APPENDIX C

Sauget Area 2 Superfund Site

Operable Unit 1

Sauget and Cahokia, St. Clair County, Illinois

Record of Decision

U.S. Environmental Protection Agency Region 5

77 W Jackson Blvd.
Chicago, IL 60604

December 2013

Table of Contents

Appendices

Part 1 – Declaration

1.1 – Site Name and Location

Sauget Area 2 Site
Operable Unit 1 (soil, sediments, surface water and groundwater contamination source areas)
CERCLIS ID# ILD000605790
Sauget and Cahokia, St. Clair County, Illinois

1.2 – Statement of Basis and Purpose

This decision document presents the remedy chosen by the U.S. Environmental Protection Agency (EPA) ("Selected Remedy") for Operable Unit 1 (OU1) at the Sauget Area 2 Site in Sauget and Cahokia, St. Clair County, Illinois. EPA chose the Selected Remedy for OU1 in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Contingency Plan (NCP). This Record of Decision (ROD) for the Selected Remedy includes the documents considered and listed in the Administrative Record Index at Appendix A.

The State of Illinois has indicated that they concur with the Selected Remedy. The State's letter supporting the Selected Remedy will be added to Appendix G upon receipt.

1.3 - Assessment of Site

The Selected Remedy is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4 - Description of Selected Remedy

As set forth in Section 2.2 below, EPA and Site potentially responsible parties (PRPs) have already implemented extensive clean-up activities in Sauget Area 2. These actions have addressed some of the more toxic and mobile contaminant source materials formerly present at the Site. A "source material" is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration for contamination to groundwater, surface water, or air; or acts as a source for direct exposure.

The Selected Remedy, referred to as remedial action for OU1, will address remaining contaminant source materials at the Site and will be the first of two remedial decisions for remedial action for the Sauget Area 2 Site. EPA's overall strategy for cleaning up the Site is to first address soil, sediments, surface water, and groundwater contamination source areas through this remedial action for OU1, which will be the final remedy for contaminated soil, sediments, surface water, and groundwater contamination source areas at the Site. Area-wide groundwater contamination resulting from contamination present in the Sauget Area 1 and 2 Sites will be

addressed in a separate, subsequent remedial action after the soil, sediment, surface water and source area remedies are implemented in the Sauget Area 1 and 2 Sites. The regional groundwater remedy will be selected in a separate groundwater ROD for the Sauget Area 1 and Sauget Area 2 Superfund Sites.

The remedial action proposed in this ROD will be the final remedy for contaminated soils, sediments, surface water, and groundwater contamination source areas at the Sauget Area 2 Site. As described further in Section 2.1 below, Sauget Area 2 consists of five inactive disposal areas (Sites O, P, Q, R, and S). Of these disposal sites, three are closed landfills (Sites P, Q, and R), one consists of four closed sludge lagoons (Site O), and one is a waste disposal site (Site S) associated with an abandoned solvent reclamation facility. Figure 1 shows the location of the Sauget Area 2 Sites. The Selected Remedy for OU1 at the Sauget Area 2 Site, in addition to the continued operation of the existing groundwater barrier wall and extraction system (described below), consists of the following alternatives:

- Selected Alternative for Site O and O North: Alternative O2: 35 IAC § 724 Compliant[1] Soil Cap Over Identified Waste Areas and Institutional and Access Controls;
- Selected Alternative for Site P: Alternative P3: Collection, Treatment, and Off-Site Disposal of NAPL at Well (LEACH P-1), Asphalt Cap over Potentially Mobile Source Area (SA-P-3/AT-P-5), 35 IAC § 807 Solid Waste Landfill Cap Over Remainder of Identified Waste Areas, Vapor Intrusion Mitigation, and Institutional and Access Controls;
- Selected Alternative for Site Q North: Alternative QN2: 35 IAC § 724 Compliant Crushed Rock Cap Over Dogleg Area, Vapor Intrusion Mitigation, and Institutional and Access Controls;
- Selected Alternative for Site Q Central: Alternative QC3: In-Situ Soil Vapor Extraction (SVE) at Potentially Mobile Source Area (AT-Q32), 35 IAC § 724 Compliant Crushed Rock Cap Over Identified Waste Areas, Shoreline Erosion Protection, and Institutional and Access Controls;
- Selected Alternative for Site Q South and Q South Ponds: Alternative QS3: Removal of Intact Drums at AT-Q35, 35 IAC § 724 Compliant Cap Over Identified Waste Areas, and Institutional and Access Controls;
- Selected Alternative for Site R: Alternative R2: 35 IAC § 724 Compliant Soil Cap Over Entire Site and Institutional and Access Controls; and
- Selected Alternative for Site S: Alternative S3: In-Situ SVE of Potentially Mobile Source Area, 35 IAC § 724 Compliant Soil Cap Over Entire Site, and Institutional and Access Controls.

[1] A 35 IAC § 724 compliant soil or crushed rock cap meets the performance standards of a RCRA subtitle C cap, except the component requiring long-term minimization of migration of liquids. This component is not appropriate for the Sauget Area 2 Sites due to Site-specific conditions (see Section 2.10.2).

This Selected Remedy for OU1 at the Sauget Area 2 Site addresses principal threat wastes that are present at the Site. A "principal threat" waste is a source material that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. Previous removal actions conducted by EPA at Site Q Central and Site Q South already have removed principal threat wastes by excavating and disposing off-Site approximately 3,271 drums and 14,000 tons of high-level polychlorinated biphenyl (PCB) contaminated soil. EPA also ordered the construction of a groundwater barrier wall, called a Groundwater Migration and Control System (GMCS), next to the Mississippi River as an early interim OU2 groundwater remedy to capture and treat area groundwater before it releases to the River.[2] However, additional principal threat wastes have been observed at Site P, Q North, Q South, and R, and the GCMS and the remedies selected in this ROD target these areas. Specifically, Alternative P3 addresses principal threat wastes on Site P by treating the recovered NAPL located there through removal and off-Site incineration. Alternative QS3 addresses principal threat wastes at Site Q South through removal and off-Site treatment and disposal of intact drums located there. The principal threat wastes identified on Site Q North and Site R, as well as the NAPL located at these two sites, is captured by the Sauget Area 2 GMCS and treated by the Village of Sauget American Bottoms Regional Water Treatment Facility (ABRTF).

To address the remaining low-level threat waste, engineering controls[3] in the form of engineered covers will be installed to prevent the direct contact exposure pathway[4]. Engineered covers meeting the requirements of 35 IAC § 724[5] will be installed over Sites O, O North, Q North, Q Central, Q South, R, and S; and a 35 IAC § 807[6] cap will be installed over Site P. Additionally, contaminants will be treated in-situ with SVE at Site Q Central and Site S.

1.5 - Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is

[2] In September 2002, EPA issued a CERLCA Section 106 unilateral administrative order (UAO) requiring potentially responsible parties (PRPs) to install the Sauget Area 2 GMCS as an interim OU2 groundwater remedy for the Sauget Area 2 Site. This system is comprised of a 3,300 ft long "U"-shaped, fully penetrating barrier wall located downgradient of Site R, Sauget Area 2, the former Clayton Chemical facility, Solutia's Krummrich plant as well as other facilities, and Sauget Area 1. The barrier wall extends from approximately 3 feet below ground surface down to the top of bedrock and includes three groundwater extraction wells on the upgradient side of the wall. The GMCS intercepts and captures an estimated 210 million gallons of contaminated groundwater a year, which is pumped to the American Bottoms Regional Water Treatment Facility (ABRTF) in Sauget. The groundwater is treated at the ABRTF and ultimately discharged to the Mississippi River in compliance with the terms and conditions of the ABRTF's National Discharge Pollutant Discharge Elimination System (NPDES) permit issued under the Clean Water Act.

[3] Engineering controls encompass a variety of engineered and constructed physical barriers (e.g., soil capping, sub-surface venting systems, mitigation barriers, fences) to contain and/or prevent exposure to contamination on a property.

[4] An exposure pathway refers to the way in which a person may come into contact with a hazardous substance, whether it is a chemical, biological, or some other harmful substance. There are three basic exposure pathways: inhalation, ingestion, or direct contact.

[5] State of Illinois Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.

[6] State of Illinois Standards for Solid Waste.

cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

This remedy satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment). The Selected Remedy calls for the treatment of NAPL through off-Site incineration of the collected NAPL from Site P, the removal and off-Site treatment and disposal of intact drums from Site Q South, and the treatment of contaminants in-situ with SVE at Site Q Central and Site S. Additionally, NAPL identified on Site Q North and Site R will continue to be captured by the GMCS and treated by the American Bottoms Regional Water Treatment Facility (ABRTF) in Sauget, Illinois. By utilizing treatment in this manner as part of the remedy for the Site, the Selected Remedy satisfies the statutory preference for remedies to employ treatment as a principal element.

However, because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-Site above levels that would allow for unlimited use and unrestricted exposure, EPA will conduct a statutory review within five years after initiation of the remedial action and every five years subsequent, to ensure that the remedy is, or will be, protective of human health and the environment.

1.6 – Data Certification Checklist

The following information is included in the *Decision Summary* section of this ROD. Additional information can be found in the Administrative Record for this Site.

Information Item	Location in ROD
Contaminants of concern and their respective concentrations	Section 2.7.2
Baseline risk represented by the contaminants of concern	Section 2.7
Clean-up levels established for contaminants of concern and the basis for these levels	Section 2.8
How source materials that constitute principal threats will be addressed	Sections 2.11 and 2.13
Current and reasonably anticipated future land use assumptions in the baseline risk assessment and the ROD	Section 2.7.1
Estimated capital, annual operation and maintenance, and total present worth costs, discount rate, and the number of years over	Section 2.9 and Appendix C

which the remedy cost estimates are projected	
Key factor(s) that led to the selection of the remedy	Sections 2.10 and 2.12

1.7 - Authorizing Signatures

EPA, as the lead agency for the Sauget Area 2 Superfund Site (ILD000605790), formally authorizes this Record of Decision.

Richard C. Karl, Director
Superfund Division
EPA Region 5

12-16-13
Date

The State of Illinois Environmental Protection Agency (Illinois EPA), as the support agency for the Sauget Area 2 Site, has indicated that they will concur with this ROD. The State's concurrence letter will be added to Appendix G upon receipt.

Part 2 – Decision Summary

2.1 - Site Name, Location, and Brief Description

The Sauget Area 2 Site is located in the Villages of Sauget and Cahokia, in St. Clair County, Illinois, just east of the Mississippi River, and consists of five inactive disposal areas (Sites O, P, Q, R, and S) described in Table 1 below. Of these disposal sites, three are closed landfills (Sites P, Q, and R), one consists of four closed sludge lagoons (Site O), and one is a waste disposal site (Site S) associated with an abandoned solvent reclamation facility. Figure 1 shows the location of the Sauget Area 2 Sites.

For organizational purposes, EPA has divided the Sauget Area 2 Site into two separate areas, each of which is called an "operable unit" or "OU." OU1 consists of the soil, sediment, surface water and groundwater contamination source areas at the Sauget Area 2 Site. OU2 is the contaminated groundwater itself. EPA will address groundwater contamination in the Sauget Area after remedies are implemented for the soil, sediments, surface water, and groundwater contamination source areas at the Sauget Area 1 and 2 Sites.

EPA is the lead agency for the Sauget Area 2 Site. Illinois EPA serves as the support agency. PRPs investigated the Site, with EPA oversight, pursuant to the remedial investigation/feasibility study (RI/FS) required under a Superfund Administrative Order on Consent (AOC) signed on November 20, 2000. EPA intends to pursue responsible parties to fund or implement the remedy for OU1 set forth in this ROD. That action would be set forth in a remedial design/remedial action (RD/RA) order or settlement for OU1.

Table 1: Descriptions of Sauget Area 2 Disposal Areas

Site Name	Size (acres)	City	Location
Site O, O North, O South	28	Sauget, Illinois	Located on Mobile Avenue, northeast of the American Bottoms Regional Wastewater Treatment Facility (ABRTF) and east of the flood control levee.
Site P	32	East St. Louis and Sauget, Illinois	Bounded by Illinois Central Gulf Railroad tracks, the Terminal Railroad Association tracks and Monsanto Avenue.
Site Q – North	52	Sauget and Cahokia, Illinois	The northern portion of Site Q is bordered on the north by Site R and Monsanto Avenue; on the south by the main track of the Alton and Southern Railroad; on the east by the flood control levee; and on the west by the Mississippi River. The northern portion of Site Q that wraps around the eastern boundary of Site R is known as the "Dogleg" portion of Site Q North.

Site Q – Central	67	Sauget and Cahokia, Illinois	The central portion of Site Q is bordered on the north by Q north; on the south by the Alton and Southern Railroad; on the east by the flood control levee and the Illinois Central Gulf Railroad; and on the west by the Mississippi River.
Site Q – South	87	Sauget and Cahokia, Illinois	The southern portion of Site Q is bordered on the north by the Alton and Southern Railroad; on the south by Cargill Road; on the east by the flood control levee and the Illinois Central Gulf Railroad; and on the west by a 10-foot wide easement owned by Union Electric for transmission lines and a spur track of the Alton and Southern Railroad.
Site R	36	Sauget, Illinois	Site R is bounded on the north by Monsanto Avenue; on the east by the dogleg portion of Site Q; on the south by the main portion of Site Q; and on the west by the Mississippi River. The address for the site is 5 Riverview Avenue.
Site S	<1	Sauget, Illinois	Site S is less than one acre in size and is located southwest of Site O.

Heavy industry has been present on the east bank of the Mississippi River between Cahokia and Alton, Illinois, for nearly a century. Industrial activity in the area peaked in the 1960s. Although many industrial facilities have closed down throughout the American Bottoms floodplain, Sauget Area 2 and the surrounding area is still highly industrialized. Currently, the area is used for industry, warehousing, bulk storage, wastewater treatment, hazardous waste treatment, waste recycling, and truck terminals. In addition to heavy industry, the area also has commercial facilities, bars, nightclubs, convenience stores, and restaurants. A number of petroleum, petroleum product, and natural gas pipelines are located in the area.

No residential land use is located immediately adjacent to or downgradient of Sites O, P, Q, R, or S. Residential areas of Sauget and East St. Louis are separated from the Sauget Area 2 Site by other industries or by undeveloped tracts of land. Limited residential areas exist approximately 3,000 feet to the northeast and southeast of the Site's boundaries. According to the 2010 census, the population of the Village of Sauget, which is where the majority of the Sauget Area 2 Site is located, is 159; the Village of Cahokia is 15,241; and East St. Louis is 27,006.

In the past, groundwater from the American Bottoms aquifer was a major source of water for the area and was used for industrial, non-potable public, and irrigation purposes. Groundwater levels prior to industrial and urban development were near land surface. Intensive industrial withdrawal, along with the use and construction of a system of drainage ditches, levees, and canals to protect developed areas, lowered the groundwater elevation for many years. By the mid-1980s; however, the groundwater levels had increased due to reduced pumping, high river

stages, and high precipitation. Currently, no groundwater is being pumped from the American Bottoms aquifer in the vicinity of Sauget Area 2 for public, private, or industrial supply purposes.

Groundwater is not a source of drinking water in the area. The Village of Sauget and the City of East St. Louis have issued ordinances prohibiting the use of groundwater as a potable water source. These ordinances were issued in response to historic industrial land use in the region and resulting groundwater quality impairments. The Village of Cahokia has an ordinance that restricts groundwater use in part of the municipality, but it does not cover the portion of the Sauget Area 2 Site that is located in Cahokia. Groundwater use restrictions will likely remain in place for the foreseeable future due to the extent of the groundwater quality impairments.

The source of drinking water for area residents is an intake in the Mississippi River. This intake is located at River Mile 181, approximately three miles north and upgradient of the Sauget Area 2 Site. The drinking water intake is owned and operated by the Illinois American Water Company (IAWC) of East St. Louis, and it serves the majority of residences in the area. IAWC supplies water to Sauget and also to portions of Cahokia and Centerville Township. Public water supply is the exclusive potable water source in the vicinity of the Sauget Area 2 Site.

The nearest downstream surface-water intake on the Illinois side of the Mississippi River is located at River Mile 110, approximately 68 miles south of Sauget Area 2. This intake supplies drinking water to residents in the Town of Chester and surrounding areas in Randolph County, Illinois. The nearest downstream public water supply on the Missouri side of the river is located at River Mile 149, approximately 29 miles south of Sauget Area 2. At this location, the Village of Crystal City, Missouri, utilizes a Ranney[7] well adjacent to the Mississippi River as a source for drinking water.

The Mississippi River is the major surface water body draining the area. The stretch of the River adjacent to Site R is bounded by steep embankments lined with rip-rap. A few scattered structures in the River, such as a wing dam and a sunken barge, offer some access points for aquatic birds and mammals and potential protection for fish. In the vicinity of the Site, no bordering wetlands, appreciable bordering vegetation, or submerged or emergent vegetation are present. Recreational and commercial fishing does occur in the Mississippi River; however, no fishing access is available along the Site border. The Sauget Area 2 Site property is used as habitat by at least six threatened and endangered species, including the federally threatened bald eagle and state endangered snowy egret and little blue heron.

