BASF
The Chemical Company

Ecology & Safety

July 2, 2010

Submitted via Hard Copy & Electronic Mail

Ms Jill Groboski
Project Manager
USEPA Region 5
11 West Jackson Boulevard, LU-9J
Chicago, IL 60604-3590

RE: RCRA 3008 (h) Administrative Order EPA ID: OHD 000 804 682
BASF Corporation Facility, 1000 Harvard Avenue, Cleveland Ohio
Description of Current Conditions Report

Dear Ms. Groboski:

Please find enclosed one hard copy of the Description of Current Conditions Report for the BASF Corporation Facility located in Cleveland, Ohio. This report has been generated consistent with the RCRA 3008 (h) Administrative Order EPA ID: OHD 000 804 682. An electronic copy of the entire report is contained on the CD which accompanies the hard copy of the report.

Feel free to call me at (973) 665-4829 if you have any questions or need additional information.

Sincerely,

Vernon C Burrows
Remediation Specialist Sr II

Cc: Nancy Lake Martin, BASF Corporation
Wendlene M. Lavey, Squire, Sanders & Dempsey L.L.P.
James Culp, AECOM Environment

AE'COM **Environment**

Prepared for
BASF
Florham Park. NJ

Prepared by
AECOM
Pittsburgh, PA
6-154775-130
June 17, 2010

Draft Description of Current Conditions

AECOM Environment

Prepared for:
BASF
Florham Park, NJ

Prepared by:
AECOM
Pittsburgh, PA
6-154775-130
June 17, 2010

Draft Description of Current Conditions

Prepared By Vince Catalano

Reviewed By James S. Culp, P.G.

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List of Acronyms

ACOE	Army Corps of Engineers
AEC	Atomic Energy Commission
ANL	Argonne National Laboratory
AOC	Administrative Order on Consent
AOC	Areas of Concern
BASF	BASF Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Constituent of Potential Concern
CWM	Chemical Waste Management
D&D	Decontamination and Decommissioning
DOCC	Description of Current Conditions
ERM	ERM-Midwest, Inc.
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
FWEC	Foster Wheeler Environmental Corporation
FWS	U.S. Fish and Wildlife Service
gpm	gallons per minute
HCC	Harshaw Chemical Company
HF	hydrofluoric acid
HFP	Harshaw/Filtrol Partnership
HWMU	Hazardous Waste Management Unit
KACC	Kaiser Aluminum and Chemical Company
KCC	Kaiser Clay and Chemical Company
MED	Manhattan Engineer District
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MSL	Mean Sea Level (North American Datum of 1983)
NEORSD	Northeast Ohio Regional Sewer District
NPDES	National Pollution Discharge Elimination System
NOV	Notice of Violation
NRC	Nuclear Regulatory Commission

ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
Order	Administrative Order
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RIR	Remedial Investigation Report
RSL	Regional Screening Level
SAIC	SAIC Corporation
Site	Former Harshaw Chemical Plant
SLERA	Screening Level Ecological Risk Assessment
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Units
TPH-DRO	Total Petroleum Hydrocarbons-Diesel Range Organics
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
µg/L	micrograms per liter
µg/kg	micrograms per kilogram
VAP	Voluntary Action Program
VOC	Volatile Organic Compound
VSI	Visual Site Inspection
WWTS	Waste Water Treatment System

1.0 Introduction

This Description of Current Conditions (DOCC) Report has been prepared on behalf of BASF Corporation (BASF) for that portion of the former Harshaw Chemical Company site currently owned by BASF located at 1000 Harvard Avenue, Cleveland, Ohio. The entire former Harshaw site is hereinafter referred to as the "Site" or "Former Harshaw Site" and the portion acquired by BASF as the "Facility". The objective of this Report is to provide information regarding the Facility and to describe existing conditions at 37 Solid Waste Management Units (SWMUs) and eight (8) Areas of Concern (AOCs) previously identified by the United States Environmental Protection Agency (USEPA) in the 1990 Visual Site Inspection Report.

Effective May 5, 2010, USEPA issued BASF an Administrative Order (Order) pursuant to Section 3008(h) of RCRA. Section VIII.C.1 of the Order requires BASF to submit a DOCC Report consistent with the RCRA Facility Investigation Scope of Work contained in Attachment II. This Report is organized to meet the requirements of Attachment II, Section I.

2.0 Facility Background

2.1 Facility Location and Features

The Facility is located approximately 3.5 miles southwest of downtown Cleveland, Ohio (Figure 2-1). It is situated along the western bank of the Cuyahoga River, just north of its confluence with Big Creek. Harvard Avenue splits the Facility into a north and south section.

The Facility consists of approximately 24.46 acres and is comprised of four parcels (2, 3, 4 and 5) (Figure 2-2). Parcel 2 is approximately 4.37 acres in size and is currently a vacant lot. Parcel 3 is approximately 18.94 acres in size and includes seven remaining buildings. The current buildings within Parcel 3 include a warehouse (Building W-1), the former foundry (Building F-1), the former boiler house (Building B-1), a groundwater recovery and treatment system building, a garage, the former hydrogen fluoride plant wastewater treatment system (Building H-10), and the former scale house. Parcel 4 is approximately 0.87 acres in size and Parcel 5 is approximately 0.28 acres in size; both are currently vacant lots.

The Facility is part of the larger Former Harshaw Site, which is the subject of response action by the United States Army Corps of Engineers (ACOE) under the federal government's Formerly Utilized Sites Remedial Action Program (FUSRAP) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Facility does not include a structure referred to as Building G-1 and the property occupied by Building G-1 (located in the north-central portion of Parcel 3 and shown on Figure 2-2 as the area marked with cross hatchmarks), which are owned by BGD Company, an affiliate of Chevron USA, Inc. Consistent with the Order, and except for historical background and context, the scope of this DOCC Report does not include a discussion of radiological contamination at the Facility, which is the subject of the ACOE's response activities at the Site. The DOCC Report does, however, include technical information from the ACOE's response activities relating to non-radiological contamination where appropriate.

Numerous other buildings that were once located at the Facility for manufacturing have been demolished with oversight by the Nuclear Regulatory Commission (NRC), although most of the floor slabs remain. The locations of former and existing buildings are shown on Figure 2-2.

2.2 Surrounding Land Use

The Facility is situated in a heavily industrialized portion of Cleveland. Facility property boundaries and land use are depicted on Figure 2-3. Land use is based upon information contained within the City of Cleveland's tax maps and represents current zoning of the land. Ownership and/or current use of the adjoining properties are also shown on Figure 2-3, where known. Land use to the north of Parcels 3 and 5 is heavy industrial. A CSX railroad right- of-way passes across the northern portion of the Facility, separating Parcel 3 from Parcels 4 and 5. Land uses bordering the western property boundary consist of commercial and small industrial facilities. Parcel 2 is bounded by Harvard Avenue to the north, and by the CSX railroad right-of-way and commercial property (formerly and presently trucking terminals) to the west and southwest. Parcel 3 is bounded to the east by the Cuyahoga River. Land use to the east and northeast of the Cuyahoga River (from south to north) consists of commercial businesses, undeveloped property, and heavy industry.

2.3 Facility Topography and Drainage

The ground surface across the Facility is relatively flat, with a gradient of less than 1 percent. The ground surface elevation across the Facility is approximately 590 feet above mean sea level (MSL). Adjacent to the Cuyahoga River and Big Creek, the ground surface elevation decreases steeply by approximately 10 to 30 feet to the edge of the water bodies (Figure 2-4).

In the northern portion (north of Harvard Avenue) of the Facility, the topography of the developed land surface is characterized by generally low relief, with a gentle slope toward the Cuyahoga River. Where the Facility property is bounded by the Cuyahoga River to the east, a relatively steep bank of 25 to 30 feet is present along the river. Large portions of the land surfaces have been further modified to permit the construction of buildings, paved surfaces and associated drainage systems. Numerous catch basins at the Facility collect precipitation runoff, which is directed to the Cuyahoga River or Big Creek via storm sewers and associated outfalls. Functionality of the storm sewers, catch basins, and outfalls appears to vary with some sewer lines apparently inactive. Areas of the Facility to the north of the CSX railroad lines (i.e., Parcels 4 and 5) are predominantly undeveloped and collect surface water during periods of rainfall.

Land surface topography in the southern portion of the Facility (south of Harvard Avenue) is generally similar to that of the northern portion, with relatively low relief. A gentle slope to the southeast directs surface water runoff flow toward Big Creek and the Cuyahoga River. The land surface in the southern portion is approximately 10 to 15 feet higher than the river and creek channel bottoms. Similar to the northern portion, the southern portion of the Facility was also developed for industrial use and surface water runoff was collected in storm sewers for eventual discharge to the Cuyahoga River and Big Creek. This area currently has very few functioning storm drains.

Portions of the Facility situated along the Cuyahoga River and Big Creek were identified by Federal Emergency Management Agency (FEMA) as being within the 100-year floodplain, and are shown on Figure 2-5.

2.4 Facility and Environmental Setting

The following sections are based on existing information provided in the Site Characterization Report (B. Koh and Associates, Inc. 1998), groundwater well logs, and other information compiled by Dames & Moore, Remcor, and ERM-Midwest, Inc. (ERM), as well as data gathered by Science Applications International Corporation, Inc. (SAIC) on behalf of ACOE and presented in their 2009 Remedial Investigation Report (Harshaw Site ACOE RIR). The regional geologic description is based on information from the Ohio Department of Natural Resources (ODNR).

2.4.1 Geology

The following sections include summaries of the regional and Facility-specific geologic setting.

2.4.1.1 Regional Geology

Cuyahoga County is situated within the Appalachian Plateau and the lower-lying Central Lowland physiographic provinces. The two provinces are separated by the Portage Escarpment, which runs northeast through the south-central portion of the county. The glacial soils of the Portage Escarpment are cut by valleys associated with rivers and tributary systems. Alluvial deposits in these valleys, including the Cuyahoga River valley, vary and are composed of silty clays, sands, and gravels.

Unconsolidated deposits in Cuyahoga County consist of made land (fill), glacial tills, lacustrine soils from glacial stages of Lake Erie, and fluvial deposits. Lacustrine soils, consisting of lake clays and beach ridges, are present along the Cuyahoga River valley as far as 15 miles south of the present shoreline, but are generally restricted to the northern part of the county (within 3 miles of Lake Erie). These soils are often covered with anthropogenic fill associated with industrial and residential development, especially in low-lying areas. Glacial soils in the county are Wisconsin age tills of the Killbuck and Cuyahoga Lobes. The majority of the tills in the county are Killbuck (Hiram and Hayesville tills), and Cuyahoga (Lavery till). The tills are primarily composed of silty clays with varying percentages of sands and gravels. Lenses of sand and gravel within the tills are usually present as relatively thin layers of limited horizontal continuity. Fluvial deposits are associated with the Rocky River, Cuyahoga River, and Chagrin River systems. These rivers flow north to Lake Erie.

Cuyahoga County lies on the eastern flank of the Findlay Arch, an extension of the Cincinnati Arch bedrock anticline. Bedrock underlying the county consists of eastward-dipping rocks of the Pennsylvanian (310-265 million years), Mississippian (355-310 million years), and Devonian (410-355 million years) periods. Rocks from these periods are represented by the Pennsylvanian Allegheny and Conemaugh Formations and the Pottsville Group, the Mississippian Cuyahoga Shale and Berea Sandstone, and the Devonian Bedford and Ohio shales. The Allegheny and Conemaugh formations consist of interbedded shales, sandstones, limestones and coals. The Pottsville group consists of sandstones and conglomerates, including the Sharon Conglomerate. The underlying Cuyahoga Formation consists of interbedded shales and sandstones, and the Berea Sandstone is composed of fine to medium quartz sandstone. The Devonian Bedford Shale consists of interbedded shales and sandstones. The Ohio Shale occurs as a gray, medium to thick bedded shale with siltstone or sandstone interbeds (Chagrin Shale Member) and dark gray to black thin-bedded shale (Cleveland Member). The Berea and Sharon Foundations are locally important sources of groundwater.

Bedrock elevations in Cuyahoga County range from 0 to 1200 ft. above MSL. Lower elevations occur in pre-glacial bedrock valleys. The largest of these extends from the Cleveland lakeshore east of downtown, south to the Summit County line. Other lesser valleys extend south from Rocky River to Middleburg Heights, from Middleburg Heights east to Independence, and from Maple Heights southeast to the Summit County line. Another significant bedrock valley runs from south to north near the Geauga County line in eastern Cuyahoga County. The valleys are filled with glacial deposits of varying grain size. Portions of these buried valleys contain sand and gravel deposits, which may be important sources of groundwater in some areas.

2.4.1.2 Facility Geology

The following discussion regarding Facility-specific geology was developed using soil boring logs from investigations conducted at the Facility by Dames and Moore, B. Koh and Associates, Remcor, ERM, Inc., and SAIC and are depicted on Figure 2-6.

The Facility is located north of the confluence of Big Creek and the Cuyahoga River. The southern portion of this area is bordered by Big Creek to the southwest and the Cuyahoga River to the east south-east. The subsurface geology consists of approximately 22 ft. of unconsolidated material that overlies shale bedrock. The bedrock is relatively shallow beneath the northern part of the property and becomes deeper toward the south, while the thickness of the unconsolidated material increases. The unconsolidated material consists of both anthropogenic fill and native fluvial sediment deposits. The native fluvial sediments are indicative of the geographic setting within the Cuyahoga River Valley. Soil boring logs contained within the Harshaw Site ACOE RIR (SAIC, 2009) note both fluvial (coarse-grained) and floodplain (fine-grained) sediments. The regional glacial moraine deposits common to the

surrounding areas are not seen at the Facility, but are presumed to be present in adjacent highlands to the west.

The native fluvial material has been covered by reworked sediments and other construction-related fill materials during what appear to be two major stages of development: the deposition of Old Fill during the initial major development of the Facility post 1903, and the deposition of New Fill during subsequent construction and operation of the Former Harshaw Facility. SAIC reported that the *Soil Survey of Cuyahoga County, Ohio* classifies the Facility soils as urban land (Ub) (SAIC, 2009). Classification Ub is defined as areas of 10 acres or more that are flat or gently sloping, and where roughly 80 percent of the surface is covered by buildings and/or manmade surfaces.

A United States Geological Survey (USGS) topographic map from 1903 was produced prior to any significant commercial/residential land development at the Facility, and indicates the presence of a topographic high in the main portion of the Facility north of Harvard Avenue with approximately 100 ft. of relief (Figure 2-7). The topographic high shown on this map generally coincides with the relatively shallow elevation of bedrock identified in the vicinity of the boiler house area.

During development of the Facility after 1903, it is likely that the bedrock was removed and the area back-filled with reworked native material (the Old Fill) which now overlies the native fluvial sediments. This work appears to have occurred during the initial major development phase that took place prior to construction of the Former Harshaw Facility. The Old Fill material is distinguished primarily by the yellow-orange and brown soil colors. This fill generally contains a higher percentage of sand than the newer fill material that was deposited during later development (New Fill). The Old Fill also contains layers of silt and clay and is predominantly heterogeneous in nature. Based on the soil boring logs contained within the various reports, this material is fairly continuous across the Facility but does pinch out in several areas. Where present, the maximum recorded thickness of the Old Fill is approximately 17 feet thick and averages 8.5 feet. The yellow-orange to brown color and orange staining noted on many soil boring logs may be indicative of weathering that occurred when the upper portion of this unit was exposed at the ground surface. The base of the Old Fill is typically marked by a thin layer of dark gray to black clay and organic matter, which likely represents organic plant matter and floodplain deposits that covered the underlying land surface prior to deposition of the newer fill. This basal layer of organic matter represents a distinguishable boundary marking the separation of the fill material from the underlying native soils.

During development for industrial purposes and the construction of the Former Harshaw Facility, a second layer of newer fill material was placed in the area. This New Fill appears in many places to be composed of construction debris and industrial materials (such as slag, sand, etc.) as noted in boring logs from several investigations. The fill placement activities conducted along the banks of the Cuyahoga River and Big Creek were most likely intended to provide increased developable land area and to minimize the potential for flooding and bank erosion.

The newer fill (New Fill) material was likely deposited during the operation and expansion of the Facility. Based on numerous soil boring logs, the newer fill material is predominantly heterogeneous in composition and grain size, and contains a significantly higher percentage of fine-grained material than the underlying fill material (Old Fill). The grain sizes range from clay to silty-clay with some sand. In many locations the New Fill contains construction debris such as bricks, glass, plastic, and various granular materials as noted on soil boring logs. A hydrocarbon odor was observed and associated with this fill as reported on some of SAIC's soil boring logs. The presence of the construction debris is the primary distinguishing characteristic of the New Fill. In many locations the base of this fill was determined by the deepest occurrence of construction debris noted on soil boring logs. In areas with

relatively thin layers of the New Fill, soil boring logs commonly note slag gravel and other obvious fill materials. The base of this fill layer appears to be characterized in some places by a thin layer of dark gray to black clay and organic material. As with the older fill material, this thin layer may represent organic plant matter and floodplain deposits representing the former land surface prior to deposition of the newer fill. Figure 2-8 presents an Isopach map showing the thickness and distribution of the newer fill material. The average thickness of this fill material is 5.6 feet.

The shale bedrock underlying the Facility is identified as the Chagrin Member of the Ohio Shale Formation (SAIC, 2009). It is characterized as a blue-gray laminated shale with inter-bedded siltstones. Soil borings advanced during the RI typically met refusal at approximately 2 ft. below the surface of bedrock, thus indicating that the weathered layer of the shale is approximately 2 ft. thick. Based on these logs, it appears that the surface of the bedrock is highly fractured and fissile, is typically wet, and bears water within the fractures.

The surface of bedrock is shallower in the north/northwest part of the Facility and becomes deeper to the southeast. Its maximum observed depth during Harshaw Site ACOE RIR was 39.7 ft. and the minimum observed depth was 4.6 ft. The minimum depth was observed in an area that represents the highest point of a subsurface bedrock ridge located near the boiler house. The subsurface bedrock ridge encountered during RI intrusive sampling represents the remnants of the bedrock ridge that existed at the surface in this area in 1903 (Figure 2-7). Figure 2-9 presents a structure map of the bedrock surface as presented in the Harshaw Site ACOE RIR. The bedrock surface in the southern and southeastern part of the Facility was determined from a regional bedrock map, as no historic or RI borehole data were available for this area. The figure clearly depicts the subsurface bedrock ridge to the south of Building G-1.

2.4.2 Hydrogeology

The following sections include summary descriptions of the regional and Facility-specific hydrogeologic setting.

2.4.2.1 Regional Hydrogeology

In general, Cuyahoga County does not possess extensive high-yield aquifers. The *Ground Water Resources of Cuyahoga County* indicates the majority of the county overlies areas of poor groundwater production, where yields of 10 gallons per minute (gpm) or less may be developed from groundwater wells (SAIC, 2009). Higher production rates in some areas can be obtained from sandstone bedrock and in other areas from unconsolidated buried valley deposits.

Groundwater in most areas is produced from Mississippian or Devonian shale bedrock and the overlying unconsolidated deposits, which are predominantly clays. Wells completed in the shale bedrock may produce 3 to 10 gpm, with lesser yields from the overlying clays. Brackish water and dry holes are common in the overburden.

Yields of 10 to 40 gpm may be obtained from the Berea Sandstone and the Sharon Sandstone in somewhat extensive but isolated areas in the southern half of Cuyahoga County. Berea Sandstone wells may be drilled in North Olmstead, Middleburg Heights, Parma Heights, Independence, and along the Geauga County line to the east. The Sharon Sandstone can be used for water in the extreme south-central portion of the county and in an area in the eastern part of Cuyahoga County.

A buried bedrock valley aquifer system extends from the lakeshore in the Cleveland area, south to the Summit County line, then west across the south-central portion of Cuyahoga County to Middleburg

Heights. Production from the northern portion of the system averages 3 to 10 gpm, except for a small portion in the center of the valley, where up to 250 gpm may be produced. Production from the remainder of the system averages 10 to 25 gpm. Additional buried valley deposits in the eastern part of the county generally produce three to 25 gpm, with the exception of a small area northwest of Maple Heights, where yields of up to 1500 gpm can be obtained. Yields of 3 to 25 gpm can also be obtained from buried valley deposits under the eastern portion of the county, near the Geauga County line.

2.4.2.2 Facility Hydrogeology

Groundwater flow at the Facility is controlled by the nature of the unconsolidated deposits, the topography of the underlying shale bedrock, and the relative elevation of the discharge areas (Cuyahoga River and Big Creek). Discussions of the Facility hydrogeology in the following sections are based on the various historical investigations conducted by Dames and Moore, Remcor, ERM Midwest, Inc., and SAIC. The following paragraphs were developed using water level measurements, slug testing, and well development/sampling activities conducted during those investigations.

A total of 75 monitoring wells, temporary piezometers, and temporary well points were installed to various depths throughout the Facility and on adjacent properties to the west during both historic investigations (Dames and Moore, Remcor, ERM Midwest, Inc., etc.) and the RI by the ACOE for the Harshaw Site. Table 2-1 provides an inventory of all existing wells, including monitoring wells, background wells, temporary piezometers, and temporary well points. Figure 2-6 shows the location of all existing pre-RI and RI wells, temporary piezometers, and temporary well points.

The potentiometric surface developed from groundwater-level data collected by AECOM on March 9, 2009 (Figure 2-10) shows groundwater flow in the unconsolidated fluvial material saturated zone to be generally from west to east across the Facility. Groundwater flow directions across the Facility appear to be influenced by changes in surface water levels and flow in the Cuyahoga River and Big Creek. Data generated during slug testing and well development/sampling provided additional information regarding Facility groundwater conditions. Slug tests conducted on 23 monitoring wells during the Harshaw Site RI produced hydraulic conductivity values that varied over several orders of magnitude due to the heterogeneity of the Facility lithology.

Local groundwater is not used at the Facility for drinking or industrial processes. The water-bearing zone below the Facility varies in production (i.e., well yields) and municipal water supplies are in place (and available for expansion), thus making future use of groundwater unlikely. SAIC stated in the Harshaw Site ACOE RIR that no potable drinking water wells are currently located in the vicinity of the Facility. Future uses of groundwater are unlikely since Lake Erie provides readily accessible and usable process and drinking water with treatment.

AECOM performed a one-mile radius, on-line water well search of the ODNR well database. A total of 275 water wells were identified within one mile of the Facility. The well records will be verified with ODNR with regard to the condition of the wells, and whether the wells are used for domestic potable or commercial/industrial use. Information regarding the presence and usage of municipal, public, private and industrial wells within one mile of the Facility will be obtained during the RCRA Facility Investigation.

The subsurface geologic units discussed in Section 2.4.1 provide the framework discussion for descriptions of the two primary groundwater-bearing saturated zones at the Facility. Primary groundwater flow occurs within the fluvial sediment saturated zone, a variably textured alluvium. The fill and alluvium coarsens to the east toward the Cuyahoga River. Due to the highly fractured nature of the uppermost portion of the shale bedrock at the Facility, groundwater in this zone appears to extend into

the upper portion of the shale bedrock. Based on geologic boring log descriptions, groundwater within this relatively thin fractured upper bedrock zone is present as a result of direct contact with the overlying saturated fluvial sediment zone at the Facility.

The fluvial sediment represents the primary water-bearing zone in the vicinity of the Facility. It underlies the fill material and is located above the shale bedrock unit. This water-bearing zone is not used as a drinking water source for the surrounding Cleveland area, which obtains metropolitan water from Lake Erie. The potentiometric map (Figure 2-10) indicates groundwater in the fluvial sediment discharges to the Cuyahoga River and Big Creek.

2.4.3 Surface Water

The Facility is located at the confluence of the Cuyahoga River and Big Creek floodplains. Surface water drainage characteristics vary across developed and undeveloped portions of the Facility. The following sections discuss characteristics of the two main surface water bodies present at the Facility, as well as Facility runoff and storm sewer drainage.

2.4.3.1 Cuyahoga River

Headwaters of the Cuyahoga River originate in Geauga County, Ohio where the river flows southward to the City of Cuyahoga Falls before turning sharply north toward Cleveland, Ohio. Along its approximately 100-mile course, the river flows through heavily populated and industrialized areas including the City of Akron and suburban land south of Cleveland. The Cuyahoga River discharges into Lake Erie at a point located approximately 4 miles north-northwest of the Facility.

The surface elevation of water within the Cuyahoga River is approximately 574 feet above MSL based on measurements collected during the ACOE's Harshaw Site RI. This elevation is approximately 20 feet below the elevation of the main developed portions of the Facility. The elevation of the river bottom (bedrock) adjacent to the Facility was not directly measured during any of the previous investigations, but is assumed to be relatively shallow based on bedrock elevations on-site and surface water elevations in the river.

The Harshaw Site ACOE RIR reports that during periods of little or no precipitation, the Cuyahoga River water level dropped to baseflow conditions, revealing gravel bars immediately north of the confluence with Big Creek and along the bank of the Cuyahoga, just north of Harvard Avenue. The presence of gravel bars at both of these locations is a result of bedload gravel carried to the Cuyahoga River by the Big Creek during periods of high flow. The suspended bedload associated with these high flows entered the Cuyahoga River at the Big Creek confluence. Gravel remained in suspension in the high flow of Big Creek, but naturally settled out as downgradient gravel bars in the lower-velocity Cuyahoga River.

