site-related sediment in potential future construction areas are described below. As discussed in Section 2.0, one or more of the following chemicals were observed in Site soil/fill, ground water and Site-related sediment: VOCs, SVOCs, PCBs and/or inorganic constituents. Potential exposure pathways associated with these chemicals will, therefore, be evaluated.

4.1.1 North Yard Soil/Fill

Under current conditions, the North Yard soil/fill is covered with exposed soil, pavement, ballast and a number of buildings (i.e., East Warehouse, Paint Shop and guardhouse). Exposure to chemicals in North Yard soil/fill can occur through:

- direct contact with exposed North Yard soil/fill by facility workers and short-term Site tenants;
- indoor air and outdoor air inhalation of VOCs from soil/fill by facility workers and short-term Site tenants.

In the future, the North Yard could be developed (together with the South Yard) for residential usage. Therefore, under future conditions in this scenario, on-Site residents could be exposed to chemicals in North Yard soil/fill through direct contact and by inhalation of VOCs in indoor air and outdoor air. The anticipated development plans for both the North Yard and the South Yard may include covering all of the existing soil/fill with pavement or clean topsoil. During construction, some soil may be disturbed and a limited amount of soil may be removed to allow construction. If used, the soil covers would eliminate the direct contact pathway for future Site residents with chemicals in North Yard soil/fill. In accordance with RAGS (USEPA, 1989), future risks to residents were quantitatively evaluated assuming surface covers are not installed.

During future Site re-development, construction workers would also be potential receptors for chemicals in soil/fill. Since significant dust generation may occur during construction activities, potential exposure pathways for construction workers include direct contact with soil/fill and inhalation of fugitive dusts.

As discussed in Section 2.6, some chemicals that were detected in ground water above their screening criteria were also present in North Yard soil/fill samples at levels above their soil screening criteria. This suggests that leaching to ground water is a current exposure pathway for North Yard soil/fill. The impacts of this soil exposure pathway will be evaluated using the ground water pathway exposure analysis.

4.1.2 *South Yard Soil/Fill*

Under current conditions, the South Yard soil/fill is covered with exposed soil, pavement, ballast and riprap.

Exposure to chemicals in South Yard soil/fill could occur through:

- direct contact with exposed South Yard soil/fill by facility workers and short-term Site tenants; and
- outdoor air inhalation of VOCs from soil/fill by facility workers and short-term Site tenants.

Under future conditions, it is expected that the South Yard could be developed (together with the North Yard) for residential usage. Therefore, under future conditions, on-Site residents could be exposed to chemicals in South Yard soil/fill through direct contact and by inhalation of VOCs in indoor air and outdoor air fill. The anticipated development plans for both the North Yard and the South Yard may include covering all of the existing soil/fill with pavement or clean topsoil. If used, the soil covers would eliminate the direct contact pathway for Site residents with chemicals in South Yard soil/fill. In accordance with RAGS (USEPA, 1989), future risks to residents were quantitatively evaluated assuming surface covers are not installed.

During future Site re-development, construction workers would also be potential receptors for chemicals in soil/fill. During construction, some soil may be moved and a limited amount of soil may be removed to allow construction. Since significant dust generation may occur during construction activities, potential exposure pathways for construction workers include direct contact with soil/fill and inhalation of fugitive dusts.

As discussed in Section 2.6, some chemicals that were detected in ground water above their screening criteria were also present in South Yard soil/fill samples at levels above their soil screening criteria. This suggests that leaching to ground water is a current exposure pathway for South Yard soil/fill. The impacts of this soil exposure pathway will be evaluated using the ground water pathway exposure analysis.

4.1.3 BICC Parking Lot Soil

The BICC Parking Lot is currently paved and used as a parking lot. Therefore, under current conditions, the only potential exposure pathway is inhalation of VOCs that have volatilized from soil/fill to ambient air. The potential receptors are facility workers and short-term Site tenants.

Under future conditions, it is expected that the parking lot will remain in use as a parking lot. Therefore, the only future exposure pathway would be inhalation of VOCs that have volatilized from soil/fill to ambient air. The paved surface itself would prevent direct contact exposures. Nevertheless, in accordance with RAGS (USEPA, 1989), an assumption was made that the BICC Parking Lot pavement is not maintained and ultimately decays, resulting in a completed pathway of exposed soil in discrete areas. This would result in the potential for direct contact exposure with BICC Parking Lot soil. As such, direct contact was considered to be a potential future exposure pathway for BICC Parking Lot soil.

Due to the presence of pavement, there is currently no pathway for leaching of chemicals from this soil to ground water. However, if the BICC Parking Lot pavement were to deteriorate, leaching of chemicals in soil to ground water would be a potential future exposure pathway. Ground water exposure pathways are addressed in Section 4.1.5.

4.1.4 Below Building Soil/Fill

Under current conditions, there is limited potential for direct contact with soil/fill below existing buildings. The only potentially accessible soil/fill is located in the bottomless floor trenches within the buildings and the exposed soil between the outer wall of the railroad siding platform and the active rail lines. The latter location, which is represented by sample location RSB-10, is located adjacent to active rail lines outside the property boundary and is not accessible to Site occupants. The floor trenches are no longer used and steel plates are bolted over their access points. The remainder of the Below Building soil/fill is located beneath the building foundation. Therefore, the only current exposure pathway for Below Building soil/fill is indoor inhalation of VOCs from soil/fill by facility workers and short-term Site tenants who may purposely access these areas for specific work activities.

Under future conditions, some or all of the buildings in this area may be removed to their existing slabs/foundations or replaced with new buildings and foundations. Direct contact with soil/fill and inhalation of fugitive dust from soil/fill beneath these buildings by construction workers are therefore potential exposure pathways. Indoor air inhalation of VOCs from soil/fill by facility workers and short-term Site tenants is also a potential future exposure pathway.

Significant leaching of chemicals in soil/fill to ground water under either current or future conditions is not expected due to the presence of the existing or new buildings. Nevertheless, the impacts of this soil exposure pathway will be evaluated using the ground water pathway exposure analysis.

4.1.5 Site Ground Water

Ground water at the Site flows to the west and discharges to the Hudson River. The depth to ground water at the Site ranges from 3.3 to 13.5 feet below grade. Based on the shallow depth to ground water, the low yield of the water bearing layer, the salinity of the ground water and the tidal influence from the Hudson River (see Section 2.6), use of shallow ground water in the Site vicinity for any purpose, including drinking water, is not expected.

Two sources of information, *The Groundwater Resources of Westchester County, New York* (Asselstine and Grossman, 1955) and well search (EDR, 2000), were reviewed to determine ground water use in the vicinity of the Site.

According to the 1955 Westchester County report, Phelps Dodge Copper Products Corp. had installed a 300-foot cooling water supply well. In addition, a 55-foot deep well had also been installed by Phelps Dodge, but the report states that this well was abandoned. The remainder of the nearby wells identified in the 1955 Westchester County report were not used for drinking water. Rather, they are all used for commercial purposes, such as laundry and cooling (Asselstine and Grossman, 1955).

The well search (EDR, 2000) identified one well associated with the Site. This well, which is reportedly 55 feet in depth, appears to be the abandoned well identified in the 1955 Westchester County report. Neither this abandoned well nor the 55-foot deep well has been located in the field at the Site. Furthermore, the Yonkers Building Department, the regional USGS office and Phelps Dodge did not have additional information regarding these wells.

No other wells were identified within a one-half mile radius of the Site. The nearest off-Site well reported is located approximately three-quarters of a mile due south of the Site, and is reportedly used for industrial purposes. Based on its location (sidegradient) and depth, this well is not expected to be impacted by chemicals in ground water at the Site. Five additional wells were identified in the well survey at a distance greater than one-half mile of the Site. All of these wells are located upgradient of the Site. Therefore, there are no exposure pathways for chemicals in ground water via well usage.

VOCs in ground water can volatilize and travel through overlying soil/fill and subsequently migrate upward to ambient air and indoor air. Potential receptors for this pathway include facility workers and short-term Site tenants (current conditions) and residents and short-term Site tenants (future conditions).

Ground water discharges to the Hudson River to the west of the Site. Therefore, potential receptors include recreational users of the Hudson River (current and future). In addition, ingestion of fish from the Hudson River represents a potential current and future exposure pathway.

4.1.6 Hudson River Sediment

As stated above, human exposure to Hudson River sediment is limited to the future use scenario. Under the intended future use, the East and West warehouses could be removed and buildings may be constructed in their place. In addition, a marina could be constructed adjacent to the Yard. Since these construction activities might entail installation of pilings to support the marina and the buildings, construction workers would come into contact with sediment adjacent to the Yard and beneath the West Warehouse. Direct contact with sediment in these areas by construction workers is, therefore, a potential future exposure pathway.

4.2 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern (COPCs) for the soil/fill and ground water exposure pathways are identified in this section. The following screening procedures was performed to identify the soil/fill COPCs:

1. Initial Screening – the maximum detected concentrations of chemicals having a frequency of detection greater than 5% were compared to their corresponding NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 Recommended Soil Cleanup Objectives (RSCOs) – chemicals present at a concentration lower than their RSCO were eliminated from further evaluation;
2. Secondary Screening – for chemicals retained after the initial screening (i.e., maximum detected concentration is greater than or equal to their RSCO level), the chemical-specific 95% Upper Confidence Limit (UCL) on the mean were compared to the corresponding background chemical-specific 95% UCL on the mean.

- VOCs that do not pass this second screen are identified as COPCs for the inhalation exposure pathways (i.e., indoor air, outdoor air, and fugitive dust).
- For SVOCs, PCBs, and inorganic constituents that do not pass the second screen, their maximum detected concentrations are further screened against the TAGM 4046 direct contact screening levels.
    - If the maximum detected concentrations for the SVOCs, PCBs, and inorganics are equal to or greater than the direct contact screening levels, the chemical is retained as a direct contact COPC for the direct contact exposure pathways. This includes any construction worker pathways

4.2.1 *North Yard Soil/Fill*

The average depth to ground water at the Site is approximately eight feet. Given the low water table, proximity to the river and the scale of future construction, any future buildings at the Site would likely be constructed on pilings. Thus access to soil/fill would be limited to the upper eight feet. In addition, volatilization of chemicals from soil/fill would be limited to the unsaturated zone. For the above reasons, the upper eight feet of soil/fill were used to determine the COPCs for all Site soil/fill.

A total of 104 soil/fill samples were collected from the upper eight feet of North Yard soil/fill (see Figure 2-1 for sample locations). These soil/fill samples were analyzed for one or more of the following compound groups: VOCs, SVOCs, PCBs and inorganic constituents. A complete set of the North Yard soil/fill data is provided in Tables 2-6A through 2-6E.

The analytical results for organic compounds and inorganic constituents for the North Yard are summarized in Tables 4-1 and 4-2, respectively. These summary tables include: the chemicals detected in one or more North Yard soil/fill samples, their frequency of detection, their maximum detected concentration, and their NYSDEC TAGM 4046 RSCOs (NYSDEC, 1994). The RSCOs are the applicable Standards, Criteria and Guidelines (SCGs) for evaluation of soil.

As shown in Tables 4-1 and 4-2, a total of 67 chemicals were detected in one or more of the North Yard soil/fill samples. The maximum detected concentrations for these 67 chemicals were initially screened against their RSCOs. If the maximum detected concentration was below the applicable RSCO, then that specific chemical was eliminated from further evaluation. Since the majority of the RSCO values for inorganic constituents are listed as Site Background (SB), the Eastern USA background concentrations listed in TAGM 4046 were used in place of the RSCOs to initially screen the inorganic data. In accordance with RAGS (USEPA, 1989), any chemical with a detection frequency of less than 5% was eliminated from further evaluation.

After the initial screening was performed (i.e., comparison to the RSCOs), a second screening was performed to address background levels typically observed in historic fill materials. As discussed in Section 2.6, the North Yard soil/fill is comprised of historic fill. This historic fill material is similar to the historic fill used at other nearby sites. Therefore, the analytical results from the nearby City of Yonkers Brownfields site investigation (presented in Section 2.6) were used to identify site-specific background concentrations. These background concentrations were then used to distinguish between the chemicals present in soil/fill due to Site activities and those present due to the historic fill material. The Brownfields site data are presented in Appendix F.

Using the 95% upper confidence limit (UCL) on the mean for the chemicals retained after the initial screening, the North Yard soil/fill results were compared to the background (i.e., Brownfield) soil/fill results. If the chemical specific North Yard 95% UCL on the mean was less than its corresponding chemical specific historic fill 95% UCL on the mean, then that chemical was eliminated from further evaluation.

Based on the results of the initial and second screening, COPCs in North Yard soil/fill were identified for further evaluation. As shown in Tables 4-1 and 4-2, a total of four VOCs, 13 SVOCs, PCBs, and 13 inorganics were preliminarily identified as COPCs in North Yard soil. These chemicals are listed below:

VOCs:	Benzene, ethylbenzene, toluene and xylene
SVOCs:	Anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene
PCBs:	Total PCBs
Inorganics:	Antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, vanadium, and zinc

As discussed in Section 4.1.1, under current and future conditions, exposure to chemicals in North Yard soil/fill can occur via direct contact, indoor air and outdoor air inhalation of VOCs, and inhalation of fugitive dust. COPCs for each of these pathways are identified below.

4.2.1.1 Direct Contact – North Yard

NYSDEC TAGM 4046 presents acceptable soil concentrations for organic compounds that are protective of direct contact with soil and leaching to ground water risks. The lower of these two values (i.e., direct contact of leaching to ground water criteria) is generally the TAGM 4046 RSCO. The TAGM 4046 RSCO was used above to initially screen the chemicals. The acceptable level for direct contact exposures is based on a residential exposure scenario, with children ages one to six ingesting soil. To further focus the HHRA on chemicals that present a potential human health risk via direct contact, the maximum detected concentration of each of the organic compounds listed above was compared to the acceptable direct contact soil criteria established by TAGM 4046.

As shown in Table 4-3, five organic compounds were detected in at least one sample at a concentration above its direct contact screening criteria (benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, dibenz(a,h)anthracene and PCBs). These organic compounds were therefore identified as COPCs for direct contact exposures in North Yard soil/fill. TAGM 4046 does not provide direct contact screening levels for six organic compounds (benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and phenanthrene) or any inorganic constituents. Therefore, these additional 6 organic compounds and all 13 inorganic constituents previously identified (antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, vanadium, and zinc) were retained as COPCs for this exposure pathway of concern (i.e., direct contact with North Yard soil/fill).

4.2.1.2 *Inhalation of VOCs from Soil/Fill – North Yard*

Four VOC COPCs (benzene, ethylbenzene, toluene, and xylene) were identified in Section 4.2.1 for North Yard soil/fill. Since this exposure pathway is only viable for VOCs, these four compounds were identified as COPCs for this exposure pathway of concern (i.e., inhalation of VOCs from North Yard soil/fill). The inhalation exposure pathway addresses both indoor and outdoor air.

4.2.1.3 *Inhalation of Fugitive Dusts – North Yard*

Under future conditions, construction workers may be exposed to chemicals in North Yard soil/fill due to fugitive dust emissions during construction activities. Because constituents, such as VOCs, SVOCs, PCBs, and inorganics may adhere to soil particulates, the fugitive dust exposure pathway is viable for any class of compounds. Therefore, the COPCs for this pathway include all of the chemicals identified in Section 4.2.1 (benzene, ethylbenzene, toluene, xylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, PCBs, antimony, arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, vanadium, and zinc). Inhalation of fugitive dust from North Yard soil/fill is therefore retained as an exposure pathway of concern.

4.2.2 *South Yard Soil/Fill*

A total of 48 soil/fill samples were collected from the upper eight feet of South Yard soil/fill (see Figure 2-1 for sample locations). As discussed in Section 4.2.1, the soil concentrations in the upper eight feet of soil/fill were used in the HHRA to evaluate the exposure pathways. These soil/fill samples were analyzed for one or more of the following compound groups: VOCs, SVOCs, PCBs and inorganic constituents. A complete set of the South Yard soil/fill data is provided in Tables 2-5A through 2-5E.

The analytical results for organic compounds and inorganic constituents for the South Yard are summarized in Tables 4-4 and 4-5. These summary tables include: the chemicals detected in one or more South Yard soil/fill samples, their frequency of detection, their maximum detected concentration, and their NYSDEC TAGM 4046 (NYSDEC,1994) or the alternate RSCO as per the guidance of Jim Harrington at the NYSDEC. The RSCOs are the applicable New York State standards, criteria and guidance (SCGs) for evaluation of soil.

As shown in Tables 4-4 and 4-5, a total of 58 chemicals were detected in one or more of the South Yard soil/fill samples. The maximum detected concentrations for these 58 chemicals were initially screened against their RSCOs. If the maximum detected concentration was below the applicable RSCO, then that specific chemical was eliminated from further evaluation. Since the majority of RSCO values for inorganic constituents are listed as Site Background (SB), the Eastern USA background concentrations listed in TAGM 4046 were used in place of the RSCOs to initially screen the inorganic data. In accordance with RAGS (USEPA, 1989), any chemical with a detection frequency of less than 5% was eliminated from further evaluation.

After the initial screening was performed (i.e., comparison to the RSCOs), a second screening was performed to address background levels typically observed in historic fill materials. As discussed in Section 2.6, the South Yard soil/fill is comprised of historic fill. This historic fill material is similar to the historic fill used at other nearby sites. Therefore, the analytical results from the nearby City of Yonkers Brownfields site investigation (presented in Section 2.6) were used to identify site-specific background concentrations. These background concentrations were then used to distinguish between the chemicals present in soil/fill due to Site activities and those present due to the historic fill material. The Brownfields site data are presented in Appendix F.

Using the 95% upper confidence limit (UCL) on the mean for the chemicals that remained, the South Yard soil/fill results were compared to the historic fill (i.e., Brownfield) soil/fill results. If the chemical specific South Yard 95% UCL on the mean was less than its corresponding chemical specific historic fill 95% UCL on the mean, then that chemical was eliminated from further evaluation.

Based on the results of this screening, COPCs in South Yard soil/fill were identified for further evaluation. As shown in Tables 4-4 and 4-5, 11 inorganic constituents were identified as COPCs in South Yard soil. These inorganic constituents are: antimony, arsenic, barium, chromium, lead, mercury, nickel, selenium, thallium, vanadium, and zinc.

As discussed in Section 4.1.2, under current and future conditions, exposure to chemicals in soil/fill in the South Yard can occur via direct contact, indoor air and outdoor air inhalation of VOCs from soil, and inhalation of fugitive dusts (same as North Yard). COPCs via the direct contact pathway include all of the inorganic constituents listed above. Since VOCs were not identified as COPCs in South Yard soil/fill, volatilization to indoor and outdoor air are not a direct exposure pathways. The inhalation exposure pathways for VOCs are therefore not further evaluated. COPCs for the inhalation of fugitive dust pathway include all of the inorganic constituents identified above. In conclusion, direct contact and inhalation of fugitive dust are retained as exposure pathways of concern.