2.2 - Site History and Enforcement Activities

A brief description of the disposal, contaminant, and enforcement history for each site is discussed below. A number of initial response actions have been taken at three of the five sites (Sites O, Q, and R) that comprise the Sauget Area 2 Site. No action has been taken at Site P or Site S.

[7] A Ranney well collection system is a patented type of radial well used to extract water from an aquifer with direct connection to a surface water source like a river or lake.

Site O - In 1952, the Village of Sauget began operating a wastewater treatment plant in the area now referred to as Site O. In addition to providing treatment for the Village of Sauget, the plant treated effluent from a number of Sauget industries. In 1965, the four lagoons which comprise Site O were constructed at the Site. Between approximately 1966 and 1978, the lagoons were used to dispose of clarifier sludge from the Village of Sauget wastewater treatment plant (WWTP). The lagoons were initially identified as Site O during an investigation conducted by Illinois EPA in the 1980s (URS, 2002a). The area known as Site O North was identified during review of aerial photographs and was subsequently determined to be the location of pits associated with operation of the Village of Sauget WWTP. Based on the aerial photographs, Site O South appeared to be associated with a breach in the dike of the sludge lagoons.

In 1980, the Village of Sauget closed the four lagoons that comprise Site O by stabilizing the sludge with lime and covering it with approximately two feet of soil. The construction of the cover was not overseen or approved by either EPA or Illinois EPA. Currently, the former lagoons are vegetated with grass, brush, bushes, and trees.

Site P - Disposal Site P was operated by Sauget and Company from 1973 to approximately 1984. It was an Illinois EPA-permitted landfill and was used for municipal and industrial waste disposal. Some of the general industrial wastes accepted at Site P included diatomaceous-earth filter cake from the Edwin Cooper Company and non-chemical waste from Monsanto. Site P is currently inactive and for the most part covered, and access to the site is unrestricted. A nightclub and asphalt parking lot occupy three acres in the southeast corner of the Site.

Site Q - Between the 1950s and the 1970s, Site Q operated as a landfill that accepted municipal waste, septic tank pumpings, drums, organic and inorganic wastes, solvents, pesticides, paint sludge, plant trash, waste from industrial facilities, and demolition debris. Disposal at Site Q occurred both on the surface and subsurface. Due to its large size and varied disposal history, Site Q was divided into sections based on the nature and extent of contamination. Site Q sub-areas are described as follows and presented in Figure 1:

- Site Q North - The northern portion of Site Q. Additionally, the "Dogleg" area is part of Site Q North, which is the northern portion of Site Q North due east of Site R, bounded on the north and south by extensions of the Site R north and south boundaries.
- Site Q Central- The central portion of Site Q.
- Site Q South- The portion of Site Q South of the Alton & Southern Railroad. Additionally, the Q South Ponds are part of Site Q South.

In 1993, Site Q was flooded and River currents unearthed a number of barrels containing hazardous waste. EPA conducted a removal action along the shore of the Mississippi River at Site Q Central; removing polychlorinated biphenyls (PCB) contaminated soils and drums exposed by erosion during the flood. On October 18, 1999, EPA initiated a second removal action at Site Q South. EPA excavated Site waste from eight different areas on 25-acres of Site Q South. Approximately 17,032 tons of waste, comprised of about 20 percent low-level waste (soil concentrations less than 50 parts per million (ppm) of PCBs) and 80 percent high-level waste (soil concentrations greater than 50 ppm of PCBs) were shipped off-Site for disposal. In

addition, 3,271 drums were removed and disposed off-Site. This second removal action was completed on April 5, 2000.

Currently, usage at Site Q includes a roadway, Pitzman Avenue, and a supply terminal along part of Site Q North; a barge terminal facility and five ethanol storage tanks are located along Site Q North and Q Central; and predominantly vacant open land at Site Q South. Access to parts of Site Q North, Site Q North Dogleg, and Q Central are restricted by fences; and access to Site Q South is unrestricted.

Site R - Industrial Salvage and Disposal Inc. operated the River's Edge Landfill, now called Site R, for Monsanto from 1957 to 1977. Hazardous and non-hazardous bulk liquid and solid chemical wastes and drummed chemical wastes from Monsanto's W.G. Krummrich plant and, to a lesser degree its Queeny plant in St. Louis, were disposed of at the site. Disposal began in the northern portion of the site and expanded southward. Wastes contained toluene, xylenes, poly-aromatic hydrocarbons (PAHs), chlorobenzenes, chlorophenols, pentachlorophenol (PCP), chloroanilines, phenols, aromatic nitro compounds, aromatic amines, aromatic nitro amines, chlorinated aromatic hydrocarbons, aromatic and aliphatic carboxylic acids, and condensation products of these compounds.

Pursuant to a negotiated agreement with the State of Illinois, Monsanto installed a clay cap on Site R in 1979 to cover the waste, limit surface water infiltration through the landfill, and prevent direct contact with the landfill material. The cap thickness ranges from 2 feet to approximately 8 feet. In 1985, Monsanto installed a 2,250 foot long rock revetment along the east bank of the Mississippi River downgradient of Site R. The purpose of the stabilization project was to prevent further erosion of the riverbank and thereby minimize potential for the release of waste material from the landfill. During a flood in 1993, Site R was flooded but the clay cap was not overtopped. No erosion of the Site R riverbank or cap resulted from this flood.

In 2000, EPA entered into an Administrative Order on Consent (AOC) with the PRPs to conduct a remedial investigation/feasibility study (RI/FS) at the five waste disposal Sites (O,P,Q,R, and S) to investigate and assess what clean-up remained to be done for the Site after the above referenced actions were completed. Under the AOC, the PRPs conducted RI activities from June 2002 through October 2002, with EPA and Illinois EPA oversight. A draft RI/FS report was submitted by the PRPs to EPA in 2004. Based upon its review of the draft RI/FS report, EPA determined that supplemental investigation (SI) work was necessary to fill data gaps. The supplemental investigation work consisted of the following: completion of supplemental field investigations; installation of monitoring well clusters; investigation of non-aqueous phase liquids (NAPL[8]), vapor intrusion[9], and principal threat wastes; and completion of a regional fate

[8] NAPLs are "non-aqueous phase liquids" that do not mix readily with water and therefore flow separately from ground water, acting as a continual source of groundwater contamination until they are removed or dissipate. Many contaminants, including chlorinated solvents and petroleum products, enter the subsurface in the form of an oily liquid, known as a NAPL.

[9] Certain hazardous chemicals that are released into the subsurface as liquids or solids may form hazardous gases (i.e., vapors) that migrate through the vadose zone and eventually enter buildings as a gas by migrating through cracks and gaps in basement floors and walls or foundations, including perforations due to utility conduits and any other openings (e.g., sump pits). Vapor intrusion is the general term given to migration of hazardous vapors from any subsurface contaminant source, such as contaminated soil or groundwater, through the vadose zone and into indoor air.

and transport groundwater model to fill data gaps in the RI/FS. During the RI and SI from 2002 through 2007, the PRPs conducted extensive Site investigations of the disposal areas, groundwater, surface water, air, waste, and soil. EPA evaluated results of these investigation studies in the Final FS Report for Sauget Area 2 (May 2013).

Additionally, during this time period, EPA determined that an interim response action was necessary to address on-going releases into the Mississippi River. In September 2002, EPA signed the ROD for the groundwater operable unit (OU2) of the Sauget Area 2 Superfund Site, which selected an interim groundwater remedy for the Sauget Area 2 Site to address the release of contaminated groundwater into the Mississippi River. Subsequently, in October 2002, EPA issued a UAO to the Sauget Area 2 Site PRPs for Remedial Design and Interim Remedial Action associated with the Sauget Area 2 interim groundwater remedy. The two main components of the remedial action called for in the Sauget Area 2 OU2 interim ROD were the construction of the barrier wall and the installation of three groundwater recovery wells. The wall, together with the extraction wells, is referred to as the Groundwater Migration Control System, or GMCS. Although the three extraction wells are intended to be the principal groundwater control measure, the barrier wall serves to reduce the volume of groundwater flowing into the extraction system from the Mississippi River during operation of the extraction wells, thereby reducing operation and maintenance (O&M) costs by reducing the volume of water treated. The PRPs began construction of the interim remedy in 2003 and completed construction in 2005, at the cost of approximately $27,000,000. Annual operation and maintenance costs for the GMCS are estimated to be $2,000,000 per year.

The Sauget Area 2 GMCS was designed to abate adverse impacts on the Mississippi River resulting from the discharge of groundwater from Sauget Area 2 Sites O, Q North, R, and S; the former Clayton Chemical facility site; Sauget Area 1 Sites G, H, I South, and L; the southern portion of the W.G. Krummrich Facility (which is also being addressed under RCRA Corrective Action); and other industries in the Sauget area.

The major components of the OU2 interim groundwater remedy include the following, subject to several EPA-approved changes to optimize the construction and operation of the barrier wall and pumping system:

- Physical Barrier - A 3,500 foot long, "U"-shaped, fully penetrating, bentonite slurry[10] barrier wall installed between the downgradient boundary of Sauget Area 2 Site R and the Mississippi River to abate the release of impacted groundwater. The barrier wall was installed to the top of the bedrock surface (approximately 120 to 140 feet deep). The purpose of the barrier wall is to minimize the volume of groundwater that needs to be extracted;

- Groundwater Extraction - Three partially penetrating groundwater recovery wells inside the "U"-shaped barrier wall to abate groundwater moving to the wall;

[10] In July 2003, EPA signed an Explanation of Significant Differences (ESD) to modify the OU2 interim remedy. The ESD documented that a conventional soil-bentonite slurry barrier wall would be constructed instead of a jet grouted barrier wall. This change did not affect the overall scope of the interim remedy.

- Groundwater Treatment - Once extracted, the contaminated groundwater is treated at the American Bottoms Regional Water Treatment Facility (ABRTF) prior to being discharged to the Mississippi River. ABRTF provides primary treatment as well as secondary biological treatment enhanced by powdered activated carbon;

- Groundwater Quality Monitoring - Groundwater samples from wells located between the barrier wall and the River are collected periodically. Concentrations of key compounds are plotted over time to determine and track long-term trends;

- Groundwater Level Monitoring - Groundwater level monitoring is performed to ensure acceptable performance of the physical barrier;

- Surface Water Monitoring - Surface water samples are collected in the plume release area to determine the effect of any contaminants migrating through, past, or beneath the barrier wall and being released to the Mississippi River; and

- Institutional Controls - Institutional controls are used to limit access to Site R and Mississippi Riverby existing fencing at Site R, a very steep riverbank, and the absence of public roads leading to this area.

The GMCS intercepts and captures an estimated 210 million gallons of contaminated groundwater a year, which is pumped to the ABRTF in Sauget, Illinois. The groundwater is treated at the ABRTF and ultimately discharged to the Mississippi River in compliance with the terms and conditions of the ABRTF's National Pollutant Discharge Elimination System (NPDES) permit issued under the Clean Water Act. Sampling has indicated that the implemented interim groundwater remedy has addressed on-going ecological risk to the Mississippi River.

Currently, access to Site R is restricted by a perimeter fence surrounding the site and monitored by the PRPs (URS, April 2002b).

Site S - In the mid-1960s, wastes from the former Clayton Chemical property were disposed of in a shallow, on-site excavation which is now designated as disposal Site S. The wastes were from the solvent recovery process at Clayton which involved steam-stripping. Still bottoms from the stripping process were disposed of at the site.

Currently, the northern portion of Site S is covered with grass and the remainder of the site is covered with crushed rock and the site is fenced.

Former Clayton Chemical Site - The former Clayton site, referred to as the "RRG/CCC Site" is located at 1 Mobile Avenue, Sauget, Illinois. The RRG/CCC Site is approximately 7 acres in size and is situated due east of Sauget Area 2 Site R and the northern portion of Sauget Area 2 Site Q. The site is located within, but is not a formally designated Sauget Area 2 Site. In its early history, the site served as a railroad roundhouse and starting in the 1960s until 1998, a solvent and waste oil recovery facility.

In June 2001, EPA conducted a site assessment at the RRG/CCC Site. The site assessment indicated soil contamination (including elevated concentrations of solvents, heavy metals,

ignitable compounds, and PCBs) from the release of hazardous substances into the environment. In addition, containers remaining at the RRG/CCC Site were found to contain hazardous substances. Based on the porous, sandy nature of the soil at the site, EPA concluded that hazardous substances could migrate into the groundwater. In October 2002, EPA and a number of the PRPs for the RRG/CCC Site entered into an AOC which required the signatories to the AOC to conduct a time critical removal action. The action involved the removal of all liquid hazardous substances contained in drums, tanks, containers, and other vessels at the RRG/CCC Site. The RRG/CCC Site AOC signatories performed this removal action between 2002 and 2004. In October 2005, EPA and numerous RRG/CCC Site PRPs entered into another AOC requiring the signatories to characterize, remove, and properly dispose of hazardous substances (solids and contaminated soils) located at the RRG/CCC Site. Additional PRPs were added in an amendment to this AOC in January 2006. Soil capping and operation and maintenance plan requirements were added in an AOC amendment in January 2008. On December 22, 2006, EPA issued General Notice of Potential Liability Letters for the Sauget Area 2 Sites to RRG/CCC Site PRPs based upon the downgradient migration of contaminated groundwater from the RRG/CCC Site into the Sauget Area 2 Sites. In March 2008, EPA issued a UAO to certain RRC/CCC Site PRPs requiring the UAO recipients to construct a cap over hazardous substances in soils remaining on the RRG/CCC Site. The construction of the cap has been completed.

2.3 – Community Participation

In June 2013, EPA made available to the public the RI and FS Reports and the Proposed Plan for the Sauget Area 2 Site. These documents can be found in the Administrative Record for the Site. The Administrative Record is maintained at two public repositories: the EPA Region 5 Docket Room, 77 West Jackson Boulevard (7th Floor) Chicago, Illinois, and the Cahokia Public Library, 140 Cahokia Drive, Cahokia, Illinois. The Proposed Plan set forth the remedial alternatives for the Site and EPA's proposed remedial action for OU1. After issuing the Proposed Plan, EPA held a public comment period between June 7 and July 8, 2013. When the Proposed Plan was issued, EPA mailed a fact sheet to area residents informing them about the Proposed Plan. The fact sheet advised residents that the RI and FS Reports and Proposed Plan were available for viewing at the public repositories. The fact sheet included the date, time, and location of the public meeting. At the public meeting on June 12, 2013, EPA and Illinois EPA representatives answered questions about the Site and the remedial alternatives. EPA's responses to the comments received during the public comment period are included in the *Responsiveness Summary*, which is Part 3 of this Record of Decision.

2.4 - Scope and Role of Operable Unit or Response Action

As with many Superfund sites the problems at the Sauget Area 2 Site are complex. The Sauget Area 2 Site consists of 4.5 million cubic yards of contaminated soil and wastes located near the Mississippi River, where the water table across the Site is approximately 10 feet below ground surface (bgs). Therefore, most of the waste from the various sites in Area 2 is located under the area groundwater table, and the rising and falling River levels cause the water table to fluctuate, creating a flushing effect in the waste areas.

Also potentially effecting Site conditions is the U. S. Army Corps of Engineers (USACE) proposal to install relief wells from levee stations 1113+00 to 1116+00 and 1133+00 to 1135+00 within the Metro East Sanitary District levee system as part of its Illinois Flood Protection Project. Relief wells are groundwater wells, which are used for flood control. Relief wells are installed adjacent to earthen levees to relieve the pressure on the river side of the levee and thus to prevent the collapse of the levee during flooding. The greater flow of water in the river during a flood creates a pressure gradient such that more water infiltrates the soil of the levee. Water may then flow through the soil towards the dry side of the levee, resulting in liquefaction of the soil, and ultimately destruction of the levee. Relief wells act like valves to relieve the water pressure and allow excess water to be diverted safely.

The USACE's project area includes areas where groundwater contamination from historical industrial activities is present, including the Sauget Area 2 Site. The Illinois Flood Protection Project is necessary to protect the people living in the surrounding area during a significant flooding event. EPA is working with the U.S. Army Corps of Engineers on this project and has provided them with information about the Site and with groundwater data for the region so that this information known as the relief well project is planned and implemented in areas containing contaminated groundwater.