2.4.3.2 Big Creek

Big Creek headwaters are found in the cities of North Royalton, Ohio (east branch) and Brook Park, Ohio (west branch). Big Creek travels east through Brooklyn and Cleveland, Ohio, and merges with the Cuyahoga River just south of the Facility, approximately 4.1 miles above the mouth of the Cuyahoga River. The surface elevation of water within Big Creek is approximately 575 feet above mean sea level, based on readings presented in the Harshaw Site ACOE RIR.

Like the Cuyahoga River, no direct bedrock elevation measurements of the river bottom have been collected. The bedrock in the creek is assumed to be shallow based on bedrock elevations observed in

soil borings advanced in the southern portion of the Facility during the previous investigations and exposed bedrock visible along Big Creek banks.

2.4.4 Local Meteorology

Local meteorological conditions were measured by SAIC during the Harshaw Site RI using an automated weather station that was located near the center of Parcel 3. Average wind speed, wind direction, temperature, and total rainfall were measured continuously from April 24, 2003 through November 6, 2003. Meteorological data collected during the RI are summarized below (SAIC, 2009):

Parameter	Value (April through October, 2003)
Mean Wind Direction	193 degrees (north=0 degrees)
Mean Wind Speed	4 miles per hour
Mean Temperature (April 24 through November 6, 2003)	63.9 F
April	54.9 F
May	58.5 F
June	71.0 F
July	72.8 F
August	73.7 F
September	64.1 F
October	51.6 F
November	59.6 F
Total Rainfall for period	22 inches

2.4.5 Habitat Types and Facility Biota

The following data on ecological receptors and habitats types identified on the Facility were obtained from the Screening Level Ecological Risk Assessment (SLERA) prepared by ACOE as part of the Harshaw Site RI (SAIC 2009). The SLERA addresses the requirements of Level I, Level II and Level III of Ohio EPA's guidance for environmental risk assessments.

2.4.5.1 Habitat Types

Each of the parcels comprising the Facility has undergone extensive modification to support industrial activities. The predominant types of terrestrial habitats at the Facility consist of anthropogenic (industrial), old field, deciduous woods, and riparian. Overall habitat quality is poor.

The predominant habitat in Parcels 2 and 3 is anthropogenic (industrial), which is characterized by pavement or bare ground with localized old field successional vegetation consisting of shrubs, immature trees, and unmaintained grasses. The old field habitat occurs predominantly along the railroad tracks adjacent to the Harvard-Denison Bridge. Thin bands of deciduous woods are present along fence lines, railroad tracks, and along the property boundaries with Cuyahoga Creek and Big Creek.

Habitat within Parcels 4 and 5 is anthropogenic (industrial). The ground surface is level, with sparse unmanaged grass and shrubs.

Riparian habitat is the transition zone between aquatic and upland terrestrial habitats. Riparian habitat at the Facility is limited to a narrow band of steep land along the boundary with Big Creek and the

Cuyahoga River, and has been impacted by placement of fill along the streams. The riparian habitat is heavily vegetated with juvenile to mature trees, grasses and shrubs.

The Cuyahoga River and Big Creek are classified as aquatic habitats. Based upon a review of the U.S. Fish and Wildlife Service National Wetland Inventory maps, there are no wetlands identified within the Facility boundaries.

2.4.5.2 Facility Biota

Terrestrial and Riparian Species

Terrestrial vegetation identified on the Facility consists of unmanaged turf grasses, shrubs, juvenile trees, and invasive old field species. Vegetation occurs sparsely across the level portions of the Facility. Vegetation in the strips of riparian habitat along the Cuyahoga River and Big Creek include immature trees, grasses, and shrubs that are subject to seasonal flooding.

Terrestrial animals referenced in the SAIC SLERA include rabbits, voles, shrews, robins, foxes, and hawks. Riparian species include muskrats, mallard ducks, mink, and herons.

Aquatic Species

The Ohio EPA has assigned warm-water habitat non-attainment status to both the Cuyahoga River and Big Creek in the vicinity of the Facility (SAIC, 2009). Information regarding the composition of fish and aquatic invertebrates in the Cuyahoga River and Big Creek are not currently available, and will be provided in subsequent reports.

Endangered Species

Inquiries regarding threatened and endangered species were made to the Ohio DNR and U.S. FWS by ACOE. The ODNR stated “the project lies within the range of the Indiana bat and piping plover (E) and eastern massasauga (C), federally listed endangered (E) and candidate (C) species. Due to the project location, the proposed project will have no effect on the piping plover and eastern massasauga” (SAIC, 2009).

The U.S. FWS stated “this project lies within the range of the Indiana bat (Myotis sodalist), a federally listed endangered species. Summer habitat requirements for the species are not well defined, but the following are thought to be of importance:

- Dead trees and snags along riparian corridors especially those with exfoliating bark or cavities in the trunk or branches which may be used as maternity roost areas;
- Live trees (such as shagbark hickory) which have exfoliating bark; and
- Stream corridors, riparian areas, and nearby wood lots which provide forage sites.

SAIC recommended that if potential bat roost trees with the above characteristics are encountered in the project area, they and the surrounding trees should be saved wherever possible. If they must be cut, they should not be cut between April 15 and September 15” (SAIC, 2009).

2.5 Facility History

Discussions of the Facility hydrogeology in the following sections are based on the various historical investigations conducted by Dames and Moore, Remcor, ERM Midwest, Inc., and SAIC, and information collected from former employees.

2.5.1 Facility History - Non-Radiological

A predecessor of Harshaw, the Harshaw, Fuller and Goodwin Company, acquired the Harvard Avenue property in 1905 from the Canadian Copper Company. Harshaw continued to operate at the property under that name until 1983 when its then parent, Gulf Oil, and Kaiser Clay and Chemical formed the Harshaw/Filtrol partnership. By acquiring Gulf Oil in 1985, Chevron Chemical Company became Kaiser's partner in the Harshaw/Filtrol partnership. Chevron sold its share of the Harshaw/Filtrol partnership, with the exception of Building G-1 (aka Plant C), to Kaiser in 1987.

Initially, Harshaw began making nickel salts and cobalt oxide and producing hydrofluoric acid from fluorspar. In 1918, cobalt manganate, nickel salts, pigments, and inorganics were generated at the Site. In the 1930s, liquid chemical brighteners were manufactured, and the capacity to make hydrofluoric acid was upgraded. The nickel salts process was expanded in the 1940s. Also in the 1940s, the processing of uranium compounds for the Manhattan Engineering District (MED) began (see Section 2.5.2 below). Between 1930 and 1950, the miscellaneous fluorides plant began operation. In the late 1960s, the fluoride production capability was increased. The waste water treatment systems were introduced in the late 1970s. Between the late 1970s and the early 1980s, nickel carbonate production was added. Hydrofluoric acid manufacturing was terminated in 1985. During the late 1980s into the 1990s, operations included the production of nickel catalysts, catalyst intermediates (i.e., nickel carbonate), extruded catalysts, miscellaneous fluorides and fluoroborates, metal finishing products, color plate products, and electrolus products.

Nickel chloride and nickel sulfide salts were produced in buildings formerly located along the northwestern border of the Facility (former buildings M-1, M-2, N-1 and N-2; Figure 2-2). In the catalyst area (former buildings C-1, C-2 and K-3, and in units situated south of building K-1) nickel compounds were processed with sodium carbonate and sodium hydroxide to form intermediate catalysts (Figure 2-2). These intermediates, as well as nickel and copper chromite-based catalysts received from another Harshaw plant, were activated with hydrogen and stabilized with oxygen to form final catalyst products. Processing of these materials included a combination of mixing, reacting, drying, forming, extruding, and milling operations.

In the inorganic fluoride area (former buildings H-1 and H-11; Figure 2-2), hydrofluoric, boric and fluoroboric acids were processed along with strontium, lithium, tin, lead, cadmium, barium, and chromium compounds to form fluoride salts and plating solutions. The processes included a combination of mixing, reacting, centrifuging, drying and milling operations.

Process wastewater treatment systems were located throughout the Site, at or near the production areas generating the waste streams. These small treatment units employed a combination of pH adjustment, chemical precipitation, and/or filter presses to remove and reclaim metals from the waste streams. For treatment systems located near the production unit, wastewater was typically collected at the process areas in concrete trenches which collected and conveyed the wastewater to the treatment system. Wastewater was also collected in sumps and pumped to treatment systems not situated near the process area, such as the former nickel wastewater treatment system that was located in building P-1, and the hydrofluoric acid wastewater treatment system formerly located in building H-10 (Figure 2-2).

2.5.2 Facility History – Radiological

The Former Harshaw Site was one of the earliest contractors to the MED and later the Atomic Energy Commission (AEC). From 1942 until at least 1953, the Site processed large quantities of uranium for a variety of national defense projects. The uranium processing equipment was decontaminated by

Harshaw under AEC guidance, and was released from AEC control in 1960. Following AEC's release of the structures to Harshaw, the NRC reviewed AEC documents and determined that the documentation was insufficient to support release of the Site for unrestricted use. Based on this determination, Argonne National Laboratories (ANL) performed several radiological surveys of the Site and properties beyond the Site boundaries between 1974 and 1979. Radiological impacts above the then-current uranium release criteria were reported in Site soil and several Site buildings.

Between 1989 and 1998, Engelhard authorized several radiological surveys of Facility buildings, soil, and groundwater to determine the extent of radiological impacts. The surveys were performed by ADA Consultants and B. Koh Associates. During 1997 and 1998, radiologically-impacted structures were decontaminated, resurveyed, and proposed to the NRC for release for unrestricted use. With the approval of the NRC, Engelhard returned the former Foundry and Warehouse into storage and warehousing service. Eleven other structures were demolished. Building G-1 remained under the ownership of Chevron (or its affiliate) and, other than the decontamination and removal of certain process equipment, was not included in the Engelhard decontamination program.

On June 3, 1999, the Site was designated for inclusion under FUSRAP. Subsequent to this designation, ACOE performed an RI between 2005 and 2009. The RI included the collection and analysis of samples collected from all environmental media, Site sewers, Building G-1, other remaining Site buildings, and adjacent or nearby off-site properties for radiological and some non-radiological impacts associated with MED/AEC activities at the Site. RI findings, including an evaluation of human and ecological risk associated with impacts from former uranium processing activities, were presented in the Harshaw Site ACOE RIR.

2.5.3 Release/Spill History

The information summarized within the following paragraphs was acquired from the Harshaw Site ACOE RIR produced by SAIC in 2009, A.T. Kearney's 1990 Visual Site Inspection (VSI) Report, a review of documents collected during a file review conducted at the Facility by AECOM in 2009 and again in 2010, and a review of Ohio Environmental Protection Agency (OEPA) Northeast Ohio District Office files. Documents supporting the spills/releases are included in Appendix A.

The A.T. Kearny VSI Report referenced several releases that reportedly occurred at the Facility after 1974. No information was reportedly available on releases prior to 1974. The releases included in the VSI are summarized below:

- Undocumented releases of hydrofluoric acid and sulfuric acid occurred during the operational life of the hydrofluoric acid production area. These releases produced numerous voids in the subsurface that impacted the integrity of structures in the area.

- Historic, undocumented releases of sulfuric acid and nickel in the nickel chloride and nickel sulfate production areas impacted groundwater in the vicinity of buildings N-1, N-2, and M-1. Northeast Ohio Regional Sewer District (NEORSD) issued a Notice of Violation (NOV) to Harshaw due to the infiltration of impacted groundwater into a sanitary sewer which passes through this area (see Section 2.5.4). The nature and extent of impacts associated with the undocumented releases were evaluated during investigations performed by Dames and Moore in January and June, 1987.

- 200 pounds of chrome chloride were discharged to the Cuyahoga River from Outfall 005 in October 1975.

- Two releases of sulfuric acid from transfer hoses occurred during 1978 near Building H-1. The spills were neutralized by plant staff using soda ash and lime, and the impacted soil was excavated and disposed of off-site. A minor release of sulfuric acid to the Cuyahoga River reportedly occurred and was reported to the Ohio Environmental Protection Agency (OEPA).

- Approximately 10,000 gallons of untreated pentavalent antimony wastewater was released to the Cuyahoga River via outfall 005 in May 1985.

- Approximately 6,500 gallons of 93 percent sulfuric acid/nickel sulfate solution was released on June 4, 1985 from a tank near Building M-1. A limited quantity of the liquid was discharged to the Cuyahoga River. The release was attributed to an act of sabotage during a labor stoppage. The spill was neutralized with soda ash and lime by plant and subcontractor personnel. Impacted soil was disposed of off-site. The OEPA, U.S. Coast Guard, City of Cleveland, and other agencies were notified. A copy of an internal Harshaw Chemical Company (HCC) memorandum is included in Appendix A.

- In July 1986, 200 gallons of tank rinsate containing lead fluoroborate were released from Building H-11 to the Cuyahoga River via Outfall 007. The incident was investigated by OEPA, resulting in a letter of noncompliance for lead. The release resulted in a modification of release response procedures. Documents associated with the release are included in Appendix A.

- An uncontrolled chemical reaction in the Color-Plate process area occurred in May 1988. Approximately 1,024 pounds of cupric chloride and 386 pounds of formaldehyde as solution were released to the Cuyahoga River via Outfall 005. Plant personnel responded to the release. The OEPA incident report is included in Appendix A.

- On March 1, 1989, Engelhard discovered the leakage of wastewater from a collection trench in the boron trifluoride process area. The untreated wastewater discharged to the Cuyahoga River through Outfall 007. The process was discontinued following discovery of the release, and the trenches were replaced. Documents associated with the release are provided in Appendix A.

- Potential environmental impacts associated with the leakage of material containing lead were identified during a Preliminary Assessment performed for the USEPA in May 1983. The impacts were identified in an area south of Harvard Avenue along the property boundary adjacent to Big Creek. No further information referring to this reference has been identified to-date.

2.5.4 Permitting and Regulatory History

Documents and studies associated with the subjects described below are included in Appendix B.

- Harshaw submitted an initial RCRA Part A Notification of Hazardous Waste Activity in August 1980 (Appendix B). The Part A application was revised over time to reflect changes in products, processes and ownership. Harshaw also was issued a Hazardous Waste Facility Installation and Operation Permit from the State of Ohio in December of 1981 (Appendix B). The Harshaw/Filtrol partnership received interim status from the USEPA in August 1982 (A.T. Kearny, 1990).

- Engelhard submitted a RCRA Part B permit application in November 1988. A partial copy of the application is included in Appendix B. Following several modifications to the application in response to OEPA comments, in October 1989 Engelhard withdrew the application and requested termination of interim status. A copy of the letter request is included in Appendix B.

- Engelhard submitted a Closure Plan for four hazardous waste management units (HWMUs) in October 1989. The HWMUs consisted of three above-ground storage tanks (Tanks T-1, T-2 and T-5), and the hazardous waste container storage area in Building G-1. Upon receiving acceptance of the Closure Plan in August of 1990, Engelhard commenced closure of the units. Closure approval for the three hazardous waste storage tanks and the hazardous waste container storage tank area was received from the Ohio EPA on February 11, 1992. Copies of the Closure Plan and the OEPA approval letter are included in Appendix B.

- Several RCRA inspections were performed by federal and state agencies between 1980 and 1988. An inspection performed in February 1983 by the OEPA identified several recordkeeping, manifesting, and drum storage violations. The violations were addressed and OEPA stated that Harshaw was in compliance. An inspection performed on January 28, 1986 identified several violations associated with training, recordkeeping and contingency plan contents. Harshaw addressed the violations, which were approved by OEPA. Associated documents are included in Appendix B. [Harshaw was permitted to discharge treated wastewater to the Cuyahoga River and Big Creek through seven outfalls under National Pollution Discharge Elimination System (NPDES) Permit No. 3EI00006. NPDES-related issues and documents are summarized below:

  - In response to a reported cyanide-like odor in air, the NEORSD collected a sample of water from Outfall 005 on September 21, 1983. Cyanide was detected at 21 parts per million (ppm). The cyanide detected in the discharge was described by Harshaw as originating from the once-per-year production of a cupric cyanide bath solution in the plating solution production area. NEORSD reported the finding to OEPA. The NEORSD report is included in Appendix B.

  - On December 28, 1987, Harshaw submitted a Proposed Intensive Monitoring Program to OEPA to support the development of effluent limitations for its processes. OEPA approved the plan on April 21, 1988. Following the acquisition of Harshaw by Engelhard, a modified Proposed Intensive Monitoring Program was submitted to OEPA on March 31, 1989. The documents are included in Appendix B.

- In May 1987, the NEORSD sampled a sanitary sewer manhole downstream from the former Harshaw Site and reported nickel concentrations exceeding the maximum wastewater limit of 10 mg/L. Additional sewer system sampling from manholes on the Harshaw Site reportedly documented concentrations of nickel above 10 mg/L within the beltline interceptor sewer that passes through the Facility adjacent to former nickel sulfate production areas located on Parcel 3 (Appendix A). In September 1989, a letter from NEORSD was issued to Engelhard requiring action be taken to mitigate the discharge of nickel to the beltline interceptor sewer (Appendix A). In January 1990, approximately 344 linear feet of the beltline sewer was relined between manholes 2 and 4 and in April 1990, manholes 2, 3, and 4 were coated in an attempt to control the infiltration of nickel impacted groundwater into the beltline interceptor sewer. In March 1991, a notice of violation of the sewer use code was issued to Engelhard by NEORSD based on samples collected from the interceptor sewer in February 1991, documenting exceedances of the 10 mg/L limit for nickel in wastewater (Appendix A). In December 1991, manholes 2, 3, 4, 6, 7, and 9 were grouted to eliminate groundwater infiltration. In January 1992, a proposal was submitted to NEORSD to reline approximately 712 linear feet of the beltline interceptor sewer with a sleeve and reseal manholes 2, 3, and 4 with epoxy cement. In September 1992, after an inspection of the sewer was performed prior to initiating the relining work, Engelhard submitted a progress report to NEORSD that documented the original liner had shown wear and infiltration was still occurring into portions of the sewer and manholes (*Engelhard Corporation Harvard-Denison NOV Progress Report,* Engelhard Corporation, September 14, 1992)(Appendix A). As a result, this work was put on hold pending

further investigation and a remedial alternatives evaluation. Following a remedial alternatives evaluation conducted by ERM between November 1992 and April 1993, Engelhard decided to address the groundwater infiltration issue by selecting an alternative that consisted of installing 6 groundwater extraction wells along the interceptor sewer between manholes 1 and 7 to capture and lower the groundwater elevation below the sewer line, and to install two additional groundwater extraction wells east of the foundry to contain the dissolved nickel groundwater plume that was documented to have migrated east toward the Cuyahoga River (ERM, 1993). In March 1994, a permit application was submitted to the OEPA Division of Water Pollution Control to construct the groundwater recovery and treatment system (Engelhard, 1994). The system consisted of a total of 8 recovery wells labeled RW-1 through RW-8 of which six wells (RW-1 through RW-5 and RW-8) were installed along the beltline sewer. Two recovery wells (RW-6 and RW-7) were installed approximately 250 feet to the east (hydraulically downgradient) of manholes 6 and 7 on the southern portion of the beltline sewer. The nickel extracted and processed by the treatment system was sent off-site and reclaimed while the treated wastewater effluent was discharged to the sanitary sewer. Please refer to Section 5 for a discussion of current system status.

3.0 Preliminary Assessment of Nature and Extent of Contamination

The Order requires that the DOCC Report provide an update on the condition of 37 SWMUs and eight (8) AOCs listed in Attachment 8 of the Order. This Report presents the observations collected during two visits to the Facility for the purpose of evaluating the current conditions of the SWMUs and AOCs included in the Order. The first visit was conducted on September 13, 2007 and the second visit on April 14, 2010. The observations recorded during these two visits are provided in the following subsections.

The VSI conducted by A.T. Kearney, Inc. for USEPA in June 1990 identified thirty-seven (37) SWMUs and seven (7) AOCs at the Former Harshaw Chemical Site (Figure 3-1) and is used as a reference for historical descriptions of the SWMUs and AOCs. An eighth AOC (AOC H) was more recently identified by BASF and presented to USEPA during discussions over the requirements of the Order.

Photographs of the SWMUs and AOCs are provided in Appendix C and the location and direction of each photograph is depicted on Figure 3-2**.** Descriptions of the SWMUs and AOCs provided in the following subsections are based on the descriptions included in the VSI Report and on site visits conducted by AECOM on September 13, 2007 and April 14, 2010.

3.1 Solid Waste Management Units (SWMU)

3.1.1 SWMU 1 – Container Storage Area

SWMU 1, the former container storage area, was located within Building G-1 owned by BGD Company, an affiliate of Chevron USA, Inc. As stated in Attachment 8 to the Order, SWMU 1 is not located within the Facility, and is therefore excluded from the scope of the Order.

3.1.2 SWMU 2 – Tank T-5

SWMU 2, former Tank T-5, was located in Building H-10 and regulated by RCRA. The unit started operation in 1986. Tank T-5 was utilized as an emergency backup to Tank T-1 in the Fluoroborate WWTS (SWMU 4). Tank T-5 was installed in 1977 and constructed of fiberglass-reinforced plastic that had a total capacity of 6,320 gallons. Tank T-5 was ten feet in diameter and stood ten feet nine inches high. The associated piping and valves for Tank T-5 were constructed of PVC or Dow-lined carbon steel. Tank T-5 discharged from the bottom of the tank via a discharge valve that flowed directly into a tanker truck through a feed hose line that was located outside of the building.

During the VSI, Tank T-5 was observed resting on the concrete flooring within Building H-10 that had an associated trench that was previously sealed with concrete. No signs of a release were present during the inspection and there was no historical documentation of a release at this location.

Former Tank T-5 received closure plan approval from OEPA on September 19, 1990. Documentation of closure activities was submitted to OEPA on September 6, 1991 and confirmed during an OEPA site inspection on September 19, 1991. Formal closure approval was received from OEPA on February 11, 1992.

SWMU 2 was visually inspected during AECOM's April 2010 visit. No visible signs of Tank T-5 were present within Building H-10 and no visible signs of impacts from the former tank were observed. Photo 20 depicts the current conditions at the former Tank T-5 location.

Because SWMU 2 was closed in February 1992, this SWMU does not require any further action and need not be included in the RFI.

3.1.3 SWMU 3 – Tank T-2

SWMU 3, former Tank T-2, was a RCRA-regulated tank located in Building K-1. This unit started operation in 1986. Tank T-2 was utilized as part of a waste collection system for corrosive waste waters. The wastes that were collected in Tank T-2 were generated from the Electrolus and Copper – Color Plate processes in Building K-1 as well as from production Tank T-53 located in the L-1 Building. Tank T-2 was constructed of fiberglass-reinforced plastic, was eight feet in diameter, stood fifteen feet high, and had a total capacity of 5,640 gallons. Tank T-2 had a level indicator to register/record the liquid height in the tank via local display as well as a remote display located within the production area. Additionally, the tank was vented to ensure no overpressure or vacuum could occur. The associated piping and valves for Tank T-2 were constructed of PVC or Dow-lined carbon steel. Tank T-2 discharged through T-2 pipe (SWMU 20) into a tanker truck.

During the VSI, Tank T-2 was located within Building K-1 inside a concrete containment area that had a capacity of 6,280 gallons. There were no visible signs of a release and no historical documentation of a release at this location.

Former Tank T-2 received closure plan approval from the OEPA on September 19, 1990. Documentation of closure activities was submitted to OEPA on September 6, 1991 and confirmed during an OEPA site inspection on September 19, 1991. Formal closure approval was received from OEPA on February 11, 1992.

The former location of SWMU 3 was visually inspected during AECOM's April 2010 visit. No visible signs of Tank T-2 were present within the former Building K-1 outline and no visible signs of impacts were observed. Photo 38 depicts the current conditions at the former Tank T-2 location.

Because SWMU 3 was closed in February 1992, this SWMU does not require any further action and need not be included in the RFI.

3.1.4 SWMU 4 – Fluoroborate Wastewater Treatment System (Including Tank T-1)

SWMU 4, the Fluoroborate Wastewater Treatment System (WWTS), consisted of the following five subunits (a through e); a – Tank T-1; b- Fluoroborate Trench; c – Copper/Lead Filter Press; d – Cadmium Filter press; and e – Fluoroborate Pipes. This unit started operation in 1979. The former Flouroborate WWTS managed wastewater from miscellaneous Fluorides Production Areas. The wastewater was considered hazardous because of corrosivity and toxicity.

Tank T-1 was located in Building H-11 and was regulated by RCRA and utilized as part of a wastewater collection system of corrosive waste waters from the filter presses associated with the Fluoroborate WWTS. Tank T-1 was constructed of polypropylene that had a total capacity of 1,030 gallons. The tank was five feet in diameter and stood seven feet high. Tank T-1 discharged through associated piping into a tanker truck.

During the VSI Tank T-1 was observed located within Building H-11. There were visible signs of staining present on the floor although there was no historical documentation of a release at this location.

Former Tank T-1 received closure plan approval from OEPA on September 19, 1990. Documentation of closure activities was submitted to OEPA on September 6, 1991 and confirmed during an OEPA site inspection on September 19, 1991. Formal closure approval was received from OEPA on February 11, 1992.

SWMU 4 was visually inspected during AECOM's April 2010 visit. No visible signs of Tank T-1 were present within the former Building H-11 outline and no visible signs of impacts were observed. Photo 8 depicts the current conditions at this SWMU.