4.2.3 BICC Parking Lot Soil

Three soil samples were collected from the upper eight feet of the BICC Parking Lot soil (see Figure 2-1 for sample locations). As discussed in Section 4.2.1, the soil concentrations in the upper eight feet of soil/fill were used in the HHRA to evaluate the exposure pathways. These soil/fill samples were analyzed for one or more of the following compound groups: VOCs, SVOCs, PCBs and inorganic constituents. A complete set of the South Yard soil/fill data is provided in Tables 2-7A through 2-5C.

The analytical results for organic compounds and inorganic constituents for the BICC Parking Lot summarized in Tables 4-6 and 4-7. These summary tables include: the chemicals detected in one or more BICC Parking Lot soil/fill samples, their frequency of detection, their maximum detected concentration, and their NYSDEC TAGM 4046 (NYSDEC, 1994). The RSCOs are the applicable SCGs for evaluation of soil.

As shown in Tables 4-6 and 4-7, a total of 21 chemicals were detected in one or more samples in the BICC Parking Lot soil. The maximum detected concentrations for these 21 chemicals were initially screened against their RSCOs. If the maximum detected concentration was below the applicable RSCO, then that specific chemical was eliminated from further evaluation. Since the majority of RSCO values for inorganic constituents are listed as Site Background (SB), the Eastern USA background concentrations listed in TAGM 4046 were used in place of the RSCOs to initially screen the inorganic data. In accordance with RAGS, any chemical with a detection frequency of less than 5% was eliminated from further evaluation.

As shown in Tables 4-6 and 4-7, no organic compounds were detected above the RSCOs and two inorganic constituents (mercury and zinc) were detected above the NYSDEC TAGM RSCO and the TAGM Eastern U.S. background level. Comparison to the Brownfields background data is not appropriate since the soil in the BICC Parking Lot is not comprised of historic fill material. Further comparison of the maximum detected concentrations to an alternate background information source (Shacklette and Boerngen, 1984) demonstrates that the detected concentrations are within published background levels. Based on the above screening, no COPCS were identified for the BICC Parking Lot soil. Therefore, there are no exposure pathways of concern for the BICC Parking Lot soil and this medium is eliminated from further evaluation.

4.2.4 *Below Building Soil/Fill*

The potential exposure pathways for chemicals in Below Building soil/fill are indoor air inhalation of VOCs from soil/fill (current and future) and direct contact with and inhalation of fugitive dusts from soil/fill should the buildings be demolished under a future use scenario.

A total of 149 soil/fill samples were collected from the upper 8 ft of Below Building soil/fill (see Figure 2-1 for sample locations). As discussed in Section 4.2.1, the soil concentrations in the upper 8 ft of soil/fill were used in the HHRA to evaluate the exposure pathways. These soil/fill samples were analyzed for one or more of the following compound groups: VOCs, SVOCs, PCBs, and inorganic constituents. A complete set of the Below Building soil/fill data is provided in Tables 2-8A through 2-8D.

The analytical results for organic compounds and inorganic constituents for Below Building soil/fill are summarized in Tables 4-8 and 4-9. These summary tables include: the chemicals detected in one or more Below Building soil/fill samples, their frequency of detection, their maximum detected concentration, and their NYSDEC TAGM 4046 (NYSDEC, 1994) or the alternate RSCO as per the guidance of Jim Harrington at the NYSDEC. The RSCOs are the applicable New York State standards, criteria and guidance (SCGs) for evaluation of soil.

As shown in Tables 4-8 and 4-9, a total of 72 chemicals were detected in one or more of the Below Building soil/fill samples. The maximum detected concentrations for these detected chemicals were initially screened against their RSCOs. If the maximum detected concentration was below the applicable RSCO, then that specific chemical was eliminated from further evaluation. Since the majority of RSCO values for inorganic constituents are listed as Site Background (SB), the Eastern USA background concentrations listed in TAGM 4046 were used in place of the RSCOs to initially screen the inorganic data. In accordance with RAGS (USEPA, 1989), any chemical with a detection frequency of less than 5% was eliminated from further evaluation.

After the initial screening was performed (i.e., comparison to the RSCOs), a second screening was performed to address background levels typically observed in historic fill materials. As discussed in Section 2.6, the Below Building soil/fill is comprised of historic fill. This historic fill material is similar to the historic fill used at other nearby sites. Therefore, the analytical results from the nearby City of Yonkers Brownfields site investigation (presented in Section 2.6) were used to identify site-specific background concentrations. These background concentrations were then used to distinguish between the chemicals present in soil/fill due to Site activities and those present due to the historic fill material. The Brownfields site data are presented in Appendix F.

Using the 95% upper confidence limit (UCL) on the mean for the chemicals that remained, the Below Building soil/fill results were compared to the historic fill (i.e., Brownfield) soil/fill results. If the chemical specific Below Building 95% UCL on the mean was less than its corresponding chemical specific historic fill 95% UCL on the mean, then that chemical was eliminated from further evaluation.

Based on the results of this screening, COPCs in Below Building soil/fill samples were identified for further evaluation. As shown in Tables 4-8 and 4-9, two VOCs, six SVOCs, PCBs, and seven inorganic constituents were preliminarily identified as COPCs in Below Building soil. These chemicals are listed below:

VOCs:	Acetone, xylene
SVOCs:	Benzo(a)anthracene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene
PCBs:	Total PCBs
Inorganics:	Antimony, arsenic, barium, lead, mercury, selenium, and zinc

As discussed in Section 4.1.4, under current and future conditions, exposure to chemicals in Below Building soil/fill can occur via direct contact, indoor air inhalation of VOCs, and inhalation of fugitive dust. COPCs for each of these pathways are identified below.

4.2.4.1 *Direct Contact – Below Building*

Under future conditions, construction workers may be exposed to chemicals in Below Building soil/fill during construction activities. NYSDEC TAGM 4046 presents acceptable soil concentrations for organic compounds that are protective of direct contact with soil/fill and leaching to ground water. The lower of these two values (i.e., direct contact or leaching to ground water) is generally the TAGM 4046 RSCO. The TAGM 4046 RSCO was used above to initially screen the chemicals. The acceptable level for direct contact exposures is based on a residential exposure scenario, with children ages one to six ingesting soil. To further focus the HHRA on those chemicals that present a potential human health risk via direct contact, the maximum detected concentration of each of the organic compounds listed above was compared to the acceptable direct contact soil criteria established by TAGM 4046 (Table 4-10). This is a highly conservative screening for a construction worker exposure.

As shown in Table 4-10, two organic compounds were detected in at least one sample at a concentration above its direct contact screening criteria (benzo(a)anthracene and PCBs). These organic compounds were therefore identified as COPCs for direct contact exposures in Below Building soil/fill. TAGM 4046 does not provide direct contact screening levels for three organic compounds (benzo(k)fluoranthene, chrysene, and phenanthrene) or any inorganic constituents. Therefore, these additional three organic compounds and all seven inorganic constituents previously identified (antimony, arsenic, barium, lead, mercury, selenium, and zinc) were retained as COPCs for this exposure pathway of concern (i.e., direct contact with Below Building soil/fill).

4.2.4.2 *Inhalation of VOCs from Soil/Fill – Below Building*

Two VOC COPCs (acetone and xylene) were identified in Section 4.2.4 for Below Building soil/fill. Since this exposure pathway is only viable for VOCs, these two compounds were identified as COPCs for this exposure pathway of concern (i.e., inhalation of VOCs in indoor air from Below Building soil/fill).

4.2.4.3 *Inhalation of Fugitive Dusts – Below Building*

Under future conditions, construction workers may be exposed to chemicals in Below Building soil/fill due to fugitive dust emissions during construction activities. Since this exposure pathway is viable for any class of compounds, the COPCs for this pathway include all of the chemicals identified in Section 4.2.4 (acetone, xylenes, benzo(a)anthracene, benzo(k)fluoranthene, chrysene, fluoranthene, phenanthrene, pyrene, PCBs, antimony, arsenic, barium, lead, mercury, selenium, and zinc). Inhalation of fugitive dust from Below Building soil/fill is therefore retained as an exposure pathway of concern.

4.2.5 *Site Ground Water*

A total of 14 monitoring wells (MW-01 through MW-11, MWI-01, MWI-02 and MWI-03)) and one dry well (PIPE-01) were sampled throughout the Site as part of the RI (see Figure 2-1). These samples were analyzed for VOCs, SVOCs, PCBs and inorganic constituents. The sampling results for all wells and monitoring rounds are provided in Tables 2-14 to 2-19A.

Two of these wells (MW-4 and MW-5) are located on the hydraulically upgradient (i.e., eastern) side of the Site. Based upon their location, they are considered to represent ground water quality moving onto the Site (i.e. background). Therefore, Site ground water is best represented by the ground water concentrations observed in the remaining monitoring wells (i.e., MW-01, MW-02, MW-03, MW-06, MW-07, MW-08, MW-09, MW-10, MW-11, MWI-01, MWI-02 and MWI-03) and the dry well.

The most recent samples from each of these locations were used in the HHRA. Table 4-11 includes chemicals detected in one or more ground water samples, their frequency of detection, their maximum detected concentration, and their screening criteria. As discussed in Section 2.6, ground water samples from MW-03, MW-06 and MW-08 met or exceeded the limits for saline water classification (NYCRR Part Section 701.17). As such, the Site ground water would not be suitable as a potable water supply. However, since there are no standards applicable to Class GB waters with which to screen the data, the NYSDEC Class GA Ground Water Quality Standards (NYSDEC, 1998b) were used as a conservative screening tool. For those chemicals for which no Class GA standard was available, the NYSDOH Drinking Water Standard (Maximum Contaminant Level or MCL) was used to screen the data. As is the case with the Class GA standards, the use of the MCLs represents an overly conservative screen since the water is not used for drinking water and is not suitable as a drinking water supply due to its salinity.

As shown in Table 4-11, a total of 36 chemicals were detected in one or more wells. If the maximum detected concentration was below the applicable, conservative screening criteria, then that specific chemical was eliminated from further evaluation.

After this initial screening, the 95% UCL on the mean concentrations of the remaining chemicals were screened against the maximum background chemical concentrations in ground water. As discussed above, MW-4 and MW-5 are representative of upgradient ground water conditions (background). Therefore, analytical results from these two wells were used in this screening to distinguish between chemicals present in ground water due to Site activities and those present due to the off-Site activities. If the chemical specific 95% UCL on the mean for the Site ground water data was less than its corresponding maximum detected background concentration, then the chemical was eliminated from further evaluation.

Based on the results of this screening, the following ground water COPCs were identified for further evaluation: two VOCs (benzene and xylene), five SVOCs (2,4-dimethylphenol, 2-methylphenol, 3&4-methylphenol, bis(2-ethylhexyl)phthalate, and phenol), and three inorganic constituents (barium, lead, and manganese) (see Table 4-11).

As discussed in Section 4.1.5, exposure to chemicals in ground water can occur in three ways: (1) inhalation of VOCs from ground water; (2) discharge of ground water to the Hudson River and subsequent ingestion of fish; and (3) discharge of ground water to the Hudson River and subsequent exposures via recreational activities. Therefore, COPCs for each of these pathways are identified below.

4.2.5.1 *Inhalation of VOCs from Site Ground Water*

Two VOC COPCs (benzene and xylene) were identified in Section 4.2.5 for Site ground water. Since this exposure pathway is only viable for VOCs, these two compounds were identified as COPCs for the volatilization pathway.

4.2.5.2 *Ingestion of Fish*

To evaluate the human health risk posed by ingestion of fish resulting from the discharge of Site ground water to the Hudson River, the chemical concentrations in the Hudson River contributed by Site ground water must be determined. As discussed in Section 2.2, Hudson River surface water samples were collected and analyzed for inorganic constituents to evaluate tidal influences on ground water quality. For the three inorganic COPCs, these surface water sample results were conservatively assumed to be equal to the chemical concentrations in the Hudson River contributed by Site ground water. This is a conservative assumption since it does not take into account the contribution of other sources to Hudson River surface water quality.

The projected concentrations of the seven organic preliminary COPCs in the Hudson River contributed by Site ground water were determined using the dilution model presented in Section 2.6. Based on site-specific data, a dilution factor of 3,380 for Site ground water discharge to the Hudson River was calculated. Using this dilution factor and the maximum detected concentration of each of the seven organic COPCs, the maximum predicted concentrations of these organic COPCs in the Hudson River were determined.

Table 4-12 presents the maximum detected concentration of each of the preliminary Site ground water COPCs, the predicted maximum concentration (or actual concentration, where available) in the Hudson River, and the screening criteria. The Hudson River is classified as a Class SB waterbody in the Site vicinity. Therefore, the NYSDEC Class SB Surface Water Quality Standards for the protection of human health via fish ingestion (NYSDEC, 1998b) were used as the screening criteria, where available, in Table 4-12. Where NYSDEC Class SB standards for fish ingestion were not available, the USEPA Ambient Water Quality Criteria for the protection of human health via fish ingestion were used as the screening criteria (USEPA, 2002).

As shown in Table 4-12, the maximum predicted (or actual, where available) concentrations of the ground water COPCs in the Hudson River are all well below the applicable standards, where available. Based on this information, there are no COPCs for this pathway. Consequently, this pathway is not a pathway of concern and is eliminated from further evaluation.

4.2.5.3 *Recreational Activities*

The maximum predicted concentrations of the COPCs in the Hudson River from Site ground water, as calculated in Section 4.2.5.2, were also used to evaluate the potential human health risks posed during recreational activities by Site ground water discharges to the Hudson River.

Table 4-13 presents the maximum detected concentration of each of the potential Site ground water COPCs, their predicted maximum concentration (or actual concentration, where available) in the Hudson River, and their screening criteria. For this exposure pathway, the maximum predicted concentrations (or actual concentration, where available) in the Hudson River were compared to the NYSDOH MCLs (i.e., the drinking water standards) presented in 10 NCYRR 5-1.52. Use of the MCLs as the screening criteria is conservative since: (1) concentrations acceptable for drinking are expected to be acceptable for recreational activities; and (2) significant quantities of water would not be ingested during recreational activities.

As shown in Table 4-13, the maximum predicted (or actual, where available) concentrations of the potential ground water COPCs in the Hudson River are well below the NYSDOH drinking water standards, where available. Therefore, there are no ground water COPCs for this pathway. Consequently, this pathway is not a pathway of concern and is eliminated from further evaluation.

4.2.6 *Hudson River Sediment*

Under future conditions, construction workers may be exposed to chemicals in sediment adjacent to the Yard and sediment below the West Warehouse since construction may be conducted in these areas. Sediment samples were collected from seven locations adjacent to the Yard (SEDYARD-01 through SEDYARD-07) and three locations beneath the West Warehouse (SED19W-01 through SED19W-03). At all locations samples were collected from the 0 to 6-inch, 6 to 12-inch, and/or 12 to 18-inch intervals. The locations of these samples are presented in Figures 2-32 through 2-34 and the analytical results for these samples are presented in Tables 2-20 through 2-23.

As discussed above, future construction worker exposure to South Yard soil/fill will be evaluated in this HHRA. The South Yard soil/fill results were reviewed to determine whether evaluation of that exposure pathway could be used to conservatively estimate construction worker exposures to sediment. This comparison indicated that the maximum concentrations of chemicals in the sediment adjacent to the Yard and beneath the West Warehouse were less than or consistent with the South Yard soil/fill results. The only exceptions were chromium and silver, which were higher in the sediment than in the South Yard soil. This is not considered to be significant since a number of other chemicals having higher toxicity were detected at considerably lower concentrations in the sediment than in the South Yard soil/fill. The construction worker exposure scenario for South Yard soil/fill will therefore be conservatively used to estimate potential risks to construction workers for future contact with sediment.

4.2.7 *Summary – COPCs*

Table 4-14 presents a summary of the COPCs for each of the exposure pathways of concern at the Site. These chemicals and pathways are quantitatively evaluated in the following sections.

4.3 *EXPOSURE ASSESSMENT*

This section presents the equations and assumptions used to evaluate the risks associated with intake of the COPCs for each pathway of concern presented in the previous sections.

4.3.1 *North Yard Soil/Fill*

4.3.1.1 *North Yard Soil/Fill – Direct Contact – Facility Workers and Tenants (Current Conditions)*

Under current conditions, facility workers and short-term Site tenants could be exposed to chemicals in North Yard surface soil through direct contact. It was assumed that the primary exposure route for direct contact is soil ingestion.

Table 4-15 presents the equations and exposure assumptions used to evaluate the soil ingestion pathway for facility workers at the Site under current conditions. Facility workers are a more sensitive receptor than short-term Site tenants since they are present at the Site more days per year and more years per lifetime. Therefore, the risks posed to facility workers from COPCs would be greater than the risks to short-term Site tenants. Hence, the facility worker exposure scenario encompasses the risks that may be posed to short-term tenants. As shown in Table 4-15, it is assumed that a facility worker is present at the Site 250 days per year for a total of 25 years and that soil is ingested at a rate of 50 mg/day.

Exposure point concentrations for North Yard soil/fill for facility workers under current conditions are presented in Table 4-16. It was assumed that the top two feet of exposed North Yard soil/fill would be available for soil ingestion under current conditions. Therefore, the 95% UCL on the mean or the maximum detected concentration of each COPC (whichever was lower) in the top two feet of soil was used as the exposure point concentration reported in Table 4-16.

4.3.1.2 *North Yard Soil/Fill – Direct Contact – Residents (Future Conditions)*

Under future conditions, the North Yard may be developed for residential use. Table 4-17 presents the equations and exposure assumptions used to evaluate the soil ingestion pathway for residents at the Site under future conditions. Exposures to children and adults are evaluated separately. As shown in this table, it is assumed that a resident is present at the Site 350 days per year. The exposure duration for adults is 24 years and the ingestion rate is 100 mg/day. The exposure duration for children is 6 years and the ingestion rate is 200 mg/day.

Exposure point concentrations for the North Yard soil/fill for future residents are presented in Table 4-18. It was assumed that the soil/fill in this area will be moved about as a result of construction activities and that all soil/fill within the top eight feet could potentially be brought to the surface and used as surface soil. The 95% UCL on the mean or the maximum detected concentration (whichever was lower) in the upper eight feet of North Yard soil/fill was used as the exposure point concentration reported in Table 4-18.

4.3.1.3 *North Yard Soil/Fill – Inhalation of VOCs from Soil/Fill – Current Facility Workers and Tenants/Future Residents*

Inhalation of VOCs from North Yard soil/fill can occur under current conditions (for facility workers and short-term Site tenants) and under potential future conditions (for residents). To evaluate this pathway on a worst-case basis, future residential usage was assumed. The Johnson and Ettinger model (USEPA, 2000b) was used to predict concentrations of VOCs in indoor air within an overlying hypothetical future residence. Due to the chemical properties of VOCs, this class of compounds may be released from underlying soil/fill, thereby migrating upward through overlying building materials and into the indoor air.

The 95% UCL on the mean concentration of each VOC COPC in North Yard soil/fill was used to estimate indoor air concentrations. The depth of chemicals in soil/fill was selected based on the depth below grade of the maximum VOC COPC concentration. This occurred at 3.5 feet below grade in the North Yard. Table 4-19 presents the equations and exposure assumptions used to evaluate this pathway. The model inputs and outputs are provided in Appendix J. Residents are assumed to be present 350 days per year for a total of 30 years.