In order to address this complex Site, EPA has organized the work into two operable units (OUs):

- Operable Unit 1: Contamination of the on-Site soils, sediments, surface water, and groundwater source areas
- Operable Unit 2: Contamination of the groundwater aquifer

The Selected Remedy, referred to as remedial action for OU1, will be the first of two remedial decisions for the Sauget Area 2 Site. EPA's overall strategy for cleaning up the Site is to first address soil, sediment, surface water, and groundwater source contamination through this remedial action for OU1, which will be the final remedy for these media at the Site. Area-wide groundwater contamination resulting from the contaminated soil, sediments, surface water, and groundwater contamination source areas present in the Sauget Area 1 and 2 Sites will be addressed as a separate remedial action. That remedial action will be selected in a separate and subsequent ROD for groundwater contamination in Sauget Areas 1 and 2, after the remedies set forth in the source area RODs for Areas 1 and 2 are implemented.

2.5 – Site Characteristics

2.5.1 - Conceptual Site Model

To guide identification of appropriate exposure pathways and receptors for evaluation in the risk assessment, a conceptual site model (CSM) for human health was developed. The purpose of the conceptual site model is to provide a framework with which to identify source areas, potential migration pathways of constituents from source areas to environmental media where exposure can occur, and to identify potential human receptors.

A general identification of exposure pathways, exposure routes, and receptors is illustrated in the conceptual site model in Figure 2. A more detailed discussion of the receptor/area matrix for the Sites (O, O North, O South, P, Q North, Q Central, Q South, R, and S) and the Mississippi River is provided below.

Sites

The Sauget Area 2 Sites (O, O North, O South, P, Q North, Q Central, Q South, R, and S) have been used for industrial purposes for many years (since the 1930s or earlier). The sites are zoned commercial/industrial and it is likely that the sites will continue to be used well into the reasonably foreseeable future for commercial/industrial purposes. Therefore, the sites were evaluated for non-residential use scenarios in the Site-wide human health risk assessment (HHRA) (AECOM, 2009).

Receptors were identified for the sites based on the CSM and the constituents of potential concern (COPCs) identified in media in the sites. COPCs are a subset of the complete list of constituents detected in site media that are carried through the quantitative risk assessment process. COPCs were identified in groundwater in Sites O, Q Central, Q South, R, and S; in leachate in Sites O North, Q North, and R; and in soils in all sites, except for surface soil in Site O South and Site R. COPCs were identified in surface water, sediment, and fish fillets in the Site Q South Ponds.

Due to the presence of volatiles in the subsurface of the sites, an on-Site indoor industrial worker scenario was evaluated in the Vapor Intrusion HHRA (ENSR, 2008) for potential exposure to COPCs via inhalation of volatile constituents present in indoor air due to vapor intrusion from the subsurface. Buildings found with potentially complete vapor intrusion pathways, were sampled during the vapor intrusion investigation. These buildings included four buildings located on Site Q North, five buildings located on Site Q Central, one building located on Site P, one building located off-Site but near Site O, and one building located off-Site but near Site S. No buildings with potentially complete vapor intrusion pathways were identified in Site O North, O South, Q South, or R. An on-Site outdoor industrial worker scenario was evaluated for potential exposure to COPCs in surface soil via incidental ingestion and dermal contact, and via inhalation of non-volatile COPCs that may be suspended as dusts from surface soils. Additionally, these receptors were re-evaluated for potential exposure to COPCs that may volatilize into outdoor air from underlying groundwater and from soils (combined surface soil, subsurface soil, and waste).

An on-Site construction/utility worker scenario was evaluated for potential exposure to COPCs in combined soils via incidental ingestion and dermal contact, and via inhalation of particulates suspended during excavation activity as well as volatile emissions. Construction/utility work was assumed to occur up to depths of 15 feet below ground surface (bgs). Due to the shallow depth of groundwater in limited areas, the construction/utility worker may contact groundwater during excavation. Therefore, the construction worker was assumed to be exposed to COPCs in shallow groundwater via incidental ingestion and dermal contact, and via inhalation of COPCs volatilized from standing water in an excavation trench. COPCs in shallow groundwater and leachate were identified in Sites O, O North, Q Central, Q North, Q South, R, and S.

A trespassing teenager scenario was evaluated for potential exposure to COPCs in surface soil via incidental ingestion and dermal contact; via inhalation of non-volatile COPCs that may be suspended as dusts from surface soils; COPCs that may volatilize into outdoor air from underlying groundwater and from soils (combined surface soil, subsurface soil, and waste); and to COPCs in surface water and sediment from the Site Q South Ponds.

Additionally, the recreational angler scenario was evaluated for potential exposure to COPCs in fish fillet from the Site Q South Ponds.

Mississippi River
Recreational angler and trespassing teenager scenarios were evaluated for potential exposure to COPCs in sediment and surface water in the Mississippi River. In addition, the recreational angler was evaluated for potential exposure to fish fillet from the Mississippi River. Both receptors were evaluated for potential exposure to seeps into the Mississippi River in Sites Q and R.

2.5.2 - Overview of Site

The Sauget Area 2 Site covers approximately 312 acres situated in a floodplain of the Mississippi River called the American Bottoms. Topographically, the area consists primarily of flat bottomland. The Site is adjacent, or in close proximity, to the Mississippi River. Two of the Sites, Sites Q and R, are located on the wet-side of the floodwall and levee, which is operated and maintained by the USACE and the Metro East Sanitary District. The floodwall is designed to protect the City of East St. Louis and the Villages of Sauget and Cahokia from flooding from the Mississippi River. Sites O, P, and S are located on the dry-side of the floodwall and levee.

Collectively, Sites O (including Site O North and O South), P, Q (including Q North, Q Central, Q South), R, and S contain an estimated 4.5 million cubic yards of soil and waste. Site Q is the largest disposal area with an estimated waste volume of 2.6 million cubic yards, followed by Site P with 1 million cubic yards, Site R with 594,000 cubic yards, Site O with 272,000 cubic yards, and Site S with 8,000 cubic yards. All of these sites were formerly used for industrial/municipal waste disposal.

2.5.3 - Geologic and Hydrogeologic Setting

The Sauget Area 2 Site is situated in the American Bottoms floodplain of the Mississippi River. More specifically, it is situated south of East St. Louis along the eastern bank of the Mississippi River. In total, the American Bottoms floodplain encompasses 175 square miles, is 30 miles long, and has a maximum width of 11 miles. It is bordered on the west by the Mississippi River and on the east by bluffs that rise 150 to 200 feet above the valley bottom. The floodplain is relatively flat and generally slopes from north to south and from east to west. Land surface lies between 400 and 445 feet above mean sea level (msl).

The stratigraphy beneath the Sauget Area 2 Site is much like that of the rest of the floodplain. The Cahokia Alluvium is approximately 40 to 50 feet thick and exists as a fine, silty sand that is

gray and brown in color. Below this, the unconsolidated deposits of the Henry Formation are present.

Locally, the Henry Formation is characterized by medium-to-coarse sand that becomes coarser and more permeable with depth. The depth to bedrock (below ground surface) ranges from 140 feet near the River and Sauget Area 2 Sites to about 100 feet on the east side of the Sauget Area 1 Site. The groundwater level is currently between 20 to 40 feet below ground surface, but fluctuates considerably throughout the year. Figure 3 presents a generalized geologic cross-section.

Three distinct hydrogeologic units are present in the Sauget Area 2 and Area 1 Sites: 1) a shallow hydrogeologic unit (SHU); 2) a middle hydrogeologic unit (MHU), and 3) a deep hydrogeologic unit (DHU). The 30 foot thick SHU includes the Cahokia Alluvium and the uppermost portion of the Henry Formation. This unit is primarily unconsolidated, fine-grained silty sand with low to moderate permeability. The 40 foot thick MHU is formed by the upper to middle, medium to coarse sand portions of the Henry Formation. It contains higher permeability sand than found in the overlying shallow hydrogeologic unit, and these sands become coarser with depth. At the bottom of the aquifer is the DHU, which includes the high permeability, coarse-grained deposits of the lower Henry Formation. This zone is estimated to be about 30 to 40 feet thick. Groundwater flow velocity is on the order of 0.02 feet per day (7 feet per year) in the SHU, 4 feet per day (1,500 feet per year) in the MHU, and 6 feet per day (2,200 feet per year) in the DHU. Groundwater beneath Sauget Area 2 generally flows from east to west, toward the Mississippi River.

During low River stage conditions, groundwater at Sauget Area 2 flows from east to west and releases to the Mississippi River, the natural point of release for groundwater in the American Bottoms aquifer. When flood stage occurs in the Mississippi River, flow reverses. Under these conditions, groundwater flows from west to east.

2.5.4 - Sampling Strategy

On November 20, 2000, the PRPs signed an AOC with EPA to perform a remedial investigation/feasibility study at five discrete waste disposal sites (Sites, O, P, Q, R, and S) on the Sauget Area 2 site. The PRPs submitted the draft RI/FS report to EPA in January 2004. Upon review of the RI/FS report, EPA determined there were data gaps in the RI/FS report and supplemental investigations (SIs) were required in order to fill identified data gaps.

The following summarizes the RI and Supplemental Investigations. SIs are included in the RI and FS Reports.

Remedial Investigations

Initial sampling and remedial investigation work, undertaken by the PRPs in 2002-2003 under the November 20, 2000 RI/FS Order, with EPA oversight, is presented below:

Disposal Area Characterization Sampling - Surface soil and subsurface soil/waste samples were collected from borings taken at each of the disposal areas (Sites O, P, Q, R, and S) in order

to characterize the depth and types of wastes present at each site and to evaluate potential exposures for the human health risk assessment including the outdoor industrial worker and construction/utility worker exposure scenarios. Additional activities included determination of disposal area boundaries using historical air photo analysis, soil gas surveys, and test trenching and identification of buried tanks and/or drums using magnetometer surveys and test trenches. Ambient air sampling was conducted upwind and downwind of the sites to determine the tendency of Site constituents to enter the atmosphere and local wind patterns. Air sampling data were subsequently evaluated in the HHRA outdoor industrial worker, construction/utility worker and trespassing teenager exposure scenarios.

Additionally, leachate wells were installed at the waste boring location within each site (three were installed at Site Q), which had the greatest indications of potential impact or the greatest depth of waste materials. Leachate samples were collected during the RI in order to assess the impact of contaminated soils and waste to groundwater.

In the original Sauget Area 2 (SA2) RI/FS document which was submitted in January 2004, the HHRA and the Baseline Ecological Risk Assessment (BERA) indicated that the ponds located in Site Q South represented a significantly different exposure potential than the surrounding non-pond area of Q South. As a result, the ponds were treated as a separate area, identified as Q South Ponds.

Groundwater Sampling - Groundwater samples were collected to define the horizontal and vertical distribution of constituents in the alluvial aquifer beneath the sites and provide information for two HHRA exposure scenarios; volatilization from groundwater to outdoor air for the outdoor industrial worker and construction/utility worker, and vapor intrusion into buildings for the indoor industrial worker. In addition, groundwater samples were collected from weathered bedrock beneath the sites to determine the vertical extent of migration from these source areas.

Groundwater flow direction was determined by installing water-level measurement piezometers in each of the three hydrogeologic units present in Sauget Area 2 and measuring groundwater-level elevations. Aquifer hydraulic conductivity was measured by conducting slug tests in piezometers completed in each of the hydrogeologic units. Aquifer grain size analyses were also performed on soil samples collected from each hydrogeologic unit.

Surface Water, Sediment, and Biota Sampling - Surface water, sediment, and biota samples were collected from the Mississippi River and the two ponds located on Site Q South to determine the extent of downstream migration of Site-related constituents and provide information for use in the HHRA (trespassing teenager and trespassing angler exposure scenarios) and the ecological risk assessment (potential ecological receptor exposures).

Additionally, in order to assess the presence of seeps and their impacts on the Mississippi River, seep grab samples were collected from one location at Site R and two locations at Site Q. A visual reconnaissance survey was conducted along the riverbank adjacent to both Sites Q and R, to identify potential sample locations. Stormwater run-off samples were also collected from two

downgradient locations at Site Q and one location at Site R to characterize run-off from the site during storm events.

Supplemental Investigations

After completion of the RI, SI field activities were performed during 2005 and 2006 through a phased approach (Phase 1, 2, and 3). Phase 1 was conducted to fill identified data gaps in the RI. Phase 2 was conducted to fill remaining data gaps associated with the groundwater impact observed at the sites. And Phase 3 consisted of a NAPL investigation to identify the nature and extent of both residual NAPL remaining in the interstitial spaces of the soil and pooled NAPL sitting on the groundwater and bedrock surfaces. In addition, a vapor intrusion investigation was completed in 2007 of occupied buildings within or near the boundaries of the sites in order to evaluate vapor intrusion as part of the HHRA.

The PRPs, with EPA oversight, performed an erosion and release aerial photo analysis in order to determine: (1) the potential for future erosion and release at Sites Q and R resulting from a flood event; (2) anomaly trenching to investigate the potential presence of buried drums or tanks based on the magnetic anomalies, and (3) soil gas concentration highs identified during the magnetometer and soil gas investigations conducted as part of the RI.

A regional survey of NAPL and potential NAPL was completed during groundwater sampling activities. Based on the NAPL survey and previous investigation results, additional NAPL investigations were conducted at Sites P and Q North. These investigations included collection of NAPL samples from the leachate well (LEACH P-1) located on Site P and advancement of soil borings and installation of monitoring wells around the regional groundwater monitoring well (Sonic-5) located on Site Q North. Soil borings and monitoring wells were not advanced or installed adjacent to LEACH P-1 because other sampling locations have provided a maximum lateral extent of NAPL observed.

Groundwater Investigations

During Phase 1 of the Sauget Area 2 SI, groundwater samples were collected from monitoring wells throughout the region. This included monitoring wells at Sauget Area 2 sites, Sauget Area 1 sites, the W.G. Krummrich facility, and the Conoco Phillips bulk storage terminal. In addition, groundwater samples were collected from 26 groundwater monitoring wells installed during Phase 2 of the Sauget Area 2 SI. Groundwater quality data from these 2005/2006 sampling programs were used for calibration of the Regional Groundwater Fate and Transport Model (GSI, 2008b).

The Regional Groundwater Fate and Transport Model was developed during the RI and SI and covers the southern portion of the American Bottoms aquifer. The fate and transport model was used to simulate the movement of groundwater plumes from the sources zones in order to characterize and define the nature and extent of groundwater contamination from the Sauget Area 1 and 2 Sites. At the request of EPA and Illinois EPA, the PRPs re-ran the model in 2012 to account for new information on pumping rates and duration of operation of the Illinois

Department of Transportation highway dewatering wells (GSI, 2012). If necessary, the model can be updated to account for changes in Site conditions, as was done in 2012.

Additionally, groundwater samples were collected from the leachate wells to determine if leaching from the disposal areas to groundwater was a migration pathway.

Vapor Investigation

The PRPs, with EPA oversight, conducted a vapor intrusion investigation and evaluation as part of the baseline HHRA for the sites. The purpose of the vapor intrusion evaluation was to determine whether volatiles and semi-volatiles (VOCs and SVOCs) detected in the subsurface air within the Sauget Area 2 Sites have potential inhalation risk associated with the vapor intrusion pathway. Only buildings with a potentially complete vapor intrusion pathway were evaluated (i.e., enclosed structures, not trailers).

Soil gas samples were collected and evaluated from 13 buildings on the Site. These buildings included four buildings located on Site Q North, five buildings located on Site Q Central, one building located on Site P, one building located off-Site but near Site O, and one building located off-Site but near Site S. No buildings with potentially complete vapor intrusion pathways were identified in Site O North, O South, Q South, or R. Therefore, no vapor intrusion sampling was conducted on these Sites. Vapor intrusion sampling was conducted in the buildings located in or near Sites O, Q North, Q Central, P and S which had potentially complete vapor intrusion pathways.

Flood Study

In 2011, at the request of EPA and Illinois EPA, the PRPs completed a flood study of Sauget Area 2 Sites R and Q (*Quantitative Analysis of Flood Velocities for Superfund Sites R and Q during the 100-Year Flooding Event*, CDG Engineers, April 2011). The study evaluated the effects of a 100-year flooding event at the Site, specifically at Sites Q and R, which are the only sites that border the Mississippi River. The 100-year flooding event was also analyzed to determine the potential for erosion.

The study concluded that during a 100-year flood event, maximum velocities calculated did not exceed 2 feet per second during the flooding event. Areas of potential concern during the 100-year flooding event include the fringes of a small sand stockpile in Site Q Central and the alluvial silts in the ephemeral ponds in Site Q South. Concerning the potential for erosion, the central portion of Site Q (Q Central) is shown to be stable due to the presence of the compacted crushed limestone covering most of this portion of Site Q. The majority of Site R was above the water surface profile for the 100-year flooding event.

2.5.5 - Sources of Contamination

The contaminant source areas at the Sauget Area 2 Site are the disposal areas at Sites O, O North, O South, P, Q North, Q Central, Q South, R, and S. These disposal areas contain

municipal and industrial waste materials, including crushed or partially crushed drums, drum fragments, construction debris, and miscellaneous trash.

