Phase I Environmental Site Assessment Update

Gateway South Redevelopment Properties
12 Parcels
Eastern Carroll-Camden Industrial Area
Baltimore, Maryland 21230

KCI Job No. 01-054370.13

Volume I of II







Prepared for:
Baltimore Development Corporation
36 Charles Street, Suite 1600
Baltimore, MD 21230

Prepared by:
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10 North Park Drive
Hunt Valley, Maryland 21030

KCI TECHNOLOGIES

April 27, 2009

Phase I Environmental Site Assessment Update

FOR

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12 Parcels in Eastern Carroll-Camden Industrial Area
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Prepared For:
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36 South Charles Street, Suite 1600
Baltimore, MD 21230

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10 North Park Drive
Hunt Valley, Maryland 21030
KCI Project: 01-054370.13

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Ms. Katie Giordano
Baltimore Development Corporation
36 South Charles Street, Suite 1600
Baltimore, MD 21230

RE: Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels in Eastern Carroll-Camden Industrial Area
Baltimore, MD 21230
KCI Project No. 01-054370.04

Dear Ms. Giordano:

KCI Technologies, Inc. (KCI) appreciates the opportunity to provide our services on this project. Herein is a report of the findings from our Phase I Environmental Site Assessment Updated (April 27, 2009) of the following properties:

1501 Warner Street	1525 Russell Street
1601 Warner Street	1551 Russell Street
1629 Warner Street	2119 Haines Street
1633 Warner Street	2110 Haines Street
1645 Warner Street	2104 Worcester Street
1501 Russell Street	2102 Oler Street

This report was prepared in general accordance with ASTM Standard E 1527-05: "*Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*" and the "*Maryland Department of the Environment (MDE) Voluntary Cleanup Program (VCP) Guidance Document"* dated March 17, 2006. If you have any questions with regard to this report or any other aspect of our services, please feel free to contact me at 410-316-7913.

Sincerely,
KCI Technologies, Inc.

William R Lyman, CHMM, REM
Senior Associate
Geo-Environmental Division

Douglas Talaber, CHMM
Environmental Scientist
Geo-Environmental Division

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Environmental Professional's Statement

I declare that, to the best of my professional knowledge and belief, I meet the definition of "Environmental Professional" as defined in §312.10 of 40 CFR 312. I have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject site. I have developed and preformed the all appropriate inquiries in conformance with the standards and practices set in 40 CFR 12.

Douglas E. Talaber, CHMM
Environmental Scientist
Geo-Environmental Division

Executive Summary

The Baltimore Development Corporation (Client) retained KCI Technologies, Inc. (KCI) to perform a Phase I Environmental Site Assessment (ESA) Update for the subject site, which is comprised of twelve parcels of property totaling 11.76 acres. The subject site is situated within the Carroll-Camden Industrial Park in Baltimore City, Maryland, and consists primarily of commercial and light industrial properties. The area in which the site is located has been used for industrial purposes for more than a century.

KCI previously completed a Phase I ESA for the site on May 7, 2007. The findings from KCI's 2007 assessment revealed numerous Recognized Environmental Conditions and/or environmental concerns associated with the subject site. Phase II Environmental Site Assessments for portions of the project site were completed on January 25, 2008 and October 10, 2008 (Supplement No.1). The Phase II ESA's were completed in order to obtain additional information regarding the environmental issues that were identified through the completion of KCI's 2007 Phase I assessment. KCI completed this Phase I ESA Update in accordance with ASTM E 1527-05 to re-evaluate the site and ensure environmental conditions have not changed substantially since the completion of KCI's 2007 Phase I ESA.

The findings from KCI's Phase I ESA Update are summarized as follows:

- A total of six (6) "Recognized Environmental Conditions" (RECs) were identified in connection with the subject site during the completion of this assessment. ASTM E 1527-05 defines a recognized environmental condition as: "the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property". The RECs identified during this assessment are listed as follows:

    1. KCI identified or discovered evidence suggesting the presence of a total of ten (10) abandoned and/or undocumented USTs within the subject site. These USTs are relatively old and releases may have occurred from the tanks.

    2. Contaminants with concentrations above applicable Maryland Department of the Environment cleanup standards (MDE CUS), including petroleum compounds, heavy metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs), and polycyclic aromatic hydrocarbon (PAH) compounds, have been documented in soils and groundwater throughout the subject site.

    3. Regulatory database records indicated that historically, chlorinated solvents were stored in USTs at the 1601 Warner Street property, and that a release of these solvents occurred. KCI is presently completing an investigation of this property to determine the presence or absence of these contaminants

    4. KCI observed approximately 120 drums within the warehouse at 1633 Warner Street. A total of 59 of the drums have reported flash point below 140 degrees Fahrenheit. By EPA's definition (Code of Federal Regulations, Title 40, Subpart C) these wastes are hazardous by the ignitability characteristic and would be coded D001 hazardous wastes. Some of the drums are highly corroded and could release their contents at any time.

    5. KCI observed green staining along the base of the interior wall of the western most 1645 Warner Street warehouse structure. KCI was informed by Mr. Andy Evans of SCI that the

drums and containers of chemicals were stored in and stained this portion of the warehouse prior to being moved to the 1501 and ultimately 1633 Warner Street. No drains appeared to be located within the stained portion of the warehouse, however, limited crazing and cracking of the concrete was observed. KCI concludes that the historic release of automotive fluids, as evident from the observed staining, has occurred. KCI has characterized and will remove and properly dispose these drums on or about May, 2009.

6. MDE performed a toxicological evaluation of the Maryland Chemical facility, which revealed elevated levels of risk to the child visitor, youth visitor, and adult worker and construction worker populations from multiple pathways. MDE reported that all populations exceeded the MDE threshold lifetime cancer risk of 1 x 10-5 with scores ranging from 1.0 x 10-5 to 6.3 x 10-5. In addition, MDE reported that all populations exceeded the EPA recognized acceptable hazard index (HI) values of less than or equal to 1 with scores ranging from two (2) to 43. MDE related that the studies risk drivers included arsenic, chromium, TCE, and PCE.

- In addition to the Recognized Environmental Conditions listed above, two (2) data gaps were identified during this assessment. ASTM defines a data gap as a lack or inability to obtain information via the practice despite good faith efforts by the environmental professional to gather such information. These are listed as follows:

  1. KCI has not identified the historic (or current) location of USTs, historically used to store chlorinated solvents, at the 1601 Warner Street property. These USTs were reported on the CERCLIS database but no location was noted. Moreover, information obtained during the completion of this assessment is inconclusive with regard to the potential locations of these reported tanks.

  2. Based on the review of the historic documents (Datanet MDE SUM Phase II 1998), one (1) suspected former gasoline UST is reputably located in the north central portion of the 1501 Russell Street warehouse adjacent to the interior wall that fronts Russell Street. The suspected UST was not identified on the Maryland UST or Historic UST databases, or historic Sanborn maps reviewed for this assessment. KCI did not observe current evidence of the suspected UST at the property during the multiple reconnaissances's completed for this assessment. KCI concludes that it is possible an undocumented UST is located at the property.

- During the review of regulatory databases, KCI identified eight (8) off-site properties that appear to be the most likely of the sites identified on the regulatory database report to represent environmental concerns with regard to the subject site. In general, these are topographically upgradient sites located relatively close to the subject site, with reported leaking underground storage tanks and/or documented contamination. In summary, these included the Bayard Street Station; the Valspar Plant; the Shell Station at 1712 Russell Street; the Public Storage, Inc. facility at 1415 Russell Street; the Bavar Property at 1530 Russell Street; the Lenmar, Inc. site at 1547 Ridgely Street; the Ilex Woodworking site at 1700 Ridgely Street; and, the former Waterford Caseworks site at 1809 Bayard Street.

- The 2110 Haines Street parcel of the subject site was identified on the Maryland Voluntary Cleanup Program database reviewed for this assessment. The database indicates that AT&T Corporation (a previous owner of the property) sought a Certificate of Completion as an Inculpable Person. The database records indicated that the application was approved, and a No Further Requirements Determination (NFRD) was issued on April 22, 2002. In general, the VCP protections and NFRDs obtained by one owner are transferable to subsequent owners. However, KCI understands that the current improvements are to be removed, and a new outdoor athletic field will be constructed. Since

the proposed use of this property represents a change versus the current use, KCI concludes that MDE may have new requirements commensurate with the proposed new use.

Based on the findings from this assessment, KCI has the following recommendations concerning the subject site:

- KCI recommends that a copy of this Phase I ESA update report be provided to MDE as part of the VCP application for the nine (9) remaining parcels, and that the client follow subsequent regulatory requirements regarding the need for additional investigation as necessary to address MDE's concerns during future redevelopment activities.

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1.0 Introduction

The Baltimore Development Corporation (BDC) (Client) retained KCI Technologies, Inc. (KCI) to perform a Phase I Environmental Site Assessment (ESA) at the following properties:

1501 Warner Street	1525 Russell Street
1601 Warner Street	1551 Russell Street
1629 Warner Street	2119 Haines Street
1633 Warner Street	2110 Haines Street
1645 Warner Street	2104 Worcester Street
1501 Russell Street	2102 Oler Street

This Phase I ESA Report was prepared in general accordance with ASTM Standard E 1527-05: "*Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*;" and the Maryland Department of the Environment (MDE) "*Voluntary Cleanup Program (VCP) Guidance Document*" dated March 17, 2006. A description of the limitations, restrictions, and qualifications applicable to this assessment are included in Section 1.5 herein.

1.1 Background

The twelve (12) above listed properties (referenced collectively as the "subject site" hereafter) are located in the Eastern Carroll-Camden Industrial Area of Baltimore City, Maryland, and total 11.66 acres of land. Several parcels within the subject site are presently improved with buildings. Some of these buildings are occupied, while others are vacant and in disrepair. It is KCI's understanding that the subject site will be redeveloped, and that current redevelopment plans include 600,000-square-foot office building, a 50,000-square-foot Greyhound terminal, 150,000 square feet of retail and restaurant space, a 100,000-square-foot sportsplex, an outdoor athletic field and approximately 2,100 structured parking spaces. This proposed redevelopment project is generally referred to as the "Gateway South Redevelopment Project". The location of the subject site is illustrated on Figure 1, which is provided on Page 5 of this report.

1.2 Purpose

This Phase I ESA was completed to support the entry of the subject site into the Maryland Department of the Environment's (MDE's) Voluntary Cleanup Program (VCP), and to help facilitate the future redevelopment of the subject site. Information from this Phase I ESA will also be used to guide development of the scope for a future Phase II ESA at the subject site.

1.3 Scope

In summary, the scope of this assessment included the following tasks:

- Site Reconnaissance: KCI performed a walking reconnaissance of the subject site. The purpose of the reconnaissance was to visually observe and assess current conditions at the subject site and on observable portions of adjacent properties.

- Interviews: KCI conducted interviews with available current and past owners of the subject site, as well as with tenants or occupants of the subject site.

- Review of Standard Environmental Databases: KCI reviewed an environmental database radius report provided by Environmental Data Resources, Inc. (EDR). The review was conducted to determine the study area's proximity to known and potential contaminant sources.

- Review of Other Historical Resources: KCI reviewed historical aerial photographs, topographic maps, and Sanborn fire insurance maps covering the area of the subject site. The review of these resources was conducted to determine former site features and to review the general types of historic land usage at properties located adjacent to (or within approximately 500 feet of) the subject site.

- Public Information Act/Freedom of Information Act Requests: KCI contacted the Maryland Department of the Environment to review departmental files related to environmental concerns or conditions at the subject site.

- Review of Land Records: KCI reviewed land record information provided by National Environmental Title Research (NETR). The information was reviewed to determine the ownership of the subject site during approximately the past fifty years, and to determine if any liens have been placed on the property.

- Review of Physical Setting: KCI reviewed available information concerning the subject site's physical setting, including surface topography; general surface drainage patterns; local soil types and underlying geologic setting; and regional hydrogeologic information.

- Scaled Site Plans: KCI developed scaled site plans (GIS mapping) illustrating the subject site and surrounding areas.

- Potable Well Radius Search: In accordance with Maryland VCP requirements, KCI reviewed data from a ½-mile potable well radius search and plotted the locations of potable wells located within this distance onto a scaled site map.

- Tax Parcel Map/Zoning and Permitted Usage: KCI contacted the Baltimore City Tax Assessor's office and obtained copies of the tax maps covering the subject site. KCI also contacted the City's zoning office concerning the subject site's zoning classification.

- Utilities: KCI plotted the locations of public and private utilities onto a scaled site map.

- Future Development Plans: KCI discussed the proposed site development plans with the developer and the Client, and has provided a written description of the proposed future use of the subject site herein.

These tasks were completed to identify "Recognized Environmental Conditions" (RECs) within the meaning of ASTM Standard E 1527-05, and to provide the MDE with the information required to support the entry of the subject site into the VCP.

ASTM E-1527-05 defines a "Recognized Environmental Condition" (REC) as: "the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in

compliance with laws. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies".

1.4 Significant Assumptions

Data and information regarding current site conditions and operations have been provided to KCI in part by the client and other sources. As is customary, KCI has assumed these data and information to be complete and factually correct. The conclusions rendered from these data and information are subject to professional opinion, and thus could result in differing interpretations. Additionally, the conclusions rendered from this work are based on qualitative and quantitative information gathered on or near the date of this report.

1.5 Limitations, Restrictions, and Qualifications

This assessment was limited to observations made during KCI's inspection and research of the site. No borings or ground water monitoring wells were installed, inspected, or sampled. No soil, sediment, surface water, ground water or building materials has been collected for laboratory analysis. KCI makes no certifications concerning subsurface conditions, soil, or surface water or ground water quality

This environmental site assessment was performed to identify potential liabilities associated with the current site conditions. KCI will not be held liable for the discovery or elimination of hazards encountered that may potentially cause damage, accidents or injuries. The recommendations rendered from work performed in no way eliminate hazards or the owner's obligation to Federal, State or Local laws. The property owner is solely responsible for notifying the proper authorities of any conditions, which violate current laws and regulations.

This work has been performed in accordance with ASTM Standard E1527-05, and the Maryland Department of the Environment (MDE) "*Voluntary Cleanup Program (VCP) Guidance Document*" dated March 17, 2006, and generally accepted engineering practices. This investigation was conducted by and/or under the direction of an Environmental Professional as defined in Section 312.10 (b)(2) of the AAI Rule. No other warranty, expressed or implied, is made. Changes as to the content or form of this report may be made only with KCI's expressed written approval. KCI has employed certain investigative and research procedures during the course of this assessment, and it should be understood that such procedures indicate actual conditions only at the location investigated and that, as is customary, KCI has made certain inferences based on the results of our assignment.

1.6 Exceptions

Conclusions regarding the potential environmental impact of off-site facilities are based on readily available information from the review of regulatory databases, distances from the subject site, and the estimated groundwater flow direction based on surficial topography. A file review of each off-site facility and a determination of actual groundwater conditions were beyond the scope of work for this project.

The scope of work did not include inspection and/or testing for light ballasts, asbestos-containing materials, radon gas, lead-in-paint, urea formaldehyde, or any other material not specifically addressed within the contract for this assessment. Therefore, as applicable, KCI will not render an opinion or provide professional advice regarding the potential, suspect or actual presence/absence of such materials without appropriate inspection and testing. In addition, the scope of work included an inspection of

current on-site conditions and operations, but did not include an evaluation of compliance with environmental regulations.

1.7 Special Terms and Conditions

This report has been prepared and is intended for the sole use of our Client and MDE. The scope of services performed in execution of this assessment is not necessarily appropriate to satisfy the needs of other users, and use of this report or the findings, conclusions, or recommendations contained herein is at the risk of said user.

2.0 Site Description

The information in the following sections was acquired from online tax record data and/or from information acquired during KCI's site reconnaissance. The initial site reconnaissance was conducted by Mr. Douglas E. Talaber, CHMM, Senior Environmental Scientist, on January 31, 2007, March, 16 2007 and April 6, 2007. The site reconnaissance completed for this update was performed by Douglas Talaber on February 6, 2009. The site inspections included a walk around the perimeter of the subject site, a visual survey of the areas of the subject site not occupied by the on-site buildings, and a visual survey of the interior of the onsite buildings.

2.1 Property Location and Legal Description

As discussed previously in Sections 1.0 and 1.1 of this report, the subject site consists of twelve parcels of property located in the Eastern Carroll-Camden Industrial Area of Baltimore City, Maryland, 21230. The location of the subject site relative to surrounding roads and features is indicated on Figure 1 on the following page. In addition, Table 2-1 (below) presents a summary of the street and legal addresses, and current ownership information for each of the parcels comprising the subject site. KCI obtained the property information summarized in the table from the Maryland Department of Assessment and Taxation (MDAT) Real Property Database.

Table 2-1: Property Information

Street Address	Legal Address				Current Owner
	Ward	Section	Block	Lot	
1501 Warner Street	21	09	0844A	001	Mayor & City Council
1601 Warner Street	21	09	0844A	001A	Mayor & City Council
1629 Warner Street	21	09	0844A	002	Mayor & City Council
1633 Warner Street	21	09	0844A	003	Mayor & City Council
1645 Warner Street	21	09	0840	002	Mayor & City Council
1501 Russell Street	21	09	0841	001	Mayor & City Council
1525 Russell Street	21	09	0841	003	Mayor & City Council
1551 Russell Street	21	09	0841	004	Mayor & City Council
2119 Haines Street	21	09	0840	003	Mayor & City Council
2110 Haines Street	21	09	0840	004	Mayor & City Council
2104 Worcester Street	21	09	0844A	010	Mayor & City Council
2102 Oler Street	21	09	0844A	005	Mayor & City Council

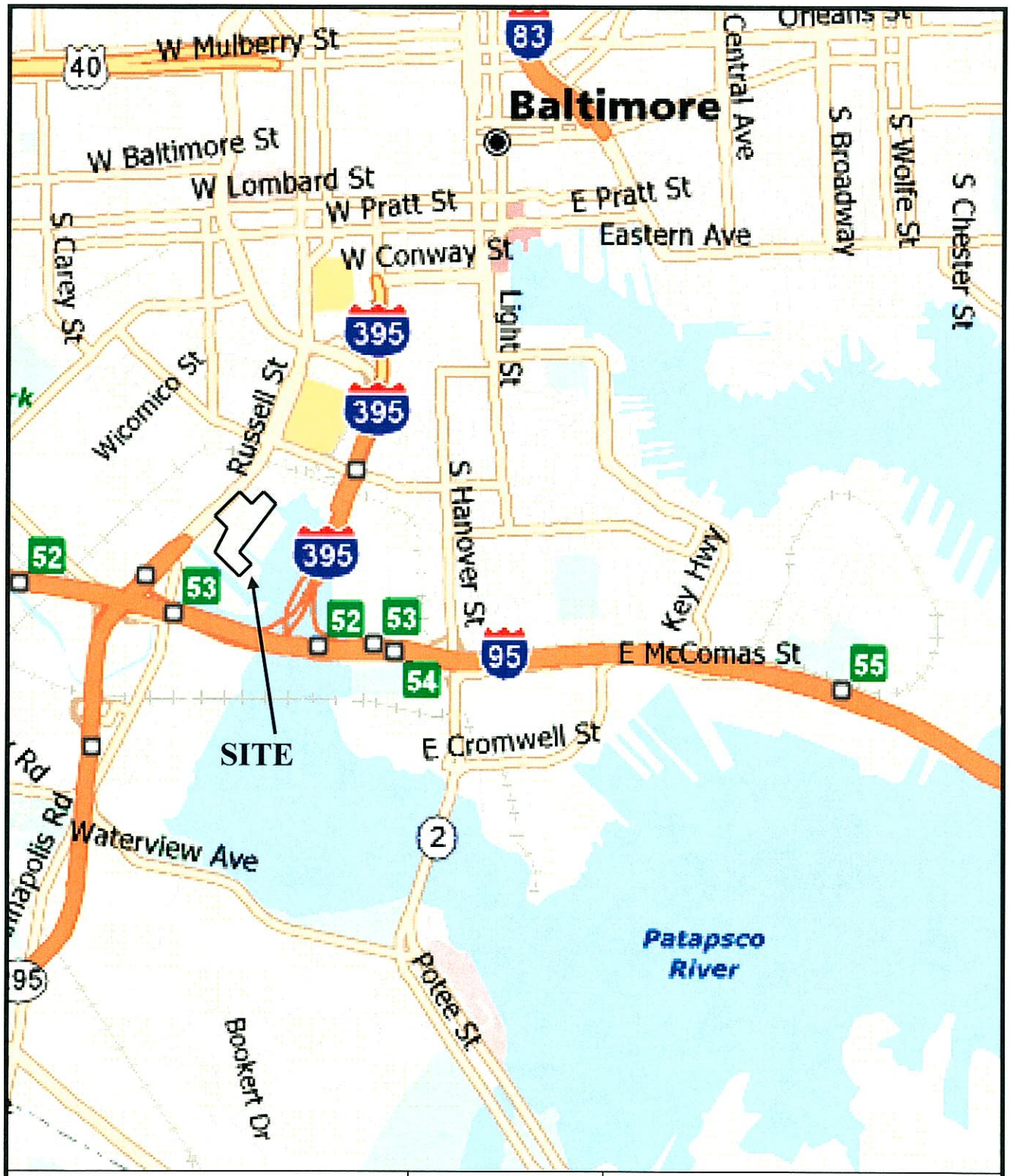

Figure 1 Gateway South Redevelopment Properties 12 Parcels Baltimore, Maryland 21230	NORTH NTS (Site boundaries are approximate.)	**Site Vicinity Map** KCI Project 01-05437004 April 2009

2.2 Site and Vicinity General Characteristics

As indicated previously, the subject site is comprised of twelve parcels totaling 11.76 acres of land located within the Carroll-Camden Industrial Park, Baltimore, Maryland. The subject site is irregular in shape, however, it can be generalized that the subject site encompasses the majority of properties along the 1500 and 1600 block of Warner Street. Figure 2 (next page) illustrates the locations of the parcels comprising the subject site, as identified on the Tax Maps obtained from the City of Baltimore's Department of Public Works, Property Location Division.

Currently, ten (10) out the 12 subject site parcels are improved with warehouse structures totaling approximately 268,183 square feet (sf). Based on the MDAT Real Property information, these current onsite buildings were constructed at various times between 1919 and 2004. The subject site is positioned within a densely-populated urban area, consisting primarily of commercial and light industrial properties. Adjacent properties will be described in more detail in Section 2.6 of this report.

2.3 Zoning

The subject site is zoned as an M-23 Industrial Zone. This type of zoning permits general manufacturing and industrial use. At the time of the completion of this report, KCI was not aware of any requested change in zoning for the subject site.

2.4 Current Use of the Property

The subject site is currently used for commercial purposes. Under the management of Second Chance, Inc. (SCI), four (4) of the 12 subject site parcels are currently utilized for commercial warehousing and storage of architectural antiques and salvage building materials. One (1) parcel is utilized as a Greyhound Bus terminal. Five (5) parcels are currently improved with vacant warehouse structures. Some of these buildings (or portions of buildings) are presently in a deteriorated condition. The remaining two (2) parcels are vacant lots that are used by SCI for stadium event parking. Table 2-2 summarizes the current use of each parcel:

Table 2-2: Current Use Summary

Parcel Street Address	Current Use
1501 Warner Street	Second Chance Inc. (SCI) Warehouse
1601 Warner Street	SCI Warehouse
1629 Warner Street	Stadium Event Parking (Former warehouse burned down and has been cleared)
1633 Warner Street	SCI Warehouse and Storage for stockpile of 55-gallon Drums
1645 Warner Street	SCI Warehouse
1501 Russell Street	Vacant Warehouse
1525 Russell Street	
1551 Russell Street	
2119 Haines Street	Stadium Event Parking
2110 Haines Street	Bus Station
2104 Worcester Street	Vacant Warehouse
2102 Oler Street	Vacant Warehouse

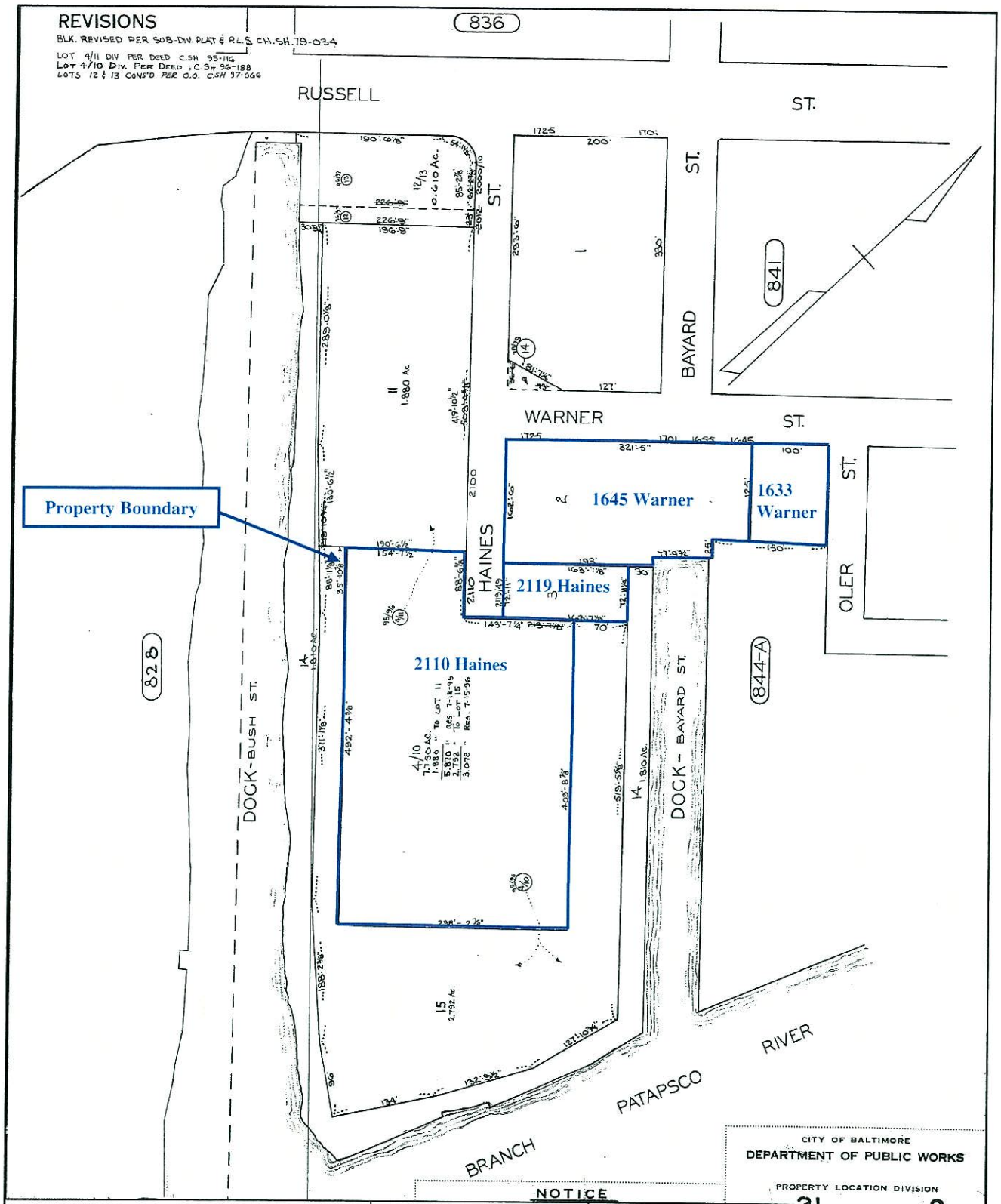

Figure 2A
KCI Technologies
Kane Street Property
Ward 21 Section 09 Block 840

NORTH

Not to Scale

Tax Parcel Map (October 1978)

Obtained from the City of Baltimore
Department of Public Works

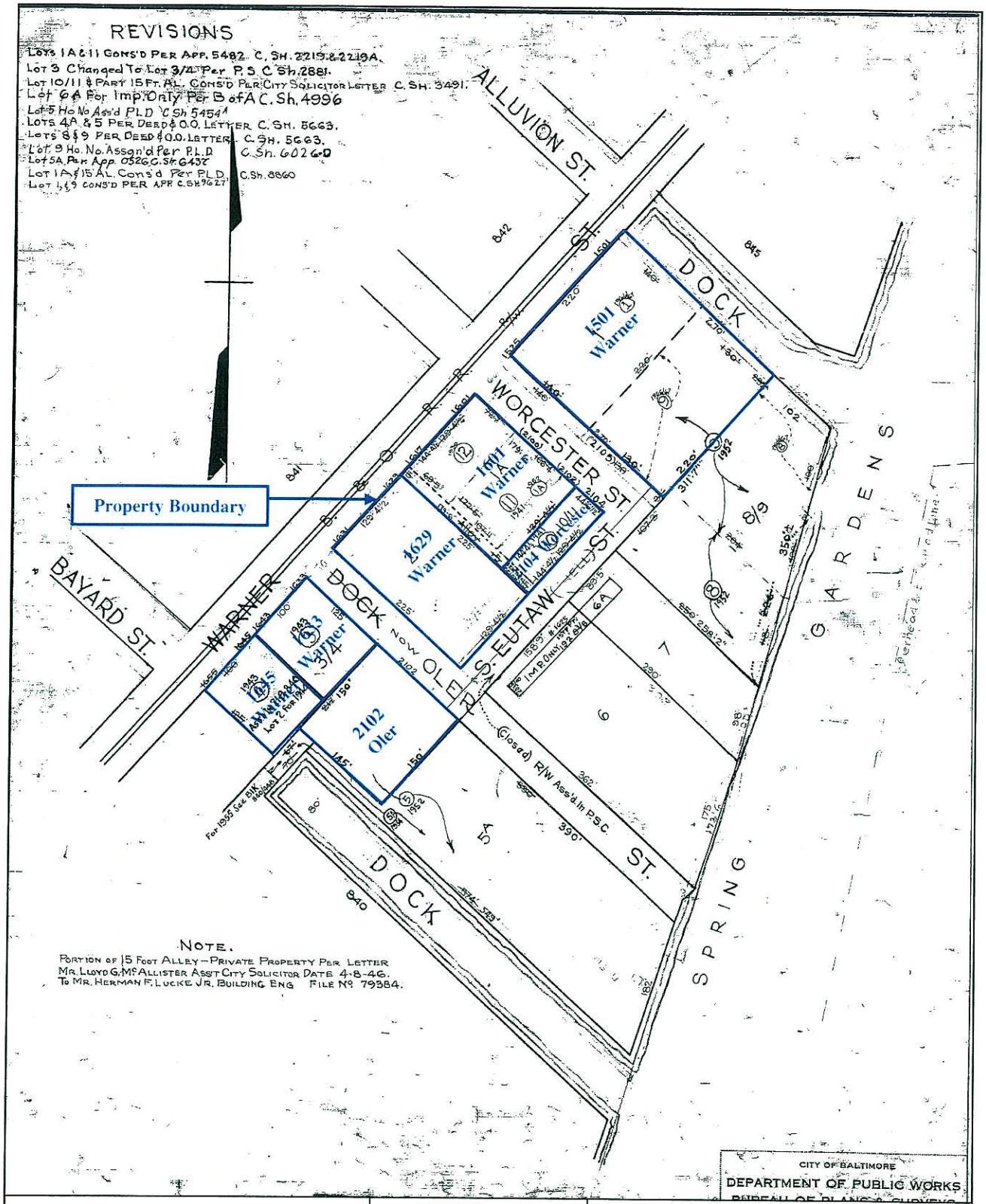

Figure 2B
KCI Technologies
Kane Street Property
Ward 21 Section 09 Block 844-A

NORTH

Not to Scale

Tax Parcel Map (Nov 1929)

Obtained from the City of Baltimore
Department of Public Works

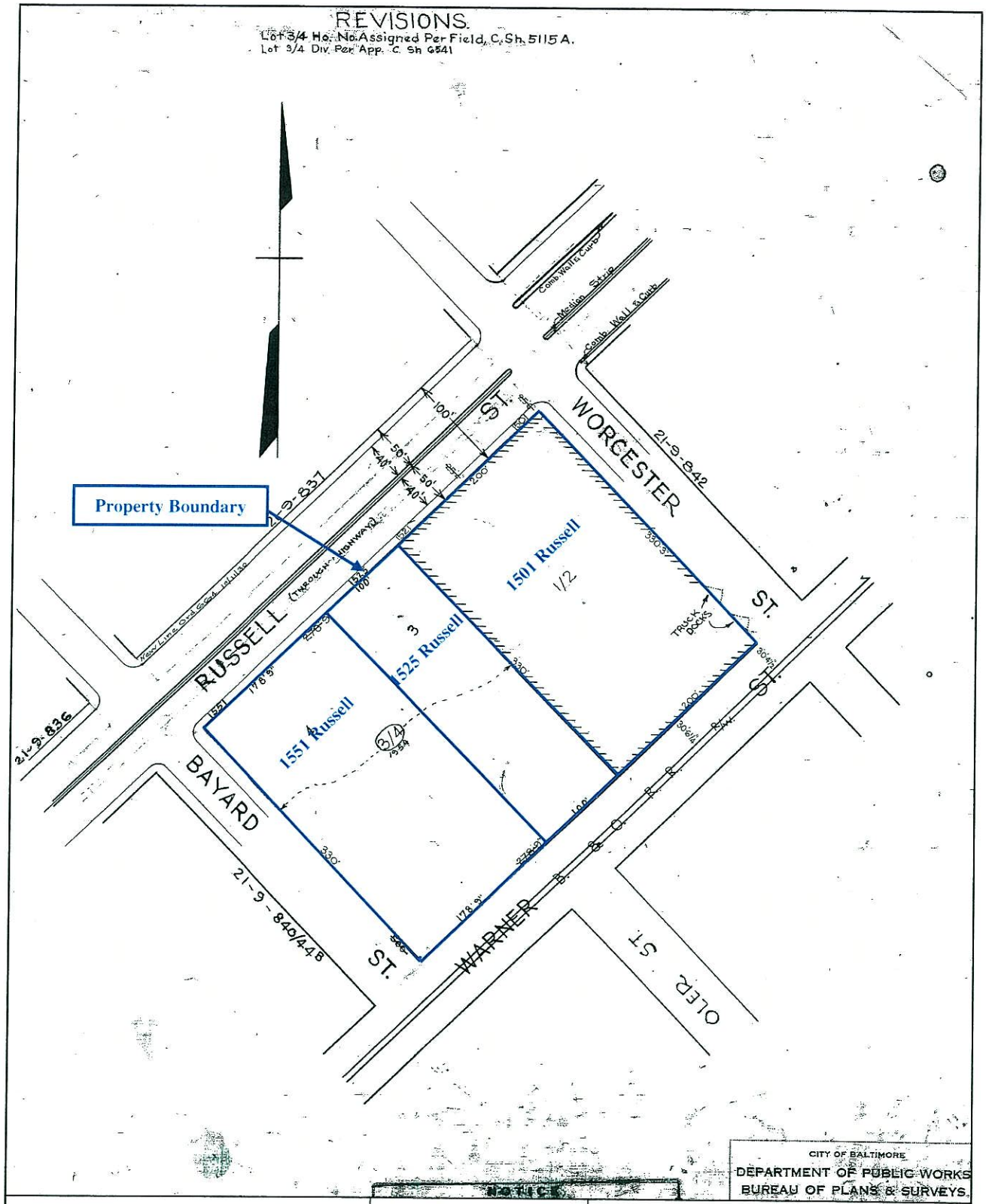

Figure 2C
KCI Technologies
Kane Street Property
Ward 21 Section 09 Block 841

NORTH

Not to Scale

Tax Parcel Map (Nov 1929)

Obtained from the City of Baltimore
Department of Public Works

2.5 Descriptions of On-Site Structures, Roads, and Other Improvements

The subject site is comprised of an irregular-shaped grouping of twelve (12) parcels, located in the Carroll-Camden Industrial Park, Baltimore, Maryland. The following is a summary of each parcel's current development features:

1501 Warner Street:

This parcel has a land area of 1.36 acres and is located on the southeastern quadrant of the intersection of Warner Street and Worcester Street. Based on KCI's reconnaissance findings, the property is improved with one warehouse structure, which is currently occupied by Second Chance Inc (SCI). Data from the MDAT Real Property website indicates that this structure was constructed in 1952. The structure is reported to have 52,000 sf of enclosed area.

Currently, SCI uses the warehouse at 1501 Warner Street for storage of architectural antiques and salvage goods. Palletized drums and gas cylinders were observed in a room located in the southwest portion of the warehouse during the initial Phase I ESA. At the time of KCI's update site reconnaissance, the Palletized drums and gas cylinders had been relocated to 1633 Warner Street. A detailed discussion of the drums and gas cylinders is provided in Section 5.3.3 of this report.

Primary building materials for SCI's warehouse include a poured concrete foundation, concrete block and brick walls, areas of exterior metal sheeting, and a flat roof with built-up tar and gravel ballast. The majority of the warehouse interior is unfinished, however, some drywall and 2' x 4' ceiling tiles were observed.

1601 Warner Street

This parcel has a land area of 0.59 acres and is located on the southwestern quadrant of the intersection of Warner Street and Worcester Street. Based on the MDAT Real Property information, the primary structure at the property (a warehouse building) was constructed in 1961 and contains 25,740 sf of enclosed area. It should be noted that this warehouse building was illustrated on the 1950 Sanborn map (See Section 4.5.1).

At the time of KCI's February 6, 2009 site reconnaissance, the warehouse at 1601 Warner Street was occupied by SCI and used for the storage of architectural antiques and salvage goods. The warehouse at 1601 Warner Street is physically connected to the adjoining south (2104 Worchester Street) structure. Primary building materials for the 1601 Warner Street warehouse include a poured concrete foundation, concrete block and brick walls, steel girders, and a flat roof with built-up tar and gravel ballast. The warehouse has essentially no interior finishing materials.

1629 Warner Street

This parcel has a land area of 0.66 acres and is located on the southeastern quadrant of the intersection of Warner Street and Oler Street. With the exception of the concrete foundation, at the time of KCI's update site reconnaissance the parcel was clear of all structures. A fire had destroyed the warehouse structure in the spring of 2008.

1633 Warner Street

This parcel has a land area of 0.29 acres and is located on the southwestern quadrant of the intersection of Warner Street and Oler Street. Based on the MDAT Real Property information, the property's primary structure (a warehouse) is reported to have 12,500 sf of enclosed area and was constructed in 1940. At the time of KCI's update site reconnaissance, the warehouse at 1633 Warner Street was occupied by SCI and used for the storage of architectural antiques and salvage goods. In addition, the northwest portion of the warehouse was being used to store the palletized drums and gas cylinders that were relocated from 1501 Warner Street.

Primary building materials include a poured concrete foundation, concrete block and brick walls, wood beams, and a flat roof with built-up tar and gravel ballast. The warehouse is physically connected on the west to the adjoining building at 1645 Warner Street, and on the south to the adjoining building at 2102 Oler Street. KCI observed very few interior finishing materials inside the warehouse.

1645 Warner Street

This parcel has a land area of 1.23 acres and is located on the southeastern quadrant of the intersection of Warner Street and Haines Street. During the update site reconnaissance, KCI observed two warehouse buildings separated by an open courtyard space at this parcel. Based on the MDAT Real Property information, the primary structure has 12,500 sf of enclosed area is reported to have been built in 1940; however, it is not clear to which of the two buildings this information refers. Currently, SCI is using the buildings for the storage of architectural antiques and salvage goods. It should be noted that SCI is in the process of decommissioning this warehouse in anticipation for its upcoming relocation.

The primary building materials used for both warehouse buildings include poured concrete foundations, concrete block and brick walls, steel girders and wood beams, and areas of exterior metal sheeting. KCI observed that both buildings have flat roofs with built-up tar and gravel ballasts. In addition, based on evident differences in building materials (i.e. different color and patterned brick walls and different types of concrete block walls) it appears that both of the warehouse buildings were constructed in phases. Interior spaces within each warehouse were generally unfinished, however, some drywall and 2' x 4' ceiling tiles were observed in the office and employee break areas.

1501 Russell Street

This parcel has a land area of 1.52 acres and is located on the southwestern quadrant of the intersection of Russell Street and Worcester Street. Based on the MDAT Real Property information, the property's primary structure (a two-story warehouse) has 66,820 sf of enclosed area and was constructed in 1919.

At the time of KCI's update reconnaissance this warehouse, (formerly occupied by Maryland Chemical Company Inc. (MDCHEM)) was abandoned. The onsite building is partitioned into two sections, referred to as Building # 3 (easternmost) and Building #2 (westernmost).

Primary building materials used in the onsite building include a poured concrete foundation, concrete block and brick walls, steel girders and wood beams, areas of exterior metal sheeting, and a built-up tar and gravel ballast roof. The majority of the interior spaces at Buildings #2 and #3 were unfinished, however, some drywall, 2' x 4' ceiling tiles, and wood paneling were observed in the office and laboratory areas. A boiler is located in a sub-basement of Building #3.

1525 Russell Street

This parcel has a land area of 0.76 acres and is located on the southern side of Russell Street, between the 1501 Russell Street and the 1551 Russell Street properties. Based on the MDAT Real Property information, the property's primary structure (a warehouse) has 32,180 sf of enclosed area and is reported to have been built in 1953.

At the time of KCI's update reconnaissance this warehouse, (formerly occupied by MDCHEM) was abandoned. The warehouse (referred to as Building #1) adjoins 1501 Russell Street Building #2 on the east side. The onsite warehouse's primary building materials include a poured concrete foundation, concrete block and brick walls, steel girders and wood beams, areas of exterior metal sheeting, and a flat roof with built-up tar and gravel ballast. The majority of the warehouse interior is unfinished, however, some drywall and 2' x 4' ceiling tiles were observed in the office areas.

1551 Russell Street

This parcel has a land area of 1.35 acres and is located on the southeastern quadrant of the intersection of Russell and Bayard Streets. Based on the MDAT Real Property information, the property's primary structure (an office/warehouse building) has 22,200 sf of enclosed area and was constructed in 1923.

At the time of KCI's update reconnaissance this office/warehouse, (formerly occupied by MDCHEM) was abandoned. In addition to the office/warehouse structure, the property includes an open courtyard area, a canopied storage area, and a small storage structure (i.e., the Acid House). Primary building materials for the on-site structures include poured concrete foundations, concrete block and brick walls, steel girders and wood beams, areas of exterior metal sheeting, and flat roofs with built-up tar and gravel ballasts. The majority of the interior spaces are unfinished, however, some drywall and 2' x 4' ceiling tiles were observed in the office and employee break areas.

2119 Haines Street

This parcel has a land area of 0.27 acres and is located on the eastern side of Haines Street. No existing structures are located on this property, which is located south of and adjacent to the 1645 Warner Street Property. SCI is currently using the property for stadium event parking purposes. The parcel was observed to be almost completely covered with asphalt.

2110 Haines Street

This parcel has a land area of 3.08 acres and is located south of and adjacent to the 2119 Haines Street property, at the southern terminus of Haines Street. Based on the MDAT Real Property information, the primary structure at the property (a bus terminal building) has 11,520 sf of enclosed area and was constructed in 2004.

Specifically, a Greyhound Lines, Inc. bus terminal currently occupies the 2110 Haines Street parcel. The parcel is accessed via an asphalt-covered driveway leading south from Haines Street. The facility includes one bus terminal structure; bus parking encompasses the area to the east of the existing bus terminal structure. In addition, a taxi and car parking area is located along the northwestern portion of the subject site. Primary building materials for the bus terminal building include a poured concrete foundation, concrete block walls with architectural finishes, and a flat roof covered with a rubber membrane. Interior

finishes include vinyl floor tiles, linoleum floor sheeting, vinyl covebase, painted drywall, and 2' x 4' dropped ceiling tiles.

2104 Worcester Street

This parcel has a land area of 0.15 acres and is located on the southwestern quadrant of the intersection of Worcester Street and South Eutaw Street. Based on the MDAT Real Property information, the property's primary structure (a vacant warehouse) has 6,435 sf of enclosed area and was constructed in 1945.

At the time of KCI's update site reconnaissance, the existing warehouse at 2104 Worcester Street was vacant and in an advanced state of deterioration. To the north, the warehouse is physically connected to the building at 1601 Warner Street. The primary building construction materials include a poured concrete foundation, concrete block and brick walls, steel girders, and a flat roof with built-up tar and gravel ballast. Portions of the roof have collapsed, and piles of water-logged building material were observed within the structure. Brush and weeds were observed to be growing within the interior of the building.

2102 Oler Street

This parcel has a land area of 0.50 acres and is located on the northeastern quadrant of the intersection of Oler Street and South Eutaw Street. Based on the MDAT Real Property information, the property's primary structure contains 20,163 sf of enclosed area and was constructed in 1950.

The onsite structure is partitioned into two independent units. For simplicity, the units will be hereafter identified as the "Northern and Southern Units". Both Units are accessed from the west side of Oler Street. Both the Northern and Southern Units are unoccupied. Primary building materials include a poured concrete foundation, concrete block and brick walls, steel girders, and flat roof with built-up tar and gravel ballast.

The Northern Unit is divided into three rooms (i.e. an eastern room, northwest room and southwest room). During KCI's update site reconnaissance, the eastern room was observed to be filled by general refuse and debris (i.e. broken furniture, paper products, and miscellaneous metal parts). Several drums, filled with debris, were observed in the eastern room. A detailed discussion of the drums is provided in Section 5.3.3 of this report. The southwestern room was primarily occupied by five above ground storage tanks (ASTs); this room was observed to be in a deteriorated state. A detailed discussion of the ASTs is provided in Section 5.3.2 of this report. The northwestern room was observed to contain the remnants of a cardboard box process machine. In addition, the northwest room contained approximately two and a half pallets of 50-pound bags of "hydrogloss". A detailed discussion concerning the hydrogloss bags is provided in Section 5.3.3.

The Southern Unit was historically utilized as storage space for a building contractor (Baltimore Renovations Inc.). During the 2007 reconnaissance, the interior was filled with steel drums, various cans of paint and solvents, and several gallons of gasoline. A detailed discussion concerning the drums is provided in Section 5.3.3 of this report. A canopied loading dock structure was observed adjacent to and south of the Southern Unit; this was also being utilized for storage purposes. Several empty drums were observed at the dock area. In addition, several empty 175-gallon heating oil ASTs were observed. A detailed discussion of the ASTs is provided in Section 5.3.2 of this report.

2.6 Current Uses of Adjoining Properties

KCI conducted a visual reconnaissance of exterior portions of properties adjacent to the subject site. As indicated previously, the subject site is situated within a densely-populated urban area that consists primarily of industrial properties, with some interdispersed small-scale commercial and public properties. It should be noted that the conditions observed at the adjacent and nearby properties described below were inspected from the closest point on the subject site and/or the nearest public road / right-of-way.

Russell Street bounds the subject site to the north, beyond which are commercial properties that include: a Citgo gas station and two single-story warehouse structures. The Citgo gas station is located on the northwest quadrant of the intersection of Russell Street and Worcester Street. The two single story warehouse structures are located to the immediate west of the Citgo gas station. Signage observed during the site reconnaissance indicated that the warehouse structure located closest to the Citgo Station (1530 Russell Street) at one time was occupied by "Just Temps". Just Temps is a temporary employment placement agency.

The warehouse structure furthest from the Citgo gas station (1540 Russell Street) is located on the northeast quadrant of the intersection of Russell Street and Bayard Street. This building had signage indicating that either it is or was occupied by P. W. Feats. PW Feats is a Baltimore event planning company specializing in special events and event management.

Adjacent to the subject site, at the northeast quadrant of Russell Street and Worcester Street, is a "U-Store" self-storage facility. The U-Store facility is comprised of exterior, single story garage type storage units, a two-story enclosed storage and office structure, and associated parking. A "Public Storage" self storage facility is located adjacent to the subject site at the southeast quadrant of Russell Street and Worcester Street. The Public Storage facility is comprised of an enclosed, three-story storage and office structure with associated parking.

Adjacent to the subject site, at the northeast quadrant of the intersection of Alluvion Street and Warner Street, is a single-story warehouse structure occupied by SCI. In addition to their operations within the subject site, SCI utilizes this off-site facility for warehousing and the retail sale of architectural antiques and salvaged materials.

To the east, south, and west of the subject site are vacant, City-owned parcels of green space (i.e., "waterfront parcels") that have been developed with a bike path for recreational use. The parcels of green space are noncontiguous in areas due to the intrusion of several historic "slips" of the Western Branch of Patapsco River that run between the parcels. The bike path contains several bridges over these historic slips. KCI has completed a separate Phase I ESA for these "waterfront parcels" on behalf of the Client. The findings from this assessment are reported under separate cover.

Further east of the subject site, beyond the waterfront parcels, lies the Western Branch of Patapsco River. Further to the west is an additional green space buffer followed by the BRESCO waste to power incinerator facility. A Holiday Inn Express facility is located adjacent to and northeast of the intersection of Haines Street and Warner Street. The Holiday Inn Express facility consists of a single, four-story main hotel building, with a connecting two-story conference/events building, and an associated parking lot.

Adjacent to the subject site, at the northwest quadrant of the intersection of Haines Street and Warner Street, is the W.W. Grainger, Inc. Industrial Supply (Grainger) facility. The Grainger facility consists of a single warehouse building with associated parking and loading docks. Further north, beyond the Grainger

facility, is a BP gasoline station. This gas station is located at the southwest quadrant of the intersection of Russell Street and Haines Street. In addition, a Shell gas station is located adjacent to the subject site, at the northwest quadrant of the intersection of Russell Street and Bayard Street.

The presence of the two adjacent gasoline stations (Shell and Citgo) and the nearby BP gasoline station could potentially represent an environmental concern to the subject site. A detailed discussion concerning these three gasoline stations, which are located within relatively close proximity to the subject site, is provided in Sections 4.1 and 4.2 of this report.

2.7 Description of Site Utilities

The subject site and vicinity are served by public water and sewer. The Baltimore City Department of Public Works (DPW) supplies water from the Prettyboy, Loch Raven, and Liberty reservoirs. Based on the location of the subject site, wastewater from the region most likely discharges to the Patapsco River via the Patapsco Wastewater Treatment Plant. The water and sewer utilities serving the subject site are illustrated on the scaled, GIS-based Utility/Drainage Plan provided as Figure 3 (Appendix G).

2.8 Future Development Plans of Subject Properties

The Client has forwarded information from Cormony Development (i.e., the development agency selected to redevelop the subject site) to KCI concerning the proposed scope of future development at the subject site. Cormony has proposed to demolish existing onsite improvements and build a 600,000-square-foot office building, a 50,000-square-foot Greyhound terminal (to replace one it will be displacing as part of the project), 150,000 square feet of retail and restaurant space, a 100,000-square-foot sportsplex, and approximately 2,100 structured parking spaces. The site will also include a mentoring center for underprivileged youth known as The Ray of Hope Center.

As indicated above, all existing structures are to be demolished, and all proposed buildings will be new construction. Grade changes will be undertaken to allow ground level to be above flood plain (as per City ordinance). The subject site will be hardscaped, except for planting beds for street trees and storm water retention. It is also likely that utility extensions will be necessary. The completed development is estimated to provide 3,200 jobs upon completion.

3.0 User Provided Information

With the exception of title record data (Section 3.1), the following sections present the information obtained from the User of this assessment (i.e., the Client).

3.1 Title Records

As part of the original 2007 assessment, KCI reviewed chain-of-title reports prepared by the National Environmental Title Research Inc. (NETR) for each subject site parcel. Each chain-of-title report included historic ownership information extending to approximately 1957 (i.e., the reports covered approximately the past fifty years). To help meet VCP requirements, additional occupants of the subject site were researched as far back as 1890 through the review of Sanborn Fire Insurance maps (Section 4.5.1).

Updated NETR chain-of-title reports were not requested as part of this update report. Based on information provided by the client and MDAT Real Property information, all twelve properties are currently owned by the Mayor and City Council of Baltimore. This infers that the only relevant change to

the chain-of-title report from the original 2007 assessment to the present is that the six (6) parcels formerly owned by Warner Street, Inc., a Maryland Corporation, (i.e., 2102 Oler Street, 1501 Warner Street, 1601, 1629, 1633 Warner Street, and 2104 Worcester Street) were bought by the Mayor and City Council of Baltimore. Therefore, information provided on the NETR chain-of-title reports prior to the Warner Street Inc. transaction will remain the same and is summarized as follows:

The titles to the properties owned by Mayor and City Council were acquired in three transactions that occurred on 5-3-1976 from The Real Estate and Improvement Company of Baltimore, on 11-3-2005 from The Pheasant Warner Company, LLC, and on 11-19-2003 from AT&T Corporation, a New York corporation. The titles to the properties owned by Warner Street, Inc. were acquired on 3-14-1989 from Edward Levin and Andrea Mattei, Substitute Trustees; and Hillco Investment Corporation, by and for Gordon Cartons, Inc. Additional information from KCI's review of NETR's chain-of-title reports has been incorporated into discussions concerning the historic uses and operations of each parcel of the subject site in Section 4.6.1. Copies of NETR's chain-of-title reports, and associated chain-of-title diagrams prepared by KCI, are provided in Appendix E of this report.

3.2 Environmental Liens or Activity and Use Limitations

Based on the research conducted for this assessment, the MDE VCP has issued a No Further Requirements Determination (NFRD) for the 2110 Haines Street parcel of the subject site. The NFRD may be subject to certain activity and use limitations, such as (for example) a requirement that the groundwater cannot be used at the property. However, no other indications of environmental liens or activity and use limitations referencing the subject site were provided to KCI by any party, agency or individual involved with this assessment, by interview or research of documentation from the various sources consulted.

3.3 Specialized Knowledge

During the original assessment Mr. Gary Suskauer, BDC representative was questioned regarding any past, current, or pending litigation, administrative proceedings, government notices, and/or violations of environmental laws relevant to hazardous substances or petroleum products in, on, or from the subject site. Mr. Suskauer stated that he was unaware of any issues of these types.

3.4 Commonly Known or Reasonably Ascertainable Information

The Client has not provided KCI with any commonly known or reasonably ascertainable information within the local community concerning the subject site that is material to Recognized Environmental Conditions (RECs) in connection with the subject site.

3.5 Valuation Reduction for Environmental Issues

Mr. Gary Suskauer has stated that he is unaware of any reduction in value of the subject site due to environmental issues of any type.

3.6 Owner, Property Manager, and Occupant Information

The owner of the subject site properties is the Mayor and City of Baltimore. The information provided by the owner, owner representatives, property managers, and occupants, has been incorporated into relevant sections of this report.

3.7 Reason for Performing Phase I ESA

As indicated previously, this Phase I ESA is being conducted to satisfy MDE VCP admittance requirements and to facilitate the beneficial redevelopment of the subject site.

4.0 Records Review

As part of this assessment, KCI reviewed standard environmental databases (Sections 4.1 and 4.2), requested permission to review regulatory files (Section 4.3), researched the subject site's physical setting (Section 4.4), and reviewed historical Sanborn maps (Section 4.5.1), aerial photographs (Section 4.5.2) and topographic maps (Section 4.5.3). Detailed discussions concerning these topics are provided in the following report sections.

4.1 Standard Environmental Databases

A review of the environmental databases listed hereafter was completed to determine the locations of known and potential contaminant sources with respect to the subject site. Environmental Data Resources, Inc. (EDR) provided the environmental database report used for this assessment. A copy of the database report is provided in Appendix I. In addition, a summary of the regulatory databases reviewed for this assessment, and the search distances applicable to each database, is provided in Table 4-1. KCI also reviewed an Orphan Summary, which is a summary of those database-listed properties that cannot be mapped within 250 feet of their true location due to incomplete or missing addresses. The findings of the Orphan Summary have been incorporated where applicable.

Table 4-1: Environmental Database Search

Database		Search Distance (Mikes)	Total Properties Plotted
FEDERAL RECORDS			
NPL	National Priority List	1.0	0
Proposed NPL	List of sites that have been proposed to the NPL	1.0	0
Delisted NPL	National Priority List Deletions.	1.0	1
NPL LIENS	Federal Superfund Liens	TP	0
CERCLIS	Comprehensive Environmental Response, Compensation and Liability System List	0.50	1
CERC-NFRAP	CERC-NFRAP No Further Remedial Action Planned List	0.50	0
LIENS 2	CERCLA Lien Information	TP	0
CORRACTS	Corrective Action Report.	1.0	2
RCRA TSDF	Resource Conservation & Recovery Act Information System – RCRA - Transporters, Storage and Disposal List	0.50	1
RCRA Lg. Quan. Gen.	Resource Conservation & Recovery Info. Sys. – Large Quantity Generators List	0.25	1
RCRA Sm. Quan. Gen.	Resource Conservation & Recovery Info. Sys. – Small Quantity Generators List	0.25	0

Table 4-1: Environmental Database Search			
Database		**Search Distance (Mikes)**	**Total Properties Plotted**
RCRA-CESQG	Resource Conservation & Recovery Act Information System RCRA - Conditionally Exempt Small Quantity Generators	0.25	3
RCRA-NonGen	Resource Conservation & Recovery Act Information System RCRA - Non Generators	0.25	6
US ENG CONTROLS	Engineering Controls List Sites.	0.50	0
US INST CONTROL	Properties that are included in the Voluntary Cleanup program, which have Deed Restrictions.	0.50	0
ERNS	Emergency Response Notification System	TP	0
HMIRS	Hazardous Materials Information Reporting System.	TP	0
DOT OPS	Incident and Accident Data	TP	0
US CDL	Clandestine Drug Labs	TP	0
US BROWNFIELDS	A Listing of Brownfields properties Addressed by Either Cooperative Agreements or Targeted Brownfields Assessments.	0.50	5
DOD	Department of Defense Sites.	1.0	0
FUDS	Formerly Used Defense Sites.	1.0	0
LUCIS	Land Use Control Information System	.50	0
CONSENT	CERCLA Consent Decrees.	1.0	0
ROD	Records of Decision.	1.0	0
UMTRA	Uranium Mill Tailings Sites.	0.50	0
ODI	Open Dump Inventory: A Listing of Disposal Facilities that do not Comply with 40 CFR Parts 257 or 258.	0.50	0
DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations	0.50	0
MINES	Mines Master Index File	0.25	0
TRIS	Toxic Chemical Release Inventory System.	TP	0
TSCA	Toxic Substances Control Act.	TP	0
FTTS	Federal Insecticide, Fungicide, and Rodenticide Act/Toxic Substances Control Act Tracking System.	TP	0
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing	TP	0
SSTS	Section 7 Tracking Systems. Refers to Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act. All Registered Facilities Must Submit a Report to EPA on a Yearly Basis.	TP	0
ICIS	Integrated Compliance Information System	TP	0
PADS	PCB Activity Database System	TP	0
MLTS	Material Licensing Tracking System	TP	0

Table 4-1: Environmental Database Search			
Database		**Search Distance (Mikes)**	**Total Properties Plotted**
RADINFO	Radiation Information Database	TP	0
FINDS	Facility Index System	TP	2
RAATS	RCRA Administrative Action Tracking System	TP	0
SCRD DRYCLEANSER	State Coalition for Remediation of Drycleaners Listing.	0.50	0
STATE AND LOCAL RECORDS			
SWHS	Notice of Potential Hazardous Waste Sites.	1.0	11
SWF/LF	Permitted Solid Waste Disposal Facilities.	0.50	2
SWRCY	Recycling Directory.	0.50	2
OCPCASES	Oil Control Program Cases.	0.50	45
HIST LUST	Listing of Historic Leaking Underground Storage Tanks.	0.50	2
UST	Registered Underground Storage Tank List.	0.25	20
Historical UST	Listing of Registered Underground Storage Tanks.	0.25	16
AST	Registered Aboveground Storage Tank List.	0.25	1
INST CONTROL	Voluntary Cleanup program Applicants/Participants.	0.50	6
VCP	Voluntary Cleanup program Applicants/Participants.	0.50	7
DRYCLEANERS	Listing of Registered Dry Cleaners.	0.25	0
BROWNFIELDS	Eligible Brownfields Properties.	0.50	3
NPDES	Wastewater Permit Listing	TP	0
AIRS	A listing of permitted facilities and emissions information.	TP	0
LEAD	Lead Inspection Database.	TP	0
TRIBAL RECORDS			
INDIAN RESERV	Indian Reservations.	1.0	0
INDIAN ODI	A listing of open dump inventories on Indian Land.	0.50	0
INDIAN LUST	A listing of leaking underground storage tank locations on Indian Land.	0.50	0
INDIAN UST	A listing of underground storage tank locations on Indian Land.	0.25	0
INDIAN VCP	.A listing of Voluntary Cleanup Programs on Indian Land.	0.50	0
EDR PROPRIETARY RECORDS			
Manufactured Gas Plants	EDR Proprietary Manufactured Gas Plants.	1.0	8

Table 4-1: Environmental Database Search			
Database		**Search Distance (Mikes)**	**Total Properties Plotted**
EDR Historical Auto Stations	EDR Proprietary Historic Gas Stations.	0.25	3
EDR Historical Cleaners	EDR Proprietary Historic Dry Cleaners.	0.25	0

The following section provides details regarding the different databases reviewed as part of this assessment, and provides information on the number of properties identified within the applicable search radii. A discussion of the identified properties of concern is provided in Section 4.2 of this report.

National Priorities List (NPL) – The National Priorities List (NPL) is the EPA's database of uncontrolled or abandoned hazardous waste sites identified for priority remedial actions under the Superfund program. A site must meet or surpass a predetermined hazard ranking system score, be chosen as a state's top priority site, or meet three specific criteria set jointly by the US Department of Health and Human Services and the US EPA in order to become a NPL site. The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. Neither the subject site nor any properties within the applicable search radius were included on the NPL database.

Proposed NPL List – The proposed NPL List includes hazardous waste sites that have been proposed to the NPL. These sites may be added to the NPL or not, depending on the results of the site investigations and other factors. Neither the study area properties nor any properties within the search radius were included on the proposed NPL List database.

Delisted NPL Sites - The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425 (e), sites may be deleted from the NPL where no further response is appropriate. The subject site was not identified on the Delisted NPL database; however, one (1) property within the search radius (i.e., the Chemical Metals site at 2103 Annapolis Road) was identified on the Delisted NPL database. Due to its downgradient position and its distance from the subject site (approximately ½-mile); the inclusion of this facility to the Delisted NPL database does not appear to represent an environmental concern to the subject site at this time.

NPL LIENS – Under the authority granted to EPA by CERCLA of 1980, the EPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property's owner received notification of potential liability. Neither the subject site nor any properties within the search radius were included on the NPL LIENS database.

NPL Recovery Database List – Under the authority granted to EPA by CERCLA of 1980, the EPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property's owner received notification of potential liability. Neither the subject site nor any properties within the search radius were included on the NPL Recovery Database List.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) List – The CERCLIS List contains sites which are either proposed to be placed on, or are included on the National Priorities List (NPL), and sites which are in the screening and assessment phase for possible inclusion to the NPL. The information for each site includes a history of all pre-remedial, remedial, removal and community relations activities or events at the site; financial funding information

for the events, and unrestricted enforcement activities. One (1) subject site parcel (i.e., 1601 Warner Street) and was included on the CERCLIS database reviewed for this assessment. No other properties within the search radius were included on the CERCLIS database. Additional discussion concerning the inclusion of a portion of the subject site to the CERCLIS database is provided in Section 4.2.

CERCLIS-No Further Remedial Action Planned (CERCLIS-NFRAP) List - As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be properties where, following an initial investigation, no contamination was found, or contamination was found but was removed quickly and without the need for the site to be placed on the NPL. Alternatively, the contamination may not have been serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties, and has archived them as historical records so that EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites. Neither the subject site nor any off-site properties within the applicable search radius were included on the CERCLIS-NFRAP database.

LIENS 2 – CERCLA Lien Information - A Federal CERCLA ('Superfund') lien which could exist by operation of law at any site or property at where the EPA has spent Superfund monies. The money is spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties. Neither the subject site nor any properties within the search radius were included on the LIENS 2 database.

Resource Conservation and Recovery Information System: Treatment, Storage, and Disposal Facilities (RCRA -TSD) List, CORRACTS Facilities List - The EPA maintains this database of RCRA facilities, which are undergoing corrective action. A corrective action order is issued pursuant to RCRA Section 3008 (h) when there has been a release of hazardous waste or constituents into the environment from a RCRA facility. Corrective actions may be required beyond the facility's boundary and can be required regardless of when the release occurred, even if it predates RCRA.

The subject site was not identified on the RCRA-TSD CORRACTS database; however, two (2) properties within the search radius were identified on the RCRA-TSD CORRACTS database. These included the Clean Harbors of Baltimore Site at 1910 Russell Street, and the Engineered Metal Products Site at 1400 Bush Street. The inclusion of the Clean Harbors of Baltimore site to the CORRACTS database is discussed in Section 4.2. Based on its distance from the subject site (more than ½-mile) the inclusion of the Engineered Metal Products Site to the CORRACTS database is not considered an environmental concern to the subject site at this time.

Resources Conservation and Recovery Information System: Treatment, Storage, and Disposal Facilities (RCRA - TSD) List, Non-Corrective Action Sites (CORRACTS) Facilities List - The EPA's Resource Conservation and Recovery Act (RCRA) Program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Facilities database is a compilation by the EPA of facilities, which report generation, storage, transportation, treatment or disposal of hazardous waste. RCRA TSDs are facilities, which treat, store and/or dispose of hazardous waste. The subject site was not identified on the RCRA-TSD Non-CORRACTS database; however, one (1) property within the search radius was identified on the RCRA-TSD Non-CORRACTS database. This facility (i.e., the Clean Harbors of Baltimore Site at 1910 Russell Street) is discussed in Section 4.2 of this report.

Resource Conservation and Recovery Information - Small and Large Quantity Generators (RCRIS - SQG and LQG) List - The EPA's Resource Conservation and Recovery Act (RCRA) Program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Facilities database is a compilation by the EPA of facilities, which report generation, storage, transportation, treatment or disposal of hazardous waste. RCRA Small and Very Small generators are facilities, which generate less than 1000 kg/month of non-acutely hazardous waste. RCRA Large Generators are facilities, which generate at least 1000 kg/month of non-acutely hazardous waste (or 1 kg/month of acutely hazardous waste). The subject site was not identified on the RCRA-LQG database; however, one (1) property (Clean Harbors - 1910 Russell Street) within the search radius was identified on the RCRA-LQG database and is discussed in Section 4.2 of this report. Neither the subject site nor any off-site properties within the applicable search radius were included on the RCRA-SQG database.

RCRA-CESQG – RCRA - Conditionally Exempt Small Quantity Generators. This database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month. One (1) subject site parcel (i.e., 1551 Russell Street) and was included on the RCRA - CESQG database reviewed for this assessment. In addition, two off-site properties within the search radius were identified on the RCRA - CESQG database; these included 1700 Ridgely Street and 1400 Ridgely Street.

The inclusion of 1700 Ridgely Street to the RCRA-CESQG database is discussed in Section 4.2 of this report. Due to its crossgradient position and its distance from the subject site (approximately 1/4-mile); the inclusion of 1400 Ridgely Street to the RCRA-CESQG database does not appear to represent an environmental concern to the subject site at this time.

RCRA-NonGen –This database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste. One (1) subject site parcel (i.e., 1551 Russell Street) and was included on the RCRA-NonGen database reviewed for this assessment. In addition, five (5) off-site properties were identified within the search radius. The inclusion of 1551 Russell Street to the RCRA-NonGen database is discussed in Section 4.2 of this report.

When reviewing the potential for a site listed to the RCRA-NonGen database to impact environmental conditions at the subject site, KCI reviews a number of factors, including the location of the listed property, the topographic conditions that exist between the listed property and the subject site, the distance of the property from the subject site, and the type of listing (i.e., whether or not a release or violation is documented). Based on these types of analyses, KCI has determined that the inclusion of the four (4) of the off-site addresses to the RCRA-NonGen database warrants further discussion herein (refer to Section 4.2). Relatively speaking, the inclusion of the remaining one (1) off-site addresses to the RCRA-NonGen database does not appear to represent as significant an environmental concern with regard to the subject site.

US ENG Controls – A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health. Neither the subject site nor any off-site properties within the search radius were included on the US ENG CONTROLS database.

United States Institutional Controls (US INST Controls) List – A listing of sites with institutional controls in place. Institutional Controls include a variety of administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Neither the subject site nor any properties within the search radius were included on the US INST Controls database.

Emergency Response Notification System (ERNS) - The Emergency Response Notification System (ERNS) is a national database used to collect information on reported releases of oil and hazardous substances. The database contains information from spill reports made to federal authorities including the EPA, the US Coast Guard, the National Response Center and the Department of Transportation. Neither the subject site nor any off-site properties within the applicable search radius were included on the ERNS database.

Hazardous Materials Information Reporting System (HMIRS) - HMIRS contains hazardous material spill incidents reported to DOT. Neither the subject site nor any properties within the search radius were included on the HMIRS database.

Incident and Accident Data (DOT OPS) - The DOT OPS contains records of Department of Transportation, Office of Pipeline Safety Incident and Accident data. Neither the subject site nor any properties within the search radius were included on the DOT OPS database.

United States Clandestine Drug Labs (US CDL) – The CDL is a listing of clandestine drug lab locations. The U.S. Department of Justice provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. Neither the subject site nor any properties within the search radius were included on the CDL database.

US Brownfields – Included in this listing are brownfields properties addressed by Cooperative Agreement Recipients and brownfields properties addresses by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities, especially those without EPA Brownfields Assessment Demonstration Pilots, minimize the uncertainties of contamination often associated with brownfields. Four (4) parcels of the subject properties were identified on the US BROWNFIELDS database. These included 1501, 1601, 1633 and 1645 Warner Street. In addition, two off-site properties within the search radius were identified on the US BROWNFIELDS database; these included 1809 Bayard Street and 901 West Ostend Street. Discussion concerning each of these identified properties is provided in Section 4.2 of this report.

Department of Defense Sites (DOD) – This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the US Virgin Islands. Neither the subject site nor any properties within the search radius were included on the DOD database.

Formerly Used Defense Sites (FUDS) – This listing indicates locations of Formerly Used Defense Sites properties where the U.S. Army Corps of Engineers is actively working or will take necessary cleanup actions. Neither the subject site nor any properties within the search radius were included on the FUDS database.

Land Use Control Information System (LUCIS) – The LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure Properties. Neither the subject site nor any properties within the search radius were included on the LUCIS database.

Superfund (CERCLA) Consent Decrees (CONSENT) – Consent Decrees are the major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. They are released periodically by United States District Courts after settlement by parties to litigation matters. Neither the subject site nor any properties within the search radius were included on the CONSENT database.

Records of Decision (ROD) - ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup. Neither the subject site nor any properties within the search radius were included ROD database.

Uranium Mill Tailings Sites (UMTRA) – Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of sand-like material (mill tailings) remain after the uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases the tailings were used as construction materials before the potential health hazards were recognized. In 1978, twenty-four (24) inactive uranium mill tailings sites in Oregon, Idaho, Wyoming, Utah, Colorado, New Mexico, Texas, North Dakota, South Dakota, Pennsylvania, and on Navajo and Hopi tribal lands, were targeted for cleanup by the Department of Energy. Neither the subject site nor any properties within the search radius were included on the UMTRA database.

Open Dump Inventory (ODI) – An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D criteria. Neither the subject site nor any properties within the search radius were included on the ODI database.

Torres Martinez Reservation Illegal Dump Site Locations (DEBRIS REGION 9) - A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California. Neither the subject site nor any properties within the search radius were included on the DEBRIS REGION 9 database.

MINES Database – Mines Master Index File. Neither the subject site nor any properties within the search radius were included on the MINES database.

Toxic Chemical Release Inventory System (TRIS) - TRIS identifies facilities, which release toxic chemicals to the air, water, and land in reportable quantities under SARA Title III Section 313. Neither the subject site nor any properties within the search radius were included on the TRIS database.

Toxic Substances Control Act (TSCA) - TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site. Neither the subject site nor any properties within the search radius were included on the TSCA database.

FIFRA/TSCA Tracking System (FTTS) - FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Toxic Substances Control Act (TSCA), and the Emergency Planning and Community Right-to-

Know Act (EPCRA). Neither the subject site nor any properties within the search radius were included on the FTTS database.

FIFRA/TSCA Tracking System Administrative Case Listing (HIST FTTS) – A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of the FIFRA (Federal Insecticide, Fungicide, and Rodenicide Act) and TSCA (Toxic Substance Control Act). Some EPA regions area no closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated. Neither the subject site nor any properties within the search radius were included on the HIST FTTS database.

Section Seven Tracking System (SSTS) – Section Seven of the Federal Insecticide, Fungicide and Rodenticide Act requires all registered pesticide-producing establishments to submit a report to the USEPA by March 1st of each year. Each facility must report the types and amounts of pesticides produced, as well as the active ingredients. Neither the subject site nor any properties within the search radius were included on the SSTS database.

Integrated Compliance Information System (**ICIS**) **–** The Integrated Compliance Information System supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program. Neither the subject site nor any properties within the search radius were included on the ICIS database.

PCB Activity Database System (PADS) - PADS identifies generators, transporters, commercial storers and/or brokers and disposers of PCBs, who are required to notify the EPA of such activities. Neither the subject site nor any properties within the search radius were included on the PADS database.

Material Licensing Tracking System (MLTS) - MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites, which possess or use radioactive materials and which are subject to NRC licensing requirements. Neither the subject site nor any properties within the search radius were included on the MLTS database.

Radiation Information Database (RADINFO) – The RADINFO contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity. Neither the subject site nor any properties within the search radius were included on the RADINFO database.

Facility Index System (FINDS)/Facility Identification Initiative Program Summary Report - FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aeromatic Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System). The subject site was included on the FINDS database (i.e., the Maryland Chemical facility at 1501 and 1551 Russell Street). Discussion concerning these properties is provided in Section 4.2 of this report.

RCRA Administrative Action Tracking System (RAATS) - RAATS contains records based on the enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database. Neither the subject site nor any properties within the search radius were included on the RAATS database.

State Coalition for Remediation of Drycleaners Listing (SCRD Drycleaners) – The SCRD Drycleaners list contains states with established drycleaner remediation programs. Neither the subject site nor any properties within the search radius were included on the SCRD Drycleaners database.

State Hazardous Waste Sites (SHWS) List, NPL and CERLIS Equivalent - The State Potential Hazardous Waste Sites List contains all of the sites currently identified by the U.S. EPA CERCLIS program. The state agency cautions that the list is not a comprehensive list of all sites or facilities in the State, which may have activities, which generate or use hazardous or toxic substances, chemicals, petroleum products, etc. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where potentially responsible parties will pay for cleanup. Available information varies by state. The subject site was not identified on the SHWS database; however, 11 off-site properties located within the search radius were identified on the SHWS database.

Of these 11 properties, two (the Bayard and Severn Street Stations) are located upgradient from and within one-quarter mile of the subject site. These facilities are discussed in Section 4.2. Based on factors such as distance and topographic conditions between the remaining SHWS-listed sites and the subject site, the inclusion of the remaining addresses to the SHWS database is not considered a significant environmental concern to the subject site at this time.

Solid Waste Disposal Facilities (SWF)/Landfill Sites (LF) List – Listings under Solid Waste Facilities (SWF) typically contain information provided by the Maryland Department of the Environment (MDE) regarding active or inactive solid waste disposal facilities or landfills. The subject site was not identified on the SWF/LF database; however, two (2) properties within the search radius were identified on the SWF/LF database (i.e. Baltimore Environmental Processing Facility, and the Southwest Resource Recovery facility). Based on factors such as their distance, location relative to the subject site and/or the type of listing, the inclusion of these two (2) facilities to the SWF/LF database is not considered a significant environmental concern to the subject site at this time.

Solid Waste Recycling Directory (SWRCY) – This is a listing of solid waste recycling facilities. One (1) subject site parcel (i.e., 1551 Russell Street) was included on the SWRCY database reviewed for this assessment. In addition, two (2) off-site properties were identified within the search radius. The inclusion of 1551 Russell Street to the SWRCY database is discussed in Section 4.2 of this report.

The two (2) off-site properties within the SWRCY database search radius were identified as the CDM E-Cycling facility, and the Berg Industries facility. Based on factors such as their distance and position relative to the subject site, the inclusion of these two (2) facilities to the SWRCY database does not appear to represent a significant environmental concern to the subject site at this time.

Maryland Oil Control Program Cases (OCPCASES) - A listing of cases monitored by the Maryland Department of the Environment's Oil Control Program. These cases can include leaking underground storage tanks and other subsurface releases, as well as aboveground storage tank spills and releases, surface spills, and administrative infractions discovered during compliance inspections. Importantly, it should be noted that the inclusion of a property to the OCPCASES database does not necessarily mean that a release of petroleum occurred at the property (unless a release is specifically cited in the database records). Two (2) parcels of the subject site were identified on the OCPCASES database. In addition, 67 off-site properties were identified within the search radius.

When reviewing the potential for a site listed to the OCPCASES database to impact environmental conditions at the subject site, KCI reviews a number of factors, including the location of the listed property, the topographic conditions that exist between the listed property and the subject site, the distance of the property from the subject site, the type of listing (i.e., whether or not a release of petroleum is documented), and whether or not the identified properties are also listed to the Historic Leaking UST (Historic LUST) database.

Based on these types of analyses, KCI has determined that the inclusion of the two (2) onsite addresses (associated with Maryland Chemical facility at 1551 and 1501 Russell Street) and ten (10) of the off-site addresses to the OCPCASES database warrants further discussion herein (refer to Section 4.2). Relatively speaking, the inclusion of the remaining 57 off-site addresses to the OCPCASES database does not appear to represent as significant an environmental concern with regard to the subject site.

Historical LUST – This database includes a list of leaking underground storage tanks (LUSTs) maintained by the MDE through 1999. The subject site was not identified on the LUST database; however, two (2) properties within the search radius were identified on the LUST database (i.e., the Warren-Ehrett Company at 610 W. West Street and the Penske Truck Leasing Company at 1711 Wicomico Street). Based their locations relative to the subject site, the inclusion of these facilities to the Historical LUST database does not appear to represent a significant environmental concern to the subject site.

Maryland Underground Storage Tank (UST) List - The Maryland Underground Storage Tank Report is a comprehensive listing of all registered active and inactive underground storage tanks located within the state. Underground Storage Tanks (USTs) are regulated under Subtitle I of RCRA and must be registered with the Maryland Department of the Environment, which is responsible for administering the state's UST program. Two (2) addresses associated with the subject site (i.e., 1501 and 1551 Russell Street) were identified on the UST database. In addition, 26 off-site properties were identified on the UST database within the search radius.

The inclusion of an address to the Maryland UST database is typically only considered a concern if the address belongs to the subject site, or if the address is also identified on the OCPCASES or Historic LUST databases as a petroleum release site, and the associated facility is positioned relatively close to and upgradient from the subject site. The inclusion of the Maryland Chemical facility at 1501 and 1551 Russell Street to the Maryland UST database is discussed further in Sections 4.2 and 5.3.2 of this report. As applicable, the inclusion of certain off-site addresses to the Maryland UST database is also discussed in Section 4.2.

Historical Underground Storage Tanks (HIST UST) List – A listing of historical underground storage tanks. These tanks may have been removed, or are otherwise no longer in service. One parcel of the

subject site (the Maryland Chemical facility at 1551 Russell Street) was identified on the HIST UST database. In addition, 21 off-site properties were identified.

As with the Maryland UST database, the inclusion of an address to the Maryland Historic UST database is typically only considered a concern if the address belongs to the subject site, or if the address is also identified on the OCPCASES or Historic LUST databases as a petroleum release site, and the associated facility is positioned relatively close to and upgradient from the subject site. The inclusion of the Maryland Chemical facility at 1551 Russell Street to the Maryland Historic UST database is discussed further in Sections 4.2 and 5.3.2 of this report. As applicable, the inclusion of certain off-site addresses to the Maryland Historic UST database is also discussed in Section 4.2.

Registered Aboveground Storage Tanks (AST) List - Registered aboveground storage tanks. The subject site was not identified on the AST database; however, one property within the search radius was identified on the AST database (i.e., the Clean Harbors facility at 1910 Russell Street). This facility is discussed further in Section 4.2 of this report.

Voluntary Cleanup Program Applicants/Participants, Institutional Control Database (INST CONTROL) – This is a listing of sites that are included in the VCP database listing, which have deed restrictions. One (1) parcel of the subject site (i.e., the Bus Station at 2110 Haines Street) was identified on the INST CONTROL database. In addition, six (6) off-site properties were identified. Discussion concerning the 2110 Haines Street property and certain of the INST CONTROL-listed, off-site properties is provided in Section 4.2.

Voluntary Cleanup Program (VCP) Applicants – The Voluntary Cleanup Program, administered by the Maryland Department of the Environment, streamlines the environmental cleanup process for sites, usually commercial or industrial properties that are contaminated or perceived to be contaminated by hazardous substances. Developers and lenders are provided with certain limitations on liability and participants in the program are provided certainty in the process by knowing exactly what will be required. One (1) parcel of the subject site (i.e., 2110 Haines Street) was identified on the VCP database; furthermore, twelve off-site properties were identified. Discussion concerning the 2110 Haines Street property and certain of the VCP-listed off-site properties is provided in Section 4.2.

Registered Drycleaning Facilities Database (DRYCLEANERS) – This is a listing of registered drycleaning facilities. Neither the subject site nor any properties within the search radius were included on the DRYCLEANERS database.

Eligible Brownfields Properties (BROWNFIELDS) Database – The Site Assessment Section of the State Superfund Division is responsible for conducting federally-funded assessments of eligible Brownfields properties. These assessments are undertaken to determine whether there are environmental cleanup requirements at these sites. A site referenced as the “Warner Street Properties” was identified on the BROWNFIELDS database within the Orphan Summary reviewed for this assessment. KCI concludes that this listing is most likely associated with the subject site. In addition, one off-site property (1809 Bayard Street) was identified on the BROWNFIELDS database. Discussion concerning these database findings is provided in Section 4.2 of this report.

Lead Inspection Database (LEAD) – This is a listing of sites that are included in the Childhood Lead Poisoning Prevention Program which consists of data of lead inspection for the state. Neither the subject site nor any properties within the search radius were included on the LEAD database.

Indian Reservations (INDIAN RESERV) – This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640-acres. Neither the subject site nor any properties within the search radius were included on the INDIAN RESERV database.

Indian Leaking Underground Storage Tanks (INDIAN LUST) – A listing of leaking underground storage tanks on Indian lands. Neither the subject site nor any properties within the applicable search radius were identified on the INDIAN LUST database.

Indian Underground Storage Tanks (INDIAN UST) – A listing of underground storage tanks on Indian lands. Neither the subject site nor any properties within the applicable search radius were identified on the INDIAN UST database.

EDR Manufactured Gas Plants – A listing of former manufactured gas (coal gas) sites. Gas production from solid and liquid hydrocarbon fuels was once a major industry. The gas manufacturing process produced a variety of wastes including tars, oils, and wastewater. The subject site was not identified on the EDR Manufactured Gas Sites database; however, eight (8) off-site properties were identified. Discussion concerning certain of these off-site properties is included in Section 4.2.

EDR Historic Auto Stations – EDR searched select national directories and has compiled a listing of potential service stations/gasoline stations/filling stations. The categories reviewed within the select business directories included but was not limited to the following: gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station. The subject site was not included on the EDR Historic Auto Stations database; however, four (4) off-site properties were identified. These included 1712 and 1724 Russell Street, 600 West Ostend Street, and 1210 Ridgely Street.

In general, the inclusion of a facility to the Historic Auto Stations database is not considered a significant environmental concern unless the property is part of the subject site and/or is also identified on other databases, such as the Maryland UST, Historical UST, Historic LUST, OCPCASES, SHWS, etc. KCI has reviewed each of the four (4) off-site addresses with respect to their location and topographic position relative to the subject site, and their inclusion to other databases. Based on these factors, KCI has concluded that the identification of 1712 Russell Street on the Historic Auto Stations database warrants further discussion (refer to Section 4.2). The inclusion of the remaining three (3) sites to the Historic Auto Stations database is not considered a significant environmental concern to the subject site at this time.

EDR Historic Dry Cleaners – EDR searched select national directories and has compiled a listing of potential dry cleaners. The categories reviewed within the select business directories included but was not limited to the following: dry cleaner, cleaners, laundry, Laundromat, cleaning/laundry, wash and dry, etc. The subject site was not identified on the EDR Historic Dry Cleaners database; however, one off-site property (514 W. West Street) was identified within the applicable search radius. Due to the location of this facility and it's distance from the subject site, KCI has concluded that the inclusion of this address to the EDR Historic Dry Cleaners database does not represent an environmental concern to the subject site.

4.2 Discussion of Standard Environmental Database Findings

As indicated in Section 4.1, numerous properties have been identified on the regulatory databases reviewed for this assessment. Moreover, some of the identified properties are included within the subject site. Discussion concerning the inclusion of subject site properties to various regulatory databases is provided in Section 4.2.1 below. In addition, discussions concerning off-site, database-listed properties that appear most likely to represent a particular concern to the subject site are provided in Section 4.2.2.

4.2.1 Subject Site Database Findings

Six (6) of the twelve parcels comprising the subject site were identified on certain regulatory databases reviewed for this assessment. These are summarized in Table 4-2. KCI's discussions and conclusions regarding the inclusion of these parcels to the regulatory databases are provided following the table.

Table 4-2: Summary of Subject Site Parcels Identified on Regulatory Databases

Parcel Address	Current Occupant	Listed to Databases:
1501 Russell Street	Vacant Warehouse	OCPCASES, UST, and FINDS
1551 Russell Street	Vacant Warehouse	OCPCASES, UST, HIST UST, and FINDS
1501 Warner Street	Second Chance, Inc.	US BROWNFIELD
1601 Warner Street	Second Chance, Inc	CERCLIS, US BROWNFIELDS
1633 Warner Street	Second Chance, Inc.	US BROWNFIELD
1645 Warner Street	Second Chance, Inc.	US BROWNFIELD, SWRCY
2104 Worcester Street	Vacant Warehouse	US BROWNFIELDS
2110 Haines Street	Greyhound Bus Terminal	INST CONTROL and VCP
2102 Oler Street	Baltimore Renovations Inc.	N/A (KCI identified UST on Sanborn map)

1501 Russell Street

As indicated in Table 4-2, 1501 Russell Street was identified on the OCPCASES database as a potential petroleum release site; on the UST database as a site with underground storage tanks; and on the FINDS database as a facility with RCRA hazardous waste activity and that releases pollutants to the atmosphere. Discussion concerning each of these issues and KCI's conclusions are presented as follows.

RCRA-NonGen: The Field Container Eastfield Division at 1501 Russell Street was identified on the RCRA-NonGen database. As indicated previously, the Maryland Chemical Company previously occupied 1501 Russell Street, and sublets a portion of the on-site building to Chemstation Mid-Atlantic. Maryland Chemical Company was engaged in the repackaging and distribution of chemicals for resale, and Chemstation Mid-Atlantic conducted blending of cleaners and soaps. The RCRA-NonGen database records indicate that no violations have been reported in connection with the former large quantity hazardous waste generation at this facility; moreover, this address was not identified on the CORRACTS database of facilities undergoing RCRA Corrective Action. Based on these factors, KCI concludes that the inclusion of 1501 Russell Street to the RCRA-NonGen database does not appear to represent a significant environmental concern to the subject site at this time.

OPCASES: The Eastfield Container Corporation at 1501 Russell Street was identified on the Maryland OCPCASES database reviewed for this assessment (Case # 99-1914BC1). The records indicate that a tank closure operation was completed on an UST, and that evidence of a release of motor or lube oil was identified during the tank closure operations. The database records indicated that a cleanup occurred following the discovery of the release. Currently the site has a "Closed" Oil Control Program Case status. Based on past experience with similar situations, it is possible that residual soil and/or groundwater contamination is still present in and/or around the old tankfield. Based on this factor, the previous

regulatory oversight, and the current "Closed" regulatory case status, KCI concludes that the discovery of a release of petroleum in the former tankfield represents an "Historic" REC. Additional discussion concerning this issue is provided in Section 8.0 herein.

Maryland UST: The Former Eastfield Container Corporation, located at the subject site (1501 Russell Street), was identified on the Maryland UST database reviewed for this assessment. The database records indicated that one 7,000-gallon, gasoline UST and one 3,000-gallon, heating oil UST are "Permanently Out of Use" at this facility. During the reconnaissance of this property, KCI observed two 12-inch, round sump lids, similar to those that typically cover tank-top appurtenances (i.e., STPs, manways, etc.), in the area of the reported abandoned fuel oil UST. As discussed in Section 4.3.2 of this report, KCI also reviewed an MDE Tank Closure Summary report for 1501 Russell Street. A letter attached to the report was dated February 1, 2000. According to the report, the tanks were closed in place and remain on-site. Both tanks were reportedly constructed of steel and utilized steel product piping. MDE reported that both tanks were greater than 20 years old at the time of closure.

The Tank Closure Summary records indicated that the owner was unaware of any leaks in association with the two (2) tanks or their product lines. However (as indicated above) the MDE Oil Control Program has reported that a release of petroleum was detected during the closure of at least one (1) of the USTs. KCI's conclusions regarding this issue were discussed previously in the OCPCASES database section.

FINDS: The 1501 Russell Street parcel of the subject site was identified on the FINDS database reviewed for this assessment. As discussed previously, FINDS typically contains "pointers" to other record sources that contain more detail. With regard to 1501 Russell Street, the FINDS database identified the AFS, RCRAInfo, MD-RCRA, and TRIS databases as additional sources of information for this facility.

- The AFS database is the national repository for information concerning airborne pollution in the United States. KCI concludes that the inclusion of 1501 Russell Street to the AFS database does not represent a significant environmental concern to the subject site, since pollutants released to the atmosphere would be relatively unlikely to impact the soils or groundwater at the site.

- The RCRAInfo database tracks the events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste, and the MD-RCRA database houses state information relating to the Resource Conservation and Recovery Act (RCRA). As described previously in this section, Maryland Chemical generates small quantities (less than 1,000kg/ month) of RCRA hazardous wastes at their facility. KCI's conclusions regarding this issue have already been provided.

- The TRIS (Toxic Release Inventory System) database contains information from facilities on the quantities of more than 300 listed, toxic chemicals that these facilities release directly to air, water, land, or that are transported off-site. Based on information obtained during interviews, KCI understands that Maryland Chemical Company discharged wastes from a neutralization tank to the sanitary sewer under a National Pollutant Discharge Elimination System (NPDES) permit. It appears likely that this is the reason that the facility was identified on the TRIS database. Additional discussion and KCI's conclusions concerning this issue are provided in Section 8.0 of this report.

1551 Russell Street

As indicated in Table 4-2, 1551 Russell Street was identified on the RCRA-CESQG database as a conditionally exempt small-quantity generator of hazardous waste; the OCPCASES database as a property with MDE Oil Control Program regulatory case history, the Maryland UST and Historic UST

databases as a site with current and/or former USTs, and the FINDS database as a site with multiple other database "hits". Each listing is discussed in detail below.

RCRA-CESQG: The subject site (1551 Russell Street) was identified as a Conditionally-Exempt, Small-Quantity Generator of hazardous waste. No violations have been reported in connection with the generation of hazardous waste at this facility, nor was this address identified on the CORRACTS database of facilities undergoing RCRA Corrective Action. Based on these factors, the inclusion of the 1551 Russell Street property to the RCRIS-CESQG database does not appear to represent an environmental concern to the study area.

OCPCASES: The subject site (1551 Russell Street) was identified on the OCPCASES database reviewed for this assessment (Case No. 94-3442BC1). The records indicate that the case has been assigned a "Closed" status by the MDE Oil Control Program. No additional information concerning the reason for the inclusion of this address was provided; however, 1551 Russell Street was also listed to the Maryland UST and Historic UST databases reviewed for this assessment (see below). Based on this factor, KCI concludes that a release of petroleum may have occurred or been discovered during or prior to UST closure activities. During the review of regulatory files at MDE's offices in Baltimore, KCI reviewed an Notice of Compliance letter dated September 7, 1994, which indicated that two (2) USTs (including one (1) 6,000-gallon, gasoline UST and one (1) 4,000-gallon, diesel UST) were removed from the property and that the site was in compliance with COMAR. It appears likely that this activity is what caused the site to be listed to the OCPCASES database. Additional discussion concerning the previous presence of USTs at the property is provided in the Maryland UST and Historic UST section below.

Maryland UST and Historic UST: The Maryland UST database identified one (1) 6,000-gallon gasoline UST (installed 1972) and one (1) 4,000-gallon diesel UST (installed 1968) in connection with the 1551 Russell Street parcel of the subject site. Both of the USTs are listed as being "Permanently Out of Use". The Historic UST database reported the same information as the UST database, with the exception that both USTs are reported as "Removed" instead of "Permanently Out of Use".

Based on KCI's review of Oil Control Program files (Section 4.3.2), it appears that the Historic UST records are correct. As indicated above in the OCPCASES section, KCI reviewed a Notice of Compliance letter from MDE dated September 7, 1994, which indicated that Oil Control Program staff had conducted an inspection of 1551 Russell Street and had determined that two (2) USTs had been removed from the property. An MDE Tank Removal/Abandonment report attached to the letter more specifically indicated that one (1) 6,000-gallon gasoline and one (1) 4,000 gallon diesel UST had been removed. The records indicated that no perforations were observed in either tank and that no groundwater or soil contamination was detected in the tank pits following the removal of the USTs.

The records indicated that evidence of a release of petroleum was not encountered during the removal of the two (2) USTs at 1551 Russell Street. However, KCI concludes that the historic presence of the tanks does not appear to represent an environmental concern to the subject site. Additional information concerning KCI's review of regulatory files is provided in Section 4.3.2 of this report.

FINDS: The 1551 Russell Street parcel of the subject site was identified on the FINDS database reviewed for this assessment. The FINDS database identified the AFS, ICIS, MD-EPSC, MD-PEMIS, NCDB, MD-RCRA, and TRIS databases as additional sources of information for this facility. Additional discussion is provided below.

- AFS Database: KCI has reviewed documentation indicating a construction permit for an oil-fired boiler was issued for the onsite Maryland Chemical facility in 1978 (refer to Section 4.3.2). KCI concludes that the boiler exhaust is probably the reason for the property's inclusion to the AFS database; moreover, the discharge of boiler exhaust to the atmosphere does not represent a significant environmental concern to the subject site, since pollutants released to the atmosphere would be relatively unlikely to significantly impact the soils or groundwater at the site.

- ICIS Database: The 1551 Russell Street parcel of the subject site was identified on the Integrated Compliance Information System (ICIS) database. The ICIS is the core information management system supporting the enforcement and compliance operations of the EPA Office of Enforcement and Compliance Assurance (OECA). The system is currently used for tracking federal enforcement and compliance activities performed by the EPA headquarters and regional offices. In order to determine the reason for 1551 Russell Street's inclusion to the ICIS database, KCI downloaded EDR's "Site Report" for this facility (a copy is provided in Appendix I). Based on KCI review of the Site Report and information obtained during interviews, KCI understands that Maryland Chemical Company discharged wastes from a neutralization tank to the sanitary sewer under a National Pollutant Discharge Elimination System (NPDES) permit. It appears likely that this is the reason that the facility was identified on the ICIS database. Additional discussion and KCI's conclusions concerning this issue are provided in Section 8.0 of this report.

- MD-EPSC, MD-PEMIS, NCDB, MD-RCRA, and TRIS Databases: Based on information obtained from interviews, Maryland Chemical stored and repackaged bulk chemicals for resale at the 1551 Russell Street facility. Review of the Maryland Chemical facility's EDR Site Report has revealed that Maryland Chemical holds a number of permits and is subject to numerous inspections in connection with their business operations, under a variety of federal regulatory programs. The inclusion of their facility to the MD-EPSC, MD-PEMIS, NCDB, MD-RCRA, and TRIS databases was apparently related to records associated with these programs and inspections. However, review of EDR's database report and the EDR Site Report, and the review of MDE regulatory files completed for this assessment have not revealed information that would describe the specific reasons for the facility's inclusion to these databases. KCI concludes that the inclusion of 1551 Russell Street to these databases does not in itself represent an environmental concern to the subject site.

1501 Warner Street

The 1501 Warner Street parcel of the subject site was identified on the US Brownfields Database reviewed for this assessment. As described in section 4.1, this database lists properties that have received Targeted Brownfields Assessments under EPA Cooperative Agreements. As part of this assessment, KCI reviewed a *Phase I Environmental Site Assessment for the Warner Street Business Properties* dated January 24, 2006. MDE prepared the Phase I ESA report for the Client under a Cooperative Agreement with USEPA Region III. The 1501 Warner Street property (and certain other parcels of the subject site) were included in the assessment. KCI concludes that this previous assessment work is the reason for the subject site's inclusion to the US Brownfields Database. Additional discussion concerning the findings of MDE's Phase I ESA is provided in Section 4.3.1 of this report, and a copy of MDE's report is provided in Appendix F.

1601 Warner Street

As indicated in Table 4-2, 1601 Warner Street was identified on the CERCLIS database as a contaminated property that is under consideration for the National Priorities List (NPL), and the US

BROWNFIELDS database as a site that has received a Brownfields Assessment under an EPA Cooperative Agreement. Discussion concerning each of these listings and KCI's conclusions are presented as follows.

CERCLIS: The Old Gordon Carton/JB MacNeal Plant, a former occupant of the 1601 Warner Street parcel of the subject site, was identified on the CERCLIS database reviewed for this assessment (CERCLA Site ID # 0306186). According to the records, the Old Gordon Carton facility used chlorinated solvents to clean presses. These solvents were reportedly stored in USTs. Poor housekeeping at the facility apparently led to a release of solvents, and thus there is potential for soil and groundwater contamination at the property. The CERCLIS database assessment history indicates that the Gordon Plant has had a discovery action that was completed on March 1, 2005. No additional information was provided in the CERCLIS database or online at the EPA or MDE websites.

As noted above, the CERCLIS database records suggest that USTs, used for storage of chlorinated solvents, were historically used at the 1601 Warner Street parcel of the subject site. However, this parcel was not identified on the Maryland UST or Historic UST databases reviewed for this assessment. In order to identify the historic locations of the reported underground storage tanks, KCI reviewed Sanborn fire insurance maps dated 1901, 1914, 1950, and 1952.

The review of Sanborn maps revealed that the Joseph B. MacNeal & Company Painting, Oils, and Varnish Works was historically located at the 1601 Warner Street parcel of the subject site. In their report titled "*Phase I Environmental Site Assessment for the Warner Street Business Properties*" (January 24, 2006) MDE reports that the Gordon Cartons facility also occupied this parcel (specifically, the southeastern portion of the property). However, the Sanborn maps appeared to show that the Gordon Cartons, Inc. Folding Box Division was actually located on the adjacent parcel (i.e., 1629 Warner Street).

On the 1914, 1950, and 1952 Sanborn maps, KCI observed an area denoted "Storage Tanks" near the central portion of 1601 Warner Street property, within the Joseph B. MacNeal & Company, Painting, Oils, and Varnish Works facility. The text and markings on the maps did not indicate whether the tanks were above ground or below ground, and it is not clear whether or not these are the tanks to which the CERCLIS database referred. Three circular markings (potentially representing tanks) were also observed in an area denoted "Varnish Factory" in the eastern corner of the J.B. MacNeal building. KCI did not identify any additional evidence of storage tanks during the review of Sanborn maps, either at the 1601 Warner Street parcel, or at the adjacent 1629 Warner Street property (refer to Section 4.5.1 of this report for additional discussion concerning Sanborn map findings).

In conjunction with the search for the current or former locations of the reported solvent USTs at 1601 Warner Street, KCI also searched for data concerning potential chlorinated solvent concentrations in groundwater at or downgradient from the 1601 Warner Street parcel of the subject site. KCI noted that one groundwater sample and a duplicate sample were collected from a temporary piezometer installed at Block 844A, Lot 6 during MDE's "*Site-Specific Investigation for Warner Street Wetlands*" (Maryland Department of the Environment, March 2006). The reported sample location is approximately 200 feet southeast of and downgradient/ slightly crossgradient from 1601 Warner Street. However, MDE did not analyze the sample for chlorinated solvents, concentrating instead on PAH compounds and metals in accordance with their investigation's focus.

In summary, KCI was not able to identify the locations of the reported former USTs at the 1601 Warner Street parcel of the subject site, nor did KCI identify data from previous investigations concerning potential chlorinated solvents in the groundwater or subsurface soils there. In addition, KCI did not

observe physical evidence of USTs during the walking reconnaissance of the property completed for this assessment, although the current onsite building was reportedly constructed in 1961, and therefore post-dates the reported use of USTs at the property. KCI concludes that the CERCLA database findings represent an REC to the subject site, and that the reported presence of USTs and groundwater contamination appear to warrant further investigation.

US BROWNFIELDS: The 1601 Warner Street parcel of the subject site was identified on the US Brownfields Database reviewed for this assessment. As was the case with 1501 Warner Street, this property was included in MDE's Phase I ESA report titled "*Phase I Environmental Site Assessment for the Warner Street Business Properties"* dated January 24, 2006. KCI concludes that this previous assessment work is the reason for the parcel's inclusion to the US Brownfields Database. Additional discussion concerning the findings of MDE's Phase I ESA is provided in Section 4.3.1 of this report, and a copy of MDE's report is provided in Appendix F.

1633 Warner Street

As indicated in Table 4-2, 1633 Warner Street was identified on the US BROWNFIELDS database as a site that has received a Brownfields Assessment under an EPA Cooperative Agreement. Discussion concerning this listing and KCI's conclusions are presented as follows:

US BROWNFIELDS: The 1633 Warner Street parcel of the subject site was identified on the US Brownfields Database reviewed for this assessment. As was the case with 1501 Warner Street, this property was included in MDE's Phase I ESA report titled "*Phase I Environmental Site Assessment for the Warner Street Business Properties"* dated January 24, 2006. KCI concludes that this previous assessment work is the reason for the parcel's inclusion to the US Brownfields Database. Additional discussion concerning the findings of MDE's Phase I ESA is provided in Section 4.3.1 of this report, and a copy of MDE's report is provided in Appendix F.

1645 Warner Street

As indicated in Table 4-2, 1645 Warner Street was identified on the SWRCY database as a salvage and reuse facility, and the US BROWNFIELDS database as a site that has received a Brownfields Assessment under an EPA Cooperative Agreement. Discussion concerning each of these listings and KCI's conclusions are presented as follows:

SWRCY: The 1645 Warner Street parcel of the subject site was identified on the SWRCY Database reviewed for this assessment. The facility is reported to be involved in the retails sales of reusable building materials, architectural salvage and antique furniture and furnishings. Non-working appliances and refrigerators are not accepted. Accepted materials are from individuals, businesses, corporations, contractors, manufacturers, distributors, etc. Donated items are tax-deductible to the full extend provided by law. Based on the SWRCY database information provided, KCI concludes that the inclusion of 1645 Warner Street to this database does not in itself represent an environmental concern to the subject site.

US BROWNFIELDS: The 1645 Warner Street parcel of the subject site was identified on the US Brownfields Database reviewed for this assessment. As was the case with 1501 Warner Street, this property was included in MDE's Phase I ESA report titled "*Phase I Environmental Site Assessment for the Warner Street Business Properties"* dated January 24, 2006. KCI concludes that this previous assessment work is the reason for the parcel's inclusion to the US Brownfields Database. Additional

discussion concerning the findings of MDE's Phase I ESA is provided in Section 4.3.1 of this report, and a copy of MDE's report is provided in Appendix F.

2104 Worcester Street

The 2104 Worcester Street parcel of the subject site was identified on the US Brownfields Database reviewed for this assessment. As was the case with 1501 and 1601 Warner Street, this property was included in MDE's Phase I ESA report titled "*Phase I Environmental Site Assessment for the Warner Street Business Properties"* dated January 24, 2006. KCI concludes that this previous assessment work is the reason for the parcel's inclusion to the US Brownfields Database. Additional discussion concerning the findings of MDE's Phase I ESA is provided in Section 4.3.1 of this report, and a copy of MDE's report is provided in Appendix F.

2110 Haines Street

The 2110 Haines Street parcel of the subject site was identified on the INST CONTROL and VCP databases reviewed for this assessment. The VCP database findings indicated that a Maryland Voluntary Cleanup program applicant (AT&T Corporation) sought a "Certificate of Completion" as an "Inculpable Person". The database records indicated that the application was approved, and a No Further Requirements Determination (NFRD) was issued on April 22, 2002.

KCI's review of land record information revealed that AT&T owned the parcel from January 19, 2000 through November 19, 2003, when it was sold to the City (refer to Section 3.1 and Appendix E of this report). In general, the VCP protections and NFRDs obtained by one owner are transferable to subsequent owners, provided that institutional and engineering controls are properly maintained, and no additional types of contaminants are discovered or released to the site. KCI understands that the current improvements are to be removed, and a new outdoor athletic field will be constructed. Since the proposed use of this property represents a change versus the current use, KCI concludes that MDE may have new requirements commensurate with the proposed new use.

The INST CONTROL database records provided no information regarding the specific institutional controls implemented at 2110 Haines Street. The institutional controls for VCP sites generally include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on-site. Deed restrictions are generally also required as part of the institutional controls.

To gain additional information concerning the types of contaminants that are present at the 2110 Haines Street parcel of the subject site, KCI reviewed the VCP Fact Sheet for the property. As part of the original phase I ESA, MDE's Voluntary Cleanup Program maintains Fact Sheets for all VCP participant sites on its Fact Sheet web page. The Fact Sheet for 2110 Haines Street was dated July 10, 2000 and is therefore somewhat out of date. A copy of the VCP Fact Sheet is provided in Appendix I.

The MDE Fact Sheet indicated that environmental investigations have been performed at the 2110 Haines Street parcel, which have identified benzo(a)pyrene in some soil samples at levels exceeding the relevant EPA Region III industrial risk-based concentration. MDE also reported that benzo(b)fluoranthene, fluoranthene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, chromium, copper, and arsenic, have been identified in soil samples at levels exceeding the EPA Region III residential risk-based soil concentrations for these constituents. Reportedly, lead levels as high as 1,700 mg/kg have been identified in on-site soils. Finally, contaminants including fluorene, fluoranthene, pyrene, benzo(a)anthracene, chrysene,

benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and acenapthene have reportedly been detected in groundwater at levels exceeding their respective EPA Region III risk-based tap water concentrations.

KCI's Phase II 2008 report, revealed soil samples, collected from a boring advanced adjacent to an abandoned UST located between the 1633 Warner Street and 2102 Oler Street parcels of the subject site, contained some petroleum contamination. This finding suggests that contaminated soils and groundwater may be present near this tank. In addition, the constituents of concern in these contaminated soils also include PAHs, and heavy metals.

KCI concludes that the presence of elevated levels of PAH compounds and heavy metals (as described above) at the subject site represents a REC. Base on the issuance of an NFRD for the property, MDE would not typically require additional investigation or other actions at the parcel unless new types of contaminants are suspected, or the proposed redevelopment of the property involves altering or removing features currently serving as engineering controls (i.e., asphalt paving, building pads, etc.). KCI's recommendations regarding this issue are provided in Section 11.0 of this report.

2102 Oler Street

Although this property was not identified on the Maryland UST database reviewed for this assessment, KCI noted that one (1) gasoline UST was illustrated at this address on the 1952 and 1973 Sanborn maps. The historic UST was located near the northwest exterior corner of the former Gordon Cartons Inc., Folding Box Division, and Paper Warehouse No 2. During the original site reconnaissance of the parcel, KCI observed a dilapidated fuel dispenser between the 1633 and 2102 Oler Street warehouses, at the eastern side of the buildings, and adjacent to Oler Street. The dispenser was no longer present when KCI conducted the reconnaissance for this update. In addition, two 12-inch, round sump lids were observed in the sidewalk near the fuel dispenser, similar to those that typically cover tank-top appurtenances (i.e., STPs, manways, etc.). The location of the apparent UST corresponds to the historic gasoline UST that was illustrated on the 1952 and 1973 Sanborn maps. KCI concludes that the UST is still present and that it is more than 55 years old. This UST represents a REC. KCI's recommendations regarding this issue are provided in Section 11.0 of this report.

4.2.2 Off-Site Database Findings

As discussed in Section 4.1, numerous off-site facilities located in the general vicinity of the subject site are listed to various regulatory databases reviewed for this assessment. Database findings associated with off-site properties, that appeared to warrant additional analysis, are discussed below. In general, KCI has chosen to focus on these off-site, database-listed properties based on factors such as: the nature of the database information; the position and distance of listed properties relative to the subject site; and, the topographic conditions that exist between the listed properties and the subject site.

1910 Russell Street

The Clean Harbors of Baltimore facility, located at 1910 Russell Street, was identified on multiple databases reviewed for this assessment, including OCPCASES, CORRACTS, RCRA-LQG, RCRA-TSDF, Maryland UST, AST, and FINDS. This off-site facility is located approximately 500 feet west-southwest of the subject site. According to the database records, the Clean Harbors facility at 1910 Russell Street is both a hazardous waste treatment, storage and disposal (TSD) facility and a large-quantity generator of hazardous waste. A total of seventy-three (73) hazardous waste generator and TSD

violations have been reported for this facility. These violations range in severity from administrative issues to releases of hazardous waste to the environment. Regulatory actions have ranged from verbal informal to consent agreements, and administering monetary penalties.

The database records suggest that the Clean Harbors facility receives, handles, treats, and ships very large volumes of hazardous waste. Moreover, it appears that the facility has numerous, significant problems with housekeeping, and that multiple releases of hazardous wastes have occurred. Review of the OCPCASES database findings for the Clean Harbors facility also suggests that multiple releases of petroleum (probably used oil) have occurred. The CORRACTS database indicates that the facility has received a "Medium" priority for corrective action.

Although the Clean Harbors facility is situated relatively close to the subject site, the position of the facility suggests that any contaminants migrating with the groundwater beneath the Clean Harbors site would most likely discharge to the Middle Branch, rather than toward the subject site. Based on this factor, KCI concludes that the Clean Harbors facility appears unlikely to represent a significant environmental concern to the subject site at this time.

901 West Ostend Street

The 901 West Ostend Street property, referred to in the database as U.S Can/Alltrista Metal and Baltimore Camden Yards, was identified on the INST CONTROL, US BROWNFIELDS and OCPCASES, databases reviewed for this assessment.

According to MDE's VCP Fact Sheet for the US Can Company site at 901 West Ostend Street, the facility consists of a single-story building with an asphalt parking area. MDE reports that "solvents and petroleum-based products have been detected at levels in the groundwater that exceed EPA established drinking water standards". This facility is located directly upgradient from the subject site, but it is more than one-quarter mile away.

The INST CONTROL database records reported that deed restrictions are the institutional controls implemented at 901 West Ostend Street. Specifically the database states that, "Use of the property for industrial or commercial purposes; no use of the groundwater for any purpose; must implement a health and safety plan; must notify MDE before any future excavation on the property; properly disposed of all excavated materials." Based on the nature of the deed restrictions, indicating impacted groundwater, and its topographically upgradient position relative to the subject site, KCI concludes that the inclusion of this facility to the INST CONTROL database may represent an environmental concern to the subject site.

Bayard Street Station

The Bayard Street Station, located near the intersection of Bayard and Bush Street, was identified on the SHWS database reviewed for this assessment (State Master List ID No. MDD980693790). This historic facility (a former Manufactured Gas Plant) is located approximately 1,000 feet northwest of and topographically upgradient from the subject site. The records indicate a "No Further Remedial Action" status for this site. KCI did not identify any additional information (such as type and extent of contamination) concerning this site.

Historically, manufactured gas plants generated a variety of wastes. Coal tar was often disposed into the environment in and around the plant locations. Commonly, waste tars were disposed of in gas holders or adits. Over time, the waste tars degrade into phenols, benzene, ferroferricyanides, and polycyclic aromatic

hydrocarbons which may be released as pollutant plumes that can escape into the surrounding environment. Based on the relative proximity of this SHWS-listed facility to the subject site, and its topographically upgradient position relative to the subject site, KCI concludes that the inclusion of this facility to the SHWS database may represent an environmental concern to the subject site.

Severn Street Station/ Valspar Plant

The Severn Street Station was identified on the SHWS, RCRA-LQG, OCPCASES, VCP, INST CONTROL, UST, HIST UST, ,FINDS and EDR's Manufactured Gas Plants databases. This property, which was historically a Manufactured Gas Plant operated by the Consolidated Gas Company, is also referred to as the Valspar Baltimore Plant because the Valspar Corporation purchased the site in 1979. This facility is situated approximately 600 feet northwest of the subject site. Specifically, this property is located on the northwest quadrant of the intersection of Severn Street and Bayard Street.

The RCRA-LQG database identifies the Valspar plant as generating Federal Waste Code D001-non-listed ignitable wastes, D002-non-listed corrosive waste, and D003-non-listed reactive wastes. In addition, the RCRA-LQG database indicates four Generator-All Requirements (Oversight), one Written Informal, and one Civil Action for Compliance violation listings. The Civil Action of Compliance violation is indicated as having a proposed monetary penalty associated with it.

The UST and HIST UST databases identified six (6) USTs at the Former Severn Street Plant/ Valspar facility. These included one 350-gallon gasoline UST, one 6,047-gallon hazardous waste UST; one 6,499-gallon hazardous waste UST; one 5037-gallon UST; one 4,010 gallon hazardous waste UST; and one 2,037-gallon hazardous waste UST. All six USTs were listed as being installed in 1956. In addition, the OCPCASES database indicates that Severn Street Plant/ Valspar facility (Facility ID # 03-0199BC1) has an "Open" case status for well/groundwater contamination from motor/lube oil. According to an MDE Voluntary Cleanup Program Fact Sheet, all USTs were removed from the property in 1986. The VCP database indicated that the Valspar Corporation sought a "Certificate of Completion" as a "Responsible Person" under VCP. A Response Action Plan was approved on June 28, 2002, and a Certification of Completion was issued on December 15, 2005 and reissued on February 8, 2006.

According to the VCP Fact Sheet, subsurface investigations conducted in November 1999 revealed both soil and groundwater contamination at the property. Reportedly, the detected contaminants included volatile organic compounds, heavy metals, and polycyclic aromatic hydrocarbons. The former Severn Street Station is relatively close to, and is positioned topographically upgradient to slightly cross-gradient from, the subject site. Based on these factors and the documented groundwater impacts at the property, KCI concludes that the inclusion of the former Severn Street plant to the SHWS and EDR's Manufactured Gas Plants database may represent an environmental concern to the subject site.

Texaco Station, 1500 Russell Street

The Texaco Station at 1500 Russell Street was identified on the OCPCASES, UST, HIST UST, and FINDS databases reviewed for this assessment. This facility is located adjacent to, northwest of, and upgradient from the subject site. Specifically this property is located on the northwest quadrant of the intersection of Russell Street and Worcester Street. Despite the name in the listing, this property is presently occupied by a Citgo Gasoline Station. The findings from KCI's analysis of the database information are provided as follows:

The OCPCASES database includes two listings for the Citgo Station property. One listing (Case # 90-1248BC1) does not provide a reason for the inclusion of the Citgo Station property to the database. These database records indicate an "Open" case status. The second OCPCASES listing (Case # 99-2876BC1) reports a "Closed" facility status. This listing indicates that a release of petroleum had occurred due to a surface spill from a UST (probably during fill operations), and that a cleanup was performed.

The UST and Historic UST databases identified three 10,000-gallon gasoline USTs and one 10,000-gallon USTs listed as currently in use at the facility. The USTs were all listed as being installed in 1984. No additional pertinent information regarding the USTs was provided.

The FINDS database identified the AFS, MD-PEMIS, RCRAInfo, and MD-RCRA databases as additional sources of information for this facility. The AFS database is the national repository for information concerning airborne pollution in the United States, and the MD-PEMIS database also contains data related to air emissions. The Citgo Station may have been included due to the storage and dispensing of fuels (i.e., fugitive emissions), a paint booth, or other reasons. The RCRAInfo database tracks the events and activities related to facilities that generate, transport, and treat, store, or dispose of hazardous waste, and the MD-RCRA database houses state information relating to the RCRA. As indicated above, the facility generates small quantities of hazardous waste. Based on review of the database findings for 1500 Russell Street, KCI concludes that the identification of this facility to the RCRA-SQG, OCPCASES, UST, HIST UST, and FINDS databases does not appear to represent an environmental concern to the subject site at this time.

1712 Russell Street

The Shell Station at 1712 Russell Street was identified on the OCPCASES, FINDS, UST, HIST UST, EDR Historical Auto Station databases reviewed for this assessment. This facility is located approximately 100 feet northwest of and topographically upgradient from the subject site. Specifically this property is located on the northwest quadrant of the intersection of Russell Street and Bayard Street.

The OPCASES database records indicate that the facility status for the Shell Station (Oil Control Program Case No. 90-1279BC1) is "Closed". However, the records indicate that a release of petroleum occurred and that groundwater contamination from "motor/lube oil" has been reported at the property. The records do not report whether a cleanup or remedial action has been performed at the 1712 Russell Street property in relation to the reported release. Based on the proximity and topographically upgradient position of the Shell Station relative to the subject site, and the reported release of petroleum and presence of groundwater contamination at the facility, KCI concludes that the inclusion of this facility to the OCPCASES database represents an environmental concern to the subject site.

The UST database identified three (3) 8,000-gallon gasoline USTs in association with the Shell Station at 1712 Russell Street. These USTs are listed as "Permanently Out of Use". The Maryland UST database also identified three (3)12,000-gallon gasoline USTs; these were listed as "Currently in Use". No additional information was reported. KCI concludes that the three (3) 8,000-gallon USTs were most likely removed and replaced with the 12,000-gallon USTs, which are currently in service. KCI does not generally consider the presence of USTs at a particular property to be an environmental concern unless there is also evidence or documentation that a release occurred from one or more of the tanks. As indicated in the OCPCASES database section above, a release of petroleum and groundwater contamination have been reported at the at the 1712 Russell Street property. KCI's conclusions regarding this issue were discussed previously.

The Historic UST database identified three (3) 12,000-gallon gasoline USTs at the 1712 Russell Street Shell Station, and indicated these tanks are "Currently in Use". It is not clear why the current tanks were listed in the Historic UST database, but the historic 8,000-gallon USTs identified at this property on the Maryland UST database were not described. However, KCI has observed numerous similar inconsistencies with regard to regulatory database records in then past, and concludes that this instance is not particularly unusual. As indicated in the OCPCASES database section above, there are records of petroleum contamination at the 1712 Russell Street property. KCI's conclusion regarding this issue were discussed previously.

The EDR Historical Auto Station databases identified the 1712 Russell Street location as the site of Jim's Parkway Atlantic gasoline station. This facility was reported to have been in operation in 1964. Based on this record, KCI concludes that fuels such as gasoline have been stored at the 1712 Russell Street property since at least the early 1960s. Moreover, past experience with similar sites suggests that multiple releases of petroleum may have occurred at the facility during the past fifty years. Based on the proximity and topographically upgradient position of the 1712 Russell Street property relative to the subject site, and the apparent long history of petroleum storage at the property, KCI concludes that the inclusion of this facility to the Historical Auto Station database represents an environmental concern to the subject site.

1400 Warner Street

The 1400 Warner Street property, referred to in the database as Hanline Brothers Inc.(Hanline) and Automotive Parts Service, was identified on the OCPCASES, and FINDS databases reviewed for this assessment. The Hanline facility is located approximately 400 feet east of, and topographically crossgradient from, the subject site.

The Hanline facility was identified on the RCRA-NonGen database as a former large-quantity generator of hazardous waste. The records indicated that no violations have been reported in connection with the generation of hazardous waste at this facility, nor was this address identified on the CORRACTS database of facilities undergoing RCRA Corrective Action. Based on these factors, the inclusion of the 1400 Warner Street property to the RCRIS- NonGen database does not appear to represent an environmental concern to the subject site.

The Hanline facility was also identified on the OCPCASES database reviewed for this assessment (Oil Control Program Case No. 91-0671BC1); however, the records did not provide a reason for the inclusion of the property. The records indicate that the Hanline facility has been assigned a "Closed" OCP case status. Based on the cross-gradient location of this facility relative to the subject site, KCI concludes that the inclusion of the Hanline facility to the OCPCASES database does not appear to represent an environmental concern to the subject site at this time.

The FINDS database identified the RCRAInfo, MD-RCRA, and ICIS databases as additional sources of information for this facility. It appears likely that the inclusion of the Hanline facility to these database is related to the reported generation of small quantities of hazardous waste. The ICIS database listing may be related to an NPDES permit or other regulatory administrative reason. Since the 1400 Warner Street property was not identified on the CORRACTS or SHWS database reviewed for this assessment, and based on the cross-gradient location of this facility relative to the subject site, the inclusion of the Hanline facility to the RCRAInfo, MD-RCRA, and ICIS databases does not appear to represent an environmental concern to the subject site.

1415 Russell Street

The Public Storage, Inc. facility at 1415 Russell Street was identified on the OCPCASES database reviewed for this assessment. The Public Storage facility is located northeast of, adjacent to, and topographically upgradient from the subject site. Specifically, this property is located on the northeast quadrant of the intersection of Worcester Street and Warner Street.

The database records indicated that the Public Storage facility (OCP Case No. 01-1864BC3) was included to the OCPCASES database due to a release and of petroleum that was discovered during a tank closure operation completed on a commercial heating oil UST. The records do not report whether a cleanup or remedial action was performed. Based on the proximity and topographically upgradient position of this off-site facility with regard to the subject site, KCI concludes that the reported release of petroleum at 1415 Russell Street represents a potential environmental concern to the subject site.

1530 Russell Street

The Bavar Property, located at 1530 Russell Street, was identified on the OCPCASES database (OCP Case No. 92-1677BC1). The Bavar Property is located north of, adjacent to, and topographically upgradient from the subject site (i.e., across Russell Street from the subject site). The database records did not provide a reason for the inclusion of the Bavar property to the OCPCASES, but indicated that the Bavar Property has been assigned a "Closed" OCP case status. Based on the proximity and topographically upgradient position of this off-site property with regard to the subject site, KCI concludes that its inclusion to the OCPCASES database could potentially represent an environmental concern to the subject site if a release of petroleum occurred there.

2000 Haines Street

The Amoco Service Station/Russell Street BP facility, located at 2000 Haines Street, was identified on the OCPCASES, UST and Historic UST databases reviewed for this assessment. This property is currently occupied by a BP service station. This facility is located approximately 300 feet northwest of, and is situated topographically upgradient from, the subject site. Specifically, the BP Station facility is located on the southwest quadrant of the intersection of Russell Street and Haines Street.

The BP Station was identified on the OCPCASES database reviewed for this assessment (Oil Control Program Case No. 98-0382BC3). Records indicate that the property appears in the OCPCASES database due to a tank closure operation completed on a commercial heating oil UST, and that no release of petroleum was reported. Moreover, the BP Station has been assigned a "Closed" OCP case status. Since no release of petroleum was reported in connection with the OCPCASES listing for the BP Station, KCI concludes that the inclusion of the BP Station to the OCPCASES database does not appear to represent an environmental concern to the subject site at this time.

The Maryland UST database identified three 12,000-gallon gasoline USTs, and one 550-gallon heating oil UST at the BP Station, which were listed as "Permanently Out of Use". In addition, the database also identified two 10,000-gallon gasoline USTs, one 10,000-gallon diesel UST, and one 8,000-gallon gasoline UST, which are listed as "Currently in Use". The first series of USTs (identified as permanently out of use) were reportedly installed in the early 1960s, while the second set of USTs (listed as currently in use) were reportedly installed in the mid-1980s. KCI concludes that the second set of USTs was probably installed to replace the first set of USTs.

The Historic UST database records for the 2000 Haines Street BP Station property indicated that three 10,000-gallon gasoline USTs, one 8,000-gallon diesel UST, and one 550-gallon heating oil UST are "Currently in Use" at the property. These records appear to conflict with the records described in the Maryland UST database (see above). However, it is not particularly unusual for regulatory database records to contain conflicting or contradictory information. KCI concludes that without additional information, it is not possible to determine which set of records is correct. However, it does appear that one older set of tanks was replaced with a newer set during the 1980s.

As discussed previously, OCPCASES database records indicated that no evidence of a release was detected during the closure of the older heating oil tank. Moreover, 2000 Haines Street was not identified on the Historic LUST database reviewed for this assessment. Based on these factors, KCI concludes that the database records do not provide evidence of documented releases in connection with the current or historic USTs at the 2000 Haines Street BP Station property. Therefore, the inclusion of the 2000 Haines Street property to the OCPCASES, UST and Historic UST databases does not appear to represent a significant environmental concern to the subject site at this time.

1501 Ridgely Street

The Bollinger Roofing facility, located at 1501 Ridgely Street, was identified on the UST, Historic UST, and OCPCASES databases reviewed for this assessment. The Bollinger Roofing facility is located approximately 700 feet north of, and topographically upgradient from, the subject site. Specifically, the Bollinger Roofing facility is located on the northwest quadrant of the intersection of Ridgely Street and Worcester Street.

The UST and Historic UST databases identified one 6,000-gallon gasoline UST at the facility. The UST was listed as being installed in 1989 and is reported as currently in use. The OPCASES database records indicate that the Bollinger Roofing facility was identified on the OCPCASES database (OCP Case No. 90-1023BC1) for administrative reasons rather than due to a release of petroleum. Currently the facility has been assigned a "Closed" OCP Case status. Based on the date of installation of the UST and the reported administrative reason for the inclusion of the facility to the OCPCASES database, the inclusion of the facility to the UST, Historic UST, and OCPCASES databases does not appear to represent an environmental concern to the subject site at this time.

1541-1543 Ridgely Street

The Butler Estate, located at 1541-1543 Ridgely Street, was identified on the Maryland UST database. The Butler Estate is located approximately 400 feet north of, and topographically upgradient from, the subject site. The UST database identified one 3,000-gallon heating oil UST and one 2,000-gallon gasoline UST at this property. Both of the USTs are listed as being permanently out of use. No additional information was reported. Since the Butler Estate was not identified on the OCPCASES or Historic LUST databases reviewed for this assessment, KCI concludes that the inclusion of the Butler Estate to the Maryland UST database does not appear to represent an environmental concern to the subject site.

1547 Ridgely Street

Lenmar, Inc located at 1547 Ridgely Street, was identified on the OCPCASES, UST, and HIST UST databases reviewed for this assessment. The Lenmar Inc. facility is located approximately 420 feet north of, and topographically upgradient from, the subject site. The OCPCASES database records indicate that a release of petroleum occurred at the 1547 Ridgely Street property (OCP Case No. 01-1609BC1). The

records also indicate that the property has been assigned a "Closed" case status by MDE; however, they do not report whether a cleanup or remedial action has been performed in relation to the release.

The Maryland UST database identified one 1,000-gallon heating oil UST at the 1547 Ridgely Street property. The UST was listed as "Permanently Out of Use". However, the Historic UST database indicates that the 1,000-gallon heating oil UST is "Currently in Use". Since the Historic UST database records sometimes report the conditions that existed at the time they were archived (i.e., they are not updated after archiving), KCI concludes that the property's heating oil UST is most likely out of service or no longer present. Based on the release of petroleum reported in the OCPCASES database, and the proximity and topographically upgradient position of the 1547 Ridgely Street property relative to the subject site, KCI concludes that the inclusion of this property to the OCPCASES, UST, and HIST UST databases represents a potential environmental concern to the subject site.

1552 Ridgely Street

Another Lenmar, Inc. facility, located at 1552 Ridgely Street, was identified on the Maryland UST database. This facility is located approximately 480 feet north of, and topographically upgradient from, the subject site. The Maryland UST database identified one 1,000-gallon heating oil UST at this facility. The UST was listed as being installed in 1980 and is reported as permanently out of use. No additional information was reported. Since this property was not identified on the OCPCASES or Historic LUST databases reviewed for this assessment, KCI concludes that the inclusion of the 1552 Ridgely Street property to the Maryland UST database does not appear to represent an environmental concern to the subject site at this time.

1619 Ridgely Street

U.S. Protective Coatings Inc., located at 1619 Ridgely Street, was identified on the Maryland UST and Historic UST databases reviewed for this assessment. This facility is located approximately 500 feet northwest of, and topographically upgradient from, the subject site. The Maryland UST and HIST UST databases identified one 1,000-gallon gasoline UST at the facility. The UST was listed as being installed in 1966 and is reported as permanently out of use. This facility was not identified on the OCPCASES or Historic LUST databases reviewed for this assessment. Based on these factors, KCI concludes that the inclusion of this facility to the Maryland UST and Historic UST databases does not appear to represent an environmental concern to the subject site at this time.

1645 Ridgely Street

Ridgely Street LLC, located at 1645 Ridgely Street, was identified on the Maryland UST database. This facility is located approximately 525 feet northwest of, and topographically upgradient from, the subject site. The Maryland UST database records identified one 1,000-gallon heating oil UST at the Ridgely Street LLC facility. The UST was listed as being installed in 1981 and is reported as permanently out of use. This facility was not identified on the OCPCASES or Historic LUST databases reviewed for this assessment. Based on these factors, KCI concludes that the inclusion of this facility to the Maryland UST database does not appear to represent an environmental concern to the subject site at this time.

1700 Ridgely Street

The EDR database report lists three (3) facility names in association with the 1700 Ridgely Street address. The facilities include Ilex Woodworking; Environmental Elements Corporation; and Dovco Industrial

Fabricators. The 1700 Ridgely Street address is located approximately 750 feet northwest of, and topographically upgradient from, the subject site.

Ilex Woodworking was identified on the RCRA-CESQG, OCPCASES, and UST databases. The Maryland UST database identified one 10,000-gallon diesel UST and one 500-gallon kerosene UST at this facility. Both of the USTs are listed as being "Permanently Out of Use". Moreover, the records do not provide a reason for the inclusion of 1700 Ridgely Avenue to the OCPCASES database. The facility (OCP Case No. 90-0077BC1) has been provided with a "Closed" regulatory case status. Since it is not clear why this property was identified on the OCPCASES database, and due to the reported historic presence of USTs at the property, KCI concludes that it is possible a release of petroleum occurred at the 1700 Ridgely Avenue site. Therefore, KCI concludes that the inclusion of 1700 Ridgely Avenue to the OCPCASES and UST databases represents a potential environmental concern to the subject site.

The RCRA-CESQG database records indicate that Ilex Woodworking is a Conditionally-Exempt, Small-Quantity Generator of hazardous waste. No violations have been reported in connection with the generation of hazardous waste at this facility, nor was this address identified on the CORRACTS database of facilities undergoing RCRA Corrective Action. Based on these factors, the inclusion of the 1700 Ridgely Street property to the RCRIS-CESQG database does not appear to represent an environmental concern to the study area.

The Environmental Elements Corporation facility was identified on the RCRA-NonGen database as a former large-quantity generator of hazardous waste. The records indicated that no violations have been reported in connection with the generation of hazardous waste at this facility, nor was this address identified on the CORRACTS database of facilities undergoing RCRA Corrective Action. Based on these factors, the inclusion of the 1400 Warner Street property to the RCRIS- NonGen database does not appear to represent an environmental concern to the subject site.

Dovco Industrial Fabricators facility was identified on the RCRA-NonGen database, however no status of the former generator status was provided in the database listing. The records indicated that no violations have been reported in connection with the generation of hazardous waste at this facility, nor was this address identified on the CORRACTS database of facilities undergoing RCRA Corrective Action. Based on these factors, the inclusion of the 1400 Warner Street property to the RCRIS- NonGen database does not appear to represent an environmental concern to the subject site.

1809 Bayard Street

The Former Waterford Caseworks, located at 1809 Bayard Street, was identified on the UST, US BROWNFIELDS, FINDS, RCRA-NonGen, VCP, UST, and HIST UST databases. This facility is also referred to in the database records as the C. M. Athet Paint Company or the Athey C. M. Paint facility. This facility is located approximately 1000 feet northwest of, and topographically upgradient from, the subject site.

The 1809 Bayard Street property was identified on the RCRA-NonGen database as a former large-quantity generator of hazardous waste. Four violations have been reported in connection with the facility's generation of hazardous waste. These include: Generator-All Requirements (Oversight); Generator-General Requirements; a Site Complaint; and a Written Informal violation. However, the facility is not listed on the CORRACTS database of facilities undergoing RCRA Corrective Action.

The Maryland UST and HIST UST databases identified five 2,000-gallon USTs, and three 5,000-gallon USTs at the 1809 Bayard Street property. One of the 2,000-gallon USTs was apparently used to store a "hazardous substance". All eight USTs are listed as being "Permanently Out of Use". The US BROWNFIELDS database indicated that a brownfields assessment was conducted on April 16, 2003. The VCP database indicated that the applicant (1809 Bayard Street LLC) sought a "No Further Requirements Determination" from MDE as an "Inculpable Person". The application was reportedly approved, and a No Further Requirements Determination was issued on March 6, 2003.

In order to obtain additional information concerning the 1809 Bayard Street site, KCI reviewed an MDE Fact Sheet for the Former Waterford Caseworks facility. Based on information contained in the Fact Sheet, the C. M. Athey Paint Company acquired the property in 1947, and manufactured paint products at the site from 1942 until January 1992. Waterford Caseworks subsequently purchased the property, and manufactured specialized cabinetry on the site between 1996 until 2001.

Reportedly, MDE's Hazardous Waste Program issued several complaints to C. M. Athey during their operational years at the property. These complaints were apparently issued in relation to improper storage of hazardous wastes, mineral spirits, resin solutions, and paints in drums. The eight underground storage tanks were reportedly abandoned in-place in May 1986. In February 2002, MDE conducted an environmental assessment of the property. MDE reported that metals including arsenic, lead, antimony and copper, as well as volatile organic compounds and semi-volatile organic compounds, were detected in soils in areas adjacent to the original main building. Groundwater contaminants were also detected; these included cis-1,2-dichloroethene and vinyl chloride.

Based on the proximity and topographically upgradient position of the 1809 Bayard Street property relative to the subject site, KCI concludes that documented cis-1,2-dichloroethene and vinyl chloride groundwater contamination at the facility may represent an environmental concern to the subject site.

4.3 Review of Agency Files

KCI submitted written requests to the Maryland Department of the Environment (MDE) pursuant to the Freedom of Information Act (FOIA) in order to review departmental files pertaining to the subject site. Copies of KCI's FOIA letters and subsequent MDE responses are provided in Appendix F. During the review of MDE regulatory files, KCI reviewed and obtained copies of previous environmental reports (Section 4.3.1) and historic letters and correspondence (Section 4.3.2). In addition, KCI reviewed certain previous environmental reports that were provided by the Client. Summaries of relevant information obtained from the review of these documents are provided in the following report sections. Copies of all previous reports, letters, etc. are provided in Appendix F.

4.3.1 Previous Environmental Reports

As part of this assessment, KCI reviewed several previous environmental reports and work plans prepared by KCI and others. As applicable, information from KCI's review of these reports has been incorporated into this assessment. With the exception of KCI's reports, it should be noted that opinions and conclusion of the following summaries do not necessarily represent KCI's views or opinions. Summaries of these previous environmental reports and work plans are provided as follows:

Preliminary Assessment of
Old Gordon Carton MD-539
MDE, October 2, 2008
(MDE PA 2008)

This Preliminary Assessment (PA), of the Old Gordon Carton site (MDN000306186), was performed by the MDE Waste Management Administration, Land Restoration Program (LRP), Federal Superfund Division under a Preremedial Cooperative Agreement with the EPA.

The purpose of this PA was to determine if there was a potential for the release of hazardous substances by way of groundwater, surface water, soil exposure, and air pathways on sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The scope of this PA included reviewing all available files and site reconnaissance.

The major findings and conclusions from the MDE PA are presented as follows:

- MDE reported that the Gordon/MacNeal property has been the site of light industry for over one hundred and twenty years. Two (2) principal industries were contributors to potential contamination in the area; they were commercial printing and paint and varnish manufacturing. Numerous hazardous chemicals were associated with both of these industries and there was a strong potential that these materials have been released into the environment.

- MDE reported that signs of past storage and housekeeping practices indicate that paints and pigments have been spilled in loading docks and fenced storage areas. MDE reported that access to the interior of the building was denied; therefore no analysis of interior issues could be verified. MDE reported that facility inspections conducted when Gordon Carton was operational indicated that chlorinated solvents were used extensively and that storage and control of the materials was haphazard at best prior to RCRA enforcement. MDE stated that releases of environmental contaminants from the facility likely resulted in contamination of soils and groundwater and would likely have an impact on indoor air quality in structures in the immediate area. MDE stated that a full sampling assessment should be performed on the Gordon/MacNeal site and adjacent properties. Soil, groundwater and indoor air should be examined to determine the extent and nature of environmental contamination relative to the former occupants of the building.

- MDE reported that Gordan/MacNeal is in an area of urban redevelopment in the Southern Gateway to Baltimore City. The 1629 Warner Street property was recently demolished by fire. All that remains of the structure was a portion of the concrete slab foundation. MDE anticipated that the owners of most of the redeveloping properties in the corridor will join the Voluntary Clean-up Program (VCP). Should the owners decide not to participate in VCP MDE stated that a Site Investigation (SI) should be performed on the property.

Phase II Environmental Site Assessment
Gateway South Redevelopment Properties
KCI, January 25, 2008
(KCI Phase II 2008)

KCI conducted a Phase II Environmental Site Assessment to address eighteen (18) contiguous parcels of real property located within the Carroll-Camden Industrial Area of Baltimore City, Maryland. The eighteen parcels comprising the subject site include twelve developed properties (the "business" parcels) and six undeveloped properties (the "waterfront" parcels). The site assessment was conducted at the request of BDC, in preparation for future redevelopment of the site as a commercial complex. The twelve "business" parcels are included as the subject site for this (KCI's) Phase I assessment.

At the time of the Phase II ESA, six (6) of the 12 business parcels were owned by Warner Street, Inc. (WSI) and the remaining six (6) "business" parcels were owned by the City of Baltimore. The City also owns the six (6) waterfront parcels.

Due the negotiations with WSI, which were on-going when KCI completed the fieldwork associated with this Phase II ESA, KCI was not permitted to enter any of the six (6) business parcels that WSI owned. Therefore, KCI was unable to complete the investigations that had originally been proposed at these properties. Nevertheless, KCI completed as much of the remaining investigation as possible.

- Due to the access issues described previously, KCI was unable to complete geophysical surveys at the 1501, 1601, and 1629 Warner Street parcels. However, KCI did complete geophysical investigations at the 1501 Russell Street and 1645 Warner Street parcels of the site. The findings from these surveys revealed one (1) geophysical anomaly (at 1501 Russell Street), which exhibited characteristics potentially consistent with a buried UST or ferrous metal object. The geophysical anomaly was identified along the central-southeastern property boundary of 1501 Russell Street. No geophysical anomaly with the characteristics of a UST was identified at the 1645 Warner Street property.

- KCI collected a total of 52 surface and subsurface soil samples from 26 direct-push technology (DPT) borings advanced across the subject site. The analysis of these soil samples revealed the presence of various contaminants; principally including heavy metals, polycyclic aromatic hydrocarbons (PAH), chlorinated solvents, and petroleum compounds, at concentrations which exceeded applicable Maryland Department of the Environment (MDE) clean up standards (CUS) for soil.

- Comparison of the soil analytical data to relevant MDE CUS revealed certain general trends of contaminant distribution at the subject site:

    1. Chlorinated solvents such as trichloroethene (TCE), tetrachloroethene (PCE), and dichloroethene (DCE) were detected in subsurface soils acquired from the vicinity of the Maryland Chemical facility, and one area located at the north side of this facility appeared to be a potential source area for PCE.

    2. Heavy metals such as lead, arsenic and mercury were generally identified at elevated concentrations (above applicable MDE CUS) in surface and subsurface soils acquired across the entire site.

    3. This investigation revealed that PAH compounds tended to exceed MDE CUS most frequently in soil samples acquired southeast of Warner Street.

4. Soil samples collected from a boring advanced adjacent to an abandoned UST located between the 1633 Warner Street and 2102 Oler Street parcels of the subject site contained some petroleum contamination. This finding suggests that contaminated soils and groundwater may be present near this tank. Additional petroleum impacts identified in surface and subsurface soils acquired from one (1) boring advanced on Lot 6 (i.e., one of the undeveloped "waterfront" parcels) appears indicative of a localized "hotspot" resulting from a past surface spill.

- KCI collected a total of nine (9) groundwater samples from selected borings across the subject site. The analysis of these samples revealed the following general trends:

    1. The analysis of groundwater samples revealed concentrations of TCE, PCE, and DCE exceeding relevant MDE CUS in borings located on and near the Maryland Chemical facility. The pattern of concentrations observed in both groundwater and soils suggests that the Maryland Chemical facility is potentially a source for these analytes.

    2. Elevated concentrations of petroleum compounds were detected in groundwater samples obtained downgradient from 1501 Russell Street, which suggests a potential leaking UST may be the source of the geophysical anomaly identified during KCI's geophysical survey. Relatively high concentrations of petroleum compounds were additionally identified in groundwater obtained from the northwestern (upgradient) boundary of 1551 Russell Street, suggesting that additional petroleum contamination is also migrating to the site from an off-site source.

    3. Numerous PAH compounds were identified at concentrations exceeding relevant MDE CUS in a groundwater sample obtained from the northwestern boundary of the 1629 Warner Street parcel of the subject site. Although KCI analyzed six (6) other groundwater samples from various locations for semi-volatile organic compounds (SVOCs) and PAHs, none of these had detectable concentrations of these compounds. The source of the PAHs identified in the sample acquired near 1629 Warner Street is not clear.

- As part of the Phase II EA, KCI collected a total of ten (10) soil gas samples from various locations across the project site. The soil gas samples were analyzed for VOCs, and the reported concentrations were measured against the values presented in the EPA document *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils.* In summary, the analysis of these samples revealed six (6) VOC analytes in four (4) of the soil gas samples. These analytes, which included benzene, hexane, pentane, 1,1,1-trichloroethane, TCE, and vinyl chloride, were identified in soil gas samples collected from locations near the center of the subject site.

- KCI confirmed the presence of several asbestos-containing materials and lead-based paint coated surfaces in association with the onsite buildings. KCI also observed light ballasts presumed to contain PCBs, and fluorescent lamps and thermostats which likely contain mercury within the buildings.

Phase II Environmental Site Assessment – Supplement No. 1
Gateway South Redevelopment Properties
KCI, October 10, 2008
(KCI Phase II SUP 2008)

KCI Technologies, Inc. (KCI) performed a Phase II Environmental Site Assessment (ESA) Supplement No. 1 of the Gateway South Redevelopment properties in order to finish tasks that were not completed during the KCI's Phase II ESA dated January 25, 2008. Specifically, these uncompleted tasks include the following:

1. Conduct geophysical investigations to search for undocumented underground storage tanks (USTs) at the 1501, 1601, and 1629 Warner Street Inc. (WSI) properties;

2. Characterize and stage drums stored within the 1501 Warner Street warehouse; and

3. Complete screening-level asbestos and lead-based paint investigations within existing buildings at the WSI parcels;

The major findings and conclusions from KCI's Phase II ESA Supplement No. 1 are presented as follows:

- At the six (6) WSI properties investigated, five (5) possible USTs were identified, and a sixth UST was implied by fill and vent pipes.

- The locations of suspected solvent-storage USTs at 1601 Warner Street, a CERCLIS site, could not be determined.

- One-hundred and thirty (120) drums are stored at 1633 Warner Street. A total of 25 of these drums were sampled. A total of ten (10) of these twenty-five (25) drums had one or more samples with flash point below 140 degrees Fahrenheit. By EPA's definition (Code of Federal Regulations, Title 40, Subpart C) these wastes are hazardous by the ignitability characteristic and would be coded D001 hazardous wastes.

- KCI has identified several Asbestos-Containing Materials (ACM) during the screening-level, Limited ACM Survey conducted as part of this assessment and has determined that several surfaces in the buildings surveyed are coated with lead-based paint (LBP).

Brownfield Site-Specific Investigation
for Warner Street Wetlands
Located in Baltimore, Maryland
MDE, March 2006
(MDE SI 2006)

This report was produced by MDE as a result of the proposed environmental and economical revitalization of the Middle Branch of the Patapsco River. As part of the revitalization plan, four (4) undeveloped off-site properties in the Warner Street corridor were under consideration for the creation of a new wetland ecosystem for the Gwynns Falls Trail system. The proposed Warner Street Wetland properties border the Middle Branch of the Patapsco River and are owned by the City of Baltimore. MDE reported the properties were created in the early 1900s with soil and fill materials related to the Great

Baltimore fire of 1904. In order to evaluate environmental concerns related to the fill, the BDC requested the MDE to conduct a Site-Specific Brownfield Assessment of the Warner Street Wetland Properties. The Assessment field events were performed in October 2005.

MDE stated that the investigation reportedly included the advancement of 12 soil borings and the installation of a temporary piezometer. Two (2) groundwater samples were collected and analyzed for metals and semi-volatile organic compounds (SVOCs). A total of 48 soil samples were collected from the soil borings. These samples were screened for metals and carcinogenic polycyclic aromatic hydrocarbons (cPAHs). Based on the screening results, MDE stated that a total of 14 soil samples were selected for analysis of metals and SVOCs. Soil samples with high chromium screening results were further selected by MDE for speciation of chromium VI and chromium III. Furthermore, a total of four (4) soil samples that were composited from the top six (6) feet of soil were analyzed using the Toxic Characteristic Leaching Procedure (TCLP) to determine potential soil disposal options.

MDE reported that soil analytical results indicate widespread detections of arsenic, lead, and mercury at concentrations that exceeded the MDE and/or EPA comparison values. Two (2) SVOCs, benzo(aq)pyrene and dibenzo(a,h)anrhracene, were detected above MDE and EPA comparison values.

MDE reported that analytical results of dissolved groundwater indicate that manganese was the only metal detected above the MDE standard for Type I and II Aquifers. Detected SVOCs included acenaphthene, fluorine, and phenanthrene; however, concentrations of these compounds were well below MDE comparison values.

MDE reported that a toxicological evaluation of soil indicated that the estimated risks from incidental ingestion or dermal contact of carcinogenic or noncarcinogenic contaminants in the surface or subsurface soil exceeded MDE and EPA recommended ranges for multiple population groups. The primary risk drivers in soil were arsenic and benzo(a)pyrene. Lead in soil may also pose a threat to the health of sensitive populations in discrete locations of the site. However, the estimated risks from incidental ingestion, inhalation, or dermal contact of carcinogenic or noncarcinogenic contaminants in the surface or subsurface soil were within the MDE and EPA recommended ranges for the construction worker commercial population.

Phase I Environmental Site Assessment
Warner Street Business Center Properties
MDE, April 21, 2004 / Updated January 24, 2006
(MDE Phase I Warner 2006)

MDE indicated that this report was prepared as part of the State of Maryland's Brownfield Site Assessment Initiative. It describes the findings from MDE's completion of a Phase I Environmental Site Assessment of the Warner Street Business Properties, located in the 1400 to 1600 blocks of Warner Street, in Baltimore, Maryland. MDE reported that the site assessment was conducted at the request of BDC in preparation for future redevelopment of the area.

In their report, MDE indicated that their subject site included thirteen lots on three blocks, and measured a total of 15.52 acres. The report stated that historic records reviewed for their assessment indicated varied industrial uses of the subject parcels, dating back through the mid-19th century. MDE reported that Sanborn Fire Insurance maps from 1890 through 1953 illustrated a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on the parcels of interest in the Warner Street corridor.

MDE performed a site reconnaissance on February 11, 2004 to photo-document site conditions. Nine of the thirteen parcels under consideration were occupied at the time of MDE's visit. The four unoccupied parcels were located in the rectangle defined by Warner, Oler, Shell, and Worcester Streets. These parcels reportedly showed signs of distress, with evidence of vandalism to both the buildings and public spaces. MDE indicated that graffiti covered certain walls, windows were broken, doors had been breached and fires had been set on building grounds and in the middle of the street. Of particular concern to MDE was the area in the rectangle formed by Warner Street, Wooster (Worcester) Street, Oler (Dock) Street, and Shell (Eutaw) Street. MDE reported that this parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which (MDE stated) used heavy metal salts and oxides and volatile organic materials in their process and operations.

Another reported area of concern was the 1600 block of Warner Street, which was once the site of a historic brass foundry. MDE stated that contaminants of concern in the foundry included volatile organic compounds, heavy metals, arsenic, acids, and metallic salts and oxides.

The Maryland Chemical site in the 1500 block of Russell Street was reported to present several potential areas of concern to MDE. This property was at one time the site of American Cyanamid, an industrial manufacturer of pesticides and agricultural chemicals. MDE identified a number of concerns stemming from the storage and sale of industrial chemicals and noted that both aboveground and underground tank storage of chemicals are documented for this site.

MDE reported thirteen (13) UST cases listed in the Warner Street corridor. Eleven (11) of these cases had been closed at the time of MDE's report. The two open cases were associated with gasoline stations on Russell Street, including the Texaco in the 1400 block, and the Amoco in the 1800 block. MDE also noted that historic discharges of contaminants in South Baltimore have had an impact on the area groundwater. MDE concluded that due to the engineering controls currently in place at the two gas stations, it was unlikely that the existing gasoline stations were impacting the groundwater. A Phase II Site Assessment was recommended to document the levels of contaminants throughout the Warner Street area and to determine the best practicable remediation and use of the subject properties.

MDE-ERRP Brownfields
Phase I Environmental Site Assessment and
Sampling and Analysis Plan
Proposed Warner Street Wetland Area
Lots 5A, 6, 7, and 8/9
MDE, September 27, 2005
(MDE Phase I SAP 2005)

MDE reported that this report was prepared as part of the State of Maryland's Brownfield Site Assessment Initiative. It describes the findings from MDE's completion of a Phase I Environmental Site Assessment of the Warner Street wetland properties and properties, located in the 1400 to 1600 blocks of Warner Street, in Baltimore, Maryland. MDE reported that the site assessment was conducted at the request of BDC in preparation for future redevelopment of the area.

In their report, MDE indicated that the wetland properties included four (4) lots on three (3) blocks, and measured a total of 5.3 acres. This report also supplies historic information on the Warner Street business parcels that consist of 13 lots on three (3) blocks and measures a total of 15.52 acres. The report stated that historic records reviewed for their assessment indicated varied industrial uses of the subject parcels,

dating back through the mid-19th century. MDE reported that Sanborn Fire Insurance maps from 1890 through 1953 illustrated a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on parcels within the Warner Street corridor.

Of particular concern to MDE was the area in the rectangle formed by Warner Street, Wooster (Worcester) Street, Oler (Dock) Street, and Shell (S. Eutaw) Street. This area was reported to be the site of a paint and varnish manufacture and a commercial printing operation, both of which used heavy metal salts, oxides, and volatile organic materials in their process and operations.

Another area of concern for MDE was the 1600 Block of Warner Street, which was once the site of a historic brass foundry. Contaminants of concern from foundry operations are VOCs, heavy metals, arsenic, acids, and metallic salts and oxides.

MDE reported that the Maryland Chemical site in the 1500 block of Russell Street presents several potential areas of concern. This property was once the site of American Cyanamid, an industrial manufacturer of pesticides and agricultural chemicals. Maryland Chemical also presents a number of concerns stemming from the storage and sale of industrial chemicals. Both aboveground and underground tank storage of chemicals were documented. The facility handled a variety of listed materials in containers ranging in size from small consumer retail-sized to 55-gallon drums, tanks and carboys.

Results from a EPA EnviroMapper listed 205 air releases, 21 discharges to surface water, and 17 toxic discharges within a two-mile radius of the Warner Street Properties. This report indicates that several of the listed sites are in the immediate vicinity of the Warner Street properties. Specifically, MDE Stated that 2110 Haines street is reported as the closest with past uses including coal and wood storage, telephone pole storage, trailer truck sales, and barge manufacturing. IOC, Gordon Carton, and Maryland Chemical Company are listed in the database as having operated in the Warner Street corridor. IOC has not been reported since 1981 and Gordon Carton since 1999. Maryland Chemical was reported as being in operation at the time this MDE report was written.

MDE reported that lots 5A, 6, 7, and 8/9 were also reported as a concern due to the presence of fill that contains SVOCs, metals, and is petroleum stained in places. MDE believes that these waterfront lots were created by filling the Middle Branch of the Patapsco River with debris from the Great Baltimore Fire of 1904.

MDE reported that the Phase I Assessment portion of this report concludes that Site-Specific Phase II Brownfields Assessments were recommended to document the levels of contaminants at sites within the Warner Street Business and Wetland areas to ascertain the best practicable use for those areas. The Phase II Brownfield Site-Specific Assessments would define the nature and extent of potential contamination was well as determine potential remediation alternatives.

MDE reported that the Sampling and Analysis Plan portion of this report indicates that the City of Baltimore, in partnership with the U.S. Army Corps of Engineers (USACE) was planning a major environmental and economic revitalization of the Middle Branch of the Patapsco River. As part of the revitalization plan, MDE proposed that the wetland properties be restored to a viable wetlands ecosystem. The restoration plan called for the removal and disposal of the first six (6) feet of soil/fill, which is comprised of debris associated with the Great Baltimore fire of 1904. The wetland properties would then have been recovered with two (2) feet of clean fill.

MDE reported that in 2001, as part of a broader MDE Brownfield Investigation of the Carroll-Camden area, samples of soil, sediment and groundwater were collected at the wetland properties. MDE reported that these samples were analyzed for VOCs, SVOCs, PCBs, and total metal. Analytical results reported by MDE in soil indicated the presence of chemicals of potential concern (COPC), specifically, MDE stated metals (arsenic, chromium, and mercury) and SVOCs (benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene) at concentrations above Maryland State Residential Cleanup Standards. Some VOCs were detected but below the Maryland State Residential Cleanup Standards. Similar results were reported by MDE for metals and SVOCs in sediment samples when compared to the National Oceanic and Atmospheric Administration (NOAA)/Effects Range Medium (ERM) values. MDE reported that in groundwater, some metals (antimony, arsenic, and manganese) were detected above Maryland State standards for Type I and II aquifers; however, MDE reported that VOCs and SVOCs were not detected above State standards.

MDE reported that the Sampling and Analysis Plan portion of this report proposed a soil sampling grid consisting of approximately 12 locations with multiple sampling horizons planned in an effort to characterize the wetland properties. Locations for the proposed sampling points were provided.

Brownfields Site Specific Sampling & Analysis Plan
Warner Street Properties, Operational Unit Three (OU3)
MDE, May 11, 2005.
(MDE SAP OU3 2005)

The MDE's Site-Specific Sampling & Analysis Plan (SAP) For OU3 is essentially a detailed work plan for environmental sampling and analysis operations at several properties, including 2119 Haines Street, 1633 and 1645 Warner Street, and 2102 Oler Street. All four of these parcels are included as part of the subject site for this (KCI's) assessment.

MDE reported that the SAP for OU3 was completed for the Client (i.e., BDC) to support proposed revitalization activities in the "Warner Street Area" of Baltimore City. The described "Warner Street Area" included thirteen individual parcels, which were to be addressed in three individual brownfields investigations. The SAP for OU3, being one of the aforementioned investigations, describes a 2.29 acre portion of the Warner Street Area (i.e., Operational Unit 3), summarizes the environmental setting and operational history of OU3, and describes the procedures and methods to be used in collecting and analyzing environmental samples.

MDE reported that historical information provided in the SAP for OU3 indicated that in the 1890s, the property bounded by Warner, Haines and Oler (Dock) Streets housed the Gibson and Kirk Brass Foundry. Biemiller Coal and Wood Wharf, and an Ice House (later the American Ice Station) occupied the 2119 Haines Street property from the 1890s through 1953. MDE reported that the Gibson and Kirk Brass Foundry occupied the 1633 and 1645 Warner Street Properties between 1915 and 1953. Saratoga Supply Company, a general hardware distributor, occupied the 1633 and 1645 Warner Street properties between 1960 and 2000 (Note that KCI's research suggests that some of this historical use information is not accurate. Please refer to Section 4.5.1)

MDE reported that the SAP for OU3 indicates that potentially contaminated areas had been identified and were to be sampled to determine the nature of the site contamination. Contaminants of concern included Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), Polycyclic Aromatic Hydrocarbons (PAHs), Priority Pollutant List (PPL) metals, and Polychlorinated Biphenyls

(PCBs). The SAP for OU3 did not specifically identify the locations of the potentially contaminated areas. Instead, MDE reported that "the non-uniform use of the property and the relatively small size of the parcel led to a design in which the site is uniformly divided into a series of ten-foot grids and samples collected from a random number of these grids". Locations for the proposed sampling points were provided.

Brownfields Site Specific Sampling & Analysis Plan
Warner Street Properties, Operational Unit Two (OU2)
MDE, January 4, 2005.
(MDE SAP OU2 2005)

MDE reported that the WP OU2 Work Plan was written to address the entire 1500 and 1600 blocks east of Warner Street in Baltimore City, Maryland. Five major structures are associated with the parcels 1501, 1601, 1629 and 1633 Warner Street, 2104 Worcester Street, and 2102 Oler Street. Pertinent information reviewed by KCI is summarized as follows.

MDE reported that within the site background section of the Work Plan, MDE reported that the C.F. Ranstead and Baltimore Cedar Co. occupied the property in the 1890s. From 1902 through 1953, MDE indicated that the J. B. MacNeal and Company Varnish and Color Works operated out of buildings on this property. In 1953 MDE reported that this property was occupied by both J. B. MacNeal and Gordon Carton. The discussion indicated J.B. MacNeal occupied the northwestern quadrant of the property and Gordon the southeastern. MDE indicated that the property was one of a number of parcels being addressed by BDC in its planned revitalization of the Warner Street I Corridor.

MDE reported that based upon the potentially contaminated areas, available historical data, and observations made during their site visit, a number of contaminants of concern were identified for the Warner Street property including: volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); polycylic aromatic hydrocarbons (PAHs); priority pollutant metals; and polychlorinated biphenyls (PCBs). The potentially contaminated areas were described based on analysis concerning the locations to which hazardous wastes or pollutants may have migrated. The EPA's Visual Sample Plan (VSP) program was used to define the sample locations for this investigation. Locations and numbers of the sampling points were provided within the report.

Brownfields Site Specific Assessment of the Maryland Chemical Company
1551 Russell Street, Baltimore City, Maryland
MDE, June 6, 2005
(MDE SSA MDCHEM 2005)

MDE reported that as part of the State of Maryland's Subtitle C State Response Programs (Module III - Brownfields Targeted Assessments) grant, the Maryland Department of the Environment (MDE) conducted a Phase II Brownfields Site Specific Assessment of the property located at 1551 Russell Street in the Carroll/Camden area of Baltimore, Maryland 21230 as OU1 on the Warner Street Business Center Properties. The site assessment was reportedly conducted at the request of BDC, in preparation for future redevelopment of the site as a commercial complex.

MDE reported that the property was occupied by the Maryland Chemical Company, which consisted primarily of two large brick structures separated by an open work area. One structure, the south building, housed the offices, a break room, storage areas, loading docks and a large caustic aboveground storage

tank (AST). The other structure, the north building, was exclusively warehouse. MDE reported that there were three (3) canopied storage areas and six (6) large ASTs within the open work area.

Following a site reconnaissance and a review of the Phase I investigation, MDE prepared a sampling plan to characterize the 3.62-acre site. MDE collected seven (7) surface and seven (7) subsurface soil grab samples, three (3) surface water grab samples and one (1) shallow groundwater grab sample plus a duplicate. Reportedly, no sediment samples were collected during this project. MDE reported that the soil samples were field screened for the presence of carcinogenic polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals. The subsurface soil samples were submitted for volatile organic compound analysis (VOC). All water samples were submitted for priority pollutant list (PPL) metals, pesticides, PCBs, semi- volatile organic compounds (SVOCs) and VOC analysis. Soil samples from locations that revealed the highest field screened levels of contamination were sent for confirmatory analyses of a suite of 14 PP metals, pesticides, PCBs, SVOCs and VOCs.

The results of MDE's investigation revealed elevated levels of the heavy metals and chlorinated organic compounds in soils. With regard to the metals, MDE stated that arsenic and mercury were detected in soils at concentrations exceeding the relevant MDE cleanup standards. In the case of mercury, MDE concluded that the results were nevertheless consistent with naturally-occurring background levels for soils in the region (i.e., the natural levels are higher than the cleanup standard). However, one of the arsenic results was apparently more than 20 times the cleanup standard. This sample was reportedly collected near the railroad spur that crosses the property. With regard to the chlorinated organic compounds in soil, MDE reported that trichloroethene (TCE), cis-1,2 dichloroethene (DCE) and tetrachloroethene (PCE) were detected at levels below the relevant MDE cleanup standards.

MDE also reported that laboratory analysis of the groundwater sample collected during the assessment revealed elevated concentrations of 1,1-dichloroethane, DCE, chloroform, TCE, and PCE. The TCE and PCE concentrations reportedly exceeded the MDE cleanup levels for Type I and II aquifers. In addition, numerous heavy metals were detected at concentrations exceeding the relevant cleanup levels in unfiltered samples. However, only nickel and copper were detected (at trace concentrations) in the filtered groundwater sample, indicating that the majority of the metals were present in suspended solids.

Following the collection of data, MDE performed a toxicological evaluation, assuming a commercial use scenario for the site. The toxicological evaluation apparently revealed elevated levels of risk to the child visitor, youth visitor, and adult worker and construction worker populations from the incidental ingestion of surface soil. Elevated levels of risk to all commercial populations were also identified from dermal contact with the groundwater beneath the site. MDE reported that all populations exceeded the MDE threshold lifetime cancer risk of 1 x 10-5 with scores ranging from 1.0 x 10-5 to 6.3 x 10-5 from the ingestion of surface soil exposure pathway, with arsenic as the risk driver.

Brownfield Assessment Work Plan for The Haines Street Property
Baltimore City Maryland
Maryland Department of the Environment, April 28, 2005
(MDE WP Hains 2005)

The MDE prepared this Brownfield Assessment Work Plan for the properties located at 2119 Haines Street, 1633 and 1645 Warner Street and 2102 Oler Street (Haines Street Properties) in support of the BDC proposed revitalization of the Warner Street area of Baltimore City.

This report indicates the following historic uses of the Haines Street Properties:

- MDE reported that in the 1890s the property bounded by Warner, Haines and Oler (Dock) Streets housed the Gibson and Kirk Brass Foundry.

- MDE reported that Biemiller Coal and Wood Wharf and Ice House (later the American Ice Station) occupied the 2119 Haines Street property from the 1890s through 1953.

- MDE reported that the Gibson and Kirk Foundry occupied the 1633 and 1645 Warner Street properties from a period after the 1915 through 1953.

- MDE reported that Saratoga Supply Company, a general hardware distributor occupied the 1633-1645 Warner Street property from between 1960 and 2000.

Based on MDEs site visit and historical information available to MDE, MDE stated that potentially contaminated areas were identified for the properties. MDE reported that these potentially contaminated areas were developed based on former locations where hazardous substances, hazardous wastes, or pollutants were known or suspected to have been discharged , handled, or disposed, or where hazardous substances, hazardous wastes, or pollutants may have migrated. MDE stated that this report indicated that contaminates of concern were identified for the Hains Street property and include: volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); polycylic aromatic hydrocarbons (PAHs); priority pollutant metals; and polychlorinated biphenyls (PCBs). MDE reported that the EPA's Visual Sample Plan (VSP) program was used to define the sample locations for this investigation. Locations and numbers of the sampling points were provided within the report.

Maryland Chemical Company
Baltimore City, Maryland
Toxicological Evaluation
MDE, April 11, 2005
(MDE MDCHEM TOX EV 2005)

For the purposes of this evaluation MDE stated a commercial use scenario was assumed for estimating risk to potentially exposed populations. Groundwater and surface water samples were analyzed for VOCs SVOCs and metals. Soil samples were analyzed for VOCs, SVOCs, PCBs, metals and selected pesticides.

MDE reported that the toxicological evaluation revealed elevated levels of risk to the child visitor, youth visitor, and adult worker and construction worker populations from multiple pathways. MDE reported that all populations exceeded the MDE threshold lifetime cancer risk of 1 x 10-5 with scores ranging from 1.0 x 10-5 to 6.3 x 10-5. In addition, MDE reported that all populations exceeded the EPA recognized acceptable hazard index (HI) values of less than or equal to 1 with scores ranging from two (2) to 43. MDE related that the risk drivers included arsenic, chromium, TCE, and PCE.

Voluntary Cleanup Program
Baseline Risk Assessment of
2110 Haines Street, Baltimore, Maryland
MDE, February 2002
(MDE VCP RA 2002)

MDE reported that this Voluntary Cleanup Program (VCP) baseline risk assessment was performed to quantify the potential human health risks associated with the 2110 Haines Street parcel of the subject site. The methodology used in this risk assessment followed the VCP baseline risk assessment template provided by MDE. This risk assessment evaluated potential exposures and risks for a child visitor (1-6 years), and a youth visitor (6-17 years) under a future commercial use scenario, and an adult worker and construction worker under a future commercial or industrial use scenario. On-site risks to ecological receptors were not evaluated because there was no ecological habitat onsite. A screening analysis of the risks due to groundwater constituents transported from the site to the Middle Branch found no unacceptable risks.

The MDE's risk benchmarks for a non-residential/residential use ("mixed use") property are a 1×10^{-5} excess lifetime cancer risk and a hazard quotient (HQ) of 1 MDE; if the estimated risks are lower than these values, MDE stated that it can be concluded that remediation is not warranted for health protection purposes. For the population considered in this assessment, all of the risk estimates were below their respective benchmarks. Therefore, consistent with MDE guidance, no remediation is required to protect public health.

MDE reported that this risk assessment employed conservative assumptions based on the MDE guidance and other approaches, thus yielding "reasonable worst-case" risk estimates. An alternative risk assessment based on assumptions that reflect realistic site-specific conditions would likely yield risk estimates much lower than those presented in this report.

Comprehensive Phase II Site Investigation
Glose Site, 1551 Russell Street, Baltimore, Maryland 21230
Datanet Engineering, Inc., December 15, 2000
(Datanet Glose Site Phase II 2000)

Datanet was contracted by MDCHEM to perform a Phase II Site Investigation of the 1551 Russell Street parcel of the subject site. A summary of the Phase II findings are as follows:

- Datanet report that levels of chlorinated organics, primarily PCE, TCE, cis-l,2-Dichloroethene (cis-1,2-DCE), and Vinyl Chloride (VC), were detected at the subject site in excess of EPA Region Ill Risk-Based Corrective Action (RBCA) screening levels in the subsurface soil and groundwater. PCE was detected at the upgradient (Russell Street) end of the property, including a boring in the sidewalk beyond the property boundary. The other chlorinated compounds appeared as the groundwater flowed across the property to Warner Street, indicating that in-situ degradation is likely occurring. Datanet report that presence in the upgradient boring also indicates that contamination is likely coming onto the property from off-site.

- Datanet stated that Contamination present at the property likely did not originate from site activities. The entire property is paved with asphalt; over a significant part of the property, the asphalt is underlain by 6" of concrete. During boring operations, penetration at many locations through a rock/concrete at depths varying from 6' to 9' bgs was difficult with refusal encountered at 8 locations.

Thus, considerable barriers to contaminant migration into the subsurface in the event of a spill exist. KCI does not agree with Datanet's finding in this matter.

- Datanet report that current levels of PCE, TCE, cis-l,2-DCE and VC in subsurface soil samples across the property are in compliance with the newly published MDE Non residential Soil Clean-Up Standards. Datanet indicated that "no active remediation of the soil is recommended and that these contaminants will likely degrade overtime in the ground to even lower levels". KCI does not agree with Datanet's finding in this matter.

- Datanet report that an exposure/risk assessment indicated that vapor intrusion into buildings through cracks in the floor followed by inhalation of vapors would be the only potential exposure pathway at the property, either currently or in the future. Using the highest levels of contaminants detected in groundwater samples, the Johnson and Ettinger (1991) model indicated incremental risk currently a the property for carcinogenic PCE, TCE, and VC of less than 1 EE-05 at current contaminant levels. Incremental risk from levels of noncarcinogenic cis- 1,2- DCE show a hazard quotient less than 0.1. Thus, active groundwater remediation is not deemed necessary.

Phase I Environmental Site Assessment
for the Carroll-Camden Area
Baltimore City
MDE, October 16, 2000
(MDE Carroll-Camden Phase I 2000)

MDE reported that this Phase I report was completed upon the request of BDC to the MDE Environmental Restoration and Redevelopment program, as part of plans for the revitalization of the Carroll Camden area. This report is considered a limited Brownfield Survey of part of approximately 600 acres in the Carroll-Camden Area.

MDE findings and conclusions from this Phase I Assessment were reported as follows:

- MDE reported that the Carroll Camden Area was partially abandoned; it exhibited obvious signs of stress and was considered a good candidate for revitalization and rehabilitation. The site was partially occupied by vacant buildings fitted with broken windows and boarded up doors. Local features also included vacant parking lots, abandoned vehicles and trailers, piles of household debris, and isolated campsites that tend to indicate occasional tenants. At times, the surface of the Gwynns Falls was covered with an oily sheen and its banks were littered with household wastes.

- MDE reported that from an environmental point of view, information was reported as currently scarce. MDE recommended a phased approach to ascertain current site conditions and evaluate potential hazards that it may enclose.

Draft Exposure & Risk Assessment
2110 Haines Street
Baltimore, Maryland
Exponent, December 7, 1999
(Exponent E&RA Draft 1999)

This report presented the results of an exposure and risk assessment for 2110 Haines Street, Baltimore, MD, that was at the time being considered for purchase by AT&T, Inc. An application for inclusion for this site under the VCP was filed with the MDE.

This risk assessment was presented in draft form, for discussion purposes. The final exposure and risk assessment was to be incorporated as Section 3 of the Response Action Plan (RAP) that was to be submitted for this site. A copy of the 2110 Haines Street RAP was not available for inclusion in this report.

A summary of the pertinent site exposure and risk assessment results reported by Exponent follows:

- Exponent reported that several constituents of interest (COI) were identified based on screening against residential and industrial RBCs. Because of the presence of several COIs, including lead in surfical soils above the US EPA screening level, unrestricted future residential use of the site may have been of concern. However, AT&T planned to use the site for exclusively nonresidential use (i.e., as a telecommunications switching facility and perhaps telecommunications-related office functions). Therefore, AT&T planned to attach a notification to the deed for the property indicating the presence of chemicals in soils and groundwater, and excluding unrestricted future residential use of the property.

- For the onsite worker, Exponent reported that the summed hazard indices for all noncarcinogenic COI and pathways was 9×10^{-23}, and the cumulative excess lifetime cancer risk for all carcinogenic COI and pathways was 1×10^{-5}. This indicated that there was a slightly elevated risk for a present worker, driven by ingestion of surface soil, and dermal contact with surface soil. This assumes continuous contact with surficial soils over a worker's 25-year career. Exponent stated that "this was clearly much higher than the actual exposure of the parking attendants at the lot for football games".

- For assumed youth trespasser or occasional visitor, Exponent reported that the summed hazard indices for all noncarcinogenic COI and pathways was 9×10^{-23} , and the cumulative excess lifetime cancer risk for all carcinogenic COI and pathways was 7×10^{-6} , This slightly elevated risk assumes 132 days of exposure per year between the ages of 6 and 18. Exponent reported that this was clearly overestimated, because there are no residential areas within a mile (by road) of the site.

- For the future adult onsite worker, Exponent reported that the assumed HI for all noncarcinogenic COI and pathways was 5×10^{-5}, and the cumulative excess lifetime cancer risk for all carcinogenic COI and pathways was 1×10^{-5}, Exponent indicates that there was a slightly elevated risk for a future worker, driven by ingestion of surface soil, and dermal contact with surface soil. Exponent reported that this assumed continuous contact with surficial soils over the worker's career. Exponent reported that AT&T intended to propose appropriate measures to manage these risks as part of the final RAP.

- For the future adult construction worker, Exponent reported that the summed hazard indices for all noncarcinogenic COI and pathways was 2, and the cumulative excess lifetime cancer risk for all carcinogenic COI and pathways was 5×10^{-4} . This indicates that there was elevated risk for a future construction worker. Exponent reported that this apparent risk was driven by dermal contact with groundwater.

- Exponent reported that several significant uncertainties affect the data and assumptions that drive the future construction worker risk. First, the risk is based on the detection of poly aromatic hydrocarbons (PAHs) in a single groundwater sample (of six (6) samples collected in the Phase II ESA). Further, the data are for total PAHs in groundwater, which in all cases exceed the solubility limits for PAHs; this is significant because dissolved PAHs are much more bioavailable and toxic than PAHs adsorbed to particulate matter. Because of this, Exponent reported that the solubility limits were used in place of any concentration that exceeded the solubility limit.

  In addition, Exponent reported that exposure assumptions for the construction worker are much more conservative than would actually occur for the AT&T facility. The assumptions used assume that the worker would be in full contact with groundwater (at a depth of 11 ft. bgs) for a full year, and that all groundwater was contaminated at the maximum concentrations detected. The reality would probably be that subsurface soil would only be disturbed in a few areas, for a few weeks, and only to a depth of a few feet, to pour the footings for the walls. AT&T intended to propose appropriate measures to manage these risks as part of the final RAP.

Phase I & II Environmental Site Assessment
Property Located at 2110 Haines Street, City
Greentree Consulting, Inc., December 3, 1999
(GCI Phase I & II Haines 1999)

In 1999, (then prospective buyer) and Baltimore Gateway Joint Venture (seller) submitted a VCP application to MDE and retained Greentree Consulting, Inc. (GCI) to perform an environmental investigation.

The findings of Greentree's Phase I and II ESA are summarized as follows:

- Greentree reported that the aerial photographs and Sanborn Co. fire insurance maps reviewed indicated that past uses of the property included wood wharf; wood and coal storage; steel barge manufacturing; and electric power pole storage. Prior use to adjacent properties included coal, wood, and ice storage, glass manufacturing; steel storage yard; and a brass foundry and machine shop.

- Greentree reported that at the time of this reports issuance, no information had been received from the regulatory agencies contacted which identified any indications of contamination or associated adverse environmental operations or conditions on the property

- Greentree reported that the laboratory analytical results of the five (5) surface soil samples indicate that concentrations of total petroleum hydrocarbon compounds (TPHC) ranged from 1,170 parts per million (ppm) to 6,860 ppm. There are no risk based concentrations (RBCs) for TPHC; however, the TPHC concentrations are consistent with the current use as a parking lot and did not indicate an immediate environmental concern.

- Greentree reported that the surface soil sample with the highest TPHC results was analyzed for volatile organics. The analytical results indicated that no volatile organics were detected. These results document that the surface solids sampled at the subject site are not impacted by any releases of hazardous materials containing volatile organics. The analytical results of the 16 subsurface soil samples indicate that one (1) soil sample had detectable levels of three (3) volatile organic compounds (VOCs): toluene, ethylbenzene, and total xylenes. The concentration were several orders of magnitude below both the industrial and residential use RBCs. These results documented that the subsurface soils sampled at the subject site were not adversely impacted by any releases of hazardous materials containing volatile organics.

- Greentree reported that 13 of the 16 subsurface soil samples had several detectable semi-volatile organic compounds (SVOCs). 13 samples had SVOC concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene above the industrial use RBCs. These SVOCs are all carcinogenic polynuclear aromatic hydrocarbons (cPAHs) and may be associated with the former storage of treated lumber and power poles at the property.

- Greentree reported that no metals with the exception of lead were detected in 16 subsurface soil samples at concentrations above the industrial RBCs. Two (2) samples had lead concentration of 910 and 1,700 mg/kg, respectively.

- Greentree reported that one (1) polychlorinated biphenyl (PCB) isomer, Aroclor-1242, was detected in one (1) soil sample. Aroclor-1242 was widely used in dielectric fluids and may be associated with the former storage of electrical transformers at the property. The reported concentration was below the industrial RBC, but above the residential RBC. Since the property is zoned for industrial use, the results document that the subsurface soils sampled at the subject site are not adversely impacted by any releases of hazardous materials containing PCBs.

- Greentree reported that one (1) groundwater sample was analyzed for TPHC. It contained TPHC of 40 mg/L. VOCs and PCBs were non detectable in all six (6) of the groundwater samples.

Summary and Discussion of Findings
May 1998 Phase II and September 1998 Supplemental Phase II
Former Eastfield Container Corporation
1501 Russell Street, Baltimore Maryland
Datanet Engineering, Inc., January 15, 1998
(Datanet MDCHEM Summary Phase II 1999)

Datanet's findings of the Phase II investigation are as follows:

- Datanet indicated that subsurface stratigraphy at the site consists of four principal layers. Datenet reported that these include:

    1. Concrete flooring, underlying stone and fill material (sand, silt, clay, debris and large rocks) to depths ranging from 4 to 8 feet below ground surface (bgs);

    2. A silty sand layer ranging in thickness from 0.5 to 2 feet was commonly encountered at a depth of approximately 7 to 9 feet bgs. This layer was typically saturated and represents the first water-bearing horizon at the subject site. Wells screened across this layer only

were readily dewater during development and sampling, indicating that the hydraulic conductivity if this layer is low.