4.3.1.4 *North Yard Soil/Fill – Direct Contact and Inhalation of Fugitive Dust - Construction Workers (Future Conditions)*

Under future conditions, construction workers can be exposed to chemicals in North Yard soil/fill through incidental ingestion and inhalation of fugitive dusts. Tables 4-20 and 4-21 present the equations and exposure assumptions used to evaluate the soil ingestion pathway and fugitive dust inhalation pathway, respectively, for future construction workers. As shown in these tables, it was assumed that a construction worker is working in the North Yard 250 days per year for a total of 2 years.

For the soil ingestion pathway, it was assumed that soil is ingested at a rate of 330 mg/day (Table 4-20). As shown in Table 4-22, the exposure point concentration would be the 95% UCL on the mean or the maximum detected concentration (whichever is lower) in the upper eight feet of North Yard soil/fill. To conservatively evaluate fugitive dust exposures, it was assumed that respirable fugitive dust (nuisance dust) would be present in the air at the maximum allowable concentration under OSHA as defined in 29 CFR 1910.1000 Table Z (i.e., 5 mg/m3). The lesser of the 95% UCL on the mean concentration or the maximum detected concentration of each COPC was multiplied by the maximum allowable respirable dust level to estimate the maximum ambient air concentration of each COPC.

4.3.2 South Yard Soil/Fill

4.3.2.1 South Yard Soil/Fill – Direct Contact – Facility Workers and Tenants (Current Conditions)

Under current conditions, facility workers and short-term Site tenants could be exposed to chemicals in South Yard surface soil/fill through direct contact. Facility workers are a more sensitive receptor than short-term Site tenants since they are present at the Site more days per year and more years per lifetime. Therefore, the risks posed to facility workers from COPCs would be greater than the risks to short-term Site tenants. Hence, the facility worker exposure scenario encompasses the risks that may be posed to short-term tenants.

Exposure point concentrations for facility workers under current conditions are presented in Table 4-23. It was assumed that the top two feet of soil are available for soil ingestion under current conditions. Therefore, the 95% UCL on the mean concentration or the maximum detected concentration (whichever was lower) of each COPC in the top two feet of soil/fill was used as the exposure point concentration.

Table 4-15 shows the equations and exposure assumptions used to evaluate soil ingestion pathways for facility workers under current conditions. As shown in this table, it is assumed that a worker is present at the Site 250 days per year for a total of 25 years and that soil is ingested at a rate of 50 mg/day.

4.3.2.2 *South Yard Soil/Fill – Direct Contact – Residents (Future Conditions)*

Under future conditions, the South Yard may be developed for residential use. Table 4-17 shows the equations and exposure assumptions used to evaluate soil ingestion pathways for residents under future conditions. Exposures to children and adults are evaluated separately. As shown in this table, it is assumed that a resident is present at the Site 350 days per year. The exposure duration for adults is 24 years and the ingestion rate is 100 mg/day. The exposure duration for children is 6 years and the ingestion rate is 200 mg/day.

Exposure point concentrations for South Yard soil/fill for future residents are presented in Table 4-24. It was assumed that the soil/fill in this area will be moved about as a result of construction activities and that all soil/fill within the top eight feet could potentially be brought to the surface and used as surface soil. The 95% UCL on the mean or the maximum detected concentration (whichever was lower) of each South Yard soil COPC in the upper eight feet of soil/fill was used as the exposure point concentration reported in Table 4-24.

4.3.2.3 *South Yard Soil/Fill – Direct Contact and Inhalation of Fugitive Dust - Construction Workers (Future Conditions)*

Future construction workers can be exposed to chemicals in South Yard soil/fill by incidental ingestion and inhalation of fugitive dusts. Tables 4-20 and 4-21 show the equations and exposure assumptions used to evaluate the soil ingestion pathway and fugitive dust inhalation pathway, respectively, for future construction workers. As shown in Tables 4-20 and 4-21, it is assumed that a construction worker is present at the Site 250 days per year for a total of 2 years.

For the soil ingestion pathway, it is assumed that soil is ingested at a rate of 330 mg/day (Table 4-20). As shown in Table 4-25, the exposure point concentration would be the 95% UCL on the mean or the maximum detected concentration (whichever was lower) in the upper eight feet of South Yard soil/fill. To conservatively evaluate fugitive dust exposures, it was assumed that respirable fugitive dust (nuisance dust) would be present in the air at the maximum allowable concentration under OSHA as defined in 29 CFR 1910.1000 Table Z (i.e., 5 mg/m3). The lesser of the 95% UCL on the mean concentration or the maximum detected concentration of each COPC was multiplied by the maximum allowable respirable dust level to estimate the maximum ambient air concentration of each COPC.

As noted above, the exposure assessment is also being used to conservatively estimate construction worker exposures to sediment adjacent to the Yard and beneath the West Warehouse. This estimation is reasonable since the exposure duration of construction worker contact to sediment during pile installation would likely be less than two years, less sediment would likely be ingested and inhalation of dust would not occur since the sediment is wet.

4.3.3 *Below Building Soil/Fill*

4.3.3.1 Below Building Soil/Fill – Inhalation of VOCs – Facility Workers and Tenants (Current/Future Conditions)

Inhalation of VOCs from soil/fill under the existing building can occur under current and future conditions for facility workers and short-term Site tenants. The Johnson and Ettinger model (USEPA, 2000b) was used to predict indoor air concentrations of VOCs from soil/fill in the overlying buildings.

The 95% UCL on the mean concentration of each VOC COPC in Below Building soil/fill was used to estimate indoor air concentrations. The depths of chemicals in soil/fill were selected based on the depth below grade of the maximum VOC COPC concentration. This occurred at 1 foot below foundation for acetone and 3.5 feet below foundation for xylene. Table 4-26 shows the equation and exposure assumptions used to evaluate this pathway. The model inputs and outputs are provided in Appendix J. It was assumed that a facility worker is present 250 days/year for a total of 25 years.

4.3.3.2 Below Northern Building Soil/Fill – Direct Contact and Inhalation of Fugitive Dust – Construction Workers (Future Conditions)

Future construction workers can be exposed to chemicals in Below Northern Building soil/fill through incidental ingestion and inhalation of fugitive dusts. Tables 4-20 and 4-21 present the equations and exposure assumptions used to evaluate the soil ingestion pathway and fugitive dust inhalation pathway, respectively, for future construction workers. As shown in these tables, it is assumed that a construction worker is present at the Site 250 days per year for a total of 2 years.

For the soil ingestion pathway, it was assumed that soil is ingested at a rate of 330 mg/day (Table 4-20). As shown in Table 4-27, the exposure point concentration would be the 95% UCL on the mean or the maximum detected concentration (whichever was lower) in the upper eight feet of Below Building soil/fill. To conservatively evaluate fugitive dust exposures, it was assumed that respirable fugitive dust (nuisance dust) would be present in the air at the maximum allowable concentration under OSHA as defined in 29 CFR 1910.1000 Table Z (i.e., 5 mg/m3). The lesser of the 95% UCL on the mean concentration or the maximum detected concentration of each COPC was multiplied by the maximum allowable respirable dust level to estimate the maximum ambient air concentration of each COPC.

4.3.4 *Site Ground Water – Inhalation of VOCs – Current Facility Workers and Tenants/Future Residents*

Inhalation of VOCs from ground water can occur under current conditions (for facility workers and short-term Site tenants) and under future conditions (for residents and short-term Site tenants). To conservatively evaluate this pathway, future residential usage was assumed. The Johnson and Ettinger model (USEPA, 2000b) was used to predict concentrations of VOCs in indoor air in an overlying hypothetical residence.

The 95% UCL on the mean concentrations of each VOC COPC in ground water was used to estimate indoor air concentrations. The model inputs and outputs are provided in Appendix J. Residents are assumed to be present 350 days per year for a total of 30 years.

4.4 *TOXICITY ASSESSMENT*

The purpose of the toxicity assessment is to compile and evaluate toxicological data for the COPCs at the Site.

4.4.1 *Noncarcinogenic Effects*

A reference dose, or RfD, is the most appropriate toxicity value used in evaluating noncarcinogenic effects resulting from chronic exposures. RfDs represent chemical doses to which one may be repeatedly exposed over the relevant exposure period without any adverse effects. Oral RfDs (RfDo) and inhalation RfDs (RfDi) for the COPCs are presented in Table 4-28. These RfDs are obtained from USEPA's Integrated Risk Information System (IRIS) (accessed in March 2002 and revised in May 2003). Where RfDs were not available on IRIS, Health Effects Assessment Summary Table (HEAST) RfD values were obtained from the USEPA Region III Risk-Based Concentration (RBC) Table (USEPA, 2003). For acetone, where values were not available from either of these sources, an inhalation RfD was obtained from the Johnson and Ettinger model (USEPA, 2000b).

Noncarcinogenic health effects are evaluated by dividing the average daily intake by the relevant RfD, as shown in the exposure assessment tables in Section 4.3. This ratio, the hazard quotient, provides a numerical indicator of the difference between acceptable and unacceptable exposure levels. Any single chemical with an exposure level greater than the reference level will result in a hazard quotient that exceeds unity (1.0). A hazard quotient greater than 1.0 indicates the possibility of a health hazard to the exposed population. To assess the overall potential for noncarcinogenic effects posed by multiple chemicals, the hazard quotients for all COPCs are summed for each potential exposure pathway. This sum is termed the hazard index. The USEPA warns that adding the individual hazard quotients can overestimate the potential for adverse effects since not all chemicals induce the same effect by the same mechanism.

4.4.2 *Carcinogenic Effects*

The cancer slope factor (CSF) or potency factor is the most appropriate toxicity value used in evaluating carcinogenic effects resulting from exposure to chemicals. The CSF is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The CSF is used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. Oral CSFs (CSFo) and inhalation CSFs (CSFi) for the COPCs at the Site are presented in Table 4-29. The CSFs are obtained from IRIS (accessed in March 2002 and revised in May 2003). Where CSFs were not available on IRIS, Health Effects Assessment Summary Tables (HEAST) CSFs were obtained from the USEPA Region III Risk-Based Concentration (RBC) Table (USEPA, 2003).

As shown in the exposure assessment tables, the incremental cancer risk due to exposure to each chemical for each exposure pathway is estimated as follows:

Incremental Cancer Risk =
CSF $(mg/kg/day)^{-1}$ x average daily intake (mg/kg/d).

4.4.3 *Risk Perspective*

The estimated carcinogenic risks associated with certain exposures are expressed numerically as excess lifetime cancer risks. With respect to noncarcinogenic risks, a numerical determination (i.e. hazard quotient) is used to ascertain whether or not the specified exposures will likely cause significant adverse effects to the exposed populations.

The quantitative risks that are derived in this process are a tool to be used by the decision-makers in striving to manage risks as part of the cleanup. For example, USEPA typically uses the general 10^{-4} to 10^{-6} risk range for carcinogens as a "target range", coupled with a hazard quotient of 1, within which the agency strives to manage risks as part of a Superfund cleanup (USEPA, 1991). The total carcinogenic risk posed by multiple chemicals may be evaluated by summing the risks for all chemicals for each exposure route.

In general, when the cumulative carcinogenic risk is less than 10^{-4}, and the non-carcinogenic hazard quotient is less than 1, remedial action is not automatically warranted, unless there is an adverse environmental impact (USEPA, 1991). When these benchmarks are exceeded, a 10^{-6} carcinogenic risk is used as a "point of departure" to establish preliminary remediation goals.

The risk characterization for the specified exposure scenarios are presented as either greater or less than 10^{-4} for carcinogens and greater or less than 1 for noncarcinogens. According to the USEPA, when the risk is greater than one or both of these benchmarks, the risk is characterized as requiring a remedial action. When it is less, than the risks are characterized as non-actionable, pending other input factors to be used by the decision-maker.

4.4.4 Exceptions

Four COPCs have neither a reference dose nor a cancer slope factor from the above references (phenanthrene, pyrene, lead and thallium) (see Tables 4-28 and 4-29. These four COPCs were, therefore, eliminated from further quantitative risk evaluation.

However, the USEPA has established standards for lead in soils (40 CFR Part 745). Under these standards, lead is considered a hazard if: the maximum lead concentration in exposed soil located in children's play areas is greater than or equal to 400 mg/kg, or if the average lead concentration in exposed soil in residential yards exceeds 1,200 mg/kg. Therefore, these benchmarks are used to evaluate soil for the residential exposure scenarios.

4.5 RISK CHARACTERIZATION

In this section, calculated risks for each of the pathways of concern are presented. Soil pathways are presented first (arranged by area) followed ground water pathways.

4.5.1 North Yard Soil/Fill

4.5.1.1 North Yard Soil/Fill – Soil Ingestion – Facility Workers and Tenants (Current Conditions)

Table 4-30 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and cumulative) for direct contact with North Yard soil/fill by facility workers under current conditions. As discussed above, facility worker exposure was evaluated since it is the more conservative exposure scenario.

As shown in this table, the total hazard index for this exposure pathway, 0.13, is below the benchmark of 1 and the total carcinogenic risk, 5×10^{-5}, is within the target risk range of 1×10^{-4} to 1×10^{-6}.

4.5.1.2 *North Yard Soil/Fill – Soil Ingestion – Residents (Future Conditions)*

Tables 4-31 and 4-32 present individual hazard quotients, hazard index and carcinogenic risks (individual and cumulative) for direct contact with North Yard soil/fill by future adult and child residents, respectively. As shown in Table 4-31, the total hazard index for adults, 0.24, is below the benchmark of 1. As shown in Table 4-32, the total hazard index for children is 2.21, which is above the benchmark of 1, although no individual chemical had a hazard quotient of greater than 1. The total carcinogenic risk for the exposure pathway (adults and children combined), 3 x 10^{-1}, is above the target risk range of 1 x 10^{-4} to 1 x 10^{-6}. The total carcinogenic risk is primarily due to the North Yard PCB concentration in soil/fill which itself had a chemical-specific cancer risk (adults and children combined) of 3 x 10^{-1}. The total carcinogenic risk for this exposure pathway, without PCBs, is 1.6 x 10^{-4}. Nevertheless, this value is also above the target carcinogenic risk range.

The 95% UCL on the mean lead concentration in North Yard soil/fill is 9,970 mg/kg. This is above the 400 mg/kg maximum benchmark for exposed soil in play areas, and the 1,200 mg/kg average benchmark for exposed soil in residential yard areas.

4.5.1.3 *North Yard Soil/Fill – Inhalation of VOCs – Current Facility Workers and Tenants/Future Residents*

Table 4-33 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for inhalation of VOCs from North Yard soil/fill for future residents. As noted in Section 4.3.1.3, this exposure pathway applies to both facility workers and short-term Site tenants (current conditions) and residents (future conditions). The more conservative residential exposure assumptions were used to evaluate this pathway. As shown in Table 4-33, the total hazard index, 0.024, is well below the benchmark of 1 and the total carcinogenic risk, 3×10^{-7}, is below the target risk range.

4.5.1.4 *North Yard Soil/Fill – Soil Ingestion and Inhalation of Fugitive Dust – Construction Workers (Future Conditions)*

Table 4-34 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for soil ingestion and inhalation of fugitive dust by future construction workers in the North Yard. As shown in this table, the hazard index, 5.82, is above the benchmark of 1. The only individual chemical with a hazard quotient above the target level of 1 is barium, and the risk is due to inhalation of barium in fugitive dust. There is no RfDi for barium on IRIS or the main table of HEAST. There is, however, a RfDi for barium in Table 2 from HEAST. RfDs presented in HEAST Table 2 are derived using alternate methods than the main table.

The total carcinogenic risk, 2×10^{-2}, is above the target risk range of 10^{-4} to 10^{-6}. The total carcinogenic risk is primarily due to the PCB concentration in the North Yard soil/fill. The total carcinogenic risk for total PCBs is 2×10^{-2}. Excluding PCBs, the total carcinogenic risk, 1.3×10^{-5}, is within the target risk range.

4.5.2 ***South Yard Soil/Fill***

4.5.2.1 *South Yard Soil/Fill – Soil Ingestion – Facility Workers and Tenants (Current Conditions)*

Table 4-35 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for direct contact with South Yard soil/fill by facility workers under current conditions. As shown in this table, the total hazard index, 0.11, is below the benchmark of 1. The total carcinogenic risk, 1×10^{-5}, is within the target risk range.

4.5.2.2 *South Yard Soil/Fill – Soil Ingestion – Residents (Future Conditions)*

Tables 4-36 and 4-37 present the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for direct contact with South Yard soil/fill by future adult and child residents, respectively. As shown in this table, the hazard index for adults, 0.14, is below the benchmark of 1. The total hazard index for children, 1.33, is above the benchmark of 1, although no individual chemical had a hazard quotient of greater than 1. The total carcinogenic risk (adults and children summed), 5.8×10^{-5}, is within the target risk range.

The 95% UCL on the mean lead concentration in South Yard soil/fill is 1,070 mg/kg, which is above the 400 mg/kg maximum benchmark for exposed soil in play areas, but below the 1,200 mg/kg average benchmark for exposed soil in the residential backyards.

The above evaluation assumed that a surface cover would not be installed at the Site. If the development plan for the South Yard includes covering all of the existing soil/fill with building, pavement and clean topsoil, the direct contact pathway would effectively be eliminated.

4.5.2.3 *South Yard Soil/Fill – Soil Ingestion and Inhalation of Fugitive Dust – Construction Workers (Future Conditions)*

Table 4-38 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for soil ingestion and inhalation of fugitive dust by future construction workers in the South Yard. As shown in this table, the hazard index, 1.01, is essentially at the benchmark of 1. The total carcinogenic risk, 5×10^{-5}, is within the target risk range of 10^{-4} to 10^{-6}.

4.5.3 *Below Building Soil/Fill*

4.5.3.1 *Below Building Soil/Fill – Inhalation of VOCs from Soil/Fill - Facility Workers and Tenants (Current Conditions)*

Table 4-39 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for inhalation of VOCs in Below Building soil/fill for current facility workers. As shown in Table 4-39, the hazard index, 0.055, is below the benchmark of 1. There are no carcinogenic COPCs for this pathway.

4.5.3.2 *Below Building Soil/Fill – Soil Ingestion and Inhalation of Fugitive Dust – Construction Workers (Future Conditions)*

Table 4-40 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for soil ingestion and inhalation of fugitive dust by future construction workers from Below Building soil/fill. As shown in this table, the hazard index, 0.90, is below the benchmark of 1. The total carcinogenic risk, 4×10^{-4}, is above the target risk range of 10^{-4} to 10^{-6}. The total carcinogenic risk is primarily due to the PCB concentration in the Below Building soil/fill. Excluding PCBs, the total carcinogenic risk, 6×10^{-6}, is within the target risk range.

4.5.4 *Ground Water – Inhalation of VOCs from Ground Water – Current Facility Workers and Tenants/Future Residents*

Table 4-41 presents the individual hazard quotients, hazard index and carcinogenic risks (individual and total) for inhalation of VOCs in Site ground water by future residents. As noted in Section 4.3.4, this exposure pathway applies to both facility workers (current conditions) and residents (future conditions). The more conservative residential exposure assumptions were used to evaluate this pathway. As shown in Table 4-41, the total hazard index, 0.00097, is well below the benchmark of 1. The total carcinogenic risk, 9×10^{-8}, is below the target risk range.