Based on the nature and extent of source areas at the Sauget Area 2 Site, the following were identified as potential routes of contaminant migration:

- Leaching of source materials to groundwater;
- Groundwater flow and discharge to the Mississippi River and GMCS;
- Volatilization of source materials to ambient air and to indoor air where buildings are present; and
- Erosion and release of source materials

Leaching to Groundwater

The potential for the source material at the various sites to leach to the groundwater has been based upon the leachability of the source material, the age and relative amount of leaching that has already occurred, and the surface cover. The source material observed in the Sauget Area 2 Sites generally consists of constituents that are relatively leachable. However, due to the age of waste material and the presence of clay layers, and based on the observed analytical concentrations in the soil, waste, and upper groundwater samples, wastes present at Sites O, P, Q Central, Q South, and S are contributing a minor degree of constituent migration from the sites into the underlying aquifer. There is most likely constituent migration from Sites Q North and R into the underlying aquifer; however, groundwater from Sites Q North and R is captured by the GMCS.

Groundwater Flow

The groundwater flow to the Mississippi River and to the GMCS has been extensively studied and modeled. In addition, the effectiveness of the GMCS has been monitored on a semi-annual basis since the remedy was installed. The surface water samples collected during the semi-annual sampling events that have been conducted since the GMCS became operational indicate reduced concentrations of the five indicator constituents in surface water when compared to 2002 data. This trend indicates the barrier wall is capturing 98 percent of mass flux from impacted groundwater from the Sauget Area 2 Sites and 94 percent of the total plume mass flux from Sauget Area 1, Sauget Area 2, Clayton Chemical, and the W. G. Krummrich facility which would have migrated into the Mississippi River without the GMCS.

Volatilization

Volatile constituents present in the subsurface of the sites may potentially volatilize to ambient air or, where buildings are present, to the indoor air of overlying buildings (i.e., vapor intrusion). The potential for constituents to volatilize from soil or groundwater to ambient air is dependent on soil characteristics (i.e., soil type, fraction of organic carbon), the depth of the constituents, and the presence of low permeability caps, which would limit volatilization. The potential for constituents to volatilize to indoor air is dependent on soil type as well as the characteristics of the building in question (i.e., size, air exchange rate). Under the current exposure scenario, vapor intrusion is a potentially complete pathway only where buildings are present. No buildings with potentially complete vapor intrusion pathways were identified in Site O North, O South, Q South, or R.

Erosion

Significant erosion will only result from flooding by the Mississippi River. Sites O, P, and S are protected by the Mississippi River levee system and no indications of erosion and release events due to flooding of the Mississippi River were observed on historic aerial photographs of Sites O, P, and S. Sites Q and R are located within the Mississippi River floodway. Portions of Site Q and R have been flooded on multiple occasions. In 2011, at the request of EPA and Illinois EPA, the PRPs completed a flood study of Sauget Area 2 Sites R and Q (*Quantitative Analysis of Flood Velocities for Superfund Sites R and Q during the 100-Year Flooding Event*, CDG Engineers, April 2011). The study conclusions are discussed above in the Section 2.5.4.

2.5.6 - Types of Contaminants and Affected Media

Various investigations have been conducted to determine the nature and extent of contamination present in various media including surface soil, subsurface soil/waste, groundwater, surface water/sediment, leachate, and air at the Sites. Nature and extent of contamination for soils and waste at the Sauget Area 2 Sites are defined based on: 1.) five indicator constituents (benzene, chlorobenzene, 1,4-dichlorobenzene, 2,4-dichlorophenol, and p-chloroaniline); 2.) constituents with concentrations greater than Illinois EPA's Tiered Approach to Corrective Action Objectives (TACO) Class I Groundwater Standards in the uppermost groundwater; and 3.) constituents with concentrations greater than 100 times Illinois EPA's TACO Class I Protection of Groundwater Soil Remediation Objectives (SROs). Indicators of potential impacts to groundwater were defined as the presence of constituents in soil at concentrations greater than 100 times Illinois TACO concentrations. The five indicator constituents were chosen because they were the most widely distributed constituents with the highest concentrations in the groundwater.

In addition to the five indicator constituents, PCBs and dioxins were also sampled for during the RI. PCB and dioxin sample results are summarized below in Tables 2 and 3, respectively.

Table 2: Minimum and Maximum PCB Concentrations in Surface and Subsurface Soil and Wastes

Site	Surface Soil (ppm)		Subsurface (ppm)	
	Min	Max	Min	Max
O	0	300	0	990
P	0	2.2	0	9.6
Q North	0	0.92	0	90
Q Central	0	0.53	0	1.7
Q South	0	5.6	0	10
R	0	0	0	130
S	0	370	0	20

Table 3: Minimum and Maximum Dioxin Concentrations in Surface and Subsurface Soil and Wastes				
Site	Surface Soil (ppb)		Subsurface (ppb)	
	Min	Max	Min	Max
O	0.16	1.9	1.9	10
P	0	0	1.5	68
Q North	0.33	0.33	1.4	1.4
Q Central	0.48	0.48	1.0	1.0
Q South	0.35	1.4	1.1	1.8
R	--	--	2.8	330
S	0.15	0.15	0.7	20

The detection of indicator constituents for Sites O, P, Q, R, and S are summarized below in Tables 4 through 16.

2.5.7 - Extent of Contamination

The following summarizes the extent of remaining contamination at the Site:

Disposal Area Waste Characterization

Disposal area waste characterization investigations completed during the RI included soil gas and magnetometer surveys, installation of test trenches and borings, and waste characterization samples. Waste materials encountered at Sites O, P, Q, R, and S consisted of municipal and industrial waste materials, construction debris, and miscellaneous trash. All four boundaries of Sites O, P, Q, R, and S identified by aerial photo analysis were confirmed by soil gas surveys (VOCs detected inside the boundaries but not outside) and by boundary trenching.

Soil and waste characterization results for each of the sites are summarized below:

Site O

Surface Soil - Benzene, chlorobenzene, ethylbenzene, and pentachlorophenol were found in samples at levels that exceeded 100 times the TACO SROs, which is summarized in Table 4 below. At Site O North, benzene, chlorobenzene, 2,4,6-trichlorophenol, tetrachloroethene, and pentachlorophenol were found in samples that exceeded 100 times the TACO SROs. At Site O South, the only constituent that exceeded 100 times the TACO SRO was pentachlorophenol and only at one location.

Table 4- Site O: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Indicator Constituents	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	7	11	1.1	1,100	243	30	3,000
Chlorobenzene	µg/kg	4	11	4.7	14,000	4,956	1,000	100,000
1,4-Dichlorobenzene	µg/kg	3	11	46	630	265	2000	200,000
2,4-Dichlorophenol	µg/kg	3	11	35	940	385	1,000	100,000
P-Chloroaniline	µg/kg	1	11	77	77	77	700	70,000
2,4,6-Trichlorophenol	µg/kg	2	11	160	1,300	730	200	20,000
Ethylbenzene	µg/kg	7	11	0.38	4,400	815	13,000	1,300,000
Pentachlorophenol	µg/kg	11	11	13	480,000	46,424	30	3,000
Tetrachloroethene	µg/kg	4	11	1	290	116	60	6,000

Subsurface Soil and Waste – Constituents that exceeded TACO SROs and 100 times the TACO SROs at Site O in subsurface soil and wastes are summarized in Table 5 below. The estimated volume of waste and soil that exceeded the TACO SROs at Sites O, O North, and O South was calculated to be approximately 50,000 cubic yards[11].

Table 5- Site O: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	13	16	1.5	500,000	58,481	30	3,000
Chlorobenzene	µg/kg	13	16	65	760,000	218,520	1,000	100,000
1,4-	µg/kg	9	15	1,800	180,000	58,433	2000	200,000

[11] The estimated volume of waste and soil that exceeded the TACO SROs is calculated based on average depth of fill material and surface area exceeding TACO SROs.

Table 5- Site O: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Dichlorobenzene								
2,4-Dichlorophenol	µg/kg	5	15	4,400	33,000	16,280	1,000	100,000
P-Chloroaniline	µg/kg	4	15	63	5,800	1,862	700	70,000
2,4,6-Trichlorophenol	µg/kg	8	15	1,100	61,000	14,338	200	20,000
Ethylbenzene	µg/kg	14	16	1.1	2,800,000	375,555	13,000	1,300,000
Pentachlorophenol	µg/kg	7	16	2,900	7,900,000	1,941,843	30	3,000
Tetrachloroethene	µg/kg	3	16	2,400	6,800	4,067	60	6,000

Leaching to Groundwater- At Sites O, O North, and O South, the analytical results indicate minimal leaching is occurring to the shallow hydraulic unit (SHU) from the waste due to the following:

- The surface of Site O consisted of an approximately 3.5 foot thick clay cover. Additionally, clay layer beneath the site, with a minimum thickness of one foot is present underlying most of the observed waste or shallow subsurface material at Sites O, O North, and O South. The clay cover and the clay layer under the waste act as a deterrent to leaching.
- Concentrations of uppermost groundwater from potential source areas and immediately downgradient of Sites O, O North, and O South were not indicative of a significant source.
- Shallow groundwater concentrations are two to three orders of magnitude lower than leachate concentrations.

The amount of migration into the groundwater system from Site O is minimal. In addition, the regional groundwater flow and transport model indicate that the plumes in the MHU and DHU under Site O are captured by the GMCS.

Vapor - No buildings with potentially complete vapor intrusion pathways were identified on Site O. No occupied or nearby buildings were present at Site O North; therefore, the vapor intrusion pathway was incomplete at Site O North.

Erosion- Site O is located on the east side (dry side) of the levee. Therefore, the potential for Site O to be affected by a flood event that could result in the erosion and release of the source material is controlled.

Principal Threat Wastes- No NAPL or buried drums were observed at Site O, O North, or O South, as documented in the Principal Threat Wastes Technical Memorandum (URS, 2008b).

Site P

Surface Soil - Surface soil exceedances of the TACO SROs were found only at one sample location, in which P-chloroaniline exceeded the TACO SRO and tetrachloroethene exceeded 100 times the TACO SRO, as summarized in Table 6.

Table 6- Site P: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	5	10	0.92	9.4	4.7	30	3,000
Chlorobenzene	µg/kg	4	11	3	540	138	1,000	100,000
1,4-Dichlorobenzene	µg/kg	0	11	--	--	--	2000	200,000
2,4-Dichlorophenol	µg/kg	0	11	--	--	--	1,000	100,000
P-Chloroaniline	µg/kg	1	11	21,000	21,000	21,000	700	70,000
Ethylbenzene	µg/kg	6	11	0.26	800	136	13,000	1,300,000
Tetrachloroethene	µg/kg	5	11	1.9	59,000	11,803	60	6,000

Subsurface Soil and Waste –Chlorobenzene, 1,4-dichlorobenzene, 2,4-dichlorophenol, p-chloroaniline, and ethylbenzene exceeded the TACO SROs, and benzene and tetrachloroethene exceeded 100 times the TACO SROs in subsurface soil and waste at Site P.

Based on the average depth of the bottom of fill material and the surface area exceeding TACO SROs at Site P, the estimated volume of waste and soil that exceeded the TACO SROs at Site P was calculated to be approximately 102,000 cubic yards.

Table 7- Site P: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	16	20	4.3	14,000	1,571	30	3,000
Chlorobenzene	µg/kg	18	20	3.8	5,500	1,248	1,000	100,000
1,4-Dichlorobenzene	µg/kg	9	20	33	160,000	29,915	2000	200,000
2,4-Dichlorophenol	µg/kg	2	20	300	16,000	8,150	1,000	100,000
P-Chloroaniline	µg/kg	5	20	220	15,000	3,462	700	70,000
Ethylbenzene	µg/kg	20	20	1.7	200,000	16,733	13,000	1,300,000
Tetrachloroethene	µg/kg	12	20	11	140,000	12,393	60	6,000

Leaching to Groundwater - At Site P, the analytical results from the RI indicated minimal leaching to the SHU from the waste is occurring. Area conditions include:

- A clay layer beneath the waste material with a minimum thickness of 1.5 feet is present over portions of the site.
- There were no exceedances of TACO GROs in the uppermost groundwater or in the MHU at Site P.
- The shallow groundwater concentrations were two to three orders of magnitude lower than the leachate concentrations.

Groundwater contamination in the DHU originates from upgradient sources (W.G. Krummrich Facility) and extends downgradient of Site P. This contamination in the DHU is migrating under Site P. Groundwater contamination in the shallow aquifer at Site P is significantly lower than groundwater contamination in the deeper aquifer, indicating the DHU contamination did not come from the SHU at Site P.

Vapor - One building with a potentially complete vapor intrusion pathway was identified at Site P. This building, PT's Adult Entertainment, was sampled and evaluated in the Vapor Intrusion HHRA.

Erosion - Site P is located on the east side (dry side) of the levee; therefore, the potential for Site P to be effected by a Mississippi River flood event that could result in the erosion and release of the source material is controlled.

Principal Threat Wastes - NAPL was identified as principal threat waste at two locations within Site P. These two locations included one test trench location (AT-P-4) and one leachate well (LEACH-P-1).

Site Q North

Surface Soil - Minimal surface soil impact was found at Site Q North. Surface soil exceedances of the TACO SROs for benzene and 2,4-dichlorophenol were found in samples from Site Q North in two of fourteen locations. There were no constituent values that exceeded 100 times the TACO SROs in surface soils at Site Q North, as summarized in Table 8.

Table 8- Site Q North: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	5	11	0.76	500	101	30	3,000
Chlorobenzene	µg/kg	2	11	0.52	2.4	1.5	1,000	100,000
1,4-Dichlorobenzene	µg/kg	2	11	170	630	400	2000	200,000
2,4-Dichlorophenol	µg/kg	1	11	1,000	1,000	1,000	1,000	100,000
P-Chloroaniline	µg/kg	0	11	--	--	--	700	70,000
Tetrachloroethene	µg/kg	5	11	0.44	11	3.6	60	6,000

Subsurface Soil and Waste – Exceedances of the TACO SROs in the subsurface soil and waste samples were found at Site Q North for chlorobenzene, 1,4-dichlorobenzene, and p-chloroaniline. One location had constituents that exceeded 100 times the TACO SROs for benzene, 2,4-dichlorophenol, 2,4,6-trichlorophenol, and tetrachloroethene. The waste concentrations at Site Q North dogleg were one to two orders of magnitude higher than the remaining southern portion of Site Q North.

Based on the average depth of fill material and the surface area exceedances of the TACO SROs at Site Q North, the estimated volume of soil and waste that exceeded the TACO SROs at Site Q North was calculated to be 161,000 cubic yards.

Table 9- Site Q North: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	18	25	0.76	8,800	579	30	3,000
Chlorobenzene	µg/kg	14	24	1.6	36,000	5,525	1,000	100,000
1,4-Dichlorobenzene	µg/kg	4	25	270	3,200	1,843	2000	200,000
2,4-Dichlorophenol	µg/kg	4	25	30	270,000	84,483	1,000	100,000
P-Chloroaniline	µg/kg	6	25	43	30,000	10,788	700	70,000
2,4,6-Trichlorophenol	µg/kg	2	25	1,400	47,000	24,200	200	20,000
Tetrachloroethene	µg/kg	11	25	0.43	28,000	2,649	60	6,000

Leaching to Groundwater – The groundwater analytical results from the uppermost aquifer at Site Q North indicate that in both the dogleg portion and near the southern boundary of Site R, leaching to the SHU from the waste was occurring; however, minimal leaching is occurring in the southern portion of the site. The waste concentrations at Site Q North dogleg were one to four orders of magnitude higher than in the remaining southern portion of Site Q North. In addition, the regional groundwater flow and transport model indicate that the plumes in the SHU, MHU, and DHU under Site Q North are captured by the GMCS.

Vapor – Four buildings with potentially complete vapor intrusion pathways were identified at Site Q North. These four locations were the River City Landscape Supply (RCSL) warehouse, Eagle Marine Industries (EMI) office trailer, ConAgra maintenance building, and the ConAgra warehouse. All four locations were sampled and evaluated in the Vapor Intrusion HHRA.

Erosion – Site Q (Site Q North, Q Central, and Q South) is covered with crushed gravel and asphalt, which minimizes the impact of erosion due to surface run-off. Approximately 2,580 feet of the Mississippi River bank adjacent to Site Q is protected by riprap armor. The riprap cover on the southern most portion approximately 470 feet of the Mississippi River bank adjacent to Site Q thins-out and is less dense. At the southern end of Site Q Central, at the barge construction area, approximately 360 feet of the Mississippi River bank is covered in approximately 3.5 feet of compacted rock.

The Mississippi River has flooded a portion of Site Q several times during recent years, reportedly causing scouring and erosion at parts of the site, and ultimately leading to EPA Removal Actions (Ecology & Environment, 1995; Ecology & Environment, 2000). Site Q has flooded recently in 1977, 1987, 1993, and 1995 (EPA, December 1998).