3. Low permeability silty-to sandy-clay to depths ranging from 16 to 20 feet bgs. The overall fine-grained soil particles in this layer would inhibit the vertical migration of fluids due to their low permeability. Secondary porosity features such as fractures and parting planes were observed in this layer, however, which would increase the hydraulic conductivity of this layer. The upper portion of this layer was saturated; wells completed into this silty-clay layer were rapidly dewatered, confirming its low permeability nature; and,

4. Silty to sandy-gravel at 19 to 24 feet in Boring B-4. These coarse grained silty sands and gravel were saturated and observed to have a higher conductivity than the shallow, water-bearing silty sand layer, based on increased well yields from the deeper layer during development of MW-1 and MW-2.

- Datenet reported that tetroleum impacts of the soil as measured by total petroleum hydrocarbons (TPH)-diesel range organics (DRO), TPH-gasoline range organics (GRO), and total recoverable petroleum hydrocarbons (TRPH), were observed in the area of the abandoned –in-place fuel oil tank as well as upgradient and downgradient of this tank. Datanet stated that the highest concentrations were observed in low permeability soil zone between 8 feet and 17 feet. TPH-DRO concentrations ranged from 117mg/kg at a depth of 17 feet in boring B-6 to 5,400 mg/kg at 8 to 10 feet in the boring for MW-1; Datanet stated that these concentrations are greater than the MDE action level of 100 mg/kg TPH but less than RBCs developed by others as remedial action levels if all of the DRO is assumed to be naphthalene or phenanthrene (2 common diesel fuel indicator compounds).

- Datanet reported that petroleum impacts of the shallow groundwater, as measured by TPH-DRO, TPH-GRO, and benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations, were observed in the area of the abandoned-in-place fuel oil tank as well as upgradient and downgradient of this tank. Datanet stated that TPH-DRO concentrations ranged from 0.210 mg/l at MP-5 to 184 mg/l at MW-1 after equilibration of the water table following well development. Datanet stated that benzene, toluene, and xylenes were not detected in any of the samples; ethylbenezene was detected in MP-4 (0.012mg/l), MP-6 (0.0039 mg/l) and MP-7 (0.0079 mg/l).

- Datanet reported that petroleum impacts in the deeper silty and sandy gravel layer are highly variable and spotty. A concentration of 19,400 mg/kg TPH-DRO was encountered in a sample collected from boring B-4 at a depth of 18-20 feet during the initial Phase II. Datanet stated that during the supplemental Phase II, a sample collected from MW-1 at the same depth interval and 2.5 feet away from B-4 had a non-detectable concentration of TPH-DRO (<5.7 mg/kg). Also, Datanet stated that screening results from a sample from MW-2 at the same depth interval showed non-detectable levels of petroleum hydrocarbons. Datanet stated that “these results indicate that widespread contamination of the silty sand and gravel layer had not occurred”.

- Datanet reported that Evidence of residual, weathered oil was detected in MP-8 during the supplemental Phase II. The thickness of the oil was not measurable because the gauging equipment would not fit into the ½-inch diameter miniwell. Datanet stated that indirect measurement using pump tubing revealed that the residual product thickness probably is less than 0.1 feet. MP-8 is the monitoring point farthest downgradient from the tank area. No residual product was encountered in the other downgradient monitoring. points.

Based on the results of the supplemental Phase II, Datanet reported that the following are the principal findings:

- Datanet reported that subsurface petroleum contamination does not appear to be widespread in the lower high permeability silty sand and gravel water-bearing zone at the property. Free-phase petroleum was not observed at a depth of 19 to 24 feet in either if the two (2) wells (MW-1 and MW-2) advanced to these depths. Datanet stated that low levels of dissolved petroleum constituents were detected in groundwater samples representative of this layer; however, Datanet stated that their levels did not exceed applicable standards. Datanet stated that this contamination appears to pose only a minimal environmental risk.

- Datanet reported that elevated levels of residual petroleum contamination, primarily TPH-DRO, were observed in the soil and groundwater in the shallow, low-permeability silty sand zone near the former fuel tank. Additionally, Datanet stated that elevated levels were observed elsewhere on the site, even upgradient of the former tank area. Datanet stated that near the upgradient boundary of the property, low levels of petroleum were detected, supporting the assertion that historical and /or regional /off-site source(s) of contamination probably exist.

- Datanet reported that a thin layer of highly weathered residual petroleum product, immeasurable in size because of the small diameter (1/2") of the monitoring point, was detected in monitoring point MP-8. Datanet stated that "this layer of product is not representative of the entire shallow water-bearing zone near the former fuel oil tank and represents minimal environmental risk".

- Datanet reported that all of the petroleum contamination at the property likely cannot be attributed to activities at the site. Datanet stated that some of it likely may have been present in the original fill or resulted from industrial activities on surrounding properties such as service stations, activities which have been ongoing for many years. Datanet stated that "given the low permeability of the shallow formation and the silty clay layer beneath it which inhibits flow to the lower water-bearing zone, this contamination poses minimal environmental risk".

- Datanet stated that "in general, the investigative data indicate that residual hydrocarbon constituents are present near the former fuel oil tank and do not represent a significant environmental threat or concern, given the historically industrial nature of the surrounding area".

Supplemental Phase II Environmental Site Assessment
Former Eastfield Container Corporation
1501 Russell Street, Baltimore, Maryland 21230
Datanet Engineering, Inc., October 13, 1998
(Datanet MDCHEM SUP Phase II 1998)

The findings of this supplemental Phase II ESA work are as follows:

- Datanet reported that site geology generally consists of two water-bearing soil layers separated by another soil layer which retards groundwater and contaminant migration between the two water-bearing zones. The uppermost water-bearing layer consists of silty sand and starts at approximately 7 feet below ground surface (bgs) and extends to 9 feet bgs. Underlying this layer is a low-permeability silty clay layer with some moisture at its top. This layer, which extends to a

depth of approximately 19 feet bgs, acts to retard groundwater flow downward. The deeper water-bearing zone starts at approximately 19 feet and consists of silty sand and gravel.

- Datanet stated that negligible levels of dissolved petroleum constituents were measured in the groundwater sample collected in monitoring well MW-1 from the deeper sand and gravel layer at a depth of 19 feet bgs. Datanet stated that no petroleum constituents were detected in the soil sample from MW-1 collected from this layer. A groundwater sample collected from the deeper layer in MW-2 at a depth of 19 feet had non-detectable levels of petroleum constituents.

- Datanet stated that "the absence of appreciable soil impacts in well MW-1, located 30 inches from the location where 19,400 mg/kg TPH-DRO was detected in a soil samples obtained from the 18 to 20 feet interval in the deeper sand and gravel layer during the initial Phase II, indicates that widespread distribution of elevated petroleum contamination does not appear to be present in the deeper water-bearing zone at the site. The elevated level detected in the initial Phase II probably reflected a localized hot spot of residual impacts from the former fuel oil tank area".

- Datanet reported that exhaustive additional tests from other new wells in the area would be required to conclusively dismiss the potential for any additional contamination in the deep water bearing zone. However, Datanet stated that "the small size of the site coupled with the site hydrogeology and soils strongly supports the conclusion that the contamination in this deeper zone is quite limited in size and significance".

- Datanet reported that the highest levels of petroleum contamination were measured in the soil and groundwater samples collected from the uppermost water-bearing layer at the property.

- Datanet reported that measurable concentrations of petroleum constituents were detected in the groundwater samples collected from the uppermost water-bearing unit both upgradient and downgradient of the former fuel oil tank. The highest dissolved levels of contamination, however, were encountered downgradient from the former fuel oil tank.

- Datanet reported that a film or thin layer of degraded petroleum was encountered in monitoring point MP-8, the furthest downgradient monitoring point. Datanet stated that it appears that this product layer is less than 0.03 feet thick, based on crude field measurements made by using downhole pump tubing coated with oil/water detection paste. More accurate measurements could not be made due to the thin diameter (0.5") of this monitoring point.

- Datanet reported that the oily substance film/layer in monitoring point MP-8 was characterized analytically as weathered diesel fuel based on a fingerprint analysis of a fluid sample. Datanet stated that "the relatively low levels of dissolved petroleum constituents at this location (118 mg/L diesel range organics) also indicate that the product at this location is weathered and does not constitute a significant source of contamination. Point MP-8 was the only monitoring point where free product was detected out of ten points sampled". (The plot of monitoring point and well locations appears in Figure 1 in the body of the report included in Appendix A.)

Phase II Environmental Site Assessment
Former Eastfield Container Corporation
1501 Russell Street
Maryland Chemical Company
1551 Russell Street
Baltimore, Maryland 21230
Datanet Engineering, Inc., June 3, 1998
(Datanet MDCHEM Phase II 1998)

The findings of this Phase II ESA are as follows:

- Datanet reported that this Phase II was an exploratory investigation for the presence of subsurface contamination at the property. As such, Datanet stated that a variety of analytical methods were used to test for a large number of potential organic and inorganic contaminants. Borings were performed to cover the entire property; some were placed adjacent to areas of past and current hazardous substance or petroleum usage. Datanet stated that results of this work indicate the presence, not the extent, of contamination detected at the property.

- Datanet reported that Semi-volatile organic compounds (SVOCs) and pesticides / PCBs were not detected in any of the soil or groundwater samples from borings on the property.

- Datanet reported that concentrations of metals in subsurface soil samples were in the range of background concentrations reported by the United States Geological Survey (USGS).

- Datanet reported that concentrations of metals in groundwater at the property were generally less than health-based risk standards with the exception of lead and vanadium. Concentrations of lead at two (2) locations and vanadium at six (6) locations were greater than health-based risk standards for non-residential, non-use aquifers. Datanet stated that "because high levels of these compounds were detected in the associated soil samples, these results likely do not pose much significance for the property. High levels of metals are common at sites containing fill material".

- Datanet reported that elevated levels of contamination appear in two (2) areas of the property (Maryland Chemical storage yard and near former fuel oil tank for boiler in former carton manufacturer). These are discussed below.

    1. Datanet stated that elevated concentrations of petroleum hydrocarbon contamination in the subsurface soil and groundwater were detected in the area of the former fuel oil tank in the former carton manufacturer warehouse. Free-floating oil was detected in the soil and water samples. Datanet stated that "the former tank, which has been abandoned in place, is likely the source of this contamination".

    2. Datanet stated that an elevated concentration of Tetrachloroethene (PCE) above health-based risk standards was detected in the groundwater inside the northwestern border (Russell Street) of the Maryland Chemical Company storage yard. Lower levels of PCE and its breakdown products were detected in downgradient borings. Concentration along the southwestern border (Warner Street) of the storage yard are below the same health-based risk standards. Thus, a plume of chlorinated VOC contamination appears to exist beneath the Maryland Chemical storage yard at the

property. Datanet stated that "if a PCE release has not occurred in the storage yard, the source of the plume is likely upgradient of the property".

4.3.2 Additional Document Review

As part of this assessment, KCI reviewed regulatory files and copied numerous letters and documents pertaining to the subject site. Information from KCI's review of these documents is summarized in Table 4-3 below. Copies of the regulatory file documents are included in Appendix F of this report.

Table 4-3: Regulatory File Document Review Summary

Property	Date	Document	Comments
1551 Russell Street	11-24-71	Dept. of Health and Mental Hygiene	Application for Fuel Burning Equipment; specifically, a natural gas-burning boiler rated at 2.5 million Btu/hr.
1629 Warner Street	4/25/77	Bureau of Air Quality and Noise Control	Report of Change in Status of Registered Equipment or Ownership Change in coordinates.
1551 Russell Street	10-5-78	Dept. of Health and Mental Hygiene	Application for Fuel Burning Equipment; specifically, for a fire tube, natural gas-burning boiler (National Radiator Model 11-66A) for heating use only.
1601 Warner Street	1-17-80	Dept. of Health and Mental Hygiene	Application for an air emissions permit for Fuel Burning Equipment; specifically, an oil-fired boiler.
1601 Warner Street	2-4-80	Dept. of Health and Mental Hygiene	Construction permit for a Cleaver-Brooks Model G-12062-M4, No. 2 oil-fired boiler, rated at 4.5 million Btu/hr
1551 Russell Street	12-17-85	Dept. of Health and Mental Hygiene	Construction permit for a 6,000-gal. gasoline UST with Stage I vapor recovery.
1551 Russell Street	9-7-94	MDE Letter, Notice of Compliance	Notice that 2 USTs have been removed and that the site is in compliance with COMAR. The two USTs were a 6,000-gallon gasoline UST and a 4,000-gallon diesel UST. Reported last usage date is 13/30/93.
1551 Russell Street	2-1-00	MDE Letter, UST registration form	Letter requesting that the owner fill out a UST registration form in order to close the case file on 1501 Russell Street.
1551 Russell Street	5-10-00	MDE Letter, UST Registration Certificate of Closure	Letter indicating that two tanks (i.e., a 3,000-gallon heating oil UST and a 7,000-gallon gasoline UST) had been closed in place, and are permanently out of use.
1551 Russell Street	3-20-03	MDE Letter	Waste Water Permit Program Notice Of Intent acceptance.
1654 Warner Street	3-24-04	Letter from Clean Venture	Proposal to segregate, pack, transport and dispose of wastes stored at the warehouse.

Table 4-3: Regulatory File Document Review Summary			
Property	**Date**	**Document**	**Comments**
1600 Warner Street	4-9-04	MDE Letter	Complaints of a discharge of antifreeze into the harbor. MDE investigated and determined that the discharge did not originate at 1600 Warner Street.
1600 Warner Street	5-20-04	MDE Letter	Follow up to check on 55 gallon drums that were being stored in the building.
1551 Russell Street	2005	EPA FORM R	Copy of a regulatory filing under Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). Essentially a listing of toxic chemicals used/stored/made onsite.
1551 Russell Street	5/19/05	MDE Inspection Finding	Inspection report associated with an NPDES compliance inspection. A General Storm Water Permit was reportedly issued. Several corrections to site operations were recommended.
1551 Russell Street	6-10-05	MDE Letter	Summary of the Draft Brownfields Site-Specific Assessment for the Operable Unit 1 – Maryland Chemical Co.
1551 Russell Street	8/3/05	MDE Inspection Findings	Site was re-inspected to follow up on the 5/19/05 inspection.

4.4 Physical Setting Sources

The type and geological stratification of soils and bedrock, as well as the location, depth, and direction of groundwater flow, comprise the subject site's physical setting. KCI researched the physical setting of the subject site to help determine the potential routes of migration for subsurface contaminants.

4.4.1 Topography and Surface Drainage

As indicated previously, the subject site is situated immediately northwest of the Middle Branch of the Patapsco River. The elevation of the study area varies from 0 feet to 10 feet above sea level (ASL). The topography of the study area is illustrated as a relatively flat, with the perimeter of the property along the waterfront being the lowest portion of the subject area. In general, the surface relief is relatively flat through the center of the subject site; however, the area slopes gently towards the southwest, south, southeast, and east of the property. Surface runoff drains toward the Middle Branch through a system of stormwater drains. A scaled Utility/Drainage plan identifying the general drainage patterns across the subject site is provided as Figure 3 in Appendix G of this report. Properties to the north and west of the subject site are situated at a higher elevation.

4.4.2 Site Geology

According to the Maryland Geologic Survey; Geologic Maps of Maryland, Baltimore County (1968), the subject site is situated near the Fall Line, which is generalized boundary between the Piedmont Physiographic Province and the Coastal Plain Physiographic Province.
In areas near the Fall Line, Coastal Plain sediments are typically found in thin layers overlying the older geologic formations associated with the Piedmont. The Coastal Plain is characterized by marine

sediments deposited during successive periods of fluctuating sea level and moving shorelines. The sediments of the Coastal Plain dip eastward at a low angle, generally less than one degree, and range in age from Triassic to Quaternary. The younger formations crop out successively to the southeast across Southern Maryland and the Eastern Shore. A thin layer of Quaternary gravel and sand covers the older formations throughout much of the area. Mineral resources of the Coastal Plain are chiefly sand gravel and clay. Small deposits of iron ore are of historical interest. Plentiful supplies of ground water are available from a number of aquifers throughout much of this region.

The Piedmont Physiographic Province is an area underlain by ancient hard, crystalline igneous and metamorphic rock types extending from the inner edge of the Coastal Plain westward to Catoctin Mountain, the eastern boundary of the Blue Ridge Province. Bedrock in the eastern part of the Piedmont consists of schist, gneiss, gabbro, and other highly metamorphosed sedimentary and igneous rocks of probable volcanic origin. In several places these rocks have been intruded by granitic plutons and pegmatites. Several domal uplifts of Precambrian gneiss mantled with quartzite, marble, and schist are present in Baltimore County and in parts of adjacent counties.

The geology beneath the subject site generally consists of the Patapsco Formation. The Patapsco Formation (Kps) is approximately 0.5 to 30 meters in thickness and consists of well-sorted, medium to fine grained quartz sand with abundant quartz gravel and clay clasts. Sands associated with the Patapsco Formation are planar to high-angle crossbedded and occasionally have fining-upward sequences.

4.4.3 Soils Information

Review of the Soil Survey Interim Report of the City of Baltimore, Maryland, published by the United States Department of Agriculture (1990), indicates native soils throughout the eastern portion of the subject site are comprised of the Udorthents series. The Udorthents series consists of an earthy fill and nonsoil material on poorly drained to somewhat excessively drained soils to provide sites for roads, recreational areas and railroads. 80% of the fill is comprised of a sandy, silty, clayey, and gravelly mixture and the remaining 20% of soil is comprised of human trash, bricks, wire and metals.

The western portion of the subject site consists of Urban Land-Beltsville-Keyport Complex. The Urban Land-Beltsville-Keyport Complex consists of moderately well drained soils that have been cut, graded, or filled for buildings, concrete or asphalt. 40% of this material is covered by concrete, buildings or asphalt. 30% of the material consists of a mixture of silt, sand and clay. The remaining 20% of the material is relatively undisturbed.

4.4.4 Groundwater Use Investigation

KCI requested MDE Water Supply Program to perform a Voluntary Cleanup Program (VCP) 0.5-mile radius well search for the subject site. The tabulated results and a scaled Groundwater Use Map of the well search data (Figure 4) are presented in Appendix H.

It should be noted that KCI's Groundwater Use Map is based on well location coordinates provided by MDE; in turn, MDE received these coordinates from drillers' reports obtained from the City of Baltimore and other parties. Many of the illustrated well locations are estimated, and presently there is no data concerning the degree of accuracy to which the estimated well locations have been plotted. Use of the Maryland Grid system began in 1970; any wells drilled prior to 1970 are reportedly plotted according to the nearest town and the original owner's name. Moreover, most wells drilled before 1970 are not included within MDE's database, and are therefore not shown on the Groundwater Use Map or well print-

out in Appendix H. Note that in some locations, the Groundwater Use Map illustrates multiple estimated well locations at single points due to the generalization of multiple well locations to the nearest 1,000-ft, Maryland Grid Coordinate.

In summary, no potable wells were identified within a 0.5-mile radius of the subject site. However, there are numerous groundwater monitoring wells and two (2) industrial wells located within the 0.5-mile radius. None of these monitoring and industrial wells appear to be located at the subject site.

4.4.5 Future Groundwater Use

The Department of Public Works, Baltimore City, provides water to the city of Baltimore from the Gunpowder Falls and the North Branch of the Patapsco River. Water collected from these sources are stored within three reservoirs (Liberty, Loch Raven, and Prettyboy) and treated at filtration plants prior to distribution to the public. In draught situations Baltimore City is also able to draw additional water from the Susquehanna River.

The Patuxent Formation, a multi-aquifer unit, underlies the subject site and Baltimore City in general. This aquifer is one of the most productive water bearing formations in Maryland. However, over-pumping and heavy industrialization in Baltimore City have caused salt-water intrusion and chemical contamination from past industrial practices. As a result, groundwater in the vicinity of the subject site is not considered potable and no groundwater production wells are anticipated to be developed in the area of the subject site.

4.5 Historical Use Information

As part of this assessment, KCI reviewed historic uses of the subject site and surrounding properties. Historic information and record sources used for this purpose included Sanborn fire insurance maps (Section 4.5.1), historic aerial photographs (Section 4.5.2), and historic topographic maps (Section 4.5.3). These records were reviewed to identify historical practices or conditions that may have impacted the subject site.

4.5.1 Sanborn Fire Insurance Maps

KCI reviewed available historic Sanborn fire insurance maps (Sanborns) covering the area of the subject site and/or nearby properties dated 1890, 1901, 1914, 1950, 1952 and 1973. The historic Sanborn fire insurance maps were provided by EDR, copies of which are provided as Appendix B to this report. Information from KCI's review of historic Sanborn fire insurance maps is tabulated as follows.

1890 Sanborn Fire Insurance Map	
Address/Parcel	**Development/Land Uses**
1501 Warner Street	Only the southern portion of the 1501 Warner Street property was illustrated on the 1890 Sanborn Map. On the 1901 Sanborn Map, the northern portion was improved with a warehouse building. Since this portion of the property was not visible on the 1890 Sanborn map, it is not clear whether the warehouse was also present in 1890.
1601 Warner Street	The Baltimore Cedar Company facility, engaged in the manufacture of wooden wares, was illustrated on the parcel. The improvements consisted of three structures that housed a warehouse, wood working machinery, and a steam dry kiln/ sawing operation.

1890 Sanborn Fire Insurance Map	
Address/Parcel	**Development/Land Uses**
1629 Warner Street	A stable located along Warner Street was illustrated at the property. The remainder of the lot appeared to be undeveloped.
1633 Warner Street	A stable and an office structure, located along Warner Street, were illustrated on the lot. The remainder of the lot appeared undeveloped.
1645 Warner Street	A small office structure present on the lot. The remainder of the lot appeared to be undeveloped.
1501 Russell Street	The lot was undeveloped.
1525 Russell Street	The lot was undeveloped.
1551 Russell Street	The lot was undeveloped.
2119 Haines Street	The lot was improved with a loading platform and storage structure, which comprised part of the C.F. Ranstead Wharf.
2110 Haines Street	One structure, occupied by an office and store, was located on the northern portion of the property. The property was part of the C.F. Ranstead and the L.T. Ranstead Wharfs.
2104 Worcester Street	A stable was located along the southwest side of the property, along Warner Street. The remainder of the lot appeared undeveloped.
2102 Oler Street	Lumber piles were illustrated across the property.

Adjoining Properties

North

The following companies or structures are illustrated north of and adjacent to the subject site: Swindell Brothers Crystal Glass Works; Mitchell Brothers Wood Wharf; and Swindell Brothers Wood Coal and Lumber Wharf.

East

No Coverage

South

The following companies or structures were illustrated south of and adjacent to the subject site: Biemiller Ice Company and Biemiller's Coal and Wood Wharf; Hamilton Z. Mitchell Wood Wharf; Consumers Ice and Coal Company.; W.H. Evans Marble Works; K.A Ranstead's Wharf; and Cochran Oler Ice Company.

West

No Coverage

1901 Sanborn Fire Insurance Map	
Address/Parcel	**Development/Land Uses**
1501 Warner Street	One warehouse-sized structure was illustrated at the north central portion of the property.
1601 Warner Street	The J.B. MacNeal & Company Varnish & Color Works facility was illustrated on this property. Two warehouses occupied the central and southern portion of the lot. An oil storage area was illustrated within the southern warehouse.
1629 Warner Street	The lot was undeveloped.
1633 Warner Street	The conditions illustrated at this lot appeared similar to those shown on the 1890 Sanborn map.
1645 Warner Street	The conditions illustrated at this lot appeared similar to those shown on the 1890 Sanborn map.
1501 Russell Street	The lot was undeveloped.
1525 Russell Street	The lot was undeveloped.
1551 Russell Street	The lot was undeveloped.
2119 Haines Street	The conditions illustrated at this lot appeared similar to those shown on the 1890 Sanborn map.
2110 Haines Street	The C.F. Ranstead and L.T. Ranstead Wharfs occupied portions of this property. One structure, illustrated as an office, was located on the northern portion of the property. In addition, lumber storage was illustrated on various other portions of the lot.
2104 Worcester Street	The conditions illustrated at this lot appeared similar to those shown on the 1890 Sanborn map, with the exception that the previously-illustrated stable was illustrated as a shed on the 1901 Sanborn map.
2102 Oler Street	The lot was undeveloped.

Adjoining Properties

North

The following companies or structures were illustrated north of and adjacent to the subject site: Swindell Brothers Glass Manufacturers; Residential row homes; Baltimore Distilling Company; and a Coal and Lumber Wharf.

East

The Hanns Distilling Company was illustrated east of and adjacent to the subject site.

South

The following companies or structures were illustrated south of and adjacent to the subject site: American Ice Station No. 17; the C.F. Ranstead and L.T. Ranstead Wharfs; Consumers Wood and Coal Company; W.H. Evans Marble Works; and, American Ice Company, Station No. 7.

West

No Coverage

1914 Sanborn Fire Insurance Map	
Address/Parcel	**Development/Land Uses**
1501 Warner Street	No Coverage – Parcel not Shown on Map.
1601 Warner Street	The J. B. MacNeal Paints, Oil, and Varnish Works facility was illustrated on this lot. Two warehouses occupied the central and southern portions of the lot. Oil storage was illustrated within the southern warehouse.
1629 Warner Street	Four shed-like structures were illustrated at this lot.
1633 Warner Street	The C.D. Pruden Company, "Manufacturers of Fire Proof Doors and Windows", was illustrated at this property. The facility included a large warehouse and several smaller shed and storage structures.
1645 Warner Street	The western portion of the site was vacant. The eastern portion of the lot was occupied by small shed and storage structures associated with the C.D. Pruden Company facility.
1501 Russell Street	The lot was undeveloped.
1525 Russell Street	The lot was undeveloped.
1551 Russell Street	The lot was undeveloped.
2119 Haines Street	This lot was occupied by "Irregular Temporary Lumber Piles".
2110 Haines Street	The conditions illustrated at this lot appeared similar to those shown on the 1901 Sanborn map.
2104 Worcester Street	The lot was undeveloped.
2102 Oler Street	The lot was undeveloped.

Adjoining Properties

North

The following companies or structures were illustrated north of and adjacent to the subject site: Swindell Brothers Glass Manufacturers and Bottle Factory; Swindell Brothers Glass Warehouse; and, residential row homes.

East

The following companies or facilities were illustrated to the east of the subject site: Baltimore Distilling Company; the Hanns Distilling Company; and, US Bonded Warehouses.

South

The following companies or facilities were illustrated to the south of the subject site: "Irregular Temporary Lumber Piles"; W.H. Evans Marble Works; and Ranstead wharf.

West

A constructed channel for vessel docking purposes was illustrated west of the subject site. Vacant properties were shown further west.

1952 Sanborn Fire Insurance Map	
Address/Parcel	**Development/Land Uses**
1501 Warner Street	No Coverage – Parcel not Shown on Map.
1601 Warner Street	The conditions illustrated at this lot appeared similar to those shown on the 1914 Sanborn map.
1629 Warner Street	Gordon Cartons Inc. Folding Box Division occupied this lot. The entire parcel was taken up by one warehouse, identified as the folding box factory.
1633 Warner Street	"Paper Warehouse No 3", associated with the Gordon Cartons Inc. Folding Box Division, occupied this lot.
1645 Warner Street	The Gibson & Kirk Company Brass Foundry and Machine Shop facility occupied this lot. The facility consisted of two adjoining warehouses on the eastern portion of the property, and a foundry and office on the western portion.
1501 Russell Street	The Maryland Container Company, Inc. facility occupied this lot. The facility consisted of two adjoining warehouse structures. The eastern structure was identified as the factory building, while the western structure was identified as the paper box warehouse.
1525 Russell Street	The lot was undeveloped.
1551 Russell Street	American Cyanamid Co. Industrial Chemical Division occupied this lot. The facility consisted of one warehouse located on the western portion of the site. A storehouse structure was located on the southeastern portion of the site. A railroad spur was illustrated in the center courtyard portion of the lot.
2119 Haines Street	The lot was undeveloped.
2110 Haines Street	American Electric Welding Company, Inc., a steel barge manufacturer, occupied the northern portion of this lot. The facility consisted of various small storage buildings, which were concentrated near the eastern border of the lot. The Consolidated Gas Electric Light and Power Co. occupied the southern portion of the lot. The Consolidated facility included a storage yard with a few sheds and one larger structure illustrated near the central portion of the property.
2104 Worcester Street	The property was occupied by one large structure containing a "stripping room" associated with the J. B. MacNeal Paints, Oil, and Varnish Works facility.
2102 Oler Street	The Gordon Cartons Inc. Folding Box Division occupied this lot. The parcel was taken up by two adjoining warehouse structures identified as "Paper Warehouse No 2" and "Paper Warehouse No 2A". An underground storage tank (UST) containing gasoline was illustrated at the exterior corner of the Paper Warehouse No 2. The southwest portion of the Paper Warehouse No. 2A was identified as a storage area for "acetates in drums". In addition, a chemical wash tank was identified at the southwest exterior corner of Paper Warehouse No. 2A.

Adjoining Properties

North

The following facilities were illustrated north of and adjacent to the subject site: Swindell Brothers Glass Manufacturers; Swindell Brothers Glass Warehouse; Georges Printing & Carton Company; a Machine Shop; a Warehouse; and the Capital Steel Company.

East

The following facilities were illustrated to the east of the subject site: Baltimore Distilling Company; The Hanns Distilling Company; and US Bonded Warehouses.

South

The following facilities were illustrated to the south of the subject site: the Gordon Carton Inc. Rest area structure; the Gordon Carton Inc. offices and repair shop; and the Consolidated facility storage yard.

West

The following facilities were illustrated to the west of the subject site: American Electric Welding Co. Inc.; a constructed channel for vessel docking purposes, and vacant lots.

1973 Sanborn Fire Insurance Map	
Address/Parcel	**Development/Land Uses**
1501 Warner Street	No Coverage – Parcel not Shown on Map.
1601 Warner Street	The written descriptions associated with this lot were illegible.
1629 Warner Street	The conditions illustrated at this lot appeared similar to those shown on the 1952 Sanborn map.
1633 Warner Street	The conditions illustrated at this lot appeared similar to those shown on the 1952 Sanborn map.
1645 Warner Street	The conditions illustrated at this lot appeared similar to those shown on the 1952 Sanborn map.
1501 Russell Street	Finn Industries Folding Carton Division facility occupied this lot. The facility consisted of two adjoining warehouse structures. Both buildings were identified as factory buildings.
1525 Russell Street	A third adjoining factory building, occupied by Finn Industries Folding Carton Division, occupied this lot.
1551 Russell Street	The Maryland Chemical Co. Inc., Industrial Chemical Division, “Manufacturer of Chemicals” occupied this lot. The facility consisted of one warehouse structure located on the western portion of the site, and a storehouse structure was located on the southeastern portion of the site. A railroad spur was illustrated in the center courtyard. A “drum and packaged chemical storage” structure was located on the northeastern portion of the lot.
2119 Haines Street	This lot was vacant.
2110 Haines Street	No coverage.
2104 Worcester Street	A warehouse was illustrated on this lot; however, the descriptions associated with this feature were barely legible. It appears that the building was still in use as a “stripping room”.
2102 Oler Street	The conditions illustrated at this lot appeared similar to those shown on the 1952 Sanborn map.

Adjoining Properties

North

The Mohawk Manor Motel was illustrated north of and adjacent to the subject site.

East

No coverage.

South

The following facilities are illustrated to the south of the subject site: the Gordon Carton Inc. Rest area structure; the Gordon Carton Inc. repair/office structure; and the Consolidated facility storage yard.

West

No coverage.

4.5.2 Aerial Photographs

Aerial photographs of the site area for the years 1957, 1964, 1971, 1980, and 1988 were obtained from EDR. In addition, an aerial photograph dated approximately 2004 was obtained from Goggle Earth. Due to the nature of the area covered by the aerial photographs (urban and medium density), it is difficult to distinguish individual property features in the historic aerial photographs. In general, the aerial photographs appeared to support the findings identified during KCI's review of historical Sanborn maps. Copies of the historic aerial photographs reviewed for this assessment are provided in Appendix C of this report. Information from KCI's review of aerial photographs is provided in tabular format as follows:

1957 Aerial Photograph

1957 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Warner Street	Warehouse/Large Building	**North-** Warehouse / Large Building **East –** Engineered Channel of Middle Branch / Undeveloped lot **South –** Undeveloped lot **West –** Warehouse / Large Building
1601 Warner Street	Warehouse/Large Building	**North –** Warner Street followed by a Warehouse. **East –** Warehouse / Large Building **South –** Undeveloped lot **West –** Warehouse
1629 Warner Street	Warehouse/Large Building	**North –** Warehouse / Large Building **East –** Warehouse / Large Building **South –** Undeveloped lot **West –** Warehouse / Large Building
1633 Warner Street	Warehouse/Large Building	**North –** Warehouse / Large Building **East –** Warehouse / Large Building **South –** Undeveloped lot **West –** Warehouse / Large Building
1645 Warner Street	Warehouse/Large Building	**North –** Warehouse / Large Building **East –** Warehouse / Large Building **South –** Warehouse / Large Building **West** – Unknown / Features not Discernable

1957 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Russell Street	Warehouse/Large Building	**North –**Unknown / Features not Discernable **East –** Warehouse / Large Building **South –** Warehouse / Large Building **West –** Warehouse / Large Building
1525 Russell Street	Warehouse/Large Building	**North –**Unknown / Features not Discernable **East –** Warehouse / Large Building **South –** Warehouse / Large Building **West –** Warehouse / Large Building
1551 Russell Street	Warehouse/Large Building	**North –**Unknown / Features not Discernable **East –** Warehouse / Large Building **South –** Warehouse / Large Building **West –** Warehouse / Large Building
2119 Haines Street	Features not visible due to poor resolution	**North –**Warehouse / Large Building **East –** Warehouse / Large Building **South –** Undeveloped lot **West –** Unknown / Features not Discernable
2110 Haines Street	Features not visible due to poor resolution	**North –** Unknown / Features not Discernable **East –** Unknown / Features not Discernable **South –** Vacant shoreline **West –** Engineered Channel of Middle Branch
2104 Worcester Street	Warehouse/Large Building	**North –**Warehouse / Large Building **East –** Warehouse / Large Building **South –** Undeveloped lot **West –** Warehouse / Large Building
2102 Oler Street	Warehouse/Large Building	**North –**Warehouse / Large Building **East –** Warehouse / Large Building **South –** Undeveloped lot **West –** Warehouse / Large Building

1964 Aerial Photograph

1964 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Warner Street	Warehouse/Large Building	**North –** Warner Street and Warehouse / Large Building **East –** Engineered Channel of Middle Branch/Undeveloped lot **South –** Tractor Trailer Parking **West –** Warehouse / Large Building
1601 Warner Street	Warehouse/Large Building	**North –** Warner Street and Warehouse / Large Building **East –** Warehouse / Large Building **South –** Eutaw Street followed by undeveloped lot **West –** Warehouse / Large Building

1964 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1629 Warner Street	Warehouse/Large Building	**North –** Warner Street and Warehouse / Large Building **East –** Warehouse / Large Building **South –** Eutaw Street followed by undeveloped lot **West –** Oler Street followed by a Warehouse / Large Building
1633 Warner Street	Warehouse/Large Building	**North –** Warner Street and Warehouse / Large Building **East –** Oler Street followed by a Warehouse / Large Building **South –** Truck loading dock and storage yard **West –** Warehouse / Large Building
1645 Warner Street	Warehouse/Large Building	**North –** Warner Street followed by a hotel structure **East –** Warehouse / Large Building **South –** Undeveloped lot **West** – Undeveloped lot
1501 Russell Street	Warehouse/Large Building	**North –**Russell Street and Warehouse / Large Building **East –** Worcester Street and Warehouse / Large Building **South –** Warner Street and Warehouse / Large Building **West –** Warehouse / Large Building
1525 Russell Street	Warehouse/Large Building	**North –** Russell Street and Warehouse / Large Building **East –** Warehouse / Large Building **South –** Warner Street and Warehouse / Large Building **West –** Warehouse / Large Building
1551 Russell Street	Warehouse/Large Building	**North –** Russell Street and Warehouse / Large Building **East –** Warehouse / Large Building **South –** Warner Street and Warehouse / Large Building **West –** Bayard Street followed by a Hotel Building
2119 Haines Street	Undeveloped lot	**North –** Warehouse / Large Building **East –** Engineered Channel of Middle Branch / Storage Yard **South –** Undeveloped lot **West –** Undeveloped lot
2110 Haines Street	Undeveloped lot	**North –** Undeveloped lot **East –** Undeveloped lot **South –** Vacant shoreline **West –** Undeveloped lot
2104 Worcester Street	Warehouse/Large Building	**North –** Warehouse / Large Building **East –** Warehouse / Large Building **South –** Eutaw Street followed by a vacant lot **West –** Warehouse / Large Building
2102 Oler Street	Warehouse/Large Building	**North –** Warehouse / Large Building **East –** Warehouse / Large Building **South –** Truck loading dock and storage yard **West –** Engineered Channel of Middle Branch

1971 Aerial Photograph

1971 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Warner Street	Warehouse/Large Building	Similar to 1964 aerial photograph
1601 Warner Street	Warehouse/Large Building	Similar to 1964 aerial photograph
1629 Warner Street	Warehouse/Large Building	Similar to 1964 aerial photograph
1633 Warner Street	Warehouse/Large Building	Similar to 1964 aerial photograph
1645 Warner Street	Warehouse/Large Building	**North –** Warner Street / Hotel building. **East –** Warehouse / Large Building **South –** Undeveloped lot. **West** – Several small structures
1501 Russell Street	Warehouse/Large Building	**North –**Russell Street and a Gas Station **East –** Worcester Street and a Warehouse / Large Building **South –** Warner Street and a Warehouse / Large Building **West –** Warehouse / Large Building
1525 Russell Street	Warehouse/Large Building	Similar to 1964 aerial photograph
1551 Russell Street	Warehouse/Large Building	Similar to 1964 aerial photograph
2119 Haines Street	Undeveloped lot	**North –** Warehouse / Large Building **East –** Engineered Channel of Middle Branch / Storage Yard **South –** Undeveloped lot **West –** Several small structures
2110 Haines Street	Undeveloped lot	**North –** Several small structures **East –** Engineered Channel of Middle Branch / Storage Yard **South –** Vacant shoreline **West –** Engineered Channel of Middle Branch / Storage Yard
2104 Worcester Street	Warehouse/Large Building	Similar to 1964 aerial photograph
2102 Oler Street	Warehouse/Large Building	Similar to 1964 aerial photograph

1980 Aerial Photograph

1980 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Warner Street	Warehouse/Large Building	Similar to 1971 aerial photograph
1601 Warner Street	Warehouse/Large Building	Similar to 1971 aerial photograph
1629 Warner Street	Warehouse/Large Building	Similar to 1971 aerial photograph
1633 Warner Street	Warehouse/Large Building	Similar to 1971 aerial photograph
1645 Warner Street	Warehouse/Large Building	Similar to 1971 aerial photograph
1501 Russell Street	Warehouse/Large Building	Similar to 1971 aerial photograph

1980 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1525 Russell Street	Warehouse/Large Building	Similar to 1971 aerial photograph
1551 Russell Street	Warehouse/Large Building	Similar to 1971 aerial photograph
2119 Haines Street	Several small structures or containers	Similar to 1971 aerial photograph
2110 Haines Street	Vacant lot	Similar to 1971 aerial photograph
2104 Worcester Street	Warehouse/Large Building	Similar to 1971 aerial photograph
2102 Oler Street	Warehouse/Large Building	Similar to 1971 aerial photograph

1988 Aerial Photograph

1988 Aerial Photograph		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Warner Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1601 Warner Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1629 Warner Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1633 Warner Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1645 Warner Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1501 Russell Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1525 Russell Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1551 Russell Street	Warehouse/Large Building	Similar to 1980 aerial photograph
2119 Haines Street	Several small structures or containers	Similar to 1980 aerial photograph
2110 Haines Street	Storage yard	Similar to 1980 aerial photograph
2104 Worcester Street	Warehouse/Large Building	Similar to 1980 aerial photograph
2102 Oler Street	Warehouse/Large Building	Similar to 1980 aerial photograph

2005 Aerial Photograph

2005 Aerial Photographs		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1501 Warner Street	Warehouse/Large Building	Similar to 1988 aerial photograph
1601 Warner Street	Warehouse/Large Building	Similar to 1988 aerial photograph

2005 Aerial Photographs		
Address/Parcel	**Description of Development/Land Uses**	
	Site/Property	**Adjoining Properties**
1629 Warner Street	Warehouse/Large Building	Similar to 1988 aerial photograph
1633 Warner Street	Warehouse/Large Building	Similar to 1988 aerial photograph
1645 Warner Street	Warehouse/Large Building	Similar to 1988 aerial photograph
1501 Russell Street	Warehouse/Large Building	Similar to 1980 aerial photograph
1525 Russell Street	Warehouse/Large Building	Similar to 1988 aerial photograph
1551 Russell Street	Warehouse/Large Building	Similar to 1988 aerial photograph
2119 Haines Street	Several small structures or containers	**North –** Warehouse/Large Building **East –** Engineered Channel of Middle Branch / Storage Yard **South –** Greyhound Bus Terminal **West** – Grainger Warehouse
2110 Haines Street	Greyhound Bus Terminal	**North –** Grainger Warehouse **East –** Engineered Channel of Middle Branch / Storage Yard **South –** Undeveloped Lot **West** – Engineered Channel of Middle Branch / Storage Yard
2104 Worcester Street	Warehouse/Large Building	Similar to 1988 aerial photograph
2102 Oler Street	Warehouse/Large Building	Similar to 1988 aerial photograph

4.5.3 Historic Topographic Maps

Historic topographic maps can often provide information concerning previous land uses. As part of this assessment, KCI obtained and reviewed a total of six (6) historic topographic maps covering the region of the study area. EDR provided the historic topographic maps, which were dated 1899, 1904, 1946, 1953, 1966, and 1974. Copies of the historic topographic maps are provided in Appendix D of this report.

1899 and 1904 Historic Topographic Maps

Due to the scale of the 1899 and 1904 topographic maps (approximately 1" = 62,500'), it was difficult to identify specific details concerning the number and size of structures at the individual parcels comprising the subject site. However, Gwynns Falls was illustrated to the south of the subject site, and the Middle Branch of the Patapsco River was present east of the subject site. Wetland and marshy areas were illustrated at the confluence of Gwynns Falls and the Middle Branch on the 1899 topographic map; however, these were not shown on the 1904 topographic map. Presumably, they were filled in at some time between 1899 and 1904. Limited residential and commercial buildings were depicted in the surrounding areas.

1946 Historic Topographic Map

Conditions illustrated on the 1946 topographic map appeared similar to those shown on 1904 topographic map, with the following exceptions. Russell Street was identified on the 1946 topographic map as Annapolis Road (301), and a railroad bridge had been constructed across the Middle Branch of the Patapsco. Several structures were illustrated along the subject site (Russell St) and the surrounding area. The majority of the land in the area was occupied by industrial and residential buildings.

1953, 1966, 1974 Historic Topographic Maps

Conditions illustrated on the 1953, 1966, and the 1974 topographic maps appeared similar to those shown on the 1946 topographic map, with the following exceptions. The 1953, 1966 and 1974 topographic maps included progressively more illustrations of structures, both new and old, along Russell St and the surrounding area. On the 1953 topographic map Annapolis Road is shown as Old Annapolis Road and the road number had been changed to ALT 301. In addition, the Baltimore-Washington Parkway had been constructed. On the 1966 topographic map a new building is shown to the north/north east of the intersection of Worcester St. and Eutaw St. On the 1974 topographic map at least two buildings, one on the project site and one off, appear to have been demolished. In addition several of the other buildings onsite appear to have been expanded or modified.

4.6 Summary of Historic Property Use Information

Using the combined information from KCI's review of chain-of-title information, Sanborn fire insurance maps, historic aerial photographs, topographic maps, and previous environmental reports, KCI has developed the following historic use summaries for each parcel of the subject site.

1501 Warner Street

Only the southern portion of the 1501 Warner Street property was illustrated on the 1890 Sanborn Map. On the 1901 Sanborn Map, the northern portion was improved with a warehouse building. Since the portion of the property that was improved with the warehouse was not visible on the 1890 Sanborn map, it is not clear whether the warehouse was also present in 1890. In Table 4-1 of MDE's Phase I Warner 2006 report, MDE suggests that the warehouse was present between 1890 and 1901.

The 1501 Warner Street property was not illustrated on the 1914, 1950, or 1973 Sanborn maps. However, two large warehouses (neither of which matched the size or shape of the warehouse illustrated on the 1901 Sanborn map) were visible at the property on the 1957 aerial photograph. Moreover, only the northernmost of these structures was illustrated on the 1946 topographic map. KCI concludes that the northern building was constructed at some time between 1901 and 1946, and the southern building was constructed between 1946 and 1957.

Title records reviewed for this assessment indicate that Gordon Cartons, Inc. acquired the 1501 Warner Street property from Bayard Realty Corporation in 1965. Warner Street, Inc. acquired the property from substitute trustees of Gordon Cartons, Inc in 1989. The property was then acquired in 2008 by the City of Baltimore. KCI was unable to definitively determine owners prior to Bayard Realty Corporation; however, MDE's SAP OU2 2005 report indicated that from 1902 to 1953 the J.B. MacNeal and Company Varnish and Color Works operated out of buildings on this property. MDE stated that paint and varnish manufacturers used heavy metal salts and oxides and volatile organic materials in their process and operations. Currently, the property is occupied by SCI. for the storage of architectural antiques and salvage goods.

1601 Warner Street

In 1890, the 1601 Warner Street property was owned by C.F. Ranstead and leased to the Baltimore Cedar Company. A warehouse building was located on the westernmost part of the property, a "woodworking machinery" building was situated on the central part of the site, and a steam dry kiln was located on the

east-central part of the property. A small outbuilding (apparently a stable) was located on the southeastern corner of the parcel.

By 1901, the J.B. MacNeal & Co. Varnish and Color Works occupied the 1601 Warner Street property. The warehouse building was no longer present. The former woodworking machinery building was occupied by the "Mill" and "Liquid" Departments. The former steam dry kiln facility was vacant, except for a possible oil storage area. The former horse stable was in use as a shed. Between 1901 and 1914, J.B. MacNeal & Co. expanded their operations and added a small office building at the northwestern corner of the property. The historic stable was also demolished at some time during this period.

In 1952, J.B. MacNeal & Co. continued to occupy the 1601 Warner Street property. Chemical storage areas included "oil storage" in the small office building located at the northwestern corner of the property, a small "varnish factory" building and outdoor storage area located at the northeastern part of the property, and the northern half of the central building, which was described as "storage tanks" on the 1952 Sanborn map. By 1973 Gordon Cartons, Inc. Folding Box Division occupied the parcel. Mr. Larry Hillman (previous property owner) indicated that the parcel was occupied by Baltimore Cycle Salvage from 1989 until 2005. The company Warner Street, Inc sold the property to the City of Baltimore in 2008. Currently, the property is occupied by Second Chance, Inc. for the storage of architectural antiques and salvage goods.

Information provided in MDE's PA 2008 report, attributed two (2) principle industries as contributors to potential contamination in the area; they were commercial printing and paint and varnish manufacturing. Numerous hazardous chemicals were associated with both of these industries and there was a strong potential that these materials have been released into the environment. MDE's PA 2008 report asserts that past storage and housekeeping practices indicated spilled paints and pigments in loading docks and fenced storage areas. Facility inspections conducted when Gordon Carton was operational at 1601 Warner Street indicated that chlorinated solvents were used extensively and that storage and control of the materials was haphazard at best prior to RCRA enforcement. Releases of environmental contaminants from the facility likely resulted in contamination of soils and groundwater and would likely have an impact on indoor air quality in structures in the immediate area.

Information provided in MDE's SAP OU2 2005 report asserted that a number of contaminants of concern (COCs) were identified in the vicinity of 1601 Warner Street. The COCs identified included: VOCs; SVOCs; PAHs; priority pollutant metals; and PCBs. The potentially contaminated areas were described based on analysis concerning the locations to which hazardous wastes or pollutants may have migrated.

1629 Warner Street

The 1629 Warner Street property was undeveloped in 1890 and 1901. At some time between 1901 and 1914, four elongated sheds were constructed on the parcel. The Sanborn maps did not reveal what was stored in the sheds, although it is possible they supported the J.B. MacNeal & Co operations at the adjacent 1601 Warner Street parcel. At some time between 1914 and 1950, a large factory building was constructed at the southern side of the parcel, and Gordon Cartons, Inc. Folding Box Division commenced operations therein.

According to a chain-of-title report reviewed as part of this assessment, the Gordon Lavin Paper Box Company (known as Gordon Cartons after a 1943 merger) purchased the property prior to 1940. Gordon Cartons occupied the facility until at least 1973; as of 1989, the parcel was owned by Hillco Investment corporation (Warner Street, Inc. acquired the property from Hillco Investment Corporation in 1989). Mr.

Hillman indicated that 1629 Warner Street was occupied by Baltimore Cycle Salvage from 1989 until 2005. With the exception of the concrete foundation, the parcel is currently clear of all structures. A fire destroyed the warehouse structure in the spring of 2008.

As previously discussed in the 1601 Warner Street past use section, information provided in MDE's PA 2008 report, attributed two (2) principle industries as contributors to potential contamination in the area; they were commercial printing and paint and varnish manufacturing. Numerous hazardous chemicals were associated with both of these industries and there was a strong potential that these materials have been released into the environment. KCI's 2008 Phase II ESA identified numerous PAH compounds at concentrations exceeding relevant MDE CUS in a groundwater sample obtained from the northwestern boundary of the 1629 Warner Street parcel of the subject site. Although KCI analyzed six (6) other groundwater samples from various locations for SVOCs and PAHs, none of these had detectable concentrations of these compounds. The source of the PAHs identified in the sample acquired near 1629 Warner Street is not clear.

1633 Warner Street

With the exception of a stable located along Warner Street, the majority of the 1633 Warner Street property was undeveloped from at least 1890 until some time between 1901 and 1914. On the 1914 Sanborn map, a large building occupied by a machine shop operated by the C.D. Pruden Company is illustrated at the parcel. Apparently, the C.D. Pruden Company was a manufacturer of fire proof doors and windows. In 1952, the building was described as Paper Warehouse No. 3, which was at that time operated by Gordon Cartons, Inc. Folding Box Division. On the 1973 Sanborn map, an area of Paper Warehouse No. 3 was labeled "Color Mixing and Grinding", which suggests chemicals such as pigments and solvents were in use at the property.

According to information provided in MDE's WP Haines 2005, the Gibson and Kirk Foundry occupied the 1633 and 1645 Warner Street properties from a period after the 1915 through 1953. Furthermore, Saratoga Supply Company, a general hardware distributor, occupied the 1633 and 1645 Warner Street properties from between 1960 and 1988. MDE's Brownfield Assessment also reported that contaminates of concern were identified for the Warner Street property and include: VOCs; SVOCs; PAHs; priority pollutant metals; and PCBs.

During an interview conducted as part of KCI's original Phase I ESA, Mr. Hillman indicated that the parcel was occupied by Baltimore Asphalt from 1988 to 1995, and then Baltimore Cycle Salvage from 2002 until 2005. The warehouse at 1633 Warner Street is currently occupied by SCI and used for the storage of architectural antiques and salvage goods. In addition, the northwest portion of the warehouse is currently being used to store the palletized drums and gas cylinders that were relocated from 1501 Warner Street.

1645 Warner Street

With the exception of two relatively small buildings (apparently residential dwellings), the majority of the 1645 Warner Street property was undeveloped in 1890 and 1901. At some time between 1901 and 1914, a moderate-sized warehouse and a smaller storage building were constructed on the western and eastern portions of the parcel, respectively. The 1914 Sanborn map also illustrated a shed on the southern part of the property. These structures were evidently in use as part of the C.D. Pruden Company's fireproof door and window manufacturing operations.

At some time between 1914 and 1953, the property was redeveloped. The 1952 Sanborn map indicated the 1645 Warner Street property was part of the Gibson & Kirk Company Brass Foundry and Machine Shop facility. This facility occupied the site through at least 1973. More recently, Mr. Mark Foster (Executive Director of SCI.) indicated that the Saratoga Plumbing Supply company occupied a portion of the parcel, and a company that repackaged automotive fluids occupied another portion of the parcel. Currently, SCI. leases the warehouse from the City of Baltimore. It should be noted that drums and containers of automotive fluids left over from the historic automotive fluid repackaging operation at 1645 Warner Street are currently stored in 1633 Warner Street.

KCI's review of land record information suggests that the 1645 Warner Street parcel was acquired in eight portions from various historic owners. These included Mr. Lyman T. Ranstead (1908); the Spring Garden Wharf and Land Company (1923); the American Ice Company (1923); three portions from the Title Holding Company (1926, 1927 and 1929); the Sun Oil Company (1932); and, the Letom Inn Corporation (1961). The City of Baltimore currently owns the property.

MDE reported that Potomac Investments owned the property in January 2006 (Phase I Warner 2006). However, KCI has not identified evidence of this reported former owner in the Chain of Title information provided by NETR or in the Maryland State Department of Taxation website database.

As previously reported in the 1633 Warner Street past history section of the MDE's WP Haines 2005 report, the Gibson and Kirk Foundry occupied the 1633 and 1645 Warner Street properties from a period after the 1915 through 1953. Furthermore, Saratoga Supply Company, a general hardware distributor, occupied the 1633 and 1645 Warner Street properties from between 1960 and 1988. MDE's WP Haines 2005 also reported that contaminates of concern were identified for the Warner Street property and include: VOCs; SVOCs; PAHs; priority pollutant metals; and PCBs.

1551 Russell Street

The 1551 Russell Street portion of the subject site was undeveloped until some time between 1914 and 1950. The 1952 Sanborn map showed that two buildings had been constructed at the property. The larger of the two buildings occupied the southern portion of the property and the smaller building (marked "storehouse" occupied the northeastern corner of the site. A railroad siding was also illustrated crossing the central portion of the property. Both buildings were apparently occupied by the American Cyanamid Company Industrial Chemicals Division. American Cyanamid Company produced (among other things) organochlorine pesticides.

By 1973, the 1551 Russell Street property was occupied by Maryland Chemical Company, Inc. A large building (a warehouse) had been constructed at the north end of the property, and several small sheds and outbuildings had also been added to the site improvements. The 1973 Sanborn map indicated that these buildings were mostly used for bulk chemical storage purposes. Ms. Jeanette Glose Partlow (current president of Maryland Chemical) reported that this parcel was used for limited bulk chemical storage up until 2008. Based on this historic operational information, it appears that various chemicals have been manufactured and/or stored at the 1551 Russell Street property since at least 1952.

Review of title records suggests that the property had multiple owners during the 1940s and 1950s, including the Maryland Container Corporation, the American Cyanamid Company, and at least one individual. Ownership was conveyed in various portions to the Westport Corporation during these years (one portion was conveyed in 1974). Mr. J. Fred Glose (Maryland Chemical) acquired the property in 1988, and then sold the site to the Pheasant Warner Company, LLC in 2001. In turn, the City of Baltimore

acquired the property from the Pheasant Warner Company in 2005. Currently the property consists of a vacant office/warehouse structure. In addition to the office/warehouse structure, the property includes an open courtyard area, a canopied storage area, and a small storage structure (i.e., the Acid House).

1525 Russell Street

Based on KCI's review of Sanborn maps, the 1525 Russell Street property was undeveloped from at least 1890 until 1952. According to the Maryland State Department of Assessments and Taxation (SDAT) records, the building currently occupying this parcel was constructed in 1953. KCI first observed the current building on the 1957 aerial photograph. The 1973 Sanborn map indicated that the building was a "Factory Building", but did not clarify what types of operations may have occurred there. During one of KCI's interviews, Ms. Jeanette Glose Partlow (President of Maryland Chemical) indicated that this parcel was utilized for the production of containers and cartons from 1953 until the late 1980s.

Based on KCI's review of a Chain-of-Title report prepared by NETR, it appears that the Westport Corporation owned the majority of the 1525 Russell Street property during the early 1950s. Subsequently, Mr. J. Fred Glose (Maryland Chemical Corporation) acquired the property from the Westport Corporation in 1988. Ms. Partlow has reported that the warehouse at 1525 Russell Street was used for bulk chemical storage purposes until 2008. The parcel is currently owned by the City of Baltimore and consists of a vacant warehouse.

1501 Russell Street

Based on KCI's review of Sanborn maps, the 1501 Russell Street property was undeveloped from 1890 until some time between 1914 and 1952. According to the Maryland State Department of Assessments and Taxation (SDAT) records, the building currently occupying this parcel was constructed in 1919. On the 1952 Sanborn map, the parcel was improved with a warehouse and factory building, which were at that time occupied by the Maryland Container Company, Inc.

Title records reviewed as part of this assessment indicate that various portions of the 1501 Russell Street property were acquired by the Westport Corporation during the mid-1940s and early 1950s. Westport Corporation also acquired one portion in 1988. Then, Mr. J. Fred Glose (Maryland Chemical) acquired the property from the Westport Corporation in 1988; he then sold the property to the Pheasant Warner Company, LLC in 2001. The Pheasant Warner Company sold the property to the City of Baltimore (present owner) in 2005.

Ms. Jeanette Glose Partlow stated that Maryland Chemical has used portions of the property for bulk chemical storage purposes since 1955. Based on this information and the other findings from this assessment, it appears that the onsite building was likely used for manufacture of containers from 1923 until 1955; between 1955 and 2008, the property has reportedly been used for chemical storage. The parcel currently consists of a vacant warehouse.

2119 Haines Street

KCI's review of Sanborn maps suggests that the 2119 Haines Street property was an undeveloped portion of the C.F. Ranstead Wharf in 1890 and 1901. The 1914 Sanborn map indicated that the 2119 Haines Street property was part of an open area being used for storage of "irregular temporary lumber piles". Since this time, the parcel has remained undeveloped. Currently the parcel is asphalt-paved, and Second Chance, Inc. uses the area for parking purposes.

KCI's review of title information provided by NETR suggests that the Real Estate and Improvement Company of Baltimore City acquired the 2119 Haines Street property in portions from various historic owners between 1908 and 1961. Portions of the property were acquired from Lyman T. Ranstead (1908); the Spring Garden Wharf and Land Company (1923); the American Ice Company (1923); the Title Holding Company (1926, 1927 and 1929); the Sun Oil Company (1932); and, the Letom Inn Corporation (1961). The City of Baltimore acquired the property from the Real Estate and Improvement Company of Baltimore City in 1976.

2110 Haines Street

In 1890 through 1914 this parcel occupied a portion of the C.F. Ranstead Wharf and was occupied by an office structure and storage shed. Piles of logs and lumber were illustrated on various portions of the property on the 1901 Sanborn map. At some time between 1914 and 1952, the parcel's occupancy changed to the American Electric Welding Co. Inc., a steel barge manufacturer. A storage yard for Consolidated Gas Electric Light and Power Co. was also present on the 1952 Sanborn map. Based on title information reviewed for this assessment, this parcel was owned by the Warner-Fruehauf Trailer Co. Inc. between 1978 and 1988. The parcel is currently owned by the City of Baltimore. According to Ms. Barbra Carter (Greyhound Bus Terminal Manager) the Greyhound bus terminal that currently occupies the property was constructed in 2005.

2104 Worcester Street

With the exception of a small horse stable, the 2104 Worcester Street property was undeveloped in 1890. The stable building was present in the southwestern corner of the property, adjacent to Eutaw Street (known then as Shell Street). The 1901 Sanborn map also illustrated the stable building, although the structure was no longer used for that purpose.

At some time between 1914 and 1952, the parcel was developed with one large building, which was occupied by the J.B. Macneal Paints, Oil, Varnish Works. The building was reportedly used as a "stripping room" (in this context, the "stripping room" was probably an area used for stripping varnish and/or paint from furniture). At some time after 1973, Gordon Cartons Inc took over occupancy of the former Stripping Room building. Gordon Cartons Inc. utilized the building as a warehouse up until approximately 1988. KCI's review of title information provided by NETR suggests that the Gordon Paper Box Company owned the 2104 Worcester Street property in 1943. Warner Street, Inc. acquired the property from trustees of Gordon Cartons, Inc. in 1989. The City of Baltimore has owned the property since 2008.

Mr. Hillman reported that following Warner Street, Inc.'s acquisition of the property, Baltimore Cycle salvage occupied the parcel for a time. However, the former Gordon Cartons warehouse was vacated when the building became badly deteriorated. Currently, the building is still present at the property but it is very dilapidated and has partially collapsed.

2102 Oler Street

Based on KCI's review of Sanborn maps, the 2102 Oler Street property was undeveloped between 1890 and 1914. The 1901 Sanborn map indicated that "scattered lumber piles" were being stored at the property. The Gordon Cartons, Inc. Folding Box Division's Paper Warehouse No. 2 was illustrated at the property on the 1952 Sanborn map. According to the Maryland State Department of Assessments and Taxation (SDAT) records, the building currently occupying this parcel was constructed in 1950. It should

be noted that the 1952 and 1973 Sanborn maps illustrated an UST near the northeastern corner of the warehouse building, adjacent to Oler Street (then known as Dock Street). Additional discussion concerning this finding was provided in Section 4.2.1 of this report.

Gordon Cartons Inc. utilized the warehouse until approximately 1988. Mr. Hillman reported that the parcel was used by Baltimore Asphalt from 1989 until 1995. The parcel was then reoccupied by Baltimore Renovation Inc in 2000. The city of Baltimore bought the property in 2008. Currently both the northern and southern units of the warehouse structure are vacant.

4.6.2 Past Uses of Adjoining Properties

Information regarding the current uses of the properties adjoining the subject site was obtained during KCI's site reconnaissance and is presented in Section 2.6 of this report. Information regarding the historic uses of adjacent properties was obtained from the review of historic aerial photographs, topographic maps, and Sanborn maps, and is summarized below.

Northern Adjacent Properties

From the 1890s through 1952 the properties to the north of the subject site were occupied by manufacturing operations such as the Swindell Bros Crystal Glass Works and the Baltimore Distilling Company. In addition, intermixed in between the manufacturing operations were residential row homes and storage warehouses. From 1952 through the 1970, the manufacturing operations generally remained; however, the residential row homes and storage warehouse were replaced by Georges Printing & Carton Company; a Machine Shop; and the Capital Steel Company. Further, the 1970s saw the addition of a gas station immediately west of 1501 Russell street (currently the Texaco Station).

Eastern Adjacent Properties

From 1890 through at least 1952, the properties to the east of the subject site were occupied by two major distilleries. Specifically, these included the Baltimore Distilling Co, and the Hanns Distilling Co. KCI did not determine when the distilling operations ceased; however, however the buildings involved were most likely converted to other commercial enterprises.

Southern Adjacent Properties

From 1890 to 1914, the properties to the south of the subject site consisted of wharfs and docks along the Middle Branch of the Patapsco River. Generally, lumber, coal, and ice operations were located along these properties. However, the W.H. Evans Marble Works also occupied a portion of these properties. At some time between 1914 and 1952, structures on the properties south of the subject site were razed and the area was left vacant. Only a few small structures associated with Gordon Cartons Inc. remained from 1952 through the early 1970s.

Western Adjacent Properties

From 1890 to the present the properties to the adjacent west of the subject site consisted of a vacant lot and an engineered channel designed for boat docking purposes.

5.0 Site Reconnaissance

KCI Environmental Scientist Douglas E. Talaber completed a site reconnaissance in support of this Phase I ESA Update on February 6, 2009. The site reconnaissance was performed to search for evidence of hazardous waste/materials; leaks or spills; stressed vegetation or soil discoloration; drinking water/environmental monitoring wells; environmental remediation activities; storage drums; industrial or commercial refuse; herbicide or pesticide containers; farm waste; septic systems; aboveground storage tanks (ASTs); underground storage tanks (USTs); pipelines; industrial/manufacturing or similar environmentally-sensitive operations or conditions; rail spurs; ruins; landfills or illicit dumping; air emissions/waste water discharges; leachate or seeps; surface or ground water contamination; and/or PCB-containing articles. Site photographs obtained during the site reconnaissance are included as Appendix G of this report.

5.2 General Site Setting

The subject site is located within the Carroll-Camden Industrial Park in Baltimore City, Maryland. The subject site is comprised of twelve parcels which total approximately 11.76 acres of land. In addition, eleven out the twelve parcels are developed with large commercial or warehouse buildings totaling approximately 268,183 square feet (SF) of interior footprint. Based on the MDAT Real Property Search, the onsite buildings were constructed at various times between 1919 and 2004. The subject site is irregular in shape, however, it can be generalized that the subject site encompasses the majority of properties along the 1500 and 1600 block of Warner Street (Warner Street Corridor). The subject site is situated within a densely-populated, urban area consisting primarily of properties used for commercial and light industrial purposes.

5.3 Interior and Exterior Observations

During the update reconnaissance of the subject site, KCI observed the interior (if applicable) and exterior of all twelve subject site parcels searching for specific features and circumstances indicative of environmental concerns or Recognized Environmental Conditions. The information provided in the following sections summarizes the observations made during KCI's update reconnaissance. As applicable, information from the records review and interview portions of this assessment have been incorporated to more fully explain KCI's update reconnaissance observations and findings.

5.3.1 Solid Waste Generation, Storage, and Disposal

1501 Warner Street

At the time of KCI's update reconnaissance, the waste generated at the Second Chance, Inc. facility was observed to be consistent with the operations of an architectural, antique, and salvage facility. General waste generated (i.e. wood and metal scraps, packaging material etc.) are disposed of in dumpsters and removed off-site by Cockey's Enterprises Inc., on an as need basis.

1601 Warner Street

At the time of the site reconnaissance, the waste generated at the Second Chance, Inc. facility was observed to be consistent with the operations of an architectural, antique, and salvage facility. General waste generated (i.e. wood and metal scraps, packaging material etc.) are disposed of in dumpsters and removed off-site by Cockey's Enterprises Inc., on an as need basis.

1629 Warner Street

As previously discussed in Section 2.5, the 1629 Warner Street structure had been destroyed in the spring of 2008 by a fire. With the exception of the concrete foundation, at the time of KCI's update site reconnaissance, the parcel was clear of all structures and associated debris. No ongoing operations were being conducted at the facility that would currently generate solid waste.

1633 Warner Street

As previously discussed in Section 2.5, the 1633 Warner Street structure was occupied by SCI and used for the storage of architectural antiques and salvage goods. In addition, the northwest portion of the warehouse was being used to store the Palletized drums and gas cylinders that were relocated from 1501 Warner Street. No ongoing operations were being conducted at the facility that would currently generate solid waste.

1645 Warner Street

At the time of the site reconnaissance, solid waste generated at the Second Chance facility was observed consistent with the operations of an architectural, antique, and salvage facility. Solid waste generated at the property includes wood and metal scraps, packaging material, etc. These wastes are disposed of in dumpsters and removed off-site by Cockey's Enterprises Inc., on an as need basis.

1501, 1525, and 1551 Russell Street

At the time of the initial site reconnaissance, the solid waste generated at the Maryland Chemical facility included wood scraps, packaging material, and office waste. These materials are disposed of in dumpsters and removed off-site on a weekly basis by Waste Management Inc. Maryland Chemicals operations had moved from the subject site, and as such no waste was being generated at the time of KCI's updated site reconnaissance.

2119 Haines Street

As indicated previously, Second Chance, Inc. currently uses this property for parking purposes. Waste generated by Second Chance includes wood and metal scraps and packaging material. This debris is disposed of in a roll-off dumpsters and removed off-site by Cockey's Enterprises Inc., on an as need basis.

2110 Haines Street

At the time of the site reconnaissance, the waste generated at the facility appeared consistent with the Greyhound Bus Terminal's operations. The solid waste includes office material, discarded food packaging materials, and similar debris. This material is disposed of in a dumpster and transported offsite on a weekly basis by Waste Management Inc.

2104 Worcester Street

At the time of the site inspection no ongoing operations were being conducted at the facility that would currently generate solid waste. Due to the poor and extremely deteriorated condition of the warehouse, KCI observations of the interior spaces were made from the exterior of the building only. In general, the

warehouse was observed to be relatively free of debris. However, waterlogged building material debris such as ceiling tiles and drywall were observed.

2102 Oler Street

As previously discussed in Section 2.4, 2102 Oler Street is partitioned into two units. The Northern Unit consists of three rooms (i.e. an eastern room, northwest room and southwest room). At the time of the site inspection no ongoing operations were being conducted at the Northern Unit that would currently generate solid waste. The three rooms were observed to contain various amounts of debris, including broken furniture, paper products, and miscellaneous metal parts.

The Southern Unit is being utilized as a storage space for a building contractor (i.e., Baltimore Renovations Inc.). According to Mr. Wayne Carlye (property manager), solid waste from renovation work is disposed of offsite. However, the KCI observed that the Southern Unit contains some debris such as broken furniture, construction material, paper products, and miscellaneous metal parts.

5.3.2 Underground and Aboveground Storage Tanks

During both rounds of Phase I ESA site reconnaissance activity, KCI inspected the site for evidence of aboveground storage tanks (ASTs) such as concrete pads, piping or secondary containment systems, pedestals, or steel support structures and evidence of underground storage tanks (USTs) such as vent pipes, fill caps, fuel pumps, or concrete islands. KCI also performed a geophysical investigation, consisting of magnetic and ground-penetrating radar surveys, to scan the subsurface for evidence of underground storage tanks as part of the limited Phase II ESA. A summery of UST and AST findings at the subject sites parcels are discussed below.

Underground Storage Tanks

During the completion of this assessment, KCI definitively identified the current or historic presence of USTs at five (5) subject site properties. In addition, KCI has tentatively identified evidence of USTs at one (1) additional property. Table 5-1 provides a summary of these properties. Discussion concerning the UST findings outlined in Table 5-1 is presented following the table.

Table 5-1: Summary of Subject Site Properties With Identified or Suspected USTs

Street Address	Current or Historic UST Systems	Status	Comments
Subject Site Properties with Current or Historic USTs			
1501 Russell Street	1 – 7,000 gallon Gasoline UST 1 – 3,000 gallon Heating Oil UST 1 - Suspected UST	Abandoned In Place	Records suggest petroleum impacts identified in tankfield of heating oil UST. Geophysical survey identified anomalies typical of UST beneath sidewalk at the southeast corner of building.
1551 Russell Street	1 – 6,000 gallon Gasoline UST 1 – 4,000 gallon Diesel UST	Removed	Records indicate no evidence of a release identified during removal.
2102 Oler Street	1 – Gasoline UST (Size Unknown)	Still Present, No Regulatory Records	UST was left in place and is more than 55 years old. Leaks are likely.

Table 5-1: Summary of Subject Site Properties With Identified or Suspected USTs			
Street Address	**Current or Historic UST Systems**	**Status**	**Comments**
1501 Warner Street	Unknown	Unknown	Vent and fuel lines disappear into concrete floor – likely UST location.
1601 Warner Street	Reported USTs for chlorinated solvent storage (location, number and size unknown)	Unknown	USTs and historic release of solvents reported on CERCLIS.
1629 Warner Street	3 - Suspected UST	Unknown	Geophysical survey identified three Possible USTs.

1501 Russell Street

The Former Eastfield Container Corporation, located at the subject site (1501 Russell Street), was identified on the Maryland UST database reviewed for this assessment. The database records indicated that one 7,000-gallon, gasoline UST and one 3,000-gallon, heating oil UST are "Permanently Out of Use" at this facility. However, as discussed in Section 4.3.2 of this report, KCI also reviewed an MDE Tank Closure Summary report, dated February 1, 2000, for 1501 Russell Street. According to the report, the tanks were actually closed in place and remain on-site. Both tanks were reportedly constructed of steel and utilized steel product piping. MDE reported that both tanks were greater than 20 years old at the time of closure. The Tank Closure Summary records indicated that the owner was unaware of any leaks in association with the two tanks or their product lines. However the MDE Oil Control Program has reported that a release of petroleum was detected during the closure of at least one of the USTs.

During the geophysical survey completed during KCI's 2008 Phase II ESA, one (1) anomalous area at 1501 Russell Street appeared indicative of a UST. The GPR detected high-amplitude, parabolic reflectors typically associated with USTs within the anomalous area, as well as elevated TW-6 anomalies indicative of large buried metallic objects. The anomalous area is located beneath the rear sidewalk of the 1501 Russell Street building, approximately 50 feet west of the intersection of Warner Street and Worcester Street. Both a fill port and vent pipe were observed immediately adjacent to this suspected UST. The location of this anomaly corresponds to the approximate location of the abandoned in place 7,000-gallon gasoline UST.

Review of historic Phase II reports prepared by Datanet Engineering, Inc. indicated the suspected presence of a former gasoline UST located in the north central portion of the warehouse adjacent to the interior wall that fronts Russell Street. The suspected UST is illustrated on the boring figures located within the Datanet reports. However, no discussion of the suspected UST is presented within the body of Datanet reports. The suspected UST was not identified on the Maryland UST or Historic UST databases, or historic Sanborn maps reviewed for this assessment. KCI did not observe current evidence of the suspected UST at the property during the multiple reconnaissances's completed for this assessment. KCI concludes that it is possible an undocumented UST is located at the property. If an undocumented UST is present, then this UST would represent a REC. Based on this factor, additional investigation (i.e., site utility engineering investigation and/or geophysical survey) appears warranted to determine whether or not an additional UST is present at 1501 Russell Street. KCI concludes that this issue currently represents a Data Gap (Section 7.0). It should be noted that the Datanet report illustrating the suspected UST was not provided to KCI until after the Phase II geophysical surveys were conducted in 2008.

1551 Russell Street

The Maryland UST database identified one 6,000-gallon gasoline UST (installed in 1972) and one 4,000-gallon diesel UST (installed in 1968) in connection with the 1551 Russell Street parcel of the subject site. Both of the USTs are listed as being "Permanently Out of Use". The Historic UST database reported the same information as the UST database, with the exception that both USTs are reported as "Removed" instead of "Permanently Out of Use". Based on KCI's review of Oil Control Program files (Section 4.3), it appears that the Historic UST records are correct. As indicated above in the OCPCASES section, KCI reviewed a Notice of Compliance letter from MDE dated September 7, 1994, which indicated that Oil Control Program staff had conducted an inspection of 1551 Russell Street and had determined that two underground storage tanks had been removed from the property. An MDE Tank Removal/Abandonment report attached to the letter more specifically indicated that one 6,000-gallon gasoline and one 4,000 gallon diesel UST had been removed. The records indicated that no perforations were observed in either tank and that no groundwater or soil contamination was detected in the tank pits following the removal of the USTs. During the reconnaissance of this property, KCI observed two patched asphalt areas in the facility's southern courtyard. Interviewees have reported that UST's were removed from these areas in the 1980s.

2102 Oler Street

Although this property was not identified on the Maryland UST database reviewed for this assessment, KCI noted that one (1) gasoline UST was illustrated at this address on the 1952 and 1973 Sanborn maps. The historic UST was located near the northwest exterior corner of the former Gordon Cartons Inc., Folding Box Division, Paper Warehouse No 2. During the update site reconnaissance of the parcel, KCI observed the remnants of a fuel dispenser on the west side of Oler Street between the 1633 Warner Street and the 2102 Oler Street warehouses. In addition, two 12-inch, round sump lids were observed in the sidewalk near the former fuel dispenser, similar to those that typically cover tank-top appurtenances (i.e., STPs, manways, etc.). The location of the apparent UST corresponds to the historic gasoline UST that was illustrated on the 1952 and 1973 Sanborn maps. KCI concludes that the UST is still present and that it is more than 55 years old. Probably due to its age, the UST was not identified on the Maryland UST or Historic UST databases reviewed for this assessment (i.e., the tank was installed and used long before current recordkeeping practices were instituted).

1501 Warner Street

During the reconnaissance of the warehouse at 1501 Warner Street, KCI observed a vent and fill pipe, typical of a heating oil AST or UST, along an exterior wall located adjacent to loading dock number five. Mr. Andy Evans, facility manager of Second Chance, Inc. indicated that to his knowledge there is no heating oil AST located in the warehouse. KCI and Mr. Evans were able to follow the vent and fill lines well into the warehouse until they entered a warehouse room that was full of stockpiled furniture. Due to the impediment of the excess furniture the terminus of the vent and fuel lines were not readily seen. However, it appeared that both lines entered the concrete slab floor. Based on this observation it appears likely that a UST is located beneath the floor at the location where the piping enters the slab.

1601 Warner Street

Information in the CERCLIS database reviewed for this assessment indicated that "the (former) Gordon Plant used chlorinated solvents to clean presses. The solvents were stored in USTs. Poor housekeeping at the facility led to the spillage of solvents and thus the potential for soil and groundwater contamination."

KCI did not identify evidence of current or historic USTs during the update reconnaissance, and Mr. Larry Hillman (former property owner) and Mr. Andy Evans indicated that they had no knowledge of historical or current USTs at the subject site. During the initial Phase I ESA, KCI did observe two large metal plates (approximately 3' x 4' each) associated with some partly-disassembled printing presses. It is possible that these may be covering surface features associated with USTs. However, during the geophysical survey conducted in August 2008 the previously observed metal plates were covered by shelving holding used material that prevented survey coverage. Furthermore, in areas that were accessible and surveyed, no USTs were detected. It is possible that the historic USTs were removed, or that they were abandoned in such a way that surface appurtenances were removed and the tanks left in the ground. KCI concludes that the reported former USTs may still be present at the site and these would be a REC.

1629 Warner Street

At the time of KCI's update site reconnaissance, with the exception of the concrete foundation, the 1629 Warner Street parcel was clear of all structures. A fire had destroyed the warehouse structure in the spring of 2008. The 1629 Warner Street property did not appear on the UST, Historic UST, or LUST databases reviewed as part of this assessment. However, results from a geophysical survey conducted during KCI's Supplemental Phase II ESA (2008) identified three (3) possible USTs within the footprint of the former warehouse structure.

1645 Warner Street

During the site reconnaissance of the Western Unit of the warehouse at 1645 Warner Street, KCI observed a 2' x 2' square access panel in the entrance floor of the structure. This access panel could indicate the potential presence of a UST or underground vault. KCI was unable to open this access panel during the initial 2007 site reconnaissance. The 1645 Warner Street property did not appear on the UST, Historic UST, or LUST databases reviewed as part of this assessment.

The KCI Phase II 2008 included GPR scanning of the courtyard entrance of 1645 Warner Street, specifically within the area of the observed of 2" x 2" access panel. The GPR scanning did not reveal anomalies indicative of USTs. With difficulty, KCI removed the 2" x 2"access panel, noting that the vault contained an historic water meter. The water meter was in a state of disrepair and did not appear to be functional. KCI concludes that no USTs appear to be present at this location.

Aboveground Storage Tanks

During both rounds of Phase I ESA site reconnaissance activity, KCI observed ASTs at two of the onsite facilities. These include Maryland Chemical and the warehouse at 2102 Oler Street. Discussion concerning KCI's reconnaissance findings is provided below.

1501, 1525, and 1551 Russell Street

During the initial 2007 Phase I site reconnaissance KCI observed eight (8) ASTs in various locations throughout the Maryland Chemical facility. Ms. Jeanette Glose Partlow (President of Maryland Chemical) reported that four (4) of the ASTs are out of service. The four (4) in-service ASTs in include one (1) 1,500-gallon diesel AST; one (1) 3,800-gallon sulfuric acid AST; one (1) 4,750-gallon sodium hypochlorite AST, and one (1) 6,000-gallon sodium hydroxide AST. The four (4) out of service ASTs include one (1) 12,000-gallon hydrochloric acid AST, one (1) 3,000-gallon nitric acid AST, one (1) 5,000-gallon hydrofluoric acid AST, and one (1) approximately 10,000-galllon wax AST.. Ms. Partlow

was unaware of the existence of the 10,000-gallon wax AST and stated it was probably used when Eastfield Containers (Cardboard Manufacture) occupied Buildings #1 thru #3. All of the ASTs were observed to have stained concrete within their immediate vicinity. The stains appeared to have been caused by incidental releases during tank filling or product removal operations. No floor drains or sumps were observed in the immediate vicinity of the ASTs, and no surficial cracking of the concrete in these areas was observed. Based on these factors, the staining appears to represent a "de minimis" condition.

During the update Phase I site Reconnaissance in 2009 only three (3) of the eight (8) ASTs reported in 2007 were observed. The reduction of ASTs located at the former MDCHEMs facility is due to the closure of MDCHEMs operations at this location and subsequent scrapping and/or relocating of the ASTs. The three (3) remaining ASTs located at the former MDCHEMs facility include one (1) 4,750-gallon sodium hypochlorite AST, one (1) 5,000-gallon hydrofluoric acid AST, and one (1) approximately 10,000-galllon wax AST. All of these three (3) remaining ASTs were observed to have stained concrete within their immediate vicinity and the staining appears to represent a "de minimis" condition.

2102 Oler Street

During both rounds of Phase I ESA site reconnaissance activity, KCI observed a total of five (5) ASTs in the southwestern room of 2102 Oler Street's Northern Unit. The size of the ASTs varied from approximately 2,000 to 6,000 gallons. All of the ASTs appeared to be empty. However, a waxy film was observed on some of the ASTs and on the floor beneath the ASTs. Mr. Carlye stated that his father worked at the 2102 Oler Street facility when it was occupied by Gordon Carton. Mr. Carlye said that waxed cardboard products were manufactured at the 2102 Oler Street facility and that the ASTs contained the wax coating material. The room in which the ASTs are located corresponds to the area identified as "acetate storage" on the 1952 Sanborn Map.
At the western exterior side of the AST room, KCI observed a rectangular cinderblock structure. KCI was unable to inspect the interior of the rectangular structure due to the presence of a metal plate which capped the structure. However, this rectangular structure corresponds to the reported historic location of a "chemical wash tank" that was identified in the 1952 Sanborn Map.

In addition, during the reconnaissance of 2102 Oler Street's Sorthern Unit interior, KCI observed two empty 275-gallon ASTs that appeared to have been left there in storage.

5.3.3 Bulk Chemical Storage Areas

During both rounds of Phase I ESA site reconnaissance activity, KCI surveyed the subject site for areas of bulk chemical storage. The findings from these investigation are described below.

1501 Warner Street

During the initial Phase I (2007) site reconnaissance, KCI observed a storage room located in the southwestern portion of the warehouse that contained approximately one hundred forty-five (145) 55-gallon drums. The drums are reported to contain approximately 5,500-gllons of ethylene glycol, 2,200-gallons of windshield wiper fluid with methanol, and 165-gallons of Deck and Siding Stain. In addition, KCI observed several compressed air cylinders, as well as 1-gallon paint, stain, and solvent containers in the storage room.

Mr. Foster (Second Chance, Inc.) stated that the drums originated from an automotive fluid repackaging company that vacated a warehouse (located at 1645 Warner) that Second Chance presently occupies. It

appears that MDE is aware of the drum storage based on the Field Inspection Report, Dated April 9, 2004 described in Section 4.3.2 of this report. Mr. Foster showed KCI an estimate prepared by Clean Venture Cycle Chem, Inc. (dated March 24, 2004) pursuant to the removal of the drums; however, this work has not been performed to date.

During the update reconnaissance, KCI was informed by Mr. Andy Evans that the 55-gallon drums and other assorted containers formerly located in 1501 Warner Street had been relocated to 1633 Warner Street. Furthermore, Mr. Evans stated that prior to the 55-gallon drums and other assorted containers being stored in 1501 Warner Street, they were located within 1645 Warner Street. The updated status of the 55-gallon drums and assorted containers are discussed within the 1633 Warner Street heading of Section 5.3.3.

1601 Warner Street

KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

1629 Warner Street

KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

1633 Warner Street

As discussed in the 1501 Warner Street section, the 55-gallon drums and assorted containers that were previously store at 1501 Warner Street were observed stored in the northwestern portion of the 1633 Warner Street warehouse during the KCI update (2009) reconnaissance. As reported in the Phase II Supplement No 1 report (Section 4.3.1), the stockpile of 55-gallon drums were initially sampled in August 2008 with additional sampling occurring in March 2009. A total of 120 drums were reported stored at 1633 Warner Street. A total of 24 drums were empty. A total of 59 drums had flash point below 200 degrees Fahrenheit. By EPA's definition (Code of Federal Register, Title 40, Subpart C) these wastes are hazardous by the ignitability characteristic and would be coded D001 hazardous wastes. A total of 57 drums with low flashpoints are a methanol-based windshield washer solvent concentrate, several being labeled as such. The other two (2) drums with low flash points are an oil product found to not have PCBs, Cd, Cr or Pb, but do have a low flashpoint. Eleven of the 59 low flashpoint drums need to be overpacked prior to off-site transportation for disposal.

There are a total of 39 drums containing liquids and/or solids that have flashpoints above 200ºF, and could be disposed as DOT Nonhaz materials. A total of 18 of the nonhaz drums need overpack, two (2) of which were already done due to the contents starting to leak during sampling activities. Four (4) of the nonhaz drums contain trash/debris.

During the update reconnaissance, KCI observed staining within the immediate vicinity of several of the stored drums, indicating leakage from one or more of the stored 55-gallon drums. No drains were observed to be in the vicinity of the observed stain. Base on the severely deteriorated state of numerous drums, evidence of leaking drums and presence of drums classified as containing hazardous waste by ignitability characteristic, KCI concludes that the presence of the drums represents a REC.

1645 Warner Street

KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

1501, 1525, and 1551 Russell Street

Due to the nature of the former Maryland Chemical's operations, which involved repackaging and distribution of industrial and analytical chemicals, as well as Chemstation Mid-Atlantic's operations, which involved the blending of cleaners and soaps, more than ninety (90) different types of chemicals were historically stored, used, or repackaged at these properties. The majority of the liquid chemicals was stored in either 55-gallon drums, or totes that range in capacity from 250-gallons to 550-gallons. Dry chemicals were typically stored in palletized bags. A copy of a product list describing typical chemicals which historically could have been at the site is provided in Appendix F.

Due to the large quantities of chemicals stored on site, KCI did not take inventory of each individual container stored on site during the initial (2007) Phase I reconnaissance. However, Ms. Partlow reported the types and quantities of chemicals to pass through the facility is roughly 2 million units per month (based on the year 2002 numbers), of which 50% were non-hazardous; 40% were corrosive solids or liquids; 7% were flammable solids or liquids; 3% were oxidizer solids or liquids; and 2% were toxic solids or liquids. The majority of chemicals were stored in the 1551 Russell Street office/warehouse building, Building #3, and the canopied storage structure adjacent to Building #1. Lesser quantities of the chemical containers were stored in Buildings #1 and #2 due to the poor condition of the buildings and their leaking roofs.

At the time of KCI's initial (2007) reconnaissance, the stored chemicals and their containers generally appeared to be in good condition. However, KCI observed staining throughout both Building #2 and Building #3. The staining in Building #2 appeared to have been caused by water from the leaking roof, but it may also have been caused by historic chemical releases. Since the staining may have been caused by a chemical release, and there was a potential for such releases to migrate out of the loading docks to the east exterior of the Building #3 (or into the pits in Building #2), KCI concluded that the staining may represent a REC. During the update (2009) site reconnaissance, KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

2119 Haines Street

KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

2110 Haines Street

KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

2104 Worcester Street

KCI did not observe drums or other bulk chemical storage containers during the reconnaissance of this parcel.

2102 Oler Street

- KCI observed four (4) 55-gallon drums within the eastern room of the Northern Unit (Section 2.4) during the both the initial (2007) and updated (2009) site reconnaissance of this parcel. The drums were filled with general rubbish. In addition, the northwestern room contained three 55-gallon plastic drums filled with an unknown, powdery material and two partial pallets of 50-lb sacks of hydrogloss. No discernable label identification was observed on the drums; however, the word "Trash" was marked on at least two of the drums. The bags of hydrogloss were observed to be in poor condition, with some bags split open with their contents spilling out. According to written descriptions on the packaging material, "hydrogloss" is a water-based, high-performance urethane coating. It appears possible that the powdery substance in the drums could also be hydrogloss. Based on this factor, KCI concludes that the presence of the hydrogloss represents a de minimis condition. However, care should be taken to disposes of the hydrogloss, prior to building demolishing, according to applicable local, state, and federal regulations..

5.3.4 Minor Chemical Storage Areas

During both rounds of Phase I ESA site reconnaissance activity, KCI inspected the project site for non-bulk chemical storage areas. A summery of these relatively minor chemical storage areas is provided below.

1501 and 1645 Warner Street

Typical wood shop chemicals consistent with refinishing furniture, such as paints, enamels, stains, and solvents were stored at various locations where repair of salvaged architectural elements were being conducted. The observed chemicals were in containers with quantities of 5-gallons or less. These storage containers were sealed with no visible evidence of staining or a leakage.

Propane tanks for the forklifts were stored in a cage area, by the northeast exterior entrance of the 1601 Warner Street property. In addition, several 5-gallon containers of gasoline were stored within a cage area located on the southeastern portion of the 1645 Warner Street parcel. These storage containers were sealed with no visible evidence of staining or a leakage.

2110 Haines Street

KCI observed typical cleaning chemicals, such as disinfectants and floor/ counter cleaners within two storage closets located in the passenger waiting area of the on-site building. The observed cleaners were in containers with quantities of 5-gallons or less. The storage containers were sealed with no visible evidence of staining or a leakage.

2102 Oler Street

The interior of the Southern Unit contained general contractor materials which included various cans of paint and solvents, and several gallons of gasoline. All container quantities were 5-gallons or less and these containers were sealed, with no visible evidence of leaks. Minor rust stains were observed in the area of some of these chemical containers.

1633 Warner Street

KCI observed 1-gallon paint, stain, and solvent containers near the 55-gallon drum storage area. All container quantities were 5-gallons or less and these containers were sealed, with no visible evidence of leaks.

KCI did not observe evidence of non-bulk, minor chemical storage at the remaining parcels comprising the subject site. Moreover, none of the minor chemical storage areas observed during both the initial and update reconnaissance are considered Recognized Environmental Conditions.

5.3.5 Potential Sources of Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are synthetic organic chemicals used in some electrical transformers, hydraulic systems, fluorescent light ballasts, electrical panels, or other similar equipment. PCBs can be found in liquid, solid or vapor form, and are usually colorless or light yellow. The production of PCBs was stopped in the U.S. in 1977 because of mounting evidence that they build up in the environment and cause harmful effects.

PCB content in electrical transformers has been categorized into three classifications by the federal government. Those units that contain less than 50 parts per million (ppm) are defined as non-PCB. Units that contain between 50 ppm and less than 500 ppm of PCBs are defined as PCB-contaminated. Units with a PCB content of 500 ppm and greater are classified as PCB transformers.

KCI's survey for equipment that could contain PCBs did not include an inspection of fluorescent light ballasts (i.e., KCI did not disassemble the light fixtures to expose the ballasts). However, KCI observed fluorescent lights throughout the subject sites multiple buildings. Light ballasts manufactured prior to 1979 could contain PCBs. Generally, the ballast will contain about a teaspoon of concentrated (900,000 parts per million or greater) PCBs sealed inside the capacitor. The capacitor is usually surrounded by a tarlike potting material, which is in turn enclosed in the ballast box. Based on the age of the on-site buildings, it is possible that the ballasts contain PCBs. No evidence of damage or leaking was observed on or in the vicinity of the light fixtures observed during the site reconnaissance. Prior to future demolition activities, the fluorescent light ballasts should be inspected for "non-PCB" labels. If such labels are not present, then the ballasts should be assumed to contain PCBs.

One (1) elevator was observed in 1501 Russell Street Building #3. Some elevators utilize hydraulic oils, which have the potential to contain PCBs. If any future renovation/demolition activities involve the elevator care should be taken during any activities that involve the dismantling of elevator equipment. Any suspect PCB containing equipment should be handled according to applicable local, state, and federal regulations.

5.3.6 Unusual Odors

During both the initial and update site reconnaissance, no uncharacteristic odors were detected at or within the immediate vicinity of the subject site.

5.3.7 Pools Of Liquid

During both the initial and update reconnaissance of the subject site, pools of water were observed in various areas within the warehouse buildings occupying certain parcels of the subject site. Specifically, these parcels included 1633, 1629, and 1601 Warner Street; 2104 Worcester Street, 2102 Oler Street, and 1501 and 1525 Russell Street. The ponding appeared to have been caused primarily by roof leaks. KCI

did not observe any pools of chemicals, wastes, or other potentially hazardous materials during the reconnaissance.

5.3.8 Pits, Ponds, and Lagoons

During both the initial and update Phase I site reconnaissance, KCI observed a pit covered by a large metal sheet in the 1501 Russell Street warehouse Building #3. The pit is located in front of the boiler room and associated chimney, which is located near the center of the warehouse. Mr. Galitzin, the director of operations at MDCHEM, indicated that the pit could possibly be an ash pit left over from a time when the boiler burned coal. Additional pits, created from the removal of manufacturing equipment, were observed at scattered locations in warehouse Buildings #1 (1525 Russell Street) and Buildings #2 and #3 (1551 Russell Street). The presence of these pits is not considered a REC at this time.

KCI also observed that pits associated with historic machinery were present in Building #2. These pits were filled with ponded water. As indicated earlier, KCI also observed staining, potentially caused by spills or releases of chemicals, in the vicinity of this ponded water. Since these chemical spills (if present) could migrate out of the loading docks, KCI considers the staining to be a REC (refer to Section 5.3.9).

5.3.9 Staining or Stressed Vegetation

During both the initial and update site reconnaissance, no evidence of stressed vegetation was observed at or within the vicinity of the subject site. Information pertaining to staining is provided in the following table.

Table 5-2: Summary of Areas with Visible Staining

Address/Parcel	Comments
1501 Warner Street	Minor spot staining throughout the bare concrete floors.
1601 Warner Street	Minor spot staining throughout the bare concrete floors.
1629 Warner Street	Staining on concrete floor possibly due to roof leaks / water damage.
1633 Warner Street	General staining on concrete floor possibly due to roof leaks / water damage and asphalt operations during Baltimore Asphalt's occupancy. Staining in vicinity of stored 55-gallon drums possibly due to leaks from the drums.
1645 Warner Street	Minor spot staining throughout the bare concrete floors.
1501 Russell Street	Major staining throughout warehouse Buildings #2 and #3, possibly due to due to roof leaks / water damage or past chemical releases.
1525 Russell Street	Major staining throughout warehouse Building #1, possibly due to roof leaks / water damage and past site operations.
1551 Russell Street	Major staining in caustic and acid rooms possibly due to past automotive shop activity (caustic room), and/or leaks from the caustic and acidic ASTs.
2119 Haines Street	Minor spot staining throughout the asphalt paved lot.
2110 Haines Street	Minor spot staining throughout the asphalt paved lot.
2104 Worcester Street	Major staining on concrete floor possibly due to water damage from no roof.
2102 Oler Street	Major staining throughout warehouse concrete floor possibly due to water damage from roof leaks and past site operations.

5.3.10 Drains and Sumps

Information pertaining to drains and sumps observed during both the initial and update site reconnaissance is provided as follows

Table 5-3: Summary of Observed Drains and Sumps

Address/Parcel	Drains and Sumps Discussion
1501 Warner Street	No floor drains or sumps were observed within the concrete floors.
1601 Warner Street	No floor drains were observed within the concrete floors.
1629 Warner Street	Possible sumps were observed. However these could also be USTs or underground vaults and were previously discussed in Section 5.3.2 of this report. It should be noted that due to the amount of trash throughout the warehouse, KCI was unable to determine if floor drains or sumps were present in some areas of the warehouse.
1633 Warner Street	No drains or sumps were observed within the concrete floors.
1645 Warner Street	A floor drain was observed within the former employee locker/wash room area. This floor drain reportedly drains into the stormwater system. No staining was observed in the area of the floor drain. No additional drains or sumps were observed within the concrete floors.
1501 Russell Street	KCI observed floor drains in the tote washout area, boiler room, and laboratory area of Building #3. Based on research conducted for this assessment, the floor drain in the tote wash area is connected to the sanitary sewage system. This discharge is permitted, subject to pH monitoring and control, under a National Pollutant Discharge Elimination System (NPDES) Permit.
1525 Russell Street	No drains or sumps were observed within the concrete floors. However, due to standing water throughout Buildings #1 and #2, KCI was unable to determine if floor drains were present.
1551 Russell Street	A floor drain was observed within the employee locker room area. This floor drain reportedly drains into the stormwater system. No staining was observed in the area of the floor drain. An additional floor drain was observed in the caustic room. The caustic room was reportedly a automotive repair shop for the facility until the late 1990s. Currently the drain entry is plugged with concrete.
2119 Haines Street	No drains or sumps were observed in the asphalt paved lot
2110 Haines Street	A oil/water separator was located in the bus parking area of the east of the terminal building. No additional floor drains or sumps were observed at this facility.
2104 Worcester Street	No drains or sumps were observed within the concrete floors. It should be noted that the interior of the existing warehouse structure was not inspected thoroughly due to access and safety concerns.
2102 Oler Street	No drains or sumps were observed within the concrete floors. However, due to the amount of trash throughout the warehouse, KCI was unable to determine if floor drains or sumps were present.

5.3.11 Wells and Septic Systems

With the exception of five (5) groundwater monitoring wells observed at 1551 Russell Street and one (1) groundwater monitoring well observed at 1501 Russell Street, no evidence of wells or septic systems was observed at or within the vicinity of the subject site during the initial and update site reconnaissance. The

five (5) wells located at 1551 Russell Street were installed as part of Datanet Engineering, Inc's December 15, 2000 Phase II ESA of the property (refer to Section 4.3.1).

According to Datanet Glose Site Phase II 2000 six (6) 2-inch monitoring wells were installed during the coarse of the phase II investigation. The wells were predominately located in the courtyard between 1551 and 1525 Russell Street. KCI is not aware of any active monitoring requirements for these wells.

5.4 Non-Scope Considerations

During both rounds of Phase I ESA site reconnaissance activity, KCI inspected the site for evidence of potential friable asbestos containing material (ACM). Furthermore, KCI also performed ACM and lead based paint surveys at the subject site as part of the phase II ESA activity conducted in January and October 2008 (See Section 4.3.1).

During the performance of this assessment, KCI observed potential asbestos containing material (ACM) in the form of thermal system insulation (TSI) in 1629 Warner Street and in 1551 Russell Street. The TSI was located on various pipes throughout 1629 Warner Street. The TSI was also located on various pipes throughout 1551 Russell Street and on the boiler. KCI also observed other potential ACM including ceiling tiles; floor tiles; transite tiles and sheeting; gaskets; window caulking; roofing tar and felts; and similar building materials in and on these buildings, and many of the other warehouse buildings, at the subject site. Although not part of the scope of this assessment, KCI notes the presence of these materials for the Client's information.

6.0 Interviews

As part of this and previous assessment, KCI interviewed Mr. Gary Suskauer, representative of BDC (Client and property owner), Mr. Mark Foster (Executive Director of SCI), Mr. Andy Evans (SCI), Mr. Vince Tully (Facility Manager for SCI), Ms. Jeanette Glose Partlow (President MDCHEM), Mr. Michel Galitzin (Director of Operations MDCHEM); Ms. Barbra Carter (Greyhound Bus Terminal Manager), Mr. Larry Hillman (Warner Properties Owner), and Mr. Wayne Carlye (Owner Baltimore Renovations Inc.). Information obtained during these interviews has been incorporated into applicable sections of this report.

7.0 Data Gaps

ASTM 1527-05 identifies a data gap as a lack or inability to obtain information via the practice despite good faith efforts by the environmental professional to gather such information. As discussed below, numerous data gaps were encountered during the completion of this assessment. Moreover, these data gaps are considered significant, since KCI's professional experience raises reasonable concerns involving the data gaps. A summary of the data gaps encountered during this assessment is provided as follows:

- KCI has not identified the historic (or current) location of USTs, historically used to store chlorinated solvents, at the 1601 Warner Street property. These USTs were reported on the CERCLIS database but no location was noted. Moreover, information obtained during the completion of this assessment is inconclusive with regard to the potential locations of these reported tanks.

- Based on the review of the historic documents (Datanet MDE SUM Phase II 1998), one (1) suspected former gasoline UST is reputably located in the north central portion of the warehouse adjacent to the interior wall that fronts Russell Street. The suspected UST was not identified on the Maryland UST or

Historic UST databases, or historic Sanborn maps reviewed for this assessment. KCI did not observe current evidence of the suspected UST at the property during the multiple reconnaissance's completed for this assessment. KCI concludes that it is possible an undocumented UST is located at the property.

8.0 Findings and Opinion

The Baltimore Development Corporation (Client) retained KCI Technologies, Inc. (KCI) to perform an updated Phase I Environmental Site Assessment (ESA) for the subject site, which is comprised of 12 parcels totaling 11.76 acres of land. The subject site is positioned within the Carroll-Camden Industrial Park in Baltimore City, Maryland, consisting primarily of commercial and light industrial properties. Currently, ten (10) out the 12 parcels comprising the subject site are improved with warehouse and/or light industrial manufacturing buildings. These buildings were constructed at various times between 1919 and 2004. A summary of the significant findings from this assessment, and KCI's opinion regarding whether the findings represent Recognized Environmental Conditions, is provided below. KCI's recommendations are provided in Section 11.0.

1501 Warner Street

The findings of this assessment have revealed that the 1501 Warner Street parcel of the subject site has been developed since at least 1901. KCI was unable to definitively determine owners prior to Bayard Realty Corporation; however, MDE's SAP OU2 2005 report indicated that from 1902 to 1953 the J.B. MacNeal and Company Varnish and Color Works operated out of buildings on this property. MDE stated that paint and varnish manufacturers used heavy metal salts and oxides and volatile organic materials in their process and operations. Gordon Cartons, Inc. owned the site between 1965 and 1989 and presumably used the onsite buildings for manufacture and/or storage of paper boxes and packaging containers. Currently the site is occupied by SCI. Significant findings and opinions related to this parcel are presented as follows:

- During the reconnaissance of the warehouse at 1501 Warner Street, KCI observed a vent and fill pipe, typical of heating oil AST or UST, along an exterior wall located adjacent to loading dock number five. The vent and fill lines run into the warehouse and then enter the warehouse floor. Based on this observation it appears likely that a UST is located beneath the floor at the location where the piping enters the slab. As indicated in KCI's Phase II 2008, a geophysical survey could not be performed inside the 1501 building because the rooms were filled with furniture.If present, it is also likely the UST is relatively old and releases may have occurred from the tank. Based on this factor, KCI concludes that if a UST is present, it does represents a REC.

- Based on historical information reviewed for this assessment, it appears that the 1501 Warner Street property has been used for varnish and paint manufacturing operations between 1902 and 1953 Moreover, additional carton manufacturing operations have occurred between 1965 and 1989. MDE's PA 2008 report asserted that the Gordon/MacNeal property has been the site of light industry for over one hundred and twenty years. Two (2) principal industries were contributors to potential contamination in the area; they were commercial printing and paint and varnish manufacturing. Numerous hazardous chemicals were associated with both of these industries and there was a strong potential that these materials have been released into the environment.

- KCI's Phase II 2008 report confirmed that contaminated soils exist in the immediate vicinity of the 1501 Warner Street building. The constituents of concern in these contaminated soils include

polycyclic aromatic hydrocarbons (PAHs), and heavy metals. KCI concludes that the presence of these impacted soils represent a REC.

- KCI's Phase II 2008 report revealed concentrations of petroleum compounds in the groundwater, in the immediate vicinity of the 1501 Warner Street building, which exceeded relevant MDE criteria. KCI concludes that this finding represent a REC.

1601 Warner Street

The 1601 Warner Street parcel of the subject site has been developed since at least 1890, at which time the property was owned by C.F. Ranstead and leased to the Baltimore Cedar Company. The J.B. McNeal Varnish and Color Works facility occupied the site between 1901 and 1952, and in 1973 Gordon Cartons occupied the parcel. Information obtained from interviews suggests that Baltimore Cycle Salvage (a motorcycle parts and repair service) occupied the property between 1989 until 2005. Significant Findings and Opinions related to this parcel are presented as follows:

- The 1601 Warner Street property was identified on the CERCLIS database reviewed for this assessment. The database records indicated that Gordon Cartons formerly stored chlorinated solvents in underground tanks at this parcel, and that poor housekeeping practices led to a release of these solvents. The records also indicate that "there is potential for soil and groundwater contamination at the property". KCI did not observe current evidence of the reported former USTs at the property during the multiple reconnaissances completed for this assessment, nor was the historic location of these reported USTs identified during KCI's historical research (see Data Gaps, Section 7.0). A geophysical survey was conducted at 1601 Warner Street during KCI's Phase II 2008 investigation. However, the locations of suspected solvent-storage USTs at 1601 Warner Street, a CERCLIS site, could not be determined. KCI concludes that the reported historic release of solvents, reported historic presence of USTs and reported soil/groundwater contamination represent a REC.

- The 1601 Warner Street property has been used for manufacturing purposes from at least 1890 through some time between 1973 and 1989. The MDE has reported that it is likely that both the former paint and varnish manufacture (JB McNeal) operations and commercial printing operations (Gordon Cartons) involved the use of heavy metal salts and oxides. KCI concludes that the relatively long (and initially, largely unregulated) history of manufacture and printing operations may have resulted in historic releases of heavy metals and solvents at the property.

- KCI's Phase II 2008 report, confirmed that contaminated soils exist in the immediate vicinity of the 1601 Warner Street building. The constituents of concern in these contaminated soils include polycyclic aromatic hydrocarbons (PAHs), and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

- KCI's Phase II 2008 report, revealed concentrations of petroleum compounds in the groundwater, in the immediate vicinity of the 1601 Warner Street building, which exceeded relevant MDE criteria. KCI concludes that this finding represents a REC.

1629 Warner Street

The 1629 Warner Street parcel of the subject site was undeveloped from at least 1890 until 1926. The findings of this assessment suggest that Gordon Cartons occupied the facility from first development through at least 1973; and possibly as late as 1989, when Warner Street, Inc. acquired the property.

Information from interviews indicates that Baltimore Cycle Salvage (a motorcycle parts and repair service) occupied the property from 1989 until 2005. With the exception of the concrete foundation, at the time of KCI's update site reconnaissance, the parcel was clear of all structures. A fire had destroyed the warehouse structure in the spring of 2008. Findings and Opinions related to this parcel are presented as follows:

- Based on information from historical records reviewed as part of this assessment, it appears that industrial container manufacturing operations occurred on this property for more than sixty years. Based on this history of industrial use and the nature of the historic operations, KCI concludes that it is possible that historic releases of volatile organic compounds, and/or heavy metal salts and oxides, may have occurred at the property.

- KCI's Phase II 2008 report, confirmed that contaminated soils exist in the immediate vicinity of the 1629 Warner Street building. The constituents of concern in these contaminated soils include PAHs, petroleum compounds, and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

- KCI's Phase II 2008 report, revealed concentrations of petroleum compounds in a groundwater sample (boring B-5) collected in the immediate vicinity of the 1601 Warner Street building, which exceeded relevant MDE criteria. Additional constituents of concern in the groundwater sample included VOCs, SVOCs, and heavy metals. KCI concludes that this finding represents a REC.

- During the initial reconnaissance of the warehouse at 1629 Warner Street, KCI observed two round access panels within the floor of the interior central portion or the warehouse building, which may be associated with an underground tank or vault. The former owner stated he is not aware of any USTs at the property; moreover, the property was not identified on the Maryland UST database reviewed for this assessment. During subsequent update site visits, the concrete warehouse foundation appeared to contain several areas of ancillary piping possibly associated with undocumented USTs.

- Results from the geophysical study completed at 1629 Warner Street, during KCI's Phase II SUP 2008 report, revealed the presence of three possible undocumented USTs. KCI concludes that the possible presence of undocumented USTs represents a REC.

<u>1633 Warner Street</u>

With the exception of a small stable, the 1633 Warner Street parcel of the subject site was undeveloped from at least 1890 until some time between 1901 and 1914. The C.D. Pruden Company, a manufacturer of fire proof doors and windows, occupied the site in 1914. By 1952, Gordon Cartons used the building as a warehouse for paper supplies. However, by 1973 "Color Mixing and Grinding" operations were reportedly carried out in one section of the building, which suggests chemicals such as pigments and solvents were in use at the property. Information from interviews indicates that Baltimore Asphalt occupied the property between 1988 to 1995, and that Baltimore Cycle Salvage occupied the property between 2002 until 2005. The warehouse at 1633 Warner Street is currently occupied by SCI and used for the storage of architectural antiques and salvage goods. In addition, the northwest portion of the warehouse is being used to store the Palletized drums and gas cylinders that were relocated from 1501 Warner Street. Significant Findings and Opinions related to this parcel are presented as follows:

- Based on information from historical records reviewed as part of this assessment, it appears that manufacturing operations, involving the production of fire doors and windows, have occurred at the 1633 Warner Street property since some time between 1901 and 1914.

- KCI's Phase II 2008 report revealed soil samples, collected from a boring advanced adjacent to an abandoned UST located between the 1633 Warner Street and 2102 Oler Street parcels of the subject site, contained some petroleum contamination. This finding suggests that contaminated soils and groundwater may be present near this tank. In addition, the constituents of concern in these contaminated soils also include PAHs, and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

- KCI's Phase II 2008 report revealed concentrations of petroleum compounds in a groundwater sample collected (boring B-5) in the immediate vicinity of the 1633 Warner Street building, which exceeded relevant MDE criteria. Additional constituents of concern in the groundwater sample included VOCs, SVOCs, and heavy metals. KCI concludes that this finding represents a REC.

- As discussed in the 1501 Warner Street heading in Section 5.3.3 the 55-gallon drums and assorted containers that were previously store at 1501 Warner Street were observed stored in the northwestern portion of the 1633 Warner Street warehouse during the KCI update (2009) reconnaissance. As reported in the Phase II Supplement No 1 report (Section 4.3.1), the stockpile of 55-gallon drums were initially sampled in August 2008 with additional sampling occurring in March 2009. A total of 120 drums were reported stored at 1633 Warner Street. A total of 24 drums were empty. A total of 59 drums had flash point below 200 degrees Fahrenheit. By EPA's definition (Code of Federal Register, Title 40, Subpart C) these wastes are hazardous by the ignitability characteristic and would be coded D001 hazardous wastes. A total of 57 drums with low flashpoints are a methanol-based windshield washer solvent concentrate, several being labeled as such. The other two (2) drums with low flash points are an oil product found to not have PCBs, Cd, Cr or Pb, but do have a low flashpoint. Eleven of the 59 low flashpoint drums need to be overpacked prior to off-site transportation for disposal.

- There are a total of 39 drums containing liquids and/or solids that have flashpoints above 200ºF, and could be disposed as DOT Nonhaz materials. A total of 18 of the nonhaz drums need overpack, two (2) of which were already done due to the contents starting to leak during sampling activities. Four (4) of the nonhaz drums contain trash/debris.

- During the update reconnaissance, KCI observed staining within the immediate vicinity of several of the stored drums, indication leakage from one or more of the stored 55-gallon drums. No drains were observed to be in the vicinity of the observed stain. Base on the severely deteriorated state of numerous drums, evidence of leaking drums and presence of drums classified as containing hazardous waste by ignitability characteristic, KCI concludes that the presence of the drums represents a REC.

- Only a portion of this parcel could be surveyed during the Supplemental Phase II ESA (2008) geophysical survey. However, the results from the geophysical survey revealed the presence of a previously undocumented UST located beneath the building slab. Furthermore, another possible undocumented UST was located by visual evidence outside the warehouse and adjacent to an abandoned dispenser along Oler Street. KCI concludes that the possible presence of undocumented USTs represents a REC.

1645 Warner Street

The 1645 Warner Street parcel of the subject site has been developed since the early 1900s. In 1914, these historic operations included warehouse operations supporting the C.D. Pruden Company's production of fireproof doors and windows at the adjoining 1633 Warner Street property. Between 1953 and 1973, the property comprised part of the Gibson & Kirk Company Brass Foundry and Machine Shop facility. Information from interviews conducted as part of this assessment suggests that more recently, the Saratoga Plumbing Supply company occupied a portion (eastern) of the parcel, and a company that repackaged automotive fluids occupied another portion (western) the site. Significant Findings and Opinions related to this parcel are presented as follows:

- Based on information from historical records reviewed as part of this assessment, it appears that the subject parcel was historically occupied by a brass foundry and machine shop facility. More recently, an automotive fluids repackaging operation apparently occupied the site; as indicated earlier, numerous drums and containers of chemicals left over from this operation are currently stored at the 1633 Warner Street parcel of the subject site. During the update reconnaissance, KCI observed greening staining along the base of the interior wall of the western most warehouse structure. KCI was informed by Mr. Andy Evans of SCI that the drums and containers of chemicals were stored in the stained portion of the warehouse prior to being moved to the 1501 and ultimately 1633 Warner Street. No drains appeared to be located within the stained portion of the warehouse, however, limited crazing and cracking of the concrete was observed. KCI concludes that the historic releases of automotive fluids, as evident from the observed staining, represent a REC.

- KCI's Phase II 2008 report confirmed that contaminated soils exist in the immediate vicinity of the 1645 Warner Street building. The constituents of concern in these contaminated soils include PAHs, and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

- KCI's Phase II 2008 report revealed concentrations of petroleum compounds in a groundwater sample collected in the immediate vicinity of the 1645 Warner Street building, which exceeded relevant MDE criteria. Additional constituents of concern in the groundwater sample included VOCs, and heavy metals. KCI concludes that this finding represents a REC.

- During the update reconnaissance of the warehouse at 1645 Warner Street, KCI observed a 2' x 2' square access panel in the entrance floor of the structure. This access panel could indicate the potential presence of a UST or underground vault. However, no anomalies indicative of a UST was detected at this location or any additional location scanned during the geophysical survey conducted by KCI. It should be noted that due to obstructions from metal shelving and stored building material KCI was unable to obtain complete coverage of the entire 1645 Warner Street warehouse structures during KCI's Supplemental Phase II ESA (2008) geophysical survey.

1551 Russell Street

The 1551 Russell Street portion of the subject site was undeveloped until some time between 1914 and 1950, when the American Cyanamid Company Industrial Chemicals Division commenced using the site for chemical and pesticide manufacturing purposes. By 1973, the property was occupied by MDCHEM, which used the property for storage and repackaging of bulk quantities of chemicals. MDCHEM no longer occupies the property. Significant Findings and Opinions related to this parcel are presented as follows:

- KCI identified records related to two (2) previous Phase II ESAs that were conducted at the 1551 Russell Street portion of the subject site. These records have revealed that TCE and its daughter compounds (cis-1,2 dichloroethene and vinyl chloride) are present in the groundwater beneath that property. Elevated levels of heavy metals have also been detected in unfiltered groundwater samples. In some cases the concentrations of these chemicals exceeded the relevant MDE human health criteria. Based on these reported findings, KCI concludes that the presence of contaminated groundwater beneath the subject site represents a REC.

- The historic operational nature (i.e. handling and storage of bulk chemicals) of MDCHEM suggest the possibility for inadvertent contamination through releases. This appears to be born out by analytical results reported in KCI's Phase II 2008. The KCI Phase II 2008 report indicated that chlorinated solvents such as TCE, PCE, and DCE were detected in subsurface soils acquired from the vicinity of the MDCHEM facility, and one (1) area located at the north side of this facility appeared to be a potential source area for PCE. Furthermore, the analysis of groundwater samples revealed concentrations of TCE, PCE, and DCE exceeding relevant MDE CUS for groundwater in borings located on and near the MDCHEM facility. The pattern of concentrations observed in both groundwater and soils suggests that the MDCHEM facility is a source for these analytes. Based on these reported findings, KCI concludes that the presence of contaminated groundwater and soils beneath the subject site represents a REC.

- MDE performed a toxicological evaluation (MDE TOE April 2005), assuming a commercial use scenario for the site (1501, 1525 and 1551 Russell Street). The toxicological evaluation apparently revealed elevated levels of risk to the child visitor, youth visitor, and adult worker and construction worker populations from multiple pathways. MDE reported that all populations exceeded the MDE threshold lifetime cancer risk of 1 x 10-5 with scores ranging from 1.0 x 10-5 to 6.3 x 10-5. In addition, MDE reported that all populations exceeded the EPA recognized acceptable hazard index (HI) values of less than or equal to 1 with scores ranging from two (2) to 43. MDE related that the risk drivers included arsenic, chromium, TCE, and PCE. Based on these reported findings, KCI concludes that the reported elevated toxicological risk at the subject site represents a REC.

- An exposure/risk assessment indicated that vapor intrusion into buildings (1501, 1525 and 1551 Russell Street) through cracks in the floor followed by inhalation of vapors would be the only potential exposure pathway at the property, either currently or in the future. Using the highest levels of contaminants detected in groundwater samples, the Johnson and Ettinger (1991) model indicated incremental risk currently a the property for carcinogenic PCE, TCE, and VC of less than 1 EE-05 at current contaminant levels. Incremental risk from levels of noncarcinogenic cis- 1,2- DCE show a hazard quotient less than 0.1. Thus, active groundwater remediation was not deemed necessary.

It should be noted that the past use of the site may not account for all the contamination discovered within the vicinity of 1551 Russell Street. KCI Phase II 2008 report also noted that relatively high concentrations of petroleum compounds were identified in groundwater obtained from the northwestern (upgradient) boundary of 1551 Russell Street, suggesting that additional petroleum contamination is also migrating to the site from an off-site source.

1525 Russell Street

The 1525 Russell Street parcel of the subject site was undeveloped from at least 1890 until 1953, when a warehouse (Currently MDCHEM "Building #1") was constructed. The warehouse was utilized for the production of containers and cartons from 1953 until the late 1980s. MDCHEM historically used the

warehouse at 1525 Russell Street (Building #1) for the storage and repackaging of chemicals for distribution. Significant Findings and Opinions related to this parcel are presented as follows:

- Based on information acquired during this assessment, the subject site was historically used for paper carton manufacturing operations. Since approximately 1989, the property has been used for bulk storage of large quantities of a variety of chemicals. Moreover, KCI observed areas of stained concrete throughout Building #1, which suggest that past releases of chemicals may have occurred. Based on the nature of historic operations at the property and the presence of staining within the warehouse, KCI concludes that soil and groundwater impacts could have occurred at the property.

- As with the other two (2) buildings associated with MDCHEM (1551 and 1501 Russell Street), the operational nature (i.e. handling and storage of bulk chemicals) of MDCHEM suggests the possibility of inadvertent contamination through historic releases. Levels of chlorinated organics, primarily PCE, TCE, cis-l,2-Dichloroethene (cis-1,2-DCE), and Vinyl Chloride (VC), were detected at the subject site in excess of EPA Region Ill RBCA screening levels in the subsurface soil and groundwater. PCE was detected at the upgradient (Russell Street) end of the property, including a boring in the sidewalk beyond the property boundary. The other chlorinated compounds appeared as the groundwater flowed across the property to Warner Street, indicating that in-situ degradation is likely occurring. Presence in the upgradient boring also indicates possible off-site contamination.

Discussion of toxicological and exposure/risk assessments and KCI's Phase II 2008 report performed for the total MDCHEM Site (1501, 1525, and 1551 Russell Street) has been previously reported in the 1551 Russell Street Section.

1501 Russell Street

The 1501 Russell Street portion of the subject site was undeveloped from 1890 until 1923. Review of title records suggests that the property had multiple owners during the 1940s and 1950s, including the American Cyanamid Company. Reportedly, MDCHEM had used portions of the property for bulk chemical storage purposes since 1955. Significant Findings and Opinions related to this parcel are presented as follows:

- Based on the findings of this assessment, two (2) USTs appear to have been abandoned in place at the 1501 Russell Street property. MDE reported that both tanks were greater than 20 years old and that a release of petroleum was detected in association with at least one (1) of the USTs. Based on this information, KCI concludes that the reported USTs and associated, petroleum-impacted soils and/or groundwater represent a REC.

- Based on the review of the historic documents (Datanet MDE SUM Phase II 1998), one (1) suspected former gasoline UST is reputably located in the north central portion of the warehouse adjacent to the interior wall that fronts Russell Street. The suspected UST was not identified on the Maryland UST or Historic UST databases, or historic Sanborn maps reviewed for this assessment. KCI did not observe current evidence of the suspected UST at the property during the multiple reconnaissance's completed for this assessment. KCI concludes that it is possible an undocumented UST is located at the property. If an undocumented UST is present, then this UST would represent a REC.

- The findings from this assessment indicate that chemical manufacturing and bulk chemical storage operations have been conducted at 1501 Russell Street since some time prior to 1950. The chemical production and storage activities have encompassed a variety of pesticides, organic and inorganic

compounds, acids and bases, oxidizing compounds, flammable materials, and some acutely toxic chemicals. Moreover, KCI observed areas of stained concrete throughout the onsite warehouse, which suggest that past releases of chemicals have occurred. Based on the nature of historic operations at the property and the presence of staining within the warehouse, KCI concludes that soil and groundwater impacts could have occurred at the property.

- Petroleum impacts of the soil as measured by TPH-DRO, TPH-GRO, and recoverable petroleum hydrocarbons (TRPH), were observed in the area of the abandoned –in-place fuel oil tank as well as upgradient and downgradient of this tank. These concentrations are greater than the MDE action level of 100 mg/kg TPH. Based on these reported findings, KCI concludes that the presence of contaminated soils beneath the subject site represents a REC.

- KCI observed one elevator in Building #3 at the 1501 Russell Street parcel of the subject site. Some elevators utilize hydraulic oils, which have may contain PCBs. KCI did not observe evidence that a release of hydraulic oil has occurred from observable elevator equipment (i.e., holding tank, hydraulic lines, etc.). Based on this factor, KCI concludes that the presence of the elevator equipment does not appear to represent a REC at this time. However, care should be taken during any activities that involve the dismantling of elevator equipment. Any suspect PCB containing equipment should be handled according to applicable local, state, and federal regulations.

- During the site reconnaissance conducted for this assessment, KCI observed eight (8) aboveground storage tanks (ASTs) in various locations throughout the onsite warehouse. All of the ASTs are reportedly empty and decommissioned. KCI observed staining in the vicinity of all eight (8) ASTs. However, no floor drains or sumps were observed in the immediate vicinity of the ASTs, and no surficial cracking of the concrete was observed in these areas. Based on the fact that no floor drains or sumps were in the vicinity of the ASTs and that the subsurface is capped by a concrete floors and paving, KCI concludes that the staining observed in the vicinity of the ASTs represents a de minimis condition.

- During the initial site reconnaissance, KCI observed floor drains in the tote washout area of 1501 Russell Street. Based on research conducted for this assessment, this floor drain was connected to the sanitary sewage system. This discharge was permitted, subject to pH monitoring and control, under a National Pollutant Discharge Elimination System (NPDES) Permit. Based on the permitted nature of the discharge and the attendant regulatory oversight, KCI concludes that the discharge of the pH-adjusted tote wash effluent to the sanitary sewer does not represent a REC. The tote washout area was observed to have been empty of all containers during the update reconnaissance

Discussion of toxicological and exposure/risk assessments and KCI's Phase II 2008 report performed for the total MDCHEM Site (1501, 1525, and 1551 Russell Street) has been previously reported in the 1551 Russell Street Section.

2119 Haines Street

The 2119 Haines Street property has been undeveloped since at least 1890. In 1914, the property was in use for "temporary" lumber storage purposes. Currently the parcel is asphalt-paved, and Second Chance, Inc. uses the area for stadium event parking purposes. Significant Findings and Opinions related to this parcel are presented as follows:

- KCI's Phase II 2008 report, confirmed that contaminated soils exist in the immediate vicinity of the 2119 Haines Street property. The constituents of concern in these contaminated soils include PAHs, and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

- KCI's Phase II 2008 report, revealed concentrations of petroleum compounds in a groundwater sample collected in the immediate vicinity of the 2119 Haines Street property, which exceeded relevant MDE criteria. Additional constituents of concern in the groundwater sample included VOCs, and heavy metals. KCI concludes that this finding represents a REC.

2110 Haines Street

The 2110 Haines Street portion of the subject site occupied a portion of the C.F. Ranstead Wharf in 1890 and 1901. At some time between 1914 and 1952, the American Electric Welding Co. Inc., a steel barge manufacturer, began operating from the property. A storage yard for Consolidated Gas Electric Light and Power Co. was also present on the property in 1952. Based on title information reviewed for this assessment, this parcel was owned by the Warner-Fruehauf Trailer Co. Inc. between 1978 and 1988. Information obtained from interviews indicates that the Greyhound bus terminal that currently occupies the property was constructed in 2005. Significant Findings and Opinions related to this parcel are presented as follows:

- The 2110 Haines Street parcel of the subject site was identified on the INST CONTROL and VCP databases reviewed for this assessment. The VCP database findings indicated that a Maryland Voluntary Cleanup program applicant (AT&T Corporation) sought a "Certificate of Completion" as an "Inculpable Person". The database records indicated that the application was approved, and a No Further Requirements Determination (NFRD) was issued on April 22, 2002. In general, the VCP protections and NFRDs obtained by one owner are transferable to subsequent owners, provided that institutional and engineering controls are properly maintained, and no additional types of contaminants are discovered or released to the site. KCI's recommendations regarding this issue are provided in Section 11.0

- Information reviewed as part of this assessment revealed that certain contaminants have been identified at the 2110 Haines Street parcel during previous environmental investigations. In soils these included heavy metals and PAH compounds; in groundwater, these included PAH compounds. KCI concludes that the presence of elevated levels of PAH compounds and heavy metals at the subject site represents a REC.

- MDE Voluntary Cleanup Program (VCP) conducted a baseline risk assessment (MDE VCP RA 2002) to quantify the potential human health risks associated with the 2110 Haines Street property. The methodology used in this risk assessment followed the VCP baseline risk assessment template provided by Maryland Department of the Environment (MDE 2001a). This risk assessment evaluated potential exposures and risks for a child visitor (1-6 years), and a youth visitor (6-17 years)under a future commercial use scenario, and an adult worker and construction worker under a future commercial or industrial use scenario. The MDE's risk benchmarks for a non-residential/residential use ("mixed use") property are a 1×10^{-5} excess lifetime cancer disk and a hazard quotient (HQ) of 1 (MDE 2001b); if the estimated risks are lower than these values, then it can be concluded that remediation is not warranted for health protection purposes. For the population considered in this assessment, all of the risk estimates were below their respective benchmarks. Therefore, consistent with MDE guidance, no remediation was required to protect public health. However, if the use of the site changes, MDE will likely re-evaluate this decision.

2104 Worcester Street

The 2104 Worcester Street parcel of the subject site was undeveloped until 1945, when a large warehouse-style building was constructed. At that time, the property was owned by the Gordon Carton company, but the J.B. Macneal Paints, Oil, Varnish Works used the building as a "stripping room", (i.e., stripping paint and varnish from furniture). This use continued until at least 1973, after which Gordon Cartons Inc. reportedly utilized the building as a warehouse until 1989. Finally, Baltimore Cycle salvage occupied the parcel for a short time after 1989; however, the building was vacated when it became badly deteriorated. Currently, the building is abandoned and partially collapsed. Significant Findings and Opinions related to this parcel are presented as follows:

- Based on KCI's review of historic information, it appears that J.B. Macneal used the former warehouse building at the 2104 Worcester Street parcel as a paint or varnish stripping facility The MDE has reported that it is likely that both the former paint and varnish manufacture (JB McNeal) operations and commercial printing operations (Gordon Cartons) involved the use of heavy metal salts and oxides. KCI concludes that the relatively long (and initially, largely unregulated) history of manufacture and printing operations may have resulted in historic releases of heavy metals at the property.

- KCI's Phase II 2008 report, confirmed that contaminated soils exist in the immediate vicinity of the 2104 Worcester Street. The constituents of concern in these contaminated soils include PAHs, petroleum compounds, and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

- KCI's Phase II 2008 report, revealed concentrations of petroleum compounds in a groundwater samples collected in the immediate vicinity of the 2104 Worcester Street, which exceeded relevant MDE criteria. KCI concludes that this finding represents a REC.

2102 Oler Street

The 2102 Oler Street property was undeveloped until 1950, at which time Gordon Cartons, Inc. Folding Box Division constructed a warehouse (i.e., "Paper Warehouse No. 2") at the property. Gordon Cartons utilized the warehouse until approximately 1988. Reportedly, Baltimore Asphalt used the building from 1989 until 1995. Afterward, the parcel was vacant for five years until Baltimore Renovation Inc moved into a portion of the building in 2000. Baltimore Renovation continues to occupy the property until spring of 2008. Significant Findings and Opinions related to this parcel are presented as follows:

- Although the 2102 Oler Street property was not identified on the Maryland UST database reviewed for this assessment, KCI noted that one (1) gasoline UST was illustrated at this address on the 1952 and 1973 Sanborn maps. The historic UST was located near the northwest exterior corner of the warehouse. During the walking reconnaissance of the property, KCI observed a dilapidated fuel dispenser between the 1633 and 2102 Oler Street warehouses, at the northern side of the buildings, and adjacent to Oler Street. In addition, two 12-inch, round sump lids were observed in the sidewalk near the fuel dispenser, similar to those that typically cover tank-top appurtenances (i.e., STPs, manways, etc.). The location of the apparent UST corresponds to the historic gasoline UST that was illustrated on the 1952 and 1973 Sanborn maps.

  KCI concludes that the UST is still present and that it is more than 55 years old. Based on its age and the fact that the UST is not being managed, KCI concludes that it is likely that the UST has leaked

gasoline into the subsurface soils and (possibly) the groundwater in the vicinity of the tankfield. Moreover, KCI concludes that the presence of this UST (and potential contaminated soils and/or groundwater) represents a REC.

- KCI's Phase II 2008 report, revealed soil samples, collected from a boring advanced adjacent to an abandoned UST located between the 1633 Warner Street and 2102 Oler Street parcels of the subject site, contained some petroleum contamination. This finding suggests that contaminated soils and groundwater may be present near this tank. In addition, the constituents of concern in these contaminated soils also include PAHs, and heavy metals. KCI concludes that the presence of these impacted soils represents a REC.

Off-Site Properties

During the review of regulatory databases, KCI identified numerous off-site properties that could potentially affect environmental conditions at the subject site (e.g., topographically upgradient sites with reported leaking underground storage tanks, documented contamination, etc.). Due to the relatively large number of identified properties, and the length of the resultant discussion, KCI opted to leave the detailed analysis and opinions regarding these off-site properties within the database section of this report (Sections 4.1 and 4.2). However, a tabular summary of KCI's findings and opinions is provided in Table 8-1 below. Note that only the off-site properties deemed to be of potential environmental concern to the subject site are summarized in the table.

Table 8-1: Summary of Potential Off-Site Environmental Concerns

Off-Site Property	Nature of Concern	Distance and Position	Closest Subject Site Parcel	Impact Ranking [1]
Bayard Street Station	Former Coal Gasification Site Included to State Haz.Waste Sites List	1,000 FT NW Upgradient	1501 Russell St. 1645 Warner St.	Low
Severn Street Station / Valspar Plant	Former Coal Gasification Site Included to State Haz. Waste Sites List	600 FT NW Upgradient	1501 Russell St	Low
Shell Station 1712 Russell Street	Leaking Underground Tanks Documented Groundwater Contamination	100 FT NW Upgradient	1501 Russell St 1645 Warner St.	High
Public Storage, Inc. 1415 Russell Street	Documented Petroleum Release Site	Adjacent NE Upgradient	1501 Warner St.	High
Bavar Property 1530 Russell Street	Possible Petroleum Release Site	Adjacent N Upgradient	1551 Russell St.	Moderate
Lenmar, Inc. 1547 Ridgely Street	Documented Petroleum Release Site	420 FT N Upgradient	1501 Russell St. 1525 Russell St.	Moderate
Ilex Woodworking 1700 Ridgely Street	Possible Petroleum Release Site	750 FT NW Upgradient	1501 Russell St.	Low
Waterford Caseworks 1809 Bayard Street	Documented TCE-Related Contamination in Groundwater / Former Hazmat USTs	1000 FT NW Upgradient	1501 Russell St. 1645 Warner St.	Moderate

Notes:

[1] These impact rankings were developed based on KCI's professional judgment and are intended as qualitative indicators of each identified issue's relative potential to impact environmental conditions at the subject site. It should be noted that without additional data (e.g., from a Phase II ESA) these rankings are simply professional "guesses" and are provided here for informational purposes only.

9.0 Deviations

In addition to meeting ASTM Standard E-1527-05, this assessment was completed in accordance with the MDE's Voluntary Cleanup Program guidelines. Therefore, this assessment included a number of deviations from the "typical" ASTM E 1527-05 assessment scope of work. In summary, these included tasks such as completing a potable well radius search, mapping potable wells, and site utility mapping. In addition, discussions concerning potential asbestos containing materials have been briefly presented for the Client's information.

10.0 Conclusions

KCI has performed a Phase I Environmental Site Assessment in conformance with the scope and limitations of ASTM Practice E 1527-05, for the subject site. Any exceptions to, or deletions from, this practice are described in Section 1.0 of this report. This assessment has revealed no evidence of Recognized Environmental Conditions in connection with the property except for the following:

1. KCI identified or discovered evidence suggesting the presence of a total of ten (10) abandoned and/or undocumented USTs within the subject site. These USTs are relatively old and releases may have occurred from the tanks.

2. Contaminants with concentrations above applicable Maryland Department of the Environment cleanup standards (MDE CUS), including petroleum compounds, heavy metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs), and polycyclic aromatic hydrocarbon (PAH) compounds, have been documented in soils and groundwater throughout the subject site.

3. Regulatory database records indicated that historically, chlorinated solvents were stored in USTs at the 1601 Warner Street property, and that a release of these solvents occurred. KCI is presently completing an investigation of this property to determine the presence or absence of these contaminants

4. KCI observed approximately 120 drums within the warehouse at 1633 Warner Street. A total of 59 of the drums have reported flash point below 140 degrees Fahrenheit. By EPA's definition (Code of Federal Regulations, Title 40, Subpart C) these wastes are hazardous by the ignitability characteristic and would be coded D001 hazardous wastes. Some of the drums are highly corroded and could release their contents at any time.

5. KCI observed green staining along the base of the interior wall of the western most 1645 Warner Street warehouse structure. KCI was informed by Mr. Andy Evans of SCI that the drums and containers of chemicals were stored in and stained this portion of the warehouse prior to being moved to the 1501 and ultimately 1633 Warner Street. No drains appeared to be located within the stained portion of the warehouse, however, limited crazing and cracking of the concrete was observed. KCI concludes that the historic release of automotive fluids, as evident from the observed staining, has occurred. KCI has characterized and will remove and properly dispose these drums on or about May, 2009.

6. MDE performed a toxicological evaluation of the Maryland Chemical facility, which revealed elevated levels of risk to the child visitor, youth visitor, and adult worker and construction worker

populations from multiple pathways. MDE reported that all populations exceeded the MDE threshold lifetime cancer risk of 1 x 10-5 with scores ranging from 1.0 x 10-5 to 6.3 x 10-5. In addition, MDE reported that all populations exceeded the EPA recognized acceptable hazard index (HI) values of less than or equal to 1 with scores ranging from two (2) to 43. MDE related that the studies risk drivers included arsenic, chromium, TCE, and PCE.

11.0 Opinion Regarding Need for Additional Investigation

- KCI recommends that a copy of this Phase I ESA update report be provided to MDE as part of the VCP application for the nine (9) remaining parcels, and that the client follow subsequent regulatory requirements regarding the need for additional investigation as necessary to address MDE's concerns during future redevelopment activities.

12.0 References

1. Alexandria Drafting Company (6440 General Green Way, Alexandria, Virginia 22312), Street Map Book of Metro Washington, DC 2000.

2. Environmental Data Resources, Inc. (440 Wheelers Farm Road, Milford, Connecticut 06461), Radius Map Report Inquiry No. 1767791.2s, October 04, 2006.

3. Environmental Data Resources, Inc. (440 Wheelers Farm Road, Milford, Connecticut 06461), Aerial Photography Inquiry No. 1767791.5, October 04, 2006.

4. Environmental Data Resources, Inc. (440 Wheelers Farm Road, Milford, Connecticut 06461), Historical Topographic Map Report Inquiry No. 1767791.4, October 04, 2006.

5. Environmental Data Resources, Inc. (440 Wheelers Farm Road, Milford, Connecticut 06461), Sanborn Map Report Inquiry No. 176779.3s, October 03, 2006.

6. KCI Technologies, Inc. (10 North Park Drive, Hunt Valley, Maryland 21030), Phase I Environmental Site Assessment of the "Gateway South Redevelopment Properties", May 07, 2007.

7. KCI Technologies, Inc. (10 North Park Drive, Hunt Valley, Maryland 21030), Phase II Environmental Site Assessment of the Gateway South Redevelopment Properties, January 25, 2008.

8. KCI Technologies, Inc. (10 North Park Drive, Hunt Valley, Maryland 21030), Phase II Environmental Site Assessment – Supplement No. 1, of the Gateway South Redevelopment Properties, October 10, 2008.

9. Maryland Geological Survey, 1968. Index to Online Geologic Maps. Accessed October 20, 2006. http://www.mgs.md.gov/esic/geo/

10. NETR-Real Estate Research and Information (2055 E. Rio Salado Parkway, Suite 201, Tempe, Arizona 85281), Historical Chain of Title Report, Project No. N06-6756, October 30, 2006

11. USDA – Soil Conservation Service, Soil Survey of Baltimore County Maryland, 1976.

APPENDIX A: SITE PHOTOGRAPHS

KCI
TECHNOLOGIES



Photo 1:Looking west – View of 2119 Haines Street parking lot.



Photo 2: Looking northwest– View of 2119 Haines Street along wall of 1645 Warner Street.



Photo 3: View of 2119 Haines Street along wall of 1645 Warner Street.



Photo 4: View of 2119 Haines Street from parking lot of 2110 Haines Street.



Photo 5:Looking northwest – View of 1501 Russell Street MDCHEM warehouse.



Photo 6: View of floor drain to sewage in 1501 Russell Street Building #3 warehouse.



Photo 7: View of potential ACM on boiler of 1501 Russell Street Building #3 warehouse.



Photo 8: View of interior of 1525 Russell Street Building #1 Warehouse..



Photo 9:.Looking northwest – View of 1551 Russell Street MDCHEM warehouse.



Photo 10: View of AST in the 1551 Russell Street courtyard.



Photo 11: View of courtyard area of 1551 Russell Street MDCHEM facility.



Photo 12: Looking west - View of fill port for suspected UST located at the exterior of 1501 Russell Street.



Photo 13: Looking northeast – West exterior view of the 1501 Warner Street warehouse.



Photo 14: View of SCI storage practices at the 1501 Warner Street warehouse.



Photo 15: Looking South - View of west exterior of the 1501 Warner Street warehouse.

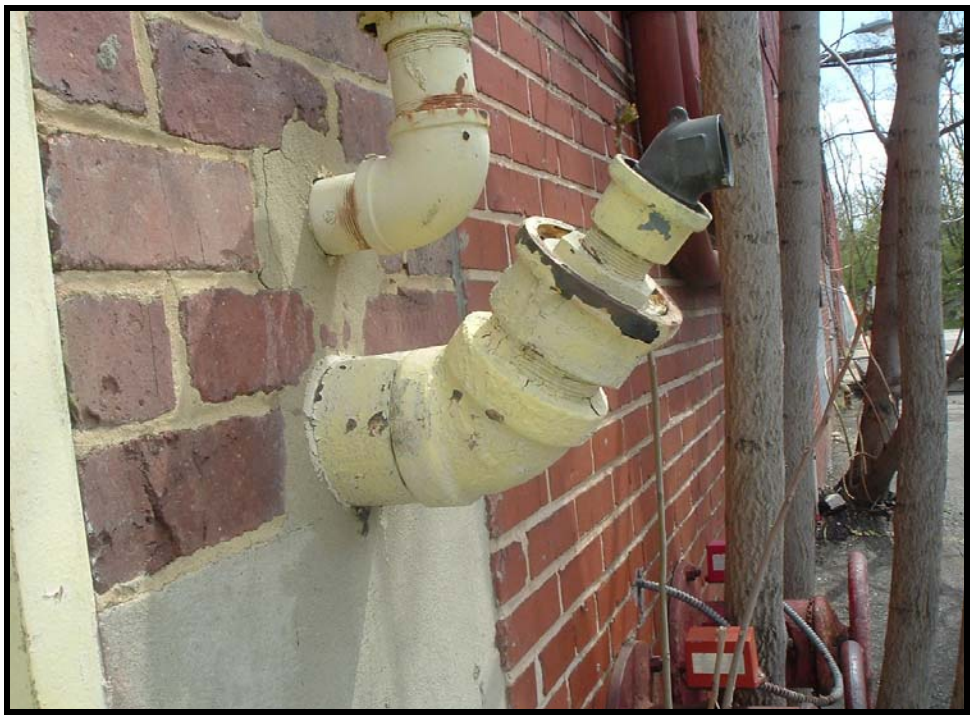

Photo 16: Looking south - View of possible UST vent and fill pipes at the west exterior of the 1501 Warner Street Warehouse.

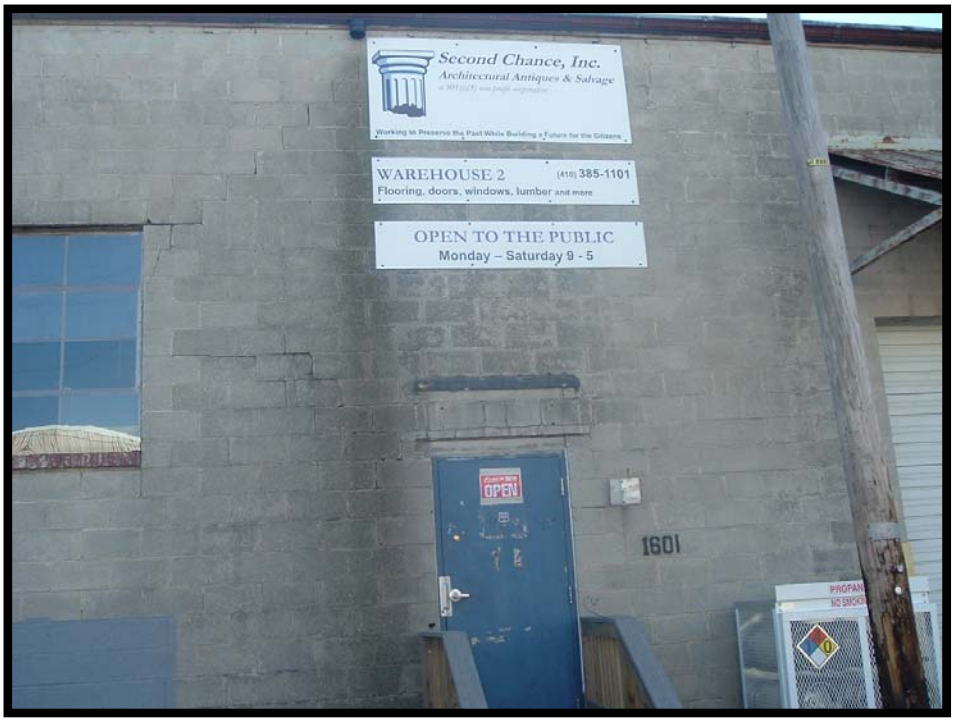

Photo 17: Looking West – View of east exterior wall and propane storage cage of 1601 Warner Street Warehouse.

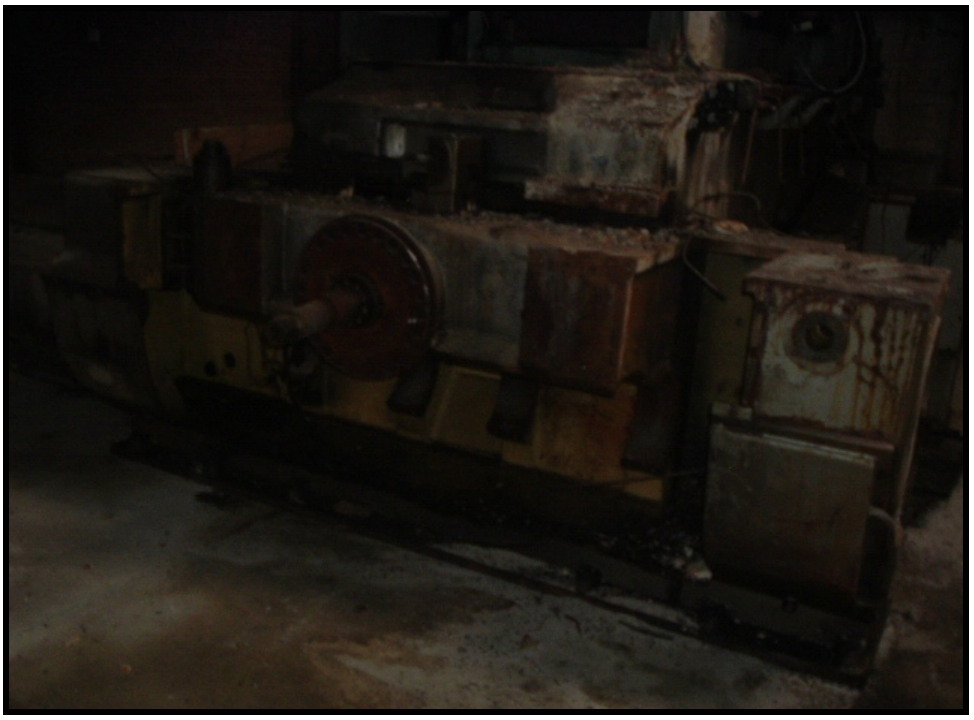

Photo18: View of one of the two former printing presses removed from 1601 Warner Street warehouse.



Photo 19: View of interior of 1601 Warner Street warehouse.



Photo 20: View of interior at 1601 Warner Street Warehouse.



Photo 21:. Looking northeast, view of former site of 1629 Warner Street . Warehouse had burned down and was then demolished in the Spring of 2008.



Photo 22: View of cut off pipes that are orientated in general accordance to industries standards for UST installation. Therefore, this configuration may indicate the presence of a suspect UST at 1629 Warner Street parcel.



Photo 23: View of suspected fill port in area of geophysical survey identified suspected UST anomaly at 1629 Warner Street.



Photo 24: Pre-fire view of access panels of suspect UST/Vault at 1629 Warner Street Western Unit warehouse.



Photo 25:. View of SCI storage at 1633 Warner Street warehouse.



Photo 26: View of a drum content sample from one of the stored drums located in the 1633 Warner Street warehouse.



Photo 27: View of stored automobile fluid containing drums stored in the 1633 Warner Street warehouse..



Photo 28: View of former fuel dispenser located between the 1633 Warner Street and 2102 Oler Street warehouses.



Photo 29:.Looking south – View of 1645 Warner Street warehouses and courtyard.



Photo 30: View of stained wall in former drum storage area of 1645 Warner western unit warehouse.



Photo 31: View of square access panel of water meter vault located at 1645 Warner Street.



Photo 32: View of interior of 1645 Warner Street eastern unit warehouse.



Photo 33:. View of Second Chance stacked doors stored in 1202 Oler Street in the former Baltimore Renovation Inc portion of the warehouse..



Photo 34: View of bags of hydrogloss at the 2102 Oler Street warehouse.



Photo 35: View of cardboard rolling machines and pallets of hydroglos (against far wall) located at the 2102 Oler Street warehouse.



Photo 36: Looking south – View of access panels of potential UST in front of exterior of 2102 Oler Street Warehouse.



Photo 37:.Looking northwest – View of 2110 Haines Street Greyhound Bus Terminal facility.



Photo 38: Looking south - View of 2110 Haines Street Greyhound Bus Terminal facility oil water separator.



Photo 39: View of Cleaning chemical storage area of 2110 Haines Street Greyhound Bus Terminal facility.



Photo 40: View of interior of 2110 Haines Street Greyhound Bus Terminal facility.

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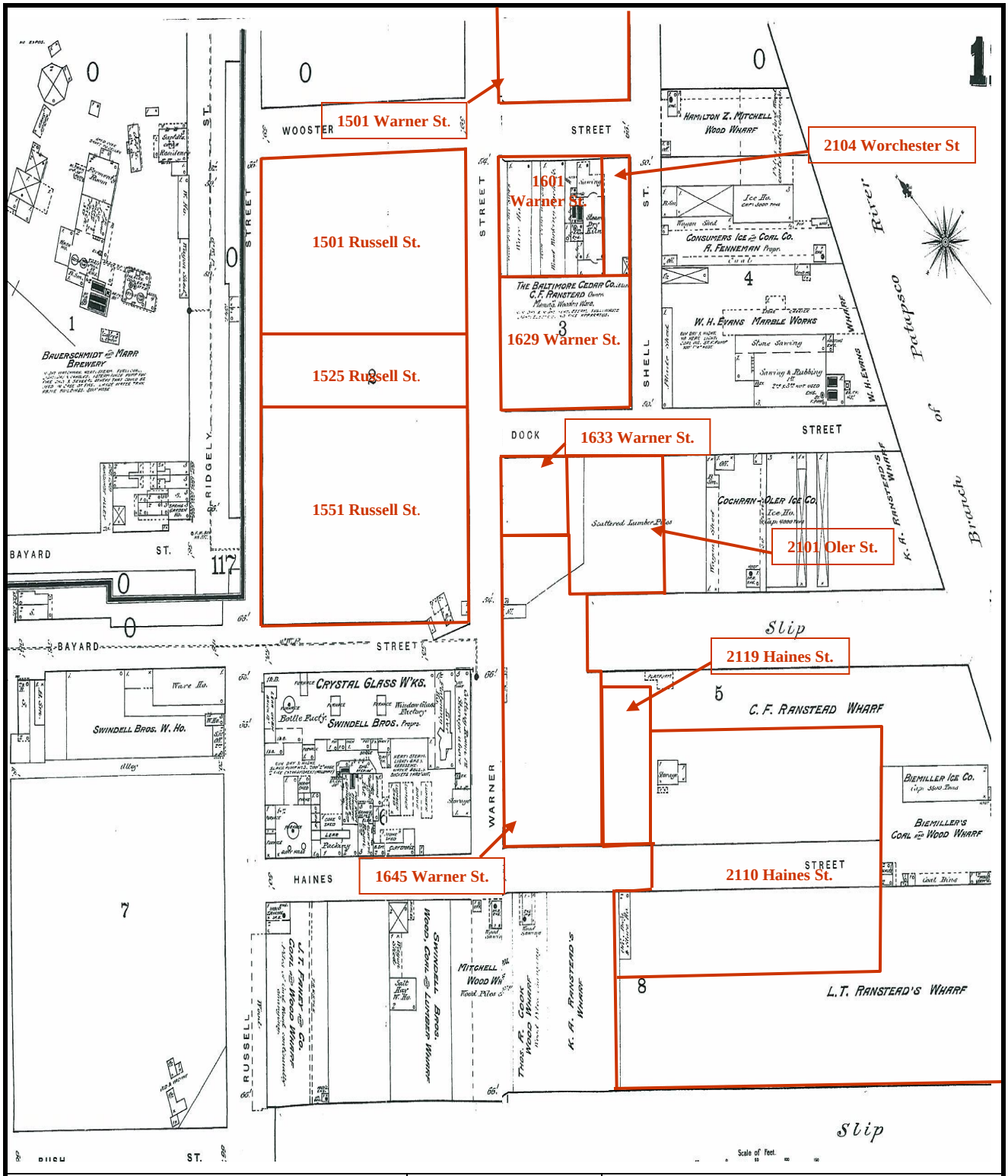
Photo 41:View of an trench located within 2104 Worcester Street.



Photo 42: View of main room of 2104 Worcester Street.

APPENDIX B: HISTORICAL SANBORN MAPS

KCI
TECHNOLOGIES



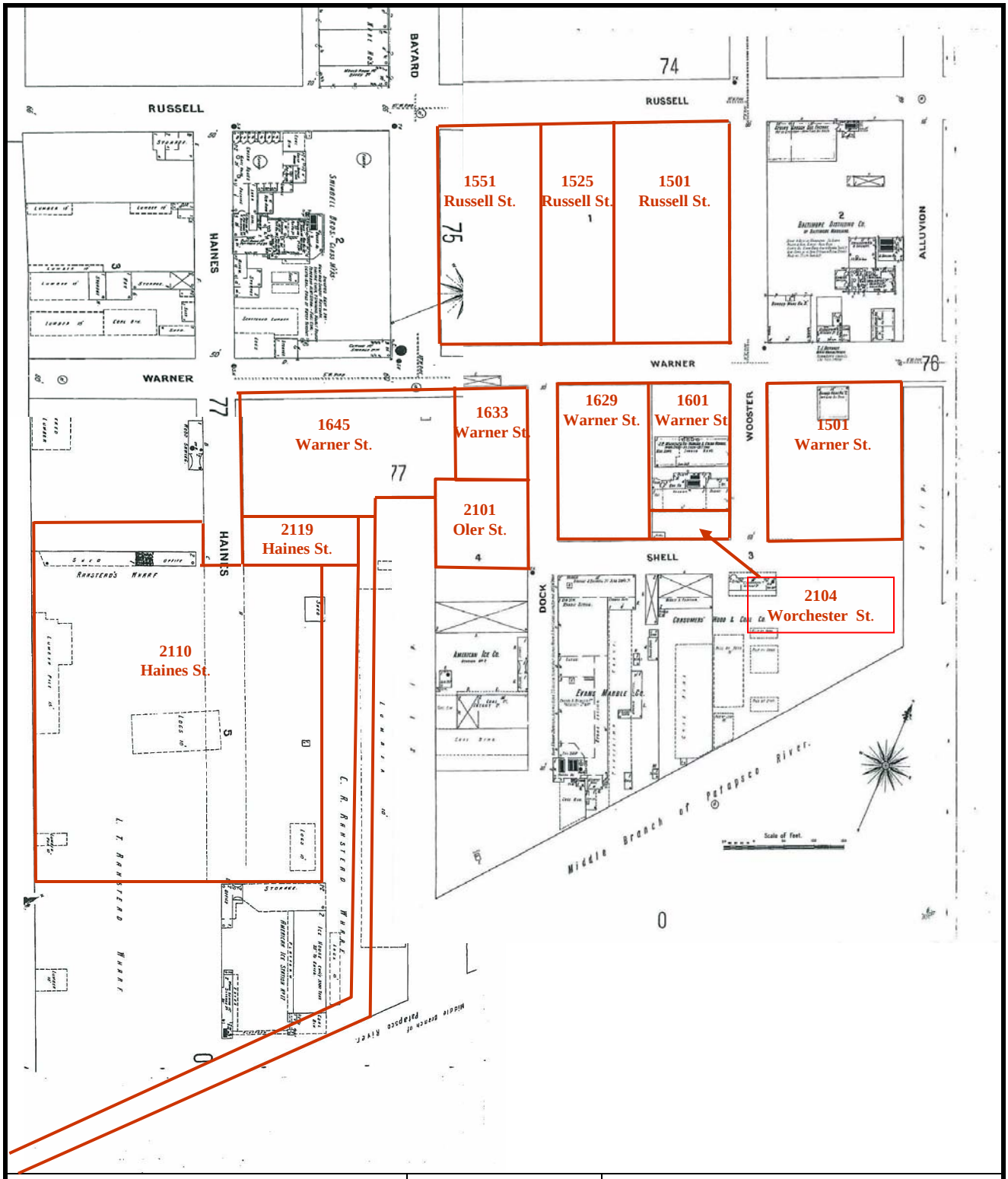
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1890 Sanborn Map

KCI Project 01-05437004
April 2007



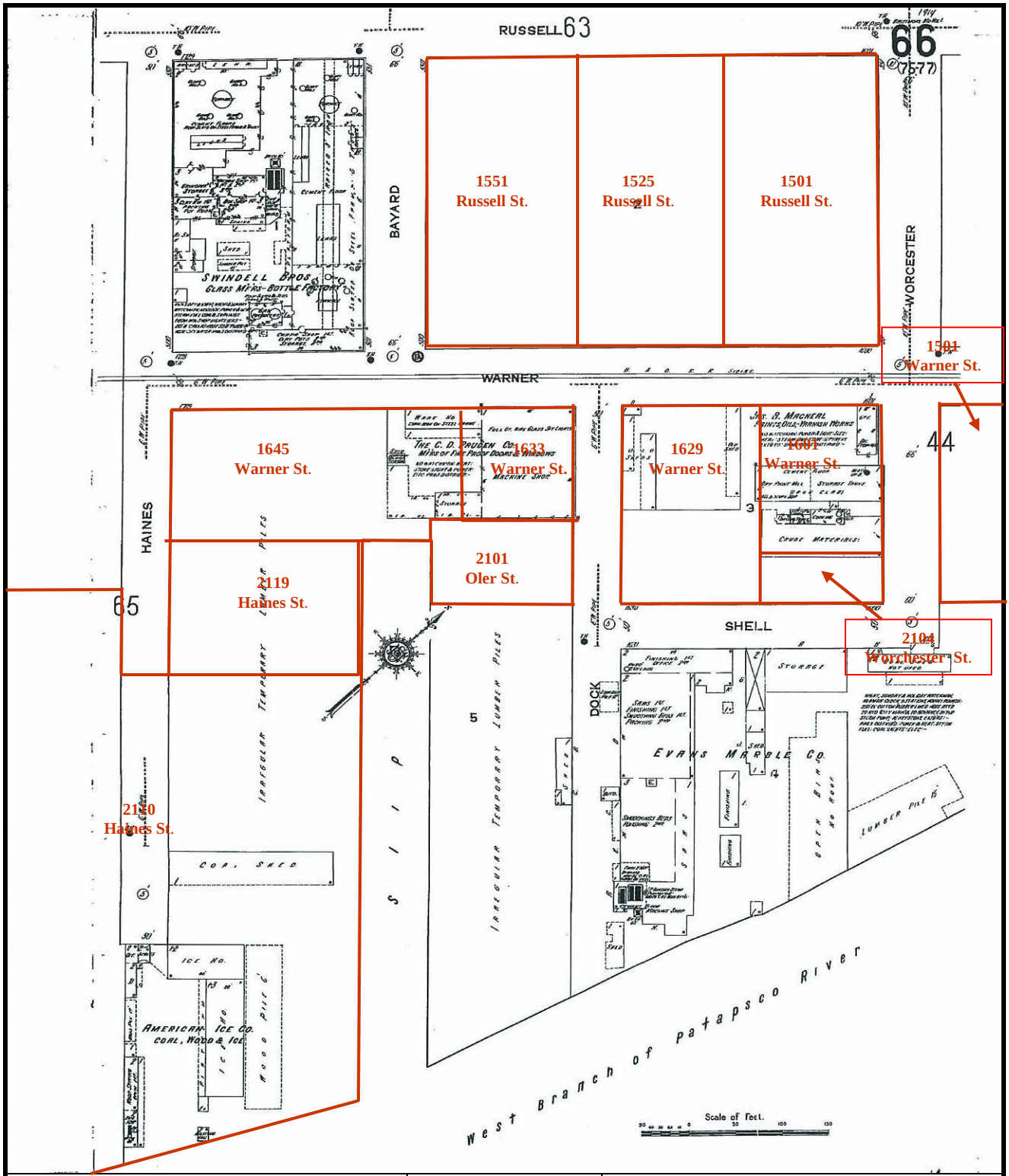
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1901 Sanborn Map

KCI Project 01-05437004
April 2007



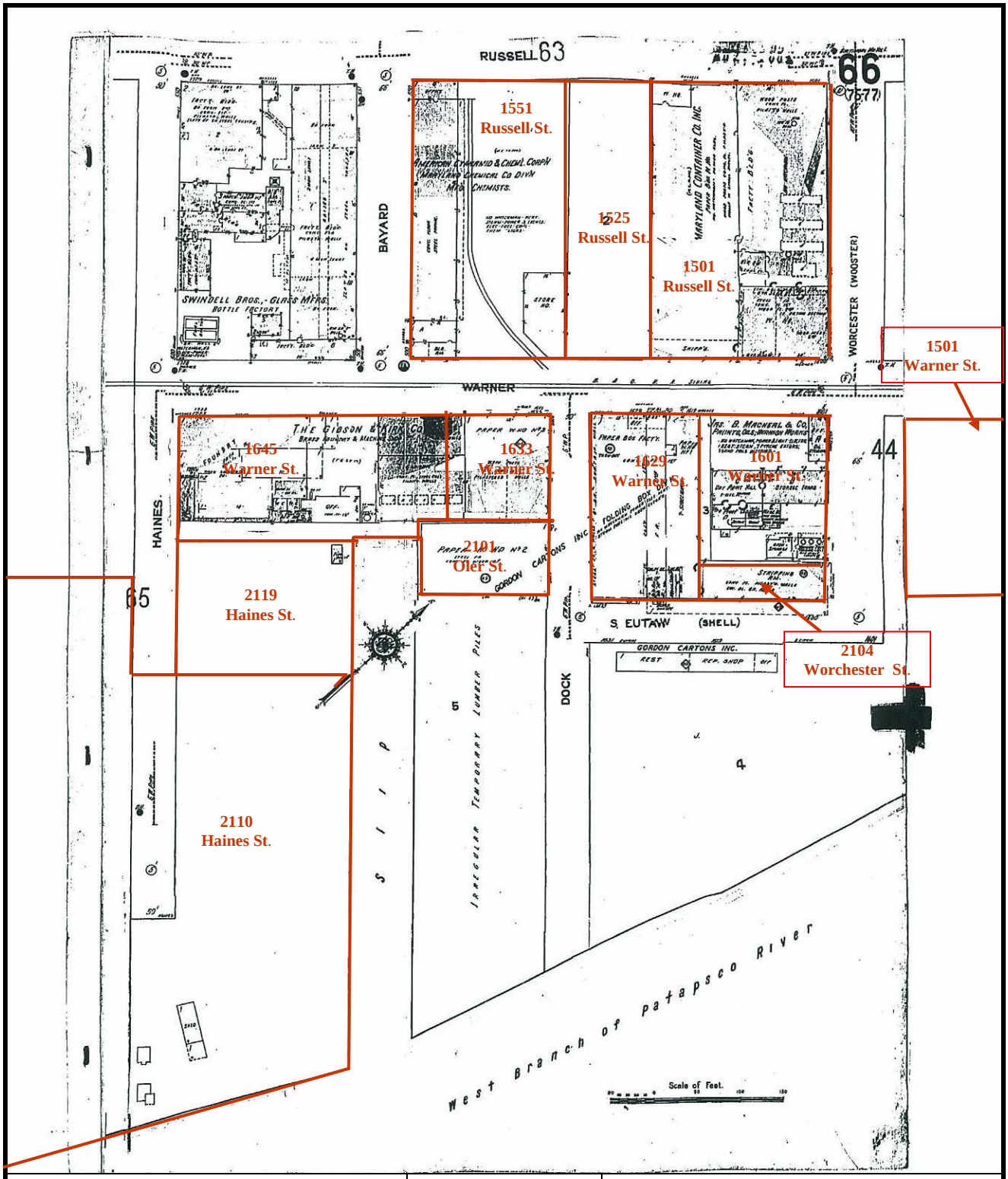
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1914 Sanborn Map

KCI Project 01-05437004
April 2007



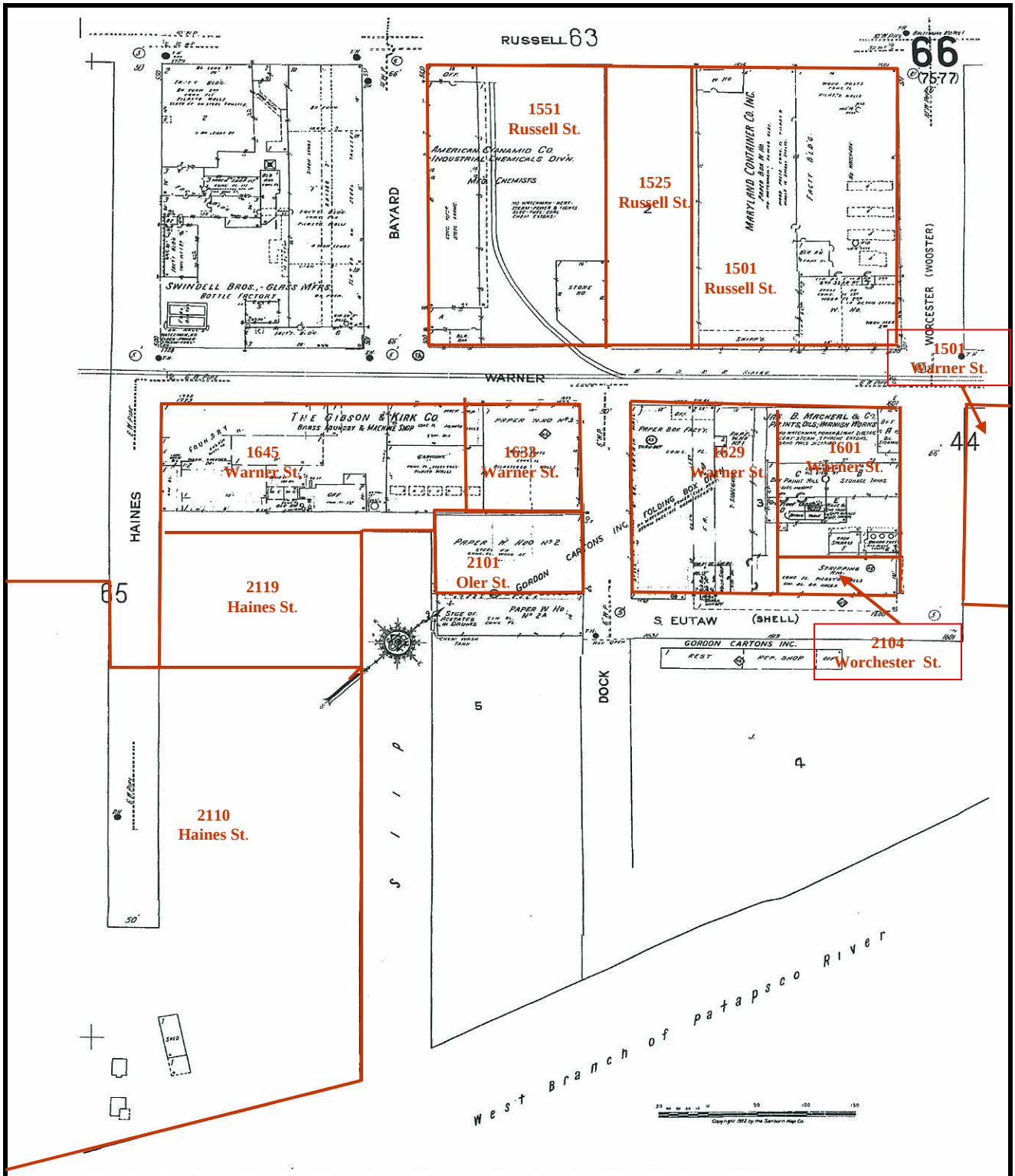
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1950 Sanborn Map

KCI Project 01-05437004
April 2007



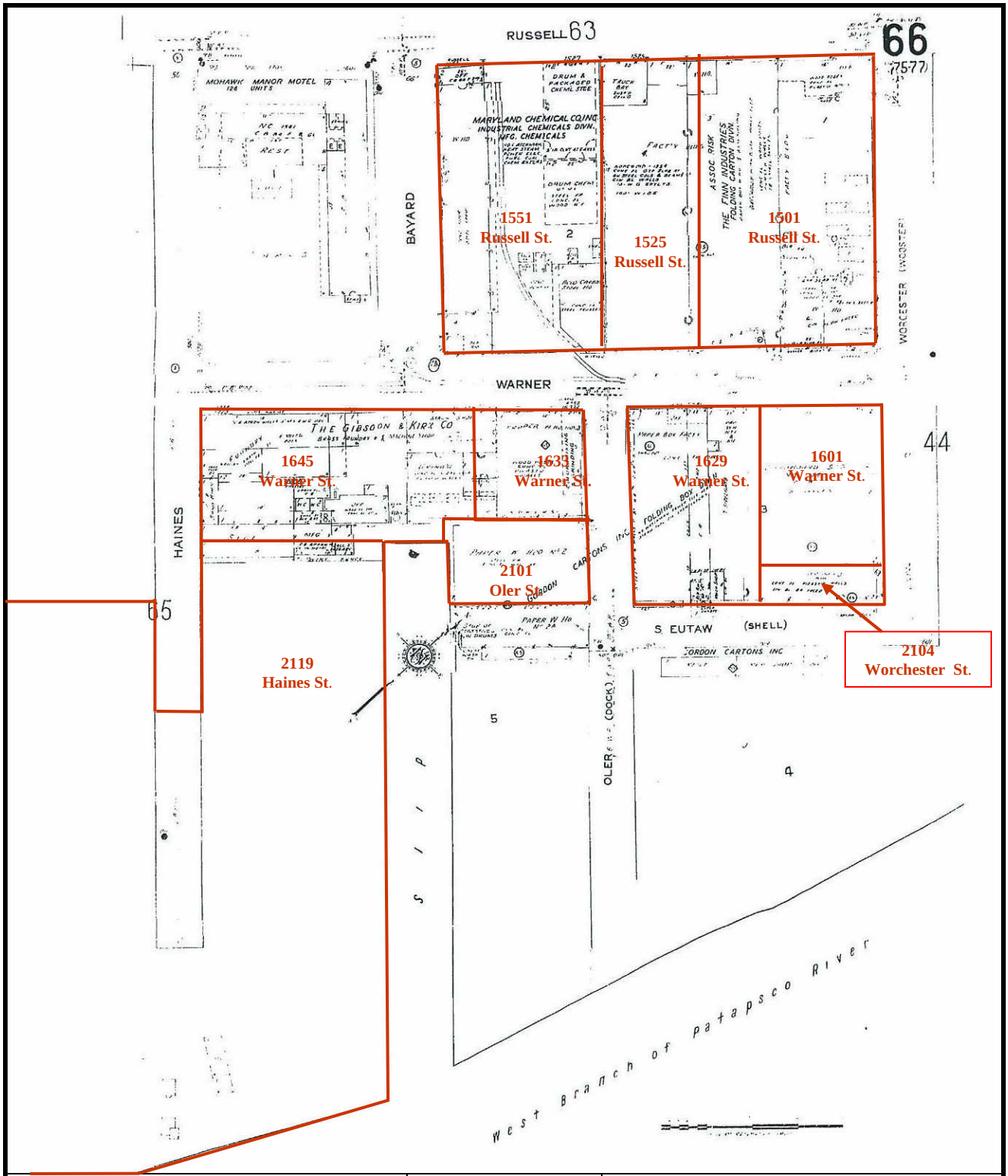
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1952 Sanborn Map

KCI Project 01-05437004
April 2007



Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1973 Sanborn Map

KCI Project 01-05437004
April 2007

APPENDIX C: AERIAL PHOTOGRAPHS

KCI
TECHNOLOGIES



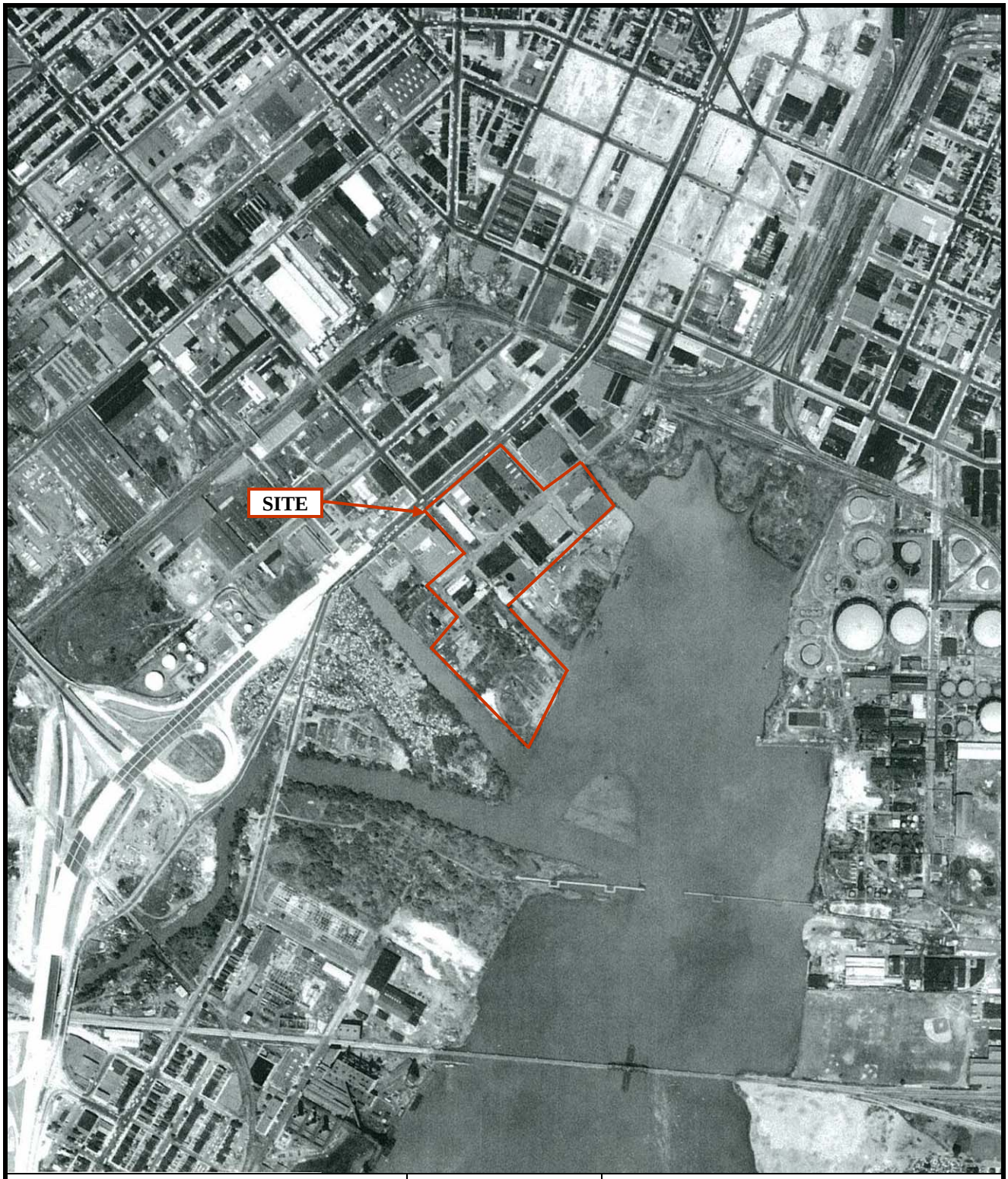
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1957 Aerial Photograph

KCI Project 01-0537004
April 2007



Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1964 Aerial Photograph

KCI Project 01-0537004
April 2007



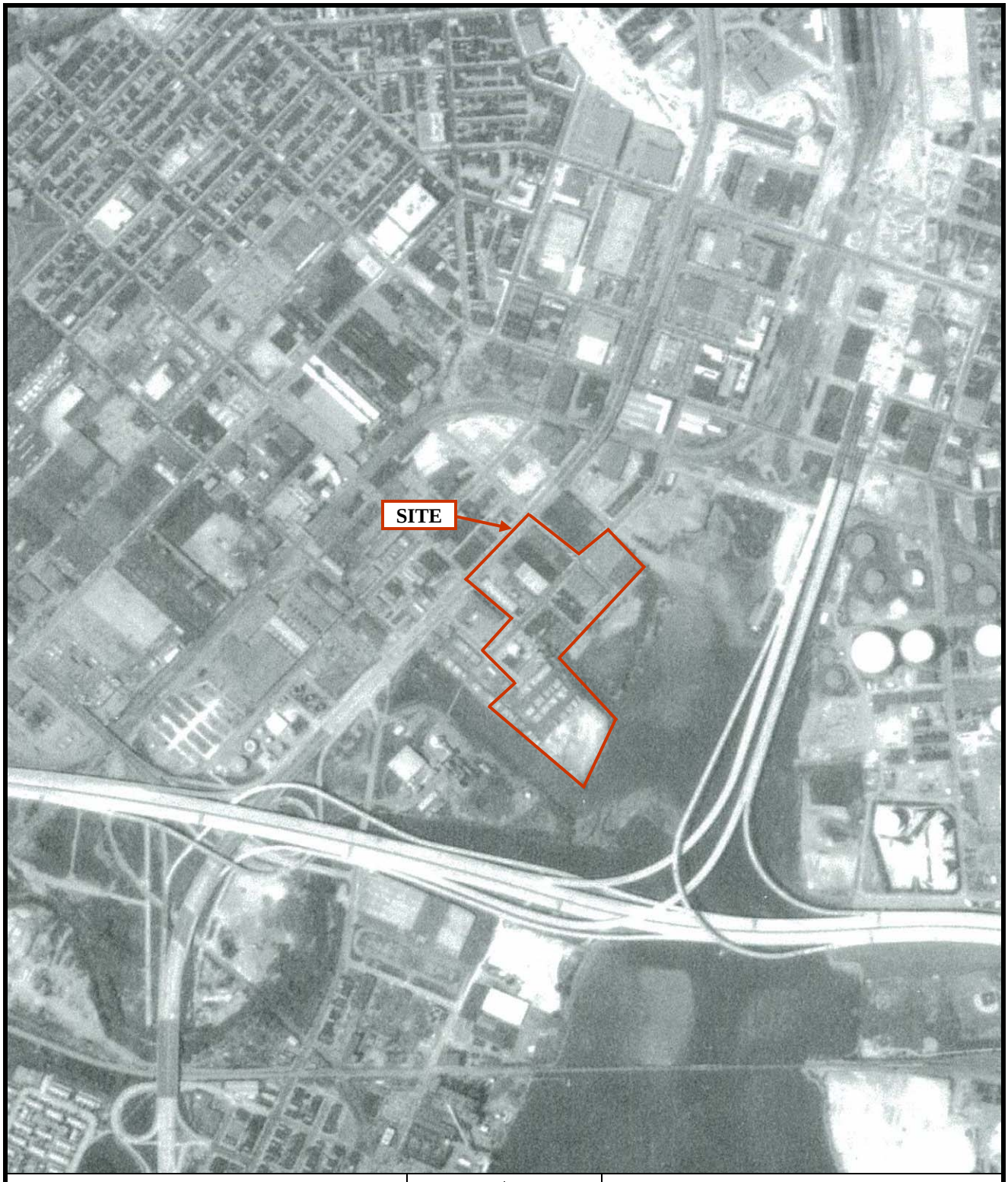
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1971 Aerial Photograph

KCI Project 01-0537004
April 2007



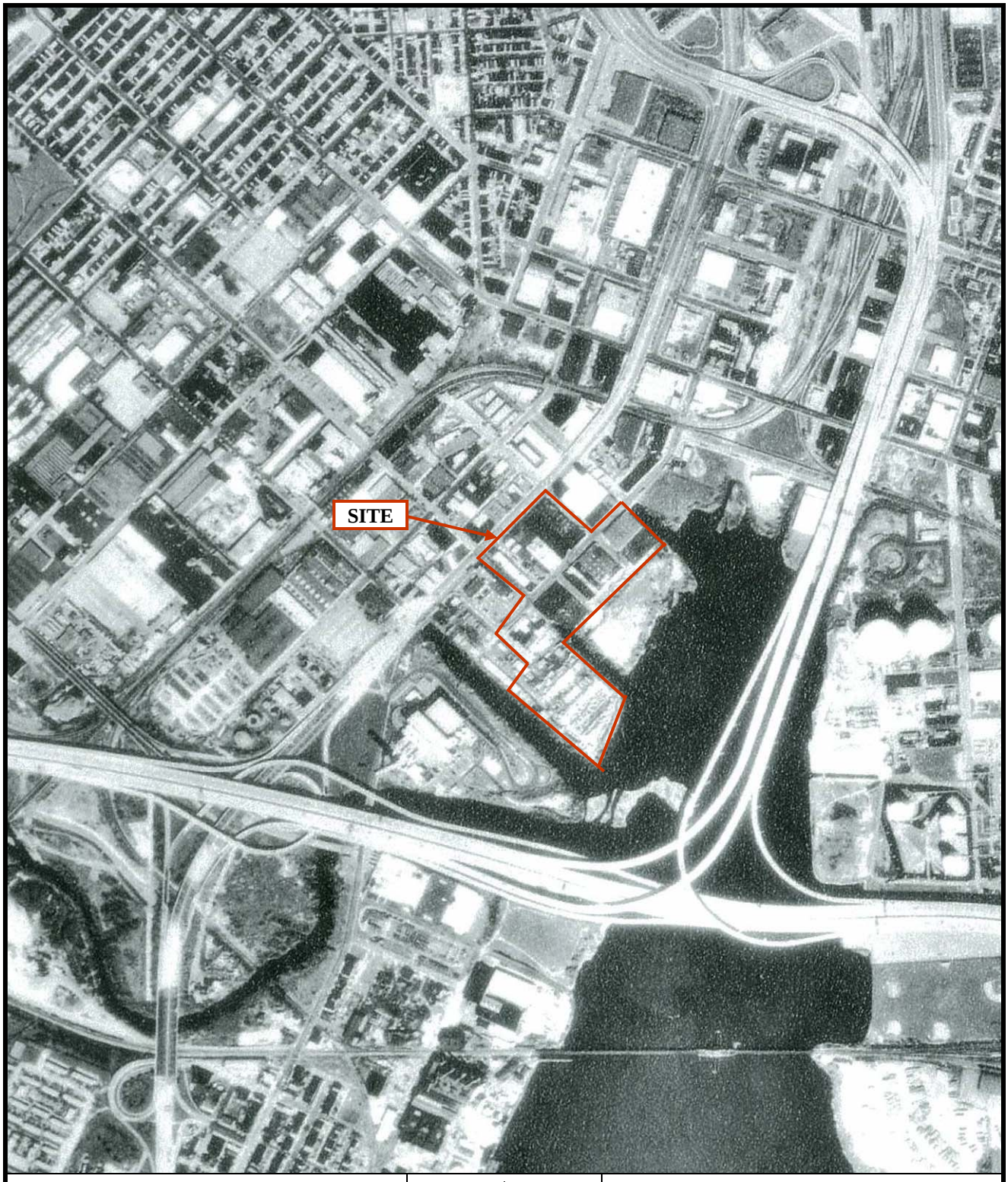
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1980 Aerial Photograph

KCI Project 01-0537004
April 2007



Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

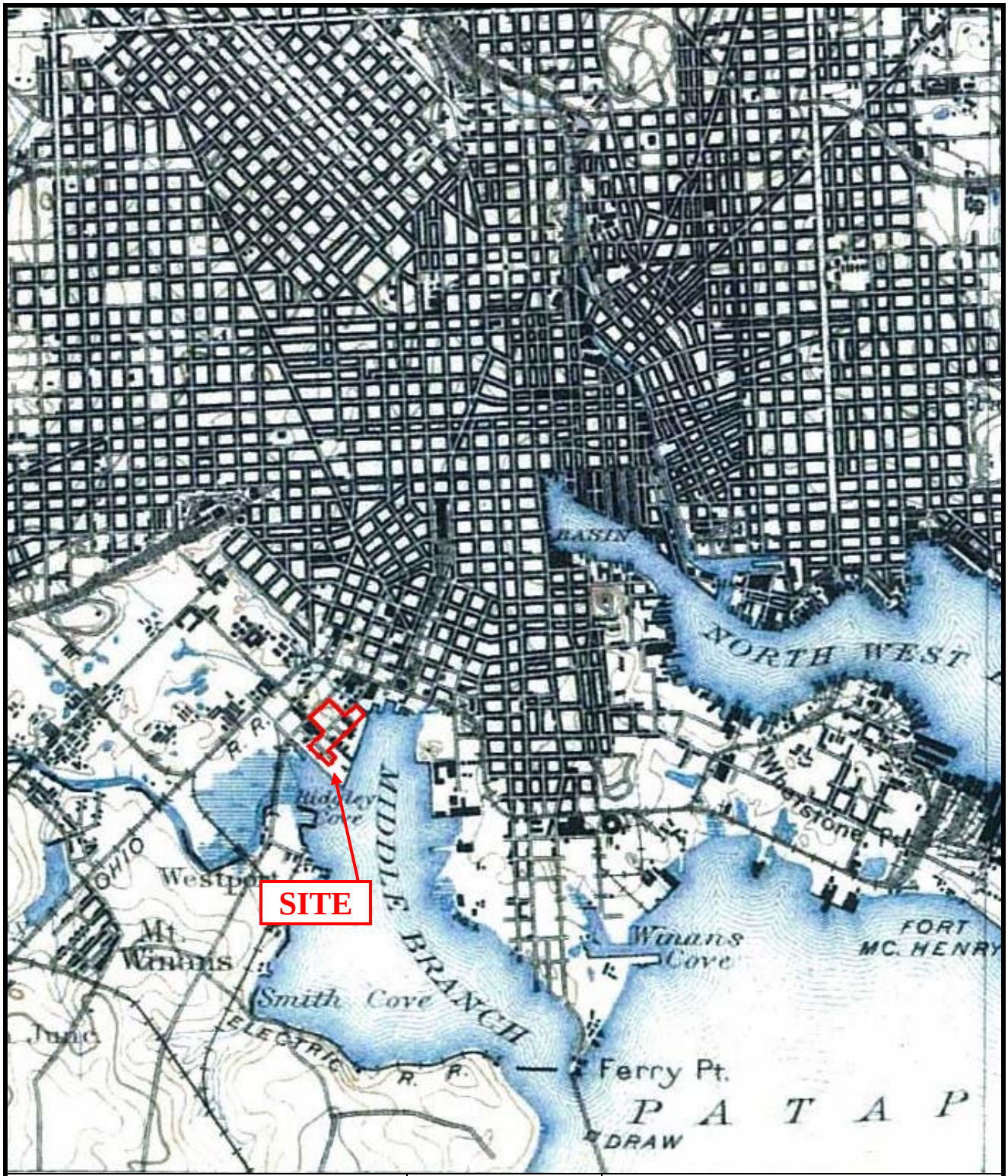
NORTH

NTS
(Site boundaries are approximate.)