4.6 CONCLUSIONS

Following is a summary of the HHRA results for North Yard soil/fill, South Yard soil/fill, BICC Parking Lot Soil, Below Building soil/fill and Site ground water under both current and future use scenarios. The uncertainty analysis for these risk calculations is presented in Appendix N.

Using the characterization data for the Site, the following exposure pathways were evaluated for Site soil/fill and ground water:

- inhalation of VOCs from soil by facility workers and tenants (current) and residents (future) -- North Yard and South Yard soil/fill;
- direct contact with soil by facility workers and tenants (current) and residents (future) -- North Yard and South Yard soil/fill;
- inhalation of VOCs from soil by facility workers and tenants (current/future) – Below Building soil/fill and BICC Parking Lot soil.
- direct contact with soil in BICC Parking Lot (future);
- direct contact with and inhalation of fugitive emissions from soil by construction workers (future) – North Yard, South Yard and Below Building soil/fill – and sediment adjacent to the Yard and beneath the West Warehouse;
- leaching from soil/fill to ground water (risks for this pathway were evaluated through the ground water exposure pathways);
- ground water ingestion;
- inhalation of VOCs from ground water by facility workers and tenants (current/future) and residents (future); and
- ground water discharge to surface water with subsequent human consumption of fish and recreational activities.

Based on the screening conducted at the beginning of the risk assessment (see Section 4.2), the following exposure pathways were eliminated from further evaluation:

- inhalation of VOCs from South Yard soil/fill (current or future);
- direct contact with and inhalation of VOCs from soil in the BICC Parking Lot (current or future);
- ground water ingestion; and

- ground water discharge to surface water with subsequent human consumption of fish and recreational activities.

The exposure pathways remaining after this initial screening were identified as pathways of concern and their quantitative risk was determined. The risk characterization for the exposure pathways of concern were divided into the following categories:

- Cumulative carcinogenic risk less than 10^{-6} and a hazard index of less than 1;
- Cumulative carcinogenic risk within the USEPA risk range (10^{-4} to 10^{-6}); and
- Cumulative carcinogenic risk greater than 10^{-4} and/or hazard index greater than 1 and/or lead concentration (residential exposures only) greater than USEPA lead criteria.

A summary of the individual chemical risks is provided in Table 4-42.

Carcinogenic Risk < 10^{-6}

- North Yard soil/fill -- inhalation of VOCs from soil by facility workers and tenants (current) and residents (future);
- Below Building soil/fill -- inhalation of VOCs from soil by facility workers and tenants (current and future); and
- Inhalation of VOCs from ground water by facility workers and tenants (current and future) and residents (future).

Carcinogenic Risk between 10^{-4} and 10^{-6}

- North Yard and South Yard soil/fill -- direct contact with soil by facility workers (current) – additional assessment would need to be conducted to determine the risks to tenants.
- South Yard soil/fill --direct contact with and inhalation of fugitive emissions from soil by construction workers (future).
- Hudson River sediment – direct contact with sediment by construction workers (this is a conservative estimate based on the South Yard soil/fill evaluation).
- South Yard soil/fill -- direct contact with soil by residents (future) - See Note (1) in table below.

Others

Exposure Pathway	Carcinogenic Risk > 10^{-4}	Hazard Index > 1	Lead
North Yard soil/fill – direct contact with soil by residents (future) (1)	X	X	> playground criteria > residential yard criteria
South Yard soil/fill – direct contact with soil by residents (future) (1)	--	X	> playground criteria < residential yard criteria
North Yard soil/fill – direct contact with and inhalation of dust from soil by construction workers (future)	X	X	Not applicable
Below Building soil/fill – direct contact with and inhalation of dust from soil by construction workers (future)	X	--	Not applicable

Notes:

(1) The risk assessment assumes that surface covers will not be installed under the future use scenario. Installation of surface covers would eliminate the direct contact residential exposure pathway.

5.0 BASELINE HUMAN HEALTH RISK ASSESSMENT OF BUILDING MATERIALS

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), a baseline Human Health Risk Assessment (HHRA) was completed for residual constituents present on the building materials. This HHRA has been conducted in accordance with the work scope provided in the RI/FS Work Plan (ERM/Roux, 2001) and the procedures identified in the *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual, Part A* (USEPA, 1989).

The goal of the baseline HHRA is to determine whether lead or PCBs present on building surfaces could potentially result in a human health risk. To accomplish this goal, the HHRA is divided into four steps. Following is a description of these steps and where they are discussed in this document.

Step 1: Potential exposure pathways are identified (Section 5.1).
Step 2: The constituents of potential concern (COPC) for building interior are selected (Section 5.2).
Step 3: Exposure assumptions and exposure point concentrations are used to estimate constituent intakes for the COPCs for each pathway identified (Section 5.3).
Step 4: The risks to human health are characterized based on the calculated constituent intakes (Section 5.4).

The conclusions of the HHRA are summarized in Section 5.5.

5.1 IDENTIFICATION OF POTENTIAL EXPOSURE PATHWAYS

Identification of exposure pathways for the building materials must take into consideration human receptors at the Site under both the current and future Site use. Under the currently anticipated future Site use, certain parts of the Site buildings could remain and be used for commercial purposes, including use as a film studio. Alternatively, the other Site buildings would have to be renovated or may be demolished as part of future Site development for commercial purposes, including use as a film studio. These specific areas are not known at this time. In addition, under the potential future use, the northern portion of the Site buildings may be demolished down to their foundations and other structures built in their place.

Current and future human receptors for the Site building interiors include the following:

- Facility workers – On-Site workers who maintain the property, grounds and buildings or work in the office area of the building (current and future use). Also includes pregnant female on-Site workers, where fetal exposure by transplacental transfer could occur.
- Short-term Site tenants – Parties (both adults and children) that occupy the Site for less than six months per year under a short-term lease. These are generally actors and staff from film companies engaged in pre-production, production and post-production filming operations (current and future use). These receptors include pregnant female short-term tenants, where fetal exposure by transplacental transfer could occur.

As discussed in Section 1.0, security guards control access to the Site 24 hours a day, seven days a week, and the Site is fenced. As such, trespassers, as current or future receptors, are not considered an exposed population in this assessment.

As discussed in Section 3.0, building materials were characterized for the two interior COPCs (PCBs and lead). The wipe sample results for these two COPCs are presented in Tables 3-3A through 3-4B. Wipe samples were also analyzed for mercury at the request of the NYSDEC (see Table 3-5).

The potential exposure pathway for lead, PCBs and mercury on building surfaces is direct contact. As discussed in Section 3.0, interim occupancy criteria that addressed the direct contact exposure pathway were developed to allow use of the building interiors prior to completion of the RI. These very conservative criteria, which were approved by the NYSDEC and NYSDOH for short-term occupancy (NYSDOH, 2000), are:

- 10 µg/100 cm^2 for PCBs on building surfaces (considered by NYSDOH as an upper bound target goal for decontamination with a preferred goal of 1 µg/100 cm^2). The 10 µg/100 cm^2 is the USEPA PCB high occupancy criteria, as provided in 40 CFR Part 761.61
- 400 µg/100 cm^2 for lead - the lower surface concentration level developed using the Adult Lead Model to evaluate potential risks posed to pregnant female workers from lead in soil[4].

As discussed further in Section 5.2, mercury was not detected in any of the wipe samples collected. Therefore, no interim occupancy criterion was required for mercury.

In accordance with the RI/FS Work Plan (ERM/Roux, 2001), the risks posed by the current lead and PCB concentrations on building interior surfaces were quantified in this HHRA. Although building demolition could pose potential risks to construction workers, these risks will not be quantified in this HHRA. Instead, engineering controls will be included in any future demolition activities to address the potential risks to construction workers. Current and future risks to facility workers and short-term Site tenants under current and future exposure scenarios are therefore evaluated in this document.

In addition to the wipe samples, a lead paint survey was conducted to determine the lead concentrations in painted surfaces within the Site buildings. These results are presented in Appendix I. The potential risks posed by lead paint were conservatively evaluated through application of

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[4] A letter from NYSDOH to Roux (NYSDOH, 2001) incorrectly identified the calculation method for the lead interim occupancy criteria as the Integrated Exposure Uptake Biokinetic Model (IEUBK) for lead in children. Rather, the interim occupancy criteria for lead was obtained from a range of results (i.e., 400 to 1,400 µg/100 cm^2) calculated using the Adult Lead Model (USEPA, 1996a) for soil ingestion by pregnant female workers.

the HUD residential criteria (i.e., 1 mg/ cm^2) and a review of the condition of the area.

5.2 *IDENTIFICATION OF CONSTITUENTS OF POTENTIAL CONCERN*

The following four types of wipe samples, which were discussed in Section 3.0, are considered representative of current Site conditions and used in this HHRA evaluation:

- post-clean samples in areas that have been cleaned;
- pre-clean samples in areas that have not yet been cleaned;
- samples collected after cleaning and encapsulation in areas of the building that were cleaned and then encapsulated; and
- pre-clean samples in areas that have been cleaned, but a post-clean sample was not collected for a specific analyte (e.g., if lead exceeded the interim occupancy criteria prior to cleaning and PCBs did not, PCBs may not have been analyzed in the post-clean sample).

The lead, mercury and PCB wipe sampling analytical results were first screened for frequency of detection. Only constituents with a frequency of detection greater than 5% were retained for further analysis. During the frequency of detection screening all Aroclors reported under Method 8082 were screened for frequency of detection. Based on this screening, Aroclor-1016, Aroclor-1221, Aroclor-1232 and Aroclor-1242 were eliminated from further evaluation. Mercury was also eliminated from further evaluation since it was not detected in any of the four types of samples collected.

Since the total PCB concentration was needed for the risk assessment, the remaining Aroclors (i.e., Aroclor-1248, Aroclor-1254, and Aroclor-1260) were combined to determine the total PCB concentration of each sample. In accordance with guidance provided by RAGS (USEPA, 1989), one-half the detection limit was assumed for analytical results having a "U" qualifier that do not have unusually high detection limits. Since there were no unusually high detection limits, this approach was valid for the HHRA. Appendix K provides a summary of the PCB results and Appendix L provides a summary of the lead results.

In summary the COPCs for the building interior wipe samples are total PCBs and lead.

Following selection of the COPCs, the statistical distribution (i.e., normal or lognormal) of the wipe sampling results obtained for the entire building (with the exception of the fourth floor [5]) was determined. This evaluation was needed to determine the exposure point concentrations for the risk characterization. In order to determine the relevant data distribution for total PCBs and lead data were tested for both normality and log normality according to the D'Agostino test (for constituents with more than 50 samples) (USEPA, 1989a; Gilbert, 1987). The test for normality consists of conducting the D'Agostino test on the individual non-transformed data points. The test for log normality consists of first "transforming" the individual data points by taking the natural log (ln*x*) of the data point and then conducting the D'Agostino test on the "transformed" data points.

The resulting Y_{test} for D'Agostino's Test was then compared to the critical value for either acceptance or rejection of the null hypothesis (*i.e.*, that the data are normally distributed when testing for normality or that the data are log normally distributed when testing for log normality) (Gilbert, 1987). The critical values chosen are based on a certainty of within 95 percent and obtained from the statistical table in Gilbert (1987). When the test statistic (Y_{test}) is out of range of the critical quantiles ($Y_{a/2}$, $Y_{1-a/2}$ for D'Agostino's test), the null hypothesis is rejected. Rejection of the null hypothesis means that there is a 95 percent certainty that the distribution

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[5] No representative data is currently available for this area. All samples collected from this area are post-clean samples and not representative of current conditions.

does not follow a normal distribution, if testing for normality, or a lognormal distribution, if testing for log normality. This process is accomplished with the use of a statistical program known as MTCA*Stat* developed by the State of Washington Department of Ecology (WDE, 1996). The results of the data distribution testing procedure are presented in Appendix M. According to the statistical results in Appendix M, both the total PCBs and lead data sets are log normally distributed.

According to RAGS (USEPA, 1989), the exposure point concentration for risk characterization are determined by calculating the 95% upper confidence limit (UCL) on the mean and the maximum concentration of the COPCs. The 95% UCL on the mean for lognormally distributed data is calculated by the following equation:

$$95\%UCL_{\log normal} = e^{(\bar{x}+0.5s^2+sH/\sqrt{n-1})} \qquad \text{(Equation 5-1)}$$

Where:

95% $UCL_{lognormal}$= 95% Upper Confidence Limit on the mean for lognormal data (μg/100 cm^2)
e = Base of the natural logarithm (ln) (equal to 2.718)
$\bar{x}$ = Arithmetic mean of ln transformed data (μg/100 cm^2)
s = Standard deviation of ln transformed data
H = H-statistic (Gilbert, 1987)
n = Total number of data points

The lognormal 95% UCL on the mean concentrations were calculated for each COPC (i.e., total PCBs and lead) for the entire building (with the exception of the 4th floor). Table 5-1 presents the exposure point concentrations used in the HHRA (*i.e.,* the lognormal 95% percent UCL on the mean.

5.3 *EXPOSURE ASSESSMENT*

As discussed above, under the anticipated future Site use, the Site will be used for film production/commercial usage. If used for film studios, the Site will most likely involve the creation of: several studios for the filming of commercials or movie scenes, areas that will be used for the construction of the sets required by the studio areas, office and dressing room facilities for visiting producers and actors (including children), and general administrative offices. Because of the difficulty of establishing discrete exclusion zones on the first three floors to represent areas of the building that remain uncleaned or only partially cleaned, the approach adopted for both present and future exposure scenarios in this HHRA is to assume that receptors can freely circulate throughout the first three floors of the building and have an equal chance of contact with contaminated floors regardless of location. Sampling locations in both previously cleaned and uncleaned building areas are presented for the first three floors in Figures 3-2through 3-4, respectively.

Under both current and future use scenarios facility (i.e., building maintenance) workers will have access to the entire building, including areas that are currently designated as previously cleaned areas and those designated as uncleaned areas on a routine basis over an upperbound exposure duration of 25 years. Therefore these receptors will be evaluated independently of film production crews and actors (i.e., short-term Site tenants).

With regard to the short-term Site tenants, the HHRA conservatively assumes that a specified receptor has free access to all areas of the buildings for the entire duration of the time that they work on the premises. Although highly conservative, this assumption has been made to allow maximum flexibility for the future uses of the buildings.

Based on a review of Site-specific conditions, the following direct contact exposure pathways were quantitatively evaluated in the HHRA:

- Incidental ingestion of constituents present on horizontal building surfaces (current and future) by:
    - short-term adult Site tenants
    - short-term child Site tenants
    - facility workers
- Dermal absorption of constituents present on horizontal surfaces (current and future)
    - short-term adult Site tenants
    - short-term child Site tenants
    - facility workers

A brief description of the buildings is provided below and this is followed by a detailed description of the approach for estimating intake of PCBs or lead from building surfaces.

5.3.1 Description of the Buildings

The Site buildings have multiple floors that cover part of, or the entire, building footprint (as previously described in Section 3.0). Within each floor there are certain portions that are currently designated as previously cleaned and other portions that are currently designated as uncleaned areas (see Figures 3-2, 3-3 and 3-4). All previously cleaned areas have undergone some level of surface cleaning/encapsulation while the other areas have not yet been cleaned.

Although it would be highly desirable to exclude everyone except the facility maintenance workers from uncleaned areas within the buildings, to be conservative and health protective the HHRA assumes that all receptors have full access to all areas of the buildings including areas on the first floor around the transformers, where the physical hazards will significantly outweigh any potential risks from the COPCs.

The HHRA assumes that the current condition of the buildings is maintained and that no additional cleaning occurs.

For the purposes of this HHRA, data from all areas of the building with the exception of the fourth floor have been consolidated and it is assumed that all receptors could be exposed anywhere in the building. The following receptors will be evaluated in the HHRA:

- Short-term adult Site tenants
- Short-term child Site tenants
- Facility workers

5.3.2 *Estimating Intake from Wipe Sample Results*

Currently, neither the NYSDEC nor the USEPA have established guidance regarding risk characterization using wipe sample analytical data. USEPA Region III is currently working on a document to evaluate the exposure and potential risks associated with constituents identified in wipe samples (J. Hubbard – Personal Communication, 2002). USEPA Region III's approach was developed with input from the National Center for Environmental Assessment (NCEA) of the USEPA and USEPA Superfund risk assessors throughout the nation. The methodology for evaluating PCB and lead intake from surfaces within the Site buildings is based on the information gathered during a discussion with USEPA Region III regarding this document.

The constituent intake, which will govern the risk characterization, is determined by the combination of the oral dose and the dermal dose. To determine these doses, the constituent transfer from the building surfaces to the skin is first determined. Using the results from this evaluation, the oral and dermal doses are determined.

5.3.2.1 *Transfer of Constituents of Potential Concern from Surface to Skin*

The equation used to define transfer from the building surface (i.e., floors) to skin assumes that in any single contact only a percentage of the material is transferred from the building surface to the skin. The primary skin contact is assumed to be the palms of one or both hands. The amount of constituent deposited on the skin is calculated as follows:

$$Ds = \frac{C * SA * CF * FTSS * EF * ED}{1000 * 100} \qquad \text{(Equation 5-2)}$$

Where:

Ds = Amount of constituent deposited on skin (mg)
C = Concentration of constituent on building surface (μg/wipe)
SA = Exposed skin surface area (cm^2)
CF = Contact frequency of skin against surface (1/day)
FTSS = Fraction transferred from the building surface to skin
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
1000 = Conversion of mg to μg
100 = Conversion factor, 1 wipe = 100 cm^2

This equation assumes that constituent volatilization from the building surface is negligible and the constituent remains on the surface at the same concentration for the entire exposure duration. Thus, it is assumed that any previous transfer of constituent from the building surface to the skin would not significantly deplete the constituent concentration on the building surface.

The specific default assumptions used in the above equation are defined below.

Exposed Skin Surface Area (SA)

Based upon the current Site building use and the anticipated future use, the most probable exposed skin surface to come in contact with building surfaces is the palm of one or both hands. The following defaults were obtained from *The Exposure Factors Handbook* (USEPA, 1997a) for this parameter: hand palm area for children ranging from five to six years in age (250 cm^2 for both hands) and adults (400 cm^2 for both hands). To take a conservative health-protective approach it is assumed that the whole of both palms could be in contact with any building surfaces (400 cm^2 for adults and 250 cm^2 for children).

Contact Frequency (CF)

For purposes of this HHRA, it is conservatively assumed that over the course of the day, an amount equivalent to the entire surface of the palms comes into contact with the floor. However, given the age of the child under consideration (i.e., equal to or greater than 5 years in age), the child would not be crawling on the floor.

Fraction Transferred from Surface to Skin (FTSS)

Based on experimental work conducted with pesticides, it has been found that the amount of a constituent on a surface that can be transferred to skin is influenced by constituent composition and physicochemical characteristics. Thus, the fraction transferred from surface to skin (FTSS) is assumed to be a constituent and surface-specific parameter.