Because SWMU 4a was closed in February 1992, this SWMU does not require any further action and need not be included in the RFI. The remaining four subunits of SWMU 4, b through e, may require investigation as part of the RFI.

3.1.5 SWMU 5 – Former Nickel Waste Water Treatment System

SWMU 5 is identified as the Former Nickel Waste Water Treatment System and was located at the north corner of former Building P-1 in the northern section of the Facility. SWMU 5 consisted of a reaction tank, headbox, sand filter, pH adjustment tank, backwash tank, nickel filter presses, and nickel waste water treatment system pipes. This unit was first activated in 1973 and was upgraded several times during its existence. The treatment system was located outdoors except for the filter presses, which were located on the second floor of Building P-1. The pH of the nickel waste water was raised in the reaction tank to precipitate the nickel. From there, the waste water was pumped to the headbox and was then discharged to the sand filter where the nickel was removed. Next, the waste water flowed to the pH adjustment tank where the pH was reduced for final discharge. The sand filter was periodically backwashed to the backwash tank. The nickel filter presses received the wastewater from the backwash tank and the treated wastewater was discharged to the floor, flowed to the drains in the floor and eventually flowed to an outfall. The filter cake that was collected in the presses was placed in sludge dollies and was then drummed for off-site reclamation of nickel.

The VSI describes the reaction tank and the backwash tank as rectangular in shape, and approximately ten feet high by ten feet wide, by 15 feet long. These two tanks shared the same release control which consisted of a concrete wall, estimated to be five feet high, and floor. The sand filter was a cylindrical tank with an approximate height of 25 feet and diameter of ten feet. The pH adjustment tank was seven feet high, 12 feet long, and was rectangular in shape.

The VSI noted that several documented releases had occurred at this unit, apparently caused by pump failure which led to the overfilling of tanks. The spills were cleaned up after they occurred. Information regarding exact dates and amount of spills is unknown. Staining was noted on the concrete and asphalt.

Monitoring well DM-27 is located down gradient of SWMU 5. A groundwater sample collected by Dames and Moore from this well on April 8, 1987 contained 0.69 ppm nickel, 190 ppm chloride, and 1,400 ppm sulfate (Table 3-1). Historic nickel concentrations in groundwater samples collected from DM-27 and replacement well DM-27R ranged from 0.30 mg/L during September 1991 to 0.69 mg/L on April 8, 1987 (Table 3-2). ACOE RI soil boring IA04-SB0008 was advanced immediately southeast of the wastewater treatment system (Figure 2-6). Soil samples collected by SAIC from beneath the concrete building pad at 1.4 to 3.4 feet, and 4 to 6 feet below ground surface contained 79.9 mg/kg and 119 mg/kg of nickel, respectively (Table 3-3).

Most of the former Nickel Wastewater Treatment System has been removed since the VSI was conducted. During a Facility visit conducted by AECOM and BASF representatives on September 13, 2007, it was noted that the reaction tank is being used as part of the groundwater treatment system currently running at the Facility. This treatment system is described in Section 5.0 and is designed to capture and treat nickel contaminated groundwater recovered from along the beltline sewer. The concrete foundations where the treatment tanks once sat are visible. SAIC installed a temporary piezometer IA04-TP-0002 nearby during the RI Investigation. No groundwater analytical results are available for this piezometer. Photos 5 and 6 depict the current conditions at this SWMU.

3.1.6 SWMU 6 – HF WWTS

SWMU 6, the Hydrofluoric Acid (HF) WWTS, was located in Building H-10 in the northeast section of the Facility and consisted of the following 11 subunits (a through k): a – Slurry Tank T-6; b – Slurry Tank T-8; c – Clarifier; d – Holding Tank T-11; e – Holding Tank T-12; f – Sludge Holding Tank; g – HF Filter Press; h – HF Pipes; i – HF Trench; j – Sludge Discharge Area; and k – HF Sump. This unit started operation in 1977. The HF WWTS managed fluoride wastewaters that were introduced through Slurry Tanks T-6 or T-8. The fluoride wastewater was sent to the Slurry Tanks (T-6 and T-8) from the HF Trench and HF Sump. From the Slurry Tanks, the wastewater was then sent to the Clarifier and treated with lime before being sent to Holding Tanks T-11 or T-12. Sludge from the Slurry Tanks was discharged to the Sludge Holding Tank. The Sludge was then sent to the Sludge Filter Press to be dewatered prior to the sludge being released to the Sludge Transport Container in the Sludge Discharge Area. The treated wastewater was discharged to an outfall and the sludge was disposed of off-site.

During the VSI, all of the tanks were described as approximately ten and one half feet high, with the exception of the Clarifier that was approximately twelve feet high. The tank capacities ranged from 4,000 gallons to 6,000 gallons with the exception of the Clarifier that had a capacity of approximately 20,000 gallons. Approximately 100 yds of sludge were generated each year. The HF WWTS unit rested on a concrete floor where visible staining was noted. The VSI also noted that several documented releases had occurred at this unit. The releases were apparently caused by pump failure which led to the overfilling of tanks. The spills were cleaned up after they occurred. Information regarding exact dates and amount of spills is unknown. There are no monitoring wells down gradient of the former HF WWTS.

SWMU 6 was visually inspected during AECOM's April 2010 visit. No visible sign of the HF WWTS was present within Building H-10 and no visible signs of impacts were observed. Photo 19 depicts the current conditions at this SWMU.

3.1.7 SWMU 7 – Fixed-Bed Reaction Tower WWTS

SWMU 7, the Fixed Bed Reaction Tower WWTS, was utilized to manage nickel waste water and was located in the east section of Building K-1. This WWTS was comprised of four associated subunits (a through d) that consisted of: a – Holding Tanks; b – Fixed-Bed Reaction Tower WWTS Trench; c – Fixed-Bed Reaction Tower WWTS Sump; and d – Fixed-Bed Reaction Tower WWTS Filter. This unit started operation in 1977. The Fixed-Bed Reaction Tower WWTS operated by collecting nickel process waste water from the Trench and Sump then discharging the waste water into two Holding Tanks. From the Holding Tanks, the waste water was sent to the Filter Presses where the nickel dust was removed. The treated waste water was then discharged to the POTW and the sludge was sent off site for nickel reclamation.

During the VSI, cracking, staining and deterioration of the concrete floor were observed although there were no documented releases on file.

SWMU 7 was visually inspected during AECOM's April 2010 visit. No visible sign of the Fixed-Bed Reaction Tower WWTS was present within the former Building K-1 outline and no visible signs of impacts were observed. Photo 41 depicts the current conditions of this SWMU.

3.1.8 SWMU 8 – Metal Plating Collection System

SWMU 8, the Metal Plating Collection System, was used to manage the nickel wastewater and was located in Building L-1. The System consisted of the following three subunits (a through c): a – Metal Plating Collection System Trench; b – Metal Plating Collection System Holding Sump; and c – Metal Plating Collection System Pumping Sump. This unit started operation in the mid 1970's. The Metal Plating Collection System gathered nickel wastewater from the metal plating area. This wastewater was collected in the Trench and flowed to the Holding Sump that had a capacity of 1,000 gallons. The Holding Sump automatically transferred the wastewater into the Pumping Sump that had a capacity of 400 gallons and had a level indicator alarm. The wastewater was discharged to Tank T-2 (SWMU 3) or the local POTW depending upon the nickel concentration.

During the VSI, cracks and staining of the concrete floor were observed although there was no historical documentation of a release at this location.

SWMU 8 was visually inspected during AECOM's April 2010 visit. No visible sign of the Metal Plating Collection System was present within the former Building L-1 outline and no visible signs of impacts were observed. Photo 34 depicts the current conditions of this SWMU.

3.1.9 SWMU 9 – Former Color-Plate Collection System

SWMU 9, the Former Color Plate Collection System, was located in former Building K-1. This unit consisted of a collection trench and associated sump. The former pentavalent antimony oxide collection system (SWMU 17) which was located adjacent to the Electrolus process area, and a four-inch curb separated the two waste streams. The collection system, which was installed in 1987, was built into the concrete floor. The trench was approximately five-inches wide and ten-inches deep and extended throughout the Color-Plate process area. The sump was square in shape and had a capacity of 200 to 300 gallons. The collection system was designed to collect the copper wastewater from the Color-Plate process and discharge it to a tank for temporary storage. The collection system remained in operation until the mid 1990s.

The VSI noted the presence of staining and cracking of the concrete flooring. There was documentation of an explosion in the Color-Plate process area in May 1988. As a result, 1,876 pounds of cupric chloride and 525 pounds of formaldehyde were released. The sprinkler system was activated and the water conveyed these materials into a nearby storm sewer which discharged to the Cuyahoga River. The estimated release to the river was 1,024 pounds of cupric chloride and 386 pound of formaldehyde.

Monitoring well DM-24 located to the east of the spill showed concentrations of dissolved nickel (90 ppm), chloride (410 ppm), and sulfate (1,000 ppm) in a groundwater sample collected by Dames and Moore on April 8, 1987 (approximately one year prior to the explosion) (Table 3-1). Monitoring well DM-22 and replacement well DM-22R, located south and east of the spill location (Figure 2-6), contained detectable concentrations of dissolved nickel, chloride and sulfate at 2.3 mg/L, 650 mg/L, and 260 mg/L, respectively, on April 8, 1987 (Dames and Moore) (Table 3-2). Concentrations of dissolved nickel in groundwater samples collected from DM-22/22R during subsequent monitoring events ranged between 1.6 mg/L and 5.2 mg/L (Table 3-2). Well DM-22R was sampled by SAIC during the remedial investigation on July 11, 2003 at which time the concentration of dissolved nickel was 0.113 mg/L (Table 3-2).

During the September 13, 2007 Facility visit, AECOM and BASF representatives identified the former location of SWMU 9. Building K-1 and all above-ground equipment have been removed. The floor slab of the former K-1 building is still intact, and the epoxy covering on the floor is deteriorated but still intact in some places. The collection trench and associated sump were identifiable although they were filled with soil and vegetation. Photo 46 depicts the current conditions in the vicinity of the former Color-Plate Collection System.

3.1.10 SWMU 10 – Electrolus Copper Collection System

SWMU 10, the Electrolus Copper Collection System, was initially located in Building L-1 but was moved to Building K-1. This System consisted of the following two subunits (a and b): a – Electrolus Copper Collection System Trench and b – Electrolus Copper Collection System Sump. This unit started operation in 1987. The location in the K-1 building was previously utilized as the Pentavalent Antimony Oxide Collection System (SWMU 17). The Trench collected the wastewater throughout the Electrolus process area and moved the wastewater to the Sump that had a capacity of 200-300 gallons. The Sump discharged the wastewater to Tank T-2 (SWMU 3)

During the VSI, cracks and staining of the concrete floor were observed although there was no historical documentation of a release at this location.

SWMU 10 was visually inspected during AECOM's April 2010 visit. No visible sign of the Electrolus Copper Collection System was present within the former Building K-1 outline and no visible signs of impacts were observed. Photo 47 depicts the current conditions of this SWMU.

3.1.11 SWMU 11 – BF_3 Collection System

SWMU 11, the Triborofloride (BF_3) Collection System, was located inside and outside of Building H-2. The System consisted of the following two subunits (a and b): a – BF_3 Collection System Trench and b – BF_3 Collection System Sump. This unit started operation in 1977. The BF_3 Collection System Trench collected the wastewater throughout the BF_3 process area and moved the wastewater to the Sump that discharged to the HF WWTS (SWMU 6).

During the VSI, cracks and staining of the concrete floor were observed although there was no historical documentation of a release at this location.

SWMU 11 was visually inspected during AECOM's April 2010 visit. No visible sign of the BF_3 Collection System was present within the former Building H-2 outline and no visible signs of impacts were observed. Photo 7 depicts the current conditions of this SWMU.

3.1.12 SWMU 12 – Milling Area Trench

SWMU 12, the Milling Area Trench, was located in the eastern portion of the former K-1 building. This unit started operation in 1978. The Milling Area Trench collected the wastewater from the milling process and discharged the wastewater to the Fixed-Bed Reaction Tower WWTS (SWMU7).

During the VSI, cracking and staining of the concrete floor was observed although there was no historical documentation of a release at this location.

SWMU 12 was visually inspected during AECOM's April 2010 visit. No visible sign of the Milling Area Trench was present within the former Building K-1 outline and no visible signs of impacts were observed. Photo 39 depicts the current conditions of this SWMU.

3.1.13 SWMU 13 – Fluoride Process Collection Trench

SWMU 13, the Fluoride Process Collection Trench, was located in former Building H-11. This unit started operation in 1979. The Fluoride Process Collection Trench collected the wastewater throughout the Fluoride process area and moved the wastewater to the HF WWTS (SWMU 6).

During the VSI, cracks and staining of the brick floor were observed although there was no historical documentation of a release at this location. This unit started operation in 1979. SWMU 13 was visually inspected during AECOM's April 2010 visit. No visible sign of the Fluoride Process Collection Trench was present within the former Building H-11 outline and no visible signs of impacts were observed. Photos 9 and 10 depict the current conditions of this SWMU.

3.1.14 SWMU 14 – K-1 Trenches

SWMU 14, the K-1 Trenches, was located in the former Building K-1. It is unknown when this unit started operation. The K-1 Trenches consisted of three 15 inch wide trenches that were 35, 25 and 30 feet in length that collected wastewater from the production of a methanol-based solvent. The point of discharge is unknown.

During the VSI, cracking and staining of the concrete floor were observed although there was no historical documentation of a release at this location.

SWMU 14 was visually inspected during AECOM's April 2010 visit. The K-1 Trenches were visible within the former Building K-1 outline but were filled with concrete. No visible signs of impacts were observed. Photo 36 depicts the current conditions of this SWMU.

3.1.15 SWMU 15 – Former Small Product Pollution Treatment System

SWMU 15, the Former Small Product Pollution Treatment System, was located in Building W-1. The Former Small Product Pollution Treatment System consisted of following components: a 50 gallon drum, pH adjuster, filter press, drain and associated piping. This unit started operation in 1975 and became inactive in the mid 1980's. Wastewater from the small batch specialty products process flowed through the unit. The treated wastewater was discharged from the drain into the Cuyahoga River and the sludge was collected, drummed and disposed of off-site.

During the VSI, cracking and staining of the concrete floor was observed although there was no historical documentation of a release at this location.

SWMU 15 was visually inspected during AECOM's April 2010 visit. The Former Small Product Pollution Treatment System was not visible within the Building W-1 outline and no visible signs of impacts were observed. Cracking of the floor was observed, however. Photos 3 and 4 depict the current condition of this SWMU.

3.1.16 SWMU 16 – Former Nibrite Pollution Treatment System

SWMU 16, the Former Nibrite Pollution Treatment System, was located in former Building L-1 next to the former Metal Plating Collection System (SWMU 8). The Former Nibrite Pollution Treatment System consisted of the following components: a trench, a small tank, and a filter press. The tank and filter press were installed in 1972; the trench was added to the system in 1980. The unit became inactive in 1985. Wastewater from the Nibrite process was collected in the trench and flowed into the tank for

caustic treatment. The treated wastewater was sent to the filter press. Finally, the treated wastewater was discharged into Big Creek and the sludge was collected and disposed of in a landfill or reclaimed.

During the VSI, cracking and staining of the concrete floor were observed although there was no historical documentation of a release at this location.

SWMU 16 was visually inspected during AECOM's April 2010 visit. The Former Nibrite Pollution Treatment System was not visible within the former Building L-1 outline and no visible signs of impacts were observed. Photo 35 depicts the current conditions of this SWMU.

3.1.17 SWMU 17 – Former Pentavalent Antimony Oxide Treatment System

SWMU 17, the Former Pentavalent Antimony Oxide Treatment System, was located in the former Building K-1. The Former Pentavalent Antimony Oxide Treatment System consisted of the following components: a 3,000 gallon treatment tank, filter press, and trench. This unit started operation in 1983 and became inactive in the 1987. Wastewater from the Pentavalent Antimony Oxide process was collected in the trench and flowed into the tank for treatment with sodium hydroxide that facilitated the neutralization and precipitation of the wastewater. The treated wastewater was sent to the plate and frame filter press. Finally, the treated wastewater was discharged into Big Creek and the sludge was collected and disposed of in a landfill.

During the VSI, cracking and staining of the concrete floor was observed although there was no historical documentation of a release at this location.

SWMU 17 was visually inspected during AECOM's April 2010 visit. The Former Pentavalent Antimony Oxide Treatment System was not visible within the former Building K-1 outline and no visible signs of impacts were observed. Photo 40 depicts the current conditions of this SWMU.

3.1.18 SWMU 18 – Former Acetate Pollution Treatment System

SWMU 18, the Former Acetate Pollution Treatment System, was located in former Building C-2. Nickel acetate and nickel nitrate were generated in this area. The Former Acetate Pollution Treatment System consisted of a treatment tank and filter press. It is unknown when this unit started operation but it became inactive in 1978. Wastewater from the production of nickel acetate and nickel nitrate was collected and sent to the treatment tank and the treated wastewater was sent to the filter press. Finally, the treated wastewater was discharged into the Cuyahoga River and the sludge was transferred to the Sludge Dollies (SWMU 29).

During the VSI, it was noted that there were no documented releases on file.

SWMU 18 was visually inspected during AECOM's April 2010 visit, it is noted that the Former Acetate Pollution Treatment System was not present, nor was the former Building C-2. No visible signs of impacts were observed. Photos 1 and 2 depict the current condition of this SWMU.

3.1.19 SWMU 19 – Fixed-Bed Reaction Towers and Pipes

SWMU 19, the former Fixed-Bed Reaction Towers and Pipes, was located in the south section of the Facility and consisted of the following components: three identical reaction towers and associated pipes. This unit started operation in 1977. The towers and pipes were housed within sheds where wastewater was quenched, scrubbed and collected. The wastewater was discharged via overhead piping to the Fixed-Bed Reaction Tower WWTS (SWMU 7).

During the VSI, staining of the concrete floor of the sheds was observed although there were no documented releases on file. .

SWMU 19 was visually inspected during AECOM's April 2010 visit. The Former Fixed-Bed Reaction Towers and Pipes were not visible within the south section of the facility and no visible signs of impacts were observed. Photo 45 depicts the current conditions of this SWMU.

3.1.20 SWMU 20 – T-2 Pipe and Loading System

SWMU 20, the former T-2 Pipe and Loading System, was located in the south section of the Facility. This unit started operation in 1978. The former T-2 Pipe and Loading System originated at Tank T-2 (SWMU 3) on the south side of former Building K-1 and continued north through Building K-1 to the truck loading area on the north side. The coupling point for tanker trucks was situated immediately inside a bay door on the building's north side. Tanker loading operations were conducted on an asphalt lot adjacent to the bay door. Pressure for the pipes was provided by the tanker truck pump. Spillage from hose coupling/uncoupling activities was collected by a small metal pan situated beneath the end of the T-2 pipe. The pipes were constructed of PVC and plastic lined steel.

During the VSI, no evidence of a release was observed and there were no documented releases on file.

SWMU 20 was visually inspected during AECOM's April 2010 visit. The former T-2 Pipe and Loading System were not visible and no visible signs of impacts were observed. Photo 37 depicts the current conditions of this SWMU.

3.1.21 SWMU 21 – Landfill A

SWMU 21, Landfill A, was situated along the bank of the Cuyahoga River in the northeast section of the Facility. It is unknown when this unit started operation however it became inactive in 1986. The landfill was approximately 550 feet long and 60 feet wide. The landfill was formed by the placement of calcium sulfate waste that was generated from the former HF Plant (AOC B) in an unlined area along the river. The calcium sulfate was used to bring the area up to grade. The northern most section of SWMU 21 is overlain by Scrap Yard A (SWMU 23).

During the VSI, Landfill A was observed to be nearly level and had a gravel covering. There were no documented releases on file and no visible signs of impacts.

SWMU 21 was visually inspected during AECOM's April 2010 visit. Landfill A was observed to be relatively level and covered with gravel and vegetation. No visible signs of impacts were observed. Photos 11 - 14 depict the current condition of this SWMU.

3.1.22 SWMU 22 – Former UST Waste Pile

SWMU 22, a Former UST Waste Pile, consisted of an area north of the Hydrogen Fluoride Plant, where soil that was removed during a fuel oil underground storage tank (UST) excavation was staged. At the time of the VSI, several mounds of soil, impacted with fuel oil, were stored on polyethylene sheeting covering an area approximately 700 square feet in size. The soils were being stored temporarily while determining the extent of contamination associated with the tank. At the time of the VSI, there was no evidence of any releases. The soil pile was reported by Engelhard to have been removed for proper disposal shortly following the VSI.

SWMU 22 was visually inspected during AECOM's April 2010 visit. No evidence of a soil pile or polyethylene sheeting was observed. The area where the soil had been staged was heavily overgrown with the exception of a small cleared area. Photo 15 depicts the current condition of SWMU 22.

3.1.23 SWMU 23 – Scrap Yard A

SWMU 23, Scrap Yard A, was located along the Cuyahoga River in the northeast section of the Facility. This unit started operation in 1986. The former Scrap Yard A consisted of approximately 5,000 square feet.

During the VSI, steel tanks excavated from AOC E and dismantled tanks from the HF Plant were being staged in the area. There were no documented releases on file and no visible signs of impacts..

SWMU 23 was visually inspected during AECOM's April 2010 visit. The area that had comprised Scrap Yard A was observed to be relatively level and covered with gravel and vegetation. Neither visible signs of the former Scrap Yard A nor impacts were observed at this SWMU. Photo 14 depicts the current conditions of this SWMU.

3.1.24 SWMU 24 – Scrap Yard B

SWMU 24, Scrap Yard B, was located on an unlined staging area to the north side of Building G-1. This unit started operation in 1980. The former Scrap Yard B was bounded by chain link fence on three sides and the exterior of Building G-1 on the south side and was approximately 10,000 square feet in size.

During the VSI, there were no evidence of a release and no documented releases on file.

SWMU 24 was visually inspected during AECOM's April 2010 visit. Scrap Yard B was observed to be level, have concrete pad with sporadic vegetation growing. Scrap materials stored during the VSI had been removed and no visible signs of impact were observed at this SWMU at the time that AECOM conducted the Site Visit. Photos 23 - 25 depict the current conditions of this SWMU.

3.1.25 SWMU 25 – Demolished Nickel Sulfate Building Staging Area

SWMU 25, the Demolished Nickel Sulfate Building Staging Area, was an area located on a concrete pad inside of Building G-1 owned by BGD Company, an affiliate of Chevron USA, Inc. As stated in Attachment 8 to the Order, SWMU 25 is not located within the Facility and is therefore excluded from the scope of the Order.

3.1.26 SWMU 26 – Former Sludge Pad

SWMU 26, the Former Sludge Pad, was located on the former site of the nickel sulfate product building (M-2), and consisted of the floor slab (a concrete pad) for former building M-2, with an area of approximately 8,000 square feet. The floor slab was constructed of 20 feet by 20 feet-square concrete slabs. According to the VSI, the plant started using this area as a sludge pad in 1978 and it received Hydrogen Fluoride sludge, nickel sulfate, nickel catalyst, and small product operations waste containing nickel, cadmium, lead, barium, chromium, and arsenic. However, it appears that the date might be a misprint in the text. The building was still in existence in 1978 according to historical photographs and existed until approximately 1986. Therefore, it is suspected that the plant started using the area as a sludge pad in 1987 rather than the reported date of 1978.

The unit had no secondary containment. In the early 1980s, sludges from the Hydrogen Fluoride wastewater treatment system (WWTS) were staged at the location prior to loading onto trucks for off-site disposal. Engelhard reported that the sludge pad was removed from operation in the early 1990s. The Former Sludge Pad was also used for storage of the Sludge Roll-off Box (SWMU 27) and the Sludge Transport Container (SWMU 28).

During the VSI, Hydrogen Fluoride sludge was observed piled on the pad. Cracks in the concrete pad were observed. No documented releases were on file.

Monitoring well DM-14 is located in the northeastern portion of SWMU 26. Wells RMW-35 and RMW-39 are located east of SWMU 26 at distances of 40 feet and 70 feet, respectively, on the opposite side of the beltline sewer (sanitary sewer) (Figure 2-6). Recovery wells #2 and #3 are situated 50 feet northeast and 25 feet southeast of the SWMU. Dames & Moore collected soil samples during the installation of DM-14 and groundwater samples following well installation and development, and analyzed the samples for selected metals, pH, chloride and sulfate. A summary of the initial soil and groundwater analyses are provided in Tables 3-4 and 3-1, respectively. Concentrations of nickel in soil at this well location decreased with depth, and ranged from 30,000 mg/kg at 1 to 3 feet bgs to 30 mg/kg at 15 to 17 feet bgs. Soil concentrations of sulfate remained elevated with depth, with concentrations decreasing from 92,000 mg/kg at 11 to 13 feet bgs to 1,300 mg/kg at 17 to 19 feet bgs. Concentrations of dissolved nickel, chloride and sulfate in groundwater collected from DM-14 on April 8, 1987 were 2,600 mg/L, 120 mg/L, and 9,800 mg/L, respectively (Table 3-1). Historic analytical results for nickel in groundwater collected from DM-14, RMW-35, and recovery wells #2 and #3 are summarized in Table 3-2. Dissolved nickel concentrations in groundwater collected from DM-14 reflect a gradual decrease in concentration between October 1985 (5,800 mg/L) and April 1998 (220 mg/L). Dissolved nickel concentrations in groundwater collected from RMW-35 and RMW-39 on April 29, 1998 and August 7, 1998 ranged from 2.5 mg/L to 3.6 mg/L.