1988 Aerial Photograph

KCI Project 01-0537004
April 2007

APPENDIX D: HISTORICAL TOPOGRAPHIC MAPS



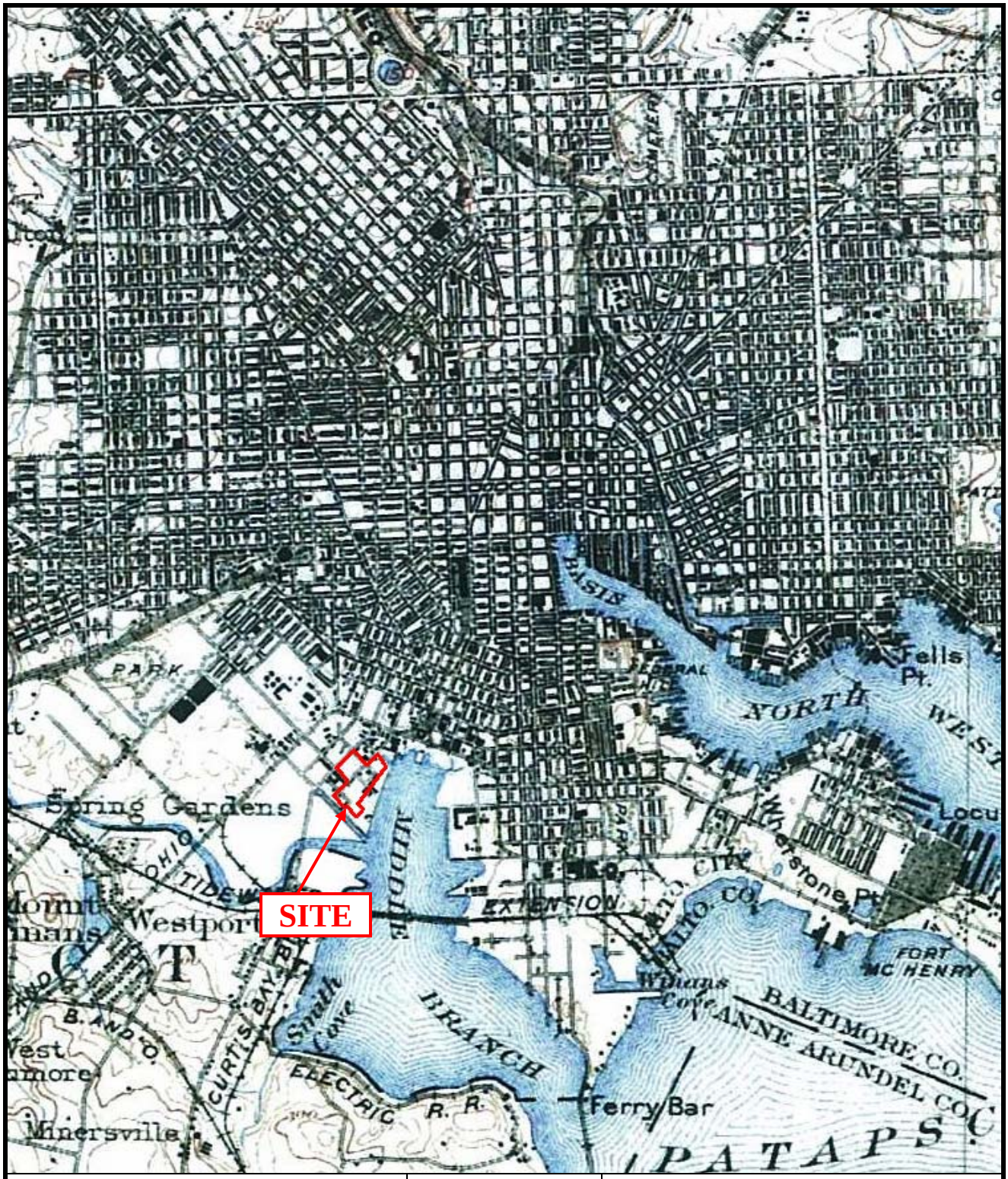
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1899 Topographic Map

KCI Project 01-05437004
April 2007



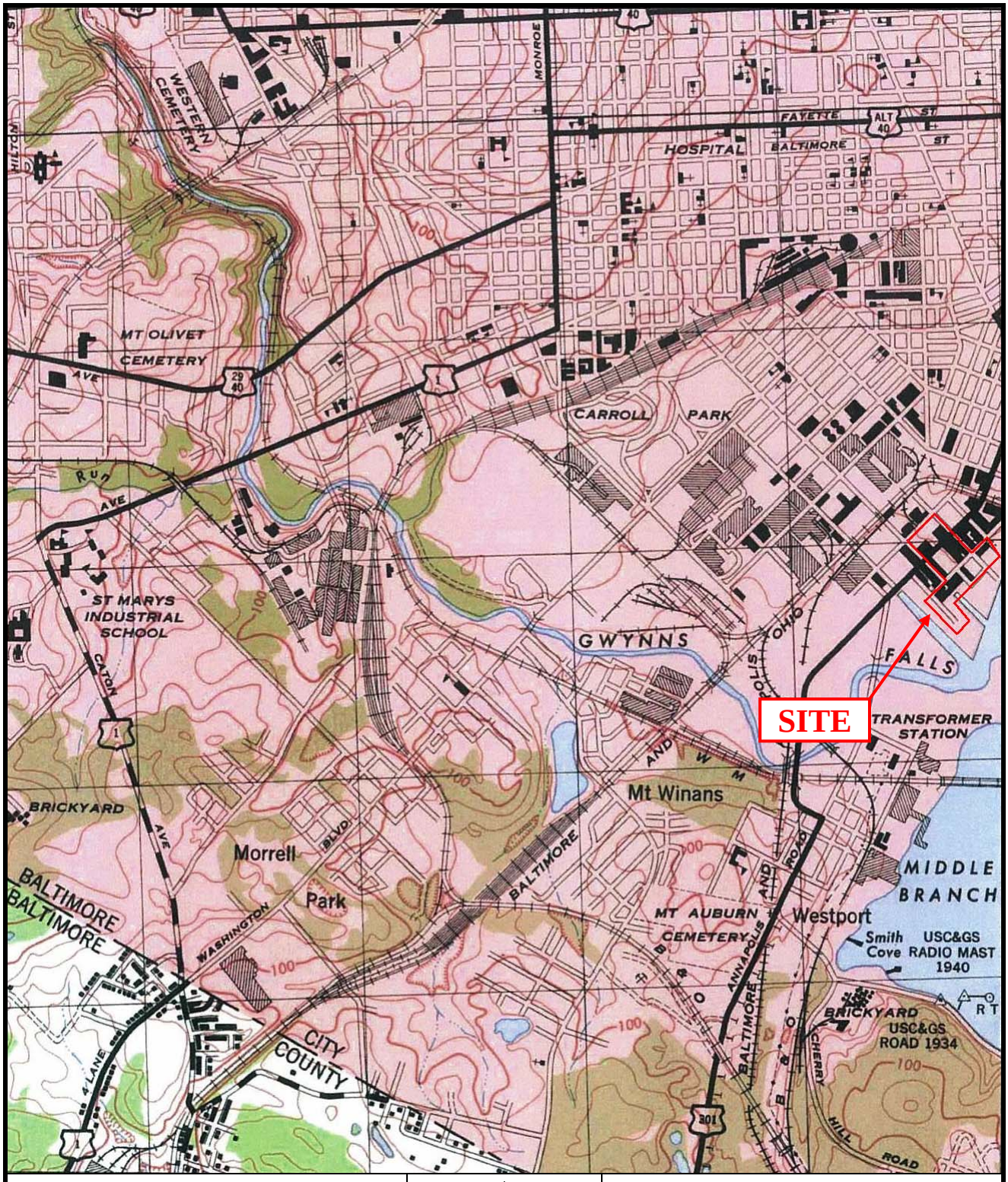
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1904 Topographic Map

KCI Project 01-05437004
April 2007



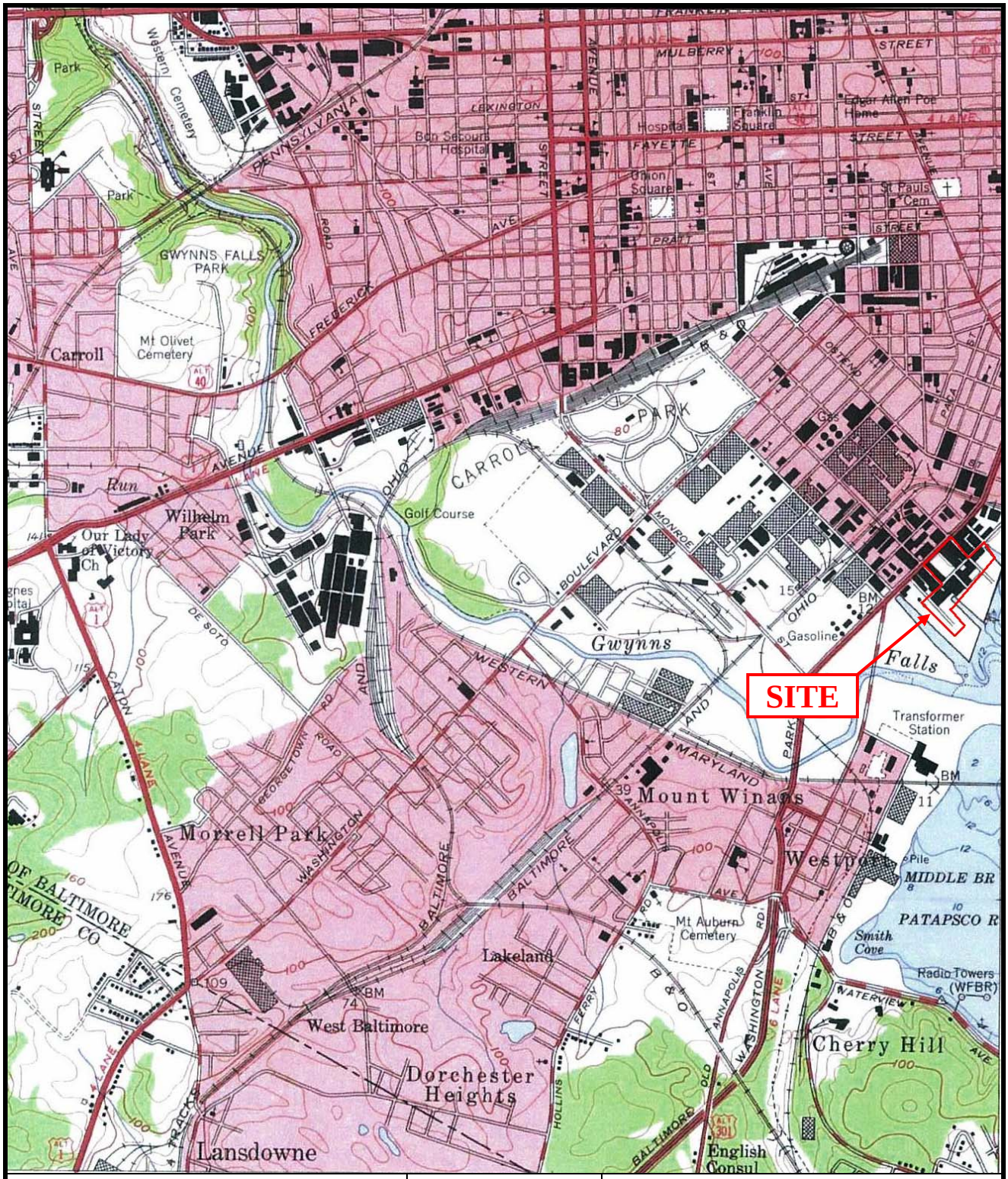
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1946 Topographic Map

KCI Project 01-05437004
April 2007



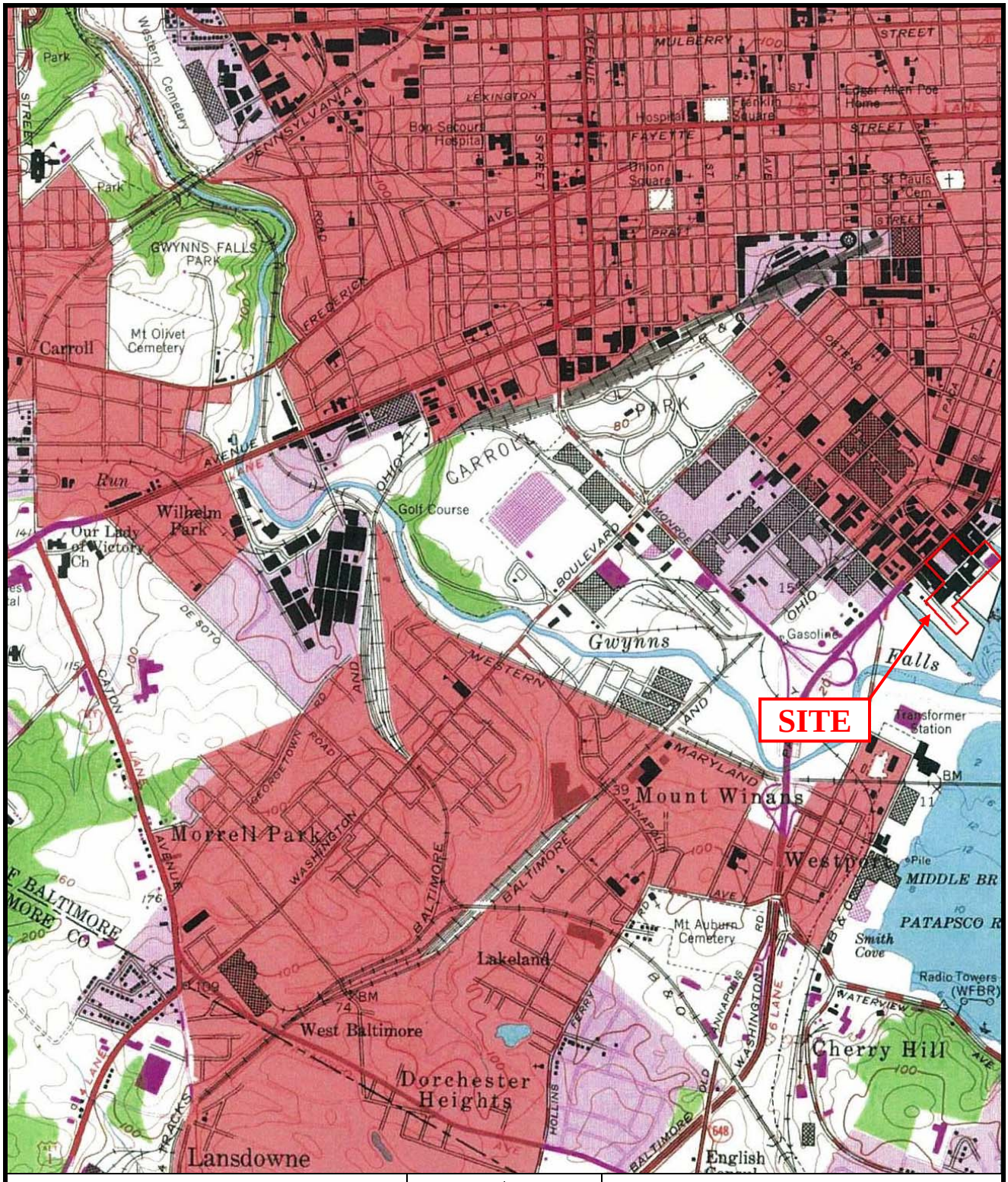
Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

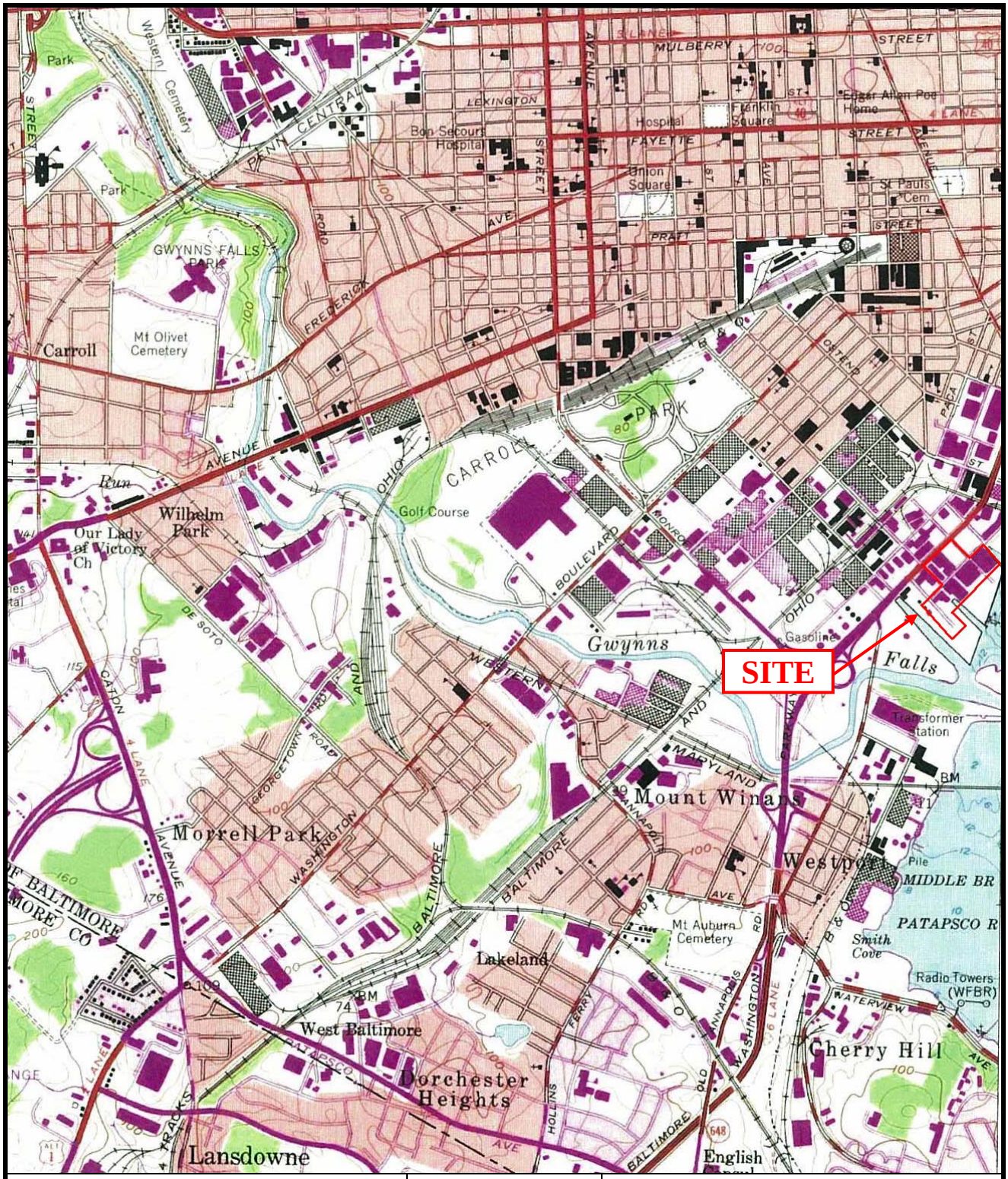
NTS
(Site boundaries are approximate.)

1953 Topographic Map

KCI Project 01-05437004
April 2007



Phase I Environmental Site Assessment Gateway South Redevelopment Properties 12 Parcels Baltimore, Maryland 21230	NORTH NTS (Site boundaries are approximate.)	**1966 Topographic Map** KCI Project 01-05437004 April 2007



Phase I Environmental Site Assessment
Gateway South Redevelopment Properties
12 Parcels
Baltimore, Maryland 21230

NORTH

NTS
(Site boundaries are approximate.)

1974 Topographic Map

KCI Project 01-05437004
April 2007

APPENDIX E: CHAIN OF TITLE INFORMATION

KCI
TECHNOLOGIES

Chain-of-Title Information
1501 Russell St
Baltimore, MD

To: Mayor & City Council of Baltimore
From: The Pheasant Warner Company, LLC
Date: 11-3-2005
Liber/Folio: 6923 / 359
↑
To: The Pheasant Warner Company, LLC
From: J. Fred Glose
Date: 1-22-2001
Liber/Folio: 1023 / 287
↑
To: J. Fred Glose
From: The Westport Corporation
Date: 12-2-1988
Liber/Folio: 1953 / 533

↗ ↑ ↖

To: The Westport Corporation
From: Maryland National Bank, Guardian for Marietta Watts, a person under disability
Date: 4-5-1974
Liber/Folio: 3115 / 884
(*conveys a portion of the property)
↑
To: Marietta Watts
From: Fidelity Trust Company, Surviving Trustee under the Last Will and Testament of Mary Ann Henrietta Watts, deceased
Date: 11-20-1946
Liber/Folio: 7038 / 391
(*conveys a portion of the property)

To: The Westport Corporation
From: The Maryland Container Company
Date: 6-6-1947
Liber/Folio: 7173 / 149
(*conveys a portion of the property)

To: The Westport Corporation
From: American Cyanamid Company
Date: 4-28-1953
Liber/Folio: 9138 / 207
(*conveys a portion of the property)

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1501 RUSSELL STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00094

Tuesday, January 23, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

MAYOR AND CITY COUNCIL OF BALTIMORE

The following is the current property legal description:

All those certain pieces or parcels of land being Ward 21, Section 09, Block 0841, Lot 001, lying and situate in the City of Baltimore City, and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 11-20-1946
   - GRANTOR: Fidelity Trust Company, Surviving Trustee under the Last Will and Testament of Mary Ann Henrietta Watts, deceased
   - GRANTEE: Marietta Watts
   - INSTRUMENT: Bk 7038, Pg 391
   - COMMENTS: Conveys a portion of the property.

2. DEED:
   - RECORDED: 06-06-1947
   - GRANTOR: The Maryland Container Company
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 7173, Pg 149
   - COMMENTS: Conveys a portion of the property.

3. DEED:
   - RECORDED: 04-28-1953
   - GRANTOR: American Cyanamid Company
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 9138, Pg 207
   - COMMENTS: Conveys a portion of the property.

4. DEED:
   - RECORDED: 04-05-1974
   - GRANTOR: Maryland National Bank, Guardian for Marietta Watts, a person under disability
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 3115, Pg 884
   - COMMENTS: Conveys a portion of the property.

5. DEED:
   - RECORDED: 12-2-1988
   - GRANTOR: The Westport Corporation
   - GRANTEE: J. Fred Glose
   - INSTRUMENT: Bk 1953, Pg 533

6. DEED:
   - RECORDED: 01-22-2001
   - GRANTOR: J. Fred Glose
   - GRANTEE: The Pheasant Warner Company, LLC
   - INSTRUMENT: Bk 1023, pg 287

7. DEED:

RECORDED:	11-03-2005
GRANTOR:	The Pheasant Warner Company, LLC
GRANTEE:	Mayor & City Council of Baltimore
INSTRUMENT:	Bk 6923, Pg 359

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1501 Warner Street
Baltimore, MD

To: Warner Street, Inc., a Maryland corporation
From: Edward J. Levin and Andrea M. Mattei, Substiture Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc.
Date: 3-14-1989
Liber/Folio: 2029 / 474

↑

To: Gordon Cartons, Inc.
From: Isidore Hettleman, Emanuel Hettleman and David Hettleman, surviving Directors and Trustees for the creditors, stockholders and members of the Bayard Realty Corporation
Date: 9-2-1965
Liber/Folio: 1959 / 130

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1501 WARNER STREET
BALTIMORE, MARYLAND

Submitted to:

ENVIRONMENTAL DATA RESOURCES, INC.
C/O
KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00095

Thursday, January 11, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

WARNER STREET, INC., a Maryland corporation

The following is the current property legal description:

All those certain pieces or parcels of land being 1.36 acres and Ward 21, Section 09, Block 0844A, Lot 1, lying and situate in Baltimore City and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:

RECORDED:	09-02-1965
GRANTOR:	Isidore Hettleman, Emanuel Hettleman and David Hettleman, surviving Directors and Trustees for the creditors, stockholders and members of the Bayard Realty Corporation
GRANTEE:	Gordon Cartons, Inc.
INSTRUMENT:	Bk 1959, Pg 130

DEED:

RECORDED:	03-14-1989
GRANTOR:	Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc
GRANTEE:	Warner Street, Inc., a Maryland corporation
INSTRUMENT:	Bk 2029, Pg 474

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of Environmental Data Resources, Inc., and KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1525 Russell St
Baltimore, MD

To: Mayor & City Council of Baltimore
From: The Pheasant Warner Company, LLC
Date: 11-3-2005
Liber/Folio: 6923 / 359
↑
To: The Pheasant Warner Company, LLC
From: J. Fred Glose
Date: 1-22-2001
Liber/Folio: 1023 / 287
↑
To: J. Fred Glose
From: The Westport Corporation
Date: 12-2-1988
Liber/Folio: 1953 / 533

↗ ↑ ↖

To: The Westport Corporation
From: Maryland National Bank, Guardian for Marietta Watts, a person under disability
Date: 4-5-1974
Liber/Folio: 3115 / 884
(*conveys a portion of the property)
↑
To: Marietta Watts
From: Fidelity Trust Company, Surviving Trustee under the Last Will and Testament of Mary Ann Henrietta Watts, deceased
Date: 11-20-1946
Liber/Folio: 7038 / 391
(*conveys a portion of the property)

To: The Westport Corporation
From: The Maryland Container Company
Date: 6-6-1947
Liber/Folio: 7173 / 149
(*conveys a portion of the property)

To: The Westport Corporation
From: American Cyanamid Company
Date: 4-28-1953
Liber/Folio: 9138 / 207
(*conveys a portion of the property)

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1525 RUSSELL STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00096

Tuesday, January 23, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

MAYOR AND CITY COUNCIL OF BALTIMORE

The following is the current property legal description:

All those certain pieces or parcels of land being Ward 21, Section 09, Block 0841, Lot 003, lying and situate in the City of Baltimore City, and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 11-20-1946
   - GRANTOR: Fidelity Trust Company, Surviving Trustee under the Last Will and Testament of Mary Ann Henrietta Watts, deceased
   - GRANTEE: Marietta Watts
   - INSTRUMENT: Bk 7038, Pg 391
   - COMMENTS: Conveys a portion of the property.

2. DEED:
   - RECORDED: 06-06-1947
   - GRANTOR: The Maryland Container Company
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 7173, Pg 149
   - COMMENTS: Conveys a portion of the property.

3. DEED:
   - RECORDED: 04-28-1953
   - GRANTOR: American Cyanamid Company
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 9138, Pg 207
   - COMMENTS: Conveys a portion of the property.

4. DEED:
   - RECORDED: 04-05-1974
   - GRANTOR: Maryland National Bank, Guardian for Marietta Watts, a person under disability
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 3115, Pg 884
   - COMMENTS: Conveys a portion of the property.

5. DEED:
   - RECORDED: 12-2-1988
   - GRANTOR: The Westport Corporation
   - GRANTEE: J. Fred Glose
   - INSTRUMENT: Bk 1953, Pg 533

6. DEED:
   - RECORDED: 01-22-2001
   - GRANTOR: J. Fred Glose
   - GRANTEE: The Pheasant Warner Company, LLC
   - INSTRUMENT: Bk 1023, pg 287

7. DEED:

RECORDED:	11-03-2005
GRANTOR:	The Pheasant Warner Company, LLC
GRANTEE:	Mayor & City Council of Baltimore
INSTRUMENT:	Bk 6923, Pg 359

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1551 Russell St
Baltimore, MD

To: Mayor & City Council of Baltimore
From: The Pheasant Warner Company, LLC
Date: 11-3-2005
Liber/Folio: 6923 / 359

↑

To: The Pheasant Warner Company, LLC
From: J. Fred Glose
Date: 1-22-2001
Liber/Folio: 1023 / 287

↑

To: J. Fred Glose
From: The Westport Corporation
Date: 12-2-1988
Liber/Folio: 1953 / 533

↗ ↑ ↖

To: The Westport Corporation
From: Maryland National Bank, Guardian for Marietta Watts, a person under disability
Date: 4-5-1974
Liber/Folio: 3115 / 884
(*conveys a portion of the property)

↑

To: Marietta Watts
From: Fidelity Trust Company, Surviving Trustee under the Last Will and Testament of Mary Ann Henrietta Watts, deceased
Date: 11-20-1946
Liber/Folio: 7038 / 391
(*conveys a portion of the property)

To: The Westport Corporation
From: The Maryland Container Company
Date: 6-6-1947
Liber/Folio: 7173 / 149
(*conveys a portion of the property)

To: The Westport Corporation
From: American Cyanamid Company
Date: 4-28-1953
Liber/Folio: 9138 / 207
(*conveys a portion of the property)

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1551 RUSSELL STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00097

Tuesday, January 23, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

MAYOR AND CITY COUNCIL OF BALTIMORE

The following is the current property legal description:

All those certain pieces or parcels of land being Ward 21, Section 09, Block 0841, Lot 004, lying and situate in the City of Baltimore City, and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 11-20-1946
   - GRANTOR: Fidelity Trust Company, Surviving Trustee under the Last Will and Testament of Mary Ann Henrietta Watts, deceased
   - GRANTEE: Marietta Watts
   - INSTRUMENT: Bk 7038, Pg 391
   - COMMENTS: Conveys a portion of the property.

2. DEED:
   - RECORDED: 06-06-1947
   - GRANTOR: The Maryland Container Company
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 7173, Pg 149
   - COMMENTS: Conveys a portion of the property.

3. DEED:
   - RECORDED: 04-28-1953
   - GRANTOR: American Cyanamid Company
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 9138, Pg 207
   - COMMENTS: Conveys a portion of the property.

4. DEED:
   - RECORDED: 04-05-1974
   - GRANTOR: Maryland National Bank, Guardian for Marietta Watts, a person under disability
   - GRANTEE: The Westport Corporation
   - INSTRUMENT: Bk 3115, Pg 884
   - COMMENTS: Conveys a portion of the property.

5. DEED:
   - RECORDED: 12-2-1988
   - GRANTOR: The Westport Corporation
   - GRANTEE: J. Fred Glose
   - INSTRUMENT: Bk 1953, Pg 533

6. DEED:
   - RECORDED: 01-22-2001
   - GRANTOR: J. Fred Glose
   - GRANTEE: The Pheasant Warner Company, LLC
   - INSTRUMENT: Bk 1023, pg 287

7. DEED:

RECORDED:	11-03-2005
GRANTOR:	The Pheasant Warner Company, LLC
GRANTEE:	Mayor & City Council of Baltimore
INSTRUMENT:	Bk 6923, Pg 359

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1601 Warner Street
Baltimore, MD

To: Warner Street, Inc., a Maryland Corporation
From: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland Corporation, by and for Gordon Cartons, Inc.
Date: 3-14-1989
Liber/Folio: 2029 / 474

↑

To: Gordon Cartons, Inc.
From: James B. McNeil & Company, Inc.
Date: 9-6-1957
Liber/Folio: 190 / 472

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
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Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1601 WARNER STREET
BALTIMORE, MARYLAND

Submitted to:

ENVIRONMENTAL DATA RESOURCES, INC.
C/O
KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00098

Thursday, January 11, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

WARNER STREET, INC., a Maryland corporation

The following is the current property legal description:

All those certain pieces or parcels of land being Lot 1A, Block 844A, Section 9, Ward 21, lying and situate in Baltimore City, and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 09-06-1957
   - GRANTOR: James B. McNeal & Company, Inc.
   - GRANTEE: Gordon Cartoons, Inc.
   - INSTRUMENT: Bk 190, Pg 472

2. DEED:
   - RECORDED: 03-14-1989
   - GRANTOR: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc.
   - GRANTEE: Warner Street, Inc., a Maryland corporation
   - INSTRUMENT: Bk 2029, Pg 474

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of Environmental Data Resources, Inc., and KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1629 Warner Street
Baltimore, MD

To: Warner Street, Inc., a Maryland corporation
From: Edward J. Levin and Andrea M. Mattei, Substiture Trustee's; and Hillco Investment Corporation, a Maryland corporation
Date: 3-14-1989
Liber/Folio: 2029 / 474

↑

To: Gordon Cartons, Inc. (Merger)
From: Gordon Lavin Paper Box Company
Date: 7-9-1643
Liber/Folio: 6492 / 572

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1629 WARNER STREET
BALTIMORE, MARYLAND

Submitted to:

ENVIRONMENTAL DATA RESOURCES, INC.
C/O
KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00099

Thursday, January 11, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

WARNER STREET, INC., a Maryland corporation

The following is the current property legal description:

All those certain pieces or parcels of land being 0.66 acres and Ward 21, Section 09, Block 0844A, Lot 2, lying and situate in Baltimore City and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. Gordon Lavin Paper Box Company acquired title to the property prior to 1940.

2. MERGER
   RECORDED: 07-09-1943
   GRANTOR: Gordon Lavin Paper Box Company
   GRANTEE: Gordon Cartons, Inc.
   INSTRUMENT: Bk 6492, Pg 572

3. DEED (Foreclosure Deed):
   RECORDED: 03-14-1989
   GRANTOR: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation
   GRANTEE: Warner Street, Inc., a Maryland corporation
   INSTRUMENT: Bk 2029, Pg 474

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of Environmental Data Resources, Inc., and KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1633 Warner Street
Baltimore, MD

To: Warner Street, Inc., a Maryland Corporation
From: Edward J. Levin and Andrea M. Mattei, substitute Trustee's; and Hillco Investment Corporation a Maryland corporation
Date: 3-14-1989
Liber/Folio: 2029 / 474 (Foreclosure deed)

↑

To: Gordon Cartons, Inc.
From: Anne Lee Cook, Paul G. Wist and W. Gibbs McKenny, Personal Representatives of the Will of the Estate of Anne H. Bowen, deceased
Date: 6-23-1981
Liber/Folio: 4066 / 38

↑

To: Herbert Bowen and Anne H. Bowen, his wife
From: Beulah Bruehl
Date: 10-30-1947
Liber/Folio: 7258 / 268
Deed of Assignment

↑

To: Herbert Bowen and Anne H. Bowen, his wife
From: William O. head and Virginia Head
Date: 10-30-1947
Liber/Folio: 7258 / 261
Deed of Reversion. Herbert L. Bowen died 7-3-1949. Anne H. Bowen died 6-16-1979.

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1633 WARNER STREET
BALTIMORE, MARYLAND

Submitted to:

ENVIRONMENTAL DATA RESOURCES, INC.
C/O
KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00100

Thursday, January 11, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

WARNER STREET, INC., a Maryland corporation

The following is the current property legal description:

All those certain pieces or parcels of land being in Ward 21, Section 09, Block 0844A, Lot 3, lying and situate in Baltimore City and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED OF ASSIGNMENT:
   - RECORDED: 10-30-1947
   - GRANTOR: Beulah Bruehl
   - GRANTEE: Herbert Bowen and Anne H. Bowen, his wife
   - INSTRUMENT: Bk 7258, Pg 268

2. DEED OF REVERSION:
   - RECORDED: 10-30-1947
   - GRANTOR: William O. Head and Virginia Head
   - GRANTEE: Herbert Bowen and Anne H. Bowen, his wife
   - INSTRUMENT: Bk 7258, Pg 261
   - COMMENTS: Herbert L. Bowen died 07-03-1949. Anne H. Bowen died 06-16-1979.

3. DEED:
   - RECORDED: 06-23-1981
   - GRANTOR: Anne Lee Cook, Paul G. Wist and W. Gibbs McKenney, Personal Representatives of the Will of the Estate of Anne H. Bowen, deceased
   - GRANTEE: Gordon Cartons, Inc.
   - INSTRUMENT: Bk 4066, Pg 38

4. DEED (Foreclosure Deed):
   - RECORDED: 03-14-1989
   - GRANTOR: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation
   - GRANTEE: Warner Street, Inc., a Maryland corporation
   - INSTRUMENT: Bk 2029, Pg 474

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of Environmental Data Resources, Inc., and KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
1645 Warner Street
Baltimore, MD

To: Mayor and City Council of Baltimore
From: The Real Estate and Improvement Company of Baltimore City
Date: 5-3-1976
Liber/Folio: 3342 / 718

↗	↗	↗	↗	↖	↖	↖	↖
To: The Real Estate and Improvement Company of Baltimore City From: Lyman T. Ranstead Date: 7-11-1908 Liber/Folio: 2514 / 116 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: Spring Garden Wharf & Land Company Date: 5-28-1923 Liber/Folio: 4020 / 19 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: American Ice Company Date: 6-29-1923 Liber/Folio: 4045 / 250 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: The Title Holding Company Date: 8-9-1926 Liber/Folio: 4616 / 273 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: The Title Holding Company Date: 5-23-1927 Liber/Folio: 4740 / 350 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: The Title Holding Company Date: 5-13-1929 Liber/Folio: 5003 / 383 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: Sun Oil Company Date: 9-13-1932 Liber/Folio: 5328 / 353 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: Letom Inn Corporation Date: 10-25-1961 Liber/Folio: 1167 / 480 (*Conveys a portion of the property)

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

1645 WARNER STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00101

Friday, January 26, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

MAYOR AND CITY COUNCIL OF BALTIMORE

The following is the current property legal description:

All those certain pieces or parcels of land being Ward 21, Section 09, Block 0840, Lot 002, lying and situate in Baltimore City, and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 07-11-1908
   - GRANTOR: Lyman T. Ranstead
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 2514, Pg 116
   - COMMENTS: Conveys a portion of the property.

2. DEED:
   - RECORDED: 05-28-1923
   - GRANTOR: Spring Garden Wharf & Land Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: BK 4020, Pg 19
   - COMMENTS: Conveys a portion of the property.

3. DEED:
   - RECORDED: 06-29-1923
   - GRANTOR: American Ice Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4045, Pg 250
   - COMMENTS: Conveys a portion of the property.

4. DEED:
   - RECORDED: 08-09-1926
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4616, Pg 273
   - COMMENTS: Conveys a portion of the property.

5. DEED:
   - RECORDED: 05-23-1927
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4740, Pg 350
   - COMMENTS: Conveys a portion of the property.

6. DEED:
   - RECORDED: 05-13-1929
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 5003, Pg 383
   - COMMENTS: Conveys a portion of the property.

7. DEED:
   - RECORDED: 09-13-1932
   - GRANTOR: Sun Oil Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 5328, Pg 353
   - COMMENTS: Conveys a portion of the property.

8. DEED:
   - RECORDED: 10-25-1961
   - GRANTOR: Letom Inn Corporation
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 1167, Pg 480
   - COMMENTS: Conveys a portion of the property.

9. DEED:
   - RECORDED: 05-03-1976
   - GRANTOR: The Real Estate and Improvement Company of Baltimore City
   - GRANTEE: Mayor and City Council of Baltimore
   - INSTRUMENT: Bk 3342, Pg 718

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
2102 Oler Street
Baltimore, MD

To: Warner Street, Inc., a Maryland corporation
From: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc
Date: 3-14-1989
Liber/Folio: 2029 / 474

↑

To: Gordon Cartons, Inc.
From: The Real Estate and Improvement Company of Baltimore City
Date: 12-10-1951
Liber/Folio: 8660 / 584

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

2102 OLER STREET
BALTIMORE, MARYLAND

Submitted to:

ENVIRONMENTAL DATA RESOURCES, INC.
C/O
KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00102

Thursday, January 11, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

WARNER STREET, INC., a Maryland corporation

The following is the current property legal description:

All those certain pieces or parcels of land being in Ward 21, Section 09, Block 0844A, Lot 5, lying and situate in Baltimore City and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. The Real Estate and improvement Company of Baltimore City acquired title to the property prior to 1940.

2. DEED:

RECORDED:	12-10-1951
GRANTOR:	The Real Estate and Improvement Company of Baltimore City
GRANTEE:	Gordon Cartons, Inc.
INSTRUMENT:	Bk 8660, Pg 584

3. DEED:

RECORDED:	03-14-1989
GRANTOR:	Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc
GRANTEE:	Warner Street, Inc., a Maryland corporation
INSTRUMENT:	Bk 2029, Pg 474

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of Environmental Data Resources, Inc., and KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
2104 Worcester Street
Baltimore, MD

To: Warner Street, Inc., a Maryland corporation
From: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc.
Date: 3-14-1989
Liber/Folio: 2029 / 474

↑

To: Gordon Cartons, Inc. (Merger)
From: Gordon Lavin Paper Box Company
Date: 7-9-1943
Liber/Folio: 6492 / 572

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

2104 WORCESTER STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00103

Friday, January 19, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

WARNER STREET, INC., a Maryland corporation

The following is the current property legal description:

All those certain pieces or parcels of land being in Ward 21, Section 09, Block 0844A, Lot 10, lying and situate in Baltimore City and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. Gordon Lavin Paper Box Company acquired title to the property prior to 1940.

2. MERER:
   - RECORDED: 07-09-1943
   - GRANTOR: Gordon Lavin Paper Box Company
   - GRANTEE: Gordon Cartons, Inc.
   - INSTRUMENT: Bk 6492, Pg 572

3. DEED (FORECLOSURE):
   - RECORDED: 03-14-1989
   - GRANTOR: Edward J. Levin and Andrea M. Mattei, Substitute Trustee's; and Hillco Investment Corporation, a Maryland corporation, by and for Gordon Cartons, Inc.
   - GRANTEE: Warner Street, Inc., a Maryland corporation
   - INSTRUMENT: Bk 2029, Pg 474

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
2110 Haines Street
Baltimore, MD

To: Mayor and City Council of Baltimore
From: AT&T Corporation, a New York corporation
Date: 11-19-2003
Liber/Folio: 4666 / 18

↑

To: AT&T Corporation, a New York corporation
From: Baltimore Gateway Joint Venture, a Maryland general partnership
Date: 1-19-2000
Liber/Folio: 51 / 49

↑

To: Baltimore Gateway Joint Venture, a Maryland general partnership
From: Warner-Fruehauf Trailer Company, Inc., a Maryland Corporation
From: The Mayor and City Council of Baltimore
Date: 5-10-1988
Liber/Folio: 1700 / 182

↑

To: Warner-Fruehauf Trailer Company, Inc., a Maryland Corporation
From: The Mayor and City Council of Baltimore
Date: 8-9-1978
Liber/Folio: 3649 / 772

↑

To: Mayor and City Council of Baltimore
From: The Real Estate and Improvement Company of Baltimore City
Date: 5-3-1976
Liber/Folio: 3342 / 718

↗ To: The Real Estate and Improvement Company of Baltimore City
From: Lyman T. Ranstead
Date: 7-11-1908
Liber/Folio: 2514 / 116
(*Conveys a portion of the property)

↗ To: The Real Estate and Improvement Company of Baltimore City
From: Spring Garden Wharf & Land Company
Date: 5-28-1923
Liber/Folio: 4020 / 19
(*Conveys a portion of the property)

↗ To: The Real Estate and Improvement Company of Baltimore City
From: American Ice Company
Date: 6-29-1923
Liber/Folio: 4045 / 250
(*Conveys a portion of the property)

↗ To: The Real Estate and Improvement Company of Baltimore City
From: The Title Holding Company
Date: 8-9-1926
Liber/Folio: 4616 / 273
(*Conveys a portion of the property)

↖ To: The Real Estate and Improvement Company of Baltimore City
From: The Title Holding Company
Date: 5-23-1927
Liber/Folio: 4740 / 350
(*Conveys a portion of the property)

↖ To: The Real Estate and Improvement Company of Baltimore City
From: The Title Holding Company
Date: 5-13-1929
Liber/Folio: 5003 / 383
(*Conveys a portion of the property)

↖ To: The Real Estate and Improvement Company of Baltimore City
From: Sun Oil Company
Date: 9-13-1932
Liber/Folio: 5328 / 353
(*Conveys a portion of the property)

↖ To: The Real Estate and Improvement Company of Baltimore City
From: Letom Inn Corporation
Date: 10-25-1961
Liber/Folio: 1167 / 480
(*Conveys a portion of the property)

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

2110 HAINES STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00104

Tuesday, January 23, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

MAYOR AND CITY COUNCIL OF BATLIMORE

The following is the current property legal description:

All those certain pieces or parcels of land being Ward 21, Section 09, Block 0840, Lot 004, lying and situate in the City of Baltimore and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 07-11-1908
   - GRANTOR: Lyman T. Ranstead
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 2514, Pg 116
   - COMMENTS: Conveys a portion of the property.

2. DEED:
   - RECORDED: 05-28-1923
   - GRANTOR: Spring Garden Wharf & Land Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: BK 4020, Pg 19
   - COMMENTS: Conveys a portion of the property.

3. DEED:
   - RECORDED: 06-29-1923
   - GRANTOR: American Ice Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4045, Pg 250
   - COMMENTS: Conveys a portion of the property.

4. DEED:
   - RECORDED: 08-09-1926
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4616, Pg 273
   - COMMENTS: Conveys a portion of the property.

5. DEED:
   - RECORDED: 05-23-1927
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4740, Pg 350
   - COMMENTS: Conveys a portion of the property.

6. DEED:
   - RECORDED: 05-13-1929
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 5003, Pg 383
   - COMMENTS: Conveys a portion of the property.

7. DEED:
   - RECORDED: 09-13-1932
   - GRANTOR: Sun Oil Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 5328, Pg 353
   - COMMENTS: Conveys a portion of the property.

8. DEED:
   - RECORDED: 10-25-1961
   - GRANTOR: Letom Inn Corporation
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 1167, Pg 480
   - COMMENTS: Conveys a portion of the property.

9. DEED:
   - RECORDED: 05-03-1976
   - GRANTOR: The Real Estate and Improvement Company of Baltimore City
   - GRANTEE: The Mayor and City Council of Baltimore
   - INSTRUMENT: Bk 3342, Pg 718

10. DEED:
   - RECORDED: 08-09-1978
   - GRANTOR: The Mayor and City Council of Baltimore
   - GRANTEE: Warner-Fruehauf Trailer Company, Inc., a Maryland corporation
   - INSTRUMENT: Bk 3649, Pg 772

11. DEED:
   - RECORDED: 05-10-1988
   - GRANTOR: Warner-Fruehauf Trailer Company, Inc., a Maryland corporation
   - GRANTEE: Baltimore Gateway Joint Venture, a Maryland general partnership
   - INSTRUMENT: Bk 1700, Pg 182

12. DEED:

RECORDED:	01-19-2000
GRANTOR:	Baltimore Gateway Joint Venture, a Maryland general partnership
GRANTEE:	AT & T Corporation, a New York corporation
INSTRUMENT:	Bk 51, Pg 49

13. DEED:

RECORDED:	11-19-2003
GRANTOR:	AT & T Corporation, a New York corporation
GRANTEE:	Mayor & City Council of Baltimore
INSTRUMENT:	Bk 4666, pg 18

2. LEASES AND MISCELLANEOUS

1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

Chain-of-Title Information
2119 Haines Street
Baltimore, MD

To: Mayor and City Council of Baltimore
From: The Real Estate and Improvement Company of Baltimore City
Date: 5-3-1976
Liber/Folio: 3342 / 718

↗	↗	↗	↗	↖	↖	↖	↖
To: The Real Estate and Improvement Company of Baltimore City From: Lyman T. Ranstead Date: 7-11-1908 Liber/Folio: 2514 / 116 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: Spring Garden Wharf & Land Company Date: 5-28-1923 Liber/Folio: 4020 / 19 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: American Ice Company Date: 6-29-1923 Liber/Folio: 4045 / 250 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: The Title Holding Company Date: 8-9-1926 Liber/Folio: 4616 / 273 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: The Title Holding Company Date: 5-23-1927 Liber/Folio: 4740 / 350 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: The Title Holding Company Date: 5-13-1929 Liber/Folio: 5003 / 383 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: Sun Oil Company Date: 9-13-1932 Liber/Folio: 5328 / 353 (*Conveys a portion of the property)	To: The Real Estate and Improvement Company of Baltimore City From: Letom Inn Corporation Date: 10-25-1961 Liber/Folio: 1167 / 480 (*Conveys a portion of the property)

2055 East Rio Salado Parkway, Suite 201
Tempe, Arizona 85281
Phone: (480) 967-6752
Fax Number: (480) 966-9422
Web Site: www.netronline.com

HISTORICAL CHAIN OF TITLE REPORT

2119 HAINES STREET
BALTIMORE, MARYLAND

Submitted to:

KCI TECHNOLOGIES
10 North Park Drive
Baltimore, Maryland 21030
4103167969

Attention: Douglas Talaber

Project No. N07-00093

Friday, January 26, 2007

NETR- Real Estate Research & Information hereby submits the following ASTM historical chain-of-title to the land described below, subject to the leases/miscellaneous shown in Section 2. Title to the estate or interest covered by this report appears to be vested in:

MAYOR AND CITY COUNCIL OF BALTIMORE

The following is the current property legal description:

All those certain pieces or parcels of land being Ward 21, Section 09, Block 0840, Lot 003, lying and situate in Baltimore City, and the State of Maryland.

1. HISTORICAL CHAIN OF TITLE

1. DEED:
   - RECORDED: 07-11-1908
   - GRANTOR: Lyman T. Ranstead
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 2514, Pg 116
   - COMMENTS: Conveys a portion of the property.

2. DEED:
   - RECORDED: 05-28-1923
   - GRANTOR: Spring Garden Wharf & Land Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: BK 4020, Pg 19
   - COMMENTS: Conveys a portion of the property.

3. DEED:
   - RECORDED: 06-29-1923
   - GRANTOR: American Ice Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4045, Pg 250
   - COMMENTS: Conveys a portion of the property.

4. DEED:
   - RECORDED: 08-09-1926
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4616, Pg 273
   - COMMENTS: Conveys a portion of the property.

5. DEED:
   - RECORDED: 05-23-1927
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 4740, Pg 350
   - COMMENTS: Conveys a portion of the property.

6. DEED:
   - RECORDED: 05-13-1929
   - GRANTOR: The Title Holding Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 5003, Pg 383
   - COMMENTS: Conveys a portion of the property.

7. DEED:
   - RECORDED: 09-13-1932
   - GRANTOR: Sun Oil Company
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 5328, Pg 353
   - COMMENTS: Conveys a portion of the property.

8. DEED:
   - RECORDED: 10-25-1961
   - GRANTOR: Letom Inn Corporation
   - GRANTEE: The Real Estate and Improvement Company of Baltimore City
   - INSTRUMENT: Bk 1167, Pg 480
   - COMMENTS: Conveys a portion of the property.

9. DEED:
   - RECORDED: 05-03-1976
   - GRANTOR: The Real Estate and Improvement Company of Baltimore City
   - GRANTEE: Mayor and City Council of Baltimore
   - INSTRUMENT: Bk 3342, Pg 718

2. LEASES AND MISCELLANEOUS

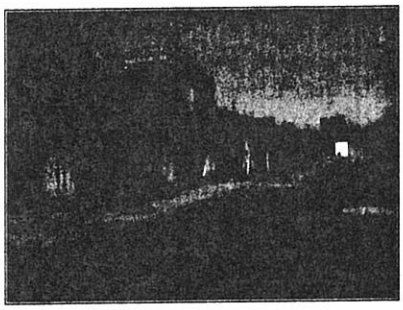
1. No leases or environmental liens were found of record.

3. LIMITATION

This report was prepared for the use of KCI Technologies, exclusively. This report is neither a guarantee of title, a commitment to insure, or a policy of title insurance. NETR- Real Estate Research & Information does not guarantee nor include any warranty of any kind whether expressed or implied, about the validity of all information included in this report since this information is retrieved as it is recorded from the various agencies that make it available. The total liability is limited to the fee paid for this report.

APPENDIX F: FOIA LETTERS, REPORTS AND DOCUMENTS

PRELIMINARY ASSESSMENT
OF
OLD GORDON CARTON
MD-539



October 2, 2008

Prepared by: Maryland Department of the Environment
Waste Management Administration
1800 Washington Blvd.
Baltimore, MD 21230

Prepared for: U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

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TABLES

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Table 2 – Population Distribution

FIGURES

Figure 1 – Warner Street Area
Figure 2 - Regional and Local Map
Figure 3 – Property Map of Gordon/MacNeal Area
Figure 4 – Area Soils Map
Figure 5 – Generalized Geological Map of the Baltimore East Area
Figure 6 – Topographic Map
Figure 7 – Area Land Use

APPENDIXES

Appendix A – Photographs

1.0 INTRODUCTION

1.1 Authorization

This Preliminary Assessment was performed by the Maryland Department of the Environment, Waste Management Administration (MDE/WAS), Land Restoration Program (LRP), Federal Superfund Division under a Preremedial Cooperative Agreement with the U.S. Environmental Protection Agency (EPA).

1.2 Scope of Work

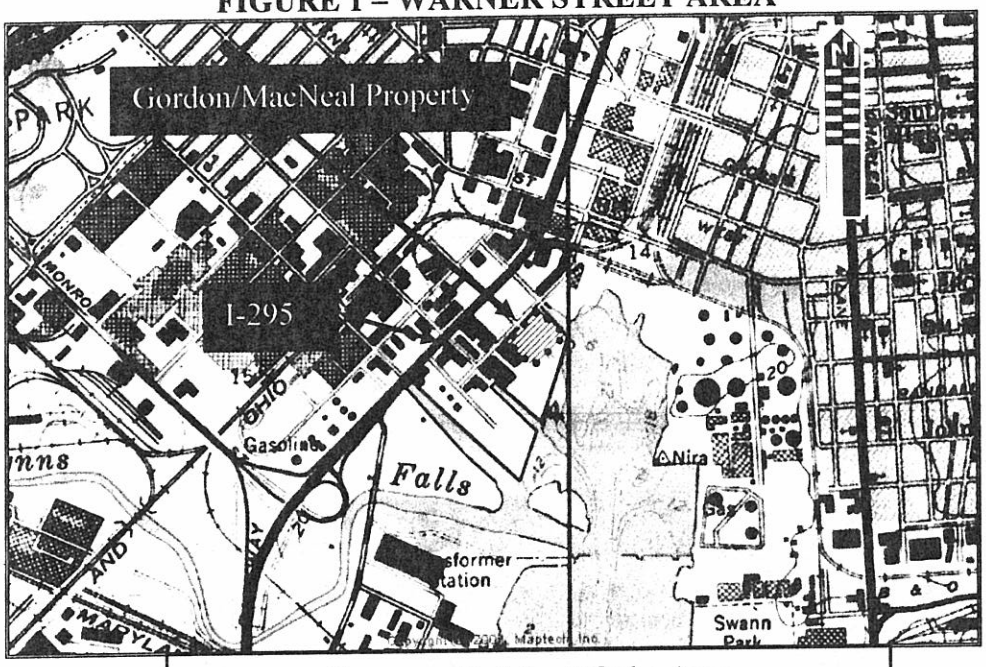
MDE performed a Preliminary Assessment (PA) of the Old Gordon Carton site (MDN000306186). The purpose of the assessment is to determine if there is a potential for the release of hazardous substances by way of groundwater, surface water, soil exposure, and air pathways on sites identified under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The scope of the assessment included reviewing the available file information and site reconnaissance.

1.3 Executive Summary and Conclusions

Industrial activity throughout the last century has impacted the Warner Street corridor. Of particular concern is the area in the rectangle formed by Warner Street, Wooster (Worcester) Street, Oler (Dock) Street, and Shell (Eutaw) Street. This parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which used hazardous materials including heavy metal salts and oxides and volatile organic materials, in their process and operations.

The Old Gordon Carton site (Gordon/MacNeal) is located in the Warner Street Corridor off I-295 in the Southern Gateway area of Baltimore City. Warner Street, Worcester Street, Eutaw Street and Oler Street bound the roughly rectangular-shaped 2.63-acre Gordon/MacNeal property. The property is off Middle Branch of the Patapsco River in a historical commercial/industrial area immediately south of the Baltimore City stadium complex. Historic records indicate varied industrial uses of these parcels dating back through the mid-19th century. Sanborn Fire Insurance maps from 1890 through 1953 detail a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on the parcels.

FIGURE 1 – WARNER STREET AREA

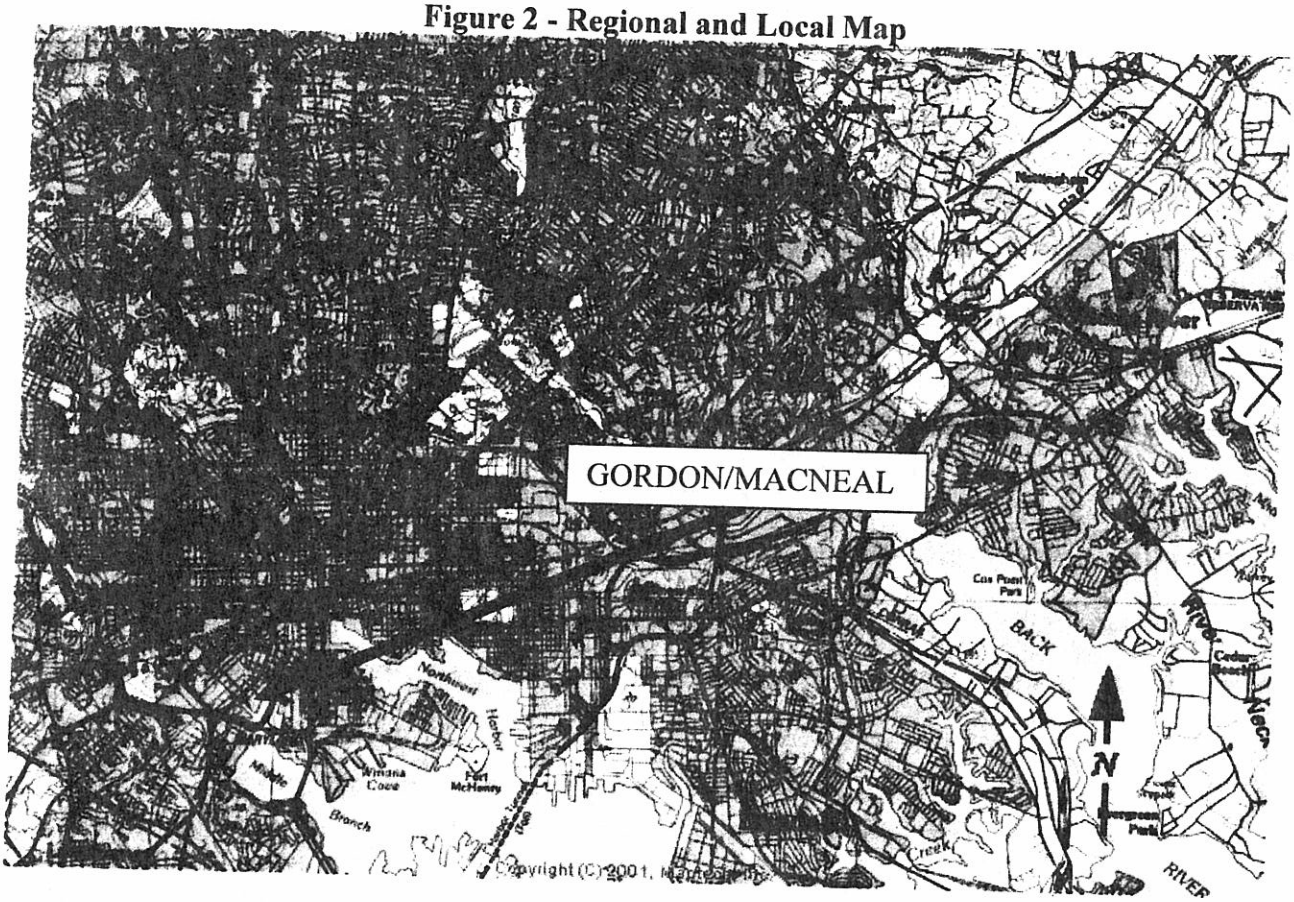


Topographic Map Of The Area
(From USGS Baltimore West Quadrangle - 1975)
1:24,000 Scale

2.0 SITE DESCRIPTION

The Gordon/MacNeal site is located in the 1600 block of Warner Street off Worcester Street, Baltimore City, Maryland. The property is situated in an urban setting on the southern edge of Baltimore City, and is currently owned by Warner Street, Inc. Geographic coordinates for the property are 39°16.3955" north latitude and 76°37.5815" west longitude, based on the North American Datum of 1983 (NAD83) data measured from the Baltimore East U.S. Geological Survey (USGS) Quadrangle Map. The Maryland grid coordinates for the site are 524,400 feet north and 905,800 feet east based on the geographic center of the property as measured on page 42 of the 2004 Alexandria Drafting Company (ADC) map for Baltimore City and County, Maryland. The site consists of three parcels identified in Maryland Department of Assessments and Taxation as Ward 21 Section 09 Block 0844A Lots 001A, 005, and 010. The property is located in Congressional District 03. Gordon/MacNeal is at approximately 10 feet above mean sea level in coastal plain alluvium.

Figure 2 - Regional and Local Map



2.1 Site Ownership and Use

In the 1890s the property housed the C.F. Ranstead Baltimore Cedar Co. From 1902 through 1953, the J. B. MacNeal and Company Varnish and Color Works operated out of buildings on this property. In 1953 this property housed both J. B. MacNeal and Gordon Carton. MacNeal occupied the northwestern quadrant and Gordon the southeastern. The pathways of concern for any residual contamination include soil, groundwater and indoor air quality.

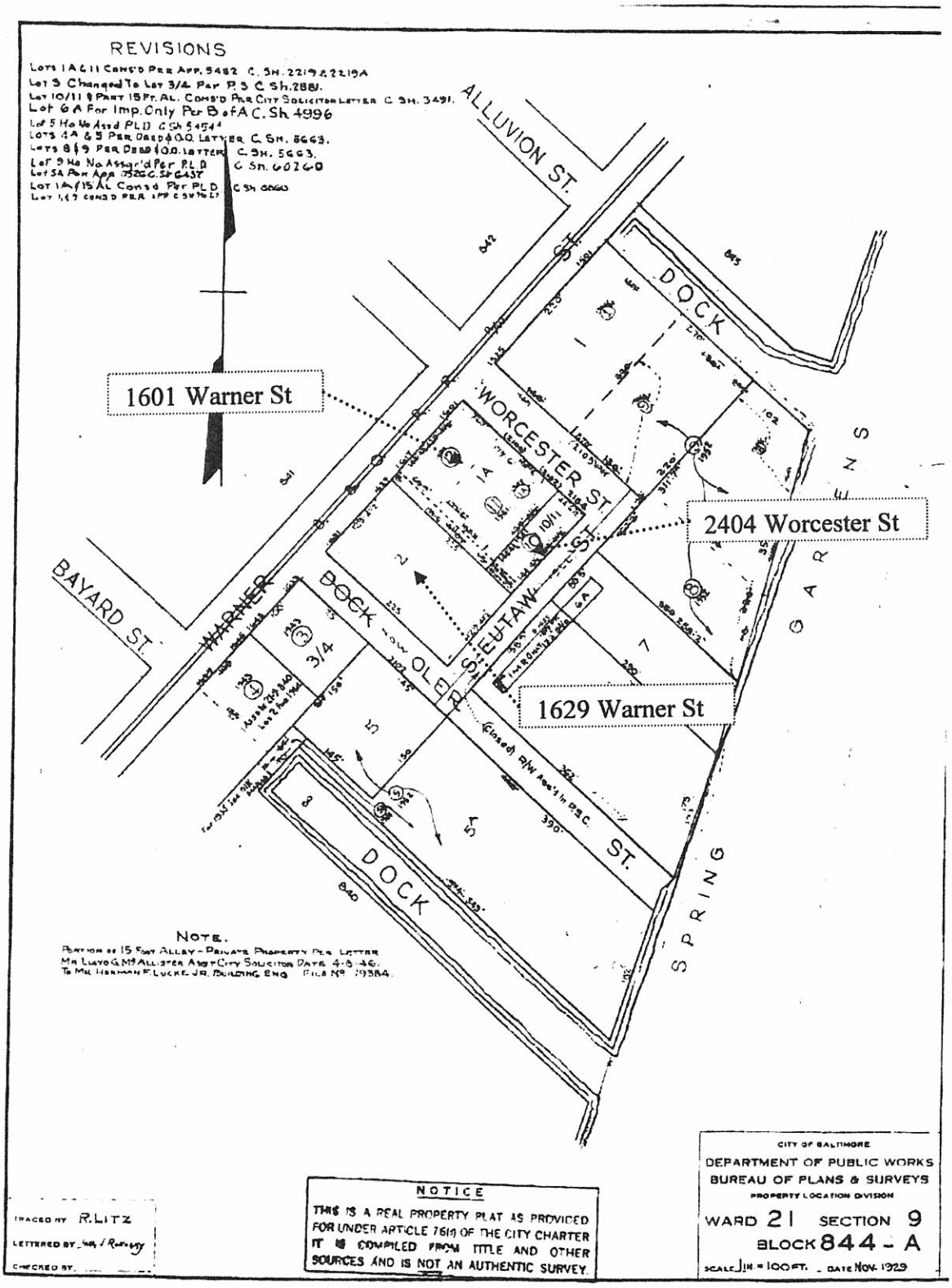


Figure 3 – Property Map of Gordon/MacNeal Area

2.2 Permitting and Regulatory Actions

Gordon Cartons had a minor air quality issue noted in July 1999.

2.3 Remedial Actions

The 2401 Oler Street building was the site of a planned removal of drums of industrial waste that had been illegally stored on a loading dock at the premises. In the late 1980s MDE worked with the property owner to characterize and remove drums of waste that had been collected from the Gordon/MacNeal plant and consolidated in the Oler Street building. There are no other records of remedial actions relative to the Warner Street facility.

3.0 ENVIRONMENTAL SETTING

3.1 Water Supply

Drinking water for Baltimore area residents is supplied by the City of Baltimore from a series of aboveground reservoirs located to the north of the City. According to the U. S. Department of Agriculture (USDA), *"the Department of Public Works, Baltimore City, provides water for the City of Baltimore from three sources: the Gunpowder Falls, the North Branch of the Patapsco River, and the Susquehanna River."* Water collected from these sources is re-routed toward three reservoirs (Liberty, Loch Raven and Prettyboy) and treated at city filtration plants prior to distribution to the local population.

Virtually all of the residents around Baltimore City receive water from municipal supplies. These consist of the Baltimore City surface water reservoirs, the nearest of which is approximately ten miles north of the site. There are no transient or non-transient non-community wells in the Gordon/MacNeal area. The closest domestic source well is located over one mile away from the site at 529 Island Point Road. The locations of the area well systems, the estimated populations and the area that they serve are represented in Table 1.

In the City of Baltimore, storm water drainage occurs through an extensive network of underground conduits; site-specific drainage flows to these storm drains and directly to Middle Branch Patapsco River via overland flow.

Table 1 – Four-Mile Radius Domestic Water Sources and Populations

RING DISTANCE FROM THE SITE	ESTIMATE NUMBER OF DOMESTIC WELLS	ESTIMATED POPULATION SERVED*	RING DISTANCE FROM THE SITE	TOTAL POPULATION
0 – ¼ mile	0	0	0 – ¼ mile	325
¼ –½ mile	0	0	¼ –½ mile	1623
½ - 1 mile	0	0	½ - 1 mile	19444
1 – 2 miles	0	0	1 – 2 miles	71445
2 – 3 miles	16	42	2 – 3 miles	141629
3 – 4 miles	7	18	3 – 4 miles	144474
Total	21	60	Total	378940

*According to 1998 U.S. Census data, the average population per household is 2.62.

3.2 Surface Waters

The Gordon/MacNeal property lies on the Middle Branch Patapsco River just north of the confluence of Gwynns Falls with the Middle Branch. Natural drainage on the site is in a generalized southeast direction to dock areas that flow into the Middle Branch. Surface water infiltrates the soil to groundwater, or is discharged via overland flow to the Middle Branch Patapsco River. The Middle Branch Patapsco River flows into the Patapsco River, which discharges into the Chesapeake Bay.

The farthest upstream probable point of entry for the surface water route originates in a drainage ditch behind the site, which flows to a dock area southeast of the site. This unnamed tributary to Middle Branch Patapsco River travels east southeast for approximately 580 feet to the Middle Branch. The Middle Branch Patapsco River, a brackish estuary and a fishery flows 3.5 miles to its confluence with the Patapsco River. The Patapsco River flows 11.5 Miles to its confluence with the Chesapeake Bay. The 15-mile surface migration pathway ends in the Chesapeake Bay at Craighill Channel off Bodkin Point. The shores of the Patapsco River and the Chesapeake Bay are classified as estuarine intertidal wetlands and are fisheries and aquatic use areas.

3.3 Soils

Four soil Associations make up most of the Baltimore City area. These include 1) Urban Land-Legore Association, which are very deep, nearly level to moderately sloping, well drained upland soils that are underlain by semibasic or mixed basic and acidic rocks (34% of the land area, of which 43% is urban land); 2) Urban Land-Joppa-Sassafras Association, which are very deep, somewhat excessively drained and well drained upland soils that are underlain by sandy or gravelly sediments (18% of the land area, of which 40% is urban land); 3) Urban Land-Sunnyside Association, which are very deep, nearly level to moderately sloping, well drained upland soils that are underlain by unstable clayey sediment (24% of land area, of which 54% is urban land); and 4) highly disturbed soils that vary in slope position, drainage, and origin that make up 24% of the land area. Based on the percentage of cover of these soil associations, the total land cover of the city that is made up of highly disturbed soils (urban land and Udorthents)

is approximately 60%, though the coverage of relatively undisturbed soils by impervious surfaces, such as roads, is not included in this estimation.

Gordon/MacNeal's soils are classed as soil types 43U and 44UG, Udorthents, 0 to 15 percent slopes. Udorthents are soils that have been impacted by human urban development. The major difference between the two soil groups is that the 43U soils are occasionally flooded.

FIGURE 4 – AREA SOILS MAP



KEY TO SOILS MAP

Map Unit Symbol	Map Unit Name
43U	Urban Land/Udorthents complex, occasionally flooded
44UC	Urban land, 0 to 15 percent slopes

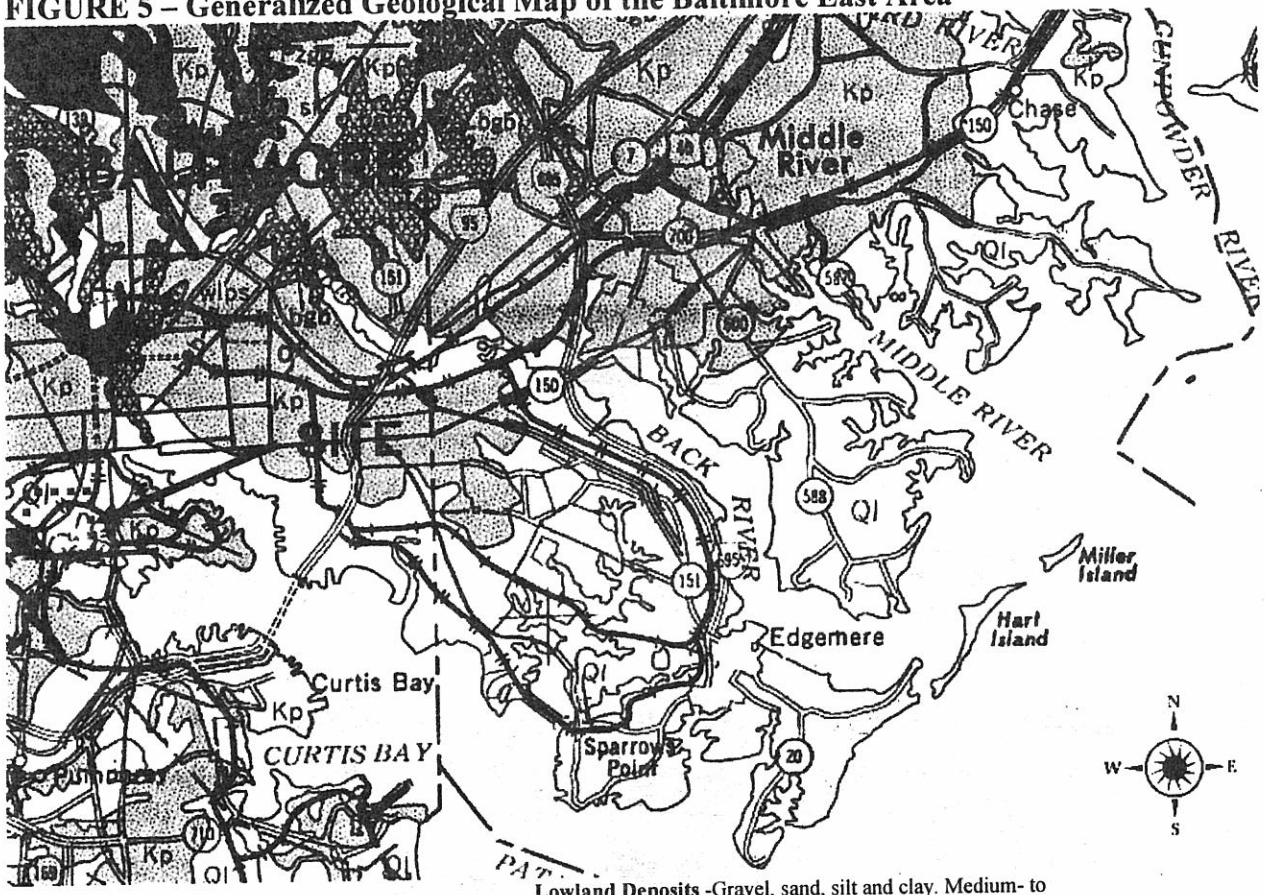
3.4 Geology and Groundwater

Gordon/MacNeal lies in the erosional remnants of the Coastal Plain Physiographic Province, near the Fall Line. The unconsolidated sediments of the Coastal Plain extend eastward from the Fall Line, dipping eastward and becoming progressively thicker with distance, eventually reaching over 8,000 feet in thickness at Ocean City.

Baltimore City lies within two physiographic provinces, the Piedmont Plateau and the Atlantic Coastal Plain. The north-northeast trending Fall Line separates the two provinces, dividing the city in half. Most of the city is characterized by nearly level to gently rolling uplands, dissected by narrow stream valleys. The Piedmont Plateau in the City of Baltimore is

underlain by old igneous and metamorphic rocks. The Coastal Plain in the city is underlain by much younger, poorly consolidated sediments.

FIGURE 5 – Generalized Geological Map of the Baltimore East Area



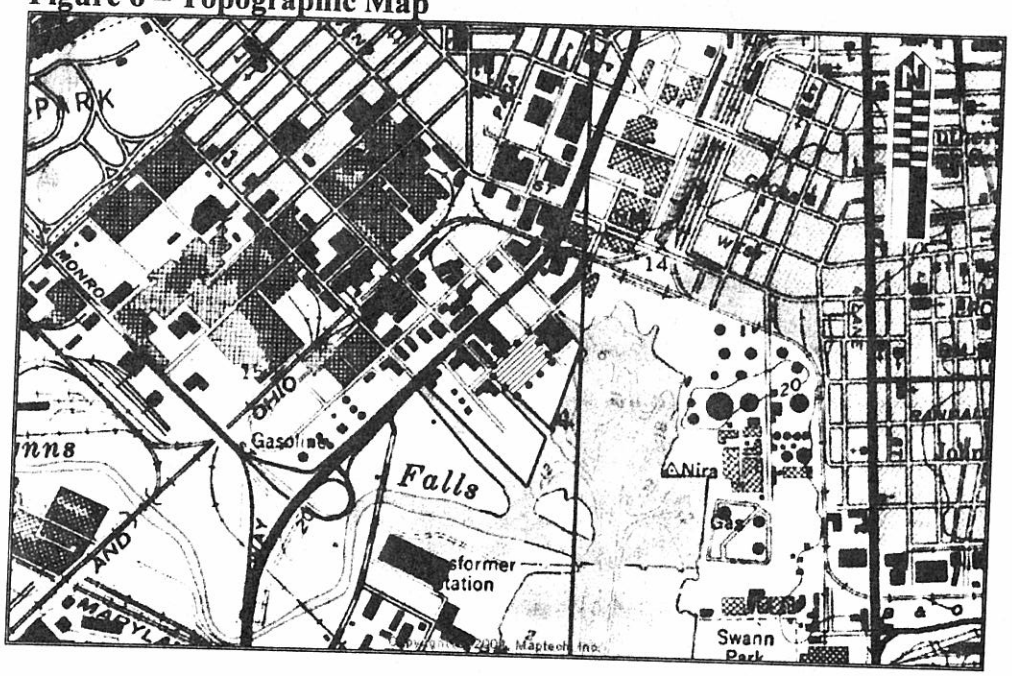
Ql — **Lowland Deposits** -Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet

Kp — **Potomac Group** - Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.

The site is situated on artificial fill consisting of heterogeneous materials such as rock and brick fragments, gravelly sand and unconsolidated sediment. The top geological strata in the area of the site are Quaternary Lowland Deposits consisting of medium to coarse grained and varicolored gravels, sands, silts and clays. Below the surficial sediments are the Cretaceous strata of the Potomac Group. The Patapsco Formation, which is made up of sand and interbedded with layers of silty clay predominantly made up of quartz, illite and kaolinite, is known to be approximately 60-foot thick. The next layer is the Arundel Formation, which is a clay layer known to be approximately 140-foot thick, interbedded with lenses of sandy silt containing traces of lignitic material. The clay minerals are predominantly kaolinite and illite. The subsequent underlying strata is the Patuxent Formation and is made up of sand and gravel with interbedded lenses of silty clay with quartz as the predominant mineral. The Patuxent Formation is underlain by bedrock consisting of a complex assemblage of schist, gneiss and gabbro.

The principal groundwater aquifers in the region are the Patapsco and Patuxent Formations. The Patapsco Formation is the layer capable of yielding large quantities of water. However, the formation is brackish due to the encroachment of seawater, and therefore not usable as a water source. The Patuxent Formation is the most important water bearing formation in the Baltimore area, capable of yielding large quantities of water.

Figure 6 – Topographic Map



3.6 Meteorology

The climate is temperate and humid with an average of 200 freeze-free days. The average temperatures range from 78.5 degrees Fahrenheit in the summer to 36.6 degrees Fahrenheit in the wintertime. The mean annual precipitation is about 42.59 inches with an average snowfall on the order of 22 inches per year. The two-year 24-hour precipitation for the Baltimore area is 4.38 inches.

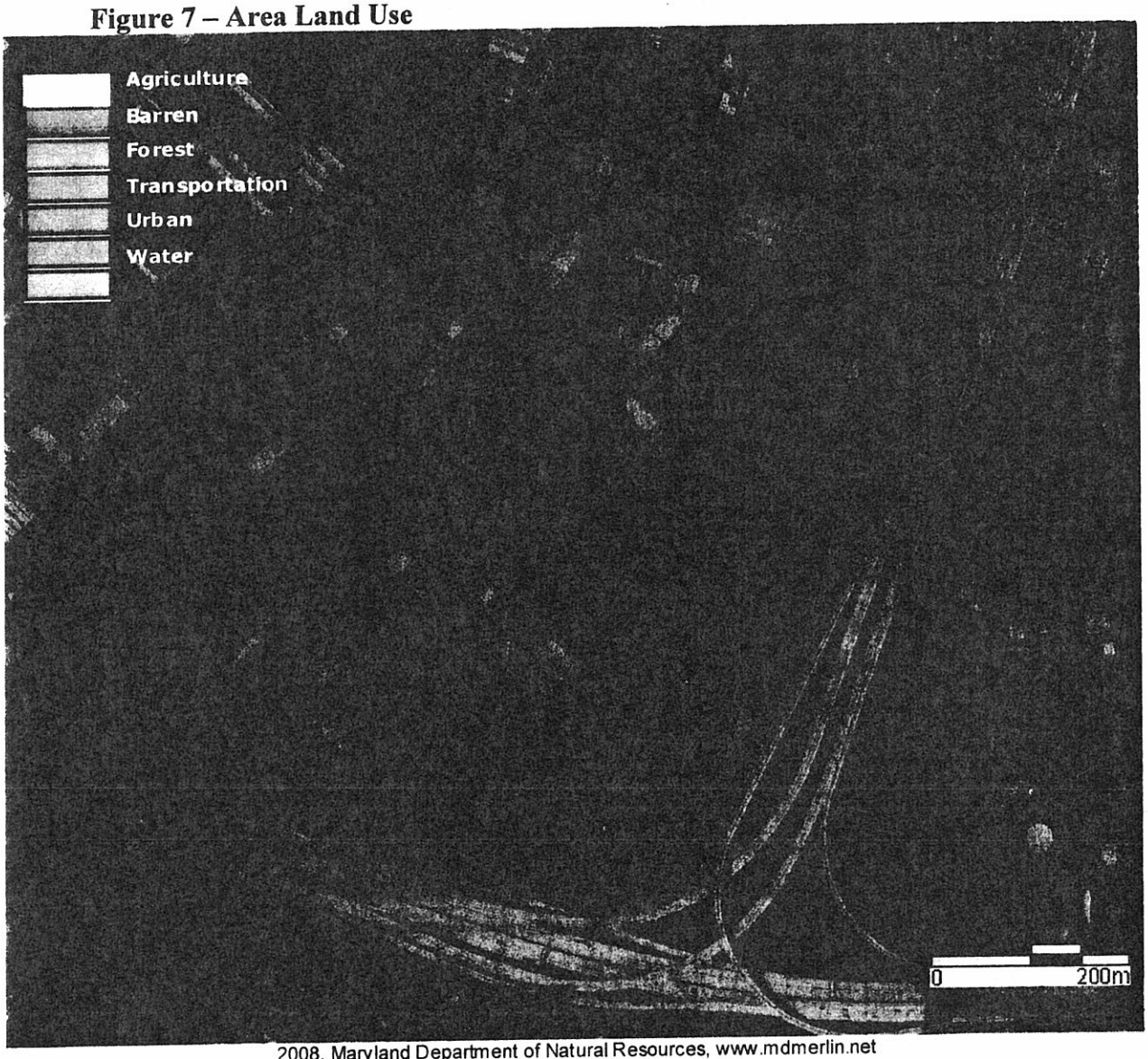
3.7 Nearby Land Use and Population Distribution

Land use surrounding the site is a mix of commercial and industrial with some transient residential. The site lies within a sixteen acre parcel dubbed "Baltimore Gateway South," which was previously occupied by Maryland Chemical Company, Second Chance, a non-profit architectural salvage company, and the vacant Gordon/MacNeal building. Gateway South is part of an urban renewal project designed to renovate and revitalize the Middle Branch Patapsco River area. Land use will change from primarily industrial use to principally residential commercial use within the corridor.

Roughly two-thousand people inhabit the area within a half mile radius of the site. Population density increases exponentially with distance from the site. There are over 21,000 people residing within one mile of the site and 380,000 within four miles of the site (Table 2).

There will be an influx of residents into the immediate area as the change from industrial use to commercial/residential use proceeds. Construction of several condominium townhome developments is currently underway in the Middle Branch Patapsco area.

Figure 7 – Area Land Use



2008, Maryland Department of Natural Resources, www.mdmerlin.net
Created with TNTserver™ from MicroImages, Inc

Table 2 – Population Distribution

Radius (miles)	Population
0 – 0.25	325
0.25 – 0.5	1623
0.5 – 1.0	19444
1.0-2.0	71445
2.0 – 3.0	141629
3.0 – 4.0	144474
Total	378940

The resident population distribution around the site was determined using Maryland census tract data for the year 2000.

4.0 WASTE DESCRIPTION

J.B. MacNeal was a manufacturer of varnish and other coatings. Chemicals associated with the manufacture of paint and varnishes include petroleum distillates, alcohols, chlorinated solvents, shellac, surfactants, chemical dryers, polymers, organic compounds, heavy metals, epoxies, solvents, mild corrosives, polyurethanes, herbicides and fungicides.

Gordon Carton was an industrial printing operation. The inks used in printing fall into four classes: letterpress, lithographic, flexographic and rotogravure. The letterpress and lithographic are based mainly in mineral oil, while flexographic and rotogravure use very volatile solvents. Gordon Carton's presses were principally rotogravure and flexographic. Common materials used include solvents, inks and corrosive cleaning materials.

Chemicals that might be anticipated at Gordon/McNeal include: acetone, alcohols, anti-bacterial agents, cadmium, chemical dryers, chlorinated solvents, chromium, corrosive cleaners, cresol, epoxies, esters, ethyl acetate, fungicides, heavy metals, herbicides, hexane, ketone, lead, methyl ethyl, methyl isobutyl ketone, mild corrosives, n-butyl acetate, organic compounds, petroleum distillates, polymers, polyurethanes, shellac, sodium hydroxide, surfactants, titanium dioxide, toluene, volatile organic compounds, waste metals, waste or spent corrosives, waste or spent polymers, xylene, and zinc.

5.0 PREVIOUS STUDIES

MDE was contacted by the Baltimore Development Corporation (BDC) to perform Brownfield Assessments of several properties in the Warner Street Corridor. A Phase I assessment was performed on the sixteen acre area containing Gordon/MacNeal. Due to access issues MDE was unable to complete a Phase II Brownfield Assessment on the Gordon/MacNeal property. BDC contracted a Phase II Environmental Assessment of Gordon/MacNeal and several of the other Warner Street Corridor properties. Results of these investigations are

documented in the KCI Technologies Report, *Phase II Environmental Assessment Gateway South Redevelopment Properties*.

6.0 FINDINGS AND CONCLUSIONS

The Gordon/MacNeal property has been the site of light industry for over one hundred and twenty years. Two principal industries are contributors to potential contamination in the area; they are commercial printing and paint and varnish manufacturing. Numerous hazardous chemicals are associated with both of these industries and there is a strong potential that these materials have been released into the environment.

Signs of past storage and housekeeping practices indicate that paints and pigments have been spilled in loading docks and fenced storage areas. Access to the interior of the building was denied; therefore no analysis of interior issues can be verified. Facility inspections conducted when Gordon Carton was operational indicated that chlorinated solvents were used extensively and that storage and control of the materials was haphazard at best prior to Resource Conservation and Recovery Act (RCRA) enforcement. Releases of environmental contaminants from the facility likely resulted in contamination of soils and groundwater and would likely have an impact on indoor air quality in structures in the immediate area. A full sampling assessment should be performed on the Gordon/MacNeal site and adjacent properties. Soil, groundwater and indoor air should be examined to determine the extent and nature of environmental contamination relative to the former occupants of the building.

Gordon/MacNeal is in an area of urban redevelopment in the Southern Gateway to Baltimore City. The 1629 Warner Street property was recently demolished by fire. All that remains of the structure is a portion of the concrete slab foundation. It is anticipated that the owners of most of the redeveloping properties in the corridor will join the Voluntary Clean-up Program (VCP). Should the owners decide not to participate in VCP a Site Investigation (SI) should be performed on the property.

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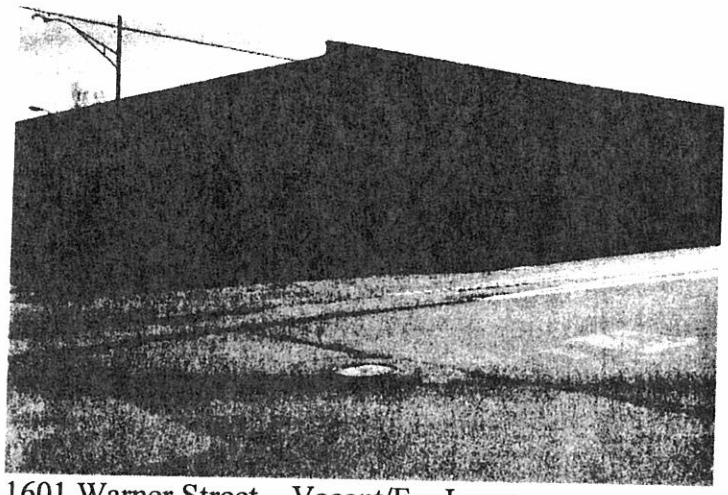
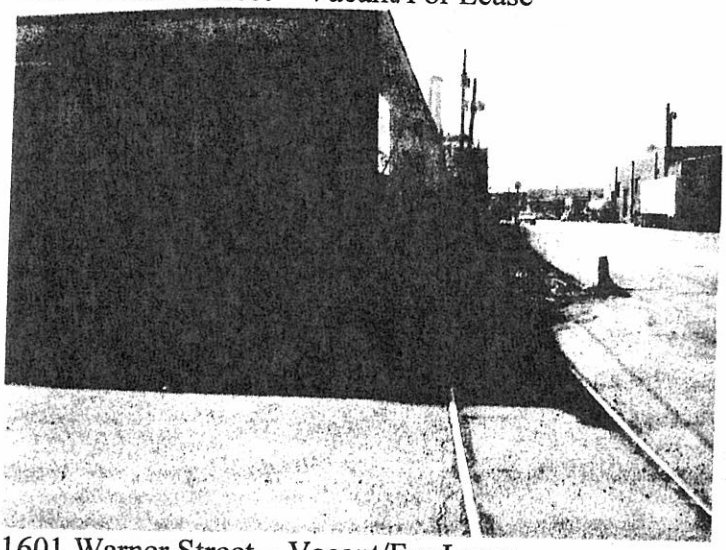
14. U.S. Department of the Interior Geological Survey, *Characteristics of Streamflow in Maryland, Report of Investigations No. 35*, 1983.

Appendix A – Photographs



1601 Warner Street – Vacant/For Lease



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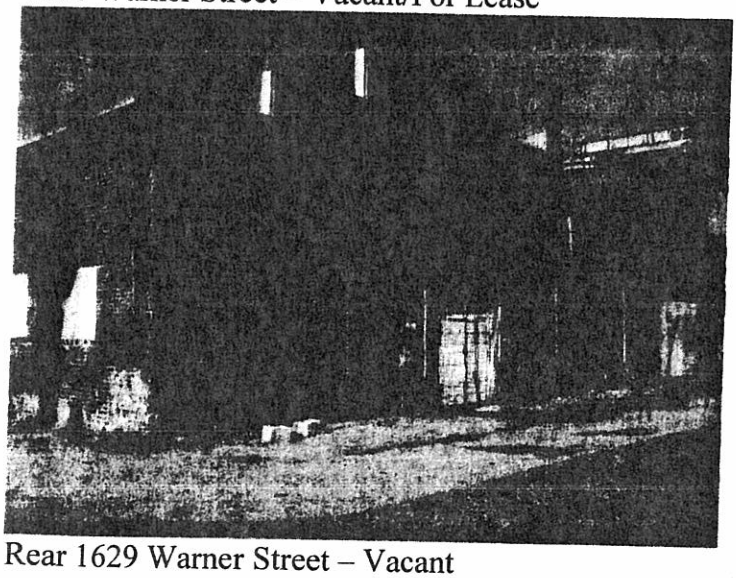
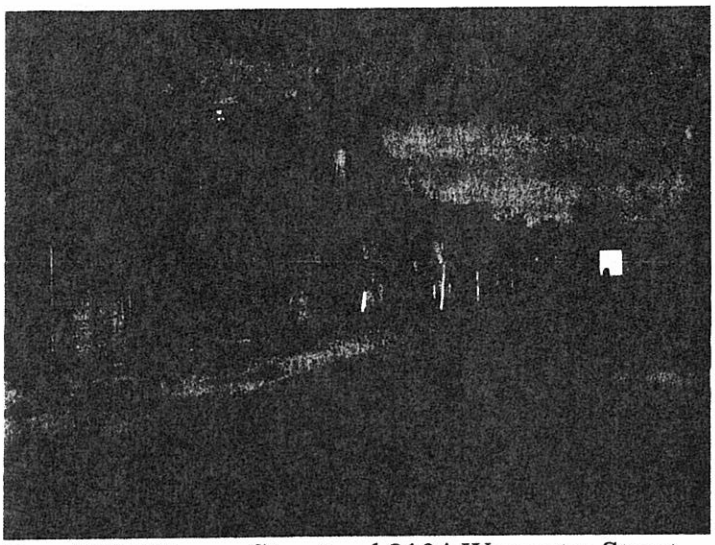
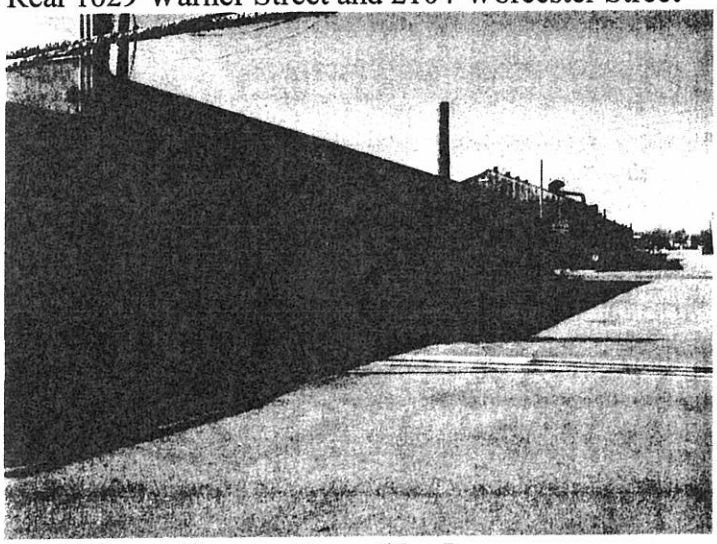


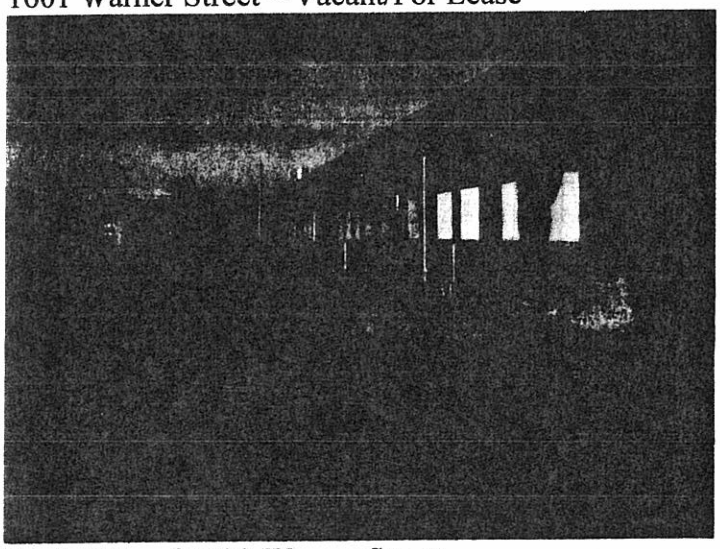
Rear 1629 Warner Street – Vacant



Rear 1629 Warner Street and 2104 Worcester Street



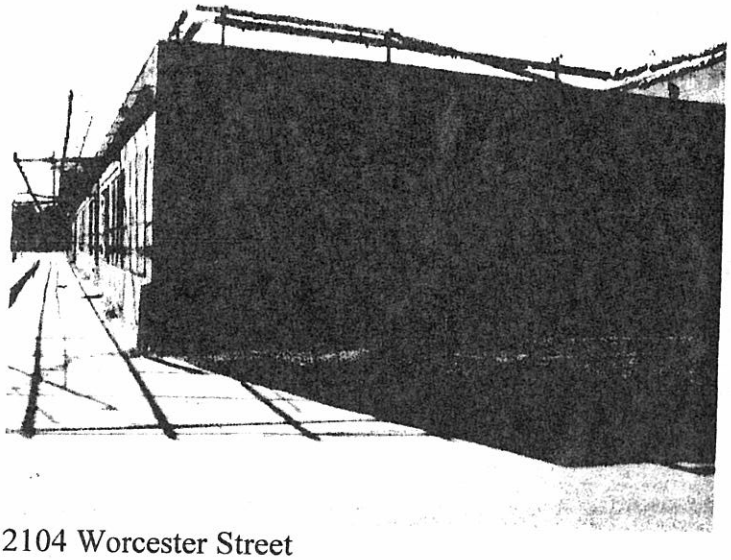
1601 Warner Street – Vacant/For Lease



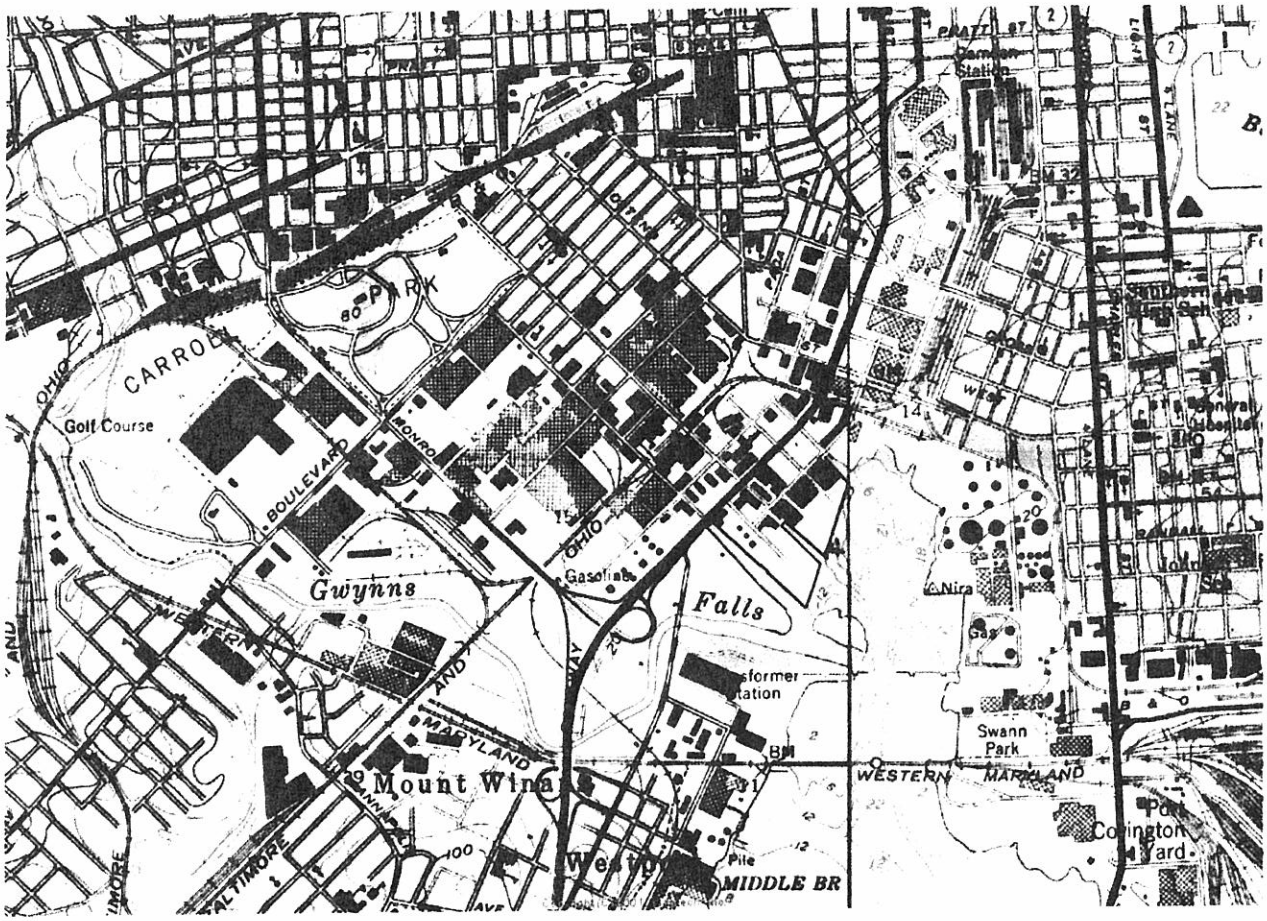
South Side of 1629 Warner Street

Gordon/MacNeal

Revision I
October 2, 2008



2104 Worcester Street


PRATT ST
Camden Station
CARROLL
PARK
Golf Course
OHIO
BOULEVARD
MONROE
Gwynns
Falls
Gasoline
WESTERN
MARYLAND
Mount Winans
Westport
MIDDLE BR
Pile
Nira
Swann Park
WESTERN MARYLAND
Port Covington Yard

Ad Stijnman

Oil-based printing ink on paper

Bleeding, browning, blanching and peroxides

Printing with oil-based ink is known in Europe from the 11th century, when it was used for decorating textile. Printing on paper is done here by the end of the 14th century. Although oil-based inks are usually considered stable, there are phenomena – such as bleeding, browning or blanching – which are typically related to printing ink on paper. To facilitate a better understanding of the presented phenomena the different printing techniques and their history, the inks, their properties and ingredients are outlined.

Das Drucken mit Farben, die auf Öl basieren, ist in Europa seit dem 11. Jahrhundert bekannt. Damals wurde es zum Dekorieren von Textilien verwendet. Papier wird seit Ende des 14. Jahrhunderts bedruckt. Obwohl Druckfarbe meistens als stabil betrachtet wird, gibt es eine Anzahl von Phänomenen – wie Ausbluten, Verbräunen und Ausblühen – die typische Begleiterscheinungen von Druckfarben auf Papier sind. Die Drucktechniken und ihre Geschichte sowie die der Druckfarben, ihrer Eigenschaften und [illegible] werden skizziert, um die [illegible] zu geben.

Reading this text is possible because [illegible] with the white paper it [illegible] image upon other [illegible] is what makes the[illegible] riers. Other ways to [illegible] such as cutting out [illegible] ter raking light cau[illegible] makes text or image v[illegible] making and for visiti[illegible] blind to read the raised

There are the idiosyn[illegible] ques that require certain [illegible] printing successfully on [illegible] paper is the subject of this [illegible] to a number of possible phe[illegible] or browning of the paper – [illegible] be on the printing ink, while [illegible] under discussion here. This [illegible] prints, images and texts on pa[illegible] ink. It is likely that similar ph[illegible] other carriers and different kind[illegible]

The little research done rega[illegible] will be sketched first. Thereafter a[illegible] tory will be given, followed by [illegible] and ingredients of printing [illegible] nderstanding of the pheno-

[illegible] on etymology. "Encre" [illegible] nkt" (Dutch) can mean [illegible] printing as well as the [illegible] homonyms. In the con-[illegible] k" is used for the paste-[illegible] English, means press-[illegible] ting form) and a car-[illegible] meaning of the term [illegible] is a press for print-[illegible] n English means [illegible] e specifically it is [illegible] agrams or repro-

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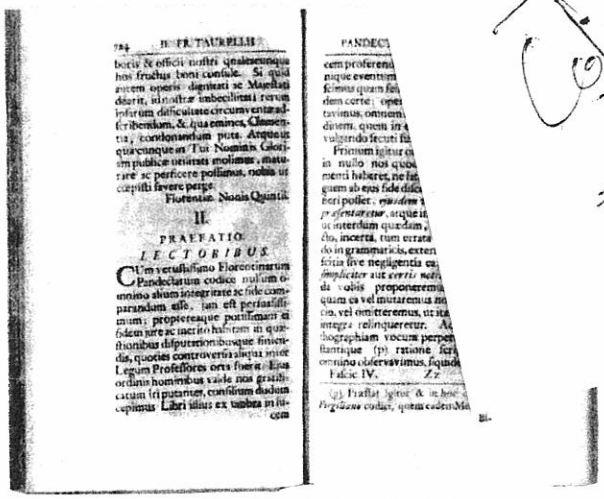
[illegible] books was [illegible] eafter the [illegible] Instituut [illegible] present [illegible] echni-[illegible] ises of [illegible] rried [illegible] -nks, [illegible] and blanching on [illegible] 1989-1; Stijnman 1992; Towns-[illegible] 1992; Brown 1994; Hallebeek, Reißland, Stijnman 1998; Schmutzler 1999).



1 **Browning in printed books related to the text.**

History

Cutting an image, symbol, text into or out of a surface is known from prehistoric times. One step further is to press this matrix into a soft surface, such as Assyrian seals pressed into

Ad Stijnman

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Reading this text is possible because the black ink contrasts with the white paper it is printed upon. One can print a text or image upon other materials but not without ink, because this is what makes them visible due to the contrast with their carriers. Other ways to create such a contrast have been sought, such as cutting out letters or blind embossment. With the latter raking light causes the relief to throw a shadow which makes text or image visible. This is occasionally used in printmaking and for visiting cards. Braille lettering enables the blind to read the raised dots.

There are the idiosyncrasies of the several graphic techniques that require certain properties of their inks needed for printing successfully on a carrier. Oil-based printing ink on paper is the subject of this essay, their interrelation giving rise to a number of possible phenomena – like bleeding of the ink or browning of the paper – after printing. The emphasis will be on the printing ink, while the properties of paper are not under discussion here. This essay is limited to books and prints, images and texts on paper printed with an oil-based ink. It is likely that similar phenomena will be visible with other carriers and different kinds of objects.

The little research done regarding printing ink on paper will be sketched first. Thereafter a brief survey of the principal graphic techniques and their history will be given, followed by a description of the properties and ingredients of printing inks. This is to create a better understanding of the phenomena described.

Before continuing, a word on etymology. "Encre" (French), "ink" (English) and "inkt" (Dutch) can mean both the paste-like material used in printing as well as the watery material for writing: they are homonyms. In the context of the present article, the term "ink" is used for the paste-like, oil-based material. "Printing", in English, means pressing an inked block, stone or plate (a printing form) and a carrier against each other. The more specific meaning of the term is "printing text", such as a printing press is a press for printing books. The term "printmaking" in English means making prints, i.e. printing images. More specifically it is used for printing works of art, thus not diagrams or reproductions.



1 **Browning in printed books related to the text.**

Research

Oil-based printing inks have long been thought to be inert. Although discolouration of the pigments is often visible, inks usually are not thought to degrade paper. There are, however, phenomena which should be taken into consideration when studying printing ink on paper (Fig. 1).

Research on browning in prints and printed books was initiated by the Royal Library in The Hague. Thereafter the Central Research Laboratory (merged into the Instituut Collectie Nederland in 1997) in Amsterdam asked the present author to do a literature search on the materials and techniques for printing books with an eye on the possible causes of browning. Several other research projects have been carried out thereafter, such as on bleeding dyes in lithographic inks, the photocatalyst zinc white in printing ink and blanching on woodcuts (Ligterink, Porck, Smit 1989-1; Stijnman 1992; Townsend, Perry 1992; Brown 1994; Hallebeek, Reißland, Stijnman 1998; Schmutzler 1999).

History

Cutting an image, symbol, text into or out of a surface is known from prehistoric times. One step further is to press this matrix into a soft surface, such as Assyrian seals pressed into

clay. However this is not printing in the sense of transporting a colourant in a vehicle from one surface to another, i.e. from plate to carrier. Early, primitive forms of printing can be seen in prehistoric cave paintings. A hand was dipped into paint and pressed against the wall, or an unpainted hand was pressed against the wall and paint sprayed over it making its outline visible, meaning: "I was here, I state that it is as I want it."

Printing in relief, as we define it, started more or less simultaneously in Central America, China and Egypt about two thousand years ago. Small ceramic, stone or wooden stamps were inked and pressed against textile to decorate it. It was in China that the first images from woodcuts were printed on paper from the 7th century onwards. Western and Southern Europe started printing decoration on textile in the 11th century, when China was already printing text with separate/loose ceramic characters. Korea followed in the 14th century with the invention of metal type.

In contrast to Europe, technical developments in Asia did not continue, let alone mechanisation. In Europe the printing of woodcuts on paper started late in the 14th century and engravings in copper plates were printed from about 1430. Printing was done by hand, machines were not yet in use. With the invention of typographic printing from metal type around 1440 came the printing press, followed in 1460 by the roller press for intaglio printing. Both were invented and in use in the Rhine area north of Basel. The use of the printing press spread rapidly in the second half of the century, the roller press was slow to follow.

Techniques refined, presses improved and shortly before 1800 new developments started taking place. Metal printing presses came on the market, experiments started with new plate materials like glass and steel, and a totally new printing technique was invented: lithography. The 19th century was full of new inventions. Experiments were made with maybe a thousand new printmaking techniques, mainly incited by the introduction of photography, many of which never came to fruition. Steampower allowed the mechanisation of the printing and lithographic presses. Roller presses were still operated manually due to the properties of the etchings and engravings. Only when new plate making techniques were developed by the turn of the century, it became possible to mechanise their printing also. In 1907 the modern screenprinting technique was patented. This allowed the printing of any kind of subject on any kind of surface.

Graphic techniques

Up until the invention of photocopying in the 1930's, and following its wide-spread use (and thereafter of inkjetprinting, laserprinting and the like), four fundamental graphic techniques were in use. These were, in chronological order of usage: stencil, relief, intaglio and planographic printing. With all these methods both texts and images may be printed.

All methods for creating a printing form were manual or mechanical before 1840. In the preceeding decades several photographic techniques had been invented and in 1839 the patent for the Daguerreotype made public. From then on many attempts were made to incorporate photography into printmaking, the so-called photomechanical techniques. Success came after 1850. Printing methods, nevertheless, basically remained the same.

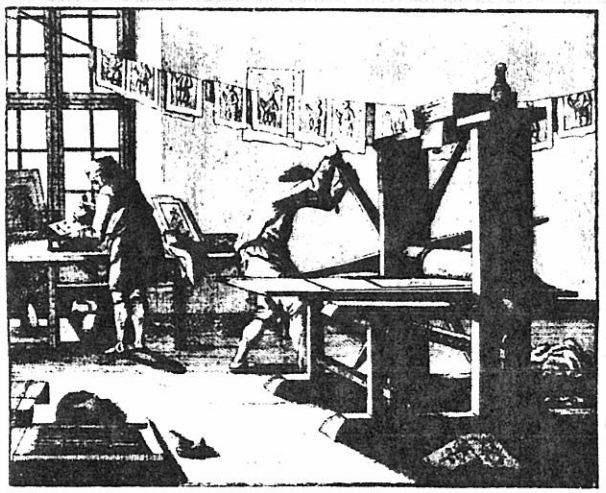
With stencil printing, either an object is laid onto a surface and ink spread around it, leaving the surface underneath the object blank, or else, an image is cut out of sheet material and the ink squeezed through, leaving the surrounding area blank. Techniques used are: stencilling, pochoir, screenprinting. Any kind of medium may be and has been used for stencil printing inks, but usually they were and are water-based. Water-based inks will not be dealt with here, nor the resin-based inks which have been used widely for screenprinting.

When an image is drawn on a block or plate, and the areas around the image are cut out, the resulting relief can be inked, leaving the cut out parts white. This inked relief and a carrier are pressed against each other and thereby the print is created. Techniques used are: woodcut, typographic printing, woodengraving, autotype.

Cutting or etching an image into a plate is called in English an intaglio technique (derived from the Italian "intagliare"). The plate is inked and the ink removed from the surface in such a way that the ink is left in the grooves. Plate and carrier are pressed against each other, the paper is pressed into the grooves against the ink and thereby the print created. Techniques used are: engraving, etching, mezzotint, dry point, helio-engraving (Fig. 2).

Treating a stone or metal plate chemically without creating a relief of some sort, causes the image to be on the same level as its surrounding whites. Therefore it is called planographic printing. The inked surface and a carrier are pressed against each other and thereby the print is created. Techniques used are: lithography, photolithography, offset printing.

Each printing technique requires its own type of press and its own manner of printing. The inks for the different techniques are alike only in the sense that they are usually oil-based. They cannot be interchanged just like that. On the



2 Image of plate printer.

contrary, specific inks are manufactured for every different plate or block as will be seen below.

Printing ink

Oil-based printing ink consists of a binder, the varnish, ground with a colourant. Varnish is vegetable oil, usually linseed oil, heated for a certain time to make it more viscous. Resin, soap, extender, drier and toner may be added to modify the ink. The essential properties of the printing ink itself are determined by the mixture of several varnishes with dry pigments in certain ratios. Driers, extenders and toners – added in the preparation of the varnish or the ink – refine the ink's properties. All these will be dealt with below in more detail.

Essential properties

The oldest varnish recipe we know is in Theophilus' manuscript from the first quarter of the 12th century. This varnish is meant as a transparent lacquer to cover paint layers on wood (Theophilus 1979: 28-29; Theophilus 1999: 20-21, 66-67). Theophilus heats linseed oil until boiling and adds resin. It was during this time that textile printing from woodblocks began in Europe, but only in the late 14th century Cennino Cennini describes its production technique, giving the oldest known recipes for printing ink (Cennini 1954: 58-59, 115-118). Both authors give basic recipes from which the inks for the different kinds of printing techniques have been developed.

Ink for printing from metal type on paper, for instance, has higher demands than ink for printing woodcuts on textile. It is important that the ink adheres to the metal in a smooth and as thin – while at the same time as opaque – as possible layer which offsets easily again onto the paper. In printing the ink may not pick, the matter may not be filled with ink and the ink should not dry on the surface of the type. It should dry on the paper directly after the sheet comes from the press. Therefore it always contains driers which accelerate oxidation of the varnish. When drying the ink should harden completely without starting to powder, offset or bleed giving rise to halos around the text.

Different requirements are needed for intaglio printing ink. Its viscosity is lower than for relief printing. The ink should be opaque, should dry but not too fast, should offset easily from the grooves of the plate onto the paper. Wiping the ink from the plate should be fairly easy, but without drying onto the plate, the pigment particles scratching the surface, or the ink being wiped from the grooves. When the ink is dry, it should harden completely without the ink starting to powder, offset or bleed giving halos around the imagery. Black intaglio inks contain no or just a little drier, coloured inks do.

For lithographic ink the most viscous varnish is used compared to other printing techniques. Also the ink has a high pigment : varnish ratio. This allows for printing extremely thin but still opaque layers of ink on the paper. The blacks contain no drier, coloured inks do. The black inks harden only slowly, but also should not bleed, offset or powder. More important is that lithographic ink should not contain a constituant that could dissolve in water, since the printing is done from dampened stones of plates.

Preparation

Formerly, in preparing his ink the printer considered the structure of the image or text he had to print and accordingly chose his varnishes, pigments and extenders. He mixed the dry and the fluid materials separately and added the varnish to the pigment in a certain ratio. The materials were mixed together and then thoroughly ground until all the dry particles were encapsulated in the medium. This is printing ink. Nowadays mixing and grinding is done by machines and the printer buys his ink ready-made, although he might admix some varnish or extender.

Oil & varnish

Varnish is a drying vegetable oil boiled and burned at temperatures starting at 250 °C to 400 °C for periods ranging from a few minutes to several hours. In the process unsaturated fatty acids oxidize and polymerise, making longer chains together with crosslinks. The temperatures at which the oil is boiled, together with the time of boiling, determine the viscosity of the final product. Additives like resins or soap modify this. A varnish with a lower viscosity gives an easier flow to the ink whereas a varnish with a higher viscosity dries faster, to mention only a couple of characteristics.

Linseed oil has always been and still is the common oil for varnish. Other vegetable oils have been used too, like walnut-oil (expensive, but discolours less than linseed-oil) and rape-oil (cheap, but with bad drying properties). Trane-oil, from whales, is mentioned in the 17th century. It was cheap, but since it does not dry it will create halos in the paper. Mineral oil came into use late in the 19th century and had preference after 1950. Nowadays the properties of vegetable oils are appreciated again.

Resin & soap

For relief printing colophony resin, or sometimes other kinds of resin, is always added to increase viscosity and adherence to the typemetal. For some kinds of lithographic ink varnishes with resin added are used. Their increased viscosity prevents emulsifying of the ink in the printing process.

Soap was boiled with the oil from the late 18th century onwards, starting in England. It reduces the viscosity of the relief printing ink and thereby its tack, which prevents picking. Cleaning the form after printing is easier.

Driers & extenders

Driers are needed in relief printing ink because lampblack, the only suitable pigment for this type of ink, acts as a retarder. In colour printing several layers of ink are printed next to each other. Driers are added here, because usually there is not enough drying time available. Driers catalyse oxidation of the unsaturated fatty acids in the varnish. Before 1800 recipes

always mention to boil lead oxides with the varnish, which oxides form chemical compounds with the oil and the resin when boiled together. These compounds are the catalysts, the actual driers. In the course of the 19th century other driers were found, such as cobalt and manganese compounds. From then on driers are not boiled with the varnish anymore, but added in the preparation of the ink.

In recipes for black intaglio ink no driers are mentioned before 1900. For colours they may be needed, depending on the colour printing technique and the colourants used, as some pigments have a drying effect. Black lithographic ink needs no drier, even though it is occasionally mentioned. The layers of ink on the paper are extremely thin and most of the varnish bleeds into the paper, which prevents offsetting. Driers are used in coloured inks.

Extenders are white inorganic solids, which are (semi-) transparent. This means they can be added to the ink without influencing its actual colour. They can have such properties as giving body to the ink, reducing the colour strength, facilitating wiping or preventing bleeding.

Blacks & toners

Only lamp-black – the finer variation of carbon black is called "gas-black" – is suited for relief and lithographic ink. It was used already by Johann Gutenberg for his typographic experiments. Lamp-black has the highest opacity of all pigments, while its particle size is very small. It therefore allows very thin layers of ink. The earliest reference to the use of lamp-black only for printing ink is found in 1555 (Alessio 1555: 189): "L'inchiostro poi da stampar lettere si fa di solo fume di ragia" [= The ink for printing letters should be made with smoke from resin only]. There follows a short description on the preparation of the varnish and the ink. In the 20th century a number of other fine grained black pigments came on the market, but carbon blacks are still most used. A small quantity of blue pigment may be added in grinding the ink. It acts as a toner, making the black optically blacker or neutralising a certain brownish hue caused by the varnish.

Concerning intaglio printing a somewhat coarser-grained pigment is needed. Before printing the plate is completely covered with ink and then wiped. With very fine pigments, such as lamp-black, the surface cannot be cleaned without constantly dragging ink from the grooves. A coarser grain prevents this. The classical pigment for intaglio ink is Frankfort black, commonly made by combustion of lees of white wine. Mentioned frequently from 1600 onwards it disappears from the market around 1900. Other suitable blacks are made from charred vine tendrils, kernels, bones and other organic matter. All black pigments of organic origin should be calcinated or washed with lye to remove bituminous matter, which may bleed from the ink after printing and thereby stain the paper.

Toners may be added to the black inks. Toners are colourants that give the black a blueish or brownish hue. They give the ink a warmer or cooler appearance depending on the kind of image wanted and the habits of the printer. Blue is usually mentioned, sometimes green and in the 19th century brown, red and even orange. Lamp-black may be added to intaglio ink for an intenser black and a greater opacity.

Colours

In principle all colourants used in oil painting may be used for coloured printing inks. The pigments should have a fairly small particle size to prevent damaging the printing plate or metal type in inking. Precipitated dyes or lakes may also be used. The pigments with the finest grains should be used for relief and planographic printing, and somewhat coarser grained pigments for intaglio printing. Colourants for lithographic ink should not dissolve in water.

Suppliers

Making an ink proper to its purpose is a difficult and slow task. Professional inkmakers are already known from the 16th century onwards in France and England and the oldest printing ink company was founded by William Blackwell in London in 1754. Most printshops, however, had a specialised inkmaker or they bought their ink from another printer.

An example is the Haarlem printer Isaac van Wesbusch, who advertised his printing ink on 17 February 1671 (Wesbusch 1671: verso): "Men laet by desen allen Boeck-druckeren weten, dat Isaac van Wesbusch, Boeckdrucker te Haerlem in de korte Zijl-straat, maeckt en verkoopt extraordinari harden en weecken Druck-Inct, welcke heeft eenen schoonen glants, en is seer wel droogende, oock ongemeen gesuyvert van de vettigheyt der Olye; soo dat deselve, natuerlijck getempert, en het Swartsel daer wel in gewreven zijnde, gants geen noot heeft van oversetten of geel deurslaen." "Have a can brought and you can buy as much as you like." [= One hereby notifies all book printers, that Isaac van Wesbusch, book printer at Haarlem in the Korte Zijl-straat, makes and sells extraordinary strong and weak printing ink, which has a beautiful shine, and dries very good, is also exceptionally well purified from the greasiness of the oil; because it is heated properly, and the blacking is ground well into it, it does not offset nor bleed yellowish.]

Phenomena

As said before, oil-based printing inks are usually considered to be inert. There are, however, some phenomena which are, or are thought to be, linked up with the ink deposit on paper. They can be related and different phenomena may occur on the same object. Varnishes and colourants with their effects will be discussed first, then the possible interaction between ink and paper, and finally white veils on the ink deposit.

Bleeding varnishes & offsetting inks

Most commonly known is the bleeding of the varnish from the ink after printing (bleeding of bituminous matter from uncalcinated black organic pigments has been mentioned above; Fig. 3). Printers are well acquainted with it. The lower its viscosity the more the ink will bleed: the varnish runs from the ink and seeps into the paper. In a modest way, this bleeding is

needed. It partly takes care of the "drying" of the ink and causes a better adherence to the paper. "Drying" means that the layer of ink only feels drier, because it contains less medium, but in fact the varnish has oxidized and polymerised only a little. Ball-point ink also dries in the same way.

Bleeding shows through halos around the ink deposit. The shape of the halos may tell something about the viscosity of the binding medium and its components, for example, a low viscous oil will seep faster and deeper into the paper and spreads wider than a thick oil varnish. Shortly after printing halos are colourless but when seen against the light the paper around the ink is transparent. In time the halo will turn yellowish or greenish to a golden tinge and finally becomes dark brown. Book printers added driers to their varnish to accelerate drying. Nowadays extenders are added to prevent halos.

It is calculated that in printing with a handpress, before 1800, 200 to 220 sheets per hour could be printed on one side (Pollak 1972: 218-264; Stijnman 1992: 23-24). This means that it took printers 18 seconds or less to print a sheet of paper on one side. These printed sheets were piled up and not interleaved. After printing one side of all the sheets, the other side was printed. It was not intended that the text on the recto side should offset on the verso side of the next sheet, this should stay blank. This means that the surface of the first printed sheet should dry in the 18 seconds it took for printing the second sheet, and so on.

In intaglio printing an interleaving with Seidenpapier to prevent offsetting is first described in 1805 (Schwarz 1805: 94-95). Before that, as in typographic printing the sheets were piled up after printing. Driers were not used, or at least not commonly in intaglio ink. Printing an etching or engraving takes one minute or longer, depending on the size of the plate, the quality of the impression required (portraits were printed with the utmost care), the qualities of the ink (particle size, viscosity of the ink), and the kind of wiping. In general, it is dependent on the care a printer takes with the plates. Again, driers are not mentioned before the 20th century and therefore offsetting is not an uncommon phenomenon in intaglio printing. So too is bleeding of the ink, especially because intaglio ink is less viscous than typographic ink. The amount of bleeding is also related to the amount of surface sizing on the paper and the depth of the etched or engraved grooves. The deeper they are, the more ink they will contain and the higher the chances are for varnish running into the paper due to the thick ink deposit. This is contrary to stencil, relief and planographic printing where the layer of ink is always of the same thickness.

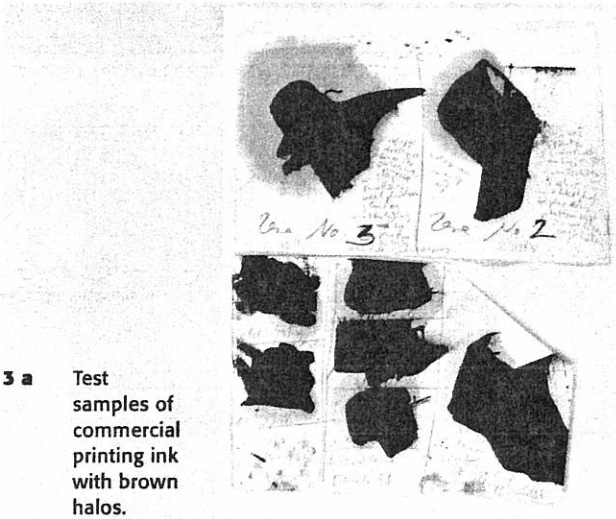
With lithography bleeding is hardly or not at all observed. This is probably due to the extreme stiffness of the ink because of the high viscosity of the varnish and the high amount of pigment. Other reasons are that lithographs are preferably printed on a thicker kind of paper and the layers of ink are extremely thin.

Up to the 1970s screenprinting was done with oil-based inks. The thick, continuous layers of ink cause similar problems as in oil painting on paper (Townsend, Perry 1992: 129-132).

Degrading, powdering, bleeding & discolouring pigments

Some pigments in the inks may have a degrading effect on the ink and on the paper (causing browning), even though not much is reported on this matter. While the blacks have no effect, some colours may, such as copper acetate (verdigris) or zinc oxide (zinc white). The former because of the corrosive effect copper has on paper, the latter because of its photocatalytic properties. Photochemical effects may include deterioration of the binder, whereby the ink is degraded by the zinc white itself. It may also promote the composition of peroxides from the varnish, which in turn may degrade the paper of the prints and/or the cardboard onto which the print is mounted (Daniels 1990: 236-243; Hallebeek, Reißland, Stijnman 1998; Whitmore, Bailie 1990: 144-149).

The whole idea behind printing ink is that all pigment particles are completely encapsulated in the varnish and will stay there. Excessive bleeding might remove too much



3 a Test samples of commercial printing ink with brown halos.



3 b Two copper engravings from the same plate: recto (left side), verso (right side). On the right side the bleeding is visible on the back of the print.

medium from the ink, laying bare a certain amount of pigment. This causes powdering of the ink, a phenomenon known to printers, and prevented by thorough grinding and the use of more viscous varnishes. Sometimes, as in printing helio-engravings, thin varnishes must be used for best results. These varnishes are so thin that most of it will seep into the paper. In the course of time the dried ink layers will start to powder.

Pigments used in planographic inks should not dissolve in water, because in the printing process the stone or plate is dampened. The bleeding of pigments is observerd though (Brown 1994).

A number of pigments – and most dyes – discolour due to light or chemical effects. The varnish itself yellows. These reactions do not seem to affect the paper.

Anastatic impressions

A phenomenon which should be taken into serious consideration is the degradation of paper at the wet/dry interface between the ink, or its halo of varnish, and the paper. This process takes place both laterally and vertically. "Laterally" is within the sheet at the sides of the ink deposit. "Vertically" is underneath the ink deposit, and to the sheets touching above and below. This is visible in books with printed texts and images, in books in which prints have been mounted on blank sheets, and in cardboard onto which prints are mounted.

Fig. 4 a shows what may be called an anastatic impression of the back of the print which was mounted on this board. A print, an impression of an engraving of the portrait of Paulus de Vos after Antony van Dyck (Fig. 4 b), was mounted on the cardboard. There was no mat and the print was kept in a stack of similar mounts. Over the course of time the cardboard started to discolour (it turned brown) where there was ink in the adhering print above. Similarly browning must have taken place in the next mount touching this van Dyck print. Comparable kinds of degradation are visible in printed books (see fig. 1).

The possible explanation behind this phenomenon is that there is a constant transport of water vapour through the sheet itself and through the pile or book. Ink may be considered as a kind of plastic: it is hydrophobic and no water gets through it. This causes three dimensional accumulations of minute amounts of water around the ink deposit, where migration is halted, with the possibility of local condensation and as a consequence degradation in the longterm at the wet/dry interface (Ligterink, Porck, Smit 1989: 225-233; Hofenk de Graaff 1994: 21-42; Dupont 1996: 1-21; see also the following).

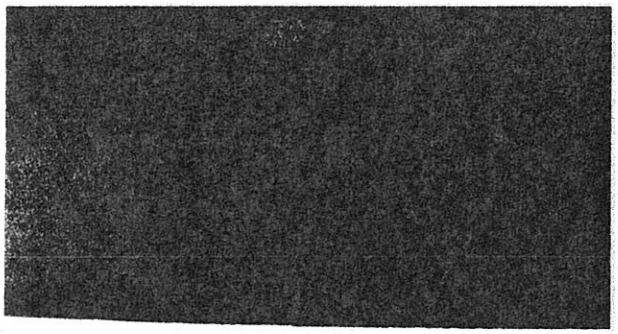
Drying oil films, water & peroxides

After printing it takes several hours to a few days before the ink is dry enough for the printed sheets to leave the printshop. It may take two years or longer before the ink is completely oxidized and polymerised. Fatty acids dry through oxidative polymerisation. In chemical terms the reaction progresses as described here: "Oxygen adds at a double bond in an unconjugated chain to form a biradical. This reacts with another unsaturated chain to give a conjugated chain. Farmer and Sutton isolated an oleate hydroperoxide from partially oxidized oleic esters. Conjugation increases with rise in peroxide content. These hydroperoxides are unstable and readily undergo dehydration. These steps correspond to the taking up of appreciable [amounts of] oxygen by the film followed by some water being evolved; one to two moles of water are liberated per mole of oil ester during drying." (Apps 1958: 293; compare with Townshend, Perry 1992: 130). In conclusion it can be stated that during the drying process of the oil film water as well as peroxides are formed. The amount of water released in the drying process depends on the amount of oil



4 a Anastatic impression on cardboard mount, an engraving of the portrait of Paulus de Vos after Antony van Dyck was mounted on this cardboard once.

4 b Etching and engraving. The actual print.



5 **Detail of a woodcut showing blanchin,. Photo courtesy by Ruth Schmutzler.**

present on the paper – but in general only minute amounts are formed.

Apps [1958: 29] further states that "It is known that printed pamphlets can cause fogging of photographic plates, and this has been traced to peroxides present to some extent in dry vegetable-oil films.". This shows that peroxides are not only formed during the drying process, but can also be formed later on as a result of oxidative degradation of the dried oil film. Some of these peroxides are volatile and can migrate and react promoting oxidation on any organic material (e.g. mounting papers, contact leaves) in the immediate surroundings of the oil film.

Blanching deposits & white mould

A phenomenon observed by Ruth Schmutzler with prints is blanching, also known as blooming: the (black) ink is covered with a white veil of fine crystals (Fig. 5). This is caused by the bleeding and following crystallization of free fatty acids from ink layers; blanching is better studied with oil-paintings. It is observed on thick deposits of ink, the ink being manufactured with excessive amounts of varnish of low viscosity or maybe even unboiled oil. It should go together with halos (Schmutzler 1999; Skaliks 2000). Blanching should not be confused with white mould growing on the size in the paper or on size used in chine collé; the difference between crystals and moulds is easily seen under high magnification.

Discussion

The second part of this essay merely mentions phenomena related to printed images and texts and their interaction. It is difficult to give causes for them let alone remedies. More will be found and hopefully more research will be carried out to gain a better understanding of these phenomena.

Acknowledgements

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MD 539

PRELIMINARY ASSESSMENT TEMPLATE

EXECUTIVE SUMMARY

- Why project is being done
- What was done
- What sites were investigated and which are environmentally significant
- What were the findings of the site visit
- What are the recommendations of the report

INTRODUCTION

- Purpose of the PA
- Site name, address, alias, ID number
- Agency/name of organization performing the PA
- Authority under which PA was conducted
- Sites RCRA status
- CERCLIS ID number
- Summary of activities

SITE DESCRIPTION

- USGS coordinates (calculation worksheets in appendix)
- Site status (active/inactive)
- Size of site
- Site accessibility (restrictions/barriers natural/manmade)
- Type of site
- Site setting
- Years in operation including chronological record of ownership and activities of each owner
- Date(s) of construction/installation
- Current site activities
- CERCLA sources and non-CERCLA sources
- Wastes generated and materials/substances stored (description, quantities, container sizes, generator status)
- Current disposal and storage practices (description, container sizes, contractor info)
- Source characterization (active, inactive, historical sources)
- Description
- Dimensions
- Known or suspected wastes or hazardous substances
- Description of contaminant and condition
- Permits -- issuing agency, date, permit number, violations, inspection results
- Site location map(s)
- Site location within the state
- 1 mile source radius
- Overland drainage route(s)
- Probable point of entry (PPE) to surface water
- Nearest well, intake, residence
- Sensitive environments

OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

- Ownership -- addresses, dates, legal claim- Current- Former
- Operators -- addresses, dates, legal claim- Current- Former
- Historical operations -- dates, duration, quantity, types
- Activities
- Wastes generated and materials/substances stored (description, quantities, container sizes)
- Disposal and storage practices (description, quantities, container size, contractor info)
- Use of: floor drains, septic systems, dry wells
- Past source areas -- CERCLA and Non-CERCLA

- Removal actions -- description, dates, legal status, performing agency/contractor, waste disposition
- Permits -- issuing agency, date, permit number, violations, inspection results
- Other regulatory agency involvement - agency, dates, results, corrective actions taken
- Sampling, including analytical data and summary of results

GROUNDWATER PATHWAY

- Physiographic province underlying site/sources
- Depth to shallowest aquifer/depth to groundwater (min, max, mean)
- Permeability to strata overlying shallowest aquifer
- Net precipitation
- Identification of aquifers in order of increasing depth
- Aquifer description - use, thickness, flow
- Confining layers
- Aquifer interconnections w/in 4 miles of the site (or 2 miles if source boundaries are well defined)
- Karst features
- Citizen complaints
- Well closures

GROUNDWATER TARGETS

- Distance to nearest drinking water well
- Description of municipal and standby wells including location/distance from site, depth of well/aquifer from which water is drawn
- If municipal and standby wells are part of a blended system, total number of wells/intakes that contribute to the overall system and the percent contribution of each well/intake within the target distance limit
- Populations served by municipal wells(s), including standby wells, by distance category within 4 miles of the site
- Description of private wells within 4 miles of the site, including aquifer(s) from which water is drawn and associated population per distance category
- Other uses of groundwater including description and distance
- Wellhead Protection Areas

SURFACE WATER PATHWAY

- Sketch of surface water migration path including probable point of entry (PPE) and target locations
- Facility distance(s) to surface water
- Facility discharges to surface water, including permit information
- Visual signs of contamination
- Surface soil type and permeability of overland drainage route
- Drainage area description
- Floodplain designations/flood frequency
- 2-year, 24-hour rainfall
- Mean annual precipitation
- Water body types along 15-stream-mile migration route, including segment descriptions and intermittent/perennial depiction
- Stream flow characteristics of each segment
- Fishery, intake, and/or surface water recreational area closures, including reason for closure
- All recreational uses

SURFACE WATER TARGETS

- Identification and location of drinking water intakes, including standby wells
- Population served by each intake (apportioned if part of blended system)
- Description and location of fisheries
- Organisms fished
- Woodland frontage
- Description and location of sensitive environments in or contiguous to the surface water migration path

SOIL EXPOSURE PATHWAY

- Identification of known/suspected areas of contamination
- Discussion of previous surface soil sampling, including analytical data and summary of results
- Attractiveness/accessibility of areas of contamination

SOIL EXPOSURE TARGETS

- Residences, schools, and associated populations within 200 feet of an area of known or suspected contamination (or within 200 feet and on the property of an area of contamination if boundaries of the area are well defined)
- Work areas and number of workers on site within 200 feet of an area of known/suspected contamination
- Use of site/areas of contamination
- Terrestrial sensitive environments located on an area of known/suspected contamination
- Nearby population within a 1-mile travel distance in: >1/4 to 1/2 mile, and >1/2 to 1 mile distance categories

AIR PATHWAY

- Direct observation of substances released to air
- Site reconnaissance safety monitoring instrument results
- Discussion of previous air sampling, including analytical data and summary of results
- Reported odors and citizen complaints
- Known reports of adverse health effects associated with a known of suspected release
- Description of cover material/containment

AIR TARGETS

- Distance to nearest residence or regularly occupied building
- Population within 0 to 1/4 mile, >1/4 to 1/2 mile, >1/2 to 1 mile, >1 to 2 miles, >2 to 3 miles, >3 to 4 miles
- Resources within 1/2 mile of site
- Identification and location of sensitive environments within 1/2 mile of the site

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

- By site and source

EPA Potential Hazardous Waste Site Preliminary Assessment Form

REFERENCES

- Includes name, position (or citizen), and dates employed of all employees interviewed
- All documents used to gather information that is actually used in the PA. Include: preparer, title, date, and where copies are located

PHOTODOCUMENTATION LOG

- Photos of the site accompanied by written description and reference to their location on a site map

DOCUMENTATION

- USGS 7.5 min quad Topographic map with 4-mile radius indicated
- Population apportionment and calculation worksheets
- County census data or population database
- Field reconnaissance logbook

The main breakthrough was the invention of printer ink by about 1460, only 15 years after the first use of oil paints for pictures. These inks were able to stick onto a metal surface and were based on heat-bodied linseed oil, kept for a year to allow the mucilage to settle. Some unknown plant resins may then have been added. It seems possible that litharge (lead monoxide) was also added to accelerate the drying process.
By 1799 an Austrian printer Alois Senefelder invented lithography. Pictures and texts could be printed from the flat, smooth surface of fine-grained limestone.

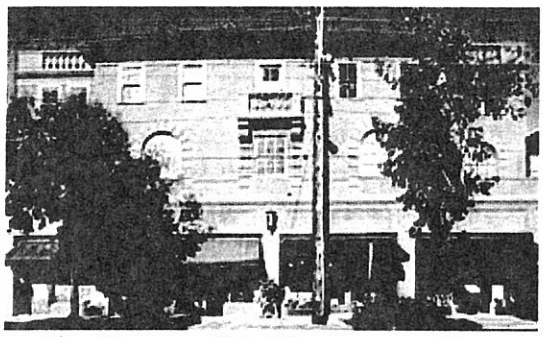
As stated by Maroger (1948), it seems evident that the van Eyck research on the cooking of painting oil led to the discovery of book printing and all its consequences. Van Eyck discovered its medium in 1410 but revealed its making only some years before his death in 1440. Gutenberg surely learnt that formula which improved its own typographic system.

Over years, inks were improved but linseed oil and other vegetable oils were mainly used to accomplish this task. The addition of heated vegetal oil rich in polyunsaturated fatty acids changed the oil into almost a varnish, speeding the drying time and giving it more viscosity. The drying time was also improved in the 19th century in adding petroleum distillate, solvent which was also used as the vehicle for organic pigments in color printing inks.

As nearly 250,000 tons of inks are used each year in USA, the petroleum shortage in the mid 1970s and ecological considerations stimulated research to find alternatives to mineral oils and other petroleum products in ink formulations. The use of soy oil-based inks has gained in popularity in reducing their volatile organic content which was considered a major threat to the air environment.
The American Soybean Association was very effective in the late 1980s at promoting the use of soy oils in printing inks. The extent to which soybean oil can replace the petroleum oil varies with the kind of ink, the greatest proportion (about 50%) being possible with news ink. Reports were made on black and colored inks consisting of 100% vegetable oil-based vehicles which met the industry standards for lithographic and letterpress newsprint applications (Erhan SZ et al., JAOCS 1992, 69, 251).
In Europe, alkyd drying oils are progressively replaced by rapeseed or sunflower alkyds. Furthermore, fatty methyl esters from these oils were also investigated (Sabin P et al., OCL 1995, 2, 401).
In 2000, the soy ink's U.S. market share reached about 22 percent and it was estimated that the full potential could consume 40 million bushels of soybeans annually. Furthermore, 25 percent of the color newsprint in Japan is now soy ink.

A Brief History of Pre-Electronic Printing

October 14, 1999



The Home of St. Hieronymus Press

The history of printing is also a history of people, culture and trade. Technological changes come as they are needed and as people are ready for them. Cultures rise to their day in the sun and fall into decline, sometimes suffering a long darkness. Printing began as all things begin: a thousand efforts, with no goal in sight, no big picture, combined in a thousand ways to effect a thousand ends. The history of printing could as well be the history of civilization.

A good starting place for this brief history of the Black Art is in China, under Indian influence, where printing finds its first expression in improvements on writing.

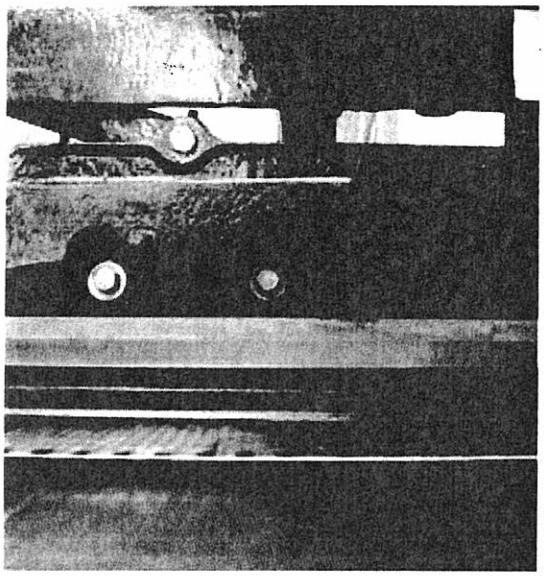
The invention of the writing brush made from hair is attributed to General Meng Tien, in the third century BC. This allowed writing to be done on silk rather than with bamboo pens on strips of bamboo. Bamboo is heavy, bulky and awkward, but for all its virtues, silk is expensive. Paper, a cheaper writing material made from macerated mulberry bark, hemp, and old rags was invented by Ts'ai Lun, in 105 AD.

Seals originated in Babylonia, and their impressions were for millennia stamped into wax or clay as a sort of "lock and key" indication of authenticity. This in turn harks back to a simpler process of authentication: in China, a contract was written in duplicate on a piece of bamboo, which was then broken in half, and one end retained by each party. The fitting together of the broken ends provided authentication. There is some evidence that seal technology penetrated China via Alexander the Great's (356-323 BC) extensive empire, and that Hellenistic influence created an increased demand for private and imperial seals. Seal impressions stamped in ink on paper arose in China around AD 500, and provided the transition that culminates in printing from carved wooden blocks.

Seal impressions were made using vermilion, much favored by Buddhist monks. A permanent black ink suitable for brush writing was invented by Wei Tan (d. 251 AD). The ink which we now know as Chinese or India ink was made by placing a number of wicks in a vessel full of oil, while over this was placed a funnel-like cover of iron. When this was well coated with soot, the lampblack was brushed off and collected on paper. It was then mixed with a solution of gum or gluten, and, when reduced to the consistency of paste, was put into small molds. The ink was sold in sticks or elongated cubes. To prepare it for writing, it was rubbed in water on a smooth ink stone. (Carter, page 33)

Rubbings of inscriptions carved in stone also originated in China, and provided the technological and philosophical transition necessary to the invention of printing. In 175 AD, a fear that inexact copying would lead to the loss of important cultural writings led Ts'ai Yung (133-192 AD) to

write the scholarly revision and corrections leading to a text of the Six Classics. This authorized version was written in his own hand on stones outside the gates of the state academy. The stone was then carved, and exact copies were made in the tens of thousands by the process of placing paper over the inscription and rubbing it with ink. The printing of books by making rubbings from incised stone carvings continued, and parallels the printing of books from wooden blocks carved in relief. (Carter 19-25)



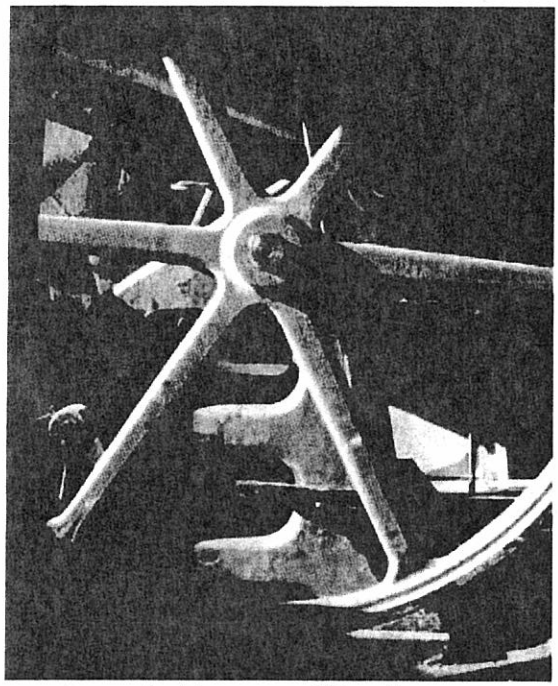
Paper Cutter

The stencil and pounce, seemingly developed in or about the seventh century, were means of reproduction of which Buddhist monks were especially fond. For the pounce, a design was first drawn with a brush, and then outlined with needle pricks. The pattern was then laid on a new surface, and a small bag filled with colored chalk tapped lightly against the holes, thus transferring the design, which could then be traced and painted accurately. Stencils were used to color blockprinted images, and in Europe were also used to apply glue, the tacky surface then "flocked" with colored lint.

Relief printing originated during the reign of Ming Huang (712-756 AD). Small stamped figures of Buddha mark the transition from the seal impression to the woodcut. The only difference between these Buddha figures and true woodcuts, other than the primitive workmanship, is that the figures are quite small, and hence were evidently made by hand pressure like the impressions from seals. Surviving stamps have handles for this purpose. When the idea occurred to some inventive genius to turn his stamp upside down, rub it with an inked brush, lay the paper over it and rub the back, the way was open for making impressions of any size desired, and for such improvement of technique as made the new invention a force in the advancement of civilization. But first it seems to have brought about only the making of better and larger Buddha figures. (Carter, 39-40)

Although Arab culture, which so profoundly influenced a reawakened Europe, knew of Chinese printing, the refusal of its literary culture to profit from the art made Islam on the whole a barrier to the transmission of this knowledge. The logic seems to stem from ultra-conservatism: the Koran was given in handwritten form, therefore the Koran must always be written by hand. This prejudice extended toward all printing: in 1727, when permission was asked for the erection of a printing press at Constaniople, the Ulema under Sultan Ahmed III delivered a verdict that it was against the religion and honor of Islam to allow the printing of the Koran, because the Koran rested upon written tradition, and must in no other way be handed down. Permission was granted for other printing, though when in 1729 a history of Egypt appeared, such public opposition was aroused that until 1825 no further printing was attempted in the Islamic world. Islamic countries thus began a slow, inevitable slide away from their former technological and philosophical ascendance. The processes of engraving (c. 1460) and lithography (1796) were deemed acceptable for non-religious works, but the Koran itself could properly speaking only be copied by hand in single editions. Thus, though trade and commerce flourished between the Arab world

and China, books in Arabic were never printed. Penetration of printing technology was left to the spread of the Mongols from the East and the Crusaders from the West. (Carter 150-153)



Letterpress Wheel

Found among the hidden manuscripts of the Caves of the Thousand Buddhas, near Tun-huang, was The Diamond Sutra, printed from blocks in 868 by Wang Chieh on behalf of his parents. This, the oldest extant printed book, shows an advanced technique behind which there must have been a long evolution. (Carter 56)

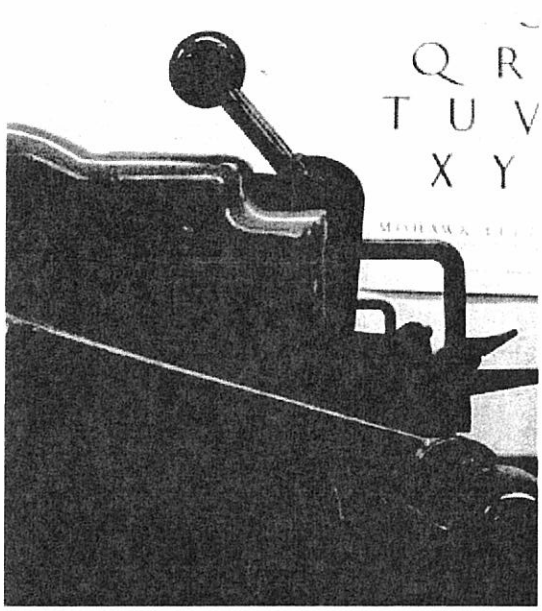
The time was right, travellers and traders in plenty went back and forth, but there is no evidence that moveable type or type-casting technology spread from the Orient to the Occident. Movable type did not catch on in the East for the simple reason that as many as 30,000 Chinese ideograms are needed--some much more than others--so that a complete font might run to the hundreds of thousands of discrete elements. It is simpler just to cut a block with all the characters on it for each separate page. Movable type made from clay and later from tin was invented by Pi Sheng (1041-1048), but does not seem to have survived his demise. Movable type made from wood appeared in China, c. 1313, but again left no lasting impression. The type mold--and with it the use of cast metal type--was invented in Korea in 1392 and used extensively, but there is no evidence of technological transfer.

The printing press, movable type, the type mold, and the invention of printing ink for use on metal are all attributed to Johannes Gutenberg (1394? 1406? -1468). The completed process appears in the form of the famous 42-line Bible of 1455 in Mainz, Germany.

Water-based Chinese ink is not suitable for taking impressions from metal. It "crawls," that is, it stands in globules on the metal surface and makes a rough impression. The first typographers of Europe, faced with this problem, solved it by using an ink whose pigment was dissolved in oil. Gutenberg took advantage of the existing technology of oil paints, which came into general use after they were perfected and popularized by the Flemish painter Jan Van Eyck (1370? - 1440?). Little modification was needed to turn oil paint into printing ink. (Bloy, 4-5)

The printing press used by Gutenberg was a clever adaptation of the screw mechanisms available in the wine press, the papermaker's press and the common linen press. One Konrad Saspach, a wood turner, was commissioned to begin building a press for Gutenberg after the death in December 1438 of Andreas Dritzehen, one of Gutenberg's early partners. The form of the first printing press, which did not change in essence for nearly four hundred years, must have resulted from a series of experiments by Gutenberg and Saspach, and by printers in the next few decades. (Moran, 21)

The goldsmiths of Florence in the middle of the 15th century were in the habit of ornamenting their works by means of engraving, after which they filled up the hollows produced by the burin with a black enamel made of silver, lead and sulphur, the result being that the design was rendered much more visible by the contrast between the metal and the enamel. An engraved design filled up in this manner was called a niello. Before this laborious and essentially irreversible process was resorted to, a "smoke-proof" was obtained by filling the lines with lampblack. At a slightly later time it was discovered that a printed proof could be taken on damped paper by filling the engraved lines with ink and wiping the excess off the surface, then pressing the paper against the engraved lines, thus transferring the design to the paper. The metal engravers, however, saw no further than this. The process of engraving as a printing method is attributed to Maso Finiguerra (1426-1464) of Florence, who developed the technique of copperplate line engraving around 1460. The few good copies obtainable before the plate became badly worn limited its utility, and it was not until the time of the German Albrecht Dürer (1471-1528), who is regarded as the inventor of etching, that engraving on metal became an established method of printing images in useful quantity. In an etching, the plate is coated with an acid-resistant ground, the ground is partially removed with etching tools, and the exposed areas are then bitten with acid. The etched lines are then printed in the same manner as an engraving.

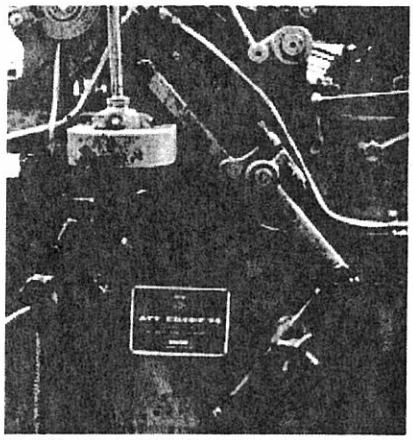


Proof Press

Learned from the Chinese, woodblock printing flowered in Japan during the Edo period (1635-1867). The ukio-e (transitory world) print celebrated the life of the pleasure quarters of Edo. Hishikawa Moronobu (1618-1694) was the first artist to design and print monochrome single-sheet woodblock prints. Kiomitsu (1735-1785) produced polychrome prints, and the work of his pupil Torii Kiohiro (fl. 1737-1776) continued the experimentation. In 1741, a color printing process was invented, and in 1745 the publisher Kichiemon Kamimura introduced the kento, or registration mark, to woodblock printing. (Yoshida, et al. 28-30)

Lithography (stone writing), based on the simple principle that oil and water won't mix, was invented by the Bavarian, Aloys Senefelder, in 1796. Its first application was in the printing of music, theretofore done at great labor and expense by copperplate engraving. From the freedom of expression inherent in the medium, the new process stimulated the wildest variety of typographic fancies. Chromolithography, the printing of multiple colors in tight register, was developed and named by M. Godefroi Engelman of MŸlhausen in 1837. Jules Cheret, called the father of the poster, improved upon this process and reduced the number of colors--usually to three--by printing with spatter tints. The combination of Cheret's formal training as a lithographic printer and the influence of Japanese woodblock prints of the ukio-e combined in 1866 to revolutionize the manner in which commercial images were presented to the public.

Photography (light writing) originates with the camera obscura (dark box), the principles of which seem to have been well understood by Euclid in his Optics (300 BC) and in Aristotle's (384-322 BC) Problems. Few allusions to the phenomena described in these books occur in later classical writers, and the first scientific investigation occurs in the great optical treatise of the Arabian philosopher Alhazen (d. Cairo 1038) Various observations from 1782 through 1802 on the photoreactive properties of silver chloride, silver nitrate and ammonia led the Englishman, Thomas Wedgewood, (1771-1805) to produce an actual photograph, which, however, he could not preserve. The first to create a photograph that was subsequently unaffected by light was the Frenchman, Nicéphore de Niepce, (1765-1833) in 1827. Niepce had from 1811 devoted himself to the rising art of lithography, and in 1813 the idea of obtaining sun pictures occurred to him in this connection. In 1826 he learned that Louis Jacques Mandé Daguerre (1789-1851) was working along similar lines, and formed with him a partnership. After Niepce's death, Daguerre improved upon the process, lending his name to the Daguerrotype. The photographic print was created by William Henry Fox Talbot (1800-1877), who in January of 1839 described the first of his inventions and discoveries in a paper to the Royal Society.



Offset Press Detail

Process (as half-tone process, four-color process) is a general term technically employed for the photo-mechanical process by which illustrations are reproduced in printing. The outcome of a discovery by Mungo Ponton, that a preparation of albumen or other colloidal substance and bichromate of potash could be hardened and rendered insoluble and nonabsorbent in water by exposure to light, and that as a photographic negative permitted the passage through it of light in varying degrees of intensity, so a film of the preparation placed under a negative was liable to be hardened and rendered insoluble in degrees varying with the intensity of the light affecting it. This discovery governs the production of process blocks or plates of all kinds. (Encyclopaedia Brittanica, 11th edition, article "Process")

The invention of line process stimulated the invention of the half-tone process, in which an image is broken up into myriad tiny dots by the passage of light through a half tone screen, and thence to a negative from which a letterpress cut or lithographic plate can be made, and the image then printed at the same time as the text. The techniques necessary to this matured between 1852 and 1886, mostly in the development of suitable glass screens.

In 1861, James Clerk Maxwell (Scottish, 1831-1879) suggested that objects could be reproduced in their natural colors by superimposing the three primary colors. Various experiments in separating images for printing by means of colored filters resulted in the first three-color blocks for letterpress printing, which were developed by F. E. Ives, of Philadelphia, in 1881.

Three major 19th century planographic (flat surfaced) printing processes, all dependent on photography and utilizing the nature of colloids, were for a time important. They are Woodburytype (Walter Woodbury, English, 1834 - 1885); Stenotype and Collotype. Woodbury

type and Stenotype utilized delicate photographic molds, which were inked and impressed on paper so as to reproduce varying degrees of light and shadow reflecting the depth of the cast.

Collotype or photogelatin printing was invented in 1870 by Joseph Albert of Munich. Collotype produced admirable color images without the use of screens (screenless printing is called continuous tone, somewhat like a photograph), and was for a time used in the production of color postcards, point-of-purchase displays and high-quality reproductions of fine art. Collotype was a viable method of printing as late as 1990.

The heliotype (sun print) process employed film and rendered a small number of photographic-quality images before wearing out.

The monotype (single print) process, whereby an original painting on glass, plastic or metal is transferred to a piece of paper using a printing press, is still much employed as a fine art medium.

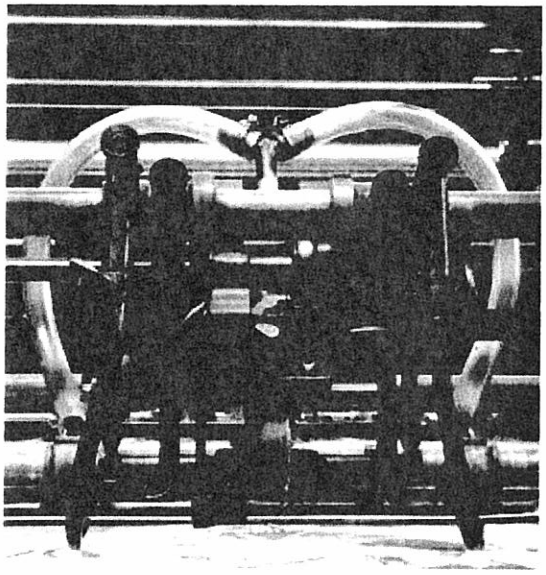
The rubber blanket, a final step in the evolution of lithography, was introduced in Chicago in 1906. This allowed a significant reduction in the pressure of printing from a zinc or aluminum lithographic plate, as the plate touched the rubber blanket with only enough pressure to transfer the image, and from thence the blanket transferred the now reversed image to the paper, again, with only a "kiss" impression. These three inventions, over the period of a century, contributed their names to photo-offset-lithography.

In 1868, an American patent was taken out by C. L. Sholes and C. Glidden for a typewriter which, after effecting various improvements, they licensed manufacture to Remington and Sons, gunmakers, of Ilion, New York in 1875. The original machine had capital letters only, but in 1878 a machine was introduced which could produce both upper and lower case. The legacy of the typewriter--and one that will be with us for the foreseeable future--is the peculiar arrangement of the keyboard, which was designed originally to prevent frequently used keys from tangling with one another. Once learned, there is no reason to unlearn, though there is no longer any mechanical obstacle to any arrangement of keys whatever. Rational or irrational, the QWERTY keyboard is here to stay.

Among James Watt's (Scottish, 1736-1819) contributions was the letter copying press, for copying manuscript by using a glutinous ink and pressing the written page against a moistened sheet of thin paper. Patented in 1780, this led to the invention and development of the hectographic or gelatin duplicator.

In 1856, British chemist William Henry Perkins (1838-1907) discovered the first synthetic dye, aniline purple. This pointed the way to a wide range of new inks, including "copying ink" used in the first practical method of reproducing business documents. An original written with copying ink was placed against a moistened sheet of tissue, the two were pressed together in a massive iron press, and a copy would appear on the tissue. Since the copy was backwards, the tissue had to be held up to the light to be read. The copy press became a fixture in every Victorian office. Today, they are sold in antique shops as "book presses," their true function long forgotten. (Dead Media, 1999)

The hektograph (hundred writer) was invented in the 1870s, and used a stiff gelatin pad coupled with special ink made with aniline dye. A document written with the ink was pressed to the pad. The gelatin absorbed the ink after a few minutes, and the original was removed. Blank sheets were then pressed against the pad, and the gelatin released a little of the ink each time, producing a positive copy. The hektograph was good for about 50 impressions. Twentieth-century spirit duplicators (such as "Ditto") were a later outgrowth of the hektograph and much easier to use. (Dead Media, 1999)



Offset Press Feeder

The spirit duplicator was invented in 1923 by Wilhelm Ritzerfeld, founder of the Ormig Company in Germany. The spirit duplicator master consisted of a smooth paper master sheet and a paper sheet, coated with a waxy compound similar to that used in the hektograph, acting backwards so that the wax compound was transferred to the back side of the master sheet itself. The master could be typed or written on, and when finished the waxy paper original was discarded. The master was wrapped around a drum in the spirit duplicator machine. As the drum turned, the master was coated with a thin layer of highly volatile duplicating fluid via a wick soaked in the fluid. The fluid acted to slightly dissolve or soften the dye. As paper (preferably calendered or coated) pressed against the drum and master copy, some of the image was transferred to make the final copy. A spirit duplicator master was capable of making up to 500 copies before the print became too faint to recognize. (Dead Media, 1999)

The mimeograph (copy writer) was invented in 1887 by the American, Thomas Alva Edison (1847-1931). It is a duplicating process by which a waxed stencil is typed or written upon, thus opening avenues for ink to penetrate. The stencil is then fitted around an inked drum, which when rotated transfers the image to paper. Inexpensive and highly accessible, the mimeograph was a staple of propagandists through the mid-1960s. After purchasing the rights to Edison's process of making stencils, in 1887 the A. B. Dick company began selling copying equipment under the trade name "Edison's Mimeograph." The device made copies of hand-drawn stencils one at a time on a flat bed duplicator. By the time Dick began selling the device, the Gestetner company in England was already selling a similar machine called the cyclostyle, but mimeograph became the generic term.

The blueprint process, also called cyanotype, is still in use, though its day as a commercial process is passing. The Cyanotype was developed in the 1840's, and is part of a group of processes that include the palladium print, the platinotype and the kallitype. The common element is that these are all iron salt processes. Iron-salt processes basically work like this: All ferric(iron) salts, when combined with organic substances, become sensitive to light. A commonly used mixture is ferric ammonium citrate and potassium ferricyanide. Exposure to actinic light breaks down the iron compound by oxidation, thereby releasing carbon in the form

of carbonic acid. The exposed print is then immersed in water, causing a reaction between the new compound (peroxide iron salt) and the potassium ferricyanide. Thus formed is a deep-blue compound (ferroprussiate). (Cyanotype web page)

The Diazo proscess (also called Diazotype, Ozalid or Blueline), was a photographic process developed in the 1890's. It required a translucint original which was contact printed onto a sheet of stock sensitized with a diazonium compound, and developed by exposure to anhydrous ammonia vapors. One of the least expensive means of reproduction, it was nonetheless limited in use because of its number of fixed colors and rapid fading. The proscess was used primarily for proofs and trial prints and was employed thrugh the 1980's.

Late 18th century Japanese stencils for fabric printing have the delicate isolated parts tied into the general pattern with silk thread, but there was no fabric backing to hold the whole together. The stencil image was printed using a large soft brush, which did not damage the delicate paper pattern. (Tuer, 6)

Stencil printing became commercially viable in the West only after considerable improvements were made to the equipment. The rubber blade of a squeegee was one such advancement. The idea of using silk fabric as a screen or ground to hold a tieless stencil is generally credited to Samuel Simon of Manchester, who was granted a silk screen process patent in England in 1907.

A multicolor method was developed by John Pilsworth of San Francisco in 1914. Anthony Velonis, a WPA artist, coined the term serigraph (silk writing) to distinguish the otherwise identical fine art application from the commercial.

These foundation stones of electronic printing survive in otherwise meaningless terminology (leading, upper and lower case, font, &c.) and in the legacy conferred by those who were trained in the older methods. But, just as the child is the father of the man, so is the antique technological process the father of the new.

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325910 (Printing Ink Manufacturing)

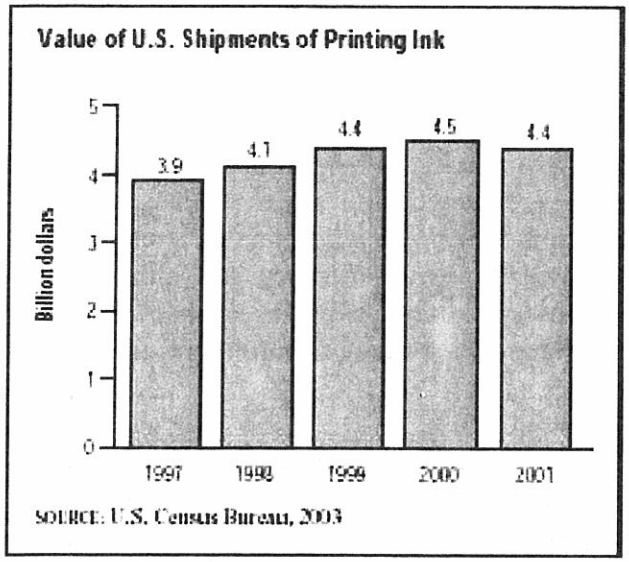
The printing ink industry is one of America's oldest, dating back to the pre-Revolutionary War days. After more than 200 years of similar operating procedures, there was little change in the structure of the industry entering the 1990s. However, the 1990s brought massive consolidation to the sector. Because the market for printing inks was mature and profits were low, the largest ink companies acquired smaller firms as a way to boost market share. By September 1999, four companies controlled more than half of the global printing ink market, according to *Chemical Market Reporter.*

During the recession at the beginning of the 1990s, raw material prices stabilized considerably. Purchasing experts in the ink industry found that there were only a few areas where upward price pressure could continue throughout 1990. The major factor affecting prices was the stable price of crude oil, from which more than 75 percent of the raw materials for ink was derived. The industry's membership sought to take full advantage of the relatively low raw material costs, resisting any price increases from raw materials suppliers unless they were fully justified. In some product areas, the companies were able to negotiate price reductions, which helped the industry hold the line on its own prices. Between 1998 and 2000, the cost of materials for the industry declined from $2.6 billion to $2.39 billion.

The National Association of Printing Ink Manufacturers (NAPIM)—the trade organization representing ink producers in the United States—reported that industry shipments were valued at $4.45 billion in 2001, down from $4.54 billion in 2000. Printing ink shipments had increased steadily throughout the late 1990s and early 2000s, before declining in 2001.

The printing ink industry is classified by ink type. In 2001, lithographic and offset printing ink shipments comprised the largest category, with shipments valued at $1.87 billion—41.9 percent of the total shipments. With 27.3 percent of the total market, flexographic printing inks were the second-largest sector, with 2001 shipments topping $1.21 billion in 2001, a substantial increase from 1997 shipments of $718.14 million. Gravure printing inks shipments totaled $594.01 million, representing 13.3 percent of the total, while nonimpact digital ink shipments were more than $271.23 million, or 6 percent of the total. Letterpress printing inks were the smallest individual ink category, with approximately $143.04 million in shipments (accounting for 3.2 percent of the total). The remaining 8.3 percent of the market was comprised of nonclassified printing inks.

The 1994 Vegetable Ink Printing Act of Congress exerted a powerful influence on the industry. The bill mandated that printers with government contracts use vegetable oil-based inks instead of volatile petroleum-based inks whenever possible. The main concerns were due to the hazardous effects of using crude oil as the ink base, as was done for most of the history of printing inks. Emissions from volatile organic compounds (VOCs) and emissions of hazardous air pollutants (HAPs) had to be controlled. Printing inks also had to be developed to make the de-inking and recycling of paper easier. Printers wanted inks that stuck to paper, and recyclers wanted inks that could be easily removed.



Further change in the industry occurred in the late 1990s as the pace of consolidation accelerated. In 1998, Flint Ink of Ann Arbor, Michigan, acquired Mander plc for $167 million. Flint continued its buying spree in November of 1999, with its acquisition of Sacramento, California-based The Ink Co. Flint—the second-largest ink producer in the world—made the purchases to remain competitive with the industry's global leader, Dainippon Ink & Chemical of Japan. Dainippon's U.S. subsidiary, Sun Chemical Corp., was the second-largest American ink producer behind Flint. In an effort to gain access to China's printing industry, which was growing at a pace of roughly 10 percent per year, Flint created an ink manufacturing joint venture with Graphic Tech, its Asian distributor, in 2003.

In the early 2000s, more than 500 establishments were involved in the production of printing ink, and roughly 200 of these were larger companies with more than 20 employees. California was home to the largest number of printing ink manufacturers, followed by Texas and New Jersey.

A total of 13,317 people worked in the printing ink production industry in 2000, with 6,798 of those directly involved in production. Production employees worked an average of 40 hours per week and earned an average wage of $18.52 per hour.

The printing ink industry has made efforts to reduce the environmental burden of its products. Before passage of the Clean Air Act, printing ink manufacturers were developing water-based ink systems to replace inks containing volatile organic compounds. Many years before the first "CONNEG Law" was passed to reduce heavy metals in packaging, the printing ink industry had been reducing the use of lead-bearing pigments in packaging inks.

Growth in vegetable-based inks leveled off in 1996 as most of the users with environmental concerns switched to newer inks. Another increase in vegetable-and water-based inks will only be likely if environmental pressure increases again.

A Short History of Ink

Ink - its history and development

"The very ink with which all history is written is merely fluid prejudice"

Mark Twain

The enigma of ink

Ink is such a tiny word, three letters, but it has played such a huge part on the stage of world history. The original use for ink was to draw and paint on the walls of caves a lasting legacy of prehistoric man. However, its greatest impact was to spread knowledge, in the form of the printed word, long before Johann Gutenberg invented the printing press in Germany in the mid fifteenth Century. Ink has been a dye since the dawn of man; early examples were a mixture of soot from wood smoke and oil, thickened with gelatine from animal skins and musk. There is no definitive history of ink, ironic really, when it ink was the medium used to preserve the archives, and historic records that tell us much of our past.

Ink is everywhere, though we often do not notice it, it has been used to print the labels of the food in the supermarket; it drips, leaks, splodges, and spurts from the faulty ballpoint pen in your pocket. Yet it has a direct impact on our everyday life, it is not possible to function without touching ink at least a couple of hundred times a day.

Fraudulent acts have been come to light because of ink analysis. Ink is a medium that has changed history, written religious tracts that have lasted for centuries, it has revolutionised our lives. It has recorded lives, sometimes accurately, sometimes fraudulently, Konrad Kujau, master forger, nearly pulled off one of the greatest frauds of the twentieth Century with his forged Hitler diaries in the 1980's.

Composition of ink

Not many people even know the composition of ink, it must be one of the most taken for granted substances, despite its daily affect on our lives. How would be know which brand of cereal we were starting the day with, without ink being used to print the label?

All ink has the same basic task it is pigmentation or colorant to fill the space between lines, but ink has evolved and there are more than one type of ink. The contents of ink depend where it comes from the main types of ink are India, Chinese and Sepia ink. Ink has a wide range of textures and capacities. Some types of ink are thin and very watery whilst screen printing ink is very thick. Despite the various types and textures of ink, they are all comprised of two components a vehicle and a colorant.

History of Ink.