Improvements since the last flood include buildings, parking lots, and, approximately 2,580 feet of bank riprap. This history suggests that future erosion due to flooding is possible. The 2011 flood study concluded that during a 100-year flood event maximum velocities calculated did not exceed 2 feet per second. Areas of potential concern during the 100-year flooding event include the fringes of a small sand stockpile in Site Q Central and the alluvial silts in the ephemeral ponds in Site Q South.

Principal Threat Wastes - NAPL was identified as principal threat waste at four locations within Site Q North. NAPL from Site Q North is captured and treated by the GMCS.

Site Q Central

Surface Soil – The surface material at Site Q Central generally consists of crushed rock, mulch, and black cinders averaging approximately 1.4 feet in thickness. There were no surface soil constituents that exceeded the TACO SROs at Site Q Central, as summarized in Table 10 below.

Table 10- Site Q Central: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	10	19	0.93	12	3.0	30	3,000
Chlorobenzene	µg/kg	5	19	1.3	220	53	1,000	100,000
1,4-Dichlorobenzene	µg/kg	3	19	45	320	168	2000	200,000
2,4-Dichlorophenol	µg/kg	0	19	--	--	--	1,000	100,000
P-Chloroaniline	µg/kg	0	19	--	--	--	700	70,000
Ethylbenzene	µg/kg	5	11	0.19	740	149	13,000	1,300,000

Subsurface Soil and Waste - A total of 20 trenches were excavated and 15 soil borings were advanced (of which six were converted to monitoring wells) at Site Q Central. Municipal waste and debris was encountered at these sample locations and found throughout the site. Industrial waste and impacted soil was also identified. In seven of twenty locations in Site Q Central subsurface soil and waste exceeded the TACO SROs for benzene, 1,4-dichlorobenzene, p-chloroaniline, and ethylbenzene, as summarized in Table 11. One location exceeded 100 times the TACO SROs for chlorobenzene. The estimated volume of soil and waste that exceeded the TACO SROs in Site Q Central is 296,000 cubic yards.

Table 11- Site Q Central: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	15	25	1.1	1,300	143	30	3,000
Chlorobenzene	µg/kg	15	26	7.6	240,000	21,333	1,000	100,000
1,4-Dichlorobenzene	µg/kg	11	26	100	24,000	3,455	2000	200,000
2,4-Dichlorophenol	µg/kg	1	25	400	400	400	1,000	100,000
P-Chloroaniline	µg/kg	1	25	1,100	1,100	1,100	700	70,000
Ethylbenzene	µg/kg	13	25	1.2	130,000	11,138	13,000	1,300,000

Leaching to Groundwater – RI results indicate minimal leaching of waste contaminants to the SHU is occurring. However, two locations within the southwestern portion of Site Q Central had detections above the TACO GROs for benzene, chlorobenzene, and p-chloroaniline.

Two groundwater plumes are present in the aquifer under Sites Q Central, which reach the Mississippi River at low level concentrations. These plumes are not captured by the GMCS.

Vapor – Five buildings with potentially complete vapor intrusion pathways were identified at Site Q Central. These buildings were sampled and evaluated in the Vapor Intrusion HHRA.

Erosion –See the above Site Q North erosion discussion about erosion at Site Q.

Principal Threat Wastes – No principal threat waste was observed at Site Q Central, as documented in the Principal Threat Wastes Technical Memorandum (URS, 2008b).

Site Q South

Surface Soil – Only tetrachloroethene exceeded the TACO SRO at Site Q South in surface soil. No indicator constituents exceeded 100 times the TACO SROs at Site Q South.

Table 12- Site Q South: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	13	24	1.1	10	3.6	30	3,000
Chlorobenzene	µg/kg	7	24	0.36	45	8.8	1,000	100,000
1,4-Dichlorobenzene	µg/kg	2	24	82	430	256	2000	200,000
2,4-Dichlorophenol	µg/kg	0	24	--	--	--	1,000	100,000
P-Chloroaniline	µg/kg	1	24	330	330	330	700	70,000
Tetrachloroethene	µg/kg	9	24	0.6	1,700	211	60	6,000

Subsurface Soil and Waste - Benzene and chlorobenzene were above TACO SROs at Site Q South, and tetrachloroethene and toluene were above 100 times the TACO SROs at Site Q South. The estimated volume of soil and waste that exceeded the TACO SROs at Site Q South is 60,000 cubic yards.

Table 13- Site Q South: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	15	21	0.62	2,000	184	30	3,000
Chlorobenzene	µg/kg	9	21	0.58	3,500	655	1,000	100,000
1,4-Dichlorobenzene	µg/kg	4	21	52	1,200	375	2000	200,000
2,4-Dichlorophenol	µg/kg	1	21	100	100	100	1,000	100,000
P-Chloroaniline	µg/kg	1	21	160	160	160	700	70,000
Tetrachloroethene	µg/kg	9	24	0.76	8,800	624	60	6,000
Toluene	µg/kg	14	21	2	1,300,000	92,912	12,000	1,200,000

Leaching to Groundwater – The RI results indicate that leaching is occurring from Site Q South to the SHU. At two locations in uppermost groundwater within Site Q South contaminant concentrations were found above TACO GROs.

A contaminated groundwater plume is present in both the MHU and the DHU at Site Q South. This plume originates from Site Q South near the boundary with Site Q Central and extends to locations in the southwestern portion of the Site Q Central. This plume reaches the Mississippi River at low level concentrations. NAPL was not identified at Site Q South; however, intact drums were identified in test trench locations.

Vapor - No buildings with potentially complete vapor intrusion pathways were identified at Site Q South.

Erosion - See the above Site Q North erosion discussion about erosion at Site Q. Additionally, the majority of the site is covered with thick vegetation, which minimizes the impact of erosion due to surface run-off.

Principal Threat Wastes - The presence of NAPL and buried drums was evaluated at Site Q South to assess the presence of principal threat wastes. Two intact drums were found near AT-Q-35 in Site Q South and potential NAPL leaked into the trench from one of the drums. Since the drums were found in close proximity to each other, both were considered to contain liquid and be principal threat waste. Three step-out trenches from AT-Q 35 were then excavated. Two step-out trenches to the west of AT-Q-35 at distances of 50 (TT-Q-35-W-1) and 100 (TT-Q-35-W-2) feet uncovered no intact drums, but did uncover metal drum remnants and fragments and industrial waste in TT-Q-35-W-1. The step-out process was continued. No metal drums or drum fragments or industrial waste were observed in TT-Q-35-W-2; therefore, further step-out trenches to the west were not excavated. One step-out trench was excavated to the north of AT-Q-35 at a distance of 50 (TTQ-35-N-1) feet. Approximately four metal drum remnants and fragments were observed in TT-Q-35-N-1 and no intact metal drums were found. The density of drum remnants was not as significant as AT-Q-35; therefore, further step-out trenches to the north were not excavated. Based on these observations, the area estimated to contain principal threat drummed waste at AT-Q-35 is approximately 100 square feet.

Site Q South Ponds

Sediments – There were no detections of the five indicator constituents in the pond sediments during the RI samplings.
Surface Water – Low concentrations of benzene were present in the surface water samples collected from the Site Q South Ponds. There were no detections of chlorobenzene, 1,4—dichlorobenzene, 2,4-dichlorophenol, and p-chloroaniline.

Site R

Surface Soil - 1,4-dichlorobenzene and p-chloroaniline were found above the TACO SROs at Site R. Benzene, chlorobenzene, 2,4-dichlorophenol, 2,4-D, 2,4,6-trichlorophenol, and nitrobenzene were found above 100 times the TACO SROs. Based on these analytical results the entire site was assumed to exceed the TACO SROs.

Table 14- Site R: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	4	4	0.68	2.1	1.4	30	3,000
Chlorobenzene	µg/kg	3	4	1.8	64	23	1,000	100,000
1,4-Dichlorobenzene	µg/kg	0	4	--	--	--	2000	200,000
2,4-Dichlorophenol	µg/kg	0	4	--	--	--	1,000	100,000
P-Chloroaniline	µg/kg	0	4	--	--	--	700	70,000
2,4 -D	µg/kg	1	4	55	55	55	1,500	150,000

Subsurface Soil and Waste - 1,4-dichlorobenzene and p-chloroaniline were found above the TACO SROs at Site R. Benzene, chlorobenzene, 2,4-dichlorophenol, 2,4-D, 2,4,6-trichlorophenol, and nitrobenzene were found above 100 times the TACO SROs.

Table 15- Site R: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	8	8	1.6	150,000	39,279	30	3,000
Chlorobenzene	µg/kg	8	8	1.4	2,400,000	349,757	1,000	100,000
1,4-Dichlorobenzene	µg/kg	3	8	580	24,000	8,727	2000	200,000
2,4-Dichlorophenol	µg/kg	6	8	30	3,500,000	654,720	1,000	100,000
P-Chloroaniline	µg/kg	6	8	49	36,000	14,255	700	70,000
2,4,6-Trichlorophenol	µg/kg	5	8	100	650,000	176,020	200	20,000
2,4 -D	µg/kg	7	8	270	580,000	115,824	1,500	150,000
Nitrobenzene	µg/kg	3	8	1,100	48,000	25,367	100	10,000

Leaching to Groundwater – The conceptual site model for contaminant fate and transport for Site R was based on site history, source material, and migration pathways. The groundwater under Site R is impacted throughout the vertical extent of the aquifer from both on-site and off-site sources. Analytical data indicates that waste from Site R is leaching into the shallow aquifer. The contaminated groundwater under Site R moves to the west, combines with the other upgradient sources (e.g., Sauget Area 1 and 2 sites, former Clayton facility and Krummrich plant), and is intercepted by the GMCS downgradient of Site R. As stated in the regional groundwater model, when all modeled constituents were included, over 94% of the total plume mass flux (mass discharge rate) is predicted to be captured and treated by the GMCS/ABRTF. For Sauget Area 2 sources only, when all modeled constituents are included, 98% of the total plume mass flux is predicted to be captured and treated by the GMCS/ABRFT.

Vapor - No buildings with potentially complete vapor intrusion pathways were identified at Site R.

Erosion –The 2011 flood study concluded that during a 100-year flood event maximum velocities calculated did not exceed 2 feet per second. The majority of Site R was above the water surface profile for the 100-year flooding event.

Principal Threat Wastes - NAPL was identified as principal threat waste at eight soil boring locations in Site R. The NAPL observed in Site R is considered a principal threat waste; however, these locations are already captured and treated by the GMCS/ABRTF. In addition, materials present in Site R leachate (LEACH-R-1) pose a potential risk in excess of EPA's principal threat waste threshold risk level of 1×10^{-3} and, therefore, is identified as principal threat wastes.

Site S

Surface Soil -1,4-dichlorobenzene and 2,4-dichlorophenol were found above the TACO SROs in surface soil at Site S. No constituents exceeded 100 times TACO SROs.

Table 16- Site S: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	2	4	1.4	1.5	1.5	30	3,000
Chlorobenzene	µg/kg	1	4	0.47	0.47	0.47	1,000	100,000
1,4-Dichlorobenzene	µg/kg	1	4	7,500	7,500	7,500	2000	200,000
2,4-Dichlorophenol	µg/kg	1	4	2,300	2,300	2,300	1,000	100,000

Table 16- Site S: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Surface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
P-Chloroaniline	µg/kg	0	4	--	--	--	700	70,000
1,1,1-Trichloroethane	µg/kg	1	4	6.6	6.6	6.6	2,000	200,000
Tetrachloroethene	µg/kg	3	4	0.83	3	2.1	60	6,000
Toluene	µg/kg	2	4	6.2	30	18	12,000	1,200,000

Subsurface Soil and Waste- Contaminant concentrations in subsurface soil and waste samples were found above TACO SROs in all four Site S locations. Benzene, chlorobenzene, 1,4-dichlorobenzene, p-chloroaniline, 1,1,1-trichloroethane, dichloromethane, tetrachloroethene, toluene, and trichloroethene were found above 100 times SROs. The estimated volume of soil and waste that exceeded the TACO SROs at Site S was calculated to be 8,000 cubic yards.

Table 17- Site S: Maximum, Minimum and Mean Concentrations of Indicator Constituents in Subsurface Soil and Wastes

Chemical	Units	No. of Detects	No. of Samples	Min Conc	Max Conc	Avg Conc	IEPA TACO Class I SROs	100X IEPA TACO Class I SROs
Benzene	µg/kg	3	7	2,400	35,000	23,800	30	3,000
Chlorobenzene	µg/kg	3	7	190	1,200,000	530,063	1,000	100,000
1,4-Dichlorobenzene	µg/kg	2	7	4,500	200,000	102,250	2000	200,000
2,4-Dichlorophenol	µg/kg	0	7	--	--	--	1,000	100,000
P-Chloroaniline	µg/kg	2	7	7,600	70,000	38,800	700	70,000
1,1,1-Trichloroethane	µg/kg	7	7	45	220,000	43,792	2,000	200,000
Dichloromethane	µg/kg	5	7	2,100	57,000	20,140	20	2,000

Leaching to Groundwater –While the soil and waste concentrations in Site S exceeded 100 times the TACO SROs at all locations, analytical results from the uppermost groundwater indicate leaching from the waste to the SHU is minimal based on:

- The surface soil at Site S consists of a low permeability silty-clay fill layer with a minimum thickness of one foot, which was present underlying most of the observed waste or shallow subsurface material at Site S.
- Only benzene is found above the TACO groundwater remediation objectives (GROs) in groundwater downgradient of Site S.
- The SHU and DHU plumes beneath Site S originate from an upgradient location and extend downgradient of Site S. Groundwater contaminant concentrations upgradient of Site S are higher in the SHU than downgradient concentrations. Groundwater impacts beneath and downgradient of Site S are found deep in the aquifer, with the concentrations in the shallow depths significantly lower or not detected.

Based on these observations, Site S soil and waste is not a significant on-going source contamination to the underlying aquifer. This is primarily due to the silty-clay layer observed beneath the waste material observed under most of Site S. Additionally, based on the regional groundwater flow and transport model, the plumes in the MHU and DHU under Site S are captured by the GMCS.

Vapor - No buildings with potentially complete vapor intrusion pathways were identified at Site S. However, the American Bottoms Laboratory building is located approximately 175 feet east of Site S, and the Veolia hazardous waste storage buildings are located approximately 50 feet west of Site S. Therefore, these buildings were evaluated in the Vapor Intrusion HHRA.

Erosion - Site S is located on the east side (dry side) of the levee; therefore, the potential for Site S to be effected by a flood event that could result in the erosion and release of the source material is minimal. Additionally, all of the waste at Site S is covered, thereby reducing the risk of erosion caused by surface run-off.

Principal Threat Waste - No principal threat waste was observed at Site S, as documented in the Principal Threat Wastes Technical Memorandum (URS, 2008b).

Summary of Extent of Contamination

The contaminant source areas at Sauget Area 2 are the disposal areas at Sites O, O North, O South, P, Q North, Q Central, Q South, Q South Ponds, R, and S. Principal threat waste was observed at Site P, Q North, Q South, and R. At Site P, NAPL was observed in Trench AT-P-4 and well LEACH P-1. At Site Q North, NAPL was observed at Sonic-5 and well LEACH-Q-1. At Site Q South, two intact drums were found from which NAPL may have leaked into the trench. At Site R, NAPL was observed at eight locations. The NAPL identified on Site Q North and Site R are captured and treated by the GMCS/ABRTF.

2.6 – Current and Potential Future Site and Resource Uses

The Sauget Area 2 Site has been used for industrial purposes for many years (since the 1930's or earlier). The sites within Sauget Area 2 are zoned commercial/industrial and it is likely that the sites will continue to be used well into the reasonably foreseeable future for commercial/industrial purposes.

Historically, groundwater from the American Bottoms aquifer was a major source of water for the area and was used for industrial, public, and irrigation purposes. Groundwater levels prior to industrial and urban development were near land surface. Intensive industrial groundwater withdrawal and use, and construction of a system of drainage ditches, levees, and canals to protect developed areas, lowered the groundwater elevation for many years. However, by the mid-1980s, the groundwater levels increased due to reduced pumpage, high river stages, and high precipitation.

Currently, no groundwater is being pumped from the American Bottoms aquifer in the vicinity of Sauget Area 2 for public, private, or industrial supply purposes. Groundwater is not a source of drinking water in the area. The Villages of Sauget and Cahokia have issued ordinances prohibiting the use of groundwater as a potable water source. These ordinances were issued in response to historic industrial use in the region and resulting groundwater quality impairments. Groundwater use restrictions will likely remain in place for the foreseeable future due to the extent of the groundwater quality impairments.