Work conducted by USEPA-EMSL (Las Vegas) regarding the transfer of Malathion from different surfaces ((Dary and Keimig, 1996) indicates that the fraction transferred to human hands was dependent on the type of surface, ranging from 0.03% (painted sheetrock) to 1.52% (carpet). The fraction transferred from vinyl flooring (0.18%) was conservatively considered the most appropriate from this study and would be most appropriate for cleaned areas of the buildings. This is conservative since the building surfaces are generally rougher than vinyl flooring.

More recent studies summarized in a document published by the American Crop Protection Association (American Crop Protection Association, 2001) indicate that the amount of pesticide transferred from an indoor surface to skin can range from 0.7% to 4% depending on the pesticide being studied. An average of the values presented is 2.82%. In the uncleaned areas where there is likely a larger accumulation of surface material that can be transferred to the skin this higher average value is considered more appropriate.

In this HHRA it is conservatively and health protectively assumed that a receptor can be exposed anywhere in the building. However, best professional judgment suggests that many of the daily activities particularly of the short-term tenants will be conducted in areas of the building that have been previously cleaned. Furthermore, even the facility workers will spend little time in most of the uncleaned areas of the buildings. Therefore, based on an average derived from the two studies cited above, the FTSS should be 1.5%.

In the absence of equivalent studies for transfer of metals to skin the FTSS for lead was conservatively considered to be identical to the FTSS used for PCBs. Other transfer fractions have been used in risk assessments following PCB fires, however, these values had no scientific basis and therefore were not considered in greater detail.

Exposure Frequency (EF)

The standard default factor for workplace exposure frequency is 250 days/year (USEPA, 1991). This represents the typical total days at work per year that is appropriate for facility workers. An exposure frequency of 250 days/year is conservatively used for all areas of the building.

For short-term Site tenants, such as actors and film crews, the exposure frequency will be significantly less. It was assumed that in any year, child actors would spend a total of three months working on a film shoot or the equivalent of 60 working days/year. Although this exposure frequency may also be appropriate for adult tenants, it was conservatively assumed that these adult tenants occupied the previously cleaned areas for 250 working days a year to simplify calculations. This frequency is an over estimate for the short-term Site tenants.

Exposure Duration (ED)

The standard default factor of 25 years (USEPA, 1991) was assumed for the facility workers. This extended exposure duration is not appropriate for the short-term Site tenants since it is not likely they will return frequently to film at this one location. For child actors, an exposure duration of two years was assumed. For adult actors and film crew, who have a greater potential to return multiple times over a period of years, an exposure duration of nine years was assumed. This assumption, which was based on information presented in *The Exposure Factors Handbook* (USEPA, 1997a), was based on the age of the work force and their occupation. Older workers generally have longer occupational tenure and longer tenure is associated with professional and managerial staff.

5.3.2.2 *Oral Uptake from Skin Surfaces*

Material that is transferred from surfaces to the skin has the potential of being ingested either by direct hand to mouth transfer or by transfer to other material such as food and cigarettes that are placed in the mouth or on the lips. Following is the USEPA Region III model to represent hand to mouth transfer of material from building surfaces (J. Hubbard - Personal Communication, 2002).

$$Do = \frac{(Ds * FTSM * ABSo)}{(BW \times AT)} \qquad \text{(Equation 5-3)}$$

Where:

Do = Oral dose (mg/kg * day)
Ds = Amount of constituent deposited on skin (mg)
FTSM = Fraction transferred from skin to mouth
ABSo = Oral absorption fraction
BW = Body weight (kg)
AT = Averaging time (days)

Amount Deposited on the Skin (Ds)

The derivation of this value was previously described in Section 5.3.2.1 and is illustrated in Equation 5-2.

Fraction Transferred from Skin to Mouth (FTSM)

For the purposes of this RA it has been assumed that 10 percent of the material that adheres to the surface of the palm of the hands will be transferred to the mouth. This value is based on discussions with USEPA Region III (J. Hubbard - Personal Communication, 2002).

Other values for FTSM are available in literature. However, since they are not based on scientific study, they were not selected for use.

Oral Absorption Fraction (ABSo)

Because of the lipophylic properties of PCBs it is assumed that 100 percent of the amount transferred to the mouth is absorbed. Lead and lead salts are generally insoluble in water and strong acids and thus are not well absorbed from the gastrointestinal tract. After ingestion, lead absorption has been reported to be between 10 percent (Rozman and Klaassen, 2001) and 20 percent (USEPA, 1996a). It is conservatively assumed that oral lead absorption will be 20 percent of the intake.

Body Weight (BW)

The standard default value for adult body weight is 70 kilograms (kg) (USEPA, 1991). For the child, a representative body weight is based on a child between the ages of 5 and 6 years old and is 20 kg (USEPA, 1997a)

Averaging Time (AT)

For non-carcinogens the averaging time is defined as the number of days represented by the total years of exposure. For example if it were assumed that an individual would be exposed for some part of the time over a two-year span, then the averaging period would be 730 days. For carcinogens, exposure is averaged over a 70-year lifetime (the factor on which the cancer slope factors are based), and the averaging time is 70 years, in days (25,550 days).

5.3.2.3 *Dermal Uptake from Skin Surfaces*

The maximum uptake of a constituent through the skin can only occur to the extent that the constituent remains on the skin. Therefore, any algorithm that addresses skin uptake must first account for removal from the skin by ingestion. The algorithm used to estimate skin uptake is:

$$Dd = \frac{(Ds * (1 - FTSM) * ABSd)}{(BW \ x \ AT)} \qquad \text{(Equation 5-4)}$$

Where:

Dd = Dermal dose (mg/kg*day)
Ds = Amount of constituent deposited on skin (mg)
FTSM = Fraction transferred from skin to mouth
ABSd = Dermal absorption fraction
BW = Body weight (kg)
AT = Averaging time (days)

Factors that are common to both oral and dermal intake of constituents are described in the previous section (Section 5.3.2.2)

Dermal Absorption Fraction (ABSd)

Dermal absorption is constituent-specific but is also highly dependent on the conditions. Dermal uptake for PCBs in solvent vehicles range from 15% to 56%, with most of the values clustering around 20% (ATSDR, 1993). The PCBs detected at the BICC Site are not in a solvent and therefore these high absorption rates are clearly not appropriate. Studies of dermal absorption of PCBs from soil indicate that uptake can range from 3% (Michaud et al., 1994) up to 6% (USEPA, 1992a). Since the conditions at BICC are more consistent with PCBs in soil than PCBs in solvent, but to remain health protective, the dermal uptake factor used for PCBs (PCB FTSM) was 6%.

Metals are poorly absorbed through the skin (Moore et al, 1980). Moore conducted studies on dermal absorption of lead acetate and concluded that the maximum absorption was approximately 0.3% (0.003) of the applied dose. This value, which lies within the range reported by USEPA for inorganic constituents (USEPA, 1995), was assumed. Since lead is absorbed less than other inorganic constituents, its ABSd would be on the lower end of the USEPA range (i.e., 0.1 to 1).

5.3.2.4 *Total Intake*

Total intake of PCBs and lead, where relevant, are derived for potential receptors in each building area by summing the oral intake and dermal uptake. The equation for deriving total intake is as follows:

$$Dt = Do + Dd \qquad \text{(Equation 5-5)}$$

Where:

Dt = Total dose (mg/kg/day)
Do = Oral dose (mg/kg/day)
Dd = Dermal dose (mg/kg/day)

Tables 5-2 to 5-7 provide the pathway specific contributions to total dose for the various receptors described above. In the case of PCBs, the estimated average daily intake is dependent on whether they are considered to be carcinogenic or non-carcinogenic. The total intake is used in the subsequent risk calculations.

5.4 RISK CHARACTERIZATION

Risk characterization integrates information on the presence of constituents at the Site, the known toxicity of those constituents, and the Site-specific exposure scenarios described in the exposure assessment. The exposure scenarios are based upon the most likely pathways by which exposure could occur to defined receptors.

5.4.1 *Estimates of Carcinogenic Risk from PCBs*

Incremental lifetime cancer risk (ILCR), also referred to as excess cancer risk, is defined as the estimated increased risk that occurs over an assumed average life span of 70 years as the result of exposure to a specific known or suspected carcinogen (USEPA, 1989a). It is expressed in terms of additional cancers, above the normal background, that might be anticipated as a result of specific exposure to an external influence, such as exposure to a carcinogen via ingestion, inhalation or absorption.

The ILCR is derived from the estimated average daily lifetime intake and a cancer potency factor (CPF). The CPF for PCBs was obtained from the Integrated Risk Information System (IRIS) (USEPA, 2002). The estimation of the ILCR is given by:

$$ILCR = CPF * LADD \qquad \text{(Equation 5-6)}$$

Where

ILCR = Incremental lifetime cancer risk for exposure to PCBs.
CPF = Cancer potency factor $(mg/kg*day)^{-1}$.
LADD = Estimated average lifetime daily dose (mg/kg*day) for exposure to PCBs based on oral and dermal uptake.

The results of these calculations are presented in Section 5.5.

5.4.2 *Estimates Of Noncarcinogenic Risk From PCBs*

PCBs are also recognized to have noncarcinogenic effects, therefore it was considered appropriate to evaluate their noncarcinogenic toxicity. The acceptable intake may be expressed in a variety of ways, such as acceptable intake-chronic (AIC) or as a reference dose (RfD).

A hazard quotient (HQ) is determined for noncarcinogens based on the ratio of the estimated daily intake to the RfD, such that:

$$HQ = \frac{ADD}{RfD} \qquad \text{(Equation 5-7)}$$

Where:

HQ = Hazard quotient (unitless)
ADD = Estimated average daily dose from all exposure pathways (mg/kg/day)
RfD = Reference dose (mg/kg/day)

The results of these calculations are presented in Section 5.5.

5.4.3 *Estimates of Risk Associated with Lead Exposure*

The following equation was used to determine the potential blood lead concentrations from the ingestion and dermal contact exposure routes. This equation, which is based on the Adult Lead Model (ALM) (USEPA, 1996a) for soil ingestion, was adapted to also address dermal contact exposure. The need to include other pathways for lead exposure was acknowledged by Bowers, et al (Bowers, et al, 1994). The ALM, which evaluates the risks associated with non-residential adult exposures to lead in soil, was adapted to accommodate the wipe sample data that has been collected at the Site.

$$PbBt = PbBb + \left[(Do + Dd) * BSF * BW * 1000\right] \qquad \text{(Equation 5-8)}$$

Where:

PbBt = Estimated geometric mean total blood lead concentration (µg/dL)
PbBb = Background blood lead concentration (µg/dL)
Do = Estimated daily oral dose (mg/kg/day)
Dd = Estimated daily dermal dose (mg/kg/day)
BSF = Biokinetic slope (µg/dL)
BW = Body weight (kg)
1,000 = Conversion from mg to µg

The biokinetic slope factor is the relationship between daily-absorbed amounts of lead and adult blood lead concentrations. The ALM (USEPA, 1996a) provides a set of default parameter values, such as background adult blood lead concentration and the geometric standard deviation (GSD). In the ALM, a background adult blood lead concentration of 1.7 μg/dL and a biokinetic slope factor of 0.4 μg/dL per μg/day (USEPA, 1996a) is assumed. The GSDs used in the model are obtained from USEPA (1996a) and are for a homogenous population (GSD of 1.8) or a heterogeneous urban population (GSD of 2.1).

The biokinetic slope factor for lead is derived from human studies, but mainly focuses on populations that have higher than normal lead intake from their daily activities. These populations are typically from a lower socio-economic class with living conditions conducive to higher lead intake due to the older tenement housing.

Lead present in the maternal circulation may be of concern to the developing fetus, since lead is known to cross the placenta. Developing fetuses are particularly sensitive to health impacts associated with lead exposure during the maturation of the neurological system. It has been estimated that the blood lead concentration of the fetus is approximately 90 percent of the maternal blood lead concentration (USEPA, 1996a). Thus, to estimate the potential blood lead concentration in the fetus of a pregnant female facility worker or Site tenant, the following equation is used:

$$PbBf = PbBt * \mathbf{0.9} \quad \text{(Equation 5-9)}$$

Where:

PbBt = Estimated geometric mean total blood lead concentration (μg/dL)
PbBf = fetus blood lead concentration (μg/dL)

In order to further evaluate the maximum potential risk associated with the mean blood lead concentration, additional statistical calculations may be performed and the results compared to the screening criteria established by the Centers for Disease Control (CDC) and the USEPA. These two regulatory agencies have established a blood lead concentration of 10 µg/dL as a screening level for young children.

The USEPA has not developed a similar “level of concern” for blood lead concentrations in youths and adults. However, the American Conference of Government Industrial Hygienists (ACGIH) recommends a blood lead level less than 30 µg/dL for male and non-pregnant female workers and a blood lead level less than 10 µg/dL for pregnant female workers. OSHA has stated that prevention of adverse health effects for most workers from lead exposure throughout a working lifetime requires that worker blood lead level be maintained at or below 40 µg/dL of whole blood (29 CFR Part 1910.1025). Thus, if a worker’s blood lead level is less than 40 µg/dL, OSHA does not require medical monitoring or workplace intervention.

The estimated geometric mean blood lead concentration is defined as the concentration exhibited by one-half the exposed population. This value is used to estimate the blood lead concentrations exhibited by 90%, 95% and 99% of the exposed population. For each of the three percentiles, blood lead concentrations are estimated using geometric standard deviations (GSDs) of either 1.8 or 2.1. The following equations are used to estimate the 90th, 95th and 99th percentile blood lead concentrations, respectively.

$$PbB_{90th} = e^{(\ln(PbBt)+1.282*\ln(GSD))} \qquad \text{(Equation 5-10)}$$

Where:

PbB_{90th} = Estimated 90th blood lead concentration (µg/dL)
PbBt = Estimated geometric mean (50th percentile) blood lead concentration (µg/dL)
GSD = Geometric standard deviation of 1.8 or 2.1

$$PbB_{95th} = e^{(ln(PbBt)+1.64*ln(GSD))} \qquad \text{(Equation 5-11)}$$

Where:

PbB_{95th} = Estimated 95th percentile blood lead concentration (µg/dL)
PbBt = Estimated geometric mean (50th percentile) blood lead concentration (µg/dL)
GSD = Geometric standard deviation of either 1.8 or 2.1

$$PbB_{99th} = e^{(ln(PbBt)+2.33*ln(GSD))} \qquad \text{(Equation 5-12)}$$

Where:

PbB_{99th} = Estimated 99th percentile blood lead concentration (µg/dL)
PbBt = Estimated geometric mean (50th percentile) blood lead concentration (µg/dL)
GSD = Geometric standard deviation of either 1.8 or 2.1

The results of these calculations are presented in Section 5.5.

5.4.4 Risk Perspective

The estimated carcinogenic risks associated with certain exposures are expressed numerically as excess lifetime cancer risks. With respect to noncarcinogenic risks, a numerical determination (i.e. hazard quotient) is used to ascertain whether or not the specified exposures will likely cause significant adverse effects to the exposed populations.

The quantitative risks that are derived in this process are a tool to be used by the decision-makers in striving to manage risks as part of the cleanup. For example, USEPA typically uses the general 10^{-4} to 10^{-6} risk range for carcinogens as a "target range", coupled with a hazard quotient of 1, within which the agency strives to manage risks as part of a Superfund cleanup (USEPA, 1991). The total carcinogenic risk posed by multiple constituents may be evaluated by summing the risks for all constituents for each exposure route.

In general, when the cumulative carcinogenic risk is less than 10^{-4}, and the non-carcinogenic hazard quotient is less than 1, remedial action is not automatically warranted unless there is an adverse environmental impact (USEPA, 1991). When these benchmarks are exceeded, a 10^{-6} carcinogenic risk is used as a “point of departure” to establish preliminary remediation goals.

The risk characterization for the specified exposure scenarios are presented as either greater or less than 10^{-4} for carcinogens and greater or less than 1 for noncarcinogens. When the risk is greater than one or both of these benchmarks, the risk is usually characterized by the regulatory agency as requiring a remedial action. When it is less, then the risks might be deemed by the regulatory agency as not requiring any remedial action, pending other input factors to be used by the decision-maker.

5.5 RESULTS

Tables 5-2 through Table 5-7 present the risk characterization results and blood lead concentrations for the building areas under the previously described exposure scenarios. Table 5-8 presents a summary of the risk characterization results and the blood lead concentrations. The blood lead concentrations reported on Table 5-8 are the estimated 95th percentile concentrations with a GSD of 2.1. Although EPA recommends use of the 95% blood lead concentration, the 90% and 99% blood lead concentrations were also presented in Tables 5-2 through 5-7. Following is a description of the results presented in these tables.

Risk characterization results for both the current and future use exposure pathways are presented in Table 5-2 through 5-7 and summarized in Table 5-8. Following is a summary of these results by receptor:

- Non-carcinogenic risks: the hazard quotient (and hazard index since only one constituent) ranged from 0.25 (2.5E-1) for the child tenant exposed to building average concentrations of PCBs to 0.64 (6.4E-1) for both an adult short-term tenant and a facility worker exposed to the building 95 percent UCL concentration;
- Carcinogenic risks: the ILCR ranged from 1.5E-7 (1.5×10^{-7}) for the child short-term tenant exposed to building average concentrations of PCBs to 5.6E-6 for a facility worker exposed to the building 95 percent UCL concentration; and
- The 95% blood lead concentrations ranged from 5.8 µg/dL for the child tenant exposed to building average concentrations to 7.2 µg/dL for both an adult short-term tenant and a facility worker to the building 95 percent UCL concentration. Maximum estimated fetal blood lead concentrations were 6.4 µg/dL.

Based on the results of this risk characterization, the 95 percent UCL concentration for PCBs poses a carcinogenic risk to an adult facility worker or a short-term tenant that is slightly elevated above the *de minimis* level of 1E-6

In addition, all estimated blood lead concentrations are well below the CDC screening level of 10 µg/dL. This screening level was used since the most sensitive potential receptors are children and the fetuses of adult workers. It should be noted that the majority of the estimated blood lead concentration for both facility workers and female adult workers is due to background (or baseline) lead concentrations and not Site-related lead concentrations. Thus, any possible contribution of lead from the Site to a developing fetus and facility workers under current Site use is minimal.

5.6 EVALUATION OF LEAD-BASED PAINT SURVEY RESULTS

As discussed in Section 3.2.10, a lead paint survey was conducted in the Site buildings. This survey identified surfaces containing lead-based paint through XRF measurements of the accumulated paint on building surfaces. This measurement is based on the mass of lead in the entire thickness of paint accumulation and is not necessarily a measurement of exposure risk. In addition, the measurement does not distinguish whether the lead paint is present in the surface layer or has been covered by subsequent layers of unleaded paint.

Currently, there are no criteria or standard for the concentration of lead in paint in non-residential settings. In the absence of non-residential criteria, the residential HUD value of 1 mg/cm^2 was used to screen the lead survey results. Therefore, all areas identified below as containing lead-based paint are conservatively considered to be potential areas of concern at this time. The manner in which lead paint is addressed in the FS will be based on the scope of the specific remedial alternative under evaluation.

This section provides an evaluation of the findings of the lead-based paint survey based on the HUD residential screening criteria. Any specific issues related to potential risks to short-term Site tenants are also discussed below.