The ancient Egyptians and the Chinese, both developed ink at approximately the same time around 2500. B.C. They used fine particles of carbon called lampblack for the colorant, and gums or glues were the vehicles. The need for ink arose at the same time that art had evolved from cutting into stone and a more fluid medium than a chisel was required.

Despite the fact that ancient inks were crude efforts the ancients strove to make them enduring, so that the information they passed on remained a permanent record. The ancient Hebrew word for ink is "deyo", which when translated blackness. Ancient Talmud teachings state that the writing of ancient documents must "Mishnah, which means the get may be written with any material, with deyo, with sam, with sikra, with kumus and with kankantum or with anything which is lasting. It may not be written with liquids, with fruit-juice, or with anything that is not lasting." Later as ink became more sophisticated oil and water was the vehicle.

"Hard that his name it should not save,

*Who first poured forth the sable wave" (*Whitehead)

Ink and its production has always been to a certain extent problematic, it has always had issues regarding durability, it fades when exposed to sunlight and different types of paper absorb different amounts of ink.

Between the eighth and the eleventh Century, a chemical ink, iron gall ink developed from tannic acid and iron salt; it became a popular colorant bound by resin. To understand the chemical structure of ink it is necessary to understand the properties of the chemicals that have gone into ink production, and why certain chemicals improve or debase its durability.

Water based inks have humectants added so that the resultant ink does not dry out too quickly. At the same time, the ink must have the correct consistency for its purpose and added biocides ensure the consistency. Sometimes a pH level is necessary and buffering additives stabilise the level. In today's complex world, the ink must be compatible with the type of machinery using it. Inkjet printers have revolutionised the printing industry, but the printing heads are so sensitive several different types of ink have developed for them.

Inkjet ink does not use dyes as the colorant but pigments, despite the early problems with inkjet ink, the process has now been improved so that colours do not fade and lose their brilliance outdoors in bright natural light. This development itself has revolutionised many aspects of the printing business not least of which in the sign industry.

Types of Ink

There are three basic types of ink

- Inks using a pigment plus a binder like a gouache, Chinese ink sticks are in this group where the pigment is soot. In general, ink sticks are regarded as the best general type of all-purpose inks, though there are differences in properties especially when writing on Eastern paper.
- Inks with a dyestuff added such as fountain pen ink.
- Inks with a chemical precipitation added such as Ferro Gallic or iron gall inks.

India Ink (Chinese Ink)

The Latin name for all these types of carbon(C) or cinnabar (HgS) based inks ink was "atramentum librarium".
Carbon inks are made of finely powdered lampblack, a type of carbon, held together by glue. The Chinese tend to apply it with small brushes, rather than pens. India ink is in liquid form is made by mixing gum Arabic, shellac, and borax, and then the carbon is suspended in the liquid. Sometimes the Indians add camphor to the ink. Borax and shellac react chemically together to produce soap, which is soluble in liquid form, but is insoluble once it evaporates. Indian ink is a writing ink, but its widest application is as a drawing ink. It is popular with artists and for technical drawings such as architects' drawings. It has fast drying properties and an intense concentrated black colour, but it is viscous, hence its popularity as a paint. If the formula includes bichromate of ammonium or potassium and the ink is exposed to sunlight, it becomes insoluble and it cannot be removed even with modern chemicals.

One of the earliest examples we have of this type of ink is on the Dead Sea Scrolls, which date from the third Century B.C. to A.D. 68. However, the base was a red cinnabar (HgS) rather than carbon. Once the liquid in the ink dries the C or HgS leaves a permanent mark. Chemically this reaction lasted longest when the writing was on semi absorbent material such as paper or papyrus; they do not make a good writing medium for parchment.
Carbon inks should be used on paper which is just slightly absorbent because the colouring material is suspended in the liquid. Writing with this ink on a non-absorbent surface will flake off when it evaporates, but it is very permanent when used on absorbent materials, because light and chemicals do not fade them.

The difficulties of Indian ink this process of flocculation, which causes particles suspended in water to aggregate into flakes, large enough to sink to the bottom of the container. Some early ink recipes had plant juices added rather than water, and gum Arabic to bind the ink. Its primary use is a stabiliser, but it does control the viscosity of ink, and it also binds watercolours.

Traditionally Chinese ink was not bottled, but the ink was watered down when required by grinding the ink stick in an inkstone, which doubled up as the inkwell. The soot was normally pine oil or lacquer, the soluble resin used to bind the ink and hold it in colloidal suspension.

Ancient dyes

Alchiber was the name of the process utilised by the Arabs to make ink. They burnt resins such as a type of tar or oil, and then honey or gum was added to bind the tablet, before the whole mixture was compressed and dried. Later water was added, when it was necessary to write with it. The early ink compressed into tablet form for two reasons; there was a shortage of bottles to store ink, and it was easier to transport.

The Chinese created raised hieroglyphics by mixing smoke and oil and the gelatinous content of asses' skin, and then they added musk to make the finished product fragrant. They required a process to blacken these raised hieroglyphics, and they perfected the manufacturing process of Indian ink roughly 1,000 years B.C.

Many ancient civilisations had dyeing arts; some of these techniques are still employed today. The colours were in general purple, blue, red, yellow, green, white, gold, silver, and black. Different colours were used to display a characteristic pictorially. Green meant regeneration, re-growth, but it was also the colour used to denote prosperity. Purity was epitomised by white, which every society recognised as innocence as conversely blackness meant disaster, misfortunes, and suffering. Blue was the chosen celestial colour, it represented revelation. In Hinduism it meant to be lucky, it was an auspicious colour. For the Hebrews it was the representative colour of Mosaic work, because, it was the symbol of God. Scarlet became the universal symbol of life as it most resembled blood, whilst purple was the colour of kings. Once Christian symbolism had prevailed white, red, green, violet and black were the only colours

allowed to have a symbolic significance.

However, the basis of the colours was not different. White was light purity and truth, whilst black was the antithesis death destruction, and sorrow. Red was represented fire and love, love, while green was hope rebirth and life as it was the colour of chlorophyll. Blue was a forbidden colour unless it depicted the Virgin Mary, whilst purple was worn in lent, as it was the colour of both sorrow and penitence.

Many of the ancient dyes were natural. The cuttle fish secreted one of the earliest inks a brown-black dye, which created a smoke screen to confuse the cuttlefish's enemies. Many pigments and dyes were used to achieve the colouration the blacks were commonly charcoal or soot, whilst the white was often white lead. Ochre made many of the sepia and brown pigments. The blue achieved to dye material came from wood, whilst the ancient Egyptians used cobalt and oxide of copper. The yellow pigment normally came from plants saffron, turmeric, and weld. Reds dyes were minium or red lead and vermilion. Scarlet came from an Arabian insect called Kermez, and the name crimson is derived from this as the dye cochineal is extracted from a beetle. Pliny named it granum, as it resembles a berry and it may have been the derivation of the term "ingrain colour". Kermez from Armenia was a common dye until the Spanish brought cochineal back in the middle of the sixteenth century. The cochineal colour was

richer and more vibrant and despite being far more expensive to use it did supersede the use of the old grub.

Indigo was in common use in India and Egypt long before the Christian era. The strips of material used to mummify the ancient Egyptians have been carbon dated and they originate about 2500 B.C. Yet Indigo did not reach Europe until the Sixteenth Century. Madder is a vegetable dye used for Centuries, piece of clothe dyed with the madder root has been found in the tomb of Tutankhamen.

In 1988, the Vatican allowed three pieces of the Shroud of Turin, to be independently tested. The University of Arizona in Tucson, Oxford University in England, and the Swiss Federal Institute in Zurich, all tested it with state of the art carbon dating materials. The results, published in 1989 in the journal Nature, revealed the fabric to be a fake as the burial shroud of Christ. The weaving of the cloth occurred between the 1260 and 1390, at least twelve hundred years after the death of Christ.

Not surprisingly, that has not been the end of the matter and intense debates still rage about the cloth. Chemical and microscopic analysis, has revealed that a madder dye and a mordant and gum mixture, had been wiped onto the cloth at another time. This would indicate that the Shroud had undergone repair at some stage. The gum would have acted as to bind the dye to the existing cloth fibres, but the madder dye did not reach Europe until the Sixteenth Century so the repairs were carried out after that time.

Cloth was once one of the most important commodities for trading, and the basis of many early industries, and the fabric dyes were worth their weight in gold. The colours found in nature the sepia browns and blacks, were relatively cheap, but the brighter colours were more expensive because they were more difficult to produce. The reds were especially difficult and that is one of the reasons that purple has been associated with royalty. Whilst sepia is the longest lasting of the natural stains because one drop of sepia renders a thousand drops of water obscure, and inks it fades when exposed to light.

"*Your sail was of fine embroidered linen from Egypt So that it became your distinguishing mark;*

Your awning was blue and purple from the coastlands of Elishah". Ezekiel 27:7

When Ezekiel wrote these words, he was referring to the people who lived on the coast of Aeolis, who were famed for their wool dying skills.

Pliny the younger confirms the expense of the dye.

"The Tyrian purple was the juice of the Purpurea, a shell-fish, the veins of its neck and jaws secreting this royal colour, but so little was obtained that it was very rare and cost one thousand Denarii per pound."

Ancient writings compare the Tyrean purple to be the approximate deep colour of the blood of coagulated bullocks. The people of Tyre were not the only civilisation to utilise a purple dye the Phoenicians obtained the dye from shellfish, Buccinum found on land and Pelagia, which was

from the sea. The Buccinum itself yielded two colours, the shells found along the Atlantic coast was darker, whilst the Phoenician coast shellfish

was a scarlet dye. Modern archaeologists believe that the Tyrian dye works operated about 600 B.C. and the dye came from a mollusc, the

Janthina prolongata, which was then an abundant shell in the Mediterranean region.

Many of these natural vegetable dyes were employed as ink. As it was not set, it was certainly not permanent and water will dissolve the ink. It was not until the middle ages that the story of ink was bound to the history of writing materials. Yet paintings remain from the time of the ancient Egyptians that have many colours and ancient hieroglyphic writings are written in more than one colour, yet the precise construction of ancient inks has been lost over the Centuries. What appears to be certain is there was a form of writing in Egypt and China long before the art of handwriting was perfected in Europe.

Yet the ancient Greeks were too proud to consider the civilisations of other nations except perhaps the Ancient Egyptians, and they altered the language of the people they conquered, and rewrote their history books.

They were a conquering nation and even their concept of democracy was built on war and war councils. Under threat from the Persian Empire, they rewrote history to suit themselves, but then history has always been the story of the victor rather than the vanquished.

"*There is the utmost uncertainty in the chronology of ancient kingdoms, arising from the vanity of each claiming the greatest antiquity, while those pretensions were favoured by their having no exact account of time.*" Isaac Newton

Certainly, the tablets of ancient writings have been more important than the ink. The stone on which Moses wrote the ten commandments, the pillars in Crete on which Corybantic ceremonies were recorded. Many of the of the oldest writings were intended to be preserved, when God instructed Moses to write the ten commandments, there is an assumption that Moses understood the instruction, when Noah was instructed to build the ark he was given precise instructions, but there was no such command to Moses.

Yet we know more about the materials on which early writings were written than we know about the writing medium. Character writing was begun on stone, then later clay or wax tablets, and a sharp pointed instrument was used. Some ancient Egyptian

obelisks carved in this way survive today such as Cleopatra's Needle, which stands in Central Park, New York, this stone dates to about 1500 B.C.

The Persians developed Clay tablets, whilst the Greeks used tablets of metal or ivory, the Romans used beech and fir, first coating them with wax. These forms of waxed writing tablets were in common use amongst scribes until the middle ages. Hebrew Scriptures were written on one side of skins, so that they could be rolled up and preserved.

It has been recorded that a copy of the Samaritan Pentateuch was written by the great-grandson of Aaron, Abisha, in the thirteenth year of the settlement of the land of Canaa, but that claim made in the dictionary of the bible is not substantiated by scholars.

The Romans had a word "encaustunt" for their purple ink with which they signed their edicts, and it a literal translation of the word means "burnt ink". The French for ink is "encre", or in Old French "enqwe" and the old English word is enke or ilzke; all of these words are probably a shorter version of encaustunt.

Ink was used by the Egyptians as early as 2500 B. C, when they wrote on old papyri, which is still in existence today. Papyrus was made by taking two pieces of rush and crossing them at right angles, and then sticking them together with the mud of the Nile. The trimmed ends made a rectangular leaf, which was capable of withstanding pressure when pulled in any direction because the fibres at right angles made it strong. Once one leaf dried about twenty were stuck together to make a continuous scroll. The drawback with the early papyrus was it could neither be folded nor creased, as it was extremely brittle; it had to be wound around a metal or a wooden roller.

To write on this new soft material rather than stone meant the invention of first brushes, and later reeds and then pens, as well as a semi fluid writing material. Early Christian paintings held at St Catherine's monastery depict books, the reeds used for writing, and the inkstands.

Pliny, the Elder (A. D. 23-79), mentions that writing could he removed by means of a wet sponge. Martial (A. D. 100), a Roman Poet, always sent a sponge when he submitted new works of poetry, so that any of then could be deleted by his publisher. Although the Roman oil carbon ink, could not have been removed by water, it is likely to refer to the natural sepia ink.

Somewhere between the early civilization of Egypt and the Roman Empire, the art of ink production declined and became almost a lost art. It was not until about 200 A. D. that the employment of ink began again. Part of the reason for this may have been the disputes between the priests and the writers' about what could and could not be used as ink. As we have seen Judaic law declared that only natural products could be used and these would have been water-soluble. However for whatever reason the basis of the pre Christian inks are lost to us.

The transition from the carbon based inks to the iron gall inks, which are the basis of the blue black writing fluids of today, took place gradually

from the tenth to the twelfth century. It was at the same time that the development of flax or linen began to be used as an early form of paper.

The raw materials for the iron gall inks were the gall nuts and the iron sulphate, both common materials in ancient Syria.

Gall Inks

The monk Theophilus, makes the first known reference to iron gall ink,

in an encyclopaedia of Christian art, during the eleventh century. He describes a method of ink preparation from a tannin bearing bark called thorn wood. The wood was first soaked in water, and then dried out; it was then mixed to a powder with green vitriol or iron sulphate.

Albertus Magnus (A. D. 1193-1280) also refers to the preparation of an ink from green vitriol in his treatise De Rebus Metallicis. Pliny's writings have recorded ink made from soot, charcoal and a gum, although he neglects to state the type of the gum. However, he does mention that addition of acid normally acetic acid or vinegar was a binding agent to adhere the ink to the papyrus.

At this time, two acerbic substances were added to black ink, a yellow additive Misy that was a yellow coloured earth and slimy mineral sediment Salsugo. Salsugo was referred to as "kalkanthum" or "chalkanthum" and it was sulphate of copper. Once it was mixed with lampblack or other black substances, it became an acceptable writing medium to the priests. This type of ink was called blue vitriolic ink for several Centuries; its disadvantage was that it was extremely corrosive it not only eroded the delicate papyrus, but also vellum, and parchment.

By the third Century A.D. the art of ink making underwent a revival, many ancient formulae's were revived. Red ink dyed vermilion by mercury, sulphur and potash or cinnabar was still popular as was ink dyed blue by indigo, oxide of copper or cobalt. Chinese ink was available for trade, as was the Tyrian purple. It had become popular to embellish writings with metallic gold or silver and specialist writers came from the East as far as Rome to illuminate manuscripts. These authors had their own jealously guarded secret ink recipes.

Julius Capitolinus wrote about gold lettering on a purple background in his biography of Emperor Maximinus the younger. (305-313 AD). Emperor Maximus achieved fame by trying to suppress Catholicism and ordering the execution of St Catherine, whose bones were then sent to the monastery at Sinai, and today holds many ancient manuscripts from this era.

However although manuscripts have survived from this era, most of the ink has not survived. A copy of the Four Gospels was discovered in the Tenth Century although it was written in the Fourth Century, with Indian ink. However many of the older writings were in fact destroyed. In 390 A.D. the Roman Senate ordered many of the book and manuscripts in Italy and Greece to be burnt, as Rome began to adopt Christianity many older manuscripts of a Pagan nature were systematically destroyed. Those that were not destroyed in this manner were destroyed in the early fifth Century when the Goths sacked Rome.

The Saracen destroyed the world-renowned library at Pergamus, the ancient name for Alexandria in A.D. 642, and with it the reputed half a million books it contained. The popular rise of Christianity did little to further knowledge and learning and the Middle Ages was commonly known as the Dark ages because the Church restricted book production to either Ecclesiastic books or a few medical textbooks.

The invention of the quill pen in the sixth century generated resurgence

in the printing world. Ink had to become thinner and greater attention

was paid to composition. However, the spread of knowledge was still restricted to the cloistered religious world. The priests wrote the ink making recipes down and not for posterity but as instruction manuals for the younger priest scribes. Not all of these recipes yielded a satisfactory ink, though they did include soot and vitriol, they also included metal and stones.

The following is an extract of an instruction left by the monk Theophilus

"When you shall have re-read this often, and have committed it to your tenacious memory, you shall thus recompense me for this care of instruction, that, as often as you shall successfully have made use of my work, you pray for me for the pity of omnipotent God, who knows that I have written these things which are here arranged, neither through love of human approbation, nor through desire of temporal reward, nor have I stolen anything precious or rare through envious jealousy, nor have I kept back anything reserved for myself alone; but, in augmentation of the honour and glory of His name, I have consulted the progress and hastened to aid the necessities of many men."

Early medieval ink

The development of black ink improved in the eight Century towards the later chemical inks. In one blue vitriol, yeast, the lees of wine, the rind of the pomegranate, was used during the reign of Charlemagne, the text still survives intact today, and the British museum has several examples of texts written with pomegranate ink. The Latin word "clericus" or "clerk," in effect meant priest, literacy was taken as proof that you had taken Holy Orders. Even the verb to sign a letter evolved from this time. If a letter written by a priest had to be authenticated, by a monarch they were instructed to place a sign next to the sign of the cross, which was next to the name of the scribe.

The history of writing in England was passed through Benedictine monks who established a school of writing and illuminating in Ireland during the Seventh century. Later they passed the knowledge to their brethren in Scotland. Each Benedictine monastery had a scriptorium or a place where writing and illuminating was carried out. The situation for this was chosen very carefully using the best natural light available, candles any form of artificial flame were banned lest it damage the manuscripts. The fame of the Irish Benedictine monks spread far and wide scholars travelled from the rest of the world to study the Greek language and the Irish monks travelled to Gaul, Germany, Switzerland, and North Italy.

"The Book of Kells, named because it was preserved and kept at the Monastery of Kells, which was founded by St Columba; was written in the seventh Century and it is an example of the style and excellence of the Irish literary schools. The four gospels in Latin are unique it has been written and illuminated in the insular style not found anywhere else but Ireland and England. It comes from the Latin which means island style and it differs in form from the writing and style of other contemporary European works.

A popular medium was parchment or processed sheepskin, but the carbon ink on this substrate was not very successful because of the lanolin content making the surface greasy. Experiments led to tannic inks being developed, although initially the ink was transparent. The slow chemical reaction between the salts and the acid penetrated the paper and left a darker residual mark. Gum Arabic improved both the keeping qualities and the inks flow because if too much acid was added it ate through the paper.

Gall ink and linen paper both came from Asia, but despite the fact that little was known about chemical reactions the use of this type of ink spread. The secret of this type of ink came from the Arabs, through Spain, then France, until the knowledge reached the Vatican, and the Church spread its use. The Moors at the same time spread the manufacturing process of paper. The art of making papyrus began to decline in the seventh Century and it had ceased to be made at all by the early middle ages. However as little new information was being written there was not much call for something to write on.

Parchment was so scarce and expensive that it had to be re-used. The lamp black carbon ink was not encaustic, as it did not sink into the parchment, so the ink was easy to remove using a weak alkaline solution, and a pumice stone. This does not entirely obliterate the ink but it became relatively indistinct and it could be rewritten on. Manuscripts rewritten this way are palimpsests and there are many examples of these writings in all the major European libraries. In some cases, original copies of the gospels can be seen underneath medieval sermons, in other cases the writings have been erased so that they cannot be read.

Early paper was known as cotton paper and it was of a very inferior quality, it was coarse with many knots. In 1221 the German monarch

Frederick II, decreed that no public document was to be written on cotton paper, and the scribes had two years to transfer all government documents onto parchment. Better quality paper, was available it was linen paper, which was durable, strong, but flexible, but it was not popular as it was very thick. The art of polishing paper, was standard practise for the Persians, the paper was rubbed down and refined, but this practice was not normal in Europe. Whilst paper was available it was considered an inferior medium to vellum. Vellum was made from fine parchment leather and by the fourteenth Century all the books that were considered valuable manuscripts were written on Vellum. Even by the fifteenth Century less than a fifth of all books were written on paper.

It has been estimated that Florence produced more manuscripts in

the fourteenth and fifteenth centuries than the rest of Europe put together.

It was not just writings in ink, but the richness of the illustrations, they illustrated their sacred books and their daily missals. Pope Nicholas V, (1397-1455) was nicknamed "Tommaso the Copyist" before he became the Pope. He is reputed to have donated five thousand books to the Vatican all of which were his creations. As Pope, he created the Vatican library. He wrote to the Enoch of Ascoli in 1451 just before his death to discuss the plan. He created the Bibliotheca secreta, Bibliotheca latina, and Bibliotheca Greaca. The bibliotheca Greaca was a vast establishment for translating the Greek classics; he preserved the works of the work of Herodotus and the work of Thucydides. After becoming pope he was nicknamed the "humanist" Pope because the knowledge was intended for all not just the clergy.

Clerical and Abbey libraries were under the care of an "armarian," who had the sole charge of preserving the manuscripts from damage from insects, light or damp. He had a record of every book borrowed and by whom and had a complete catalogue of all the books in his care. Some of these catalogues have survived to the present day and it serves an in interesting testament to the names of authors lost forever. Part of his duties was also to write the contracts for the books to be copied, and also assign the materials and supervise the quality of the work. The armarian was also responsible for the work carried out in the scriptoria, which were adjuncts technically of a library, but at the time adjuncts of a Christian library; a room devoted for writing.

Some of the monks had skills in all branches, writing, book binding and illustrating; however it appears to be more normal that the work was specialised. When a work was being written colour was important and the term "rubric" describes a printed title, heading or a beginning word of a paragraph, distinguishable from the other text because it was coloured. In general pigments were not used for writing except the embellishments of capitals.

In the Middle Ages both the carbon inks and the iron gall and iron tannin inks appear to have been in common use, although it is presumed they superseded the carbon inks as the secret of making a satisfactory carbon ink was lost. The iron gall inks from the

eleventh century until the middle of the nineteenth century were known as oxidised inks, as opposed to the unoxidised blue or black inks.

They were referred to as oxidised inks because the process of making them mixed the gall or tannin extract with iron sulphate and gum, which was then oxidised or exposed to the air until the insoluble iron tannates

remained in suspension in the liquid. However, gall ink was not a successful writing ink as most of the ink remained on the surface of the paper, rather than sinking into the paper and this was because iron tannates were precipitated before the ink was used. If the ink does not penetrate into the writing fibre it cannot be permanent, to achieve this permanence the ink should oxidise after it comes into contact with the paper.

Writing inks are fluid substances containing a solution of colouring material or the colouring material is suspended in the liquid. The colouring material can be any type of pigment that can be suspended or dissolve. Inks are classified into

- aniline inks, or coaltar inks
- logwood inks,
- nutgall inks
- and specialist inks such as invisible ink.

Aniline inks are used when printing plastic materials, which contain shellac, or synthetic resins, or methyl alcohol. Aniline inks are made by dissolving aniline or coal tar dyes, in distilled water and adding a preservative. Common preservatives are Phenol, or carbolic acid or thymol, and they are added to prevent the formation of mould.

About a fifth of an ounce of the dye is added to 1000 c.c's of distilled water. They are fugitive or washable inks and they do not corrode metal pens. Washable when used in the context of ink means it is capable of being washed out of fabric without damage to the fabric or the fabrics colour. By washing the ink, you do remove its colour, but by writing with this ink the dye is deposited as the ink evaporates, but there is no chemical reaction on paper. The new aniline inks were less corrosive than the tannic gall inks, and the range of colours available was larger than that of any other ink, but they smear when wet and also fade with exposure to light. In certain parts of the world aniline inks are used as a dye, the Fijians have long used blue ink to dye their straw hats a rather distinctive shade of blue.

Logwood Inks

Logwood inks are manufactured from extracts of the Haematoxylon campecheartzim tree mixed with crystallized sodium carbonate and potassium chromate. The pieces of wood are purchased as small chips and they are steeped in water to extract the dye. The ink dries easily into a purplish black which becomes a concentrated black on the surface and in the paper. It can be washed, but when exposed to air it decomposes into small flakes.

Nutgall or iron tannin inks are made from gallic acids and ferrous sulphate, or green vitriol. When mixed together these chemicals form a substance which is virtually colourless, but which darkens when it is exposed to air. Once the ink comes into contact with paper it reacts with the paper fibres, forming a black iron compound in the fibres, which will last as long as the paper survives. Unfortunately, an almost colourless liquid is not much use as a writing material so an indigo or water-soluble blue aniline dye is added. As the ink writes the colour is blue, but with time the blue fades leaving a predominant black, which results from the

the oxidation of the ferrous tannate and gallate. Blue black ink describes the inks which write blue but become black. Because of the permanent nature of nutgall ink they are used for recording official documents.

The chemical iron tannim ink can form quite naturally, in Algeria there is a River of naturally occurring ink. Two tributaries join and one of the streams runs through iron enriched soil, and the water has absorbed the iron content. The other stream comes from a peat swamp and has tannin in it. When the two streams joined, there is a chemical reaction between

the tannic acid, the iron and the oxygen in the water, which causes

black ferric tannate, or ink to form.

The nutgalls are abnormal growths of the oak tree, the Quercus infectoria, which is abundant in the Middle East. They yield Aleppo galls which make the most suitable tannic acid for the manufacture of inks. Tannic and gallic acids in solution gradually turn a light brown when exposed to air, before they react with the ferrous sulphate to develop black. It takes time for the black precipitate to form and to prevent this occurring whilst the ink is still in the ink well sulphuric or hydrochloric acid to the ferrous sulphate which prevents this. The acid makes it more soluble which means that it penetrates the fibres of the paper and prevents the ink from clogging the pen.

The city of Baltimore suffered a fire in 1904 and one of the city jewellers J. McDonald burnt, and their commercial records lay in water for week, once they were recovered and dried out, they were still legible.

Miscellaneous inks

Secret Inks

This type of ink is the ink of espionage and subterfuge, referred to as invisible, sympathetic, or secret ink. It can be made from common foodstuffs, for instance the British used rice starch to manufacture Invisible ink during the Indian mutiny in 1857, a method developed from iodine. The most common of the sympathetic ink is one made from cobalt chloride, when diluted before writing the ink dries to a very pale shade of pink, but once the ink is warmed, it becomes a clear and distinct blue. When

phenolphthalein is added to the ink it remains invisible until it is exposed to ammonia vapours. Some of the earliest invisible inks were lemon, orange or onion juice it had to be scorched to make it visible, because it is an undigested juice, once heated they return to their natural colour.

Typewriter ribbon inks

The base of typewriter ink is usually castor oil, because it is slow drying

and it is then mixed with oleic acid to which ground colouring agents have been added. To get the ink onto the ribbons is an art in itself. The ribbon is passed through rollers, which have been set at a specific distance apart. Most typewriter ribbons have two colours, but each section is inked at the same time from two separate reservoirs of colour. There has to be a partition at the rollers to prevent the two inks from merging. Even so, the viscosity of both inks has to be equal if it is not the colours will blend. The finished ribbon has a line in the centre, which is the width of the partition.

If one uses a typewriter continuously the ink begins to fade, because the later words are not as clearly pressed onto the paper. This is because the ink has been used, if the user leaves the ribbon for an hour the ink will flow back into the ribbon.

Printers Ink.

Printers' Ink

The first printing inks in use until 1864 were made from burnt rosin,

turpentine, pitch, and petroleum oils. By 1864 the carbon black was

made by burning natural gas rather than rosin, although lampblack made from the resin can still be added to printing ink.

Printing

Historically printing was a technique to apply under pressure a quantity of colouring agent onto a specified surface to form text or an illustration, it involved a press, lead and ink. When printing colours the combination of colours is achieved by submitting each sheet to successive impressions by type form each of which his designed to carry only a single colour. There is sufficient wavelength in the three primary colours of red, blue and green to make every colour when they are combined. We see colour from an inked impression because the ink reflects some colours so we are aware of them, other colours it absorbs which in effect means that they are masked from our sight.

Red, blue and green have sufficient colours in their wavelength to reconstitute all the colours in the spectrum when they are combined appropriately. Yellow absorbs all the wavelengths of colour in the blue band, but it reflects any colour of red and green.

Magenta totally absorbs green and it reflects red and blue. Cyan being close to turquoise absorbs red and reflects all blue and green. When any two of these ink colours combine, both annul the capability to reflect any of the two primary colours that it cannot itself reflect. The eye then perceives only the one primary colour that inks are capable of reflecting. When yellow and magenta are mixed, the only colour they can reflect is red. Once the three inks are combined, they are incapable of reflecting any colour and they appear as black.

Nowadays illustrations and text can be reproduced without a press and a colouring agent. The print monopoly has been broken, printing has allowed the explosion of knowledge in many forms, and it is precisely the number of these applications that has challenged the role of the printing press. By its definition, it has produced newspapers, books, periodicals, textiles, plates, ceramics, microfilm, radio and television.

The age of print banished forever the dark ages, it heralded a new age of

Discovery, which would herald a modern world. When the printing press was discovered there was a rise of a new economic class, the landed feudal aristocracy was in decline and a new mercantile class based on trade was burgeoning. The trade generated by the Flemish cities, and the Italian republics fulfilled economic ambitions, but ideas were to change rapidly the religious crisis would deepen and create the Reformation. This new breed of commercial merchants also had political ambitions.

The first role of the printed book spread literacy once literacy was established then the concept of general knowledge became possible.

The first books published often had a scientific based as well as contemporary literature. Later it was used to publicise Catholic and then Protestant tracts.

William Caxton was the first British printer and despite the fact that less than forty of his books are still in existence today, he revolutionised life in England. He was born in Tenterden, Kent in approximately 1422 and he died in 1491. His translation and print of "The Recuyell of the Historyes of Troye", was the first book printed in English in 1474, it was a translation of a contemporary French romance. During the course of his life, he printed nearly one hundred publications and about a fifth of these were translations from the original Dutch, Latin or French manuscripts.

The more famous books from his press include The Canterbury Tales, and also Troilus, and Criseyde both written by the renowned English poet Geoffrey Chaucer. He also published "Confessio Amantis" by another English poet John Gower. "The Game and Play of Chess Moralised" was a translation of the first major European work on chess, it was the first printed book in English to make extensive use of woodcuts.

His printing press shop was in the borough of Westminster at the sign of the Red Pale. Here, he published such major works as Troilus and Creseide, Morte d'Arthur, The History of Reynart the Foxe, and The Canterbury Tales. The early typefaces used by Caxton were all varieties of "black letter" or "gothic" type. By 1490, he had acquired a

more round and open typeface, a textura originally used by the Parisian printer Antoine Verard and later used more extensively by Caxton's successor, Wynkyn de Worde.

The printing press was developed in Europe rather than in China or the orient, and there was a practical reason for this. Occidental writing characters, is based on an alphabet with a small number of letters. Chinese calligraphy has over 80,000 distinct symbols, and this vast number meant that it was technically more difficult for the moveable type to be manufactured in a series.

To prevent any new discovery from being lost there must be publicity, and the advent of publicity was suppressed in the dark ages. For new paradigms to grow and develop, the error of one hypothesis must be proved, and a new concept better fitted to contemporary facts must prevail. The problem with new paradigms is that they must fit their age and the civilizations of ancient Greece and Rome did not require printing.

Typography would not have bestowed any advantages on society. Writing was carried out by educated slaves, booksellers flourished, and wealthy publishers had few expenses other than feeding and clothing the slaves.

Books were present everywhere in Rome, even in the public baths, in part because they were so cheap and easy to produce.

Ancient Roman printing was not confined to books, a daily newspaper

"Acta Diurna", recorded the official business of the Senate, as well as city gossip. It was dispatched to the far flung parts of the empire to bring a taste of life on Rome, for the Roman soldiers many of whom spent years abroad, and often settled in the conquered lands.

Once the Roman Empire declined so did the need for knowledge and printing declined. By 500 A.D. Emperor Justin was illiterate, he was forced to leave his mark on state papers rather than sign them. By the end of the Seventh Century, books were so scarce in Rome that the bishops of Germany were asked to send some of theirs.

The printed word created its own impetus for questioning and change, once knowledge became general more people could participate in the debate. This in itself precipitated more debate and discussion and this in its turn led to ideas being generated. Europe, witnessed a revival of the scholastic learning, new ideas from poets, orators, novelists, writers, philosophers, chemists, alchemists, mathematicians and astronomers, breathed new life into a dawning age. Thus the middle Ages, which had accomplished their work of social renovation, made way for the Renaissance, which scattered knowledge in the fields of Science, Literature and art. The Industrial Revolution and later the enormous technological advances of the Twentieth Century accelerated this change. It could be said that there were more ideas and inventions in the last hundred years than in the accumulation of all the ideas of history combined.

It has been predicted that with the dawn of a new age of information that the printed word will die out. However, this seems to be a rather dire prediction as the printed word does have its own advantages, but only time will tell. I cannot be alone in reading newspapers online rather than buying the printed hard copy. However, one of the advantages of the printed word is that it takes longer to produce than television pictures or audio, and it has a greater visual impact that tends to be memorised.

Many people find that watching news on the television gives such a fleeting glimpse that it tends to be forgotten very quickly. Another advantage of print is that it offers time to reflect on an idea, its permanence means that one can go back to it to study. Psychologically humans learn facts easier when they read tracts quickly several times rather than watching the same information on the television.

Ink from the sixteenth Century onwards.

By the Sixteenth Century despite several styles of writing, the ink colour in Europe was a uniform grey colour, whatever the medium written on.

As the colour was the same on all mediums it appears that it was either a part of the process of manufacture or a dye. The following quote from William Shakespeare attest to the use of gall ink.

"Go write it in a martial hand; be curst and brief; it is no matter how witty, so it be eloquent, and full of invention; taunt him with the license of ink; if thou thou'st him thrice, it shall nor be amiss; and as many lies as will lie on a sheet of paper, although the sheet were big enough for the bed of Ware in England, set 'em down; go, about it. Let there be gall enough in thy ink, though thou write with a goose pen, no matter: about it." Twelfth Night William Shakespeare *Act* three scene 2.

By the Seventeenth Century there is a still a long way to go before there is a standard ink, but the fact that so much black ink remains that is as colourfast now as when it was new indicates that more care must have been taken in the ink recipes and the mixing of the ingredients. Pietro Caneparius, a Venetian physician and writer of "De Atrametis", gives an extensive treatise about inks in particular the gold, silver and sympathetic ink.

"De Atrametis", was published in London in 1660, and it is a reference book for its time as it contains many recipes and formula for ink as well as the notes on its composition. A Dutch Chemist Jacques Lemort wrote an article called "Ink Formulas and Colours," and whilst he did not have new information that had not previously been recorded he did attest to the fact that gall inks were of a superior quality if care had been taken to make sure that they were properly compounded. Curiously, about this time a whole series of books were published in Europe about calligraphy and handwriting, but not the formula of ink.

Ink manufacturer must have been an industry for many people but we have little knowledge of it. A Frenchman, Monsieur Guyot, a chemist, manufactured and sold ink

in Paris in 1609, and whilst there must have been many manufacturers' before him, he holds the distinction of being the first recorded ink manufacturer of which a note remains. In 1626, the French government concluded an arrangement for the manufacture of a "gall" ink without any added colour. This was the start of the process of standardising the manufacture of ink.

The quality of ink was so inferior at this time that the Royal Society became involved. The Royal Society established in the middle of the 1640's to meet once a week to discuss the ideas of Francis Bacon. They met to discuss scientific topics and it would not be much of an exaggeration to state that the History of the Royal Society in the U.K. was synonymous with the history of science.

Dr. Charles Blagden read his paper entitled "Philosophical Transactions" in 1787. He did conclude that the quality of contemporary ink was inferior to ink manufactured centuries before. Many gall inks, looked good when new but as they aged the durability and permanence of the ink deteriorated. However, whilst there were documents written in the twelfth Century that still had perfect ink it would have to have been taken into consideration that these were written with Indian ink.

Although William Lewis, an English Physician, began making experiments on ink in 1748, to determine the chemical components, necessary to make ink permanent. As chemical reactions were still not understood at this tome much of Lewis's work has been subsequently disproved. However, he did discover that an excess of iron salt affects the permanence of the colour of ink and it becomes brown as it ages. His experiments did not greatly contribute to the knowledge of ink, but he was the first to record that logwood as an excellent colouring agent in the gall inks.

Dr. James Stark, a chemist, undertook one of the most comprehensive studies of contemporary ink in 1832; he did not complete his experiments until 1855, when he submitted his results to the Scottish Society of Arts.

Dr William Inglis Clark in 1879 wrote his thesis, which was entitled "An Attempt to Place the Manufacture of Ink on a Scientific Basis," He concentrated much of his work on the modern methods of manufacturing blue black inks. He departed from modern thought because he refuted the idea indigo paste kept the gallo tannate in solution, he decided that it was the action of the sulphuric acid, which was the vital ingredient. He also concluded that a hot water gall infusion was not suitable for blue-black inks, it had to be done in cold water. The excess tannin released with a hot infusion inhibited the action of the indigo as a colouring agent.

It has only been in the last hundred years that a standard has been adopted for ink. In 1890 Schluttig and Neumann, investigations, published a formula for what they believed to be the best iron gallo tannate ink. This formula was adopted by the State of Massachusetts as the standard ink for all its official documents. In 1912, the Prussian Government issued regulations requiring that documentary or record inks should meet certain standard specifications. The United States Government incorporated in its

specification for "Treasury Standard" writing fluid the requirement that ink should conform to the standard ink of the State of Massachusetts.

The British government decreed that all ink used in the public departments are obtained by public tender, controlled by conditions set by H. M. stationery office. They are assisted in this task by the chief chemist of the Inland Revenue who test random samples of ink. In this way the British government hoped to ensure that the correct inks are used for each purpose.

Although most ink has a chemical composition, and it is possible to duplicate the formula exactly the resulting ink is not always the same. These differences are more noticeable in the inks made from nut galls, sulphate of iron and a gum and especially when the ink is black. However, the differences in the twenty first Century are not as marked because most are now manufactured by steeping the galls in a cold press, rather than the earlier method of warm water

Red is the most important coloured ink in demand today, and its manufacturing process has changed. The colour used to be the natural cochineal dye made from beetle, but today soluble aniline red is added to water. Copying ink has two types, dependant on the amount of glycerine, or how soluble the pigment is in water, but copying ink is not recommended for record keeping. Apart from aniline colourings, added colour for ink can either a colour yielding compound or a colour and a tannin. Some colouring agents can be added with tannin whilst others react and best used alone. Many of the dyes used through the ages have not stood the test of time, light, humidity and heat, affects all aniline dyes, if they are obliterated, they cannot again be rendered legible again. That is the principal reason why records, which need to be permanent, have used black ink.

Anilines.

Anilines, is an organic chemical compound now more commonly used in the manufacture of polyurethane, although its historical use has been a dye. The name itself derives from anil, the Sanskrit word from dark blue and later the Arab word for indigo.

Early in the nineteenth century the development of synthetic chemical substances occurred. In 1825, Faraday's experiments isolated benzole, which react with nitric acid to become nitro-benzole; when agitated acetic acid or vinegar and water and iron filings becomes aniline. At the same time mauve as a synthetic dye was discovered, by William Henry Perkins, when he was searching for a cure for malaria. Because this dye could be added to ink, it became commercially important. For the next fifty years, the number of discoveries of synthetic dyes was to increase and the Germans dominated the work as the Americans lacked industrial chemists to carry out the research.

Graebe and Liebermann synthetically produced alizarin, which was the colouring ingredient of the madder root. This was perfected in 1873 by Springmuhl who made a

superior blue dye from anthracene, these new discoveries were kept very secret and the cost of the new synthetic dyes astronomical. Springmuhl's original blue cost $1,500 for a pound. Later the reds were discovered, but the commercial cost of making these dyes still far outweighed the cost of extracting them from natural plant materials. However, these synthetic dyes were extremely intense compared to the natural product and a single grain eosine in ten million parts of water could be seen as a clear rose pink. It was not until 1897 that the commercial use of manufactured indigo was viable.

Modern Printing

The advent of the personal computer has meant the need for home printers, and this has revolutionised the history of ink and its development. Early models of home computer printers used a process called impact printing, it worked by an electromagnetic print head, driving a number of pins into a pattern. As the pins were propelled forward, it struck the inked ribbon and transferred the pinhead dot to the paper. The pattern of the multiple dots formed either the letters or the characters.

However once this matrix of dots has been formed there are several ways of transferring the image to paper.

Laser Printers.

During the seventies Rank Xerox was one of the most powerful companies in the world. In 1959 they had developed the Xerox 914 the first plain paper office copier, and by they had formed the Palo Alto Research Centre opens in Palo Alto, California commonly shortened to Parc. Parc invented some of the world's firsts, yet they failed to market, patent or capitalise on any of them. PARC invented the prototype of the world's first personal computer, known as the Alto, though unless you are a geek you could be forgiven for not knowing that!

In 1981, Xerox unveiled the Star 8010, including the bitmapped screen, What you see it what you get editor, (WYSIWYG), mouse, laser printer, Smalltalk language, Ethernet, as well as software which enabled the user to combine text and graphics in the same document. Less than a hundred thousand units were produced and its launch was a total commercial flop.

Despite having the first GUI interface, the first commercial use of the mouse, as well as the first what you see is what you get editor. All of these were inventions were utilised by other companies such as Apple because Xerox having invented the technology was so arrogant and confident of its commercial position that it did nothing with it. In 1984, the Hewlett Packard company introduced the LaserJet laser printer, for sale US$3,600, they did not introduce a laser printer which retailed at less than a thousand dollars until 1990.

The story of the laser printer, yet another technology developed by Xerox PARC, epitomizes the lack of communication between the research laboratory and

management that resulted in Xerox's inability to capitalize on PARC innovations. Laser printers focus a beam of light, which etches patterns of positively charged ions, onto the surface of a cylindrical drum composing organic photosensitive material, which is negatively charged. The drum rotates and the negative toner particles adhere to the patterns etched by the laser and are transferred to the paper.

The inkjet printer is another example of a non-impact printer; they spray minute particles of ionised ink, which form a dot matrix, on the print surface. Magnetised plates that project the ink in a specific path determine the inks shape. They are capable of producing a print quality at home approaching that of the laser printers. There advantage is that they use smaller moving part and are cheaper to produce and buy. If they have a drawback it is that, they require a special type of ink and it does tend to smudge on inferior quality paper.

One of the characteristics of an inkjet printer is that the dots are minuscule, and are positioned precisely. The diameter of an average human hair is seventy microns, but the dots of an inkjet printer are between fifty and sixty microns.

The quality of print depends on the type of paper, standard photocopying paper will produce a printout, but the image will be crisper sharper and more bright if inkjet paper is used. The print quality is altered by both brightness and absorption. Paper brightness is defined by the roughness of the paper. The smoother the paper surface the brighter the resultant image will appear to be. When the light from the paper is reflected back in the same direction the image appears brighter, but this illusion is not achieved on coarse paper because it scatter lights everywhere in more than one direction. This can be illustrated by the fact that a glossy magazine illustrates a clear concise image and a newspaper does not. Dye has an opposite charge to the paper so the solvent soaks into the paper and the coating retains it.

Ideally, inkjet images print better when the ink remains in a fixed dot, which should be symmetrical, once the dot is absorbed by the paper the edges feather out and this bleeding covers a larger non symmetrical area. The effect of the feathering is to blur the edges and make them less defined, in other words fuzzy around the edges! High quality inkjet paper is formulated to prevent the feathering it prevents the ink from splurging a larger area than it should because the paper has been treated with wax which makes it impervious to ink absorption.

The waxed paper is the key to the success of the high-resolution capabilities of inkjet printer. Just twenty-five years ago, printing shops carried out highly expensive contracts to print images. Dots per inch (dpi) are a printing term, which means how many dots centimetre the printer can place on a square inch or centimetre. Typically most printers place the same number of dots both horizontally and vertically (some printers are different) that means a 720 dpi printer prints 720 vertically as well as 720 horizontally within the given area.

In general the higher the resolution of the printer, the better quality the printed product will be. With coated paper, the resolution doubles, because the printer shifts the paper, almost imperceptivity, and adds a second row of dots both horizontally and vertically; the image will not feather because there is no absorption.

With the introduction of inkjet printers, there was a new challenge, the development of a successful ink. Changing ink cartridges was certainly easier than either the dot method of changing a ribbon or inserting a toner cartridge. Inkjet printers have also had an impact on the processes used to make ink; it has become a truly specialised industry. Inkjet inks are both water and solvent based. The older types of inks that had dyes as a colorant were no longer suitable for inkjet printers.

Inkjet orifices in the printer are miniscule; the range is between ten and twenty microns, whilst a micron being one thousandth of a millimetre. The ink for the first generation of inkjet printers was problematical; the original pigments inks constantly clogged the machinery, until an effective detergent, which acted as a dispersant was added. Both dyes and pigments are dyestuffs, because although they have a different molecular structure they both come from the same root, indistinguishable organic chemical compounds. Dyes are a solution and their molecular structure is smaller than pigments, which are a heterogeneous mixture.

Dye molecules need functional polar groups, as the plates are magnetised, and it is this, which gives the ink the disintegrating quality that is necessary to dissolve in the vehicle. Because the ink disintegrates, it becomes smaller than pigment ink. Pigments stay in their particle form, which remains insoluble in the vehicle without the polar groups.

To prevent the pigments from clustering, ink makers must add a dispersing agent to the mixture, which in effect acts as a detergent. A complication in the use of pigment ink rather than the use of dye is that pigment is composed of several hundreds of thousandths or even millions of molecules, whilst a dye particle is composed of a single molecule. Pigments have the advantage as their tiny size means they become less damaged by exposure to the elements and ultraviolet light. In contrast, the singular composition of dye means that it can be demolished easily, quickly and utterly, the pigment structure means that it has at its disposal an infinite number of backup particles that stops deterioration. Although pigment ink is by definition more difficult to manufacture it is this type of ink that has revolutionised the sign industry, because it is more permanent on a wider variety of materials.

The dye molecules interact with the other ingredients, and they can benefit from colour enhancing agents to increase the intensity of the colour. When the electrons in the dye interact and move the colour materialises because of the light energy that falls on the dye. If the colour enhancer absorbs light energy, the spectrum of light reflected from the dye changes are various characteristics which are necessary for the functioning of inkjet printers they require

Droplets of ink identical in size

No clogging of the printer head

High optical density

Quick drying

Fade resistant when used outdoors.

Both solvent and water based inks fulfil these requirements; but water-soluble inks are more common, as they are used for the smaller inkjet printers designed for home use. Water based dyes are still classified as dye based and pigment based. Stable images cannot be guaranteed without ink injection being stable. Water-soluble inks consist of water, a colorant, anti-drying agent, penetrant, pH adjuster and a type of preservative or fungicide. Water-soluble inks using dyes are less likely to clog the printing head, but they run more easily. Water-soluble pigment inks have improved dramatically since the original concept and they are now considered superior.

	Water soluble dye based ink	Water soluble pigment based ink.
CHARACTERISTIC	The colorants have been dissolved in the vehicle	The colorants have been dispersed in the vehicle
Advantages	High-definition colours over a wide range of colours. High optical density with excellent colour.	The colour does not change. High light and water fastness, they do not tend to run.
Disadvantages	The colours deteriorate and run. They do not have good light and water fastness	They have low optical density, a limited range of colour, which have a greater tendency to clog the printer.
	Solvent Based Inks use solvents as the vehicle of colorants.	
advantages	Non aqueous colorants makes the ink very water fast, and reduced the drying time. Storage time is improved	The reduced of available pigments as colorants means the range of colour is limited.
Disadvantages		

A solid inkjet printing system means that there is no drying procedure after printing, there are no solvents used with the melted solid inks. Chemically the ink is similar to the wax used in candle manufacture; it is made up of a plasticizer, stabiliser, viscosity modifier and colorant, which may be either a dye or a pigment.

Four Colour Process Printing

This is the most common method for producing a colour print for a book or magazine. Originally, the artwork had to be separated using photographic filters to produce four different printing plates, but nowadays the separation is carried out digitally. As modern inks are translucent the proportions that they can be mixed in is almost infinite and they can produce a wide range of colours.

Today ink making is a specialist industry; each printing process requires its own classification of ink. Despite the dour predictions about the future of the printing industry, the ink bill in the United States is estimated to be several billion dollars per annum. The future of ink looks as secure now as at any time in its history. Between 192-s and the 1960's ink had its heyday before the advent of the biro pen, but home computers and printers have made the use of ink secure at least for the next few years.

Glossary

Air

The amount of white space in a printing layout, or web page.

Artwork

Illustrated printed matter or graphic images such as photographs, paintings, drawings, hand lettering, or other art media, which accompanies and illustrates text.

Bitmap

A grid of pixels or a series of printed dots, which looks like an image, but is generated by a computer

Indian Ink

Indian Ink is also called Chinese Ink, it is a black pigment in the form of sticks that are moistened before use in drawing and lettering, or the fluid ink consisting of this pigment finely suspended in a liquid medium, such as water, and a glutinous binder.

The sticks or cakes consist of specially prepared lampblack, or carbon black, mixed with a gum or glue and sometimes a perfume. India ink was used in China and Egypt Centuries before the Christian era and is still valued for its opacity and durability. In India, burning bones, tar, pitch, and other substances obtain the carbon black from which India ink is produced.

Ink

Ink is a fluid or a paste used for writing and printing it is made up of various colours, but is usually black or dark blue. It is composed of a pigment or dyes dissolved or dispersed in a liquid called the vehicle.

Intaglio inks

Intaglio inks are composed of petroleum naphtha's, resins, and coal tar solvents. The intaglio printing process is used mainly to print rotogravure newspaper supplements and cartons, labels, and wrappers.

Landscape.

A page or image, which is wider along its horizon and its height, is smaller than the horizon.

Pigment

A pigment is a substance, which gives ink its colour. It is also a particle that reflects and absorbs light, which makes something appear to our eyes as a colour.

Pixel

Pixel is an abbreviation for picture element, which, is the smallest distinct unit of a bitmapped image, in effect a dot made by a computer, scanner or other digital device. It may also be referred to as a pel.

Portrait

An upright page or an image which is a taller than its width.

Sympathetic ink

Ink naturally invisible or made invisible, unless viewed under special light conditions, or treated with heat.

Brief Chemistry Lesson On Printing Ink Pigments

Nov 1, 2001 12:00 PM, Richard M. Podhajny, Ph.D., Contributing Editor

I have received various inquiries about pigments and pigment chemistry. I will try to answer a few of these questions as they relate to package printing and converting.

What is the difference between pigments and dyes?

The primary difference between these colorants is their solubility. Pigments used in printing inks are colorants that are insoluble in water and most solvents. For instance, copper phthalocyanine blue is the primary blue colorant used in packaging and is quite insoluble in water and organic solvents. As the name indicates, it is a blue pigment that includes copper. The rest of its structure is a highly complex aromatic structure of benzene rings that include nitrogen atoms.

Unlike pigments, the number of dye colorants is seemingly infinite. Dyes are organic colorants that are soluble, and they are commonly used in the textile industry and in office products, such as ink jet printers. In packaging applications, dyes do not have the product resistance of pigments. Dyes provide brilliant color and are used in products that do not require long-term resistance. Most have inferior solvent bleed and oxidation resistance.

Many dyes are chemically acids or bases and usually are found in the form of salts. For example, sodium salts of sulfonic or carboxylic acid groups are used to solubilize certain dyes. Dyes used in printing paper can be made insoluble chemically by reacting with components in the paper. For instance, presence of calcium ion or tetra-alkyl ammonium ion will make the dye insoluble and "cement" it to the substrate.

The basic difference between dyes and pigments is their solubility. Whereas pigments are insoluble and must be used as dispersions in inks and coatings, dyes are soluble colorants.

Do organic pigments contain chlorinated aromatics?

The copper phthalocyanine chemical structure is also part of the green copper phthalocyanine pigments, which are chlorinated versions of copper phthalocyanine. These organic green pigments have similar resistance properties to copper phthalocyanine blue and are used extensively in package printing.

Some yellow pigments used in printing inks are based on diaryllide yellows. These azo pigments (pigments that have an N=N double bond) are made from intermediates that are based on dichlorobenzidine. These pigments are vulnerable to very high temperatures and/or chemical degradation. Although such chemical reactions are possible, normal printing and converting operations do not create such chemical or thermal conditions.

Can pigments be a source of cyanide?

Certain pigments used in printing inks have chemical structures that utilize cyanide complexes. They are iron pigments based on ferro and ferric cyanides, such as potash blue or soda blue pigments. Under conditions that decompose the pigment, cyanide can be liberated. Some tests conducted to determine free cyanide in water decompose these pigments in the test protocol and find "free cyanide." Pigments that may test positive for "free cyanide" under some test protocols include CI Pigment Blue 27, CI Pigment Red 169, as well as PMTA green and violet pigments.

Can certain pigments produce aromatic amines?

This question concerns aromatic amines in packaging products. Like chlorinated aromatics, aromatic amines are a concern due to their potential carcinogenic properties as a chemical class. Many pigments used in printing inks contain nitrogen in their chemical structure. Nitrogen-based pigments contain nitrogen within the pigment skeletal structure, but some may contain secondary and tertiary amine functional groups on the skeletal exterior.

The question of generating amines is likely associated with recent concerns over the potential reactivity of organic azo pigments to strong acids that can break down these pigments into aromatic amines. Azo-based pigments include most yellow and red packaging pigments. Although such chemical reactions are possible, normal printing and converting operations do not create such chemical conditions.

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Common Chemicals based on Industry Profiles

Prior to performing an Environmental Assessment, the types of chemicals on the site can be determined based on the past use of the site. This document provides common chemicals at the following industries:

abandoned chemical facilities
abandoned laboratories
abandoned oil facility
asbestos pile
auto body facilities
asbestos/tailing mine
battery reclamation facilities
dry cleaners
dye facilities
drum recycling facility
electronics manufacturing
electroplating
gas stations
glass manufacturing facilities
infectious wastes
manufactured gas plants/coal tar sites
machine shops/metal fabrication
municipal landfill
ordnance sites
paint industry
print shops
pesticide facilities
petroleum recycling facility
pharmaceutical manufacturing
plastics
quarry sites
rail yard facilities
radiation
salvage yards
scrap metal
shipbuilding and repair industry
steel manufacturing – electric arc/coke
tanning facility
wood treating facility

ABANDONED CHEMICAL FACILITIES

Chemical production facilities produce or repackage a wide range of chemicals including the production of acids, bases, oxidizers, polymers, plastics, surfactants, cleaning solvents, dyes, soaps and waxes. The raw materials are specific to the individual process and final product. Chemical facilities typically handle large volumes of chemicals utilizing above and below ground bulk storage tanks, transfer equipment, process lines and piping and raw material/final product storage areas. Some of these materials may be found on site in surface impoundments, bulk storage tanks, waste piles and disposal pits. All of these areas may contribute to soil, building and groundwater contamination.

ABANDONED LABORATORIES

Small laboratories which combine research and development with public analytical support are very common. Large research laboratories are less common, but can usually be found in conjunction with an individual chemical manufacturing and product testing facilities. Storage shelves containing large numbers of individual chemicals in limited quantity are always present.

The raw materials are specific to the individual laboratory, but usually contain all classes of hazardous materials including explosive, corrosive, flammable or radioactive materials, mercuric products and metal compounds.

Commonly found waste groups at laboratories include volatile, semivolatile, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and metal compounds. Severe building contamination may be present as related to broken chemical containers and poor housekeeping. A direct inhalation threat is also likely. Soil contamination may be associated with small burial pits encountered at rural lab locations.

ABANDONED OIL FACILITY

The term abandoned oil facility refers to any structure, group of structures, equipment, or device (other than a vessel) which is used for drilling, producing, storing, handling, transferring, processing, recycling and/or transporting of oil.

Typical raw materials found at abandoned oil facilities include, but are not limited to fuel oils, motor oils, oil sludges, oil refuse and oil mixed with wastes. Waste streams associated with abandoned oil facilities include solids and liquids containing petroleum hydrocarbons, metals (such as sulfur, zinc, calcium, barium, phosphorus, lead, aluminum, iron) and polychlorinated biphenyls (PCBs). Facilities may also contain oils that are corrosive. Used or recycled oils may contain additional contaminants from their prior use. These waste streams can contaminate soil and groundwater from repetitive spills, burial of sludges/tank bottoms and leaking tanks and process lines.

ASBESTOS PILE

Asbestos piles can result from natural resources (including mining operation), ship building yards, tailing from industrial operations and disposal of operation debris. Any material containing asbestos at more than one percent is designated as asbestos containing material (ACM).

The common types of asbestos found in a pile are chrysotile, amosite, and crocidolite. Other types of asbestos which can also be found in small quantities in the pile are anthophyllite, tremolite, and actinolite.

The main contributor of asbestos to an asbestos pile is domestic debris. Three forms of ACM are typically found in buildings: (1) sprayed or trawled-on material; (2) insulation on pipes, boilers and ducts; and (3) miscellaneous forms, such as wallboard, ceiling tiles and floor tiles. This material arrives at the pile from building demolition work or during remodeling of existing structures. Naturally occurring asbestos may result from the excavation for a building foundation, in areas where bed rock contains asbestos fibers. ACM can also be generated during mining operations and as tailings from certain

industrial manufacturing processes. During earlier times, ACM was used as an insulating agent in various areas of a ship. Easily crumbled asbestos may be responsible for the pollution of air, water and soil. Asbestos is a direct inhalation threat to humans. Potential health effects of asbestos exposure are asbestosis, mesothelioma, lung cancer and other cancer disorders.

AUTO BODY FACILITIES

Repairs often require the use of cutting and welding equipment, cleaners, solvents, paints, epoxies and polymers. A smaller concern may also be the automotive fluids that leak from heavily damaged vehicles kept on the property. This industry typically stores small quantities of paints, cleaners, solvents, epoxies, polymers and compressed gases. Some typical chemicals utilized in the auto body industry include: acetylene, oxygen, acetone, ammonia, carbon tetrachloride, hydrochloric acid, monostyrene, nitrous oxide, perchloroethylene, toluene, trichloroethylene and xylene.

There is minimal storage of waste products on site due to the use of small quantities of hazardous materials. The highest areas of contamination tend to be associated with the stripping and painting operations. Common wastes encountered at Superfund assessment and remediation projects include waste paints, corrosive liquids and sludges, metals- and solvent-contaminated soils, metals- and solvent-contaminated groundwater, and unused raw materials. The toxicity and mobility of paint mixtures and related cleaning solvents make groundwater contamination the primary environmental concern. Minor and localized soil contamination may also be encountered.

BATTERY RECLAMATION FACILITIES

Battery reclamation facilities salvaged the metals, primarily lead compounds, from automobile and truck batteries. This industry was primarily a recovery operation; so, very few raw materials were used. Due to the volume and concentration of the sulfuric acid generated during recovery, it was not usually cost effective to neutralize the sulfuric acid. Soda ash or similar neutralizing agents were occasionally used for neutralizing sulfuric acid at newer facilities.

On-site waste piles and burial pits for battery casings, and unlined lagoons and waste pits for sulfuric acid were common treatment/storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Common waste products encountered at Superfund assessment and remediation projects include lead-contaminated soils and ground water, highly acidified (pH as low as 1.5) soils and leachate, and large volumes of contaminated battery casings. Nickel, cadmium, copper, zinc, arsenic, mercury and chromium-contaminated soils and groundwater may also be encountered at facilities which accepted non-vehicle batteries and associated materials.

DYE FACILITIES

There are presently approximately some 1,200 different commercial dyes manufactured in the United States, and another 800 are imported. Dyes can be classified as acid dyes, basic dyes, direct dyes, disperse dyes, fluorescent highlighters, reactive dyes, sulfur dyes and vat dyes. Dyes are produced by a variety of chemical reactions from raw materials; most of these materials are hazardous to humans.

Common raw materials used to produce dyes include compounds, such as benzene, naphthalene sulfuric acid, oleum, nitric acid, chlorine, bromine, caustic soda, caustic potash, sodium nitrite, ammonia, hydrochloric acid, chlorosulfonic acid, sodium carbonate, bicarbonate, and sulfide. The heavy metals (copper, chromium, mercury, nickel, and zinc) which are used as catalysts and complexing agents for the synthesis of dyes and dye intermediates are considered priority pollutants.

On-site waste piles, lagoons and waste pits were common treatment/storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). The toxic nature of some dyes has long been recognized. The specific carcinogenic compounds involved in the dye industry include the following: 2-naphthylamine, 4-aminobiphenyl, benzidine (4,4=-diaminobiphenyl), fuchsine (CI Basic Violet 14), auramine (CI Solvent Yellow 2). The possible contamination of drinking water supplies is of concern because certain classes of dyes are known to be degraded in the human digestion system, producing carcinogenic substances.

DRUM RECYCLING FACILITY

Drum recycling facilities receive drums with residual chemicals and oil from various facilities. Based on the label information or field screening, the drums are separated into in various compatibility categories. When the residual chemicals are consolidated, the drums are rinsed, leak tested, reshaped, and painted for reuse. Soap detergent and steam cleaning are the most common process for rinsing. Unusable drums are crushed and disposed as scrap material.

Any kind of chemical can be found on a drum recycling facility. The most common chemicals are: oils and greases, paints and thinners, soaps and detergents, corrosive liquids, organic solvents, and pesticides

On-site storage of consolidated bottoms/sludges from the drum cleaning process are common at drum recycling facilities. Incompatible, leaking and unusable drums are often stored in large drum storage yards. These areas may contain heavily contaminated soils. At some abandoned facilities, lagoons, waste pits or buried drums may contribute to subsurface soil or groundwater contamination. The drum rinsate is generally reused, or treated and discharged into the municipal sewer.

DRY CLEANING

The dry cleaning industry uses processes which avoid saturating fabrics with water which may cause the dye to run or shrinkage of the garment. Solvents are used in place of water based cleaning methods. The four main solvents used in the dry cleaning industry are: perchloroethylene (PCE), petroleum solvents, chlorofluorocarbons (CFC-113) and trichloroethane (TCA). CFC-113 and TCA have subsequently been banned since 1995 under the Clean Air Act Amendments. When redeveloping a dry cleaning brownfields site one of these four contaminants are likely to be found on site if contamination exists.

ELECTRONICS MANUFACTURING

The electronics and computer industry manufacturing industry create numerous wastes affecting land and water. These wastes are produced during crystal preparation, wafer fabrication, circuit board preparation, electroless plating, imaging and cathode ray tube production. Some of the typical wastes produced in these industries are solvents, alkaline cleaning solutions, acids, etching materials, epoxies, metals (lead, nickel, silver and copper), surfactants, and lacquers.

ELECTROPLATING

A wide variety of metal components are transported from the original manufacturing location to an electroplating facility to be coated with specific metals to improve the appearance, resistance to corrosion, or engineering performance. Metal components are cleaned, etched, electroplated and finished by dipping into a series of vats containing a combination of corrosive, metal and/or cyanide containing chemical solutions.

This industry typically uses a series of plating solutions containing strong acids, strong bases, metals and cyanide salts. Acid and bases are usually received by the facility in drums and occasionally by bulk transport (tank trucks). The metal and cyanide containing salts are usually received as bagged or containerized solids, or drummed liquids, which are dissolved or diluted into large plating vats. The following chemical compounds are/were commonly utilized in the electroplating process: zinc cyanide, sodium cyanide, potassium cyanide, basic cyanide solutions, sulfuric acid, hydrochloric acid, nitric acid, hydrofluoric acid, chromic acid, and purified metal compounds.

On-site waste piles, lagoons and waste pits were common treatment/storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Common waste products encountered at Superfund assessment and remediation projects include waste cyanide, heavy metals and corrosive liquids and sludges, metals and cyanide-contaminated soils, metals and cyanide-contaminated groundwater, and unused raw materials listed above. The relative toxicity of cyanide, cadmium, and chromium warrant special concern when evaluating groundwater contamination.

GAS STATIONS

The largest concern in assessing a gas station is the presence of underground storage tanks containing old gasoline products which could contaminate sub-surface soils and groundwater. These storage tanks, and the lines used to transfer the fuels to the pumps, may erode over time and begin to leak. If the station also provided automotive service, it may also have small containers of various lubricants, degreasers, cleaners, fuel additives, tires, automotive batteries (lead and acids) and possibly compressed gas cylinders.

Some materials often found in a gas station with a small service center include acetylene gas, ethylene glycol, rubber, compressed oxygen, automotive oils, degreasing agents, gasoline, hydraulic oils, fuel additives, diesel fuels, common lubricants, and lead.

The primary environmental hazard involves fuel contamination of subsurface soils and groundwater. This contamination is usually caused by leaking USTs or a long history of minor spills, leaks and tank overflows.

On-site dumping was common prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Common waste products encountered at Superfund assessment and remediation projects include waste oils, used solvents, old automotive batteries, tires and/or rubber sealing agents, oil sludges, compressed gas cylinders of acetylene and oxygen, volatile organic contaminated soil and groundwater and unused raw materials.

GLASS MANUFACTURING FACILITIES

Most glass manufacturing utilizes a process in which raw materials are converted at high temperatures to a molten glass. The molten glass is then formed into various products using molding, pressing and blowing processes.

The hazardous components of the raw materials include the etching agents, typically hydrogen fluoride and fluoride-donating salts. Strong oxidizing corrosives, such as nitric acid, may be present in limited quantities. Amines and strong reducing agents are occasionally utilized in the process. Heavy metals containing arsenic, cobalt, zinc, thorium, and uranium were common pigment materials in addition to specialty organic dyes. Above or below ground bulk storage tanks containing fuels for primary and secondary kilns may also be present.

Solid waste streams containing spent pigments and dyes are typical surface soil contaminants. Some small volume liquid waste streams, resulting from the etching process, may also be present. These liquid waste streams may also contain dissolved metals. Discharges to waterways and sensitive areas present significant threats from the heavy metals pigments, organic dyes, and strong corrosives. The fluoride waste streams are extremely dangerous to human populations. Waste piles consisting of off-spec materials and glass products may be a source of contaminated run-off.

INFECTIOUS WASTES

Biohazards and infectious wastes can range from plant dusts, allergens and toxins, to microbiological organisms. An infectious waste is derived from a biohazard agent which is capable of reproducing itself and has the ability to produce harmful effects upon other biological organisms. The common classes of biohazard agents include infectious and parasitic agents, microorganisms such as fungi, yeast and algae, and animal products which cause infectious disease.

Infectious or a red bag waste can contain anything classifiable as infectious waste from sharps hazards (needles) to autoclaved bacteria and virus strains.

There is no safe level of uncontained pathogen. Illegally dumped infectious wastes are often found in loose piles, plastic bags or drums. The actual infectious material can often be disinfected with bleach or other agents, repackaged and sent for proper disposal.

MACHINE SHOPS/METAL FABRICATION

Machine shops and metal fabricators typically shape and form metals into their desired final shape after casting is completed. They perform cutting operations, shearing operations, drilling, milling, forging and various other processes. Cutting oils (e.g. ethylene glycol), degreasing and cleaning solvents (e.g. trichlorethane, methyl ethyl ketone), acids (e.g., hydrochloric, sulfuric), alkalis and heavy metals are utilized in machine and metal fabrication shops.

MANUFACTURED GAS PLANTS/COAL TAR SITES

Manufactured gas has been produced since the early 1800s as a fuel source for residential and industrial locations. Coal, or to a lesser extent oil, was burned to volatilize the desired gas fuel. The primary gas product from this reaction was purified, while the wastes were consolidated in a tar-like matrix known as coal tar.

The heating of the coal volatilizes the impurities into oven or furnace gas which is transferred to a by-products recovery plant. The oven gas usually goes through distillation processes to remove the waste products as coal tar. Numerous waste products may be generated including hydrogen sulfide gas, coal tar, complex cyanide salts, coal fines, wastewater and process still bottoms.

Due to the immense amounts of coal which could be handled per year, manufactured gas plant sites often have very large wastewater lagoons and coal tar pits. Common waste

products encountered at Superfund assessment and remediation projects include high concentrations of polynuclear aromatic hydrocarbons (PAHs), sulfur compounds, complex cyanide compounds and lower concentrations of volatile and phenolic compounds. These wastes are concentrated in a dense, aromatic coal tar and associated waste waters. This coal tar waste is typically found in large on-site pits, many of which are over 20 feet deep. The metals concentration accumulated in the ash collection system is dependent on the content of the original fuel. The most common metals include aluminum, iron, lead, nickel, and chromium. The ash may be encountered on site mixed with the coal tar or as a separate waste pile. Other inorganic compounds are not typically encountered at significant levels.

Groundwater may be contaminated as a result of leaching or percolation of surface and subsurface contaminants, surface impoundments and leaking process lines and tanks.

MUNICIPAL LANDFILL

Landfilling of solid waste has been practiced since very early times, when refuse was deposited in an open dump and allowed to decompose naturally. In most states today, a municipal landfill is restricted primarily to household garbage, office waste, rubble and debris from the construction industry, and vegetation from land clearing, lawn and leaf waste, etc. Modern municipal landfills should not be used to dispose of chemical or industrial wastes.

Because of unregulated use or illegal dumping practices, landfills in use prior to 1970 may contain volatile organic compounds, pesticide/PCBs, polynuclear aromatic hydrocarbons (PAHs), cyanides, heavy metals, and other contamination. Even strictly domestic or household waste can contain small quantities of oil and grease, paint, corrosives, solvents and other miscellaneous consumer chemicals. Methane, which may be explosive, and hydrogen sulfide, which is toxic and lethal, are two gasses that may be produced by the decomposition of landfill materials . Leachate produced by water moving through deposited refuse represents a potential hazard to soils as well as surface or groundwater.

ORDNANCE SITES

Ordnance consists of a wide variety of military munitions and weaponry including rifle rounds, shells, bombs, grenades, mines, explosives and special purpose explosive agents. Ordnance sites include a range of facilities which manufactured, assembled, disposed or stored military ordnance or associated components. In many cases, the facilities are not

identified with any special markings, signs or warnings. Characteristic features may include increased security (high, barbed-wire fencing), bunker-style/mounded buildings, unusually remote or uncharacteristic industrial locations, and well-spaced small buildings.

Due to their specialty nature, ordnance facilities may include various chemicals used in the final stages of explosives manufacturing. The following chemical compounds are common raw materials, chemical intermediates or waste products encountered in the manufacturing of explosives: di and tri-nitro benzene, strong acids, ethyl alcohol di and tri-nitro phenol, mercury, ethylene glycol, di and tri-nitro toluene, reactive metals, phenols, ketones, ethers, formaldehyde, nitroglycerine, ammoniated compounds, and sodium hydroxide.

On-site waste piles and burial pits were common treatment/disposal techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Common waste products encountered at Superfund assessment and remediation projects include: buried spent ordnance, unexploded ordnance (UXO) and ordnance components, such as di- and tri-nitro compounds (commonly used in explosives), solvents (e.g., toluene, formaldehyde), and fuels (gasoline, diesel and aircraft fuels). These compounds may be encountered in contaminated soils, surface water, and/or groundwater.

PAINT INDUSTRY

This industry typically uses a wide variety of materials depending on what type of coating/paint is being manufactured. Some common materials found include surfactants, chemical dryers, polymers, organic compounds, heavy metals (in the coloring agents), epoxies, solvents, mild corrosives, polyurethanes, herbicides and fungicides. Due to a wide variety of specialty paints, it is difficult to name specific chemicals; however, the following is a list of some commonly encountered materials: toluene, xylene, ethyl acetate, lead, acetone, titanium dioxide, cadmium, zinc, and chromium.

In general, there is little waste generated by a paint manufacturer because most of the materials are used up in the process. During the vat cleanings, waste products were often washed into a sewer drain. Common waste products encountered at Superfund assessment and remediation projects include off-spec paint, volatile organic compounds, waste metals (from the pigments), waste or spent polymers, surfactants, herbicides, anti-bacterial agents and mild corrosives (for cleaning the process line and vats). Most of these compounds are in the form of sludges and/or solids and will harden over time if not utilized. These materials may be in drums, tanks or in the process lines themselves.

PESTICIDE FACILITIES

Pesticides include insecticides, herbicides, fungicides and all other chemicals used to control insects, weeds and other pests from disturbing grown or stored materials. There are three ways of applying pesticides: spraying (utilizing oil and/or water), dusting (spreading dry powder) and fumigating (releasing a gas).

A wide variety of materials, almost all of which are hazardous to humans, are used in pesticide production. Contamination can be found at abandoned manufacturing facilities, bulk storage locations, and end-user sites such as farms, golf courses, and orchards. This industry typically combines a series of separate compounds in a process line and incorporates them into a final product for distribution and sale.

Compounds typically found at a pesticide facility include the following: ammonia, benzene, carbon tetrachloride, hydrogen cyanide, mercury, nitric acid, phosgene, sulfuric acid, and xylene.

On-site waste piles, lagoons and waste pits were common treatment/storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Waste products are often containerized on site in medium to large quantities for recycling into the process or disposal. Common waste products encountered at Superfund assessment and remediation projects include waste cyanide, heavy metals, corrosive liquids and sludges, unused raw materials listed above, and discarded finished product. These materials may be found in soils, sediments, and surface and/or groundwater. They may also pose an inhalation hazard under certain conditions.

PRINT SHOPS

Print shops store large quantities of inks and paper due to the nature of their service. The inks used in printing fall into four classes: letterpress, lithographic, flexographic and rotogravure. The letterpress and lithographic are based mainly in mineral oil, while flexographic and rotogravure use very volatile solvents.

This industry typically uses a wide variety of materials depending on what type of printing is used. Common materials used include solvents, inks and cleaning materials (which may be corrosive). The following is a list of some commonly encountered materials: acetone, alcohol, n-butyl acetate, cresol, ethyl acetate, methyl ethyl, ketone, methyl isobutyl ketone, toluene, xylene, sodium hydroxide, hexane, and esters.

In general, there is minimal waste generated by a print shop as most of the materials are used up in the process. Waste materials are usually generated during machine cleanings or during unexpected break downs. Occasionally, stored materials may leak, resulting in contamination to the storage area, which may or may not have been addressed. Spills, leaks, and discarded material will typically migrate to and contaminate soils, stream sediments, and groundwater. Common waste products encountered at Superfund assessment and remediation projects include volatile organic compounds, waste metals

(from the pigments), waste or spent corrosives (for cleaning) and solvents. Most of these compounds are in the form of sludges and/or solids as they will harden over time if not utilized. These materials may be in drums, but are often in small containers.

PETROLEUM RECYCLING FACILITY

The primary types of used petroleum oil that are being recycled are motor, hydraulic and industrial lubricating oils. The additives and contaminants typically found in these oils may cause environmental problems associated with the recycling process. Generally, used oil recycling facilities have three kinds of processes: recycling used oil as a fuel, reclaiming and re-refining. In many cases, an oil recycler may be involved with all of these processes.

At older facilities, polychlorinated biphenyls (PCBs) were often not detected in used or waste oils, despite the strict regulations concerning PCB containing oil. These regulations on PCBs are established by the Toxic Substances Control Act (TSCA) with additional regulations based on hazardous waste provisions in the Resource Conservation and Recovery Act (RCRA).

The primary waste streams from a petroleum oil recycling facility include oily sludges and wastewater containing metals (sulfur, zinc, calcium, barium, phosphorus, lead, aluminum, iron) and PCBs. These contaminants are frequently found in surface and subsurface soils as well as groundwater due to poor facility housekeeping, repetitive spills and undetected releases from bulk storage tanks. These contaminants may also become airborne as dust particles during demolition and construction operations.

PHARMACEUTICAL INDUSTRY

Each manufacturing or formulation plant is special, differing from other similar pharmaceutical plants in size, types of intermediates, bulk substances, or products produced, amounts and types of solvents used, and thus, in the raw materials used and wastes/emissions generated. The top four chemicals discharged into waste water are methanol, ethanol, acetone and isopropanol..

Typical contaminants which may be found at brownfield sites are solvents and acids which may have been spilled or even dumped on site. On-site waste pits and vats were common treatment/storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA).

PLASTICS

The term plastics is given to any compound that has been made from a resin through a manufacturing process involving the application of heat and/or

pressure. The actual production of the resin is generally thought of as part of the chemical industry (refer to the Abandoned Chemical Facility Profile). The use of these resins as they are treated and shaped to become components of other products as starting materials is considered the plastics industry.

Some examples of resins used in plastics manufacturing are: acrylonitrile-butadiene-styrene (ABS), acrylics, nylons and vinyls (PVC), epoxies, silicones, and urethanes. Most, if not all, of the raw materials in the plastics process are recycled. During the working process, some gases and vapors encountered might be: acrylonitrile, butadiene, carbon dioxide, hydrogen sulfide, olefins, styrene, and vinyl chloride. Spillage of liquid resins could result in contaminated soil, sediment, and/or groundwater.

QUARRY SITES

The hazardous substances most likely to be present at quarry sites are fuels for heavy equipment, detonators, explosive charges, detonation cord, various metals, and nitrate fertilizers used for large fragmentation charges.

Any of the detonators or explosive charges would be listed as a dangerous waste stream and would require specialized and trained personnel for handling operations. As the explosives industry is highly regulated, an examination of previous quarry permits would indicate what types, if any, of explosives were utilized.

Most quarry operations are conducted below the groundwater table, so constant pumping is required to keep the site dry. An abandoned or unused quarry can fill with water, and are often used as illegal dumping sites for hazardous materials. The intersection of the water table allows easy transport of the fuels and hazardous substances into the surface or groundwater.

RAIL YARD FACILITIES

Rail yard facilities are highly specialized facilities consisting of one or more areas including engine maintenance buildings, fueling areas, track and switching areas, and track maintenance/material storage yards. The engine maintenance building was used to perform a wide variety of work on train engines.

The raw materials associated with this industry are primarily used in fueling and maintenance operations. Numerous solvents, paints, coatings, PCB oils, creosote compounds, and degreasers were commonly used and stored in maintenance and storage areas.

Typical contamination includes degreasing solvents, PCBs from engines and electrical equipment, and some heavy metals. Since most newer train engines use diesel fuel, diesel range organics (DRO) may be a common contaminant of the surface and subsurface soils

and shallow groundwater in engine fueling areas. Track and switching areas may have DRO and oil-contaminated surface soils and rail ballast due to the constant use and repetitive minor leakage of engines and rail cars. The maintenance/material storage yard areas used a wide variety of solvents, paints, treated railroad ties and wastes. Historical leakage due to poor housekeeping and spills of oils, hazardous materials, paints, solvents, and creosote from railroad ties, account for the majority of the contamination incurred. Due to the volume and concentration of the hazardous materials shipped via rail, special attention should be given to areas where historical tank car releases of hazardous materials have occurred.

Common waste products encountered at Superfund assessment and remediation projects include PCB-contaminated soils and run-off from electrical generation areas and maintenance shops, DRO-contaminated soils and groundwater from fueling operations and leaking above- and below-ground storage tanks, solvent-contaminated soils and groundwater from maintenance and painting operations, and miscellaneous heavy metals contamination associated with many industrial operations.

RADIATION

The majority of radiation sites which could be encountered under the Brownfield initiatives may be divided into two primary categories: research/medical facilities and mining/refining operations. Research/medical facilities include research laboratories, universities, x-ray photography facilities, munitions and instrument manufacturing plants, and hospitals. Mining/refining operations include pit and shaft mining locations, ore handling and refining facilities, and tailings piles.

The majority of the mining and refining operations in the United States involve thorium and uranium ores and related compounds. The research/medical fields utilize primarily isotopes of cesium, cobalt, and radium. The munitions industry fabricates spent uranium into dense armor-piercing projectiles.

Many research/medical radioactive materials and wastes are stored on site until the radioisotopes become stabilized through relatively short half-life decay cycles. There is the potential for human and multi-media environmental contamination during these cycles if the radioactive materials are not properly managed.

The form of radiation contamination can affect soil, surface water, ground water, and air quality as the high energy particles are transported away from the original sources.

Contaminated buildings and the associated demolition debris may be encountered at abandoned or inactive sites. Decontamination and monitoring of these of these materials may be required prior to off-site landfill disposal.

SCRAP METAL

The scrap metal industry purchases metals from various industrial and private sources for reuse in the fabrication of new metal stock and products. Common metals found at scrap metal sites could include iron, steel, aluminum, copper, tin, brass, lead and zinc.

Heavy metals contamination is the main concern at a former scrap metal site. Soil contamination should be suspected. Waste piles of non-metallic materials may be present. These piles consist of materials which were associated with the original metal such as asbestos, foam padding and insulating materials. Other associated waste stream materials are trichloroethylene, trichloroethane, xylenes, benzene, ethyl benzene and toluene. PCB-contaminated soils may be at facilities which recovered copper and other metals from electrical equipment. Many scrap metal facilities utilize a wide variety of hydraulic equipment to move, compact and process scrap. Hydraulic oil and fuels may also contribute to soil contamination.

SALVAGE YARDS

Salvage yards accept a wide variety of materials, depending on the type of salvage yard (i.e. auto, tank, etc.), to be disassembled to recover parts or reusable scrap metals, plastics or building aggregates. The non-recyclable components are then stored on site or sent to a municipal landfill. Salvage yards often contain a wide variety of materials and containers due to the nature of their business; however, automobile salvage is the most common.

This industry typically uses hydraulic oils for heavy equipment, compressed gases for metal cutting operations, and petroleum-based materials as solvents. These materials are usually received by the facility in compressed gas cylinders and small containers, but are occasionally obtained in larger quantities. The following chemical compounds are/were commonly found in scrap yards: acetylene gas, common solvents, rubber, compressed oxygen, automotive fluids, degreasing agents, gasoline, hydraulic oils, fuel additives, diesel fuels, common lubricants, asbestos, lead, and sulfuric acid.

In addition to the compounds used by the facility, waste products were stored in the scrap and are also present in varying concentrations. On-site waste piles, burial pits, and bulk storage tanks were common storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Common waste products encountered at Superfund assessment and remediation projects include fuels, waste oils,

used solvents, tires and/or rubber sealing agents, asbestos insulation, oil sludges, old battery casings, and compressed gas cylinders. Fuel, oil and solvent contaminated soils and groundwater may be present due to poor housekeeping, repetitive small spills, leaking bulk storage tanks and run-off from waste piles.

STEEL MANUFACTURING - ELECTRIC ARC/COKE

Modern steel making relies primarily on scrap metal. Additives, including molybdenum, nickel, titanium and chrome, are used to improve the engineering qualities and appearance of the steel. Oxidation is used to remove unwanted elements by forming oxides which enter the furnace stack gas or the oven slag.

Modern plants may generate wastewater, oven slag, oven ash and materials from the air pollution control equipment as waste streams. Waste products associated with older operations may include coal tar, hydrogen sulfide gas, complex cyanide salts, coal fines, quenching wastewater, process still bottoms, slag, and sulfuric acid. The metals concentration in the ash is dependent on the furnace type, plant configuration and content of the original fuel. The most common metals include aluminum, iron, lead, manganese, sulfur, nickel, and chromium. Common waste products encountered at Superfund assessment and remediation projects contain high concentrations of polynuclear aromatic hydrocarbons (PAHs), sulfur compounds, and complex cyanide, volatile or phenolic compounds. Other inorganic compounds are not typically encountered at significant levels.

Large volumes of wastewater are generated in coke quenching and steel processing operations. This wastewater is commonly stored in large on-site surface impoundments. Coal tars, coal fines, sludges and tank bottoms may be encountered in waste piles and large tar pits. Groundwater may be contaminated as a result of leaching or percolation of surface and subsurface contaminants, surface impoundments or leaking process lines and tanks.

SHIPBUILDING AND REPAIR INDUSTRY

The shipbuilding and repair industry contains within it many of the industries previously described. Machining and metal fabrication are prominent activities in shipyards. The wastes which are produced from those industries are also applicable in shipbuilding. Surface preparation for painting adds other potential sources of waste. Sand, grit and paint flakes from sand blasting or grit blasting must be addressed. The paints themselves may be a source of contamination at brownfield sites. Metal plating and surface finishing produce cyanide, acid, alkali, and solvents waste. If fiberglass work is performed, resins, waste fiberglass, gelcoats and solvent waste may be found on site. Other contaminants possibly found in shipyards include petroleum compounds and oils from leaking tanks and equipment.

TANNING FACILITY

Tanning is the process of manufacturing leathers from animal hides. Before shipping to the tanning facility, animal hides are preserved with a brine solution. A typical tanning facility consists of three sections: the beam house, tanning room, and finishing area. In the beam, house salt and hair are removed from the hide. The hides are then pickled with sulfuric acid to a pH of less than 3. During the tanning process the tanning solution is allowed to fully penetrate the hide. The most common tanning solution is trivalent chromium sulfate solution. The pH is then raised slowly with sodium bicarbonate and dried. In the finishing area, the hide surface is treated and dyed as required.

This industry typically uses chemicals for dehairing, liming, deliming, tanning and curing. The following chemicals are/were commonly utilized in tanning industries: Trivalent chromium sulfate, Sodium bicarbonate, Sodium sulfide or sodium sulfhydrate, Arsenic or cyanide as sharpening agent, Ammonium sulfate, Sulfuric acid, Lime, and Aniline dyes.

On-site waste piles, pits and vats were common treatment/storage techniques prior to the Resource Conservation and Recovery Act of 1976 (RCRA). Common waste products encountered at Superfund assessment and remediation projects include solid and liquid wastes containing trivalent chromium sulfate, corrosive liquids and sludges, volatile organic compounds, metals, cyanides, and sulfides, in addition to unused raw materials. These compounds often are absorbed into building walls, floors, ceilings, and underlying soils.

WOOD TREATING FACILITY

A wood treating facility normally consists of a wood or log preparation area, process building with pressure vessels, and numerous chemical storage tanks, drip or drying areas and a roofed wood storage area. Wood was treated with a preservative compound which was injected using a steam and pressure or dipping process. Some facilities have components of a water treatment system.

If the facility was active before 1980, they may have used coal tar creosote and/or pentachlorophenol for treating the wood. If the facility started after 1980, it is more likely that chromium, copper and arsenic (CCA) was used for treating wood.

Oily waste with tar or creosote oil and pentachlorophenol are the main contaminants from a wood treating industry.

Coal tar creosote, pentachlorophenol (PCP) and CCA are used as preservatives in the wood treating industry. Waste generated consists of water

squeezed from the wood during processing, retort and cylinder sludge, process waste and spillage. Existence of less toxic forms of dibenzo-dioxins may also be associated with the waste and associated contaminated soils.

If the industry used CCA for treating the wood, then copper, chromium and arsenic would be the main contamination concern in the soil, surface water, groundwater and the sludge beneath the pit, lagoon or tank.

Wastewater generated during the treatment process, slugs, and tank bottoms is generally treated or stored on site in lined or unlined lagoons. If the lagoons are lined and monitored regularly, associated groundwater contamination is less likely. Unlined lagoons are a constant source of surface water as well as groundwater contamination.

Typical Contaminants from Land Uses / Sources	
Land Use / Facility / Source	*Typical Contaminants* [1,2,3]
Commercial / Industrial	
Automobile Body shops/repair shops	Waste oils; solvents; acids; paints; automotive wastes;[4] miscellaneous cutting oils
Car washes	Soaps; detergents, waxes; miscellaneous chemicals
Gas stations/sumps	Oils; solvents; miscellaneous wastes
Boat Services/repair/refinishing	Diesel fuels; oil; septage from boat waste disposal area; wood preservative and treatment chemicals; paints; waxes; varnishes; automotive wastes[4]
Cement/concrete plants	Diesel fuels; solvents; oils; miscellaneous wastes
Chemical/petroleum processing/storage	Hazardous chemicals; solvents; hydrocarbons; heavy metals; asphalt
Dry cleaners	Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate)
Electrical/electronic manufacturing	Cyanides; metal sludges; caustic (chromic acid); solvents; oils; alkalis; acids; paints and paint sludges; calcium fluoride sludges; methylene chloride; perchloroethylene; trichloroethane; acetone; methanol; toluene; PCBs
Fleet/trucking/bus terminals	Waste oil; solvents; gasoline and diesel fuel from vehicles and storage tanks; fuel oil; other automotive wastes[4]
Food processing	Nitrates; salts; phosphorus; miscellaneous food wastes; chlorine; ammonia; ethylene glycol
Furniture repair/manufacturing	Paints; solvents; degreasing and solvent recovery sludges; lacquers; sealants
Hardware/lumber/parts stores	Hazardous chemical products in inventories; heating oil and fork lift fuel from storage tanks; wood-staining and treating products such as creosote; paints; thinners; lacquers; varnishes
Home manufacturing	Solvents; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy wastes; miscellaneous chemical wastes
Junk/scrap/salvage yards	Automotive wastes [4]; PCB contaminated wastes; any wastes from businesses[6] and households[7]; oils; lead
Machine shops	Solvents; metals; miscellaneous organics; sludges; oily metal shavings; lubricant and cutting oils; degreasers (tetrachloroethylene); metal marking fluids; mold-release agents
Medical/vet offices	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes; disinfectants; asbestos; beryllium; dental acids; miscellaneous chemicals
Metal plating/finishing/ fabricating	Sodium and hydrogen cyanide; metallic salts; hydrochloric acid; sulfuric acid; chromic acid; boric acid; paint wastes; heavy metals; plating wastes; oils; solvents
Mines/gravel pits	Mine spills or tailings that often contain metals; acids; highly corrosive mineralized waters; metal sulfides; metals; acids; minerals sulfides; other hazardous and nonhazardous chemicals[9]
Office buildings/complexes	Building wastes[6]; lawn and garden maintenance chemicals[5]; gasoline; motor oil
Parking lots/malls	Hydrocarbons; heavy metals; building wastes[6]
Photo processing/printing	Biosludges; silver sludges; cyanides; miscellaneous sludges; solvents; inks; dyes; oils; photographic chemicals
Plastics/synthetics producers	Solvents; oils; miscellaneous organic and inorganics (phenols, resins); paint wastes; cyanides; acids; alkalis; wastewater treatment sludges; cellulose esters; surfacant; glycols; phenols; formaldehyde; peroxides; etc.
Research laboratories	X-ray developers and fixers[8]; infectious wastes; radiological wastes;

Typical Contaminants from Land Uses / Sources	
Land Use / Facility / Source	*Typical Contaminants* [1,2,3]
Commercial / Industrial	
Automobile Body shops/repair shops	Waste oils; solvents; acids; paints; automotive wastes;[4] miscellaneous cutting oils
Car washes	Soaps; detergents, waxes; miscellaneous chemicals
Gas stations/sumps	Oils; solvents; miscellaneous wastes
Boat Services/repair/refinishing	Diesel fuels; oil; septage from boat waste disposal area; wood preservative and treatment chemicals; paints; waxes; varnishes; automotive wastes[4]
Cement/concrete plants	Diesel fuels; solvents; oils; miscellaneous wastes
Chemical/petroleum processing/storage	Hazardous chemicals; solvents; hydrocarbons; heavy metals; asphalt
Dry cleaners	Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate)
Electrical/electronic manufacturing	Cyanides; metal sludges; caustic (chromic acid); solvents; oils; alkalis; acids; paints and paint sludges; calcium fluoride sludges; methylene chloride; perchloroethylene; trichloroethane; acetone; methanol; toluene; PCBs
Fleet/trucking/bus terminals	Waste oil; solvents; gasoline and diesel fuel from vehicles and storage tanks; fuel oil; other automotive wastes[4]
Food processing	Nitrates; salts; phosphorus; miscellaneous food wastes; chlorine; ammonia; ethylene glycol
Furniture repair/manufacturing	Paints; solvents; degreasing and solvent recovery sludges; lacquers; sealants
Hardware/lumber/parts stores	Hazardous chemical products in inventories; heating oil and fork lift fuel from storage tanks; wood-staining and treating products such as creosote; paints; thinners; lacquers; varnishes
Home manufacturing	Solvents; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy wastes; miscellaneous chemical wastes
Junk/scrap/salvage yards	Automotive wastes [4]; PCB contaminated wastes; any wastes from businesses[6] and households[7]; oils; lead
Machine shops	Solvents; metals; miscellaneous organics; sludges; oily metal shavings; lubricant and cutting oils; degreasers (tetrachloroethylene); metal marking fluids; mold-release agents
Medical/vet offices	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes; disinfectants; asbestos; beryllium; dental acids; miscellaneous chemicals
Metal plating/finishing/ fabricating	Sodium and hydrogen cyanide; metallic salts; hydrochloric acid; sulfuric acid; chromic acid; boric acid; paint wastes; heavy metals; plating wastes; oils; solvents
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Office buildings/complexes	Building wastes[6]; lawn and garden maintenance chemicals[5]; gasoline; motor oil
Parking lots/malls	Hydrocarbons; heavy metals; building wastes[6]
Photo processing/printing	Biosludges; silver sludges; cyanides; miscellaneous sludges; solvents; inks; dyes; oils; photographic chemicals
Plastics/synthetics producers	Solvents; oils; miscellaneous organic and inorganics (phenols, resins); paint wastes; cyanides; acids; alkalis; wastewater treatment sludges; cellulose esters; surfacant; glycols; phenols; formaldehyde; peroxides; etc.
Research laboratories	X-ray developers and fixers[8]; infectious wastes; radiological wastes;

	biological wastes, disinfectants; asbestos; beryllium; solvents; infectious materials; drugs; disinfectants; (quaternary ammonia, hexachlorophene, peroxides, chlornexade, bleach); miscellaneous chemicals
RV/mini storage	Automobile wastes[4]; gasoline and diesel fuel from vehicles and storage tanks
Wood preserving/treating	Wood preservatives; creosote, pentachlorophenol, arsenic
Wood/pulp/paper processing and mills	Metals; acids; minerals; sulfides; other hazardous and nonhazardous chemicals[9]; organic sludges; sodium hydroxide; chlorine; hypochlorite; chlorine dioxide; hydrogen peroxide; treated wood residue (copper quinolate, mercury, sodium bazide); tanner gas; paint sludges; solvents; creosote; coating and gluing wastes
Agricultural/Forest	
Auction lots	Livestock sewage wastes; nitrates; phosphates; coliform and noncoliform bacteria; giardia, viruses; total dissolved solids
Chicken/turkeys	Nitrates; phosphates; potassium; total dissolved solids; salts
Confined animal feeding operations	Livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral and fungal pests on livestocks; coliform[10] and noncoliform bacteria; viruses; giardia; total dissolved solids
Dairies	Nitrates; total dissolved solids; salts; phosphates; potassium
Farm chemical distributor/application service	Pesticides[11]; fertilizers[12]; hydrocarbons from motor vehicles and storage tanks
Farm machinery repair	Automotive wastes[4]; welding wastes
Irrigated crops	Pesticides[11]; fertilizers [12]; nitrates; phosphates; potassium (can be worsened by over-watering)
Lagoons	Nitrates; Livestock sewage wastes; salts; pesticides[11]; fertilizers[17]; bacteria
Managed forest lands	Sediments; pesticides[11]; fertilizers[12]; petroleum (spills)
Nonirrigated crops	Pesticides[11]; fertilizers[12]; nitrates; phosphates; potassium
Pesticide/fertilizer/petroleum storage & transfer areas	Pesticides[11]; fertilizers[12]; petroleum residues
Rural homesteads	*Machine shops:* Automotive wastes[4]; welding wastes; solvents; metals; lubricants; sludges *Septic systems:* Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemicals;[14] septic tank/cesspool cleaner chemicals;[15] elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate
Swine	Nitrates; phosphates; potassium
Residential / Municipal	
Airports (maintenance/fueling areas)	Jet fuels; deicers; diesel fuel; chlorinated solvents; automotive wastes;[4] heating oil; building wastes[6]
Apartments and condominiums	Swimming pool maintenance chemicals[14]; pesticides for lawn and garden maintenance and cockroach, termite, ant, rodent, and other pest control[5,13], wastes from on-site sewage treatment plants; household hazardous wastes[7]
Camp grounds/RV parks	Septage; gasoline; diesel fuel from boats; pesticides for controlling mosquitoes, ants, ticks, gypsy moths, and other pests[11,13]; household hazardous wastes from recreational vehicles (RVs)[7]
Drinking water treatment plants	Treatment chemicals; pesticides[11]
Fire stations	General building wastes[6]; hydrocarbons from test burn areas
Golf courses	Fertilizers[12]; herbicides[11]; pesticides for controlling mosquitoes, ticks, ants, gypsy moths, and other pests[5]

Housing	*Household hazardous wastes*[1] Household cleaners; oven cleaners; drain cleaners; toilet cleaners; disinfectants; metal polishes; jewelry cleaners; shoe polishes; synthetic detergents; bleach; laundry soil and stain removers; spot removers and dry cleaning fluid; solvents; lye or caustic soda; household pesticides;[13] photo chemical; printing ink, paints; varnishes; stains; dyes; wood preservatives (creosote); paint and lacquer thinners; paint and varnish removers and deglossers; paint brush cleaners; floor and furniture strippers *Mechanical Repair and Other Maintenance Products:* Automotive wastes;[4] waste oils; diesel fuel; kerosene; #2 heating oil; grease; degreasers for driveways and garages; metal degreasers; asphalt and roofing tar; tar removers; lubricants; rustproofers; car wash detergents; car waxes and polishes; rock salt; refrigerants *Lawn/garden care:* Fertilizers;[11] herbicides and other pesticides used for lawn and garden maintenance[5] (can be worsened by over-watering) *Swimming pools:* Swimming pool maintenance chemicals[14] *Urban runoff/stormwater*[3]: Gasoline; oil; other petroleum products; microbiological contaminants
Landfills/dumps	Leachate; organic and inorganic chemical contaminants; waste from households[7] and businesses[6]; nitrates; oils; metals; solvents; sludge
Motor pools	Automotive wastes[4]: solvents; waste oils; hydrocarbons from storage tanks
Parks	Fertilizers[12]; herbicides[5]; insecticides[11,13]; (can be worsened by over-watering)
Railroad yards/maintenance/fueling areas	Diesel fuel; herbicides for rights-of-way [11]; creosote fro preserving wood ties; solvents; paints; waste oils
Schools	Machinery/vehicle serving wastes; gasoline and heating oil from storage tanks; general building wastes[6]; pesticides[11,13];
Septic systems	Nitrates; septage; Cryptosporidium; Giardia; coliform[10] and noncoliform bacteria; viruses; drain cleaners; solvents; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemicals;[14] septic tank/cesspool cleaner chemicals[15]; elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate; other household hazardous wastes[7]
Utility stations/maintenance areas	PCBs from transformers and capacitors; oils; solvents; sludges; acid solution; metal plating solutions (chromium, nickel, cadmium); herbicides from utility rights-of-way
Waste transfer/recycling stations	Residential and commercial solid waste residues
Wastewater	Municipal wastewater; sludge[16]; treatment chemicals[17]; nitrates; heavy metals; coliform[10] and noncoliform bacteria; nonhazardous wastes[16]
Miscellaneous	
Above ground storage tanks	Heating oil; diesel fuel; gasoline; other chemicals
Construction/demolition areas (plumbing, heating, and air conditioning, painting, paper hanging, decorating, drywall and plastering, acoustical insulation, carpentry, flooring, roofing, and sheet metal etc.)	Solvents; asbestos; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy waste; miscellaneous chemical wastes
Historic gas stations	Diesel fuel; gasoline; kerosene
Historic waste dumps/landfills	Leachate; organic and inorganic chemicals; waste from households [7]; and businesses [6]; nitrates; oils; heavy metals; solvents
Injection wells/drywells/sumps	Stormwater runoff [3]; spilled liquids; used oils; antifreeze; gasoline; solvents; other petroleum products; pesticides[11]; and a wide variety

	of other substances
Military installations	Wide variety of hazardous and nonhazardous wastes depending on the nature of the facility and operation[3,9]; diesel fuels; jet fuels; solvents; paints; waste oils; heavy metals; radioactive wastes
Surface water - stream/lakes/rivers	(Directly related to surface water quality in the stream, lake, or river which is recharging groundwater)
Transportation corridors	Herbicides in highway right-of-way[11,5]; road salt (sodium and calcium chloride); road salt, anticaking additives (ferric ferrocyanide, sodium ferrocyanide); road salt anticorrosives (phosphate and chromate); automotive wastes[4]
Underground storage tanks	Diesel fuel; gasoline; heating oil; other chemical and petroleum products
Wells (such as water supply wells, monitoring wells, unsealed or abandoned wells, and test holes)	Storm water runoff [3]; solvents; nitrates; septic tanks; hydrocarbons; and a wide variety of other substances

SOURCE: Adapted from EPA ; Supplemented with information from Oregon DEQ hazardous waste / water quality databases and Drinking Water Protection citizen's and technical advisory committees

NOTES

[1]In general, water contamination stems from the misuse and improper disposal of liquid and solid wastes; the illegal dumping or abandonment of household, commercial, or industrial chemicals; the accidental spilling of chemicals from trucks, railways, aircraft, handling facilities, and storage tanks; or the improper siting, design, construction, operation, or maintenance of agricultural, residential, municipal, commercial, and industrial drinking water wells and liquid and solid waste disposal facilities. Contaminants also can stem from atmospheric pollutants, such as airborne sulfur and nitrogen compounds, which are created by smoke, flue dust, aerosols, and automobile emissions, fall as acid rain, and percolate through the soil. When the contaminants list in this table are used and managed properly, environmental contamination is not likely to occur.

[2]Contaminants can reach water bodies from activities occurring on the land surface, such as industrial waste storage; from sources below the land surface but above the water table, such as septic systems; from structures beneath the water table, such as wells; or from contaminated recharge water.

[3]This table lists the most common wastes, but not all potential wastes. For example, it is not possible to list all potential contaminants contained in stormwater runoff or from military installations.

[4]Automobile wastes can include gasoline; antifreeze; automatic transmission fluid; battery acid; engine and radiator flushes; engine and metal degreasers; hydraulic (brake) fluid; and motor oils.

[5]Common pesticides used for lawn and garden maintenance (i.e., weed killers, and mite, grub, and aphid controls) include such chemicals as 2,4-D; chlorpyrifos; diazinon; benomyl; captan; dicofol; and methoxychlor.

[6]Common wastes from public and commercial buildings include automotive wastes; and residues from cleaning products that may contain chemicals such a xylenols, glycol esters, isopropanol, 1,1,1,-trichloroethane, sulfonates, chlorinated phenols, and cresols.

[7] Household hazardous wastes are common household products which contain a wide variety of toxic or hazardous components (contact Oregon DEQ Household Waste Program for list).

[8]X-ray developers and fixers may contain reclaimable silver, glutaldehyde, hydroquinone, potassium bromide, sodium sulfite, sodium carbonate, thiosulfates, and potassium alum.

[9]The Resource Conservation and Recovery Act (RCRA) defines a hazardous waste as a solid waste that may cause an increase in mortality or serious illness or pose a substantial threat to human health and the environment when improperly treated, stored, transported, disposed of, or otherwise managed. A waste is hazardous if it exhibits characteristics of ignitability, corrosivity, reactivity, and/or toxicity. Not covered by RCRA regulations are domestic sewage; irrigation waters or industrial discharges allowed by the Clean Water Act; certain nuclear and mining wastes; household wastes; agricultural wastes (excluding some pesticides); and small quantity hazardous wastes (i.e., less than 220 pounds per month) generated by businesses.

[10]Coliform bacteria can indicate the presence of pathogenic (disease-causing) microorganisms that may be transmitted in human feces. Diseases such as typhoid fever, hepatitis, diarrhea, and dysentery can result from sewage contamination of drinking water supplies.

[11]Pesticides include herbicides, insecticides, rodenticides, fungicides and avicides. EPA has registered approximately 50,000 different pesticide products for use in the United States. Many are highly toxic and quite mobile in the subsurface. An EPA survey found that the most common pesticides found in drinking water wells were DCPA (dacthal) and atrazine, which EPA classifies as moderately toxic (class 3) and slightly toxic (class 4) materials, respectively

[12]The EPA National Pesticides Survey found that the use of fertilizers correlates to nitrate contamination of groundwater supplies.

[13]Common household pesticides for controlling pests such as ants, termites, bees, wasps, flies, cockroaches, silverfish, mites, ticks, fleas, worm, rates, and mice can contain active ingredients include naphthalene, phosphorus, xylene, chloroform, heavy metals, chlorinated hydrocarbons, arsenic, strychnine, kerosene, nitrosamines, and dioxin.

[14]Swimming pool chemicals can contain free and combined chlorine; bromine; iodine; mercury-based, copper-based, and quaternary algaecides; cyanuric acid; calcium or sodium hypochlorite; muriatic acid; sodium carbonate.

[15]Septic tank/cesspool cleaners include synthetic organic chemicals such as 1,1,1 trichloroethane, tetrachloroethylene, carbon tetrachlorine, and methylene chloride.

[16]Municipal wastewater treatment sludge can contain organic matter, nitrates; inorganic salts, heavy metals; coliform and noncoliform bacteria; and viruses.

[17]Municipal wastewater treatment chemicals include calcium oxide; alum; activated alum, carbon, and silica; polymers; ion exchange resins; sodium hydroxide; chlorine; ozone; and corrosion inhibitors.

ENVIRONMENTAL RISK MANAGEMENT AUTHORITY
NGĀ KAIWHAKATŪPATO WHAKARARU TAIAO

Printing Industry

including lithographic, flexographic, screen and gravure printers

The chemicals you use for printing are now controlled by the Hazardous Substances and New Organisms (HSNO) Act 1996, which replaces previous laws such as the Dangerous Goods Act 1974 and the Toxic Substances Act 1979.

These are some of the typical chemicals that might be used in the printing industry.

Solvents
: such as acetone, white spirit, mineral turpentine, butanol, dichloromethane, ethanol, ethyl acetate, ethylene glycol, hexane, isopropyl alcohol, methanol, methyl ethyl ketone (MEK), perchloroethylene, styrene, toluene, trichloroethylene, and xylene

Adhesives
: which may contain isocyanates as well as solvents

Inks and coatings
: which may contain chromates/chromic acids - such as lead chromate, N-vinyl pyrrolidone (NVP, N-Vinyl-2-pyrrolidinone), Michler's ketone, and solvents

From 1 October 2004, if you want to continue using some of these substances, the law may require you to have the right Test Certificates. You may need:

- a Location Test Certificate for your premises (previously a Dangerous Goods Licence)
- an Approved Handler Test Certificate for employees responsible for the handling of certain highly hazardous chemicals.

Location Test Certificates

You will need a Location Test Certificate:

- if you are using and/or storing particular chemicals above certain minimum quantities
- as a general rule, if you hold a Dangerous Goods Licence for your premises you will need a Location Test Certificate. There are exceptions eg for diesel.

Approved Handlers

An Approved Handler must make sure that certain chemicals are handled safely, that they do not harm people, nor damage the environment.

The table below shows you which chemicals you commonly use will need an Approved Handler. Note that not all employees handling these hazardous substances will have to be Approved Handlers, as long as they are working under the guidance of an Approved Handler. However, an Approved Handler must be present at the location and be available to provide assistance.

How to get Test Certificates

You must obtain your certificates from a Test Certifier. To find your nearest Test Certifier check the register or call ERMA New Zealand for a list of Test Certifiers to be posted to you.

Tracked chemicals

The most hazardous chemicals need tracking, and you will need an Approved Handler in order to use them. To buy them your supplier will need to confirm you are an Approved Handler, and that you have a Location Test Certificate if needed. The table at the end shows which chemicals are tracked.

When do I need to have all my Certificates?

If you are handling tracked substances you need to have your Location and Approved Handler Test Certificates in place by 1 January 2005. ERMA New Zealand will not allow any extension of this date.

For substances that do not require tracking, Test Certificates for Locations and Approved Handlers will be needed following a timetable starting in October 2004 and ending in June 2006. More details can be found in Dangerous Goods Dispatch - Issue 3 (March 2004) at www.ermanz.govt.nz/hs/dangerous-goods/dg-dispatch3.pdf.

If the substance is not tracked and you cannot meet the date required, you may submit a plan to ERMA New Zealand for approval, providing a date by when you will comply.

At a glance

The following is an overview of some of the substances that require Approved Handlers, Location Certificates and Tracking. Note: these are for the pure substances. Some of the substances you use, such as isocyanic acid, lead chromate and n-vinyl pyrrolidone are currently classified as Notified Toxic Substances (NOTS) and will be transferred to the HSNO Act by July 2006. All NOTS are still subject to Dangerous Goods or Toxic Substances Regulations until transferred.

Chemical Name	Location	Approved	Tracking

	Test Certificate	Handler Test Certificate	
Ammonium dichromate	Yes >500 kg	Yes (any quantity)	Yes
Dichloromethane	No	No	No
Ethylene glycol	No	No	No
Nitric acid >70% (not fuming)	Yes >1000 litres	Yes (any quantity)	No
Perchloroethylene	No	Yes >10 litres	No
Potassium dichromate	No	Yes (any quantity)	Yes
Sodium dichromate	Yes >500 kg	Yes (any quantity)	Yes
Sodium dichromate, dihydrate	No	Yes (any quantity)	Yes
Sodium hydroxide	No	No	No
Solvents (low flashpoint): Acetone; butyl acetate; ethanol; ethyl acetate; h eptane; h exane; isopropyl acetate; isopropyl alcohol; methanol; methyl ethyl ketone (MEK); toluene	Yes >100 litres in large closed containers*	Yes >250 litres	No
Solvents (medium flashpoint): Butanol ; Mineral Turpentine; Styrene; p-xylene	Yes >500 litres in large closed containers*	No	No
Sulphuric acid - fuming	No	Yes (any quantity)	Yes
Trichloroethylene	No	Yes >10 litres	No

* ie containers that are larger than 5 litres, this includes containers that are open occasionally for the contents to be removed.

NOTE: If you have more than one substance that requires a Location Test Certificate it is the total quantity of all those substances that will

determine whether a Test Certificate is needed. Please contact a Test Certifier for advice.

What must I do now?

Not all the chemicals you use, distribute, or store will be listed in this leaflet, but please be aware that all hazardous chemicals are controlled by the HSNO Act.

You should:

- check your chemicals by using the Step by Step Guide to Finding Controls and Other Useful Links
- identify and obtain Test Certificates for Locations and/or Approved Handlers for those substances that require them
- contact a Test Certifier if you have any queries about what is required for a particular chemical.

Further information

You can also contact a hazardous substance enforcement officer, normally Department of Labour Workplace Group (Occupational Safety and Health Service), in your district.

In addition to enforcement officers there are also regional consultants for hazardous substances who can offer independent advice. Refer to:

- List of Hazardous Substances Advisers
- Register of Test Certifiers

Contamination Industrial Properties

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Contaminated Soil Testing
Does your site contain contaminatec
We test and dispose if needed
www.hilltopenterprises.com

Ads t

Guide to Contaminants Found at Contaminated Industrial Properties

The following table identifies several activities that may have caused contamination at industrial properties. The table summarizes contaminants that are related to such activities and identifies sources for the contaminants; however, it is not an exhaustive list of contaminants that can be found at a site. Identifying contaminants that may be present should be determined on a site-by-site basis. Such a determination should be conducted thoroughly and carefully. Information for this table was compiled from several sources, including various EPA *Guides to Pollution Prevention* for selected industries. A list of the specific citations used follows the table.

Past Activities Typically Conducted at Brownfields Sites	Typical Contaminants and Typical Sources
Agriculture	Volatile organic compounds (VOC); arsenic, copper, carbon tetrachloride, ethylene dibromide, and methylene chloride; pesticides; insecticides; herbicides; grain fumigants
Automotive refinishing and repair	Some metals and metal dust; various organic compounds; solvents; paint and paint sludges; scrap metal; waste oils
Battery recycling and disposal	Lead; cadmium; acids
Chloro-alkali manufacturing	Chlorine compounds; mercury
Coal gasification	Polynuclear aromatic hydrocarbons (PAH)
Cosmetics manufacturing	Heavy metals; dusts; solvents; acids
Dry cleaning activities	VOCs such as chloroform and tetrachloroethane; various solvents; spot removers; fluorocarbon 113
Electroplating operations	Various metals such as cadmium, chromium, cyanide, copper, and nickel
Glass manufacturing	Arsenic; lead
Herbicide manufacturing and use	Dioxin; metals; herbicides
Hospitals	Formaldehyde; radionuclides; photographic chemicals; solvents; mercury; ethylene oxide; chemotherapy chemicals

Incinerators	Dioxin; various municipal and industrial waste
Landfills—municipal and industrial	Metals; VOCs; polychlorinated biphenyl (PCB); ammonia; methane; household products and cleaners; pesticides; various wastes
Leather manufacturing	Toluene; benzene
Machine shops/metal fabrication	Metals; VOCs; dioxin; beryllium; degreasing agents; solvents; waste oils
Marine maintenance industry	Solvents; paints; cyanide; acids; VOC emissions; heavy metal sludges; degreasers
Munitions manufacturing	Lead; explosives; copper; antimony
Paint/ink manufacturing	Metals (such as chromium, cadmium, lead, and zinc); VOCs; chloroform; ethyl benzene; solvents; paints; inks
Pesticide manufacturing	VOCs; arsenic; copper; pesticides; insecticides; herbicides; fungicides; xylene; chlorinated organic compounds; solvents
Petroleum refining and reuse	Petroleum hydrocarbons; benzene, toluene, ethylbenzene, xylene (BTEX); fuels; oil and grease
Pharmaceutical manufacturing	Lead; various organic chemicals; organic solvents
Photographic manufacturing and uses	Silver bromide; methylene chloride; solvents; photographic products
Plastics manufacturing	Polymers; phthalates; cadmium; solvents; resins; chemical additives; VOCs
Printing industry	Silver; solvents; acids; waste oils; inks and dyes; photographic chemicals
Railroad yards	Petroleum hydrocarbons; VOCs; BTEX; solvents; fuels; oil and grease; lead; PCBs
Research and educational institutions	Inorganic acids; organic solvents; metals and metal dust; photographic waste; waste oil; paint; heavy metals; pesticides
Scrap metal operations	Various metals (such as lead and nickel); PCBs; dioxin; transformers
Smelter operations	Metals (such as lead, copper, and arsenic)
Semiconductor manufacturing	Metals; VOCs; carbon tetrachloride; degreasing agents; solvents
Wood pulp and paper manufacturing	Chlorinated organic compounds; dioxin; furans; chloroform; resin acids
Wood preserving	Creosote; pentachlorophenol (PCP); arsenic; chromium; copper; PCB; PAHs; beryllium; dioxin; wood preservatives

List of Citations Used to Identify Common Contaminants

- Contaminants and Remedial Options at Selected Metal-Contaminated Sites (EPA 540-R-95-512, PB95-271961)
- Dry Cleaning and Laundry Plants, Fact Sheet (EPA 530-SW-90-027b)
- Guidelines for Waste Reduction and Recycling: Metal Finishing, Electroplating, Printed Circuit Board Manufacturing, Hazardous Waste Reduction Program, Oregon Department of Environmental Quality (No document number)
- Guides to Pollution Prevention:

- Research and Educational Institutions (EPA 625-7-90-010)
- Selected Hospital Waste Streams (EPA 625-7-90-009)
- The Automotive Refinishing Industry (EPA 625-7-91-016)
- The Automotive Repair Industry (EPA 625-7-91-013)
- The Commercial Printing Industry (EPA 625-7-90-008)
- The Fiberglass-Reinforced and Composite Plastics Industry (EPA 625-7-91-014)
- The Marine Maintenance and Repair Industry (EPA 625-7-91-015)
- The Mechanical Equipment Repair Industry (EPA 625-R-92-008)
- The Pesticide Formulating Industry (EPA 625-7-90-004)
- The Pharmaceutical Industry (EPA 625-7-91-017)

- Innovative Treatment Technologies: Annual Status Report (EPA 542-R-95-008)
- Low-Level Mixed Waste: A RCRA Perspective for NRC Licenses (EPA 530-SW-90-057)
- Pollution Prevention Technologies for the Bleached Kraft Segment of the U.S. Pulp and Paper Industry (EPA 600-R-93-110)
- Solving the Hazardous Waste Problem: EPA's RCRA Program (EPA 530-SW-86-037)
- Waste Minimization Audit Report: Case Studies of Minimization of Mercury-Bearing Wastes at a Mercury Cell Chloralkali Plant: Project Summary (EPA 600-S2-88-011)
- Waste Minimization Opportunity Assessment: Philadelphia Naval Shipyard: Project Summary (EPA 600-S2-90-046)
- Waste Reduction for the Aerospace Industry: Fact Sheet, California Department of Health Services Technology Clearinghouse (no document number)

This page was updated on January 04, 2007

DRAFT 1

PRELIMINARY ASSESSMENT
OF
OLD GORDON CARTON/J.B. MACNEAL PLANT



September 5, 2008

Prepared by: Maryland Department of the Environment
Waste Management Administration
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Prepared for: U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

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1.0 INTRODUCTION

1.1 Authorization

This Site Inspection was performed by the Maryland Department of the Environment, Waste Management Administration (MDE/WAS), Land Restoration Program (ERRP), Federal Superfund Division under a Preremedial Cooperative Agreement with the U.S. Environmental Protection Agency (EPA).

1.2 Scope of Work

MDE performed a Preliminary Assessment (PA) of the Old Gordon Carton/J.B. MacNeal site (MDN000306186). The purpose of the assessment is to determine if there is a potential for the release of hazardous substances by way of groundwater, surface water, soil exposure, and air pathways on sites identified under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The scope of the assessment included reviewing the available file information and site reconnaissance.

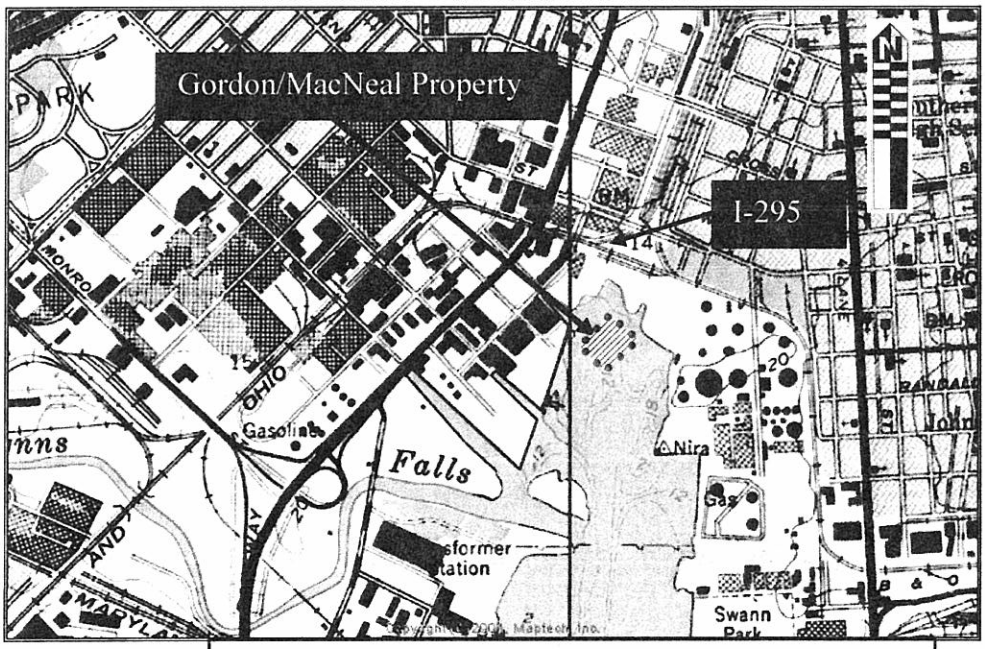
1.3 Executive Summary and Conclusions

Industrial activity throughout the last century has impacted the Warner Street corridor. Of particular concern is the area in the rectangle formed by Warner Street, Wooster (Worcester) Street, Oler (Dock) Street, and Shell (Eutaw) Street. This parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which used hazardous

materials including heavy metal salts and oxides and volatile organic materials, in their process and operations.

The Old Gordon Carton/J.B. MacNeal site (Gordon/MacNeal) is located in the Warner Street Corridor off I-295 in the Southern Gateway area of Baltimore City. Warner Street, Worcester Street, Eutaw Street and Oler Street bound the roughly rectangular-shaped 2.63-acre Gordon/MacNeal property. The property is off Middle Branch of the Patapsco River in a historical commercial/industrial area immediately south of the Baltimore City stadium complex. Historic records indicate varied industrial uses of these parcels dating back through the mid-19th century. Sanborn Fire Insurance maps from 1890 through 1953 detail a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on the parcels.

FIGURE 1 – WARNER STREET AREA

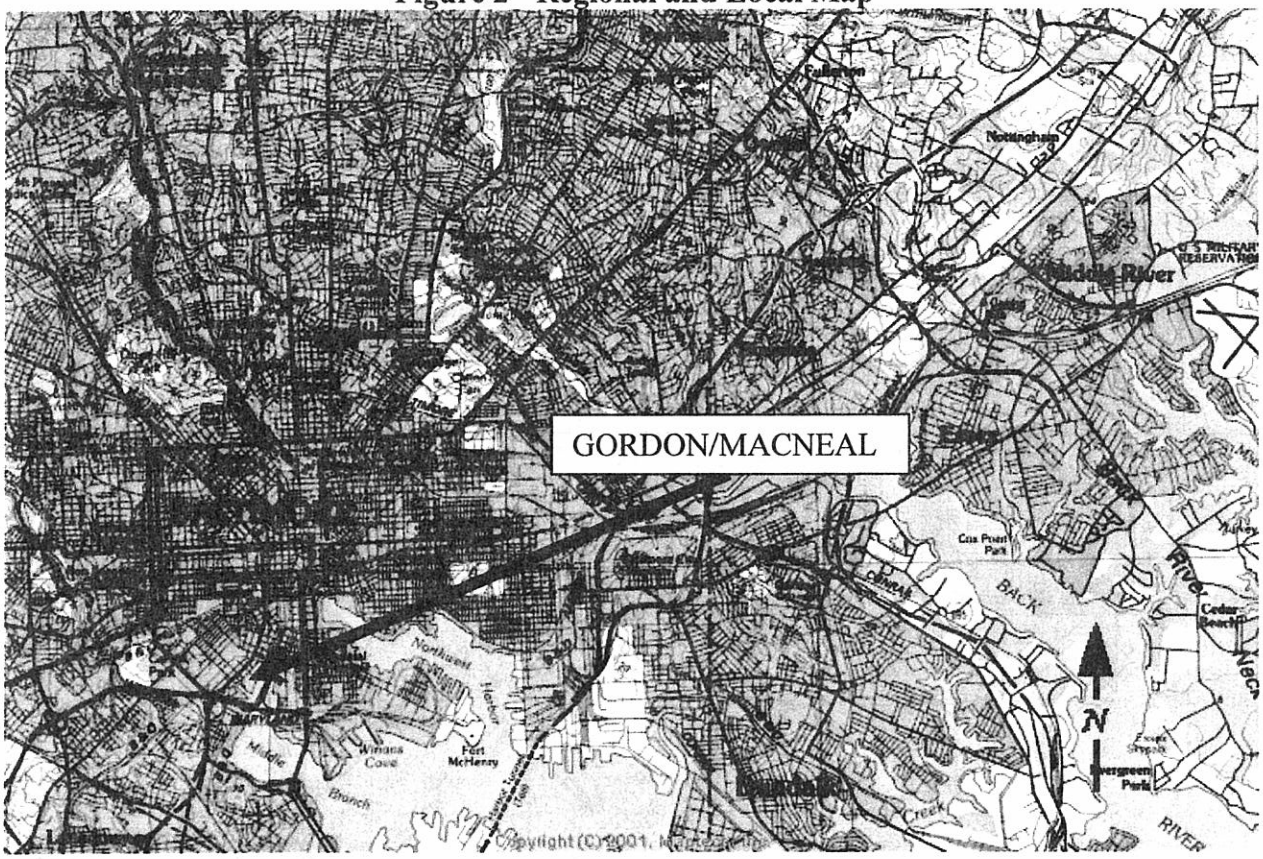


Topographic Map Of The Area
(From USGS Baltimore West Quadrangle - 1975)
1:24,000 Scale

2.0 SITE DESCRIPTION

The Gordon/MacNeal site is located in the 1600 block of Warner Street off Worcester Street, Baltimore City, Maryland. The property is situated in an urban setting on the southern edge of Baltimore City, and is currently owned by Warner Street, Inc. Geographic coordinates for the property are 39°16.3955" north latitude and 76°37.5815" west longitude, based on the North American Datum of 1983 (NAD83) data measured from the Baltimore East U.S. Geological Survey (USGS) Quadrangle Map. The Maryland grid coordinates for the site are 524,400 feet north and 905,800 feet east based on the geographic center of the property as measured on page 42 of the 2004 Alexandria Drafting Company (ADC) map for Baltimore City and County, Maryland. The site consists of three parcels identified in Maryland Department of Assessments and Taxation as Ward 21 Section 09 Block 0844A Lots 001A, 005, and 010. The property is located in Congressional District 03. Gordon/MacNeal is at approximately 10 feet above mean sea level in coastal plain alluvium.

Figure 2 - Regional and Local Map



2.1 Site Ownership and Use

In the 1890s the property housed the C.F. Ranstead Baltimore Cedar Co. From 1902 through 1953, the J. B. MacNeal and Company Varnish and Color Works operated out of buildings on this property. In 1953 this property housed both J. B. MacNeal and Gordon Carton. MacNeal occupied the northwestern quadrant and Gordon the southeastern. The pathways of concern for any residual contamination include soil, groundwater and indoor air quality.

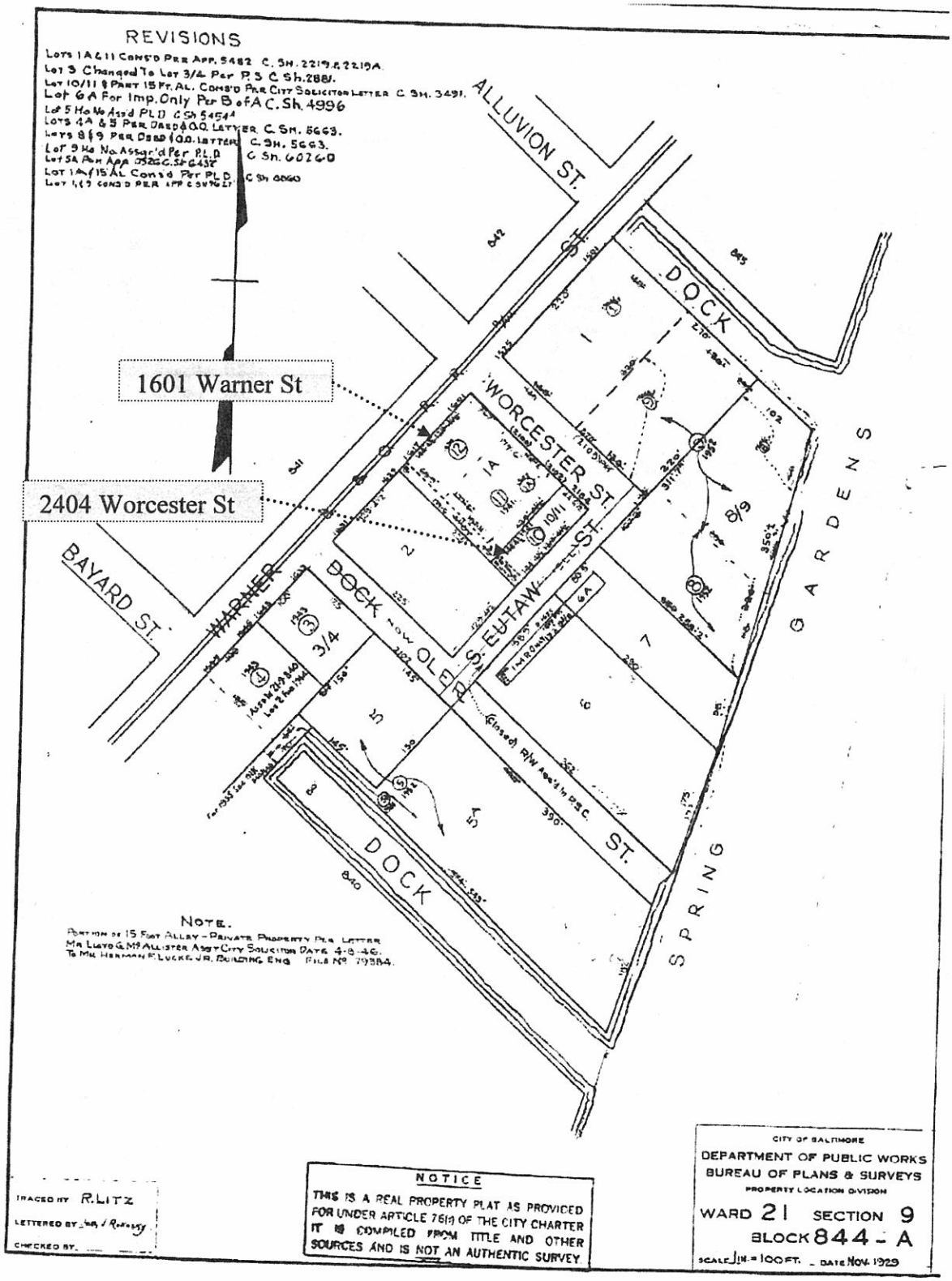


Figure 3 – Property Map of Gordon/MacNeal Area

2.2 Permitting and Regulatory Actions

Gordon Cartons had a minor air quality issue noted in July 1999.

2.3 Remedial Actions

The 2401 Oler Street building was the site of a planned removal of drums of industrial waste that had been illegally stored on a loading dock at the premises. In the late 1980s MDE worked with the property owner to characterized and remove drums of waste that had been collected from the Gordon/MacNeal plant and consolidated in the Oler Street building. There are no other records of remedial actions relative to the Warner Street facility.

3.0 ENVIRONMENTAL SETTING

3.1 Water Supply

Drinking water for Baltimore area residents is supplied by the City of Baltimore from a series of aboveground reservoirs located to the north of the City. According to the U. S. Department of Agriculture (USDA), *"the Department of Public Works, Baltimore City, provides water for the City of Baltimore from three sources: the Gunpowder Falls, the North Branch of the Patapsco River, and the Susquehanna River."* Water collected from these sources is re-routed toward three reservoirs (Liberty, Loch Raven and Prettyboy) and treated at city filtration plants prior to distribution to the local population.

Virtually all of the residents around Baltimore City receive water from municipal supplies. These consist of the Baltimore City surface water reservoirs, the nearest of which is

approximately ten miles north of the site. There are no transient or non-transient non-community wells in the Gordon/MacNeal area. The closest domestic source well is located over one mile away from the site at 529 Island Point Road. The locations of the area well systems, the estimated populations and the area that they serve are represented in Table 1.

In the City of Baltimore, storm water drainage occurs through an extensive network of underground conduits; site-specific drainage flows to these storm drains and directly to Middle Branch Patapsco River via overland flow.

Table 1 – Four-Mile Radius Domestic Water Sources and Populations

RING DISTANCE FROM THE SITE	ESTIMATE NUMBER OF DOMESTIC WELLS	ESTIMATED POPULATION SERVED*	RING DISTANCE FROM THE SITE	TOTAL POPULATION
0 – ¼ mile	0	0	0 – ¼ mile	325
¼ –½ mile	0	0	¼ –½ mile	1623
½ - 1 mile	0	0	½ - 1 mile	19444
1 – 2 miles	0	0	1 – 2 miles	71445
2 – 3 miles	16	42	2 – 3 miles	141629
3 – 4 miles	7	18	3 – 4 miles	144474
Total	21	60	Total	378940

*According to 1998 U.S. Census data, the average population per household is 2.62.

3.2 Surface Waters

The Gordon/MacNeal property lies on the Middle Branch Patapsco River just north of the confluence of Gwynns Falls with the Middle Branch. Natural drainage on the site is in a generalized southeast direction to dock areas that flow into the Middle Branch. Surface water infiltrates the soil to groundwater, or is discharged via overland flow to the Middle Branch Patapsco River. The Middle Branch Patapsco River flows into the Patapsco River, which discharges into the Chesapeake Bay.

The farthest upstream probable point of entry for the surface water route originates in a dock area southeast of the site. This unnamed tributary to Middle Branch Patapsco River travels east southeast for approximately 580 feet to the Middle Branch. The Middle Branch Patapsco River, a brackish estuary and a fishery flows 3.5 miles to its confluence with the Patapsco River. The Patapsco River flows 11.5 Miles to its confluence with the Chesapeake Bay. The 15-mile surface migration pathway ends in the Chesapeake Bay at Craighill Channel off Bodkin Point. The shores of the Patapsco River and the Chesapeake Bay are classified as estuarine intertidal wetlands and are fisheries and aquatic use areas.

3.3 Soils

Gordon/MacNeal's soils are classed as soil types 43U and 44UG, Udorthents, 0 to 15 percent slopes. Udorthents are soils that have been impacted by human urban development. The major difference between the two soil groups is that the 43U soils are occasionally flooded.

FIGURE 4 – AREA SOILS MAP



KEY FOR SOILS MAP

Map Unit Symbol	Map Unit Name
43U	Urban Land/Udorthents complex, occasionally flooded
44UC	Urban land, 0 to 15 percent slopes

3.4 Geology and Groundwater

Gordon/MacNeal lies in the erosional remnants of the Coastal Plain Physiographic Province, near the Fall Line. The unconsolidated sediments of the Coastal Plain extend eastward from the Fall Line, dipping eastward and becoming progressively thicker with distance, eventually reaching over 8,000 feet in thickness at Ocean City.

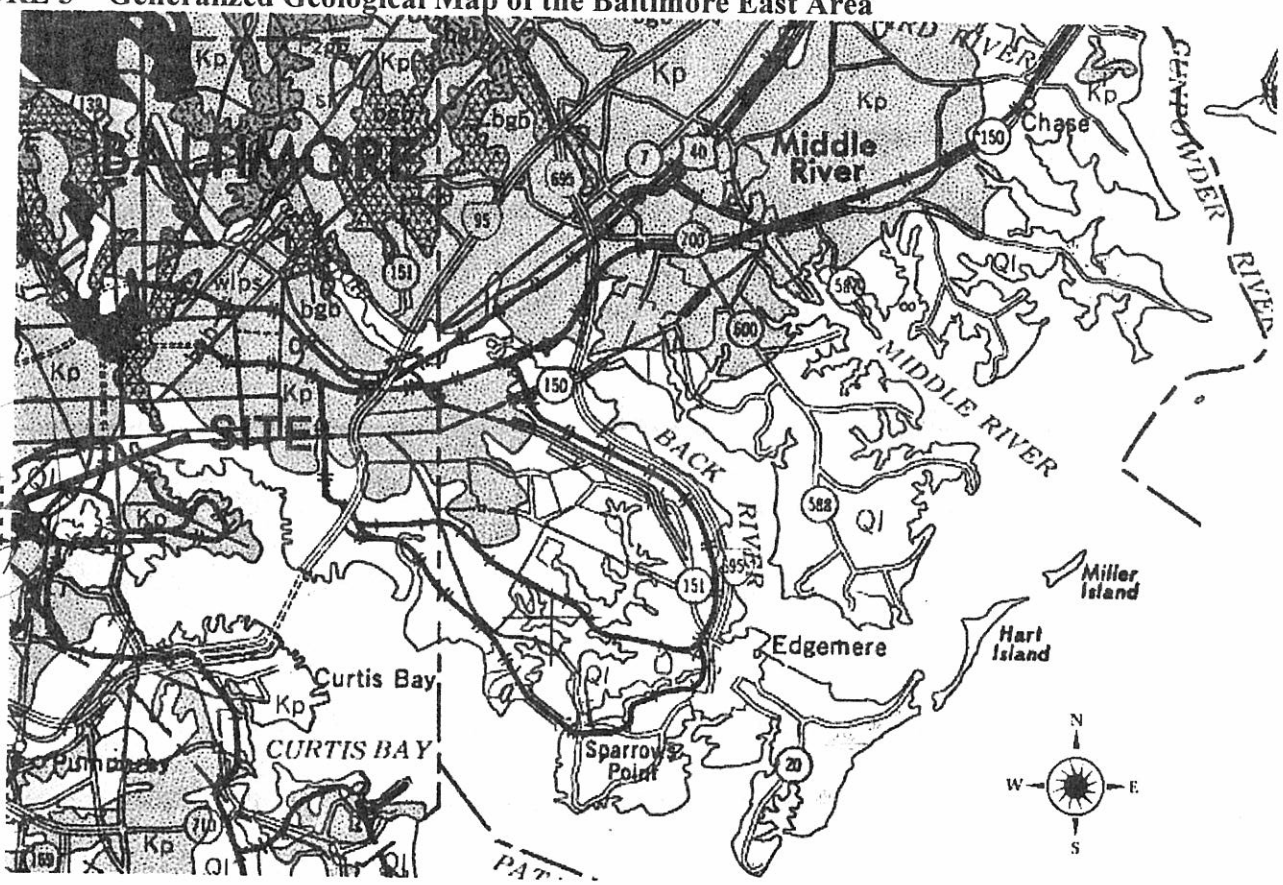
The site lies within the Potomac Group, a thick sequence of non-marine sands, silts, clays, and gravelly sands (Figure 6). Planar and trough-type cross-stratification is common in this group. Gravel in the Potomac Group consists almost entirely of quartz and quartzite clasts,

which are usually less than three inches in diameter. Clay layers are lenticular and are mottled red, purple, yellow, and white. Locally, clay is dark gray and lignitic and in places contains carbonized plant fragments. The maximum thickness of the group is about 1300 feet, but only about half of the formation is exposed in Cecil County, the rest being overlain by younger sedimentary series.

Localized Quaternary Lowland Deposits of the Talbot Formation may be found along stream beds. These materials are generally less than 40 feet in thickness in Cecil County.

Site soils have been classified as soil group 43C and 44UG by the U.S. Department of Agriculture, Natural Resources Conservation Service. The designation indicates that the soils are udorthents; lands disturbed by human influences, which have a zero to fifteen percent slope.

FIGURE 5 – Generalized Geological Map of the Baltimore East Area



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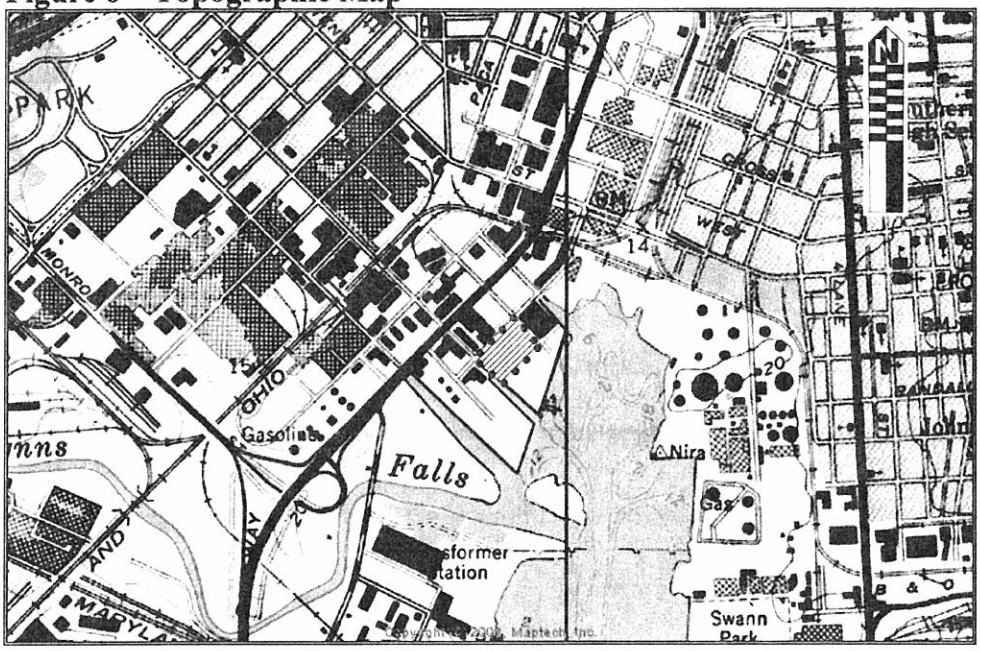
Lowland Deposits -Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet

Kp

Potomac Group - Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.

Figure 6 – Topographic Map



3.6 Meteorology

The climate is temperate and humid with an average of 200 freeze-free days. The average temperatures range from 78.5 degrees Fahrenheit in the summer to 36.6 degrees Fahrenheit in the wintertime. The mean annual precipitation is about 42.59 inches with an average snowfall on the order of 22 inches per year. The two-year 24-hour precipitation for the Baltimore area is 4.38 inches.

3.7 Nearby Land Use and Population Distribution

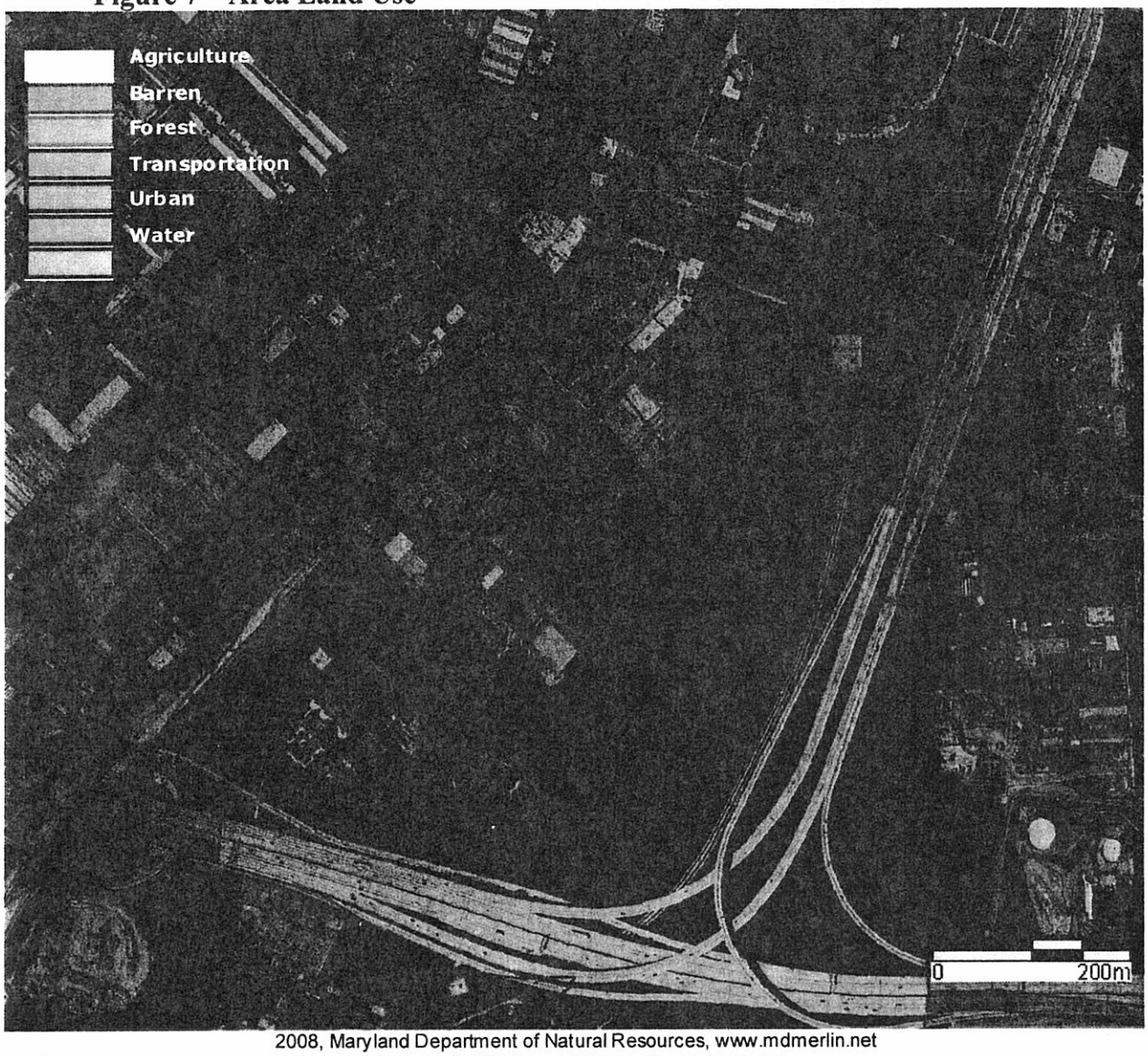
Land use surrounding the site is a mix of commercial, and industrial with some transient residential. The site lies within a sixteen acre parcel dubbed "Baltimore Gateway South," which was previously occupied by Maryland Chemical Company, Second Chance, a non-profit

architectural salvage company, and the vacant Gordon/MacNeal building. Gateway South is part of an urban renewal project designed to renovate and revitalize the Middle Branch Patapsco River area. Land use will change from primarily industrial use to principally residential commercial use within the corridor.

Roughly two-thousand people inhabit the area within a half mile radius of the site. Population density increases exponentially with distance from the site. There are over 21,000 people residing within one mile of the site and 380,000 within four miles of the site. (Table 2)

There will be an influx of residents into the immediate area as the change from industrial use to commercial/residential use proceeds. Construction of several condominium townhome developments is currently underway in the Middle Branch Patapsco area.

Figure 7 – Area Land Use



2008, Maryland Department of Natural Resources, www.mdmerlin.net
Created with TNTserver™ from MicroImages, Inc

Table 2 – Population Distribution

Radius (miles)	Population
0 – 0.25	325
0.25 – 0.5	1623
0.5 – 1.0	19444
1.0-2.0	71445
2.0 – 3.0	141629
3.0 – 4.0	144474
Total	378940

The resident population distribution around the site was determined using Maryland census tract data for the year 2000.

4.0 WASTE DESCRIPTION

J.B. MacNeal was a manufacturer of varnish and other coatings. Chemicals associated with the manufacture of paint and varnishes include petroleum distillates, alcohols, chlorinated solvents, shellac, surfactants, chemical dryers, polymers, organic compounds, heavy metals, epoxies, solvents, mild corrosives, polyurethanes, herbicides and fungicides.

Gordon Carton was an industrial printing operation. The inks used in printing fall into four classes: letterpress, lithographic, flexographic and rotogravure. The letterpress and lithographic are based mainly in mineral oil, while flexographic and rotogravure use very volatile solvents. Gordon Carton's presses were principally rotogravure and flexographic. Common materials used include solvents, inks and corrosive cleaning materials.

Chemicals that might be anticipated at Gordon/McNeal include: acetone, alcohols, anti-bacterial agents, cadmium, chemical dryers, chlorinated solvents, chromium, corrosive cleaners, cresol, epoxies, esters, ethyl acetate, fungicides, heavy metals, herbicides, hexane, ketone, lead, methyl ethyl, methyl isobutyl ketone, mild corrosives, n-butyl acetate, organic compounds, petroleum distillates, polymers, polyurethanes, shellac, sodium hydroxide, surfactants, titanium dioxide, toluene, volatile organic compounds, waste metals, waste or spent corrosives, waste or spent polymers, xylene, and zinc.

5.0 PREVIOUS STUDIES

MDE was contacted by the Baltimore Development Corporation (BDC) to perform Brownfield Assessments of several properties in the Warner Street Corridor. A Phase I assessment was performed on the sixteen acre area containing Gordon/MacNeal. Due to access issues MDE was unable to complete a Phase II Brownfield Assessment on the Gordon/MacNeal property. BDC contracted a Phase II Environmental Assessment of Gordon/MacNeal and several of the other Warner Street Corridor properties. Results of these investigations are not available at this time.

6.0 FINDINGS AND CONCLUSIONS

The Gordon/MacNeal property has been the site of light industry for over one hundred and twenty years. Two principal industries are contributor to potential contamination in the area; they are commercial printing and paint and varnish manufacturing. Numerous hazardous chemicals are associated with both of these industries and there is a strong potential that these materials have been released into the environment.

Signs of past storage and housekeeping practices indicate that paints and pigments have been spilled in loading docks and fenced storage areas. Access to interior of the building was denied therefore no analysis of interior issues can be verified. Facility inspections conducted when Gordon Carton was operational indicated that chlorinated solvents were used extensively and that storage and control of the materials was haphazard at best prior to Resources Conservation and Recovery Act (RCRA) enforcement. Releases of environmental contaminants from the facility likely resulted in contamination of soils and groundwater and would likely have

an impact on indoor air quality in structures in the immediate area. A full sampling assessment should be performed on the Gordon/MacNeal site and adjacent properties. Soil, groundwater and indoor air should be examined to determine the extent and nature of environmental contamination relative to the former occupants of the building.

Gordon/MacNeal is in an area of urban redevelopment in the Southern Gateway to Baltimore City. It is anticipated that the owners of most of the redeveloping properties in the corridor will join the Voluntary Clean-up Program. Should the owners decide not to participate in VCP a Site Investigation (SI) should be performed on the property.

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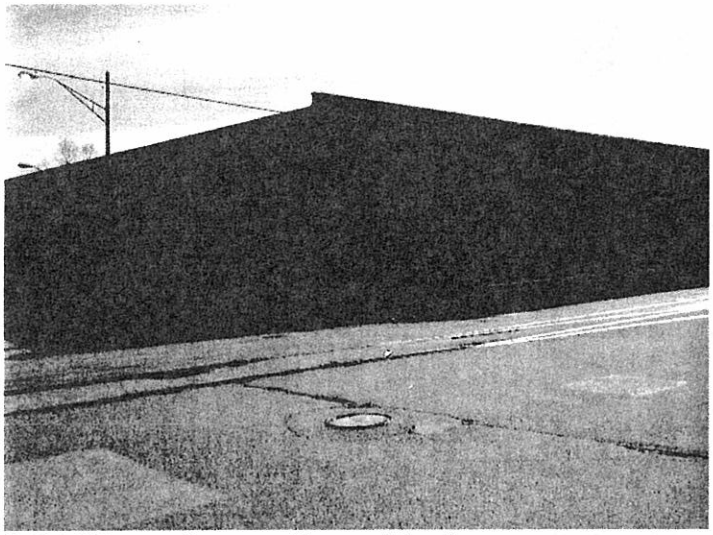
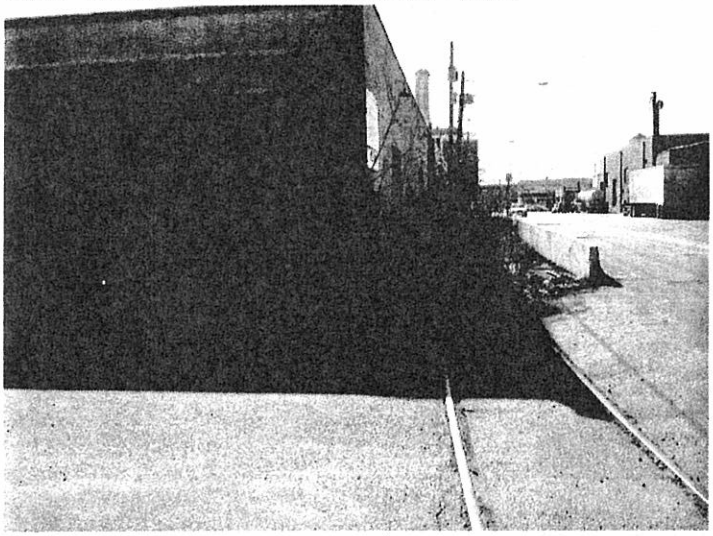
9. U.S. Department of the Interior Geological Survey, *Characteristics of Streamflow in Maryland, Report of Investigations No. 35*, 1983.

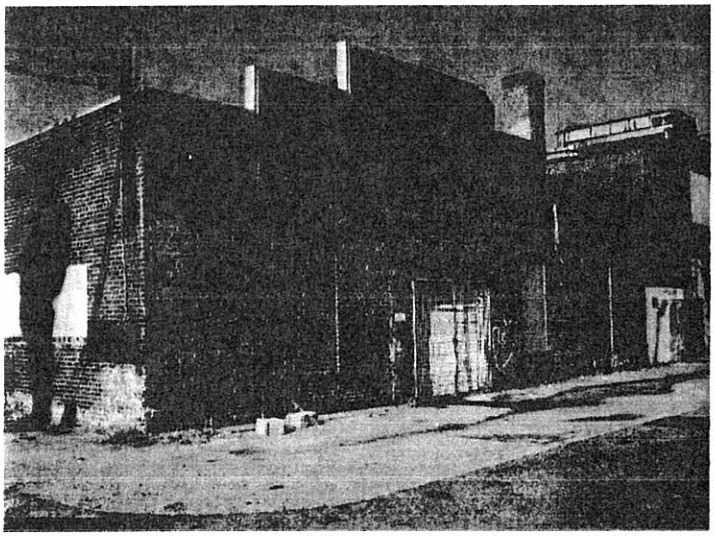
Appendix A – Photographs



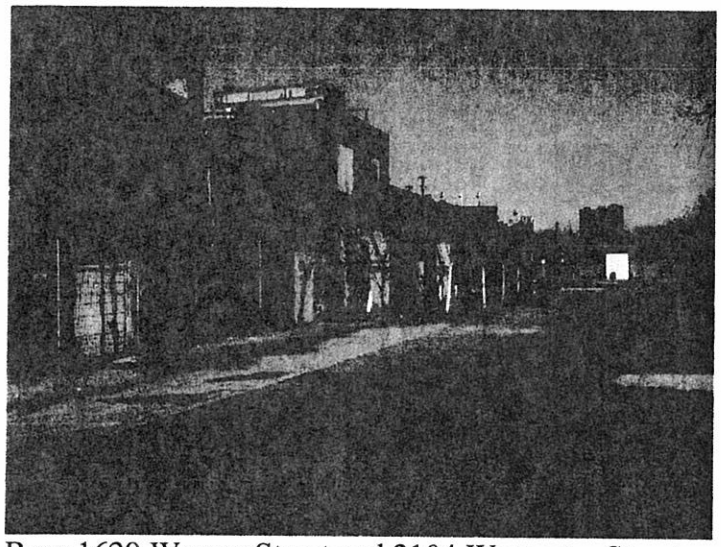
1601 Warner Street – Vacant/For Lease



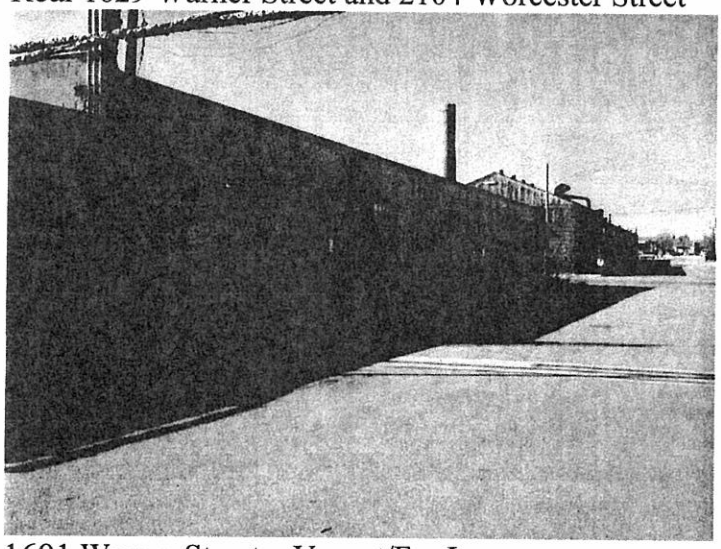
1601 Warner Street – Vacant/For Lease



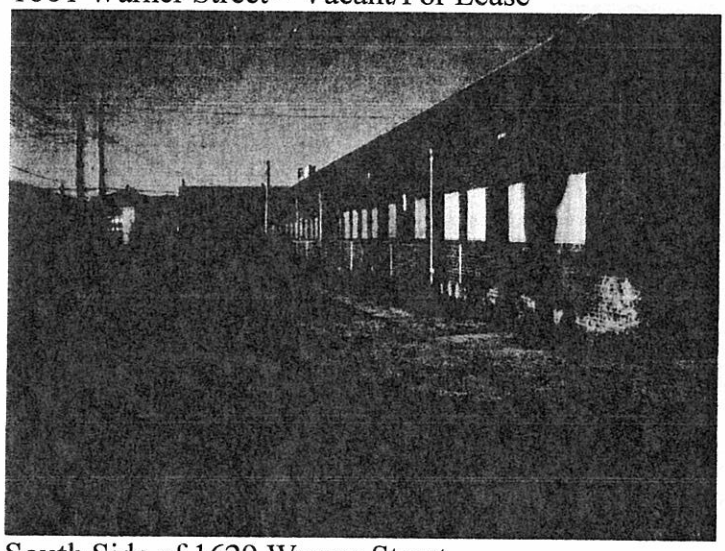
Rear 1629 Warner Street – Vacant



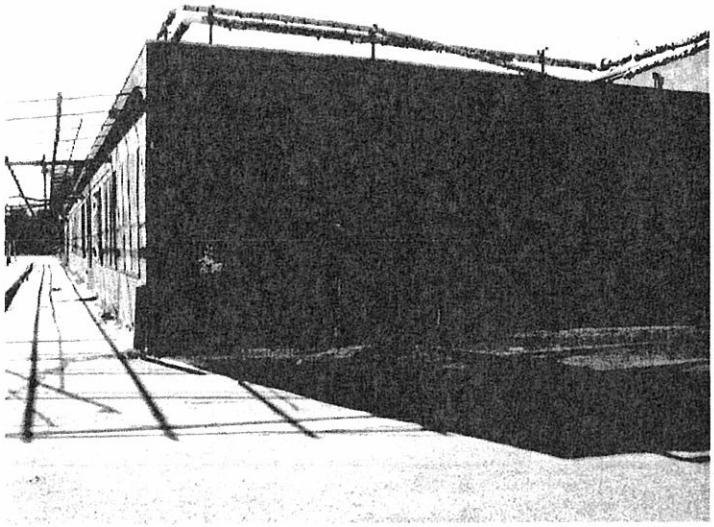
Rear 1629 Warner Street and 2104 Worcester Street



1601 Warner Street – Vacant/For Lease



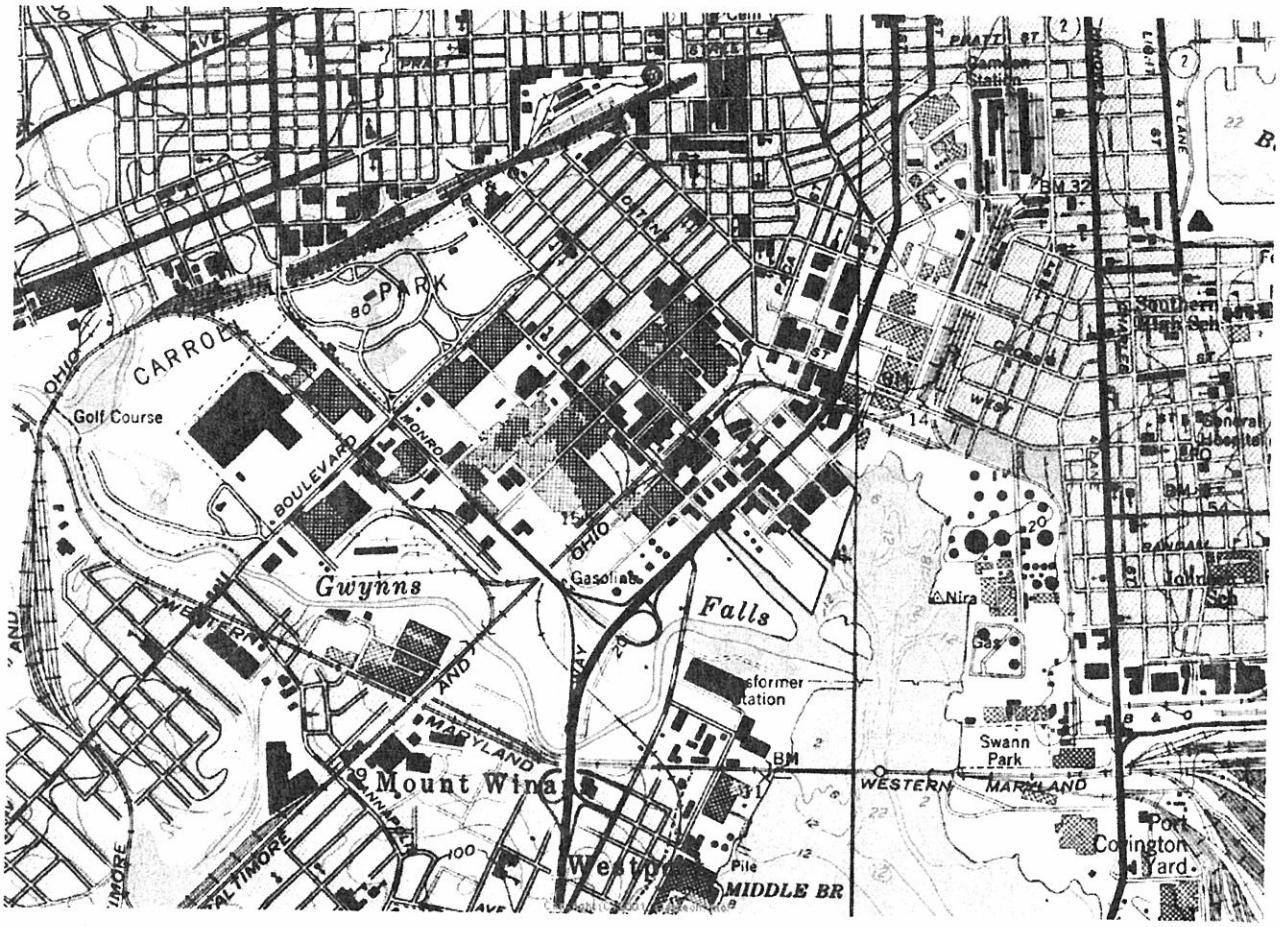
South Side of 1629 Warner Street



2104 Worcester Street

Gordon/MacNeal

Revision I
September 5, 2008



DRAFT

PHASE I ENVIRONMENTAL SITE ASSESSMENT

WARNER STREET

BUSINESS CENTER PROPERTIES

BALTIMORE CITY, MARYLAND



July 15, 2008

Prepared by: Maryland Department of the Environment
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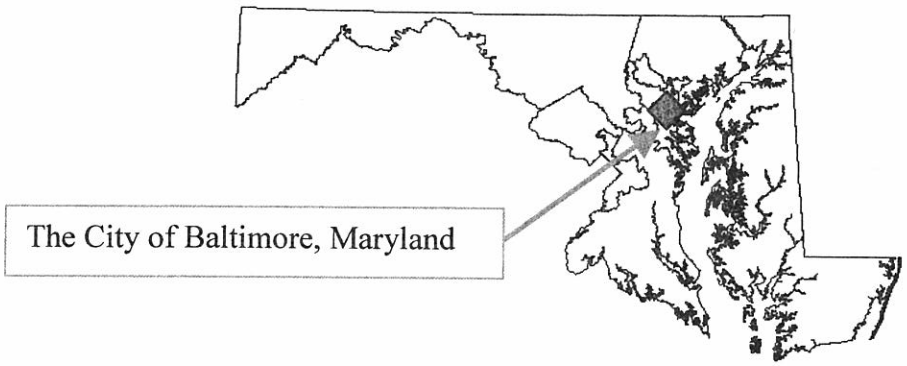
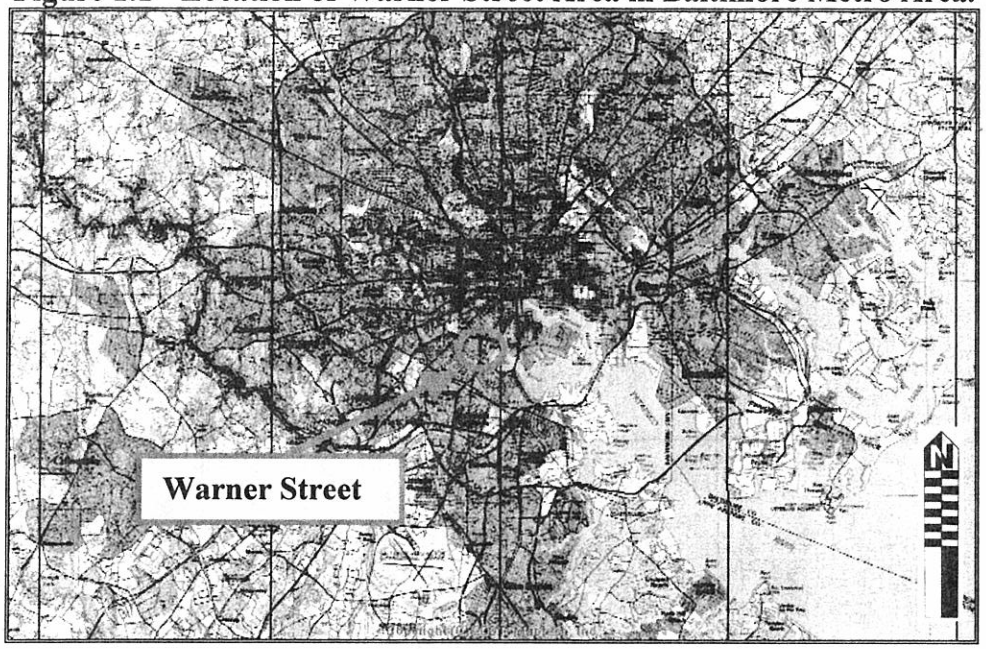
1.0 Executive Summary

As part of the State of Maryland's Brownfields Site Assessment Initiative, the Maryland Department of the Environment (MDE) conducted a Phase I Environmental Site Assessment of the Warner Street Business Properties located in the 1400 to 1600 blocks of Warner Street in Baltimore, Maryland. The site assessment was conducted at the request of Baltimore Development Corporation (BDC) in preparation for future redevelopment of the area. According to the BDC and available records there have been no previous Phased investigations conducted on this property. Several other adjacent properties were however the subject of MDE investigations in October 2000 and March 2002.



Warner Street is located in the southern portion of the City of Baltimore, Maryland on the Middle Branch of the Patapsco River (Figure 1.1). The property consists of thirteen lots on three blocks and measures a total of 15.52 acres. These parcels will be collectively referred to as "the site" or as "the property" throughout this report. Historic records indicate varied industrial uses of these parcels dating back through the mid-19th century. Sanborn Fire Insurance maps from 1890 through 1953 detail a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on the parcels of interest in the Warner Street corridor.

Figure 1.1 - Location of Warner Street Area in Baltimore Metro Area.



On February 11, 2004 a site reconnaissance was performed to photo-document current site conditions. Nine of the thirteen parcels under consideration are occupied at this time. The four unoccupied parcels are located in the rectangle defined by Warner, Oler, Shell, and Worcester Streets. These parcels show signs of distress with evidence of vandalism to both the buildings and public spaces. Graffiti covers certain walls, windows are broken, doors have been breached and fires have been set on building grounds and in the middle of the street.

The Warner Street corridor is partially abandoned; the area exhibits signs of stress and is a good candidate for revitalization and rehabilitation.

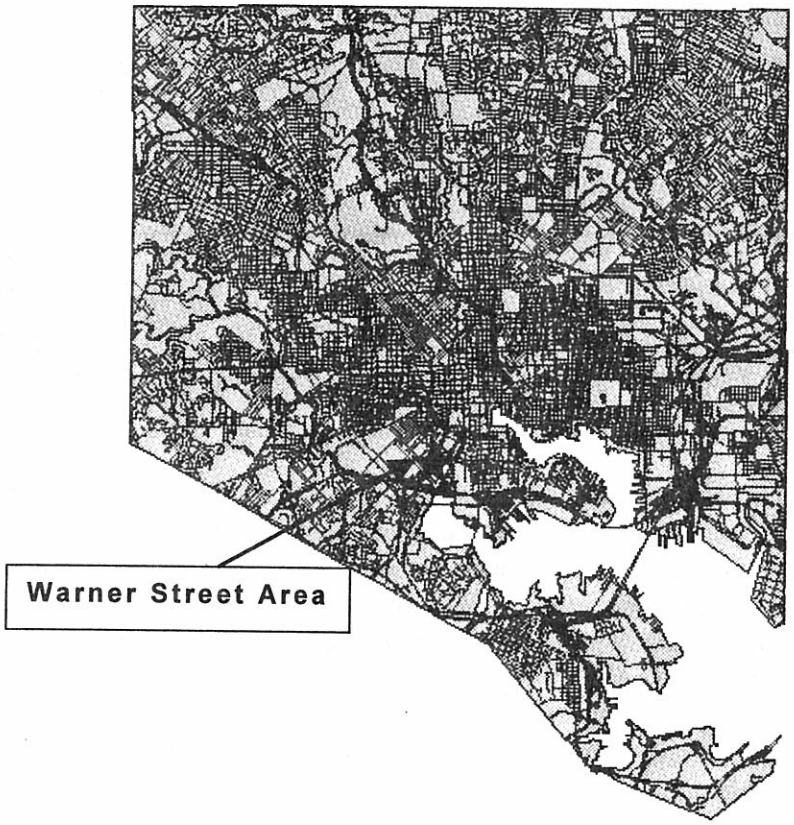
Industrial activity throughout the last century has impacted the Warner Street corridor. Of particular concern is the area in the rectangle formed by Warner Street, Wooster (Worcester) Street, Oler (Dock) Street, and Shell (Eutaw) Street. This parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which used heavy metal salts and oxides and volatile organic materials in their process and operations.

Another area of concern is the 1600 block of Warner Street, which was once the site of a historic brass foundry. Contaminants of concern in the foundry are volatile organic compounds, heavy metals, arsenic, acids, and metallic salts and oxides.

The Maryland Chemical site in the 1500 block of Russell Street presents several potential areas of concern. This property was at one time the site of American Cyanamid, an industrial manufacturer of pesticides and agricultural chemicals. Maryland Chemical itself presents a number of concerns stemming from the storage and sale of industrial chemicals. Both aboveground and underground tank storage of chemicals are documented. Consumer quantity sizes through 55-gallon drums, tanks and carboys of listed materials have been handled by the facility.

A Phase II Site Assessment is recomended to document the levels of contaminants throughout the Warner Street area and to determine the best practicable remediation and use of the subject properties.

Figure 1.2 - Location of Warner Street Area in Baltimore City.



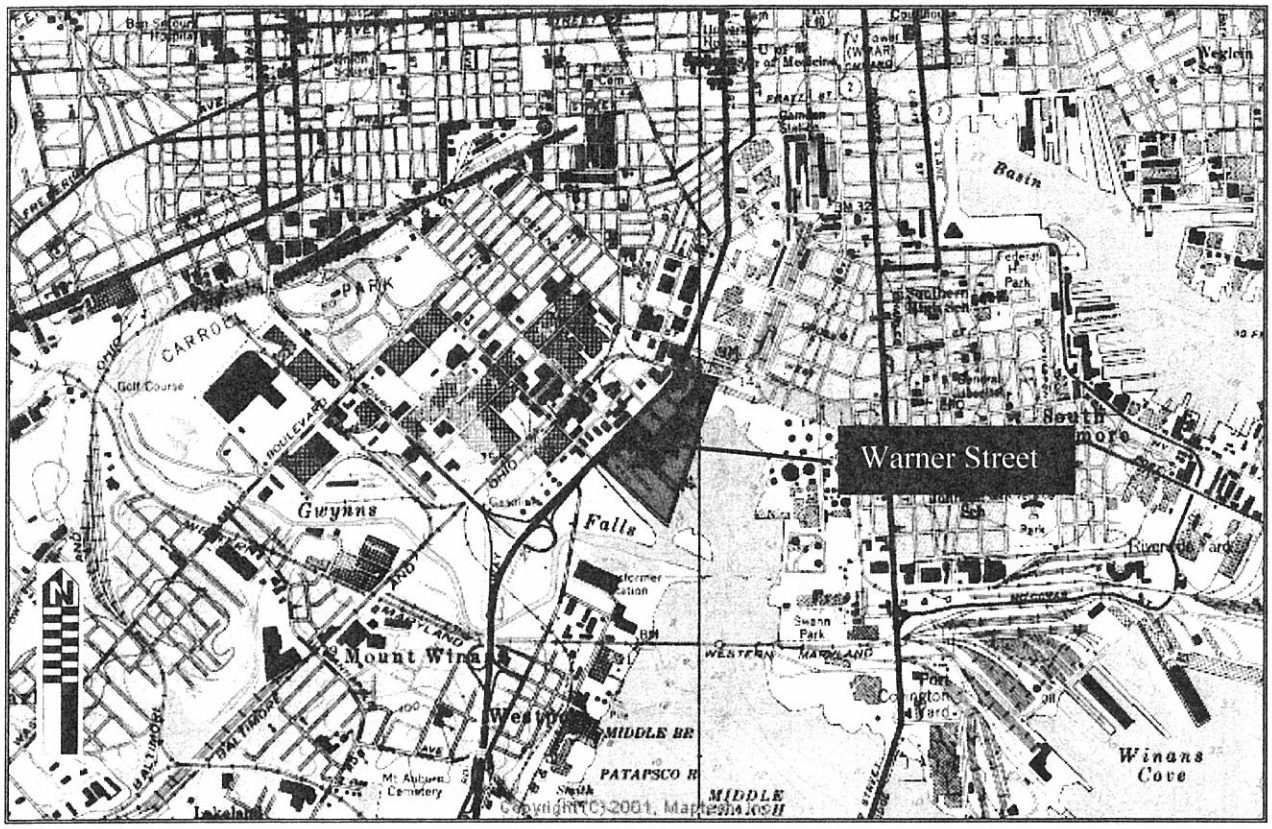
2.0 Objectives and Limitations

The objective of this study is to help BDC define the redevelopment potential of the Warner Street Business Center properties by identifying potential environmental concerns in the area. This investigation includes research into the history of the industrial use of the area, property ownership, and known potential environmental contamination contributors. This report builds the foundation upon which a Phase II Environmental Assessment of the area will be launched.

3.0 Site Overview

The Warner Street Business Center is located in the midst of roughly 500 acres of industrial land at the southern gateway to the City and downtown Baltimore. Figure 3.1 sets the location of the Warner Street Area in this context. At present, this industrial area has significant quantities of under-utilized land and a limited development interest.

FIGURE 3.1 – WARNER STREET AREA



The Warner Street Business Center area is bounded by Russell Street on the West, Ostend Street on the North, Hamburg Street Viaduct on the South and the Middle Branch of the Patapsco River on the East. The 15.52 acres of property within the scope of this investigation incorporates 13 parcels of land currently owned by five entities.

Tenants occupy the buildings on six of the thirteen parcels. Maryland Chemical Company occupies the three Russell Street parcels. Signs on the building at 1501 Warner Street indicate that it is occupied by Bayfair Warehouses. Baltimore Cycle Salvage occupies 1629 Warner Street. Second Chance, an architectural resale business, occupies 1633 and 1645 Warner Street. Signage on 2102 Oler Street indicated that it is occupied by Baltimore Renovations, Inc. At the time of the site visit, only Maryland Chemical and Second Chance were open and occupied.

Figures 3.2 and 3.3 show the locations of the subject parcels on the City tax maps. Five corporate entities control these thirteen parcels as follows:

- The Mayor and City Council of Baltimore, controls 2110 and 2119 Haines Street;
- Warner Street Inc, is the owner of record for 2102 Oler Street, 2104 Worcester Street, 1501, 1601, 1629 and 1633 Warner Street;
- Pheasant Warner Co. LLC, owns 1501, 1525, and 1551 Russell Street;
- Six GS, LLC, owns 1411 Warner Street; and
- Potomac Investments owns 1645 Warner Street.