The current condition of this SWMU was assessed during the Facility visits conducted by AECOM and BASF representatives on September 13, 2007 and April 2010. Evidence of the SWMU still existed in the form of the cracked concrete pad and a wooden wall used to keep material from exiting the pad to the west. No soil or sludge piles were observed at the SWMU. The concrete pad was heavily cracked and vegetation had grown between the cracks and along the outside of the pad. Photos 26 - 28 depict the current conditions of this SWMU.

3.1.27 SWMU 27 – Sludge Roll-off Box

SWMU 27, the Sludge Roll-off Box, was an opened-topped storage container constructed of steel with a capacity of 18 cubic yards that was located in the northwest corner of the sludge pad (SWMU 27). This unit started operation in 1983. The roll-off box received sludge from the HF WWTS (SWMU 6) via the Sludge Transport Container (SWMU 28).

During the VSI, no evidence of a release was observed and no documented releases were on file.

SWMU 27 was visually inspected during AECOM's April 2010 visit. The former Sludge Roll-off Box was not present and no visible signs of impacts were observed. Photos 26 - 28 depict the current condition of this SWMU.

3.1.28 SWMU 28 – Sludge Transport Container

SWMU 28, the Sludge Transport Container, was used to transfer HF sludge from the HF WWTS (SWMU 6) to the Sludge Roll-off Box (SWMU 27). This unit started operation in 1978. However, it

appears that the date might be a misprint in the text. SWMU 27 was not in existence until approximately 1986. Therefore, it is suspected that the plant started using the sludge transport containers in 1987 rather than the reported date of 1978.

When this container was not in use it was stored in the northeast section of the Sludge Pad (SWMU 26). The container was constructed of steel and had a capacity of approximately three cubic yards.

During the VSI, no evidence of a release was observed and no documented releases were on file.

SWMU 28 was visually inspected during AECOM's April 2010 visit. The former Sludge Transport Container was not present and no visible signs of impacts were observed. Photos 26 - 28 depict the current condition of this SWMU.

3.1.29 SWMU 29 – Sludge Dollies

SWMU 29, the Sludge Dollies, was opened-topped steel carts with a capacity of two cubic yards, used to collect filter cake from various filter presses throughout the Facility. This unit started operation in 1978. When full, the contents of the dollies were emptied into drums which were transported off-site for disposal or recycling.

During the VSI, Sludge Dollies were observed on the second floor of Building P-1 at the Nickel WWTS Filter Presses (SWMU 5f) and at the Fixed-Bed Reaction Filter Presses (SWMU 7d) in Building K-1. No evidence of a release was observed and no documented releases were on file.

During the AECOM site visit, the Sludge Dollies were not able to be located, Building P-1 and K-1 have been razed and the storage locations of the Sludge dollies during the VSI (SWMU 5 and SWMU 7) are discussed in previous subsections. Because the sludge dollies were not permanent fixtures, SWMU 29 was unable to be located and inspected during AECOM's April 2010 visit.

3.1.30 SWMU 30 – South Empty Drum Storage Area

SWMU 30, the South Empty Drum Storage Area, was a concrete pad located on the north side of Building K-1 in the south section of the Facility. This unit started operation in 1978. The former South Empty Drum Storage Area was approximately 500 square feet in size where empty drums were stored two high until the drums were transferred off-site to a drum reconditioner.

During the VSI, the South Empty Drum Storage Area was observed to have approximately 60 drums staged in the area. No evidence of release was observed and no documented releases were on.

SWMU 30 was visually inspected during AECOM's April 2010 visit. Evidence of the SWMU still existed in the form of relatively level concrete with minor fractures. No impacts were observed. Photo 42 depicts the current condition of this SWMU.

3.1.31 SWMU 31 – North Empty Drum Storage Area

SWMU 31, the North Empty Drum Storage Area, was located on the floor of the former Nickel Sulfate Building. This unit started operation in 1987. Empty drums were stored on pallets up to three high until the drums were transferred off-site to a drum reconditioner.

During the VSI, the North Empty Drum Storage Area was observed to have approximately 25 drums staged in the area. There was no evidence of a release and no documented releases were on file.

SWMU 31 was visually inspected during AECOM's April 2010 visit. Evidence of the SWMU still existed in the form of relatively level concrete with minor fractures. No impacts were observed. Photo 30 depicts the current condition of this SWMU.

3.1.32 SWMU 32 – Sanitary Sewer

SMWU 32 is the entire Sanitary Sewer comprised of an underground system of pipes of varying sizes and materials of construction. Among other things, the SWMU transferred treated waste water from the HF WWTS (SWMU 6), Backwash Tank of the Nickel WWTS (SWMU 5); Fixed-Bed Reaction Tower WWTS (SWMU 7); and Building L-1, to the City of Cleveland POTW (now known as the NEORSD). Domestic sewage and plant runoff also discharged to the Sanitary Sewer.

During the VSI, no evidence of a release was noted and no documented releases were on file. The integrity of the Sanitary Sewer was not evaluated.

AECOM did not inspect the Sanitary Sewer during either of the Facility visits.

3.1.33 SWMU 33 – Storm Sewer

SMWU 32 is the entire Storm Sewer consisting of an underground system of pipes of varying sizes and materials of construction. The Storm Sewer receives run-off from roofs and catch basins located throughout the facility for discharge to the Cuyahoga River as well as Big Creek via NPDES permitted outfalls.

During the VSI, no evidence of a release was observed although there was documentation on file of two releases to the Cuyahoga River. The first release was in July 1986 and consisted of approximately 200 gallons of dilute lead fluoroborate and the second release was in May 1988 and consisted of 150 gallons of formaldehyde and 250 gallons of copper chloride. The integrity of the Storm Sewer was not evaluated.

AECOM did not inspect the Storm Sewer during either of the Facility visits.

3.1.34 SWMU 34 – Tank Vent Scrubber

SWMU 34, the Tank Vent Scrubber, was located in the HF Plant (AOC B). This unit started operations in the mid 1970's and was decommissioned in 1985. The Tank Vent Scrubber was utilized to reduce emissions from the HF storage operations. The wastewater from the Tank Vent Scrubber was collected in a sump and transferred to the HF WWTS (SWMU 6) via pipes of unknown dimensions and materials.

During the VSI exact dimensions as well as the materials comprising the Tank Vent Scrubber and associated sump could not be ascertained. There was no evidence of a release and no documented releases were on file.

Since this unit was decommissioned in 1985, there was nothing for AECOM to inspect during its Facility visits. No evidence of impacts was observed at its former location. Photos 17 and 18 depict the current condition of the former HF WWTS where SMWU 34 was housed.

3.1.35 SWMU 35 – HF Kiln Scrubber

SWMU 35 is identified as the HF Kiln Scrubber located at the HF Plant (AOC B). This unit started operations in the mid 1970's and was decommissioned in 1985. The HF Kiln Scrubber was used to treat acid emissions generated from the HF operations.

During the VSI exact dimensions and materials comprising the HF Kiln Scrubber could not be provided. There was no evidence of a release and no documented releases on file.

Since this unit was decommissioned in 1985, there was nothing for AECOM to inspect during its Facility visits. No evidence of impacts was observed at the SWMU's former location. Photo 18 depicts the current condition of the location of the former HF Kiln Scrubber.

3.1.36 SWMU 36 – 70 Percent Sump

SWMU 36 was the 70 Percent Sump located at the former HF Plant (AOC B. The 70 Percent Sump was utilized to collect spillage from the HF Acid operations.

During the VSI, it was noted that the concrete pad where the 70 Percent Sump was located had dimensions of approximately 15 feet by 15 feet with four concrete tanks support piers approximately six feet by six feet overlying the pad. This unit started operations in the mid 1970's and was decommissioned in 1985. There was no evidence of a release and no documented releases on file. Photo 18 depicts the current condition of the location of the former 70 Percent Sump.

Since this unit was decommissioned in 1985, there was nothing for AECOM to inspect during its Facility visits. The concrete pad was still present, however no evidence of impacts was observed at this location.

3.1.37 SWMU 37 – Filling Station Pump

SWMU 37 was identified as the Filling Station Pump located at the former HF Plant (AOC B). The Filling Station Pump consisted of a scrubber, sump, and trench that were associated with the HF operations.

During the VSI, it was noted that the concrete pad where the Filling Station Pump was located had dimensions of approximately 10 feet by 10 feet. This unit started operations in the mid 1970's and was decommissioned in 1985. There was no evidence of a release and no documented releases on file.

Since the unit was decommissioned in 1985, there was nothing for AECOM to inspect during its Facility visits. No evidence of impacts was observed at the SWMU's former location. Photo 16 depicts the current condition of the location of the former Filling Station Pump.

3.2 Areas of Concern (AOC)

3.2.1 AOC A – Former Tank 57

AOC A, the Former Tank 57, was a steel above-ground fuel oil storage tank with a 300,000 gallon capacity that was located in the central portion of the Facility (Figure 3-1). The tank was supported by a concrete base and had secondary containment consisting of a concrete berm and a gravel bottom. The VSI Report states that the AST was not in use at the time of the inspection, but that a small heel of oil was present.

AEOCM and BASF representatives assessed the current condition of this AOC during the Facility visit conducted on September 13, 2007. No evidence of the former SWMU remains. The tank, concrete base, and concrete secondary containment berm have all been removed since the VSI. Two monitoring wells were identified in the vicinity of this AOC. Photo 32 depicts the current condition of the location of this AOC. There is currently no soil or groundwater analytical data addressing fuel oil for AOC A.

3.2.2 AOC B – Inactive Hydrogen Fluoride Plant

AOC B, the Hydrogen Fluoride (HF) Plant, was located in the northeast section of the Facility and operated from approximately 1935 to 1985. During the VSI, several tanks and associated appurtenances were observed. Records reviewed during the VSI noted that spillage apparently occurred throughout the plant's operation. However, the quantities spilled and the methods used to remedy the spills were not documented. Numerous subsurface voids associated with the dissolution of fill material by acids released from the unit had been identified by Harshaw and Engelhard.

Monitoring wells DM-28 and DM-29, and replacement wells DM-28R and DM-29R are located to the east and downgradient of AOC B. However, there is very limited analytical data assessing groundwater conditions associated with AOC B (Table 3-2).

The only remaining evidence of the Hydrogen Fluoride Plant is the concrete access road, some small concrete pads, and a fence line that separates the area from the rest of the Facility. During the Facility visit conducted by AECOM and BASF representatives, it was noted that the entire area of the former plant is heavily vegetated and overgrown. Photos 15, 17 and 18 document the current conditions of the area of the former HF Plant.

3.2.3 AOC C – Inactive Nickel Tanks

AOC C, the Inactive Nickel Tanks, was located on the south side of Building G-1. The tanks were used during the early 1980's as part of the nickel reclamation operations. There were five above-ground tanks of steel construction each with an approximate capacity of 5,000 gallons. The tanks were elevated above the concrete pad by wooden timbers; secondary containment was provided by the curbed concrete pad as well as the southern wall of Building G-1.

During the VSI, green stains were observed on the concrete pad that appeared to be in poor condition. Due to the tank placement at the time of the VSI, the integrity of the concrete pad could not be ascertained.

AOC C was visually inspected during AECOM's April 2010 visit. The concrete pad was level and in fair condition. There was no evidence of the former tanks and no evidence of impacts was observed. Photo 31 depicts the current conditions at this AOC.

3.2.4 AOC D – Fiberglass UST Area

AOC D, the Fiberglass UST Area, was located to the north of Building K-1 in the south section of the facility. The 10,000 gallon UST was installed in the 1970's and contained fuel oil for use as a backup energy supply. The UST was removed in November 1989 under the supervision of the City of Cleveland Fire Marshall. A small quantity of fuel oil reportedly leaked from the UST during excavation. The impacted soil was removed and placed in drums. Both the impacted soil and the UST were transferred to and stored at Scrap Yard A (SWMU 23).

AOC D was visually inspected during AECOM's April 2010 visit. The area was slightly sloped to the south/southeast, there was an area of gravel, possibly where the UST was removed, and asphalt that was cracked, with vegetation growing up through the cracks. There was no evidence of the former UST and no impacts were observed. Photos 43 and 44 depict the current conditions at the location of this AOC.

3.2.5 AOC E – Steel UST Area

AOC E, the Steel UST Area, was comprised of thirteen (13) steel USTs: five - 8,000 gallon USTS, 7 – 6,000 gallon USTs, and 1 -4,000 gallon UST. The tanks were used to store fuel oil for use as a backup energy source and were located to the east side of Building W-1. The USTs were removed in December 1989 under the supervision of the City of Cleveland Fire Marshall. Both the impacted soil and the USTs were transferred to and stored at Scrap Yard A (SWMU 23).

AOC E was visually inspected during AECOM's April 2010 visit. The area was relatively level with a slight depression that was thought to be where the USTs were removed. The area was comprised of gravel with vegetation growing throughout. There was no evidence of the former USTs and no impacts were observed. Photos 21 and 22 depict the current conditions at this AOC.

3.2.6 AOC F – 20, 000 Gallon UST Area

AOC F, the 20,000 gallon UST Area, was located near the northeast corner of Building G-1. The UST was used to store fuel oil.

During the VSI, a gravel filled area was observed where the former UST was located. In the vicinity of the former UST, two small diesel ASTs, approximately 80 gallons in size, were observed to be elevated on a stand that was approximately eight feet long, four feet wide and ten feet tall. The ASTs were utilized to refuel forklifts that worked in Building G-1.

AOC F was visually inspected during AECOM's April 2010 visit. The area was relatively level with a slight depression that was thought to be where the UST was removed. The area was comprised of gravel with vegetation growing throughout. There was no evidence of the former UST and no impacts were observed. Photos 23 and 24 depict the current conditions at this AOC.

3.2.7 AOC G – Sabotage Spill Area

The Sabotage Spill Area was created when approximately 6,500 gallons of a mixture containing sulfuric acid and nickel sulfate were released from an above ground tank on June 4, 1985. The tank was located in the vicinity of Building M-1 in the northwest section of the Facility (Figure 3-1). The tank was part of the nickel recycling operations. The spill was reportedly caused by an act of sabotage during a work stoppage. According to the VSI Report, the spill was properly neutralized with soda ash and lime to the satisfaction of OEPA representatives on-site during the cleanup. The contaminated soil was excavated and disposed off-site. An unknown quantity of the spill was reportedly released to the Cuyahoga River.

Monitoring well DM-12 is located immediately west of AOC G. DM-12 was installed in March 1986, less than a year following the release. Soil samples were collected by Dames and Moore from DM-12 and analyzed for selected metals (Table 3-4). The concentration of nickel in the soil samples collected from DM-12 generally decreased with depth, and ranged from 1,700 mg/kg at 3 to 5 feet to 76 mg/kg at 17 to 19 feet (Table 3-4). Dames and Moore collected a groundwater sample from DM-12 on October 9, 1986 and analyzed the sample for selected metals, chloride, and sulfate. Groundwater analytical results are

summarized in Table 3-1. Concentrations of nickel, chloride and sulfate measured in the groundwater sample were 0.16 mg/L, 130 mg/L, and 140 mg/L, respectively. Historic concentrations of dissolved nickel measured in groundwater collected from DM-12 range from 0.69 mg/L (September 8, 1987) to 6.5 mg/L (September, 1991).

AECOM and BASF representatives used the remaining building M-1 floor slab to generally locate this AOC during the visit conducted on September 13, 2007. There was no evidence of the former AST and no impacts were observed. The area was overgrown with vegetation. Photo 29 depicts the current condition of this AOC.

3.2.8 AOC H – Groundwater contamination associated with the former Nickel Chloride/Sulfate Production Area

AOC H is identified as the groundwater contamination associated with the Former Nickel Chloride/Sulfate Production Area (former M-1, M-2 and N-2 buildings). A total of thirty (30) wells (DM-1 through DM 30) were historically installed by Dames and Moore in two phases (Phase I, 1986 and Phase II, 1987) in an attempt to evaluate the extent of potential impacts from the former nickel chloride operations. A groundwater treatment system was installed in June 1994 to capture nickel-impacted groundwater. The system is described in Section 5.0 of this report.

The VSI did not identify AOC H. BASF proposed the addition of AOC H due to the elevated levels of nickel in groundwater in the western and northwestern portions of the Facility. Groundwater from this portion of the Facility is presently extracted and sent to the nickel WWTS (SWMU 5) for treatment prior to discharge to the NEORSD.

The ground surface in the area of AOC H was visually inspected during AECOM's April 2010 visit. it is noted that AOC H was observed to have visible signs of impacts and staining from the former Nickel Chloride/Sulfate Production Area at this AOC. There are still several foundations in place from former buildings including N-1, N-2, N-3, R-3, M-1 and M-2. Overgrown vegetation was observed growing through cracks in the building foundations. Photos 26 - 30 and 33 depict the current condition of the ground surface in the area of this AOC.

3.3 Degree and Extent of Facility-Related Impacts

3.3.1 Previous Investigations

This summary of known degree and extent of impacts to environmental media at the Facility has been developed from data collected during historic Facility investigations and the Harshaw Site ACOE RI. Documents and reports used to determine the degree and extent of Facility-related impacts, identify potential migration pathways, and identify potential receptors are listed below:

Author	Date	Title and Remarks
Dames & Moore	January 27, 1987	"Preliminary Ground Water Quality Study, Building M-1, M-2, and N-2 Complex". Assessment of subsurface conditions in the vicinity of the former nickel sulfate and nickel chloride production area. Prepared for the Harshaw Filtrol Partnership.
Dames & Moore	June 9, 1987	"Draft Report, Phase II Ground Water Quality Investigation". Expanded subsurface assessment

Author	Date	Title and Remarks
		including additional wells south of Harvard Avenue and along Cuyahoga River. Prepared for the Harshaw Filtrol Partnership.
Remcor	May 30, 1990	"Report, Underground Remediation Project, Harvard-Denison Plant". Investigation of subsurface including installation of RMW-series wells, groundwater sampling. Recommendations for remediation of Beltline Sewer. Prepared for Engelhard Corporation.
A.T. Kearny, Inc.	June 22, 1990	"Preliminary Review/Visual Site Inspection Report, RCRA Facility Assessment". Summary of Facility operational history and processes, releases, visual inspection of then-existing conditions at identified SWMUs. Prepared for USEPA, Region 5.
ERM Group	April 7, 1993	"Preliminary Corrective Action Alternative Development and Conceptual Design". Technical evaluation of remedial alternatives to address Beltline Sewer infiltration issue, and selection of groundwater recovery with treatment. Evaluation of treatment capability. Prepared for Engelhard Corporation.
B. Koh Associates	August 4, 1997	Report on groundwater investigation performed in vicinity of Building G-1 for radionuclides and other constituents. Prepared for Engelhard Corporation.
Solar Testing Labs	June 19, 1998	Letter summary of groundwater sampling event for total and dissolved metals, wells located north and south of Harvard Avenue. Prepared for Cleveland Fluid Systems.
B. Koh Associates	August 1, 1998	"Site Characterization Report, Harvard/Denison Site". Report on the findings and methods of a site-wide radiological investigation, including soil, groundwater, vegetation sampling and analyses for radionuclides. Prepared for Engelhard Corporation.
Arcadis	January, 2000	Draft report "Groundwater Flow Assessment, Harvard-Denison Facility". Summarizes Facility history, installation of groundwater recovery system, and describes the findings of a groundwater flow assessment for the groundwater recovery system. Prepared for the Harvard Denison Facility.
SAIC	September 22, 2006	"Former Harshaw Chemical Site Remedial Investigation, Remedial Investigation Report, Revision 0". Prepared for U.S. ACOE. Presents the methods and findings of initial investigation, including fate and transport modeling,

Author	Date	Title and Remarks
		groundwater modeling , and baseline risk assessment. Prepared for the USCOE.
SAIC	December, 2009	"Former Harshaw Chemical Site Remedial Investigation, Remedial Investigation Report, Revision 1". Prepared for U.S. ACOE. Presents the methods and findings of initial investigation and subsequent Facility activities, and baseline risk assessment. Prepared for the USCOE.

A summary of the known degree and extent of impacts to environmental media is provided in the following sections.

3.3.2 Soil

Laboratory analyses for potential non-radiological Constituents of Concern (COCs) have historically been limited primarily to inorganic constituents associated with former Facility processes and waste materials. Analytical results for inorganic constituents in soil samples collected from the nickel sulfate and nickel chloride areas during the 1986 investigation conducted by Dames and Moore are shown in Table 3-4. Inorganic constituents reported in soil samples collected from DM-12 and DM-14 at elevated concentrations include nickel, chloride, and sulfate, which are the primary constituents associated with the nickel chloride/nickel sulfate production processes. In general, nickel concentrations in source area soil decrease with depth. The maximum nickel concentrations measured in soil collected from these two source area borings are 1,700 mg/kg in DM-12 at 3 to 5 feet bgs, and 30,000 mg/kg in DM-14 at 1 to 3 feet bgs. Concentrations of sulfate and chloride in source area soil remain somewhat more consistent with depth.

Non-radiological constituents included in the initial ACOE RI soil sampling program consisted of nickel, molybdenum, lithium, and TPH-DRO. Laboratory analytical results for non-radiological constituents recorded in the ACOE database are included in Appendix D.

Of the COCs identified in soil to-date, nickel is the most prevalent, with concentrations that are consistent with or higher than other co-occurring COCs. Nickel results in soil samples that were collected from SB-series soil borings during the ACOE RI are included in Table 3-3. In addition to the constituents identified above, surface and shallow sub-surface soil samples collected from AB-series soil borings advanced during the ACOE RI were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic constituents (Appendix D). In general, acid-extractable SVOCs and VOCs were reported as being below analytical reporting levels or at low concentrations. COCs reported in one or more AB-series soil samples at include polynuclear aromatic hydrocarbons (PAHs), which are typically associated with lubricating oils or petroleum hydrocarbons, and metals (Appendix D).

The distribution of nickel in surface and shallow subsurface soil is shown on Figures 3-3A, 3-3B, and 3-3C. Nickel concentrations at the facility are highest in soil samples collected from former production areas and waste management areas, including the nickel chloride and nickel sulfate area (AOC H), near the fixed bed reactors (SWMU-19), and downgradient from building K-1.

The Ohio EPA Voluntary Action Program (VAP) has established generic risk-based exposure standards for commercial and industrial soils, which may be used to screen for the potential for human health and environmental exposure pending the completion of a site-specific risk assessment. U.S. EPA Region IX has also developed risk-based Regional Screening Levels for preliminary evaluation of constituents identified in soil. Constituents identified in Facility soil at concentrations above Ohio EPA generic soil standards for human exposure or groundwater leaching, and the U.S. EPA RSLs are summarized in Table 3-5. These constituents constitute COPCs for Facility soil.

3.3.3 Groundwater

Historical groundwater analytical results obtained during investigations performed through 1998 are summarized in Tables 3-1 and 3-2. Analytical results for non-radiological constituents in groundwater samples collected during the ACOE RI are summarized in Appendix D. These constituents include nickel, lithium, molybdenum, and TPH-DRO.

Historical groundwater investigations analyzed for constituents used in Facility processes, specifically nickel, chloride, and sulfate. Elevated concentrations of these constituents were reported in groundwater samples collected beneath or hydraulically downgradient from the former nickel sulfate and nickel chloride manufacturing areas (AOC H) immediately west of and adjacent to the beltline interceptor sewer. Dissolved nickel concentrations measured in groundwater samples collected for the ACOE RI during 2003 and 2004 are shown on Figure 3-4. The highest concentrations of dissolved nickel were measured in the vicinity of AOC H. Elevated dissolved nickel concentrations were also documented in two monitoring wells (DM-26 and DM-27R) east of the former foundry building. The elevated dissolved nickel impacts also extend northward from well DM-27R to monitoring wells DM-28R, DM-29R, and DM-30R located on the eastern portion of the Facility along the Cuyahoga River. The elevated concentrations of nickel reported in groundwater at DM-28R, DM-29R, and DM-30R may be the result of elevated nickel impacts documented in soil at this location.

During March 2009, AECOM sampled 28 groundwater monitoring wells for dissolved nickel to evaluate the current distribution of the groundwater nickel impacts that have been historically documented at the Facility. The laboratory analytical results for dissolved nickel in the groundwater samples collected during the March 2009 sampling event are presented in Table 3-6 and the spatial distribution of the dissolved nickel concentrations in groundwater are illustrated in Figure 3-5. The distribution of dissolved nickel in groundwater is generally consistent with the results of the ACOE RI investigation.

Constituents detected in Facility groundwater samples during historic investigations and the ACOE RI at concentrations greater than OEPA VAP generic unrestricted potable use standards or the USEPA Region 9 Screening Levels for Tap Water are summarized in Table 3-7. These constituents constitute COPCs for groundwater.

3.3.4 Stream Sediment

Stream sediment samples were collected from eight locations along the Cuyahoga River and Big Creek in the vicinity of the Facility (IA06 SD-0003 to IA06 SD-0010) during the ACOE RI. ACOE analyzed the stream sediments for mercury, molybdenum, nickel, lithium, and TPH-DRO. Laboratory analytical results are included in Appendix D. Stream sediment sampling locations are shown on Figure 3-6.