2.7 - Summary of Site Risks

2.7.1 - Summary of Human Health Risk Assessment

A human health risk assessment (HHRA) estimates what potential risks a site poses to human health if no action is taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the HHRA for the Sauget Area 2 Site. Two HHRAs were conducted by the PRPs, with EPA oversight, the Site-wide HHRA (2009) and Vapor Intrusion HHRA (2009). The PRPs completed these Site-specific risk assessments to quantify the potential threat to public health from actual or threatened releases of hazardous substances into the environment. The HHRAs were prepared using EPA's Risk Assessment Guidance for Superfund (RAGS) and evaluated potential current and future exposure scenarios at the Site.

The objectives of the risk evaluation using the HHRA were : (1) to evaluate whether Site-related constituents detected in environmental media pose risks above EPA-acceptable levels for current and future human receptors, and (2) to support decisions concerning the need for further evaluation or action, based upon current and reasonably anticipated future land use. Future land uses were assumed to be the same as current land uses. Current land uses are commercial/industrial and the Sites will likely continue to be used well into the reasonable foreseeable future for commercial/industrial purposes. Therefore, the Sites were evaluated for non-residential use scenarios. Receptors were identified for the Sites based on the CSM for

human health and the COPCs identified in media at each site. The potential receptor groups considered included:

- Sites (O, P, Q , R and S)
  - Future indoor industrial worker
  - Future outdoor industrial workers
  - Future construction/ utility workers
  - Future trespassing teenagers
- Site Q South Ponds
  - Current and future trespassing teenager
  - Current and future recreational anglers

Two general types of health risk were characterized for each potential exposure pathway: potential carcinogenic risk (risk) and potential non-carcinogenic hazard (hazard). Risks and hazards were calculated using standard risk assessment methodologies. Risks were compared to EPA's acceptable risk range: from $1x10^{-6}$ (one excess cancer per one million exposed receptors) to $1x10^{-4}$ (one excess cancer per ten thousand exposed receptors). Risks less than $1x10^{-6}$ are considered insignificant. Risks within the above range are remediated at the discretion of EPA risk managers. Risks greater than $1x10^{-4}$ typically require remediation. Non-carcinogenic hazards are compared to a target hazard index (HI) of 1. The potential risks from the individual contaminants and exposure pathways are added up to calculate total Site risk.

The following provides a brief description of the various HHRAs conducted in the Sauget Area 1 Site:

- **Site-Wide HHRA**: PRPs conducted a Site-wide HHRA for the Sauget Area 2 Sites (HHRA, AECOM, 2009).
- **Vapor Intrusion HHRA**: PRPs conducted a Vapor Intrusion HHRA for the Sauget Area 2 Sites (VI HHRA, AECOM, 2008).

To guide identification of appropriate exposure pathways for the risk assessments, the PRPs, with EPA oversight, developed a CSM for human health (Figure 2) which presents source areas, potential migration pathways of contaminants from source areas to environmental media where exposure can occur, and potential human receptors. The CSM for human health was discussed in Section 2.5.1.

The CSM links contaminant concentrations in various media to potential human exposure and identified the following exposure scenarios for each site:

- Sites (O, P, Q , R and S)
  - Future indoor industrial worker - Potential exposure to COPCs via inhalation of volatile constituents present in indoor air due to vapor intrusion from the subsurface.
  - Future outdoor industrial workers - Potential exposure to COPCs in surface soil via: (1) incidental ingestion and dermal contact, (2) inhalation of non-volatile COPCs that may be suspended as dusts from surface soils, and (3) inhalation of COPCs that may volatilize into outdoor air from underlying groundwater and from soils (combined surface soil, subsurface soil, and waste).

  - Future construction/ utility workers - Potential exposure to COPCs in soils (combined surface soil, subsurface soil, waste) via: (1) incidental ingestion and dermal contact, (2) inhalation of volatile emissions and particulates suspended during excavation activity, (3) incidental ingestions and dermal contact with COPCs in shallow groundwater and leachate, and (4) inhalation of COPCs volatilized from standing water in an excavation trench.
  - Future trespassing teenagers - Potential exposure to COPCs in surface soils via: (1) incidental ingestion and dermal contact, (2) inhalation of non-volatile COPCs that may be suspended as dusts from surface soils, and (3) inhalation to COPCs that may volatilize into outdoor air from underlying groundwater and from soils (combined surface soil, subsurface soil, and waste).
- Site Q Ponds
  - Current and future trespassing teenager - Potential exposure to COPCs in surface water and sediment from the Site Q Ponds.
  - Current and future recreational anglers - Potential exposure to COPCs in surface water, sediment, and fish fillet from the Site Q Ponds.

Assumptions about exposure frequency, duration, and other exposure factors are discussed in more detail in the HHRAs.

2.7.2 - Data Quality and Usability

Data were evaluated based on completeness, holding times, initial and continuing calibrations, surrogate recoveries, internal standards, compound identification, laboratory and field quality assurance/quality control (QA/QC) procedures and results, reporting limits, documentation practices, and application of validation qualifiers. Analytical data collected during the RI and SI were considered to be acceptable for use in the HHRAs.

2.7.3 - Identification of Contaminants of Concern

For potentially carcinogenic risk results, COCs are identified as those COPCs that result in target risk above $1x10^{-4}$. For noncarcinogenic hazard results, COCs are identified as those COPCs that result in toxic-endpoint specific HI greater than 1.

Tables 18 through 26 present the contaminants of concern (COCs) that pose potential threats to human health in the specified media for Sites O, P, Q, R, and S. The tables also identify the exposure point concentrations (EPCs), the concentration ranges, the detection frequency, and how the EPCs were derived. An EPC is an estimate of the true arithmetic mean concentration of a chemical in a medium at an exposure point and is discussed in Section 2.7.5.

2.7.4 - Exposure Assessment

The purpose of the exposure assessment is to predict the magnitude and frequency of potential human exposure to each of the COPCs retained for quantitative evaluation in the HHRA. The

first step in the exposure assessment is the characterization of the site setting and surrounding area. Current and potential future site uses and potential receptors (i.e., people who may contact the impacted environmental media of interest) are then identified. Potential exposure scenarios identifying appropriate environmental media and exposure pathways for current and potential future site uses and receptors are then developed. Those potential exposure pathways for which COPCs are identified and are judged to be complete are evaluated quantitatively in the risk assessment. The exposure pathways and receptors considered for evaluation at the Sauget Area 2 Site, along with the rationale for their inclusion in, or exclusion from, the quantitative risk assessment are described in the HHRAs.

Sauget Area 2 Sites have been used for industrial purposes for many years and use of these areas is expected to remain industrial. Therefore, the sites were evaluated for commercial/industrial use scenarios in the Site-wide HHRA (AECOM, 2009).

2.7.5 - Exposure Point Concentrations

Exposure points are located where potential receptors may contact COCs at or from the Site. The concentration of COCs in the environmental medium that receptors contact is called the Exposure Point Concentration (EPC) and is estimated. Both measured and modeled EPCs scenarios were developed. The approaches used to calculate EPCs under the two scenarios are presented in the HHRA. EPCs were calculated following the methods and recommendations provided in EPA's risk assessment guidance. A summary of the EPCs for COCs for the sites is provided in Tables 18 through 26.

Table 18 – Summary of Contaminants of Concern for Site O

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection (2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Surface Soil	Dioxin TEQ-HH	6.37E-5	6.77E-3	2:2:2	6.77E-3	Max
Combined Soil	PCBs, Total	5.32E-2	2.98E+2	9:11:11	1.63E+2	95% UCL

(1) Soil units – mg/kg
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Max – Maximum Detected Concentration
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration
PCB - Polychlorinated Biphenyls
95% UCL – 95% Upper Confidence Limit

Table 19 – Summary of Contaminants of Concern for Site O North

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection (2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Surface Soil	Dioxin TEQ-HH	5.15E-2	5.15E-2	1:1:1	5.15E-2	Max
	PCBs, Total	7.09E+2	7.09E+2	1:1:1	7.09E+2	Max
Combined Soil	Dioxin TEQ-HH	5.15E-2	6.08E-1	5:5:5	6.08E-1	Max
	PCBs, Total	5.98E-2	3.05E+3	6:6:6	3.05E+3	Max
Leachate	PCBs, Total	5.49E-2	5.49E-2	1:1:1	5.49E-2	Max

(1) Soil units – mg/kg; Leachate units – mg/L
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Max – Maximum Detected Concentration
PCB - Polychlorinated Biphenyls
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration

Table 20 – Summary of Contaminants of Concern for Site P

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection (2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Combined Soil	PCBs, Total	5.19E-2	4.03E+2	16:20:20	1.22E+2	95% UCL

(1) Soil units – mg/kg
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
PCB - Polychlorinated Biphenyls
95% UCL – 95% Upper Confidence Limit

Table 21 – Summary of Contaminants of Concern for Site Q North

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection(2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Combined Soil	Dioxin TEQ-HH	5.88E-5	6.78E-2	15:17:17	4.59E-2	95% UCL
	PCBs, Total	4.51E-1	2.21E+2	17:22:22	1.49E+2	95% UCL
	Lead	7.60E+0	2.40E+4	28:29:29	1.16E+3	Average
Leachate	2,4-DCP	9.80E+1	1.80E+2	5:5:5	1.80E+2	Max
	Lead	4.15E-1	2.80E+0	2:5:5	1.61E+0	Average
	PCP	5.00E-1	6.30E+0	4:5:5	6.30E+0	Max
	PCBs, Total	1.25E-3	4.79E-2	4:4:4	4.79E-2	Max

(1) Soil units – mg/kg
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Max – Maximum Detected Concentration
PCB - Polychlorinated Biphenyls
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration
95% UCL – 95% Upper Confidence Limit
2,4-DCP - 2,4-Dichlorophenol
PCP - Pentachlorophenol

Table 22 – Summary of Contaminants of Concern for Site Q Central

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection(2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Surface Soil	Dioxin TEQ-HH	5.78E-5	3.87E-3	10:14:14	2.09E-3	95% UCL

(1) Soil units – mg/kg
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration
95% UCL – 95% Upper Confidence Limit

Table 23 – Summary of Contaminants of Concern for Site Q South

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection(2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Surface Soil	Dioxin TEQ-HH	5.27E-5	7.11E-3	22:22:22	3.70E-3	95% UCL
	Cadmium	4.10E-1	8.00E+3	24:24:24	3.65E+3	95% UCL
Combined Soil	Cadmium	1.30E-1	8.00E+3	43:45:45	2.46E+3	95% UCL

(1) Soil units – mg/kg
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration
95% UCL – 95% Upper Confidence Limit

Table 24 – Summary of Contaminants of Concern for Site Q South Ponds

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection(2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Large Pond Fish	**Black Bullhead**					
	Dieldrin	1.00E-1	1.00E-1	1:1:1	1.00E-1	Max
	PCBs, Total	3.87E+0	3.87E+0	1:1:1	3.87E+0	Max
	Carp					
	Arsenic	8.20E-1	8.20E-1	1:1:1	8.20E-1	Max
	Benzo(a)pyrene	1.80E-1	1.80E-1	1:1:1	1.80E-1	Max
	Dieldrin	1.90E-1	1.90E-1	1:1:1	1.90E-1	Max
	Dioxin TEQ-HH	1.53E-5	1.53E-5	1:1:1	1.53E-5	Max
	PCBs, Total	1.00E+1	1.00E+1	1:1:1	1.00E+1	Max
Small Pond Surface Water	Benzo(a)pyrene	1.50E-3	4.60E-3	2:3:3	4.60E-3	Max

(1) Fish units – mg/kg; Surface water units – mg/L
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Max – Maximum Detected Concentration
PCB - Polychlorinated Biphenyls
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration

Table 25 – Summary of Contaminants of Concern for Site R

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection (2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Combined Soil	Tetrachloroethene	2.60E-3	1.20E+3	10:12:12	7.64E+2	95% UCL
	PCBs, Total	7.91E-2	2.78E+2	8:12:12	9.53E+1	95% UCL
Leachate	Benzene	5.90E+0	1.47E+3	4 : 4 : 4	1.47E+3	Max
	Benzo(a)pyrene	1.80E-1	1.80E-1	1 : 4 : 4	1.80E-1	Max
	Benzo(b)fluoranthene	1.42E+1	1.42E+1	1 : 4 : 4	1.42E+1	Max
	Benzo(k)fluoranthene	2.00E-1	1.41E+1	2 : 4 : 4	1.41E+1	Max
	Chlorobenzene	1.10E+0	1.03E+3	4 : 4 : 4	1.03E+3	Max
	Chloroform	2.00E+0	3.07E+2	4 : 4 : 4	3.07E+2	Max
	Chloromethane	1.51E+2	1.51E+2	1 : 4 : 4	1.51E+2	Max
	Dibenzo(a,h)anthracene	1.90E-1	1.90E-1	1 : 4 : 4	1.90E-1	Max
	Dioxin TEQ-HH	1.53E-8	2.81E-6	3 : 4 : 4	2.81E-6	Max
	1,2,4-Trichlorobenzene	2.77E+1	2.77E+1	1 : 4 : 4	2.77E+1	Max
	1,2-Dichloroethane	4.70E+1	1.97E+3	4 : 4 : 4	1.97E+3	Max
	1,2-Dichloroethene (total)	1.30E+1	1.20E+3	4 : 4 : 4	1.20E+3	Max
	1,4-Dichlorobenzene	7.60E+0	3.77E+1	2 : 4 : 4	3.77E+1	Max
	2-Methylnaphthalene	8.20E-1	1.62E+1	2 : 4 : 4	1.62E+1	Max
	2,4-Dichlorophenol	5.20E-1	2.43E+1	3 : 4 : 4	2.43E+1	Max
	4-Chloroanaline	2.00E+1	5.39E+2	4 : 4 : 4	5.39E+2	Max
	4,4'-DDT	2.10E-1	8.20E-1	2 : 4 : 4	8.20E-1	Max
	Manganese	9.20E+1	2.50E+2	4 : 4 : 4	2.50E+2	Max
	MCPA	1.09E+3	1.09E+3	1 : 4 : 4	1.09E+3	Max
	Naphthalene	5.60E+0	5.60E+0	1 : 4 : 4	5.60E+0	Max
	PCBs, Total	4.06E+0	1.75E+2	4 : 4 : 4	1.75E+2	Max
	Tetrachloroethene	1.80E+1	6.87E+4	4 : 4 : 4	6.87E+4	Max
	Trichloroethene	1.00E+2	7.97E+4	4 : 4 : 4	7.97E+4	Max
	Toluene	1.60E+1	1.73E+4	4 : 4 : 4	1.73E+4	Max
	Xylenes, Total	4.70E-1	1.07E+3	3 : 4 : 4	1.07E+3	Max

(1) Soil units – mg/kg; Leachate units – mg/L

(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Max – Maximum Detected Concentration
PCB - Polychlorinated Biphenyls
Dioxin TEQ-HH - 2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Concentration
95% UCL – 95% Upper Confidence Limit
MCPA - 2-methyl-4-chlorophenoxyacetic acid

Table 26 – Summary of Contaminants of Concern for Site S

Exposure Point	COC	Concentration Detected (1)		Frequency of Detection (2)	Exposure Point Concentration	Statistical Measure
		Min	Max			
Surface Soil	PCBs, Total	1.38E-1	1.01E+3	2:2:2	1.01E+3	Max
Combined Soil	PCBs, Total	1.38E-1	1.01E+3	7:8:8	1.01E+3	Max

(1) Soil units – mg/kg
(2) FOD - Number of samples detected: Number of valid results (i.e., not rejected): Total number of samples.

COC – Contaminant of Concern
Max – Maximum Detected Concentration
PCB - Polychlorinated Biphenyls

2.7.6 - Toxicity Assessment

The toxicity assessment provides a description of the relationship between a dose of a chemical and the potential likelihood of an adverse health effect. The purpose of the toxicity assessment is to provide a quantitative estimate of the inherent toxicity of COCs for use in risk characterization. Potential health risks for COCs are evaluated for both carcinogenic and non-carcinogenic risks.

The purpose of the toxicity assessment is to assign toxicity values (criteria) to each contaminant evaluated in the risk assessment. The toxicity values are used in conjunction with the estimated doses to which a human could be exposed to evaluate the potential human health risk associated with each contaminant. In evaluating potential health risks, both carcinogenic and non-carcinogenic health effects were considered.

Cancer slope factors (CSFs) are developed by the EPA under the assumption that the risk of cancer from a given chemical is linearly related to dose. CSFs are developed from laboratory animal studies or human epidemiology studies and classified according to route of administration. The CSF is expressed as $(mg/kg/day)^{-1}$ and when multiplied by the lifetime average daily dose expressed as mg/kg/day will provide an estimate of the probability that the dose will cause cancer during the lifetime of the exposed individual. Cancer toxicity data for the COCs are summarized in Appendix D, Table 1.

The toxicity criteria used to evaluate potential non-carcinogenic health effects are reference doses (RfDs). The RfD is expressed as mg/kg/day and represents that dose that has been determined by experimental animal tests or by human observation to not cause adverse health effects, even if the dose is continued for a lifetime. The procedure used to estimate this dose incorporates safety or uncertainty factors that assume it will not over-estimate this safe dose. Non-cancer toxicity data for the COCs are summarized in Appendix D, Table 2.