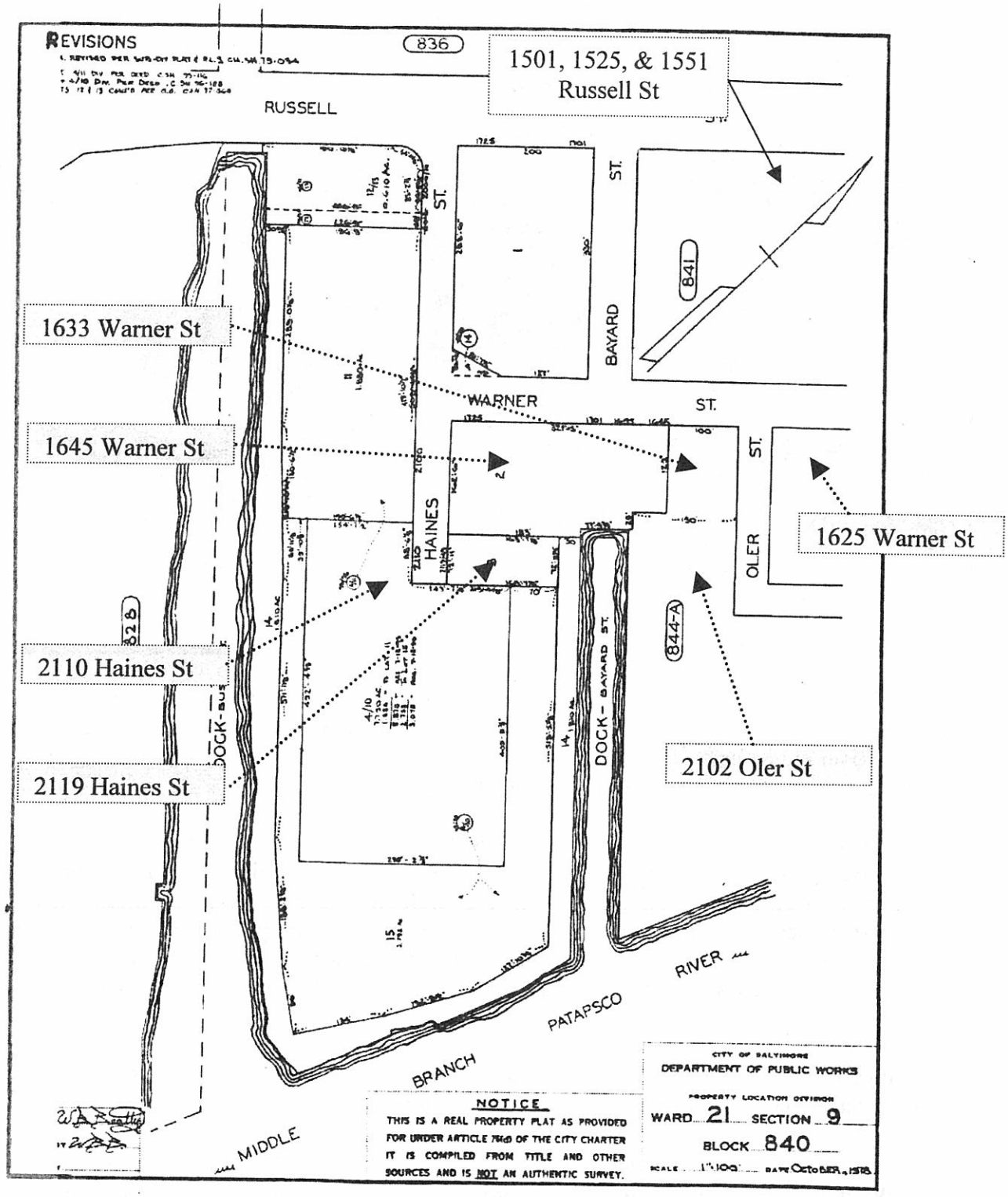


Figure 3.2: Properties in Block 840[i]

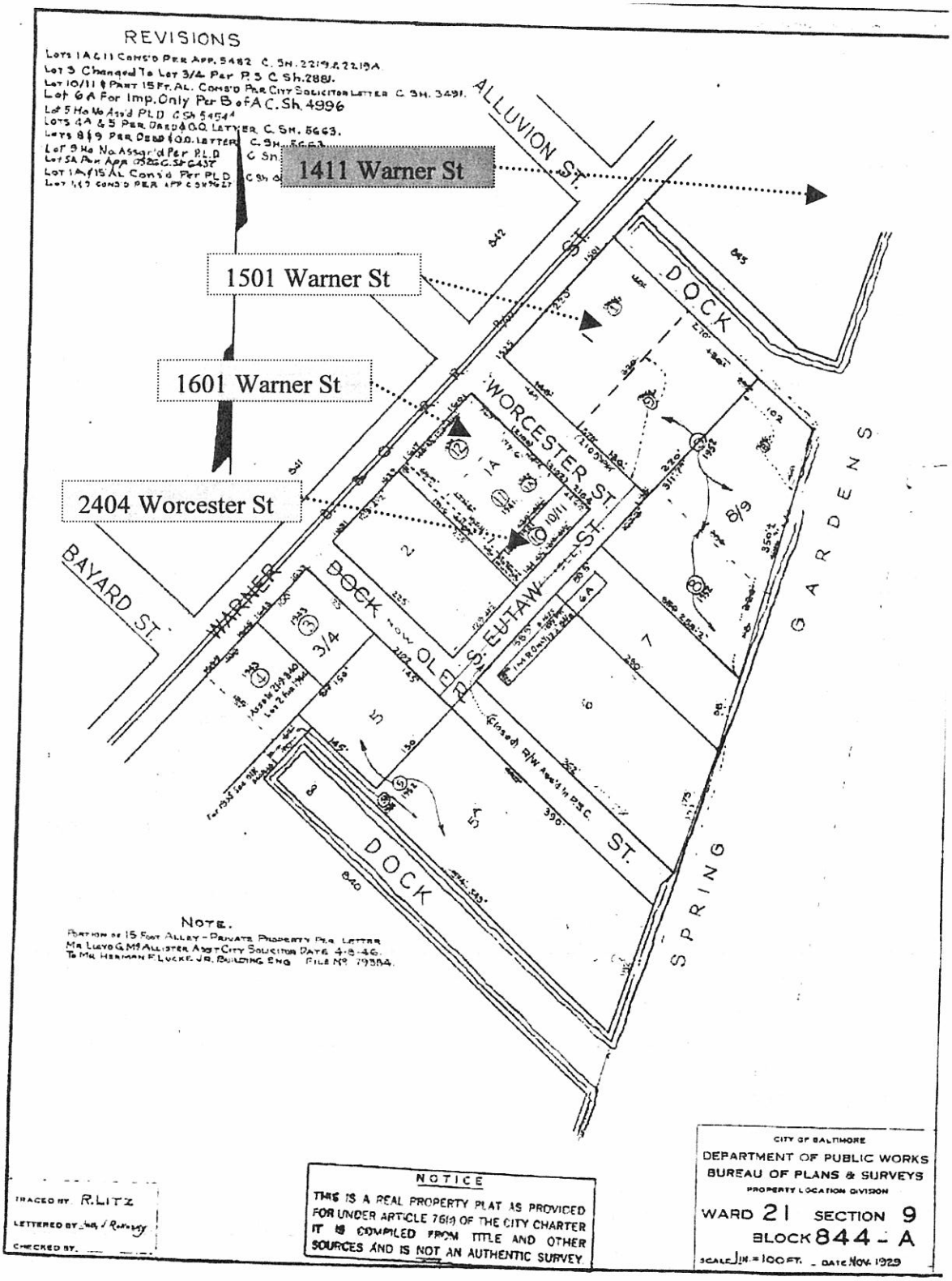


Figure 3.3: Properties in Block 844A.[ii]

4.0 Site Background

Dating back to at least 1890, the area has been primarily industrial in nature. Sanborn Fire Insurance Maps of the era detail wharves, an icehouse, coal yards, a chemical manufacturer, glass manufacturing plants, a brass foundry, a distillery and a malt house scattered along the Warner Street corridor. In the more recent past, a number of small businesses, storage companies, industrial-printing concerns, and a wholesale chemical distribution company have operated in the area.

Table 4.1 – Property Ownership

Property Address	Current Owner	Last Owner	Current Occupant	1890-1901
2110 Haines St.	City of Baltimore	AT&T	Vacant	L. T. Ranstead Wharf
2119 Haines St.	City of Baltimore	AT&T	Unknown Business	C. R. Ranstead Wharf
1501 Russell St.	Pheasant Warner	Fred J. Close	Maryland Chemical	American Cyanamid
1525 Russell St.				
1551 Russell St.				
1411 Warner St.	Six GS LLC	Fred J. Close	Vacant/Lot J	Baltimore Glass Works
2102 Oler St.	Warner Street Inc.	*No Record*	Baltimore Renovations Inc.	Gibson & Kirk Foundary
2104 Worcester St.			Vacant	Abandonded Building
1501 Warner St.			Bayfair Warehouse	Warehouse
1601 Warner St.			Vacant	J.B. MacNeal Varnish & Color
1629 Warner St.			Baltimore Cycle Salvage	Baltimore Cedar Co.
1633 Warner St.			Second Chance	Gibson & Kirk Brass Foundry
1645 Warner St.	Potomac Investments	*No Record*	Second Chance	Gibson & Kirk Brass Foundry

Sanborn Fire Insurance Maps

The Sanborn Map Company kept detailed records on the state of industrial buildings in many metropolitan areas from 1867 through 1970. Digitized copies of the maps are available through ProQuest UMI. Maps for the years between 1890 and 1953 are available for the Warner Street Area. Copies of the Sanborn Maps for the Warner Street Area are found in Appendix D of this document (Figures S1 through S11.) Figures S1, S2, & S3 detail the 1953 era industry. Figures S4 & S5 detail the 1915 era industry. Figures S6, S7 & S8 show the area industry circa 1902. Figures S9, S10 & S11 show area industry from the 1890s. The maps detail several businesses on the Warner Street parcels.[iii]

Haines Street

- From the 1890s through 1953, the 2110 and 2119 Haines Street properties were occupied by the Ransteads wharves and the Biemiller Coal and Wood Wharf and Ice House (later the American Ice Station).

Warner Street

- The Gibson and Kirk Foundry occupied the 1633 through 1645 Warner Street properties from a period after 1915 through 1953.

- In the 1890s the property bounded by Wooster (Worcester), Warner, Shell, and Oler (Dock) Streets housed the C.F. Ranstead Baltimore Cedar Co. From 1902 through 1953 the J. B. Macneal and Company Varnish and Color Works operated out of buildings on this property. In 1953 this property housed both J. B. Macneal and Gordon Carton. Macneal occupied the northwestern quadrant and Gordon the southeastern.

- The property northeast of the Alluvion Street Slip housed Baker Brothers Glass Company and the Marr Malting Company from 1890 through 1915. The map from 1953 has the Holtite Rubber Cement Mill occupying the property.

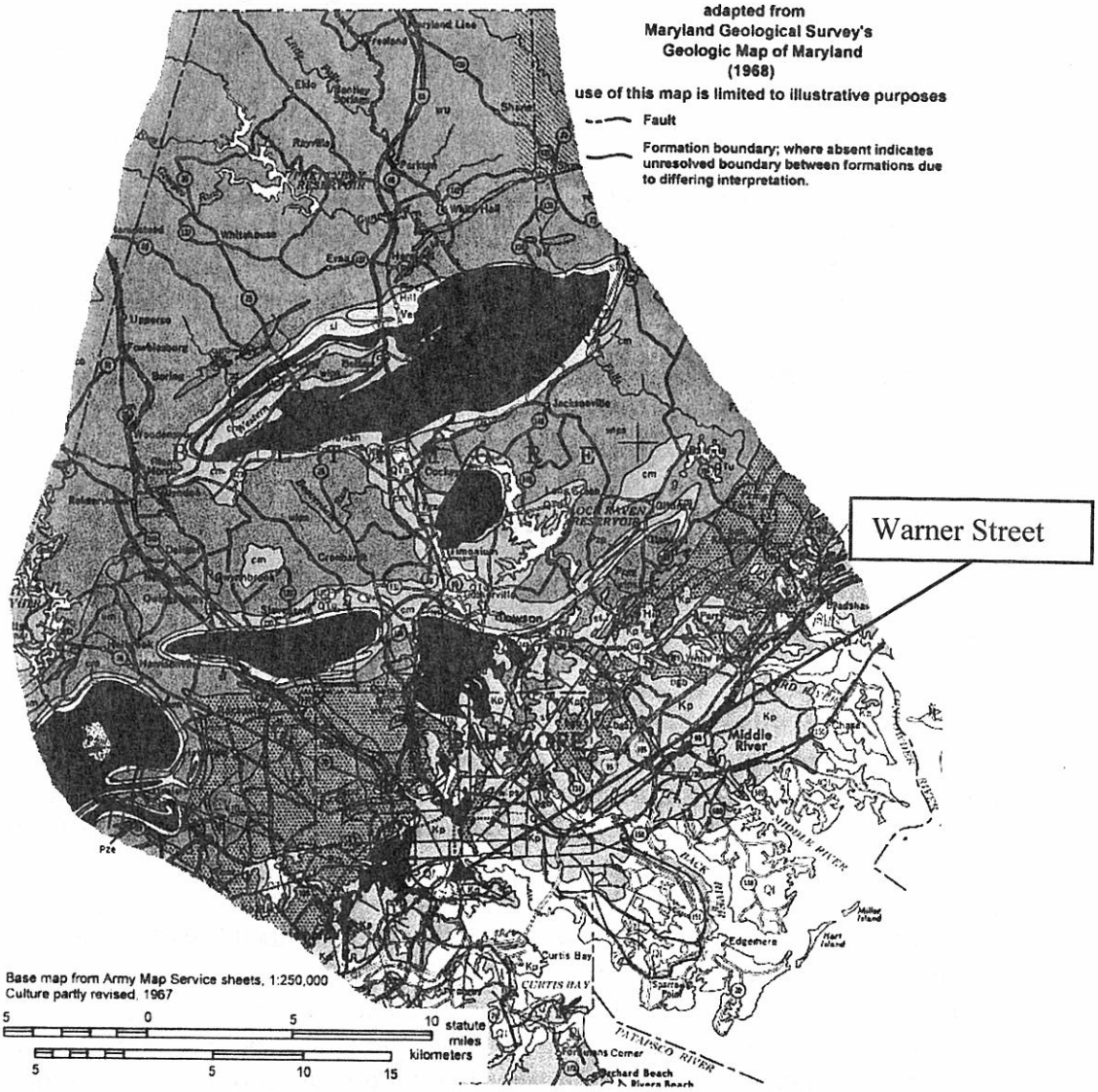
5.0 Environmental Setting

5.1 Geology

Baltimore City lies on the Fall Line, which is an area of abrupt elevation change between the Coastal Plain and Piedmont Physiographic Provences. The Coastal Plain consists of a series of southeasterly dipping layers of relatively unconsolidated sand and clay with lesser amounts of gravel superimposed on the eastward continuation of the crystalline rocks of the Piedmont Plateau.

The Warner Street site lies near the fall line where the Coastal Plain is only a thin veneer over the crystalline bedrock. The generalized Geologic Map of Baltimore City and County (Figure 5.1) indicates that the site rests on the Quaternary Lowland Deposits, which consist of gravel, sand, silt and clay with cobbles and bolders near the base. Below the lowland deposits is the Potomac Group, of which the Patuxent Formation outcrops just north of the site along the Fall Line. The Patuxent Formation consists of irregularly stratified, crossbedded and linticular sands and gravels with silt and clay beds occurring locally.

Figure 5.1: Generalized Geologic Map. [iv]



Kp

Potomac Group - Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.
Raritan and Patapsco Formations - Gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels; thickness 0 to 400 feet.
Arundel Clay - Dark gray and maroon lignitic clays; abundant siderite concretions; present only in Baltimore-Washington area; thickness 0 to 100 feet.
Patuxent Formation - White or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels; silts and clays subordinate, predominately pale gray; thickness 0 to 250 feet.

Ql

Lowland Deposits - Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet.

5.2 Soils

In 1998, the Department of Agriculture, Soil Conservation Service classified soils in the vicinity of the Warner Street site as the Sunnyside fine sandy loams and associated Christiana

and Urban Land Association (Undorthent) soils. Undorthents consist of manmade, nearly level to steep soils. Theses soils consist of cut, filled, or otherwise disturbed areas. The cut areas are generally the steeper parts of the landscape, and the fill areas generally have smoother, less sloping topography. The texture of the soils in this association is variable. However, generally it reflects that of the soils mapped in adjacent areas. In some areas these soils contain artifacts; in other areas they were once used as sanitary landfills and are underlain by refuse. In some areas theses soils were created from materials dredged from the Patapsco River. This association is defined as consisting of, "mostly miscellaneous artificial fill." The area is further characterized as being totally covered with roads, buildings, or other structures.[v]

The majority of surface soils in the Warner Street corridor are of the *Urban Land Complex* (44UC). These Urban Lands are characterized as being covered by impervious surfaces. A small portion of the area is composed of similarly defined *Urban Land–Udorthents Complex, occasionally flooded* soils (43U). These udorthents are noted to consist of a thin layer of sandy loam mixed with glass fragments overlaying a stratified series of sandy loam, silt loam, loam or gravelly loam down to about 65 inches below grade. The United States Department of Agriculture (USDA) report notes that, "Examination and identification of soils or soil like materials in this unit is impractical. Careful onsite investigation is needed to determine the potential and limitations for any proposed use." [vi]

5.3 Weather

Baltimore City, Maryland lies about 50 miles east of Appalachian Mountains and 12 miles west of the Chesapeake Bay. The Warner Street area is less than 10 feet above mean sea level in a region of relatively flat urban terrain. The average annual rainfall is on the order of 43 inches per year. Average annual temperature is about 60°Fahrenheit. Baltimore's summers are warm and humid and its winters are relatively mild. The areas coldest weather generally occurs in late December through early February, with an average daily maximum temperature of 45°F and an average daily minimum of 28°F. The warmest weather occurs in late July and early August when daily temperatures range from 70° to 90° F. There are no well-defined wet and dry seasons. Snowfall averages on the order of 17 inches per winter season. During the summer months, showers are frequent and thunderstorms may occur one out of five days. Significant temperature differences within the Baltimore metropolitan area are not unusual. Temperatures are commonly warmer in the Baltimore Metropolitan Area, due to the heat island effect of the city in the summer and the moderating influence of the Chesapeake Bay in the winter. [vii]

5.4 Hydrogeologic Conditions

Groundwater recharge in this area occurs mainly through infiltration of precipitation in the exposed areas in the vicinity of the site. Due to the slope of the immediate area and the proximity to the Patapsco River, area groundwater discharges to the river. Generalized groundwater flow in the area is to the south southeast towards the Chesapeake Bay. The elevation of the site ranges from approximately 20' above Mean Sea Level to 100' above Mean Sea Level. Groundwater is expected to be encountered at an elevation above Mean Sea Level.

The Patuxent Formation, which is recharged in the Baltimore City Area, is a multi-aquifer unit and is one of the most productive water bearing formations in Maryland. However, over pumping and heavy industrialization in Baltimore have caused salt-water intrusion and chemical contamination from past industrial practices. As a result groundwater in the vicinity of the site is not considered potable.[viii]

The site is located on the Middle Branch of the Patapsco River, a surface water body that discharges into the Chesapeake Bay (Figure 3.1). Several other surface water bodies exist within a 2-mile radius of the site. These include Gwynns Falls (approximately 0.5 mile to the southwest) and the Baltimore Inner Harbor (approximately 0.5 mile to the northeast).

According to the USDA, *"the Department of Public Works, Baltimore City, provides water for the City of Baltimore from three sources: the Gunpowder Falls, the North Branch of the Patapsco River, and the Susquehanna River."* Water collected from these sources is re-routed toward two (3) reservoirs (Liberty, Loch Raven and Prettyboy) and treated at the Montebello Filtration Plants prior to distribution to the local population.

Virtually all of the residents around Baltimore City receive water from municipal supplies. These consist of ten surface water reservoirs in the vicinity of Baltimore City, the nearest of which is approximately ten miles north of the site, and a series of municipal well systems located in Anne Arundel County. No residential wells exist within a ½ mile radius of the site. However, there are numerous monitoring wells within one mile of the site and four domestic wells within a two mile radius of the site (MDE Well Database). [ix]

In the City of Baltimore, stormwater drainage occurs through an extensive network of underground conduits; site-specific drainage flows to these storm drains and directly to the Middle Branch of the Patapcso River via overland flow.

6.0 Site Reconnaissance

On February 11, 2004 a site reconnaissance was performed to photo-document current site conditions. Nine of the thirteen parcels under consideration are occupied at this time. The four unoccupied parcels are located in the rectangle defined by Warner, Oler, Shell, and Worcester Streets. These parcels show signs of distress with evidence of vandalism to both the

buildings and public spaces. Graffiti covers certain walls, windows are broken, doors have been breached and fires have been set on building grounds and in the middle of the street.

7.0 Environmental Regulatory Inquiries

MDE researched the databases listed below (Table 7.1) to identify potential on-site and off-site sources of contamination. Research was completed for facilities located within American Society of Testing and Materials (ASTM) guidance radius of one [1] mile. The ASTM radius refer to the minimum search distance around the area of interest. This search was conducted to assess the attributality of on-site contaminants to off-site sources.

TABLE 7.1 DATABASES

DATABASE	SEARCH DISTANCE
USEPA EnviroMapper	1 mile
MDE Integrated Internet Mapping System	1 mile
UST Database	Adjacent properties

The environmental records review indicates that several facilities located near the Warner Street corridor are also listed on the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). These facilities include the Scott Street and Severn Street Stations (MD 191 and 245, respectively), the J. W. Boarman, Inc. facility (MD-283), the Bayard Street Station (MD-161), the BGE Spring Gardens facility (MD-145) and the American Chemmate facility (MD-152). Additional CERCLIS facilities in the area are documented in the EnviroMapper Website published by the EPA and are listed in Appendix C. There are a number of other facilities in the area listed on the voluntary clean-up program (VCP), the Brownfields (BF) program, and the State Master List (SML) rosters.

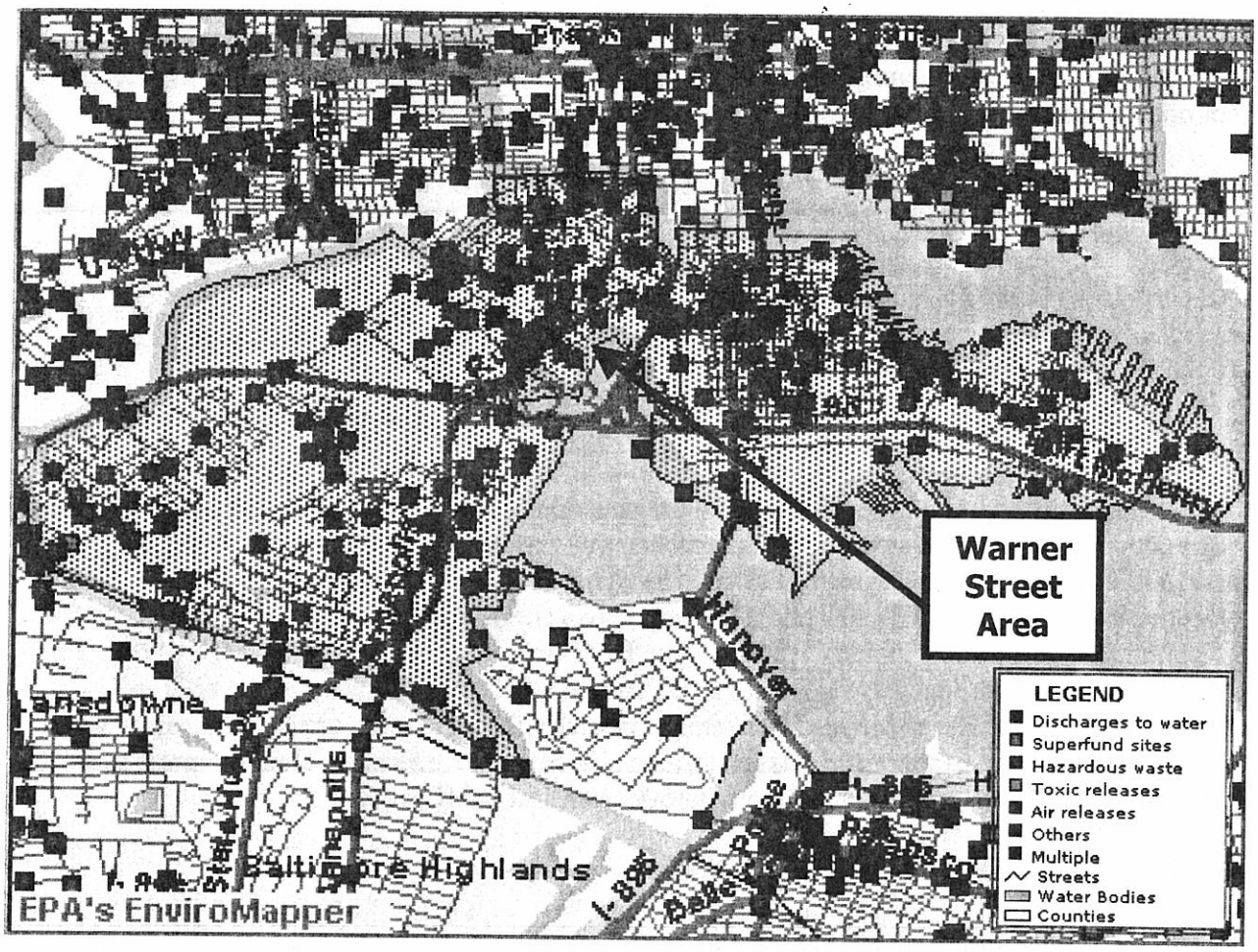
7.1 - USEPA ENVIROMAPPER

A query of the EPA EnviroMapper website yielded a location map and lists of regulated sites within a two-mile radius of the Warner Street Business Center (Figure 7.1). The lists focused on CERCLIS sites, documented air releases, wastewater discharges, and toxic substances spills/releases. The EPA EnviroMapper lists 205 air release related sites, 21 discharges to surface water, and 17 toxic discharges within a 2-mile radius of the Warner Street sites. The printouts from the EnviroMapper query are found in Appendix C at the end of this document.

Several of the listed sites are in the immediate vicinity of the Warner Street properties. The closest site is 2110 Haines Street, a 3.1-acre parcel that has, since the late 19th century, been used for various commercial purposes, including coal and wood storage, telephone pole storage, trailer truck sales, and barge manufacturing. IOC, Gordon Carton, and Maryland Chemical Company are listed in the database as having operated in the Warner Street corridor. IOC has not reported since 1981 and Gordon Cartons since 1999. Neither corporation maintains a

physical presence in the Warner Street area. There are no operating sites identified in the radii which have a direct impact on the subject properties with the notable exception of Maryland Chemical Company which handles bulk quantities of listed materials and is itself part of the study.

Figure 7.1 EPA Enviromap Of Warner Street Area[x]



7.2 - MDE INTERNET MAPPING SYSTEM

The Maryland Department of the Environment maintains a Geographic Information System (GIS) database of environmentally related sites in Maryland. The geographic representation of sites in the Warner Street area is show on Figure 7.2. Table 7.2 lists environmentally relative sites in the one-mile radius of the Warner Street properties. This list includes, VCP sites, Brownfield investigation sites and State Master List sites. The State Master List mirrors the 1984 CERCLIS database. Only two of these listed sites, 1645 Warner Street property and the Carroll Camden Area, could possibly impact the Warner Street area. The 1645 Warner Street property is part of this current investigation and the Carroll Camden Area encompasses many of the parcels adjacent to the Warner Street properties. The Carroll Camden and Warner Street investigations will be used to evaluate the entire Warner Street corridor.

FIGURE 7.2 – MDE ERRP MAP OF WARNER STREET AREA

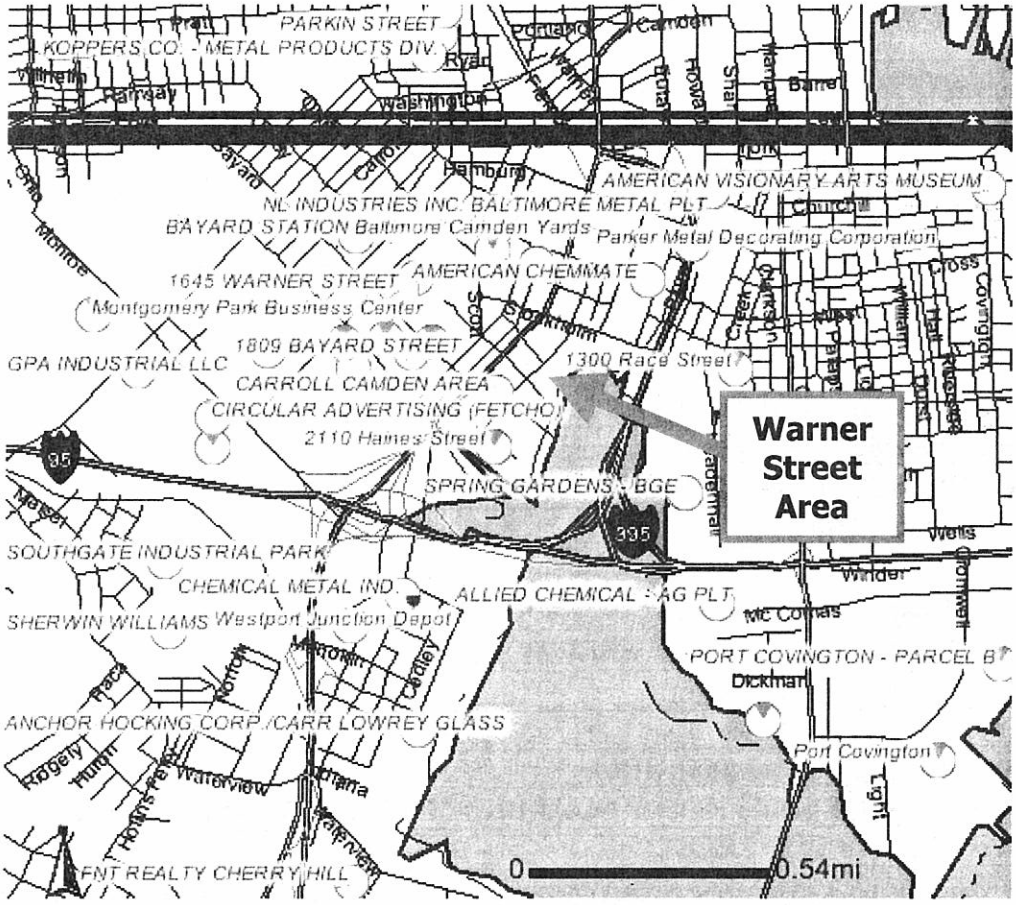


Table 7.2 - ERRP Sites Identified In Warner Street Area

State Master List Sites
• ALLIED CHEMICAL - AG PLT
• AMERICAN CHEMMATE
• ANCHOR HOCKING CORP./CARR LOWREY GLASS
• BALTIMORE CAMDEN YARDS
• BAYARD STATION
• BOARMAN, JW CO. INC
• KOPPERS CO. - METAL PRODUCTS DIV.
• KOPPERS CO. - ENGR MET PROD
• NL INDUSTRIES INC. BALTIMORE METAL PLT
• SCOTT STREET STATION
• SEVERN STREET STATION
• SHERWIN WILLIAMS
• SPRING GARDENS - BGE
• SOUTHGATE INDUSTRIAL PARK

NPL/State Master List Sites
• CHEMICAL METAL IND.
Voluntary Cleanup Program Sites
• BALTIMORE NATIONAL AQUARIUM/MIDDLE BRANCH PARK
• Baltimore Camden Yards
• 1600 -1606 Bush Street
• Camden Crossing (Barre Station, Koppers Site)
• CIRCULAR ADVERTISING (FETCHO)
• GPA INDUSTRIAL LLC
• 2110 Haines Street
• Montgomery Park Business Center
• Parker Metal Decorating Corporation
• PHILLIPS DISTRIBUTION CENTER LLC
• 1300 Race Street
• SSI REALTY CORPORATION
• Valspar Baltimore Plant
• FORMER WATERFORD CASEWORKS
• Westport Junction Depot
Brownfields Investigation Sites
• BALTIMORE NATIONAL AQUARIUM/MIDDLE BRANCH PARK
• 1809 BAYARD STREET
• CARROLL CAMDEN AREA
• 1645 WARNER STREET

7.3 - UNDERGROUND STORAGE TANK SITES

There are thirteen underground storage tank cases listed in the Warner Street corridor. Eleven of theses cases have been closed. The two open cases are at gasoline stations on Russell Street, Texaco in the 1400 block and Amoco in the 1800 Block. Historic discharges of contaminants in South Baltimore have had an impact on the area groundwater. Due to the engineering controls currently in place at the two operational facilities it is unlikely that the existing gasoline stations are presently impacting the groundwater.

8.0 Findings And Conclusions

The Warner Street corridor is partially abandoned; the area exhibits signs of stress and is a good candidate for revitalization and rehabilitation.

Industrial activity throughout the last century has impacted the Warner Street corridor. Of particular concern is the area in the rectangle formed by Warner Street, Worcester (Wooster) Street, Oler (Dock) Street, and Shell (Eutaw) Street. This parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which used heavy metal salts and oxides and volatile organic materials in their process and operations.

Another area of concern is the 1600 block of Warner Street, which was once the site of a historic brass foundry. Contaminants of concern in the foundry are volatile organic compounds, heavy metals, arsenic, acids, and metallic salts and oxides.

The Maryland Chemical site in the 1500 block of Russell Street presents several potential areas of concern. This property was at one time the site of American Cyanamid, an industrial manufacturer of pesticides and agricultural chemicals. Maryland Chemical itself presents a number of concerns stemming from the storage and sale of industrial chemicals. Both aboveground and underground tank storage of chemicals are documented. Consumer quantity sizes through 55-gallon drums, tanks and carboys of listed materials have been handled by the facility.

A Phase II Site Assessment is recommended to document the levels of contaminants throughout the Warner Street area and to determine the best practicable remediation and use of the subject properties.

9.0 References

i. Zoning District Map for the City of Baltimore, Maryland. Department of Public Works (no date)

ii. ibid

iii. Sanborn Fire Insurance Maps 1868 to 1972 –Proquest Digital Sanborn Maps [http;//sanborn.umi.com]

iv. Maryland Geological Survey, Geologic Map of Maryland; 1968.

v. U.S. Department of Agriculture, Soil Survey of City of Baltimore, Maryland, 1998

vi. USDA Soil Survey of City of Baltimore, Maryland. 1998.

vii. University of Maryland Climatological Data, 2004.

viii. State of Maryland Department of Natural Resources, 1987, The Quantity and Natural Quality of Ground Water in Maryland.

ix. MDE Well Database.

x. USEPA ENVIROFACTS http://www.epa.gov/enviro/html/em/index.html

APPENDIX A – Site Photographs

APPENDIX B – EPA ENVIROMAP DATA

APPENDIX C – Sanborn Maps

9.0 - REFERENCES

[i] Zoning District Map for the City of Baltimore, Maryland. Department of Public Works (no date)

[ii] ibid

[iii] Sanborn Fire Insurance Maps 1868 to 1972 –Proquest Digital Sanborn Maps [http;//sanborn.umi.com]

[iv] Maryland Geological Survey, Geologic Map of Maryland; 1968.

[v] U.S. Department of Agriculture, Soil Survey of City of Baltimore, Maryland, 1998

[vi] Ibid

[vii] University of Maryland Climatological Data, 2004.

[viii] State of Maryland Department of Natural Resources, 1987, The Quantity and Natural Quality of Ground Water in Maryland.

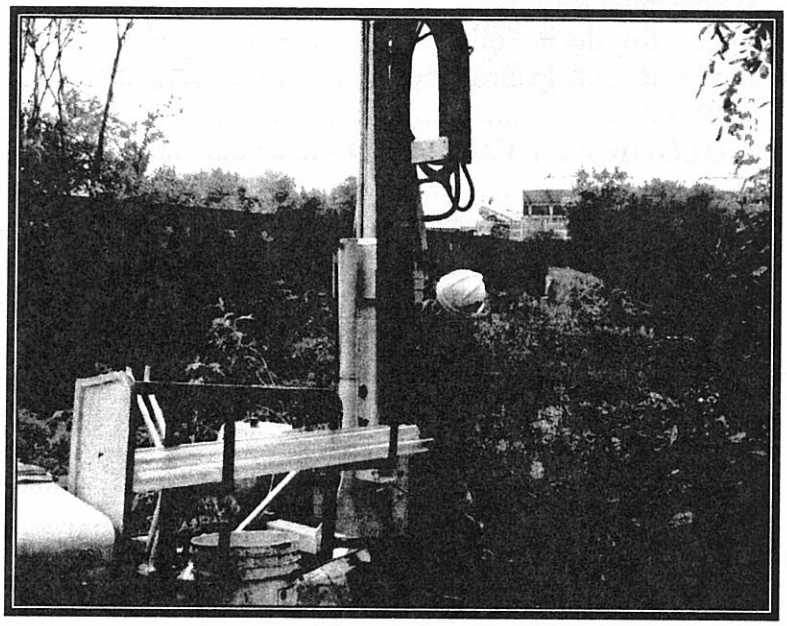
[ix] MDE Well Database.

[x] USEPA ENVIROFACTS http://www.epa.gov/enviro/html/em/index.html

MDE

DRAFT

BROWNFIELDS SITE-SPECIFIC INVESTIGATION FOR WARNER STREET WETLANDS LOCATED IN BALTIMORE, MARYLAND



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ACRONYM LIST

AWQC	ambient water-quality criteria
AWQS	ambient water-quality standard
BDC	Baltimore Development Corporation
bgs	below ground surface
Cr III	trivalent chromium
Cr VI	hexavalent chromium
COCs	contaminants of concern
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
GPS	global positioning system
HI	hazard index
MDE	Maryland Department of the Environment
MCL	maximum contaminant level
msl	mean sea level
NOAA	National Oceanic and Atmospheric Administration
PAHs	polycyclic aromatic hydrocarbons
ppm	parts per million
QAPP	quality assurance project plan
RBC	risk based concentration
SMCL	secondary maximum contaminant level
SOPs	standard operating procedures
SVOCs	semi-volatile organic compounds
SW	solid waste
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
UCL	upper confidence level
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geologic Survey
VOCs	volatile organic compounds
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

The City of Baltimore, in partnership with the U.S. Army Corps of Engineers (USACE), is planning a major environmental and economic revitalization of the Middle Branch of the Patapsco River. As part of the revitalization plan, four undeveloped properties in the Warner Street corridor are under consideration for the creation of a new wetlands ecosystem for the Gwynns Falls Trail system. The proposed Warner Street Wetland Properties border the Middle Branch of the Patapsco River and are owned by the City of Baltimore. The properties were created in the early 1900s with soil and fill materials related to the Great Baltimore Fire of 1904. In order to evaluate environmental concerns related to the fill, the Baltimore Development Corporation (BDC) requested the Maryland Department of the Environment (MDE) conduct a Site-Specific Brownfields Assessment of the Warner Street Wetland Properties. This assessment took place in October 2005.

During the investigation, 12 soil borings and a temporary piezometer were installed. Two groundwater samples were collected and analyzed for metals and semi-volatile organic compounds (SVOCs) at a fixed-based laboratory. A total of 48 soil samples were collected from the soil borings. These samples were screened for metals and carcinogenic polycyclic aromatic hydrocarbons (cPAHs). A total of 14 soil samples were selected for analysis of metals and SVOCs at a fixed-based laboratory based on field screening results. Soil samples with high total chromium screening results were further selected for speciation of chromium VI and chromium III. In addition, a total of four soil samples that were composited from the top six feet of soil were analyzed using the Toxic Characteristic Leaching Procedure (TCLP) to determine potential soil disposal options.

Soil analytical results indicate widespread detections of arsenic, lead, and mercury at concentrations that exceeded MDE and/or Environmental Protection Agency (EPA) comparison values. Two SVOCs, benzo(a)pyrene and dibenzo(a,h)anthracene, were detected above MDE and EPA comparison values.

Analytical results of dissolved groundwater indicate that manganese was the only metal detected above the MDE Standard for Type I and II Aquifers. Detected SVOCs included acenaphthene, fluorene, and phenanthrene; however, concentrations of these compounds were well below MDE comparison values. It should be noted that shallow groundwater samples (collected approximately three feet below ground surface [bgs]) were most likely collected from perched groundwater as the groundwater at the rest of the site was encountered at approximately 10 feet bgs.

A toxicological evaluation of soil indicated that the estimated risks from incidental ingestion or dermal contact of carcinogenic or noncarcinogenic contaminants in the surface or subsurface soil exceeded MDE and EPA recommended ranges for multiple population groups. The primary risk drivers in soil were arsenic and benzo(a)pyrene. Lead in soil may also pose a threat to the health of sensitive populations in discrete locations of the site. However, the estimated risks from incidental ingestion, inhalation, or dermal contact of carcinogenic or noncarcinogenic contaminants in the surface or subsurface soil were within the MDE and EPA recommended ranges for the construction worker commercial population.

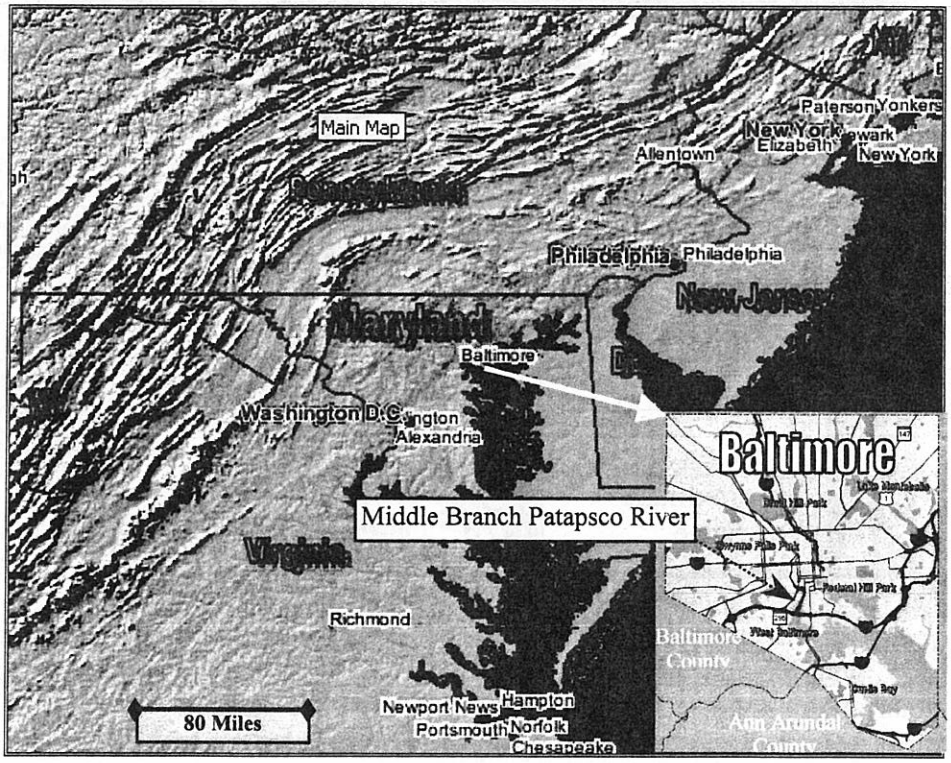
A toxicological evaluation of groundwater indicated that risk estimates from the incidental ingestion or dermal contact of detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges for all commercial populations and EPA recommended risk ranges for the youth visitor and adult worker commercial populations using total metals data. Arsenic was the incidental ingestion carcinogenic risk driver. However, using dissolved metals data, risk estimates from the incidental ingestion or dermal contact of detected carcinogenic or noncarcenogenic groundwater contaminants were within MDE and EPA recommended risk ranges for all commercial populations.

Results from this Site-Specific Brownfields Assessment support the planned creation of wetlands at the Warner Street Properties provided appropriate measures are implemented to mitigate potential risks during and after construction.

1.0 INTRODUCTION

The Maryland Department of the Environment (MDE) has prepared this report as part of a Brownfields Site-Specific Assessment of the Warner Street Wetland Properties. The assessment is part of the Maryland Brownfields Assessment Initiative and funded through the Subtitle C State Response Program Cooperative Agreement. MDE conducted the assessment at the request of the Baltimore Development Corporation (BDC) in preparation for future redevelopment of the area. The City of Baltimore, in partnership with the United States Army Corps of Engineers (USACE), has planned for a major environmental and economic revitalization of the Middle Branch of the Patapsco River (Figure 1.1). As part of the revitalization plan, four undeveloped properties in the Warner Street corridor are under consideration for the creation of a new wetlands ecosystem.

Figure 1.0
Location of Baltimore, Maryland



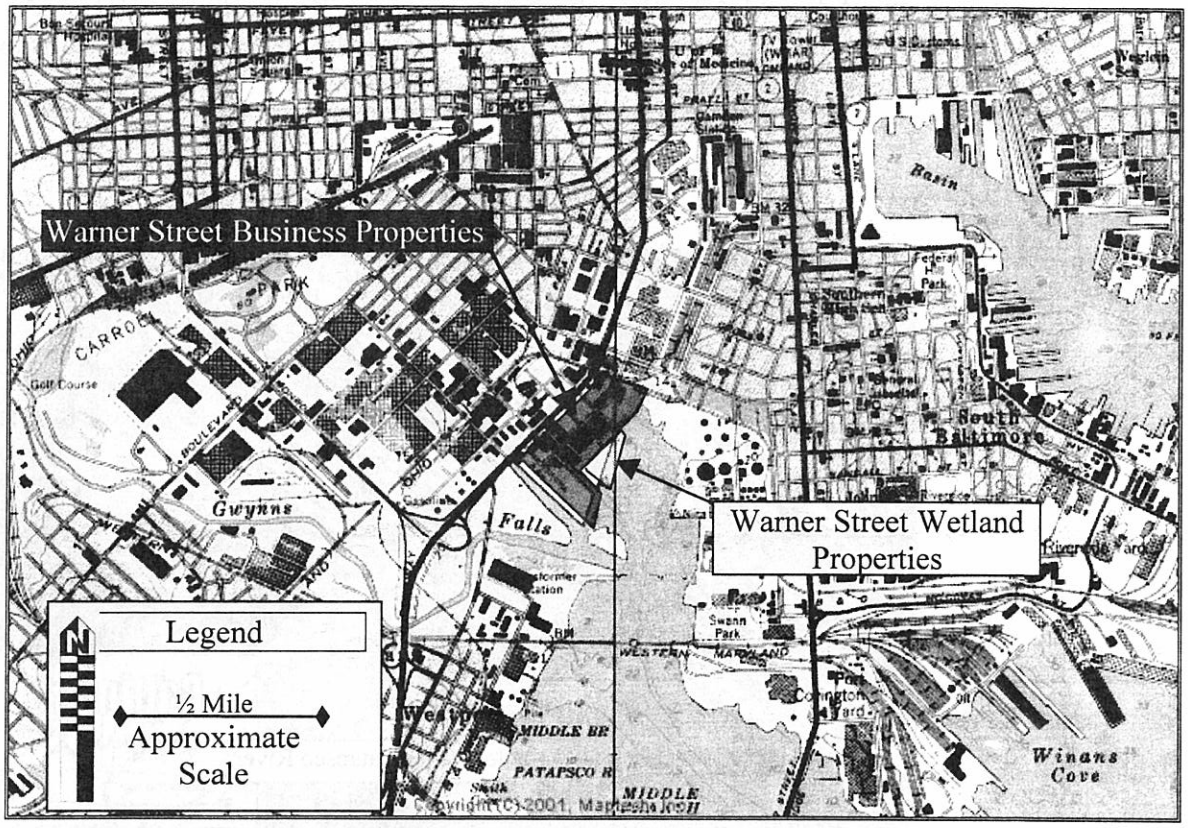
From United States Geological Survey (USGS) – The National Map Data Distribution System

1.1 Site Overview

The Warner Street Wetland Area is located in the midst of roughly 500 acres of industrial land at the southern gateway to the City and downtown Baltimore. It is believed that the Warner Street corridor overlays fill materials brought to the shores of the Middle Branch after the Great Baltimore Fire of 1904. The archives of the Maryland Fire Museum indicate that remnants of the Great Baltimore Fire of 1904 were encountered as far as the

present-day Market Place. The artifacts encountered included "charred wood, wheel barrel parts, containers…tools that were once part of the harbor." In addition to these artifacts, soil borings located along the eastern portion of Warner Street corridor encountered construction debris and heavily stained fill materials (MDE 2002). Figure 1.1 sets the location of the Warner Street Area in this context. At present, this industrial area has significant quantities of under-utilized land and a limited development interest.

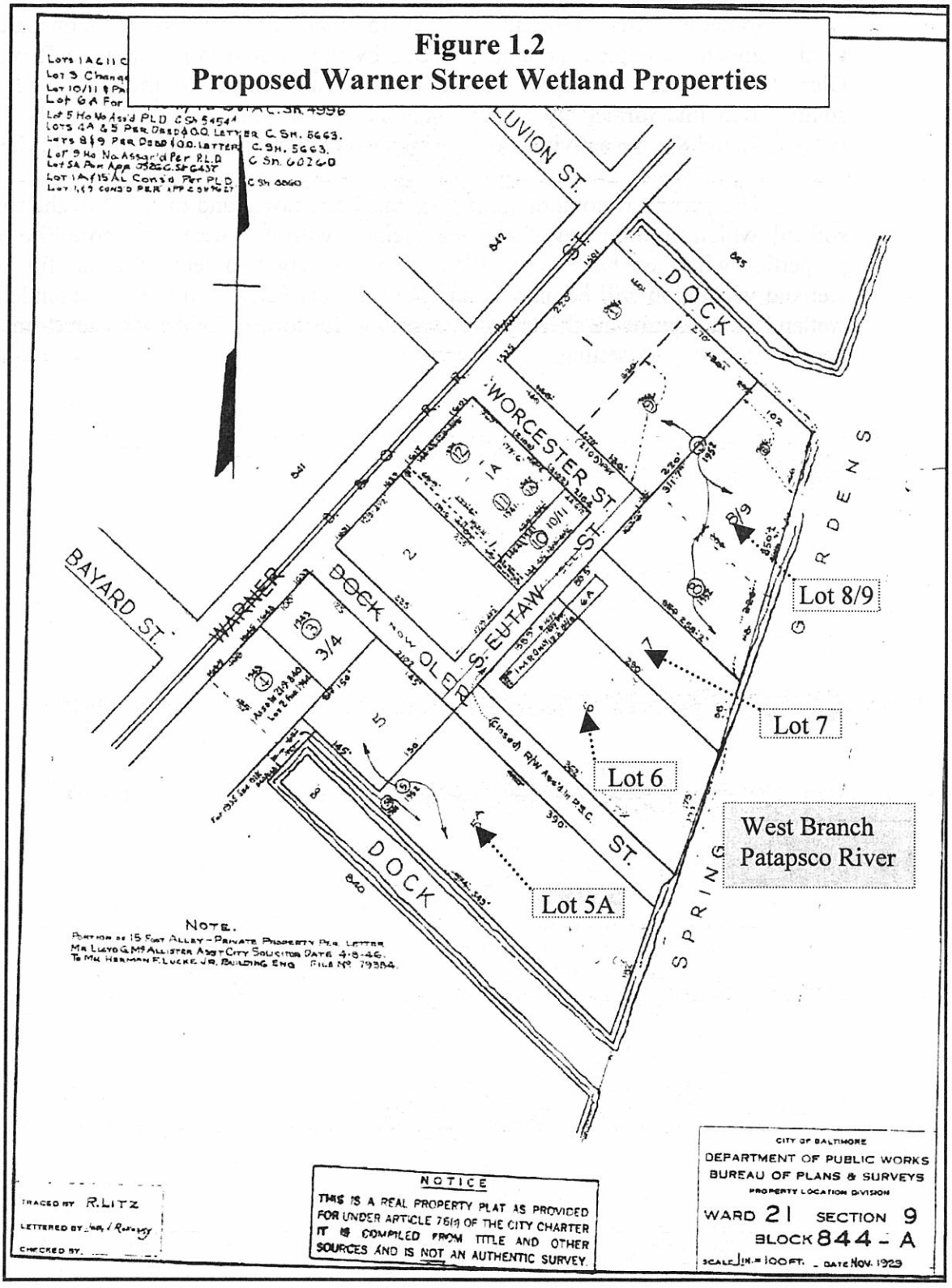
FIGURE 1.1
Location of Warner Street Area in Baltimore



The proposed Warner Street Wetland properties consist of four contiguous lots (5A, 6, 7, and 8/9) that are owned by the City of Baltimore (Figure 1.2). The properties, which total approximately 5.3 acres of vacant land, are currently covered with vegetation ranging from grass and scrub to trees. They are bounded by the Middle Branch of the Patapsco River to the southeast, the Bayard Street Dock to the southwest, Shell Street (S. Eutaw Street) to the northwest, and the Alluvion Street Dock to the northeast.

Historic records indicate varied industrial uses of the wetland properties dating back through the mid-19th century. Sanborn Fire Insurance maps from 1890 through 1953 detail a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on business properties adjacent to the Warner Street Wetland Properties.

Figure 1.2
Proposed Warner Street Wetland Properties



Sometime after 1890 and before 1915, coal bins owned by the Consumer Wood and Coal Company occupied the area bounded by the Middle Fork Patapsco River to the east, Oler (Dock) Street to the south, Shell (S. Eutaw) Street to the west and an extended southeastern line formed by the continuation of the northeastern side of Worcester Street (Lots 6, 7, and 8). No activities for this area were noted in the 1953 Sanborn Map.

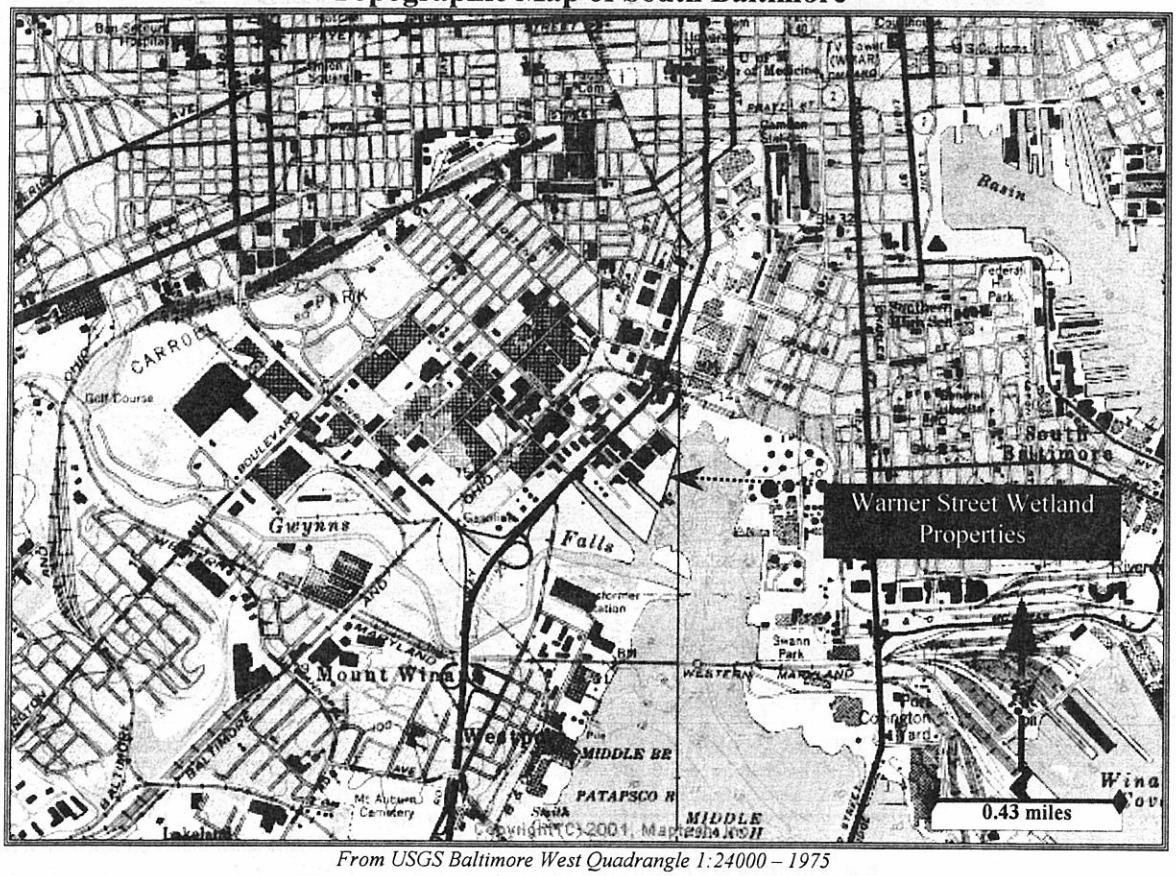
The current restoration plan calls for the removal and disposal of the first six feet of soil/fill, which is composed of debris associated with the Great Baltimore Fire of 1904. The properties will then be covered with approximately two feet of clean fill. Appropriate wetland vegetation will be planted and the Gwynns Falls Trail will be extended through the wetland as a boardwalk thereby transforming the former industrial waterfront into a more people-friendly park setting.

2.0 ENVIRONMENTAL SETTING

2.1 Topography/Geology/Hydrogeology

Figure 2.0 shows a detail of the topographic map for the Warner Street Wetlands area. The center of the property is a mounded plateau approximately 12 feet above mean sea level (msl). Surface runoff from the properties ponds onsite or flows overland in all directions: northwest to the former South Eutaw Street, northeast to the Alluvion Street Dock, east to the Middle Branch Patapsco River, and south to the Bayard Street.

FIGURE 2.0
Topographic Map of South Baltimore



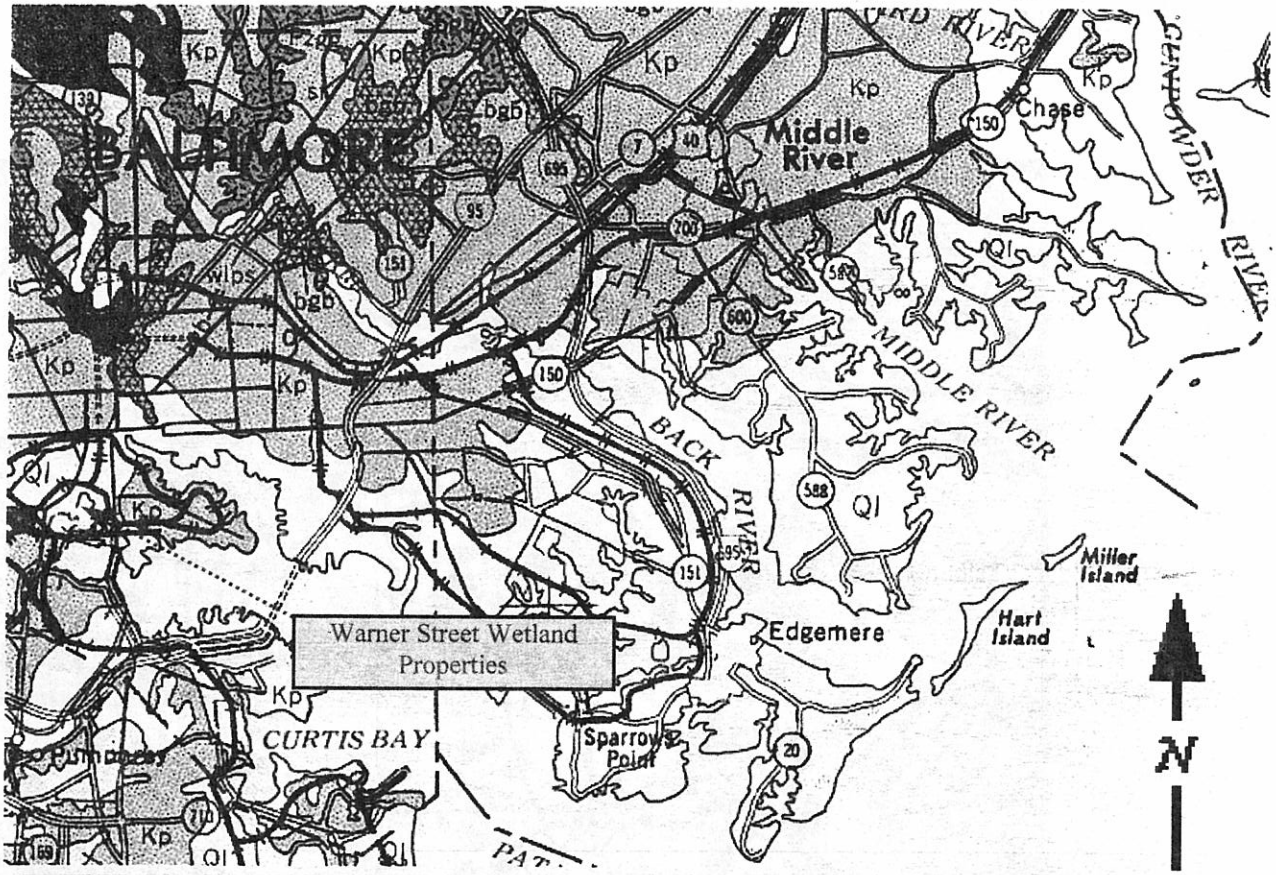
From USGS Baltimore West Quadrangle 1:24000 – 1975

Baltimore City lies on the Fall Line, which is an area of abrupt elevation change between the Coastal Plain and Piedmont Physiographic Provinces. The Coastal Plain consists of a series of southeasterly dipping layers of relatively unconsolidated sand and clay with lesser amounts of gravel superimposed on the eastward continuation of the crystalline rocks of the Piedmont Plateau.

The property lies near the fall line where the Coastal Plain is only a thin veneer over the crystalline bedrock. The generalized Geologic Map of Baltimore City and County (Figure 2.1) indicates that the site rests on the Quaternary Lowland Deposits, which consist of

gravel, sand, silt and clay with cobbles and boulders near the base. Below the Quaternary Lowland Deposits is the Cretaceous Potomac Group, of which the Patuxent Formation outcrops just to the east of the property. The Patuxent Formation consists of irregularly stratified, cross-bedded and lenticular sands and gravels with silt and clay beds occurring locally.

Figure 2.1
Generalized Geologic Map of the Area



Kp

Potomac Group - Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.
Raritan and Patapsco Formations - Gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels; thickness 0 to 400 feet.
Arundel Clay - Dark gray and maroon lignitic clays; abundant siderite concretions; present only in Baltimore-Washington area; thickness 0 to 100 feet.
Patuxent Formation - White or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels; silts and clays subordinate, predominately pale gray; thickness 0 to 250 feet.

Ql

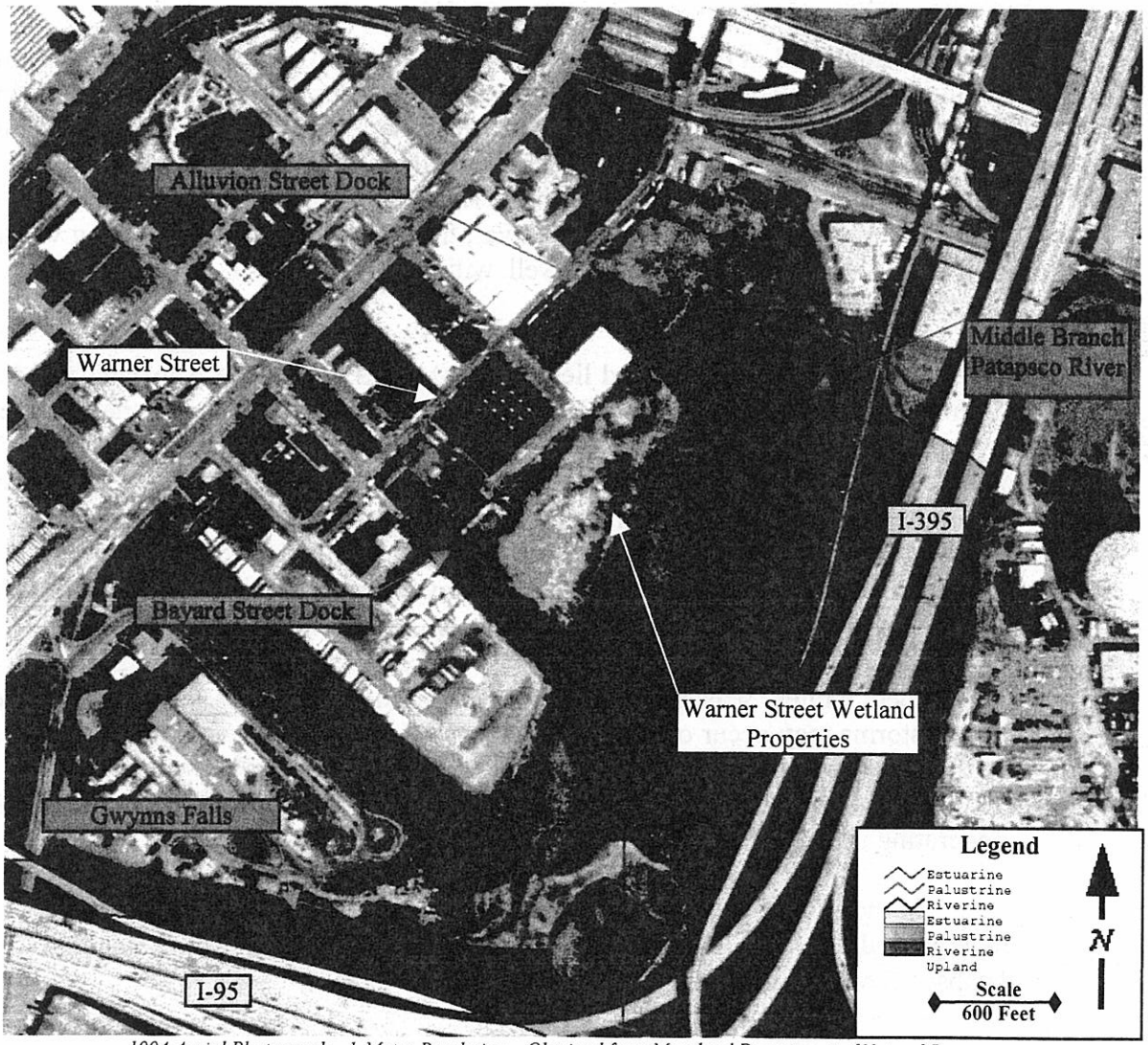
Lowland Deposits - Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet.

From Maryland Geological Survey, 1998. (Map for Illustrative Purposes Only – Not To Scale)

In 1998, the United States Department of Agriculture (USDA), Soil Conservation Service classified soils in the vicinity of the Garrett Street property as *Undorthents, smoothed, with 0 to 35 percent slopes* (42E). Undorthents consist of manmade, earthen fill

and nonsoil material that has been placed on poorly drained to excessively drained soils. The thickness of the fill varies, but is generally greater than 20 inches. The source of the fill material in this unit is variable, mixed, organic, and inorganic waste from human activity mixed with poorly sorted sand, clay, silt, gravelly, and micaceous soil material. In some areas these soils contain artifacts; in other areas, they were once used as sanitary landfills and are underlain by refuse. Permeability and available water capacity are variable in this unit. In areas of higher compaction, water tends to pond on the surface after a rainfall event. The Warner Street Wetlands Site is a mounded plateau surrounded by trees that is approximately six feet above the land to the west and 15 feet above msl. As such, precipitation mostly ponds, but during periods of heavy precipitation surface water flow is radial with westward flow collected by an intermittent stream that drains into the Bayard Street Dock (Figure 2.2).

Figure 2.2
Surface Water Features Near the Warner Street Wetland Properties



1994 Aerial Photograph - 1-Meter Resolution – Obtained from Maryland Department of Natural Resources

Groundwater recharge in this area occurs mainly through infiltration of precipitation in the exposed areas in the vicinity of the site. Due to the slope of the immediate area and the proximity to the Patapsco River, area groundwater discharges to the river. Generalized groundwater flow in the area is eastward towards the Middle Branch Patapsco River. The elevation of the site ranges from approximately 0 to 15 feet msl. Depth to groundwater ranges from 9 to 12.5 feet below ground surface (bgs). Site specific groundwater flow is likely radial: southwest to the Bayard Street Dock, northwest to the Alluvion Street Dock and east to the Middle Branch Patapsco River.

The Patuxent Formation is a multi-aquifer unit and is one of the most productive water-bearing formations in Maryland. Portions of the surface recharge belt for the Patuxent Formation are present the Baltimore City area. However, over pumping and heavy industrialization in Baltimore have caused salt-water intrusion and chemical contamination from past industrial practices. As a result, groundwater in the vicinity of the site is not considered potable.

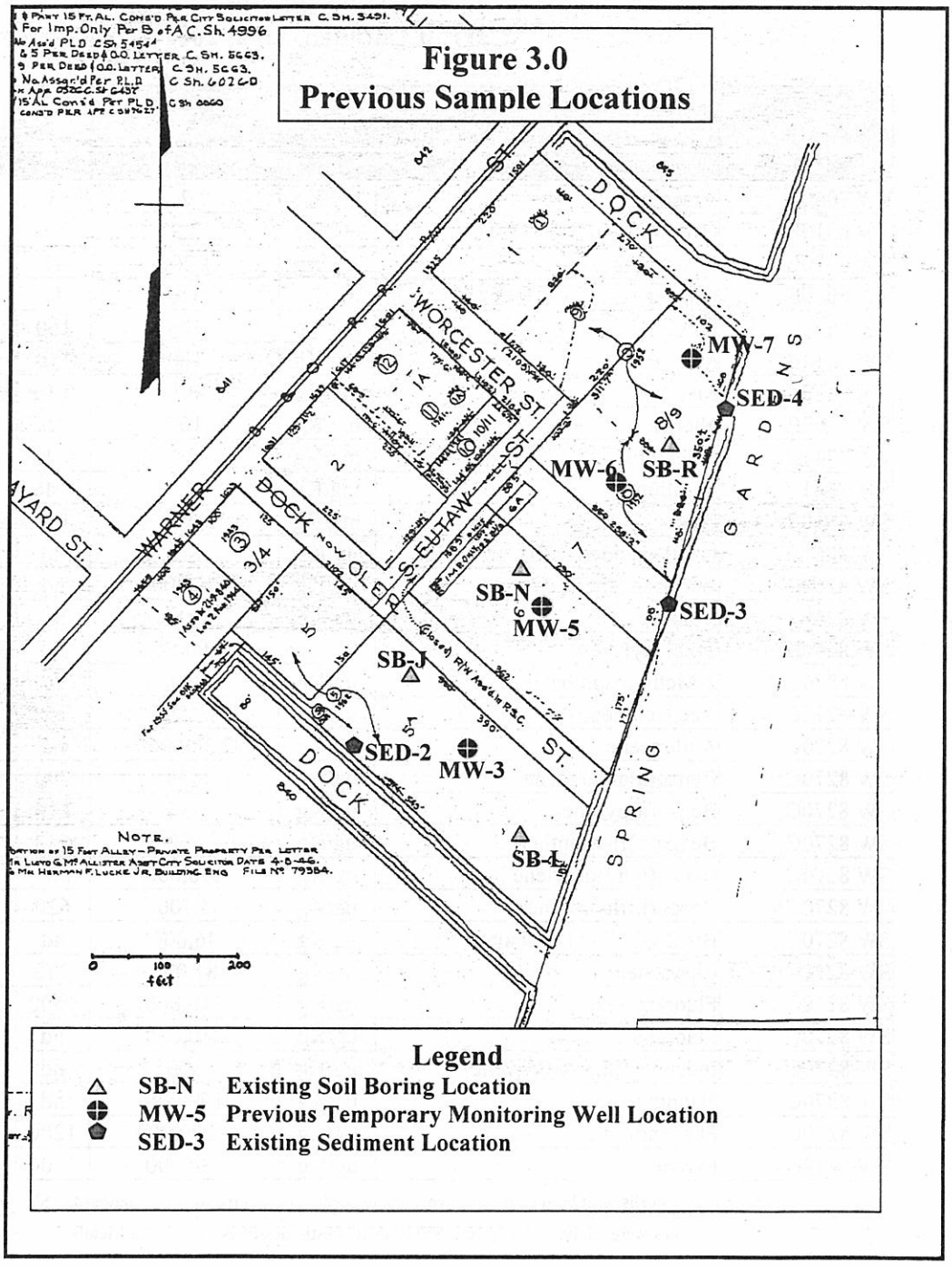
Virtually all of the residents around Baltimore City receive their water from municipal supplies. These supplies consist of several surface water reservoirs (Liberty, Loch Raven and Prettyboy) in and around Baltimore City, and a series of municipal well systems located in Anne Arundel County. Water collected from these sources is treated at the Baltimore City Filtration Plants prior to distribution to the local population. No residential wells exist within a 0.5-mile radius of the property. However, there are numerous monitoring wells within one mile of the site and one domestic well within a mile radius of the property (MDE Well Database, 2004).

Baltimore City, Maryland lies about 50 miles east of the Appalachian Mountains and 12 miles west of the Chesapeake Bay. The Warner Street area is less than 20 feet above msl in a region of relatively flat urban terrain. The average annual rainfall is on the order of 43 inches per year. Average annual temperature is about 60 degrees Fahrenheit (°F). Baltimore's summers are warm and humid and its winters are relatively mild. The area's coldest weather generally occurs in late December through early February, with an average daily maximum temperature of 45°F and an average daily minimum of 28°F. The warmest weather occurs in late July and early August when daily temperatures range from 70° to 100° F. There are no well-defined wet and dry seasons. Snowfall averages on the order of 17 inches per winter season. During the summer months, showers are frequent and thunderstorms may occur one out of five days. Significant temperature differences within the Baltimore metropolitan area are not unusual. Temperatures are commonly warmer in the Baltimore metropolitan area, due to the heat island effect of the city in the summer and the moderating influence of the Chesapeake Bay in winter.

In the City of Baltimore, storm water drainage occurs through an extensive network of underground conduits; site-specific drainage flows to these storm drains and directly to the Patapsco River via overland flow.

3.0 SUMMARY OF PREVIOUS INVESTIGATIONS

In 2001, as part of a broader MDE Brownfields Investigation of the Carroll-Camden area, samples of soil, sediment, and groundwater were collected at the subject properties (MDE, 2001). These samples were analyzed for VOCs, SVOCs, polychlorinated biphenyls (PCBs), and total metals. Sample locations are depicted in Figure 3.0.



Analytical results in soil indicated the presence of metals and SVOCs at concentrations above Maryland State Residential Cleanup standards (Table 3.1). Some VOCs were detected in soil, but the detections were below the Maryland State Residential Cleanup standards. Similar results were reported for metals and SVOCs in sediment samples when compared to the National Oceanic and Atmospheric Administration (NOAA)/Effects Range Median (ERM) values (Table 3.2).

TABLE 3.1
Detections in Soil
Carroll-Camden Area, 2001

EPA Method	Constituents	Units	MDE Residential Standard	SB-J	SB-L	SB-N	SB-R
SW 7060	Arsenic	mg/Kg	2	**4**	**8.2**	**14**	**5**
SW 6010B	Cadmium	mg/Kg	3.9	3.1	2.9	**4.8**	3.4
SW 6010B	Chromium	mg/Kg	1,200	41	65	130	810
SW 6010B	Copper	mg/Kg	310	41	89	190	65
SW 6010B	Lead	mg/Kg	400	160	160	340	130
SW 6010B	Manganese	mg/Kg	160	110	110	**180**	**160**
SW 7470A	Mercury	mg/Kg	0.1	**0.19**	nd	**0.47**	**0.19**
SW 6010B	Nickel	mg/Kg	160	16	19	30	110
SW 7741	Selenium	mg/Kg	39	0.45	0.69	0.78	0.93
SW 7841	Thallium	mg/Kg	2	0.46	0.36	0.93	nd
SW 6010B	Zinc	mg/Kg	2300	150	220	1200	86
SW 8081A	OC Pesticides/PCBs	ug/Kg	MS	nd	nd	nd	nd
SW 8260B	Ethylbenzene	ug/Kg	78,000	nd	nd	5.9	nd
SW 8260B	Toluene	ug/Kg	1,600,000	nd	nd	33	nd
SW 8260B	Total Xylenes	ug/Kg	16,000,000	nd	nd	27	nd
SW 8270C	2-Methylnaphthalene	ug/Kg	160,000	nd	nd	1100	nd
SW 8270C	Acenaphthene	ug/Kg	47,000	nd	nd	4500	nd
SW 8270C	Anthracene	ug/Kg	2,300,000	nd	nd	2300	nd
SW 8270C	Benzo(a)anthracene	ug/Kg	870	790	600	**1700**	nd
SW 8270C	Benzo(a)pyrene	ug/Kg	330	**810**	**834**	**2000**	nd
SW 8270C	Benzo(b)fluoranthene	ug/Kg	870	540	790	**1300**	nd
SW 8270C	Benzo(g,h,i)perylene	ug/Kg	230,000	500	700	780	nd
SW 8270C	Benzo(k)fluoranthene	ug/Kg	8,700	620	610	1030	nd
SW 8270C	Bis(2-ethylhexl)phthalate	ug/Kg	46,000	nd	650	17300	nd
SW 8270C	Chrysene	ug/Kg	87,000	740	840	1600	nd
SW 8270C	Fluoranthene	ug/Kg	310,000	1500	1030	3500	540
SW 8270C	Fluorene	ug/Kg	310,000	nd	nd	1500	nd
SW 8270C	Indeneo(1,2,3,-cd)pyrene	ug/Kg	870	nd	530	610	nd
SW 8270C	Naphthalene	ug/Kg	160,000	nd	nd	1300	nd
SW 8270C	Phenanthrene	ug/Kg	2,300,000	1200	970	3000	nd
SW 8270C	Pyrene	ug/Kg	230,000	1500	1300	5100	620

Note: Shaded cells with bold characters represent exceedences relative to MDE standards. SW - Solid Waste
Samples were analyzed for VOCs, SVOCs, OC Pesticides/PCBs, and Total Metals.

TABLE 3.2
Detections in Sediment
Carroll-Camden Area, 2001

EPA Method	Constituents	Units	NOAA/ERM Values*	SED-2	SED-3	SED-4
SW 7060	Arsenic	mg/Kg	70	15	8.2	12
SW 6010B	Cadmium	mg/Kg		2.9	1.7	1.9
SW 6010B	Chromium	mg/Kg		160	49	56
SW 6010B	Copper	mg/Kg	270	100	43	84
SW 6010B	Lead	mg/Kg	218	**320**	0.24	**430**
SW 6010B	Manganese	mg/Kg		480	190	370
SW 7470A	Mercury	mg/Kg		0.95	nd	0.7
SW 6010B	Nickel	mg/Kg	51.6	21	14	18
SW 7741	Selenium	mg/Kg		1.2	0.9	1.4
SW 7841	Thallium	mg/Kg		nd	0.52	1
SW 6010B	Zinc	mg/Kg		280	170	340
SW 8081A	OC Pesticides/PCBs	ug/Kg	MS	nd	nd	nd
SW 8260B	VOCs	ug/Kg	MS	nd	nd	nd
SW 8270C	3,3'-Dichlorobenzinidine	ug/Kg		nd	nd	1900
SW 8270C	Acenaphthene	ug/Kg	500	nd	nd	**1200**
SW 8270C	Acenaphthylene	ug/Kg	640	nd	nd	**1400**
SW 8270C	Anthracene	ug/Kg	1100	nd	nd	**3100**
SW 8270C	Benzo(a)anthracene	ug/Kg	1600	670	1200	**6300**
SW 8270C	Benzo(a)pyrene	ug/Kg	1600	960	1300	**6800**
SW 8270C	Benzo(b)fluoranthene	ug/Kg		650	870	4300
SW 8270C	Benzo(g,h,i)perylene	ug/Kg		500	640	2600
SW 8270C	Benzo(k)fluoranthene	ug/Kg		540	740	3400
SW 8270C	Chrysene	ug/Kg	2800	670	1030	**5400**
SW 8270C	Fluoranthene	ug/Kg	5100	1000	1900	**7500**
SW 8270C	Fluorene	ug/Kg	540	nd	nd	**1800**
SW 8270C	Indeneo(1,2,3,-cd)pyrene	ug/Kg		nd	580	2300
SW 8270C	Phenanthrene	ug/Kg	1500	770	**1500**	**9600**
SW 8270C	Pyrene	ug/Kg	2600	1300	**2400**	**12000**

Note: MS - Multiple Standards (The complete list of SW Method analytes were below detection limits)

NOAA/ERM Values - National Oceanic and Atmospheric Administration/Effects Range-Median.

* Not all constituents have available NOAA/ERM values; No MDE Standards for sediment

Shaded cells with bold characters represent exceedences relative to NOAA/ERM values.

Samples were analyzed for VOCs, SVOCs, OC Pesticides/PCBs, and Total Metals.

SW - Solid Waste

MS - Multiple Standards (The complete list of SW Method analytes were below detection limits)

In groundwater, some metals (antimony, arsenic and manganese) were detected above Maryland State standards for Type I and II aquifers; however, VOCs and SVOCs were not detected above State standards (Table 3.3).

TABLE 3.3
Detections in Groundwater
Carroll-Camden Area, 2001

Concentrations reported in ug/L.

EPA Method	Constituents	MDE Standard	MW-3	Duplicate MW-3	MW-5	MW-6	MW-7
SW 204.2	Antimony	6	**6**	5	**10**	**7**	**6**
SW 206.2	Arsenic	50	nd	nd	nd	nd	6
SW 200.7	Manganese	50	**280**	**280**	**230**	**320**	**190**
SW 200.7	Nickel	73	nd	nd	40	nd	nd
SW 279.2	Thallium	2	nd	nd	6	5	nd
SW 200.7	Zinc	1100	10	20	nd	nd	nd
SW 8081A	OC Pesticides/PCBs	MS	nd	nd	nd	nd	nd
SW 8260B	VOCs	MS	nd	nd	nd	nd	nd
SW 8270C	Naphthalene	10	nd	nd	nd	**11**	nd

Note: Shaded cells with bold characters represent exceedences relative to MDE Standards for Type I and II Aquifers.
Samples were analyzed for VOCs, SVOCs, OC Pesticides/PCBs, and Total Metals.
The MW-3 duplicate sample was designated as MW-4 during the investigation.
MS - Multiple Standards (The complete list of SW Method analytes were below detection limits)
SW - Solid Waste

The BDC on behalf of the City of Baltimore requested that MDE conduct a site-specific Brownfields Assessment of lots 5A, 6, 7 and 8/9 to address USACE concerns about potential contamination so that the wetlands portion of the revitalization project could move forward.

4.0 INVESTIGATION ACTIVITIES

4.1 Project Objectives

The overall objective of the Warner Street revitalization project of Lots 5A, 6, 7, and 8/9 is the creation of a wetland greenway for the Gwynns Falls Trail. To achieve this objective, removal of the top six feet of soil fill was proposed. However, as noted above, previous soil sampling by MDE in 2001 at the subject properties revealed the presence of contaminants of concern (COCs) at concentrations above Maryland State Residential Cleanup standards. Consequently, a Brownfields Site-Specific investigation of the fill material and COCs was initiated to determine whether the wetlands creation project could proceed. The objectives of the investigation were the screening of top six feet of soil fill so that appropriate disposal options could be ascertained and the characterization of the site in general.

Analytical methods selected for the analysis of soil and groundwater samples were based on COCs detected in the previous MDE Brownfields Investigation (MDE, 2001). The following COCs were identified in soil during the previous investigation:

- Metals – Elevated levels of arsenic, chromium, and mercury were detected in soil.
- SVOCs – Benzo(a)anthracene, benzo(b)fluoranthene, and benzo(a)pyrene, were detected in soil at concentrations above Maryland State Residential Standards.

The following COCs were identified in groundwater during the previous investigation:

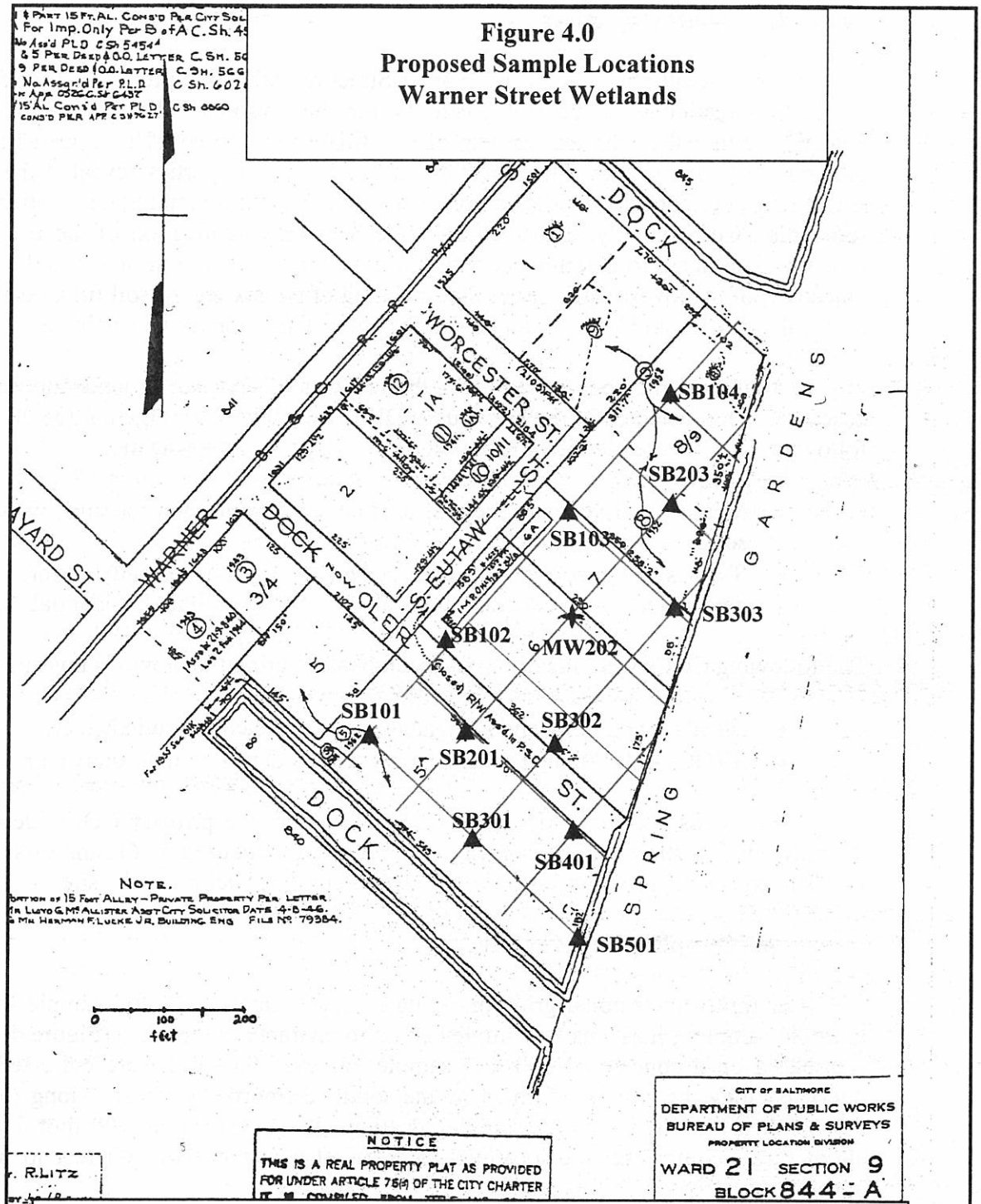
- Metals - Antimony and manganese were detected in groundwater.
- SVOCs - Naphthalene was the only SVOC detected in groundwater.

As metals and the PAH subset of SVOCs were the primary COCs identified during the previous investigation, the current investigation was focused on the analysis of metals and PAHs in soils and groundwater to further characterize and delineate the site.

4.2 Sampling and Analysis

A three-dimensional grid consisting of approximately 12 soil sample locations with multiple sampling horizons was implemented to characterize the site (Figure 4.1). The grid was based on a conceptual 100-foot sample pattern. Samples were collected at 200-foot intervals along the columns formed by the southwest-northeast axes. Along rows based on the southeast-northwest axes, sample locations were spaced at 100-foot intervals. On alternating columns, sample locations were offset a distance of 100 feet to maximize the coverage area.

Figure 4.0
Proposed Sample Locations
Warner Street Wetlands



Legend

▲ SB101 – Proposed Soil Boring Location
✦ MW202 – Proposed Soil Boring/Temporary Monitoring well Location

Direct push technology (DPT) borings were obtained to visually characterize the fill. Continuous cores for lithologic and visual observation were completed to approximately 10 feet below ground surface (bgs) where the water table was encountered. Soil samples were field screened at four sample horizons from the ground surface to the water table (0-, 3-, 6- and 10-foot bgs) resulting in a total of 48 samples for field screening. These samples were field screened using X-ray fluorescence (XRF) for metals and immunoassay techniques for carcinogenic PAHs (cPAHs). Soil samples for confirmatory laboratory analysis were selected based on field screening results. A total of 14 soil samples were collected for fixed laboratory analysis. A temporary monitoring well was also installed and sampled at soil boring (SB202) located in the central area of the properties to confirm groundwater quality results from the previous MDE Brownfields Investigation (MDE, 2001).

For each of the four lots (5A, 6, 7, and 8/9), a composite soil sample was collected from the top six feet of continuous core soil borings from within individual lots (a total of four soil samples). These soil samples were submitted for analysis using the Toxicity Characteristic Leaching Procedure (TCLP) for Metals only. Results from the TCLP analysis, in conjunction with analytical results from soil samples collected from the top six feet of soil, could be used to estimate the volume of fill disposed at a Subtitle D solid waste facility or, if needed, the volume to be disposed at a Subtitle C hazardous waste facility.

Applicable or Relevant and Appropriate Standards, and proposed action levels were discussed in the USEPA-approved MDE Brownfields QAPP (MDE, 2004). All field activities associated with this sampling and analysis plan were performed in accordance with the provisions of the MDE Sampling and Analysis Plan (MDE, 2005).

5.0 PRESENTATION OF RESULTS

5.1 Soil Boring Observations

A total of 12 Direct Push Technology (DPT) soil borings were cored to the water table, which was approximately 10 feet below ground surface (bgs) based on soil boring moisture content. Actual soil boring locations are depicted on Figure 5.0. Visual logs of soil borings show that the primary types of materials buried at the proposed Warner Street Wetlands site consist of soil with construction debris, bricks, glass, coal, slag, marble, and at some locations, paint pigments were interlaced with soil and shell fragments. Soil boring logs are presented in Appendix A.

Soil-boring SB202 was cored beyond the water table to a depth of 32 feet bgs to determine the vertical extent of fill. Fill materials extended to a depth of approximately 25 feet bgs at SB202. Because the depth of fill is approximately 15 feet below the level of the Patapsco River, it is likely that the weight of the fill supplemented by periodic filling over a 100-year period has displaced the native soft marsh sediments and soft clay outwards and upwards into the Patapsco channel.

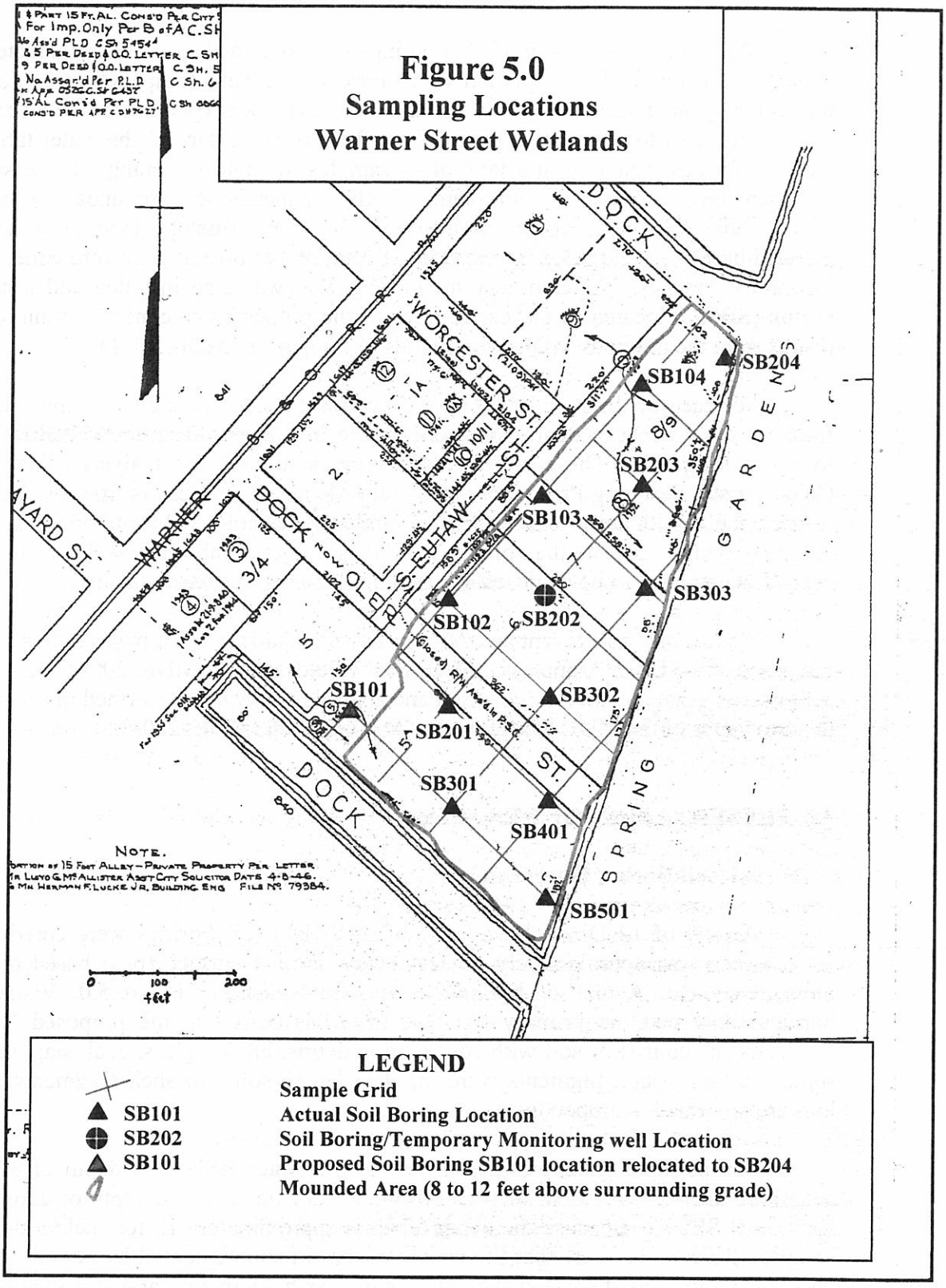


Figure 5.0
Sampling Locations
Warner Street Wetlands
SB204
SB104
SB203
SB103
SB303
SB102
SB202
SB101
SB302
SB201
SB301
SB401
SB501
WORCESTER ST.
DOCK
WARNER
DOCK
S. EUTAW ST.
SPRING GARDENS
DOCK
NOTE.
0 100 200
feet
LEGEND
Sample Grid
SB101 Actual Soil Boring Location
SB202 Soil Boring/Temporary Monitoring well Location
SB101 Proposed Soil Boring SB101 location relocated to SB204
Mounded Area (8 to 12 feet above surrounding grade)

It should be noted that soil-boring SB101 was relocated to SB204 because the surface elevation at SB101 was approximately 12 feet lower than the grade of the mounded area of fill that comprises a majority of the site. The location of the mounded area is depicted in Figure 5.0. Site photographs are presented in Appendix B (Pictures No. 1 through 8).

5.1.1 Groundwater Elevations

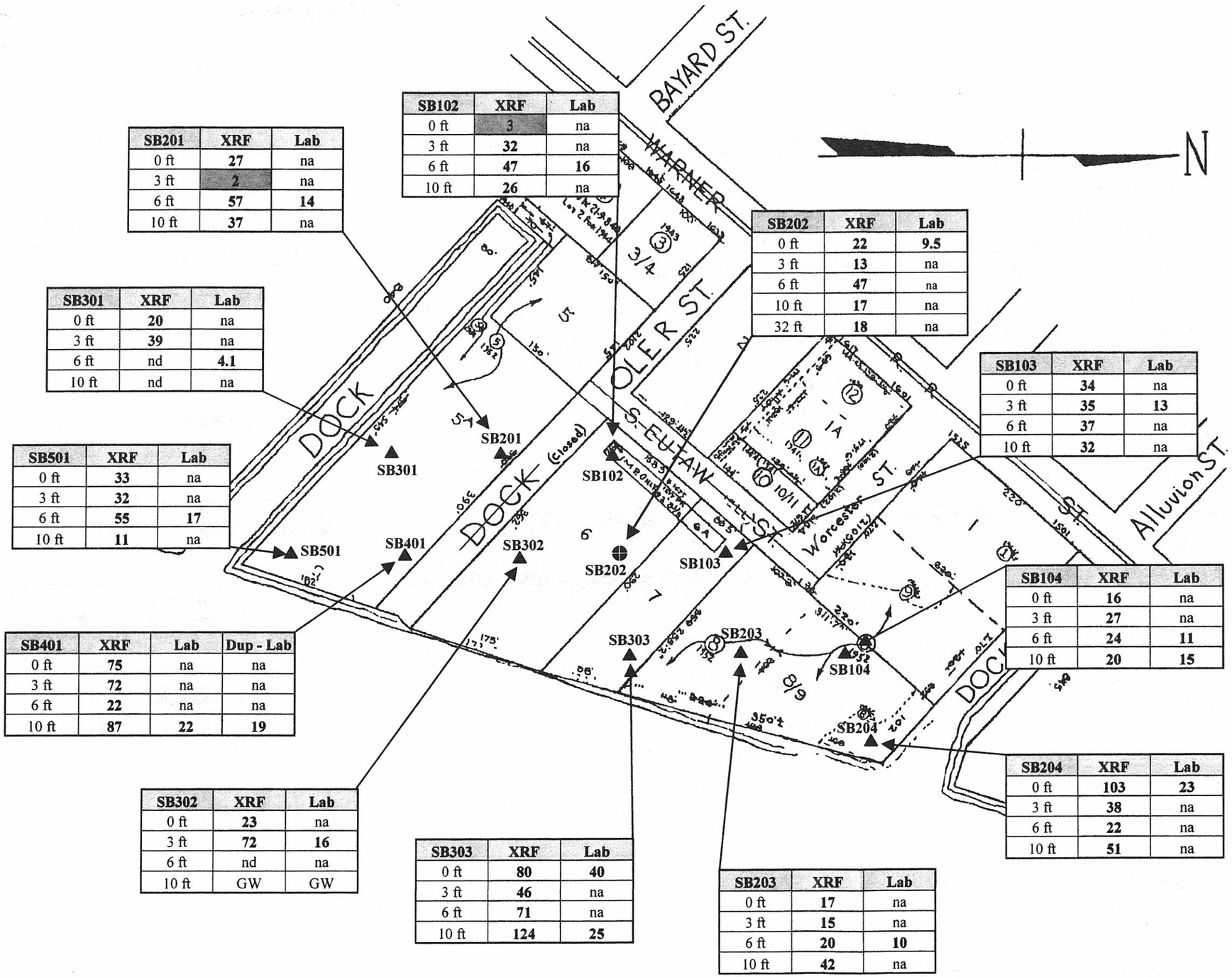
The proposed Warner Street Wetland properties are located on fill that has been mounded above the adjacent land along the former South Eutaw Street by approximately six feet in the northwest to 12 feet in the southwest. Groundwater samples from SB202 were collected from approximately three feet bgs; however, most of the other borings did not encounter significantly moist or wet soils until a depth of approximately 10 feet was reached. Thus, it is inferred that the groundwater collected at SB202 was perched water.

5.2 Field Screening Results

Soil samples were collected for field screening at all 12 DPT locations. Three sample intervals (0-, 3-, and 6-feet) were selected to characterize the top six feet of soil proposed for potential removal. Soil samples were also collected just above the water table (~10-foot) and one sample was collected at a depth of 32 feet (SB-202-32). A total of 48 samples were screened for cPAHs using Strategic Diagnostic Inc. (SDI) immunoassay test kit on a SDI RaPID Photometric Analyzer and XRF. Metals were screened by XRF using a Spectrace QuanX Analyzer System with an electronically cooled detector. A representative subset of the samples with a range of contaminant concentrations was subsequently selected for analysis at a fixed-based laboratory. In addition, metals samples with high total chromium screening results were selected for further analysis to determine if chromium VI was present.

As seen on the Figures 5.1 and 5.2, laboratory results for arsenic and lead confirmed the widespread presence of these metals at concentrations above comparison criteria; however, the laboratory concentrations were generally lower (50 to 70 percent lower for arsenic) than XRF screening results. Similarly, XRF screening detections above comparison criteria for chromium, magnesium, and antimony were not confirmed by laboratory results for these metals. In contrast, the laboratory results for mercury (Figure 5.3) revealed that XRF screening produced a significant number of false negatives suggesting mercury is more widespread than indicated by the XRF screening. Field screening results for metals are presented Table 1 of Appendix C.

The results of field screening for cPAHs revealed a ubiquitous pattern of low-level petroleum-impacted soils at the site (Table 2, Appendix C). Laboratory results confirmed the immunoassay detections. In general, higher concentrations of cPAHs (greater than 4.5 mg/kg) corresponded to detections of benzo(a)pyrene and/or dibenzo(a,h)anthracene at concentrations above MDE Non-Residential Soil Standards or EPA Region III RBCs (Figure 5.4).



SB201	XRF	Lab
0 ft	27	na
3 ft	2	na
6 ft	57	14
10 ft	37	na

SB102	XRF	Lab
0 ft	3	na
3 ft	32	na
6 ft	47	16
10 ft	26	na

SB202	XRF	Lab
0 ft	22	9.5
3 ft	13	na
6 ft	47	na
10 ft	17	na
32 ft	18	na

SB301	XRF	Lab
0 ft	20	na
3 ft	39	na
6 ft	nd	4.1
10 ft	nd	na

SB103	XRF	Lab
0 ft	34	na
3 ft	35	13
6 ft	37	na
10 ft	32	na

SB501	XRF	Lab
0 ft	33	na
3 ft	32	na
6 ft	55	17
10 ft	11	na

SB104	XRF	Lab
0 ft	16	na
3 ft	27	na
6 ft	24	11
10 ft	20	15

SB401	XRF	Lab	Dup - Lab
0 ft	75	na	na
3 ft	72	na	na
6 ft	22	na	na
10 ft	87	22	19

SB204	XRF	Lab
0 ft	103	23
3 ft	38	na
6 ft	22	na
10 ft	51	na

SB302	XRF	Lab
0 ft	23	na
3 ft	72	16
6 ft	nd	na
10 ft	GW	GW

SB303	XRF	Lab
0 ft	80	40
3 ft	46	na
6 ft	71	na
10 ft	124	25

SB203	XRF	Lab
0 ft	17	na
3 ft	15	na
6 ft	20	10
10 ft	42	na

MDE

Figure 5.1

Arsenic in Soil XRF Screening Results Warner Street Wetlands

Legend

Concentrations presented in mg/kg

▲ SB204 - Soil Boring

⊕ SB202 - Soil Boring/Piezometer

Comparison Criteria

Metal	MDE Soil Non-Residential Standard	EPA Region III Industrial RBC
Arsenic	3.8	1.9

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

Indicates concentration > EPA, but < MDE comparison values.

MDE - Maryland Department of the Environment

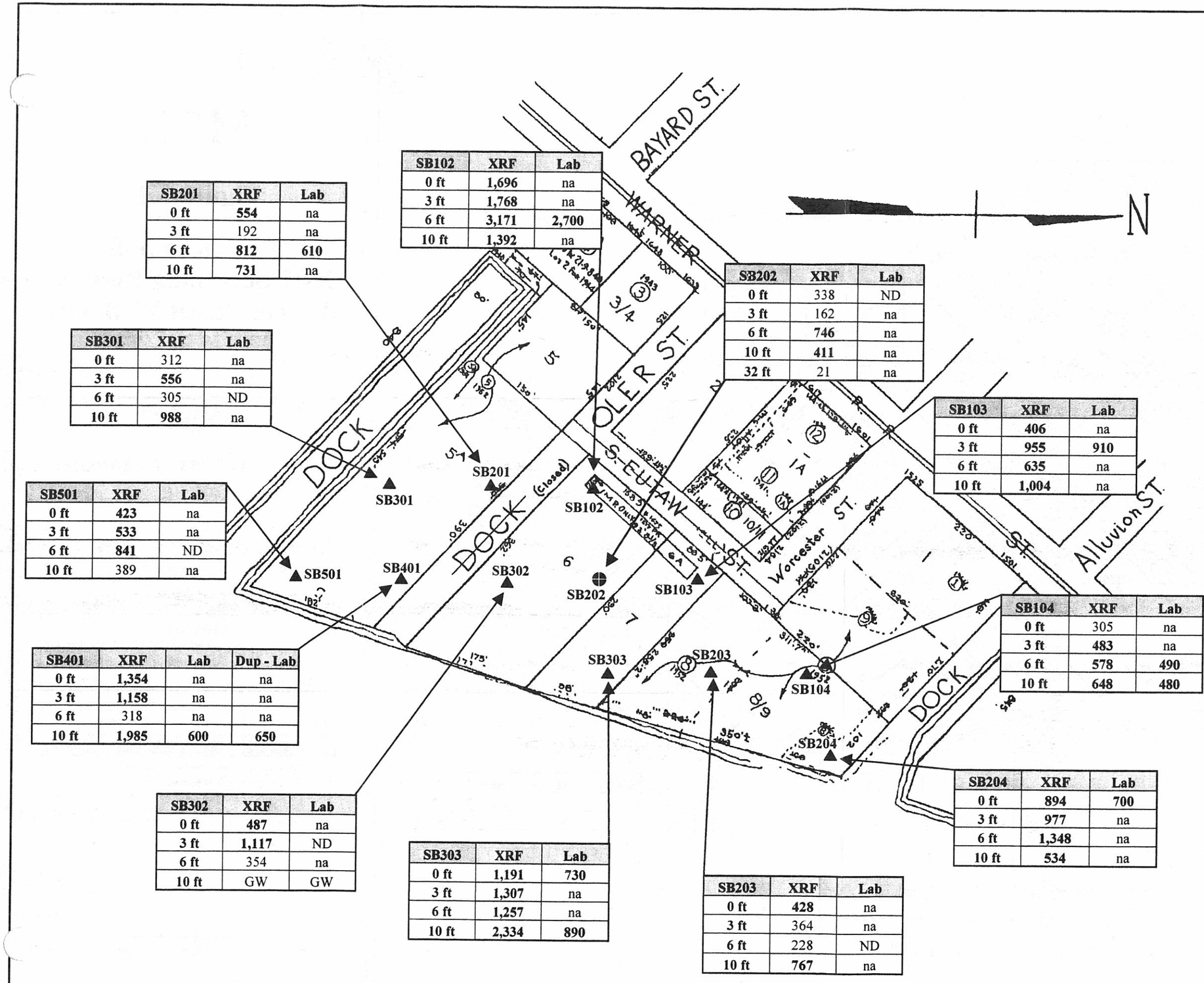
EPA - Environmental Protection Agency

RBC - Risk Based Concentration
NA - Not available
XRF – X-Ray Fluorescence
GW - Groundwater

NR - Non-residential standard
na - Not analyzed
ND - non-detect

Scale in Feet

0 100 200



SB201	XRF	Lab
0 ft	554	na
3 ft	192	na
6 ft	812	610
10 ft	731	na

SB102	XRF	Lab
0 ft	1,696	na
3 ft	1,768	na
6 ft	3,171	2,700
10 ft	1,392	na

SB202	XRF	Lab
0 ft	338	ND
3 ft	162	na
6 ft	746	na
10 ft	411	na
32 ft	21	na

SB301	XRF	Lab
0 ft	312	na
3 ft	556	na
6 ft	305	ND
10 ft	988	na

SB103	XRF	Lab
0 ft	406	na
3 ft	955	910
6 ft	635	na
10 ft	1,004	na

SB501	XRF	Lab
0 ft	423	na
3 ft	533	na
6 ft	841	ND
10 ft	389	na

SB104	XRF	Lab
0 ft	305	na
3 ft	483	na
6 ft	578	490
10 ft	648	480

SB401	XRF	Lab	Dup - Lab
0 ft	1,354	na	na
3 ft	1,158	na	na
6 ft	318	na	na
10 ft	1,985	600	650

SB302	XRF	Lab
0 ft	487	na
3 ft	1,117	ND
6 ft	354	na
10 ft	GW	GW

SB303	XRF	Lab
0 ft	1,191	730
3 ft	1,307	na
6 ft	1,257	na
10 ft	2,334	890

SB203	XRF	Lab
0 ft	428	na
3 ft	364	na
6 ft	228	ND
10 ft	767	na

SB204	XRF	Lab
0 ft	894	700
3 ft	977	na
6 ft	1,348	na
10 ft	534	na

MDE

Figure 5.2

Lead in Soil XRF Screening Results Warner Street Wetlands

Legend

Concentrations presented in mg/kg

▲ SB204 - Soil Boring

⊕ SB202 - Soil Boring/Piezometer

Comparison Criteria

Metal	MDE Soil Non-Residential Standard	EPA Region III Industrial RBC
Lead	400	NA

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

Indicates concentration > EPA, but < MDE comparison values.

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency

RBC - Risk Based Concentration

NA - Not available

XRF - X-Ray Fluorescence

GW - Groundwater

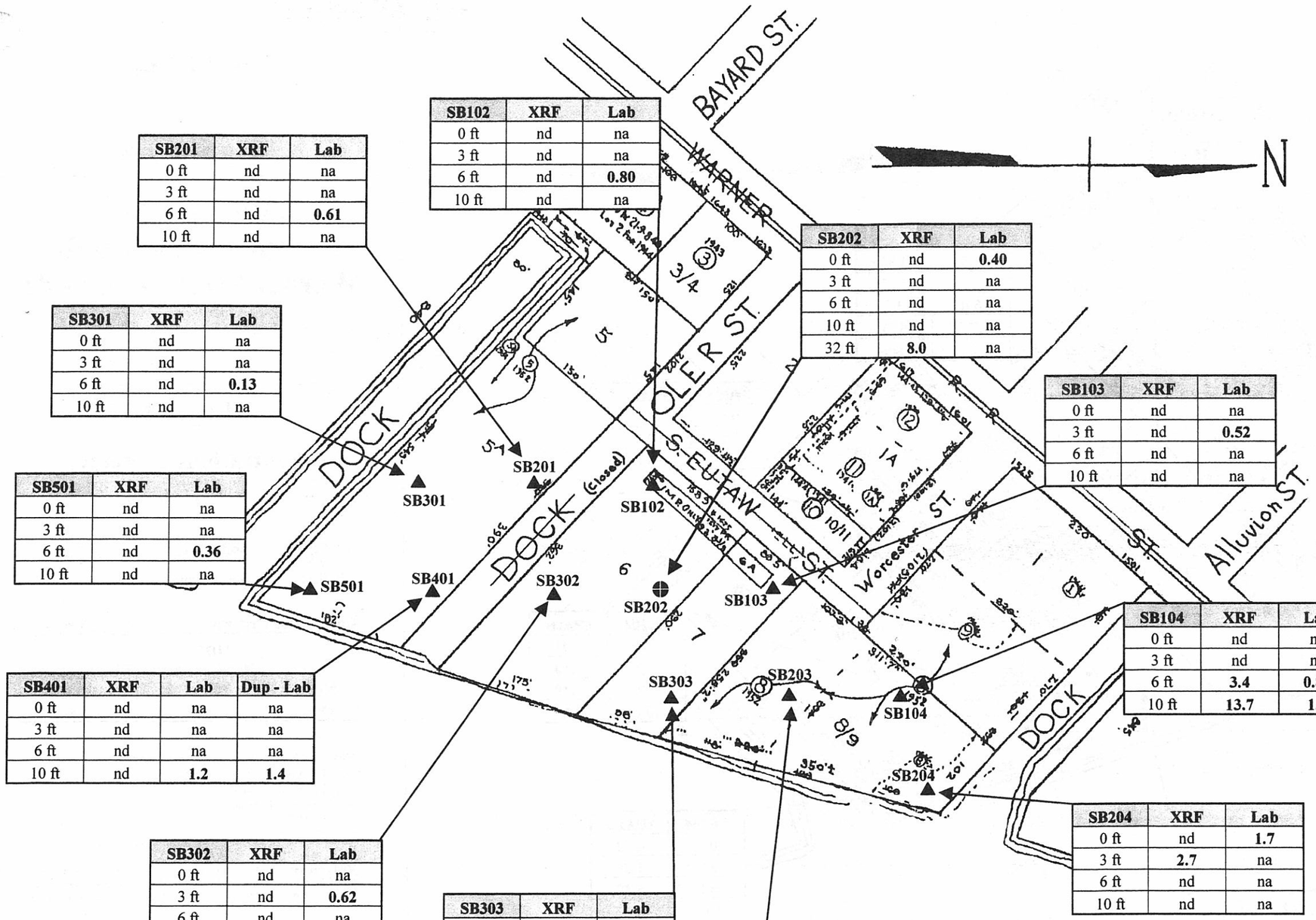
NR - Non-residential standard

na - Not analyzed

ND - Non-detect

Scale in Feet

0 100 200



SB201	XRF	Lab
0 ft	nd	na
3 ft	nd	na
6 ft	nd	**0.61**
10 ft	nd	na

SB102	XRF	Lab
0 ft	nd	na
3 ft	nd	na
6 ft	nd	**0.80**
10 ft	nd	na

SB202	XRF	Lab
0 ft	nd	**0.40**
3 ft	nd	na
6 ft	nd	na
10 ft	nd	na
32 ft	**8.0**	na

SB301	XRF	Lab
0 ft	nd	na
3 ft	nd	na
6 ft	nd	**0.13**
10 ft	nd	na

SB103	XRF	Lab
0 ft	nd	na
3 ft	nd	**0.52**
6 ft	nd	na
10 ft	nd	na

SB501	XRF	Lab
0 ft	nd	na
3 ft	nd	na
6 ft	nd	**0.36**
10 ft	nd	na

SB104	XRF	Lab
0 ft	nd	na
3 ft	nd	na
6 ft	**3.4**	**0.87**
10 ft	**13.7**	**1.2**

SB401	XRF	Lab	Dup - Lab
0 ft	nd	na	na
3 ft	nd	na	na
6 ft	nd	na	na
10 ft	nd	**1.2**	**1.4**

SB204	XRF	Lab
0 ft	nd	**1.7**
3 ft	**2.7**	na
6 ft	nd	na
10 ft	nd	na

SB302	XRF	Lab
0 ft	nd	na
3 ft	nd	**0.62**
6 ft	nd	na
10 ft	GW	GW

SB303	XRF	Lab
0 ft	nd	**0.74**
3 ft	nd	na
6 ft	nd	na
10 ft	nd	**3.7**

SB203	XRF	Lab
0 ft	nd	na
3 ft	**3.4**	na
6 ft	nd	**0.48**
10 ft	nd	na

MDE

Figure 5.3

Mercury in Soil XRF Screening Results Warner Street Wetlands

Legend

Concentrations presented in mg/kg

▲ SB204 - Soil Boring

⊕ SB202 - Soil Boring/Piezometer

Comparison Criteria

Metal	MDE Soil Non-Residential Standard	EPA Region III Industrial RBC
Mercury	0.12	100*

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

Indicates concentration > EPA, but < MDE comparison values.

MDE - Maryland Department of the Environment

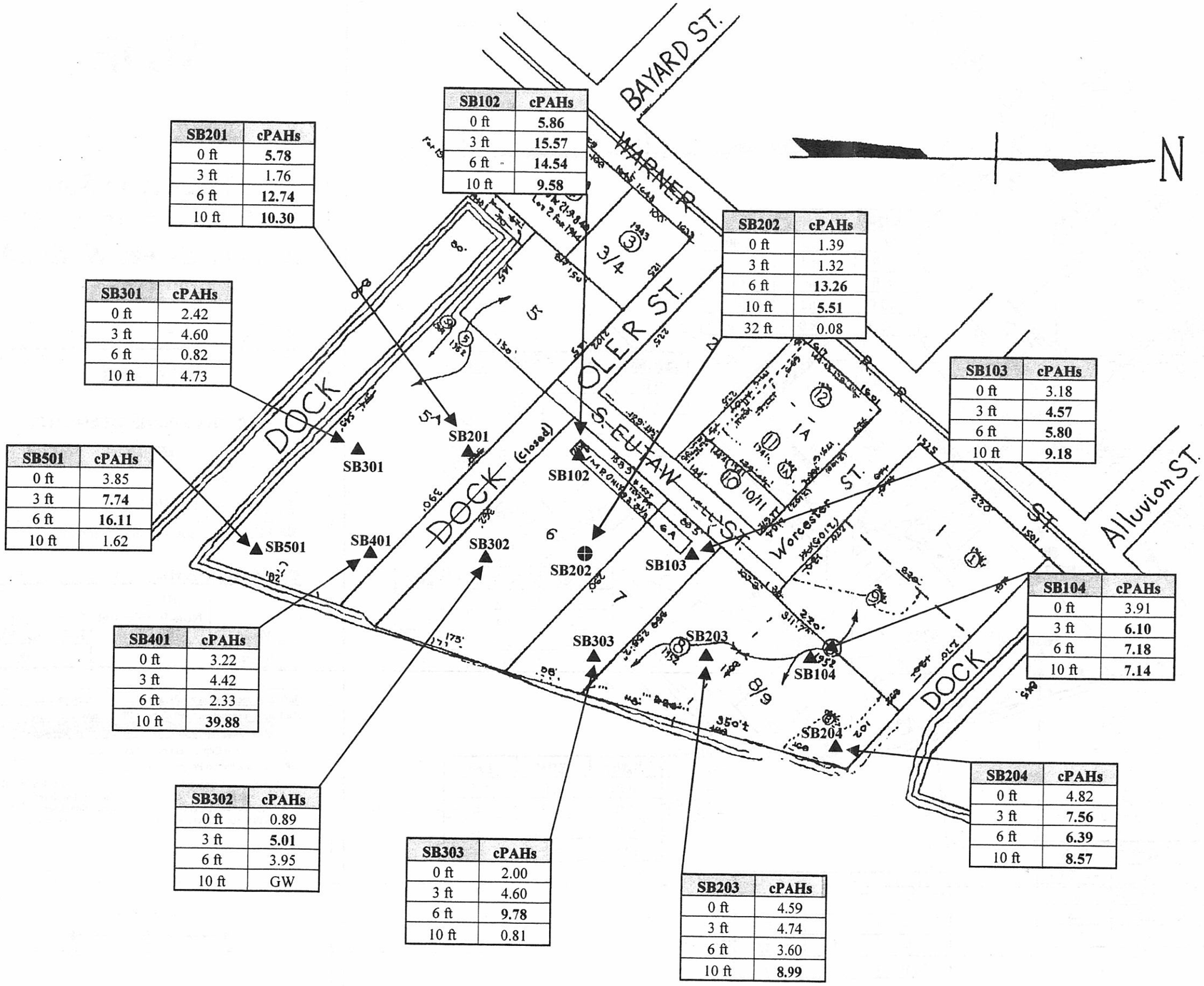
EPA - Environmental Protection Agency

RBC - Risk Based Concentration
NA - Not available
XRF – X-Ray Fluorescence
* - EPA RBC for methyl mercury

NR - Non-residential standard
na - Not analyzed
nd - Non-detect
GW - Groundwater

Scale in Feet

0 100 200



MDE

Figure 5.4

cPAHs in Soil Immunoassay Results Warner Street Wetlands

Legend

Concentrations presented in mg/kg

▲ SB204 - Soil Boring

⊕ SB202 - Soil Boring/Piezometer

Comparison Criteria

Analysis	MDE Soil Non-Residential Standard	EPA Region III Industrial RBC
cPAHs	NS	NS

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency

RBC - Risk Based Concentration
NR - Non-residential Standard
NS – No Standard
GW – Groundwater
cPAHs – Carcinogenic polycyclic aromatic hydrocarbons

Bold numbers indicate concentration over 4.5 mg/kg. Concentrations over 4.5 mg/kg generally corresponded to detections of benzo(a)pyrene and/or dibenzo(a,h)anthracene over MDE and EPA Comparison Criteria.

Scale in Feet

0 100 200

5.3 Analytical Results in Soil

The fixed-based laboratory, Phase Separation Science (PSS), analyzed a total of 14 soil samples for total metals by EPA Method 6020, the PAH subset of SVOCs by EPA Method 8270, and cyanide by EPA Method 9010b. In addition, metals samples with high total chromium screening results were selected for further analysis by EPA Method 7196A to determine if chromium VI was present. Analytical results were compared to Maryland Department of the Environment (MDE) Non-Residential Soil Standards and Environmental Protection Agency (EPA) Risk Based Concentrations (RBCs) for Industrial Soils. All detections of soil contaminants from fixed-based laboratory analysis are presented in Table 3.0 of Appendix C and discussed below.

- Organic Compounds in Soil: A total of 12 PAHs were detected in various combinations and at low concentration in every sample analyzed. However, only two PAHs (benzo(a)pyrene and dibenzo(a,h)anthracene) were consistently detected above MDE and/or EPA comparison values.

- Metals in Soil: A total of 15 metals were detected in soil samples collected for laboratory analysis. Twelve of the 15 metals were detected at concentrations below MDE and EPA comparison criteria. However, arsenic, lead and mercury were detected in nearly every sample analyzed at concentrations that exceeded MDE and/or EPA comparison values. Cyanide was not detected in any soil sample. Similarly, hexavalent chromium was not detected in any of the soil samples that were selected for analysis based on high XRF screening results.

Contaminants detected in soil above MDE and/or EPA comparison values are presented in Figure 5.5.

Table 5.1
Detections of Metals and PAHs in Soil
Warner Street Wetlands

Analyte Concentrations presented in mg/kg.	MDE Soil NR Std	EPA Ind. RBC	SB102 6 ft	SB103 3 ft	SB104 6 ft	SB104 10 ft	SB201 6 ft	SB202 surface	SB203 6 ft	SB204 surface
Aluminum	500,000	1,000,000	5,300	4,600	4,000	3,600	9,400	5,300	6,300	7,300
Antimony	82	410	3.1	nd	nd	nd	nd	nd	nd	6.1
Arsenic	3.8	1.9	**16**	**13**	**11**	**15**	**14**	**9.5**	**10**	**23**
Barium	14,000	72,000	410	210	120	120	540	91	87	200
Cadmium	100	1,000	nd	nd	nd	nd	3.0	nd	nd	nd
Chromium III	310,000	1,500,000	350	110	49	31	690	65	81	61
Chromium VI	610	3,100	na	na	na	na	nd	na	na	na
Cobalt	4,100	20,000	21 J	13 J	6.2 J	5.4 J	15 J	11 J	10 J	7.7 J
Copper	8,200	41,000	220 K	130 K	96 K	100 K	190 K	100 K	130 K	260 K
Iron	61,000	310,000	15,000	13,000	14,000	19,000	21,000	13,000	13,000	21,000
Lead	400	NA	**2,700**	**910**	**490**	**480**	**610**	300	210	**700**
Manganese	4,100	20,000	180 J	200 J	160 J	190 J	340 J	270 J	220 J	220 J
Mercury	0.12	NA	**0.80**	**0.52**	**0.87**	**1.2**	**0.61**	**0.40**	**0.48**	**1.7**
Nickel	4,100	20,000	23	20	17	13	37	22	27	19
Vanadium	1,400	1,000	29	24	24	19	37	25	29	27
Zinc	64,000	31,000	590	530	340	420	3,200	300	300	470
Acenaphthene	12,000	61,000	0.32 J	0.19 J	0.1 J	nd	0.15 J	nd	nd	0.053 J
Acenaphthylene	12,000	NA	0.048 J	0.092 J	0.037 J	nd	nd	nd	nd	nd
Anthracene	61,000	310,000	0.7	0.52	0.25 J	0.094 J	0.17 J	0.064 J	nd	0.096 J
Benzo (a) anthracene	7.8	3.9	2	1.8	0.71	0.36 J	0.43 J	0.3 J	0.12 J	0.43
Benzo (a) pyrene	0.78	0.39	**2**	**2**	**0.83**	**0.45**	**0.47**	0.36 J	0.17 J	**0.54**
Benzo (b,k) fluoranthene	7.8 / 78	3.9 / 39	1.7	1.4	0.65 J	0.36 J	0.36 J	0.29 J	0.13 J	0.52 J
Benzo (g,h,i) perylene	6,100	NA	1.4	1.4	0.59	0.28 J	0.31 J	nd	0.099 J	0.34 J
Chrysene	780	390	2.1	1.7	0.74	0.38 J	0.44 J	0.32 J	0.13 J	0.47
Dibenzo (a,h) anthracene	0.78	0.39	**0.51**	**0.49**	0.23	0.11 J	0.12 J	0.084 J	nd	0.13 J
Fluoranthene	8,200	41,000	3.8	2.8	1.5	0.7	0.89	0.46	0.19 J	0.79
Fluorene	8,200	41,000	0.34 J	0.16 J	0.1 J	nd	0.15 J	nd	nd	0.041 J
Indeno (1,2,3-cd) pyrene	7.8	3.9	1.2	1.2	0.5	0.24 J	0.25 J	0.22 J	0.098 J	0.31 J
2-Methylnaphthalene	4,100	4,100	0.091 J	0.07 J	0.056 J	nd	nd	nd	nd	nd
Naphthalene	4,100	20,000	0.14 J	0.1 J	0.1 J	nd	nd	nd	nd	nd
Phenanthrene	61,000	NA	3.4	2.2	1.1	0.42	0.81	0.34 J	0.1 J	0.52
Pyrene	6,100	31,000	3.1	3	1.1	0.63	0.86	0.47	0.2 J	0.84

Notes: EPA - Environmental Protection Agency

MDE - Maryland Department of the Environment. NR -Non-Residential

Indicates concentration > EPA and MDE comparison values.

NA – Not available

J - Estimated concentration

Indicates concentration > MDE, but < EPA comparison values.

nd - non-detect

K - Analyte present, reported value may be biased high

Indicates concentration > EPA, but < MDE comparison values.

Std - Standard

RBC - Risk Based Concentration

Table 5.1 continued
Detections of Metals and PAHs in Soil
Warner Street Wetlands

Analyte Concentrations presented in mg/kg.	MDE Soil NR Std	EPA Ind. RBC	SB301 6 ft	SB302 3 ft	SB303 surface	SB303 10 ft	SB401 10 ft	SB601-10 Duplicate SB401 10 ft	SB501 06 ft
Aluminum	500,000	1,000,000	2,900	8,600	9,100	4,900	9,300	3,200	3,300
Antimony	82	410	nd	nd	nd	7.4	nd	nd	nd
Arsenic	3.8	1.9	**4.1**	**16**	**40**	**25**	**22**	**19**	**17**
Barium	14,000	72,000	36	230	150	1,300	190	190	110
Cadmium	100	1,000	nd	nd	4.2	5.1	3.1	3.0	nd
Chromium III	310,000	1,500,000	30	210	92	51	23	19	51
Chromium VI	610	3,100	na	nd	na	na	na	na	na
Cobalt	4,100	20,000	7.2 J	15 J	17 J	22 J	5.8 J	5.7 J	8.4 J
Copper	8,200	41,000	37 K	170 K	190 K	110 K	110 K	110 K	130 K
Iron	61,000	310,000	7,400	21,000	20,000	19,000	17,000	15,000	11,000
Lead	400	NA	130	390	**730**	**890**	**600**	**650**	330
Manganese	4,100	20,000	150 J	510 J	270 J	150 J	2,500 J	2,800 J	130 J
Mercury	0.12	NA	**0.13**	**0.62**	**0.74**	**3.7**	**1.2**	**1.4**	**0.36**
Nickel	4,100	20,000	15	31	32	20	33	27	19
Vanadium	1,400	1,000	13	29	41	27	18	18	19
Zinc	64,000	31,000	nd	1,000	560	1,700	1,100	1,100	360
Acenaphthene	12,000	61,000	nd	0.12 J	0.051 J	nd	0.078 J	0.058 J	0.21 J
Acenaphthylene	12,000	NA	nd	0.059 J	nd	nd	0.057 J	0.078 J	0.071 J
Anthracene	61,000	310,000	nd	0.22 J	0.083 J	nd	0.23 J	0.23 J	0.23 J
Benzo (a) anthracene	7.8	3.9	0.07 J	0.82	0.4 J	0.093 J	1.6	2	0.98
Benzo (a) pyrene	0.78	0.39	0.092 J	**1.1**	**0.55**	nd	**2.3**	**2.9**	**1.3**
Benzo (b,k) fluoranthene	7.8 / 78	3.9 / 39	0.071 J	0.73 J	0.38 J	nd	1.8	2.2	0.78
Benzo (g,h,i) perylene	6,100	NA	0.072 J	0.84	0.32 J	0.069 J	1.6	2	0.92
Chrysene	780	390	0.067 J	0.89	0.42 J	0.1 J	1.9	2.4	1
Dibenzo (a,h) anthracene	0.78	0.39	nd	0.2 J	0.12 J	nd	**0.45**	**0.5**	0.28
Fluoranthene	8,200	41,000	0.098 J	1.2	0.66	0.21 J	3.2	4.2	1.2
Fluorene	8,200	41,000	nd	0.09 J	nd	nd	0.087 J	0.068 J	0.089 J
Indeno (1,2,3-cd) pyrene	7.8	3.9	0.065 J	0.64	0.3 J	0.061 J	1.4	1.6	0.75
2-Methylnaphthalene	4,100	4,100	nd	0.07 J	nd	nd	nd	nd	nd
Naphthalene	4,100	20,000	nd	0.086 J	nd	nd	nd	nd	0.067 J
Phenanthrene	61,000	NA	0.044 J	1.1	0.49	0.16 J	1.2	1.3	0.93
Pyrene	6,100	31,000	0.11 J	1.5	0.68	0.17 J	3.5	4.7	1.5

Notes: EPA - Environmental Protection Agency

MDE - Maryland Department of the Environment, NR -Non-Residential

Indicates concentration > EPA and MDE comparison values.

NA – Not available

J - Estimated concentration

Indicates concentration > MDE, but < EPA comparison values.

nd - non-detect

K - Analyte present, reported value may be biased high

Indicates concentration > EPA, but < MDE comparison values.

Std - Standard

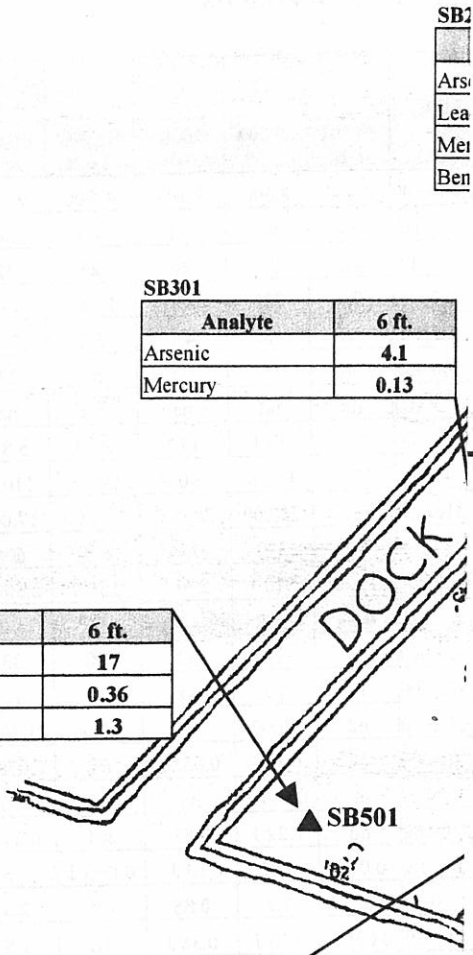
RBC - Risk Based Concentration

MDE

Figure 5.5

Detections in Soil Above Comparison Criteria Warner Street Wetlands

(Concentrations above MDE Non-Residential Soil Standard and/or EPA Industrial RBC)



SB301

Analyte	6 ft.
Arsenic	4.1
Mercury	0.13

SB501

Analyte	6 ft.
Arsenic	17
Mercury	0.36
Benzo (a) pyrene	1.3

SB401

Analyte	10 ft.	10 ft. Dup.
Arsenic	22	19
Lead	600	650
Mercury	1.2	1.4
Benzo (a) pyrene	2.3	2.9
Dibenzo (a,h) anthracene	0.45	0.5

Legend

Concentrations presented in mg/kg

▲ **SB204 - Soil Boring**

⊕ **SB202 - Soil Boring/Piezometer**

Comparison Criteria

Analyte	MDE Non-Residential Soil Standard	EPA Region III Industrial RBC
Arsenic	3.8	1.9
Lead	400	NA
Mercury	0.12	100 *
Benzo(a)pyrene	0.78	0.39
Dibenzo(a,h)anthracene	0.78	0.39

Indicates concentration > EPA and MDE comparison values.
Indicates concentration > MDE, but < EPA comparison values.
Indicates concentration > EPA, but < MDE comparison values.

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency nd - Non-detect

J - Estimated concentration below the reporting limit.

RBC - Risk Based Concentration NR - Non-residential standard

N/A - Not applicable NA - Not available

* - EPA RBC for methyl mercury

Scale in Feet

0 100 200

5.4 Analytical Results in Groundwater

A temporary monitoring well was installed at SB202, which is located in the center of the proposed Warner Street Wetlands. Groundwater levels were allowed to reach equilibrium over a 24-hour period. Samples were then collected with a peristaltic pump using dedicated tubing. The temporary well did not develop well; consequently, the groundwater samples collected for total metals were very turbid due to high amounts of silt. Groundwater samples were analyzed at a fixed-based laboratory for total metals, dissolved metals, and PAHs. Results were compared to MDE Standards for Type I and II Aquifers and EPA RBCs for Tap Water. Analytical results for groundwater at SB202 are presented in Table 5.1 and discussed below:

Table 5.2
Detections in Perched Groundwater
Warner Street Wetlands

Concentrations reported in ug/L

Analyte	MDE Standard. Type I & II Aquifers	EPA RBCs Tap Water	GW202	GW302 Duplicate GW202	GW202 Dissolved	GW302 Dissolved
Acenaphthene	37	370	3 J	1 J	na	na
Fluorene	24	240		nd	na	na
Phenanthrene	180	NA	2 J	1 J	na	na
Aluminum	50	37,000	5,800	4,400	nd	nd
Arsenic	50	0.045	22	18	nd	nd
Barium	2000	2,600	310	260	75	76
Cadmium	5	18	**6.5**	**5.1**	nd	nd
Calcium	EN	EN	87,000	83,000	66,000	64,000
Total Chromium	5,500,000	55,000	190	140	nd	nd
Cobalt	72	730	31	25	9.5	nd
Copper	1,300	1,500	280	260	nd	nd
Iron	3,000	11,000	**16,000**	**13,000**	230	240
Lead	15	NA	**1,100**	**910**	nd	nd
Magnesium	EN	EN	9,300	8,700	6,900 L	6,900 L
Manganese	50	730	**650**	**560**	**220**	**200**
Nickel	73	730	57	45	nd	nd
Potassium	EN	EN	7,400	7,400	6,500	6,700
Selenium	50	180	6.7	6.5	8.0	8.0
Sodium	EN	EN	8,400	8,000	8,600 L	7,700 L
Vanadium	50	37	**60**	49	nd	nd
Zinc	1,100	11,000	2,000	1,700	nd	nd

Notes: RBC - Risk-Based Concentration, EN - Essential nutrient NA - Not available nd - Non detect na - Not analyzed

Indicates concentration > EPA and MDE comparison values. L - Analyte pesent, reported value may be biased low.

Indicates concentration > MDE, but < EPA comparison values. J - Estimated concentration

Indicates concentration > EPA, but < MDE comparison values.

The complete list of 18 metals was detected in unfiltered groundwater from samples GW202 and its duplicate GW302. Cadmium, iron, lead, manganese, and vanadium were detected at concentrations above MDE comparison values. However, only eight confirmed detections were found in filtered groundwater. Of the eight detections, only manganese (GW202 – 220 ug/L and GW302 – 200 ug/L) was detected above the MDE Standard for Type 1 and II Aquifers (50 ug/L). Barium, calcium, iron, magnesium, potassium, selenium and sodium were detected at concentrations below MDE Standards.

PAHs detected in unfiltered groundwater included acenaphthene, fluorene, and phenanthrene; however, concentrations were below MDE comparison values and the detection of fluorene was not confirmed in the duplicate sample. Filtered groundwater samples were not analyzed for PAHs.

5.5 TCLP Results

Soil samples were consolidated from the first six feet of every soil core collected at each of the four lots. These four soil samples were analyzed for Resource Conservation and Recovery Act (RCRA) metals using TCLP. Results from the TCLP analysis show that metals were not detected in the leachate from all four samples (Table 5.3). Therefore, it is likely that the top six feet of soil could be excavated and shipped to a RCRA Subtitle D non-hazardous waste landfill.

Table 5.3
TCLP Results
Warner Street Wetlands

Concentrations reported in mg/L

Analyte	MDE Maximum Concentration for Toxicity Characteristic	TCLP PQL	STCLP-5A	STCLP-06	STCLP-07	STCLP-89
Arsenic	5	0.5	nd	nd	nd	nd
Barium	100	10	nd	nd	nd	nd
Cadmium	1	0.1	nd	nd	nd	nd
Total Chromium	5	0.5	nd	nd	nd	nd
Lead	5	0.5	nd	nd	nd	nd
Mercury	0.2	0.1	nd	nd	nd	nd
Selenium	1	0.1	nd	nd	nd	nd
Silver	5	0.5	nd	nd	nd	nd

Notes: MDE - Maryland Department of the Environment
TCLP - Toxicity Characteristic Leaching Procedure
PQL - Proactical Quantitation Limit nd - Non detect

6.0 TOXICOLOGICAL EVALUATION

A toxicological evaluation of the fixed-laboratory data was performed as part of this Brownfields Assessment (Appendix D). A data validation report assessing the fixed-laboratory results is presented in Appendix E. For the purposes of this evaluation a commercial use scenario was assumed for estimating risk to potentially exposed populations. Groundwater and soil samples were analyzed for SVOCs and metals.

6.1 Soils

6.1.1 Surface Soil – Ingestion

The estimated risks from the incidental ingestion of detected noncarcinogenic surface soil contaminants were below MDE and EPA recommended levels for all commercial populations. The estimated risks from the incidental ingestion of detected carcinogenic surface soil contaminants exceeded MDE recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations.

The estimated risks from the incidental ingestion of detected carcinogenic surface soil contaminants were within MDE recommended risk ranges for the construction worker commercial population and EPA recommended risk ranges for all commercial populations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants exceeded MDE and EPA recommended levels for the child visitor and construction worker commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations.

6.1.2 Subsurface Soil – Ingestion

The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended levels for the youth visitor and adult worker commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended levels for all commercial populations utilizing the 95% UCL concentrations as the site-wide average concentrations.

The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations. The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants were within MDE recommended risk ranges for the construction worker commercial population and EPA recommended risk ranges for all commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations.

The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population utilizing the 95% upper confidence level (UCL) concentrations as the site-wide average concentrations. The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants were within MDE recommended risk ranges for the child visitor, youth visitor and construction worker commercial populations and EPA recommended risk ranges for all commercial populations utilizing the 95% UCL concentrations as the site-wide average concentrations.

6.1.3 Surface and Subsurface Soil – Inhalation

The estimated noncarcinogenic and carcinogenic risk levels from the inhalation of detected and nondetected volatiles and fugitive dust from surface and subsurface soils were within acceptable levels as recommended by MDE and EPA for all commercial populations using both the maximum detected concentrations and the 95% UCL concentrations as the site-wide average concentrations.

6.1.4 Surface Soil – Dermal Exposure

Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants exceeded MDE and EPA recommended levels for the child visitor population utilizing the maximum detected concentrations as the site-wide average concentrations. Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants were within MDE and EPA recommended risk levels for the youth visitor, adult worker and construction worker commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations. Carcinogenic risk estimates for dermal exposure to detected surface soil contaminants were within MDE and EPA recommended risk ranges for all commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations.

6.1.5 Subsurface Soil – Dermal Exposure

Risk estimates for dermal exposure to detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended levels for all commercial populations utilizing both the maximum detected concentrations and the 95% UCL concentrations as the site-wide average concentrations. Carcinogenic risk estimates for dermal exposure to detected subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population utilizing the maximum detected concentrations as the site-wide average concentrations.

Carcinogenic risk estimates for dermal exposure to detected subsurface soil contaminants were within MDE recommended risk ranges for the youth visitor, adult worker and construction worker commercial populations and EPA recommended risk ranges for all commercial populations using maximum detected concentrations as the site-wide average concentrations. Carcinogenic risk estimates for dermal exposure to detected subsurface soil contaminants were within MDE and EPA recommended risk ranges for all commercial

populations utilizing both the maximum detected concentrations and 95% UCL concentrations as the site-wide average concentrations.

The maximum concentration of lead detected in surface and subsurface soils on site exceeded the 400 mg/kg residential soil screening value. The arithmetic mean surface soil, subsurface soil and total soil lead concentrations on site were 577, 699 and 675 mg/kg, respectively. Based on the available data, the concentrations of lead in soil may pose a threat to the health of sensitive populations and the environment in discrete locations on site.

6.2 Groundwater

6.2.1 Groundwater – Ingestion

Potential adverse effects from groundwater exposure were evaluated utilizing total and dissolved metals data on site. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for all commercial populations using total metals data. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for all commercial populations using dissolved metals data. Risk estimates from the incidental ingestion of detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges for all commercial populations and EPA recommended risk ranges for the youth visitor and adult worker commercial populations using total metals data. Arsenic was the incidental ingestion carcinogenic risk driver. Risk estimates from the incidental ingestion of detected carcinogenic groundwater contaminants were within MDE and EPA recommended risk ranges for all commercial populations using dissolved metals data.

6.2.2 Groundwater – Dermal Contact

Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for the adult worker and construction worker commercial populations using total metals data. Chromium was the noncarcinogenic dermal contact risk driver. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for the child and youth visitor commercial populations using total metals data. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants were within MDE and EPA recommended risk levels for all commercial populations using dissolved metals data. Risk estimates for dermal contact with detected carcinogenic groundwater contaminants were within MDE and EPA recommended risk ranges for all commercial populations using total and dissolved metals data.

The lack of critical physical constants and the methods for derivation of dermal exposures lead to a high degree of uncertainty associated with this route of exposure. This high degree of uncertainty should be considered when evaluating the hazards of dermal exposure to groundwater.

6.3 Comparison to Regulatory Criteria and Standards

One detected contaminant, manganese, and five nondetected contaminants exceeded their respective maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL). One detected groundwater contaminant (selenium) exceeded the ambient water-quality standard (AWQS) or ambient water-quality criteria (AWQC) for the protection of aquatic life (acute or chronic) and no detected contaminant exceeded the recommended AWQC for the protection of human health via fish consumption.

No detected contaminant in groundwater on site exceeded a hazard index (HI) of 1 or a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air. Vapor intrusion from mercury contamination in both surface and subsurface soil exceeded a hazard index (HI) of 1 for commercial populations. No detected contaminant in soil on site exceeded a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air.

Multiple detected contaminants exceeded their corresponding MDE groundwater cleanup standard. Three detected surface soil contaminants, arsenic, mercury and lead and five detected subsurface soil contaminants, arsenic, chromium, lead, mercury, and benzo(a)pyrene exceeded their recommended MDE non-residential soil cleanup standard. In order to further evaluate potential chromium risks the subsurface soil chromium samples with the highest detected chromium concentrations were speciated to determine if chromium present on site was hexavalent chromium (Cr VI) or trivalent chromium (Cr III). The additional analysis indicated no detectable hexavalent chromium above non-residential cleanup standards; therefore, chromium was not considerable as a contaminant of concern on site.

Refer to the toxicological evaluation in Appendix D for details regarding specific risk drivers for each exposure pathway.

7.0 CONCLUSIONS

1. Soil Fill: Based on the results of continuous core sampling, the proposed Warner Street Wetlands properties consist of soil fill mixed with construction debris, glass, slag, and minor traces of industrial and household wastes. The estimated fill thickness is 25 feet bgs. Because the depth of fill is approximately 15 feet below the level of the Patapsco River, it is likely that the weight of the fill supplemented by periodic filling over a 100-year period has displaced the native soft marsh sediments and soft clay outwards and upwards into the Patapsco channel. The Warner Street Wetland properties are essentially on a plateau with the height of fill above the former South Eutaw Street ranging from 6 to 10 feet and a fill elevation above the sea level ranging from 12 to 15 feet.

2. Contact with Contaminated Soil: Significant concentrations of arsenic, lead, and mercury were encountered in surface and subsurface soil. Construction workers should take OSHA precautions while regrading and excavation operations are in progress. After regrading operations have been completed, the placement of a two-foot soil cover is recommended to minimize the possibility of human contact with contaminated soils.

3. Contact with Contaminated Groundwater: Elevated concentrations of manganese were encountered in perched groundwater collected from temporary monitoring well SB202. Perched groundwater was encountered at approximately three feet bgs. Actual groundwater elevations are expected to occur between 8 and 12 feet bgs. Currently, the removal six feet of soil is proposed followed by the placement of two feet of clean soil. Groundwater should not be used for drinking purposes.

4. TCLP Results: Results from the TCLP analysis show that metals were not detected in leachate. Therefore, it is likely that the top six feet of soil could be excavated and shipped to a RCRA Subtitle D non-hazardous waste landfill. It is also probable that soil from deeper excavations (up to 10 feet bgs) would pass TCLP and be accepted by RCRA Subtitle D non-hazardous waste landfills.

8.0 REFERENCES

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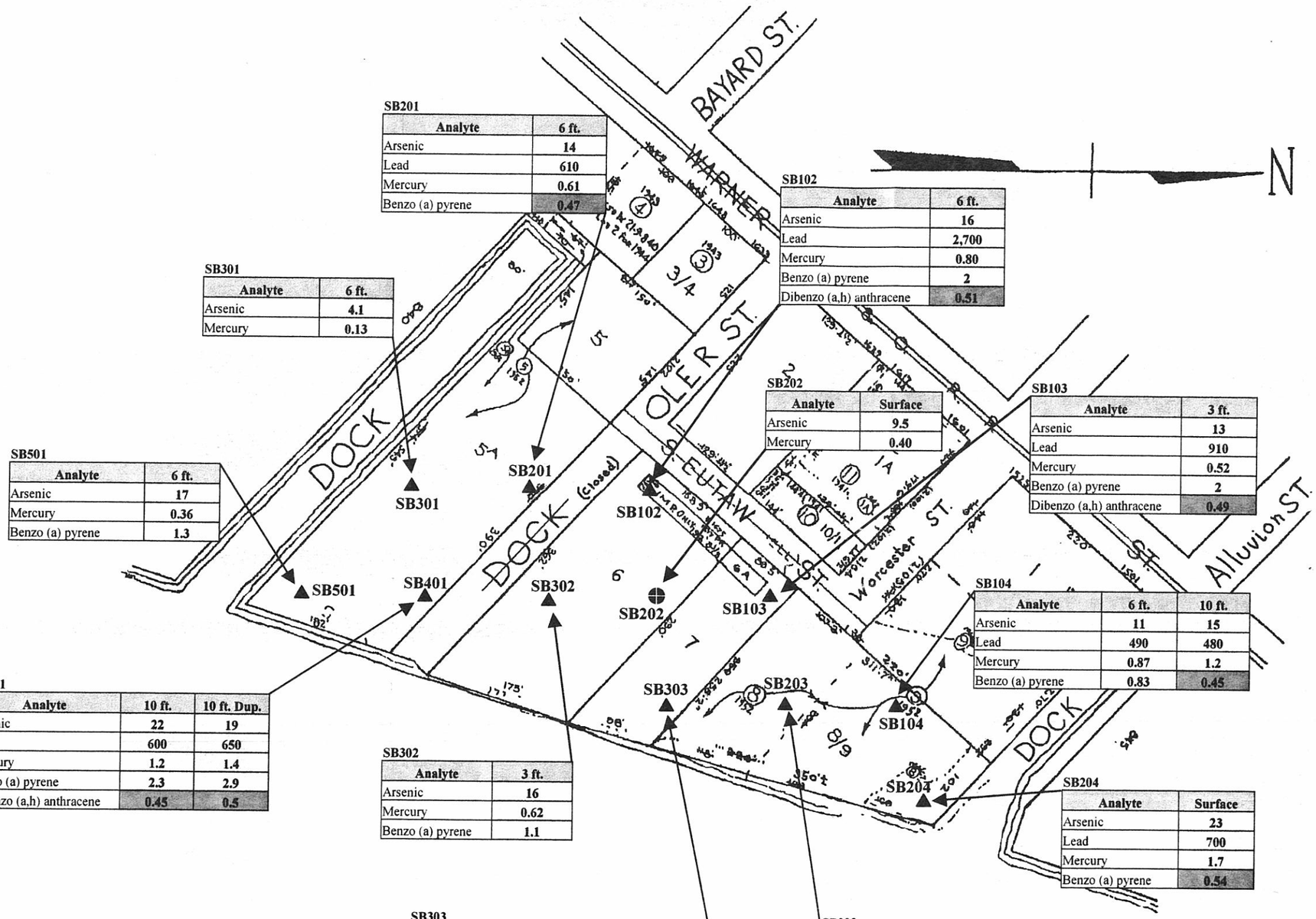
APPENDIX A

BORING LOGS



MDE

Figure 5.5

Detections in Soil Above Comparison Criteria Warner Street Wetlands

(Concentrations above MDE Non-Residential Soil Standard and/or EPA Industrial RBC)

Legend

Concentrations presented in mg/kg

▲ **SB204 - Soil Boring**

⊕ **SB202 - Soil Boring/Piezometer**

Comparison Criteria

Analyte	MDE Non-Residential Soil Standard	EPA Region III Industrial RBC
Arsenic	3.8	1.9
Lead	400	NA
Mercury	0.12	100 *
Benzo(a)pyrene	0.78	0.39
Dibenzo(a,h)anthracene	0.78	0.39

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

Indicates concentration > EPA, but < MDE comparison values.

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency nd - Non-detect

J - Estimated concentration below the reporting limit.

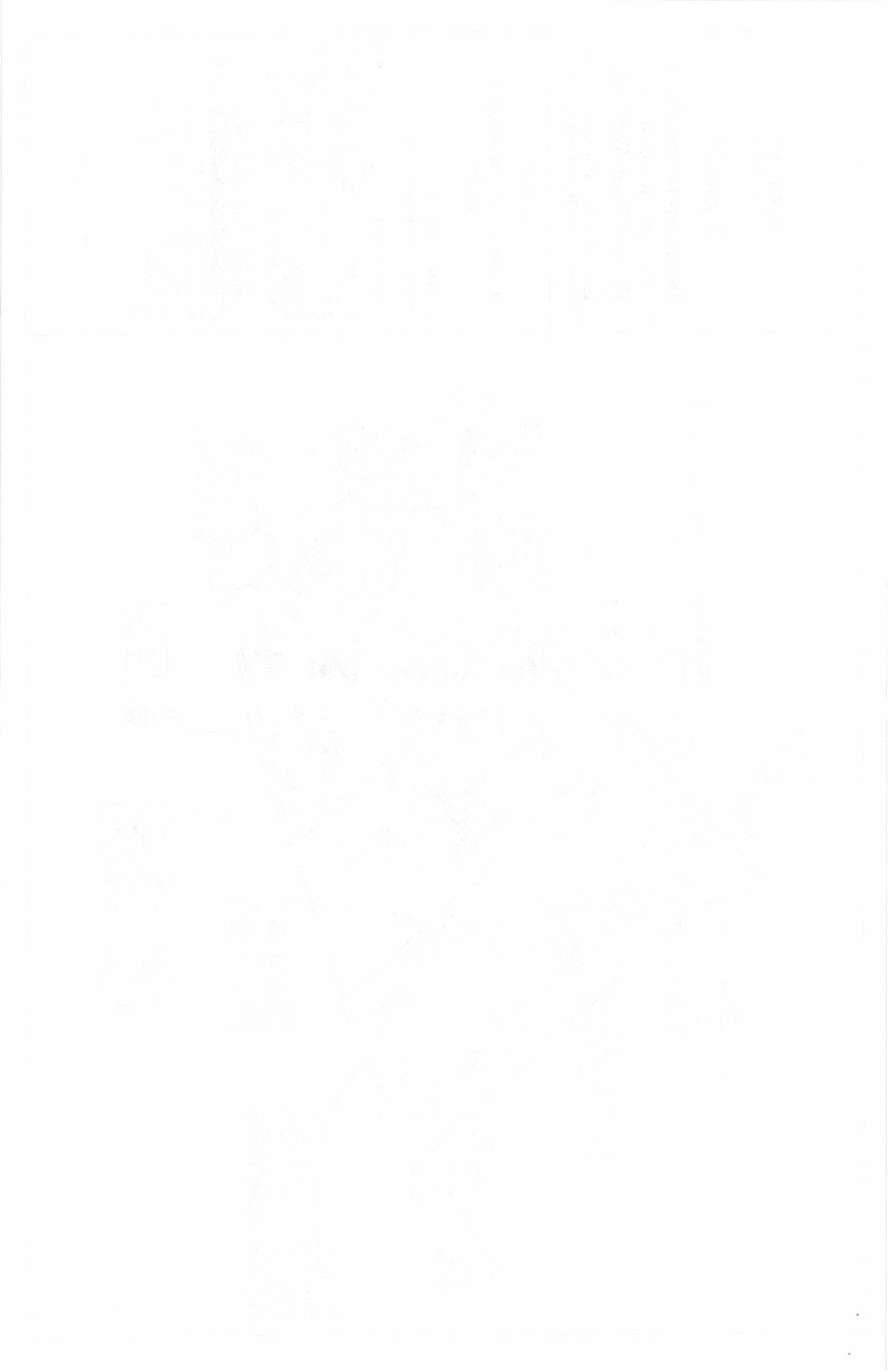
RBC - Risk Based Concentration NR - Non-residential standard

N/A - Not applicable NA - Not available

* - EPA RBC for methyl mercury

Scale in Feet

0 100 200



10/12/05
DATE

MDE-ERRP BORING LOG AND SAMPLE DATA

SITE CODE

MPLE LOCATION BH202

SURFACE CONDITIONS: Grass

LOCATION:

WEATHER: Cloudy

PCA CODE: 66-82M

PROJECT NAME: Warner Street Wetlands

OBSERVER/GEOLOGIST: Bob Wallace

	0	Fine sand with silt light to dark brown	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	1	damp	
		Poorly sorted silty clayey fine to medium	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	2	sand w/glass & brick fragments moist	
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
	4	wet at 4'	
	5		☐GRAVEL ☐SAND ☐SILT ☐CLAY
	6	Dark black silty soft clay w/plastic, wood,	
		& glass fragments some broken fragments of fine shell	☐GRAVEL ☐SAND ☐SILT ☐CLAY
10ft ⇒	8	moist	
		Poorly sorted silty clayey fine to coarse sand	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	10	& debris brick chunks + mica wet	
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
	12		
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
	14		
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
	16	Well sorted silty v. fine sand damp	
		Mottled gray & black soft silty clay No odor	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	18	~~Poorly sorted fine Brick, Glass & Cloth~~	
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
	20	Poorly sorted wet silty fine to medium sand	
		w/glass fine & wood fragments, mica Fuel odor (weathered)	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	22	Mottled gray & black soft silty clay w/mica No odor	

DRILLER _____ START DATE: __/__/__ END DATE: __/__/__

__/__/__ DATE

MDE-ERRP BORING LOG AND SAMPLE DATA

SITE CODE

MPLE LOCATION BH202 continued

SURFACE CONDITIONS:

LOCATION:

WEATHER:

PCA CODE:

PROJECT NAME:

OBSERVER/GEOLOGIST:

		Light gray/black mottled silty clay grading to sandy, silty clay	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	24	w/ mica Damp slight pet. odor	
		peach pit (burned odor) @ 25'	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	26		
		Dk gray to Black very soft clay w/ shell fragments No odor	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	28		
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
	30		
		Dark brown soft clay	☐GRAVEL ☐SAND ☐SILT ☐CLAY
	32		
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY
			☐GRAVEL ☐SAND ☐SILT ☐CLAY

DRILLER START DATE: __/__/__ END DATE: __/__/__/

10 / 12 / 05
DATE

MDE-ERRP BORING LOG AND SAMPLE DATA

SITE CODE

SAMPLE LOCATION SB#302

SURFACE CONDITIONS: Woods

LOCATION:

WEATHER: Cloudy

PCA CODE: 66-82M

PROJECT NAME: Warner Street Wetlands

OBSERVER/GEOLOGIST: Bob Wallace

		GRAVEL	SAND	SILT	CLAY	
0	Poorly Sorted Dk Brn. Silty Fine Sand w/ roots + Brick Frag. Damp	☐	☐	☐	☐	
1						
2	Poorly Sorted Silty Fine - Coarse Sandy w/ Black Vitrified Material					
3						
3.3	Dry Lt. Brown Clayey Silt w/ Mica and Root mass plastic mat					
4	Poorly Sorted Silty Sand (F-M) w/ iron stone debris, glass Quartzite, Pebble					
6	20 mm					
6.5	Black + Gray Mottled Clay w/ Petro odors. Fine Gravel					
7	Concrete (Crushed Run Gravel)					

DRILLER _____ START DATE: ___/___/___ END DATE: ___/___/___

10 / 12 / 05
DATE

MDE-ERRP BORING LOG AND SAMPLE DATA

SITE CODE

MPLE LOCATION SB 201

SURFACE CONDITIONS: grass

LOCATION:

WEATHER: Cloudy

PCA CODE: 66-82M

PROJECT NAME: Warren St. Wetland

OBSERVER/GEOLOGIST: Bob Wallace

		GRAVEL	SAND	SILT	CLAY
0		☐	☐	☐	☐
0.5	Brown Silty Loam w/ Plant Debris				
1		☐	☐	☐	☐
	Light Brown Silty - Fine Coarse Sand				
	Shell at Brick Frag Poorly Sorted	☐	☐	☐	☐
3	micca, shell, Grass, Plastic,				
		☐	☐	☐	☐
4	Moist Black Silty Soft Clay				
	Petro odor, Wood Fragments,	☐	☐	☐	☐
6	Sandy Black, Poorly Sorted	☐	☐	☐	☐
	Clay Silty Sand, F-M Sand				
	Slight Petro Odor. Moist	☐	☐	☐	☐
9		☐	☐	☐	☐
10	Grades to Sandy Clay, Micaceous				
	Poorly Sorted w/ Gravel. Plastic	☐	☐	☐	☐
12	wet at bottom				
		☐	☐	☐	☐
		☐	☐	☐	☐
		☐	☐	☐	☐

DRILLER _____ START DATE: __/__/__ END DATE: __/__/__/

10 / 12 / 05
DATE

MDE-ERRP BORING LOG AND SAMPLE DATA

SITE CODE

MPLE LOCATION SB 401

SURFACE CONDITIONS: woods / grass

WEATHER: Cloudy

PCA CODE: 66-82M

PROJECT NAME: Warner St. Wetlands

OBSERVER/GEOLOGIST: Bob Wallace

LOCATION:

		GRAVEL	SAND	SILT	CLAY
0	Sandy, Silt				
0.5					
	Lt - Dk Brown Poorly Sorted				
	Fine - Coarse Sand w/ Brick Frag.				
	Gravel (5-20 mm), Plastic Debris, Glass				
4	Damp				
	Lt Brown Fine - (Coarse) Medium Sand				
	w/ 5% Gravel, Brick Frag.				
	Rubber detritus slag / Fly Ash				
8	Wooden Plank - (Sawn Edge)				
9	(Same Material as above)				
	Very Poorly Sorted Silty F-C				
	Sand w/ Gravel, Slag, Concrete				
11	Poorly Sorted Clayey Silt w/ Gravel,				
12	wet at Bottom	Quartzite, Glass			

DRILLER _____ START DATE: __/__/__ END DATE: __/__/__/

10/2/05

MDE ...ORING LOG AND SAM...LE DATA

HOLE No.: SB 501

SURFACE CONDITIONS: Woods

WEATHER: Cloudy 70°

PROJECT No.: 06-82M

PROJECT SITE: Warner Street Wetlands

GEOLOGIST: Bob Wallace

LOCATION

DRILLER

DATE END

DATE START

1	Dark Brown Fine Sandy Silt w/ Glass fragments + Brick fragments
2	Mottled Dark Brown - Orange Silty Fine Sand w/ Gravel + Shell
	Dk Brown Poorly Sorted Sandy Fine Silt w/ Concrete Asphalt, Slag
4	Poorly Sorted light Brown Silt w/ Gravel, Brick Pieces, shell Frag.
6	
10.5	Light Brown - Gray Fine Sand w/ Fine Gravel (5-10 mm) Brick fragments Slag Damp
12	Poorly Sorted silty Clay Fine - Course Sandy Gravel w/ shell Fragments Wet. No Odor.

10/12/05

MODELING LOG AND SAMPLE DATA

HOLE No.: SB 301

SURFACE CONDITIONS: Woods/Grass

WEATHER: Cloudy 20°F

PROJECT No.: 66-82M

PROJECT SITE: Warner St. Wetland

GEOLOGIST: Bob Wallace

LOCATION

DRILLER

DATE END

DATE START

0	Dk Br – Fine Sandy Silt w/ Root	↑
0.5	Poorly Sorted Silty Micaceous	
1	Fine - Coarse Sand w/ Fine Gravel	
	Medium Brown, Damp	Dry
3		↓
	20% Gravel Poorly Sorted	2-20 mm Gravel
5	Lt Brown Fine - Coarse Sandy Gravel	↓
	Same but less Gravel (10%)	↓
8	Fine - Coarse Sand w/ Gravel Damp	Damp
		↓
10		↓
	Poorly Sorted Silty Sandy Gravelly Clay	Moist
11	Dark Grey to Black	
	Beigh Mottled Black well Sorted	
12	Fine Sand w/ some Gravel.	Wet

10/12/05

MDE BORING LOG AND SAMPLE DATA

HOLE No.: SB 102

SURFACE CONDITIONS: Woods

WEATHER: Cloudy 70°F

PROJECT No.: CC-82M

PROJECT SITE: Warner St. Wetland

GEOLOGIST: Bob Williams

LOCATION

DRILLER

DATE END

DATE START

0	Dk Brown Silt Root Mass
0.5	Poorly Sorted Silty Fine Sand w/ Gravel, Quartz, Concrete, Glass, Slag. Red + Yellow Pigment at 0.5 feet
4	Damp
8	
10	Brown/Orange Poorly Sorted Fine to Medium Sand w/ Gravel and Micas. Moist
12	Pink Clayey Fine Sand

10/12/05

MDE BORING LOG AND SAMPLE DATA

HOLE No.: SB 303
SURFACE CONDITIONS: Woods

WEATHER: Cloudy 70°F
PROJECT No.: 66-82M
PROJECT SITE: Warner St. Wetlands
GEOLOGIST: Bob Wallace

LOCATION

DRILLER

DATE END

DATE START

0		
0.5	Dk Brown Clayey Silt	
	Brown Silt w/ Shell Fragments Fine Gravel, Wood, Brick Frags	
4		
6.5	Orange Silty Fine Sand w/ some Clay	
8	Slag, Brick, Burnt Wood	wet at 8
9	Black Vitrious Slag	
10	Gravel Slag Clay Gravel	Metal
	Poorly Sorted Dark Grey Clayey Silty Fine Sandy Gravel Slight Petro Odor	
14		
	Beige Clayey Fine Sand.	

10/13/05

MDE BORING LOG AND SAMPLE DATA

HOLE No.: SB 203

SURFACE CONDITIONS: Grass

WEATHER: Drizzle 60°F

PROJECT No.: 66-82M

PROJECT SITE: Warner St. wetlands

GEOLOGIST: Bob Valley

LOCATION

DRILLER

DATE END

DATE START

0	Poorly Sorted Fine - Coarse Sand	
1	w/ Gravel. Dark Brn - Black	
	Redish Brown Poorly Sorted	
	F-M Sand w/ Brick Frag w/	
6	Gravel, Glass, slags, shells	Damp
	Lt. Brown Clay, soft	
7	Grading into Black micaceous	
	w/ Petro Odor	
		Moist
12		

10/13/05

MDE BORING LOG AND SAMPLE DATA

HOLE No.: SB 103

SURFACE CONDITIONS: Woods

WEATHER: Drizzle 60°F

PROJECT No.: 66-82M

PROJECT SITE: Wagner St. Wetlands

GEOLOGIST: Rob Walker

LOCATION

DRILLER

DATE END

DATE START

0	Black Silt mixed w/ Gravel/ slag	~~Moist~~
1	Fine-Med Sand Poorly Sorted w/ Gravel, Brick, Shell, Glass	Damp
4	silty, Sandy, Clay	
6	Soft Lt Brown Clayey Silt w/ slag, glass, gravel	Damp
10	Fine-Med Sand w/ Fine Gravel Glass. Pinkish Brown	Moist

10/13/05

MDE[illegible]RING LOG AND SAM[illegible]E DATA

HOLE No.: SB 104
SURFACE CONDITIONS: Woods
WEATHER: Cloudy 64° F
PROJECT No.: CC-82M
PROJECT SITE: Warner St - Wetlands
GEOLOGIST: Paul Walker

LOCATION

DRILLER
DATE END
DATE START

0	Dk Brown - Black Silt	
0.5	Poorly Sorted Brown Silty Clayey Gravelly Fine to Medium Sand w/ shell fragments, wood, slag	Damp
4	Concrete, marble,	
	Lt Brown Poorly Sorted Fine Sandy w/ Fine Gravel (Rounded) mixed w/ Angular Gravel, Shells Slag	Dry
8	Shell Sand Weathered Brick Poorly Sorted Silty, Clayey, Gravelly Coal	Dry
10		
11.5	Black Poorly Sorted Silty Sandy Gravel No Hydro Odor	Moist

10/13/05

MODIFIED BORING LOG AND SAMPLE DATA

HOLE No.: SB 204

SURFACE CONDITIONS: Grass

WEATHER: Cloudy 64°F

PROJECT No.: CC-82 M

PROJECT SITE: Warner St. Wetland

GEOLOGIST: Bob Wallace

LOCATION

DRILLER

DATE END

DATE START

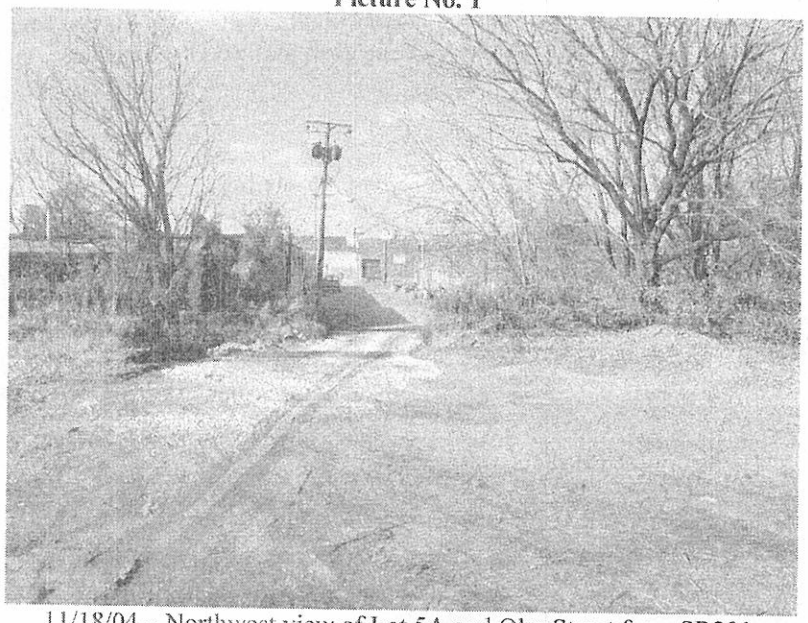
0		
0.5	Dk Brown Clay Silt w/ oyst shells, Brick, Gravel	(Moist)
	Lt to Dk Brown Poorly Sorted Fine Sandy Clayey Silt w/ Coarse Gravel - Fine Gravel	(Damp)
6.5	Bricks, Rocks, Slag, Slate, Marble, Glass	
11.5	Dk Grey to Black Very Angular slag Gravel on top of Orange/Pink Clayey Fine Sand No Odor	(Moist at 10') (Wet)

APPENDIX B

SITE PHOTOGRAPHS

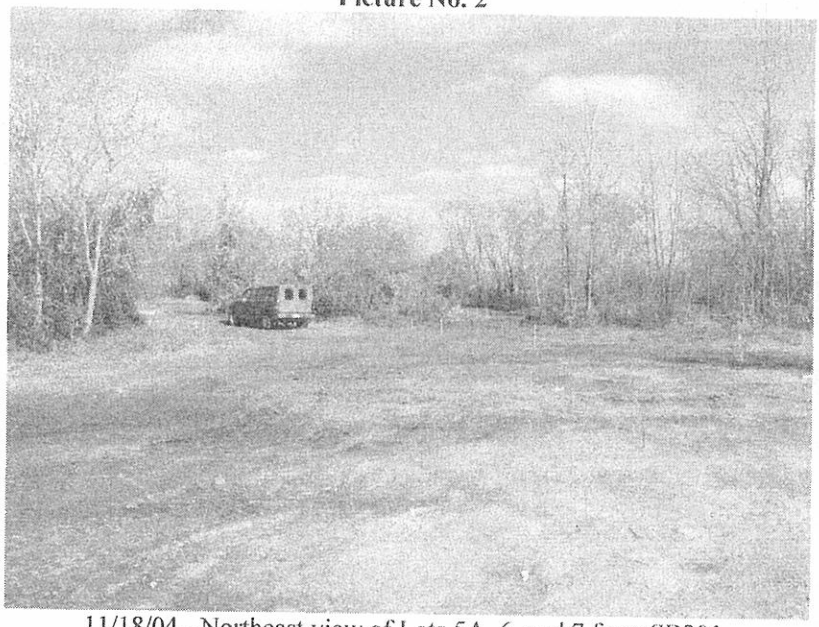
Pictures of Warner Street Wetlands

Picture No. 1



11/18/04 – Northwest view of Lot 5A and Oler Street from SB201.

Picture No. 2



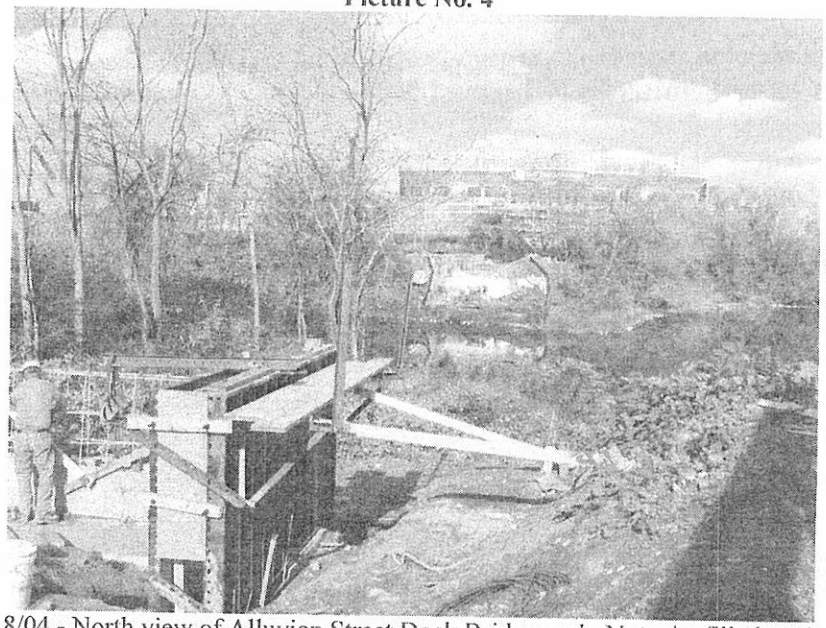
11/18/04 - Northeast view of Lots 5A, 6, and 7 from SB201.

Picture No. 3



11/18/04 - West view of construction debris near SB202.

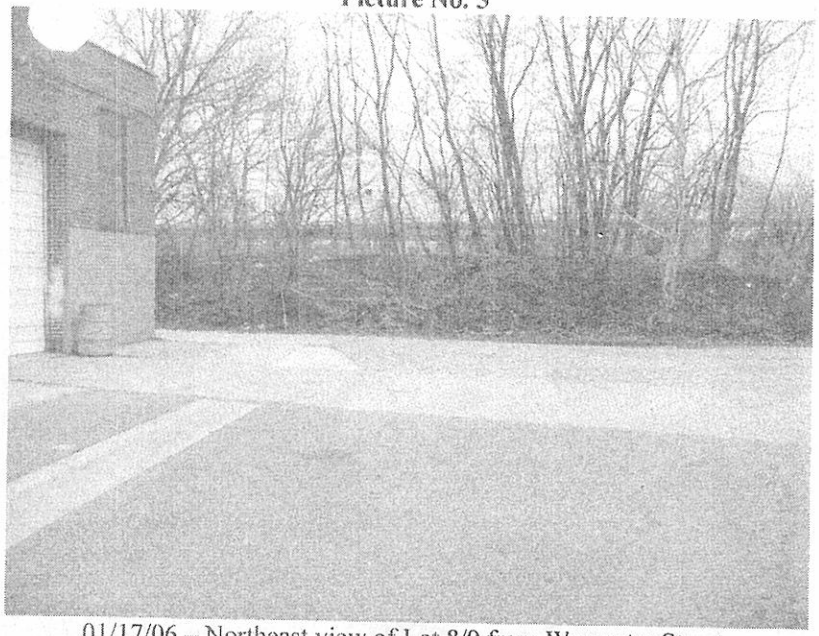
Picture No. 4



11/18/04 - North view of Alluvion Street Dock Bridgework. Note the fill elevation is approximately 12 to 15 feet over mean sea level.

Pictures of Warner Street Wetlands (continued)

Picture No. 5



01/17/06 – Northeast view of Lot 8/9 from Worcester Street. Note the fill height is approximately 6- to 7-foot over Worcester Street.

Picture No. 6



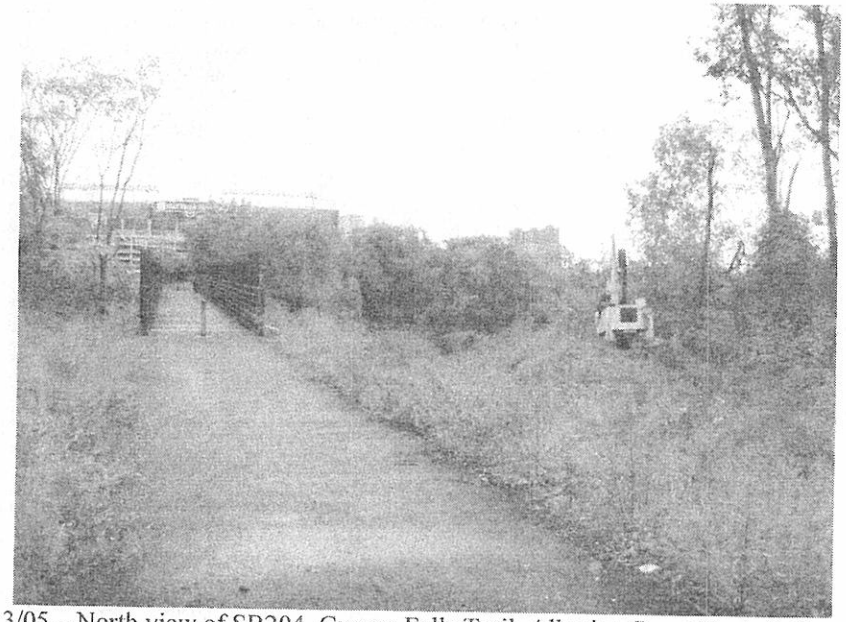
01/17/06 – Northeast view of Lot 5A from cancelled boring SB101. Note the fill height is approximately 12 feet above SB101, which is ~3 feet above mean sea level.

Picture No. 7



10/12/05 – South view of 32-foot deep boring and piezometer SB202. Groundwater encountered at 3 feet below ground surface is considered perched groundwater.

Picture No. 8



10/13/05 – North view of SB204, Gwynn Falls Trail, Alluvion Street Dock Bridge, and M&T Bank Stadium.

APPENDIX C

FIELD SCREENING RESULTS

Table 1.0
Metals Screening Results
X-Ray Fluorescence
Warner Street Wetlands

Concentrations presented in PPM.

Lot			Lot 5A															
Metal	**MDE Soil NR Std**	**Ind RBC**	**SB 201 0 ft**	**SB 201 3 ft**	**SB 201 6 ft**	**SB 201 10 ft**	**SB 301 0 ft**	**SB 301 3 ft**	**SB 301 6 ft**	**SB 301 10 ft**	**SB 401 0 ft**	**SB 401 3 ft**	**SB 401 6 ft**	**SB 401 10 ft**	**SB 501 0 ft**	**SB 501 3 ft**	**SB 501 6 ft**	**SB 501 10 ft**
Antimony	82	410	25	2	6	15	12	12	2	5	35	19	15	25	nd	19	7	8
Arsenic	3.8	1.9	**27**	[redacted]	**57**	**37**	**20**	**39**	nd	nd	**75**	**72**	**22**	**87**	**33**	**32**	**55**	**11**
Barium	14,000	72,000	266	277	1,423	423	186	383	409	618	565	682	478	1,142	328	668	679	496
Cadmium	100	1,000	1.8	0.9	12.1	6.4	1.2	3.4	2.7	8.2	12.4	6.9	2.4	17.6	0.7	7.1	nd	nd
Chromium	610	3100	211	258	**1,948**	**628**	207	538	168	258	**939**	**731**	516	414	310	458	**664**	**827**
Copper	8,200	41,000	278	95	337	317	103	229	75	213	528	385	99	374	118	160	424	175
Iron	61,000	310,000	69,850	35,760	56,910	58,230	33,520	73,610	47,550	52,510	74,970	71,440	52,020	90,790	36,820	51,240	65,400	58,760
Lead	400	NA	**554**	192	**812**	**731**	312	**556**	305	**988**	**1,354**	**1,158**	318	**1,985**	**423**	**533**	**841**	389
Manganese	4,100	20,000	496	546	699	748	417	592	479	440	**1,589**	1,211	1,121	**11,850**	610	803	950	1,251
Mercury	0.12	NA	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Nickel	4,100	20,000	nd	33.8	51.9	71.9	1.2	nd	34.6	82.1	68.7	nd	57.4	152.3	57.1	nd	62.8	nd
Selenium	1,000	5,100	nd	nd	nd	nd	nd	2.3	nd	0.5	4.8	nd	0.8	2.1	nd	3.1	nd	2.6
Silver	1,000	5,100	2.6	2.1	5.4	2.2	nd	nd	nd	4.0	nd	4.3	nd	nd	0.8	nd	nd	1.5
Thallium	14	72	1.5	0.4	2.0	nd	nd	0.7	nd	nd	2.6	1.1	0.8	0.2	nd	nd	nd	0.3
Vanadium	1,400	1,000	142	77	258	195	111	86	91	122	349	388	293	326	175	238	243	276
Zinc	64,000	31,000	524	198	7,623	2,387	364	1,517	353	834	1,388	1,132	363	3,919	461	502	1,140	372

Notes: PPM - Parts Per Million

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

[redacted]

Samples selected for fixed-laboratory analysis.