In total, 181 of the 1,525 locations surveyed contain lead-based paint based on the HUD residential criteria. As discussed in Section 3.2.9, lead-based painted surfaces are located in both previously cleaned and uncleaned areas of the Site buildings. Some of these lead-based painted areas are currently peeling. In summary lead-based paint is present in:

- 4 first floor rooms (Room Nos. 1028, 1034, 1037 and 1038) on walls, columns, beams, an unused limited access steel staircase and yellow paint markings on the floor – the lead-based paint in all four rooms is peeling;

- 5 second floor rooms (Room Nos. 2007, 2008, 2012, 2013 and 2014) on floors, walls, columns and railings – the lead-based paint in 4 of the 5 rooms (Room Nos. 2007, 2008, 2012 and 2013) is peeling;
- 15 third floor rooms (Room Nos. 3006, 3010, 3011, 3012, 3013, 3015, 3016, 3017, 3018, 3026, 3028, 3035, 3036, 3037 and 3038) on walls – the lead-based paint in 4 of the 15 rooms (Room Nos. 3013, 3018, 3036 and 3037) is currently peeling;

Therefore, there are a total of 24 rooms on the first, second and third floors with lead-based paint on walls, metal stairs, boilers, doors, floors, columns and cabinets – the lead-based paint in 12 of the 24 rooms is currently peeling.

During the previous cleaning conducted to remove surface accumulations in the first and second floor areas, floors and walls were pressure washed and some floors were shot-blasted. In addition to removing the surface accumulation, this cleaning also removed some peeling paint from the floor and wall surfaces. Since the majority of the peeling paint within a reachable distance (i.e., floor and walls) was removed during this cleaning, the rooms located on the first and second floor with peeling lead-based paint are not expected to pose an unacceptable risk under the current building use scenario. Maintenance activities are conducted to ensure that paint chips falling from peeling areas are immediately removed from the floor surface. Under current use, areas of the third floor containing peeling lead-based paint should be physically restricted or abated prior to any future tenant occupancy in order to eliminate the potential for exposure to the lead-based paint. For areas containing lead-based paint that is not in peeling condition, lead paint abatement, maintenance or demolition will be considered for any future use of these areas.

6.0 FISH AND WILDLIFE IMPACT ANALYSIS

This section presents the Fish and Wildlife Impact Analysis (FWIA) for the Site. The FWIA was conducted in accordance with NYSDEC guidance including *Fish and Wildlife Impact Analysis* (NYSDEC, 1994) and *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC, 2002). According to the NYSDEC guidance, the initial phase of the FWIA involves two steps:

Step I – Site Description
Step II – Contaminant-specific Impact Assessment

The objectives of Step I of the FWIA are to: (1) identify the fish and wildlife resources that presently exist at the Site; (2) describe those resources that existed in the area of the Site; and (3) provide information to evaluate the need for additional study and/or remedy evaluation. The objective of Step II of the FWIA is to determine the impacts of site-related chemicals on fish and wildlife resources. This is accomplished in a three-step process. Step IIA, Pathway Analysis, is the first step of the chemical-specific impact assessment. If no resources are present or pathways are incomplete, there is no impact to the resources, and no further analysis is required. Step IIB, Criteria-Specific Analysis, is conducted to compare site-specific chemical levels with numerical criteria, and to determine the need for an additional and more in-depth phase of ecological investigation. Finally, Step IIC, Toxic Effects Analysis, involves an analysis of the toxic effects of constituents of concern at the individual, organism, population, community or ecosystem level. The evaluation assessed impacts by evaluating whether constituents of concern potentially affect the productivity and diversity of populations, species assemblages, communities or ecosystems through direct toxicological and indirect ecological effects.

6.1 *SITE DESCRIPTION*

A general Site description is provided in Section 1.3.1. As discussed in that section, the Site, which is located in a mixed industrial/residential area, is bordered by the Hudson River. Buildings located at the Site are constructed on soil/fill or over the river on pilings. The high and low water lines beneath these buildings are shown on Figure 2-33. The majority of the river sediment underlying the Site buildings is located within the intertidal zone. Debris piles are present beneath a number of the Site buildings that overlie the river. The locations of the debris piles are shown in Figure 2-33.

6.1.1 *Fish & Wildlife Resources*

A topographic map of the Site is provided as Figure 6-1. Documented fish and wildlife resources within a two-mile radius of the Site are shown on this figure, including the Hudson River and the Palisades State Park in New Jersey on the opposite shoreline. Other than a very small segment of the Saw Mill River nearly 2 miles to the east of the Site, no state or federally designated freshwater wetlands occur on, or in the vicinity of the Site.

The Hudson River is classified as an estuarine wetland by State and Federal agencies. The nearshore areas of the Hudson River adjacent to the Site are classified as LZ (littoral zone) on the NYSDEC Tidal Wetland Map 592-532 for Westchester County. According to the United States Fish and Wildlife Service National Wetland Inventory map, the Hudson River is classified as an Estuarine Subtidal Unconsolidated Bottom wetland (E1UBL).

A cover-type map of the Site is provided as Figure 6-2. The cover types shown in this figure are defined as follows based on the *Ecological Communities of New York State* (NYSDEC, 1990):

Terrestrial Communities

Urban Vacant Lot: an open site in a developed, urban area. Sparsely vegetated with areas of exposed soil, rubble and other debris.

Urban Structure Exterior: exterior surface of structures in an urban area. Surfaces may provide substrate for vegetation, invertebrates, nesting or resting areas for wildlife.

Interior of Non-Agricultural Building: interior space of a building used primarily by people for work or storage space.

Paved Road/Path: a road or pathway paved with asphalt, concrete, etc.

Artificial Beach: a sand beach on the river shore.

Estuarine Communities

Estuarine Riprap/Artificial Shore: substrate composed of rocks, bulkheads, or concrete. Vegetative cover and species diversity are low compared with natural estuarine shores.

Tidal River: the submerged aquatic community of substrates continuously flooded by tidal water.

Land use of the Site and surrounding area is primarily industrial and commercial. Developed parts of the Site consist of buildings and an asphalt parking lot, covering greater than 70% of the Site. The Hudson River Railroad Line is located to the east between the Site and adjacent residential and commercial areas of Yonkers. The railway right-of-way and a few small areas of the Site along roadways are vegetated with disturbed herbaceous growth including invasive weeds, shrubs and a few small trees. The soils underlying the Site are primarily fill. The upland community types are classified as Urban Vacant Lot, interspersed with pavement. The history of disturbance, lack of well-developed vegetative communities, and fragmented areas where ecological communities may exist contribute to limited ecological value in these areas. Therefore, upland communities are not addressed any further in the FWIA.

The Hudson River adjacent to the Site is a brackish, tidal river. The exposed portion of the shoreline along the Yard consists of a barren intertidal area made up of riprap and a small beach area at the southern edge of the property. The pilings have created an intertidal area underneath the buildings. Based on observations by the field team during the diver survey and sediment sampling, there were no signs of biological presence or activity in any of the samples collected from directly beneath the buildings. Although piers and pilings are traditionally thought to add structure to the fish habitat in the river, there has been little investigation of this in the published literature for the Hudson Estuary. Moreover, the building structures shut out sunlight from this intertidal area, a further impediment to the development of any sustained, ecological habitat. In the sediment samples collected from the river at a southern location just beyond the pilings, some shells and a live bivalve were noted. The sediment samples collected north of Site as Upriver samples, and the sediment samples collected from locations adjacent to the Yard contained shell fragments, but no other signs of biological activity.

According to the NYSDEC classification system, the estuarine community is classified as Tidal River in the areas below the lowest tide where the substrate is permanently flooded with tidal water. The aquatic community does not support emergent vegetation in the continuously submerged substrate.

Based on information provided by the New York Department of State (NYS DOS) Division of Coastal Resources & Waterfront Revitalization, the Site falls within a designated significant coastal fish and wildlife habitat, named the Lower Hudson Reach (see Section 6.1.2 below). This area extends for 19 river miles from Battery Park in Manhattan to Glenwood just north of Yonkers. Since New Jersey borders on the west and New York borders on the east of the Hudson River, the NJ-NY state line is in the middle of the river, so the Lower Hudson Reach refers only to the NY portion of the river. The depth, tide, and salinity of the Hudson River vary according to location. The depth ranges from 6 to 70 feet with a tide of 4 to 5 feet. The salinity of the River ranges from 3.8 parts per thousand (ppt) to 18.7 ppt and is therefore considered a brackish environment. The salinity also varies according to the season and the amount of precipitation. Since there is typically a high volume of freshwater precipitation during the winter months, the salt front is pushed south towards New York City. During the summer months, the amount of precipitation decreases and the salt front pushes north for many miles. This varies from year to year and is dependent on the amount of precipitation.

Most of the shoreline along this habitat has been extensively disturbed through filling, bulkheading, and development including residential, commercial, industrial, and public uses. There are still limited areas of natural shoreline and wetland vegetation along the Lower Hudson Reach even though it continues to receive pollutants from stormwater runoff, sewage effluents, and industrial or commercial point sources.

Despite extensive disturbance from filling and development, and impaired water quality, this habitat sustains a diverse community of benthic, planktonic, and pelagic species. The striped bass is a regionally significant fish that seasonally inhabits the Lower Hudson Reach. Their spawning typically occurs above the salt front, which is located farther to the north from April to mid-June in areas between West Point and Kingston at Hudson River Miles 44 to 56. Juvenile fish can be widely distributed through the Hudson River estuary and nearby coastal waters, with significant concentrations typically found in proximity to the salt front as it recedes downriver to its winter position in the Lower Hudson

Reach. Yearling striped bass (those spawned in the previous year) generally remain within 25 to 50 miles of the mouth of the Hudson River. On average, after two years of age the striped bass move out into the coastal waters and only return to the Hudson River to spawn beyond age four.

In addition to the striped bass, several other finfish species use the area. These include the yearling winter flounder, summer flounder, white perch, Atlantic tomcod, Atlantic silversides, bay anchovy, hogchokers, American eel, bluefish, weakfish young, Atlantic sturgeon, shortnose sturgeon adults only, American shad, and blue crabs. Animals of lower trophic levels are also present in substantial numbers providing an important food source. These include planktonic forms such as copepods, rotifers, mysid shrimp; and, benthic forms such as nematodes, oligochaetes, polychaetes, and amphipods. The Lower Hudson Reach also provides habitat for wintering waterfowl. These include canvasback, scaup, merganser, mallard, and Canada goose.

6.1.2 *Fish & Wildlife Regulatory Criteria*

Applicable fish and wildlife regulatory criteria at the Site include water quality standards, sediment criteria, and other acts and regulations governing rivers and navigable water bodies in New York State. Other applicable regulations include: Environmental Conservation Law (ECL) Article 15 Title 5 Protection of Waters; Article 25 Tidal Wetlands; Article 11 Title 5 11-0503 Polluting Streams Prohibited, and 11-0535 Endangered and Threatened Species; and Article 11 Title 3 11-0306 Hudson River Estuary Management Program.

Based on correspondence with the New York State Natural Heritage Program, there are no records of known occurrences of state listed threatened or endangered species in the Site vicinity. Based on correspondence with the United States Department of Interior, Fish and Wildlife Service, the short-nosed sturgeon (*Acipenser brevirostrum*) is a federally endangered fish that occurs in the Hudson River and other Atlantic coastal rivers. This species uses the lower Hudson River as a nursery area and for foraging during migration (http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/shnostur.html).

The New York State Department of State (NYS DOS) Coastal Management Program designates the Lower Hudson Reach of the Hudson River as a Significant Habitat. Under NYS DOS Policy 7, significant coastal fish and wildlife habitats will be protected, preserved, and where practical, restored so as to maintain their viability as habitats. The NYS DOS Coastal Management Program is part of the federal Coastal Zone Management Program administered by the National Oceanic and Atmospheric Administration (NOAA), and authorized by the Coastal Zone Management Act of 1972. Day-to-day management under this program rests at the state level. The Lower Hudson Reach was designated as a significant habitat on September 15, 1992.

6.1.3 Site Drainage

Site drainage pathways are shown on Figure 6-3. The Site is relatively flat with relief of less than 10 feet. Drainage of overland stormwater flow is generally toward the river, but direct discharge to the river is largely prevented by the elevated riprap along the shoreline. No drainage swales, ditches or ponded areas were observed during the Site visit. After heavy precipitation events, runoff collects in a small ponded area on the paved area as shown on Figure 6-3, and is pumped to the river as necessary to avoid flooding. Stormwater runoff is described in greater detail in Section 1.4.4 of the RI report.

6.2 CONTAMINANT-SPECIFIC IMPACT ASSESSMENT

As stated previously, the objective of the contaminant-specific impact assessment is to determine the impacts of site-related contaminants on fish and wildlife resources. This task consists of three steps of increasing complexity which are Pathway Analysis, Criteria-Specific Analysis and Analysis of Toxic Effects. Each of these steps is further discussed below.

6.2.1 Pathway Analysis

The objective of the Pathway Analysis is to identify constituents of potential concern (COPCs), their sources, potential pathways of migration, and exposure. The Site-related organic compounds and inorganic constituents are described in Section 2.0. These data were reviewed to identify potential constituents of concern and migration pathways and exposures for fish and wildlife. Based on the Site survey, there do not appear to be wildlife resources present in sufficient abundance or quality on the terrestrial portion of the Site to warrant an extensive evaluation of ecological risks. In contrast, the Hudson River, which is adjacent to the western border of the Site, contains fish and wildlife resources that have the potential to be impacted by Site-related constituents. Therefore, a conceptual Site model was developed to summarize the potential migration pathways and to evaluate the risks from exposure to Site-related constituents. This conceptual site model is provided in Figure 6-4.

As shown on this figure, the primary migration pathways are discharge to the surface water and sediment in the Hudson River in the vicinity of the Site. This could occur from surface runoff, discharges from the drain systems and outfalls, and seepage of ground water to the river. Debris piles located under the buildings could also be a source of chemicals in sediment in the Site vicinity. Thus, fish and wildlife resources in the river or sediment may be exposed to Site-related constituents that migrate to these media. Therefore, this FWIA focuses on evaluating potential impacts from Site-related constituents to surface water and sediment.

6.2.2 *Criteria-Specific Analysis*

The criteria-specific analysis uses numerical criteria to assess potential impacts associated with the constituents of concern. The numerical sediment screening criteria are obtained from the New York State Department of Environmental Conservation *Technical Guidance for Screening Contaminated Sediments* (NYSDEC, 1999) and other references, as described below. If constituent concentrations are less than the numerical screening criteria, no further evaluation or analysis is necessary. Since the numerical screening levels are conservative where constituent concentrations exceed the criteria, a further evaluation is needed to ascertain the likelihood of any adverse effect on aquatic biota and/or whether such effects can be predicted. Specifically, the NYSDEC's sediment screening guidance states that, though criteria can be used to identify contaminated areas and evaluate potential risk to aquatic life, a site-specific evaluation may be required to quantify the level of risk, establish remediation goals, and determine the appropriate risk management actions.

The criteria-specific analysis considered available analytical data for sediment, surface water and ground water. Sediment samples were collected from various locations in the Hudson River, including: (1) the river channel adjacent to the Yard; (2) Upriver; and (3) beneath and adjacent to the Site buildings. Sediment sampling was conducted in two distinct phases, with the Phase I samples being collected in December 2001, and the Phase II samples collected in March 2003. It should be noted that the samples collected adjacent to the Yard, adjacent to the Site buildings and Upriver are subtidal (i.e., always submerged beneath water), with the exception of one Upriver sample (SEDN-3A), which is intertidal. In contrast, most of the samples collected from beneath the buildings are intertidal (i.e., alternately submerged and exposed). Accordingly, samples beneath and adjacent to the buildings have been grouped into intertidal and subtidal categories, respectively, for the purposes of the criteria-specific analysis.

The Phase I sediment samples were collected at various depth intervals, including the surface (0 to 6 inch) interval, which is considered to be the layer with the greatest biotic activity and hence the greatest potential for exposure to aquatic life. The samples were analyzed for SVOCs, PCBs and inorganics. In Phase II, samples were analyzed for a subset of these constituents, depending on their location, as described in earlier Sections. In addition, to support data interpretation, pore water samples were collected from selected locations adjacent to the Yard and from the subtidal building areas in Phase II and analyzed for a subset of metals. Acid Volatile Sulfide (AVS)/Simultaneously Extracted Metal (SEM) parameters were also evaluated in some of the sediment samples from both Phase I and Phase II to address bioavailability of metals.

To address the potential for surface water impacts, two surface water samples were collected from the river adjacent to the Site and analyzed for inorganic constituents. Finally, ground water samples were collected from the on-site monitoring wells and analyzed for VOCs, SVOCs, PCBs and inorganics. The specific methods and results of the criteria-specific analysis are discussed below by medium.

6.2.2.1 *Sediment Screening*

The available sediment data from the yard and the buildings were evaluated according to the methodology presented in *Technical Guidance for Screening Contaminated Sediments* (NYSDEC, 1999). In addition, Upriver sediment data were evaluated. Because the top 6 inches of sediment is generally considered the biologically active zone, data collected from 0 to 6 inches was evaluated separately from the data collected between 6 and 12 inches.

Reported concentrations of the positively detected constituents, as well as maximum detection limits, were compared with the sediment screening levels identified in the NYSDEC sediment screening guidance document. Because the Hudson River in the vicinity of the site is classified as a Class SB saline surface water, ER-L guidance values as presented in Appendix 4 of the *Technical Guidance for Screening Contaminated Sediments* (NYSDEC, 1999) were utilized, where available, in this analysis. For constituents lacking ER-L values, the sediment criteria based on benthic aquatic life chronic toxicity for salt water, as presented on Table 1 of the NYSDEC guidance document, were utilized. In instances where neither of the above screening values was available, screening values were derived based on the following hierarchy:

- Ambient Water Quality Criteria – Criteria Continuous Concentrations (CCC) for marine waters as presented in Buchman (1999) were used, where available, to derive sediment screening values based on equilibrium partitioning for non-polar organics.
- For non-polar organic constituents lacking the above criteria and inorganic constituents, the lowest marine sediment screening value presented in Buchman (1999) was selected. For each constituent under consideration, the lowest value reported for marine sediments was an Apparent Effects Threshold (AET).

The screening evaluation described above assesses direct toxicity. Hence, a second screening evaluation was simultaneously conducted to assess potential risks to piscivorous wildlife through bioaccumulation. This analysis was based on the wildlife bioaccumulation sediment criteria presented on Table 1 of the *Technical Guidance for Screening Contaminated Sediments* (NYSDEC, 1999).

The results of the screening evaluation for positively detected and non-detected constituents are discussed separately below.

Screening Results for Positively Detected Constituents

Tables 6-1 through 6-8 summarize the results of the direct toxicity screening conducted for sediment samples collected adjacent to the Yard, intertidal and subtidal building locations and at Upriver locations. These comparisons are presented separately for the 0 to 6 inch and 6 to 12 inch sediment sample depths. The results of this screening evaluation indicated that various PAHs, PCBs and several inorganic constituents in samples collected from the Yard, intertidal and subtidal building areas and Upriver locations consistently exceed the screening criteria in both the 0 to 6 inch and 6 to 12 inch sample intervals. In addition, the following constituents were occasionally reported at concentrations in excess of the screening criteria:

- Dibenzofuran exceeded its screening criterion in the Upriver samples (both sampling intervals) and in samples collected from the 6 to 12 inch interval in the intertidal and subtidal building areas.
- Bis(2-ethylhexyl)phthalate exceeded criteria in both the 0 to 6 inch interval and the 6 to 12 inch interval in the intertidal building area.
- 1,4-Dichlorobenzene and dimethyl phthalate exceeded criteria in one sample each from the intertidal building area within the 6 to 12 inch interval.
- Diethyl phthalate exceeded criteria in a single sample from the intertidal building area within the 0 to 6 inch interval.