2.7.7 - Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

Where:

risk = a unit less probability (e.g., $2x10^{-5}$) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that are expressed typically in scientific notation (e.g., $1x10^{-6}$). An excess lifetime risk of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as excess lifetime cancer risk because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally-acceptable risk range for site-related exposures is $1x10^{-4}$ to $1x10^{-6}$.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., a lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any adverse effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs to which a given individual may reasonably be exposed that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media. An HI of 1 or less indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health. When the total site HI is greater than 1 for any receptor, a more detailed evaluation of potential non-carcinogenic effects based on specific health or target endpoints (e.g., liver effects, neurotoxicity) is performed (EPA, 1989a).

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = CDI/RfD$$

Where:

CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Tables 27 through Table 40 provide a summary of the potential carcinogenic and non-carcinogenic risks from each site's COCs and potential receptors. Further risk summary details are included for each site in Appendix D. HIs that are greater than one on a total basis, but are below one on a target organ basis are not highlighted in the risk summary tables.

Site O

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. Carcinogenic risks greater than $1x10^{-4}$ are highlighted. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 27: Site O - Total Potential Risk and Hazard Index

Receptor	Cancer	Non-Cancer
Indoor Industrial Worker	2.0E-08	3.7E-04
Outdoor Industrial Worker	3.2E-04	7.4E+00
Construction/Utility Worker	4.0E-05	3.1E+00
Trespassing Teenager	2.5E-05	1.0E+00

Site O is located in an isolated area and is not currently used. Currently, the former ABRTF lagoons are covered and vegetated, and the vegetation is mowed periodically during the warmer months of the year. Therefore, the risks presented above for workers represent a potential future scenario (the only activity under the current scenario is mowing, which is limited in frequency and duration).

Site O North

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. Carcinogenic risks greater than $1x10^{-4}$ are highlighted. HIs are highlighted where the total is greater than one on a target organ basis.

Table 28: Site O North- Total Potential Risk and Hazard Index

Receptor	Cancer	Non-Cancer
Outdoor Industrial Worker	2.2E-03	7.5E+01
Construction/Utility Worker	4.9E-04	4.8E+01
Trespassing Teenager	1.9E-04	1.0E+01

Site O North is located in an isolated area and is not currently used. The former ABRTF lagoons are covered and vegetated, and the vegetation is mowed periodically during the warmer months of the year. Therefore, the risks presented above for construction/utility workers represent a potential future scenario (the only activity under the current scenario is mowing, which is limited in frequency and duration).

Site O South

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below.

Table 29: Site O South- Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Outdoor Industrial Worker	NCOPC	NCOPC
Construction/Utility Worker	2.3E-08	4.5E-04
Trespassing Teenager	NCOPC	NCOPC

The risks noted above are below the target risk level of $1x10^{-4}$, and the HIs are below one. Because there were no target risk levels above acceptable levels, no COCs are identified.

Site P

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. The carcinogenic risks were less than the target risk level of $1x10^{-4}$. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 30: Site P-Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Indoor Industrial Worker	2.0E-05	9.9E-01
Outdoor Industrial Worker	7.2E-05	1.4E+00
Construction/Utility Worker	7.0E-06	1.9E+00
Trespassing Teenager	2.7E-06	1.2E-01

Site P is currently inactive and in large part covered, and access to the site is unrestricted. A nightclub and asphalt parking lot occupy three acres in the southeast corner of the site. The risks presented above for construction/utility workers represent a potential future scenario. Although risks and hazards are acceptable for the indoor industrial worker, vapor intrusion sampling and subsequent risk analysis could not rule out a potential for risk due to exposure to vapors inside the on-site nightclub.

Site Q North

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. Carcinogenic risks were less than $1x10^{-4}$. HIs are highlighted where the total is greater than one on a target organ basis.

Table 31: Site Q North – Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Indoor Industrial Worker	4E-6	6.4E-1
Outdoor Industrial Worker	7.8E-05	1.4E+00
Construction/Utility Worker	8.5E-05	1.1E+01

Table 31: Site Q North – Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Trespassing Teenager	1.9E-05	1.7E-01

A 10-acre area on Site Q North is currently used by River City Landscape Supply as a bulk storage terminal for lawn and garden products. Raw landscape products such as mulch, rock and soil are processed and packed on this portion of the site. Access to some portions of the site is restricted by fencing and gates. Other parts of the site have unrestricted access. As noted above, unacceptable risk for this area was identified for the construction/utility worker, not for the outdoor industrial worker. Therefore, the risks presented above are for a potential future construction/utility worker, as there is no current excavation work in this area.

Site Q Central

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. In addition, the total carcinogenic risk and the total HI for the trespassing teenager and the recreational angler from seep exposure are listed in Table 33. Carcinogenic risks were less than $1x10^{-4}$. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 32: Site Q Central- Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Indoor Industrial Worker	1.0E-05	1.5E+00
Outdoor Industrial Worker	7.5E-05	1.6E+00
Construction/Utility Worker	5.7E-06	5.2E-01
Trespassing Teenager	3.5E-05	2.1E-01

Table 33: Site Q Central Seep- Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Trespassing Teenager	1.0E-05	4.7E-01
Recreational Angler	4.0E-05	6.7E-01

Site Q Central houses a barge terminal facility and is largely covered by gravel or buildings. Therefore, the surface soil is not readily accessible in all locations. In 2007, construction of a rail, river barge, and truck transportation facility for the ethanol industry began on Site Q Central. Five 98,900-barrel capacity ethanol storage tanks are located on the site. Access to parts of Site Q Central is restricted by fences.

Site Q South

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. Carcinogenic risks greater than $1x10^{-4}$ are highlighted. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 34: Site Q South -Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Outdoor Industrial Worker	1.2E-04	6.7E+00
Construction/Utility Worker	9.3E-06	3.6E+00
Trespassing Teenager	1.4E-05	1.0E+00

Site Q South is predominantly vacant open land and access is unrestricted. The risks presented above for workers represent a potential future scenario.

Site Q South Ponds

The total risk and the total HI for the trespassing teenager and the recreational angler are listed below. Carcinogenic risks greater than $1x10^{-4}$ are highlighted. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 35: Site Q South Large Pond - Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Trespassing Teenager	2.0E-06	3.2E-01
Recreational Angler (with Black Bullhead Fillet)	5.6E-04	2.4E+01
Recreational Angler (with Carp Fillet)	1.4E-03	6.0E+01

Table 36: Site Q South Small Pond -Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Trespassing Teenager	2.3E-04	1.8E-01
Recreational Angler	3.0E-04	3.2E-01

Although risks were identified in the Site Q South Large Pond and Small Pond for trespassing teenagers and recreational anglers, it is important to note that these risks are only present as a result of flood events in the Mississippi River. After the ponds dry out, fish are not reintroduced until another flood event, although water may collect in the ponds from precipitation.

Site R

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. The total carcinogenic risk and the total HI for the trespassing teenager and the recreational angler seep exposure are also listed.

Carcinogenic risks greater than $1x10^{-4}$ are highlighted. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 37: Site R - Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Outdoor Industrial Worker	4.2E-01	4.7E+03
Construction/Utility Worker	8.8E-02	1.1E+04
Trespassing Teenager	7.0E-03	1.8E+02

Table 38: Site R Seep - Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Trespassing Teenager	9.0E-07	4.7E-02
Recreational Angler	3.5E-06	6.6E-02

Site R is a closed industrial-waste disposal area owned by Solutia, Inc. The site is not currently used. Access to Site R is restricted by fencing and is monitored by Solutia plant personnel. The trespasser and utility/construction worker risks represent a potential future scenario. Excavation is not allowed at Site R. There are no utilities located in Site R.

Site S

The total carcinogenic risk and the total HI for the outdoor industrial worker, the construction/utility worker, and the trespassing teenager are listed below. Carcinogenic risks greater than $1x10^{-4}$ are highlighted. HIs are highlighted where the total is greater than one on a target endpoint basis.

Table 39: Site S - Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Indoor Industrial Worker	2.0E-06	1.7E-03
Outdoor Industrial Worker	1.0E-03	6.6E+01
Construction/Utility Worker	4.3E-05	1.2E+01
Trespassing Teenager	5.6E-05	8.1E+00

The 1-acre site is currently not used. The northern portion of the site is grassed, and its southern portion is covered with gravel and fenced. Therefore, the potential risks presented above for workers represent the future scenario only.

Mississippi River

The total carcinogenic risk and the total HI for the trespassing teenager and the recreational angler are listed below.

Table 40: Mississippi River - Total Potential Risk and Hazard Index		
Receptor	**Cancer**	**Non-Cancer**
Trespassing Teenager	4.1E-08	1.7E-03
Recreational Angler- Plume Discharge Area	3.9E-06	6.0E-02
Recreational Angler – Upstream Discharge Area	3.9E-05	5.3E-01
Recreational Angler – Downstream Discharge Area	5.3E-06	8.2E-02

The risks noted above are below or within the target risk range of $1x10^{-6}$ to $1x10^{-4}$, and the potential HIs are below one. Because there were no unacceptable risks identified, no COCs are identified.

2.7.8 - Uncertainties

Uncertainty is inherent in the process of quantitative risk assessment because of the use of environmental sampling results, assumptions regarding exposure, and the quantitative representation of chemical toxicity. Potentially significant sources of uncertainty for this assessment are discussed in the HHRA and include analytical data, exposure estimates, toxicity estimates, and background conditions.

2.7.9 – Summary of Ecological Risk Assessment

In July 2008, the PRPs conducted a baseline ecological risk assessment (BERA), with EPA oversight, to evaluate the risks to ecological receptors on a site by site basis. Ecological risks to biological receptors living within the aquatic and terrestrial ecosystems located on or adjacent to the Sites, as a result of exposures to Site-related constituents were evaluated.

Surface water and sediment samples from locations upstream, adjacent to, and downstream of the Sites were collected and evaluated. The BERA concluded prior to the construction of the Sauget Area 2, OU2 interim remedial action for groundwater (known as the GMCS), there were some ecological risks associated with the presence of contaminants of potential ecological concern (COPEC) in Mississippi River sediments and surface water. After construction of the GMCS, there were no adverse ecological impacts associated with the presence of COPECs in Mississippi River sediments adjacent to or downstream of the sites or surface water. Thus, the risks posed by COPECs have been eliminated by the installation of the GMCS barrier wall.

The BERA identified risks associated with COPECs in surface soil at only two sites at the Sauget Area 2 Site: Site O and Site Q South. Ecological risks to herbivores and carnivores from exposure to dioxins/furans are present at Site O and Site Q South. Sites O (vole and fox) and Q (fox only) were considered to pose risks to mammals from exposure to dioxins/furans in the floodplain.

2.7.10 - Risk Assessment Conclusions

The 2008 ecological risk evaluation, as discussed above, concluded there were no adverse ecological impacts to Mississippi River sediments or surface water adjacent to or downstream of the Site due to contaminates discharging into the River from the Site. Thus, the risks to the Mississippi River have been eliminated by the installation of the GMCS barrier wall. However, two sites, Site O and Site Q South, had identified ecological risks associated with contaminants in surface soils.

The Vapor Intrusion HHRA evaluated buildings located on or nearby the Site with potentially complete vapor intrusion pathways, which included Site P, Q North, Q Central and S. Sites O, Q South, and R did not have buildings with complete vapor intrusion pathways; therefore were not evaluated in the Vapor Intrusion HHRA. The Vapor Intrusion HHRA concluded potential risks

from vapor intrusion to the indoor industrial worker were within EPA's acceptable levels for all the sites evaluated. However, vapor intrusion sampling and subsequent risk analysis could not rule out a potential for risk due to exposure to vapors inside the night club located at Site P and the RCLS warehouse located on Site Q North.

Previous removal actions conducted by EPA at Site Q Central and Site Q South have removed a significant source of principal threat wastes at the site by excavating and disposing off-Site approximately 3,271 drums and 14,000 tons of high-level PCB contaminated soil; thereby significantly reducing risk at the Site.

The remaining contaminant source areas at the Sauget Area 2 Site are the disposal areas at Sites O, O North, P, Q North, Q Central, Q South, R, and S. Risks or hazards above EPA's acceptable level for human health and the environment were identified in these disposal areas and summarized below.

In summary, risks and hazards were within or below EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$ and a target hazard index of 1 on a target endpoint basis and, therefore, no COCs were identified in the soils, sediments, and surface water in the following area:

- Site O South

Some risks or hazards exceeded EPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$ and/or a target hazard index of 1 on a target endpoint basis and, therefore, COCs were identified for the following Sites:

- Site O and O North – Outdoor industrial worker, construction/utility worker, and trespassing teenager receptors
- Site P - Indoor industrial worker[12], outdoor industrial worker, and construction/utility worker receptors
- Site Q North – Indoor industrial worker[13], outdoor industrial worker, and construction/utility worker
- Site Q Central – Outdoor industrial worker
- Site Q South – Outdoor industrial worker, construction/utility worker, and trespassing teenager
- Site Q South Ponds - Recreational angler and trespassing teenager receptors
- Site R – Outdoor industrial worker, construction/utility worker, and trespassing teenager receptors

[12] Although the VI HHRA concluded risks and hazards are acceptable for the indoor industrial worker, vapor intrusion sampling and subsequent risk analysis could not rule out a potential for risk due to exposure to vapors inside the PT's Adult Entertainment located on Site P.

[13] Although the VI HHRA concluded risks and hazards are acceptable for the indoor industrial worker, vapor intrusion sampling and subsequent risk analysis could not rule out a potential for risk due to exposure to vapors inside the RCLS warehouse building located on Site Q North.

- Site S – Outdoor industrial worker, construction/utility worker, and trespassing teenager receptors

The potential risk to human health and the environment from COCs in soils, sediments, surface water, and groundwater sources at Sites O, O North, P, Q North, Q Central, Q South, R, and S drives the need for remedial action at OU1 of the Sauget Area 2 Site. The response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

2.8 – Remedial Action Objectives

Remedial action objectives (RAOs) are goals specific to media or operable units for protecting human health and the environment. Risk can be associated with current or potential future exposures. RAOs should be as specific as possible, but not so specific that the range of alternatives to be developed is unduly limited.

As discussed in Section 2.7, the HHRA recognized the following receptors for current and future land-use scenarios: indoor industrial workers, outdoor industrial workers, construction/utility workers, trespassing teenagers, and recreational anglers. Potential exposure routes for each receptor are depicted in the conceptual site model for human health (Figure 2). Current OU1 land uses are industrial/commercial, trespassing, and recreational angling. EPA assumed that future land uses of all properties would be the same as current land uses (e.g., industrial and commercial).

The following RAOs have been identified for the Sauget Area 2 Site based on the summary of receptor potential risks and hazards for the exposure scenarios presented in the HHRAs:

Site O and O North

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for future construction/utility work, industrial/commercial, and trespassing teenager uses.
- Minimize current and future migration of COCs from soil and waste to groundwater at levels causing unacceptable risks.
- Prevent ecological exposure to COCs in surface soils at levels causing unacceptable risk to the environment.
- Minimize migration of mobile source material.

Site P

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for industrial/commercial uses and future construction/utility work.

- Prevent human exposure to vapor intrusion into indoor air at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater.
- Minimize current and future migration of COCs from soil and waste to groundwater at levels causing unacceptable risks.
- Minimize migration of principal threat/ mobile source material.

Site Q North

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for industrial/commercial uses and future construction/utility work.
- Minimize current and future migration of COCs from soils and waste to groundwater at levels causing unacceptable risks.
- Minimize the potential for releases of COCs in wastes and soils due to bank erosion and Mississippi River flooding.
- Minimize migration of principal threat/mobile source material.
- Prevent human exposure to vapor intrusion into indoor air at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater.

Site Q Central

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for industrial/commercial uses and future construction/utility work.
- Minimize current and future migration of COCs from soils and waste to groundwater at levels causing unacceptable risks.
- Minimize the potential for releases of COCs in wastes and soils due to bank erosion and Mississippi River flooding.
- Minimize migration of principal threat/mobile source material.
- Prevent human exposure to vapor intrusion into indoor air in potential future buildings at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater.

Site Q South and Q South Ponds

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for industrial/commercial uses, construction/utility work, and trespassing teenagers.
- Minimize current and future migration of COCs from soils and waste to groundwater at levels causing unacceptable risks.

- Minimize the potential for releases of COCs in wastes and soils due to bank erosion and Mississippi River flooding.
- Minimize migration of principal threat/mobile source material.
- Prevent human exposure to vapor intrusion into indoor air in potential future buildings at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater.
- Prevent human exposure to particulates in outdoor air at levels that result in unacceptable risk from COCs in waste materials or soils due to future construction activities.
- Prevent ecological exposure to COCs in surface soils at levels causing unacceptable risk to the environment. Prevent human exposure to COCs in surface water and sediments via incidental ingestion and dermal contact while wading in the Site Q South ponds to trespassing teenagers.
- Prevent unacceptable risk to recreational angler resulting from exposure via ingestion of fish caught in the Site Q South ponds.