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency

RBC - Risk Based Concentration Std - Standard

NR - Non-residential, nd - non-detect

NA – Not available, SB - Soil boring

Red Numbers - Highest concentration

Blue Numbers - 2nd highest concentration

Table 1.0
Metals Screening Results
X-Ray Fluorescence
Warner Street Wetlands

Concentrations presented in PPM.

Lot																			
Metal	**MDE Soil NR Std**	**Ind RBC**	**SB 102 0 ft**	**SB 102 3 ft**	**SB 102 6 ft**	**SB 102 10 ft**	**SB 202 0 ft**	**SB 202 3 ft**	**SB 202 6 ft**	**SB 202 10 ft**	**SB 202 32 ft**	**SB 302 0 ft**	**SB 302 3 ft**	**SB 302 6 ft**	**SB 103 0 ft**	**SB 103 3 ft**	**SB 103 6 ft**	**SB 103 10 ft**	**SB 303 0 ft**
Antimony	82	410	19	38	39	45	15	11	17	7	nd	9	34	7	14	22	25	9	86
Arsenic	3.8	1.9		**32**	**47**	**26**	**22**	**13**	**47**	**17**	**18**	**23**	**72**	nd	**34**	**35**	**37**	**32**	**80**
Barium	14,000	72,000	518	640	1,003	797	326	292	449	332	521	594	1,520	508	428	468	439	319	728
Cadmium	100	1,000	4.2	nd	5.3	0.8	1.2	3.8	7.5	1.3	1.9	2.2	15.3	1.2	0.9	2.4	2.8	2.6	11.6
Chromium	610	3100	462	447	**625**	392	282	243	**696**	445	171	193	**1,081**	225	166	263	199	165	**818**
Copper	8,200	41,000	148	252	315	164	133	81	619	244	74	172	685	127	116	197	176	178	437
Iron	61,000	310,000	33,910	44,510	41,950	38,330	40,530	39,640	61,010	45,840	65,670	67,390	85,800	51,450	43,370	39,910	41,730	35,710	79,170
Lead	400	NA	**1,696**	**1,768**	**3,171**	**1,392**	338	162	**746**	**411**	21	**487**	**1,117**	354	**406**	**955**	**635**	**1,004**	**1,191**
Manganese	4,100	20,000	455	623	408	397	648	526	652	589	415	639	759	462	457	464	421	303	**1,424**
Mercury	0.12	NA	nd	nd	nd	nd	nd	nd	nd	nd	**8.0**	nd	nd	nd	nd	nd	nd	nd	nd
Nickel	4,100	20,000	27.7	nd	nd	nd	32.1	24.9	67.2	43.9	67.5	69.8	49.4	46.8	nd	47.9	72.8	21.7	67.3
Selenium	1,000	5,100	4.0	nd	nd	0.4	1.2	3.9	4.8	nd	3.3	4.5	nd	nd	nd	nd	5.9	1.0	4.2
Silver	1,000	5,100	2.8	nd	7.8	0.4	4.9	5.3	3.7	0.1	8.2	nd	1.1	3.8	5.0	0.8	1.5	nd	0.9
Thallium	14	72	nd	nd	nd	nd	nd	nd	0.1	nd	0.9	0.9	nd	nd	nd	0.6	nd	0.5	nd
Vanadium	1,400	1,000	144	234	137	188	149	75	196	157	140	152	206	95	121	116	161	97	330
Zinc	64,000	31,000	665	1,001	1,050	857	479	203	2,445	1,058	149	640	4,619	2,922	434	699	685	880	1,408

Notes: PPM - Parts Per Million

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

Samples selected for fixed-laboratory analysis.

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency

RBC - Risk Based Concentration Std - Standard

NR - Non-residential, nd - non-detect

NA – Not available, SB - Soil boring

Red Numbers - Highest concentration

Blue Numbers - 2nd highest concentration

Table 1.0
Metals Screening Results
X-Ray Fluorescence
Warner Street Wetlands

Concentrations presented in PPM.

Lot																		
Metal	MDE Soil NR Std	Ind RBC	SB 303 3 ft	SB 303 6 ft	SB 303 10 ft	SB 104 0 ft	SB 104 3 ft	SB 104 6 ft	SB 104 10 ft	SB 203 0 ft	SB 203 3 ft	SB 203 6 ft	SB 203 10 ft	SB 204 0 ft	SB 204 3 ft	SB 204 6 ft	SB 204 10 ft
Antimony	82	410	84	82	42	9	11	15	4	nd	4	3	19	**92**	22	16	5
Arsenic	3.8	1.9	**46**	**71**	**124**	**16**	**27**	**24**	**20**	**17**	**15**	**20**	**42**	**103**	**38**	**22**	**51**
Barium	14,000	72,000	889	888	1,080	273	225	377	276	478	442	334	424	692	494	732	486
Cadmium	100	1,000	8.4	5.0	5.1	0.6	nd	4.7	2.1	6.5	0.0	3.5	2.7	7.1	3.8	1.7	5.4
Chromium	610	3100	**871**	**786**	593	150	195	171	117	138	174	223	**700**	257	229	223	134
Copper	8,200	41,000	543	445	457	121	188	183	146	191	74	109	538	601	366	185	118
Iron	61,000	310,000	77,530	76,780	67,580	34,900	32,450	33,510	32,770	50,620	36,870	37,020	57,790	188,230	54,340	37,690	34,790
Lead	400	NA	**1,307**	**1,257**	**2,334**	305	**483**	**578**	**648**	**428**	364	228	**767**	**894**	**977**	**1,348**	**534**
Manganese	4,100	20,000	1,313	1,366	481	403	334	292	246	364	472	488	645	625	360	360	451
Mercury	0.12	NA	nd	nd	nd	nd	nd	**3.4**	**13.7**	nd	**3.4**	nd	nd	nd	**2.7**	nd	nd
Nickel	4,100	20,000	53.8	60.3	13.8	35.7	10.7	59.8	22.7	nd	nd	6.6	93.9	nd	nd	nd	50.0
Selenium	1,000	5,100	4.1	nd	4.3	1.5	0.6	nd	nd	3.5	5.0	nd	3.6	nd	nd	nd	2.8
Silver	1,000	5,100	0.0	nd	8.0	4.6	nd	nd	nd	nd	nd	nd	6.4	4.0	nd	5.8	nd
Thallium	14	72	nd	nd	1.6	nd	nd	nd	1.0	nd	nd	nd	nd	nd	nd	nd	nd
Vanadium	1,400	1,000	376	391	448	103	95	129	108	136	128	85	252	146	101	126	75
Zinc	64,000	31,000	1,502	1,268	2,390	314	515	524	420	740	317	323	2,540	1,575	860	714	1,289

Notes: PPM - Parts Per Million

Indicates concentration > EPA and MDE comparison values.

Indicates concentration > MDE, but < EPA comparison values.

Samples selected for fixed-laboratory analysis.

MDE - Maryland Department of the Environment

EPA - Environmental Protection Agency

RBC - Risk Based Concentration Std - Standard

NR - Non-residential, nd - non-detect

NA – Not available, SB - Soil boring

Red Numbers - Highest concentration

Blue Numbers - 2nd highest concentration

APPENDIX D

TOXICOLOGICAL EVALUATION

Warner Street Wetlands
Baltimore City, Maryland
Toxicological Evaluation

Summary

This toxicological evaluation examines the human health risks associated with the Warner Street Wetlands property located in Baltimore City, Maryland. This site was evaluated for child visitor (1-6 years), youth visitor (6-17), adult worker and construction worker populations under a commercial future use scenario. This toxicological evaluation evaluates risks to commercial use populations only. Residential use scenarios are expected to have greater levels of risk and should be evaluated to reflect appropriate land use scenarios. The United States Environmental Protection Agency (EPA) has recommended default exposure parameters that were used to estimate cumulative risk from all chemicals (1, 2, and 3). EPA recognizes as an acceptable Hazard Index (HI) values less than or equal to 1 (noncarcinogenic chemicals) and excess lifetime cancer risk (CR) less than or equal to 10^{-6} to 10^{-4}. The Maryland Department of the Environment (MDE) recognizes as an acceptable HI values less than or equal to 1 and excess lifetime cancer risk less than or equal to 10^{-6} to 10^{-5}. Risks to ecological receptors were evaluated by comparing groundwater contaminant concentrations to ambient surface water quality criteria. Based on these exposures, estimated risks at the site were compared to MDE and EPA recommended levels, and the following conclusions were reached:

Summary table of Hazard Indices (HI) values and Cancer Risk (CR) values for commercial populations using maximum detected concentrations

Noncarcinogenic Endpoints Detected Contaminants Only			
Population	**Pathway**	**Hazard Index**	**Risk Drivers**
Child visitor	Ingestion-subsurface soil	2	Potential additive effects
Construction worker	Ingestion-subsurface soil	2	Potential additive effects
Child visitor	Dermal Contact-surface soil	2	Potential additive effects
Carcinogenic Endpoints Detected Contaminants Only			
Population	**Pathway**	**Cancer Risk**	**Risk Drivers**
Child visitor	Ingestion-surface soil	2.7×10^{-5}	Arsenic
Youth visitor	Ingestion-surface soil	1.0×10^{-5}	Arsenic
Adult worker	Ingestion-surface soil	1.1×10^{-5}	Arsenic
Child visitor	Ingestion-subsurface soil	2.7×10^{-5}	Arsenic, benzo(a)pyrene
Youth visitor	Ingestion-subsurface soil	1.0×10^{-5}	Potential additive effects
Adult worker	Ingestion-subsurface soil	1.1×10^{-5}	Potential additive effects
Child visitor	Dermal contact-subsurface soil	1.1×10^{-5}	Potential additive effects

Summary table of Hazard Indices (HI) values and Cancer Risk (CR) values for commercial populations utilizing 95% UCL concentrations (soil only)

Noncarcinogenic Endpoints Detected Contaminants Only			
Population	**Pathway**	**Hazard Index**	**Risk Drivers**
N/A	N/A	N/A	N/A
Carcinogenic Endpoints Detected Contaminants Only			
Population	**Pathway**	**Cancer Risk**	**Risk Drivers**
Child visitor	Ingestion-subsurface soil	1.8×10^{-5}	Arsenic

N/A= Not applicable; no detected noncarcinogenic contaminants exceeded MDE or EPA recommended risk levels utilizing 95% UCL concentrations.

Site Description

The Warner Street Business and Wetland Areas are located in the midst of roughly 500 acres of industrial land at the southern gateway to the City and downtown Baltimore. The 15.52 acres of property incorporates 17 parcels of land currently owned by five entities. Russell Street bounds the Warner Street Business Center area on the West, Ostend Street on the North, Hamburg Street Viaduct on the South and the Middle Branch of the Patapsco River on the East. Nine of 17 parcels under consideration are occupied at this time. The remaining eight parcels are either unoccupied or undeveloped. The four unoccupied parcels are located in the rectangle defined by Warner, Oler, Shell (formerly S. Eutaw Street), and Worcester Streets. These parcels show signs of distress with evidence of vandalism to both the buildings and public spaces. Graffiti covers various walls, windows are broken, doors have been breached and fires have been set on building grounds and in the middle of the street. Tenants occupy the buildings on six of the 17 parcels. Maryland Chemical Company occupies the three Russell Street parcels. Signs on the building at 1501 Warner Street indicate that it is occupied by Bayfair Warehouses. Baltimore Cycle Salvage occupies 1629 Warner Street. Second Chance, an architectural resale business, occupies 1633 and 1645 Warner Street. Signage on 2102 Oler Street indicated that it is occupied by Baltimore Renovations, Inc. Dating back to at least 1890, the area has been primarily industrial in nature. Sanborn Fire Insurance Maps of the era detail wharves, an icehouse, coal yards, a chemical manufacturer, glass manufacturing plants, a brass foundry, a distillery and a malt house scattered along the Warner Street corridor. In the more recent past, a number of small businesses, storage companies, industrial-printing concerns, and a wholesale chemical distribution company have operated in the area. Other sections of the Warner Street corridor consist of vacant land parcels currently covered with vegetation ranging from grass to trees. The Ransteads wharves and the Biemiller Coal and Wood Wharf and Ice House (later the American Ice Station) occupied the 2110 and 2119 Haines Street properties from the 1890s through 1953. The Gibson and Kirk Foundry occupied the 1633 through 1645 Warner Street properties from a period after 1915 through 1953. In the 1890s the property bounded by Wooster (Worcester), Warner, Shell (S. Eutaw), and Oler (Dock) Streets housed the C.F. Ranstead Baltimore Cedar Co. From 1902 through 1953 the J. B. Macneal and Company Varnish and Color Works operated out of buildings on this property. In 1953 this property housed both J. B. Macneal and Gordon Carton. Macneal occupied the northwestern quadrant and Gordon the southeastern. In 1901, a marble storage facility owned by the Evans Marble Company occupied the area bounded by the Middle Fork Patapsco River, Bayard Dock and Shell (S. Eutaw) and Oler (Dock) Streets (Lot 5). This storage area was not depicted in Sanborn Maps from 1890 or 1915. No activities for this area were noted in the 1953 Sanborn Map. Sometime after 1890 and before 1915, coal bins owned by the Consumer Wood and Coal Company occupied the area bounded by the Middle Fork Patapsco River to the east, Oler (Dock) Street to the south, Shell (S. Eutaw) Street to the west and an extended southeastern line formed by the continuation of the northeastern side of Worcester Street (Lots 6, 7, and 8). No activities for this area were noted in the 1953 Sanborn Map. The property northeast of the Alluvion Street Slip housed Baker Brothers Glass Company and the Marr Malting Company from 1890

through 1915. The map from 1953 has the Holtite Rubber Cement Mill occupying the property.

In 2001 MDE conducted a site investigation of the Warner Street Wetlands property. Soil, sediment, and groundwater samples were collected as part of the investigation. Analytical results in soil and sediment indicated the presence of metals and SVOCs at concentrations above Maryland State Residential Cleanup standards, however only metals were present in the groundwater samples.

The City of Baltimore, in partnership with the U.S. Army Corps of Engineers (USACE), is planning a major environmental and economic revitalization of the Middle Branch of the Patapsco River. As part of the revitalization plan, it is proposed that contiguous lots 5A, 6, 7 and 8/9 of the Warner Street properties be restored to a viable wetlands ecosystem (Figure 2.1). The current restoration plan calls for the removal and disposal of the first six feet of soil/fill, which is composed of debris associated with the Great Baltimore Fire of 1904. The properties will then be covered with approximately two feet of clean fill. Appropriate wetland vegetation will be planted and the Gwynns Falls Trail will be extended through the wetland as a boardwalk thereby transforming the former industrial waterfront into a more people-friendly park setting.

The depth to groundwater is estimated to be approximately 3 to 7 feet. The nearest surface water body is the Patapsco River. Municipal water and sanitary sewer services are provided to the site and the vicinity. No drinking water wells are located within ½ mile of the site.

1.0 Method

In evaluating risk to human health, maximum concentrations of all chemicals detected in soil and groundwater were compared to medium-specific screening levels (EPA Region III Risk Based Concentration values and Maryland Department of the Environment Cleanup Standards). Chemicals that exceeded human health Risk Based Concentration (RBC) values were then evaluated quantitatively. Relevant toxicological data and RBC values from surrogate compounds (structurally similar analogues) were used for some of the chemicals with no corresponding RBC value. Soil and groundwater samples were collected from several locations on the site. The evaluation of groundwater was performed as if the water were being used as drinking water.

1.1 Human Health

Maximum concentrations of all chemicals detected in soils (dry weight values) were compared to the EPA Region III Risk Based Concentrations (RBC) for residential soil (4). Comparison of dry weight analytical values to the RBCs is recognized as a conservative measure but provides consistency in risk assessments across sites (with variable soil moisture content) and sampling time. Groundwater concentrations were compared to the EPA Region III Risk Based Concentrations (RBCs) for tap water. Prior to comparison with each chemical concentration noncarcinogenic RBCs were multiplied

by 0.1 to account for any additivity of systemic effects. Carcinogenic RBC values were not adjusted and represent a target risk level of 10^{-6}. Carcinogenic and noncarcinogenic risk levels for all contaminants that exceeded their respective RBC screening level were evaluated quantitatively. The quantitative evaluation was based on expected future use and development scenarios and includes populations typically expected to frequent the site based on this proposed future use.

The future land use at the site was assumed to be commercial; therefore, the commercial exposure scenario was used to evaluate risk at the site. The contaminants identified at the site at concentrations that exceeded residential RBCs were further evaluated with regard to risk to relevant populations under the following scenarios (1, 2, 3, and 7):

Commercial Development:

Surface/Subsurface Soil:

Adult Worker: 70 kg body weight, 3280 cm^2 skin surface area (soil), 250 days per year exposure for soil ingestion, 50 mg soil ingested per day, 8 hours inhalation, 0.05 mg/cm^2-event soil to skin adherence factor. 1 m^3/hour inhalation rate, 25-year exposure duration, 70-year lifetime.

Construction Worker: 70 kg body weight, 3280 cm^2 skin surface area (soil), 0.05mg/cm^2-event soil to skin adherence factor, 250 days per year exposure for soil ingestion, 480 mg soil ingested per day, 1.5 m^3/hour inhalation rate, 8 hour exposure time (inhalation soil), 1 year exposure duration, 70 year lifetime.

Youth (6 - 17 years) Visitor: 40 kg body weight, 4320 cm^2 skin surface area (soil), 0.02mg/cm^2-event soil to skin adherence factor, 132 days per year soil ingestion, 100 mg soil ingested per day, 0.56 m^3/hour inhalation rate, 4 hours inhalation exposure, 12 year exposure duration, 70 year lifetime.

Child (1 - 6 years) Visitor: 15 kg body weight, 2350 cm^2 skin surface area (soil), 0.06mg/cm^2-event soil to skin adherence factor, 132 days per year soil ingestion, 200 mg soil ingested per day, 0.32 m^3/hour inhalation rate, 4 hour inhalation exposure, 6 year exposure duration, 70 year lifetime.

Groundwater:

Adult Worker: 70 kg body weight, 1 liter drinking (ground) water ingested per day, 5670 cm^2 skin surface area, 250 days per year drinking (ground) water ingestion, 25-year exposure duration, 70 year lifetime.

Construction Worker: 70 kg body weight, 5670 cm^2 skin surface area (groundwater), 250 days per year drinking (ground) water ingestion, 3 liter drinking (ground) water ingested per day, 1 year exposure duration, 70 year lifetime.

Youth (6 - 17 years) Visitor: 40 kg body weight, 13100 cm^2 skin surface area (groundwater), 132 days per year drinking (ground) water ingestion, 2 liter drinking (ground) water ingested, 12 year exposure duration, 70 year lifetime.

Child (1 - 6 years) Visitor: 15 kg body weight, 6560 cm^2 skin surface area (groundwater), 132 days per year drinking (ground) water ingestion, 1 liter drinking (ground) water ingested, 6 year exposure duration, 70 year lifetime.

2.0 Human Health Evaluation

Groundwater and soil samples were analyzed for SVOCs and metals. Chemicals that were detected on site were compared to medium-specific screening levels (EPA Region III RBC values). Chemicals that were not detected at the site and exceeded RBC values (at an assumed concentration of one half the detection level) were carried through the quantitative risk assessment and were included in the summation of noncarcinogenic hazard quotients and carcinogenic cancer risk values for comparative purposes only. Chemicals detected at the site that exceeded human health RBC values were evaluated quantitatively using the maximum detected concentration as the site-wide average concentration. 95% upper confidence level (95 % UCL) concentrations were calculated for those chemicals identified as risk drivers in the quantitative evaluation and an additional quantitative evaluation performed utilizing the 95% UCL concentrations as the site-wide average concentrations. 95% UCL concentrations were only calculated for the subsurface soil sampling data set. 95% UCL concentrations were not calculated for the surface soil data set due to an insufficient number of surface soil samples, consequently, the maximum detected concentrations were used as the site-wide average concentrations for surface soil exposure pathways. Characterization of the mercury contamination on site was limited to total mercury analysis, therefore, mercury was evaluated on site as inorganic mercury, methyl mercury and mercuric chloride.

No RBC values were available for 4-bromophenyl phenyl ether, 4-chloro-3-methylphenol, 4-chlorophenyl phenyl ether, bis (2-chloroethoxy) methane, and 3,4-methylphenol. were not detected in any medium on site. Based on historical site operations and the non-detection of these chemicals they were not considered further qualitatively or quantitatively in the risk assessment. Magnesium, calcium, potassium, iron and sodium are essential nutrients that may be present on site and are toxic only at very high concentrations. These compounds are found naturally in the soil of this geographic region; therefore, they are not included in the quantitative risk estimates.

The EPA has issued a directive for lead that recommends a soil screening level of 400 mg/kg for residential scenarios at RCRA facilities and CERCLA sites; the 400-mg/kg soil screening level was used in this evaluation for soil (5).

2.1 Soil

Soil samples from the site were analyzed for SVOCs and metals. Contaminants that were detected above their respective commercial soil RBCs (i.e. failed the initial screening

process, see Attachment A) were evaluated quantitatively. Surface and subsurface soil exposures were evaluated via the ingestion, inhalation, dermal contact and vapor intrusion of volatiles to indoor air pathways. Reference dose (RfD) and cancer slope factor (CSF) values were obtained from EPA Region III and IRIS (4, 6). Estimates of noncarcinogenic and carcinogenic risks from dermal contact were calculated when sufficient data (permeability constants (8), oral absorption efficiencies and dermal absorption factors (9)) were available.

2.2 Groundwater

Groundwater samples from the site were analyzed for VOCs, SVOCs, PCBs, select pesticides and herbicides and metals. Contaminants that were detected above their respective RBC screening level (Attachment A) were evaluated quantitatively for risk. Groundwater exposures were evaluated via the ingestion, dermal contact, and vapor intrusion of volatiles to indoor air pathways. Estimates of noncarcinogenic and carcinogenic risks from dermal contact were calculated when sufficient data (permeability constants (8), oral absorption efficiencies and dermal absorption factors (9)) were available. Organic and inorganic contaminants detected in groundwater were also compared to their corresponding MCL (Maximum Contaminant Level). Additionally, groundwater contaminant concentrations were compared to Maryland's ambient water quality standards (AWQS) and EPA's recommended ambient water quality criteria (AWQC) for the protection of aquatic life and human health.

2.3 Vapor Intrusion

All volatile and semivolatile contaminants detected in soil and groundwater samples at the site were quantitatively evaluated for vapor intrusion using the Johnson and Ettinger Tier I vapor intrusion model (11).

2.4 MDE Cleanup Standards Screen

All soil and groundwater samples collected on site were compared to the MDE *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater* Interim Final Guidance, August 2001 (12).

3.0 Conclusion

3.1 Soil

The estimated risks from the incidental ingestion of detected noncarcinogenic surface soil contaminants were below MDE and EPA recommended levels for all commercial populations (Tables 1 through 1MERC). The estimated risks from the incidental ingestion of detected carcinogenic surface soil contaminants exceeded MDE recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations (Table 2). Arsenic was the primary carcinogenic risk driver for the affected populations. The estimated risks from the incidental ingestion of detected carcinogenic

surface soil contaminants were within MDE recommended risk ranges for the construction worker commercial population and EPA recommended risk ranges for all commercial populations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants exceeded MDE and EPA recommended levels for the child visitor and construction worker commercial populations (Tables 3 through 3MERC) utilizing the maximum detected concentrations as the site-wide average concentrations. Potential additive effects were the noncarcinogenic risk drivers for the affected populations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended levels for the youth visitor and adult worker commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended levels for all commercial populations (Table 3UCL) utilizing the 95% UCL concentrations as the site-wide average concentrations. The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations (Table 4) utilizing the maximum detected concentrations as the site-wide average concentrations. Arsenic was the primary carcinogenic risk driver for the affected populations. The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants were within MDE recommended risk ranges for the construction worker commercial population and EPA recommended risk ranges for all commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations. The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population (Table 4UCL) utilizing the 95%UCL concentrations as the site-wide average concentrations. Arsenic was the primary carcinogenic risk driver for the affected population. The estimated risks from the incidental ingestion of detected carcinogenic subsurface soil contaminants were within MDE recommended risk ranges for the child visitor, youth visitor and construction worker commercial populations and EPA recommended risk ranges for all commercial populations utilizing the 95% UCL concentrations as the site-wide average concentrations.

The estimated noncarcinogenic and carcinogenic risk levels from the inhalation of detected and nondetected volatiles and fugitive dust from surface and subsurface soils were within acceptable levels as recommended by MDE and EPA for all commercial populations using both the maximum detected concentrations and the 95% UCL concentrations as the site-wide average concentrations (Tables 5 through 8).

Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants exceeded MDE and EPA recommended levels for the child visitor population (Tables 9 through 9MERC) utilizing the maximum detected concentrations as the site-wide average concentrations. Potential additive effects were the noncarcinogenic risk drivers for the affected commercial population. Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants were within MDE and EPA recommended risk

levels for the youth visitor, adult worker and construction worker commercial populations utilizing the maximum detected concentrations as the site-wide average concentrations. Carcinogenic risk estimates for dermal exposure to detected surface soil contaminants were within MDE and EPA recommended risk ranges for all commercial populations (Table 10) utilizing the maximum detected concentrations as the site-wide average concentrations. Risk estimates for dermal exposure to detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended levels for all commercial populations utilizing both the maximum detected concentrations and the 95% UCL concentrations as the site-wide average concentrations (Tables 11 through 11UCL). Carcinogenic risk estimates for dermal exposure to detected subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population (Table 12) utilizing the maximum detected concentrations as the site-wide average concentrations. Potential additive effects were the primary carcinogenic risk drivers for the affected population. Carcinogenic risk estimates for dermal exposure to detected subsurface soil contaminants were within MDE recommended risk ranges for the youth visitor, adult worker and construction worker commercial populations and EPA recommended risk ranges for all commercial populations using maximum detected concentrations as the site-wide average concentrations. Carcinogenic risk estimates for dermal exposure to detected subsurface soil contaminants were within MDE and EPA recommended risk ranges for all commercial populations (Table 12UCL) utilizing both the maximum detected concentrations and 95% UCL concentrations as the site-wide average concentrations.

No RBC values for lead are available; however, the maximum concentration of lead detected in surface and subsurface soils on site exceeded the 400 mg/kg residential soil screening value. The arithmetic mean surface soil, subsurface soil and total soil lead concentrations on site were 577, 699 and 675 mg kg, respectively. Based on the available data, the concentrations of lead in soil may pose a threat to the health of sensitive populations and the environment in discrete locations on site.

3.2 Groundwater

Potential adverse effects from groundwater exposure were evaluated utilizing total and dissolved metals data on site. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels (Table 13) for all commercial populations using total metals data. Multiple noncarcinogenic contaminants were the noncarcinogenic groundwater incidental ingestion risk drivers. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels (Table 13DISS) for all commercial populations using dissolved metals data. Risk estimates from the incidental ingestion of detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges (Table 14) for all commercial populations and EPA recommended risk ranges for the youth visitor and adult worker commercial populations using total metals data. Arsenic was the incidental ingestion carcinogenic risk driver. Risk estimates from the incidental ingestion of detected

carcinogenic groundwater contaminants were within MDE and EPA recommended risk ranges (Table 14DISS) for all commercial populations using dissolved metals data.

Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for the adult worker and construction worker commercial populations (Table 15) using total metals data. Chromium was the noncarcinogenic dermal contact risk driver. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for the child and youth visitor commercial populations using total metals data. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants were within MDE and EPA recommended risk levels for all commercial populations (Table 15DISS) using dissolved metals data. Risk estimates for dermal contact with detected carcinogenic groundwater contaminants were within MDE and EPA recommended risk ranges for all commercial populations (Tables 16 and 16DISS) using total and dissolved metals data. The lack of calculable dermal hazard values for many of the contaminants of concern result from the limited availability of required physical constants (permeability constants (8), oral absorption efficiencies and dermal absorption factors (9)) for estimating carcinogenic and noncarcinogenic risk. The lack of critical physical constants and the methods for derivation of dermal exposures lead to a high degree of uncertainty associated with this route of exposure. This high degree of uncertainty should be considered when evaluating the hazards of dermal exposure to groundwater.

Groundwater contaminant concentrations (dissolved metals) were compared to available MCLs and SMCLs. One detected contaminant, manganese, and five nondetected contaminants exceeded their respective MCL or SMCL (Table 17DISS). Groundwater contaminant concentrations (dissolved metals) were also compared to available Maryland ambient water quality standards (AWQS) or EPA recommended ambient water quality criteria (AWQC). One detected groundwater contaminant (selenium) exceeded the AWQS or AWQC for the protection of aquatic life (acute or chronic) (Table 18DISS) and no detected contaminant exceeded the recommended AWQC for the protection of human health via fish consumption.

3.3 Vapor Intrusion

The risk from vapor intrusion of detected volatile and semivolatile contaminants in groundwater and soil into buildings was evaluated using the Johnson and Ettinger vapor intrusion model (Attachment B). No detected contaminant in groundwater on site exceeded a hazard index (HI) of 1 or a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air. Vapor intrusion from mercury contamination in both surface and subsurface soil exceeded a hazard index (HI) of 1 for commercial populations. No detected contaminant in soil on site exceeded a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air.

3.4 MDE Cleanup Standards Screen

The concentration of all chemicals analyzed in soil and groundwater were compared to their corresponding MDE non-residential cleanup standards (Attachment A). Multiple detected and nondetected contaminants exceeded their corresponding MDE groundwater cleanup standard. Three detected surface soil contaminants, arsenic, mercury and lead and five detected subsurface soil contaminants, arsenic, chromium, lead, mercury, and benzo(a)pyrene exceeded their recommended MDE non-residential soil cleanup standard. In order to further evaluate potential chromium risks the subsurface soil chromium samples with the highest detected chromium concentrations were speciated to determine if chromium present on site was hexavalent chromium (Cr VI) or trivalent chromium (Cr III). The additional analysis indicated no detectable hexavalent chromium above non-residential cleanup standards, therefore, chromium was not considerable as a contaminant of concern on site.

3.5 Evaluation Assumptions

When determining whether an increased risk to human health exists at this site, it is important to understand that this evaluation was prepared as a first level screening evaluation. Many conservative assumptions are included in this evaluation, which were developed with the understanding that if the estimated risk, using the conservative assumptions, does not exceed EPA's recommended levels, then the risk estimated using more realistic scenarios will not exceed these levels.

Since this evaluation includes many conservative assumptions, a risk that exceeds EPA's recommended level of risk does not necessarily indicate an increased risk to human health. When this situation occurs, it is necessary to consider several points when determining if the risk actually does represent a threat to human health. For example, the quantitative risk estimate in this evaluation assumes people will be exposed to a contaminant at the maximum concentration all throughout the site and for the entire exposure duration. These assumptions do not take into account whether the maximum concentration is anomalous or characteristic of the site, or that biodegradation, dispersion, dilution, or other factors may decrease the contaminant concentration throughout the time of exposure.

This evaluation also assumes that the bioavailability of each contaminant is 100 percent, and that all of the contaminant taken into the body is absorbed across the digestive tract into the body. A chemical is harmful to human health only if it is absorbed into the body. Assuming complete bioavailability does not consider the fact that it is common for a fraction of the chemical taken into the body to be excreted rather than absorbed into the body. The bioavailability of a contaminant is dependent on many factors, such as the state or form of the contaminant and if the actual size of the contaminant particle would permit incidental ingestion. These issues must be considered when evaluating the appropriateness of assuming total bioavailability of a contaminant.

4.0 References

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4. EPA, Region III. Risk-Based Concentration Table, April 7, 2005.

5. EPA. *Memorandum: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.* Office of Solid Waste and Emergency Response. OSWER Directive # 9355.4-12.

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9. EPA. Region III, 1995. *Technical Guidance Manual, Risk Assessment, Assessing Dermal Exposure from Soil.* EPA/903-K-95-003.

10. EPA. *User's Guide for the Johnson and Ettinger (1991) Model for subsurface Vapor Intrusion into Buildings.* June, 2003.

11. Maryland Department of the Environment. *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater.* Interim Final Guidance. August 2001.

TABLES

Table 1. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Surface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9100		1E+00	4E-03	4E-03	4E-02	4E-02	8E-03	8E-03	4E-02	4E-02
ANTIMONY	6.1		4E-04	3E-06	7E-03	3E-05	7E-02	6E-06	1E-02	3E-05	7E-02
ARSENIC	40		3E-04	2E-05	7E-02	2E-04	6E-01	4E-05	1E-01	2E-04	6E-01
CHROMIUM	92		3E-03	5E-05	2E-02	4E-04	1E-01	8E-05	3E-02	4E-04	1E-01
MANGANESE	270	J	2E-02	1E-04	7E-03	1E-03	6E-02	2E-04	1E-02	1E-03	7E-02
VANADIUM	41		1E-03	2E-05	2E-02	2E-04	2E-01	4E-05	4E-02	2E-04	2E-01
thallium	1.15	U	7E-05	6E-07	8E-03	5E-06	8E-02	1E-06	1E-02	6E-06	8E-02
Hazard Index for Detected Compounds Only:				Sum =	1.2E-01	Sum =	1.1E+00	Sum =	2.2E-01	Sum =	1.2E+00
Hazard Index for Nondetected Compounds Only:				Sum =	8.0E-03	Sum =	7.7E-02	Sum =	1.5E-02	Sum =	7.9E-02
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.3E-01	Sum =	1.2E+00	Sum =	2.3E-01	Sum =	1.3E+00

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
* Hazard quotient or hazard index exceeds 1.5.

Table 1MERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Surface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9100		1E+00	4E-03	4E-03	4E-02	4E-02	8E-03	8E-03	4E-02	4E-02
ANTIMONY	6.1		4E-04	3E-06	7E-03	3E-05	7E-02	6E-06	1E-02	3E-05	7E-02
ARSENIC	40		3E-04	2E-05	7E-02	2E-04	6E-01	4E-05	1E-01	2E-04	6E-01
CHROMIUM	92		3E-03	5E-05	2E-02	4E-04	1E-01	8E-05	3E-02	4E-04	1E-01
MANGANESE	270	J	2E-02	1E-04	7E-03	1E-03	6E-02	2E-04	1E-02	1E-03	7E-02
VANADIUM	41		1E-03	2E-05	2E-02	2E-04	2E-01	4E-05	4E-02	2E-04	2E-01
METHYLMERCURY	1.7		1E-04	8E-07	8E-03	8E-06	8E-02	2E-06	2E-02	8E-06	8E-02
thallium	1.15	U	7E-05	6E-07	8E-03	5E-06	8E-02	1E-06	1E-02	6E-06	8E-02
Hazard Index for Detected Compounds Only:				Sum =	1.3E-01	Sum =	1.2E+00	Sum =	2.3E-01	Sum =	1.3E+00
Hazard Index for Nondetected Compounds Only:				Sum =	8.0E-03	Sum =	7.7E-02	Sum =	1.5E-02	Sum =	7.9E-02
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.4E-01	Sum =	1.3E+00	Sum =	2.5E-01	Sum =	1.3E+00

ADD = average daily [illegible] (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
* Hazard quotient or [illegible] index exceeds 1.5.

Table 2. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Incidental Ingestion/Surface soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	40		2E+00	7E-06	1E-05	3E-06	4E-06	6E-06	9E-06	2E-05	2E-05
BENZO[A]PYRENE	0.55		7E+00	1E-07	7E-07	4E-08	3E-07	9E-08	6E-07	2E-07	2E-06
DIBENZO[A,H]ANTHRACENE	0.13	J	7E+00	2E-08	2E-07	9E-09	6E-08	2E-08	1E-07	5E-08	4E-07
Cancer Risk for Detected Compounds Only:				**Sum =**	**1.1E-05**	**Sum =**	**4.4E-06**	**Sum =**	**1.0E-05**	**Sum =**	**2.7E-05**
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**1.1E-05**	**Sum =**	**4.4E-06**	**Sum =**	**1.0E-05**	**Sum =**	**2.7E-05**

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.
* Cancer risk exceeds 10E-4.

Table 3. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		1E+00	5E-03	5E-03	4E-02	4E-02	8E-03	8E-03	5E-02	5E-02
ANTIMONY	7.4		4E-04	4E-06	9E-03	3E-05	9E-02	7E-06	2E-02	4E-05	9E-02
ARSENIC	25		3E-04	1E-05	4E-02	1E-04	4E-01	2E-05	8E-02	1E-04	4E-01
BARIUM	1300		7E-02	6E-04	9E-03	6E-03	9E-02	1E-03	2E-02	6E-03	9E-02
MANGANESE	2800	J	2E-02	1E-03	7E-02	1E-02	7E-01	3E-03	1E-01	1E-02	7E-01
VANADIUM	37		1E-03	2E-05	2E-02	2E-04	2E-01	3E-05	3E-02	2E-04	2E-01
ZINC	3200		3E-01	2E-03	5E-03	2E-02	5E-02	3E-03	1E-02	2E-02	5E-02
thallium	1.35	U	7E-05	7E-07	9E-03	6E-06	9E-02	1E-06	2E-02	7E-06	9E-02
Hazard Index for Detected Compounds Only:				Sum =	1.6E-01	Sum =	1.5E+00	Sum =	2.9E-01	Sum =	1.5E+00 *
Hazard Index for Nondetected Compounds Only:				Sum =	9.4E-03	Sum =	9.1E-02	Sum =	1.7E-02	Sum =	9.3E-02
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.6E-01	Sum =	1.6E+00 *	Sum =	3.0E-01	Sum =	1.6E+00 *

ADD = average daily [illegible]mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or [illegible]index exceeds 1.5.

Table 3MERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		1E+00	5E-03	5E-03	4E-02	4E-02	8E-03	8E-03	5E-02	5E-02
ANTIMONY	7.4		4E-04	4E-06	9E-03	3E-05	9E-02	7E-06	2E-02	4E-05	9E-02
ARSENIC	25		3E-04	1E-05	4E-02	1E-04	4E-01	2E-05	8E-02	1E-04	4E-01
BARIUM	1300		7E-02	6E-04	9E-03	6E-03	9E-02	1E-03	2E-02	6E-03	9E-02
MANGANESE	2800	J	2E-02	1E-03	7E-02	1E-02	7E-01	3E-03	1E-01	1E-02	7E-01
VANADIUM	37		1E-03	2E-05	2E-02	2E-04	2E-01	3E-05	3E-02	2E-04	2E-01
ZINC	3200		3E-01	2E-03	5E-03	2E-02	5E-02	3E-03	1E-02	2E-02	5E-02
METHYLMERCURY	3.7		1E-04	2E-06	2E-02	2E-05	2E-01	3E-06	3E-02	2E-05	2E-01
thallium	1.35	U	7E-05	7E-07	9E-03	6E-06	9E-02	1E-06	2E-02	7E-06	9E-02
Hazard Index for Detected Compounds Only:				Sum =	1.7E-01	Sum =	1.7E+00 *	Sum =	3.2E-01	Sum =	1.7E+00 *
Hazard Index for Nondetected Compounds Only:				Sum =	9.4E-03	Sum =	9.1E-02	Sum =	1.7E-02	Sum =	9.3E-02
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.8E-01	Sum =	1.8E+00 *	Sum =	3.4E-01	Sum =	1.8E+00 *

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 3MERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		1E+00	5E-03	5E-03	4E-02	4E-02	8E-03	8E-03	5E-02	5E-02
ANTIMONY	7.4		4E-04	4E-06	9E-03	3E-05	9E-02	7E-06	2E-02	4E-05	9E-02
ARSENIC	25		3E-04	1E-05	4E-02	1E-04	4E-01	2E-05	8E-02	1E-04	4E-01
BARIUM	1300		7E-02	6E-04	9E-03	6E-03	9E-02	1E-03	2E-02	6E-03	9E-02
MANGANESE	2800	J	2E-02	1E-03	7E-02	1E-02	7E-01	3E-03	1E-01	1E-02	7E-01
VANADIUM	37		1E-03	2E-05	2E-02	2E-04	2E-01	3E-05	3E-02	2E-04	2E-01
ZINC	3200		3E-01	2E-03	5E-03	2E-02	5E-02	3E-03	1E-02	2E-02	5E-02
MERCURIC CHLORIDE	3.7		3E-04	2E-06	6E-03	2E-05	6E-02	3E-06	1E-02	2E-05	6E-02
thallium	1.35	U	7E-05	7E-07	9E-03	6E-06	9E-02	1E-06	2E-02	7E-06	9E-02
Hazard Index for Detected Compounds Only:				**Sum =**	**1.6E-01**	**Sum =**	**1.5E+00 ***	**Sum =**	**3.0E-01**	**Sum =**	**1.6E+00 ***
Hazard Index for Nondetected Compounds Only:				**Sum =**	**9.4E-03**	**Sum =**	**9.1E-02**	**Sum =**	**1.7E-02**	**Sum =**	**9.3E-02**
Hazard Index for Detected and Nondetected Compounds:				**Sum =**	**1.7E-01**	**Sum =**	**1.6E+00 ***	**Sum =**	**3.2E-01**	**Sum =**	**1.7E+00 ***

ADD = average daily [illegible]mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or [illegible] index exceeds 1.5.

Table 3UCL. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		1E+00	5E-03	5E-03	4E-02	4E-02	8E-03	8E-03	5E-02	5E-02
ANTIMONY	7.4		4E-04	4E-06	9E-03	3E-05	9E-02	7E-06	2E-02	4E-05	9E-02
ARSENIC	18	UCL	3E-04	9E-06	3E-02	8E-05	3E-01	2E-05	5E-02	9E-05	3E-01
BARIUM	1300		7E-02	6E-04	9E-03	6E-03	9E-02	1E-03	2E-02	6E-03	9E-02
MANGANESE	2800	MAX	2E-02	1E-03	7E-02	1E-02	7E-01	3E-03	1E-01	1E-02	7E-01
VANADIUM	37		1E-03	2E-05	2E-02	2E-04	2E-01	3E-05	3E-02	2E-04	2E-01
ZINC	3200		3E-01	2E-03	5E-03	2E-02	5E-02	3E-03	1E-02	2E-02	5E-02
thallium	1.35	U	7E-05	7E-07	9E-03	6E-06	9E-02	1E-06	2E-02	7E-06	9E-02
Hazard Index for Detected Compounds Only:				**Sum =**	**1.4E-01**	**Sum =**	**1.4E+00**	**Sum =**	**2.7E-01**	**Sum =**	**1.4E+00**
Hazard Index for Nondetected Compounds Only:				**Sum =**	**9.4E-03**	**Sum =**	**9.1E-02**	**Sum =**	**1.7E-02**	**Sum =**	**9.3E-02**
Hazard Index for Detected and Nondetected Compounds:				**Sum =**	**1.5E-01**	**Sum =**	**1.5E+00**	**Sum =**	**2.8E-01**	**Sum =**	**1.5E+00 ***

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 3UCLMERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Incidental Ingestion/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		1E+00	5E-03	5E-03	4E-02	4E-02	8E-03	8E-03	5E-02	5E-02
ANTIMONY	7.4		4E-04	4E-06	9E-03	3E-05	9E-02	7E-06	2E-02	4E-05	9E-02
ARSENIC	18	UCL	3E-04	9E-06	3E-02	8E-05	3E-01	2E-05	5E-02	9E-05	3E-01
BARIUM	1300		7E-02	6E-04	9E-03	6E-03	9E-02	1E-03	2E-02	6E-03	9E-02
MANGANESE	2800	MAX	2E-02	1E-03	7E-02	1E-02	7E-01	3E-03	1E-01	1E-02	7E-01
VANADIUM	37		1E-03	2E-05	2E-02	2E-04	2E-01	3E-05	3E-02	2E-04	2E-01
ZINC	3200		3E-01	2E-03	5E-03	2E-02	5E-02	3E-03	1E-02	2E-02	5E-02
METHYLMERCURY	1.56	UCL	1E-04	8E-07	8E-03	7E-06	7E-02	1E-06	1E-02	8E-06	8E-02
thallium	1.35	U	7E-05	7E-07	9E-03	6E-06	9E-02	1E-06	2E-02	7E-06	9E-02
Hazard Index for Detected Compounds Only:				Sum =	1.5E-01	Sum =	1.5E+00	Sum =	2.8E-01	Sum =	1.5E+00
Hazard Index for Nondetected Compounds Only:				Sum =	9.4E-03	Sum =	9.1E-02	Sum =	1.7E-02	Sum =	9.3E-02
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.6E-01	Sum =	1.5E+00 *	Sum =	3.0E-01	Sum =	1.6E+00 *

ADD = average daily (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or index exceeds 1.5.

Table 4. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Incidental Ingestion/Subsurface soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	25		2E+00	4E-06	7E-06	2E-06	3E-06	4E-06	6E-06	1E-05	2E-05
BENZO[A]ANTHRACENE	2		7E-01	3E-07	3E-07	1E-07	1E-07	3E-07	2E-07	8E-07	6E-07
BENZO[A]PYRENE	2.9		7E+00	5E-07	4E-06	2E-07	1E-06	4E-07	3E-06	1E-06	9E-06
DIBENZO[A,H]ANTHRACENE	0.51		7E+00	9E-08	7E-07	3E-08	2E-07	8E-08	6E-07	2E-07	2E-06
INDENO[1,2,3-CD]PYRENE	1.6		7E-01	3E-07	2E-07	1E-07	8E-08	2E-07	2E-07	7E-07	5E-07
Cancer Risk for Detected Compounds Only:				**Sum =**	**1.1E-05**	**Sum =**	**4.4E-06**	**Sum =**	**1.0E-05**	**Sum =**	**2.7E-05**
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**1.1E-05**	**Sum =**	**4.4E-06**	**Sum =**	**1.0E-05**	**Sum =**	**2.7E-05**

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.
* Cancer risk exceeds 10E-4.

Table 4UCL. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Incidental Ingestion/Subsurface soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	18	UCL	2E+00	3E-06	5E-06	1E-06	2E-06	3E-06	4E-06	7E-06	1E-05
BENZO[A]ANTHRACENE	2		7E-01	3E-07	3E-07	1E-07	1E-07	3E-07	2E-07	8E-07	6E-07
BENZO[A]PYRENE	1.64	UCL	7E+00	3E-07	2E-06	1E-07	8E-07	3E-07	2E-06	7E-07	5E-06
DIBENZO[A,H]ANTHRACENE	0.39	UCL	7E+00	7E-08	5E-07	3E-08	2E-07	6E-08	4E-07	2E-07	1E-06
INDENO[1,2,3-CD]PYRENE	1.6		7E-01	3E-07	2E-07	1E-07	8E-08	2E-07	2E-07	7E-07	5E-07
Cancer Risk for Detected Compounds Only:				**Sum =**	**7.8E-06**	**Sum =**	**3.0E-06**	**Sum =**	**6.9E-06**	**Sum =**	**1.8E-05**
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**7.8E-06**	**Sum =**	**3.0E-06**	**Sum =**	**6.9E-06**	**Sum =**	**1.8E-05**

LADD = lifetime aver[illegible]ily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds

Table 5. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Inhalation of Volatiles and Fugitive Dust (Surface Soil).
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	PEF/VF	Adult Worker ADD	Adult Worker HQ	Construction Worker ADD	Construction Worker HQ	Youth Visitor ADD	Youth Visitor HQ	Child Visitor ADD	Child Visitor HQ
Particulate Emission:				PEF								
ALUMINUM	9100		1E-03	6.63E+08	1E-06	1E-03	2E-06	2E-03	3E-07	3E-04	4E-07	4E-04
CHROMIUM	92		3E-05	6.63E+08	1E-08	4E-04	2E-08	5E-04	3E-09	9E-05	4E-09	1E-04
MANGANESE	270	J	1E-05	6.63E+08	3E-08	2E-03	5E-08	3E-03	8E-09	6E-04	1E-08	9E-04
MERCURY	1.7		9E-05	6.63E+08	2E-10	2E-06	3E-10	4E-06	5E-11	6E-07	8E-11	9E-07
Volatilization:				VF								
ALUMINUM	9100		1E-03									
CHROMIUM	92		3E-05									
MANGANESE	270	J	1E-05									
MERCURY	1.7		9E-05	2.20E+04	6E-06	7E-02	9E-06	1E-01	2E-06	2E-02	2E-06	3E-02
Particle Hazard Index for Detected Compounds Only:					**Sum =**	**3.7E-03**	**Sum =**	**5.5E-03**	**Sum =**	**9.5E-04**	**Sum =**	**1.4E-03**
Volatile Hazard Index for Detected Compounds Only:					**Sum =**	**7.0E-02**	**Sum =**	**1.1E-01**	**Sum =**	**1.8E-02**	**Sum =**	**2.8E-02**
Hazard Index via Inhalation (Detected and nondetected compounds):					**Sum =**	**7.4E-02**	**Sum =**	**1.1E-01**	**Sum =**	**1.9E-02**	**Sum =**	**2.9E-02**

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
* Hazard quotient or hazard index exceeds 1.5.

Table 6. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Inhalation of Volatiles and Fugitive Dust (Surface Soil).
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	PEF/VF	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
					LADD	CR	LADD	CR	LADD	CR	LADD	CR
Particulate Emission:				PEF								
ARSENIC	40		2E+01	6.63E+08	2E-09	3E-08	1E-10	2E-09	2E-10	3E-09	2E-10	2E-09
CHROMIUM	92		4E+01	6.63E+08	4E-09	2E-07	2E-10	1E-08	5E-10	2E-08	4E-10	2E-08
BENZO[A]PYRENE	0.55		3E+00	6.63E+08	2E-11	7E-11	1E-12	4E-12	3E-12	9E-12	2E-12	7E-12
Volatilization:				VF								
ARSENIC	40		2E+01									
CHROMIUM	92		4E+01									
BENZO[A]PYRENE	0.55		3E+00	1.62E+07	1E-09	3E-09	6E-11	2E-10	1E-10	4E-10	9E-11	3E-10
Particle Cancer Risk Totals for Detected Compounds Only:					**Sum =**	**1.8E-07**	**Sum =**	**1.1E-08**	**Sum =**	**2.3E-08**	**Sum =**	**1.7E-08**
Volatile Cancer Risk Totals for Detected Compounds Only:					**Sum =**	**2.9E-09**	**Sum =**	**1.8E-10**	**Sum =**	**3.7E-10**	**Sum =**	**2.8E-10**
Total Cancer Risk via Inhalation (Detected and nondetected compounds):					**Sum =**	**1.9E-07**	**Sum =**	**1.1E-08**	**Sum =**	**2.3E-08**	**Sum =**	**1.8E-08**

LADD = lifetime aver ily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds

Table 7. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Inhalation of Volatiles and Fugitive Dust (Subsurface Soil).
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	PEF/VF	Adult Worker ADD	Adult Worker HQ	Construction Worker ADD	Construction Worker HQ	Youth Visitor ADD	Youth Visitor HQ	Child Visitor ADD	Child Visitor HQ
Particulate Emission:				PEF								
ALUMINUM	9400		1E-03	6.63E+08	1E-06	1E-03	2E-06	2E-03	3E-07	3E-04	4E-07	4E-04
BARIUM	1300		1E-04	6.63E+08	2E-07	1E-03	2E-07	2E-03	4E-08	3E-04	6E-08	4E-04
MANGANESE	2800	J	1E-05	6.63E+08	3E-07	2E-02	5E-07	3E-02	9E-08	6E-03	1E-07	9E-03
MERCURY	3.7		9E-05	6.63E+08	4E-10	5E-06	7E-10	8E-06	1E-10	1E-06	2E-10	2E-06
Volatilization:				VF								
ALUMINUM	9400		1E-03									
BARIUM	1300		1E-04									
MANGANESE	2800	J	1E-05									
MERCURY	3.7		9E-05	2.20E+04	1E-05	2E-01	2E-05	2E-01	3E-06	4E-02	5E-06	6E-02
Particle Hazard Index for Detected Compounds Only:					**Sum =**	**2.5E-02**	**Sum =**	**3.8E-02**	**Sum =**	**6.6E-03**	**Sum =**	**1.0E-02**
Volatile Hazard Index for Detected Compounds Only:					**Sum =**	**1.5E-01**	**Sum =**	**2.3E-01**	**Sum =**	**4.0E-02**	**Sum =**	**6.0E-02**
Hazard Index via Inhalation (Detected and nondetected compounds):					**Sum =**	**1.8E-01**	**Sum =**	**2.7E-01**	**Sum =**	**4.6E-02**	**Sum =**	**7.0E-02**

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
* Hazard quotient or hazard index exceeds 1.5.

Table 7UCL. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Inhalation of Volatiles and Fugitive Dust (Subsurface Soil).
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	PEF/VF	Adult Worker ADD	Adult Worker HQ	Construction Worker ADD	Construction Worker HQ	Youth Visitor ADD	Youth Visitor HQ	Child Visitor ADD	Child Visitor HQ
Particulate Emission:				PEF								
ALUMINUM	9400		1E-03	6.63E+08	1E-06	1E-03	2E-06	2E-03	3E-07	3E-04	4E-07	4E-04
BARIUM	1300		1E-04	6.63E+08	2E-07	1E-03	2E-07	2E-03	4E-08	3E-04	6E-08	4E-04
MANGANESE	2800	MAX	1E-05	6.63E+08	3E-07	2E-02	5E-07	3E-02	9E-08	6E-03	1E-07	9E-03
MERCURY	3.7		9E-05	6.63E+08	4E-10	5E-06	7E-10	8E-06	1E-10	1E-06	2E-10	2E-06
Volatilization:				VF								
ALUMINUM	9400		1E-03									
BARIUM	1300		1E-04									
MANGANESE	2800	MAX	1E-05									
MERCURY	3.7		9E-05	2.20E+04	1E-05	2E-01	2E-05	2E-01	3E-06	4E-02	5E-06	6E-02
Particle Hazard Index for Detected Compounds Only:					**Sum =**	**2.5E-02**	**Sum =**	**3.8E-02**	**Sum =**	**6.6E-03**	**Sum =**	**1.0E-02**
Volatile Hazard Index for Detected Compounds Only:					**Sum =**	**1.5E-01**	**Sum =**	**2.3E-01**	**Sum =**	**4.0E-02**	**Sum =**	**6.0E-02**
Hazard Index via Inhalation (Detected and nondetected compounds):					**Sum =**	**1.8E-01**	**Sum =**	**2.7E-01**	**Sum =**	**4.6E-02**	**Sum =**	**7.0E-02**

ADD = average daily [illegible]ng/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or I[illegible]ndex exceeds 1.5.

Table 8. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Inhalation of Volatiles and Fugitive Dust (Subsurface Soil).
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	PEF/VF	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
					LADD	CR	LADD	CR	LADD	CR	LADD	CR
Particulate Emission:				PEF								
ARSENIC	25		2E+01	6.63E+08	1E-09	2E-08	6E-11	1E-09	1E-10	2E-09	1E-10	2E-09
BENZO[A]PYRENE	2.9		3E+00	6.63E+08	1E-10	4E-10	7E-12	2E-11	2E-11	5E-11	1E-11	4E-11
Volatilization:				VF								
ARSENIC	25		2E+01									
BENZO[A]PYRENE	2.9		3E+00	1.62E+07	5E-09	2E-08	3E-10	9E-10	6E-10	2E-09	5E-10	1E-09
Particle Cancer Risk Totals for Detected Compounds Only:					**Sum =**	**1.6E-08**	**Sum =**	**9.8E-10**	**Sum =**	**2.0E-09**	**Sum =**	**1.5E-09**
Volatile Cancer Risk Totals for Detected Compounds Only:					**Sum =**	**1.6E-08**	**Sum =**	**9.3E-10**	**Sum =**	**1.9E-09**	**Sum =**	**1.5E-09**
Total Cancer Risk via Inhalation (Detected and nondetected compounds):					**Sum =**	**3.2E-08**	**Sum =**	**1.9E-09**	**Sum =**	**4.0E-09**	**Sum =**	**3.0E-09**

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4.

Table 8UCL. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Inhalation of Volatiles and Fugitive Dust (Subsurface Soil).
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	PEF/VF	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
					LADD	CR	LADD	CR	LADD	CR	LADD	CR
Particulate Emission:				PEF								
ARSENIC	18	UCL	2E+01	6.63E+08	8E-10	1E-08	5E-11	7E-10	9E-11	1E-09	7E-11	1E-09
BENZO[A]PYRENE	1.64	UCL	3E+00	6.63E+08	7E-11	2E-10	4E-12	1E-11	9E-12	3E-11	7E-12	2E-11
Volatilization:				VF								
ARSENIC	18	UCL	2E+01									
BENZO[A]PYRENE	1.64	UCL	3E+00	1.62E+07	3E-09	9E-09	2E-10	5E-10	4E-10	1E-09	3E-10	8E-10
Particle Cancer Risk Totals for Detected Compounds Only:					**Sum =**	**1.2E-08**	**Sum =**	**7.0E-10**	**Sum =**	**1.5E-09**	**Sum =**	**1.1E-09**
Volatile Cancer Risk Totals for Detected Compounds Only:					**Sum =**	**8.8E-09**	**Sum =**	**5.3E-10**	**Sum =**	**1.1E-09**	**Sum =**	**8.3E-10**
Total Cancer Risk via Inhalation (Detected and nondetected compounds):					**Sum =**	**2.0E-08**	**Sum =**	**1.2E-09**	**Sum =**	**2.5E-09**	**Sum =**	**1.9E-09**

LADD = lifetime aver ily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds

Table 9. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Surface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9100		3E-01	2E-04	8E-04	2E-04	9E-04	2E-04	9E-04	3E-03	1E-02
ANTIMONY	6.1		4E-05	1E-07	3E-03	2E-07	4E-03	2E-07	4E-03	2E-06	4E-02
ARSENIC	40		3E-04	3E-06	9E-03	3E-06	1E-02	3E-06	1E-02	3E-05	1E-01
CHROMIUM	92		3E-05	2E-06	7E-02	2E-06	8E-02	3E-06	8E-02	3E-05	9E-01
MANGANESE	270	J	1E-03	6E-06	5E-03	7E-06	6E-03	7E-06	6E-03	8E-05	6E-02
VANADIUM	41		2E-05	9E-07	5E-02	1E-06	5E-02	1E-06	6E-02	1E-05	6E-01
thallium	1.15	U	7E-05	3E-08	4E-04	3E-08	4E-04	3E-08	4E-04	3E-07	5E-03
Hazard Index for Detected Compounds Only:				Sum =	1.3E-01	Sum =	1.5E-01	Sum =	1.6E-01	Sum =	1.7E+00 *
Hazard Index for Nondetected Compounds Only:				Sum =	3.7E-04	Sum =	4.2E-04	Sum =	4.5E-04	Sum =	4.7E-03
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.3E-01	Sum =	1.5E-01	Sum =	1.6E-01	Sum =	1.7E+00 *

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 9MERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Surface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9100		3E-01	2E-04	8E-04	2E-04	9E-04	2E-04	9E-04	3E-03	1E-02
ANTIMONY	6.1		4E-05	1E-07	3E-03	2E-07	4E-03	2E-07	4E-03	2E-06	4E-02
ARSENIC	40		3E-04	3E-06	9E-03	3E-06	1E-02	3E-06	1E-02	3E-05	1E-01
CHROMIUM	92		3E-05	2E-06	7E-02	2E-06	8E-02	3E-06	8E-02	3E-05	9E-01
MANGANESE	270	J	1E-03	6E-06	5E-03	7E-06	6E-03	7E-06	6E-03	8E-05	6E-02
VANADIUM	41		2E-05	9E-07	5E-02	1E-06	5E-02	1E-06	6E-02	1E-05	6E-01
METHYLMERCURY	1.7			4E-08		4E-08		5E-08		5E-07	
thallium	1.15	U	7E-05	3E-08	4E-04	3E-08	4E-04	3E-08	4E-04	3E-07	5E-03
Hazard Index for Detected Compounds Only:				Sum =	1.3E-01	Sum =	1.5E-01	Sum =	1.6E-01	Sum =	1.7E+00 *
Hazard Index for Nondetected Compounds Only:				Sum =	3.7E-04	Sum =	4.2E-04	Sum =	4.5E-04	Sum =	4.7E-03
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.3E-01	Sum =	1.5E-01	Sum =	1.6E-01	Sum =	1.7E+00 *

ADD = average daily [illegible] (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or [illegible]ndex exceeds 1.5.

Table 10. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Dermal Contact/Surface soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	40		2E+00	1E-06	1E-06	4E-08	7E-08	6E-07	8E-07	3E-06	4E-06
BENZO[A]PYRENE	0.55		7E+00	6E-08	4E-07	3E-09	2E-08	3E-08	2E-07	2E-07	1E-06
DIBENZO[A,H]ANTHRACENE	0.13	J	7E+00	1E-08	1E-07	6E-10	5E-09	8E-09	6E-08	4E-08	3E-07
Cancer Risk for Detected Compounds Only:				**Sum =**	**2.0E-06**	**Sum =**	**9.0E-08**	**Sum =**	**1.1E-06**	**Sum =**	**5.9E-06**
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**2.0E-06**	**Sum =**	**9.0E-08**	**Sum =**	**1.1E-06**	**Sum =**	**5.9E-06**

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4.

Table 11. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		3E-01	2E-04	8E-04	2E-04	9E-04	3E-04	1E-03	3E-03	1E-02
ANTIMONY	7.4		4E-05	2E-07	4E-03	2E-07	5E-03	2E-07	5E-03	2E-06	5E-02
ARSENIC	25		3E-04	2E-06	6E-03	2E-06	6E-03	2E-06	7E-03	2E-05	7E-02
BARIUM	1300		7E-02	3E-05	4E-04	3E-05	5E-04	4E-05	5E-04	4E-04	5E-03
MANGANESE	2800	J	1E-03	6E-05	5E-02	7E-05	6E-02	8E-05	6E-02	8E-04	7E-01
VANADIUM	37		2E-05	8E-07	4E-02	9E-07	5E-02	1E-06	5E-02	1E-05	5E-01
ZINC	3200		7E-02	7E-05	1E-03	8E-05	1E-03	9E-05	1E-03	9E-04	1E-02
thallium	1.35	U	7E-05	3E-08	4E-04	3E-08	5E-04	4E-08	5E-04	4E-07	5E-03
Hazard Index for Detected Compounds Only:				Sum =	1.1E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00
Hazard Index for Nondetected Compounds Only:				Sum =	4.3E-04	Sum =	5.0E-04	Sum =	5.3E-04	Sum =	5.5E-03
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.1E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00

ADD = average daily [illegible] (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or [illegible]ndex exceeds 1.5.

Table 11MERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		3E-01	2E-04	8E-04	2E-04	9E-04	3E-04	1E-03	3E-03	1E-02
ANTIMONY	7.4		4E-05	2E-07	4E-03	2E-07	5E-03	2E-07	5E-03	2E-06	5E-02
ARSENIC	25		3E-04	2E-06	6E-03	2E-06	6E-03	2E-06	7E-03	2E-05	7E-02
BARIUM	1300		7E-02	3E-05	4E-04	3E-05	5E-04	4E-05	5E-04	4E-04	5E-03
MANGANESE	2800	J	1E-03	6E-05	5E-02	7E-05	6E-02	8E-05	6E-02	8E-04	7E-01
VANADIUM	37		2E-05	8E-07	4E-02	9E-07	5E-02	1E-06	5E-02	1E-05	5E-01
ZINC	3200		7E-02	7E-05	1E-03	8E-05	1E-03	9E-05	1E-03	9E-04	1E-02
METHYLMERCURY	3.7			8E-08		9E-08		1E-07		1E-06	
thallium	1.35	U	7E-05	3E-08	4E-04	3E-08	5E-04	4E-08	5E-04	4E-07	5E-03
Hazard Index for Detected Compounds Only:				Sum =	1.1E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00
Hazard Index for Nondetected Compounds Only:				Sum =	4.3E-04	Sum =	5.0E-04	Sum =	5.3E-04	Sum =	5.5E-03
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.1E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 11MERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		3E-01	2E-04	8E-04	2E-04	9E-04	3E-04	1E-03	3E-03	1E-02
ANTIMONY	7.4		4E-05	2E-07	4E-03	2E-07	5E-03	2E-07	5E-03	2E-06	5E-02
ARSENIC	25		3E-04	2E-06	6E-03	2E-06	6E-03	2E-06	7E-03	2E-05	7E-02
BARIUM	1300		7E-02	3E-05	4E-04	3E-05	5E-04	4E-05	5E-04	4E-04	5E-03
MANGANESE	2800	J	1E-03	6E-05	5E-02	7E-05	6E-02	8E-05	6E-02	8E-04	7E-01
VANADIUM	37		2E-05	8E-07	4E-02	9E-07	5E-02	1E-06	5E-02	1E-05	5E-01
ZINC	3200		7E-02	7E-05	1E-03	8E-05	1E-03	9E-05	1E-03	9E-04	1E-02
MERCURIC CHLORIDE	3.7										
thallium	1.35	U	7E-05	3E-08	4E-04	3E-08	5E-04	4E-08	5E-04	4E-07	5E-03
Hazard Index for Detected Compounds Only:				Sum =	1.1E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00
Hazard Index for Nondetected Compounds Only:				Sum =	4.3E-04	Sum =	5.0E-04	Sum =	5.3E-04	Sum =	5.5E-03
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.1E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00

ADD = average daily (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or index exceeds 1.5.

Table 11UCL. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		3E-01	2E-04	8E-04	2E-04	9E-04	3E-04	1E-03	3E-03	1E-02
ANTIMONY	7.4		4E-05	2E-07	4E-03	2E-07	5E-03	2E-07	5E-03	2E-06	5E-02
ARSENIC	18	UCL	3E-04	1E-06	4E-03	1E-06	5E-03	1E-06	5E-03	2E-05	5E-02
BARIUM	1300		7E-02	3E-05	4E-04	3E-05	5E-04	4E-05	5E-04	4E-04	5E-03
MANGANESE	2800	MAX	1E-03	6E-05	5E-02	7E-05	6E-02	8E-05	6E-02	8E-04	7E-01
VANADIUM	37		2E-05	8E-07	4E-02	9E-07	5E-02	1E-06	5E-02	1E-05	5E-01
ZINC	3200		7E-02	7E-05	1E-03	8E-05	1E-03	9E-05	1E-03	9E-04	1E-02
thallium	1.35	U	7E-05	3E-08	4E-04	3E-08	5E-04	4E-08	5E-04	4E-07	5E-03
Hazard Index for Detected Compounds Only:				**Sum = 1.0E-01**		**Sum = 1.2E-01**		**Sum = 1.3E-01**		**Sum = 1.3E+00**	
Hazard Index for Nondetected Compounds Only:				**Sum = 4.3E-04**		**Sum = 5.0E-04**		**Sum = 5.3E-04**		**Sum = 5.5E-03**	
Hazard Index for Detected and Nondetected Compounds:				**Sum = 1.0E-01**		**Sum = 1.2E-01**		**Sum = 1.3E-01**		**Sum = 1.3E+00**	

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 11UCLMERC. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Subsurface Soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	9400		3E-01	2E-04	8E-04	2E-04	9E-04	3E-04	1E-03	3E-03	1E-02
ANTIMONY	7.4		4E-05	2E-07	4E-03	2E-07	5E-03	2E-07	5E-03	2E-06	5E-02
ARSENIC	18	UCL	3E-04	1E-06	4E-03	1E-06	5E-03	1E-06	5E-03	2E-05	5E-02
BARIUM	1300		7E-02	3E-05	4E-04	3E-05	5E-04	4E-05	5E-04	4E-04	5E-03
MANGANESE	2800	MAX	1E-03	6E-05	5E-02	7E-05	6E-02	8E-05	6E-02	8E-04	7E-01
VANADIUM	37		2E-05	8E-07	4E-02	9E-07	5E-02	1E-06	5E-02	1E-05	5E-01
ZINC	3200		7E-02	7E-05	1E-03	8E-05	1E-03	9E-05	1E-03	9E-04	1E-02
METHYLMERCURY	1.56	UCL		4E-08		4E-08		4E-08		4E-07	
thallium	1.35	U	7E-05	3E-08	4E-04	3E-08	5E-04	4E-08	5E-04	4E-07	5E-03
Hazard Index for Detected Compounds Only:				Sum =	1.0E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00
Hazard Index for Nondetected Compounds Only:				Sum =	4.3E-04	Sum =	5.0E-04	Sum =	5.3E-04	Sum =	5.5E-03
Hazard Index for Detected and Nondetected Compounds:				Sum =	1.0E-01	Sum =	1.2E-01	Sum =	1.3E-01	Sum =	1.3E+00

ADD = average daily (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or index exceeds 1.5.

Table 12. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Dermal Contact/Subsurface soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	25		2E+00	6E-07	9E-07	3E-08	4E-08	4E-07	5E-07	2E-06	3E-06
BENZO[A]ANTHRACENE	2		7E-01	2E-07	2E-07	1E-08	7E-09	1E-07	9E-08	6E-07	5E-07
BENZO[A]PYRENE	2.9		7E+00	3E-07	2E-06	1E-08	1E-07	2E-07	1E-06	9E-07	7E-06
DIBENZO[A,H]ANTHRACENE	0.51		7E+00	5E-08	4E-07	2E-09	2E-08	3E-08	2E-07	2E-07	1E-06
INDENO[1,2,3-CD]PYRENE	1.6		7E-01	2E-07	1E-07	8E-09	6E-09	1E-07	7E-08	5E-07	4E-07
Cancer Risk for Detected Compounds Only:				**Sum =**	**3.8E-06**	**Sum =**	**1.7E-07**	**Sum =**	**2.2E-06**	**Sum =**	**1.1E-05**
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**3.8E-06**	**Sum =**	**1.7E-07**	**Sum =**	**2.2E-06**	**Sum =**	**1.1E-05**

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4.

Table 12UCL. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Dermal Contact/Subsurface soil.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (mg/kg)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	18	UCL	2E+00	4E-07	6E-07	2E-08	3E-08	3E-07	4E-07	1E-06	2E-06
BENZO[A]ANTHRACENE	2		7E-01	2E-07	2E-07	1E-08	7E-09	1E-07	9E-08	6E-07	5E-07
BENZO[A]PYRENE	1.64	UCL	7E+00	2E-07	1E-06	8E-09	6E-08	1E-07	7E-07	5E-07	4E-06
DIBENZO[A,H]ANTHRACENE	0.39	UCL	7E+00	4E-08	3E-07	2E-09	1E-08	2E-08	2E-07	1E-07	9E-07
INDENO[1,2,3-CD]PYRENE	1.6		7E-01	2E-07	1E-07	8E-09	6E-09	1E-07	7E-08	5E-07	4E-07
Cancer Risk for Detected Compounds Only:				**Sum = 2.5E-06**		**Sum = 1.1E-07**		**Sum = 1.4E-06**		**Sum = 7.5E-06**	
Cancer Risk for Detected and Nondetected Compounds:				**Sum = 2.5E-06**		**Sum = 1.1E-07**		**Sum = 1.4E-06**		**Sum = 7.5E-06**	

LADD = lifetime aver ily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds

Table 13. Quantitative Risk Assessment - Noncarcinogenic Commercial Use - Ingestion of Drinking Water/Groundwater. For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	5800		1E+00	6E-02	6E-02	2E-01	2E-01	1E-01	1E-01	1E-01	1E-01
ARSENIC	22		3E-04	2E-04	7E-01	6E-04	2E+00 *	4E-04	1E+00	5E-04	2E+00 *
BARIUM	310		7E-02	3E-03	4E-02	9E-03	1E-01	6E-03	8E-02	7E-03	1E-01
CADMIUM	6.5		1E-03	6E-05	6E-02	2E-04	2E-01	1E-04	1E-01	2E-04	2E-01
CHROMIUM	190		3E-03	2E-03	6E-01	6E-03	2E+00 *	3E-03	1E+00	5E-03	2E+00 *
COPPER	280		4E-02	3E-03	7E-02	8E-03	2E-01	5E-03	1E-01	7E-03	2E-01
MANGANESE	650		2E-02	6E-03	3E-01	2E-02	1E+00	1E-02	6E-01	2E-02	8E-01
VANADIUM	60		1E-03	6E-04	6E-01	2E-03	2E+00 *	1E-03	1E+00	1E-03	1E+00
ZINC	2000		3E-01	2E-02	7E-02	6E-02	2E-01	4E-02	1E-01	5E-02	2E-01
antimony	5	UL	4E-04	5E-05	1E-01	1E-04	4E-01	9E-05	2E-01	1E-04	3E-01
thallium	2.5	U	7E-05	2E-05	3E-01	7E-05	1E+00	5E-05	6E-01	6E-05	9E-01
2,4-dinitrophenol	11	U	2E-03	1E-04	5E-02	3E-04	2E-01	2E-04	1E-01	3E-04	1E-01
2,6-dinitrotoluene	11	U	1E-03	1E-04	1E-01	3E-04	3E-01	2E-04	2E-01	3E-04	3E-01
2-chlorophenol	5.5	U	5E-03	5E-05	1E-02	2E-04	3E-02	1E-04	2E-02	1E-04	3E-02
2-methylnaphthalene	5.5	U	4E-03	5E-05	1E-02	2E-04	4E-02	1E-04	2E-02	1E-04	3E-02
4,6-dinitro-2-methylphenol	11	U	1E-04	1E-04	1E+00	3E-04	3E+00 *	2E-04	2E+00 *	3E-04	3E+00 *
4-chloroaniline	5.5	U	4E-03	5E-05	1E-02	2E-04	4E-02	1E-04	2E-02	1E-04	3E-02
atrazine	5.5	U	4E-02	5E-05	2E-03	2E-04	5E-03	1E-04	3E-03	1E-04	4E-03
bis(2-chloroisopropyl)ether	5.5	U	4E-02	5E-05	1E-03	2E-04	4E-03	1E-04	2E-03	1E-04	3E-03
bis(2-ethylhexyl)phthalate	5.5	U	2E-02	5E-05	3E-03	2E-04	8E-03	1E-04	5E-03	1E-04	7E-03
dibenzofuran	5.5	U	2E-03	5E-05	3E-02	2E-04	8E-02	1E-04	5E-02	1E-04	7E-02
hexachlorobenzene	5.5	U	8E-04	5E-05	7E-02	2E-04	2E-01	1E-04	1E-01	1E-04	2E-01
hexachlorobutadiene	5.5	U	2E-04	5E-05	3E-01	2E-04	8E-01	1E-04	5E-01	1E-04	7E-01
hexachloroethane	5.5	U	1E-03	5E-05	5E-02	2E-04	2E-01	1E-04	1E-01	1E-04	1E-01
naphthalene	5.5	U	2E-02	5E-05	3E-03	2E-04	8E-03	1E-04	5E-03	1E-04	7E-03
nitrobenzene	5.5	U	5E-04	5E-05	1E-01	2E-04	3E-01	1E-04	2E-01	1E-04	3E-01
pentachlorophenol	11	U	3E-02	1E-04	4E-03	3E-04	1E-02	2E-04	7E-03	3E-04	9E-03

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 13 (continued). Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Ingestion of Drinking Water/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker ADD	Adult Worker HQ	Construction Worker ADD	Construction Worker HQ	Youth Visitor ADD	Youth Visitor HQ	Child Visitor ADD	Child Visitor HQ
Hazard Index for Detected Compounds Only:				Sum =	2.5E+00 *	Sum =	7.6E+00 *	Sum =	4.7E+00 *	Sum =	6.3E+00 *
Hazard Index for Nondetected Compounds Only:				Sum =	2.3E+00 *	Sum =	6.9E+00 *	Sum =	4.2E+00 *	Sum =	5.6E+00 *
Hazard Index for Detected and Nondetected Compounds:				Sum =	4.8E+00 *	Sum =	1.4E+01 *	Sum =	8.9E+00 *	Sum =	1.2E+01 *

ADD = average daily [illegible] (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
* Hazard quotient or [illegible] index exceeds 1.5.

Table 13DISS. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Ingestion of Drinking Water/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
MANGANESE	220		2E-02	2E-03	1E-01	6E-03	3E-01	4E-03	2E-01	5E-03	3E-01
antimony	5	UL	4E-04	5E-05	1E-01	1E-04	4E-01	9E-05	2E-01	1E-04	3E-01
arsenic	2.5	U	3E-04	2E-05	8E-02	7E-05	2E-01	5E-05	2E-01	6E-05	2E-01
thallium	2.5	U	7E-05	2E-05	3E-01	7E-05	1E+00	5E-05	6E-01	6E-05	9E-01
2,4-dinitrophenol	11	U	2E-03	1E-04	5E-02	3E-04	2E-01	2E-04	1E-01	3E-04	1E-01
2,6-dinitrotoluene	11	U	1E-03	1E-04	1E-01	3E-04	3E-01	2E-04	2E-01	3E-04	3E-01
2-chlorophenol	5.5	U	5E-03	5E-05	1E-02	2E-04	3E-02	1E-04	2E-02	1E-04	3E-02
2-methylnaphthalene	5.5	U	4E-03	5E-05	1E-02	2E-04	4E-02	1E-04	2E-02	1E-04	3E-02
4,6-dinitro-2-methylphenol	11	U	1E-04	1E-04	1E+00	3E-04	3E+00 *	2E-04	2E+00 *	3E-04	3E+00 *
4-chloroaniline	5.5	U	4E-03	5E-05	1E-02	2E-04	4E-02	1E-04	2E-02	1E-04	3E-02
atrazine	5.5	U	4E-02	5E-05	2E-03	2E-04	5E-03	1E-04	3E-03	1E-04	4E-03
bis(2-chloroisopropyl)ether	5.5	U	4E-02	5E-05	1E-03	2E-04	4E-03	1E-04	2E-03	1E-04	3E-03
bis(2-ethylhexyl)phthalate	5.5	U	2E-02	5E-05	3E-03	2E-04	8E-03	1E-04	5E-03	1E-04	7E-03
dibenzofuran	5.5	U	2E-03	5E-05	3E-02	2E-04	8E-02	1E-04	5E-02	1E-04	7E-02
hexachlorobenzene	5.5	U	8E-04	5E-05	7E-02	2E-04	2E-01	1E-04	1E-01	1E-04	2E-01
hexachlorobutadiene	5.5	U	2E-04	5E-05	3E-01	2E-04	8E-01	1E-04	5E-01	1E-04	7E-01
hexachloroethane	5.5	U	1E-03	5E-05	5E-02	2E-04	2E-01	1E-04	1E-01	1E-04	1E-01
naphthalene	5.5	U	2E-02	5E-05	3E-03	2E-04	8E-03	1E-04	5E-03	1E-04	7E-03
nitrobenzene	5.5	U	5E-04	5E-05	1E-01	2E-04	3E-01	1E-04	2E-01	1E-04	3E-01
pentachlorophenol	11	U	3E-02	1E-04	4E-03	3E-04	1E-02	2E-04	7E-03	3E-04	9E-03

Hazard Index for Detected Compounds Only:	Sum = 1.1E-01	Sum = 3.2E-01	Sum = 2.0E-01	Sum = 2.7E-01
Hazard Index for Nondetected Compounds Only:	Sum = 2.4E+00 *	Sum = 7.1E+00 *	Sum = 4.4E+00 *	Sum = 5.8E+00 *
Hazard Index for Detected and Nondetected Compounds:	Sum = 2.5E+00 *	Sum = 7.4E+00 *	Sum = 4.6E+00 *	Sum = 6.1E+00 *

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or hazard index exceeds 1.5.

Table 14. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Ingestion of Drinking Water/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	22		2E+00	8E-05	1E-04 *	9E-06	1E-05	7E-05	1E-04 *	5E-05	7E-05
3,3'-dichlorobenzidine	5.5	U	5E-01	2E-05	9E-06	2E-06	1E-06	2E-05	8E-06	1E-05	5E-06
4-chloroaniline	5.5	U	5E-02	2E-05	1E-06	2E-06	1E-07	2E-05	9E-07	1E-05	6E-07
atrazine	5.5	U	2E-01	2E-05	4E-06	2E-06	5E-07	2E-05	4E-06	1E-05	3E-06
benzo(b,k)fluoranthene	11	U	7E-02	4E-05	3E-06	5E-06	3E-07	3E-05	2E-06	2E-05	2E-06
benzo[a]anthracene	5.5	U	7E-01	2E-05	1E-05	2E-06	2E-06	2E-05	1E-05	1E-05	8E-06
benzo[a]pyrene	3	U	7E+00	1E-05	8E-05	1E-06	9E-06	9E-06	7E-05	6E-06	5E-05
bis(2-chloroethyl)ether	5.5	U	1E+00	2E-05	2E-05	2E-06	3E-06	2E-05	2E-05	1E-05	1E-05
bis(2-chloroisopropyl)ether	5.5	U	7E-02	2E-05	1E-06	2E-06	2E-07	2E-05	1E-06	1E-05	8E-07
bis(2-ethylhexyl)phthalate	5.5	U	1E-02	2E-05	3E-07	2E-06	3E-08	2E-05	2E-07	1E-05	2E-07
carbazole	5.5	U	2E-02	2E-05	4E-07	2E-06	5E-08	2E-05	3E-07	1E-05	2E-07
dibenzo[a,h]anthracene	3	U	7E+00	1E-05	8E-05	1E-06	9E-06	9E-06	7E-05	6E-06	5E-05
hexachlorobenzene	5.5	U	2E+00	2E-05	3E-05	2E-06	4E-06	2E-05	3E-05	1E-05	2E-05
hexachlorobutadiene	5.5	U	8E-02	2E-05	1E-06	2E-06	2E-07	2E-05	1E-06	1E-05	9E-07
hexachloroethane	5.5	U	1E-02	2E-05	3E-07	2E-06	3E-08	2E-05	2E-07	1E-05	2E-07
indeno[1,2,3-cd]pyrene	5.5	U	7E-01	2E-05	1E-05	2E-06	2E-06	2E-05	1E-05	1E-05	8E-06
n-nitrosodipropylamine	5.5	U	7E+00	2E-05	1E-04 *	2E-06	2E-05	2E-05	1E-04 *	1E-05	8E-05
pentachlorophenol	11	U	1E-01	4E-05	5E-06	5E-06	6E-07	3E-05	4E-06	2E-05	3E-06
Cancer Risk for Detected Compounds Only:				**Sum =**	**1.2E-04 ***	**Sum =**	**1.4E-05**	**Sum =**	**1.0E-04 ***	**Sum =**	**6.8E-05**
Cancer Risk for Nondetected Compounds Only:				**Sum =**	**3.9E-04 ***	**Sum =**	**4.7E-05**	**Sum =**	**3.5E-04 ***	**Sum =**	**2.3E-04 ***
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**5.1E-04 ***	**Sum =**	**6.1E-05**	**Sum =**	**4.5E-04 ***	**Sum =**	**3.0E-04 ***

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceed

Table 14DISS. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Ingestion of Drinking Water/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
arsenic	2.5	U	2E+00	9E-06	1E-05	1E-06	2E-06	8E-06	1E-05	5E-06	8E-06
3,3'-dichlorobenzidine	5.5	U	5E-01	2E-05	9E-06	2E-06	1E-06	2E-05	8E-06	1E-05	5E-06
4-chloroaniline	5.5	U	5E-02	2E-05	1E-06	2E-06	1E-07	2E-05	9E-07	1E-05	6E-07
atrazine	5.5	U	2E-01	2E-05	4E-06	2E-06	5E-07	2E-05	4E-06	1E-05	3E-06
benzo(b,k)fluoranthene	11	U	7E-02	4E-05	3E-06	5E-06	3E-07	3E-05	2E-06	2E-05	2E-06
benzo[a]anthracene	5.5	U	7E-01	2E-05	1E-05	2E-06	2E-06	2E-05	1E-05	1E-05	8E-06
benzo[a]pyrene	3	U	7E+00	1E-05	8E-05	1E-06	9E-06	9E-06	7E-05	6E-06	5E-05
bis(2-chloroethyl)ether	5.5	U	1E+00	2E-05	2E-05	2E-06	3E-06	2E-05	2E-05	1E-05	1E-05
bis(2-chloroisopropyl)ether	5.5	U	7E-02	2E-05	1E-06	2E-06	2E-07	2E-05	1E-06	1E-05	8E-07
bis(2-ethylhexyl)phthalate	5.5	U	1E-02	2E-05	3E-07	2E-06	3E-08	2E-05	2E-07	1E-05	2E-07
carbazole	5.5	U	2E-02	2E-05	4E-07	2E-06	5E-08	2E-05	3E-07	1E-05	2E-07
dibenzo[a,h]anthracene	3	U	7E+00	1E-05	8E-05	1E-06	9E-06	9E-06	7E-05	6E-06	5E-05
hexachlorobenzene	5.5	U	2E+00	2E-05	3E-05	2E-06	4E-06	2E-05	3E-05	1E-05	2E-05
hexachlorobutadiene	5.5	U	8E-02	2E-05	1E-06	2E-06	2E-07	2E-05	1E-06	1E-05	9E-07
hexachloroethane	5.5	U	1E-02	2E-05	3E-07	2E-06	3E-08	2E-05	2E-07	1E-05	2E-07
indeno[1,2,3-cd]pyrene	5.5	U	7E-01	2E-05	1E-05	2E-06	2E-06	2E-05	1E-05	1E-05	8E-06
n-nitrosodipropylamine	5.5	U	7E+00	2E-05	1E-04 *	2E-06	2E-05	2E-05	1E-04 *	1E-05	8E-05
pentachlorophenol	11	U	1E-01	4E-05	5E-06	5E-06	6E-07	3E-05	4E-06	2E-05	3E-06
Cancer Risk for Nondetected Compounds Only:				**Sum =**	**4.1E-04 ***	**Sum =**	**4.9E-05**	**Sum =**	**3.6E-04 ***	**Sum =**	**2.4E-04 ***
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**4.1E-04 ***	**Sum =**	**4.9E-05**	**Sum =**	**3.6E-04 ***	**Sum =**	**2.4E-04 ***

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4.

Table 15. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
ALUMINUM	5800		3E-01								
ARSENIC	22		3E-04								
BARIUM	310		7E-02								
CADMIUM	6.5		3E-05	3E-06	1E-01	1E-06	6E-02	4E-07	2E-02	5E-07	2E-02
CHROMIUM	190		3E-05	2E-04	6E+00 *	8E-05	3E+00 *	2E-05	8E-01	3E-05	1E+00
COPPER	280		4E-02								
MANGANESE	650		1E-03								
VANADIUM	60		2E-05								
ZINC	2000		7E-02	5E-04	7E-03	3E-04	4E-03	7E-05	9E-04	9E-05	1E-03
antimony	5	UL	4E-05								
thallium	2.5	U	7E-05								
2,4-dinitrophenol	11	U	2E-03	9E-06	4E-03	4E-06	2E-03	1E-06	6E-04	2E-06	8E-04
2,6-dinitrotoluene	11	U	1E-03	1E-05	1E-02	6E-06	6E-03	2E-06	2E-03	2E-06	2E-03
2-chlorophenol	5.5	U	5E-03								
2-methylnaphthalene	5.5	U	4E-03								
4,6-dinitro-2-methylphenol	11	U	1E-04								
4-chloroaniline	5.5	U	4E-03								
atrazine	5.5	U	4E-02								
bis(2-chloroisopropyl)ether	5.5	U	4E-02								
bis(2-ethylhexyl)phthalate	5.5	U	2E-02	8E-05	4E-03	4E-05	2E-03	1E-05	5E-04	1E-05	7E-04
dibenzofuran	5.5	U	2E-03								
hexachlorobenzene	5.5	U									
hexachlorobutadiene	5.5	U	2E-04	3E-04	1E+00	1E-04	7E-01	4E-05	2E-01	5E-05	3E-01
hexachloroethane	5.5	U	1E-03	1E-04	1E-01	5E-05	5E-02	1E-05	1E-02	2E-05	2E-02
naphthalene	5.5	U	2E-02	2E-04	8E-03	8E-05	4E-03	2E-05	1E-03	3E-05	2E-03
nitrobenzene	5.5	U	5E-04								
pentachlorophenol	11	U	3E-02	3E-03	1E-01	2E-03	5E-02	4E-04	1E-02	6E-04	2E-02

ADD = average daily [illegible] (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or [illegible]ndex exceeds 1.5.

Table 15 (continued). Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker ADD	Adult Worker HQ	Construction Worker ADD	Construction Worker HQ	Youth Visitor ADD	Youth Visitor HQ	Child Visitor ADD	Child Visitor HQ
Hazard Index for Detected Compounds Only:				Sum =	5.7E+00 *	Sum =	2.9E+00 *	Sum =	7.7E-01	Sum =	1.0E+00
Hazard Index for Nondetected Compounds Only:				Sum =	1.7E+00 *	Sum =	8.5E-01	Sum =	2.3E-01	Sum =	3.0E-01
Hazard Index for Detected and Nondetected Compounds:				Sum =	7.4E+00 *	Sum =	3.7E+00 *	Sum =	9.9E-01	Sum =	1.3E+00

ADD = average daily dose (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.
* Hazard quotient or hazard index exceeds 1.5.

Table 15DISS. Quantitative Risk Assessment - Noncarcinogenic
Commercial Use - Dermal Contact/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Reference Dose (mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				ADD	HQ	ADD	HQ	ADD	HQ	ADD	HQ
MANGANESE	220		1E-03								
antimony	5	UL	4E-05								
arsenic	2.5	U	3E-04								
thallium	2.5	U	7E-05								
2,4-dinitrophenol	11	U	2E-03	9E-06	4E-03	4E-06	2E-03	1E-06	6E-04	2E-06	8E-04
2,6-dinitrotoluene	11	U	1E-03	1E-05	1E-02	6E-06	6E-03	2E-06	2E-03	2E-06	2E-03
2-chlorophenol	5.5	U	5E-03								
2-methylnaphthalene	5.5	U	4E-03								
4,6-dinitro-2-methylphenol	11	U	1E-04								
4-chloroaniline	5.5	U	4E-03								
atrazine	5.5	U	4E-02								
bis(2-chloroisopropyl)ether	5.5	U	4E-02								
bis(2-ethylhexyl)phthalate	5.5	U	2E-02	8E-05	4E-03	4E-05	2E-03	1E-05	5E-04	1E-05	7E-04
dibenzofuran	5.5	U	2E-03								
hexachlorobenzene	5.5	U									
hexachlorobutadiene	5.5	U	2E-04	3E-04	1E+00	1E-04	7E-01	4E-05	2E-01	5E-05	3E-01
hexachloroethane	5.5	U	1E-03	1E-04	1E-01	5E-05	5E-02	1E-05	1E-02	2E-05	2E-02
naphthalene	5.5	U	2E-02	2E-04	8E-03	8E-05	4E-03	2E-05	1E-03	3E-05	2E-03
nitrobenzene	5.5	U	5E-04								
pentachlorophenol	11	U	3E-02	3E-03	1E-01	2E-03	5E-02	4E-04	1E-02	6E-04	2E-02

Hazard Index for Detected Compounds Only:	**Sum = --**	**Sum = --**	**Sum = --**	**Sum = --**
Hazard Index for Nondetected Compounds Only:	**Sum = 1.7E+00 ***	**Sum = 8.5E-01**	**Sum = 2.3E-01**	**Sum = 3.0E-01**
Hazard Index for Detected and Nondetected Compounds:	**Sum = 1.7E+00 ***	**Sum = 8.5E-01**	**Sum = 2.3E-01**	**Sum = 3.0E-01**

ADD = average daily [illegible] (mg/kg/d). HQ = Hazard Quotient (unitless). Compounds printed in lowercase letters were not detected in any sample.

* Hazard quotient or [illegible] index exceeds 1.5.

Table 16. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Dermal Contact/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
ARSENIC	22		2E+00								
3,3'-dichlorobenzidine	5.5	U	5E-01	1E-05	7E-06	3E-07	1E-07	9E-07	4E-07	6E-07	3E-07
4-chloroaniline	5.5	U	5E-02								
atrazine	5.5	U	2E-01								
benzo(b,k)fluoranthene	11	U	7E-02								
benzo[a]anthracene	5.5	U	7E-01	7E-04	5E-04 *	1E-05	1E-05	5E-05	3E-05	3E-05	2E-05
benzo[a]pyrene	3	U	7E+00	6E-04	4E-03 *	1E-05	8E-05	4E-05	3E-04 *	2E-05	2E-04 *
bis(2-chloroethyl)ether	5.5	U	1E+00								
bis(2-chloroisopropyl)ether	5.5	U	7E-02								
bis(2-ethylhexyl)phthalate	5.5	U	1E-02	3E-05	4E-07	6E-07	8E-09	2E-06	3E-08	1E-06	2E-08
carbazole	5.5	U	2E-02								
dibenzo[a,h]anthracene	3	U	7E+00	1E-03	9E-03 *	3E-05	2E-04 *	8E-05	6E-04 *	5E-05	4E-04 *
hexachlorobenzene	5.5	U									
hexachlorobutadiene	5.5	U	8E-02	1E-04	8E-06	2E-06	2E-07	7E-06	5E-07	4E-06	3E-07
hexachloroethane	5.5	U	1E-02	4E-05	5E-07	7E-07	1E-08	2E-06	3E-08	2E-06	2E-08
indeno[1,2,3-cd]pyrene	5.5	U	7E-01	2E-03	1E-03 *	3E-05	2E-05	1E-04	8E-05	7E-05	5E-05
n-nitrosodipropylamine	5.5	U	7E+00								
pentachlorophenol	11	U	1E-01	1E-03	1E-04 *	2E-05	3E-06	7E-05	9E-06	5E-05	6E-06
Cancer Risk for Detected Compounds Only:				Sum =	--	Sum =	--	Sum =	--	Sum =	--
Cancer Risk for Nondetected Compounds Only:				Sum =	1.5E-02 *	Sum =	3.1E-04 *	Sum =	9.9E-04 *	Sum =	6.6E-04 *
Cancer Risk for Detected and Nondetected Compounds:				Sum =	1.5E-02 *	Sum =	3.1E-04 *	Sum =	9.9E-04 *	Sum =	6.6E-04 *

LADD = lifetime average daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceeds 10E-4.

Table 16DISS. Quantitative Risk Assessment - Carcinogenic
Commercial Use - Dermal Contact/Groundwater.
For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Concentration (ug/L)	Qualifier	Slope Factor (1/mg/kg/d)	Adult Worker		Construction Worker		Youth Visitor		Child Visitor	
				LADD	CR	LADD	CR	LADD	CR	LADD	CR
arsenic	2.5	U	2E+00								
3,3'-dichlorobenzidine	5.5	U	5E-01	1E-05	7E-06	3E-07	1E-07	9E-07	4E-07	6E-07	3E-07
4-chloroaniline	5.5	U	5E-02								
atrazine	5.5	U	2E-01								
benzo(b,k)fluoranthene	11	U	7E-02								
benzo[a]anthracene	5.5	U	7E-01	7E-04	5E-04 *	1E-05	1E-05	5E-05	3E-05	3E-05	2E-05
benzo[a]pyrene	3	U	7E+00	6E-04	4E-03 *	1E-05	8E-05	4E-05	3E-04 *	2E-05	2E-04 *
bis(2-chloroethyl)ether	5.5	U	1E+00								
bis(2-chloroisopropyl)ether	5.5	U	7E-02								
bis(2-ethylhexyl)phthalate	5.5	U	1E-02	3E-05	4E-07	6E-07	8E-09	2E-06	3E-08	1E-06	2E-08
carbazole	5.5	U	2E-02								
dibenzo[a,h]anthracene	3	U	7E+00	1E-03	9E-03 *	3E-05	2E-04 *	8E-05	6E-04 *	5E-05	4E-04 *
hexachlorobenzene	5.5	U									
hexachlorobutadiene	5.5	U	8E-02	1E-04	8E-06	2E-06	2E-07	7E-06	5E-07	4E-06	3E-07
hexachloroethane	5.5	U	1E-02	4E-05	5E-07	7E-07	1E-08	2E-06	3E-08	2E-06	2E-08
indeno[1,2,3-cd]pyrene	5.5	U	7E-01	2E-03	1E-03 *	3E-05	2E-05	1E-04	8E-05	7E-05	5E-05
n-nitrosodipropylamine	5.5	U	7E+00								
pentachlorophenol	11	U	1E-01	1E-03	1E-04 *	2E-05	3E-06	7E-05	9E-06	5E-05	6E-06
Cancer Risk for Nondetected Compounds Only:				**Sum =**	**1.5E-02 ***	**Sum =**	**3.1E-04 ***	**Sum =**	**9.9E-04 ***	**Sum =**	**6.6E-04 ***
Cancer Risk for Detected and Nondetected Compounds:				**Sum =**	**1.5E-02 ***	**Sum =**	**3.1E-04 ***	**Sum =**	**9.9E-04 ***	**Sum =**	**6.6E-04 ***

LADD = lifetime aver daily dose (mg/kg/d). CR = Cancer risk. Compounds printed in lowercase letters were not detected in any sample.

* Cancer risk exceed

Table 17DISS. Comparison of groundwater contaminant concentrations to MCLs For Warner Street Wetland, Warner Street Baltimore, Maryland.

Analyte	Qualifier	Concentration	MCL	Exceeds MCL (Yes/No)
Aluminum	U	25	200	No
Antimony	UL	5	6	No
Arsenic	U	2.5	50	No
Atrazine	U	5.5	3	Yes
Barium		76	2000	No
Benzo[a]pyrene	U	3	0.2	Yes
Beryllium	U	2.5	4	No
BIS(2-ethylhexyl)phthalate	U	5.5	6	No
Cadmium	U	2.5	5	No
Chromium	U	2.5	100	No
Copper	U	2.5	1300	No
Hexachlorobenzene	U	5.5	1	Yes
Hexachlorocyclopentadiene	U	5.5	50	No
Lead	U	2.5	15	No
Manganese		220	50	Yes
Mercury	U	1	2	No
Pentachlorophenol	U	11	1	Yes
Selenium		8	50	No
Thallium	U	2.5	2	Yes

< or U = compound was not detected, reported concentration represents one half the detection level.
Contaminant concentrations and MCLs are reported in units of ug/L.

Table 18DISS. Comparison of detected groundwater contaminant concentrations to MDE and EPA Freshwater Ambient Water Quality Criteria For Warner Street Wetland, Warner Street Baltimore, Maryland.

		Freshwater Criteria				Fish Consumption (Organism only)	
		MDE Aquatic Life Criteria		EPA Water Quality Criteria			
Analyte	Concentration	Acute:	Chronic:	Acute:	Chronic:	MDE	USEPA
BARIUM	76	--	--	--	--	--	--
COBALT	9.5	--	--	--	--	--	--
MANGANESE	220	--	--	--	--	--	--
SELENIUM	8	20	5	--	--	4200	--
ACENAPHTHENE	3	--	--	--	--	990	990
FLUORENE	1	--	--	--	--	--	--
PHENANTHRENE	2	--	--	--	--	40000	40000

a = The toxicicty of certain substances is decreased or increased by hardness or pH. For these substances MDE may modify the criteria at a site; b = The fresh water aquatic life criteria for cyanide apply only to those waters of the State designed as uses III, III-P, IV, or IV-P. In all other waters of the State cyanide acute and chronic aquatic life criteria of 31.3 and 7.3 ug/L, respectively, apply; c = Insufficient data to develop criteria. Value represents the lowest observed effect level (LOEL); d = Proposed criterion; e = Hardness dependent criteria (100 mg/L CaCO3 used); f = pH dependent criteria, (7.8 pH used); g = Silver has a hardness dependent value as well as different proposed criteria values.

Contaminant concentrations are reported in units of ug/L.

ATTACHMENT A

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC		Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)	Pass Tier 1 Screen ?
Water: Groundwater											
No RBCs Available											
GW202	3,4-METHYLPHENOL		Water	5.5	U	ug/L			?	--	--
GW202	4-BROMOPHENYL PHENYL ETHER		Water	5.5	U	ug/L			?	--	--
GW202	4-CHLORO-3-METHYLPHENOL		Water	5.5	U	ug/L			?	--	--
GW202	4-CHLOROPHENYL PHENYL ETHER		Water	5.5	U	ug/L			?	--	--
GW302	BIS(2-CHLOROETHOXY)METHANE		Water	5.5	U	ug/L			?	--	--
Inorganics:											
GW202	ALUMINUM	7429905	Water	5800		ug/L	3.65E+03	* N	Fail	--	--
GW202-DISSOLVED	ANTIMONY	7440360	Water	5	UL	ug/L	1.46E+00	* N	Fail	--	--
GW202	ARSENIC	7440382	Water	22		ug/L	4.46E-02	C	Fail	--	--
GW202	BARIUM	7440393	Water	310		ug/L	2.56E+02	* N	Fail	--	--
GW302	BERYLLIUM	7440417	Water	2.5	U	ug/L	7.30E+00	* N	Pass	--	--
GW202	CADMIUM	7440439	Water	6.5		ug/L	3.65E+00	* N	Fail	--	--
GW202	CHROMIUM	18540299	Water	190		ug/L	1.09E+01	* N	Fail	--	--
GW202	COBALT	7440484	Water	31		ug/L	7.30E+01	* N	Pass	--	--
GW202	COPPER	7440508	Water	280		ug/L	1.46E+02	* N	Fail	--	--
GW202	LEAD		Water	1100		ug/L			?	--	--
GW202	MANGANESE	7439965	Water	650		ug/L	7.30E+01	* N	Fail	--	--
GW202-DISSOLVED	MERCURY	7439976	Water	1	U	ug/L			?	--	--
GW202	NICKEL	7440020	Water	57		ug/L	7.30E+01	* N	Pass	--	--
GW202-DISSOLVED	SELENIUM	7782492	Water	8		ug/L	1.83E+01	* N	Pass	--	--
GW302-DISSOLVED	SILVER	7440224	Water	2.5	U	ug/L	1.83E+01	* N	Pass	--	--
GW302-DISSOLVED	THALLIUM	7440280	Water	2.5	U	ug/L	2.56E-01	* N	Fail	--	--
GW202	VANADIUM	7440622	Water	60		ug/L	3.70E+00	* N	Fail	--	--
GW202	ZINC	7440666	Water	2000		ug/L	1.10E+03	* N	Fail	--	--
Organics:											
GW202	1,1-BIPHENYL	92524	Water	5.5	U	ug/L	3.04E+01	* N	Pass	--	--
GW302	2,4,5-TRICHLOROPHENOL	95954	Water	11	U	ug/L	3.65E+02	* N	Pass	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC		Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)	Pass Tier 1 Screen ?
Water: Groundwater											
Organics:											
GW302	2,4,6-TRICHLOROPHENOL	88062	Water	5.5	U	ug/L	6.09E+00	C	Pass	--	--
GW302	2,4-DICHLOROPHENOL	120832	Water	5.5	U	ug/L	1.09E+01	* N	Pass	--	--
GW302	2,4-DIMETHYLPHENOL	105679	Water	5.5	U	ug/L	7.30E+01	* N	Pass	--	--
GW302	2,4-DINITROPHENOL	51285	Water	11	U	ug/L	7.30E+00	* N	Fail	--	--
GW302	2,4-DINITROTOLUENE	121142	Water	5.5	U	ug/L	7.30E+00	* N	Pass	--	--
GW202	2,6-DINITROTOLUENE	606202	Water	11	U	ug/L	3.65E+00	* N	Fail	--	--
GW202	2-CHLORONAPHTHALENE	91587	Water	5.5	U	ug/L	4.87E+01	* N	Pass	--	--
GW302	2-CHLOROPHENOL	95578	Water	5.5	U	ug/L	3.04E+00	* N	Fail	--	--
GW302	2-METHYLNAPHTHALENE	91576	Water	5.5	U	ug/L	2.40E+00	* N	Fail	--	--
GW302	2-METHYLPHENOL	95487	Water	5.5	U	ug/L	1.83E+02	* N	Pass	--	--
GW302	2-NITROANILINE	88744	Water	5.5	U	ug/L	1.10E+01	* N	Pass	--	--
GW302	2-NITROPHENOL	100027	Water	5.5	U	ug/L	2.92E+01	* N	Pass	--	--
GW302	3,3'-DICHLOROBENZIDINE	91941	Water	5.5	U	ug/L	1.49E-01	C	Fail	--	--
GW302	3-NITROANILINE	88744	Water	11	U	ug/L	1.10E+01	* N	Pass	--	--
GW202	4,6-DINITRO-2-METHYLPHENOL	534521	Water	11	U	ug/L	3.70E-01	* N	Fail	--	--
GW302	4-CHLOROANILINE	106478	Water	5.5	U	ug/L	1.20E+00	C	Fail	--	--
GW302	4-NITROANILINE	88744	Water	5.5	U	ug/L	1.10E+01	* N	Pass	--	--
GW302	4-NITROPHENOL	100027	Water	11	U	ug/L	2.92E+01	* N	Pass	--	--
GW202	ACENAPHTHENE	83329	Water	3	J	ug/L	3.65E+01	* N	Pass	--	--
GW202	ACENAPHTHYLENE	83329	Water	5.5	U	ug/L	3.65E+01	* N	Pass	--	--
GW202	ACETOPHENONE	98862	Water	5.5	U	ug/L	6.10E+01	* N	Pass	--	--
GW202	ANTHRACENE	120127	Water	5.5	U	ug/L	1.83E+02	* N	Pass	--	--
GW202	ATRAZINE	1912249	Water	5.5	U	ug/L	3.04E-01	C	Fail	--	--
GW202	BENZO(B,K)FLUORANTHENE	207089	Water	11	U	ug/L	9.17E-01	C	Fail	--	--
GW202	BENZO[A]ANTHRACENE	56553	Water	5.5	U	ug/L	9.17E-02	C	Fail	--	--
GW202	BENZO[A]PYRENE	50328	Water	3	U	ug/L	9.17E-03	C	Fail	--	--
GW202	BENZO[G,H,I]PERYLENE	129000	Water	5.5	U	ug/L	1.83E+01	* N	Pass	--	--
GW202	BIS(2-CHLOROETHYL)ETHER	111444	Water	5.5	U	ug/L	9.59E-03	C	Fail	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC		Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)	Pass Tier 1 Screen ?
Water: Groundwater											
Organics:											
GW202	BIS(2-CHLOROISOPROPYL)ETHER	108601	Water	5.5	U	ug/L	2.60E-01	C	Fail	--	--
GW202	BIS(2-ETHYLHEXYL)PHTHALATE	117817	Water	5.5	U	ug/L	4.78E+00	C	Fail	--	--
GW202	BUTYLBENZYLPHTHALATE	85687	Water	5.5	U	ug/L	3.50E+01	C	Pass	--	--
GW202	CAPROLACTAM	105602	Water	5.5	U	ug/L	1.83E+03	* N	Pass	--	--
GW202	CARBAZOLE	86748	Water	5.5	U	ug/L	3.35E+00	C	Fail	--	--
GW202	CHRYSENE	218019	Water	5.5	U	ug/L	9.17E+00	C	Pass	--	--
GW202	DIBENZO[A,H]ANTHRACENE	53703	Water	3	U	ug/L	9.17E-03	C	Fail	--	--
GW202	DIBENZOFURAN	132649	Water	5.5	U	ug/L	1.20E+00	* N	Fail	--	--
GW202	DIBUTYLPHTHALATE	84742	Water	5.5	U	ug/L	3.65E+02	* N	Pass	--	--
GW202	DIETHYLPHTHALATE	84662	Water	5.5	U	ug/L	2.92E+03	* N	Pass	--	--
GW202	DIMETHYLPHTHALATE	131113	Water	5.5	U	ug/L	3.65E+04	* N	Pass	--	--
GW202	DIOCTYLPHTHALATE	117840	Water	5.5	U	ug/L	1.50E+02	* N	Pass	--	--
GW202	FLUORANTHENE	206440	Water	5.5	U	ug/L	1.46E+02	* N	Pass	--	--
GW302	FLUORENE	86737	Water	5.5	U	ug/L	2.43E+01	* N	Pass	--	--
GW202	HEXACHLOROBENZENE	118741	Water	5.5	U	ug/L	4.19E-02	C	Fail	--	--
GW202	HEXACHLOROBUTADIENE	87683	Water	5.5	U	ug/L	8.59E-01	C	Fail	--	--
GW202	HEXACHLOROCYCLOPENTADIENE	77474	Water	5.5	U	ug/L	2.19E+01	* N	Pass	--	--
GW202	HEXACHLOROETHANE	67721	Water	5.5	U	ug/L	4.78E+00	C	Fail	--	--
GW202	INDENO[1,2,3-CD]PYRENE	193395	Water	5.5	U	ug/L	9.17E-02	C	Fail	--	--
GW202	ISOPHORONE	78591	Water	5.5	U	ug/L	7.05E+01	C	Pass	--	--
GW202	N-NITROSODIPHENYLAMINE	86306	Water	5.5	U	ug/L	1.37E+01	C	Pass	--	--
GW202	N-NITROSODIPROPYLAMINE	621647	Water	5.5	U	ug/L	9.57E-03	C	Fail	--	--
GW202	NAPHTHALENE	91203	Water	5.5	U	ug/L	6.51E-01	* N	Fail	--	--
GW202	NITROBENZENE	98953	Water	5.5	U	ug/L	3.53E-01	* N	Fail	--	--
GW202	PENTACHLOROPHENOL	87865	Water	11	U	ug/L	5.58E-01	C	Fail	--	--
GW202	PHENANTHRENE	120127	Water	2	J	ug/L	1.83E+02	* N	Pass	--	--
GW202	PHENOL	108952	Water	5.5	U	ug/L	1.10E+03	* N	Pass	--	--
GW202	PYRENE	129000	Water	5.5	U	ug/L	1.83E+01	* N	Pass	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC	Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)		Pass Tier 1 Screen ?
Soil											
Surface:											
Inorganics:											
SB303-00	ALUMINUM	7429905	Soil	9100		mg/kg	--	--	7.80E+03	* N	Fail
SB204-00	ANTIMONY	7440360	Soil	6.1		mg/kg	--	--	3.10E+00	* N	Fail
SB303-00	ARSENIC	7440382	Soil	40		mg/kg	--	--	4.30E-01	C	Fail
SB204-00	BARIUM	7440393	Soil	200		mg/kg	--	--	5.50E+02	* N	Pass
SB303-00	BERYLLIUM	7440417	Soil	1.45	U	mg/kg	--	--	1.60E+01	* N	Pass
SB303-00	CADMIUM	7440439	Soil	4.2		mg/kg	--	--	7.80E+00	* N	Pass
SB303-00	CHROMIUM	18540299	Soil	92		mg/kg	--	--	2.30E+01	* N	Fail
SB303-00	COBALT	7440484	Soil	17	J	mg/kg	--	--	1.56E+02	* N	Pass
SB204-00	COPPER	7440508	Soil	260	K	mg/kg	--	--	3.10E+02	* N	Pass
SB303-00	CYANIDE (FREE)	57125	Soil	3.35	U	mg/kg	--	--	1.60E+02	* N	Pass
SB303-00	LEAD		Soil	730		mg/kg	--	--			?
SB303-00	MANGANESE	7439965	Soil	270	J	mg/kg	--	--	1.60E+02	* N	Fail
SB204-00	MERCURY	7439976	Soil	1.7		mg/kg	--	--	1.00E-06	MDE	Fail
SB303-00	NICKEL	7440020	Soil	32		mg/kg	--	--	1.60E+02	* N	Pass
SB303-00	SELENIUM	7782492	Soil	1.45	U	mg/kg	--	--	3.90E+01	* N	Pass
SB303-00	SILVER	7440224	Soil	1.45	U	mg/kg	--	--	3.90E+01	* N	Pass
SB204-00	THALLIUM	7440280	Soil	1.15	U	mg/kg	--	--	5.50E-01	* N	Fail
SB303-00	VANADIUM	7440622	Soil	41		mg/kg	--	--	7.80E+00	* N	Fail
SB303-00	ZINC	7440666	Soil	560		mg/kg	--	--	2.30E+03	* N	Pass
Organics:											
SB303-00	2-METHYLNAPHTHALENE	91576	Soil	0.22	U	mg/kg	--	--	3.10E+01	* N	Pass
SB202-00	ACENAPHTHENE	83329	Soil	0.19	U	mg/kg	--	--	4.70E+02	* N	Pass
SB303-00	ACENAPHTHYLENE	83329	Soil	0.22	U	mg/kg	--	--	4.70E+02	* N	Pass
SB204-00	ANTHRACENE	120127	Soil	0.096	J	mg/kg	--	--	2.30E+03	* N	Pass
SB204-00	BENZO(B,K)FLUORANTHENE	207089	Soil	0.52	J	mg/kg	--	--	8.80E+00	C	Pass
SB204-00	BENZO[A]ANTHRACENE	56553	Soil	0.43		mg/kg	--	--	8.80E-01	C	Pass
SB303-00	BENZO[A]PYRENE	50328	Soil	0.55		mg/kg	--	--	8.80E-02	C	Fail

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC	Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)		Pass Tier 1 Screen ?
Soil											
Surface:											
Organics:											
SB204-00	BENZO[G,H,I]PERYLENE	129000	Soil	0.34	J	mg/kg	--	--	2.30E+02	* N	Pass
SB204-00	CHRYSENE	218019	Soil	0.47		mg/kg	--	--	8.80E+01	C	Pass
SB204-00	DIBENZO[A,H]ANTHRACENE	53703	Soil	0.13	J	mg/kg	--	--	8.80E-02	C	Fail
SB204-00	FLUORANTHENE	206440	Soil	0.79		mg/kg	--	--	3.10E+02	* N	Pass
SB303-00	FLUORENE	86737	Soil	0.22	U	mg/kg	--	--	3.10E+02	* N	Pass
SB204-00	INDENO[1,2,3-CD]PYRENE	193395	Soil	0.31	J	mg/kg	--	--	8.80E-01	C	Pass
SB303-00	NAPHTHALENE	91203	Soil	0.22	U	mg/kg	--	--	1.60E+02	* N	Pass
SB204-00	PHENANTHRENE	120127	Soil	0.52		mg/kg	--	--	2.30E+03	* N	Pass
SB204-00	PYRENE	129000	Soil	0.84		mg/kg	--	--	2.30E+02	* N	Pass
Subsurface:											
Inorganics:											
SB201-06	ALUMINUM	7429905	Soil	9400		mg/kg	--	--	7.80E+03	* N	Fail
SB303-10	ANTIMONY	7440360	Soil	7.4		mg/kg	--	--	3.10E+00	* N	Fail
SB303-10	ARSENIC	7440382	Soil	25		mg/kg	--	--	4.30E-01	C	Fail
SB303-10	BARIUM	7440393	Soil	1300		mg/kg	--	--	5.50E+02	* N	Fail
SB303-10	BERYLLIUM	7440417	Soil	1.7	U	mg/kg	--	--	1.60E+01	* N	Pass
SB303-10	CADMIUM	7440439	Soil	5.1		mg/kg	--	--	7.80E+00	* N	Pass
SB201-06	CHROMIUM	18540299	Soil	690		mg/kg	--	--	2.30E+01	* N	Fail
SB201-06	CHROMIUM VI	18540299	Soil	6.5	U	mg/kg	--	--	2.30E+01	* N	Pass
SB303-10	COBALT	7440484	Soil	22	J	mg/kg	--	--	1.56E+02	* N	Pass
SB102-06	COPPER	7440508	Soil	220	K	mg/kg	--	--	3.10E+02	* N	Pass
SB303-10	CYANIDE (FREE)	57125	Soil	3.9	U	mg/kg	--	--	1.60E+02	* N	Pass
SB102-06	LEAD		Soil	2700		mg/kg	--	--			?
SB601-10	MANGANESE	7439965	Soil	2800	J	mg/kg	--	--	1.60E+02	* N	Fail
SB303-10	MERCURY	7439976	Soil	3.7		mg/kg	--	--	1.00E-06	MDE	Fail
SB201-06	NICKEL	7440020	Soil	37		mg/kg	--	--	1.60E+02	* N	Pass
SB303-10	SELENIUM	7782492	Soil	1.7	U	mg/kg	--	--	3.90E+01	* N	Pass

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	Adjusted Tap Water RBC	Pass Tier 1 Screen ?	Adjusted Soil RBC (Residential)		Pass Tier 1 Screen ?
Soil											
Subsurface:											
Inorganics:											
SB303-10	SILVER	7440224	Soil	1.7	U	mg/kg	--	--	3.90E+01	* N	Pass
SB303-10	THALLIUM	7440280	Soil	1.35	U	mg/kg	--	--	5.50E-01	* N	Fail
SB201-06	VANADIUM	7440622	Soil	37		mg/kg	--	--	7.80E+00	* N	Fail
SB201-06	ZINC	7440666	Soil	3200		mg/kg	--	--	2.30E+03	* N	Fail
Organics:											
SB303-10	2-METHYLNAPHTHALENE	91576	Soil	0.26	U	mg/kg	--	--	3.10E+01	* N	Pass
SB102-06	ACENAPHTHENE	83329	Soil	0.32	J	mg/kg	--	--	4.70E+02	* N	Pass
SB303-10	ACENAPHTHYLENE	83329	Soil	0.26	U	mg/kg	--	--	4.70E+02	* N	Pass
SB102-06	ANTHRACENE	120127	Soil	0.7		mg/kg	--	--	2.30E+03	* N	Pass
SB601-10	BENZO(B,K)FLUORANTHENE	207089	Soil	2.2		mg/kg	--	--	8.80E+00	C	Pass
SB102-06	BENZO[A]ANTHRACENE	56553	Soil	2		mg/kg	--	--	8.80E-01	C	Fail
SB601-10	BENZO[A]PYRENE	50328	Soil	2.9		mg/kg	--	--	8.80E-02	C	Fail
SB601-10	BENZO[G,H,I]PERYLENE	129000	Soil	2		mg/kg	--	--	2.30E+02	* N	Pass
SB601-10	CHRYSENE	218019	Soil	2.4		mg/kg	--	--	8.80E+01	C	Pass
SB102-06	DIBENZO[A,H]ANTHRACENE	53703	Soil	0.51		mg/kg	--	--	8.80E-02	C	Fail
SB601-10	FLUORANTHENE	206440	Soil	4.2		mg/kg	--	--	3.10E+02	* N	Pass
SB102-06	FLUORENE	86737	Soil	0.34	J	mg/kg	--	--	3.10E+02	* N	Pass
SB601-10	INDENO[1,2,3-CD]PYRENE	193395	Soil	1.6		mg/kg	--	--	8.80E-01	C	Fail
SB303-10	NAPHTHALENE	91203	Soil	0.26	U	mg/kg	--	--	1.60E+02	* N	Pass
SB102-06	PHENANTHRENE	120127	Soil	3.4		mg/kg	--	--	2.30E+03	* N	Pass
SB601-10	PYRENE	129000	Soil	4.7		mg/kg	--	--	2.30E+02	* N	Pass

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Attachment A. Identification of Chemicals of Concern (Non-Residential Use): Warner Street Wetland, Baltimore, Maryland; PCA C[illegible] 6682MW

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Water: Groundwater										
No Standards Available										
GW302	3,4-METHYLPHENOL		Water	5.5	U	ug/L		?	--	--
GW302	4-BROMOPHENYL PHENYL ETHER		Water	5.5	U	ug/L		?	--	--
GW302	4-CHLORO-3-METHYLPHENOL		Water	5.5	U	ug/L		?	--	--
GW302	4-CHLOROPHENYL PHENYL ETHER		Water	5.5	U	ug/L		?	--	--
GW302	BIS(2-CHLOROETHOXY)METHANE		Water	5.5	U	ug/L		?	--	--
Inorganics:										
GW202	ALUMINUM	7429905	Water	5800		ug/L	5.00E+01	Fail	--	--
GW302-DISSOLVED	ANTIMONY	7440360	Water	5	UL	ug/L	6.00E+00	Pass	--	--
GW202	ARSENIC	7440382	Water	22		ug/L	5.00E+01	Pass	--	--
GW202	BARIUM	7440393	Water	310		ug/L	2.00E+03	Pass	--	--
GW202-DISSOLVED	BERYLLIUM	7440417	Water	2.5	U	ug/L	4.00E+00	Pass	--	--
GW202	CADMIUM	7440439	Water	6.5		ug/L	5.00E+00	Fail	--	--
GW202	CHROMIUM	18540299	Water	190		ug/L	1.00E+02	Fail	--	--
GW202	COBALT	7440484	Water	31		ug/L	7.30E+01	Pass	--	--
GW202	COPPER	7440508	Water	280		ug/L	1.30E+03	Pass	--	--
GW202	LEAD		Water	1100		ug/L	1.50E+01	Fail	--	--
GW202	MANGANESE	7439965	Water	650		ug/L	5.00E+01	Fail	--	--
GW202-DISSOLVED	MERCURY	7439976	Water	1	U	ug/L	2.00E+00	Pass	--	--
GW202	NICKEL	7440020	Water	57		ug/L	7.30E+01	Pass	--	--
GW302-DISSOLVED	SELENIUM	7782492	Water	8		ug/L	5.00E+01	Pass	--	--
GW302-DISSOLVED	SILVER	7440224	Water	2.5	U	ug/L	1.80E+01	Pass	--	--
GW302-DISSOLVED	THALLIUM	7440280	Water	2.5	U	ug/L	2.00E+00	Fail	--	--
GW202	VANADIUM	7440622	Water	60		ug/L	5.00E+01	Fail	--	--
GW202	ZINC	7440666	Water	2000		ug/L	1.10E+03	Fail	--	--
Organics:										
GW302	1,1-BIPHENYL		Water	5.5	U	ug/L		?	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Water: Groundwater										
Organics:										
GW202	2,4,5-TRICHLOROPHENOL	95954	Water	11	U	ug/L	3.70E+02	Pass	--	--
GW302	2,4,6-TRICHLOROPHENOL	88062	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	2,4-DICHLOROPHENOL	120832	Water	5.5	U	ug/L	1.10E+01	Pass	--	--
GW302	2,4-DIMETHYLPHENOL	105679	Water	5.5	U	ug/L	7.30E+01	Pass	--	--
GW302	2,4-DINITROPHENOL	51285	Water	11	U	ug/L	1.00E+01	Fail	--	--
GW202	2,4-DINITROTOLUENE	121142	Water	5.5	U	ug/L	5.00E+01	Pass	--	--
GW202	2,6-DINITROTOLUENE	606202	Water	11	U	ug/L	5.00E+01	Pass	--	--
GW302	2-CHLORONAPHTHALENE	91587	Water	5.5	U	ug/L	4.90E+01	Pass	--	--
GW302	2-CHLOROPHENOL	95578	Water	5.5	U	ug/L	2.00E+01	Pass	--	--
GW302	2-METHYLNAPHTHALENE	91576	Water	5.5	U	ug/L	2.00E+01	Pass	--	--
GW302	2-METHYLPHENOL	95487	Water	5.5	U	ug/L	1.80E+02	Pass	--	--
GW302	2-NITROANILINE	88744	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	2-NITROPHENOL	100027	Water	5.5	U	ug/L	2.90E+01	Pass	--	--
GW302	3,3'-DICHLOROBENZIDINE	91941	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	3-NITROANILINE	88744	Water	11	U	ug/L	1.00E+01	Fail	--	--
GW202	4,6-DINITRO-2-METHYLPHENOL	534521	Water	11	U	ug/L	5.00E+01	Pass	--	--
GW202	4-CHLOROANILINE	106478	Water	5.5	U	ug/L	2.00E+01	Pass	--	--
GW202	4-NITROANILINE	88744	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	4-NITROPHENOL	100027	Water	11	U	ug/L	2.90E+01	Pass	--	--
GW202	ACENAPHTHENE	83329	Water	3	J	ug/L	3.70E+01	Pass	--	--
GW202	ACENAPHTHYLENE	83329	Water	5.5	U	ug/L	3.70E+01	Pass	--	--
GW202	ACETOPHENONE		Water	5.5	U	ug/L		?	--	--
GW202	ANTHRACENE	120127	Water	5.5	U	ug/L	1.80E+02	Pass	--	--
GW302	ATRAZINE	1912249	Water	5.5	U	ug/L	3.00E+00	Fail	--	--
GW202	BENZO(B,K)FLUORANTHENE	207089	Water	11	U	ug/L	1.00E+01	Fail	--	--
GW302	BENZO[A]ANTHRACENE	56553	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW202	BENZO[A]PYRENE	50328	Water	3	U	ug/L	1.00E+01	Pass	--	--
GW302	BENZO[G,H,I]PERYLENE	129000	Water	5.5	U	ug/L	1.80E+01	Pass	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Water: Groundwater										
Organics:										
GW302	BIS(2-CHLOROETHYL)ETHER	111444	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	BIS(2-CHLOROISOPROPYL)ETHER	108601	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	BIS(2-ETHYLHEXYL)PHTHALATE	117817	Water	5.5	U	ug/L	2.00E+01	Pass	--	--
GW302	BUTYLBENZYLPHTHALATE		Water	5.5	U	ug/L		?	--	--
GW302	CAPROLACTAM		Water	5.5	U	ug/L		?	--	--
GW302	CARBAZOLE	86748	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	CHRYSENE	218019	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW202	DIBENZO[A,H]ANTHRACENE	53703	Water	3	U	ug/L	1.00E+01	Pass	--	--
GW302	DIBENZOFURAN	132649	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	DIBUTYLPHTHALATE	84742	Water	5.5	U	ug/L	3.70E+02	Pass	--	--
GW302	DIETHYLPHTHALATE	84662	Water	5.5	U	ug/L	2.90E+03	Pass	--	--
GW202	DIMETHYLPHTHALATE	131113	Water	5.5	U	ug/L	3.70E+04	Pass	--	--
GW202	DIOCTYLPHTHALATE	117840	Water	5.5	U	ug/L	7.30E+01	Pass	--	--
GW202	FLUORANTHENE	206440	Water	5.5	U	ug/L	1.50E+02	Pass	--	--
GW302	FLUORENE	86737	Water	5.5	U	ug/L	2.40E+01	Pass	--	--
GW202	HEXACHLOROBENZENE		Water	5.5	U	ug/L		?	--	--
GW202	HEXACHLOROBUTADIENE	87683	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW202	HEXACHLOROCYCLOPENTADIENE	77474	Water	5.5	U	ug/L	5.00E+01	Pass	--	--
GW202	HEXACHLOROETHANE	67721	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW202	INDENO[1,2,3-CD]PYRENE	193395	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW202	ISOPHORONE	78591	Water	5.5	U	ug/L	7.00E+01	Pass	--	--
GW202	N-NITROSODIPHENYLAMINE	86306	Water	5.5	U	ug/L	5.00E+01	Pass	--	--
GW202	N-NITROSODIPROPYLAMINE	621647	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	NAPHTHALENE	91203	Water	5.5	U	ug/L	1.00E+01	Pass	--	--
GW302	NITROBENZENE	98953	Water	5.5	U	ug/L	2.00E+01	Pass	--	--
GW202	PENTACHLOROPHENOL	87865	Water	11	U	ug/L	5.00E+01	Pass	--	--
GW202	PHENANTHRENE	120127	Water	2	J	ug/L	1.80E+02	Pass	--	--
GW202	PHENOL	108952	Water	5.5	U	ug/L	2.20E+03	Pass	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Water: Groundwater										
Organics:										
GW302	PYRENE	129000	Water	5.5	U	ug/L	1.80E+01	Pass	--	--

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Soil										
Surface:										
Inorganics:										
SB303-00	ALUMINUM	7429905	Soil	9100		mg/kg	--	--	2.00E+05	Pass
SB204-00	ANTIMONY	7440360	Soil	6.1		mg/kg	--	--	8.20E+01	Pass
SB303-00	ARSENIC	7440382	Soil	40		mg/kg	--	--	3.80E+00	Fail
SB204-00	BARIUM	7440393	Soil	200		mg/kg	--	--	1.40E+04	Pass
SB204-00	BERYLLIUM	7440417	Soil	1.45	U	mg/kg	--	--	4.10E+02	Pass
SB303-00	CADMIUM	7440439	Soil	4.2		mg/kg	--	--	1.00E+02	Pass
SB303-00	CHROMIUM	18540299	Soil	92		mg/kg	--	--	6.10E+02	Pass
SB303-00	COBALT	7440484	Soil	17	J	mg/kg	--	--	4.10E+03	Pass
SB204-00	COPPER	7440508	Soil	260	K	mg/kg	--	--	8.20E+03	Pass
SB303-00	CYANIDE (FREE)	57125	Soil	3.35	U	mg/kg	--	--	4.10E+03	Pass
SB303-00	LEAD		Soil	730		mg/kg	--	--	4.00E+02	Fail
SB303-00	MANGANESE	7439965	Soil	270	J	mg/kg	--	--	4.10E+03	Pass
SB204-00	MERCURY	7439976	Soil	1.7		mg/kg	--	--	1.20E-01	Fail
SB303-00	NICKEL	7440020	Soil	32		mg/kg	--	--	4.10E+03	Pass
SB204-00	SELENIUM	7782492	Soil	1.45	U	mg/kg	--	--	1.00E+03	Pass
SB204-00	SILVER	7440224	Soil	1.45	U	mg/kg	--	--	1.00E+03	Pass
SB204-00	THALLIUM	7440280	Soil	1.15	U	mg/kg	--	--	1.40E+01	Pass
SB303-00	VANADIUM	7440622	Soil	41		mg/kg	--	--	1.40E+03	Pass
SB303-00	ZINC	7440666	Soil	560		mg/kg	--	--	6.10E+04	Pass
Organics:										
SB303-00	2-METHYLNAPHTHALENE	91576	Soil	0.22	U	mg/kg	--	--	4.10E+03	Pass
SB202-00	ACENAPHTHENE	83329	Soil	0.19	U	mg/kg	--	--	1.20E+04	Pass
SB303-00	ACENAPHTHYLENE	83329	Soil	0.22	U	mg/kg	--	--	1.20E+04	Pass
SB204-00	ANTHRACENE	120127	Soil	0.096	J	mg/kg	--	--	6.10E+04	Pass
SB204-00	BENZO(B,K)FLUORANTHENE	207089	Soil	0.52	J	mg/kg	--	--	7.80E+01	Pass
SB204-00	BENZO[A]ANTHRACENE	56553	Soil	0.43		mg/kg	--	--	7.80E+00	Pass
SB303-00	BENZO[A]PYRENE	50328	Soil	0.55		mg/kg	--	--	7.80E-01	Pass

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Attachment A (cont.). Identification of Chemicals of Concern (Non-Residential Use): Warner Street Wetland, Baltimore, Maryland; PCA Code: 6682MW

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Soil										
Surface:										
Organics:										
SB204-00	BENZO[G,H,I]PERYLENE	129000	Soil	0.34	J	mg/kg	--	--	6.10E+03	Pass
SB204-00	CHRYSENE	218019	Soil	0.47		mg/kg	--	--	7.80E+02	Pass
SB204-00	DIBENZO[A,H]ANTHRACENE	53703	Soil	0.13	J	mg/kg	--	--	7.80E-01	Pass
SB204-00	FLUORANTHENE	206440	Soil	0.79		mg/kg	--	--	8.20E+03	Pass
SB303-00	FLUORENE	86737	Soil	0.22	U	mg/kg	--	--	8.20E+03	Pass
SB204-00	INDENO[1,2,3-CD]PYRENE	193395	Soil	0.31	J	mg/kg	--	--	7.80E+00	Pass
SB303-00	NAPHTHALENE	91203	Soil	0.22	U	mg/kg	--	--	4.10E+03	Pass
SB204-00	PHENANTHRENE	120127	Soil	0.52		mg/kg	--	--	6.10E+04	Pass
SB204-00	PYRENE	129000	Soil	0.84		mg/kg	--	--	6.10E+03	Pass
Subsurface:										
Inorganics:										
SB201-06	ALUMINUM	7429905	Soil	9400		mg/kg	--	--	2.00E+05	Pass
SB303-10	ANTIMONY	7440360	Soil	7.4		mg/kg	--	--	8.20E+01	Pass
SB303-10	ARSENIC	7440382	Soil	25		mg/kg	--	--	3.80E+00	Fail
SB303-10	BARIUM	7440393	Soil	1300		mg/kg	--	--	1.40E+04	Pass
SB303-10	BERYLLIUM	7440417	Soil	1.7	U	mg/kg	--	--	4.10E+02	Pass
SB303-10	CADMIUM	7440439	Soil	5.1		mg/kg	--	--	1.00E+02	Pass
SB201-06	CHROMIUM	18540299	Soil	690		mg/kg	--	--	6.10E+02	Fail
SB201-06	CHROMIUM VI	18540299	Soil	6.5	U	mg/kg	--	--	6.10E+02	Pass
SB303-10	COBALT	7440484	Soil	22	J	mg/kg	--	--	4.10E+03	Pass
SB102-06	COPPER	7440508	Soil	220	K	mg/kg	--	--	8.20E+03	Pass
SB303-10	CYANIDE (FREE)	57125	Soil	3.9	U	mg/kg	--	--	4.10E+03	Pass
SB102-06	LEAD		Soil	2700		mg/kg	--	--	4.00E+02	Fail
SB601-10	MANGANESE	7439965	Soil	2800	J	mg/kg	--	--	4.10E+03	Pass
SB303-10	MERCURY	7439976	Soil	3.7		mg/kg	--	--	1.20E-01	Fail
SB201-06	NICKEL	7440020	Soil	37		mg/kg	--	--	4.10E+03	Pass
SB303-10	SELENIUM	7782492	Soil	1.7	U	mg/kg	--	--	1.00E+03	Pass

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

Sample ID	Analyte	CAS	Matrix	Concentration	Qual.	Units	MDE Groundwater Standard	Pass Tier 1 Screen ?	MDE Soil Standard (Non-Residential)	Pass Tier 1 Screen ?
Soil										
Subsurface:										
Inorganics:										
SB303-10	SILVER	7440224	Soil	1.7	U	mg/kg	--	--	1.00E+03	Pass
SB303-10	THALLIUM	7440280	Soil	1.35	U	mg/kg	--	--	1.40E+01	Pass
SB201-06	VANADIUM	7440622	Soil	37		mg/kg	--	--	1.40E+03	Pass
SB201-06	ZINC	7440666	Soil	3200		mg/kg	--	--	6.10E+04	Pass
Organics:										
SB303-10	2-METHYLNAPHTHALENE	91576	Soil	0.26	U	mg/kg	--	--	4.10E+03	Pass
SB102-06	ACENAPHTHENE	83329	Soil	0.32	J	mg/kg	--	--	1.20E+04	Pass
SB303-10	ACENAPHTHYLENE	83329	Soil	0.26	U	mg/kg	--	--	1.20E+04	Pass
SB102-06	ANTHRACENE	120127	Soil	0.7		mg/kg	--	--	6.10E+04	Pass
SB601-10	BENZO(B,K)FLUORANTHENE	207089	Soil	2.2		mg/kg	--	--	7.80E+01	Pass
SB601-10	BENZO[A]ANTHRACENE	56553	Soil	2		mg/kg	--	--	7.80E+00	Pass
SB601-10	BENZO[A]PYRENE	50328	Soil	2.9		mg/kg	--	--	7.80E-01	Fail
SB601-10	BENZO[G,H,I]PERYLENE	129000	Soil	2		mg/kg	--	--	6.10E+03	Pass
SB601-10	CHRYSENE	218019	Soil	2.4		mg/kg	--	--	7.80E+02	Pass
SB102-06	DIBENZO[A,H]ANTHRACENE	53703	Soil	0.51		mg/kg	--	--	7.80E-01	Pass
SB601-10	FLUORANTHENE	206440	Soil	4.2		mg/kg	--	--	8.20E+03	Pass
SB102-06	FLUORENE	86737	Soil	0.34	J	mg/kg	--	--	8.20E+03	Pass
SB601-10	INDENO[1,2,3-CD]PYRENE	193395	Soil	1.6		mg/kg	--	--	7.80E+00	Pass
SB303-10	NAPHTHALENE	91203	Soil	0.26	U	mg/kg	--	--	4.10E+03	Pass
SB102-06	PHENANTHRENE	120127	Soil	3.4		mg/kg	--	--	6.10E+04	Pass
SB601-10	PYRENE	129000	Soil	4.7		mg/kg	--	--	6.10E+03	Pass

* RBC adjusted for non-carcinogenic additive effects; N = non-carcinogenic; C = carcinogenic. Note: no RBC value exists for inorganic mercury; the screening value was arbitrarily set at 1E-6 for soil and water.

ANALYTE MAX REPORT

PCAcode	*Analyte*	*Matrix*	*Depth*	*SampleID*	*Concentration*	*Qualifier*	*ConcUnit*
6682MW							
	ARSENIC						
		Soil					
			S				
				SB303-00	40.0000		mg/kg
				SB202-00	9.5000		mg/kg
				SB204-00	23.0000		mg/kg
			SS				
				SB302-03	16.0000		mg/kg
				SB201-06	14.0000		mg/kg
				SB401-10	22.0000		mg/kg
				SB501-06	17.0000		mg/kg
				SB102-06	16.0000		mg/kg
				SB303-10	25.0000		mg/kg
				SB601-10	19.0000		mg/kg
				SB203-06	10.0000		mg/kg
				SB103-03	13.0000		mg/kg
				SB104-06	11.0000		mg/kg
				SB104-10	15.0000		mg/kg
				SB-301-06	4.1000		mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202-DISSOLV	2.5000	U	ug/L
				GW302-DISSOLV	2.5000	U	ug/L

ANALYTE MAX REPORT

PCAcode	*Analyte*	*Matrix*	*Depth*	*SampleID*	*Concentration*	*Qualifier*	*ConcUnit*
6682MW							
	CHROMIUM						
		Soil					
			S				
				SB303-00	92.0000		mg/kg
				SB202-00	65.0000		mg/kg
				SB204-00	61.0000		mg/kg
			SS				
				SB302-03	210.0000		mg/kg
				SB201-06	690.0000		mg/kg
				SB401-10	23.0000		mg/kg
				SB501-06	51.0000		mg/kg
				SB102-06	350.0000		mg/kg
				SB303-10	51.0000		mg/kg
				SB601-10	19.0000		mg/kg
				SB203-06	81.0000		mg/kg
				SB103-03	110.0000		mg/kg
				SB104-06	49.0000		mg/kg
				SB104-10	31.0000		mg/kg
				SB-301-06	30.0000		mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202-DISSOLV	2.5000	U	ug/L
				GW302-DISSOLV	2.5000	U	ug/L

ANALYTE MAX REPORT

PCAcode	*Analyte*	*Matrix*	*Depth*	*SampleID*	*Concentration*	*Qualifier*	*ConcUnit*
6682MW							
	CHROMIUM VI						
		Soil					
			SS				
				SB201-06	6.5000	U	mg/kg
				SB302-03	6.0000	U	mg/kg

ANALYTE MAX REPORT

PCAcode	*Analyte*	*Matrix*	*Depth*	*SampleID*	*Concentration*	*Qualifier*	*ConcUnit*
6682MW							
	LEAD						
		Soil					
			S				
				SB303-00	730.0000		mg/kg
				SB202-00	300.0000		mg/kg
				SB204-00	700.0000		mg/kg
			SS				
				SB302-03	390.0000		mg/kg
				SB201-06	610.0000		mg/kg
				SB401-10	600.0000		mg/kg
				SB501-06	330.0000		mg/kg
				SB102-06	2700.0000		mg/kg
				SB303-10	890.0000		mg/kg
				SB601-10	650.0000		mg/kg
				SB203-06	210.0000		mg/kg
				SB103-03	910.0000		mg/kg
				SB104-06	490.0000		mg/kg
				SB104-10	480.0000		mg/kg
				SB-301-06	130.0000		mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202-DISSOLV	2.5000	U	ug/L
				GW302-DISSOLV	2.5000	U	ug/L

ANALYTE MAX REPORT

PCAcode	*Analyte*	*Matrix*	*Depth*	*SampleID*	*Concentration*	*Qualifier*	*ConcUnit*
6682MW							
	MANGANESE						
		Soil					
			S				
				SB303-00	270.0000	J	mg/kg
				SB202-00	270.0000	J	mg/kg
				SB204-00	220.0000	J	mg/kg
			SS				
				SB302-03	510.0000	J	mg/kg
				SB201-06	340.0000	J	mg/kg
				SB401-10	2500.0000	J	mg/kg
				SB501-06	130.0000	J	mg/kg
				SB102-06	180.0000	J	mg/kg
				SB303-10	150.0000	J	mg/kg
				SB601-10	2800.0000	J	mg/kg
				SB203-06	220.0000	J	mg/kg
				SB103-03	200.0000	J	mg/kg
				SB104-06	160.0000	J	mg/kg
				SB104-10	190.0000	J	mg/kg
				SB-301-06	150.0000	J	mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202-DISSOLV	220.0000		ug/L
				GW302-DISSOLV	200.0000		ug/L

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
6682MW							
	DIBENZO[A,H]ANTHRACENE						
		Soil					
			S				
				SB303-00	0.1200	J	mg/kg
				SB202-00	0.0840	J	mg/kg
				SB204-00	0.1300	J	mg/kg
			SS				
				SB302-03	0.2000	J	mg/kg
				SB201-06	0.1200	J	mg/kg
				SB401-10	0.4500		mg/kg
				SB501-06	0.2800		mg/kg
				SB102-06	0.5100		mg/kg
				SB303-10	0.1300	U	mg/kg
				SB601-10	0.5000		mg/kg
				SB203-06	0.1100	U	mg/kg
				SB103-03	0.4900		mg/kg
				SB104-06	0.2300		mg/kg
				SB104-10	0.1100	J	mg/kg
				SB-301-06	0.0900	U	mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202	3.0000	U	ug/L
				GW302	2.5000	U	ug/L

ANALYTE MAX REPORT

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
6682MW							
	BENZO[A]PYRENE						
		Soil					
			S				
				SB303-00	0.5500		mg/kg
				SB202-00	0.3600		mg/kg
				SB204-00	0.5400		mg/kg
			SS				
				SB302-03	1.1000		mg/kg
				SB201-06	0.4700		mg/kg
				SB401-10	2.3000		mg/kg
				SB501-06	1.3000		mg/kg
				SB102-06	2.0000		mg/kg
				SB303-10	0.1300	U	mg/kg
				SB601-10	2.9000		mg/kg
				SB203-06	0.1700	J	mg/kg
				SB103-03	2.0000		mg/kg
				SB104-06	0.8300		mg/kg
				SB104-10	0.4500		mg/kg
				SB-301-06	0.0920	J	mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202	3.0000	U	ug/L
				GW302	2.5000	U	ug/L

ANALYTE MAX REPORT

PCAcode	*Analyte*	*Matrix*	*Depth*	*SampleID*	*Concentration*	*Qualifier*	*ConcUnit*
6682MW							
	MERCURY						
		Soil					
			S				
				SB202-00	0.4000		mg/kg
				SB204-00	1.7000		mg/kg
				SB303-00	0.7400		mg/kg
			SS				
				SB102-06	0.8000		mg/kg
				SB401-10	1.2000		mg/kg
				SB201-06	0.6100		mg/kg
				SB302-03	0.6200		mg/kg
				SB-301-06	0.1300		mg/kg
				SB303-10	3.7000		mg/kg
				SB601-10	1.4000		mg/kg
				SB203-06	0.4800		mg/kg
				SB103-03	0.5200		mg/kg
				SB104-06	0.8700		mg/kg
				SB104-10	1.2000		mg/kg
				SB501-06	0.3600		mg/kg

PCAcode	Analyte	Matrix	Depth	SampleID	Concentration	Qualifier	ConcUnit
		Water					
			NA				
				GW202-DISSOLV	1.0000	U	ug/L
				GW302-DISSOLV	1.0000	U	ug/L
				GW202	0.5000	U	ug/L
				GW302	0.5000	U	ug/L

Summary Statistics for Raw Data

From File								
Variable name		NumObs	Minimum	Maximum	Mean	Median	Sd	CV
lead ss		12	130	2700	699.1667	545	673.6125	0.963451

Summary Statistics for Raw Data

Skewness	Variance
2.720918	453753.8

General Statistics

Data File		Variable:	Mn ss

Raw Statistics	
Number of Valid Samples	12
Number of Unique Samples	11
Minimum	130
Maximum	2800
Mean	627.5
Median	195
Standard Deviation	952.7484
Variance	907729.5
Coefficient of Variation	1.518324
Skewness	2.022224

Gamma Statistics	
k hat	0.843954
k star (bias corrected)	0.688521
Theta hat	743.5244
Theta star	911.3742
nu hat	20.25488
nu star	16.5245
Approx.Chi Square Value (.05)	8.332184
Adjusted Level of Significance	0.02896
Adjusted Chi Square Value	7.460166

Log-transformed Statistics	
Minimum of log data	4.867534
Maximum of log data	7.937375
Mean of log data	5.74339
Standard Deviation of log data	1.068065
Variance of log data	1.140763

RECOMMENDATION
Data are Non-parametric (0.05)
Use 99% Chebyshev (Mean, Sd) UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.557904
Shapiro-Wilk 5% Critical Value	0.859
Data not normal at 5% significance level	
95% UCL (Assuming Normal Distribution)	
Student's-t UCL	1121.431

Gamma Distribution Test	
A-D Test Statistic	1.907703
A-D 5% Critical Value	0.76227
K-S Test Statistic	0.334299
K-S 5% Critical Value	0.253885
Data do not follow gamma distribution	
at 5% significance level	
95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	1244.466
Adjusted Gamma UCL	1389.932

Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.737941
Shapiro-Wilk 5% Critical Value	0.859
Data not lognormal at 5% significance level	
95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	1469.42
95% Chebyshev (MVUE) UCL	1262.415
97.5% Chebyshev (MVUE) UCL	1585.198
99% Chebyshev (MVUE) UCL	2219.244

95% Non-parametric UCLs	
CLT UCL	1079.892
Adj-CLT UCL (Adjusted for skewness)	1251.448
Mod-t UCL (Adjusted for skewness)	1148.19
Jackknife UCL	1121.431
Standard Bootstrap UCL	1058.039
Bootstrap-t UCL	4205.321
Hall's Bootstrap UCL	5009.98
Percentile Bootstrap UCL	1092.5
BCA Bootstrap UCL	1242.5
95% Chebyshev (Mean, Sd) UCL	1826.349
97.5% Chebyshev (Mean, Sd) UCL	2345.092
99% Chebyshev (Mean, Sd) UCL	3364.061

Recommended UCL exceeds the maximum observation

Consider using 95% or 97.5% Chebyshev (Mean, Sd) UCL

General Statistics

Data File		Variable:	Dibenz SS
Raw Statistics		Normal Distribution Test	
Number of Valid Samples	12	Shapiro-Wilk Test Statisitic	0.822521
Number of Unique Samples	11	Shapiro-Wilk 5% Critical Value	0.859
Minimum	0.09	Data not normal at 5% significance level	
Maximum	0.51		
Mean	0.268333	95% UCL (Assuming Normal Distribution)	
Median	0.215	Student's-t UCL	0.357248
Standard Deviation	0.171508		
Variance	0.029415	Gamma Distribution Test	
Coefficient of Variation	0.639162	A-D Test Statistic	0.725017
Skewness	0.509022	A-D 5% Critical Value	0.739947
		K-S Test Statistic	0.213696
Gamma Statistics		K-S 5% Critical Value	0.247835
k hat	2.626795	Data follow gamma distribution	
k star (bias corrected)	2.025652	at 5% significance level	
Theta hat	0.102152		
Theta star	0.132468	95% UCLs (Assuming Gamma Distribution)	
nu hat	63.04309	Approximate Gamma UCL	0.388163
nu star	48.61565	Adjusted Gamma UCL	0.411366
Approx.Chi Square Value (.05)	33.60753		
Adjusted Level of Significance	0.02896	Lognormal Distribution Test	
Adjusted Chi Square Value	31.71188	Shapiro-Wilk Test Statisitic	0.870982
		Shapiro-Wilk 5% Critical Value	0.859
Log-transformed Statistics		Data are lognormal at 5% significance level	
Minimum of log data	-2.407946		
Maximum of log data	-0.673345	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	-1.517784	95% H-UCL	0.446322
Standard Deviation of log data	0.674694	95% Chebyshev (MVUE) UCL	0.506739
Variance of log data	0.455212	97.5% Chebyshev (MVUE) UCL	0.60953
		99% Chebyshev (MVUE) UCL	0.811445
		95% Non-parametric UCLs	
		CLT UCL	0.34977
		Adj-CLT UCL (Adjusted for skewness)	0.357544
		Mod-t UCL (Adjusted for skewness)	0.358461
		Jackknife UCL	0.357248
		Standard Bootstrap UCL	0.346661
		Bootstrap-t UCL	0.374068
RECOMMENDATION		Hall's Bootstrap UCL	0.336413
Data follow gamma distribution (0.05)		Percentile Bootstrap UCL	0.351667
		BCA Bootstrap UCL	0.341667
Use Approximate Gamma UCL		95% Chebyshev (Mean, Sd) UCL	0.484143
		97.5% Chebyshev (Mean, Sd) UCL	0.577525
		99% Chebyshev (Mean, Sd) UCL	0.760954

General Statistics

Data File		Variable:	BAP SS

Raw Statistics	
Number of Valid Samples	12
Number of Unique Samples	11
Minimum	0.092
Maximum	2.9
Mean	1.145167
Median	0.965
Standard Deviation	0.954877
Variance	0.911789
Coefficient of Variation	0.833832
Skewness	0.548845

Gamma Statistics	
k hat	1.151059
k star (bias corrected)	0.91885
Theta hat	0.994881
Theta star	1.246304
nu hat	27.62543
nu star	22.0524
Approx.Chi Square Value (.05)	12.37597
Adjusted Level of Significance	0.02896
Adjusted Chi Square Value	11.2833

Log-transformed Statistics	
Minimum of log data	-2.385967
Maximum of log data	1.064711
Mean of log data	-0.358035
Standard Deviation of log data	1.189556
Variance of log data	1.415043

RECOMMENDATION
Data are normal (0.05)
Use Student's-t UCL

Normal Distribution Test	
Shapiro-Wilk Test Statisitic	0.908704
Shapiro-Wilk 5% Critical Value	0.859
Data are normal at 5% significance level	

95% UCL (Assuming Normal Distribution)	
Student's-t UCL	1.640201

Gamma Distribution Test	
A-D Test Statistic	0.342678
A-D 5% Critical Value	0.753347
K-S Test Statistic	0.164668
K-S 5% Critical Value	0.251495
Data follow gamma distribution at 5% significance level	

95% UCLs (Assuming Gamma Distribution)	
Approximate Gamma UCL	2.040541
Adjusted Gamma UCL	2.238147

Lognormal Distribution Test	
Shapiro-Wilk Test Statisitic	0.90925
Shapiro-Wilk 5% Critical Value	0.859
Data are lognormal at 5% significance level	

95% UCLs (Assuming Lognormal Distribution)	
95% H-UCL	4.583291
95% Chebyshev (MVUE) UCL	3.404513
97.5% Chebyshev (MVUE) UCL	4.315664
99% Chebyshev (MVUE) UCL	6.105444

95% Non-parametric UCLs	
CLT UCL	1.598569
Adj-CLT UCL (Adjusted for skewness)	1.645235
Mod-t UCL (Adjusted for skewness)	1.64748
Jackknife UCL	1.640201
Standard Bootstrap UCL	1.580454
Bootstrap-t UCL	1.726297
Hall's Bootstrap UCL	1.631472
Percentile Bootstrap UCL	1.5775
BCA Bootstrap UCL	1.605833
95% Chebyshev (Mean, Sd) UCL	2.346693
97.5% Chebyshev (Mean, Sd) UCL	2.866595
99% Chebyshev (Mean, Sd) UCL	3.887841

General Statistics

Data File		Variable:	arsenic SS
Raw Statistics		Normal Distribution Test	
Number of Valid Samples	12	Shapiro-Wilk Test Statisitic	0.983076
Number of Unique Samples	11	Shapiro-Wilk 5% Critical Value	0.859
Minimum	4.1	Data are normal at 5% significance level	
Maximum	25		
Mean	15.175	95% UCL (Assuming Normal Distribution)	
Median	15.5	Student's-t UCL	18.03786
Standard Deviation	5.522207		
Variance	30.49477	Gamma Distribution Test	
Coefficient of Variation	0.363902	A-D Test Statistic	0.390251
Skewness	-0.163379	A-D 5% Critical Value	0.731555
		K-S Test Statistic	0.153956
Gamma Statistics		K-S 5% Critical Value	0.245788
k hat	6.287418	Data follow gamma distribution	
k star (bias corrected)	4.771119	at 5% significance level	
Theta hat	2.41355		
Theta star	3.180596	95% UCLs (Assuming Gamma Distribution)	
nu hat	150.898	Approximate Gamma UCL	19.13743
nu star	114.5069	Adjusted Gamma UCL	19.84057
Approx.Chi Square Value (.05)	90.79808		
Adjusted Level of Significance	0.02896	Lognormal Distribution Test	
Adjusted Chi Square Value	87.58023	Shapiro-Wilk Test Statisitic	0.861612
		Shapiro-Wilk 5% Critical Value	0.859
Log-transformed Statistics		Data are lognormal at 5% significance level	
Minimum of log data	1.410987		
Maximum of log data	3.218876	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	2.638023	95% H-UCL	20.96133
Standard Deviation of log data	0.466794	95% Chebyshev (MVUE) UCL	24.70326
Variance of log data	0.217897	97.5% Chebyshev (MVUE) UCL	28.7103
		99% Chebyshev (MVUE) UCL	36.58135
		95% Non-parametric UCLs	
		CLT UCL	17.7971
		Adj-CLT UCL (Adjusted for skewness)	17.71676
		Mod-t UCL (Adjusted for skewness)	18.02533
		Jackknife UCL	18.03786
		Standard Bootstrap UCL	17.66424
		Bootstrap-t UCL	18.05654
RECOMMENDATION		Hall's Bootstrap UCL	17.99319
Data are normal (0.05)		Percentile Bootstrap UCL	17.66667
		BCA Bootstrap UCL	17.66667
Use Student's-t UCL		95% Chebyshev (Mean, Sd) UCL	22.12363
		97.5% Chebyshev (Mean, Sd) UCL	25.1303
		99% Chebyshev (Mean, Sd) UCL	31.03633

General Statistics

Data File		Variable: MERCURY SS	
Raw Statistics		Normal Distribution Test	
Number of Valid Samples	12	Shapiro-Wilk Test Statisitic	0.711493
Number of Unique Samples	11	Shapiro-Wilk 5% Critical Value	0.859
Minimum	0.13	Data not normal at 5% significance level	
Maximum	3.7		
Mean	0.990833	95% UCL (Assuming Normal Distribution)	
Median	0.71	Student's-t UCL	1.473877
Standard Deviation	0.931748		
Variance	0.868154	Gamma Distribution Test	
Coefficient of Variation	0.940368	A-D Test Statistic	0.394235
Skewness	2.525906	A-D 5% Critical Value	0.743229
		K-S Test Statistic	0.147874
Gamma Statistics		K-S 5% Critical Value	0.248965
k hat	1.785876	Data follow gamma distribution	
k star (bias corrected)	1.394963	at 5% significance level	
Theta hat	0.554816		
Theta star	0.710294	95% UCLs (Assuming Gamma Distribution)	
nu hat	42.86103	Approximate Gamma UCL	1.561316
nu star	33.47911	Adjusted Gamma UCL	1.677908
Approx.Chi Square Value (.05)	21.24632		
Adjusted Level of Significance	0.02896	Lognormal Distribution Test	
Adjusted Chi Square Value	19.76999	Shapiro-Wilk Test Statisitic	0.963161
		Shapiro-Wilk 5% Critical Value	0.859
Log-transformed Statistics		Data are lognormal at 5% significance level	
Minimum of log data	-2.040221		
Maximum of log data	1.308333	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	-0.314588	95% H-UCL	1.949452
Standard Deviation of log data	0.821223	95% Chebyshev (MVUE) UCL	2.062711
Variance of log data	0.674407	97.5% Chebyshev (MVUE) UCL	2.527904
		99% Chebyshev (MVUE) UCL	3.441685
		95% Non-parametric UCLs	
		CLT UCL	1.433254
		Adj-CLT UCL (Adjusted for skewness)	1.642817
		Mod-t UCL (Adjusted for skewness)	1.506564
		Jackknife UCL	1.473877
		Standard Bootstrap UCL	1.405379
		Bootstrap-t UCL	2.028672
RECOMMENDATION		Hall's Bootstrap UCL	3.273134
Data follow gamma distribution (0.05)		Percentile Bootstrap UCL	1.434167
		BCA Bootstrap UCL	1.751667
Use Approximate Gamma UCL		95% Chebyshev (Mean, Sd) UCL	2.163257
		97.5% Chebyshev (Mean, Sd) UCL	2.670565
		99% Chebyshev (Mean, Sd) UCL	3.667075

ATTACHMENT B

DATA ENTRY SHEET

GW-SCREEN Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_w (µg/L)	Chemical
83329	3.00E+00	Acenaphthene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
15	305	S	13.9	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^v (g/cm^3)	ENTER Vadose zone soil total porosity, n^v (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^v (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	3.57E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.6E-05

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

DATA ENTRY SHEET

SL- EN
Version . ., 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and Initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
7439976	1.70E+03	Mercury (elemental)

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_I (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	15	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	1.04E+06	NA

MESSAGE SUMMARY BELOW:

END

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.2E+04

SL- EN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
129000	8.40E+02	Pyrene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	15	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	2.84E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.8E-05

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

END

DATA ENTRY SHEET

SL- EN
Version .1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
218019	4.70E+02	Chrysene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_I (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	15	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

[ ]

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	5.02E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.4E-09	NA

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

END

SL- N
Version 3.1, 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
7439976	3.70E+03	Mercury (elemental)

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	305	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	1.04E+06	NA

MESSAGE SUMMARY BELOW:

END

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	7.2E+03

SL-\ .N
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
129000	4.70E+03	Pyrene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	305	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	2.84E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.4E-05

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

END

SL[illegible].N
Version [illegible], 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
218019	2.40E+03	Chrysene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_I (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	305	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	5.02E+03	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
9.0E-10	NA

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

END

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Versio , ..; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
86737	3.40E+02	Fluorene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_1 (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	183	13.9	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
S	1.66	0.375	0.054	0.002

ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	NA	NA	5.47E+04	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	8.6E-05

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

END

APPENDIX E

DATA VALIDATION REPORT

DATA VALIDATION REPORT:
WARNER STREET WETLANDS
BALTIMORE, MD
MDE PROJECT NUMBER 66-82M

PHASE SEPARATION SCIENCE, INC.

Prepared for:

ENSAT CORPORATION
5405 Twin Knolls Road, Suite 1
Columbia, Maryland 21045



Prepared by:

BMT-Entech Inc.,
13755 Sunrise Valley Drive, Suite 320
Herndon, VA 20171

ENSAT Project No. CO5-1837

December 2005

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DATA VALIDATION REPORT, WARNER STREET WETLANDS SITE INVESTIGATION

Overview

This report provides a summary of findings encountered during data validation, and a statement of data usability for Polynuclear Aromatic Hydrocarbons (PAHs), Target Compound List (TCL) Semivolatile Organics (SVOCs), Target Analyte List (TAL) Metals, Toxicity Characteristic Leachate Procedure (TCLP) metals, hexavalent chromium, and total cyanide analyzed by Phase Separation Science, Inc. of Baltimore, MD. The samples were collected as part of the Warner Street Wetlands Site Investigation, near Warner Street along the Patapsco River, in Baltimore, MD, by Maryland Department of Environment (MDE) on October 12 and 13, 2005 (MDE Project Number 66-82M). Samples were shipped to the laboratory in 2 sample delivery groups, and reported in Certificates of Analysis 05101315 and 05101914. A cross-referenced summary of field sample IDs with corresponding lab sample IDs, dates of collection, and requested analytical methods is shown in Table 1.

The analytical data for this project were reviewed following M2 guidelines for organics, and IM-1 guidelines for inorganics, as presented in *EPA Region III Innovative Approaches to Data Validation* (EPA, 1995). The M2 level of review focuses on information presented on the data reporting forms, and a review of chromatograms. The IM-1 level of review is based on the use of quality control (QC) information contained on the laboratory QC summary forms, and does not utilize raw data. Table 2 presents the QC criteria evaluated during the data review procedures for GC and GC/MS organic analyses, and Table 3 presents the QC criteria evaluated during the data review procedures for inorganic analyses.

The M2 procedures are based on modifications to EPA Region III's *Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration* (EPA, 1994). The IM-1 procedures are based on modifications to EPA Region III's *Modifications to Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1993). Data validated using these procedures may be considered useable for the following purposes:

- Oversight of activities led by other parties.
- Comparison to action levels.
- Initial site investigation.
- Characterization of contamination sources.
- Determining the nature and extent of contamination.

- Preliminary risk assessment.
- Risk assessment with known levels of toxics.
- Feasibility study.
- Preliminary design.
- Treatability study.
- Initial cleanup verification.

Table 1. Warner Street Wetlands Lab Sample ID/Field Sample ID/Analytical Method Cross Reference Table

Certificate of Analysis	Field Sample ID	Laboratory ID	Date Collected	PAHs (SW8270C)	SVOCs (SW8270C)	TAL Metals (SW6020)	Total Cyanide (SW9010B)	Hexavalent Chromium (SW7196A)	TCLP Metals (SW1311/6020)
05101914	SB202-00	05101914-01	10/12/05	X		X	X		
05101914	SB302-03	05101914-02	10/12/05	X		X	X	X	
05101914	SB201-06	05101914-03	10/12/05	X		X	X	X	
05101914	SB401-10 (1)	05101914-04	10/12/05	X		X	X		
05101914	SB501-06	05101914-05	10/12/05	X		X	X		
05101914	SB301-06*	05101914-06	10/12/05	X		X	X		
05101914	SB102-06	05101914-07	10/12/05	X		X	X		
05101914	SB303-00	05101914-08	10/12/05	X		X	X		
05101914	SB303-10	05101914-09	10/12/05	X		X	X		
05101914	SB601-10 (2)	05101914-10	10/12/05	X		X	X		
05101914	SB203-06	05101914-11	10/13/05	X		X	X		
05101914	SB103-03	05101914-12	10/13/05	X		X	X		
05101914	SB104-06	05101914-13	10/13/05	X		X	X		
05101914	SB104-10	05101914-14	10/13/05	X		X	X		
05101914	SB204-00	05101914-15	10/13/05	X		X	X		
05101914	STCLP-5A	05101914-16	10/12/05						X
05101914	STCLP-06	05101914-17	10/12/05						X
05101914	STCLP-07	05101914-18	10/13/05						X
05101914	STCLP-89	05101914-19	10/13/05						X

Table 1 (Continued). Warner Street Wetlands Lab Sample ID/Field Sample ID/Analytical Method Cross Reference Table

Certificate of Analysis	Field Sample ID	Laboratory ID	Date Collected	PAHs (SW8270C)	SVOCs (SW8270C)	TAL Metals (SW6020)	Total Cyanide (SW9010B)	Hexavalent Chromium (SW7196A)	TCLP Metals (SW1311/6020)
05101315	GW 202* (1)	05101315-01	10/13/05		X	X			
05101315	GW 202* (1) (Dissolved)	05101315-02	10/13/05			X			
05101315	GW 302 (2)	05101315-03	10/13/05		X	X			
05101315	GW 302* (2) (Dissolved)	05101315-04	10/13/05			X			

Notes
* Field-designated MS/MSD
(1) Parent sample
(2) Blind duplicate

Table 2. QC Checklist for GC, GC/MS Organic Analyses

QC Measures	Manual		
	M1	M2	M3
Action Level Notification (Groundwater samples only)	x	X	x
Instrument Tune		X	x
Initial Calibration (ICAL) Relative Response Factors (RRF)		X	x
ICAL Percent Relative Standard Deviation (%RSD)		X	x
Continuing Calibration (CCAL) RRF		X	x
CCAL Percent Difference (%D)		X	x
Laboratory Blanks	x	X	x
Matrix Spike/Matrix Spike Duplicate (MS/MSD) Percent Recovery (%R), Relative Percent Difference (%RPD)		X	x
Internal Standard Area (Gas Chromatography/Mass Spectroscopy (GC/MS) only)		X	x

Table 2 (Continued). QC Checklist for GC, GC/MS Organic Analyses

QC Measures	Manual		
	M1	M2	M3
Gas Chromatography (GC)/Electrolytic Conductivity Detector (ECD) Performance Check (Pesticides only)		X	x
Pesticide Cleanup Checks (Pesticides only)		X	
Field Quality Assurance/Quality Control (QA/QC)	x	X	x
Sample Paperwork	x	X	x
Holding Times		X	x
Retention Time	x	X	x
Surrogate %R		X	x
Dilution Factor		X	x
Moisture Content		X	x
Mass Spectra	x		x
Chromatograms	x	X	x
Raw Data			x

Note: QC is specific to the analysis being performed. Therefore, not all QC elements identified above are applicable to all GC, GC/MS methods.

Table 3. QC Checklist for Target Analyte List (TAL) Metals and Toxicity Characteristic Leachate Procedure (TCLP) Metals

QC Measures	IM-1	IM-2
Action Level Notification (Groundwater samples only)	X	x
Holding Times	X	x
ICAL	X	x
Initial Calibration Verification (ICV)	X	x
Continuing Calibration Verification (CCV)	X	x

Table 3 (Continued). QC Checklist for TAL Metals and TCLP Metals

QC Measures	IM-1	IM-2
Instrument Blanks	X	x
Laboratory Blank	X	x
Inductively Coupled Plasma (ICP) Interference Check	X	x
Laboratory Control Sample (LCS)	X	x
Duplicate Precision	X	x
MS Recoveries	X	x
ICP Serial Dilution	X	x
Field Duplicates	X	X
Reporting Limit Verification	X	X
Sample Paperwork	X	X
Raw Data		X

This report has 4 appendices, A through D. Appendix A includes chain-of-custody forms. Appendix B includes the case narratives prepared by the laboratory, with cross-reference tables showing laboratory sample IDs and MDE field sample IDs. Appendix C includes the laboratory results sheets showing hand-annotated data validation qualifiers.

Appendix D includes data validation forms and worksheets used during the review process. One data validation form was completed for each method reviewed for each Certificate of Analysis, with the exception of total cyanide and hexavalent chromium. The available data for total cyanide and hexavalent chromium were reviewed in full, but because there are no EPA Region III published data validation guidelines for these methods (and hence no set of pre-determined limits for precision and accuracy), a standardized review checklist has not been developed. The data provided were reviewed by checking the data against limits specified in each method, as well as laboratory-based performance.

Each data validation form presents a summary checklist for each QC element reviewed during M2 and IM-1 data validation highlighted on Tables 2 and 3. If appropriate, worksheets were completed to summarize and highlight out of control QC, which may (or may not) have resulted in data qualification. During the review process, whenever an out of control event or non-correctable deficiency was identified

that warranted sample qualification, only approved and recognized EPA Region III data validation qualifiers were hand annotated on the results sheets. A detailed explanation for the reason for sample qualification is also provided in the data validation narrative for each method.

The analytical results for this project were reviewed following M2 and IM-1 data review guidelines as described in *EPA Region III Innovative Approaches to Data Validation* (EPA, 1995). Some minor QC outliers were noted during data validation. Overall, the data fall within the limits of precision and accuracy prescribed in each analytical method and the EPA Region III Guidelines, and may be used for their intended purpose. The review findings and data quality assessments for each method are presented below.

2. SVOCs and PAHs by EPA Method SW8270C

Fifteen soil samples were collected on October 12 and 13, 2005 and submitted for PAH analysis. Results for these samples were reported in Certificate of Analysis 05101914. Two groundwater samples were collected on October 13 and submitted for SVOC analysis. Results for these samples were reported in Certificate of Analysis 05101315. PAHs are a subset of the full TCL SVOC list. Both lists share the same method, and the validation findings are presented together as method QC is common to both.

The samples in Certificate of Analysis 05101914 were delivered by hand to the laboratory on October 19, and were packed on ice with containers intact. However, the samples were received at the laboratory at 17 degrees centigrade. The correct temperature for sample preservation is 4 °C +/- 2 °C. Other minor QC problems were noted during validation, but none were judged to have a significant impact on data quality.

Overall, the data meet data quality objectives as specified in the method and EPA Region III Guidance with respect to precision, accuracy, and completeness (with the exceptions of the outliers identified under the subheadings below), and may be used for their intended purpose. No results were rejected.

Action Level Notification: There were no Action Level exceedances for water samples reported in Certificate of Analysis 05101315. Certificate of Analysis 05101914 contains only soil samples, and therefore a comparison to EPA Region III Action Levels is not applicable, as Action Levels apply only to water samples.

Instrument Tune: All instrument tunes had acceptable ion abundance criteria for decafluorotriphenylphosphine (DFTPP). The instrument was correctly tuned on each day of analysis, prior to actual sample analysis.

Initial Calibration (RRF): Six-point ICALs were performed. Average RRFs for all target compounds were within acceptable control limits.

Initial Calibration (%RSD): All initial calibration %RSDs were within acceptable control limits.

Continuing Calibration (RRF): A 50 parts per million (ppm) continuing calibration was performed on each day of analysis. RRFs were within acceptance criteria.

Continuing Calibration (%D): In Certificate of Analysis 05101315, the CCAL analyzed on 10/18/05 at 09:37 for water samples generated a %D of 34.2% for pyridine and 37.8% for N-Nitrosodimethylamine (Table D-1, Appendix D).

The %D between the ICAL RRF and the CCAL RRF must be within ± 25.0%. If the %D falls outside the ±25% control limit for any target compound, positive results are qualified "J." Non-detects do not require qualification if the affected compound CCAL RRF is ≥ 0.05. Parameters in the CCAL that exceeded the allowable control limit were not detected in any associated field samples. Additionally, individual SVOC CCAL RRFs were acceptable (i.e., all > 0.05), and therefore sample qualification of non-detects was not required.

In Certificate of Analysis 05101914, continuing calibrations were within acceptable control limits.

Laboratory Blanks: Target SVOCs were not detected in laboratory method blanks.

Matrix Spike/Matrix Spike Duplicates: In Certificate of Analysis 05101914, the field-designated MS/MSD was SB301-06. In Certificate of Analysis 05101315, the field-designated MS/MSD was GW202. All percent recoveries and RPDs were within acceptable control limits.

Internal Standard Area: All internal standards had acceptable area counts, and retention time windows.

Field Blanks: A field blank was not collected as part of this project.

Sample Paperwork: The Chain-of-Custody (CoC) forms were reviewed for completeness and accuracy. Field sample IDs on the CoCs matched those on the Certificates of Analysis, and all requested analytical methods were completed by the laboratory.

Samples reported in Certificate of Analysis 05101914 were received at the laboratory at 17 degrees centigrade. The correct temperature for sample preservation is 4 degrees centigrade +/- 2 degrees centigrade. EPA Region III M2-SVOA does not offer explicit guidance on how to qualify samples if samples were received at an elevated temperature. Note, however, that the target compounds of interest (PAHs), generally have low volatility and compound loss due to inadequate temperature preservation may not be a significant factor.

Holding Times: All samples were analyzed within required holding times. The water and soil samples were extracted within 7 days of collection and were analyzed within 40 days of extraction.

Retention Time: Expected retention times for target compounds were within acceptance criteria.

Surrogate Recovery: All surrogate recoveries were within acceptable control limits.

Dilution Factors: In Certificates of Analysis 05101315 and 05101914, sample dilutions were not required.

Chromatograms: Water samples in Certificate of Analysis 05101315 had flat baselines and no indication of interferences.

In Certificate of Analysis 05101914, base line rise and interferences were noted in the latter part of the chromatograms in samples SB302-03, SB201-06, SB401-10, SB501-6, SB102-06, SB303-00, SB601-10, SB103-03, and SB104-06. Internal standards and surrogate recoveries were acceptable in each sample however, indicating that compound quantitation was not affected. For the remaining samples, only minor interferences were noted. Compound quantitation was not affected.

Field Duplicates: In Certificate of Analysis 05101914, SB601-10 is the blind duplicate of SB401-10. In Certificate of Analysis 05101315, GW 302 is the blind duplicate of GW 202. Sample and blind duplicate PAH/SVOC detections, and calculated RPDs are summarized on Table 4.

Table 4. SVOC/PAH Blind Duplicate Sample Results and Calculated RPDs

PAH (µg/kg)	SB401-10	SB601-10 (Blind Dup)	RPD
Acenaphthene	78	58	29%
Acenaphthylene	57	78	31%
Antharacene	230	230	0.0%
Benzo(a)anthracene	1,600	2,000	22.
Benzo(a)pyrene	2,300	2,900	23%
Benzo(b,k)fluoranthene	1,800	2,200	20%
Benzo(g,h,I)perylene	1,600	2,000	22%
Chrysene	1,900	2,400	23%
Dibenzo(a,h)anthracene	450	500	11%
Fluoranthene	3,200	4,200	27%
Fluorene	87	68	25%
Indendo(1,2,3-cd)pyrene	1,400	1,600	13%
Phenanthrene	1,200	1,300	8
Pyrene	3,500	4,700	29%
SVOC (µg/L)	**GW 202**	**GW 302 (Blind Dup)**	**RPD**
Acenaphthene	3	1	100%
Fluorene	1	ND	NA
Phenanthrene	2	1	67%

Notes
ND. Not Detected
NA. Not applicable

There are no EPA Region III review criteria for evaluating field duplicates. No sample data is qualified based on RPDs.

2. TAL and TCLP Metals by EPA Methods SW6020 and SW1311

(Note, there are no EPA Region III data validation guidelines published for reviewing metals by Method SW6020 (Inductively Coupled Plasma (ICP) / Mass Spectroscopy (MS)) or SW1311 (TCLP). The results and all supporting QC provided by the laboratory were reviewed for precision and accuracy based on limits defined in the method, combined with demonstrated in-house performance for recoveries of spikes. The data generated by the method were reviewed for conformance with IM-1 requirements.

Fifteen soil samples were collected on October 12 and 13, 2005 and submitted for TAL metals analysis. Four soil samples were also collected on October 12 and 13 and submitted for TCLP metals analysis. Results for these samples were reported in Certificate of Analysis 05101914. Two groundwater samples were collected on October 13 and submitted for total and dissolved TAL metals analysis. Results for these samples were reported in Certificate of Analysis 05101315.

The samples in Certificate of Analysis 05101914 were delivered by hand to the laboratory on October 19, and were packed on ice with containers intact. However, the samples were received at the laboratory at 17 degrees centigrade. The correct temperature for sample preservation is 4 °C +/- 2 °C. Other, minor QC problems were noted during validation, but none were judged to have a significant impact on data quality.

The metals data may be considered useable with the appropriate qualifiers hand-annotated on the Certificates of Analysis. The data meet data quality objectives as specified in the method with respect to precision, accuracy, and completeness. All data may be used for their intended purpose.

Action Level Notification: Samples that exceeded their respective Action Level are summarized on Table 5.

Table 5. Warner Street Wetland Samples Exceeding EPA Region III Action Level

Sample ID	Matrix	Parameter	EPA Region III Action Level	Concentration
SB201-06	Soil	Lead	500 mg/kg	610 mg/kg
SB401-10	Soil	Lead	500 mg/kg	600 mg/kg
SB102-06	Soil	Lead	500 mg/kg	2,700 mg/kg
SB303-10	Soil	Lead	500 mg/kg	890 mg/kg

Table 5 (Continued). Warner Street Wetland Samples Exceeding EPA Region III Action Level

Sample ID	Matrix	Parameter	EPA Region III Action Level	Concentration
SB601-10	Soil	Lead	500 mg/kg	650 mg/kg
SB103-03	Soil	Lead	500 mg/kg	910 mg/kg
SB204-00	Soil	Lead	500 mg/kg	700 mg/kg
GW 202	Water	Lead	15 µg/L	1,100 µg/L
GW 302	Water	Lead	15 µg/L	910 µg/L

Holding Times: All samples were analyzed within allowable holding times.

Initial Calibration: All initial calibrations were acceptable.

Initial Calibration Verification: ICVs analyzed in Certificate of Analysis 05101315 were within acceptable control limits.

In Certificate of Analysis 05101914, copper was recovered above the Upper Control Limit (UCL) in the ICV analyzed on 10/26/05 at 2:20pm (113%R, 89.5-110.5%R limits) that relates to soil sample analysis (sequence 051026B) (Table D-4, Appendix D). As per EPA Region III guidance, positive detected copper results were qualified "K" (biased high). Copper was detected in all soil samples analyzed.

Continuing Calibration Verification: All CCVs were acceptable in Certificates of Analysis 05101914. In Certificate of Analysis 05101315, samples GW 202 (total) and GW 302 (total) initially had high biased CCVs for sodium, aluminum, and magnesium in the original analyses performed on 10/19/05. These samples were re-run for sodium, aluminum, and magnesium on 10/20/05 with passing QC. Only the 10/20/05 re-run results were reported by the laboratory. No sample qualification was necessary.

Also in Certificate of Analysis 05101315, the CCVs bracketing analysis of samples GW 202 (dissolved), and GW 302 (dissolved) had failing CCVs for antimony, sodium, and magnesium (Table D-2, Appendix D). As per EPA Region III guidelines, detected results for sodium, and magnesium in GW 202 (dissolved) and GW 302 (dissolved) were qualified "L" (biased low). Antimony was not detected in either sample; however, the qualifier "UL" was applied to show a biased low reporting limit.