Maximum detected concentrations of lithium, molybdenum and TPH-DRO in sediment samples collected near the Facility are 17.5 mg/kg, 9.82 mg/kg, and 148 mg/kg, respectively. These constituents were not identified as significant COPCs for sediment in the baseline risk assessment (BRA) prepared for the ACOE RI.

Nickel and mercury were reported in sediment samples collected near the Facility at concentrations ranging from 12.4 mg/kg to 194 mg/kg and from0.0124 mg/kg to 0.673 mg/kg, respectively. Nickel and mercury were included in the sediment analytical suite, but were not evaluated during the ACOE RI BRA or SLERA.

3.3.5 Sewer and Outfall Sediment

Sewer and outfall sediments were collected from 19 locations during the ACOE RI, and were analyzed for molybdenum, lithium, and TPH-DRO. Fourteen of the sediment samples were analyzed for nickel and mercury. Laboratory analytical results are included in Appendix D. Sewer and outfall sampling locations are depicted on Figure 3-5.

Maximum concentrations reported for lithium, molybdenum, and TPH-DRO in outfall sediment samples (IA09 SD-0001 through SD0009) were 28.5 mg/kg, 21.2 mg/kg, and 5,130 mg/kg, respectively. Maximum concentrations reported for these constituents in the sewer manhole sediment samples were 15.2 mg/kg for lithium, 33.2 mg/kg for molybdenum, and 28,800 mg/kg for TPH-DRO.

Nickel and mercury were reported in outfall sediment samples ranging from 40.1 mg/kg to 14,300 mg/kg, and 0.0736 mg/kg to 13 mg/kg, respectively. Concentrations of nickel and mercury reported in sewer manhole sediment samples ranged from 599 mg/kg to 17,810 mg/kg, and 0.484 mg/kg to 6.61 mg/kg, respectively. Nickel and mercury were not evaluated during the ACOE RI BRA.

3.3.6 Surface Water

During the ACOE RI, surface water samples were collected from 10 locations along Big Creek and the Cuyahoga River adjacent to the Facility (IA06 SW-0001 to IA06 SW-0010). ACOE analyzed the surface water for mercury, molybdenum, nickel, lithium, and TPH-DRO. Laboratory analytical results are included in Appendix D**.** The surface water sampling locations were co-located with the stream sediment sampling locations (Figure 3-6).

Maximum surface water concentrations for lithium, molybdenum, and TPH-DRO are 0.0227 mg/L (IA08 SW0010), 0.0174 mg/L (IA09 SW-0009), and 0.29 mg/L (IA08 SW-0002), respectively. These constituents were not identified as significant COPCs for sediment in the BRA prepared for the ACOE RI.

Nickel reported in surface water samples ranged from 0.00794 mg/kg to 0.0189 mg/kg. Mercury was not detected in the surface water samples. Nickel was not evaluated during the ACOE RI BRA or the SLERA.

3.4 Conceptual Site Model/Evaluation of Potential Exposure

This qualitative conceptual site model has been developed using information provided in historic technical reports prepared for the Facility (Section 3.2.1), and the ACOE RI (SAIC 2009). Potential exposure pathways, migration routes, and potential receptors are identified to the extent permitted by existing information.

3.4.1 Current and Potential Future Land Use

The Facility is located in a heavily industrialized area, with surrounding property usage consisting of medium to heavy industry and commercial establishments. The Facility was most recently used for warehousing of chemicals. Surrounding properties are used for heavy and light industry, as although

some properties are undeveloped. There are no current or potential future plans to redevelop the Facility for uses other than industrial or commercial. There are currently no hospitals, nursing homes, schools, or other potentially sensitive human receptors in the vicinity of the Facility.

3.4.2 Potential Receptors and Exposure Pathways

Based upon current and potential future Facility use under current Facility exposure conditions, the following human receptors and potentially complete exposure pathways have been identified:

Receptor	Potential Exposure Pathway
Industrial Employee/Site Worker	Inhalation of fugitive dust from surface soil (0-2 feet); Contact with surface soil; Incidental ingestion of surface soil.
Construction Worker/Remediation Contractor	Inhalation of fugitive dust from surface (0-2 feet) or subsurface soil (2-10 feet); Contact with surface soil, subsurface soil, groundwater, surface water, impacted sediments; Incidental ingestion of surface soil, subsurface soil, groundwater, surface water, impacted sediments.

Potential exposure pathways for all users assume that existing Facility conditions will exist at the time of use.

Based upon information obtained during the ACOE RI, there are no domestic or commercial water-supply wells in the vicinity of the Facility. Potable water is provided to local businesses and residences from Lake Erie. Based upon the poor quality of groundwater from the unconsolidated deposits, and the availability of potable water for use and consumption, the exposure to groundwater pathway is considered to be incomplete. AECOM performed a one-mile radius, on-line water well search of the ODNR well database. A total of 275 records were identified within one-mile of the Facility. The well records will be verified with ODNR with regard to the current condition of the wells, and whether the wells are used for domestic potable or commercial/industrial use. Consumption of wild game collected from the Facility is also considered an incomplete pathway, since the Facility is situated in an urban area, and hunting is prohibited.

Incidental ingestion of, or contact with surface soil, subsurface soil, and groundwater are considered to be potentially complete exposure pathways to applicable human receptors described above, based upon the occurrence of nickel and other COCs identified above Ohio EPA generic soil and groundwater standards in environmental media (Tables 3-3 and 3-7). Secondary exposure pathways that may be complete include the following:

- Leaching of COCs from soil into groundwater, with subsequent exposure to construction/remediation workers.
- Erosion of potentially impacted surface soil with deposition in surface water or stream sediments.
- Discharge of impacted groundwater to surface water, with subsequent exposure to human and ecological receptors.

Potential ecological receptors for terrestrial, riparian and aquatic habitats identified by ACOE are summarized in Section 2.4.5.2. Existing habitat on the Facility is classified as poor, with no sensitive ecosystems existing within or near the Facility (SAIC, 2009).

Potential exposure pathways for animals and birds occupying terrestrial and riparian habitats include direct contact with, and inhalation of particulates from surface soil; direct contact with, and ingestion of surface water and sediment; and bioaccumulation.

Potential human health and environmental risks associated with the current nature and distribution of COCs in environmental media will be developed and evaluated during the risk evaluation phase of the RFI/CMS.

4.0 Implementation of Past/Present Interim/Stabilization Measures

There are no past or present interim/stabilization measures are being conducted at the Facility and there are no proposed interim measures currently planned.

5.0 Groundwater Extraction and Treatment System

5.1 Groundwater Extraction and Treatment System

In June of 1994, a groundwater extraction and treatment system was installed to control the infiltration of nickel-impacted groundwater into an interceptor beltline sewer that passes through the Facility adjacent to former nickel chloride and nickel sulfate production areas. The system consists of a total of 8 recovery wells identified as RW-1 through RW-8 (Figure 2-6). Six of the wells (RW-1 through RW-5, and RW-8) were installed along the beltline sewer. Two recovery wells (RW-6 and RW-7) were installed approximately 250 feet to the east (downgradient) of manholes 6 and 7 on the southern portion of the beltline sewer. The nickel extracted from the individual recovery wells is pumped to a treatment building located on-site and the extracted groundwater is processed using chemical precipitation/flocculation with solids being processed through a filter press (collectively referred to as the "treatment system"). The filter cake generated by the filter press is sent off-site and reclaimed for beneficial use. The treated wastewater effluent is discharged to the sanitary sewer following pH adjustment under a discharge permit issued by the NEORSD.

5.1.1 System Operation

The average daily flow rate of groundwater extracted and treated by the system from September 1998 through June 2008 was 3,382 gallons per day (gpd) or approximately 2.71 gpm. The minimum and maximum flow rates recorded during this period was 783 gpd and 6,748 gpd, respectively.

Based on the quarterly treatment system effluent monitoring results, the system has been consistently meeting the NEORSD discharge limit of 10 mg/l for total nickel. Concentrations of total nickel in the treated effluent have ranged from 0.016 mg/l to 4.5 mg/l with two exceptions. A concentration of 77.2 mg/l was reported during the September 2007 sampling event, the cause of which is unknown and a concentration of 11 mg/l was reported in the third quarter of 1999 due to a malfunctioning pH probe. The probe was repaired and the system re-sampled with a concentration of nickel being reported at 0.28 mg/l.

5.1.2 System Maintenance Requirements

The system is being maintained by a BASF contractor on a weekly basis. Routine maintenance of the system includes equipment repair and upkeep, chemical storage drum change-outs, and transferring filter cake material from the filter press to a storage bin located adjacent to the treatment system building. Once the bin is full, the filter cake material is recycled through a reclamation contractor.

5.1.3 System Monitoring and Reporting Schedules

Samples of the treated wastewater effluent for total Nickel, pH, and total flow are collected quarterly for compliance with NEORSD wastewater discharge permit requirements. The treated wastewater effluent discharged to the sewer is also reported to NEORSD on a quarterly basis.

6.0 References

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Tables

TABLE 2-1
SUMMARY OF MONITORING WELLS AND RECOVERY WELLS
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

Well dentification	Date Installed	Total Depth (feet)	Well Type	X Coordinate	Y Coordinate	TOC Elevation	Ground Surface Elevation	Top of Screen Elevation[a] (feet)	Bottom of Screen Elevation[a] (feet)	Geologic Horizon Screened
KA-48	NA	17	Existing Pre-RI Well	2191690.02	650842.78	594.87	592.70	NA	NA	NA
KA-51	1997	35.5	Existing Pre-RI Well	2191592.31	649653.75	595.76	593.18	NA	NA	NA
KA-52	1997	39	Existing Pre-RI Well	2191758.05	649730.48	593.13	593.40	NA	NA	NA
KA-53	1997	35.5	Existing Pre-RI Well	2191937.30	649459.32	593.40	591.16	NA	NA	NA
DT-MW0001	NA	NM	Existing Pre-RI Well	2191310.37	649612.52	588.09	588.42	NA	NA	NA
DT-M20002	NA	23.9	Existing Pre-RI Well	2191471.66	649538.84	587.21	587.43	NA	NA	NA
M-1	1986	19.5	Existing Pre-RI Well	2191465.84	650137.02	596.13	593.71	586.71	574.21	Old fill/Till
M-2	1986	15.5	Existing Pre-RI Well	2191511.78	650188.40	594.02	594.25	590.75	578.75	Old fill/Till
M-3	1986	12.5	Existing Pre-RI Well	2191431.18	650291.16	594.14	594.48	591.98	581.98	New fill/Old fill/Till
M-4	1986	14.5	Existing Pre-RI Well	2191471.88	650294.53	593.84	594.20	591.70	579.70	Old fill/Till
M-5	1997	18.17	Existing Pre-RI Well	2191432.21	650360.73	596.36	594.13	588.13	576.13	Old fill/Till
M-9	1986	19	Existing Pre-RI Well	2191527.01	650452.64	598.01	594.83	587.83	576.83	Till
M-10	1986	29.5	Existing Pre-RI Well	2191405.93	650534.87	592.71	593.21	575.71	563.71	Till/Bedrock
M-11	1997	25	Existing Pre-RI Well	2191520.52	650597.82	595.89	593.88	583.38	569.88	Old fill/Till
M-12	1997	27	Existing Pre-RI Well	2191426.01	650643.80	596.13	593.93	578.93	566.93	Till/Bedrock
M-14	1997	19	Existing Pre-RI Well	2191443.51	650747.03	596.33	594.19	587.19	575.19	Old fill/Till
M-15	1986	19	Existing Pre-RI Well	2191564.93	650795.45	596.46	594.26	587.76	575.76	Old fill/Till
M-22R	1997	35	Existing Pre-RI Well	2191721.35	649560.49	594.81	592.70	565.70	553.20	Till
M-23R	1997	35	Existing Pre-RI Well	2191933.53	649357.34	593.06	590.82	567.82	556.32	Till
M-25R	1992	32	Existing Pre-RI Well	2191937.08	650039.94	592.84	593.37	575.37	561.37	Till
M-26	1987	34	Existing Pre-RI Well	2191850.75	650200.89	592.99	593.48	573.48	559.48	Till
M-27R	NA	34	Existing Pre-RI Well	2192072.44	650184.85	594.78	592.29	565.29	558.29	Till
M-28R	NA	34	Existing Pre-RI Well	2192219.28	650346.09	595.09	592.57	565.57	558.57	Till
M-29R	NA	37	Existing Pre-RI Well	2192116.32	650463.86	595.49	593.16	564.16	556.16	Till/Bedrock
M-30R	NA	34	Existing Pre-RI Well	2192328.28	650525.05	594.91	593.02	567.02	559.02	Till
RM-47	1992	32.5	Existing Pre-RI Well	2192934.55	650347.59	593.06	593.56	572.56	561.06	Till/Bedrock
MW-35	1997	18	Existing Pre-RI Well	2191566.09	650682.82	596.44	594.65	586.65	576.65	Old fill/Till
MW-38	1997	22	Existing Pre-RI Well	2191739.01	650453.12	596.76	594.55	585.55	572.55	Bedrock

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SUMMARY OF MONITORING WELLS AND RECOVERY WELLS
Former Harshaw Chemical Company Site
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MW-39	1997	19	Existing Pre-RI Well	2191523.35	650696.53	595.93	593.78	NA	NA	NA
03-TW0001	2003	12.7	RI Temporary Well Point	2191929.07	650543.65	596.50	593.90	592.70	581.20	New fill/Old fill/Till
03-TW0002	2003	11.8	RI Temporary Well Point	2191860.42	650782.56	595.39	592.00	586.40	580.20	Old fill/Till/Bedrock
03-TW0003	2003	20.8	RI Temporary Well Point	2191537.92	650917.84	593.39	590.49	581.09	569.69	Till/Bedrock
03-TW0004	2003	29	RI Temporary Well Point	2191684.59	650974.55	592.92	589.80	573.20	560.80	Till/Bedrock
03-TW0005	2003	9.1	RI Temporary Well Point	2191736.91	650685.07	NA	596.00	NA	NA	NA
03-TW0006	2003	11.6	RI Temporary Well Point	2191832.86	650657.07	NA	596.00	NA	NA	NA
04-TW0001	2003	38.4	RI Temporary Well Point	2191867.55	649878.02	595.16	592.71	565.91	555.01	Till
04-TW0002	2003	23.5	RI Temporary Well Point	2191510.29	649967.14	593.59	591.86	580.06	568.36	Till
04-TW0003	2003	15.3	RI Temporary Well Point	2192075.24	650700.56	596.03	592.94	588.94	577.64	Old fill/Bedrock
04-TW0004	2003	35.3	RI Temporary Well Point	2192426.35	650466.22	594.44	591.22	570.42	555.92	Till
04-TW0005	2003	25	RI Temporary Well Point	2192127.99	650840.91	593.23	590.24	577.74	565.34	Till
04-TW0006	2003	32.9	RI Temporary Well Point	2192521.62	650652.21	589.71	586.35	565.75	553.55	Till/Bedrock
05-TW0001	2003	37.8	RI Temporary Well Point	2191929.22	649644.71	598.64	596.27	571.77	558.47	Till
10-MW0001	2003	30	RI On-site Well	2191641.12	651100.68	593.86	591.61	580.61	561.11	Till/Bedrock
10-MW0002	2003	32.6	RI On-site Well	2191965.68	650913.46	595.72	593.69	580.09	560.19	Till/Bedrock
10-MW0003	2003	14	RI On-site Well	2191901.56	650614.32	597.98	595.55	587.55	581.05	Till/Bedrock
10-MW0004	2003	19.5	RI On-site Well	2192091.08	650693.74	595.88	593.54	583.04	571.54	Old fill/Till/Bedrock
03-TP0001	2004	21	RI Temporary Piezometer	2191564.45	650912.66	594.16	591.50	568.50	553.50	Bedrock
04-TP0001	2004	11.5	RI Temporary Piezometer	2191682.62	650370.27	596.32	594.34	590.34	582.84	Till/Bedrock
04-TP0002	2004	26	RI Temporary Piezometer	2191844.20	650322.94	595.74	593.33	580.33	567.33	Old fill/Till/Bedrock
04-TP0003	2004	36	RI Temporary Piezometer	2192021.55	650325.15	595.39	592.77	571.77	556.77	Till
04-TP0004	2004	23.5	RI Temporary Piezometer	2192065.09	650553.99	595.20	593.30	584.80	569.80	Old fill/Till
04-TP0005	2004	38	RI Temporary Piezometer	2192240.10	650616.47	594.47	591.92	568.92	553.92	Till/Bedrock
KG-MW0001	2003	16	RI Background Well	2191081.12	649708.88	592.10	592.67	584.67	576.17	Old fill/Till
KG-MW0002	2003	21.5	RI Background Well	2191322.01	649989.17	593.42	594.39	586.39	572.89	Old fill/Till/Bedrock
KG-MW0003	2003	26	RI Background Well	2191324.77	650473.30	591.98	592.73	584.73	566.23	Old fill/Till/Bedrock
KG-MW0004	2003	26	RI Background Well	2191331.18	650541.24	592.30	592.69	NA	NA	NA
KG-MW0005	2003	28	RI Background Well	2191218.21	651099.73	592.20	592.37	583.37	563.87	Old fill/Till

Screened interval is marked by the top and bottom of the sandpak.
NA - not applicable or unknown

TABLE 3-1
RESULTS OF LABORATORY ANALYSES FOR INORGANICS IN GROUNDWATER
1986-1987 DAMES & MOORE INVESTIGATION
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

	Analysis	pH	Nickel	Silver	Arsenic	Barium	Beryllium	Cadmium	Cobalt	Chromium	Copper	Mercury	Lead	Selenium	Chloride	Sulfate
	Units	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
DM-12	10/9/1986	11.3	0.16	<0.01	<0.05	0.15	<0.005	<0.01	<0.05	<0.02	<0.01	<0.05	<0.05	<0.1	130	140
	4/8/1987	6.7	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	150	290
DM-14	10/9/1986	2.6	5800	<0.01	<0.05	<0.1	0.05	<0.01	15	1.6	<0.01	<0.05	<0.05	<0.1	100	6300
	4/8/1987	5.3	2600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	120	9800
DM-22	4/8/1987	6.0	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	650	260
DM-24	4/8/1987	5.9	90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	410	1000
DM-27	4/8/1987	6.1	0.69	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	190	1400
DM-28	4/8/1987	4.0	3.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	260	14000
DM-29	4/8/1987	6.0	0.38	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	380	1800

TABLE 3-2
HISTORIC LABORATORY ANALYTICAL RESULTS FOR NICKEL IN GROUNDWATER
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

	Dissolved Nickel Concentration (mg/L)												
Well	10/9/86	4/8/87	7//89	9/1/91	6/10-12/92	8/1/96	8/21/96	3/13/97	8/8-11/97	1/22/98	4/29/98	8/7/98	7&9/03
DM-1	**1500**	**3400**	NS	NS	**3400**	NS	NS	NS	NS	NS	NS	NS	**238.0**
DM-5	**990**	**1200**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**34.2**
DM-12	**0.16**	**1.80**	**1.60**	**6.50**	NS	NS	NS	NS	NS	NS	NS	NS	**23.5**
DM-14	**5800**	**2600**	**940**	**450**	NS	NS	NS	**160**	**300**	**320**	**220**	**360**	**88.8**
DM-22/22R	NS	**2.30**	**1.60**	**5.20**	**2.30**	NS	NS	NS	NS	NS	NS	NS	**0.113**
DM-24	NS	**90.00**	**78.00**	**56.00**	**61.00**	NS	NS	NS	NS	NS	NS	NS	NS
DM-27/27R	NS	**0.69**	NS	**0.30**	**0.37**	NS	NS	NS	NS	NS	NS	NS	**1.98**
DM-28/28R	NS	**3.60**	NS	**42.00**	**50.00**	NS	NS	NS	NS	NS	NS	NS	**3.67**
DM-29/29R	NS	**0.38**	NS	**2.70**	NS	NS	NS	NS	NS	NS	NS	NS	NS
DM-30R	NS	**0.17**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**0.234**
RMW-35	NS	NS	**0.10**	**0.07**	NS	NS	NS	**3.70**	**1.20**	**2.20**	**2.50**	**3.50**	NS
RMW-39	NS	NS	NS	NS	NS	NS	NS	NS	**2.30**	**1.80**	**3.60**	**3.10**	NS
Well #2	NS	NS	NS	NS	NS	**130**	**160**	NS	NS	NS	NS	NS	NS
Well #3	NS	NS	NS	NS	NS	NS	**540**	NS	NS	NS	NS	NS	NS
ERM-47	NS	NS	NS	NS	**<0.04**	NS	NS	NS	NS	NS	NS	NS	**0.008**

mg/L: Milligrams per liter

TABLE 3-3
RI LABORATORY ANALYTICAL RESULTS FOR NICKEL IN SOIL
COLLECTED BY SAIC THROUGH 2003
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

RI Area	Boring	Sample Increment feet	Nickel Concentration mg/kg
IA03	SB0001	1.1-2.9	1670
		2.9-4.0	364
		4.0-6.0	94.8
	SB0002	0.5-1.4	20.7
		1.4-3.4	41.2
		4.0-6.0	46
	SB0003	0.5-2.5	37.2
		4.0-6.0	35.5
	SB0004	0.5-2.5	64.3
		4.0-6.0	38.7
	SB0005	0.6-2.6	1650
		4.0-6.0	40.3
	SB0007	0.0-2.0	215/308
		4.0-6.0	38.1/39.8
	SB0009	0.0-2.0	187/118
		8.0-10.0	35.6
	SB0013	2.0-4.0	16
		7.0-9.0	33.5
	SB0014	0.0-2.0	157
		8.0-10.0	46.5
	SB0015	0.4-2.4	220
		4.0-6.0	40
	SB0016	.07-2.7	189
		4.0-6.0	36.3
	SB0017	0.3-2.3	4380
		4.0-6.0	1520
	SB0018	0.8-2.8	5430
		4.0-6.0	7480
	SB0019	0.5-2.5	2320
		4.0-6.0	3080
	SB0020	0.0-1.4	9600
		4.0-6.0	400
	SB0033	0.5-1.0	768
		0.5-2.5	449/351
		4.0-6.0	33.1
	SB0037	0.0-2.0	386
		4.0-6.0	109
	SB0038	0.0-1.5	174/189
		4.0-6.0	20.5
	SB0141		4410
	IA09 SB0002		48
	IA09 SB0003		2070
	IA09 SB0004		1390
	MW-1	0-2	41.5
	AB-1	0-2.3	280
	AB-2	0-4	27.9
	AB-3	8-Apr	66.3
IA03	AB-4	0-4	8820
	AB-5	0-4	8490
IA04	SB0005	1.5-3.5	22.4
		8.0-10.0	34.6
	SB0007	0.2-2.2	17.9/28.4
		4.0-6.0	13.3
	SB0008	1.4-3.4	79.9
		4.0-6.0	119
	SB0009	0.0-2.0	641/894
		4.0-6.0	38.3
	SB0010	0.5-2.5	4310
		8.0-10.0	5070
	SB0011	0.0-2.0	646/250
		8.0-10.0	57650
	SB0012	0.0-2.0	326
		4.0-6.0	193
	SB0013	0.0-2.0	6320
		8.0-10.0	35.5
	SB0019	0.0-2.0	37.2
		4.0-5.0	73.7
	SB0001	0.4-2.4	252
		4.0-6.0	53.8
	SB0002	0.7-2.7	1250
		4.0-6.0	414
	SB0003	0.6-2.6	72.6
		8.0-10.0	76.3
	SB0004	0.9-2.9	3660
		4.0-6.0	276
	IA09 SB0005		156
	AB-6	4-8	27.7
	AB-7	0-4	89.2
	AB-8	12-13.5	23
IA05	SB0003	0.2-1.5	130
		0.2-2.2	54.9
		4.0-6.0	23.8
	SB0005	0.0-2.0	20730/6900
		8.0-10.0	807
	SB0007	0.0-2.0	4200
		4.0-6.0	798
	SB0009	0.5-2.5	74.4/37.2
		4.0-6.0	2300
	SB0010	0.6-2.6	372
		4.0-6.0	37.8
	SB0014	0.5-2.5	25500
		4.0-6.0	32.6
	SB0015	0.5-2.5	43.3
		4.0-6.0	37.3
	SB0016	0.8-2.8	3110
		4.0-6.0	71.8
	SB0022	0.4-2.4	223
		4.0-6.0	42.7
	SB0023	0.5-2.5	121
		4.0-6.0	42.7
	SB0023	0.5-2.5	121
		4.0-6.0	36.2
	IA09 SB0006		40200

TABLE 3-4
RESULTS OF LABORATORY ANALYSES FOR INORGANICS IN SOIL BORING SAMPLES
1986 DAMES & MOORE INVESTIGATION
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

DM-12	Sample Increment	pH	Nickel	Silver	Arsenic	Barium	Beryllium	Cadmium	Cobalt	Chromium	Copper	Mercury	Lead	Selenium	Chloride	Sulfate
	feet	SU	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	1-3	6.0	1000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<200	2100
	3-5	7.0	1700	<0.2	13	62	0.68	5.8	580	150	220	0.12	200	0.14	240	2700
	5-7	7.0	850	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3800	24000
	7-9	5.6	460	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1500	26000
	9-11	6.4	770	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	700	10000
	11-13	6.5	230	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<200	1600
	13-15	7.5	270	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1500	19000
	15-17	6.7	160	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	900	12000
	17-19	6.0	76	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1200	13000
	19-21	7.6	110	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1200	16000
	21-23	6.6	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<200	1300
	23-25	6.9	220	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1300	190000
	25-26.5	7.8	340	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2700	27000