Figures 6-5 and 6-6 graphically depict the maximum concentrations of total PAHs/total PCBs and inorganic constituents, respectively, exceeding the screening criteria in the sediment samples collected adjacent to the Yard, intertidal and subtidal building areas and at the Upriver locations. As shown on these figures, the maximum concentrations of constituents of concern in the 0 to 6 inch interval are frequently comparable to, or lower than, the deeper interval, regardless of location. One apparent exception to this is PCBs in the intertidal and subtidal building areas. Maximum PCB concentrations in the 0 to 6 inch interval in these areas are higher than the maximum concentrations observed in the 6 to 12 inch interval. With respect to the subtidal building area, PCB concentrations in the 0 to 6 inch samples at two locations adjacent to the buildings (SED8W-01 and SED12-02) are higher than in the 6 to 12 inch samples. The concentrations of total PCBs and metals such as lead and copper at the remaining sampling locations in the subtidal building area are lower in the 0 to 6 inch interval than in the 6 to 12 inch interval (see Section 2.4.3). Lastly, it is worth noting that fewer constituents are present at concentrations above the screening criteria in the 0 to 6 inch interval than in the deeper interval samples that were collected adjacent to the Yard, in the intertidal and subtidal building areas.

Other notable observations from these results include:

- The maximum concentrations of constituents detected in the sediment samples collected adjacent to the Yard were generally similar to those detected in the Upriver samples.
- There does not appear to be site-related constituent migration from the intertidal building area to the areas adjacent to the Yard (based on similarity of the Upriver sediment samples and the samples collected adjacent to the Yard);
- The Upriver sample locations exhibited the highest concentrations of total PAHs.
- The concentrations of total PAHs in the sediment samples collected adjacent to the Yard were also substantially lower than the total PAH concentrations from the sediment samples collected from the intertidal and subtidal building areas and the Upriver samples.
- The observed difference in sediment sample PAH concentrations between the areas may be due, in part, to differences in the physical environment or other potential anthropogenic source of PAHs, such as the former power plant located north of the Site. Additional discussion regarding the potential impacts from the power plant is provided in Section 6.2.3.1.
- The observation that many of the deeper sampling intervals generally contained higher constituent concentrations and more frequent

excursions of screening criteria suggests that some degree of natural recovery is occurring in the river.

As stated previously, in addition to the screening evaluation based on direct toxicity, a second screening evaluation was conducted to assess potential risks to piscivorous wildlife from bioaccumulation. Total PCBs were the only constituents identified at levels in excess of this second screening criterion. As shown on Tables 6-9 and 6-10, PCBs exceeded the bioaccumulation screening criteria in both the 0 to 6 inch and 6 to 12 inch sampling intervals, respectively. Further discussion of PCB toxicity is provided in Section 6.2.3 (Toxic Effect Analysis).

Screening Results for Non-Detects

Constituents with detection limits frequently exceeding screening criteria based on direct toxicity included dibenzofuran, diethyl phthalate, dimethyl phthalate, hexachlorobutadiene, hexachlorocyclopentadiene, pentachlorophenol, phenol, various PAHs, PCBs, cadmium, cobalt, selenium and silver. In addition, dichlorobenzene detection limits exceeded criteria in one location from each depth within the intertidal building area. With respect to these results, the following points should be noted:

- There are a sufficient number of detections of dibenzofuran, PAHs, PCBs, cadmium, cobalt and silver to adequately characterize the distribution of potential risks associated with these constituents.
- Detection limits for the dichlorobenzenes in the intertidal building area were normalized based on organic carbon. Criteria were exceeded at this location due to very low sediment organic carbon content. Samples at this location were noted to have a high content of sand and gravel. This was the only location where detection limits for these constituents exceeded screening values.
- The detection limits for diethyl phthalate, dimethyl phthalate, hexachlorobutadiene, hexachlorocyclopentadiene, pentachlorophenol, phenol and selenium are within those normally achievable by the analytical methods and were within acceptable quality control limits. With the exception of diethyl phthalate, dimethyl phthalate and

selenium, there were no other detections of the above constituent identified at the Site. The scarcity of positive detections of diethyl phthalate and dimethyl phthalate (one sample in one interval) and selenium, suggests that these constituents are not an ecological concern.

As shown on Tables 6-11 and 6-12, constituents with detection limits exceeding screening criteria based on wildlife bioaccumulation included hexachlorobenzene, hexachlorobutadiene and total PCBs. With respect to these results, the following points should be noted:

- There are a sufficient number of positive detections of PCBs to adequately characterize the distribution of, and potential risks that may be associated with this class of constituents.
- With the exception of samples from the intertidal building area, the detection limits for PCBs were only marginally higher (i.e. no more than a factor of two) than the wildlife bioaccumulation criteria. Detection limits for samples collected from the intertidal building area were normalized based on organic carbon and were above criteria due to very low sediment organic carbon content. Samples at this location were noted to have a high content of sand and gravel. In addition, one sample location had elevated detection limits; however, the remaining sample detection limits were not elevated.
- Overall, the detection limits for hexachlorobenzene, hexachlorobutadiene and PCB Aroclors 1016, 1221, 1232, 1242 and 1254, is within those normally achievable by the analytical methods and was within acceptable quality control limits, with the exception noted previously. No detections of these chemicals were identified at the Site, and they are presumed to be not of ecological concern.

<u>Background Evaluation (Upriver)</u>

In order to place the aforementioned sediment screening into a proper perspective, the constituents that exceeded criteria in sediment samples adjacent to the Yard and in the intertidal and subtidal building areas were statistically compared to Upriver data. This was based on the nonparametric, distribution-free methodologies presented in NYSDEC (2002). In accordance with this guidance, the concentrations of constituents exceeding NYSDEC sediment criteria were compared to the maximum Upriver values for the appropriate depth interval. Prior to comparing Site data to the Upriver maximum values, the Upriver data were evaluated to identify outliers following methods recommended in NYSDEC (2002). However, this methodology was only applicable for metals and PCBs in the 0 to 6 inch interval, because of the small sample size for the other constituents and sample intervals. Therefore, for the constituents with no more than 5 Upriver samples in a given sample interval, the maximum was used to represent background conditions, but no outlier test could be conducted. In addition:

- Upriver sediment samples were collected as part of the RI for the specific purpose of distinguishing site-related impacts from ambient, upstream conditions within the river (as opposed to evaluating naturally occurring conditions). The dynamic nature of sediments, as well as release and transport characteristics, was considered in the sediment sampling plan.
- To account for the complex dynamics of sedimentary environments the physical characteristics of the sediment data collected in close proximity to the Site were assessed and compared to the Upriver samples. This comparison demonstrates that sediment from Upriver locations is comparable to sediment from the Site. For example, the grain size analysis shows that three of the four surface sediment samples from the Upriver locations had >80% fines, as did all of the Site surface sediment samples from adjacent to the Yard. The majority of the samples from the subtidal buildings (11 out of 14) also had >80% fines. Thus, both the Upriver and the Site sediments taken from subtidal locations exhibit a predominance of fine sediments indicative of a depositional environment.

The samples included in the Upriver data set included the site-specific Upriver samples collected north of the Site (i.e., SEDN samples 1B, 2B, 3B and 3A) and the three most southerly Harbor-at-Hastings samples (i.e., EB-4, EB-5 and EB-34). These samples were collected during the RI for the Harbor at Hastings site and were found to be outside the area of influence of potential site-related releases. The Harbor at Hastings site is located approximately 3 miles north of the Site. Use of the EB-4 and EB-5 sediment samples as Upriver samples was agreed to by the NYSDEC (NYSDEC, 2001e). The EB-34 sample was added by ERM because it is the southernmost of the Harbor at Hastings samples. It also is expected to be outside of the influence of the site. In addition, the PCB concentrations in this sample was lower than the PCB concentrations in the other agreed upon Upriver samples. An additional off-site sample, SEDS-1B, was not used in the Upriver data set based on input from NYSDEC because of its location downstream from the site. In addition, at NYSDEC's request, additional PCB and metal background data collected from 10 locations by NYSDEC for the Harbor at Hastings investigations were included in the BICC Upriver data set.

Similar to the approach used in the screening evaluation, background comparisons were conducted separately for the 0 to 6 inch and 6 to 12 inch depth interval. In addition, the comparisons were conducted separately for each area.

Tables 6-3 through 6-8 summarize the comparison of Site sediment samples to the maximum Upriver concentrations. A variety of constituents in the intertidal building sediment results exceeded Upriver concentrations in both the 0 to 6 inch and 6 to 12 inch intervals at one or more locations. The frequency decreases (i.e. fewer samples that exceed Upriver sediment sample concentrations) in the subtidal building area locations (see Tables 6-5 and 6-6). As shown on these tables, although several individual PAHs exceed Upriver concentrations in the subtidal building area, total PAHs do not exceed Upriver levels. PCBs exceed Upriver levels at only three out of 15 and five out of 15 subtidal building locations in the 0 to 6 inch interval and 6 to 12 inch interval, respectively. Of the metals, lead and silver are the only constituents with more than one exceedance of Upriver levels in the 0 to 6 inch interval for the subtidal building locations.

For the samples collected adjacent to the Yard from the 0 to 6 inch depth interval, only barium and lead exceed Upriver levels in more than one sample.

6.2.2.2 *Pore Water Screening*

Pore water samples were collected from eight locations adjacent to the Yard and nine locations from the subtidal building area. These samples were analyzed for metals including cadmium, copper, lead, nickel, silver and zinc. Of these, only copper and lead were positively detected. Copper was positively detected in 5 samples adjacent to the Yard and 4 samples from the subtidal building area, and zinc was positively detected in one sample adjacent to the Yard and 5 samples from the subtidal building area.

Pore water results were compared with available surface water quality criteria. Positively detected concentrations of copper in pore water exceeded the NYSDEC Ambient Water Quality Standard for Class SB saline surface waters. In contrast, all reported concentrations of zinc were less than applicable surface water quality standards.

With respect to the pore water results that exceed ambient water quality criteria for copper, it should be noted that the AVS/SEM molar ratios at these locations were consistently less than 1, and copper sediment concentrations did not exceed ER-M values. In addition, it should be noted that there was no apparent correlation between bulk sediment copper concentration and copper pore water concentration. For instance, based on a review of the data available from locations where both pore water and bulk sediment samples were collected, the maximum copper pore water concentration was observed at the sampling location with the lowest copper bulk sediment concentration (i.e., SED09-01-01).

The occurrence of AVS/SEM molar ratios of <1 along with the simultaneous exceedance of water quality criteria for copper in pore water at some locations may appear inconsistent because AVS/SEM theory predicts that any freely dissolved metal will be bound by sulfide if the moles of acid volatile sulfide exceed the moles of simultaneously extractable metals. However, forms of metals other than the divalent cation can occur in pore water solutions, such as ligands with dissolved organic carbon (DOC). In fact, as pointed out by NYSDEC's *Technical Guidance for Screening Contaminated Sediments*, sediment interstitial water frequently contains a higher concentration of DOC than surface water. Although DOC was not measured as a part of the Site investigations, relatively high levels of DOC would be expected, particularly in organic-enriched, eutrophic systems such as the lower Hudson. The literature indicates that binding to DOC reduces the toxicity of copper. Therefore, even though copper concentrations exceeded surface water quality criteria in some pore water samples, given the AVS/SEM ratio <1, the weight of evidence suggests that pore water would not be toxic to benthic life as a result of copper and other divalent metals. Further discussion of metals bioavailability and AVS/SEM is provided in Section 6.2.3.4.

Elevated detection limits were reported for copper and nickel that are above the aforementioned water quality criteria. Thus, the non-detect results for copper and nickel are inconclusive. It should be noted, however, that reported detection limits for cadmium, lead and zinc were generally less than applicable surface water quality criteria and, therefore, represent usable data. Finally, it should be noted that a NYSDEC Ambient Water Quality Standard for Class SB saline surface waters was not available for evaluation of the reported silver detection limits.

6.2.2.3 *Surface Water Screening*

Two surface water samples were collected as part of the RI sampling activities, River-1 and River-2. These samples were analyzed for inorganic constituents. Table 6-13 presents a comparison of maximum detected constituent concentrations and the maximum detection limits with available surface water quality criteria. As shown on this table, the only inorganic constituents detected in surface water were aluminum, calcium, chloride, iron, magnesium, manganese, potassium and sodium. These constituents occur naturally in seawater at detectable concentrations. Furthermore, there are no NYSDEC Ambient Water Quality Standards or guidance values for Class SB saline surface waters, or other ecologically based water quality criteria available for these constituents.

Three inorganic constituents that were not positively identified exhibited detection limits above the aforementioned water quality criteria. These were copper, cyanide, mercury and nickel. With respect to these results, the following points should be noted:

- The detection limits for copper, cyanide, mercury and nickel are within those normally achievable by the analytical methods and are not considered elevated.
- Cyanide, mercury and nickel are not known to be Site-related.

6.2.2.4 *Ground Water Screening*

To further evaluate the potential for site-related impacts to surface water, available ground water data for the Site were included in the criteria-specific analysis. The maximum detected concentration of constituents in ground water were compared with the lowest applicable NYSDEC Ambient Water Quality Standards or guidance values for Class SB saline surface waters. Where no NYSDEC standards or guidance values were available, marine ambient water quality chronic criteria as presented in Buchman (1999) were used.

Table 6-14 summarizes the maximum ground water concentrations of fluorene, phenanthrene, copper, lead, mercury and zinc that were identified above the identified surface water quality criteria. These constituents underwent further evaluation as described below.

Site-specific modeling was conducted to estimate concentrations of fluorene, phenanthrene, copper, lead, mercury and zinc in surface water resulting from ground water discharge to the Hudson River. The estimation of surface water concentrations was based on the dilution factor of 3,380 calculated in Section 2.6 of the RI. These surface water concentrations were compared with the surface water quality criteria discussed above. Table 6-15 summarizes the results of the Site-specific modeling, indicating that groundwater discharge to surface water would not result in concentrations in excess of the available criteria.

The dilution factor utilized in this evaluation was derived based on average ground water flow. It is worth noting that if maximum ground water flow is used, the resulting dilution factor would be reduced by approximately 50%. However, even if the lower dilution factor were used, the estimated surface water concentration would still be well below available water quality criteria for the constituents under consideration. In addition, based on the Site-specific dilution factor, constituents potentially present in ground water at concentrations less than their detection limits are not expected to result in elevated surface water concentrations. Thus, potential impacts to fish and wildlife resources as a result of ground water discharge to surface water are not expected.

6.2.3 *Toxic Effect Analysis – Literature Review*

The Toxic Effect Analysis entails an evaluation of the potential toxic effects of constituents of concern at the individual, organism, population, community or ecosystem level. Evaluating the degree to which constituents of concern potentially affect the productivity and diversity of populations, species assemblages, communities or ecosystems through direct toxicological and indirect ecological effects assesses impacts. This Toxic Effects Analysis was based on a literature review that considered existing water quality conditions in the Lower Hudson River and the significance of reported instances where criteria exceeded PCB toxicity and metals toxicity.

6.2.3.1 *Conditions in the Lower Hudson River*

Considerable research is available on the water quality and sediment quality of the Lower Hudson River in the areas encompassing the Site. The data collected at the Site indicate that sediment samples and Upriver locations exceed NYSDEC screening values for aquatic life. However, with the exception of barium, which is a minor constituent from a toxicity perspective, the concentrations of constituents in sediment samples adjacent to the Yard do not differ consistently from Upriver locations. This suggests that anthropogenic sources are likely contributing to the elevated concentrations found in this part of the Hudson River. One category of constituents, PAHs, was actually found at higher levels at Upriver locations. Furthermore, both the Upriver and the Site data indicate that concentrations of many constituents are higher in subsurface sediment versus the surface layer. This suggests the possibility that cleaner sediments are accumulating over time. Therefore, the literature was also examined for major trends in water quality in the Hudson River over the past several decades to determine if water quality improvements were apparent. The review focused on inorganic constituents, PAHs and PCBs.

One of the important recent studies of water quality in the Hudson River was performed by the USGS for the period of 1992 to 1995 (Wall, G.R., Riva-Murray, K., and P. Phillips, 1998). This study addressed the entire

Hudson watershed with numerous sample locations in the Hudson River and its tributaries, including locations upstream and downstream of the Site. Overall, the USGS study found a strong correlation between chemical levels and the degree of urban land use. Given that the Lower Hudson River is the most urbanized area within the watershed, this region appears to be particularly heavily impacted. Concentrations of inorganic constituents such as copper, lead, mercury, nickel, and zinc in stream and river sediments were highest in the urban sites and frequently exceeded the NYSDEC Severe Effect Level thresholds. A similar pattern was observed with PAHs, with the highest levels of these constituents found at a sample location south of Hastings-on-Hudson, just upstream of the Site in the vicinity of the power plant. Streams draining the Hudson Highlands area to the north of the Site were also found to have elevated PAH levels in sediment, suggesting that PAH loading to the Lower Hudson River is also possible via mobilization and transport from these tributaries.

Another recent study focused on long-term trends in dissolved inorganic constituents in the Hudson River estuary (Sanudo-Wilhelmy, S.A., and G.A. Gill, 1999). Summarizing information from other studies, this report states that the lower estuary receives wastewater from more than 30 sewage treatment facilities serving 10 million people in New York and New Jersey. The input from wastewater can account for up to 40% of the total freshwater budget to the estuary under low-flow conditions. In addition, the estuary is also the receiving water for wastes from over 400 industrial discharges and about 700 combined stormwater/wastewater sewer outfalls. About 90% of this wastewater is discharged along the 20-mile stretch of the river near Manhattan, which includes the area of the Site.

Despite these substantial inputs, the authors of this study were able to document a significant reduction of trace inorganic constituent concentrations over a period of 23 years, particularly for copper, cadmium, nickel, and zinc. The reductions can be attributed to reduced fluxes from sewage and industrial operations as a result of the Clean Water Act implemented in 1972. All of these constituents are currently well below their respective New York Water Quality Criteria. Thus, for these metals and perhaps others, dissolved waterborne concentrations are no longer significant, suggesting that deposition of particulate forms of these metals to sediments may also be decreasing. The authors also found that inputs of constituents such as mercury and lead are related to runoff from diffuse sources and may be a function of atmospheric deposition to soils throughout the watershed. In addition, they determined that remobilization of nickel and copper from sediment could also account for a majority of the loading of these constituents to the water column.

Overall, the findings of these and other studies conducted in the Lower Hudson River over the past several decades support the view that there are many widespread sources within the watershed for the elevated levels of many of the organic compound and inorganic constituents that are currently observed in sediment. Improvements in water quality over recent years related to the Clean Water Act have also been observed, suggesting that natural recovery processes in sediment as well as surface water conditions are occurring and can be expected to continue to occur in the future.