Instrument Blanks: Metals were not detected above the PQL in any instrument blanks in Certificates of Analysis 05101315 and 05101914.

Laboratory Blank: Metals were not detected above the PQL in any laboratory (method) blanks in Certificates of Analysis 05101315 and 05101914.

Laboratory Control Sample (LCS): In Certificates of Analysis 05101315 and 05101914, all LCS recoveries were within acceptable control limits.

Interference Check: In Certificate of Analysis 05101315, all interference check samples were within acceptable control limits.

In Certificate of Analysis 05101914, cobalt and manganese were recovered above the UCL in ICSB STD (sequence 051026B) (Table D-5, Appendix D). All cobalt and manganese results were qualified "J" (estimated) due to interference. Copper was recovered above the UCL in ICSB STD (sequence 051027A) (Table D-5, Appendix D). However, copper results had previously been qualified "K" (biased high) due to high ICV recovery. Additional qualification of copper results is not necessary.

Duplicate Precision: In Certificate of Analysis 05101315, analytical duplicate precision failed in GW 202 (total) and GW 202 (dissolved) for total mercury, total thallium, dissolved cadmium, and dissolved thallium (Table D-3, Appendix D). However, using RPD as a measure of precision fails in cases where the results are approaching the PQL (for example, total thallium concentrations were 0.5 µg/L, and 0.3 µg/L in the duplicate analysis). Although very close in magnitude, these results have an RPD of 68.4%, which exceeds the 20% maximum. Inspection of the sample and duplicate results shows that all RPD exceedances were at very low concentrations and the RPD presents a misleading interpretation of the data. Therefore, no sample data were qualified on this basis.

In Certificate of Analysis 05101914, laboratory duplicate analysis was performed on SB202-00. All RPDs were below the allowable 40 percent maximum for soil samples.

MS Recoveries: In Certificate of Analysis 05101315, a matrix spike was performed on GW 202 (total), and GW 202 (dissolved). In GW 202 (dissolved) MS, silver was recovered at the lower control limit (LCL) (Table D-3, Appendix D).

The laboratory duplicate analysis and LCS for silver were in control. Considering that the MS recovery was at the LCL (75%R, 75-125%R limits), and other QC checks were in control (eliminating instrument error), no further action was taken by the laboratory, and no silver data were qualified.

In Certificate of Analysis 05101914, a matrix spike was performed on SB202-00. Magnesium, potassium, and silver were each recovered outside the control limits (Table D-6, Appendix D).

Other QC data taken into consideration when reviewing the MS and assessing the need to qualify data includes the PDS, the laboratory duplicate analysis, and the batch LCS.

In the case of magnesium and potassium, the concentrations present in the native sample (4,500 mg/kg and 1,500 mg/kg respectively) far exceeded the spike concentration (500 mg/kg). In such cases, the spike concentration is indistinguishable from the sample concentration, and percent recoveries do not yield useful or meaningful information. The batch LCS and PDS were in control, and duplicate precision was acceptable (i.e., less than 40 percent). Therefore, no further action was required by the laboratory and sample qualification was not judged to be necessary.

In the case of silver, although the MS recovery was low, the LCS, PDS, and duplicate analysis were all in control. Therefore, the low bias is due to matrix interference in the sample, and is not a digestion (i.e., preparation) or instrument problem. Although silver was not detected in the MS sample, as per EPA Region III guidelines, the non-detected silver result in SB202-00 was qualified "UR" as unusable.

Post Digestion Spike: In Certificate of Analysis 05101315, a PDS was performed on GW 202 (total), and GW 202 (dissolved). Recoveries were low for manganese and zinc in GW 202 (total) (Table D-3, Appendix D). However, for each metal, the concentration in the native sample exceeded 4 times the spike amount, thus rendering the spike indistinguishable from the sample concentration. The MS recoveries, LCS recoveries, and duplicate precision were acceptable for manganese and zinc. No further action was taken by the laboratory, and no sample data was qualified.

In Certificate of Analysis 05101914, a PDS was performed on SB202-00. All percent recoveries were within acceptable control limits.

Dilution: Several TAL metals typically require dilution due to the high concentrations present in the samples. The dilution factors were correctly accounted for by the laboratory in the reported concentrations.

Field Duplicates: In Certificate of Analysis 05101315, GW 302 (total and dissolved) is the blind duplicate of GW 202 (total and dissolved). In Certificate of Analysis 05101914, SB601-10 is the blind duplicate of SB401-10. Sample and blind duplicate TAL metal detections, and calculated RPDs are summarized on Table 6.

Table 6. TAL Metals Blind Duplicate Sample Results and Calculated RPDs

Metal (mg/kg)	SB401-10	SB601-10 (Blind Dup)	RPD
Aluminum	9,300	3,200	98%
Arsenic	22	19	15%
Barium	190	190	0%
Cadmium	.3.1	3.0	3%
Calcium	26,600	39,000	38%
Chromium	23	19	19%
Cobalt	5.8	5.7	2%
Copper	110	110	0%
Iron	17,000	15,000	13%
Lead	600	650	8%
Magnesium	1,500	1,500	0%
Manganese	2,500	2,800	11%
Mercury	1.2	1.4	15%
Nickel	33	27	20%
Potassium	320	290	10%
Sodium	280	310	10%
Vanadium	18	18	0%
Zinc	1,100	1,100	0%
Metal (µg/L)	**GW 202 (Total)**	**GW 302 (Total) (Blind Dup)**	**RPD**
Aluminum	5,800	4,400	27
Arsenic	22	18	20%
Barium	310	260	18%
Cadmium	6.5	5.1	24%
Calcium	87,000	83,000	5%
Chromium	190	140	30%
Cobalt	31	25	21%

Table 6 (Continued). TAL Metals Blind Duplicate Sample Results and Calculated RPDs

Metal (µg/L)	GW 202 (Total)	GW 302 (Total) (Blind Dup)	RPD
Copper	280	260	7%
Iron	16,000	13,000	21%
Lead	1,100	910	19%
Magnesium	9,300	8,700	7%
Manganese	650	560	15%
Nickel	57	45	24%
Potassium	7,400	7,400	0%
Selenium	6.7	6.5	3%
Sodium	8,400	8,000	5%
Vanadium	60	49	20%
Zinc	2,000	1,700	16%
Metal (µg/L)	**GW 202 (Dissolved)**	**GW 302 (Dissolved) (Blind Dup)**	**RPD**
Barium	75	76	1%
Calcium	66,000	64,000	3%
Cobalt	9.5	ND	NA
Iron	230	240	4%
Magnesium	6,900	6,900	0%
Manganese	220	200	10%
Potassium	6,500	6,700	3%
Selenium	8.0	8.0	0%
Sodium	8,600	7,700	11%

Notes
ND. Not Detected
NA. Not Applicable

There are no EPA Region III review criteria for evaluating field duplicates. No sample data is qualified based on RPDs.

Reporting Limit Verification: Reporting limits were acceptable.

Field Blanks: A field blank was not collected as part of this project.

Sample Paperwork: The Chain-of-Custody (CoC) forms were reviewed for completeness and accuracy. The column header on each CoC requested "TCL" metals. This was presumed by the laboratory to be intended as "TAL" metals. Samples were analyzed for the full list of 23 TAL metals. Also, although not explicitly requested on the CoC, each soil sample in Certificate of Analysis 05101914 was analyzed for total cyanide.

In Certificate of Analysis 05101914, inadequate temperature preservation was noted on the Sample Receipt Checklist. Samples were received at the laboratory at 17 degrees centigrade. The correct temperature for sample preservation is 4 degrees centigrade +/- 2 degrees centigrade.

4. Total Cyanide by EPA Method SW9010B

Fifteen soil samples were analyzed for Total Cyanide by EPA Method 9010B. Results for these samples were reported in Certificate of Analysis 05101914.

The raw data provided for total cyanide analysis included preparation blanks, LCS, MS recovery, ICAL calibration factors, and correlation coefficient (CC). However, a checklist has not been developed because there are no published EPA Region III data validation guidelines for total cyanide analysis, and no standard reporting format. The supporting raw data applies to soil samples analyzed in Certificate of Analysis 05101914.

The total cyanide data meet the limits for precision and accuracy, and may be used for their intended purpose.

Preparation Blank: Total cyanide was not detected in the preparation blanks.

LCS: The soils LCS recoveries were within acceptable control limits (Batch 6381, 95%R, and batch 6481, 95 %R). Acceptable control limits are 80-120%R.

MS/MSD: A MS/MSD was performed on SB301-06. All percent recoveries were within acceptable control limits.

ICAL (CF): A 7-point initial calibration was performed. The average calibration factor (1.513) was acceptable for quantitative analysis.

ICAL (CC): The ICAL correlation coefficient was 0.9994, which is acceptable for quantitative analysis.

Field Duplicates: In Certificate of Analysis 05101914, SB601-10 is the blind duplicate of SB401-10. Cyanide was not detected in either the sample or its duplicate, thus generating acceptable sampling and analytical precision.

5. Hexavalent Chromium by EPA Method SW7196A

Two soil samples were collected on October 12, 2005 and submitted for hexavalent chromium analysis. Results for these samples were reported in Certificate of Analysis 05101914.

The raw data provided for hexavalent chromium analysis included preparation blanks, LCS, MS recovery, duplicate analysis, ICAL calibration factors, and correlation coefficient (CC). However, a checklist has not been developed for hexavalent chromium analysis because there are no published EPA Region III data validation guidelines, and no standard reporting format. The supporting raw data applies to samples analyzed in Certificate of Analysis 05101914.

The hexavalent chromium data meet the limits for precision and accuracy, and may be used for their intended purpose

Preparation Blank: Hexavalent chromium was not detected in the preparation blanks.

LCS: The LCS recovery was acceptable (100%R, 80-120%R limits).

MS: A matrix spike was performed on SB302-03. Percent recovery was acceptable (90%R, 80-120%R limits).

Laboratory Duplicate Analysis: A duplicate analysis was performed on SB302-03. Hexavalent chromium was non-detect in the sample and duplicate, thus generating acceptable sampling and analytical precision.

ICAL (CF): A 6-point initial calibration was performed. The average calibration factor (0.78) was acceptable for quantitative analysis.

ICAL (CC): The ICAL correlation coefficient was 0.9997, which is acceptable for quantitative analysis.

REFERENCES

U.S. EPA, 1993. *EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses.* April.

U.S. EPA, 1994. *EPA Region III Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (OLM01.0-OLM01.9).* September.

U.S. EPA, 1995. *EPA Region III Innovative Approaches for Validation of Organic and Inorganic Data - Standard Operating Procedures.* June.

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APPENDIX A

Chain of Custody Forms

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SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC.

www.phaseonline.com
email: info@phaseonline.com

(1)

CLIENT: MDE PHONE NO.: (410) 537 3440

PROJECT MGR: Bob Wallace FAX NO.: (410) 537 3472

EMAIL: Bwallace@MDE.State.MD.US

PROJECT NAME: Warner Street Landfills

SITE LOCATION: Balto MD

PROJECT NO.: 66 - 82M P.O. NO.:

PSS Project #: 0510 135

PAGE ____ OF ____

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C = COMP G = GRAB	Preservatives Used	Analysis Required (3) Semi Volatile Org	TCL Metals	D. Metals	REMARKS
01	GW202	10/13/05	1105	Water	3	G		✓	✓	✓	
02	GW 302	10/13/05	1210	Water	3	G		✓	✓	✓	
01	GW202 MS	10/13/05	1115	Water	3	G		✓	✓	✓	
01	GW202 MSMSD	10/13/05	1120	Water	3	G		✓	✓	✓	

(5)

	Date	Time	Received By:
Collected / Relinquished By: (1) Robert A Wallace	10/13/05	1615	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Collected / Relinquished By: (4)	Date 10/13/05	Time 1615	Received By:

(4)

Requested Turnaround Time
☐ 5-Day (Std.) ☐ 3-Day ☐ 2-Day
☐ Next Day ☐ Emergency ☐ Other

Sample Condition Upon Receipt: Good

Custody Seal:

Data Deliverables Required:

Shipping Carrier:

Shipping Ticket No.:

Special Instructions:

6630 Baltimore National Pike • Route 40 West • Baltimore, Maryland 21228 • (410) 747-8770 • (800) 932-9047 • Fax (410) 788-8723

The client (Client Name), by signing, or having client's agent sign, this "Sample Chain of Custody/Agreement Form", agrees to pay for the above requested services per the latest version of the Service Brochure or PSS-provided quotation including any and all attorney's or other reasonable fees if collection becomes necessary.

OFFICES:
6630 BALTIMORE NAT'L PIKE
ROUTE 40 WEST
BALTIMORE, MD 21228
410-747-8770
800-932-9047
FAX 410-788-8723

PHASE SEPARATION SCIENCE, INC.

Sample Receipt Checklist

Lab ID Number	05101315	**Received By**	Patricia Smith
Client Name	Maryland Department of the Environme	**Date Received:**	10/13/2005 4:15:39 PM
Project	Warner Street Wetlands	**Delivered_By**	Hand
Project Number	66-82M	**Tracking_No**	

Packaging

Custody Seals	Cooler
Ice	Present
Temp C	6

Documentation

Chain of Custody (COC)	Yes
COC agrees with sample labels?	Yes

Sample Containers

Appropriate for specified analysis?	Yes
Intact?	Yes
Labeled and labels legible	Yes

Preservation (waters)

Metals	(pH<2)	Yes	No	NA
Cyanides	(pH>12)	Yes	No	NA
Sulfide	(pH>9)	Yes	No	NA
BNA, Pest, PCB, CN, Phenols, NO3	(Cl2 absent)	Yes	No	NA
TOC, COD, OG, Phenols, TPH	(pH<2)	Yes	No	NA
TOX, TKN, NH3, Total Phos.	(pH<2)	Yes	No	NA
VOC, BTEX	(pH<2)	Yes	No	NA
Were preservatives added at lab?		Yes	No	NA
Were air bubbles present in the VOA vials?		Yes	No	NA

Comments: (Any No response must be detailed in the comments section below.)

Checklist Completed By: Patricia Smith Date 10/13/2005

SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC.

www.phaseonline.com
email: info@phaseonline.com

(1)
CLIENT: MDE PHONE NO.: (410) 537-3440
PROJECT MGR: Robert Wallace FAX NO.: (410) 537-3472
EMAIL: rwallace@mde.state.md.us
PROJECT NAME: Warner Street Wetlands
SITE LOCATION: Near Warner street along Patapsco
PROJECT NO.: 66-82M P.O. NO.: V00P6200183

PSS Project #: 0 S101914

PAGE 1 OF 2

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C = COMP G = GRAB	Preservatives Used / Analysis Required (3): PAHs (SW8270)	TCL Metals	Chromium VI	REMARKS
C1	✓ SB202-00	10/12/05	1050	Soil	2	G	X	X		
C2	✓ SB302-03		1120	Soil	3	G	X	X	X	
C3	✓ SB201-06		1140	Soil	3	G	X	X	X	
C4	✓ SB401-10		1215	Soil	2	G	X	X		
C5	✓ SB501-06		1240	Soil	2	G	X	X		
C6	✓ SB301-MS-06		1325	Soil	2	G	X	X		6-foot interval MS
C6	✓ SB301-MD		1325	Soil	2	G	X	X		6-foot interval MSD
C7	✓ SB102-06		1425	Soil	2	G	X	X		
C8	✓ SB303-00		1505	Soil	2	G	X	X		
C9	✓ SB303-10		1530	Soil	2	G	X	X		

(5)

Collected / Relinquished By: (1)	Date	Time	Received By:
Robert Wallace	10/14/05	16:30	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Collected / Relinquished By: (4)	Date	Time	Received By:

(4)
Requested Turnaround Time
☒ 5-Day (Std.) ☐ 3-Day ☐ 2-Day
☐ Next Day ☐ Emergency ☐ Other

Sample Condition Upon Receipt: ambient
Custody Seal:
Data Deliverables Required:
Shipping Carrier: Hand
Shipping Ticket No.:

Special Instructions:
10/20/05 Per R Wallace - change sample SB301-.. to SB301-06 & do MS/MSD on this sample & TAL Metals + Cyanide CAT

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The client (Client Name), by signing, or having client's agent sign, this "Sample Chain of Custody/Agreement Form", agrees to pay for the above requested services per the latest version of the Service Brochure or PSS-provided quotation including any and all attorney's or other reasonable fees if collection becomes necessary.

SAMPLE CHAIN OF CUSTODY/AGREEMENT FORM

PHASE SEPARATION SCIENCE, INC.

www.phaseonline.com
email: info@phaseonline.com

(1)

CLIENT: MDE PHONE NO.: (410) 537-3490
PROJECT MGR: Robert Wallace FAX NO.: (410) 537-3472
EMAIL: rwallace@mde.state.md.us
PROJECT NAME: Warner Street Wetlands (WSW)
SITE LOCATION: Near Warner Street along Patapsco
PROJECT NO.: 66-82M P.O. NO.: U00P6200183

PSS Project #: CS101914

PAGE 2 OF 2

(2)

LAB NO.	SAMPLE IDENTIFICATION	DATE	TIME	MATRIX	No. CONTAINERS	SAMPLE TYPE C = COMP G = GRAB	Preservatives Used	Analysis Required (3) PAHs (SW8270)	TCL metals	TCLP (metals only)	REMARKS
10	✓ SB601-10	10/12/05	1600	Soil	2	G		X	X		
11	✓ SB203-06	10/13/05	0830	Soil	2	G		X	X		
12	✓ SB103-03	10/13/05	0905	Soil	2	G		X	X		
13	✓ SB104-06	10/13/05	0950	Soil	2	G		X	X		
14	✓ SB104-10	10/13/05	0955	Soil	2	G		X	X		
15	✓ SB204-00	10/13/05	1020	Soil	2	G		X	X		
16	✓ STCLP-5A	10/12/05	1700	Soil	1	C				X	
17	✓ STCLP-06	10/12/05	1730	Soil	1	C				X	
18	✓ STCLP-07	10/13/05	1300	Soil	1	C				X	
19	✓ STCLP-89	10/13/05	1330	Soil	1	C				X	

(5)

	Date	Time	Received By:
Collected / Relinquished By: (1)	10/14/05	16:30	
Relinquished By: (2)	Date	Time	Received By:
Relinquished By: (3)	Date	Time	Received By:
Collected / Relinquished By: (4)	Date	Time	Received By:

(4)

Requested Turnaround Time
☒ 5-Day (Std.) ☐ 3-Day ☐ 2-Day
☐ Next Day ☐ Emergency ☐ Other

Sample Condition Upon Receipt:
Custody Seal:
Data Deliverables Required:
Shipping Carrier:
Shipping Ticket No.:
Special Instructions:

6630 Baltimore National Pike • Route 40 West • Baltimore, Maryland 21228 • (410) 747-8770 • (800) 932-9047 • Fax (410) 788-8723

The client (Print Name), by signing, or having client's agent sign, this "Sample Chain of Custody/Agreement Form", agrees to pay for the above requested services per the latest version of the Service Brochure or PSS-provided quotation including any and all attorney's or other reasonable fees if collection becomes necessary.

OFFICES:
3630 BALTIMORE NAT'L PIKE
ROUTE 40 WEST
BALTIMORE, MD 21228
410-747-8770
800-932-9047
FAX 788-8723

PHASE SEPARATION SCIENCE, INC.

Sample Receipt Checklist

Lab ID Number	05101914	**Received By**	Patricia Smith
Client Name	ENSAT	**Date Received:**	10/19/2005 4:30:47 PM
Project	Warner Street Wetlands	**Delivered_By**	Hand
Project Number	66-82M	**Tracking_No**	

Packaging					
Custody Seals		None			
Ice		Present			
Temp C		17			
Documentation					
Chain of Custody (COC)		Yes			
COC agrees with sample labels?		Yes			
Sample Container					
Appropriate for specified analysis?		Yes			
Intact?		Yes			
Labeled and labels legible		Yes			
Preservation (waters)					
Metals	(pH<2)	Yes	No	NA	
Cyanides	(pH>12)	Yes	No	NA	
Sulfide	(pH>9)	Yes	No	NA	
BNA, Pest, PCB, CN, Phenols, NO3	(Cl2 absent)	Yes	No	NA	
TOC, COD, OG, Phenols, TPH	(pH<2)	Yes	No	NA	
TOX, TKN, NH3, Total Phos.	(pH<2)	Yes	No	NA	
VOC, BTEX	(pH<2)	Yes	No	NA	
Were preservatives added at lab?		Yes	No	NA	
Were air bubbles present in the VOA vials?		Yes	No	NA	

Comments: (Any No response must be detailed in the comments section below.)

Checklist Completed By: Patricia Smith Date 10/19/2005

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APPENDIX B

Phase Separation Science, Inc.

Laboratory Case Narrative

Lab Sample ID/Field Sample ID/Method References Cross-Reference Tables

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PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

Case Narrative

Client: ENSAT **Lab ID Number:** 05101315
Project: Warner Street Wetlands
Project #: 66-82M

The following samples were received by Phase Separation Science, Inc. on Thursday, October 13, 2005 at 04:15 PM. The samples were delivered by a client representative.

Lab ID	Field Sample ID	Analysis	Method	Matrix	Date Sampled
05101315-01	GW 202	Target Compound List - SEMIVOLATILES	EPA 8270C	Water	10/13/2005 11:05:00 AM
		Target Analyte List - Metals	EPA 6020	Water	10/13/2005 11:05:00 AM
05101315-02	GW 202 (Dissolved)	Dissolved Target Analyte List - Metals	EPA 6020	Water	10/13/2005 11:05:00 AM
05101315-03	GW 302	Target Compound List - SEMIVOLATILES	EPA 8270C	Water	10/13/2005 12:10:00 PM
		Target Analyte List - Metals	EPA 6020	Water	10/13/2005 12:10:00 PM
05101315-04	GW 302 (Dissolved)	Dissolved Target Analyte List - Metals	EPA 6020	Water	10/13/2005 12:10:00 PM

All analyses were performed in accordance with the referenced USEPA Methodologies and the Quality Assurance Plan of Phase Separation Science, Inc (PSS). Considerations and references were made to the guidelines outlined in the State of Maryland Department of the Environment, Cleanup Standards for Soil and Groundwater - Update 1, August 2001.

Samples were received with all containers intact. Please reference the Chain of Custody for specific container counts and preservatives.

The samples were analyzed within the recommended holding times.

The enclosed results were delivered electronically via e-mail to the project manager in the format required by the Maryland Department of the Environment.

Quality control comments: Please reference the Certificate of Analysis and QC Summary reports for any specific data qualifiers. The Method Blank associated to semivolatile batch 6302 contained 5.4 ug/L Diethyl phthalate.

Reviewed by: _____ Date: 11/23/05
Quality Assurance Manager

PHASE SEPARATION SCIENCE, INC.

Analytical Chemistry Environmental Science

Case Narrative

Client: ENSAT
Project: Warner Street Wetlands
Project #: 66-82M

Lab ID Number: 05101914

The following samples were received by Phase Separation Science, Inc. on Wednesday, October 19, 2005 at 04:30 PM. The samples were delivered by a client representative.

Lab ID	Field Sample ID	Analysis	Method	Matrix	Date Sampled
05101914-01	SB202-00	Total Cyanide	EPA 9010B	Soil	10/12/2005 10:50:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 10:50:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 10:50:00 AM
05101914-02	SB302-03	Hexavalent Chromium in Soil	EPA 7196A	Soil	10/12/2005 11:20:00 AM
		Total Cyanide	EPA 9010B	Soil	10/12/2005 11:20:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 11:20:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 11:20:00 AM
05101914-03	SB201-06	Hexavalent Chromium in Soil	EPA 7196A	Soil	10/12/2005 11:40:00 AM
		Total Cyanide	EPA 9010B	Soil	10/12/2005 11:40:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 11:40:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 11:40:00 AM
05101914-04	SB401-10	Total Cyanide	EPA 9010B	Soil	10/12/2005 12:15:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 12:15:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 12:15:00 PM
05101914-05	SB501-06	Total Cyanide	EPA 9010B	Soil	10/12/2005 12:40:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 12:40:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 12:40:00 PM
05101914-06	SB301-06	Total Cyanide	EPA 9010B	Soil	10/12/2005 1:25:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 1:25:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 1:25:00 PM
05101914-07	SB102-06	Total Cyanide	EPA 9010B	Soil	10/12/2005 2:25:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 2:25:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 2:25:00 PM
05101914-08	SB303-00	Total Cyanide	EPA 9010B	Soil	10/12/2005 3:05:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 3:05:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 3:05:00 PM
05101914-09	SB303-10	Total Cyanide	EPA 9010B	Soil	10/12/2005 3:30:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 3:30:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 3:30:00 PM
05101914-10	SB601-10	Total Cyanide	EPA 9010B	Soil	10/12/2005 4:00:00 PM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/12/2005 4:00:00 PM
		Target Analyte List - Metals	EPA 6020	Soil	10/12/2005 4:00:00 PM
05101914-11	SB203-06	Total Cyanide	EPA 9010B	Soil	10/13/2005 8:30:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/13/2005 8:30:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/13/2005 8:30:00 AM
05101914-12	SB103-03	Total Cyanide	EPA 9010B	Soil	10/13/2005 9:05:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/13/2005 9:05:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/13/2005 9:05:00 AM
05101914-13	SB104-06	Total Cyanide	EPA 9010B	Soil	10/13/2005 9:50:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/13/2005 9:50:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/13/2005 9:50:00 AM

Lab ID	Field Sample ID	Analysis	Method	Matrix	Date Sampled
05101914-14	SB104-10	Total Cyanide	EPA 9010B	Soil	10/13/2005 9:55:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/13/2005 9:55:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/13/2005 9:55:00 AM
0510[illegible]-15	SB204-00	Total Cyanide	EPA 9010B	Soil	10/13/2005 10:20:00 AM
		Polynuclear Aromatic Hydrocarbons	EPA 8270C	Soil	10/13/2005 10:20:00 AM
		Target Analyte List - Metals	EPA 6020	Soil	10/13/2005 10:20:00 AM
05101914-16	STCLP-5A	TCLP Metals	1311/6020	Soil	10/12/2005 5:00:00 PM
05101914-17	STCLP-06	TCLP Metals	1311/6020	Soil	10/12/2005 5:30:00 PM
05101914-18	STCLP-07	TCLP Metals	1311/6020	Soil	10/13/2005 1:00:00 PM
05101914-19	STCLP-89	TCLP Metals	1311/6020	Soil	10/13/2005 1:30:00 PM

All analyses were performed in accordance with the referenced USEPA Methodologies and the Quality Assurance Plan of Phase Separation Science, Inc (PSS). Considerations and references were made to the guidelines outlined in the State of Maryland Department of the Environment, Cleanup Standards for Soil and Groundwater - Update 1, August 2001.

Samples were received with all containers intact. Please reference the Chain of Custody for specific container counts and preservatives.

The samples were analyzed within the recommended holding times.

The enclosed results were delivered electronically via e-mail to the project manager in the format required by the Maryland Department of the Environment.

Quality control comments: Please reference the Certificate of Analysis and QC Summary reports for any specific data qualifiers.

Reviewed by: _____ Date: 11/23/05
Quality Assurance Manager

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APPENDIX C

Phase Separation Science, Inc.

Laboratory Results Sheets with Data Validation Qualifiers

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Allowed GC, GC/MS and Inorganic Data Validation Qualifiers

Codes Related to Identification	
U	Analyte was analyzed for, but not detected above the associated value.
No Code	Confirmed identification.
B	The reported concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.
R	Analyte may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical difficulties.
N (GC/MS methods only)	Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence.
Codes Related to Quantitation (used for both positive results and sample quantitation limits)	
J	Analyte present. Reported value may or may not be precise. This qualifier also applies to detected concentrations reported below the reporting limit (RL), but above the method detection limit (MDL).
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
UJ	Not detected. However, the reporting limit (quantitation limit) may be inaccurate or imprecise and no bias can be determined.
UL	Not detected. However, the reporting limit (quantitation limit) is probably higher.
UR	Analyte may or may not be present. The non detected result is considered to be unreliable and unusable. This is a consequence of gross technical difficulties (i.e., holding times missed by a factor of 2 times the specified limit, severe calibration non-compliance, or extremely low quality control recoveries). Results qualified UR are considered to be biased low.
Other Codes	
Q	No analytical result.
*	Results reported from diluted analysis.

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ROUTE 40 WEST
BALTIMORE, MARYLAND 21228
410-747-8770
800-932-9047
410-788-8723 Fax
www.phaseonline.com

PHASE SEPARATION SCIENCE, INC.

ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE

CERTIFICATE OF ANALYSIS
No. 05101315 Page 1 of 8
ENSAT
November 16, 2005
Revised-Replaces Report Issued October 20, 2005

Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 11:05
Date Received: 10/13/05 16:15

	Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Sample ID: GW 202 / 05101315-01 / Water							
Target Analyte List - Metals							
Aluminum	**5,800**	ug/L	EPA 6020	500	10/19/05	10/20/05 13:37	LM
Antimony	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Arsenic	**22**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Barium	**310**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Beryllium	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Cadmium	**6.5**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Calcium	**87,000**	ug/L	EPA 6020	1000	10/19/05	10/20/05 13:37	LM
Chromium	**190**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Cobalt	**31**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Copper	**280**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Iron	**16,000**	ug/L	EPA 6020	100	10/19/05	10/19/05 21:18	LM
Lead	**1,100**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Magnesium	**9,300**	ug/L	EPA 6020	1000	10/19/05	10/20/05 13:37	LM
Manganese	**650**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Mercury	ND	ug/L	EPA 6020	1	10/19/05	10/19/05 21:18	LM
Nickel	**57**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Potassium	**7,400**	ug/L	EPA 6020	1000	10/19/05	10/20/05 13:37	LM
Selenium	**6.7**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Silver	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Sodium	**8,400**	ug/L	EPA 6020	1000	10/19/05	10/20/05 13:37	LM
Thallium	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Vanadium	**60**	ug/L	EPA 6020	5	10/19/05	10/19/05 21:18	LM
Zinc	**2,000**	ug/L	EPA 6020	50	10/19/05	10/19/05 21:18	LM
Target Compound List - SEMIVOLATILES							
Phenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Bis (2-chloroethyl) ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2-Chlorophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2-Methylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
[illegible]chloroisopropyl) ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
[illegible]ophenone	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
3,4-Methylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
N-Nitroso-di-n-propylamine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Hexachloroethane	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Nitrobenzene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW

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November 16, 2005
Revised-Replaces Report Issued October 20, 2005

Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 11:05
Date Received: 10/13/05 16:15

	Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Sample ID: GW 202 / 05101315-01 / Water							
Target Compound List - SEMIVOLATILES							
Isophorone	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2-Nitrophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,4-Dimethylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Bis (2-chloroethoxy) methane	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,4-Dichlorophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Naphthalene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
4-Chloroaniline	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Hexachlorobutadiene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Caprolactam	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
4-Chloro-3-methylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2-Methylnaphthalene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Hexachlorocyclopentadiene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,4,6-Trichlorophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,4,5-Trichlorophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
1,1-Biphenyl	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2-Chloronaphthalene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2-Nitroaniline	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Dimethyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,6-Dinitrotoluene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Acenaphthylene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
3-Nitroaniline	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
Acenaphthene	j 3	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,4-Dinitrophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
4-Nitrophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
Dibenzofuran	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
2,4-Dinitrotoluene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Diethyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Fluorene	j 1	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
4-Chlorophenyl phenyl ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
4-Nitroaniline	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
4,6-Dinitro-2-methylphenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
N-Nitrosodiphenylamine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
4-Bromophenyl phenyl ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW

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Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 11:05
Date Received: 10/13/05 16:15

	Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Sample ID: GW 202 / 05101315-01 / Water							
Target Compound List - SEMIVOLATILES							
Hexachlorobenzene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Atrazine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Pentachlorophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
Phenanthrene	j 2	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Anthracene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Carbazole	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Di-n-butyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Fluoranthene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Pyrene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Butyl benzyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
3,3-Dichlorobenzidine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Benzo (a) anthracene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Chrysene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Bis (2-ethylhexyl) phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Di-n-octyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Benzo (b,k) fluoranthene	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 17:38	BW
Benzo (a) pyrene	ND	ug/L	EPA 8270C	6	10/17/05	10/18/05 17:38	BW
Indeno (1,2,3-cd) pyrene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW
Dibenzo (a,h) anthracene	ND	ug/L	EPA 8270C	6	10/17/05	10/18/05 17:38	BW
Benzo (g,h,i) perylene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 17:38	BW

Reviewed By: _____
Quality Assurance Chemist

Notes/Comments:
PQL - Practical Quantitation Limit
ND - Not Detected at a concentration greater than or equal to the PQL.
j - estimated value, less than quantitation limit.
Revised report reflects correction in metals dilution factor from 100X to 10X.

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Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 11:05
Date Received: 10/13/05 16:15

Sample ID: GW 202 (Dissolved) / 05101315-02 / Water

		Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Dissolved Target Analyte List - Metals								
Aluminum	DV Qualifier	ND	ug/L	EPA 6020	50	10/18/05	10/19/05 4:22	LM
Antimony	UL	ND	ug/L	EPA 6020	10	10/18/05	10/19/05 17:33	LM
Arsenic		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Barium		75	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Beryllium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Cadmium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Calcium		66,000	ug/L	EPA 6020	1000	10/18/05	10/19/05 17:23	LM
Chromium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Cobalt		9.5	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Copper		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Iron		230	ug/L	EPA 6020	100	10/18/05	10/19/05 4:22	LM
Lead		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Magnesium	L	6,900	ug/L	EPA 6020	1000	10/18/05	10/19/05 17:23	LM
Manganese		220	ug/L	EPA 6020	50	10/18/05	10/19/05 17:23	LM
Mercury		ND	ug/L	EPA 6020	2	10/18/05	10/19/05 17:33	LM
Nickel		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Potassium		6,500	ug/L	EPA 6020	100	10/18/05	10/19/05 4:22	LM
Selenium		8.0	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Silver		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Sodium	L	8,600	ug/L	EPA 6020	1000	10/18/05	10/19/05 17:23	LM
Thallium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Vanadium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:22	LM
Zinc		ND	ug/L	EPA 6020	50	10/18/05	10/19/05 4:22	LM

JD 12/21/05

Notes/Comments:
PQL - Practical Quantitation Limit
ND - Not Detected at a concentration greater than or equal to the PQL.

Reviewed By:

Quality Assurance Chemist

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Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 12:10
Date Received: 10/13/05 16:15

	Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Sample ID: GW 302 / 05101315-03 / Water							
Target Analyte List - Metals							
Aluminum	**4,400**	ug/L	EPA 6020	500	10/19/05	10/20/05 14:04	LM
Antimony	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Arsenic	**18**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Barium	**260**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Beryllium	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Cadmium	**5.1**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Calcium	**83,000**	ug/L	EPA 6020	1000	10/19/05	10/20/05 14:04	LM
Chromium	**140**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Cobalt	**25**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Copper	**260**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Iron	**13,000**	ug/L	EPA 6020	100	10/19/05	10/19/05 22:05	LM
Lead	**910**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Magnesium	**8,700**	ug/L	EPA 6020	1000	10/19/05	10/20/05 14:04	LM
Manganese	**560**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Mercury	ND	ug/L	EPA 6020	1	10/19/05	10/19/05 22:05	LM
Nickel	**45**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Potassium	**7,400**	ug/L	EPA 6020	1000	10/19/05	10/20/05 14:04	LM
Selenium	**6.5**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Silver	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Sodium	**8,000**	ug/L	EPA 6020	1000	10/19/05	10/20/05 14:04	LM
Thallium	ND	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Vanadium	**49**	ug/L	EPA 6020	5	10/19/05	10/19/05 22:05	LM
Zinc	**1,700**	ug/L	EPA 6020	50	10/19/05	10/19/05 22:05	LM
Target Compound List - SEMIVOLATILES							
Phenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Bis (2-chloroethyl) ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2-Chlorophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2-Methylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
[illegible]loroisopropyl) ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
[illegible]tophenone	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
3,4-Methylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
N-Nitroso-di-n-propylamine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Hexachloroethane	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Nitrobenzene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW

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Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 12:10
Date Received: 10/13/05 16:15

Sample ID: GW 302 / 05101315-03 / Water

Target Compound List - SEMIVOLATILES	Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Isophorone	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2-Nitrophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,4-Dimethylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Bis (2-chloroethoxy) methane	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,4-Dichlorophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Naphthalene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
4-Chloroaniline	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Hexachlorobutadiene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Caprolactam	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
4-Chloro-3-methylphenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2-Methylnaphthalene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Hexachlorocyclopentadiene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,4,6-Trichlorophenol	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,4,5-Trichlorophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
1,1-Biphenyl	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2-Chloronaphthalene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2-Nitroaniline	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Dimethyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,6-Dinitrotoluene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Acenaphthylene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
3-Nitroaniline	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
Acenaphthene	j 1	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,4-Dinitrophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
4-Nitrophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
Dibenzofuran	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
2,4-Dinitrotoluene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Diethyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Fluorene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
4-Chlorophenyl phenyl ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
4-Nitroaniline	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
4,6-Dinitro-2-methylphenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
N-Nitrosodiphenylamine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
4-Bromophenyl phenyl ether	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW

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Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 12:10
Date Received: 10/13/05 16:15

	Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Sample ID: GW 302 / 05101315-03 / Water							
Target Compound List - SEMIVOLATILES							
Hexachlorobenzene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Atrazine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Pentachlorophenol	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
Phenanthrene	j 1	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Anthracene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Carbazole	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Di-n-butyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Fluoranthene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Pyrene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Butyl benzyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
3,3-Dichlorobenzidine	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Benzo (a) anthracene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Chrysene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Bis (2-ethylhexyl) phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Di-n-octyl phthalate	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Benzo (b,k) fluoranthene	ND	ug/L	EPA 8270C	22	10/17/05	10/18/05 18:34	BW
Benzo (a) pyrene	ND	ug/L	EPA 8270C	5	10/17/05	10/18/05 18:34	BW
Indeno (1,2,3-cd) pyrene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW
Dibenzo (a,h) anthracene	ND	ug/L	EPA 8270C	5	10/17/05	10/18/05 18:34	BW
Benzo (g,h,i) perylene	ND	ug/L	EPA 8270C	11	10/17/05	10/18/05 18:34	BW

Reviewed By: _____
Quality Assurance Chemist

Notes/Comments:
PQL - Practical Quantitation Limit
ND - Not Detected at a concentration greater than or equal to the PQL.
j - estimated value, less than quantitation limit.

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ENSAT
November 16, 2005
Revised-Replaces Report Issued October 20, 2005

Project: Warner Street Wetlands
Site Location: Baltimore, MD
Project Number: 66-82M

Date Sampled: 10/13/05 12:10
Date Received: 10/13/05 16:15

Sample ID: GW 302 (Dissolved) / 05101315-04 / Water

Dissolved Target Analyte List - Metals

		Result	Unit	Method	PQL	Prepared	Analyzed	Init.
Aluminum	DV Qualifier	ND	ug/L	EPA 6020	50	10/18/05	10/19/05 4:44	LM
Antimony	UL	ND	ug/L	EPA 6020	10	10/18/05	10/19/05 18:15	LM
Arsenic		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Barium		76	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Beryllium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Cadmium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Calcium		64,000	ug/L	EPA 6020	1000	10/18/05	10/19/05 18:09	LM
Chromium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Cobalt		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Copper		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Iron		240	ug/L	EPA 6020	100	10/18/05	10/19/05 4:44	LM
Lead		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Magnesium	L	6,900	ug/L	EPA 6020	1000	10/18/05	10/19/05 18:09	LM
Manganese		200	ug/L	EPA 6020	50	10/18/05	10/19/05 18:09	LM
Mercury		ND	ug/L	EPA 6020	2	10/18/05	10/19/05 18:15	LM
Nickel		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Potassium		6,700	ug/L	EPA 6020	100	10/18/05	10/19/05 4:44	LM
Selenium		8.0	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Silver		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Sodium	L	7,700	ug/L	EPA 6020	1000	10/18/05	10/19/05 18:09	LM
Thallium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Vanadium		ND	ug/L	EPA 6020	5	10/18/05	10/19/05 4:44	LM
Zinc		ND	ug/L	EPA 6020	50	10/18/05	10/19/05 4:44	LM

JD 12/21/05

Reviewed By:

Quality Assurance Chemist

Notes/Comments:
PQL - Practical Quantitation Limit
ND - Not Detected at a concentration greater than or equal to the PQL.

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ENSAT
November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB202-00 / 05101914-01 / Soil							
Percent Solids							
Percent Solids	86	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	ND	ug/kg	EPA 8270C	380			10/26/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	380			10/26/2005
Anthracene	j 64	ug/kg	EPA 8270C	380			10/26/2005
Benzo (a) anthracene	j 300	ug/kg	EPA 8270C	380			10/26/2005
Benzo (a) pyrene	360	ug/kg	EPA 8270C	190			10/26/2005
Benzo (b,k) fluoranthene	j 290	ug/kg	EPA 8270C	770			10/26/2005
Benzo (g,h,i) perylene	ND	ug/kg	EPA 8270C	380			10/26/2005
Chrysene	j 320	ug/kg	EPA 8270C	380			10/26/2005
Dibenzo (a,h) anthracene	j 84	ug/kg	EPA 8270C	190			10/26/2005
Fluoranthene	460	ug/kg	EPA 8270C	380			10/26/2005
Fluorene	ND	ug/kg	EPA 8270C	380			10/26/2005
Indeno (1,2,3-cd) pyrene	j 220	ug/kg	EPA 8270C	380			10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	380			10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	380			10/26/2005
Phenanthrene	j 340	ug/kg	EPA 8270C	380			10/26/2005
Pyrene	470	ug/kg	EPA 8270C	380			10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	5,300	mg/kg	EPA 6020	2600		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Arsenic	9.5	mg/kg	EPA 6020	0.53		10/24/2005	10/26/2005
Barium	91	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Calcium	7,600	mg/kg	EPA 6020	5300		10/24/2005	10/26/2005
Chromium	65	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Cobalt J	11	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Copper K	100	mg/kg	EPA 6020	26		10/24/2005	10/27/2005
Iron	13,000	mg/kg	EPA 6020	5300		10/24/2005	10/26/2005
Lead	300	mg/kg	EPA 6020	260		10/24/2005	10/26/2005
[illegible]um	2,400	mg/kg	EPA 6020	53		10/24/2005	10/26/2005
[illegible]ganese J	270	mg/kg	EPA 6020	26		10/24/2005	10/27/2005
Mercury	0.40	mg/kg	EPA 6020	0.11		10/24/2005	10/26/2005
Nickel	22	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Potassium	800	mg/kg	EPA 6020	53		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005

JD 12/8/05

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ENSAT
November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB202-00 / 05101914-01 / Soil							
Target Analyte List - Metals							
Silver DV Qualifier UR	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Sodium	60	mg/kg	EPA 6020	53		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.1		10/24/2005	10/26/2005
Vanadium	25	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Zinc JD 12/21/05	300	mg/kg	EPA 6020	260		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.8		10/20/2005	10/20/2005

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB302-03 / 05101914-02 / Soil							
Hexavalent Chromium in Soil							
Hexavalent Chromium	ND	mg/kg	EPA 7196A	12		10/24/2005	10/25/2005
Percent Solids							
Percent Solids	81	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 120	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Acenaphthylene	j 59	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Anthracene	j 220	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Benzo (a) anthracene	820	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Benzo (a) pyrene	1,100	ug/kg	EPA 8270C	200		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	j 730	ug/kg	EPA 8270C	810		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	840	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Chrysene	890	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	j 200	ug/kg	EPA 8270C	200		10/24/2005	10/26/2005
Fluoranthene	1,200	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Fluorene	j 90	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	640	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
2-Methylnaphthalene	j 70	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Naphthalene	j 86	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Phenanthrene	1,100	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Pyrene	1,500	ug/kg	EPA 8270C	410		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum	8,600	mg/kg	EPA 6020	2900		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Arsenic	16	mg/kg	EPA 6020	0.58		10/24/2005	10/26/2005
Barium	230	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Calcium	ND	mg/kg	EPA 6020	5800		10/24/2005	10/26/2005
Chromium	210	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Cobalt	J 15	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
	K 170	mg/kg	EPA 6020	29		10/24/2005	10/27/2005
	21,000	mg/kg	EPA 6020	5800		10/24/2005	10/26/2005
Lead	390	mg/kg	EPA 6020	290		10/24/2005	10/26/2005
Magnesium	3,600	mg/kg	EPA 6020	58		10/24/2005	10/26/2005
Manganese	J 510	mg/kg	EPA 6020	29		10/24/2005	10/27/2005
Mercury	0.62	mg/kg	EPA 6020	0.12		10/24/2005	10/26/2005
Nickel	31	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005

DV Qualifier

JD 12/8/05

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB302-03 / 05101914-02 / Soil							
Target Analyte List - Metals							
Potassium	**700**	mg/kg	EPA 6020	58		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Silver	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Sodium	**83**	mg/kg	EPA 6020	58		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Vanadium	**29**	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Zinc	**1,000**	mg/kg	EPA 6020	290		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	6.1		10/20/2005	10/20/2005

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB201-06 / 05101914-03 / Soil							
Hexavalent Chromium in Soil							
Hexavalent Chromium	ND	mg/kg	EPA 7196A	13		10/24/2005	10/25/2005
Percent Solids							
Percent Solids	74	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 150	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Anthracene	j 170	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Benzo (a) anthracene	j 430	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Benzo (a) pyrene	470	ug/kg	EPA 8270C	220		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	j 360	ug/kg	EPA 8270C	890		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	j 310	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Chrysene	j 440	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	j 120	ug/kg	EPA 8270C	220		10/24/2005	10/26/2005
Fluoranthene	890	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Fluorene	j 150	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	j 250	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Phenanthrene	810	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Pyrene	860	ug/kg	EPA 8270C	450		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	9,400	mg/kg	EPA 6020	2800		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Arsenic	14	mg/kg	EPA 6020	0.56		10/24/2005	10/26/2005
Barium	540	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Cadmium	3.0	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Calcium	8,700	mg/kg	EPA 6020	5600		10/24/2005	10/26/2005
Chromium	690	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Cobalt J	15	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
K	190	mg/kg	EPA 6020	28		10/24/2005	10/27/2005
	21,000	mg/kg	EPA 6020	5600		10/24/2005	10/26/2005
Lead	610	mg/kg	EPA 6020	280		10/24/2005	10/26/2005
Magnesium	3,800	mg/kg	EPA 6020	56		10/24/2005	10/26/2005
Manganese J	340	mg/kg	EPA 6020	28		10/24/2005	10/27/2005
Mercury	0.61	mg/kg	EPA 6020	0.11		10/24/2005	10/26/2005
Nickel	37	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB201-06 / 05101914-03 / Soil							
Target Analyte List - Metals							
Potassium	1,100	mg/kg	EPA 6020	56		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Silver	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Sodium	110	mg/kg	EPA 6020	56		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Vanadium	37	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Zinc	3,200	mg/kg	EPA 6020	280		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	6.7		10/20/2005	10/20/2005

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Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB401-10 / 05101914-04 / Soil							
Percent Solids							
Percent Solids	87	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 78	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Acenaphthylene	j 57	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Anthracene	j 230	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Benzo (a) anthracene	1,600	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Benzo (a) pyrene	2,300	ug/kg	EPA 8270C	190		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	1,800	ug/kg	EPA 8270C	760		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	1,600	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Chrysene	1,900	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	450	ug/kg	EPA 8270C	190		10/24/2005	10/26/2005
Fluoranthene	3,200	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Fluorene	j 87	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	1,400	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Phenanthrene	1,200	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Pyrene	3,500	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	9,300	mg/kg	EPA 6020	2800		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Arsenic	22	mg/kg	EPA 6020	0.56		10/24/2005	10/26/2005
Barium	190	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Cadmium	3.1	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Calcium	26,000	mg/kg	EPA 6020	5600		10/24/2005	10/26/2005
Chromium	23	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Cobalt J	5.8	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Copper K	110	mg/kg	EPA 6020	28		10/24/2005	10/27/2005
Iron	17,000	mg/kg	EPA 6020	5600		10/24/2005	10/26/2005
Lead	600	mg/kg	EPA 6020	280		10/24/2005	10/26/2005
[illegible]ium	1,500	mg/kg	EPA 6020	56		10/24/2005	10/26/2005
Manganese J	2,500	mg/kg	EPA 6020	28		10/24/2005	10/27/2005
Mercury	1.2	mg/kg	EPA 6020	0.11		10/24/2005	10/26/2005
Nickel	33	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Potassium	320	mg/kg	EPA 6020	56		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB401-10 / 05101914-04 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Sodium	280	mg/kg	EPA 6020	56		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.2		10/24/2005	10/26/2005
Vanadium	18	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Zinc	1,100	mg/kg	EPA 6020	280		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.7		10/20/2005	10/20/2005

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Sample ID: SB501-06 / 05101914-05 / Soil

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Percent Solids							
Percent Solids	96	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 210	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Acenaphthylene	j 71	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Anthracene	j 230	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Benzo (a) anthracene	980	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Benzo (a) pyrene	1,300	ug/kg	EPA 8270C	170		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	780	ug/kg	EPA 8270C	690		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	920	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Chrysene	1,000	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	280	ug/kg	EPA 8270C	170		10/24/2005	10/26/2005
Fluoranthene	1,200	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Fluorene	j 89	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	750	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Naphthalene	j 67	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Phenanthrene	930	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Pyrene	1,500	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	3,300	mg/kg	EPA 6020	2400		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Arsenic	17	mg/kg	EPA 6020	0.48		10/24/2005	10/26/2005
Barium	110	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Calcium	31,000	mg/kg	EPA 6020	4800		10/24/2005	10/26/2005
Chromium	51	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Cobalt J	8.4	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Copper K	130	mg/kg	EPA 6020	24		10/24/2005	10/27/2005
Iron	11,000	mg/kg	EPA 6020	4800		10/24/2005	10/26/2005
Lead	330	mg/kg	EPA 6020	240		10/24/2005	10/26/2005
[illegible]ium	1,400	mg/kg	EPA 6020	48		10/24/2005	10/26/2005
[illegible]anese J	130	mg/kg	EPA 6020	24		10/24/2005	10/27/2005
Mercury	0.36	mg/kg	EPA 6020	0.096		10/24/2005	10/26/2005
Nickel	19	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Potassium	310	mg/kg	EPA 6020	48		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB501-06 / 05101914-05 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Sodium	140	mg/kg	EPA 6020	48		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	1.9		10/24/2005	10/26/2005
Vanadium	19	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Zinc	360	mg/kg	EPA 6020	240		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.2		10/20/2005	10/20/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB301-06 / 05101914-06 / Soil							
Percent Solids							
Percent Solids	92	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	ND	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Anthracene	ND	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Benzo (a) anthracene	j 70	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Benzo (a) pyrene	j 92	ug/kg	EPA 8270C	180		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	j 71	ug/kg	EPA 8270C	720		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	j 72	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Chrysene	j 67	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	ND	ug/kg	EPA 8270C	180		10/24/2005	10/26/2005
Fluoranthene	j 98	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Fluorene	ND	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	j 65	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Phenanthrene	j 44	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Pyrene	j 110	ug/kg	EPA 8270C	360		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	2,900	mg/kg	EPA 6020	2500		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Arsenic	4.1	mg/kg	EPA 6020	0.5		10/24/2005	10/26/2005
Barium	36	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Calcium	ND	mg/kg	EPA 6020	5000		10/24/2005	10/26/2005
Chromium	30	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Cobalt J	7.2	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Copper K	37	mg/kg	EPA 6020	25		10/24/2005	10/27/2005
Iron	7,400	mg/kg	EPA 6020	5000		10/24/2005	10/26/2005
Lead	130	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
[illegible]um	1,800	mg/kg	EPA 6020	50		10/24/2005	10/26/2005
Manganese J	150	mg/kg	EPA 6020	25		10/24/2005	10/27/2005
Mercury	0.13	mg/kg	EPA 6020	0.1		10/24/2005	10/26/2005
Nickel	15	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Potassium	320	mg/kg	EPA 6020	50		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB301-06 / 05101914-06 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Sodium	56	mg/kg	EPA 6020	50		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2		10/24/2005	10/26/2005
Vanadium	13	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Zinc	ND	mg/kg	EPA 6020	250		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.4		10/21/2005	10/21/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB102-06 / 05101914-07 / Soil							
Percent Solids							
Percent Solids	88	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 320	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Acenaphthylene	j 48	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Anthracene	700	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Benzo (a) anthracene	2,000	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Benzo (a) pyrene	2,000	ug/kg	EPA 8270C	190		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	1,700	ug/kg	EPA 8270C	750		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	1,400	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Chrysene	2,100	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	510	ug/kg	EPA 8270C	190		10/24/2005	10/26/2005
Fluoranthene	3,800	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Fluorene	j 340	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	1,200	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
2-Methylnaphthalene	j 91	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Naphthalene	j 140	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Phenanthrene	3,400	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Pyrene	3,100	ug/kg	EPA 8270C	380		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	5,300	mg/kg	EPA 6020	2800		10/24/2005	10/26/2005
Antimony	3.1	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Arsenic	16	mg/kg	EPA 6020	0.55		10/24/2005	10/26/2005
Barium	410	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Calcium	57,000	mg/kg	EPA 6020	5500		10/24/2005	10/26/2005
Chromium	350	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Cobalt J	21	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Copper K	220	mg/kg	EPA 6020	28		10/24/2005	10/27/2005
Iron	15,000	mg/kg	EPA 6020	5500		10/24/2005	10/26/2005
Lead	2,700	mg/kg	EPA 6020	280		10/24/2005	10/26/2005
[illegible]ium	1,600	mg/kg	EPA 6020	55		10/24/2005	10/26/2005
Manganese J	180	mg/kg	EPA 6020	28		10/24/2005	10/27/2005
Mercury	0.80	mg/kg	EPA 6020	0.11		10/24/2005	10/26/2005
Nickel	23	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Potassium	470	mg/kg	EPA 6020	55		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB102-06 / 05101914-07 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Sodium	460	mg/kg	EPA 6020	55		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.2		10/24/2005	10/26/2005
Vanadium	29	mg/kg	EPA 6020	2.8		10/24/2005	10/26/2005
Zinc	590	mg/kg	EPA 6020	280		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.7		10/21/2005	10/21/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB303-00 / 05101914-08 / Soil							
Percent Solids							
Percent Solids	74	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 51	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Anthracene	j 83	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Benzo (a) anthracene	j 400	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Benzo (a) pyrene	550	ug/kg	EPA 8270C	220		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	j 380	ug/kg	EPA 8270C	890		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	j 320	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Chrysene	j 420	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	j 120	ug/kg	EPA 8270C	220		10/24/2005	10/26/2005
Fluoranthene	660	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Fluorene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	j 300	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Phenanthrene	490	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Pyrene	680	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	9,100	mg/kg	EPA 6020	2900		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Arsenic	40	mg/kg	EPA 6020	0.58		10/24/2005	10/26/2005
Barium	150	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Cadmium	4.2	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Calcium	8,100	mg/kg	EPA 6020	5800		10/24/2005	10/26/2005
Chromium	92	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Cobalt J	17	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Copper K	190	mg/kg	EPA 6020	29		10/24/2005	10/27/2005
Iron	20,000	mg/kg	EPA 6020	5800		10/24/2005	10/26/2005
Lead	730	mg/kg	EPA 6020	290		10/24/2005	10/26/2005
[illegible]ium	2,300	mg/kg	EPA 6020	58		10/24/2005	10/26/2005
M[illegible]anese J	270	mg/kg	EPA 6020	29		10/24/2005	10/27/2005
Mercury	0.74	mg/kg	EPA 6020	0.12		10/24/2005	10/26/2005
Nickel	32	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Potassium	1,200	mg/kg	EPA 6020	58		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005

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Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/12/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB303-00 // 05101914-08 // Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Sodium	84	mg/kg	EPA 6020	58		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Vanadium	41	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Zinc	560	mg/kg	EPA 6020	290		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	6.7		10/21/2005	10/21/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB303-10 / 05101914-09 / Soil							
Percent Solids							
Percent Solids	64	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	ND	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Anthracene	ND	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Benzo (a) anthracene	j 93	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Benzo (a) pyrene	ND	ug/kg	EPA 8270C	260		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	ND	ug/kg	EPA 8270C	1000		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	j 69	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Chrysene	j 100	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	ND	ug/kg	EPA 8270C	260		10/24/2005	10/26/2005
Fluoranthene	j 210	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Fluorene	ND	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	j 61	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Phenanthrene	j 160	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Pyrene	j 170	ug/kg	EPA 8270C	520		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	4,900	mg/kg	EPA 6020	3400		10/24/2005	10/26/2005
Antimony	7.4	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Arsenic	25	mg/kg	EPA 6020	0.67		10/24/2005	10/26/2005
Barium	1,300	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Cadmium	5.1	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Calcium	17,000	mg/kg	EPA 6020	6700		10/24/2005	10/26/2005
Chromium	51	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Cobalt J	22	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Copper K	110	mg/kg	EPA 6020	34		10/24/2005	10/27/2005
Iron	19,000	mg/kg	EPA 6020	6700		10/24/2005	10/26/2005
Lead	890	mg/kg	EPA 6020	340		10/24/2005	10/26/2005
[illegible]ium	1,600	mg/kg	EPA 6020	67		10/24/2005	10/26/2005
Manganese J	150	mg/kg	EPA 6020	34		10/24/2005	10/27/2005
Mercury	3.7	mg/kg	EPA 6020	0.13		10/24/2005	10/26/2005
Nickel	20	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Potassium	470	mg/kg	EPA 6020	67		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005

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Date Sampled: 10/12/2005
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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB303-10 / 05101914-09 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Sodium	260	mg/kg	EPA 6020	67		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Vanadium	27	mg/kg	EPA 6020	3.4		10/24/2005	10/26/2005
Zinc	1,700	mg/kg	EPA 6020	340		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	7.8		10/21/2005	10/21/2005

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Date Sampled: 10/12/2005
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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB601-10 / 05101914-10 / Soil							
Percent Solids							
Percent Solids	85	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 58	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Acenaphthylene	j 78	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Anthracene	j 230	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Benzo (a) anthracene	2,000	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Benzo (a) pyrene	2,900	ug/kg	EPA 8270C	190		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	2,200	ug/kg	EPA 8270C	770		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	2,000	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Chrysene	2,400	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	500	ug/kg	EPA 8270C	190		10/24/2005	10/26/2005
Fluoranthene	4,200	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Fluorene	j 68	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	1,600	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Phenanthrene	1,300	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Pyrene	4,700	ug/kg	EPA 8270C	390		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	3,200	mg/kg	EPA 6020	2500		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Arsenic	19	mg/kg	EPA 6020	0.51		10/24/2005	10/26/2005
Barium	190	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Cadmium	3.0	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Calcium	39,000	mg/kg	EPA 6020	5100		10/24/2005	10/26/2005
Chromium	19	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Cobalt J	5.7	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Copper K	110	mg/kg	EPA 6020	25		10/24/2005	10/27/2005
Iron	15,000	mg/kg	EPA 6020	5100		10/24/2005	10/26/2005
[illegible]	650	mg/kg	EPA 6020	250		10/24/2005	10/26/2005
[illegible]sium	1,500	mg/kg	EPA 6020	51		10/24/2005	10/26/2005
Manganese J	2,800	mg/kg	EPA 6020	25		10/24/2005	10/27/2005
Mercury	1.4	mg/kg	EPA 6020	0.1		10/24/2005	10/26/2005
Nickel	27	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Potassium	290	mg/kg	EPA 6020	51		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005

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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB601-10 / 05101914-10 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Sodium	310	mg/kg	EPA 6020	51		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2		10/24/2005	10/26/2005
Vanadium	18	mg/kg	EPA 6020	2.5		10/24/2005	10/26/2005
Zinc	1,100	mg/kg	EPA 6020	250		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.9		10/21/2005	10/21/2005

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Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB203-06 / 05101914-11 / Soil							
Percent Solids							
Percent Solids	75	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Anthracene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Benzo (a) anthracene	j 120	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Benzo (a) pyrene	j 170	ug/kg	EPA 8270C	220		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	j 130	ug/kg	EPA 8270C	890		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	j 99	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Chrysene	j 130	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	ND	ug/kg	EPA 8270C	220		10/24/2005	10/26/2005
Fluoranthene	j 190	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Fluorene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	j 98	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Naphthalene	ND	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Phenanthrene	j 100	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Pyrene	j 200	ug/kg	EPA 8270C	440		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	6,300	mg/kg	EPA 6020	2700		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Arsenic	10	mg/kg	EPA 6020	0.53		10/24/2005	10/26/2005
Barium	87	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Calcium	ND	mg/kg	EPA 6020	5300		10/24/2005	10/26/2005
Chromium	81	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Cobalt J	10	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Copper K	130	mg/kg	EPA 6020	27		10/24/2005	10/27/2005
Iron	13,000	mg/kg	EPA 6020	5300		10/24/2005	10/26/2005
Lead	210	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
[illegible]um	2,300	mg/kg	EPA 6020	53		10/24/2005	10/26/2005
[illegible]ese J	220	mg/kg	EPA 6020	27		10/24/2005	10/27/2005
Mercury	0.48	mg/kg	EPA 6020	0.11		10/24/2005	10/26/2005
Nickel	27	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Potassium	690	mg/kg	EPA 6020	53		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005

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Project Number: 66-82M

Date Sampled: 10/13/2005
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	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB203-06 // 05101914-11 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Sodium	80	mg/kg	EPA 6020	53		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.1		10/24/2005	10/26/2005
Vanadium	29	mg/kg	EPA 6020	2.7		10/24/2005	10/26/2005
Zinc	300	mg/kg	EPA 6020	270		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	6.7		10/21/2005	10/21/2005

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Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB103-03 / 05101914-12 / Soil							
Percent Solids							
Percent Solids	90	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 190	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Acenaphthylene	j 92	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Anthracene	520	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Benzo (a) anthracene	1,800	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Benzo (a) pyrene	2,000	ug/kg	EPA 8270C	180		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	1,400	ug/kg	EPA 8270C	730		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	1,400	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Chrysene	1,700	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	490	ug/kg	EPA 8270C	180		10/24/2005	10/26/2005
Fluoranthene	2,800	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Fluorene	j 160	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	1,200	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
2-Methylnaphthalene	j 70	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Naphthalene	j 100	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Phenanthrene	2,200	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Pyrene	3,000	ug/kg	EPA 8270C	370		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	4,600	mg/kg	EPA 6020	2400		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Arsenic	13	mg/kg	EPA 6020	0.49		10/24/2005	10/26/2005
Barium	210	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Calcium	24,000	mg/kg	EPA 6020	4900		10/24/2005	10/26/2005
Chromium	110	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Cobalt	13	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Copper KJ	130	mg/kg	EPA 6020	24		10/24/2005	10/27/2005
Iron	13,000	mg/kg	EPA 6020	4900		10/24/2005	10/26/2005
Lead	910	mg/kg	EPA 6020	240		10/24/2005	10/26/2005
[illegible]ium	1,800	mg/kg	EPA 6020	49		10/24/2005	10/26/2005
M[illegible]ganese J	200	mg/kg	EPA 6020	24		10/24/2005	10/27/2005
Mercury	0.52	mg/kg	EPA 6020	0.098		10/24/2005	10/26/2005
Nickel	20	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Potassium	440	mg/kg	EPA 6020	49		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005

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Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB103-03 / 05101914-12 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Sodium	97	mg/kg	EPA 6020	49		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2		10/24/2005	10/26/2005
Vanadium	24	mg/kg	EPA 6020	2.4		10/24/2005	10/26/2005
Zinc	530	mg/kg	EPA 6020	240		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.5		10/21/2005	10/21/2005

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PHASE SEPARATION SCIENCE, INC.

ANALYTICAL CHEMISTRY • ENVIRONMENTAL SCIENCE

CERTIFICATE OF ANALYSIS
No. 05101914 Page 25 of 31
ENSAT
November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB104-06 // 05101914-13 / Soil							
Percent Solids							
Percent Solids	93	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 100	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Acenaphthylene	j 37	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Anthracene	j 250	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Benzo (a) anthracene	710	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Benzo (a) pyrene	830	ug/kg	EPA 8270C	180		10/24/2005	10/26/2005
Benzo (b,k) fluoranthene	j 650	ug/kg	EPA 8270C	710		10/24/2005	10/26/2005
Benzo (g,h,i) perylene	590	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Chrysene	740	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Dibenzo (a,h) anthracene	230	ug/kg	EPA 8270C	180		10/24/2005	10/26/2005
Fluoranthene	1,500	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Fluorene	j 100	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Indeno (1,2,3-cd) pyrene	500	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
2-Methylnaphthalene	j 56	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Naphthalene	j 100	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Phenanthrene	1,100	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Pyrene	1,100	ug/kg	EPA 8270C	350		10/24/2005	10/26/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	4,000	mg/kg	EPA 6020	2600		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Arsenic	11	mg/kg	EPA 6020	0.51		10/24/2005	10/26/2005
Barium	120	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Calcium	68,000	mg/kg	EPA 6020	5100		10/24/2005	10/26/2005
Chromium	49	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Cobalt J	6.2	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Copper K	96	mg/kg	EPA 6020	26		10/24/2005	10/27/2005
Iron	14,000	mg/kg	EPA 6020	5100		10/24/2005	10/26/2005
Lead	490	mg/kg	EPA 6020	260		10/24/2005	10/26/2005
[illegible]ium	1,700	mg/kg	EPA 6020	51		10/24/2005	10/26/2005
M[illegible]ganese J	160	mg/kg	EPA 6020	26		10/24/2005	10/27/2005
Mercury	0.87	mg/kg	EPA 6020	0.1		10/24/2005	10/26/2005
Nickel	17	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Potassium	310	mg/kg	EPA 6020	51		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005

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ENSAT
November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB104-06 / 05101914-13 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Sodium	200	mg/kg	EPA 6020	51		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.1		10/24/2005	10/26/2005
Vanadium	24	mg/kg	EPA 6020	2.6		10/24/2005	10/26/2005
Zinc	340	mg/kg	EPA 6020	260		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.4		10/21/2005	10/21/2005

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB104-10 / 05101914-14 / Soil							
Percent Solids							
Percent Solids	87	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	ND	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Anthracene	j 94	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Benzo (a) anthracene	j 360	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Benzo (a) pyrene	450	ug/kg	EPA 8270C	190		10/25/2005	10/25/2005
Benzo (b,k) fluoranthene	j 360	ug/kg	EPA 8270C	770		10/25/2005	10/25/2005
Benzo (g,h,i) perylene	j 280	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Chrysene	j 380	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Dibenzo (a,h) anthracene	j 110	ug/kg	EPA 8270C	190		10/25/2005	10/25/2005
Fluoranthene	700	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Fluorene	ND	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Indeno (1,2,3-cd) pyrene	j 240	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Naphthalene	ND	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Phenanthrene	420	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Pyrene	630	ug/kg	EPA 8270C	380		10/25/2005	10/25/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	3,600	mg/kg	EPA 6020	2300		10/24/2005	10/26/2005
Antimony	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Arsenic	15	mg/kg	EPA 6020	0.47		10/24/2005	10/26/2005
Barium	120	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Calcium	68,000	mg/kg	EPA 6020	4700		10/24/2005	10/26/2005
Chromium	31	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Cobalt KJ	5.4	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Copper	100	mg/kg	EPA 6020	23		10/24/2005	10/27/2005
Iron	19,000	mg/kg	EPA 6020	4700		10/24/2005	10/26/2005
Lead	480	mg/kg	EPA 6020	230		10/24/2005	10/26/2005
[illegible]um	1,200	mg/kg	EPA 6020	47		10/24/2005	10/26/2005
M[illegible]anese J	190	mg/kg	EPA 6020	23		10/24/2005	10/27/2005
Mercury	1.2	mg/kg	EPA 6020	0.093		10/24/2005	10/26/2005
Nickel	13	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Potassium	430	mg/kg	EPA 6020	47		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005

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Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB104-10 / 05101914-14 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Sodium	410	mg/kg	EPA 6020	47		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	1.9		10/24/2005	10/26/2005
Vanadium	19	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Zinc	420	mg/kg	EPA 6020	230		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	5.8		10/21/2005	10/21/2005

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Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB204-00 / 05101914-15 / Soil							
Percent Solids							
Percent Solids	83	%	Gravimetry				10/24/2005
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	j 53	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Acenaphthylene	ND	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Anthracene	j 96	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Benzo (a) anthracene	430	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Benzo (a) pyrene	540	ug/kg	EPA 8270C	200		10/25/2005	10/25/2005
Benzo (b,k) fluoranthene	j 520	ug/kg	EPA 8270C	800		10/25/2005	10/25/2005
Benzo (g,h,i) perylene	j 340	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Chrysene	470	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Dibenzo (a,h) anthracene	j 130	ug/kg	EPA 8270C	200		10/25/2005	10/25/2005
Fluoranthene	790	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Fluorene	j 41	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Indeno (1,2,3-cd) pyrene	j 310	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
2-Methylnaphthalene	ND	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Naphthalene	ND	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Phenanthrene	520	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Pyrene	840	ug/kg	EPA 8270C	400		10/25/2005	10/25/2005
Target Analyte List - Metals							
Aluminum DV Qualifier	7,300	mg/kg	EPA 6020	2900		10/24/2005	10/26/2005
Antimony	6.1	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Arsenic	23	mg/kg	EPA 6020	0.57		10/24/2005	10/26/2005
Barium	200	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Beryllium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Cadmium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Calcium	18,000	mg/kg	EPA 6020	5700		10/24/2005	10/26/2005
Chromium	61	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Cobalt H	7.7	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Copper K	260	mg/kg	EPA 6020	29		10/24/2005	10/27/2005
Iron	21,000	mg/kg	EPA 6020	5700		10/24/2005	10/26/2005
Lead	700	mg/kg	EPA 6020	290		10/24/2005	10/26/2005
[illegible]um	1,400	mg/kg	EPA 6020	57		10/24/2005	10/26/2005
M[illegible]anese J	220	mg/kg	EPA 6020	29		10/24/2005	10/27/2005
Mercury	1.7	mg/kg	EPA 6020	0.11		10/24/2005	10/26/2005
Nickel	19	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Potassium	590	mg/kg	EPA 6020	57		10/24/2005	10/26/2005
Selenium	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: SB204-00 / 05101914-15 / Soil							
Target Analyte List - Metals							
Silver	ND	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Sodium	97	mg/kg	EPA 6020	57		10/24/2005	10/26/2005
Thallium	ND	mg/kg	EPA 6020	2.3		10/24/2005	10/26/2005
Vanadium	27	mg/kg	EPA 6020	2.9		10/24/2005	10/26/2005
Zinc	470	mg/kg	EPA 6020	290		10/24/2005	10/27/2005
Total Cyanide							
Cyanide	ND	mg/kg	EPA 9010B	6		10/21/2005	10/21/2005
Sample ID: STCLP-5A / 05101914-16 / Soil							
TCLP Metals							
Arsenic	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Barium	ND	mg/L	1311/6020	10	100	10/26/2005	10/26/2005
Cadmium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Chromium	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Lead	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Mercury	ND	mg/L	1311/6020	0.1	0.2	10/26/2005	10/26/2005
Selenium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Silver	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Sample ID: STCLP-06 / 05101914-17 / Soil							
TCLP Metals							
Arsenic	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Barium	ND	mg/L	1311/6020	10	100	10/26/2005	10/26/2005
Cadmium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Chromium	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Lead	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Mercury	ND	mg/L	1311/6020	0.1	0.2	10/26/2005	10/26/2005
Selenium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Silver	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005

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November 2, 2005

Project: Warner Street Wetlands
Site Location: Near Warner Street Along Patapsco
Project Number: 66-82M

Date Sampled: 10/13/2005
Date Received: 10/19/2005

	Result	Unit	Method	PQL	Limits	Extracted	Analyzed
Sample ID: STCLP-07 / 05101914-18 / Soil							
TCLP Metals							
Arsenic	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Barium	ND	mg/L	1311/6020	10	100	10/26/2005	10/26/2005
Cadmium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Chromium	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Lead	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Mercury	ND	mg/L	1311/6020	0.1	0.2	10/26/2005	10/26/2005
Selenium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Silver	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Sample ID: STCLP-89 / 05101914-19 / Soil							
TCLP Metals							
Arsenic	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Barium	ND	mg/L	1311/6020	10	100	10/26/2005	10/26/2005
Cadmium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Chromium	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Lead	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005
Mercury	ND	mg/L	1311/6020	0.1	0.2	10/26/2005	10/26/2005
Selenium	ND	mg/L	1311/6020	0.1	1	10/26/2005	10/26/2005
Silver	ND	mg/L	1311/6020	0.5	5	10/26/2005	10/26/2005

Reviewed by: Don Pruneau
Quality Assurance Chemist

Notes:
Limits derived from 40CFR, Part 261.24, Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic
ND - Not Detected at a concentration greater than or equal to the PQL.

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APPENDIX D

Phase Separation Science, Inc.

Data Validation Forms and Worksheets

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EPA REGION III M2-SVOC DATA REVIEW CHECKLIST

Analytical Method:	SVOCs by Method SW8270C
Analytical Laboratory	Phase Separation Science, Inc., Baltimore, MD
Project:	Warner Street Wetlands Site Investigation
MDE Project No.:	66-82M
Certificate of Analysis:	05101315
Reviewer:	JDA
Review Date:	12/12/05
Page:	1 of 6

QC Measure	Manual		
	M1	M2	M3
Action Level Notification (Groundwater Samples Only)	x	X	x
Instrument Tune		X	x
Initial Calibration (ICAL) Relative Response Factors (RRF)		X	x
ICAL Percent Relative Standard Deviation (%RSD)		X	x
Continuing Calibration (CCAL) RRF		X	x
CCAL Percent Difference (%D)		X	x
Laboratory Blanks	x	X	x
Matrix Spike/Matrix Spike Duplicate (MS/MSD) Percent Recovery (%R), Relative Percent Difference (RPD)		X	x
Internal Standard Area		X	x
Field QC (Includes field blanks, equipment blank, and trip blanks, and field duplicates)	x	X	x
Sample Paperwork	x	X	x
Holding Times		X	x
Retention Times	x	X	x
Surrogate %R		X	x
Dilution Factors		X	x
Moisture Content		X	x
Mass Spectra	x		x
Chromatograms	x	X	x
Raw Data			x

1. ACTION LEVEL NOTIFICATION

COMPOUND	Action Level (µg/L)	Sample ID	Concentration (µg/L)
1,3-Dichlorobenzene	8,930		
Pentachlorophenol	300		
1,4-Dichlorobenzene	10,700		

No Action Level exceedances

2. INSTRUMENT TUNE

- Is spectra generated using appropriate background subtraction techniques? Y_✓_N___
- Is m/z 198 the base peak? Y_✓_N___
- Is ion abundance criteria met? The criteria for m/z 68, 70, 441, and 443 are calculated by normalizing to specified m/z Y_✓_N___
- Were all samples analyzed with 12-hour period? Y_✓_N____

3. INITIAL CALIBRATION RELATIVE RRF

- Did the laboratory conduct an acceptable 5-point (minimum) calibration prior to sample analysis? Y_✓_N___ (6 point)
- Are all ICAL target compound (including surrogates) RRFs ≥ 0.05? Y_✓_N____

4. INITIAL CALIBRATION %RSD

- Do all target SVOCs have a %RSD ± 30.0%. Y_✓_N____

(Refer to EPA Region III Guidance for the appropriate action if ICAL review criteria are not met)

5. CONTINUING CALIBRATION RRF

- Was a CCAL standard run at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of the method blank and samples? Y_✓_N___
- Were all CCAL RRFs for target SVOCs and surrogates ≥ 0.05 Y_✓_N___

6. CONTINUING CALIBRATION %D

- Verify the %D between the ICAL RRF and CCAL RRF are within ± 25.0% Y____N_✓ (Table D-1)

(Refer to EPA Region III Guidance for the appropriate action if ICAL review criteria are not met)

7. LABORATORY BLANKS

- Was a method blank analyzed for each matrix? Y_✓_N___
- Was a method blank associated with every sample? Y_✓_N___
- Was the blank contaminated? If yes, see worksheet? Y___N_✓

8. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

No action is taken based on MS or replicate data alone. However, using professional judgement the data reviewer may use the MS results in conjunction with other QC criteria and determine the need for some qualification of the data. In some instances it may be determined that only the spiked samples are affected. Alternatively, the data may suggest that the laboratory is having a systematic problem with one or more analytes, thereby affecting all associated samples. One MS/MSD per 20 samples or each batch of samples, which ever is more frequent.

- Was a MS/MSD analyzed for every 20 samples? Y_✓_N___
- Was the MS/MSD field-designated? Y_✓_N____
- If "Yes", specify client sample GW202
- Did the laboratory provide their developed in-house MS/MSD recoveries? Y_✓_N___
- Were the MS/MSD %R and the RPDs within QC limits? Y_✓_N____

9. INTERNAL STANDARDS

- Were all internal standard area counts within -50 to +100 of the associated calibration standard? Y_✓_N____
- Were the retention times of the internal standards within +/- 30 seconds of the retention times of the associated calibration standard? Y_✓_N___

(Refer to EPA Region III Guidance for the appropriate action if IS review criteria are not met)

10. FIELD QC

- Was a field blank collected? Y____N_✓
- Were target compounds detected in the field blank? Y___N____N/A_✓

- Was an equipment blank collected? Y___N_✓
- Were target compounds detected in the equipment blank? Y___N____N/A_✓
- Were field duplicates collected? Y_✓_N____
- If "Yes," what was the identity of the sample/duplicate pair? GW 202 (Sample)/GW 302 (Blind duplicate)
- Were target compounds detected in the sample duplicate pair? Y_✓_N___ (Refer to Table 4 in main report for sample and duplicate RPD calculations)

11. SAMPLE PAPERWORK

- Was the chain of custody legible and complete? Y_✓_N___.
- Were all method requested on the CoC analyzed by the laboratory? Y_✓_N___
- Do the traffic reports, chain of custody forms, or case narrative indicate any problems with sample receipt, condition of samples, analytical problems or special circumstances affecting the quality of the data? Y____N_✓

12. HOLDING TIME

- All matrices; 7 days from collection to extraction, 40 days from extraction to analysis? Y_✓_N___

13. RETENTION TIMES

- Were Relative Retention Times (RRT) within ± 0.06 RRT units of the standard?Y_✓_N__

14. SURROGATE RECOVERIES

- Were percent recoveries (%R) for surrogates within QC limits? Y_✓_N____
- Did the laboratory provide their developed in-house surrogate recoveries? Y_✓_N___
- If the percent recovery (%R) for one or more surrogates was out of QC limits, was a reanalysis performed? Y___N____N/A_✓

Data are not qualified with respect to surrogate recovery unless 2 or more surrogates within the same fraction (base/neutral or acid fraction), are out of specification. Refer to EPA Region III Guidance.

Guidance For Sample Qualification With Out Of Control Surrogates

	2 or 3 All High	2 or 3 All Low	2 or 3 Mixed High/Low	1 or more < 10%R
Detected Analytes	K	L	J	L
Non-Detected Analytes	None	UL	UJ	R

15. DILUTION FACTOR

- Did any samples require dilution? Y____N_✓
- Was a reason provided by the laboratory for the dilution? Y__N___N/A_✓
- Were sample quantitations calculated correctly? Y_✓_N____
- Were detection limits adjusted accordingly? Y____N___N/A_✓
- Did the laboratory report the initial and diluted analyses? Y___N____N/A_✓
- Were data qualified by the laboratory? Y_✓__N____ (Results less than the Practical Quantitation Limit were qualified "J").

16. MOISTURE CONTENT

- Did the laboratory determine moisture content of solid samples? Y____N___N/A_✓ (water samples only in this Certificate of Analysis)
- Were the results reported on a dry weight basis? Y____N___N/A_✓
- Did the laboratory perform calculations correctly? Y_✓_N___

17. CHROMATOGRAMS

Specific areas to review include:

1. Baseline rise, particularly in the later part of the chromatogram (due to previously injected grossly contaminated samples).
2. Degradation of peak definition and shape (clues of active site development within the GC).
3. Loss of sensitivity of the mass analyzer (loss of internal standard area counts are evidence of degrading performance and potential build-up of contamination within the mass analyzer).

- Were target compound peaks all verified and accounted for? Y_✓_N___

- Were manual integrations required? Y____N_✓
- Were before and after integrations provided? Y___N____N/A_✓
- Was a reason provided by the analyst for the manual integration? Y___N____N/A_✓
- Was the manual integration acceptable? Y___N____N/A_✓
- Was the system performance acceptable? Y_✓_N___

OVERALL ASSESSMENT OF DATA

All available information pertaining to the data was reviewed using professional judgment to compliment the determination of the overall qualify of the data.

- Was the overall quality and usability of the data acceptable? Y_✓_N___

Table D-1. 05101315 SVOC CCAL Summary Table

Analytical Method: SVOCs by Method SW8270C
Analytical Laboratory: Phase Separation Science, Inc., Baltimore, MD
Project: Warner Street Wetlands Site Investigation
MDE Project No.: 66-82M
Certificate of Analysis: 05101315
Reviewer: JDA
Review Date: 12/12/2005
Page 1 of 1

Certificate of Analysis	Matrix	Date	Time	CCAL ID	Instrument ID	Compound	%D[1]	RRF[2]	Affected Samples	DV Qualifier
05101315	WATER	10/18/05	9:37	HPBNA	SVOC GC/MS	PRYADINE	34.2	0.781	All aqueous samples	None (not detected)
05101315	WATER	10/18/05	9:37	HPBNA	SVOC GC/MS	N-NITROSODIMETHYTLAMINE	37.8	0.47	All aqueous samples	None (not detected)

1. Maximum CCAL RRF %D = 25.0%
2. Minimum RRF = 0.05

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EPA REGION III IM-1 INORG DATA REVIEW CHECKLIST

(Note, there are no EPA Region III data review guidelines published for reviewing method SW6020 by inductively coupled plasma (ICP)/mass spectroscopy (MS). The data and supporting documentation generated by the method are reviewed for conformance with IM-1 requirements.)

Analytical Method:	TAL Metals by Method SW6020
Analytical Laboratory	Phase Separation Science, Inc., Baltimore, MD
Project:	Warner Street Wetlands Site Investigation
MDE Project No.:	66-82M
Certificate of Analysis:	05101315
Reviewer:	JDA
Review Date:	12/12/05
Page:	1 of 5

QC Measures	IM-1	IM-2
Action Level Notification (Groundwater samples only)	X	x
Holding Times	X	x
Initial Calibration (ICAL)	X	x
Initial Calibration Verification (ICV)	X	x
Continuing Calibration Verification (CCV)	X	x
Instrument Blanks	X	x
Laboratory Blank	X	x
Inductively Coupled Plasma (ICP) Interference Check	X	x
Laboratory Control Sample (LCS)	X	x
Laboratory Duplicate Precision	X	x
Matrix Spike (MS)/Post Digestion Spike (PDS) Recoveries	X	x
ICP Serial Dilution	X	x
Field (QC) (Equipment blanks, duplicates)	X	x
Reporting Limit Verification	X	x
Sample Paperwork	X	x
Raw Data		x

1. ACTION LEVEL NOTIFICATION

METAL	Action Level (µg/L)	Sample ID	Concentration (µg/L)
Arsenic	50		
Chromium	1,000		
Nickel	1,000		
Cadmium	40		
Lead	15	GW 202 GW 302	1,100 910
Cyanide	200		
Lead in soil	500 mg/kg		

2. HOLDING TIMES

- Were aqueous samples preserved with HNO_3 to a pH <2? Y_✓_N___
- Were samples analyzed within 6 months? Y_✓_N___

3. INITIAL CALIBRATION

- Were initial calibrations performed at the correct frequency? Y_✓_N___
- Was interference correction applied? Y_✓_N___
- Was an acceptable, 4-point calibration performed for each element? Y_✓_N___
- Was an internal standard identified for each element in the calibration? Y_✓_N___
- Was the m/z ratio correctly identified for each element in the calibration? Y_✓_N___
- Was the correlation coefficient acceptable for each element? (>0.99)? Y_✓_N___

4. INITIAL CALIBRATION VERIFICATION (ICV)

- Were in-house %recovery limits available? Y_✓_N___
- Were %Rs within control limits? Y_✓_N____
- Were %RSDs for each element acceptable? Y_✓_N___
- Were the %Rs of all internal standard elements within acceptable control limits in the ICV? Y_✓_N___N/A____

5. CONTINUING CALIBRATION VERIFICATION

- Were CCVs analyzed at the correct frequency? Y_✓_N___
- Were CCV %Rs within acceptable control limits? Y____N_✓ (Table D-2)
- Were the %Rs of all internal standard elements within acceptable control limits in the CCV? Y_✓_N___N/A___

6. INSTRUMENT BLANKS

6a. Initial Calibration Blank (ICB)

- Were ICBs analyzed at the correct frequency? Y_✓_N___
- Were reportable concentrations of any elements present in the ICB? Y__N_✓
- Were the %Rs of all internal standard elements within acceptable control limits in the ICB? Y_✓_N___ N/A____

6b. Continuing Calibration Blank (CCB)

- Were CCBs analyzed at the correct frequency? Y_✓_N___
- Were reportable concentrations of any elements present in the CCB? Y__N_✓
- Were the %Rs of all internal standard elements within acceptable control limits in the ICB? Y_✓_N___ N/A____

7. LABORATORY BLANKS

- Was a method blank analyzed for each matrix? Y_✓_N___
- Was a method blank associated with every sample? Y_✓_N___
- Was the blank contaminated? If yes, see qualification below Y___N_✓
- Were the %Rs of all internal standard elements within acceptable control limits in the method blank? Y_✓_N___ N/A_____

8. INTERFERENCE CHECK

- Were any element failures noted in ICS_A or ICS_AB? Y____N_✓

9. LABORATORY CONTROL SAMPLES

- Was an LCS run for each matrix? Y_✓_N___
- Were recoveries within acceptable control limits? Y_✓_N____

- Were the %Rs of all internal standard elements within acceptable control limits in the LCS? Y_✓_N__

10. LABORATORY DUPLICATE PRECISION

- Was duplicate analysis performed? Y__✓__N____ (GW 202 (Total), and GW 202 (Dissolved))
- Were the %Rs of all internal standard elements within acceptable control limits in the duplicate analysis? Y_✓_N____N/A____
- Were RPDs within ± 40% for soil, ±20% for waters? Y____N_✓_ (Table D-3. Total mercury, total thallium, dissolved cadmium, and dissolved thallium.)

11a. MS RECOVERY

- Was a MS analyzed at a frequency of one per matrix per batch (20 samples)? Y_✓_N___
- Was the MS field-designated? Y_✓_N___
- If "Yes", specify client sample ID GW 202 (total), GW 202 (Dissolved)
- Were recoveries in the range 75-125%? Y____N_✓_ (Table D-3. Dissolved silver)
- Were the %Rs of all internal standard elements within acceptable control limits in the MS? Y_✓_N___N/A_____

11b. PDS RECOVERY

- Was a PDS analyzed? Y_✓_N___ (GW 202 (total), GW 202 (dissolved))
- Were PDS recoveries in the range 75-125%? Y____N_✓_ (Table D-3. Total manganese and total zinc)
- Were the %Rs of all internal standard elements within acceptable control limits in the PDS? Y_✓_N___ N/A_____

12. DILUTIONS

If the analyte concentration is sufficiently high (minimally, a factor of 100 above the IDL after dilution), an analysis of a 5x dilution should agree within ±10% of the original determination. If not a chemical or physical interference should be suspected.

- Were dilutions required Y_✓_N____
- Were diluted results within the acceptable range? Y_✓_N___

13. FIELD QC

- Was a field blank collected? Y____N_✓
- Were target analytes detected in the field blank? Y___N___N/A_✓
- Was an equipment blank collected? Y___N_✓
- Were target analytes detected in the equipment blank? Y___N____N/A_✓
- Were field duplicates collected? Y_✓_N____
- If "Yes," what was the identity of the sample/duplicate pair?GW 202 (total and dissolved) (Sample)/GW 302 (total and dissolved) (Blind duplicate)
- Were target analytes detected in the sample duplicate pair? Y_✓_N___ (Refer to Table 6 in main report for sample and duplicate RPD calculations)

14. REPORTING LIMIT VERIFICATION

- Were Reporting Limits acceptable Y_✓_N___

15. SAMPLE PAPERWORK

- Was the chain of custody legible and complete? Y_✓_N___
- Were all method requested on the CoC analyzed by the laboratory? Y_✓_N___
- Do the traffic reports, Chain of Custody forms, or case narrative indicate any problems with sample receipt, condition of samples, analytical problems or special circumstances affecting the quality of the data? Y____N_✓

OVERALL ASSESSMENT OF DATA

All available information pertaining to the data was reviewed using professional judgment to compliment the determination of the overall qualify of the data.

- Was the overall quality and usability of the data acceptable? Y_✓_N___

Table D-2. 05101315 TAL Metals CCV SUMMARY

Analytical Method: TAL Metals by Method SW6020
Analytical Laboratory: Phase Separation Science, Inc., Baltimore, MD
Project: Warner Street Wetlands SI
MDE Project No.: 66-82M
Certificate of Analysis: 05101315
Reviewer: JDA
Review Date: 12/12/2005

Matrix	Date	Time	ICV ID	File Name	Element	%R	Control Limits	Affected Samples	DV Qualifier
WATER	10/19/2005	4:02	CCV	033CCV1.D	SODIUM	88	89.5-110.5	GW 202 (DISS), GW 302 (DISS)	"L"
WATER	10/19/2005	4:02	CCV	033CCV1.D	MAGNESIUM	87	89.5-110.5	GW 202 (DISS), GW 302 (DISS)	"L"
WATER	10/19/2005	4:02	CCV	033CCV1.D	ANTIMONY	88	89.5-110.5	GW 202 (DISS), GW 302 (DISS)	"UL"
WATER	10/19/2005	5:10	CCV	046CCV1.D	MAGNESIUM	87	89.5-110.5	GW 202 (DISS), GW 302 (DISS)	"L"
WATER	10/19/2005	5:10	CCV	046CCV1.D	ANTIMONY	86	89.5-110.5	GW 202 (DISS), GW 302 (DISS)	"UL"

Table D-3. 05101315 Metals MS/PDS/Duplicate Summary Table

Analytical Method: TAL Metals by Method SW6020
Analytical Laboratory: Phase Separation Science, Inc., Baltimore, MD
Project: Warner Street Wetlands Investigation
MDE Project No.: 66-82M
Certificate of Analysis: 05101315
Reviewer: JDA
Review Date: 12/12/2005
Page 1 of 1

Sample ID	Element	Sample Conc.	Spike Concentration	MS %R	MS Limits	PDS%R	PDS Limits	Duplicate Result	Duplicate RPD	Max. Duplicate Waters RPD	LCS %R	LCS Limits	Qualifier
GW 202 (TOTAL)	MANGANESE	652.5	50.0	107	75-125	**71**	75-125	653.1	0.1	20	102	75-125	None
GW 202 (TOTAL)	MERCURY	0.1	2.0	109	75-125	98	75-125	0.0	**80.0**	20	104	75-125	None
GW 202 (TOTAL)	THALLIUM	0.5	50.0	98	75-125	95	75-125	0.3	**68.4**	20	99	75-125	None
GW 202 (TOTAL)	ZINC	1,999	50.0	92	75-125	**72**	75-125	2,018.0	0.9	20	99	75-125	None
GW 202 (DISS.)	SILVER	0.0	50.0	**75**	75-125	No PDS	75-125	0.0	0.0	20	98	75-125	None
GW 202 (DISS.)	CADMIUM	0.1	50.0	100	75-125	No PDS	75-125	0.0	**40**	20	96	75-125	None
GW 202 (DISS.)	THALLIUM	0.1	50.0	94	75-125	No PDS	75-125	0.0	**200**	200	99	75-125	None

Note. *No action is taken on MS/MSD data alone. Using informed professional judgment, the reviewer may use the MS results in conjunction with other QC criteria (PDS, duplicate, LCS) to determine the need for some qualification of data. The reviewer must use professional judgment to determine the need for qualification of positive results of non-spiked compounds*

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EPA REGION III M2-SVOC DATA REVIEW CHECKLIST

Analytical Method:	PAHs by Method SW8270C
Analytical Laboratory	Phase Separation Science, Inc., Baltimore, MD
Project:	Warner Street Wetlands Site Investigation
MDE Project No.:	66-82M
Certificate of Analysis:	05101914
Reviewer:	JDA
Review Date:	12/13/05
Page:	1 of 6

QC Measure	Manual		
	M1	M2	M3
Action Level Notification (Groundwater Samples Only)	x	X	x
Instrument Tune		X	x
Initial Calibration (ICAL) Relative Response Factors (RRF)		X	x
ICAL Percent Relative Standard Deviation (%RSD)		X	x
Continuing Calibration (CCAL) RRF		X	x
CCAL Percent Difference (%D)		X	x
Laboratory Blanks	x	X	x
Matrix Spike/Matrix Spike Duplicate (MS/MSD) Percent Recovery (%R), Relative Percent Difference (RPD)		X	x
Internal Standard Area		X	x
Field QC (Includes field blanks, equipment blank, and trip blanks, and field duplicates)	x	X	x
Sample Paperwork	x	X	x
Holding Times		X	x
Retention Times	x	X	x
Surrogate %R		X	x
Dilution Factors		X	x
Moisture Content		X	x
Mass Spectra	x		x
Chromatograms	x	X	x
Raw Data			x

1. ACTION LEVEL NOTIFICATION

Not applicable. EPA Region III Action Levels applies to water samples. Only soil samples analyzed in this Certificate of Analysis.

2. INSTRUMENT TUNE

- Is spectra generated using appropriate background subtraction techniques? Y_✓_N___
- Is m/z 198 the base peak? Y_✓_N___
- Is ion abundance criteria met? The criteria for m/z 68, 70, 441, and 443 are calculated by normalizing to specified m/z Y_✓_N___
- Were all samples analyzed with 12-hour period? Y_✓_N____

3. INITIAL CALIBRATION RELATIVE RRF

- Did the laboratory conduct an acceptable 5-point (minimum) calibration prior to sample analysis? Y_✓_N___ (6 point)
- Are all ICAL target compound (including surrogates) RRFs ≥ 0.05? Y_✓_N____

4. INITIAL CALIBRATION %RSD

- Do all target SVOCs have a %RSD ± 30.0%. Y_✓_N____

(Refer to EPA Region III Guidance for the appropriate action if ICAL review criteria are not met)

5. CONTINUING CALIBRATION RRF

- Was a CCAL standard run at the beginning of each 12-hour analysis period following the analysis of the instrument performance check and prior to the analysis of the method blank and samples? Y_✓_N___
- Were all CCAL RRFs for target PAHs and surrogates ≥ 0.05 Y_✓_N___

6. CONTINUING CALIBRATION %D

- Verify the %D between the ICAL RRF and CCAL RRF are within ± 25.0% Y_✓_N____

(Refer to EPA Region III Guidance for the appropriate action if ICAL review criteria are not met)

7. LABORATORY BLANKS

- Was a method blank analyzed for each matrix? Y ✓ N ___
- Was a method blank associated with every sample? Y ✓ N ___
- Was the blank contaminated? If yes, see worksheet? Y ___ N ✓

8. MATRIX SPIKE/MATRIX SPIKE DUPLICATE

No action is taken based on MS or replicate data alone. However, using professional judgement the data reviewer may use the MS results in conjunction with other QC criteria and determine the need for some qualification of the data. In some instances it may be determined that only the spiked samples are affected. Alternatively, the data may suggest that the laboratory is having a systematic problem with one or more analytes, thereby affecting all associated samples. One MS/MSD per 20 samples or each batch of samples, which ever is more frequent.

- Was a MS/MSD analyzed for every 20 samples? Y ✓ N ___
- Was the MS/MSD field-designated? Y ✓ N ____
- If "Yes", specify client sample SB301-06
- Did the laboratory provide their developed in-house MS/MSD recoveries? Y ✓ N ___
- Were the MS/MSD %R and the RPDs within QC limits? Y ✓ N ____

9. INTERNAL STANDARDS

- Were all internal standard area counts within -50 to +100 of the associated calibration standard? Y ✓ N ____
- Were the retention times of the internal standards within +/- 30 seconds of the retention times of the associated calibration standard? Y ✓ N ___

(Refer to EPA Region III Guidance for the appropriate action if IS review criteria are not met)

10. FIELD QC

- Was a field blank collected? Y ____ N ✓
- Were target compounds detected in the field blank? Y ___ N ____ N/A ✓
- Was an equipment blank collected? Y ___ N ✓
- Were target compounds detected in the equipment blank? Y ___ N ____ N/A ✓
- Were field duplicates collected? Y ✓ N ____

- If "Yes," what was the identity of the sample/duplicate pair? SB401-10 (Sample)/SB601-10 (Blind duplicate)
- Were target compounds detected in the sample duplicate pair? Y_✓_N____ (Refer to Table 4 in main report for sample and duplicate RPD calculations)

11. SAMPLE PAPERWORK

- Was the chain of custody legible and complete? Y_✓_N___
- Were all method requested on the CoC analyzed by the laboratory? Y_✓_N___
- Do the traffic reports, chain of custody forms, or case narrative indicate any problems with sample receipt, condition of samples, analytical problems or special circumstances affecting the quality of the data? Y_✓_N____ (Cooler received at the laboratory at 17 degrees C)

12. HOLDING TIME

- All matrices; 7 days from collection to extraction, 40 days from extraction to analysis? Y_✓_N___

13. RETENTION TIMES

- Were Relative Retention Times (RRT) within ± 0.06 RRT units of the standard?Y_✓_N__

14. SURROGATE RECOVERIES

- Were percent recoveries (%R) for surrogates within QC limits? Y_✓_N____
- Did the laboratory provide their developed in-house surrogate recoveries? Y_✓_N___
- If the percent recovery (%R) for one or more surrogates was out of QC limits, was a reanalysis performed? Y___N____N/A_✓

Data are not qualified with respect to surrogate recovery unless 2 or more surrogates within the same fraction (base/neutral or acid fraction), are out of specification. Refer to EPA Region III Guidance.

Guidance For Sample Qualification With Out Of Control Surrogates

	2 or 3 All High	2 or 3 All Low	2 or 3 Mixed High/Low	1 or more < 10%R
Detected Analytes	K	L	J	L
Non-Detected Analytes	None	UL	UJ	R

15. DILUTION FACTOR

- Did any samples require dilution? Y____N_✓
- Was a reason provided by the laboratory for the dilution? Y__N___N/A_✓
- Were sample quantitations calculated correctly? Y_✓_N____
- Were detection limits adjusted accordingly? Y____N___N/A_✓
- Did the laboratory report the initial and diluted analyses? Y___N____N/A_✓
- Were data qualified by the laboratory? Y_✓__N____ (Results less than the Practical Quantitation Limit were qualified "J").

16. MOISTURE CONTENT

- Did the laboratory determine moisture content of solid samples? Y_✓_N___
- Were the results reported on a dry weight basis? Y_✓_N___
- Did the laboratory perform calculations correctly? Y_✓_N___

17. CHROMATOGRAMS

Specific areas to review include:

1. Baseline rise, particularly in the later part of the chromatogram (due to previously injected grossly contaminated samples).
2. Degradation of peak definition and shape (clues of active site development within the GC).
3. Loss of sensitivity of the mass analyzer (loss of internal standard area counts are evidence of degrading performance and potential build-up of contamination within the mass analyzer).

- Were target compound peaks all verified and accounted for? Y_✓_N___
- Were manual integrations required? Y_✓_N____
- Were before and after integrations provided? Y___N_✓

- Was a reason provided by the analyst for the manual integration? Y___N__✓__ (By inspection of the chromatograms, manual integrations were necessary due to the interferences present in some samples.)
- Was the manual integration acceptable? Y___N____N/A_✓_ (Unable to verify)
- Was the system performance acceptable? Y_✓_N___

OVERALL ASSESSMENT OF DATA

All available information pertaining to the data was reviewed using professional judgment to compliment the determination of the overall qualify of the data.

- Was the overall quality and usability of the data acceptable? Y_✓_N___

EPA REGION III IM-1 INORG DATA REVIEW CHECKLIST

(Note, there are no EPA Region III data review guidelines published for reviewing method SW6020 by inductively coupled plasma (ICP)/mass spectroscopy (MS). The data and supporting documentation generated by the method are reviewed for conformance with IM-1 requirements.)

Analytical Method:	TAL and TCLP Metals by Method SW6020
Analytical Laboratory	Phase Separation Science, Inc., Baltimore, MD
Project:	Warner Street Wetlands Site Investigation
MDE Project No.:	66-82M
Certificate of Analysis:	05101914
Reviewer:	JDA
Review Date:	12/13/05
Page:	1 of 5

QC Measures	IM-1	IM-2
Action Level Notification (Groundwater samples only)	X	x
Holding Times	X	x
Initial Calibration (ICAL)	X	x
Initial Calibration Verification (ICV)	X	x
Continuing Calibration Verification (CCV)	X	x
Instrument Blanks	X	x
Laboratory Blank	X	x
Inductively Coupled Plasma (ICP) Interference Check	X	x
Laboratory Control Sample (LCS)	X	x
Laboratory Duplicate Precision	X	x
Matrix Spike (MS)/Post Digestion Spike (PDS) Recoveries	X	x
ICP Serial Dilution	X	x
Field (QC) (Equipment blanks, duplicates)	X	x
Reporting Limit Verification	X	x
Sample Paperwork	X	x
Raw Data		x

1. ACTION LEVEL NOTIFICATION

Samples listed below exceeded the EPA Region III Action Level for lead of 500 mg/kg.

Sample ID	Lead Concentration (mg/kg)
SB201-06	610
SB401-10	600
SB102-06	2,700
SB303-10	890
SB601-10	650
SB103-03	910
SB204-00	700

2. HOLDING TIMES

- Were aqueous samples preserved with HNO_3 to a pH <2? Y____N___N/A_✓
- Were samples analyzed within 6 months? Y_✓_N___

3. INITIAL CALIBRATION

- Were initial calibrations performed at the correct frequency? Y_✓_N___
- Was interference correction applied? Y_✓_N___
- Was an acceptable, 4-point calibration performed for each element? Y_✓_N___
- Was an internal standard identified for each element in the calibration? Y_✓_N___
- Was the m/z ratio correctly identified for each element in the calibration? Y_✓_N___
- Was the correlation coefficient acceptable for each element? (>0.99)? Y_✓_N___

4. INITIAL CALIBRATION VERIFICATION (ICV)

- Were in-house %recovery limits available? Y_✓_N___
- Were %Rs within control limits? Y____N_✓_ (Table D-4)
- Were %RSDs for each element acceptable? Y_✓_N___
- Were the %Rs of all internal standard elements within acceptable control limits in the ICV? Y_✓_N___N/A____

5. CONTINUING CALIBRATION VERIFICATION

- Were CCVs analyzed at the correct frequency? Y_✓_N___
- Were CCV %Rs within acceptable control limits? Y_✓_N____
- Were the %Rs of all internal standard elements within acceptable control limits in the CCV? Y_✓_N___N/A___

6. INSTRUMENT BLANKS

6a. Initial Calibration Blank (ICB)

- Were ICBs analyzed at the correct frequency? Y_✓_N___
- Were reportable concentrations of any elements present in the ICB? Y__N_✓
- Were the %Rs of all internal standard elements within acceptable control limits in the ICB? Y_✓_N___ N/A____

6b. Continuing Calibration Blank (CCB)

- Were CCBs analyzed at the correct frequency? Y_✓_N___
- Were reportable concentrations of any elements present in the CCB? Y__N_✓
- Were the %Rs of all internal standard elements within acceptable control limits in the ICB? Y_✓_N___ N/A____

7. LABORATORY BLANKS

- Was a method blank analyzed for each matrix? Y_✓_N___
- Was a method blank associated with every sample? Y_✓_N___
- Was the blank contaminated? If yes, see qualification below Y___N_✓
- Were the %Rs of all internal standard elements within acceptable control limits in the method blank? Y_✓_N___ N/A_____

8. INTERFERENCE CHECK

- Were any element failures noted in ICS_A or ICS_AB? Y_✓_N____ (Table D-5)

9. LABORATORY CONTROL SAMPLES

- Was an LCS run for each matrix? Y_✓_N___
- Were recoveries within acceptable control limits? Y_✓_N____

- Were the %Rs of all internal standard elements within acceptable control limits in the LCS? Y_✓_N__

10. LABORATORY DUPLICATE PRECISION

- Was duplicate analysis performed? Y_✓_N____ (SB202-00)
- Were the %Rs of all internal standard elements within acceptable control limits in the duplicate analysis? Y_✓_N____N/A____
- Were RPDs within ± 40% for soil, ±20% for waters? Y_✓_N____

11a. MS RECOVERY

- Was a MS analyzed at a frequency of one per matrix per batch (20 samples)? Y_✓_N___
- Was the MS field-designated? Y_✓_N___
- If "Yes", specify client sample ID SB202-00
- Were recoveries in the range 75-125%? Y___N_✓_ (Table D-6)
- Were the %Rs of all internal standard elements within acceptable control limits in the MS? Y_✓_N___N/A_____

11b. PDS RECOVERY

- Was a PDS analyzed? Y_✓_N___ (SB202-00)
- Were PDS recoveries in the range 75-125%? Y_✓_N____
- Were the %Rs of all internal standard elements within acceptable control limits in the PDS? Y_✓_N___ N/A_____

12. DILUTIONS

If the analyte concentration is sufficiently high (minimally, a factor of 100 above the IDL after dilution), an analysis of a 5x dilution should agree within ±10% of the original determination. If not a chemical or physical interference should be suspected.

- Were dilutions required Y_✓_N____
- Were diluted results within the acceptable range? Y_✓_N___

13. FIELD QC

- Was a field blank collected? Y____N_✓
- Were target analytes detected in the field blank? Y___N___N/A_✓
- Was an equipment blank collected? Y___N_✓

- Were target analytes detected in the equipment blank? Y___N____N/A_✓
- Were field duplicates collected? Y_✓_N____
- If "Yes," what was the identity of the sample/duplicate pair? SB401-10 (Sample)/SB601-10 (Blind duplicate)
- Were target compounds detected in the sample duplicate pair? Y_✓__N___ (Refer to Table 6 in main report for sample and duplicate RPD calculations)

14. REPORTING LIMIT VERIFICATION

- Were Reporting Limits acceptable Y_✓_N___

15. SAMPLE PAPERWORK

- Was the chain of custody legible and complete? Y_✓_N___
- Were all method requested on the CoC analyzed by the laboratory? Y_✓_N___
- Do the traffic reports, Chain of Custody forms, or case narrative indicate any problems with sample receipt, condition of samples, analytical problems or special circumstances affecting the quality of the data? Y_✓_N___ (Samples were received at the laboratory at 17 degrees centigrade).

OVERALL ASSESSMENT OF DATA

All available information pertaining to the data was reviewed using professional judgment to compliment the determination of the overall qualify of the data.

- Was the overall quality and usability of the data acceptable? Y_✓_N___

Table D-4. 05101914 TAL Metals ICV SUMMARY

Analytical Method: TAL Metals by Method SW6020
Analytical Laboratory: Phase Separation Science, Inc., Baltimore, MD
Project: Warner Street Wetlands SI
MDE Project No.: 66-82M
Certificate of Analysis: 05101914
Reviewer: JDA
Review Date: 12/13/2005

Matrix	Date	Time	ICV ID	File Name	Element	%R	Control Limits	Affected Samples	DV Qualifier
SOIL	10/26/2005	14:20	ICV-50 PPB ; 2 PPB HG	007ICV1.D	COPPER	113	89.5-110.5	Batch Soils	"K" (Detects only)

Table D-5. 05101914 TAL Metals Interference Check Sample Summary

Analytical Method: TAL Metals by Method SW6020
Analytical Laboratory: Phase Separation Science, Inc., Baltimore, MD
Project: Warner Street Wetlands SI
MDE Project No.: 66-82M
Certificate of Analysis: 05101914
Reviewer: JDA
Review Date: 12/13/2005

Matrix	Date	Time	ICV ID	File Name	Element	%R	Control Limits	Affected Samples	DV Qualifier
SOIL	10/26/2005	14:20	ICSB STD	014ICSB.D	COBALT	121	80-120	Batch Soils	"J" (Detects only)
SOIL	10/26/2005	14:20	ICSB STD	014ICSB.D	MANGANESE	121	80-120	Batch Soils	"J" (Detects only)
SOIL	10/26/2005	14:20	ICSB STD	013ICSB.D	COPPER	122	80-120	Batch Soils	See Note 1

Notes:

1. Detected copper results have previously been qualified "K" (biased high) due to high recovery in the Initial Calibration Verification. Further qualification is not required.

Table D-6. 05101914 Metals MS/PDS/Duplicate Summary Table

Analytical Method: TAL Metals by Method SW6020
Analytical Laboratory: Phase Separation Science, Inc., Baltimore, MD
Project: Warner Street Wetlands Site Investigation
MDE Project No.: 66-82M
Certificate of Analysis: 05101914
Reviewer: JDA
Review Date: 12/13/2005

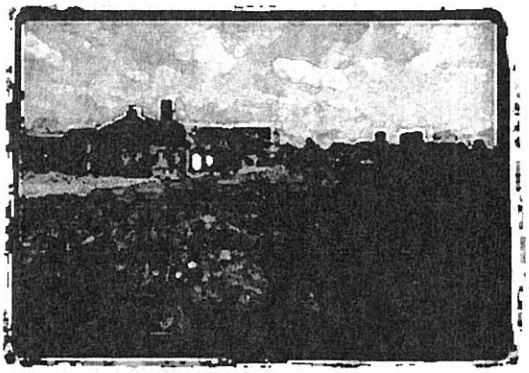
Sample ID	Element	Sample Conc.	Spike Concentration	MS %R	MS Limits	PDS %R	PDS Limits	Duplicate Result	Duplicate RPD	Max. Duplicate Soils RPD	LCS %R	LCS Limits	Qualifier
SB202-00	MAGNESIUM	4504	500.0	**284**	75-125	125	75-125	5661	22.8	40	103	75-125	None
SB202-00	POTASSIUM	1524	500.0	**163**	75-125	105	75-125	1521	0.2	40	100	75-125	None
SB202-00	SILVER	1.1	50.0	**25**	75-125	94	75-125	1.0	6.6	40	87	75-125	UR

Note. *No action is taken on MS/MSD data alone. Using informed professional judgment, the reviewer may use the MS results in conjunction with other QC criteria (PDS, duplicate, LCS) to determine the need for some qualification of data. The reviewer must use professional judgment to determine the need for qualification of positive results of non-spiked compounds*

DRAFT

MDE-ERRP
BROWNFIELDS

PHASE I ENVIRONMENTAL SITE ASSESSMENT
AND
SAMPLING AND ANALYSIS PLAN
PROPOSED WARNER STREET WETLANDS AREA
LOTS 5A, 6, 7, and 8/9



September 27, 2005

PREPARED BY: **MARYLAND DEPARTMENT OF THE ENVIRONMENT**

Environmental Restoration and Redevelopment Program
1800 Washington Blvd., Suite 625
Baltimore, MD 21230

Prepared for: Baltimore Development Corporation
100 N. Holliday Street
Baltimore, MD 21202

And:

U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard, Suite 625 • Baltimore MD 21230-1719
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Robert L. Ehrlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Secretary

Jonas A. Jacobson
Deputy Secretary

February 3, 2005

Ms. Lori Baker
Brownfields and Site Assessment Section (3HS34)
U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Re: Proposed Warner Street Wetlands Area, Lots 5A, 6, 7 and 8/9
Baltimore, Maryland

Dear Ms. Baker:

Enclosed is the draft Brownfields Phase I Environmental Site Assessment and Sample and Analysis Plan for the subject property.

If you should have any questions, please contact me at (410) 537-3440.

Sincerely,

Robert Wallace, Geologist
Federal Superfund Division

cc: Mr. Horacio Tablada
Mr. James Carroll
Mr. Kim Lemaster
Ms. Patti Davis

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APPENDICES

APPENDIX A SITE PHOTOGRAPHS
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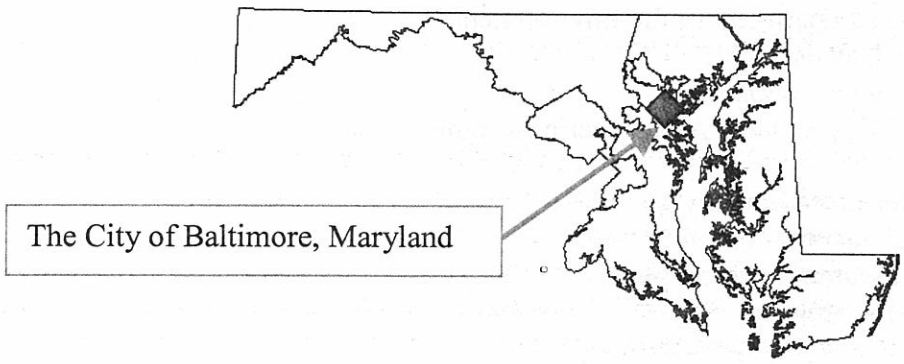
ACRONYM LIST

ASTM	American Society of Testing and Materials
BGE	Baltimore Gas and Electric
BDC	Baltimore Development Company
bgs	below ground surface
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
COPCs	chemicals of potential concern
DPT	direct push technology
ERRP	Environmental Restoration and Redevelopment Program
ERM	Effects Range Medium
°F	degrees Fahrenheit
GIS	geographic information system
HSA	hollow stem auger
ICP/MS	inductively coupled plasma/mass spectrometer
MDE	Maryland Department of the Environment
MDL	method detection limit
MW202	monitoring well 202
NOAA	National Oceanic and Atmospheric Administration
PCBs	polychlorinated biphenyls
PQL	practical quantitation limit
QAPP	quality assurance project plan
RFP	request for proposal
SAP	sampling and analysis plan
SB202	soil boring 202
SOPs	standard operating procedures
SVOCs	semi-volatile organic compounds
TCLP	toxicity characteristic leaching procedure
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds
VCP	Voluntary Cleanup Program
XRF	X-ray fluorescence

1.0 PHASE I ENVIRONMENTAL SITE ASSESSMENT

1.1 Phase I - Executive Summary

The Maryland Department of the Environment (MDE) has prepared a Phase I[1] Environmental Site Assessment report of the Warner Street Business Properties located in the 1400 to 1600 blocks of Warner Street in Baltimore City, Maryland (Subject Property). MDE has prepared this report as part of a Brownfields Site-Specific Assessment of the Subject Property. The assessment is part of the Maryland Brownfields Assessment Initiative and funded through the Subtitle C State Response Program Cooperative Agreement. MDE is conducting the assessment at the request of the Baltimore Development Corporation (BDC) in preparation for future redevelopment of the area. According to the BDC and available records, there have been no previous Phased investigations conducted on these properties. However, several other adjacent properties including the Warner Street Wetland Properties were the subject of MDE investigations in October 2000 and March 2002. Background information for the Warner Street Wetland Properties is also presented in this Phase I Site-Specific Assessment of the Warner Street Area.

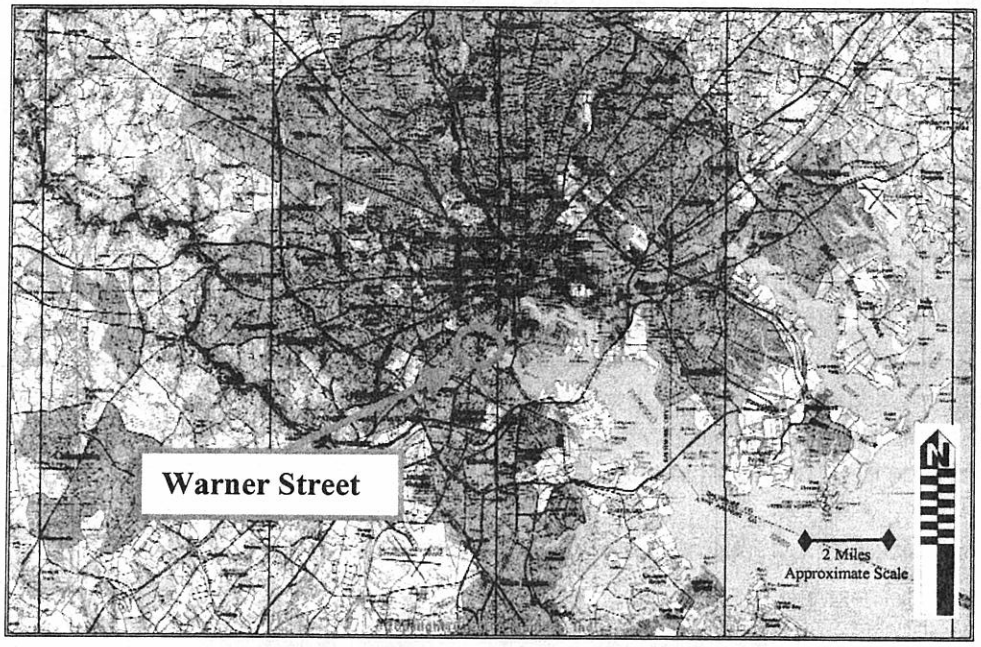


Warner Street is located in the southern portion of the City of Baltimore, Maryland on the Middle Branch of the Patapsco River (Figures 1.1 and 1.2). The business property consists of 13 lots on three blocks and measures a total of 15.52 acres. The wetland properties consist of four lots on three blocks that measure approximately 5.3 acres. The parcels within these two sets of properties will be collectively referred to as either "the business properties" or as "the wetland properties" throughout this report. Historic records indicate varied industrial uses of the business and wetland properties dating back through the mid-19th century. Sanborn Fire Insurance maps

[1] *ASTM (American Society for Testing and materials). June 1994. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, ASTM Standard E 1527-94, Philadelphia, PA.*

from 1890 through 1953 detail a distillery, brass foundry, chemical manufacturer, varnish and paint manufacturing plant and a commercial box printing plant on the business properties of interest in the Warner Street corridor.

Figure 1.1 - Location of Warner Street Area in Baltimore Metro Area.



Site reconnaissance was performed on February 11, 2004 for the business properties and again on November 15, 2004 for the wetlands properties to document site conditions. Nine of 17 parcels under consideration are occupied at this time. The remaining eight parcels are either unoccupied or undeveloped. The four unoccupied parcels are located in the rectangle defined by Warner, Oler, Shell (formerly S. Eutaw Street), and Worcester Streets. These parcels show signs of distress with evidence of vandalism to both the buildings and public spaces. Graffiti covers various walls, windows are broken, doors have been breached and fires have been set on building grounds and in the middle of the street. The remaining four parcels (Lots 5A, 6, 7, and 8/9) are bounded by the Middle Branch of the Patapsco River to the southeast, the Bayard Street Dock to the southwest, Shell Street (S. Eutaw Street) to the northwest, and the Alluvion Street Dock to the northeast. These parcels are undeveloped at this time and are under consideration for the creation of a new wetlands area.

The Warner Street corridor is partially abandoned; the area exhibits signs of stress and is a good candidate for revitalization and rehabilitation.

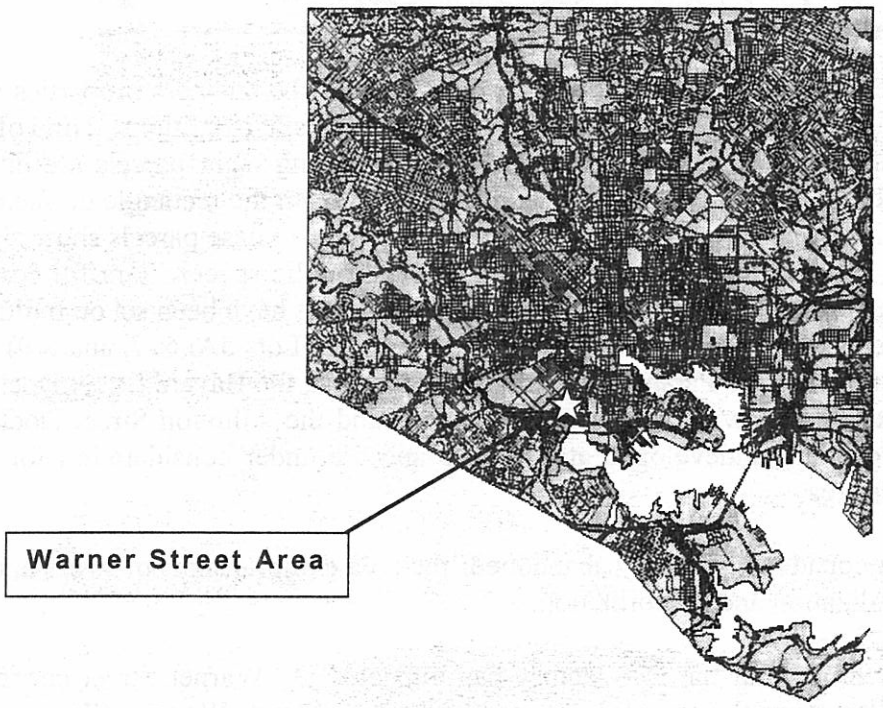
Industrial activity throughout the last century has impacted the Warner Street corridor. Of particular concern is the area in the rectangle formed by Warner Street, Wooster (Worcester) Street, Oler (Dock) Street, and Shell (S. Eutaw) Street. This parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which used heavy metal salts and oxides and volatile organic materials in their process and operations.

Another area of concern is the 1600 block of Warner Street, which was once the site of a historic brass foundry. Contaminants of concern in the foundry are volatile organic compounds, heavy metals, arsenic, acids, and metallic salts and oxides.

The Maryland Chemical site in the 1500 block of Russell Street presents several potential areas of concern. This property was at one time the site of American Cyanamid, an industrial manufacturer of pesticides and agricultural chemicals. Maryland Chemical itself presents a number of concerns stemming from the storage and sale of industrial chemicals. Both aboveground and underground tank storage of chemicals are documented. The facility handles a variety of listed materials ranging in size from small, consumer retail-sized to 55-gallon drums, tanks and carboys. The Maryland Chemical site is currently the subject of a Phase II Brownfields Site-Specific Assessment.

A Sampling and Analysis Plan for the Phase II Brownfields Site-Specific Assessment of the Proposed Warner Street Wetlands area is presented in Section 2 of this document. Additional Phase II Brownfields Site-Specific Assessments are recommended for several of the other properties discussed in this Phase I Environmental Assessment of the Warner Street area. These assessments will help determine the best practicable remediation and potential use for the subject properties before development can proceed.

Figure 1.2 - Location of Warner Street Area in Baltimore City.



1.2 Objectives and Limitations

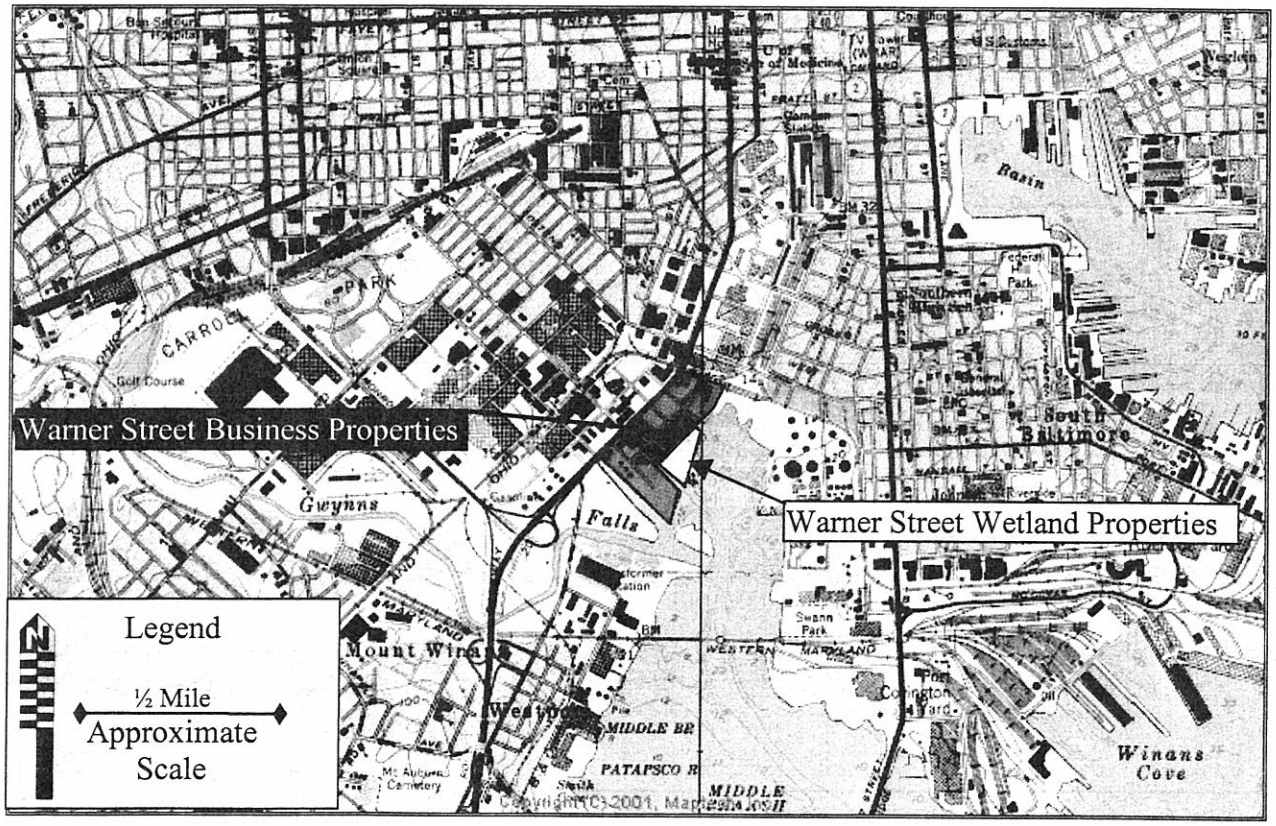
The objective of this study is to help BDC define the redevelopment potential of the Warner Street Business Center and Wetland properties by identifying potential environmental

concerns in the area. This investigation includes research into the history of the industrial use of the area, property ownership, and known potential environmental contamination contributors. This report builds the foundation upon which Phase II Brownfields Site-Specific Assessments of the areas will be completed.

1.3 Site Overview

The Warner Street Business and Wetland Areas are located in the midst of roughly 500 acres of industrial land at the southern gateway to the City and downtown Baltimore. It is believed that the Warner Street corridor overlays fill materials brought to the shores of the Middle Branch after the Great Baltimore Fire of 1904 (see photographs in Appendix A). The archives of the Maryland Fire Museum indicate that remnants of the Great Baltimore Fire of 1904 were encountered as far as the present-day Market Place. The artifacts encountered included "charred wood, wheel barrel parts, containers…tools that were once part of the harbor." In addition to these artifacts, soil borings located along the eastern portion of Warner Street corridor encountered construction debris and heavily stained fill materials (MDE 2002). Figure 1.3 sets the location of the Warner Street Area in this context. At present, this industrial area has significant quantities of under-utilized land and a limited development interest.

FIGURE 1.3
Warner Street Area



Russell Street bounds the Warner Street Business Center area on the West, Ostend Street on the North, Hamburg Street Viaduct on the South and the Middle Branch of the Patapsco River on the East. The 15.52 acres of property within the scope of this investigation incorporates 17 parcels of land currently owned by five entities (Figures 1.4 and 1.5).

Tenants occupy the buildings on six of the 17 parcels. Maryland Chemical Company occupies the three Russell Street parcels. Signs on the building at 1501 Warner Street indicate that it is occupied by Bayfair Warehouses. Baltimore Cycle Salvage occupies 1629 Warner Street. Second Chance, an architectural resale business, occupies 1633 and 1645 Warner Street. Signage on 2102 Oler Street indicated that it is occupied by Baltimore Renovations, Inc. At the time of the site visit, only Maryland Chemical and Second Chance were open and occupied.

Figures 1.3 and 1.4 show the locations of the subject parcels on the City tax maps (Baltimore Department of Public Works, date unknown). Five corporate entities control these 13 parcels as follows:

- The Mayor and City Council of Baltimore control 2110 and 2119 Haines Street; and Lots 5A, 6, 7, and 8/9 of Block 844;
- Warner Street Inc, is the owner of record for 2102 Oler Street, 2104 Worcester Street, 1501, 1601, 1629 and 1633 Warner Street;
- Pheasant Warner Co. LLC, owns 1501, 1525, and 1551 Russell Street;
- Six GS, LLC, owns 1411 Warner Street; and
- Potomac Investments owns 1645 Warner Street.

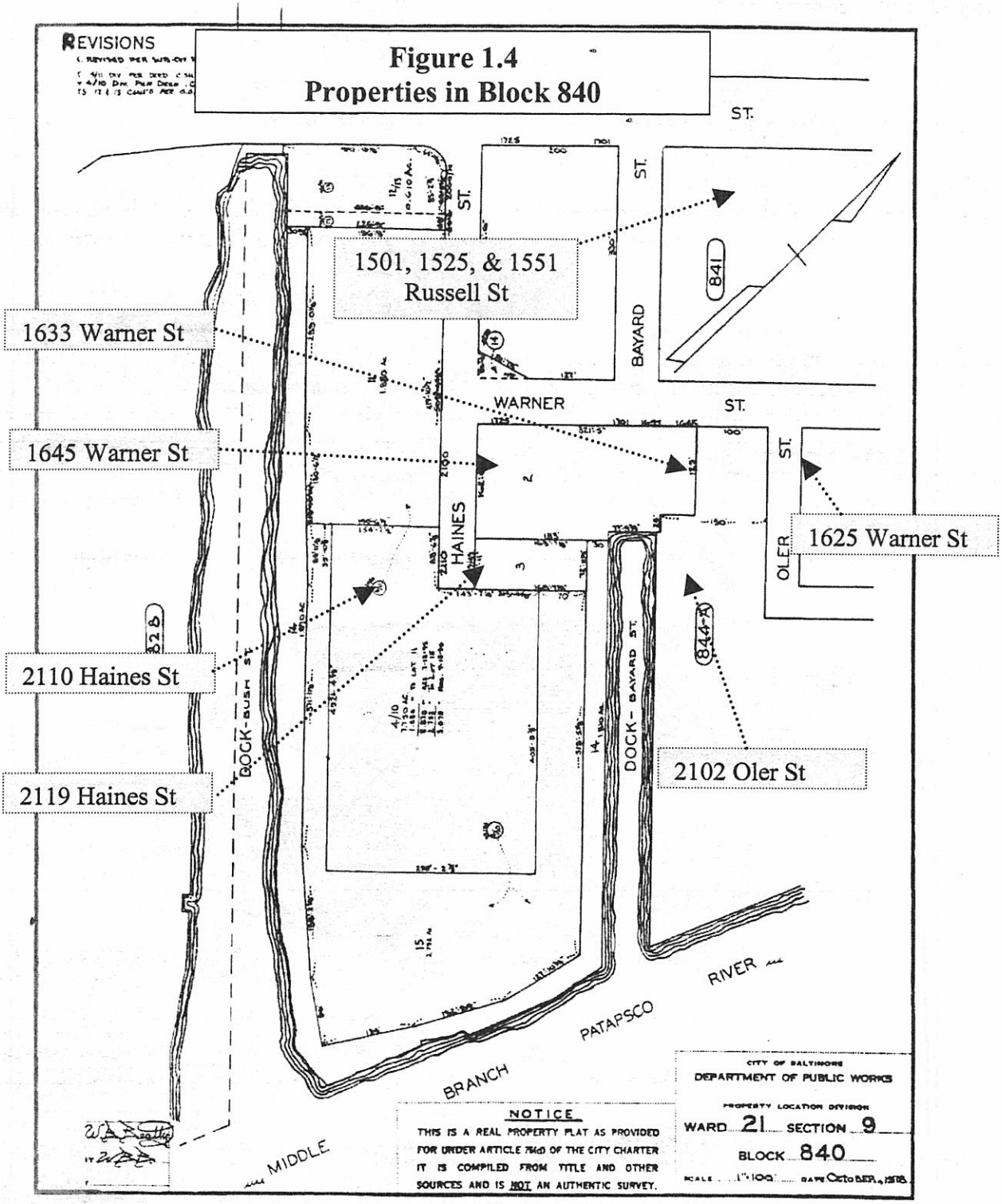


Figure 1.4
Properties in Block 840
1501, 1525, & 1551 Russell St
1633 Warner St
1645 Warner St
2110 Haines St
2119 Haines St
1625 Warner St
2102 Oler St
WARNER ST.
HAINES
OLER
BAYARD
DOCK - BUSH ST.
DOCK - BAYARD ST.
PATAPSCO
RIVER
BRANCH
MIDDLE
841
844-A
NOTICE
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CITY OF BALTIMORE
DEPARTMENT OF PUBLIC WORKS
PROPERTY LOCATION DIVISION
WARD 21 SECTION 9
BLOCK 840

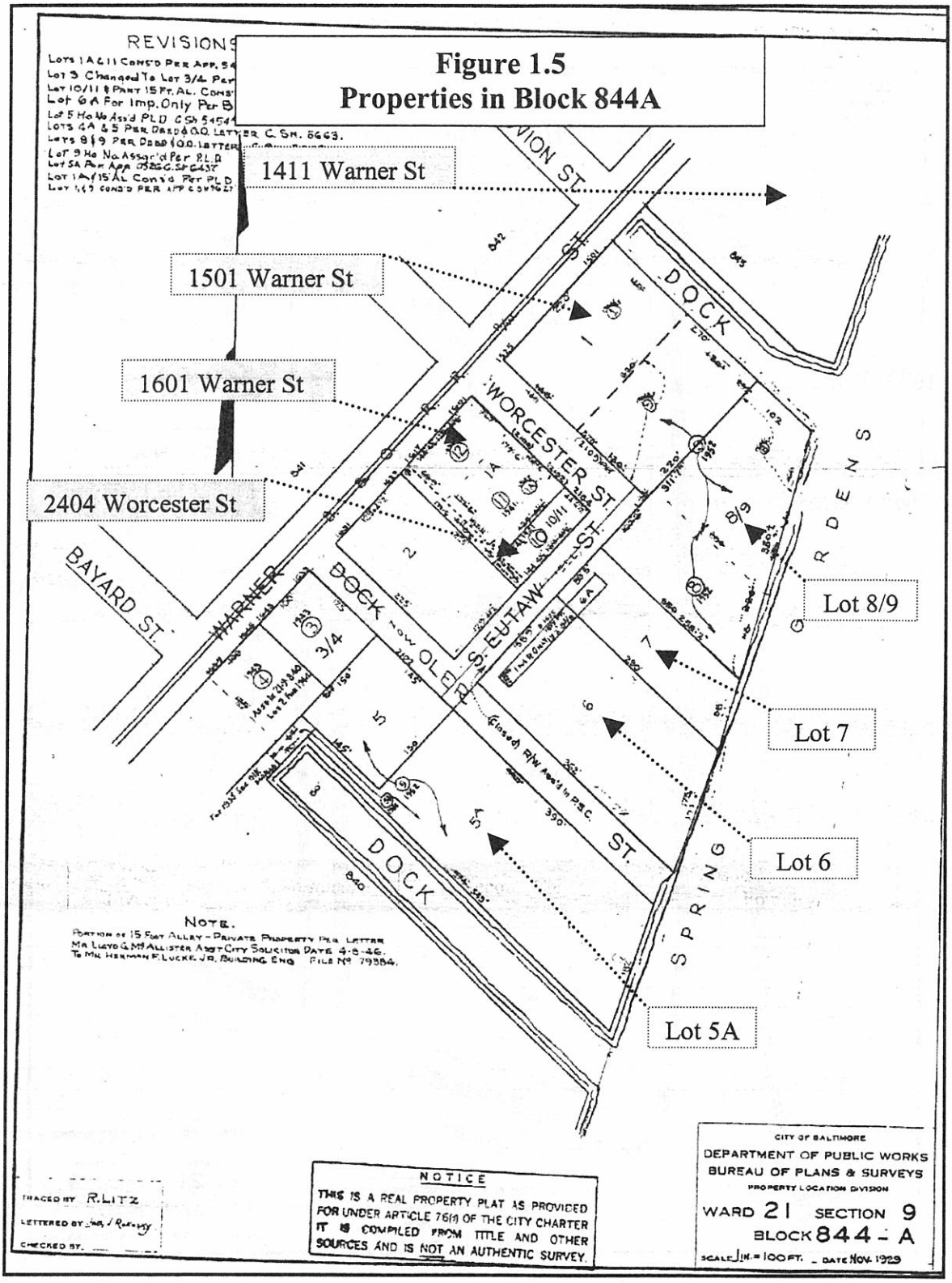
Figure 1.5
Properties in Block 844A
1411 Warner St
1501 Warner St
1601 Warner St
2404 Worcester St
Lot 8/9
Lot 7
Lot 6
Lot 5A
WORCESTER ST.
DOCK
BAYARD ST.
WARNER
DOCK
OLD
EUTAW
ST.
SPRING
GARDENS
NOTE.
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DEPARTMENT OF PUBLIC WORKS
BUREAU OF PLANS & SURVEYS
PROPERTY LOCATION DIVISION
WARD 21 SECTION 9
BLOCK 844 - A
SCALE 1 IN. = 100 FT. DATE NOV. 1929
TRACED BY R.LITZ

1.4 Site Background

Dating back to at least 1890, the area has been primarily industrial in nature. Sanborn Fire Insurance Maps of the era detail wharves, an icehouse, coal yards, a chemical manufacturer, glass manufacturing plants, a brass foundry, a distillery and a malt house scattered along the Warner Street corridor. In the more recent past, a number of small businesses, storage companies, industrial-printing concerns, and a wholesale chemical distribution company have operated in the area (Table 1.1). Other sections of the Warner Street corridor consist of vacant land parcels currently covered with vegetation ranging from grass to trees.

Table 1.1 – Property Ownership

Property Address	Current Owner	Last Owner	Current Occupant	1890-1901
2110 Haines St.	City of Baltimore	AT&T	Vacant	L. T. Ranstead Wharf
2119 Haines St.	City of Baltimore	AT&T	Unknown Business	C. R. Ranstead Wharf
1501 Russell St.	Pheasant Warner	Fred J. Close	Maryland Chemical	American Cyanamid
1525 Russell St.				
1551 Russell St.				
1411 Warner St.	Six GS LLC	Fred J. Close	Vacant/Lot J	Baltimore Glass Works
2102 Oler St.	Warner Street Inc.	*No Record*	Baltimore Renovations Inc.	Gibson & Kirk Foundary
2104 Worcester St.			Vacant	Abandonded Building
1501 Warner St.			Bayfair Warehouse	Warehouse
1601 Warner St.			Vacant	J.B. MacNeal Varnish & Color
1629 Warner St.			Baltimore Cycle Salvage	Baltimore Cedar Co.
1633 Warner St.			Second Chance	Gibson & Kirk Brass Foundry
1645 Warner St.	Potomac Investments	*No Record*	Second Chance	Gibson & Kirk Brass Foundry
Block 844A Lot 5A	City of Baltimore	*No Record*	Vacant Lot	Evans Marble Company
Block 844A Lot 6	City of Baltimore	*No Record*	Vacant Lot	Consumer Wood & Coal Company
Block 844A Lot 7	City of Baltimore	*No Record*	Vacant Lot	Consumer Wood & Coal Company
Block 844A Lots 8/9	City of Baltimore	*No Record*	Vacant Lot	Consumer Wood & Coal Company

Sanborn Fire Insurance Maps

The Sanborn Map Company kept detailed records on the state of industrial buildings in many metropolitan areas from 1867 through 1970. Digitized copies of the maps are available through ProQuest UMI. Maps for the years between 1890 and 1953 are available for the Warner Street Area. Copies of the Sanborn Maps for the Warner Street Area are found in Appendix B of

this document. Figures and accompanying key tables detail the 1890, 1915 and 1953 era industries and businesses located on the Warner Street parcels.

Haines Street

The Ransteads wharves and the Biemiller Coal and Wood Wharf and Ice House (later the American Ice Station) occupied the 2110 and 2119 Haines Street properties from the 1890s through 1953.

Warner Street

The Gibson and Kirk Foundry occupied the 1633 through 1645 Warner Street properties from a period after 1915 through 1953.

In the 1890s the property bounded by Wooster (Worcester), Warner, Shell (S. Eutaw), and Oler (Dock) Streets housed the C.F. Ranstead Baltimore Cedar Co. From 1902 through 1953 the J. B. Macneal and Company Varnish and Color Works operated out of buildings on this property. In 1953 this property housed both J. B. Macneal and Gordon Carton. Macneal occupied the northwestern quadrant and Gordon the southeastern.

In 1901, a marble storage facility owned by the Evans Marble Company occupied the area bounded by the Middle Fork Patapsco River, Bayard Dock and Shell (S. Eutaw) and Oler (Dock) Streets (Lot 5). This storage area was not depicted in Sanborn Maps from 1890 or 1915. No activities for this area were noted in the 1953 Sanborn Map.

Sometime after 1890 and before 1915, coal bins owned by the Consumer Wood and Coal Company occupied the area bounded by the Middle Fork Patapsco River to the east, Oler (Dock) Street to the south, Shell (S. Eutaw) Street to the west and an extended southeastern line formed by the continuation of the northeastern side of Worcester Street (Lots 6, 7, and 8). No activities for this area were noted in the 1953 Sanborn Map.

The property northeast of the Alluvion Street Slip housed Baker Brothers Glass Company and the Marr Malting Company from 1890 through 1915. The map from 1953 has the Holtite Rubber Cement Mill occupying the property.

1.5 Environmental Setting

1.5.1 Geology

Baltimore City lies on the Fall Line, which is an area of abrupt elevation change between the Coastal Plain and Piedmont Physiographic Provinces. The Coastal Plain consists of a series of southeasterly dipping layers of relatively unconsolidated sand and clay with lesser amounts of gravel superimposed on the eastward continuation of the crystalline rocks of the Piedmont Plateau.

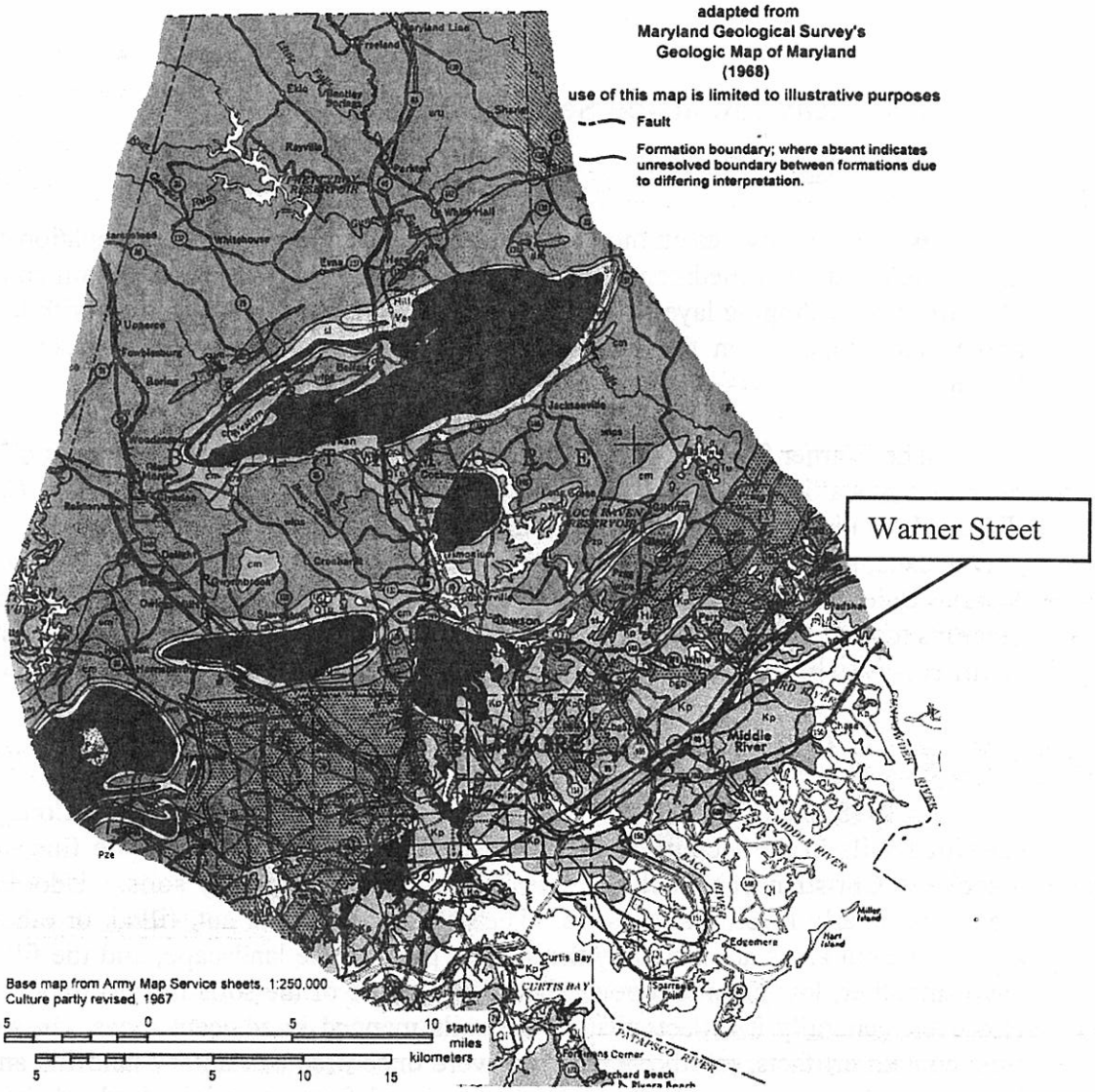
The Warner Street site lies near the fall line where the Coastal Plain is only a thin veneer over the crystalline bedrock. The generalized Geologic Map of Baltimore City and County (Figure 1.5.1) indicates that the site rests on the Quaternary Lowland Deposits, which consist of gravel, sand, silt and clay with cobbles and boulders near the base (Maryland Geological Survey, 1968). Below the lowland deposits is the Potomac Group, of which the Patuxent Formation outcrops just north of the site along the Fall Line. The Patuxent Formation consists of irregularly stratified, cross-bedded and linticular sands and gravels with silt and clay beds occurring locally.

1.5.2 Soils

In 1998, the United States Department of Agriculture (USDA), Soil Conservation Service classified soils in the vicinity of the Warner Street site as the Sunnyside fine sandy loams and associated Christiana and Urban Land Association (Udorthent) soils. Udorthents consist of manmade, nearly level to steep soils. Theses soils consist of cut, filled, or otherwise disturbed areas. The cut areas are generally the steeper parts of the landscape, and the fill areas generally have smoother, less sloping topography. The texture of the soils in this association is variable. However, generally it reflects that of the soils mapped in adjacent areas. In some areas these soils contain artifacts; in other areas they were once used as sanitary landfills and are underlain by refuse. In some areas these soils were created from materials dredged from the Patapsco River. This association is defined as consisting of, "mostly miscellaneous artificial fill." The area is further characterized as being totally covered with roads, buildings, or other structures.

Figure 1.6

Generalized Geologic Map.



Kp

Potomac Group - Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.

Raritan and Patapsco Formations - Gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels; thickness 0 to 400 feet.

Arundel Clay - Dark gray and maroon lignitic clays; abundant siderite concretions; present only in Baltimore-Washington area; thickness 0 to 100 feet.

Patuxent Formation - White or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels; silts and clays subordinate, predominately pale gray; thickness 0 to 250 feet.

Ql

Lowland Deposits - Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet.

The majority of surface soils in the Warner Street corridor are of the *Urban Land Complex* (44UC). These Urban Lands are characterized as being covered by impervious surfaces. A small portion of the area is composed of similarly defined *Urban Land–Udorthents Complex, occasionally flooded* soils (43U). These udorthents are noted to consist of a thin layer of sandy loam mixed with glass fragments overlaying a stratified series of sandy loam, silt loam, loam or gravelly loam down to about 65 inches below grade. The USDA Report titled Soil Survey of the City of Baltimore, Maryland (USDA, 1998) notes that, "*Examination and identification of soils or soil like materials in this unit is impractical. Careful onsite investigation is needed to determine the potential and limitations for any proposed use.*"

1.5.3 Weather

Baltimore City, Maryland lies about 50 miles east of Appalachian Mountains and 12 miles west of the Chesapeake Bay. The Warner Street area is less than 10 feet above mean sea level in a region of relatively flat urban terrain. The average annual rainfall is on the order of 43 inches per year. Average annual temperature is about 60 degrees Fahrenheit (°F). Baltimore's summers are warm and humid and its winters are relatively mild. The coldest weather generally occurs in late December through early February, with an average daily maximum temperature of 45°F and an average daily minimum of 28°F. The warmest weather occurs in late July and early August when daily temperatures range from 70 to 90 °F. There are no well-defined wet and dry seasons. Snowfall averages on the order of 17 inches per Winter season. During the Summer months, showers are frequent and thunderstorms may occur one out of five days. Significant temperature differences within the Baltimore metropolitan area are not unusual. Temperatures are commonly warmer in the Baltimore Metropolitan Area, due to the heat island effect of the city in the Summer and the moderating influence of the Chesapeake Bay in the Winter (University of Maryland, 2004).

1.5.4 Hydrogeologic Conditions

Groundwater recharge in this area occurs mainly through infiltration of precipitation in the exposed areas in the vicinity of the site. Due to the slope of the immediate area and the proximity to the Patapsco River, area groundwater discharges to the river. Generalized groundwater flow in the area is to the south southeast towards the Chesapeake Bay. The elevation of the site ranges from approximately 20' above Mean Sea Level to 100' above Mean Sea Level. It is expected that groundwater will be encountered at an elevation above Mean Sea Level.

The Patuxent Formation, which is recharged in the Baltimore City Area, is a multi-aquifer unit and is one of the most productive water bearing formations in Maryland. However, over pumping and heavy industrialization in Baltimore have caused salt-water intrusion and chemical contamination from past industrial practices. As a result, groundwater in the vicinity of the site is not considered potable (Maryland Department of Natural Resources, 1987).

The site is located on the Middle Branch of the Patapsco River, a surface water body that discharges into the Chesapeake Bay (Figure 1.3). Several other surface water bodies exist within

a two-mile radius of the site. These include Gwynns Falls (approximately 0.5-mile to the southwest) and the Baltimore Inner Harbor (approximately 0.5 mile to the northeast).

According to the USDA, *"The Department of Public Works, Baltimore City, provides water for the City of Baltimore from three sources: the Gunpowder Falls, the North Branch of the Patapsco River, and the Susquehanna River."* (USDA, 1998). Water collected from these sources is re-routed toward three reservoirs (Liberty, Loch Raven and Prettyboy) and treated at the Montebello and Ashburton Filtration Plants prior to distribution to the local population.

Virtually all of the residents around Baltimore City receive water from municipal supplies. These consist of ten surface water reservoirs in the vicinity of Baltimore City, the nearest of which is approximately ten miles north of the site, and a series of municipal well systems located in Anne Arundel County. No residential wells exist within a 0.5-mile radius of the site. However, there are numerous monitoring wells within one mile of the site and four domestic wells within a two-mile radius of the site (MDE Well Database, 2004).

In the City of Baltimore, storm water drainage occurs through an extensive network of underground conduits; site-specific drainage flows to these storm drains and directly to the Middle Branch of the Patapsco River via overland flow.

1.6 Site Reconnaissance

On February 11, 2004 a site reconnaissance was performed to document current conditions in the Warner Street Business Area. Nine of the 13 parcels under consideration are occupied at this time. The four unoccupied parcels are located in the rectangle defined by Warner, Oler, Shell, and Worcester Streets. These parcels show signs of distress with evidence of vandalism to both the buildings and public spaces. Graffiti covers certain walls, windows are broken, doors have been breached and fires have been set on building grounds and in the middle of the street.

On November 15, 2004 an additional site reconnaissance was performed to photo-document current conditions in the Warner Street Wetland Area (Appendix A). All four of the lots were vacant and undeveloped; however, a makeshift shelter for homeless people was also noted on Lot 6. The area has received nuisance dumping as evidenced by household debris found on the lots. At the time of the site reconnaissance, active construction of footbridges for the Gwynns Falls Trail crossing over the Bayard Street and Alluvion Street Docks was in progress.

1.7 Environmental Regulatory Inquiries

MDE researched the databases listed below (Table 1.2) to identify potential on-site and off-site sources of contamination. Research was completed for facilities located within the ASTM guidance radius of one mile. The ASTM radius refers to the minimum search distance around the area of interest. This search was conducted to assess the attribution of off-site sources to potential on-site contaminants.

TABLE 1.2
DATABASES

DATABASE	SEARCH DISTANCE
USEPA EnviroMapper	1 mile
MDE Integrated Internet Mapping System	1 mile
UST Database	Adjacent properties

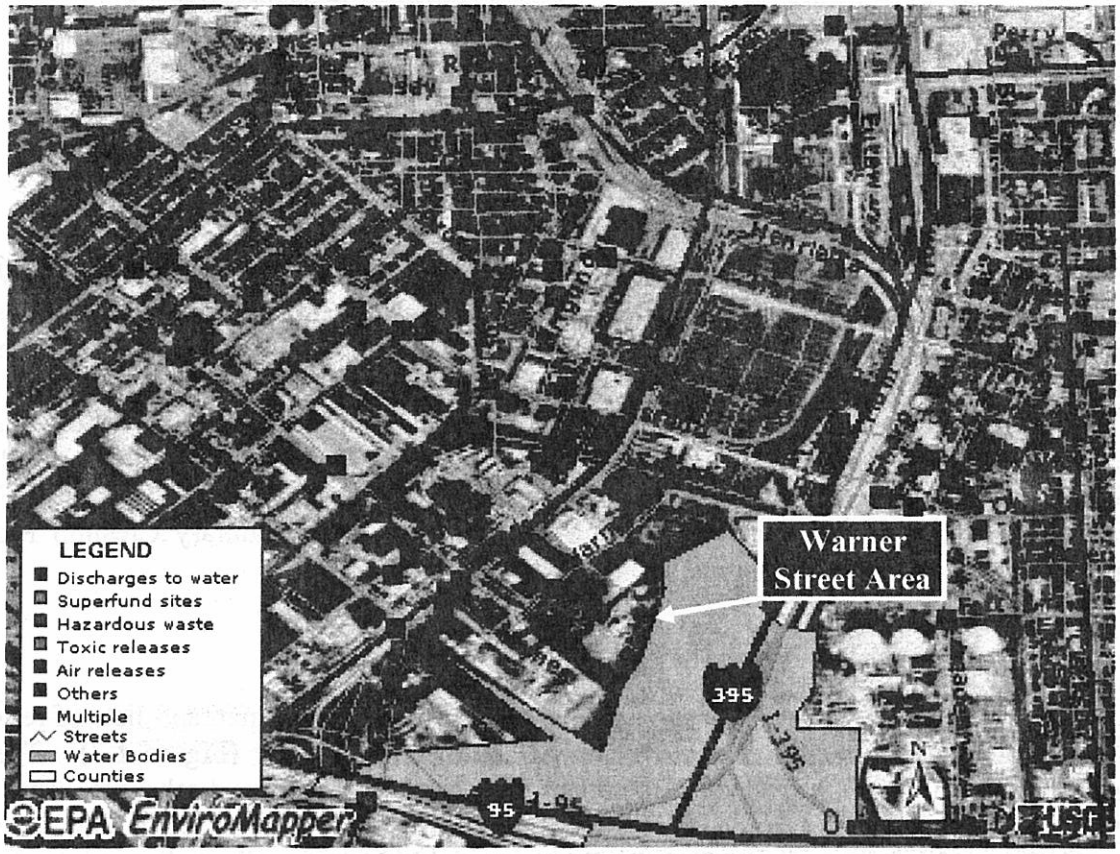
The environmental records review indicates that several facilities located near the Warner Street corridor are also listed on the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). These facilities include the Scott Street and Severn Street Stations (MD 191 and 245, respectively), the J. W. Boarman, Inc. facility (MD-283), the Bayard Street Station (MD-161), the Baltimore Gas and Electric (BGE) Spring Gardens facility (MD-145) and the American Chemmate facility (MD-152). Additional CERCLIS facilities in the area are documented in the EnviroMapper Website published by the USEPA. There are a number of other facilities in the area listed on the Voluntary Cleanup Program (VCP), the Brownfields program, and the State Master List rosters.

1.7.1 USEPA Enviromapper

A query of the EPA EnviroMapper website yielded a location map and lists of regulated sites within a two-mile radius of the Warner Street Business Center (Figure 1.7). The lists focused on CERCLIS sites, documented air releases, wastewater discharges, and toxic substances spills/releases. The EPA EnviroMapper lists 205 air release related sites, 21 discharges to surface water, and 17 toxic discharges within a two-mile radius of the Warner Street sites.

Several of the listed sites are in the immediate vicinity of the Warner Street properties. The closest site is 2110 Haines Street, a 3.1-acre parcel that has, since the late 19th century, been used for various commercial purposes, including coal and wood storage, telephone pole storage, trailer truck sales, and barge manufacturing. IOC, Gordon Carton, and Maryland Chemical Company are listed in the database as having operated in the Warner Street corridor. IOC has not reported since 1981 and Gordon Cartons since 1999. Neither corporation maintains a physical presence in the Warner Street area. With the exception of Maryland Chemical Company, no operating sites were identified in the radius having a direct impact on the subject properties. The Maryland Chemical Company, which handles bulk quantities of listed materials, is the subject of a separate study.

Figure 1.7
USEPA Enviromap Of Warner Street Area



1.7.2 MDE Internet Mapping System

MDE maintains a Geographic Information System (GIS) database of environmentally related sites in Maryland. The geographic representation of sites in the Warner Street area is show on Figure 1.8. Table 1.3 lists the Environmental Restoration and Redevelopment Program (ERRP) sites in the one-mile radius of the Warner Street properties. This list includes, VCP sites, Brownfield investigation sites and State Master List sites. The State Master List mirrors the 1984 CERCLIS database. Only two of these listed sites, 1645 Warner Street property and the Carroll Camden Area, could possibly impact the Warner Street area. The 1645 Warner Street property is part of this current investigation and the Carroll Camden Area encompasses many of the parcels adjacent to the Warner Street properties. The Carroll Camden and Warner Street investigations will be used to evaluate the entire Warner Street corridor.

FIGURE 1.8
MDE ERRP MAP of Warner Street Area

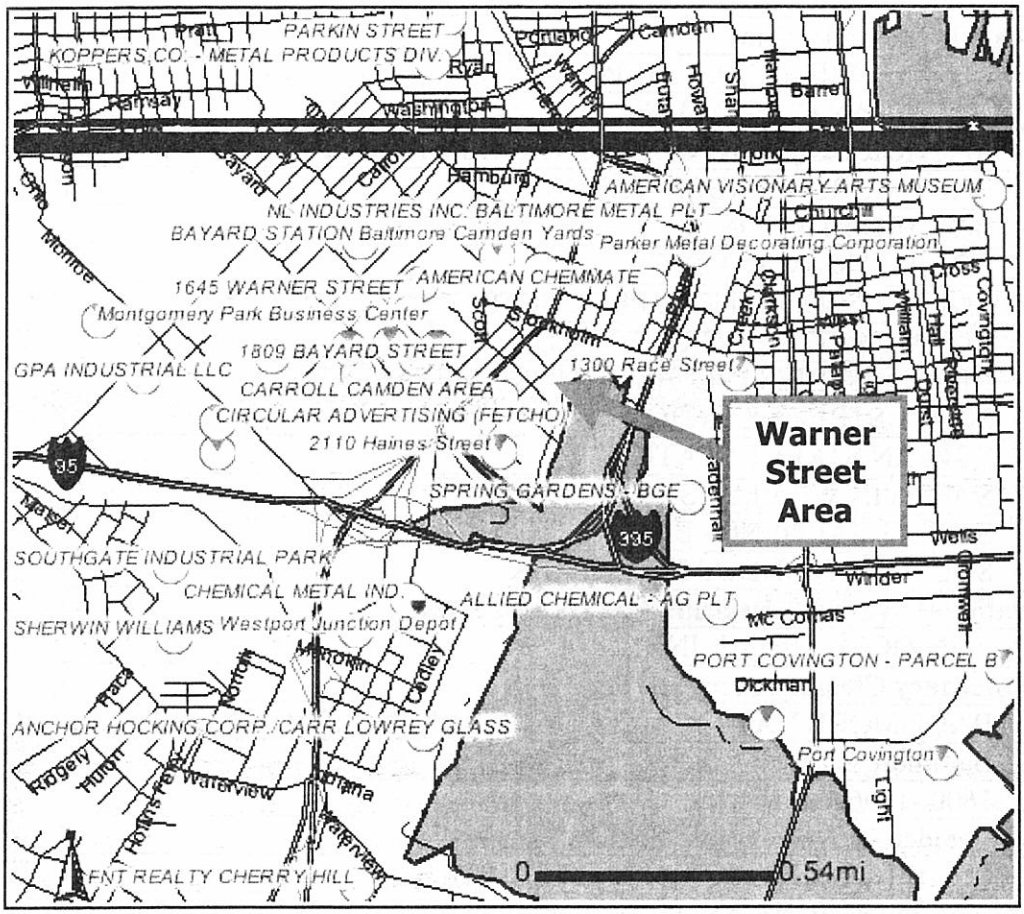


Table 1.3
ERRP Sites Identified In Warner Street Area

State Master List Sites
☐ ALLIED CHEMICAL - AG PLT
☐ AMERICAN CHEMMATE
☐ ANCHOR HOCKING CORP./CARR LOWREY GLASS
☐ BALTIMORE CAMDEN YARDS
☐ BAYARD STATION
☐ BOARMAN, JW CO. INC
☐ KOPPERS CO. - METAL PRODUCTS DIV.
☐ KOPPERS CO. - ENGR MET PROD
☐ NL INDUSTRIES INC. BALTIMORE METAL PLT
☐ SCOTT STREET STATION
☐ SEVERN STREET STATION
☐ SHERWIN WILLIAMS
☐ SPRING GARDENS - BGE
☐ SOUTHGATE INDUSTRIAL PARK
National Priority List/State Master List Sites
☐ CHEMICAL METAL IND.
Voluntary Cleanup Program Sites
☐ BALTIMORE NATIONAL AQUARIUM/MIDDLE BRANCH PARK
☐ Baltimore Camden Yards
☐ 1600 -1606 Bush Street
☐ Camden Crossing (Barre Station, Koppers Site)
☐ CIRCULAR ADVERTISING (FETCHO)
☐ GPA INDUSTRIAL LLC
☐ 2110 Haines Street
☐ Montgomery Park Business Center
☐ Parker Metal Decorating Corporation
☐ PHILLIPS DISTRIBUTION CENTER LLC
☐ 1300 Race Street
☐ SSI REALTY CORPORATION
☐ Valspar Baltimore Plant
☐ FORMER WATERFORD CASEWORKS
☐ Westport Junction Depot
Brownfields Investigation Sites
☐ BALTIMORE NATIONAL AQUARIUM/MIDDLE BRANCH PARK
☐ 1809 BAYARD STREET
☐ CARROLL CAMDEN AREA
☐ 1645 WARNER STREET

1.7.3 Underground Storage Tank Sites

There are 13 underground storage tank cases listed in the Warner Street corridor. Eleven of these cases have been closed. The two open cases are at service stations on Russell Street, Texaco in the 1400 block and Amoco in the 1800 Block. Historic discharges of contaminants in South Baltimore have had an impact on the area groundwater. Due to the engineering controls currently in place at the two operational facilities, it is unlikely that the existing service stations are presently impacting the groundwater.

1.8 Phase I - Findings And Conclusions

The Warner Street corridor is partially abandoned; the area exhibits signs of stress and is a good candidate for revitalization and rehabilitation.

Industrial activity throughout the last century has impacted the Warner Street corridor. Of particular concern is the area in the rectangle formed by Warner Street, Worcester (Wooster) Street, Oler (Dock) Street, and Shell (Eutaw) Street. This parcel was the site of a paint and varnish manufacture and a commercial printing operation, both of which used heavy metal salts and oxides and volatile organic materials in their process and operations.

Another area of concern is the 1600 block of Warner Street, which was once the site of a historic brass foundry. Contaminants of concern in the foundry are volatile organic compounds, heavy metals, arsenic, acids, and oxides.

The Maryland Chemical site in the 1500 block of Russell Street presents several potential areas of concern. This property was at one time the site of American Cyanamid, an industrial manufacturer of pesticides and agricultural chemicals. Maryland Chemical itself presents a number of concerns stemming from the storage and sale of industrial chemicals. Both aboveground and underground tank storage of chemicals are documented. Consumer quantity sizes through 55-gallon drums, tanks and carboys of listed materials have been handled by the facility.

Lots 5A, 6, 7, and 8/9 are also a concern due to the presence of fill that contains SVOCs, metals and is petroleum stained-soil in places. It is thought that these lots were created by filling the Middle Branch of the Patapsco River with debris from the Great Baltimore Fire of 1904.

Site-Specific Phase II Brownfields Assessments are recommended to document the levels of contaminants at sites within the Warner Street Business and Wetland areas to ascertain the best practicable use for these areas. The Phase II Brownfields Site-Specific Assessments would define the nature and extent of potential contamination as well as determine potential remediation alternatives.

2.0 SAMPLING AND ANALYSIS PLAN

This Site-Specific Brownfields Sampling and Analysis Plan for the Warner Street Wetland Properties is a companion document to the USEPA-approved Quality Assurance Project Plan (QAPP) for MDE. All of the policies and procedures specified in the MDE QAPP will be followed for this project.

2.1 Site Information/Background

The City of Baltimore, in partnership with the U.S. Army Corps of Engineers (USACE), is planning a major environmental and economic revitalization of the Middle Branch of the Patapsco River. As part of the revitalization plan, it is proposed that contiguous lots 5A, 6, 7 and 8/9 of the Warner Street properties be restored to a viable wetlands ecosystem (Figure 2.1). The current restoration plan calls for the removal and disposal of the first six feet of soil/fill, which is composed of debris associated with the Great Baltimore Fire of 1904. The properties will then be covered with approximately two feet of clean fill. Appropriate wetland vegetation will be planted and the Gwynns Falls Trail will be extended through the wetland as a boardwalk thereby transforming the former industrial waterfront into a more people-friendly park setting.

There are potential environmental concerns for soil at the site location. As noted above in the Phase I Environmental Site Assessment, the subject properties are located on fill composed of remnants from the Baltimore Fire of 1904. This fill would likely contain semi-volatile organic compounds (SVOCs) and metals associated with burned building debris. Properties near the site included a brass metal foundry, a glass production facility, a chemical manufacturer, and a varnish and paint manufacturer; however, no buildings are known to have existed on the subject properties. Chemicals of potential concern (COPCs) at the properties near the site included heavy metals, pesticides, and volatile organic compounds (VOCs).

In 2001, as part of a broader MDE Brownfields Investigation of the Carroll-Camden area, samples of soil, sediment, and groundwater were collected at the subject properties (MDE, 2001). Sample locations are depicted in Figure 2.2. These samples were analyzed for VOCs, SVOCs, polychlorinated biphenyls (PCBs), and total metals. Analytical results in soil indicated the presence of metals and SVOCs at concentrations above Maryland State Residential Cleanup standards (Table 2.1). Some VOCs were detected in soil, but were below the Maryland State Residential Cleanup standards. Similar results were reported for metals and SVOCs in sediment samples when compared to the National Oceanic and Atmospheric Administration (NOAA)/Effects Range Medium (ERM) values (Table 2.2). In groundwater, some metals (antimony, arsenic and manganese) were detected above Maryland State standards for Type I and II aquifers; however, VOCs and SVOCs were not detected above State standards (Table 2.3).

Figure 2.1
Warner Street Properties
Lots 5, 6, 7, and 8/9

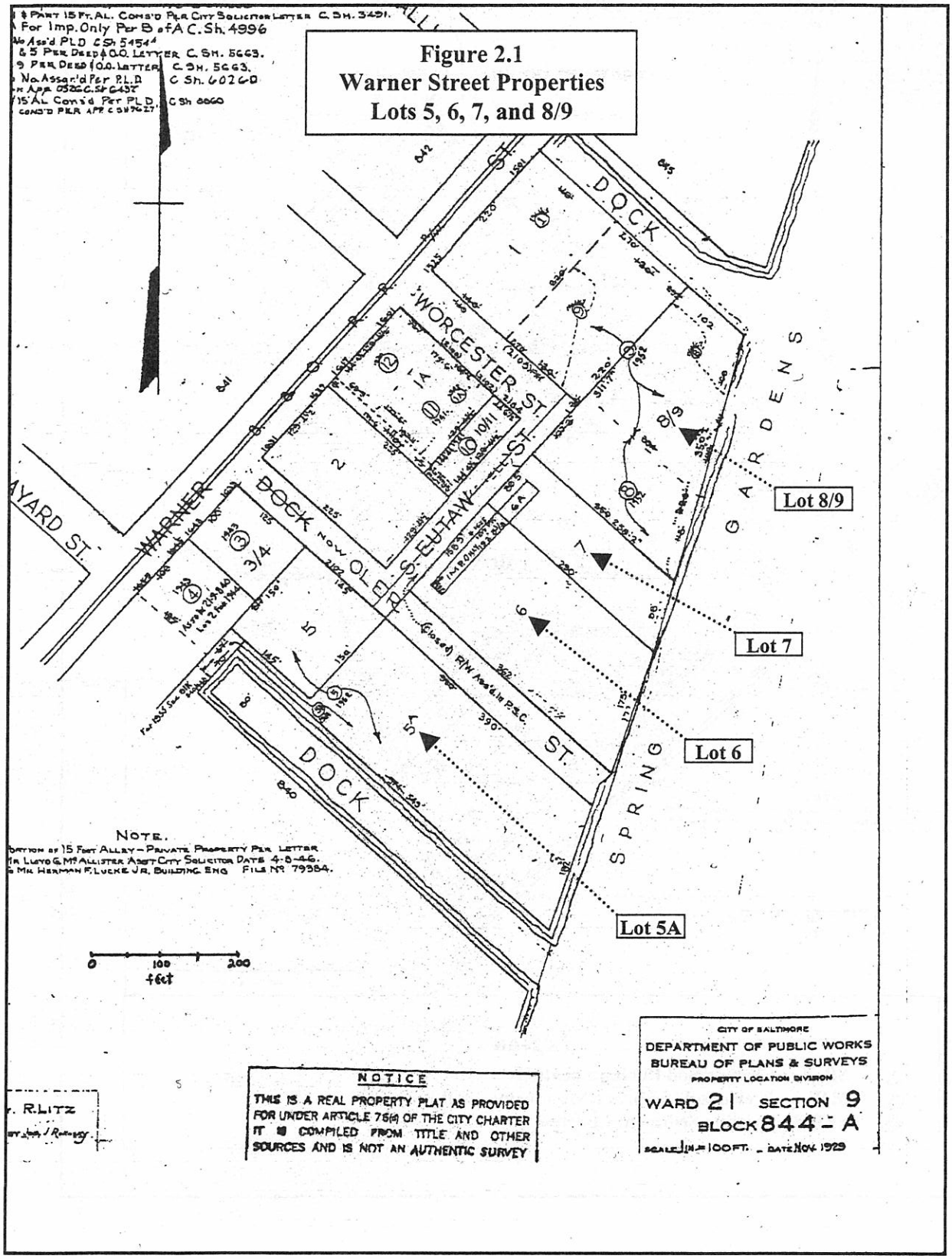
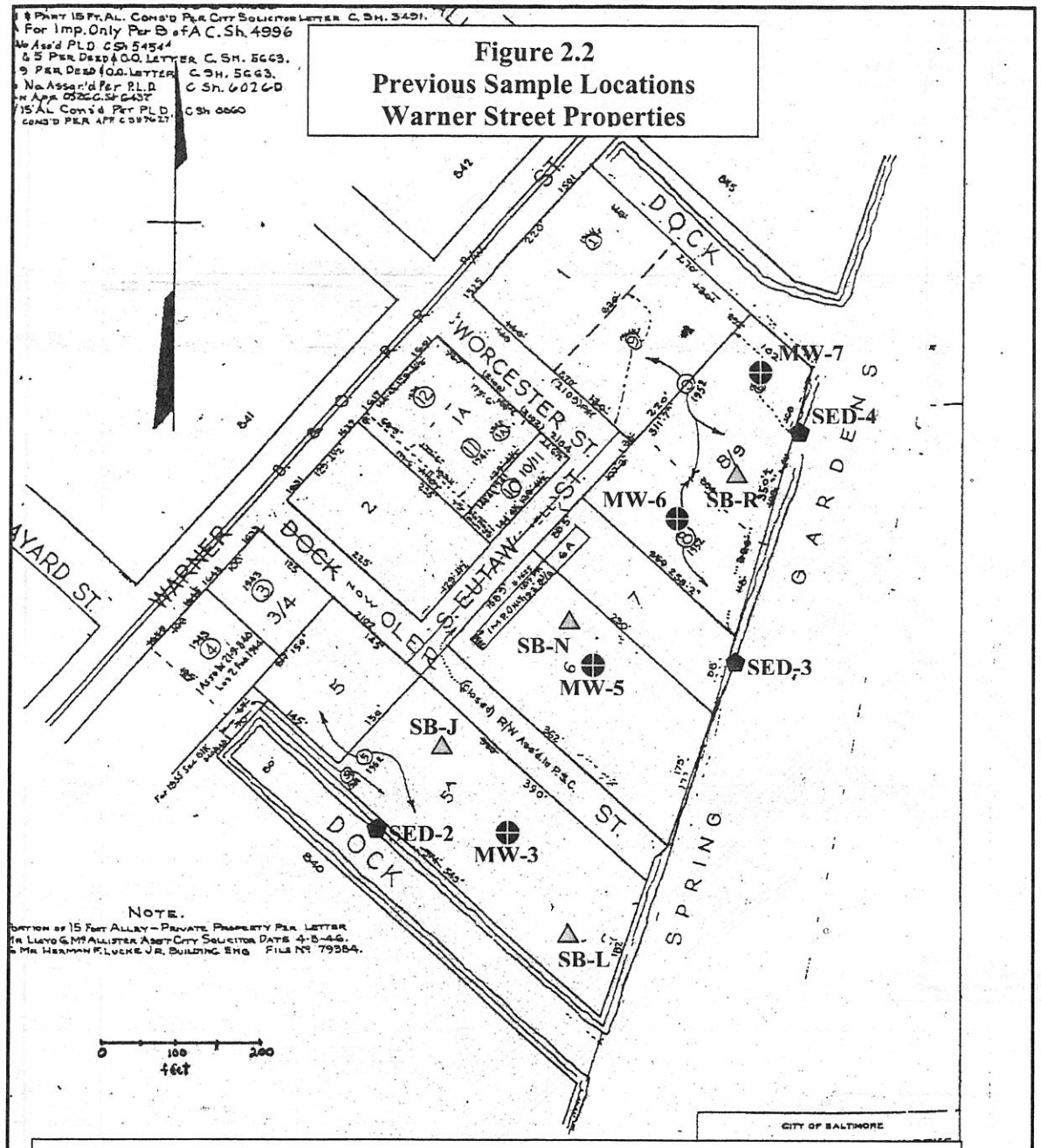


Figure 2.2
Previous Sample Locations
Warner Street Properties



Legend

△	SB-N	Existing Soil Boring Location
⊕	MW-5	Previous Temporary Monitoring Well Location
⬟	SED-3	Existing Sediment Location

TABLE 2.1
Detections in Soil
Warner Street Properties
Lots 5, 6, 7, 8/9

EPA Method	Constituents	Units	MDE Residential Standard	SB-J	SB-L	SB-N	SB-R
SW 7060	Arsenic	mg/Kg	2	**4**	**8.2**	**14**	**5**
SW 6010B	Cadmium	mg/Kg	3.9	3.1	2.9	**4.8**	3.4
SW 6010B	Chromium	mg/Kg	1,200	41	65	130	810
SW 6010B	Copper	mg/Kg	310	41	89	190	65
SW 6010B	Lead	mg/Kg	400	160	160	340	130
SW 6010B	Manganese	mg/Kg	160	110	110	**180**	**160**
SW 7470A	Mercury	mg/Kg	0.1	**0.19**	nd	**0.47**	**0.19**
SW 6010B	Nickel	mg/Kg	160	16	19	30	110
SW 7741	Selenium	mg/Kg	39	0.45	0.69	0.78	0.93
SW 7841	Thallium	mg/Kg	2	0.46	0.36	0.93	nd
SW 6010B	Zinc	mg/Kg	2300	150	220	1200	86
SW 8081A	OC Pesticides/PCBs	ug/Kg	MS	nd	nd	nd	nd
SW 8260B	Ethylbenzene	ug/Kg	78,000	nd	nd	5.9	nd
SW 8260B	Toluene	ug/Kg	1,600,000	nd	nd	33	nd
SW 8260B	Total Xylenes	ug/Kg	16,000,000	nd	nd	27	nd
SW 8270C	2-Methylnaphthalene	ug/Kg	160,000	nd	nd	1100	nd
SW 8270C	Acenaphthene	ug/Kg	47,000	nd	nd	4500	nd
SW 8270C	Anthracene	ug/Kg	2,300,000	nd	nd	2300	nd
SW 8270C	Benzo(a)anthracene	ug/Kg	870	790	600	**1700**	nd
SW 8270C	Benzo(a)pyrene	ug/Kg	330	**810**	**834**	**2000**	nd
SW 8270C	Benzo(b)fluoranthene	ug/Kg	870	540	790	**1300**	nd
SW 8270C	Benzo(g,h,i)perylene	ug/Kg	230,000	500	700	780	nd
SW 8270C	Benzo(k)fluoranthene	ug/Kg	8,700	620	610	1030	nd
SW 8270C	Bis(2-ethylhexl)phthalate	ug/Kg	46,000	nd	650	17300	nd
SW 8270C	Chrysene	ug/Kg	87,000	740	840	1600	nd
SW 8270C	Fluoranthene	ug/Kg	310,000	1500	1030	3500	540
SW 8270C	Fluorene	ug/Kg	310,000	nd	nd	1500	nd
SW 8270C	Indeneo(1,2,3,-cd)pyrene	ug/Kg	870	nd	530	610	nd
SW 8270C	Naphthalene	ug/Kg	160,000	nd	nd	1300	nd
SW 8270C	Phenanthrene	ug/Kg	2,300,000	1200	970	3000	nd
SW 8270C	Pyrene	ug/Kg	230,000	1500	1300	5100	620

Note: Shaded cells with bold characters represent exceedences relative to MDE standards.