DM-14	Sample Increment	pH	Nickel	Silver	Arsenic	Barium	Beryllium	Cadmium	Cobalt	Chromium	Copper	Mercury	Lead	Selenium	Chloride	Sulfate
	feet	SU	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	1-3	5.5	30000	<0.2	6.2	34	0.33	23	150	20	18	0.21	38	0.13	2100	39000
	3-5	6.0	9600	<0.2	5.8	56	0.22	0.8	67	20	17	0.1	15	0.1	<200	3300
	5-7	6.2	2000	<0.2	2	65	<0.10	1.6	17	16	34	<0.10	29	0.19	<200	6700
	7-9	3.7	1800	<0.2	1.7	88	<0.10	<0.2	14	17	24	0.22	80	0.14	<200	43000
	9-11	3.8	900	<0.2	1.9	51	<0.10	<0.2	9.4	23	27	0.2	6.9	0.15	410	27000
	11-13	3.6	640	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<200	92000
	13-15	4.0	520	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	310	24000
	15-17	5.8	30	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<200	7400
	17-19	6.1	470	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<200	1300

Note: Soil samples collected during October 1986

TABLE 3-5
CONSTITUENTS OF POTENTIAL CONCERN FOR SOIL
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

Constituent	Maximum Soil Concentration	Location	Ohio EPA Generic Residential Direct Contact Standard[2]	Ohio EPA Generic Soil Leach-Based Value[2]	Ohio EPA Generic Commercial/ Industrial Direct Contact Standard[2]	USEPA Region 9 Regional Screening Levels[3]		
						Residential Soil	Nonresidential Soil	Risk-Based Protection of Groundwaer
	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
INORGANICS								
Antimony	20.4	IA03 AB-4	30	3.6	1200	31	410	0.66
Arsenic	38.7	IA03 AB-5	6.7	3	82	0.39	1.6	0.0013
Cadmium	32.9	IA03 AB-4	72	21	2300	70	800	4.5
Chromium	549	IA03 AB-4	110000	56	1.00E+06	1.20E+05	1.50E+06	9.90E+07
Cobalt	327	IA03 AB-5	1400	--	2.30E+04	23	300	0.49
Copper	3,150	IA03 AB-4				3100	4.10E+04	51
Iron	77,900	IA03 AB-2				5.50E+04	7.20E+05	640
Lead	1810	IA03 AB-4	400	89	1800	400	800	14
Mercury	25.8	IA05 SB0007	7.6	12	290	23	310	0.57
Lithium	48.2	IA03 SB0002	--	--	--	160	2000	22
Molybdenum	289	IA04 SB0011	--	--	--	390	2100	3.7
Nickel	30,000	DM-14	1500	182	4.40E+04	1500	2.00E+04	48
Selenium	57.9	IA03 SB0141	380	2.15	1.50E+04	390	5100	0.95
Selenium (2nd highest)[1]	4.38	IA03 AB-4	380	2.15	1.50E+04	390	5100	0.95
Silver	1040	IA03 SB0141	380	3120	1.50E+04	390	5100	1.6
Silver (2nd highest)[1]	1.07	IA03 AB-4	380	3120	1.50E+04	390	5100	1.6
Thallium	9.6	IA03 AB-4	6.1	1.5	2.30E+02	--	--	0.14
TOTAL PETROLEUM HYDROCARBONS								
TPH-DRO[4]	5960	IA03 SB0017	10,000	10,000	10,000	--	--	--
VOLATILE ORGANIC COMPOUNDS								
Tetrachloroethylene	12.5	IA03 AB-4	53	0.11	--	0.55	2.6	0.0023
Xylene, total	30.9	IA05 SB0020	370	96	370	630	2700	0.2
POLYNUCLEAR AROMATIC HYDROCARBONS								
Anthracene	3300	IA03 AB-2	18,000	--	2.80E+05	1.70E+04	1.70E+05	360
Benzo (a)Anthracene	14000	IA03 AB-2	11	--	76	0.15	2.1	0.01
Benzo(a)Pyrene	12000	IA03 AB-2	1.1	--	7.7	0.015	0.21	0.01
Benzo(b)Fluoranthene	12000	IA03 AB-2	11	--	77	0.15	2.1	0.35

TABLE 3-5 (continued)

CONSTITUENTS OF POTENTIAL CONCERN FOR SOIL

Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

Constituent	Maximum Soil Concentration	Location	Ohio EPA Generic Residential Direct Contact Standard[2]	Ohio EPA Generic Soil Leach-Based Value[2]	Ohio EPA Generic Commercial/ Industrial Direct Contact Standard[2]	USEPA Region 9 Regional Screening Levels[3]		
						Residential Soil	Nonresidential Soil	Risk-Based Protection of Groundwaer
	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
POLYNUCLEAR AROMATIC HYDROCARBONS								
Benzo(k)Fluoranthene	13000	IA03 AB-2	110	--	770	1.5	21	3.5
Carbazole	820	IA03 AB-2	430	--	3400	--	--	--
Dibenz(a,h)Anthracene	2900	IA03 AB-2	1.1	--	7.7	0.015	0.21	0.011
Fluoranthene	28000	IA03 AB-2	2400	--	3.70E+04	2300	2.20E+04	160
Fluorene	470	IA03 AB-3	2400	--	3.70E+04	2300	2.20E+04	160
Indeno(1,2,3-cd)Pyrene	7600	IA03 AB-2	11	--	77	0.15	2.1	0.12
Pyrene	21000	IA03 AB-2	1800	--	2.80E+04	1700	1.70E+04	120

[1]: Included for reference. Single sample detected above referenced screening level(s).
[2]: Ohio EPA generic numerical standards OAC 3745-300-08(A), and generic leach-based soil values from Ohio EPA Voluntary Action Program Derived Leach-Based Soil Values, Technical Guidance Document.
[3]: U.S. EPA Region IX screening levels for constituents in soil.
[4]: Ohio Bureau of Underground Storage Tank Regulation soil cleanup action level for TPH C10 to C20 fraction, soil class 2 (low plasticity clays, silt).

TABLE 3-6
RESULTS OF LABORATORY ANALYSES FOR NICKEL IN GROUNDWATER
MARCH 2009
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

Monitoring Well ID	Dissolved Nickel (µg/L)
BKA-48	15 B
BKA-51	151
BKA-53	20.2 B
DM-1	100,000
DM-3	56,200
DM-4	11,900
DM-5	12,800
DM-9	16,300
DM-10	323,000
DM-11	49,900
DM-12	355,000
DM-14	66,600
DM-15	21.4 B
DM-22R	36.8 B
DM-23R	2,080
DM-25R	< 3.2
DM-26	91,100
DM-27R	1,060
DM-28R	2,330
DM-29R	8,990
DM-30R	3,250
ERM-47	< 3.2
IA10-MW0003	4.9 B
IA10-MW0004	11.7 B
IA10-MW0009	1,200
RMW-35	1,930
RMW-38	< 3.2
RMW-39	678

Notes:

µg/L=micrograms per liter.

Samples having turbidity greater than 5 NTU were field filtered.

Refer to Table 4 for turbidity results.

B - Flag indicating results between the Method Detection Limit (MDL) and the Reporting Limit (RL).

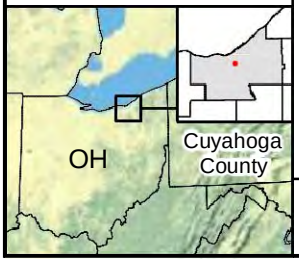
TABLE 3-7
CONSTITUENTS OF POTENTIAL CONCERN FOR GROUNDWATER
Former Harshaw Chemical Company Site
1000 Harvard Avenue
Cleveland, Ohio

Constituent	Maximum Groundwater Concentration	Location	Sample Date	Ohio EPA Unrestricted Use Standard[1]	USEPA Region 9 regional Screening Levels for Tap Water[2]
	ug/L			ug/L	ug/L
Cadmium	71.1	DM-27R	8/31/2004	5	
Lead	1300	DM-27R	8/31/2004	15	
Lithium	463	DM-14	9/23/2003		73
Manganese	2470	BKG MW0004	8/24/2004		880
Nickel	5800000	DM-14	10/9/1986	100	

[1]: Ohio EPA generic unrestricted potable use standard.
[2]: U.S. EPA Region IX regional screening level for tap water.

Figures

Map Location



Facility Location Map

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

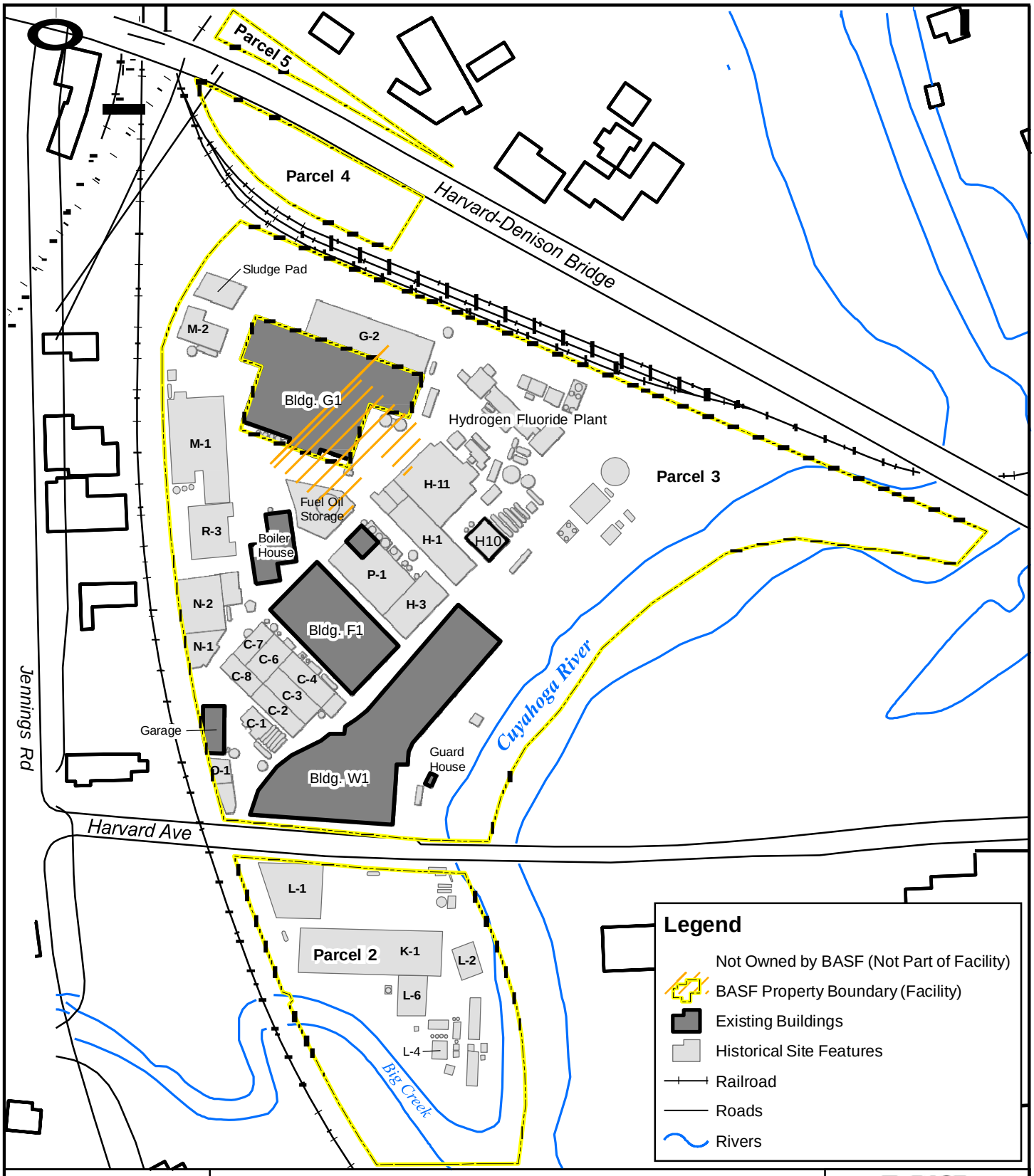
0 0.25 0.5 Miles

BASF The Chemical Company

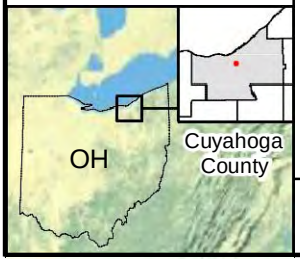
AECOM

Project #60154775
July 2010

Figure 2-1



Map Location



Existing and Former Building Locations

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

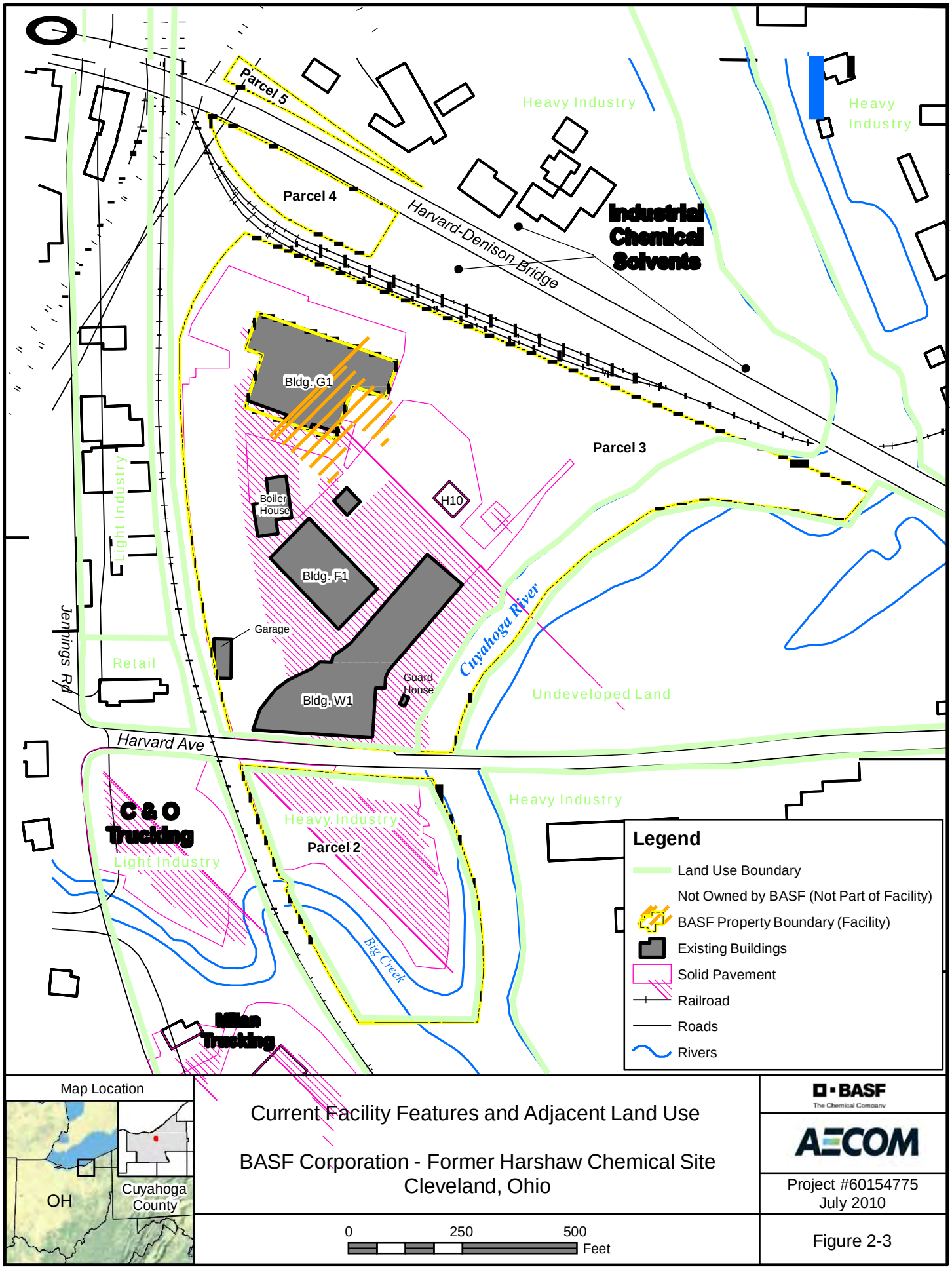
0 250 500 Feet

BASF The Chemical Company

AECOM

Project #60154775
July 2010

Figure 2-2



Map Location

Current Facility Features and Adjacent Land Use

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

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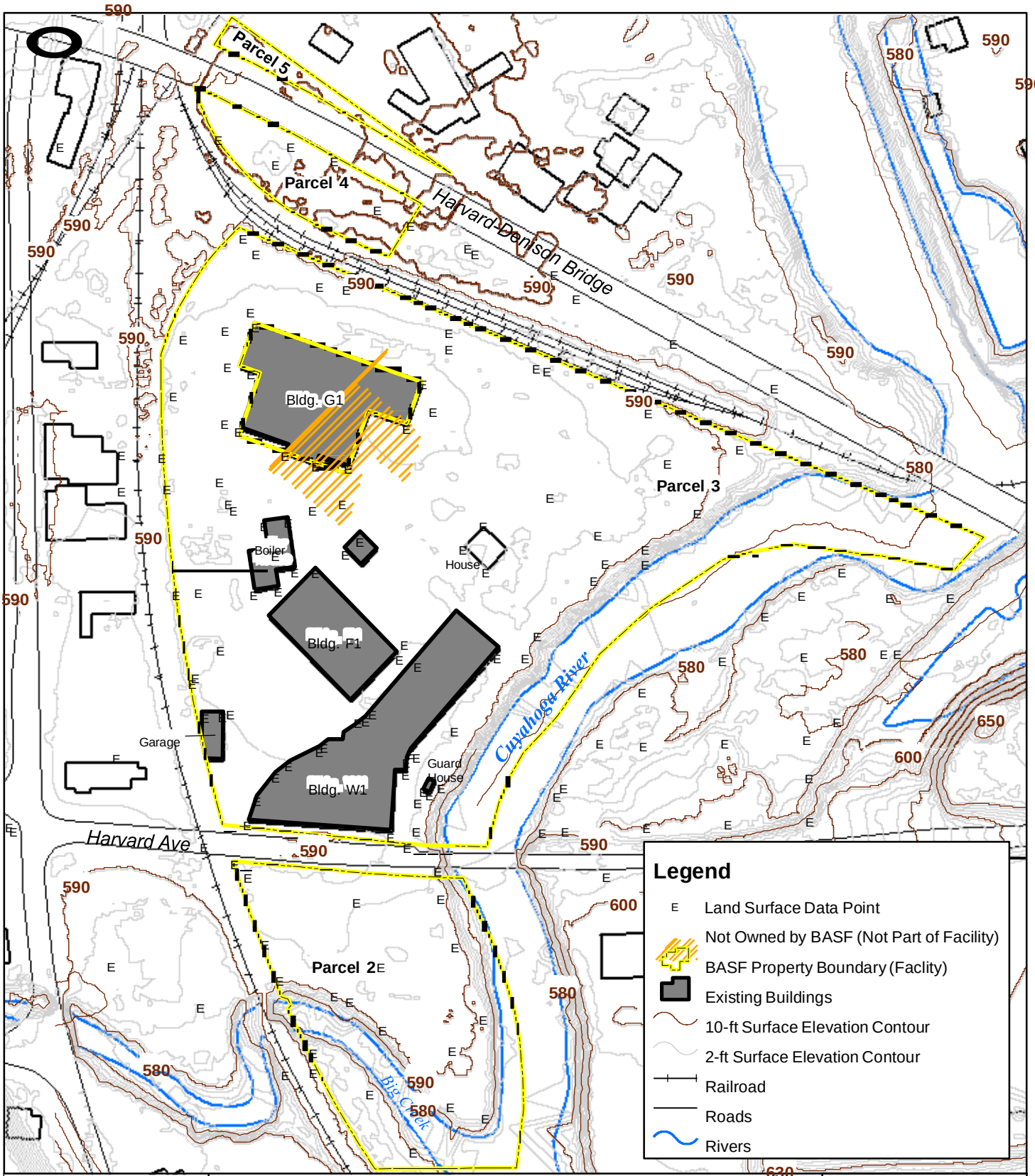
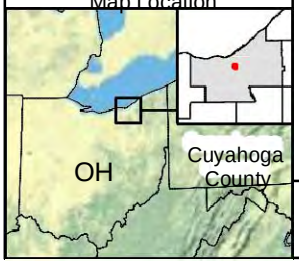
Figure 2-3





Modeled Topographic Map
Reference: SAIC RI Report, 2009
BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

BASF The Chemical Company

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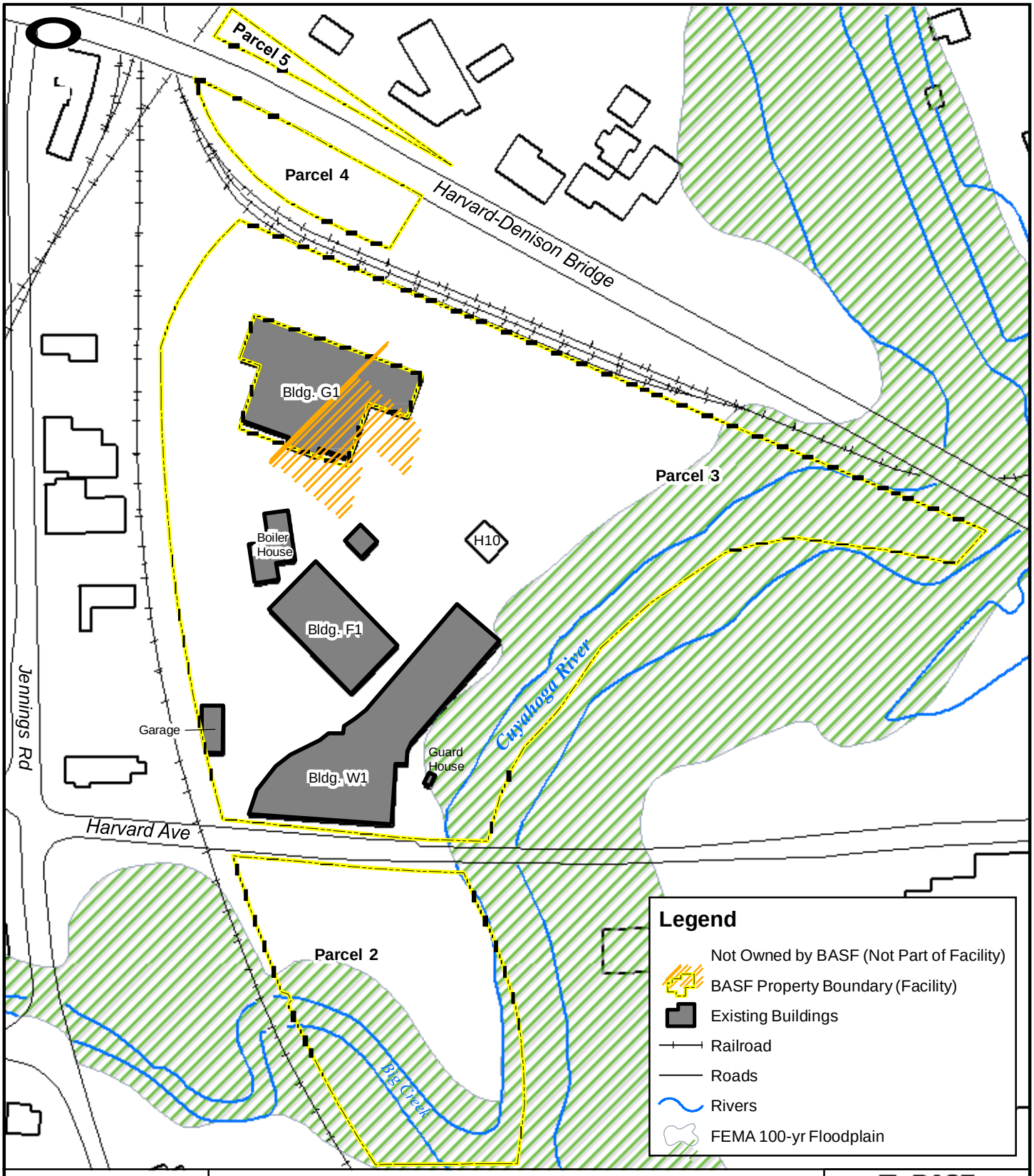
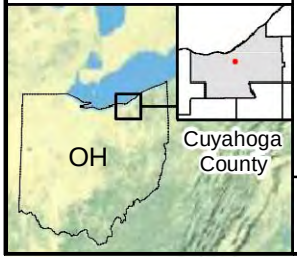
July 2010