6.2.3.2 *Significance of Reported Criteria Exceedances*

As previously stated, the equilibrium partitioning approach was used for screening potential risks of organics in sediment, and the Long and Morgan (1995) ER-L and ER-M values were used for screening potential risks of metals in sediment, as recommended by NYSDEC guidance. It should be noted once again that these guidance values are quite conservative, and they do not incorporate any site-specific factors that can mitigate toxicity to benthic aquatic life. It is generally acknowledged that many factors influence the bioavailability and toxicity of COPCs, including physical and chemical factors such as organic matter, sulfides, grain size, dissolved oxygen, pH, etc. In this section, and the sections that follow, some of these factors are discussed with reference to organics and metals that exceed the screening criteria. In addition, the concentrations of metals, PCBs, and PAHs are compared to ER-Ms to provide a range of potential risks, as discussed below.

The majority of the constituents that exhibited concentrations above the direct toxicity screening exceeded ER-L values. These values represent concentrations at which adverse benthic impacts are found in approximately 10% of the studies. It is worth noting that with the exception of silver (6 to 12 inch interval only), PCBs and mercury, the constituent concentrations in sediment samples collected adjacent to the Yard did not exceed their ER-M values. With respect to the subtidal building area, only total PCBs, lead and mercury exceeded ER-M values in the 0 to 6 inch interval. It should be noted that lead exceeded the ER-M value at only two sampling locations, and the majority of PCB and mercury detections above the ER-M values were less than the background level.

With respect to the intertidal sediments, individual PAHs, total PCBs and several metals exceeded ER-M values. Similarly, the ER-M values were exceeded in the Upriver samples for individual PAHs, total PCBs, mercury and silver.

ER-M values represent concentrations above which adverse benthic impacts are indicated in more than 50% of cases studied. Thus, the majority of constituents present in sediment samples adjacent to the Yard would not be expected to present a widespread and substantial risk to ecological receptors.

The ER-L and ER-M values are drawn from a nationwide database and conditions in the Hudson estuary could differ significantly from other regions. Therefore, it is of interest to compare Site data to regional sediment quality guidelines. ERM identified a set of values that have been developed for New York/New Jersey (NY/NJ) Harbor based on various approaches. While not official, these values are available from a presentation by W. Scott Douglass titled *"Muddying the Waters: The role of sediment toxicity in a TMDL for NY/NJ Harbor"* at http://www.hdcsetac.org/meetings/ fall2002.htm

In summary, when applied to sediment samples from NY/NJ Harbor, the ER-Ls and ER-Ms (used as NYSDEC guidelines) correctly predict toxicity in samples that are toxic in laboratory tests, but the guidelines also predict toxicity in samples that are not toxic when tested in the laboratory. By contrast, the regional sediment quality guidelines provide less conservative and more accurate predictions of toxicity in the Harbor. Similarly, comparing sediment metals concentrations in the samples from the Site to the regional guidelines, the maximum concentrations of copper, lead, and zinc from surface sediments adjacent to the Yard exceed the regional Lowest Observed Effect Levels (LOELs) but are all less than the regional Apparent Effects Thresholds (AETs). The AETs are levels above which toxicity is nearly always observed. Therefore, the regional sediment quality studies also support the view that toxicity of metals is not necessarily expected in surface sediments from locations where NYSDEC screening benchmarks are exceeded.

Based on the information obtained from the Contaminant-Specific Impact Analysis, including consideration of background conditions, the constituents of ecological concern in sediments potentially associated with the Site are limited to PCBs and metals. PAH concentrations observed in Site-sediment are consistent within, or lower than, Upriver levels, and the scarcity of locations that exceed other organic compounds suggests that these constituents are not a Site-related ecological concerns. Thus, the following subsections focus on the potential toxicity of PCBs and metals.

6.2.3.3 *PCB Toxicity*

PCBs were one of the constituents of concern identified through the screening sediment data at the Site. The highest levels of PCBs in sediment were found to occur in the intertidal building area, whereas concentrations in sediment samples adjacent to the Yard were much lower and did not differ significantly from Upriver samples (see Figure 6-5). PCB concentrations reported in all areas, including Upriver, were above the NYSDEC screening values.

As with any chemical, the potential toxicity of PCBs is a function not only of total concentration but also the magnitude, extent, and duration of exposure. Additionally, the toxicity of PCBs varies considerably depending on their chemical form and other factors. A brief review of PCB toxicity, based on recent literature, particularly those that focus on studies in the Hudson River, is presented below. The Site-related PCB sediment data are examined in light of the recent literature on PCB toxicity to gauge the potential for adverse ecological impacts on the Hudson River ecosystem from Site-related PCBs.

As discussed in Section 2.5, PCBs are mixtures of compounds that vary in their chemical composition. The variations in PCB mixtures and compounds also exhibit a variety of associated physical-chemical properties affecting bioavailability, persistence, transport, bioaccumulation potential, and toxicity. When introduced to the environment, PCB Aroclor mixtures undergo a variety of transformation processes and the congener profiles of environmental samples frequently differ considerably from the original Aroclor mixtures.

PCB toxicity is largely a consequence of metabolic activation, and the biological activity of PCBs is congener specific. Therefore, different mixtures of PCB congeners have differing toxicological effects. The most significant factors contributing to variation in congener toxicity are the degree of chlorination and the position of the chlorines on the biphenyl structure (Safe et al., 1985). PCBs with higher chlorine content and chlorines in the *meta* and *para* positions typically have the highest toxicity.

The toxic effects of these non-*ortho* and mono-*ortho* PCBs with four or more chlorine substitutions have been shown to be similar to, but less potent than the toxic effects of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD), hence the activity of these particular PCB congeners is referred to as dioxin-like. Similar to dioxin, these PCBs assume a rigid coplanar configuration that facilitates binding to the cytosolic *Ah* (aryl hydrocarbon) receptor, resulting in the synthesis of enzymes known as mixed-function oxidases (MFOs). The MFOs catalyze reactions with epoxide derivatives that are thought to be the carcinogenic, mutagenic, or teratogenic metabolites of the parent PCB compounds (McFarland and Clarke, 1989). In wildlife, reproductive effects of this metabolic process tend to be the most sensitive endpoint for organisms exposed to PCBs.

PCBs in the Hudson River have been the focus of extensive studies due to their presence at high levels in Upper Hudson River sediments. Studies have focused on both the total PCBs and congeners occurring at various locations in sediment, surface water, and biota over a 200-mile reach of the river from its headwaters to the Atlantic Ocean. The major source areas located upstream of Albany, NY along with a variety of other sources are a likely contributor to downstream transport of PCBs into the Lower Hudson. Perhaps 50% of the in-place and recently deposited inventory of PCBs in the saline Hudson are attributable to contaminant transport from upstream sources (EPA 2000). The PCBs from upstream have also likely contributed to uptake of PCBs in the food chain throughout the lower Hudson. For example, whole-fish concentrations from locations near Poughkeepsie exceed the Food and Drug Administration action level of 2 mg/kg PCBs in edible fillet (Wall *et al*, 1998).

The NYSDOH has a general advisory for eating no more than one meal per week of sport fish from the lower Hudson based on concentrations of PCBs in fish. EPA has estimated that current and future PCB exposures may reduce or impair the survival, growth, and reproductive capability of resident piscivorous fish such as largemouth bass and striped bass, as well as species of avian and mammalian wildlife in the lower Hudson River. These risks are based on modeling the transport of PCBs with dioxin-like activity in the water column from upstream sources. Based on the watershed study described in the previous section, USGS has also concluded that bioaccumulation of PCBs is occurring even in areas where these compounds are not detected in sediment. This suggests that PCBs are leaching from sediment or other sources into the water column at upstream locations at concentrations sufficient to impact food chains farther downstream (Wall *et al*, 1998).

In this regard, it is of interest to note that the congeners present at the Site do not appear to contain the most potent of the non-*ortho* PCBs at concentrations significantly greater than Upriver. Four non-*ortho* PCB congeners are generally considered to have the greatest equivalence to 2,3,7,8-dioxin: these are 3,4,4′,5-tetrachlorobenzene (81), 3,3′,4,4′-tetrachlorobenzene (77), 3,3′,4,4′,5-pentachlorobenzene (126), and 3,3′,4,4′,5,5′-hexachlorobenzene (169). Of these, only congener 77 was detected in one sample at the Site in the 0 to 6 inch sediment interval, and its concentration was 5.2 μg/kg, only marginally greater than the concentration of 4.2 μg/kg for this congener at the Upriver sample. The sample with the maximum concentration of congener 77 was obtained adjacent to the Yard where overall PCB concentrations did not differ significantly from Upriver. Therefore, the contribution of the Site to exposure for the most toxic congeners of PCBs appears to be marginal in comparison to Upriver.

6.2.3.4 *Metals Toxicity*

The toxic effects of metals in sediment have been found, in part, to be related to bioavailability (USEPA, 2000). Bioavailability has been defined as the fraction of the total contaminant in the interstitial pore water and on the sediment particle that is biologically available for uptake by organisms (i.e., direct absorption, food, water, etc.). Currently, the literature provides a basis for evaluating the bioavailability of cadmium, copper, nickel, lead, silver and zinc based on the ratios of SEM and Acid Volatile Sulfides (AVS), a binding factor for metals in sediments.

Specifically, research has indicated that these metals would not be expected to cause toxicity or bioaccumulation where SEM concentrations are lower than AVS concentrations (or the ratio of SEM:AVS <1) (Long et al., 1998). USEPA (2000) states that the theory behind this conclusion is that AVS in sediments control metal concentrations in interstitial pore water, limits bioavailability of metals in sediment through the formation of insoluble sulfides, and consequently limits overall metal availability and toxicity to benthic organisms. The results of these analyses are provided in Table 2-23.

This evaluation involved the conversion of the bulk concentration of these metals to molar concentrations that were subsequently totaled and compared to the concentration of AVS. Where the ratio of SEM:AVS was less than 1, toxicity due to cadmium, copper, nickel, lead, silver and zinc is not expected (USEPA, 2000).

The results of the evaluation of SEM/AVS indicated that SEM/AVS ratios were less than 1, with the exception of a few samples collected from the intertidal building area and three samples collected from the subtidal building area. Excluding these sample locations where AVS levels were low, the surface sediment interval consistently had higher AVS compared with subsurface sediment (average difference of 41%) based on the Phase I data. Consequently, the surface sediment also had a lower SEM/AVS ratio compared to the subsurface sediment. For example, ratios for the sediment samples collected adjacent to the Yard in the 0 to 6-inch interval ranged from 0.062 to 0.203 based on both the Phase I and Phase II data. Ratios for these samples in the 6 to 12 inch interval (Phase I data only) were slightly higher but still less than 1, ranging from 0.117 to 0.256. The greater AVS in this sediment zone suggests that metal-sulfide complexation is particularly favored near the sediment-water interface where biological activity and exposure potential is greatest.

Ratios in the subtidal building area surface (0 to 6 inch) sediment (excluding the locations with low AVS mentioned previously) ranged from 0.071 to 0.36, similar to the results for the Yard. In addition, ratios for the Upriver samples in the two sampling intervals were similar to those observed in adjacent Yard sediment samples. Thus, toxicity to benthic organisms in the Yard sediment, Upriver sediments and the majority of the subtidal building sediments associated with the presence of these metals is not expected based on the results of the SEM/AVS analyses.

Finally, it should also be noted that although the USEPA's Science Advisory Board recommends the use of SEM/AVS data, such data has limitations. One of the primary limitations is that environmental conditions in many areas may violate the underlying assumptions of the SEM/AVS approach. In the current situation, for example, variability of AVS could occur by season and sediment depth. The potential for seasonal variability was not investigated in the RI, but the comparison of AVS at each sample location shows higher concentrations at the sediment surface layer where biological activity is the greatest. In addition, the behavior of benthic organisms can create small oxic zones with a consequent release of sulfide-bound metals. However, the limited occurrence or virtual absence of benthic invertebrates from Site sediments, particularly in the subterranean, intertidal environment below the buildings, would likely mitigate the potential for extensive aeration effects by burrowing macroinvertebrates. This approach further assumes that equilibrium conditions exist, the effects of metals are no more than additive and that toxicity can be predicted by interstitial pore water concentrations (USEPA, 2000). There is some concern that research has not demonstrated the applicability of the SEM/AVS approach beyond the assumed set of conditions. In spite of these limitations, the SEM/AVS approach lends useful insight to the potential that metals may bind to sulfides, thereby mitigating overall metals toxicity

6.2.3.5 *Natural Recovery Processes for PCBs and Metals*

The investigations of PCBs and metals in sediment reported here, along with studies of the Hudson River conducted by others and discussed above, provide evidence that natural recovery processes can result in a decreased risk of exposure for fish and wildlife resources over time. To further investigate this hypothesis, the distribution of PCBs and metals with depth was analyzed. This analysis found that higher concentrations of most constituents tend to occur in deeper samples, especially in subtidal locations adjacent to the buildings and the Yard (see Section 2.6.4.3). Moreover, the grain size analysis indicates that the vast majority of samples from subtidal locations have greater than 80% fines in the surface 0 to 6 inch layer, which is indicative of deposition. By contrast, the samples taken from intertidal locations beneath the buildings included both depositional sediments (10 samples with > 80% fines) and coarser sediments (8 samples with <80% fines, varying from 1.2% to 73.7% fines) in the surface layer. This is indicative of the erosional influence of tidal action in the intertidal zone, which would tend to resuspend sediments and remove them to deeper parts of the river channel. In the intertidal area, there also appears to be a correlation of PCB concentrations with percentage of fine sediments, which is consistent with expectations based on the tendency of PCBs to adsorb to fine particles.

In general, therefore, to the extent that persistent COPCs such as PCBs and metals have migrated from the Site, they are likely buried in the depositional environment of the main river channel. To the extent that these COPCs remain beneath and immediately adjacent to the buildings, exposure is expected to be minimal because the physical conditions and limited penetration of sunlight results in an absence of suitable habitat for most intertidal forms of aquatic life. Thus, natural hydrodynamic processes are expected to result over time in a diminution of exposure potential for persistent COPCs at the Site.

6.3 CONCLUSIONS

The Pathway and Criteria-Specific Analyses (Step II A & B) suggest that certain Site-related constituents may pose an ecological concern in the sediment. Therefore, the test results of these particular Site-related constituents were initially compared to the concentrations of similar constituents in Upriver sediment samples to evaluate these potential impacts from a regional perspective. A further evaluation of the fate and transport potential of PCBs, inorganic constituents and physical conditions , which influence ecological habitats, supplement the overall evaluation of sediment quality data.

The initial comparison indicates that the sediment quality of samples from the subtidal areas adjacent to the Yard and building areas was generally consistent with Upriver concentrations in Hudson River sediment. As such, the sediments adjacent to the Yard and the majority of the subtidal building area do not represent areas of potential ecological concern as a result of Site-related constituents. In contrast, the sediment in the intertidal building area and the subtidal area immediately adjacent to the buildings exhibited concentrations of certain inorganic constituents and PCBs above the Upriver sediment concentrations.

As shown in Table 2-24, similar constituents in sediment samples from the intertidal area beneath the buildings and the subtidal area immediately adjacent to the buildings were detected in the debris samples from these locations. This suggests that these debris piles may also contribute to chemicals in the sediment beneath and immediately adjacent to the Site buildings. The defined areas of impacted sediment in the building intertidal area and subtidal area immediately adjacent to the buildings is not widespread and does not extend far into the Hudson River channel. PCBs and lead define the largest zone with these two areas (i.e. intertidal beneath the building and subtidal immediately adjacent to the building).

Lead exceeded Upriver levels at only one location in the river (i.e., SED12-02-02). The SEM/AVS ratio at this location was less than 1, and lead was not positively detected in pore water at this location. Thus, it can be reasonably concluded that lead in sediment at this location does not pose an ecological concern. With respect to the occurrence of other inorganic constituents in sediment, most of the samples beneath and immediately adjacent to the buildings indicate that the inorganics are largely bound up in sulfidic forms, thus exhibiting low bioavailability and toxicity.

According to the literature, the type of PCBs identified in sediment in the intertidal area beneath the building and subtidal area immediately adjacent to the building may also have limited toxicity. That is, the identified PCBs do not appear to consist of coplanar congeners at concentrations significantly greater than Upriver samples. Based on findings of adverse reproductive effects and a known physiological mechanism at the cellular level, there is widespread agreement among USEPA, World Health Organization, and other scientists that coplanar PCBs elicit known adverse effects on fish and wildlife. Although the scientific literature has not provided investigative results for the relative toxicity and bioaccumulation potential of all of the PCB congeners, PCBs other than the coplanar congeners are also considered to be toxic and bioaccumulative. The fact that down river sediment concentrations (i.e., adjacent to Yard results) are consistent with Upriver levels indicate that any migration of the affected Site-related areas does not result in down river concentrations above Upriver levels. Moreover, the physical environment beneath the buildings also presents an obstacle to any sustained ecological habitat in this area. Together with the debris, this lack of sunlight in the area would also affect the viability of the ecological habitat.

Lastly, at the majority of subtidal sample locations, burial of both organic and inorganic constituents in deeper sediments is an observed physical mechanism that serves to limit current and future exposure. Natural recovery due to source reduction measures under the Clean Water Act is well documented for the Hudson River. Therefore, contaminated sediments in the biologically active surface layer are expected to continue to improve over time as cleaner sediment is deposited, particularly in the subtidal area.

In summary, the sampling conducted in the vicinity of the Site provides a satisfactory characterization of sediment quality. Only those samples from the intertidal area beneath the building and subtidal area immediately adjacent to the buildings exhibit levels that: 1) indicates a potential ecological concern, based on the Pathway and Criteria-Specific Analyses; and, 2) are elevated in comparison to the Upriver sediment samples.

Literature review of potential ecological effects resulting from the impacted sediment suggests that their chemical form, location, and other factors may mitigate bioavailability and toxicity of constituents that exceed the referenced screening levels. Consistent with NYSDEC guidance, these site-specific conditions should be weighed prior to making risk management decisions based solely on the ecological screening results. These factors, together with the physical limitations to sustain an ecological habitat, particularly in the intertidal are beneath the buildings, provide a sufficient basis for assessing the implication of sediment impacts from Site-related activities.

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APPENDIX A

Soil Boring Logs, Monitoring Well Logs, Ground Water Event Logs and Sediment Coring Logs

APPENDIX B

Test Pit Logs and Photographs of Test Pits

APPENDIX C

Grain Size Distribution Results

APPENDIX D

Tidal Graphs and Slug Test Data

APPENDIX E

Waste Characterization Testing and Manifests

APPENDIX F

Yonkers Downtown Redevelopment Data and Sanborn Maps

APPENDIX G

Building Interior Summary Report

APPENDIX H

Interim Deliverable No. 7 Summary Report

APPENDIX I

Lead Paint Survey

APPENDIX J

Johnson and Ettinger Model Results

APPENDIX K

PCB Surface Wipe Data Collected from Floors

APPENDIX L

Lead Surface Wipe Data Collected from Floors

APPENDIX M

Statistical Analysis of Wipe Data from Floors

APPENDIX N

Uncertainty Analysis