Samples were analyzed for VOCs, SVOCs, OC Pesticides/PCBs, and Total Metals.

MS - Multiple Standards (The complete list of SW Method analytes were below detection limits)

SW - Solid Waste

TABLE 2.2
Detections in Sediment
Warner Street Properties
Lots 5A, 6, 7, 8/9

EPA Method	Constituents	Units	NOAA/ERM Values*	SED-2	SED-3	SED-4
SW 7060	Arsenic	mg/Kg	70	15	8.2	12
SW 6010B	Cadmium	mg/Kg		2.9	1.7	1.9
SW 6010B	Chromium	mg/Kg		160	49	56
SW 6010B	Copper	mg/Kg	270	100	43	84
SW 6010B	Lead	mg/Kg	218	**320**	0.24	**430**
SW 6010B	Manganese	mg/Kg		480	190	370
SW 7470A	Mercury	mg/Kg		0.95	nd	0.7
SW 6010B	Nickel	mg/Kg	51.6	21	14	18
SW 7741	Selenium	mg/Kg		1.2	0.9	1.4
SW 7841	Thallium	mg/Kg		nd	0.52	1
SW 6010B	Zinc	mg/Kg		280	170	340
SW 8081A	OC Pesticides/PCBs	ug/Kg	MS	nd	nd	nd
SW 8260B	VOCs	ug/Kg	MS	nd	nd	nd
SW 8270C	3,3'-Dichlorobenzinidine	ug/Kg		nd	nd	1900
SW 8270C	Acenaphthene	ug/Kg	500	nd	nd	**1200**
SW 8270C	Acenaphthylene	ug/Kg	640	nd	nd	**1400**
SW 8270C	Anthracene	ug/Kg	1100	nd	nd	**3100**
SW 8270C	Benzo(a)anthracene	ug/Kg	1600	670	1200	**6300**
SW 8270C	Benzo(a)pyrene	ug/Kg	1600	960	1300	**6800**
SW 8270C	Benzo(b)fluoranthene	ug/Kg		650	870	4300
SW 8270C	Benzo(g,h,i)perylene	ug/Kg		500	640	2600
SW 8270C	Benzo(k)fluoranthene	ug/Kg		540	740	3400
SW 8270C	Chrysene	ug/Kg	2800	670	1030	**5400**
SW 8270C	Fluoranthene	ug/Kg	5100	1000	1900	**7500**
SW 8270C	Fluorene	ug/Kg	540	nd	nd	**1800**
SW 8270C	Indeneo(1,2,3,-cd)pyrene	ug/Kg		nd	580	2300
SW 8270C	Phenanthrene	ug/Kg	1500	770	**1500**	**9600**
SW 8270C	Pyrene	ug/Kg	2600	1300	2400	**12000**

Note: MS - Multiple Standards (The complete list of SW Method analytes were below detection limits).

NOAA/ERM Values - National Oceanic and Atmospheric Administration/Effects Range-Median.

*** Not all constituents have available NOAA/ERM values; No MDE Standards for sediment.**

Shaded cells with bold characters represent exceedences relative to NOAA/ERM values.

Samples were analyzed for VOCs, SVOCs, OC Pesticides/PCBs, and Total Metals.

SW - Solid Waste.

TABLE 2.3
Detections in Groundwater
Warner Street Properties
Lots 5A, 6, 7, 8/9

Concentrations reported in ug/L.

EPA Method	Constituents	MDE Standard	MW-3	Duplicate MW-3	MW-5	MW-6	MW-7
SW 204.2	Antimony	6	**6**	5	**10**	**7**	**6**
SW 206.2	Arsenic	50	nd	nd	nd	nd	6
SW 200.7	Manganese	50	**280**	**280**	**230**	**320**	**190**
SW 200.7	Nickel	73	nd	nd	40	nd	nd
SW 279.2	Thallium	2	nd	nd	6	5	nd
SW 200.7	Zinc	1100	10	20	nd	nd	nd
SW 8081A	OC Pesticides/PCBs	MS	nd	nd	nd	nd	nd
SW 8260B	VOCs	MS	nd	nd	nd	nd	nd
SW 8270C	Naphthalene	10	nd	nd	nd	**11**	nd

Note: Shaded cells with bold characters represent exceedences relative to MDE Standards for Type I and II Aquifers.
Samples were analyzed for VOCs, SVOCs, OC Pesticides/PCBs, and Total Metals.
The MW-3 duplicate sample was designated as MW-4 during the investigation.
MS - Multiple Standards (The complete list of SW Method analytes were below detection limits)
SW - Solid Waste

The BDC on behalf of the City of Baltimore has requested that MDE conduct a site-specific Brownfields Assessment of lots 5A, 6, 7 and 8/9 to address USACE concerns about potential contamination so that the wetlands portion of the revitalization project can move forward.

2.1.1 Project Description

The overall objective of the Warner Street revitalization project of Lots 5A, 6, 7, and 8/9 is the creation of a viable wetland. To achieve this objective, removal of the top six feet of soil fill is proposed. However, as noted above, previous soil sampling by MDE in 2001 at the subject properties revealed the presence of COPCs at concentrations above Maryland State Residential Cleanup standards. Before the wetlands creation project can proceed, the extent of the fill material and COPCs related to the Baltimore Fire of 1904 needs to be assessed. The top six feet of soil fill will also be evaluated so that appropriate disposal options can be ascertained.

A soil sampling grid consisting of approximately 12 locations with multiple sampling horizons is planned to characterize the site (Figure 2.3). Continuous soil cores will be obtained using direct push technology (DPT) and/or a hollow stem auger (HSA) to visually characterize the fill and lithology of soil until native soils are encountered. It should be noted that an HSA rig would be used only if the DPT rig were unable to fully penetrate the fill material to native soil. Soil samples will be collected from the continuous soil cores at three horizons from the ground

surface to the water table. It is likely that debris related to the Baltimore Fire of 1904 will be found below the water table as this debris was used to fill in portions of the Middle Branch of the Patapsco River. A temporary monitoring well will also be installed and sampled at a soil boring located in the central area of the properties to confirm groundwater quality results from the previous MDE Brownfields Investigation (MDE, 2001).

Analytical methods selected for the analysis of soil and groundwater samples will be based on COPCs detected in the previous MDE Brownfields Investigation (MDE, 2001). The following COPCs were identified in soil during the previous investigation:

- Metals – Elevated levels of arsenic, chromium, and mercury were detected in soil.
- SVOCs – Benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene were detected in soil at concentrations above Maryland State Residential Standards.

The following COPCs were identified in groundwater during the previous investigation:

- Metals - Antimony and manganese were detected in groundwater.
- SVOCs - Naphthalene was the only SVOC detected in groundwater.

Applicable or Relevant and Appropriate Standards, and proposed action levels are discussed in the USEPA-approved MDE Brownfields QAPP.

For each of the four lots (5A, 6, 7, and 8/9), a composite soil sample will be collected from the top six feet of the continuous core soil borings from within individual lots (a total of four soil samples). These soil samples will be submitted for analysis using the Toxicity Characteristic Leaching Procedure (TCLP) for Metals only. Results from the TCLP analysis, in conjunction with analytical results from soil samples collected from the top six feet of soil, will be used to estimate the volume of fill that will be disposed at a Subtitle D solid waste facility or, if needed, the volume to be disposed at a Subtitle C hazardous waste facility.

2.1.2 Project Time Line

The progress of any project will be tracked from its inception through implementation to ensure all sampling and analytical activities are performed in a correct and cost effective manner. Each step in this process will be scheduled in an objective and realistic time frame to assure that adequate attention is devoted to the minimization of effort and the maximization of information. Table 2.4 provides a project time line for this project.

TABLE 2.4
Project Time Line
Warner Street Properties, Baltimore Maryland

Activities	Dates *(MM/DD/YY)*	
	Activity Start Date	**Activity End Date**
Draft Sampling and Analysis Plan (SAP)	02/01/2005	9/22/2005
Submit SAP to USEPA for Review	9/26/2005	
Receive USEPA Comments on the SAP	TBD	
Submit Request for Proposal (RFP) for Lab Work	TBD + 1	+ 30 days
Submit RFP for DPT Services	TBD + 1	TBD
Draft Purchase Orders	TBD + 15	+ 30 days
Schedule Sample Dates	TBD + 15	+ 1 day
Soil, Sample Collection	TBD + 45	+ 3 days
Samples Submitted to Fixed Lab for Analysis	TBD + 48	+ 60 days
Data Validation	TBD + 108	45
Review Laboratory Data Package	TBD + 153	10
Draft Brownfields Report	TBD + 163	TBD + 180 days
Submit Final Report to USEPA	TBD + 180	TBD + 200 days

2.1.3 Measurement Quality Indicators

Measurement quality indicators for this project are listed in Table 2.5 and discussed in detail in the USEPA-approved MDE QAPP.

TABLE 2.5
Measurement Quality Indicators
Warner Street Properties

Constituents	Matrix	MDE* Standard	Units	Precision	Accuracy	Completeness
Acenaphthene	Soil	470	mg/Kg	Field Duplicate & Matrix Spike	Analysis of QC Samples Matrix Spike Recovery	Amount of Valid Data Obtained (Percent of the number of valid samples to total samples)
Acenaphthalene	Soil	470	mg/Kg			
Anthracene	Soil	2,300	mg/Kg			
Benzo(a)anthracene	Soil	0.87	mg/Kg			
Benzo(a)pyrene	Soil	0.33	mg/Kg			
Benzo(b)fluoranthene	Soil	0.87	mg/Kg			
Benzo(g,h,I)perylene	Soil	230	mg/Kg			
Benzo(k)fluoranthene	Soil	8.7	mg/Kg			
Chrysene	Soil	87	mg/Kg			
Dibenzo(a,h)anthracene	Soil	0.33	mg/Kg			
Fluoranthene	Soil	310	mg/Kg			
Fluorene	Soil	310	mg/Kg			
Indeneo(1,2,3,-cd)pyrene	Soil	0.87	mg/Kg			
Naphthalene	Soil	160	mg/Kg			
Phenanthrene	Soil	2,300	mg/Kg			
Pyrene	Soil	230	mg/Kg			
Arsenic	Soil	2	mg/Kg			
Cadmium	Soil	3.9	mg/Kg			
Chromium III/VI	Soil	12,000/23	mg/Kg			
Copper	Soil	310	mg/Kg			
Lead	Soil	400	mg/Kg			
Manganese	Soil	160	mg/Kg			
Mercury	Soil	0.1	mg/Kg			
Nickel	Soil	160	mg/Kg			
Selenium	Soil	39	mg/Kg			
Thallium	Soil	2	mg/Kg			
Zinc	Soil	2,300	mg/Kg			
Naphthalene	water	10	ug/L			
Antimony	water	6	ug/L			
Arsenic	water	50	ug/L			
Lead	water	0.015	ug/L			
Manganese	water	50	ug/L			
Mercury	water	0.002	ug/L			
Nickel	water	73	ug/L			
Thallium	water	2	ug/L			
Zinc	water	1,100	ug/L			

Note:

* Maryland Department of the Environment Cleanup Standards for soil and groundwater, August 2001.

Soil: Residential Cleanup Standard.

Water: Type I and II Aquifers.

2.2 Measurement/Data Acquisition

2.2.1 Sampling Design

A three-dimensional grid consisting of approximately 12 soil sample locations with multiple sampling horizons is planned to characterize the site (Figure 2.3). The grid is based on a conceptual 100-foot sample pattern. Samples will be collected at 200-foot intervals along the columns formed by the southwest-northeast axes. Along rows based on the southeast-northwest axes, sample locations will be spaced at 100-foot intervals. On alternating columns, sample locations will be offset a distance of 100 feet to maximize the coverage area.

Continuous DPT and/or HSA soil cores will be obtained to visually characterize the fill. Continuous cores for lithologic and visual observation will be completed to the depth where native soils are encountered. As the surface water of the Middle Branch of the Patapsco River is approximately 10 feet below grade, it is anticipated that native soils will be encountered at depths ranging from 10 to 15 feet below ground surface (bgs). Continuous core soils will be field screened at three sample horizons from the ground surface to the water table (0-, 3- and 6-foot bgs) resulting in a total of approximately 36 samples for field screening. Selection of soil samples for fixed laboratory analysis will be based on field screening results in this manner. For each lot, three soil sample intervals that exhibit the highest concentrations during field screening will be selected for fixed-laboratory confirmation. One soil sample will be used as a wildcard to obtain results from the highest screening result (over four lots) that does not fall into the above criteria. A total of 13 soil samples will be collected for fixed laboratory analysis.

A temporary one-inch monitoring well will also be installed in the center of the properties at location collocated soil boring 202 (SB202) and monitoring well 202 (MW202) to assess the water quality at the site and verify previous results. Table 2.6 provides the types and number of samples and analyses required for this project.

All field activities associated with this sampling and analysis plan will comply with the provisions of the MDE Health and Safety Plan (Appendix C).

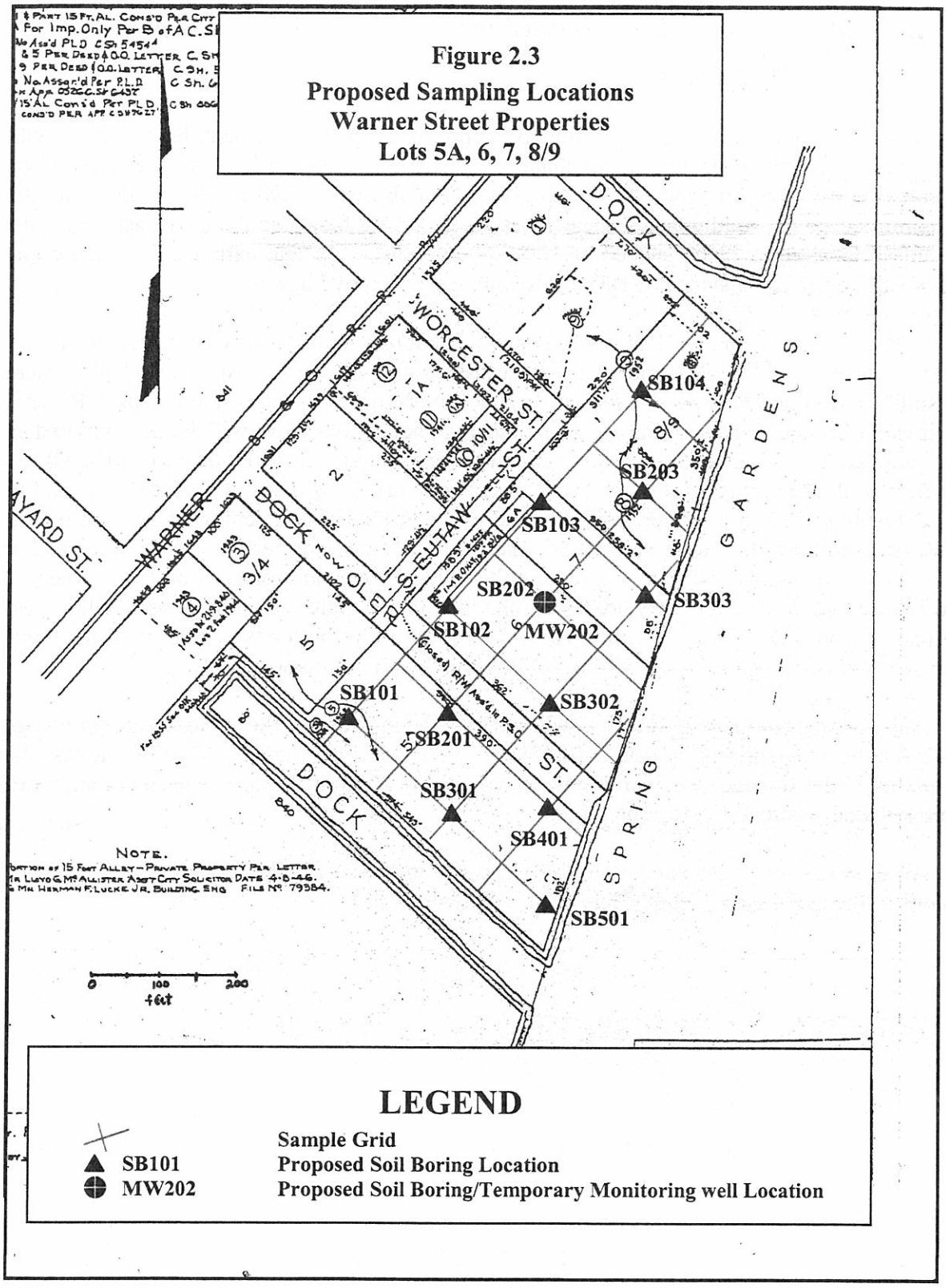


Figure 2.3
Proposed Sampling Locations
Warner Street Properties
Lots 5A, 6, 7, 8/9
SB104
SB203
SB103
SB202
MW202
SB102
SB303
SB101
SB302
SB201
SB301
SB401
SB501
WORCESTER ST.
WARNER
DOCK
S. EUTAW ST.
SPRING GARDENS
NOTE.
0 100 200
feet
LEGEND
Sample Grid
SB101 Proposed Soil Boring Location
MW202 Proposed Soil Boring/Temporary Monitoring well Location

TABLE 2.6
Proposed Sampling Summary
Warner Street Properties

Sample ID*	Sample Location	Sample Depth (Feet)	Analytical Parameters	Rationale
SOIL				
SB101-00	Lot 5A	0-1	Metals / PAHs	Characterize surface soil in the southwestern portion of Lot 5A.
SB101-03	Lot 5A	2-4	Metals / PAHs	Characterize subsurface soil at the 3-foot interval of SB101.
SB101-06	Lot 5A	5-7	Metals / PAHs	Characterize subsurface soil at the 6-foot interval of SB101.
SB203-00	Lot 8/9	0-1	Metals / PAHs	Characterize surface soil in the southeastern portion of Lot 8/9.
SB203-03	Lot 8/9	2-4	Metals / PAHs	Characterize subsurface soil at the 3-foot interval of SB203.
SB203-06	Lot 8/9	5-7	Metals / PAHs	Characterize subsurface soil at the 6-foot interval of SB233.
SB302-00	Lot 6	0-1	Metals / PAHs	Characterize surface soil in the southeastern portion of Lot 6.
SB302-03	Lot 6	2-4	Metals / PAHs	Characterize subsurface soil at the 3-foot interval of SB302.
SB302-03	Lot 6	5-7	Metals / PAHs	Characterize subsurface soil at the 6-foot interval of SB302.
SB303-00	Lot 7	0-1	Metals / PAHs	Characterize surface soil in the southeastern portion of Lot 7.
SB303-03	Lot 7	2-4	Metals / PAHs	Characterize subsurface soil at the 3-foot interval of SB303.
SB303-06	Lot 7	5-7	Metals / PAHs	Characterize subsurface soil at the 6-foot interval of SB303.
SB501-09	Lot 5A	8-10	Metals / PAHs	Characterize subsurface soil at the 9-foot interval of SB501.
SB605-03	Lot 6	2-4	Metals / PAHs	Duplicate of SB302-03.
SB101-MS	Lot 5A	0-1	Metals / PAHs	Matrix Spike of SB101-00.
SB101-MSD	Lot 5A	0-1	Metals / PAHs	Matrix Spike Duplicate of SB101-00.
STCLP-5A	Lot 5A	0-6	TCLP - Metals	Lot 5A Composite sample for TCLP Metals Analysis
STCLP-6	Lot 6	0-6	TCLP - Metals	Lot 6 Composite sample for TCLP Metals Analysis
STCLP-7	Lot 7	0-6	TCLP - Metals	Lot 7 Composite sample for TCLP Metals Analysis
STCLP-8/9	Lot 8/9	0-6	TCLP - Metals	Lot 8/9 Composite sample for TCLP Metals Analysis
Groundwater				
GW-202	Lot 6	n/a	Metals / PAHs	Determine quality of first water bearing zone under site.
GW-302	Lot 6	n/a	Metals / PAHs	Duplicate Sample of GW-202.
GW202-MS	Lot 5A	n/a	Metals / PAHs	Matrix Spike of GW202.
GW202-MSD	Lot 5A	n/a	Metals / PAHs	Matrix Spike Duplicate of GW202.
QA/QC				
RW100-01	n/a	n/a	Metals / PAHs	Rinsate Blank - Day 1; Verify decontamination procedures.
RW100-02	n/a	n/a	Metals / PAHs	Rinsate Blank - Day 2; Verify decontamination procedures.

Note: * The actual soil sample number and depth interval will be based on field screening results.

n/a - not applicable

2.2.2 Sampling Methods Requirements

Soil and groundwater samples collected during this Brownfields Site Investigation will be sampled in accordance with MDE's QAPP Standard Operating Procedures (SOPs).

The general approach will be to collect environmental samples from surface soil, subsurface soil, and groundwater from locations identified on the sampling grid. Soil borings will be advanced at all subsurface soil sampling locations. Borings will be driven using a standard Geoprobe® rig and a continuous soil profile will be obtained down to the point where native soil is encountered or the groundwater surface if native soil is encountered before reaching the water table. In general, samples will be obtained from four-foot continuous core intervals. Geologic classification and field screening and observations will be noted on each four-foot core.

For the installation of the temporary monitoring well, a 10-foot screen will be placed approximately three feet above the water table to seven feet below the water table to account for tidal variations in water level. The temporary monitoring well will be completed and developed as detailed in Appendices H and I of the MDE QAPP. Low flow sampling procedures will follow specifications outlined in the MDE QAPP. For specific details about the sampling procedures referenced in Table B-1, refer to the appropriate section of the QAPP.

MDE will submit selected soil and all groundwater samples to a fixed-based laboratory for analysis. Specific parameters have been selected based on analytical results at the subject properties obtained during the broader MDE Brownfields Assessment of the Carroll-Camden Area (MDE, 2002). All samples will be collected and preserved in accordance with procedures found in Table 1 of the QAPP. Field Quality Control Requirements for this sampling activity are found in Table 2 of the QAPP.

2.2.3 Analytical Methods Requirements

Table 2.7 provides information about the analytical methods (including any extraction or digestion methods) being used for this project. Additional information about USEPA Solid Waste (SW) analytical methods requirements (method detection limit [MDL], practical quantitation limit [PQL], etc.), laboratory quality control requirements and laboratory equipment calibration procedures can be found in the MDE QAPP.

TABLE 2.7
Sampling and Analytical Methods Requirements
Warner Street Properties

Matrix	Analytical Method Number	Sample Preparation/ Extraction Method Number	Parameter[1]	Number of Normal Samples	Sampling Procedure
Soil	SW 8270	SW-3510C, -3520C, -3540C, -3541, -3545, -3550B	PAHs	13	Grab
Soil	SW200.8/6020	SW-3005A, -3010A, -3015, -3050B, -3051	Priority Pollutant Metals by ICP/MS	13	Grab
Soil	SW 1311	See analytical method	TCLP Analysis: Metals only	4	Composite
Water	SW 8270	SW-3510C, -3520C, -3540C, -3541, -3545, -3550B	PAHs	1	Grab
Water	SW6020	SW-3005A, -3010A, -3015, -3050B, -3051	Priority Pollutant Metals by ICP/MS	1	Grab

Note: [1]May include other categories of analyses or individual analyses.

2.3.1 Data Validation and Usability

To ensure that measurement data generated when performing a Brownfields Assessment or a Site Investigation are of an appropriate quality, all fixed laboratory data will be validated. Data validation is a systematic procedure of reviewing a body of data against a set of established criteria to provide a specified level of assurance of its validity prior to its intended use. It requires that the techniques utilized be applied to the body of the data in a systemic and uniform manner. The process of data validation must be close to the origin of the data, independent of the data production and objective in its approach.

All fixed laboratory data from a Brownfields Assessment will be validated in accordance with IM1 and M2 level of data validation found in the *Region III Innovative Approaches to Data Review Guidance Document* (Appendix G of MDE Brownfields QAPP, 2004).

2.3.1 Reconciliation With User Requirements

2.3.1.1 Accuracy

Accuracy will be assessed through the analysis of quality control samples. The analytical accuracy will be expressed as the percent recovery (%R) of an analyte that has been added to the environmental sample at a known concentration before analysis and is calculated according to the following equation.

$$\%R = 100\frac{S - U}{C_{sa}}$$

Where: %R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

The following formula should be used for measurements where a standard reference material is used.

$$\%R = 10\frac{C_m}{C_a}$$

Where: %R = percent recovery
C_m = measured concentration of standard reference material
C_a = actual concentration of standard reference material

2.3.1.2 Precision

Precision will be determined through the use of field duplicates, matrix spike/matrix spike duplicates and duplicate quality control samples. The Relative Percent Difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

The following formula should be used to calculate precision:

$$RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \times 100$$

Where: RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

2.3.1.3 Completeness

Completeness is defined as the measure of the amount of valid data obtained from a measurement system compared to the total amount data that was expected under normal conditions. Data completeness will be expressed as the percentage of valid data obtained from the measurement system. For data to be considered valid, it must meet all the acceptable criteria

including accuracy and precision, as well as any other criteria required by the prescribed analytical method.

The following formula should be used to calculate completeness:

$$\%C = 100 \frac{V}{n}$$

Where: %C = percent completeness
V = number of measurements judged valid
n = total number of measurements necessary to achieve a specified statistical level of confidence in decision making.

2.4 Report Preparation

Subsequent to completion of all fieldwork and receipt of laboratory analytical results, a Brownfields Assessment Report will be prepared presenting and discussing the information obtained during execution of this work plan. The report will present the following:

- Summarized historical information;
- Physical setting;
- Technical overview with a general profile of the Brownfields Assessment investigation execution and results;
- Toxicological evaluation prepared by an MDE toxicologist;
- Findings and recommendations.

The report will also include:

- Results of all analyses, copies of all laboratory and field data sheets, and the required laboratory data deliverables;
- A summary of analytical methods and quality assurance indicators;
- Tables summarizing all sampling results, including sample locations, media, sample depth, field and laboratory identification numbers, analytical results, and comparison to the MDE Cleanup Standards for Soil and Groundwater, August 2001 (interim final guidance);
- Stratigraphic logs and soil boring records (including state permit numbers, if applicable), which include physical characteristics of the soil and field instrument readings detected during drilling for each soil boring;
- Stratigraphic cross-sections, if applicable;
- Sample location maps; and
- Other information obtained during the assessment.

One copy of the final report will be submitted to the USEPA, one copy will be submitted to BDC and one copy will be submitted to the site owner.

3.0 REFERENCES

ASTM (American Society for Testing and Materials). June 1994. Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, ASTM Standard E 1527-94, Philadelphia, PA.

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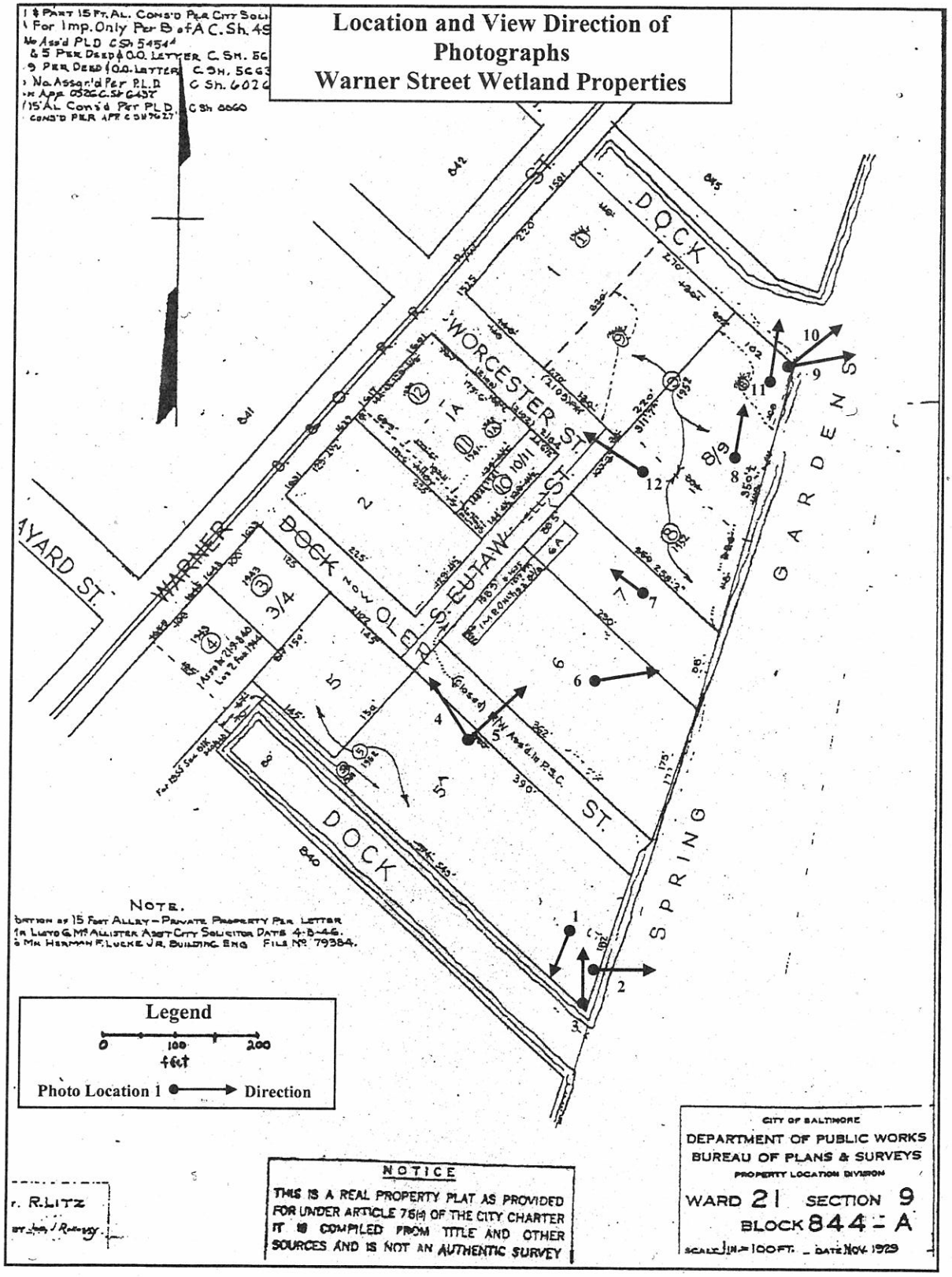
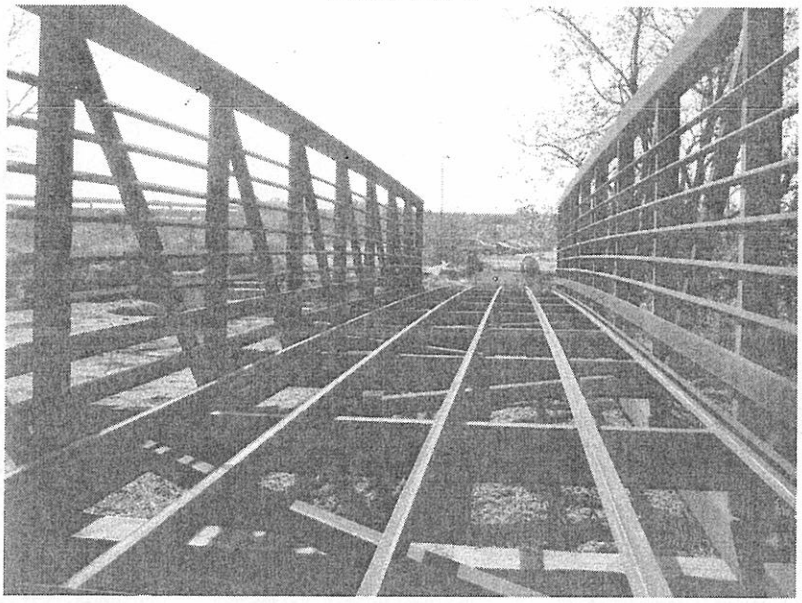
APPENDIX A – SITE PHOTOGRAPHS


Location and View Direction of Photographs
Warner Street Wetland Properties
WORCESTER ST.
DOCK
WARNER
DOCK
OLD
EUTAW
ST.
DOCK
ST.
SPRING
GARDENS
NOTE.
Legend
0 100 200
feet
Photo Location 1 Direction
NOTICE
THIS IS A REAL PROPERTY PLAT AS PROVIDED FOR UNDER ARTICLE 76(4) OF THE CITY CHARTER IT IS COMPILED FROM TITLE AND OTHER SOURCES AND IS NOT AN AUTHENTIC SURVEY
CITY OF BALTIMORE
DEPARTMENT OF PUBLIC WORKS
BUREAU OF PLANS & SURVEYS
PROPERTY LOCATION DIVISION
WARD 21 SECTION 9
BLOCK 844 - A
SCALE 1 IN. = 100 FT. DATE NOV. 1929

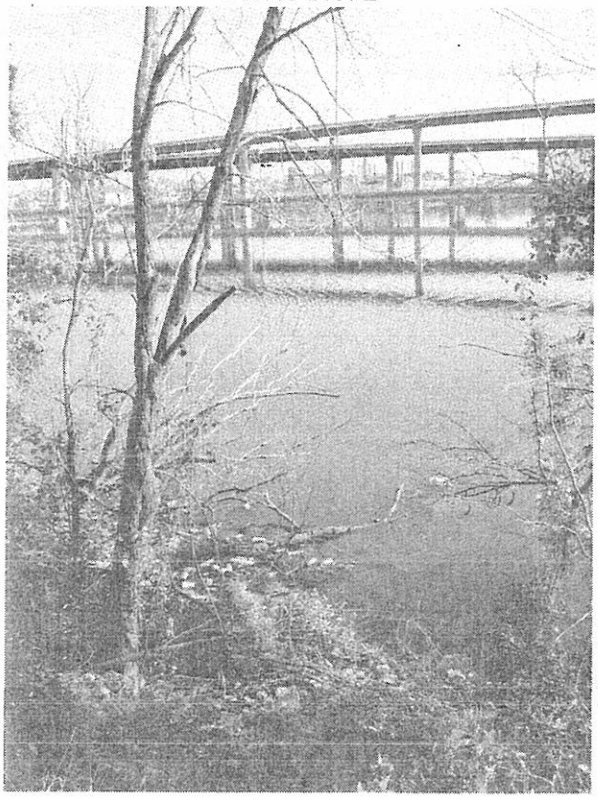
Photographs of Proposed Warner Street Wetland Area - November 18, 2004

Photo No. 1



Lot 5A - South View Showing Bridge Frame for Gwinns Falls Trail

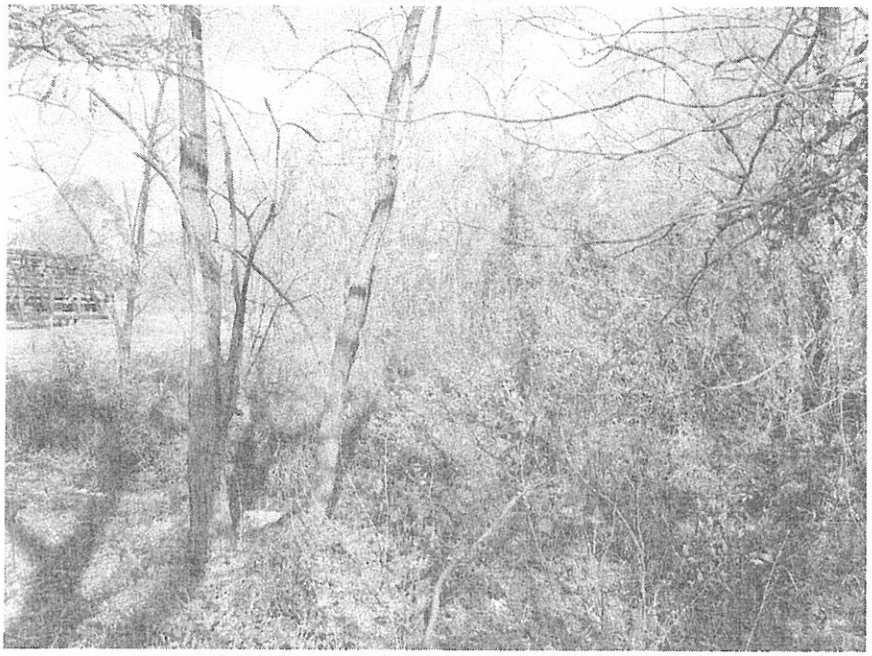
Photo No. 2



Lot 5A - East View of Middle Fork Patapsco River and I-395.

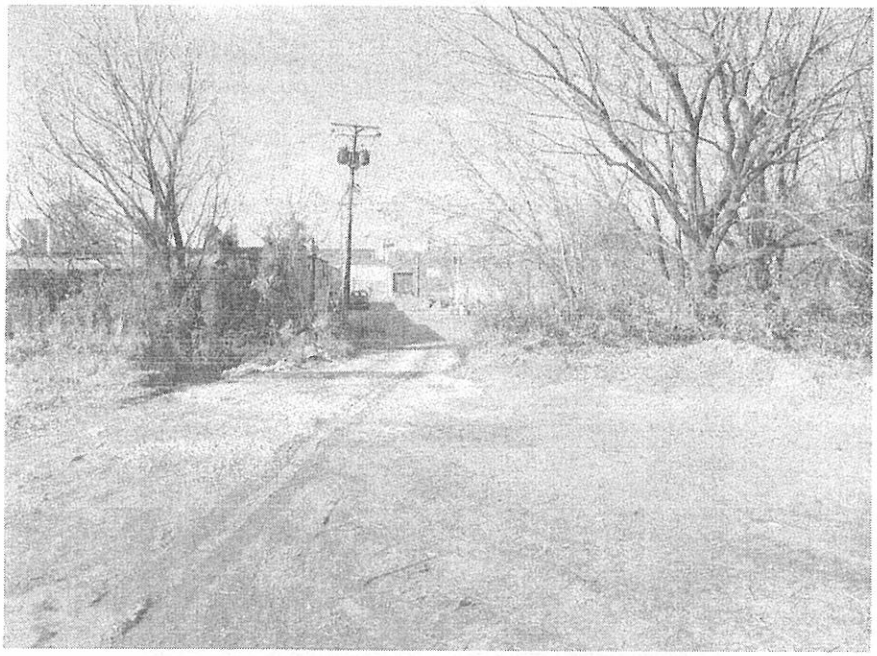
Photographs of Proposed Warner Street Wetland Area - November 18, 2004

Photo No. 3



Lot 5A - North View of Lot 5A from Southeast tip of Lot.

Photo No. 4



Lot 5A - Northwest View of Oler Street.

Photographs of Proposed Warner Street Wetland Area - November 18, 2004

Photo No. 5



Lot 5A – Northeast View of Lots 5A, 6, and 7.

Photo No. 6



Lot 6 – East View of Makeshift Homeless Shelter.

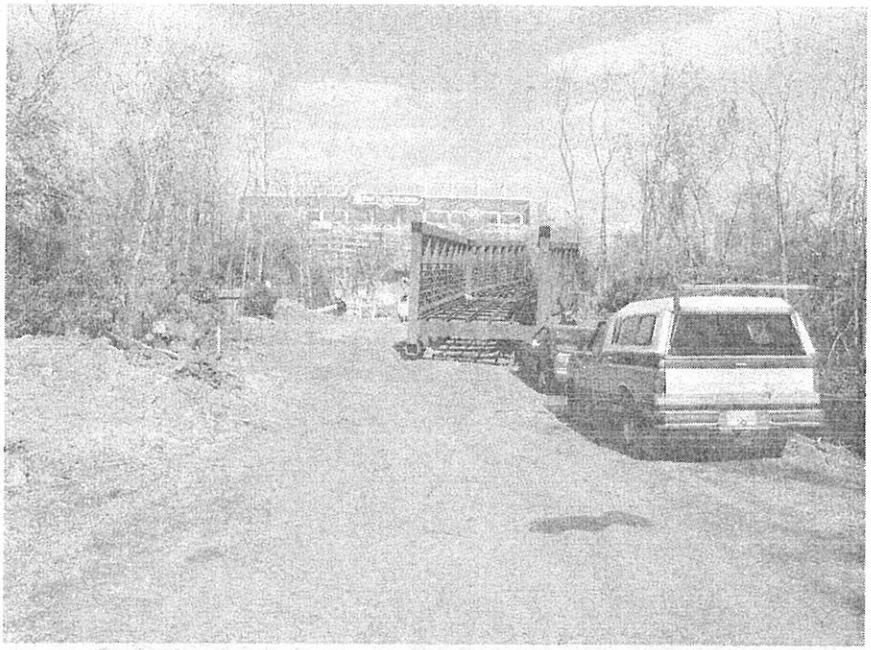
Photographs of Proposed Warner Street Wetland Area - November 18, 2004

Photo No. 7



Lot 7 – West View of Debris Pile in Center of Lot.

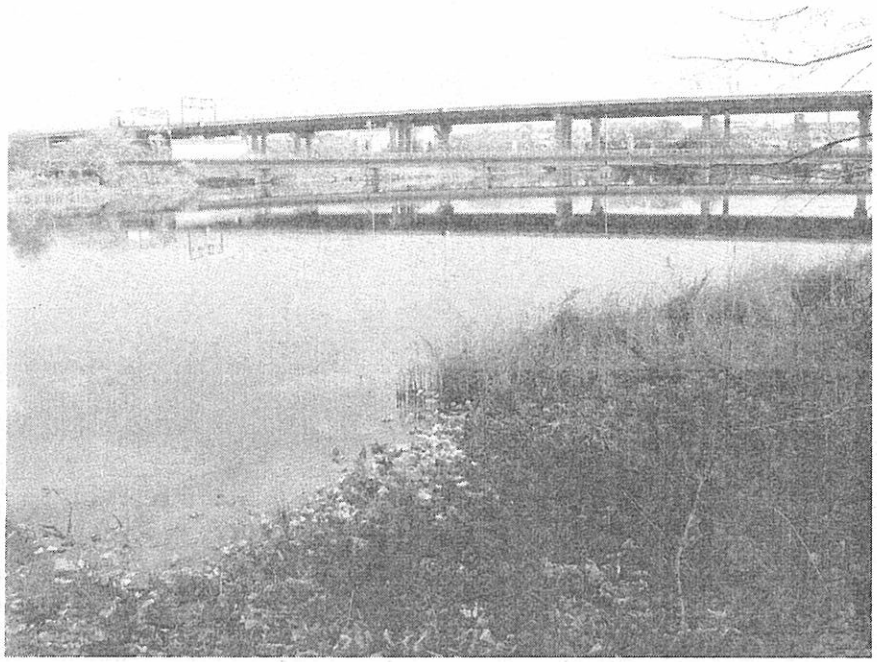
Photo No. 8



Lot 8 – North View of Lots 8/9 of the Bridge Frame for the Gwinns Falls Trail over Alluvion Street Dock.

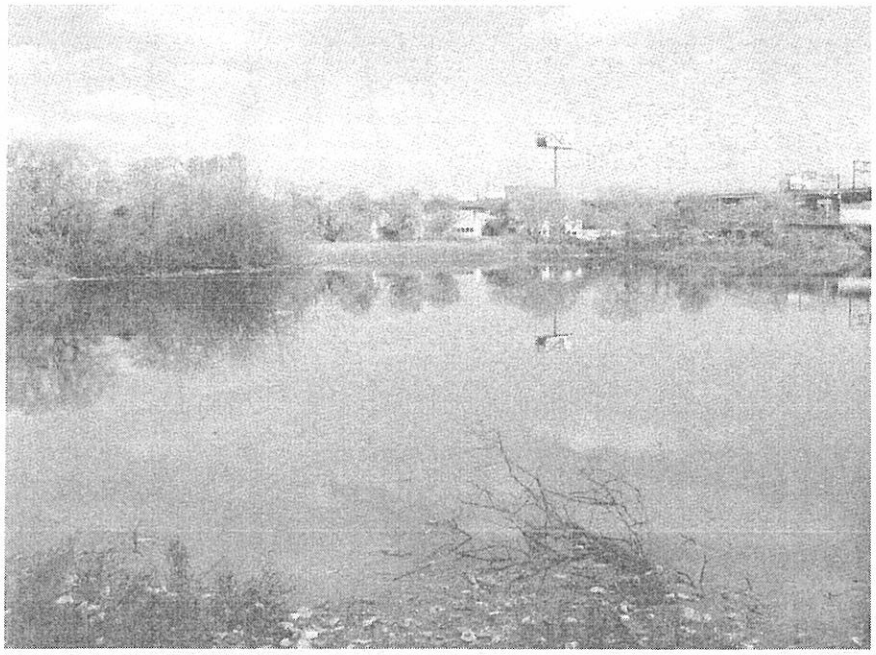
Photographs of Proposed Warner Street Wetland Area - November 18, 2004

Photo No. 9



Lot 9 – East Northeast View of Middle Fork Patapsco River and I-395.

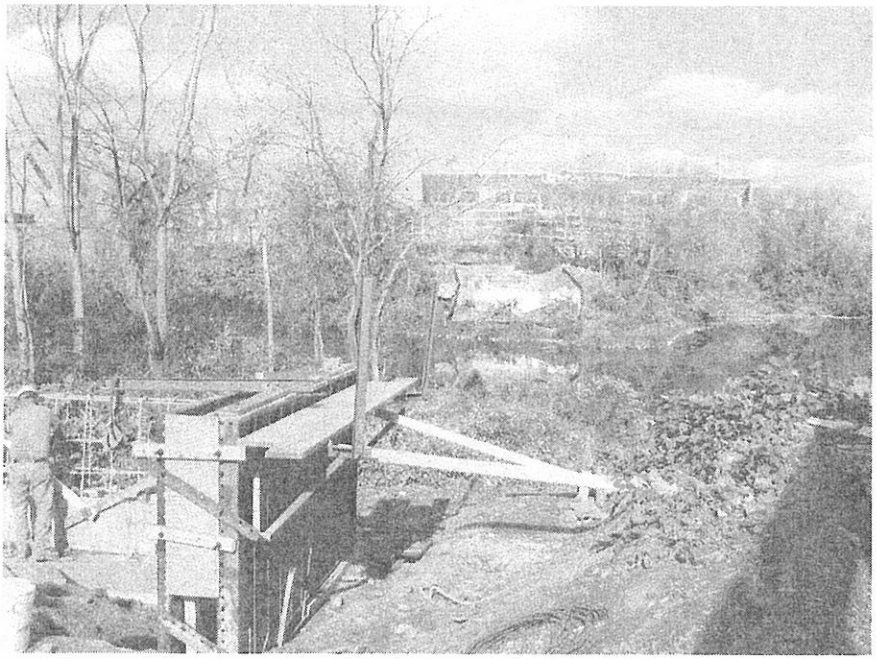
Photo No. 10



Lot 9 – Northeast View from the Northeast Tip of Lot 9.

Photographs of Proposed Warner Street Wetland Area - November 18, 2004

Photo No. 11



Lot 9 – North View of Bridge Foundations for Alluvion Street Dock with M&T Stadium in Background.

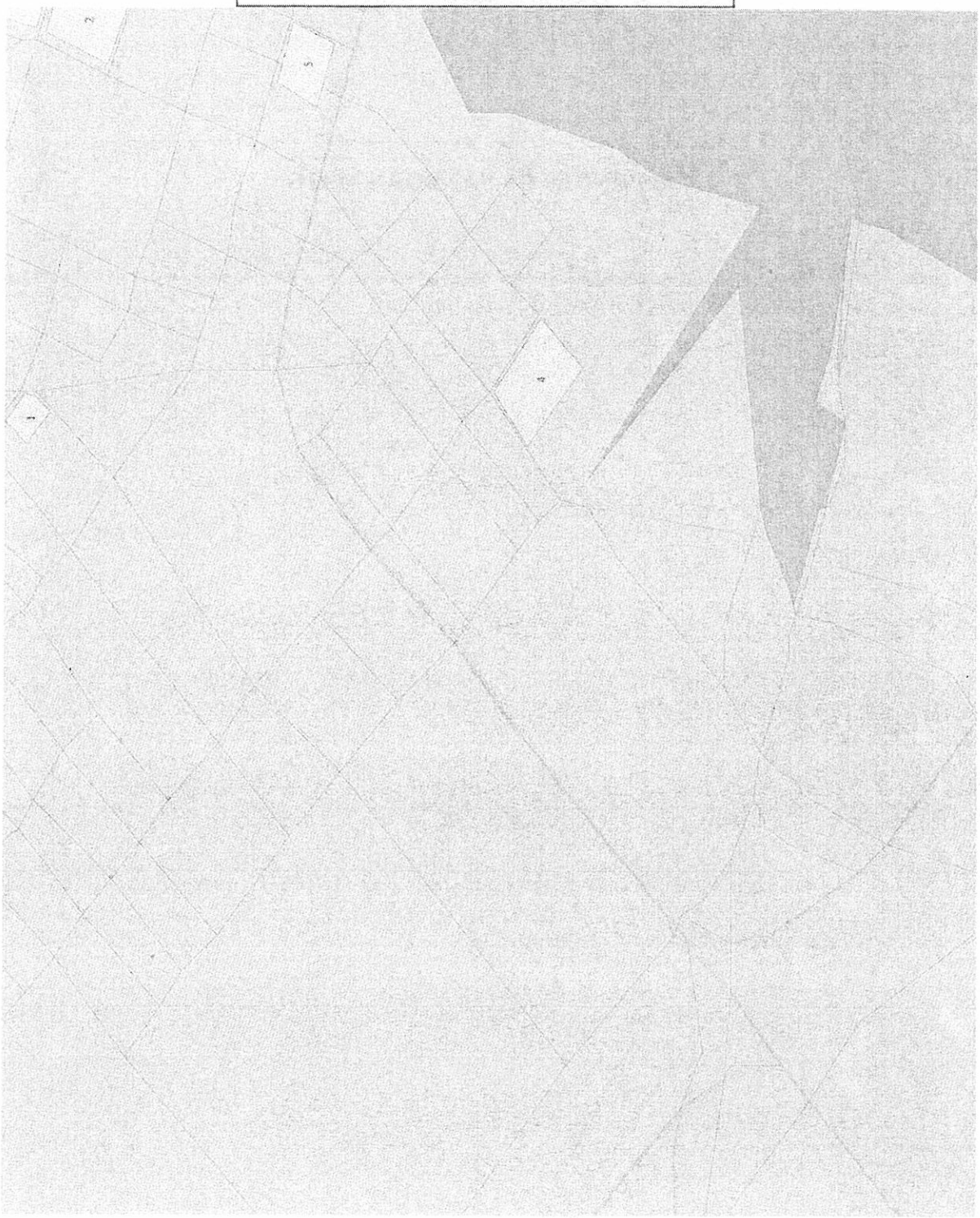
Photo No. 12



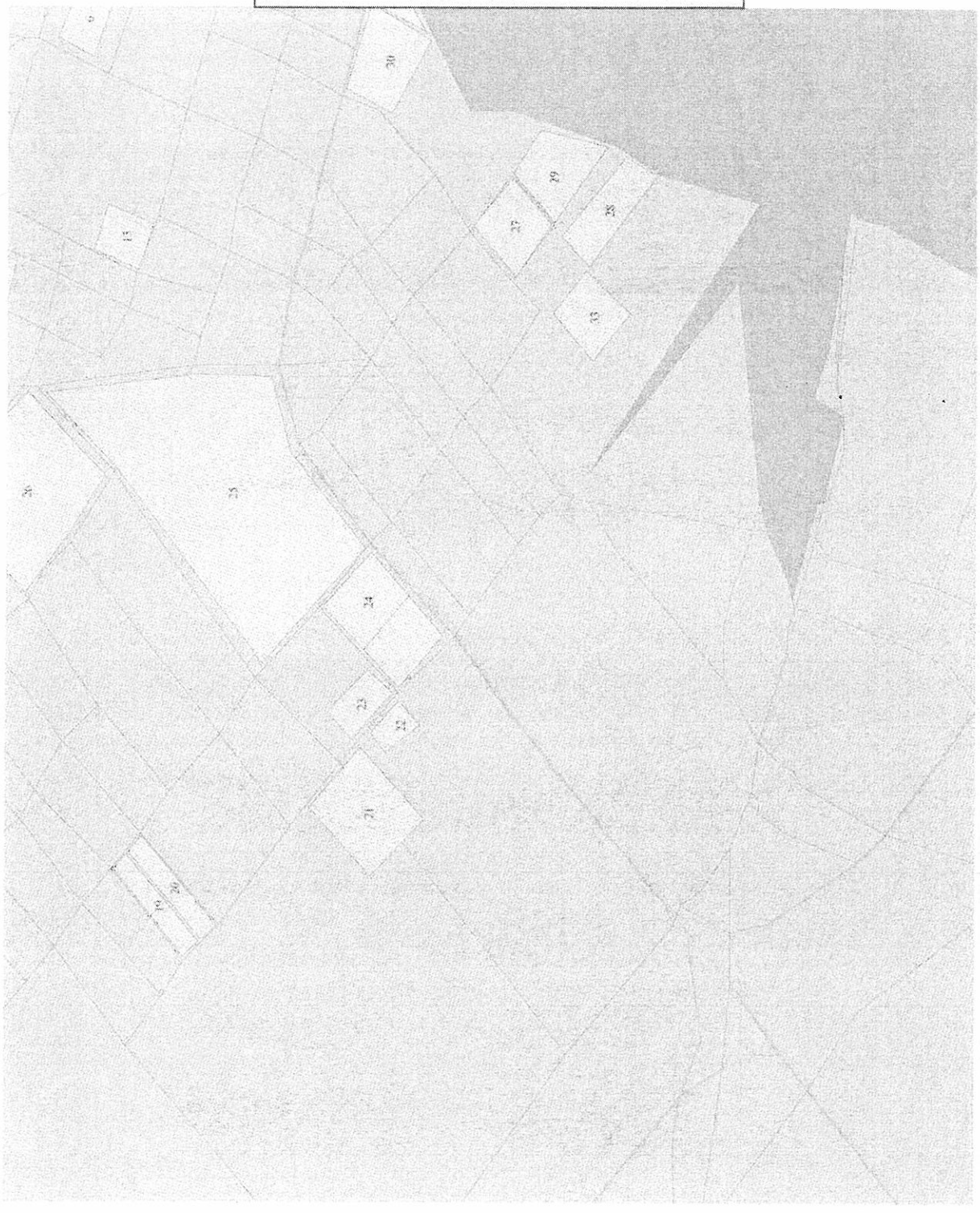
Lot 8 – Northwest View of Worcester Street from Lot 8.

APPENDIX B – SANBORN MAPS

Carroll Camden
1890 Sanborn Map Information

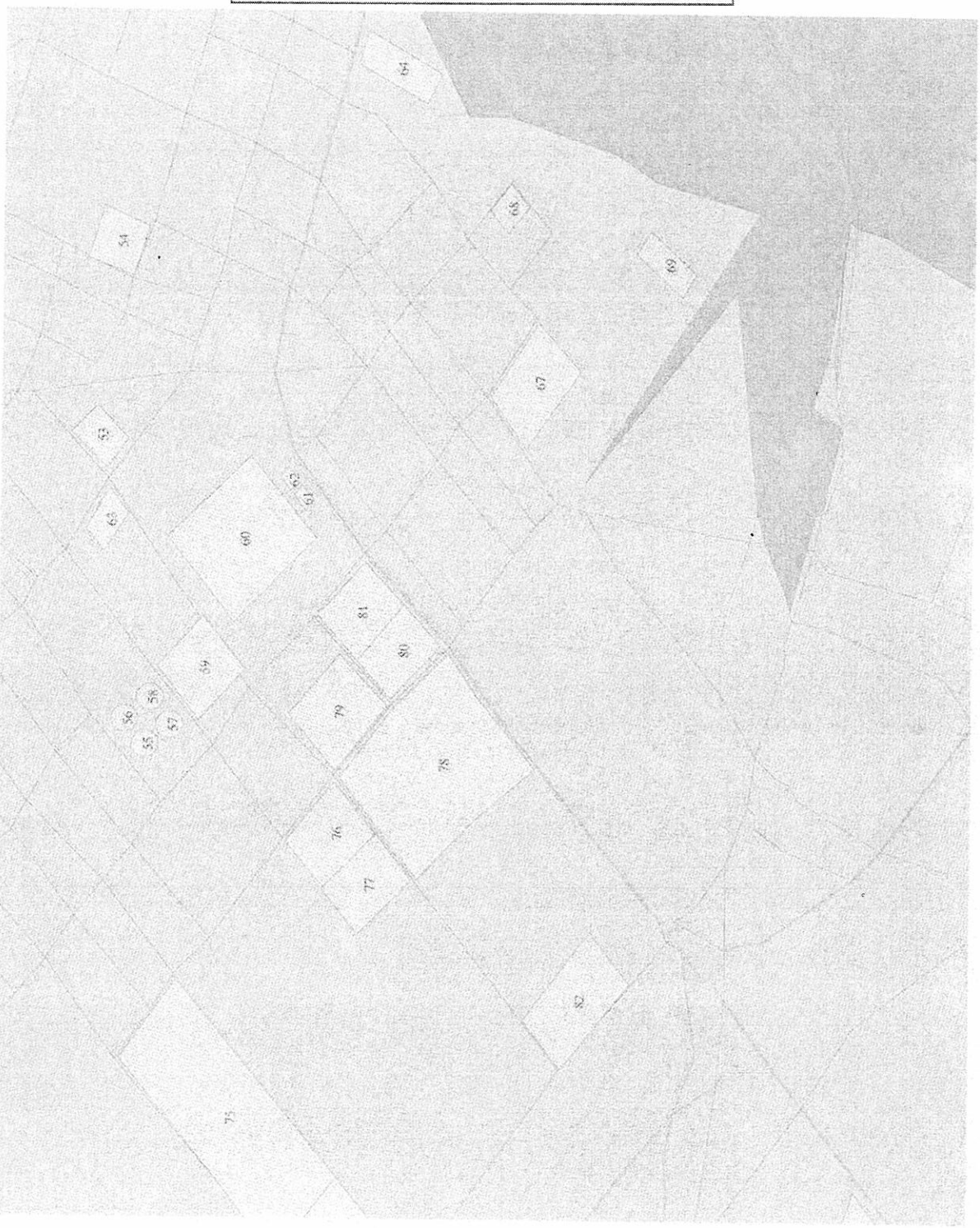


Carroll Camden
1901 Sanborn Map Information

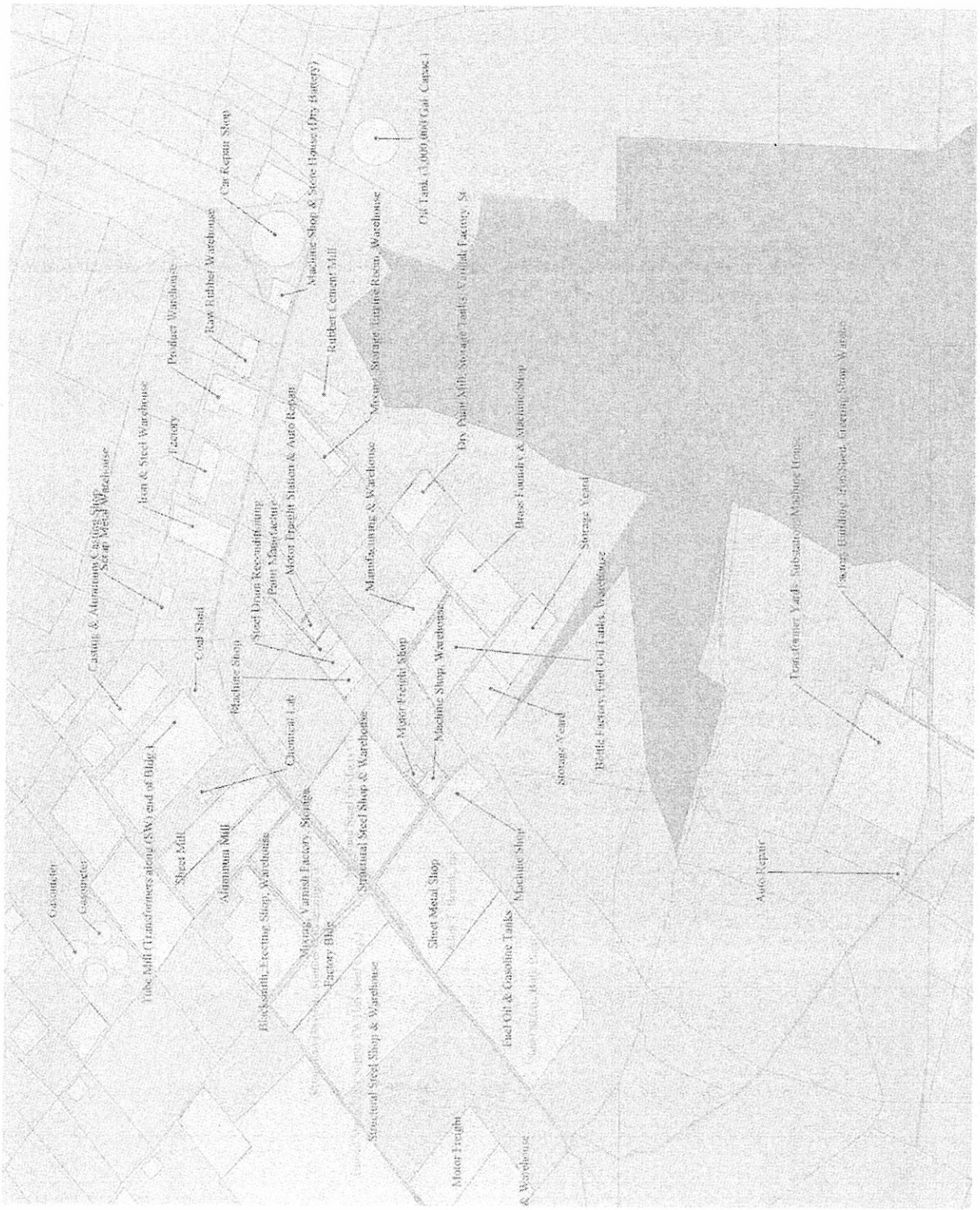


9/27/2005

Carroll Camden
1915 Sanborn Map Information



Carroll Camden
1953 Sanborn Map Information



APPENDIX C – SITE SAFETY AND HEALTH PLAN

APPENDIX C - SITE SAFETY PLAN

1.0 SITE DESCRIPTION

1.1 Site Name and Address: Warner Street Wetlands
Block 844, Lots 5A, 6, 7, and 8/9

Located Near: 2104 Worcester Street
Baltimore, MD 21230

1.2 Site Number: Not Applicable

1.3 Dates Planned On-Site: TBA

1.4 Hazards Present or Suspected: Unknown other than slip, trip and fall.

1.5 Total Area of Site: 15 acres

1.6 Area Being Studied: Approximately 5 acres

1.7 Surrounding Population:

On-Site:	0
0 - 1/4 Mile:	1
1/4 - 1/2 Mile:	100
1/2 - 1 Mile:	6155

1.8 Topography of Site:

The site is generally flat and steeply slopes southeast towards the Middle Branch Patapsco River to the south, east and north.

1.9.1 Weather Conditions and Forecast: TBA

1.10 Site Access Maps:

Topographic Map:	Refer to figure 1.3 of the sampling plan.
Site/Sampling Sketch:	Refer to figures 2.3 of the sampling plan.

2.0 ENTRY OBJECTIVES

The purpose(s) of this site entry are:

X to identify the suspected contamination of groundwater, surface water, sediment and soil in the vicinity of the site.

X to determine the degree of contamination of groundwater, surface water, sediment and soil in vicinity of the site.

The following number of samples will be collected:

24 – 48	Soil Samples
_____	Soil Gas Samples
1	On-site Groundwater Sample
_____	Production Well Water Samples
_____	Monitoring Well Water Samples
_____	Residential Well Water Samples in the Vicinity
_____	Surface Water Samples
_____	Sediment Samples
_____	Air Samples
_____	Container Samples
_____	Leachate
4	TCLP Soil Samples

3.0 ON-SITE ORGANIZATION AND COORDINATION

3.1 MDE Reps:

Contact: Kim Lemaster, Division Chief
1800 Washington Blvd.
Baltimore, Maryland 21230
410-537-3440

The following personnel are designated to carry out the stated job functions on-site. One person may carry out more than one job function. In case of absence of personnel, the alternative will be designated by the Project Manager and/or authorized personnel.

JOB FUNCTION	NAME	WORK PHONE
Project Manager	Robert Wallace	410-537-4406
Site Safety Officer	TBA	
Field Quality Assurance Officer	TBA	
Site Geologist	TBA	
Sampling Team	TBA	
Drilling Team	TBA	

AGENCY	NAME	PHONE
FEDERAL AGENCY REPS:		
EPA	Lorie Baker	(215) 814-3355
LOCAL AGENCY REPS:	*TBA*	
OTHER STATE REPS:	Emergency Response	(866) 633-4686
OTHER REPS:	*TBA*	

4.0 ON-SITE WORK PLAN

The designated personnel will perform the following on-site tasks: *TBA*

TASK	TEAM MEMBERS
Decontamination Zone Setup	
Decontamination Team	
Grid System Setup	
On-Site Well Sampling	
Soil Sampling	
Well Sampling	
Surface Water/Sediment	
Air Sampling	
Water Level Measuring/Well Purging	

5.0 SITE CONTROL - WORK ZONES

The following personnel have been designated to coordinate access control and security on-site: *TBA*
In order to prevent or reduce the migration of contaminants controlled work zones and control points should be set up and marked. Work zones include the Exclusion Zone (hot zone), Contamination Reduction Zone (decon zone), and Support Zone (clean zone). No unauthorized person should be within these areas. Command Post (support zone) should be located upwind from the Exclusion Zone. The control boundaries and access control points into each zone will be marked and made known to all personnel during daily briefing. The work zone is sketched below:

**Sampling events at the Warner Street Wetlands site will be initiated in level "D" protective wear. The work zones as indicated above are not applicable for this phase of work to be completed.*

6.0 SAFETY AND SPECIAL TRAINING REQUIRED

All personnel permitted in areas requiring personnel protective equipment and clothing (the hot zone and decontamination zone) must have, as a minimum requirement, attended EPA's Personnel Protection and Safety training course (165-2) or equivalent (165-5). A safety and task-briefing meeting will be conducted each day before site entry. The safety procedures, evacuation procedures, escape procedures, as well as the day's planned activities will be discussed.

7.0 HAZARD EVALUATION

7.1 Primary Hazards

The following substance(s) are known or suspected to be on-site at concentrations above Maryland State Residential Soil Standards:

Metals - Arsenic, Cadmium, Manganese, and Mercury
PAHs - Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene

Note that the concentrations detected for each of these compounds were within one magnitude of the Maryland State Residential Soil Standards

7.2 Additional Hazards

The following additional hazards are expected on-site: *Unknown*

8.0 PERSONNEL PROTECTION EQUIPMENT

Based on evaluation of potential hazards, the ESI will be conducted in Level D.

LEVEL D
Coveralls*
Gloves*
Boots/Shoes, leather or chemical-resistant, steel toe and shank
Safety glasses or chemical-splash goggles*
Hard hat (face shield)*
Disposable boot covers*
Escape mask*
(*) OPTIONAL

9.0 MONITORING

9.1 Environmental Monitoring

The following environmental monitoring instruments shall be used on-site (circle when applicable) at the specified intervals.

INSTRUMENT	FREQUENCY	
Metal Detector	continuous/hourly/daily/other	
HNU/OVA	continuous/hourly/daily/other	Microtip

*Microtip to be used on an as needed basis and for soil samples.
Radiation Detector Equipment:
Mini Alert Monitor 4
Personal Radiation Monitor **BADGES**

10.0 COMMUNICATION PROCEDURES

10.1 Hand Signals

The following standard hand signals will be used in case of radio communication failure:

HAND SIGNALS	INDICATIONS
Hand gripping throat	Out of air, can't breathe
Pat on partner's shoulders	Leave area immediately
Both hands around waist	Leave area immediately
Grip partner's wrist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, I am alright, I understand
Thumbs down	No, negative

*Communication at the Warner Street Wetlands site will be done through verbal contact and hand-held two-way radios.

10.2 Location of Telephone

The location of on-site phone: *Mobile phone in sampling van.*
The location of the nearest off-site phone will be mentioned during briefing.

11.0 DECONTAMINATION PROCEDURES

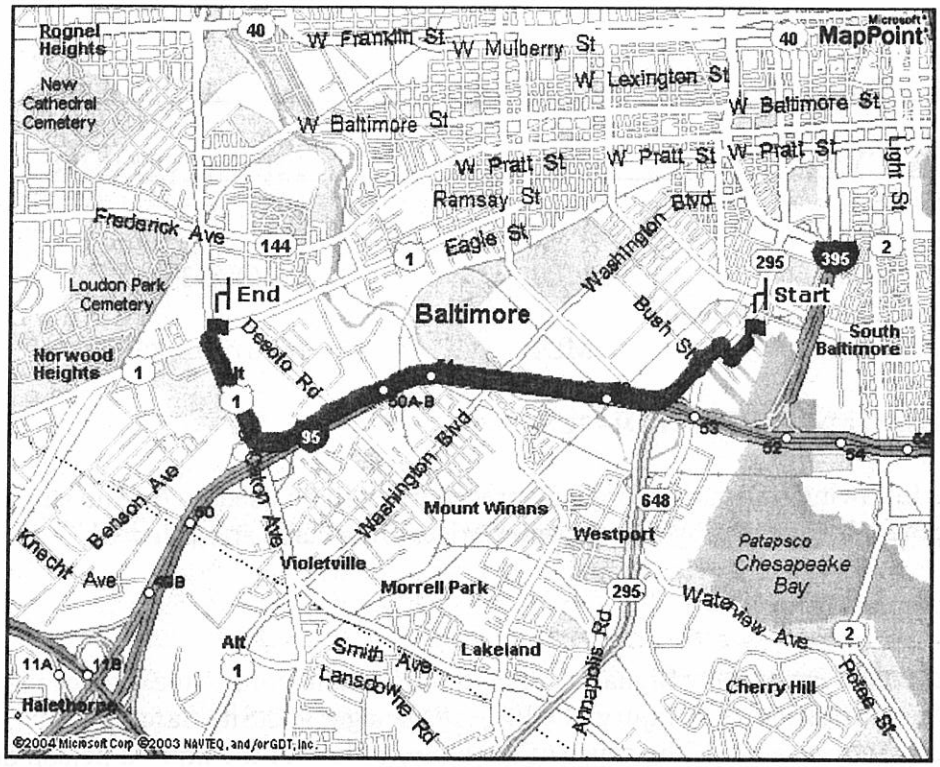
Refer to Standard procedures for field operations in Appendix B.

12.0 EMERGENCY PLAN

12.1 Emergency Medical Facility

Medical Facility: Saint Agnes Hospital of Baltimore
Address: 900 Caton Avenue
Baltimore, MD 21229

Phone Number: **(410) 368-6000**
Time Needed to Reach Facility: 5 minutes



Directions to Saint Agnes Hospital from site:

Start: Depart 2104 Worcester St, Baltimore, MD 21230 on Warner St (South-West)	**0.1 mi**
1: Turn RIGHT (North-West) onto Bayard St	**0.1 mi**
2: Turn LEFT (South-West) onto SR-295 [Russell St]	**0.2 mi**
3: Take Ramp (RIGHT) onto I-95 towards I-95 / Washington	**1.4 mi**
4: At exit 50A-B, turn RIGHT onto Ramp towards Caton Ave	**0.5 mi**
5: Take Ramp (RIGHT) onto US-1 Alt [S Caton Ave] towards Caton Ave North / Wilkins Ave	**0.6 mi**
End: Arrive 900 S Caton Ave, Baltimore, MD 21229	

Designated place for medical facility access map: Sampling Van:
Local ambulance available: Yes
Ambulance phone number: 911
Ambulance response time: Unknown

12.2 First Aid Equipment On Site

First-aid equipment is available on-site at the following locations:
First-Aid Kit: Sampling Van
Emergency Eye Wash: Sampling Van

12.3 Emergency Medical Information

Emergency medical information for substances present (from NIOSH Pocket Guide to Chemical Hazards):

12.4 Other Emergency Phone Number List

AGENCY/FACILITY	CONTACT	PHONE NUMBER
Police		911
Fire		911
Haz Mat Unit	MDE	(866) 633-4686
State Hazardous Material and Oil Response Unit	MDE	(866) 633-4686

13.0 EMERGENCY PROCEDURES

The following standard emergency procedures will be used by on-site staff who are also responsible for ensuring that the appropriate procedures are followed.

13.1 Personnel Injury.

Designated Emergency Signal: Verbal through radio communication or vehicle horn. Upon notification of an injury, the Project Manager and Site Safety Officer will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of site personnel, operations may continue, with the Site Safety Officer initiating the appropriate first aid and necessary follow-up as stated above. If the injury increases the risk of others, the designated emergency signal shall be sounded and all site personnel shall move to the decontamination line for further instructions. Activities on-site will stop until the added risk is removed or minimized.

13.2 Fire or Explosion.

Designated Emergency Signal:
Upon notification of a fire or explosion on-site, the designated emergency signal shall be sounded and all site personnel assembled at the sampling van. The fire department shall be alerted and all personnel moved to a safe distance from the involved area.

13.3 Other Equipment Failure.

If any other equipment on-site fails to operate properly, the Project Manager and Site Safety Officer shall be notified and then determine the effect of this failure on continuing operations on-site. If the failure affects the safety of personnel or prevents completion of the Work Plan tasks, all personnel shall assemble at the sampling van until the situation is evaluated and appropriate actions taken. .

EMERGENCY PROCEDURES SUMMARY:

* Designated work zones are not applicable during this phase of the ESI, therefore emergency signals other than those indicated in section 10.1 and 10.2 have not been established. The primary means of communication on site will be through verbal contact.

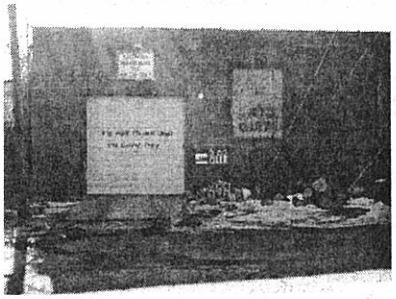
SAFETY PLAN ACKNOWLEDGEMENT FORM

All site personnel and site visitors have read the above plan and are familiar with its provisions.

NAME	AGENCY	SIGNATURE

BROWNFIELDS ASSESSMENT WORK PLAN
FOR
THE HAINES STREET PROPERTY
LOCATED IN
Baltimore City, Maryland

DRAFT 1



April 28, 2005

Prepared by: Maryland Department of the Environment
1800 Washington Blvd; Suite 625
Baltimore, MD 21230

Prepared for: Baltimore Development Corporation
100 N. Holliday Street
Baltimore, MD 21202

And:

U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

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1.0 SITE DESCRIPTION

1.1 Introduction

Baltimore Development Corporation (BDC) has proposed revitalizing the Warner Street area of Baltimore City. A significant portion of this area is comprised of property located at 2119 Haines Street, 1633 and 1645 Warner Street and 2102 Oler Street (Haines Street property). The general plan envisioned by BDC is to incorporate the Warner Street property into a revitalization project for the southern gateway to Baltimore City.

The Haines Street property is a 2.29-acre portion of the Warner Street Corridor Brownfield investigation documented in the Maryland Department of the Environment (MDE) report titled, Phase I Environmental Site Assessment Warner Street Business Center Properties Baltimore City, Maryland.

1.2 Current and Former Use

The property to be addressed by this phase of the assessment occupies the parcels located east of Warner Street in Baltimore City, Maryland (the Haines Street property). The Haines Street property is bounded by Warner Street to the west, Oler Street to the north, and Haines Street to the south (Figure 1). There are four major structures associated with this site. A brief history of these buildings is given in Table I.

TABLE 1 – HISTORY OF PARCELS IN THE WARNER STREET PROPERTY

Property Address	Current Owner	Last Owner	Current Occupant	1890-1901
2119 Haines St.	City of Baltimore	AT&T	Unknown Business	C. R. Ranstead Wharf
2102 Oler St.	Warner Street Inc.	*No Record*	Baltimore Renovations Inc.	Gibson & Kirk Foundry
1633 Warner St.			Second Chance	Gibson & Kirk Brass Foundry
1645 Warner St.	Potomac Investments	*No Record*	Second Chance	Gibson & Kirk Brass Foundry

- In the 1890s the property bounded by Warner, Haines and Oler (Dock) Streets housed the Gibson and Kirk Brass Foundry.
- Biemiller Coal and Wood Wharf and Ice House (later the American Ice Station)occupied the 2119 Haines Street property from the 1890s through 1953.
- The Gibson and Kirk Foundry occupied the 1633 through 1645 Warner Street properties from a period after 1915 through 1953.
- Saratoga Supply Company, a general hardware distributor occupied the 1633 – 1645 Warner Street property from between 1960 and 2000.

1.3 Potential Future Use

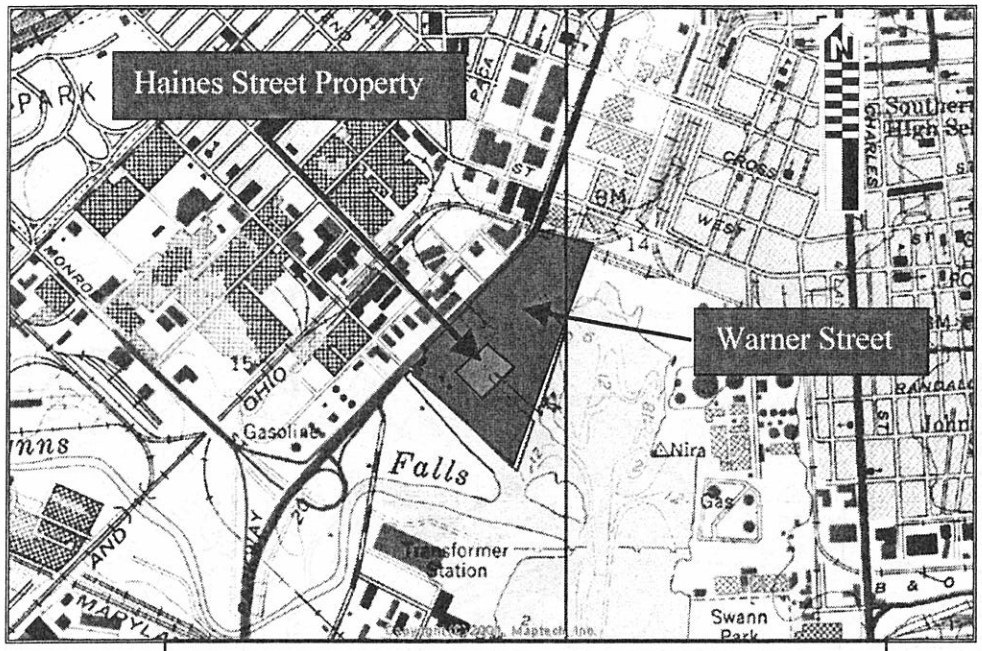
BDC has proposed the property for redevelopment and incorporation into the Gateway South project. The proposed use of the parcel is commercial.

2.0 ENVIRONMENTAL SETTING

2.1 Topography/Geology/Hydrogeology

Figure 1 shows a detail of the topographic map for the Warner Street property Company area. The property is fairly level and all runoff from the site either flows overland to the Middle Branch Patapsco River or enters Baltimore City storm drains surrounding the site. There are no streams or surface water impoundments directly associated with the site; however, storm water from the site discharges to the Middle Branch Patapsco River via City storm drains.

FIGURE 1 – WARNER STREET AREA



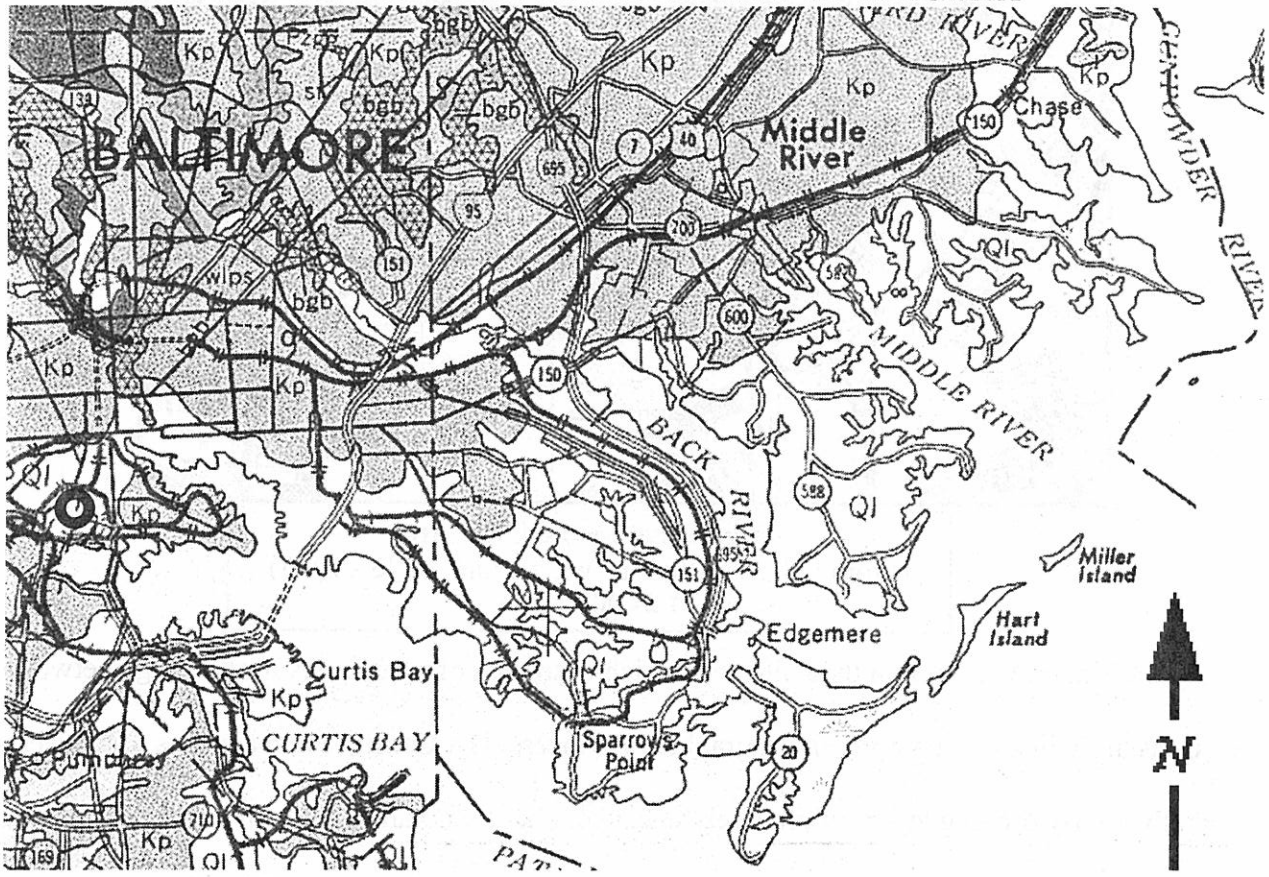
Topographic Map Of The Area
(From USGS Baltimore West Quadrangle - 1975)
1:24,000 Scale

Baltimore City lies on the Fall Line, which is an area of abrupt elevation change between the Coastal Plain and Piedmont Physiographic Provinces. The Coastal Plain consists of a series of southeasterly dipping layers of relatively unconsolidated sand and clay with lesser amounts of gravel superimposed on the eastward continuation of the crystalline rocks of the piedmont plateau.

The property lies near the Fall Line where the Coastal Plain is only a thin veneer over the crystalline bedrock. The generalized Geologic Map of Baltimore City and County (Figure 2) indicates that the site rests on the Quaternary Lowland Deposits, which consist of gravel, sand, silt and clay with cobbles and bolders near the base. Below the lowland deposits is the Potomac Group, of which the Patuxent Formation outcrops just north of the site along the Fall Line. The

Patuxent Formation consists of irregularly stratified, cross-bedded and lenticular sands and gravels with silt and clay beds occurring locally.

FIGURE 2 – GENERALIZED GEOLOGIC MAP OF THE AREA



Kp

Potomac Group - Interbedded quartzose gravels; protoquartzitic to orthoquartzitic argillaceous sands; and white, dark gray and multicolored silts and clays; thickness 0 to 800 feet.
Raritan and Patapsco Formations - Gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels; thickness 0 to 400 feet.
Arundel Clay - Dark gray and maroon lignitic clays; abundant siderite concretions; present only in Baltimore-Washington area; thickness 0 to 100 feet.
Patuxent Formation - White or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels; silts and clays subordinate, predominately pale gray; thickness 0 to 250 feet.

Ql

Lowland Deposits - Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas (includes in part Pamlico, Talbot, Wicomico and Sunderland Formations of earlier reports); thickness 0 to 150 feet.

(Map for Illustrative Purposes Only – Not To Scale)

In 1998, the United States Department of Agriculture (USDA), Soil Conservation Service classified soils in the vicinity of the Warner Street property site as the Sunnyside fine sandy loams and associated Christiana and Urban Land Association (Udorthent) soils. Udorthents

consist of manmade, nearly level to steep soils. These soils consist of cut, filled, or otherwise disturbed areas. The cut areas are generally the steeper parts of the landscape, and the fill areas generally have smoother, less sloping topography. The texture of the soils in this association is variable. However, generally it reflects that of the soils mapped in adjacent areas. In some areas these soils contain artifacts; in other areas they were once used as sanitary landfills and are underlain by refuse. In some areas theses soils were created from materials dredged from the Patapsco River. This association is defined as consisting of, "mostly miscellaneous artificial fill." The area is further characterized as being totally covered with roads, buildings, or other structures.

The majority of surface soils in the Warner Street corridor are of the *Urban Land Complex* (44UC). These Urban Lands are characterized as being covered by impervious surfaces. A small portion of the area is composed of similarly defined *Urban Land–Udorthents Complex, occasionally flooded* soils (43U). These udorthents are noted to consist of a thin layer of sandy load mixed with glass fragments overlaying a stratified series of sandy loam, silt loam, loam or gravelly loam down to about 65 inches below grade. The USDA report notes that, "Examination and identification of soils or soil like materials in this unit is impractical. Careful onsite investigation is needed to determine the potential and limitations for any proposed use."

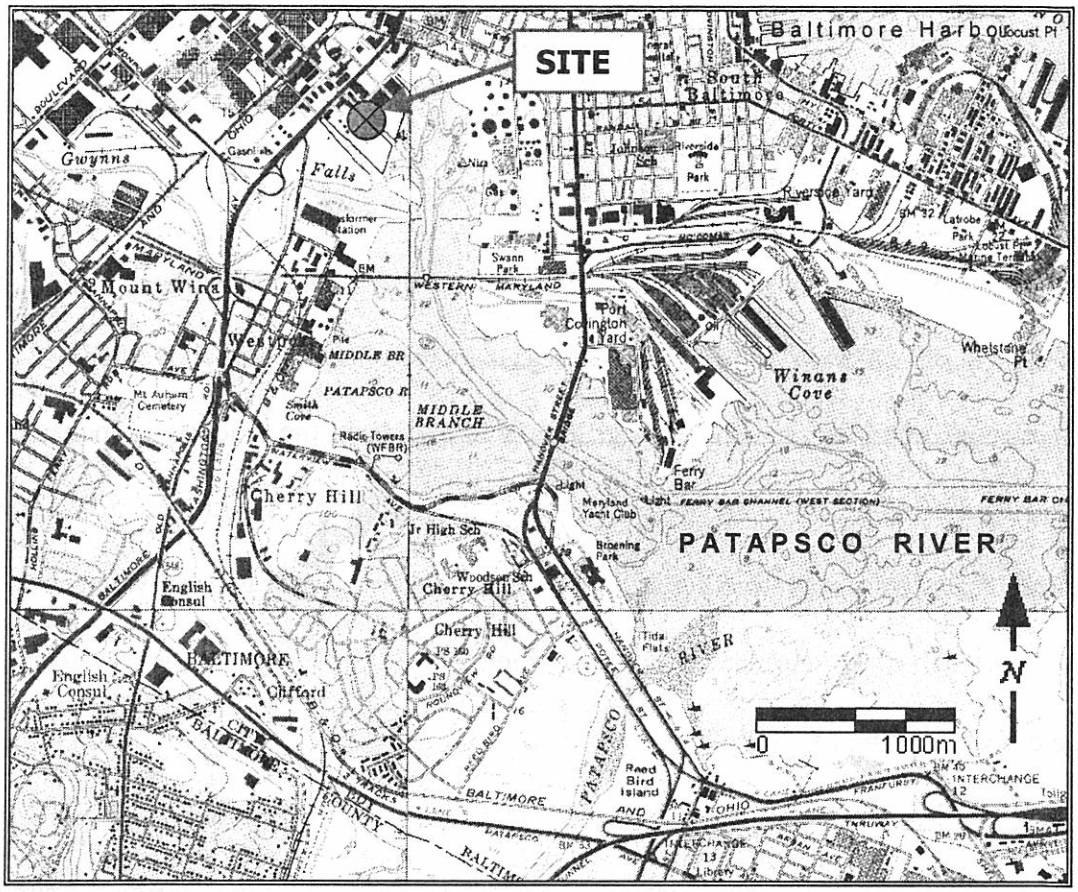
Groundwater recharge in this area occurs mainly through infiltration of precipitation in the exposed areas in the vicinity of the site. Due to the slope of the immediate area and the proximity to the Patapsco River, area groundwater discharges to the river. Generalized groundwater flow in the area is to the south southeast towards the Chesapeake Bay. The

elevation of the site ranges from approximately 20 feet above Mean Sea Level (MSL)to 100 feet above MSL. Groundwater is expected to be encountered at an elevation above Mean Sea Level.

The Patuxent Formation, which is recharged in the Baltimore City Area, is a multi-aquifer unit and is one of the most productive water bearing formations in Maryland. However, over-pumping and heavy industrialization in Baltimore have caused salt-water intrusion and chemical contamination from past industrial practices. As a result, groundwater in the vicinity of the site is not considered potable.

The site is located on the Middle Branch of the Patapsco River, a surface water body that discharges into Chesapeake Bay (Figure 3). Several other surface water bodies exist within a 2-mile radius of the site. These include Gwynns Falls (approximately 0.5-mile to the southwest) and the Baltimore Inner Harbor (approximately 0.5-mile to the northeast).

FIGURE 3 – WARNER STREET AREA



The Department of Public Works, Baltimore City, provides water for the City of Baltimore from two sources: the Gunpowder Falls and the North Branch of the Patapsco River. Water collected from these sources is stored in three reservoirs (Liberty, Loch Raven and Prettyboy) and treated at the Baltimore City Filtration Plants prior to distribution to the local population. In addition, the City is able to draw additional water from the Susquehanna River if so required.

Virtually all of the residents around Baltimore City receive their water from municipal supplies. These supplies consist of several surface water reservoirs in and around Baltimore City, and a series of municipal well systems located in Anne Arundel County. No residential wells exist within a 0.5-mile radius of the site. However, there are numerous monitoring wells

within one mile of the site and four domestic wells within a two-mile radius of the site (MDE Well Database).

Baltimore City, Maryland lies about 50 miles east of Appalachian Mountains and 12 miles west of the Chesapeake Bay. The Warner Street area is less than 10 feet above MSL in a region of relatively flat urban terrain. The average annual rainfall is on the order of 43 inches per year. Average annual temperature is about 60°Fahrenheit (F). Baltimore's summers are warm and humid and its winters are relatively mild. The area's coldest weather generally occurs in late December through early February, with an average daily maximum temperature of 45°F and an average daily minimum of 28°F. The warmest weather occurs in late July and early August when daily temperatures range from 70° to 90° F. There are no well-defined wet and dry seasons. Snowfall averages on the order of 17 inches per winter season. During the summer months, showers are frequent and thunderstorms may occur one out of five days. Significant temperature differences within the Baltimore metropolitan area are not unusual. Temperatures are commonly warmer in the Baltimore metropolitan area, due to the heat island effect of the city in the summer and the moderating influence of the Chesapeake Bay in winter.

In the City of Baltimore, storm water drainage occurs through an extensive network of underground conduits; site-specific drainage flows to these storm drains and directly to the Middle Branch of the Patapsco River via overland flow.

2.2 Surface Water

The property is situated on a flat terrace adjacent to the Middle Branch Patapsco River west of Baltimore Harbor. Surface water runoff from the facility reaches the Patapsco via both overland flow and the Baltimore City storm drain system. There are no surface water bodies on the Warner Street property Site.

3.0 OPERATIONAL HISTORY

In the 1890s the property bounded by Warner, Haines and Oler (Dock) Streets housed the Gibson and Kirk Brass Foundry. Biemiller Coal and Wood Wharf and Ice House (later the American Ice Station) occupied the 2119 Haines Street property from the 1890s through 1953. The Gibson and Kirk Foundry occupied the 1633 through 1645 Warner Street properties for a period between 1915 and 1953. Saratoga Supply Company, a general hardware distributor occupied the 1633 – 1645 Warner Street property from between 1960 and 2000. The pathways of concern for any residual contamination include soil and groundwater. The property is one of a number of parcels being addressed by BDC in its planned revitalization of the Warner Street Corridor.

3.1 Potentially Contaminated Areas

Based upon the site visits and the historical information available, potentially contaminated areas were identified for the properties. These potentially contaminated areas are considered possible release points or source areas that will be investigated.

Industrial concerns have operated on the parcel for over 100 years. The soils and groundwater in these areas will be sampled to determine the nature of site contamination. This investigation will focus on several contaminants including priority pollutant metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs). Groundwater samples will be collected from a temporary well set in a Geoprobe boring.

3.2 Potential Contaminants of Concern

Based upon the above discussion of the potentially contaminated areas, the available historical data, and observations made during the site visit, a number of contaminants of concern were identified for the Warner Street property including:

- VOCs;
- SVOCs;
- Polycyclic aromatic hydrocarbons (PAHs);
- Priority Pollutant Metals; and
- PCBs.

4.0 DESCRIPTION OF PROPOSED SAMPLING LOCATIONS

As discussed in Section 3.1, a list of potentially contaminated areas was developed from the file review and the site visits. The potentially contaminated areas were developed based on former locations where hazardous substances, hazardous wastes, or pollutants were known or suspected to have been discharged, handled, or disposed, or where hazardous substances,

hazardous wastes, or pollutants may have migrated. The EPA's Visual Sample Plan (VSP) program was used to define the sample locations for this investigation. The non-uniform use of the property and the relatively small size of the parcel led to a design in which the site is uniformly divided into a series of ten-foot grids and samples collected from a random number of these grids.

This section discusses the methodology used to determine areas where environmental sampling is proposed. Table 2 presents a summary of the proposed analytical parameters and number of samples to be collected for each of the areas. Figure 4 shows a site sketch with the proposed sampling locations superimposed upon it. Figure 5 shows an aerial photograph of the area with the approximate sample locations identified.

The potentially contaminated areas identified for the facility will be investigated in accordance with MDE's Standard Operating Procedures and Quality Assurance Project Plan. The general approach will be to collect environmental samples from soil and groundwater, from the areas identified. MDE will then perform field screening analyses on soil samples. MDE will submit all groundwater samples along with a subset of the soil samples, to a fixed laboratory for analysis. Particular parameters have been selected for each potentially contaminated area based on known or suspected contamination.

FIGURE 4 – HAINES STREET PROPERTY SITE SKETCH

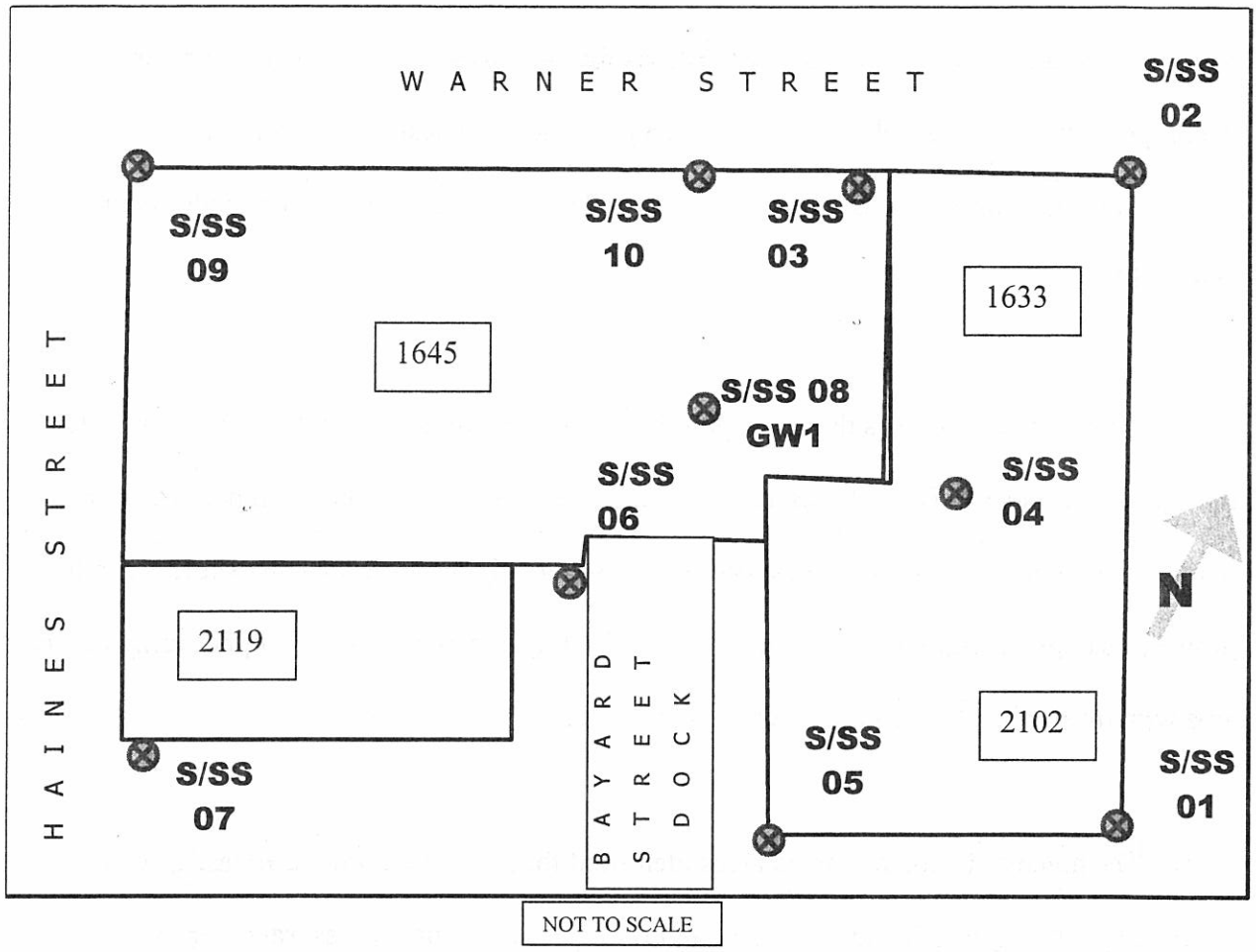


TABLE 2 – PROPOSED SAMPLING SUMMARY

Sample ID	Sample Location	Sample Depth	Analytical Parameters (see section 4.1)		Rationale
			Field Screening	Fixed Laboratory	
SOIL (*subset of soil samples will go to fixed lab)					
S-1	Corner of Dock & Eutaw Streets	0-1 ft	X	TBD	Characterize surface soil in Grid 1
SS-1	Corner of Dock & Eutaw Streets	4-5 ft	X	TBD	Characterize subsurface soil at the same location as S-1.
S-2	Corner of Dock & Warner Streets	0-1 ft	X	TBD	Characterize surface soil in Grid 2
SS-2	Corner of Dock & Warner Streets	4-5 ft	X	TBD	Characterize subsurface soil at the same location as S-2
S-3	SW Corner of building at Warner Street	0-1 ft	X	TBD	Characterize surface soil in Grid 3
SS-3	SW Corner of building at Warner Street	4-5 ft	X	TBD	Characterize subsurface soil in the northeastern quarter.
S-4	Center Gordon Carton South Building	0-1 ft	X	X	Characterize surface soil in Grid 4
SS-4	Center 8Gordon Carton South Building	4-5 ft	X	X	Characterize subsurface soil at the same location as S-4
S-5	SE Corner of building at Bayard Street Slip	0-1 ft	X	TBD	Characterize surface soil in Grid 5
SS-5	SE Corner of building at Bayard Street Slip	4-5 ft	X	TBD	Characterize subsurface soil in the same location as S-5.
S-6	Center of Courtyard of 2110 Building	0-1 ft	X	TBD	Characterize surface soil in Grid 6
SS-6	Center of Courtyard of 2110 Building	4-5 ft	X	TBD	Characterize subsurface soil in the same location as S-6.
S-7	SE Corner of 2110 Building	0-1 ft	X	TBD	Characterize surface soil in Grid 7
SS-7	SE Corner of 2110 Building	4-5 ft	X	TBD	Characterize subsurface soil at the same location as S-7.
S-8	Center of Courtyard of 1645 Building	0-1 ft	X	TBD	Characterize surface soil in Grid 8
SS-8	Center of Courtyard of 1645 Building	4-5 ft	X	TBD	Characterize subsurface soil at the same location as S-8
S-9	Corner of Haines & Warner Street	0-1 ft	X	TBD	Characterize surface soil in Grid 9
SS-9	Corner of Haines & Warner Street	4-5 ft	X	TBD	Characterize subsurface soil at the same location as S-9.
S-10	Entrance to Courtyard of 1645 Building	0-1 ft	X	X	Characterize surface soil in Grid 10
SS-10	Entrance to Courtyard of 1645 Building	4-5 ft	X	X	Characterize subsurface soil at the same location as S-10
S-11	Warner Street	0-1 ft	X	X	Duplicate of S-10
SS-11	Warner Street	4-5 ft	X	X	Duplicate of SS-10 (VOA only)
Groundwater					
GW-1	Same location as S-8	n/a	No	X	Determine quality of first water bearing zone under site.
GW-10	Same location as S-8	n/a	No	X	Duplicate Sample of GW-1

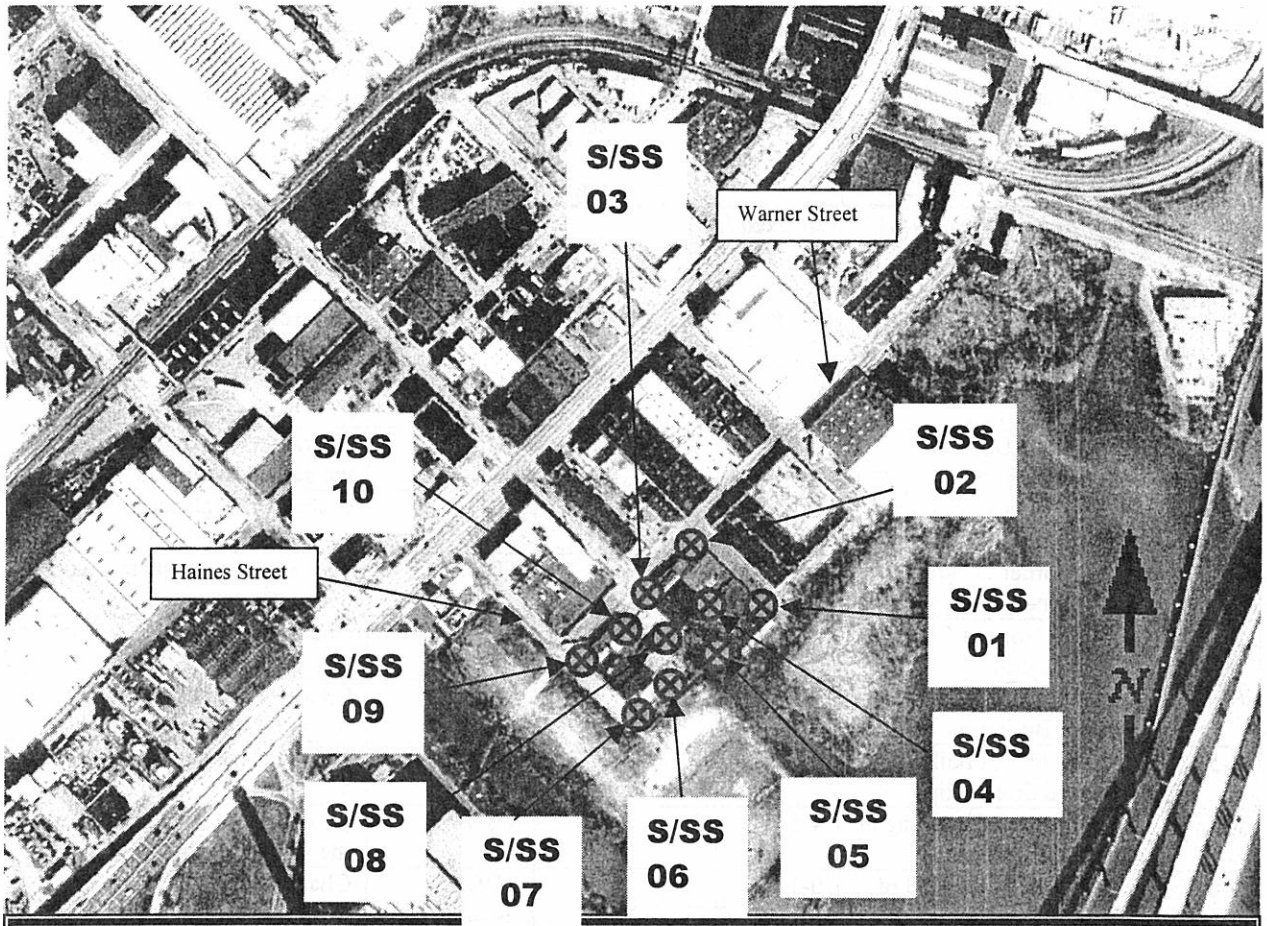


FIGURE 5 – Aerial Photo with Sample Locations
(Not to Scale)

4.1 Field Screening and Fixed Laboratory Analyses

A total of twenty-two soil samples will be collected from the site. Ten surface soil (S-#) samples, ten subsurface soil (SS-#) samples, plus one set of duplicate samples will be collected. These soil samples will be screened at MDE by X-ray fluorescence (XRF) for metals, and by immunoassay techniques for carcinogenic polynuclear aromatic hydrocarbons (cPAHs), and PCBs. A subset of these samples will then be submitted to the fixed laboratory for confirmatory analysis of parameters detailed in Table 3. The soil samples submitted to the fixed laboratory will consist of samples that are, where possible, a mix of low, medium and high concentrations detected in the field-screened samples. Data from the fixed laboratory analyses alone will be used by an MDE toxicologist to prepare a toxicological evaluation.

All samples, both field screened and fixed laboratory, will be compared to MDE's Nonresidential Cleanup Standards. If total chromium is detected in the soil samples exceeding MDE's Cleanup Standards, then the two samples that contain the highest field screening concentrations for chromium will be speciated for hexavalent chromium (Cr VI) and trivalent chromium (Cr III). If mercury is detected in soil samples exceeding MDE's Cleanup Standards, inorganic elemental mercury will be differentiated in two of the samples that have the highest concentrations.

A series of samples will be collected to monitor field and laboratory Quality Control (QC). These will consist of one solid matrix duplicate sample, one aqueous matrix duplicate sample and a matrix spike sample. Matrix duplicate samples will be submitted to the lab as blind samples. Matrix spike and matrix spike duplicate (MS/MSD) samples will be

collected in accordance with the MDE QAPP. Measurement quality indicators for this project are listed in Table 5 and discussed in detail in the EPA-approved MDE QAPP.

TABLE 3 – FIXED LABORATORY ANALYTICAL METHODS REQUIREMENTS

Matrix	Parameter	Number of Samples	Sampling Procedure	Sample Preparation/Extraction Method Number	Analytical Method Number
Soil	Volatile Organics (VOCs)	10	Grab	3585, 5021, 75030B, 5031, 5032, 5035	EPA Method 8260B
Soil	Semi-volatile Organics (SVOC)	10	Grab	3510C, 3520C, 3540C, 3541, 3545, 3550B	EPA Method 8270C
Soil	Pesticides/Aroclors (PCBs)	10	Grab	3510C, 3520C, 3540C, 3541, 3545, 3550B	EPA Methods 8081/8082
Soil	Total Metals	10	Grab	3005A, 3010A, 3015, 3050B, 3051	EPA Method 6020
Soil	Cyanide	10	Grab	See analytical method	EPA Method 9010B
Soil	Elemental Mercury	2	Grab	See analytical method	EPA Method 7471A
Soil	Chromium VI	2	Grab	3060A	EPA Method 7196A
Water	Volatile Organics (VOCs)	2	Low Flow	3585, 5021, 5030B, 5031, 5032, 5035	EPA Method 8260B
Water	Semi-volatile Organics (SVOC)	2	Low Flow	3510C, 3520C, 3540C, 3541, 3545, 3550B	EPA Method 8270C
Water	Pesticides/Aroclors (PCBs)	2	Low Flow	3510C, 3520C, 3540C, 3541, 3545, 3550B	EPA Methods 8081A/8082
Water	Total & Dissolved Metals	2	Grab	3005A, 3010A, 3045, 3050B, 3051	EPA Method 6020

4.2 Borings

Soil borings will be advanced at all subsurface soil sampling locations. Soil sampling is proposed as described in Table 2 and shown in Figure 4. Borings will be advanced using a standard Geoprobe rig and a continuous soil profile will be obtained down to the groundwater surface. In general, samples will be obtained from 4-foot continuous core intervals. Geologic classification and field screening and observations will be noted on each 4-foot core. General boring advancement procedures are presented in MDE's Standard Operating Procedures.

4.3 Soil Sampling

Soil samples will be collected from the Warner Street property in the area bordered by Warner Street, Haines Street, Oler Street and the Gwynns Falls Bike Path. The sample locations are described in Table 2 and shown in Figure 4. Soil sampling procedures are presented in MDE's Standard Operating Procedures and Quality Assurance Project Plan. Laboratory analytical procedures are detailed in Table 3 of this report.

4.4 Surface Water/Sediment Sampling

Surface water and sediment sampling is not proposed for this investigation. Samples collected for the Maryland Chemical Investigation revealed no contaminants of concern in the area of the Warner Street Property

4.5 Groundwater Sampling

Two groundwater samples will be collected in the study area using the Geoprobe. The groundwater sampling procedures associated with groundwater samples collected from existing monitoring wells and via Geoprobe are presented in MDE's Standard Operating Procedures and Quality Assurance Project Plan. Laboratory analytical procedures are detailed in Table 3 of this report.

5.0 REPORT PREPARATION

Subsequent to completion of all fieldwork and receipt of laboratory analytical results, a Brownfields Assessment Report will be prepared presenting and discussing the information obtained during execution of this work plan. The report will present the following:

- Summarized historical information;
- Physical setting;
- Technical overview with a general profile of the Brownfields Assessment investigation execution and results;
- Toxicological evaluation prepared by an MDE toxicologist;
- Findings and recommendations.

The report will also include:

- Results of all analyses, copies of all laboratory and field data sheets, and the required laboratory data deliverables;
- A summary of analytical methods and quality assurance indicators;
- Tables summarizing all sampling results, including sample locations, media, sample depth, field and laboratory identification numbers, analytical results, and comparison to the State of Maryland, Department of the Environment, Cleanup Standards for Soil and Groundwater, August 2001 (interim final guidance);

- Stratigraphic logs and soil boring records (including state permit numbers, if applicable), which include physical characteristics of the soil and field instrument readings detected during drilling for each soil boring;
- Stratigraphic cross-sections, if applicable;
- Sample location maps; and
- Other information obtained during the assessment.

One copy of the final report will be submitted to the EPA, one copy will be submitted to BDC and one copy will be submitted to the site owner.

The progress of the project will be tracked from its inception through implementation to ensure all sampling and analytical activities are performed in a correct and cost effective manner. Each step in this process will be scheduled in an objective and realistic time frame to assure that adequate attention is devoted to the minimization of effort and the maximization of information. Table 4 provides a proposed project time line for this project.

TABLE 4- PROJECT TIME LINE

Activities	Dates *(MM/DD/YY)*	
	Activity Start Date	Activity End Date
Site Visit and Phase I Information Collection	05/23/04	05/25/04
Draft Sampling and Analysis Plan (SAP)	04/284/05	
Submit SAP to EPA for Review	NA	NA
Receive EPA Comments on SAP	TBD	
Submit RFP for Lab Work	TBD + 1	+ 30 days
Submit RFP for Geoprobe	TBD + 1	+ 30 days
Draft Purchase Orders	TBD + 15	+ 30 days
Schedule Sample Dates	TBD + 15	+ 1 day
Soil and Groundwater Sample Collection	TBD + 45	+ 2 days
Field Screening Samples	TBD + 46	+ 2 days
Review Field Screening Data and Select Lab Samples	TBD + 47	+ 1 day
Samples Submitted to Fixed Lab for Analysis	TBD +48	+ 60 days
Third Party Validation of Laboratory Data Package	TBD + 60	+ 120 days
Review Laboratory Data Package	TBD + 180	+ 10
Draft Brownfields Report	TBD + 190	TBD + 220 days
Submit Final Report to EPA	TBD + 250	TBD + 250 days

TABLE 5- MEASUREMENT QUALITY INDICATORS

Compound	Matrix	Action Limit*	Precision	Accuracy	Completeness
Arsenic	Soil	2000 µg/Kg	Field Duplicate & Matrix Spike RDP = >80%	Analysis of QC Samples Matrix Spike Recovery	Amount of Valid Data Obtained % of # of Samples
Mercury	Soil	100 µg/Kg			
Lead	Soil	400 µg/Kg			
Acetone	Soil	7.8 E + 05 µg/Kg			
Methylene Chloride	Soil	8.5 E + 04 µg/Kg			
Benzo(a)pyrene	Soil	780 µg/Kg			

*=MDE Cleanup Standards for Soil and Groundwater, August 2001.

6.0 REFERENCES

1. MapTech Terrain Navigator Digital USGS 7.5 Minute Quadrangle, Baltimore West, 1974

2. U.S. Department of Agriculture, Soil Survey of City of Baltimore, Maryland, 1998

3. Ibid.

4. State of Maryland Department of Natural Resources, 1987, The Quantity and Natural Quality of Ground Water in Maryland.

5. MDE Well Database.

6. University of Maryland Climatological Data, 2004.

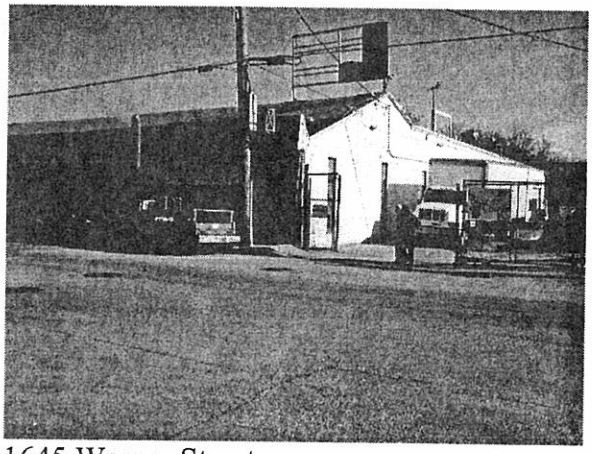
APPENDIX I – SITE SAFETY AND HEALTH PLAN

APPENDIX II – SOPs

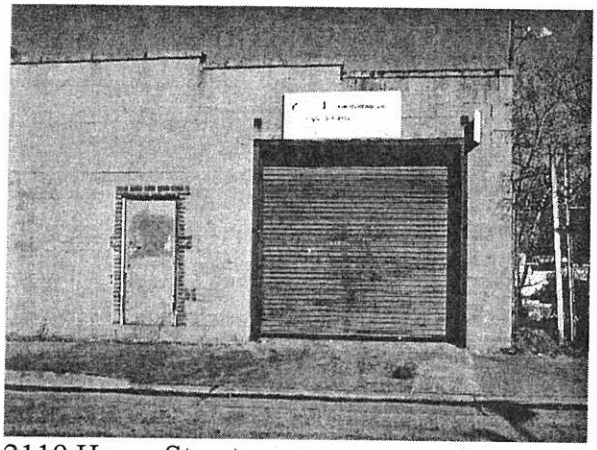
APPENDIX III – SITE PHOTOGRAPHS



2119 Hanes Street



1645 Warner Street



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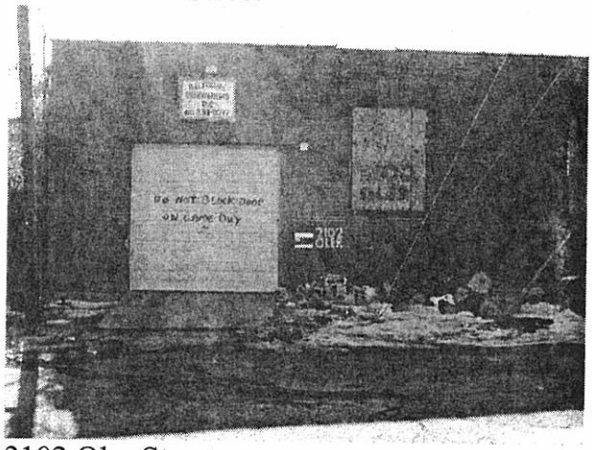
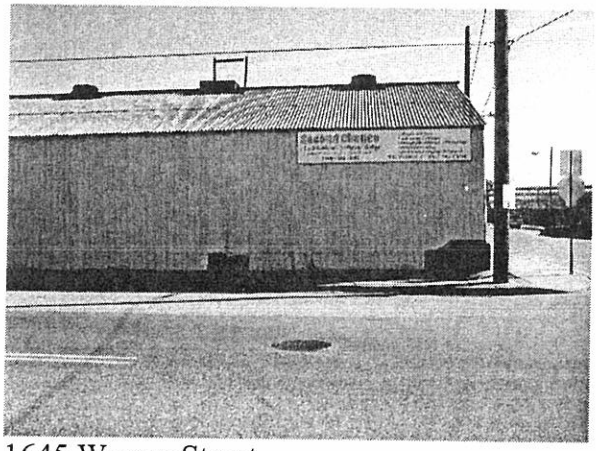


2102 Oler Street



1645 Warner Street



2102 Oler Street

Maryland Department of the Environment
Waste Management Administration
Environmental Restoration and Redevelopment Program

MEMORANDUM

TO: Alex Cox, Project Manager
Brownfields/Site Assessment Division

THROUGH: Patti Davis, Section Head
Brownfields/Site Assessment Division

FROM: Mark A. Mank, Toxicologist
Environmental Restoration and Redevelopment Program

SUBJECT: Toxicological Data Screen – Maryland Chemical Company Warner Street Properties, Baltimore City, Maryland

DATE: April 11, 2005

The toxicological data screen for the Maryland Chemical Company Warner Street properties, Baltimore City, Maryland is attached. For the purposes of this evaluation a commercial use scenario was assumed for estimating risk to potentially exposed populations. Groundwater and surface water samples were analyzed for VOCs, SVOCs and metals. Soil samples were analyzed for VOCs, SVOCs, PCBs, metals and select pesticides.

The estimated risks from the incidental ingestion of detected noncarcinogenic surface soil contaminants exceeded MDE and EPA recommended risk levels for the child visitor and construction worker commercial populations. Noncarcinogenic risk estimates for the incidental ingestion of detected surface soil contaminants were below MDE and EPA recommended risk levels for the youth visitor and adult worker commercial populations. Risk estimates for the incidental ingestion of detected carcinogenic surface soil contaminants exceeded MDE recommended risk ranges for all commercial populations. Carcinogenic risk estimates for the incidental ingestion of detected surface soil contaminants were within EPA recommended risk ranges for all commercial populations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants were within MDE and EPA recommended risk levels for all commercial populations. Carcinogenic risk estimates for the incidental ingestion of detected subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population. Carcinogenic risk estimates for the incidental ingestion of detected subsurface soil contaminants were within MDE recommend risk ranges for the youth visitor, adult worker and construction worker commercial populations and EPA recommended risk ranges for all commercial populations.

The estimated noncarcinogenic and carcinogenic risk levels from the inhalation of detected and nondetected volatiles and fugitive dust from surface and subsurface soils were within acceptable levels as recommended by MDE and EPA for all commercial populations.

Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants were below MDE and EPA recommended risk levels for all commercial populations. Risk estimates for dermal exposure to detected carcinogenic surface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population. Risk estimates for dermal exposure to detected carcinogenic surface soil contaminants were within MDE recommended risk ranges for the youth visitor, adult worker and construction worker commercial populations and EPA recommended risk ranges for all commercial populations. Risk estimates for dermal exposure to detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended risk levels for all commercial populations. Risk estimates for dermal exposure to detected carcinogenic subsurface soil contaminants were within MDE and EPA recommended risk ranges for all commercial populations.

The maximum concentration of lead detected in soils on site was less than the 400 mg/kg residential soil screening value. Based on the available data, the concentrations of lead in soils should not pose a threat to the health of sensitive populations and the environment on site.

Potential adverse effects from groundwater exposure were evaluated using total and dissolved metals concentration data on site. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for all commercial populations using total metals data. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for all commercial populations using dissolved metals data. Risk estimates from the incidental ingestion of detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges for the all commercial populations and EPA recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations using total metals data. Risk estimates from the incidental ingestion of detected carcinogenic contaminants were within EPA recommended risk ranges for the construction worker commercial population using total metals data. Carcinogenic risk estimates for the incidental ingestion of detected groundwater contaminants exceeded MDE recommended risk ranges for the all commercial populations and EPA recommended risk ranges for the youth visitor and adult worker commercial populations using dissolved metals data. Tetrachloroethene and trichloroethene were the carcinogenic risk drivers for the affected populations. Carcinogenic risk estimates for the incidental ingestion of detected groundwater contaminants were within EPA recommended risk ranges for the child visitor and construction worker commercial populations using dissolved metals data. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for all commercial populations using total metals data. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for all commercial populations using dissolved metals data. Risk estimates for dermal contact with detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations and EPA

recommended risk ranges for the adult worker commercial population using both total and dissolved metal data. Risk estimates for dermal contact with detected carcinogenic groundwater contaminants were within MDE recommended risk ranges for the construction worker commercial population and EPA recommended risk ranges for the child visitor, youth visitor and construction worker commercial populations using both total and dissolved metal data. The lack of critical physical constants and the methods for derivation of dermal exposures lead to a high degree of uncertainty associated with this route of exposure. This high degree of uncertainty should be considered when evaluating the hazards of dermal exposure to groundwater.

Two detected contaminants, tetrachloroethene and trichloroethene exceeded their respective MCL or SMCL and four nondetected compounds exceeded their respective MCL or SMCL but these contaminants were not detected on site. No detected groundwater contaminant exceeded the AWQS or AWQC for the protection of aquatic life (acute or chronic) or human health via fish consumption. Noncarcinogenic and carcinogenic risk estimates for the incidental ingestion of detected and nondetected surface water contaminants while swimming were below MDE and EPA recommended risk levels for all commercial populations using both total and dissolved metal data. Two detected surface water contaminants exceeded the freshwater AWQS or AWQC for the protection of aquatic life (acute or chronic) and no detected contaminant exceeded EPA fish consumption AWQC. The magnitude of these exceedance and the potential impact to receptors cannot be determined from the data available at this time.

Total mercury, conservatively evaluated as elemental mercury, exceeded the recommended MDE and EPA hazard index (HI) of 1 in surface and subsurface soil from vapor intrusion to indoor air, however, mercury detections on site were less than the anticipated typical concentration for mercury in the central region of Maryland. Based upon these results no additional evaluation of mercury vapor intrusion on site is warranted. No detected contaminant in soil on site exceeded a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air. No detected contaminant in groundwater on site exceeded a hazard index (HI) of 1 or a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air.

Ten detected groundwater contaminants exceeded their corresponding MDE groundwater cleanup standard. Two nondetected groundwater contaminants exceeded their corresponding groundwater cleanup standards but were not detected on site. No detected surface water contaminant and one nondetected surface water contaminant exceeded their corresponding MDE groundwater cleanup standards. Two detected surface soil contaminants, arsenic and mercury, and three detected subsurface soil contaminants, arsenic, benzo(a)pyrene and mercury exceeded their recommended MDE non-residential soil cleanup standard.

Refer to the attached toxicological evaluation for details regarding specific risk drivers for each exposure pathway.

Please contact me (x3436) if you have any questions.
/MAM
attachment

Maryland Chemical Company
Baltimore City, Maryland
Toxicological Evaluation

Summary

This toxicological evaluation examines the human health risks associated with the Maryland Chemical Company property located in Baltimore City, Maryland. This site was evaluated for child visitor (1-6 years), youth visitor (6-17), adult worker and construction worker populations under a commercial future use scenario. This toxicological evaluation evaluates risks to commercial use populations only. The United States Environmental Protection Agency (EPA) has recommended default exposure parameters that were used to estimate cumulative risk from all chemicals (1, 2, and 3). EPA recognizes as an acceptable Hazard Index (HI) values less than or equal to 1 (noncarcinogenic chemicals) and excess lifetime cancer risk (CR) less than or equal to 10^{-6} to 10^{-4}. The Maryland Department of the Environment (MDE) recognizes as an acceptable HI values less than or equal to 1 and excess lifetime cancer risk less than or equal to 10^{-6} to 10^{-5}. Risks to nearby surface water ecological receptors were evaluated by comparing groundwater and surface water contaminant concentrations to ambient surface water quality criteria. Based on these exposures, estimated risks at the site were compared to MDE and EPA recommended levels, and the following conclusions were reached:

Summary table of Hazard Indices (HI) values and Cancer Risk (CR) values for commercial populations using maximum detected concentrations

Noncarcinogenic Endpoints Detected Contaminants Only			
Population	**Pathway**	**Hazard Index**	**Risk Drivers**
Child visitor	Ingestion-surface soil	2	Arsenic
Construction worker	Ingestion-surface soil	2	Arsenic
Child visitor (total)	Dermal contact-groundwater	8	Chromium
Youth visitor (total)	Dermal contact-groundwater	6	Chromium
Adult worker (total)	Dermal contact-groundwater	43	Chromium
Construction worker (total)	Dermal contact-groundwater	21	Chromium
Carcinogenic Endpoints Detected Contaminants Only			
Population	**Pathway**	**Cancer Risk**	**Risk Drivers**
Child visitor	Ingestion-surface soil	6.3×10^{-5}	Arsenic
Youth visitor	Ingestion-surface soil	2.4×10^{-5}	Arsenic
Adult worker	Ingestion-surface soil	1.0×10^{-5}	Arsenic
Construction worker	Ingestion-surface soil	2.7×10^{-5}	Arsenic
Child visitor	Ingestion-subsurface soil	1.8×10^{-5}	Potential additive effects
Child visitor	Dermal contact-surface soil	1.2×10^{-5}	Arsenic
Child visitor (diss)	Ingestion-groundwater	9.6×10^{-5}	Tetrachloroethene
Youth visitor (diss)	Ingestion-groundwater	1.4×10^{-4}	Tetrachloroethene, trichloroethene
Adult worker (diss)	Ingestion-groundwater	1.6×10^{-4}	Tetrachloroethene, trichloroethene
Construction worker (diss)	Ingestion-groundwater	2.0×10^{-5}	Tetrachloroethene
Child visitor (total)	Dermal contact-groundwater	1.4×10^{-5}	Tetrachloroethene
Youth visitor (total)	Dermal contact-groundwater	2.1×10^{-5}	Tetrachloroethene
Adult worker	Dermal contact-groundwater	3.3×10^{-4}	Tetrachloroethene, trichloroethene

Site Description

The Maryland Chemical Company is Maryland Chemical is an operating chemical business located 1551 Russell Street in Baltimore City, Maryland. Russell Street to the west; Bayard Street to the south; Worcester Street to the north; and Warner Street to the east bound the 3.62-acre property. Several major structures occupy the property, which is located just west of the Baltimore Inner Harbor. The property lies near the fall line, an area of abrupt elevation change between the Coastal Plain and the Piedmont Physiographic Provinces. American Cyanamid operated a facility on the property from the 1890s through the early 1900s. Maryland Chemical has operated on the property since 1904. The property is one of a number of parcels being addressed by the Baltimore Development Corporation (BDC) in its planned revitalization of the Warner Street Corridor. Phase I and II studies of the facility were conducted by Datanet Engineering, Inc. These reports are held by Maryland Chemical Company and are not available for general review. MDE conducted a Brownfield assessment of the facility in December 2004. Site soil, surface water, and groundwater were sampled and the samples were submitted to Phase Separation Science Labs for analysis. The Baltimore Development Corporation is working with Maryland Chemical to transfer the property to City ownership. BDC intends to relocate an interstate bus terminal from its temporary location off Warner Street, to the Maryland Chemical site, once the property transfer is complete. Depth to groundwater is estimated to be approximately 20 feet. No groundwater drinking wells were located within ½-mile of the site. The closest surface body of water is Baltimore Inner Harbor.

1.0 Method

In evaluating risk to human health, maximum concentrations of all chemicals detected in soil, groundwater and surface water were compared to medium-specific screening levels (EPA Region III Risk Based Concentration values and Maryland Department of the Environment Cleanup Standards). Chemicals that exceeded human health Risk Based Concentration (RBC) values were then evaluated quantitatively. Relevant toxicological data and RBC values from surrogate compounds (structurally similar analogues) were used for some of the chemicals with no corresponding RBC value. Soil, groundwater and surface water samples were collected from locations on the site. The evaluation of groundwater was performed as if the water were being used as drinking water.

1.1 Human Health

Maximum concentrations of all chemicals detected in soils (dry weight values) were compared to the EPA Region III Risk Based Concentrations (RBC) for residential soil (4). Comparison of dry weight analytical values to the RBCs is recognized as a conservative measure but provides consistency in risk assessments across sites (with variable soil moisture content) and sampling time. Groundwater and surface water maximum concentrations were compared to the EPA Region III Risk Based Concentrations (RBCs) for tap water. Prior to comparison with each chemical concentration, noncarcinogenic RBCs were multiplied by

0.1, in order to account for any additivity of systemic effects. Carcinogenic RBC values were not adjusted and represent a target risk level of 10^{-6}. Carcinogenic and noncarcinogenic risk levels for all contaminants that exceeded their respective RBC screening level were evaluated quantitatively. The quantitative evaluation was based on expected future use and development scenarios and includes populations typically expected to frequent the site based on this proposed future use.

The future land use at the site was assumed to be commercial; therefore, the commercial exposure scenario was used to evaluate risk at the site. The contaminants identified at the site at concentrations that exceeded commercial RBCs were further evaluated with regard to risk to relevant populations under the following scenarios (1, 2, 3, and 7):

Commercial Development:

Surface/Subsurface Soil:
Adult Worker: 70 kg body weight, 3280 cm^2 skin surface area (soil), 250 days per year exposure for soil ingestion, 50 mg soil ingested per day, 8 hours inhalation, 0.05 mg/cm^2-event soil to skin adherence factor. 1 m^3/hour inhalation rate, 25-year exposure duration, 70-year lifetime.

Construction Worker: 70 kg body weight, 3280 cm^2 skin surface area (soil), 0.05mg/cm^2-event soil to skin adherence factor, 250 days per year exposure for soil ingestion, 480 mg soil ingested per day, 1.5 m^3/hour inhalation rate, 8 hour exposure time (inhalation soil), 1 year exposure duration, 70 year lifetime.

Youth (6 - 17 years) Visitor: 40 kg body weight, 4320 cm^2 skin surface area (soil), 0.02mg/cm^2-event soil to skin adherence factor, 132 days per year soil ingestion, 100 mg soil ingested per day, 0.56 m^3/hour inhalation rate, 4 hours inhalation exposure, 12 year exposure duration, 70 year lifetime.

Child (1 - 6 years) Visitor: 15 kg body weight, 2350 cm^2 skin surface area (soil), 0.06mg/cm^2-event soil to skin adherence factor, 132 days per year soil ingestion, 200 mg soil ingested per day, 0.32 m^3/hour inhalation rate, 4 hour inhalation exposure, 6 year exposure duration, 70 year lifetime.

Groundwater/Surface water:
Adult Worker: 70 kg body weight, 1 liter drinking (ground) water ingested per day, 5670 cm^2 skin surface area, 250 days per year drinking (ground) water ingestion, 25-year exposure duration, 70 year lifetime.

Construction Worker: 70 kg body weight, 5670 cm^2 skin surface area (groundwater), 250 days per year drinking (ground) water ingestion, 3 liter drinking (ground) water ingested per day, 1 year exposure duration, 70 year lifetime.

Youth (6 - 17 years) Visitor: 40 kg body weight, 13100 cm^2 skin surface area (groundwater), 132 days per year drinking (ground) water ingestion, 2 liter drinking (ground) water ingested, 12 year exposure duration, 70 year lifetime.

Child (1 - 6 years) Visitor: 15 kg body weight, 6560 cm^2 skin surface area (groundwater), 132 days per year drinking (ground) water ingestion, 1 liter drinking (ground) water ingested, 6 year exposure duration, 70 year lifetime.

Adult Swimmer: 70kg body weight, 12 events per year, 50 ml water ingested per event, 1 hour exposure time per event, 30 year exposure duration, 70 year lifetime

Youth Swimmer (6-17 years): 40kg body weight, 12 events per year, 50 ml water ingested per event, 1 hour exposure time per event, 12 year exposure duration, 70 year lifetime

Child Swimmer (1-6 years): 15kg body weight, 12 events per year, 50 ml water ingested per event, 1 hour exposure time per event, 6 year exposure duration, 70 year lifetime

2.0 Human Health Evaluation

Groundwater and surface water samples were analyzed for VOCs, SVOCs and metals. Soil samples were analyzed for VOCs, SVOCs, PCBs, metals and select pesticides. Chemicals that were detected on site were compared to medium-specific screening levels (EPA Region III RBC values). Chemicals that were not detected at the site and exceeded RBC values (at an assumed concentration of one half the detection level) were carried through the quantitative risk assessment and were included in the summation of noncarcinogenic hazard quotients and carcinogenic cancer risk values for comparative purposes only. Additionally, maximum detected and nondetected contaminant concentrations in soil groundwater and surface water were compared to the Maryland Department of the Environment (MDE) Soil and Groundwater Cleanup Standards Interim Final Guidance, August 2001, for non-residential soil and groundwater[3].

Maximum analyte concentrations for soil, groundwater and surface water were screened to identify chemicals of concern (COCs). Since future development at the site has the potential for exposing subsurface soils, the maximum analyte concentration for subsurface soils was also screened using the same methodology. The screening process for the ingestion of soil and groundwater identified several chemicals at concentrations exceeding the risk-based screening levels. The results of the initial screening process are presented in Attachment A. Volatile contaminants in soil, groundwater and surface water detected on site were evaluated for vapor intrusion to indoor air using the Johnson and Ettinger model for vapor intrusion, provided by EPA[4] (Appendix B).

No RBC values were available for 4-bromophenyl phenyl ether, 4-chloro-3-methylphenol, 4-chlorophenyl phenyl ether, bis (2-chloroethoxy) however, none of these chemicals were detected in any medium on site. Based on historical site operations and the non-detection of these chemicals they were not considered further qualitatively or quantitatively in the risk assessment.

The EPA has issued a directive for lead that recommends a soil screening level of 400 mg/kg for residential scenarios at RCRA facilities and CERCLA sites; the 400-mg/kg soil screening level was used in this evaluation for soil (5).

2.1 Soil

Soil samples from the site were analyzed for VOCs, SVOCs, PCBs, metals and select pesticides. Contaminants that were detected above their respective residential soil RBCs (i.e. failed the initial screening process, see Attachment A) were evaluated quantitatively. Surface and subsurface soil exposures were evaluated via the ingestion, inhalation, dermal contact and vapor intrusion of volatiles to indoor air pathways. Reference dose (RfD) and cancer slope factor (CSF) values were obtained from EPA Region III and IRIS (4, 6). Estimates of noncarcinogenic and carcinogenic risks from dermal contact were calculated when sufficient data (permeability constants (8), oral absorption efficiencies and dermal absorption factors (9)) were available.

2.2 Groundwater

Groundwater samples from the site were analyzed for VOCs, SVOCs and metals. Contaminants that were detected above their respective RBC screening level (Attachment A) were evaluated quantitatively for risk. Groundwater exposures were evaluated via the ingestion, dermal contact, and vapor intrusion of volatiles to indoor air pathways. Estimates of noncarcinogenic and carcinogenic risks from dermal contact were calculated when sufficient data (permeability constants (8), oral absorption efficiencies and dermal absorption factors (9)) were available. Organic and inorganic contaminants detected in groundwater were also compared to their corresponding MCL (Maximum Contaminant Level). Additionally, groundwater contaminant concentrations were compared to Maryland's ambient water quality standards (AWQS) and EPA's recommended ambient water quality criteria (AWQC) for the protection of aquatic life and human health.

2.3 Surface water

Surface water samples from the site were analyzed for VOCs, SVOCs and metals. Contaminants that were detected above their respective RBC screening level (Attachment A) were evaluated quantitatively for risk. Surface water exposures were evaluated via the incidental ingestion while swimming or wading pathway. Surface water contaminant concentrations were compared to Maryland's ambient water quality standards (AWQS) and EPA's recommended ambient water quality criteria (AWQC) for the protection of aquatic life and human health.

2.4 Vapor Intrusion

All volatile and semivolatile contaminants detected in soil and groundwater samples at the site were quantitatively evaluated for vapor intrusion using the Johnson and Ettinger Tier I vapor intrusion model (10).

2.5 MDE Cleanup Standards Screen

All soil, groundwater and surface water samples collected on site were compared to the MDE *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater* Interim Final Guidance, August 2001 (11).

3.0 Conclusion

3.1 Soil

The estimated risks from the incidental ingestion of detected noncarcinogenic surface soil contaminants exceeded MDE and EPA recommended risk levels for the child visitor and construction worker commercial populations (Table 1). Arsenic was the noncarcinogenic risk driver for the affected populations. Noncarcinogenic risk estimates for the incidental ingestion of detected surface soil contaminants were below MDE and EPA recommended risk levels for the youth visitor and adult worker commercial populations. Risk estimates for the incidental ingestion of detected carcinogenic surface soil contaminants exceeded MDE recommended risk ranges for all commercial populations (Table 2). Arsenic was the primary risk driver for the affected populations. Carcinogenic risk estimates for the incidental ingestion of detected surface soil contaminants were within EPA recommended risk ranges for all commercial populations. The estimated risks from the incidental ingestion of detected noncarcinogenic subsurface soil contaminants were within MDE and EPA recommended risk levels for all commercial populations (Table 3). Carcinogenic risk estimates for the incidental ingestion of detected subsurface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population (Table 4). Potential additive effects were the risk drivers for the affected population. Carcinogenic risk estimates for the incidental ingestion of detected subsurface soil contaminants were within MDE recommend risk ranges for the youth visitor, adult worker and construction worker commercial populations and EPA recommended risk ranges for all commercial populations.

The estimated noncarcinogenic and carcinogenic risk levels from the inhalation of detected and nondetected volatiles and fugitive dust from surface and subsurface soils were within acceptable levels as recommended by MDE and EPA for all commercial populations (Tables 5 through 8).

Risk estimates for dermal exposure to detected noncarcinogenic surface soil contaminants were below MDE and EPA recommended risk levels for all commercial populations (Table 9). Risk estimates for dermal exposure to detected carcinogenic surface soil contaminants exceeded MDE recommended risk ranges for the child visitor commercial population (Table 10). Arsenic was the carcinogenic dermal contact risk driver. Risk estimates for dermal exposure to detected carcinogenic surface soil contaminants were within MDE recommended risk ranges for the youth visitor, adult worker and construction worker commercial populations and EPA recommended risk ranges for all commercial populations. Risk estimates for dermal exposure to detected noncarcinogenic subsurface soil contaminants were below MDE and EPA recommended risk levels for all commercial populations (Table 11).

Risk estimates for dermal exposure to detected carcinogenic subsurface soil contaminants were within MDE and EPA recommended risk ranges for all commercial populations (Table 12).

No RBC values for lead are available; however, the maximum concentration of lead detected in soils on site was less than the 400 mg/kg residential soil screening value. Based on the available data, the concentrations of lead in soils should not pose a threat to the health of sensitive populations and the environment on site.

3.2 Groundwater

Potential adverse effects from groundwater exposure were evaluated using total and dissolved metals concentration data on site. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for all commercial populations (Table 13) using total metals data. Arsenic and chromium were the noncarcinogenic incidental ingestion total metals risk drivers. Risk estimates from the incidental ingestion of detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for all commercial populations (Table 13diss) using dissolved metals data. Risk estimates from the incidental ingestion of detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges for the all commercial populations and EPA recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations (Table 14) using total metals data. Arsenic, tetrachloroethene and trichloroethene were the carcinogenic risk drivers for the affected populations. Risk estimates from the incidental ingestion of detected carcinogenic contaminants were within EPA recommended risk ranges for the construction worker commercial population using total metals data. Carcinogenic risk estimates for the incidental ingestion of detected groundwater contaminants exceeded MDE recommended risk ranges for the all commercial populations and EPA recommended risk ranges for the youth visitor and adult worker commercial populations (Table 14diss) using dissolved metals data. Tetrachloroethene and trichloroethene were the carcinogenic risk drivers for the affected populations. Carcinogenic risk estimates for the incidental ingestion of detected groundwater contaminants were within EPA recommended risk ranges for the child visitor and construction worker commercial populations using dissolved metals data. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants exceeded MDE and EPA recommended risk levels for all commercial populations (Table 15) using total metals data. Chromium, conservatively evaluated as hexavalent chromium, was the noncarcinogenic dermal contact risk driver. Risk estimates for dermal contact with detected noncarcinogenic groundwater contaminants were below MDE and EPA recommended risk levels for all commercial populations (Table 15diss) using dissolved metals data. Risk estimates for dermal contact with detected carcinogenic groundwater contaminants exceeded MDE recommended risk ranges for the child visitor, youth visitor and adult worker commercial populations and EPA recommended risk ranges for the adult worker commercial population (Tables 16 and 16diss) using both total and dissolved metal data. Tetrachloroethene and trichloroethene were the carcinogenic risk drivers for the affected populations. Risk estimates for dermal contact with detected carcinogenic groundwater contaminants were within MDE recommended risk ranges for the construction worker

commercial population and EPA recommended risk ranges for the child visitor, youth visitor and construction worker commercial populations using both total and dissolved metal data. The lack of critical physical constants and the methods for derivation of dermal exposures lead to a high degree of uncertainty associated with this route of exposure. This high degree of uncertainty should be considered when evaluating the hazards of dermal exposure to groundwater.

Groundwater contaminant concentrations were compared to available MCLs and SMCLs using dissolved metals data. Two detected contaminants, tetrachloroethene and trichloroethene exceeded their respective MCL or SMCL and four nondetected compounds exceeded their respective MCL or SMCL (Table 17diss) but these contaminants were not detected on site. Groundwater contaminant concentrations (dissolved metals) were also compared to available Maryland ambient water quality standards (AWQS) or EPA recommended ambient water quality criteria (AWQC). No detected groundwater contaminant exceeded the AWQS or AWQC for the protection of aquatic life (acute or chronic) (Table 18diss) or human health via fish consumption.

3.3 Surface water

Noncarcinogenic and carcinogenic risk estimates for the incidental ingestion of detected and nondetected surface water contaminants while swimming were below MDE and EPA recommended risk levels for all commercial populations (Tables 19 through 20diss) using both total and dissolved metal data. Surface water contaminant concentrations (dissolved metals) were also compared to available Maryland AWQS or EPA recommended AWQC for freshwater environments (Table 21diss). Two detected surface water contaminants exceeded the freshwater AWQS or AWQC for the protection of aquatic life (acute or chronic) and no detected contaminant exceeded EPA fish consumption AWQC. The magnitude of these exceedances and the potential impact to receptors cannot be determined from the data available at this time.

3.4 Vapor Intrusion

The risk from vapor intrusion of detected volatile and semivolatile contaminants in groundwater and soil into buildings was evaluated using the Johnson and Ettinger vapor intrusion model (Attachment B). Total mercury, conservatively evaluated as elemental mercury, exceeded the recommended MDE and EPA hazard index (HI) of 1 in surface and subsurface soil from vapor intrusion to indoor air, however, mercury detections on site were less than the anticipated typical concentration for mercury in the central region of Maryland. Based upon these results no additional evaluation of mercury vapor intrusion on site is warranted. No detected contaminant in soil on site exceeded a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air. No detected contaminant in groundwater on site exceeded a hazard index (HI) of 1 or a cancer risk of greater than 1×10^{-5} for commercial populations from vapor intrusion to indoor air.

3.5 MDE Cleanup Standards Screen

The concentration of all chemicals analyzed in soil, groundwater and surface water were compared to their corresponding MDE commercial cleanup standard (Attachment A). Ten detected groundwater contaminants exceeded their corresponding MDE groundwater cleanup standard. Two nondetected groundwater contaminants exceeded their corresponding groundwater cleanup standards but were not detected on site. No detected surface water contaminant and one nondetected surface water contaminant exceeded their corresponding MDE groundwater cleanup standards. Two detected surface soil contaminants, arsenic and mercury, and three detected subsurface soil contaminants, arsenic, benzo(a)pyrene and mercury exceeded their recommended MDE non-residential soil cleanup standard.

3.6 Evaluation Assumptions

When determining whether an increased risk to human health exists at this site, it is important to understand that this evaluation was prepared as a first level screening evaluation. Many conservative assumptions are included in this evaluation, which were developed with the understanding that if the estimated risk, using the conservative assumptions, does not exceed EPA's recommended levels, then the risk estimated using more realistic scenarios will not exceed these levels.

Since this evaluation includes many conservative assumptions, a risk that exceeds EPA's recommended level of risk does not necessarily indicate an increased risk to human health. When this situation occurs, it is necessary to consider several points when determining if the risk actually does represent a threat to human health. For example, the quantitative risk estimate in this evaluation assumes people will be exposed to a contaminant at the maximum concentration all throughout the site and for the entire exposure duration. These assumptions do not take into account whether the maximum concentration is anomalous or characteristic of the site, or that biodegradation, dispersion, dilution, or other factors may decrease the contaminant concentration throughout the time of exposure.

This evaluation also assumes that the bioavailability of each contaminant is 100 percent, and that all of the contaminant taken into the body is absorbed across the digestive tract into the body. A chemical is harmful to human health only if it is absorbed into the body. Assuming complete bioavailability does not consider the fact that it is common for a fraction of the chemical taken into the body to be excreted rather than absorbed into the body. The bioavailability of a contaminant is dependent on many factors, such as the state or form of the contaminant and if the actual size of the contaminant particle would permit incidental ingestion. These issues must be considered when evaluating the appropriateness of assuming total bioavailability of a contaminant.

4.0 References

1. EPA. 1989. *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final.* Office of Emergency and Remedial Response. EPA/540/1-89/002.

2. EPA. 1991. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors" Interim Final.* Office of Emergency and Remedial Response. OSWER Directive: 9285.6-03.

3. EPA. 1991. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk/based Preliminary Remediation Goals) Interim.* Office of Emergency and Remedial Response. EPA/540/R-92/003.

4. EPA, Region III. Risk-Based Concentration Table, April 14, 2004.

5. EPA. *Memorandum: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.* Office of Solid Waste and Emergency Response. OSWER Directive # 9355.4-12.

6. EPA. Integrated Risk Information System. 2000.

7. EPA. 1997. *Exposure Factors Handbook, Volume I, General Factors.* Office of Research and Development. EPA/600/P-95/002Fa.

8. EPA. 1992. *Dermal Exposure Assessment: Principles and Applications.* EPA/600/8-91/011B.

9. EPA. Region III, 1995. *Technical Guidance Manual, Risk Assessment, Assessing Dermal Exposure from Soil.* EPA/903-K-95-003.

10. EPA. *User's Guide for the Johnson and Ettinger (1991) Model for subsurface Vapor Intrusion into Buildings.* June, 2003.

11. Maryland Department of the Environment. *State of Maryland Department of the Environment Cleanup Standards for Soil and Groundwater.* Interim Final Guidance. August 2001.

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Maryland Department of Assessments and Taxation
BALTIMORE CITY
Real Property Data Search

Go Back
New Search
Ground Rent

Account Identifier: **Ward -** 21 **Section -** 09 **Block -** 0841 **Lot -** 001

Owner Information

Owner Name:	PHEASANT WARNER CO., LLC, THE	**Use:**	INDUSTRIAL
		Principal Residence:	NO
Mailing Address:	1551 RUSSELL ST. BALTIMORE MD 21230	**Deed Reference:**	1) FMC/ 1023/ 287 2)

Location & Structure Information

Premises Address
1501 RUSSELL ST
BALTIMORE 21230-2017

Legal Description
200X330-3

Map	Grid	Parcel	Sub District	Subdivision	Section	Block	Lot	Assesment Area	Plat No:
21					9	841	1	3	Plat Ref:

Special Tax Areas **Town** **Ad Valorem** **Tax Class**

Primary Structure Built	Enclosed Area	Property Land Area	County Use
1919	66,820 SF	66,037.00 SF	21310

Stories	Basement	Type	Exterior

Value Information

	Base Value	Value As Of 01/01/2003	Phase-in Assessments As Of 07/01/2004	As Of 07/01/2005
Land:	198,100	198,100		
Improvements:	149,500	376,000		
Total:	347,600	574,100	498,600	574,100
Preferential Land:	0	0	0	0

Transfer Information

Seller:	GLOSE, J FRED	**Date:**	01/22/2001	**Price:**	$0
Type:	NOT ARMS-LENGTH	**Deed1:**	FMC/ 1023/ 287	**Deed2:**	
Seller:		**Date:**		**Price:**	
Type:		**Deed1:**		**Deed2:**	
Seller:		**Date:**		**Price:**	
Type:		**Deed1:**		**Deed2:**	

Exemption Information

Partial Exempt Assessments	Class	07/01/2004	07/01/2005
County	000	0	0
State	000	0	0
Municipal	000	0	0

Tax Exempt: NO
Exempt Class:

Special Tax Recapture:

* NONE *

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BALTIMORE CITY
Real Property Data Search

Go Back
New Search
Ground Rent

Account Identifier: **Ward -** 21 **Section -** 09 **Block -** 0841 **Lot -** 003

Owner Information

Owner Name:	PHEASANT WARNER CO., LLC, THE	**Use:**	INDUSTRIAL
		Principal Residence:	NO
Mailing Address:	1551 RUSSELL ST. BALTIMORE MD 21230	**Deed Reference:**	1) FMC/ 1023/ 287 2)

Location & Structure Information

Premises Address
1525 RUSSELL ST
BALTIMORE 21230-2017

Legal Description
100X330

Map	Grid	Parcel	Sub District	Subdivision	Section	Block	Lot	Assesment Area	Plat No:
21					9	841	3	3	Plat Ref:

Special Tax Areas **Town** **Ad Valorem** **Tax Class**

Primary Structure Built	Enclosed Area	Property Land Area	County Use
1953	32,180 SF	32,975.00 SF	63760

Stories	Basement	Type	Exterior

Value Information

	Base Value	Value As Of 01/01/2003	Phase-in Assessments As Of 07/01/2004	As Of 07/01/2005
Land:	98,900	98,900		
Improvements:	73,100	175,100		
Total:	172,000	274,000	240,000	274,000
Preferential Land:	0	0	0	0

Transfer Information

Seller:	GLOSE, J FRED	**Date:**	01/22/2001	**Price:**	$0
Type:	NOT ARMS-LENGTH	**Deed1:**	FMC/ 1023/ 287	**Deed2:**	
Seller:		**Date:**		**Price:**	
Type:		**Deed1:**		**Deed2:**	
Seller:		**Date:**		**Price:**	
Type:		**Deed1:**		**Deed2:**	

Exemption Information

Partial Exempt Assessments	Class	07/01/2004	07/01/2005
County	000	0	0
State	000	0	0
Municipal	000	0	0

Tax Exempt: NO
Exempt Class:

Special Tax Recapture:

* NONE *

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Maryland Department of Assessments and Taxation
BALTIMORE CITY
Real Property Data Search

Go Back
New Search
Ground Rent

Account Identifier: **Ward -** 21 **Section -** 09 **Block -** 0841 **Lot -** 004

Owner Information

Owner Name:	PHEASANT WARNER CO., LLC, THE	**Use:**	INDUSTRIAL
		Principal Residence:	NO
Mailing Address:	1551 RUSSELL ST BALTIMORE MD 21230-2017	**Deed Reference:**	1) FMC/ 1023/ 287 2)

Location & Structure Information

Premises Address
1551 RUSSELL ST
BALTIMORE 21230-2017

Legal Description
178-9X330

Map	Grid	Parcel	Sub District	Subdivision	Section	Block	Lot	Assesment Area	Plat No:
21					9	841	4	3	Plat Ref:

Special Tax Areas **Town** **Ad Valorem** **Tax Class**

Primary Structure Built	Enclosed Area	Property Land Area	County Use
1923	22,200 SF	58,980.00 SF	63760

Stories	Basement	Type	Exterior

Value Information

	Base Value	Value As Of 01/01/2003	Phase-in Assessments As Of 07/01/2004	As Of 07/01/2005
Land:	176,900	176,900		
Improvements:	176,500	190,900		
Total:	353,400	367,800	363,000	367,800
Preferential Land:	0	0	0	0

Transfer Information

Seller:	GLOSE, J FRED	**Date:**	01/22/2001	**Price:**	$0
Type:	NOT ARMS-LENGTH	**Deed1:**	FMC/ 1023/ 287	**Deed2:**	
Seller:		**Date:**		**Price:**	
Type:		**Deed1:**		**Deed2:**	
Seller:		**Date:**		**Price:**	
Type:		**Deed1:**		**Deed2:**	

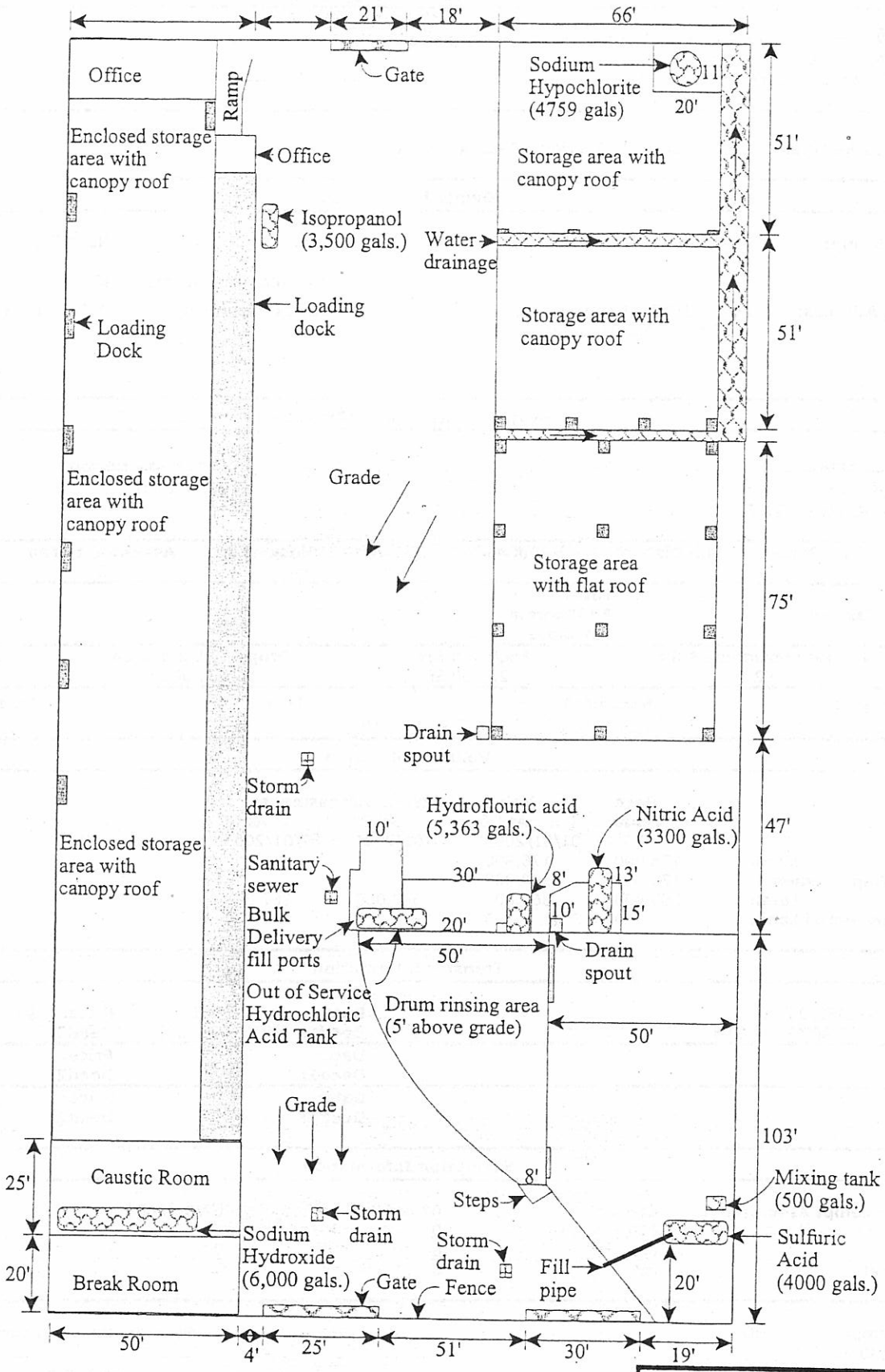
Exemption Information

Partial Exempt Assessments	Class	07/01/2004	07/01/2005
County	000	0	0
State	000	0	0
Municipal	000	0	0

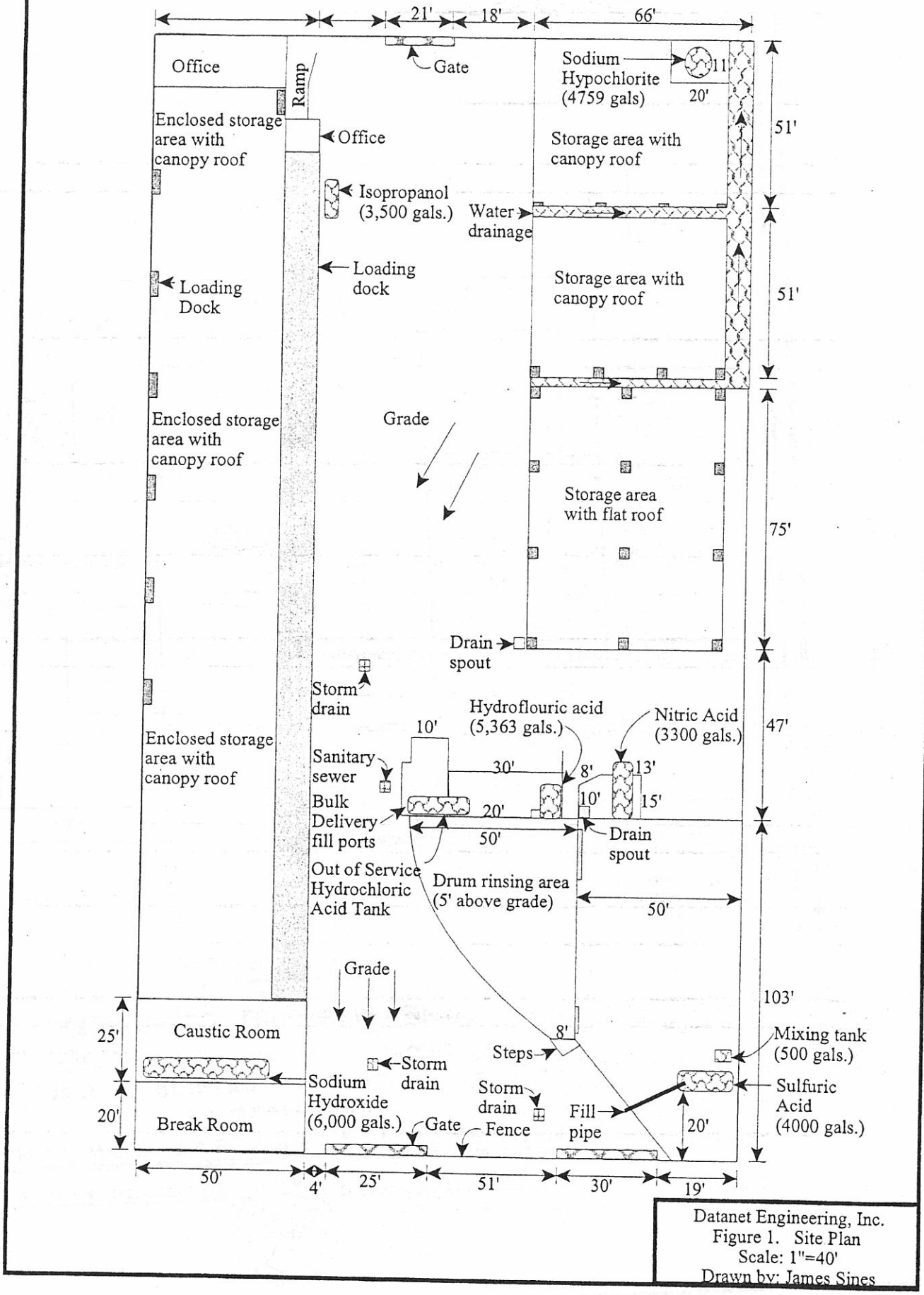
Tax Exempt: NO
Exempt Class:

Special Tax Recapture:

* NONE *

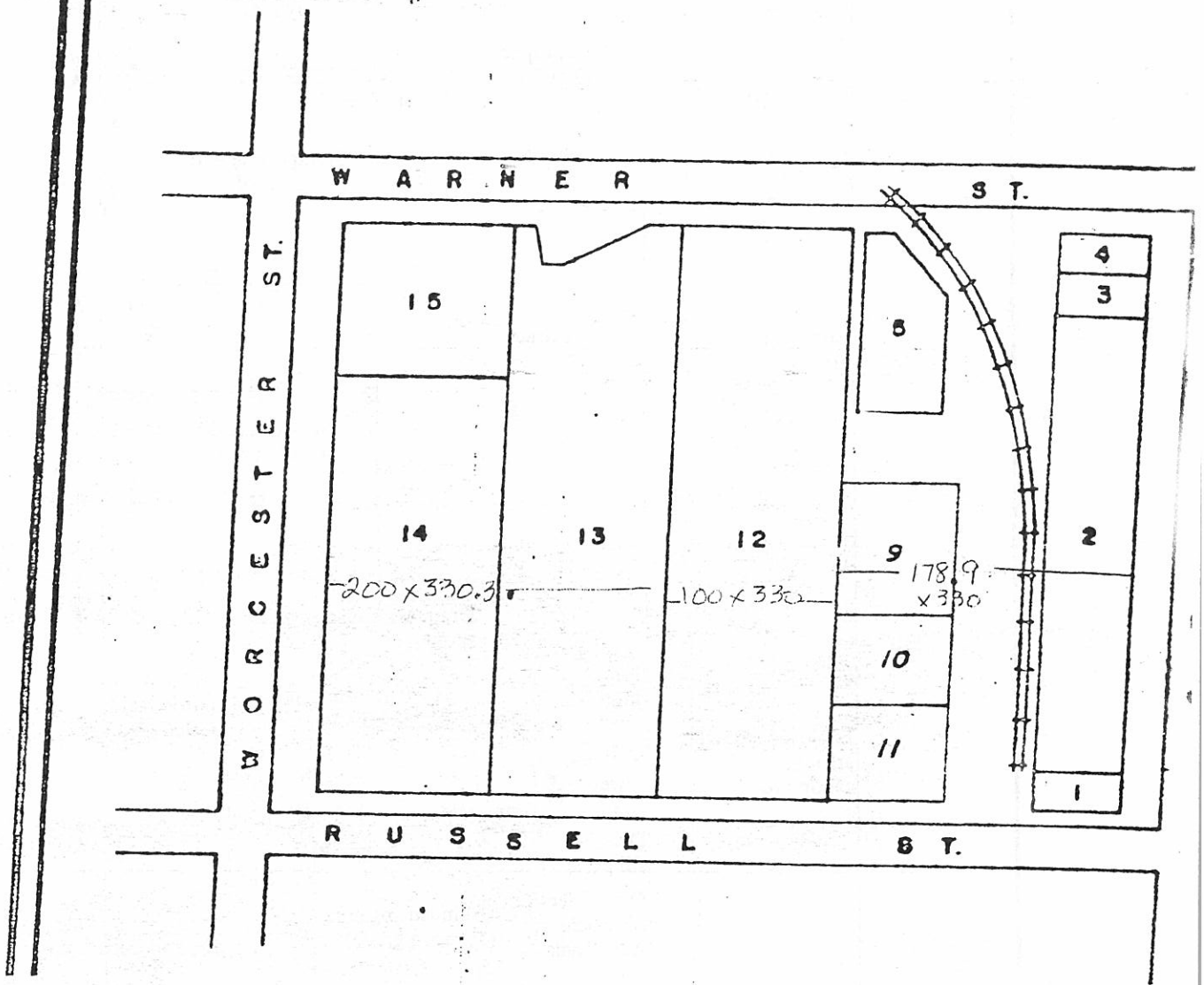


Datanet Engineering, Inc.
Figure 1. Site Plan
Scale: 1"=40'
Drawn by: James Sines



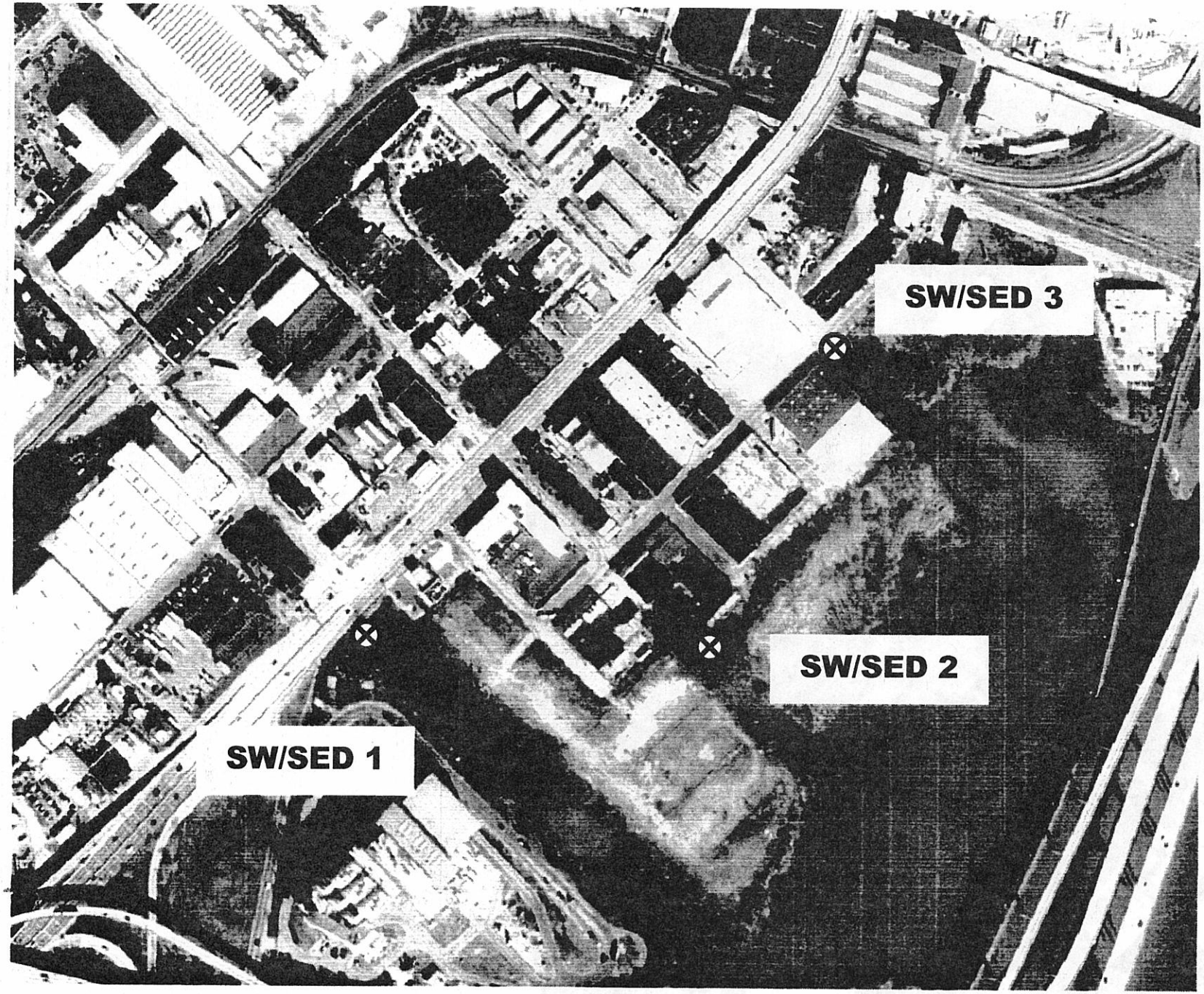
Datanet Engineering, Inc.
Figure 1. Site Plan
Scale: 1"=40'
Drawn by: James Sines

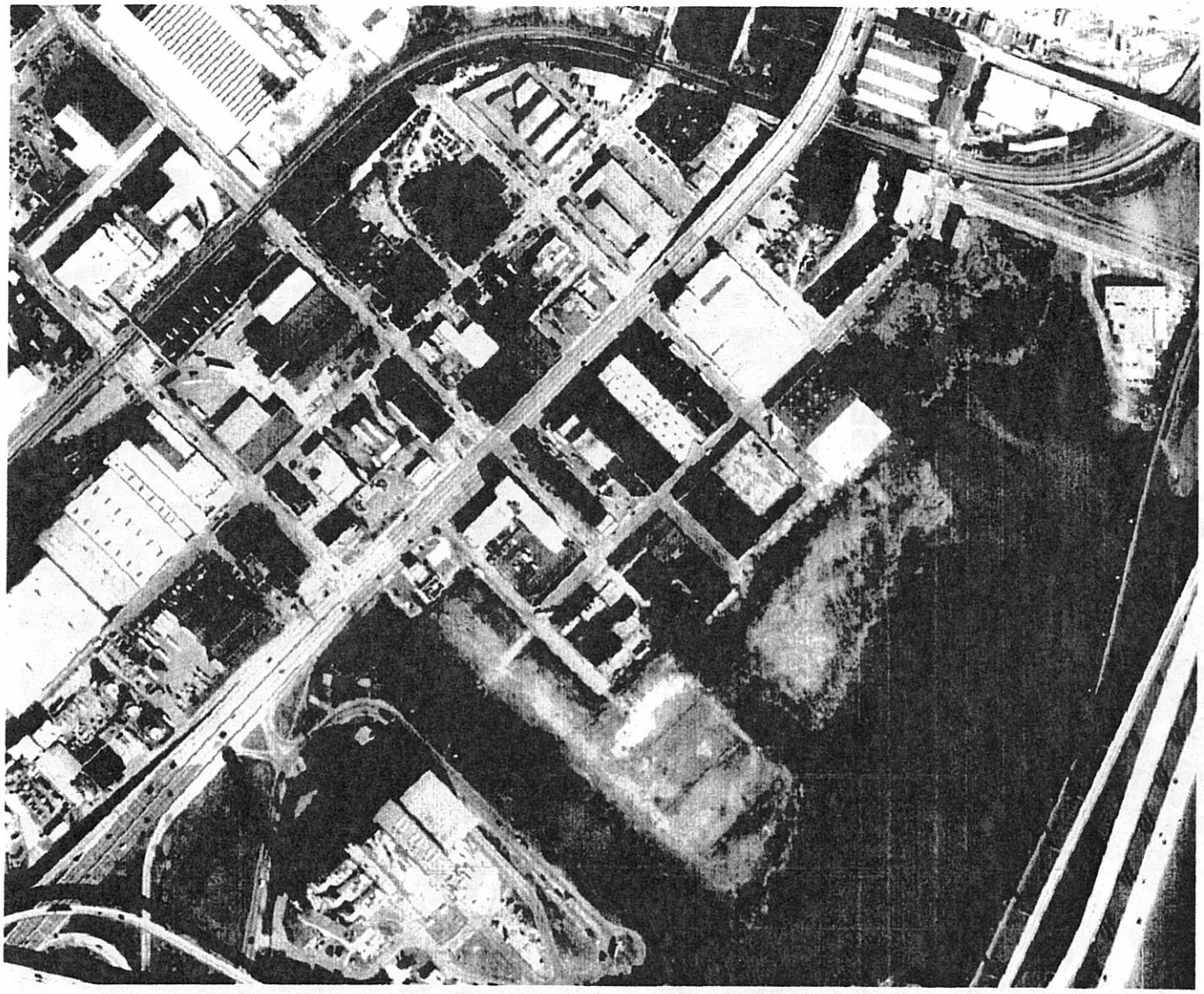
158,037 SQ. FT. ÷ 43,560 SQFT/ACRE = ± 3.62 ACR



LATITUDE 76° DEG. 37 MIN. 40 SEC.
LONGITUDE 39° DEG. 16 MIN. 26 SEC.

PLAT PLAN
OF
THE WESTPORT CORPORATION
BALTIMORE MARYLAND
SCALE: 1"=100'-0" DATE: JULY 1976
APPRAISED BY
INDUSTRIAL APPRAISAL COMPANY
BLVD. OF THE ALLIES PITTSBURGH, PENNA.


SW/SED 3
SW/SED 2
SW/SED 1



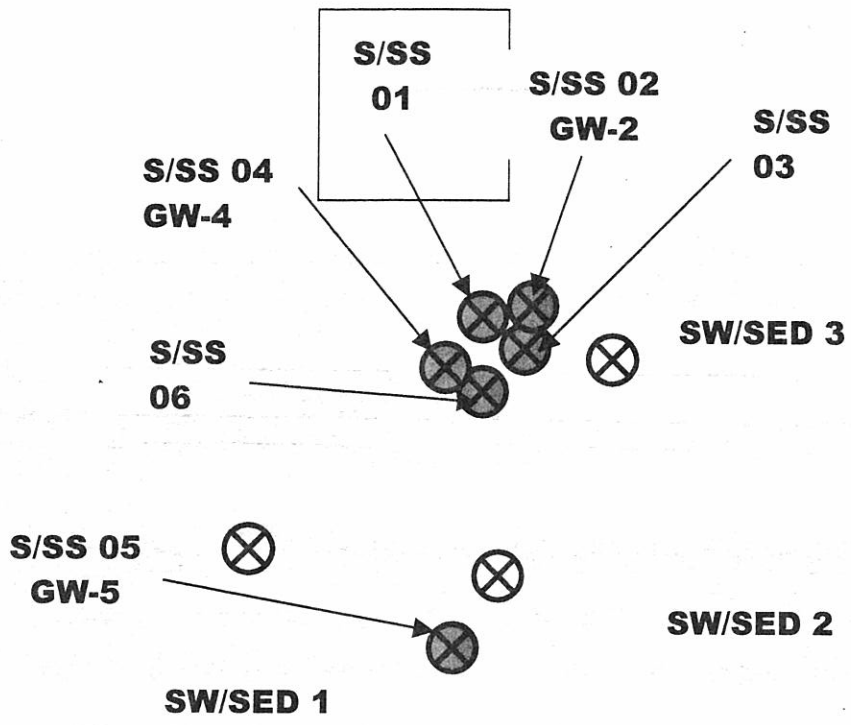


FIGURE 2 – Sample Locations

MDE

MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101

Robert L. Ehrlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Secretary

Jonas A. Jacobson
Deputy Secretary

November 5, 2004

Ms. Lorie Baker
Brownfields and Site Assessment Section (3HS34)
U.S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia PA 19103-2029

RE: Maryland Chemical Company

Dear Ms. Baker:

Enclosed is the draft Sample and Analysis Plan (SAP) for the Maryland Chemical Company unit of the Warner Street Corridor Brownfields Investigation Project. The subject site is located in Baltimore, Maryland.

If you have additional questions concerning this matter, please contact me at (410) 537-3440.

Sincerely,

Alex M. Cox
Brownfields/Site Assessment Section

AMC:bjm

cc: Mr. Horacio Tblada
Mr. James Carroll
Mr. Kim Lemaster
Ms. Patti Davis