Figure 2-4



Map Location



FEMA 100-Year Event Flood Hazard Areas

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

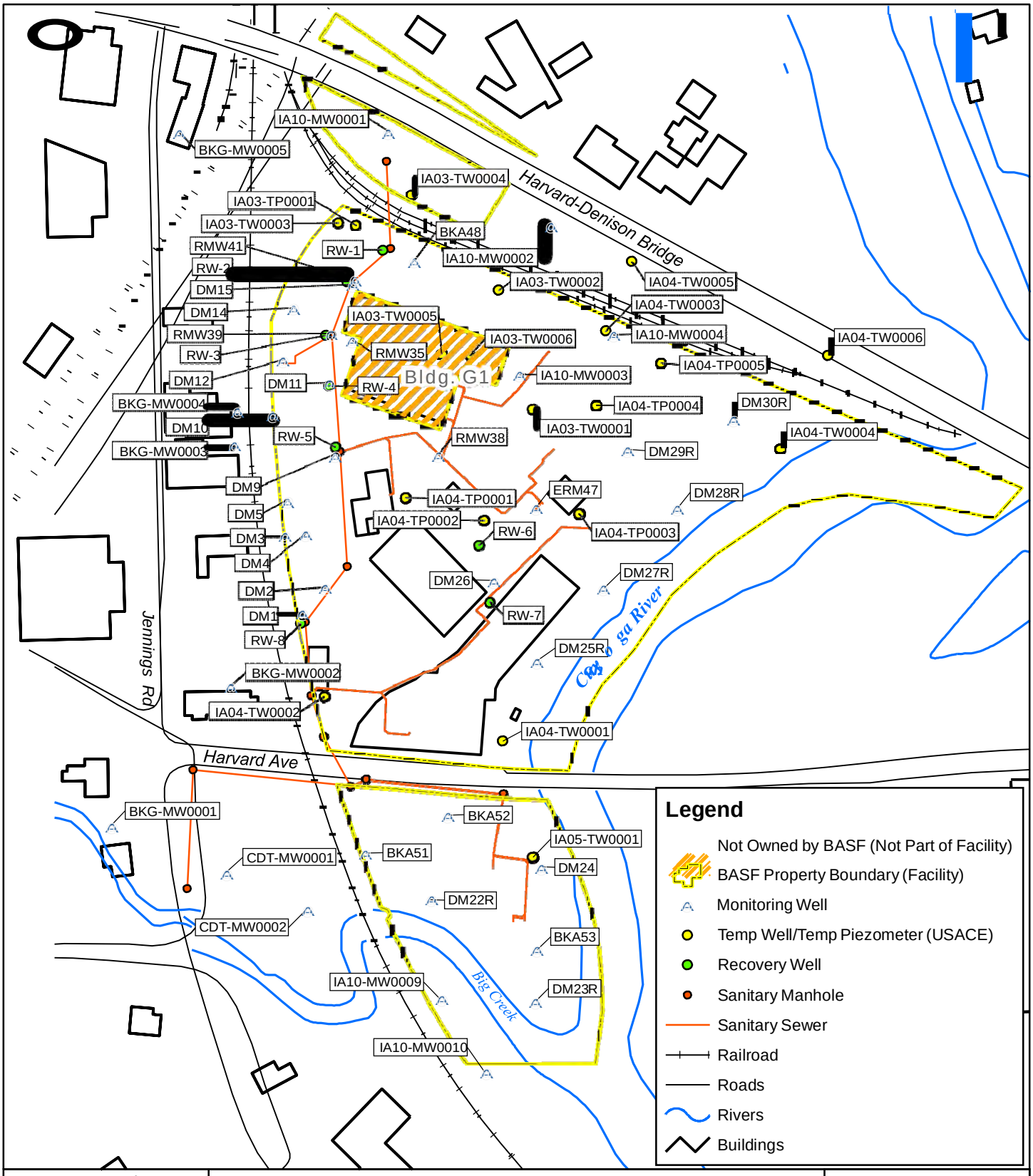
0 250 500 Feet

BASF The Chemical Company

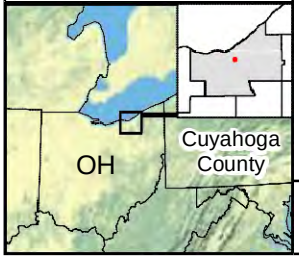
AECOM

Project #60154775
July 2010

Figure 2-5



Map Location



Monitoring Well Locations

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

BASF The Chemical Company

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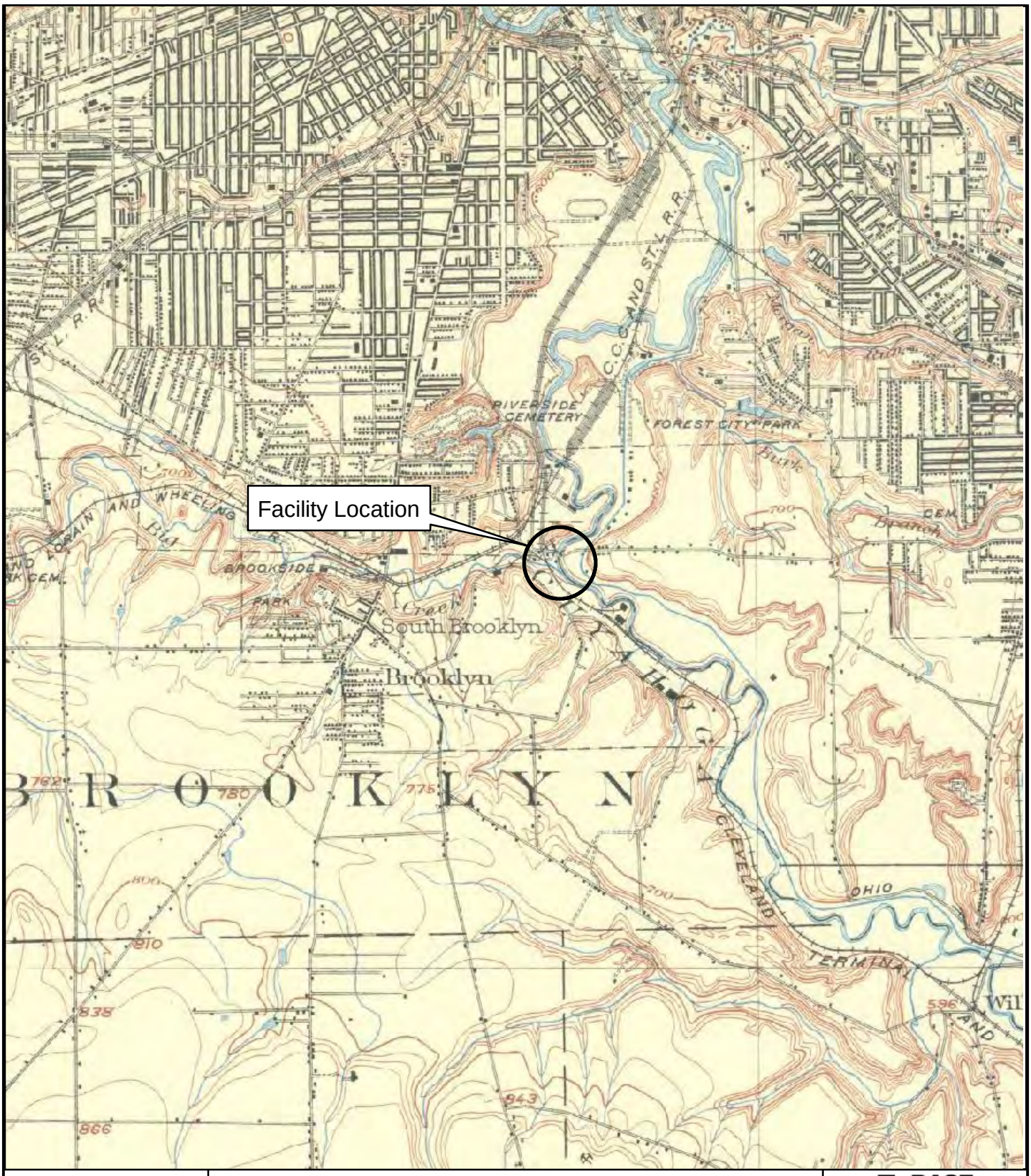
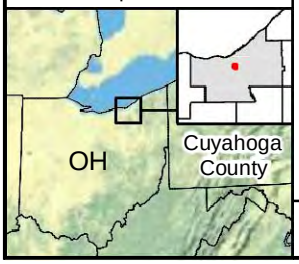
July 2010

Figure 2-6



Map Location



1903 USGS Map

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

Source: USGS Geological Survey

BASF The Chemical Company

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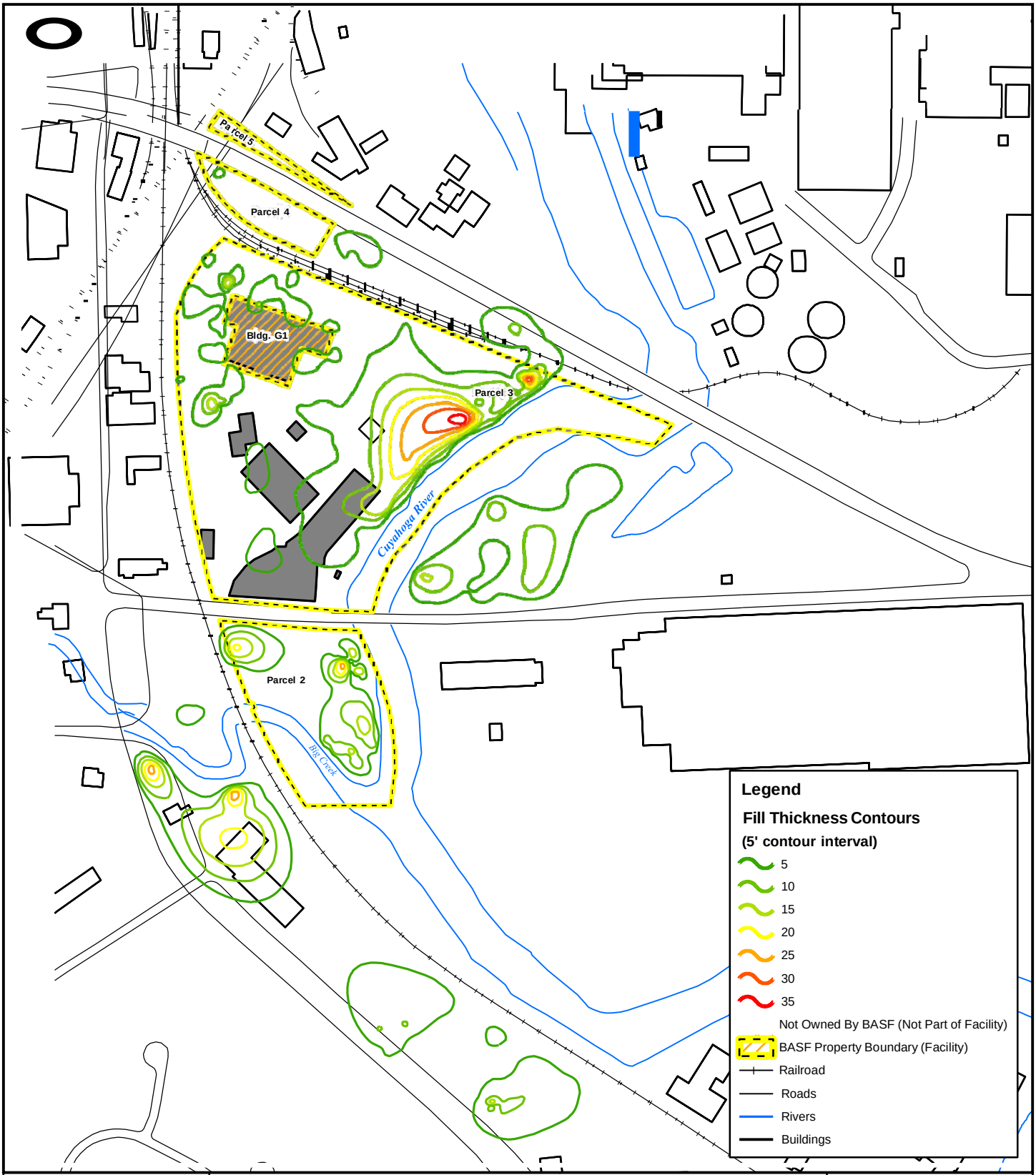
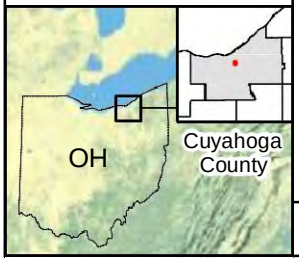
Project #60154775
July 2010

Figure 2-7



Map Location



New Fill Isopach Map

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

BASF The Chemical Company

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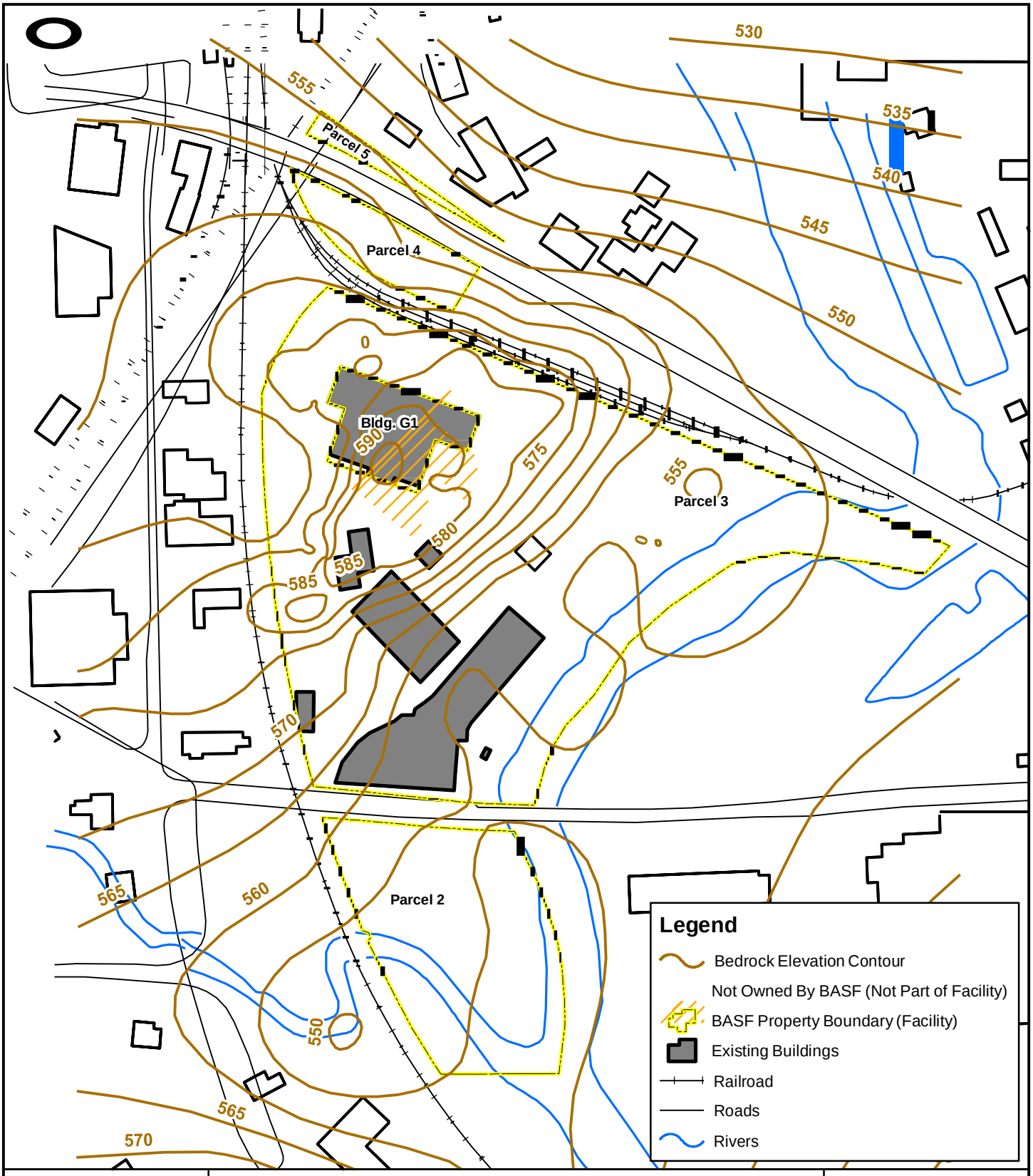
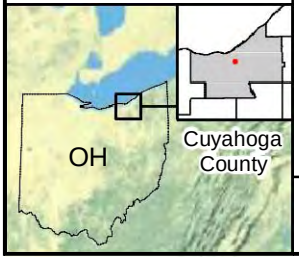
Source: SAIC Remedial Investigation Report, 2006, Figure 2-6

Figure 2-8



Map Location



Bedrock Surface Map

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

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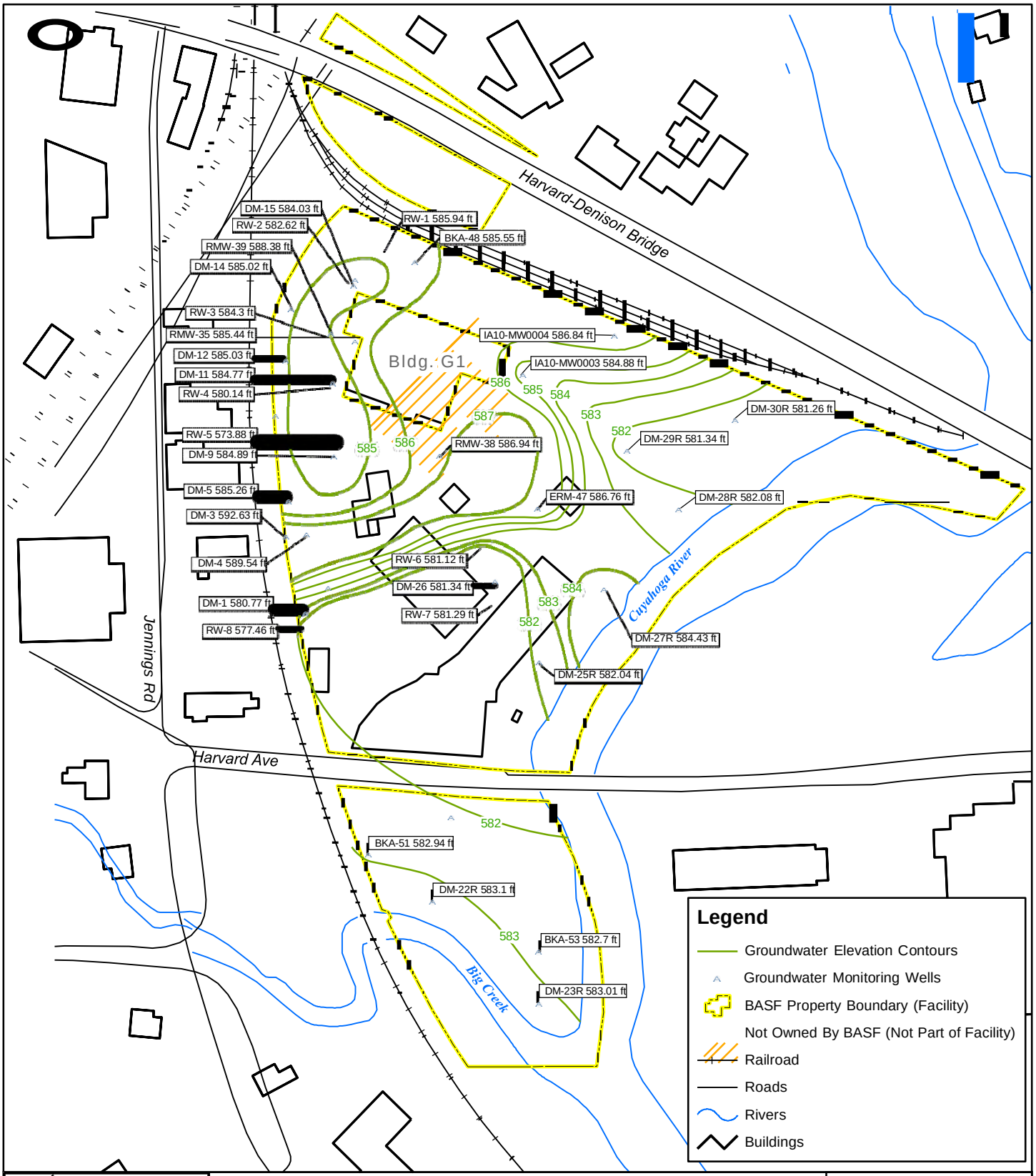
July 2010

Figure 2-9



Groundwater Potentiometric Surface
March 9, 2009

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

1 inch equals 275 feet

0 275 550 Feet

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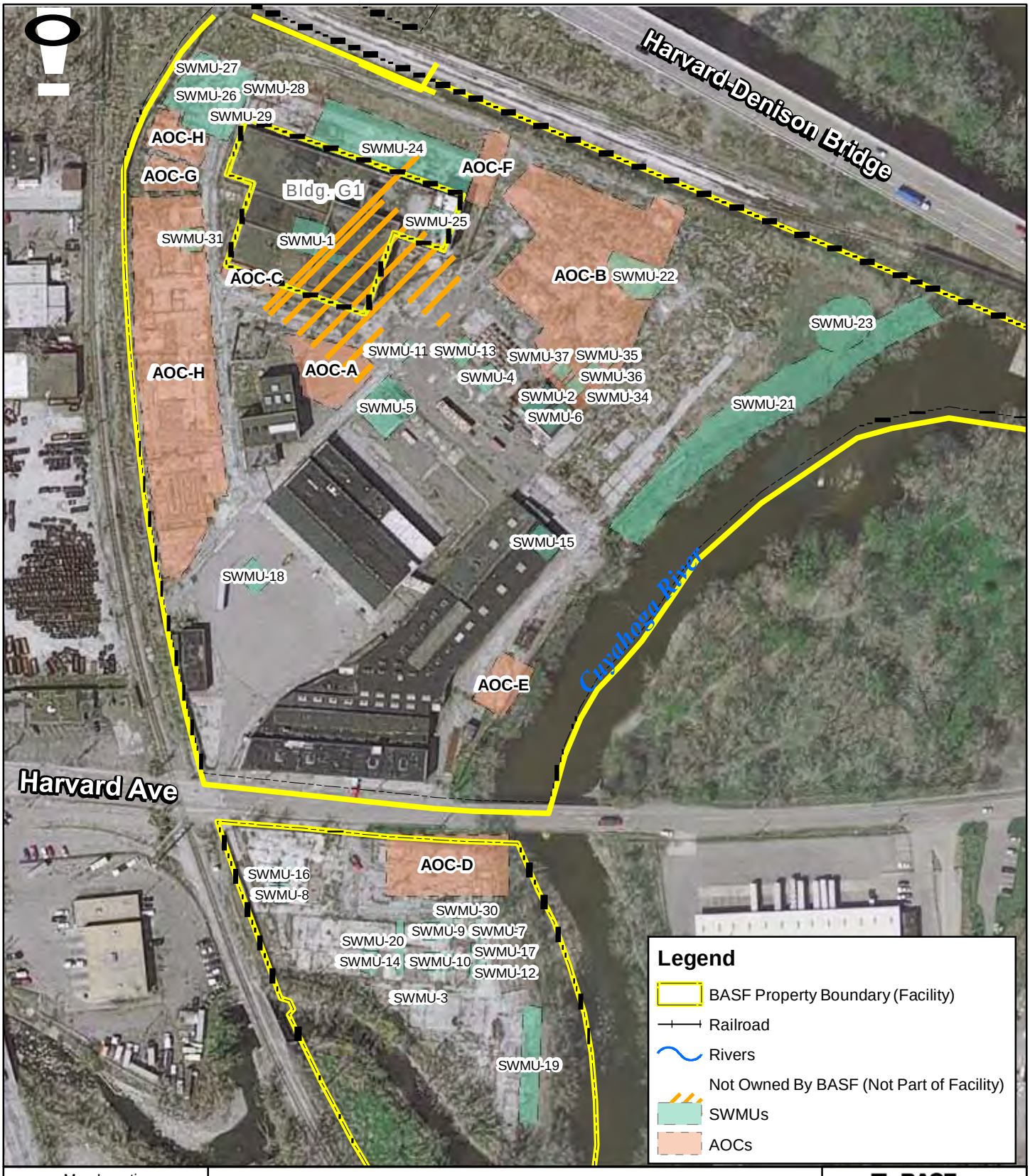
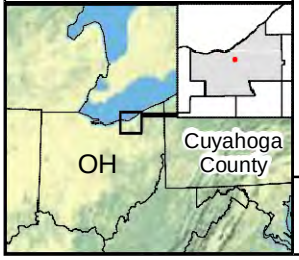
Figure 2-10



Map Location



SWMU and AOC Layout

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

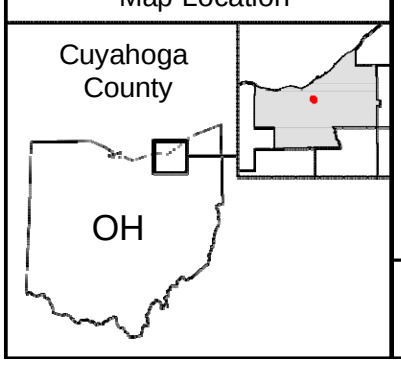
BASF The Chemical Company

AECOM

Project #60154775
July 2010

Figure 3-1

Map Location



SWMU and AOC Photo Log
BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

BASF The Chemical Company

AECOM

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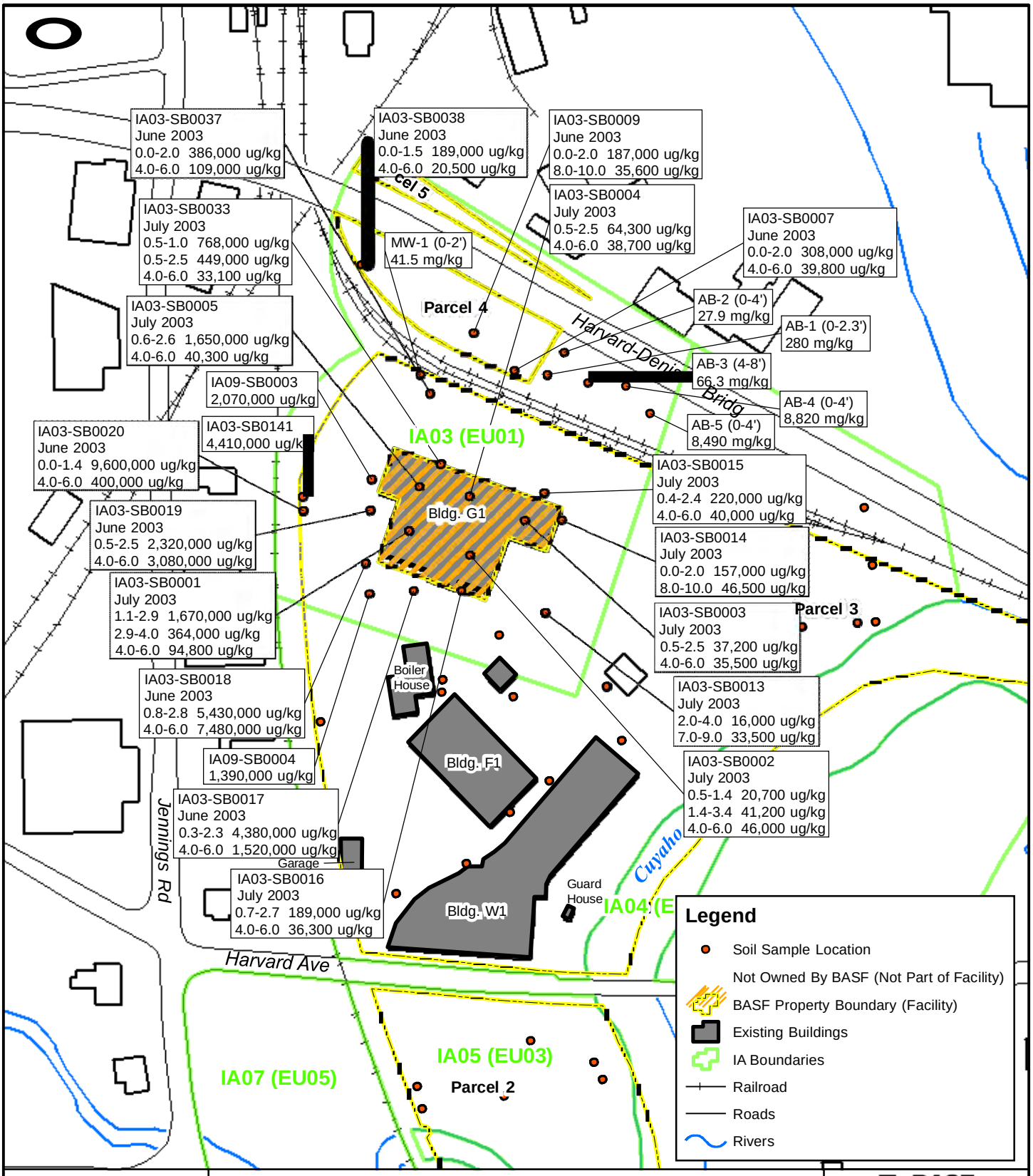
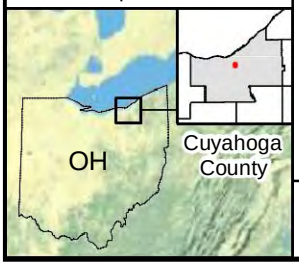
July 2010

Figure 3-2



Map Location



Historic Nickel Concentrations in Soil

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

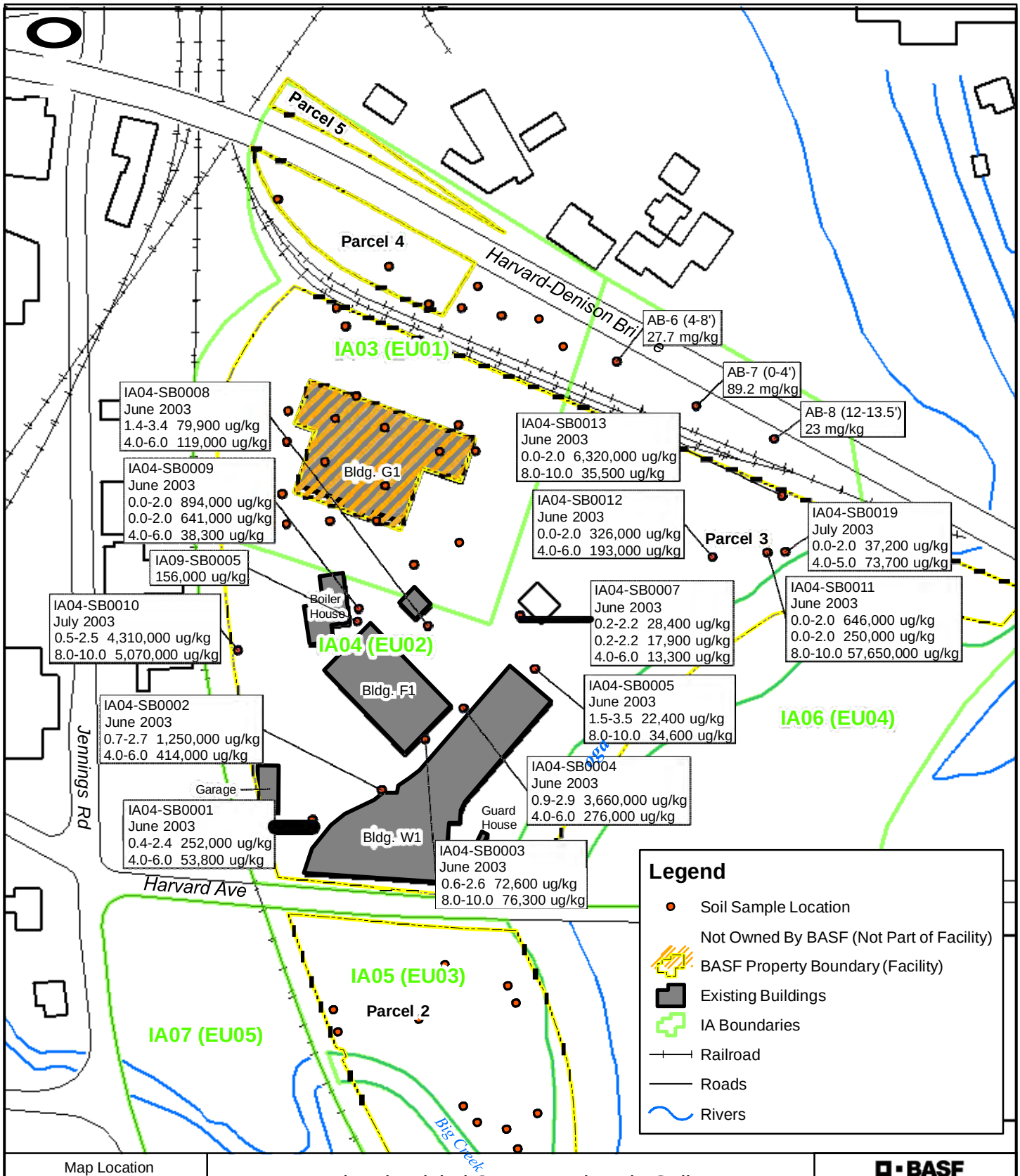
0 250 500 Feet

BASF The Chemical Company

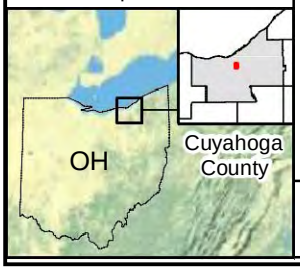
AECOM

Project #60154775
July 2010

Figure 3-3A



Map Location



Historic Nickel Concentrations in Soil

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

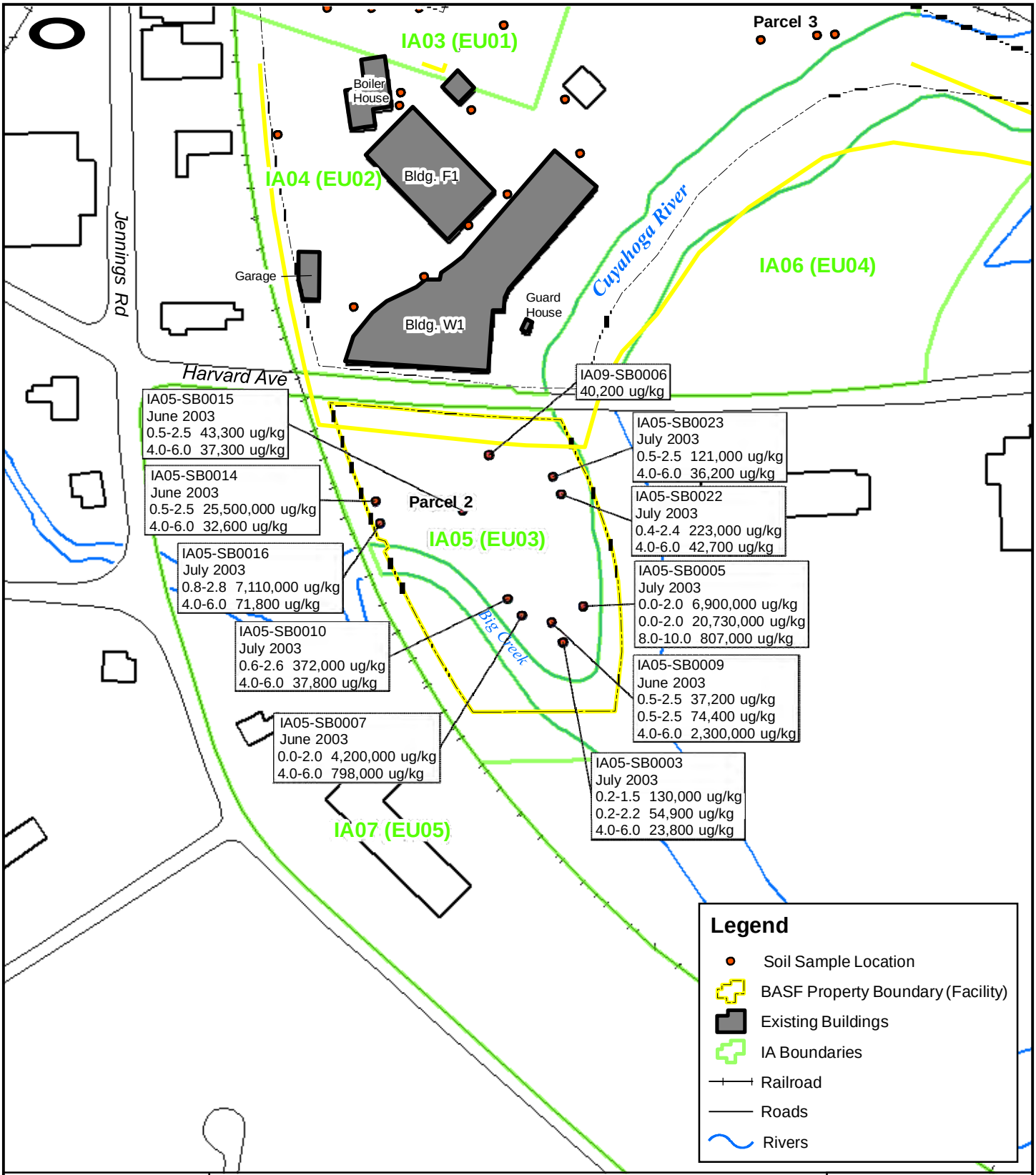
0 250 500 Feet

BASF The Chemical Company

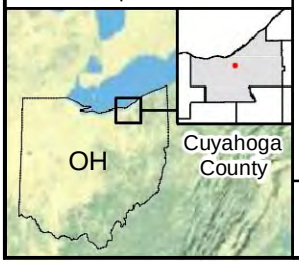
AECOM

Project #60154775
July 2010

Figure 3-3B



Map Location



Historic Nickel Concentrations in Soil

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

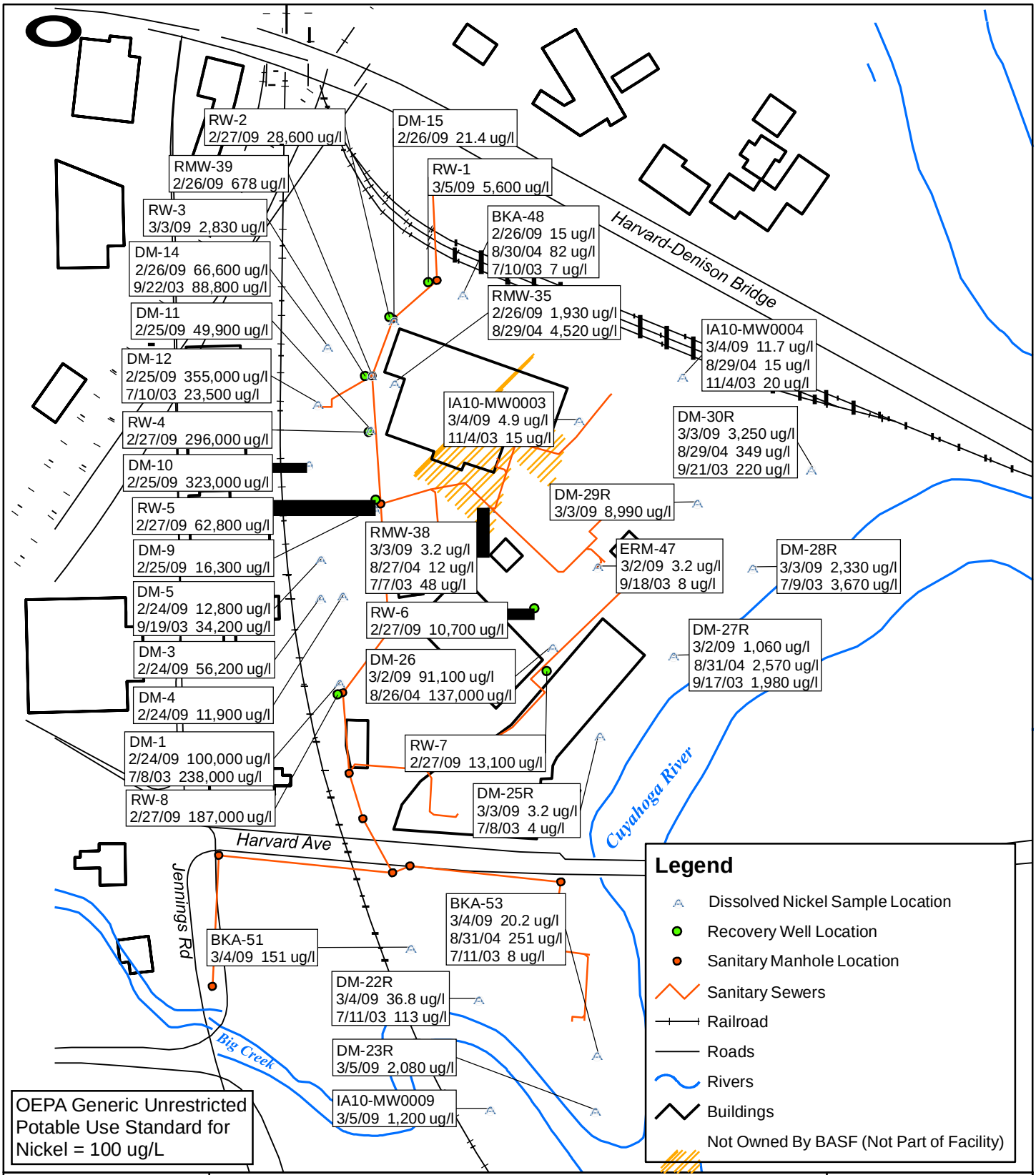
0 250 500 Feet

BASF The Chemical Company

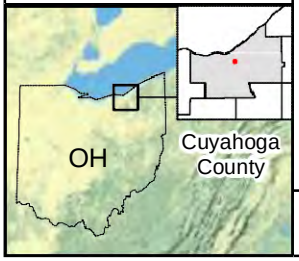
AECOM

Project #60154775
July 2010

Figure 3-3C



Map Location



Dissolved Nickel Concentrations in Groundwater - July 2003 to March 2009

BASF Corporation - Former Harshaw Chemical Facility
Cleveland, Ohio

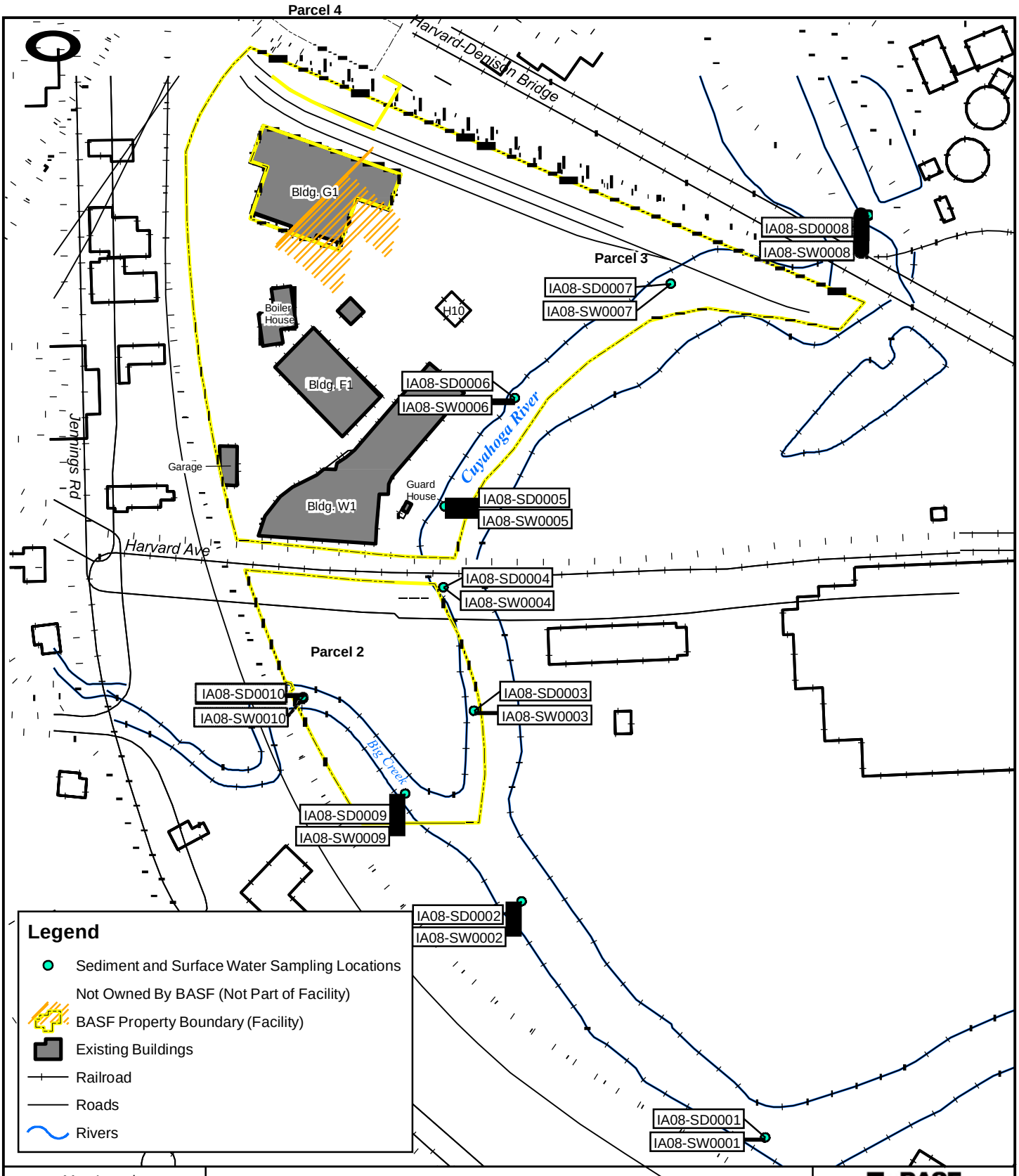
0 250 500 Feet

BASF The Chemical Company

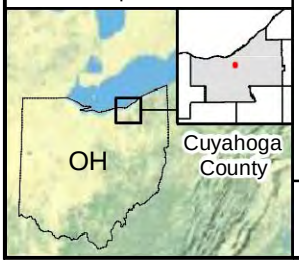
AECOM

Project #60154775
July 2010

Figure 3-4



Map Location



Stream Sediment and Surface Water Sampling Locations

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

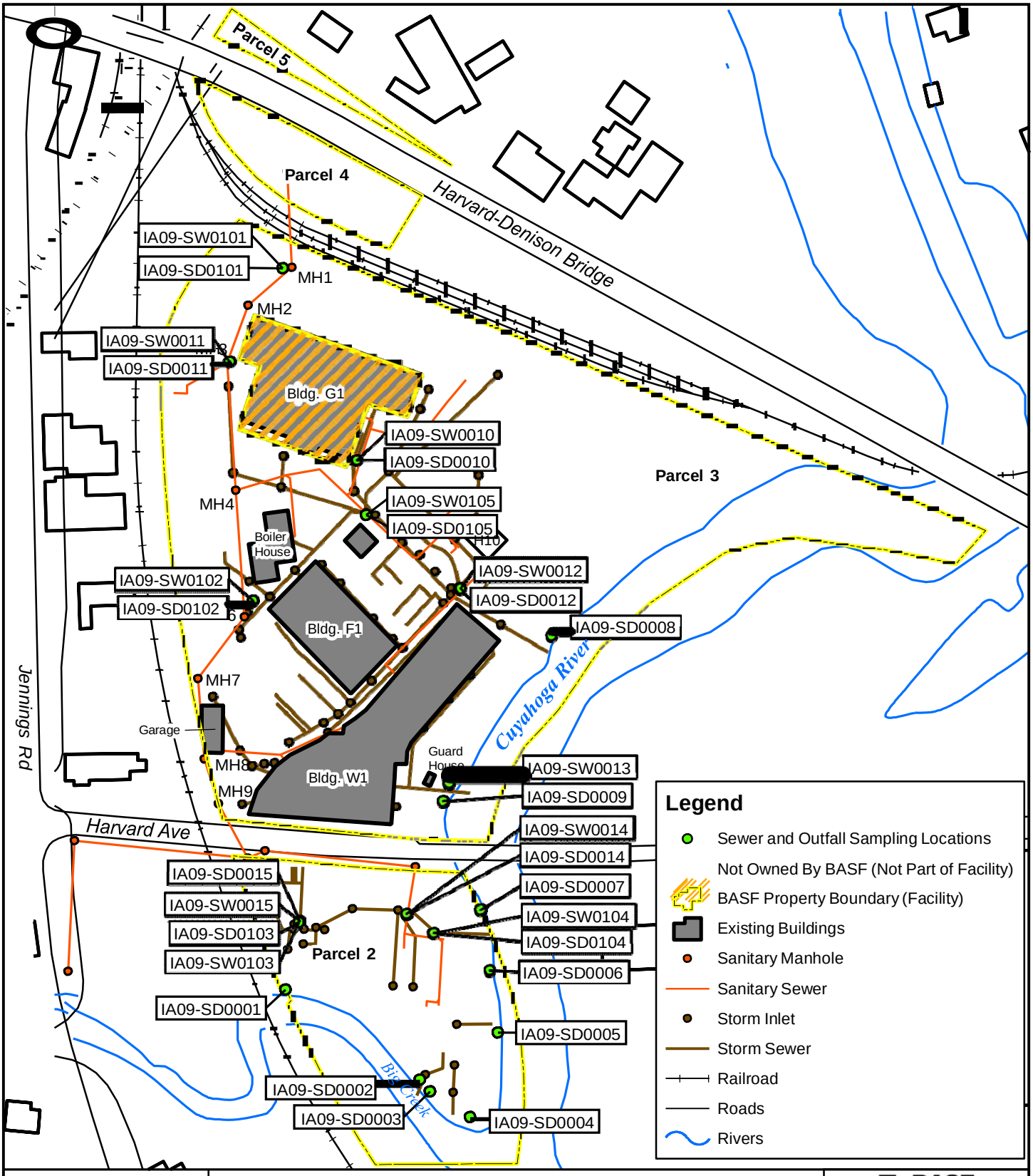
0 250 500 Feet

BASF The Chemical Company

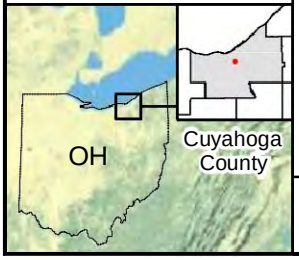
AECOM

Project #60154775
July 2010

Figure 3-5



Map Location



Sewer and Outfall Sampling Locations

BASF Corporation - Former Harshaw Chemical Site
Cleveland, Ohio

0 250 500 Feet

BASF The Chemical Company

AECOM

Project #60154775
July 2010

Figure 3-6