Site R

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for industrial commercial uses and future construction/utility work.
- Minimize the potential for releases of COCs in wastes or soils due to bank erosion and Mississippi River flooding.
- Minimize current and future migration of COCs from soil and waste to groundwater at levels causing unacceptable risks.
- Minimize migration of principal threat/mobile source material.
- Prevent human exposure to vapors released to outdoor air at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater due to trespassing.
- Prevent human exposure to vapor intrusion into indoor air in potential future buildings at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater.

Site S

- Prevent human exposure to COCs in surface and near-surface wastes and soils at levels causing unacceptable risk for industrial/commercial uses, construction/utility work, and trespassing teenagers.
- Minimize current and future migration of COCs from soil and waste to groundwater at levels causing unacceptable risks.
- Minimize migration of mobile source material.

- Prevent human exposure to vapor intrusion into indoor air in potential future buildings at levels that result in unacceptable risk from COCs in waste materials, soils, or groundwater.

A clean-up that achieves these RAOs will be protective of human health and the environment because it will address current and future risks above EPA-acceptable levels in Site media.

Remedial Goals

For potentially carcinogenic risk results, COCs are identified as those COPCs that cause an exceedance of the target risk level of $1x10^{-4}$. For non-carcinogenic hazard results, COCs are identified as those COPCs that cause an exceedance of the toxic-endpoint specific HI of 1. Remediation goal options (RGOs) have been calculated for those COPCs identified as COCs in the HHRAs. RGOs are summarized in Appendix E of this ROD.

2.9 – Description of Alternatives

This section presents the remedial alternatives for OU1, which are numbered to correspond with the numbering system used in the FS Report. The alternatives are described more fully in Section 2.9.2.

In accordance with EPA guidance, the potential remedial alternatives identified in the FS were screened against three broad criteria: (1) effectiveness (both short-term and long-term), (2) implementability (including technical and administrative feasibility), and (3) relative cost (capital and operation and maintenance (O&M)). The purpose of the screening evaluation was to reduce the number of alternatives chosen for a more thorough analysis.

2.9.1 - Common Element of Alternatives

All of the alternatives, except Alternatives O1, P1, QN1, QC1, QS1, R1, and S1 ("no action" alternatives) include the following common elements:

Engineered Caps - Engineered caps minimize the potential for exposure to COCs in soils and waste in covered areas. The types of engineered caps selected for a remedial alternative will vary depending on the existing uses of the Sites and the types of fill or waste materials present at the Sites and will follow the requirements of the federal or more stringent state requirements.

Federal regulations governing hazardous waste landfill closure are RCRA Subpart G (Closure and Post-Closure) and Subpart N (Closure and Post-Closure for Landfills). Illinois has been authorized by EPA to implement RCRA. The corresponding Illinois regulations are 35 Illinois Administrative Code (IAC) Part 724, Subtitle G (Waste Disposal), Subchapter C, Subpart G (Closure and Post-Closure), Sections 724.400 to 724.417. Groundwater monitoring requirements are identified in 35 IAC 724.197. These requirements are equivalent to the federal requirements. In addition, the Illinois solid waste landfill requirements, including closure and post-closure care (Subpart E), for non-hazardous waste are presented in 35 IAC Part 807.

The types of engineered covers included in the remedial alternatives for the Sauget Area 2 Sites include RCRA Subtitle C designed caps, 35IAC § 724[14] compliant soil caps, 35 IAC § 724 compliant crushed rock caps, asphalt caps, and 35 IAC § 807 caps.

RCRA Subtitle C designed caps are multi-layer caps that promote surface water drainage and minimize surface water infiltration into subsurface soils that lie beneath the capped area. They include a low-permeability layer underlain by a gas collection layer and overlain by a drainage layer and protective soil cover and vegetative layer. At traffic areas, the protective surface layer of a RCRA Subtitle C designed cap can be constructed of alternate materials such as crushed rock or asphalt pavement.

A 35 IAC § 724 compliant soil or crushed rock cap will meet the performance standards of a RCRA Subtitle C cap, except the component requiring long-term minimization of migration of liquids. This component is not appropriate for the Sauget Area 2 Sites (see Section 2.10.2). Both the soil and crushed rock caps will use clean material to minimize potential for exposure to COCs in soil and waste. Both caps would require a minimum of two feet of suitable material. Crushed rock caps will use granular material to cover an area. The granular material can be free-draining or less permeable material, depending on Site-specific conditions.

35 IAC § 807 caps generally consist of 6 inches of soil overlying approximately 18 inches of compacted clay over the waste areas.

Asphalt caps include a prepared sub-grade, aggregate base, and an asphalt surface layer. The pavement and aggregate base thickness can be tailored to location specific conditions. Asphalt covers require long-term inspection and maintenance to retain their effectiveness to reduce surface water infiltration and significantly reduce the potential for exposure to COCs in the covered area.

Details of the engineered cap designs for Sauget Area 2 would be developed during the remedial design process.

Institutional and Access Controls – Institutional controls are designed to control access to the Site, manage construction or other intrusive activities that may disturb soil or waste, minimize potential exposure to COCs, and ensure that groundwater is not used for drinking water purposes. Institutional controls that could be implemented include deed restrictions, zoning restrictions and access restrictions such as fences or warning signs. At a minimum, institutional

[14] Subtitle C of RCRA, 42 U.S.C §§ 6921-6939e, directs the EPA Administrator, among other things, to regulate the owners and operators of hazardous waste treatment, storage, and disposal ("TSD") facilities, including landfills. Pursuant to this statutory scheme, EPA has promulgated regulations, codified at 40 C.F.R. Parts 264 and Illinois has adopted analogous regulations codified at 35 IAC Part 724 establishing standards applicable to hazardous waste generators, transporters, and TSD facilities. The federal regulations governing hazardous waste landfill closure are at 40 CFR Part 264, Subpart G (Closure and Post-Closure) and Subpart N (Landfills) *See* 40 CFR § 264.310. Illinois has been authorized by EPA to implement RCRA through its state law and regulations. The corresponding Illinois regulations are 35 IAC Part 724, Subpart G (Closure and Post-Closure Care) and Subpart N (Landfills) *See* 35 IAC § 724.410. These requirements are equivalent to the federal requirements. In addition, the Illinois solid waste landfill requirements for non hazardous waste are presented in 35 IAC Part 807.

controls will be implemented in accordance with the Illinois Uniform Environmental Covenant Act to restrict residential development of the Site. Consistent with expectations set out in the Superfund regulations, none of the remedies rely exclusively on institutional controls to achieve protectiveness. A detailed description of the institutional controls for Sauget Area 2 will be developed in an Institutional Controls Implementation Plan to be prepared during the remedial design process.

2.9.2 – Summary of Remedial Alternatives

Alternatives O1, P1, Q1, R1, and S1:

- **No Action**

Estimated Capital Cost: $0
Estimated Total O&M Cost: $0
Estimated Present Worth Cost: $0
Estimated Construction Timeframe: None

Regulations governing the Superfund program require that the "no action" alternative be evaluated to establish a baseline for comparison. Under this alternative, EPA would take no action at the Site to prevent exposure to the soil and groundwater source contamination.

Site O and O North
Alternative O2:

- **35 IAC § 724 Compliant Soil Cap Over Identified Waste Areas**
- **Institutional and Access Controls**

Estimated Capital Cost: $5,900,000
Estimated O&M Present Worth Cost: $420,000
Estimated Present Worth Cost: $6,300,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements" above. This alternative includes a 35 IAC § 724 compliant soil cap over the identified waste areas and institutional controls. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a) as shown on Figure 4. Through RI sampling, it is believed that much of the site already has a minimum of 2 feet of soil cover. These areas would not require additional soil cover if the pre-design investigation can confirm cover thickness. Areas requiring additional cover in order to meet the 2-foot minimum requirement would be identified during the pre-design investigation.

Alternative O3:

- **Phytotechnology in Potentially Mobile Source Areas**
- **35 IAC § 724 Compliant Soil Cap Over Remainder of Identified Waste Areas**
- **Institutional and Access Controls**

Estimated Capital Cost: $5,400,000
Estimated Present Worth O&M Cost: $400,000
Estimated Present Worth Cost: $5,800,000
Estimated Construction Timeframe: 1 to 2 years

This alternative includes the components of Alternative O2 above, with phytotechnology in the potential mobile source areas, as described below. Institutional controls and engineered caps were described under "Common Elements" above. This alternative includes a 35 IAC § 724 compliant soil cap over the identified waste areas and institutional controls. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a) as shown on Figure 5 outside of areas subject to phytotechnology, as described below.

Phytotechnology in Potential Mobile Source Areas - This process option involves a soil cover and phytotechnology in potential mobile source areas, as shown on Figure 5. Phytotechnology is the use of specially selected plants to provide added benefit in contaminant reduction (i.e., remediation) of selected COCs. It utilizes a variety of plant biological processes and the physical characteristics of plants to aid in Site remediation. Phytotechnology encompasses a number of different processes that can lead to contaminant degradation, removal (through accumulation or dissipation), or immobilization including: degradation, rhizodegradation (enhancement of biodegradation in the below-ground root zone by microorganisms), phytodegradation (contaminant uptake and metabolism above or below ground, within the root, stem, or leaves), phytoextraction (contaminant uptake and accumulation), phytovolatilization (contaminant uptake and volatilization), and phytostabilization (contaminant immobilization in the soil). Phytotechnology enhanced vegetated covers can combine a variety of these methods for containment, removal, and/or destruction of COCs.

Alternative O4:

- **RCRA Subtitle C Designed Cap Over Identified Waste Areas**
- **Institutional and Access Controls**

Estimated Capital Cost: $16,000,000
Estimated Present Worth O&M Cost: $600,000
Estimated Present Worth Cost: $17,000,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements" above. This alternative includes a RCRA subtitle C designed cap over the identified waste areas. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 4.

Site P

Alternative P2:

- **Asphalt Cover Over Potentially Mobile Source Area (SA-P-3/AT-P-5)**
- **35 IAC § 807 Solid Waste Landfill Cap Over Remainder of Identified Waste Areas**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $2,300,000
Estimated Present Worth O&M Cost: $ 300,000
Estimated Present Worth Cost: $2,600,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements" above. The additional component of Alternative P is described below. This alternative includes asphalt and 35 IAC § 807 caps over the identified waste areas, as identified in Figure 6, and institutional controls. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a) as shown on Figure 6, outside of the area with an asphalt cover.

Vapor Intrusion Mitigation - Vapor intrusion sampling during the RI and the subsequent risk analysis could not rule out the potential for risk due to exposure to vapors inside the nightclub. As part of the Site P remedial design, indoor air and/or sub-slab sampling will be completed to further evaluate if a potential risk does exist. If the analysis indicates a potential risk does exist, a vapor control system would be designed and installed inside the nightclub as part of Alternative P2. Institutional controls will also be implemented to address vapor intrusion into any newly constructed buildings within the boundaries of the Site. Vapor intrusion would be addressed through an evaluation of each new building and vapor mitigation measures would be designed into the building to address any potential unacceptable risk.

Alternative P3:

- **NAPL Collection at Well LEACH P-1**
- **Asphalt Cap Over Potentially Mobile Source Area (SA-P-3/AT-P-5)**
- **35 IAC § 807 Solid Waste Landfill Cap Over Remainder of Identified Waste Areas**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $2,300,000
Estimated Present Worth O&M Cost: $600,000
Estimated Present Worth Cost: $2,900,000
Estimated Construction Timeframe: 1 to 2 years

This alternative includes the components of Alternative P2 above, and NAPL collection at well LEACH P-1, as described below.

NAPL Collection at Well LEACH P-1 - The NAPL recovery well system for Site P will include a pump and a collection and storage system to remove NAPL that accumulates in the well. Accumulated NAPL will be periodically removed from the storage system and disposed of in compliance with state and federal regulations. The complete system and details of operation will be specified in the remedial design. The endpoint for the NAPL recovery system will be when NAPL reaches an asymptotic rate of recovery based on empirical recovery data.

Alternative P4:

- **Asphalt Cover Over Potentially Mobile Source Area (SA-P-3/AT-P-5)**
- **RCRA Subtitle C Designed Cap Over Remainder of Identified Waste Areas**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $4,700,000
Estimated Present Worth O&M Cost: $450,000
Estimated Present Worth Cost: $5,200,000

Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements" above. Vapor intrusion migration was discussed under Alternative P2 above. This alternative includes asphalt and RCRA Subtitle C designed caps over the identified waste areas, as identified in Figure 6, and institutional controls. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a) as shown on Figure 6, outside of the area with an asphalt cover, as identified on Figure 6.

Site Q North

Alternative QN2:

- **35 IAC § 724 Compliant Crushed Rock Cap Over Dogleg Area**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $1,100,000
Estimated Present Worth O&M Cost: $170,000
Estimated Present Worth Cost: $1,300,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements" above. The additional component of Alternative QN2 is described below. This alternative includes a 35 IAC § 724 crushed rock cap over the dogleg area, as shown on Figure 7.

Vapor Intrusion Mitigation - Vapor intrusion sampling during the RI and the subsequent risk analysis could not rule out the potential for risk due to exposure to vapors inside the warehouse building. As part of the Site Q North remedial design, indoor air and/or sub-slab sampling will be completed to further evaluate if a potential risk does exist. If the analysis indicates a potential risk does exist, a vapor control system would be designed and installed inside the warehouse building as part of Alternative QN2. Institutional controls will also be implemented to address vapor intrusion into any newly constructed buildings within the boundaries of the Site. Vapor intrusion would be addressed through an evaluation of each new building and vapor mitigation measures would be designed into the building to address any potential unacceptable risk.

Alternative QN3:

- **RCRA Subtitle C Designed Cap Over Dogleg Area**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $12,000,000
Estimated Present Worth O&M Cost: $550,000
Estimated Present Worth Cost: $13,000,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." Vapor intrusion mitigation is described under Alternative QN2 above. This alternative includes a RCRA Subtitle C designed cap over the dogleg area, as shown on Figure 7.

Alternative QN4:

- **RCRA Subtitle C Designed Cover Over Identified Waste Areas**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $32,000,000
Estimated Present Worth O&M Cost: $1,400,000
Estimated Present Worth Cost: $33,400,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." Vapor intrusion mitigation is described under Alternative QN2 above. This alternative includes a RCRA subtitle C designed cap over the identified waste areas, as identified on Figure 8. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 8.

Alternative QN5:

- **35 IAC § 724 Compliant Crushed Rock Cap Over Identified Waste Areas**
- **Vapor Intrusion Mitigation**
- **Institutional and Access Controls**

Estimated Capital Cost: $2,700,000
Estimated Present Worth O&M Cost: $340,000
Estimated Present Worth Cost: $3,000,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered covers were described under "Common Elements." Vapor intrusion mitigation is described under Alternative QN2 above. This alternative includes a 35 IAC § 724 compliant crushed rock cap over the identified waste areas. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 8.

Site Q Central

Alternative QC2:

- **35 IAC § 724 Compliant Crushed Rock Cap Over Identified Waste Areas**
- **Shoreline Erosion Protection**
- **Institutional and Access Controls**

Estimated Capital Cost: $1,900,000
Estimated Present Worth O&M Cost: $200,000
Estimated Present Worth Cost: $2,100,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." The additional component of Alternative QC2 is described below. This alternative includes a 35 IAC § 724 compliant crushed rock cap over the identified waste areas, as shown on Figure 9. The areas to be capped under this alternative are the areas where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 9.

Shoreline Erosion Protection - Site Q Central encompasses approximately 1,500 feet of shoreline along the east bank of the Mississippi River. Approximately 1,000 feet of the shoreline has been covered with riprap to provide erosion protection. There is a segment of the shoreline located upstream of an existing barge ramp where the riprap is not as dense as other areas. A localized area near this segment experienced significant erosion during the 1993 flood event. The eroded area was repaired after the flood event. Alternative QC2 includes placement of additional riprap along portions of the shoreline upstream of the barge ramp to supplement the existing riprap to provide additional shoreline protection. The segment to receive additional riprap is estimated to be 470 feet long.

Alternative QC3:

- **In-Situ SVE Treatment of Potentially Mobile Source Area at AT-Q32**
- **35 IAC § 724 Compliant Crushed Rock Cap Over Identified Waste Areas**
- **Shoreline Erosion Protection**
- **Institutional and Access Controls**

Estimated Capital Cost: $2,400,000
Estimated Present Worth O&M Cost: $380,000
Estimated Present Worth Cost: $2,800,000
Estimated Construction Timeframe: 1 to 2 years

This alternative includes the components of Alternative QC2 above, and in-situ SVE treatment of potentially mobile source areas at AT-Q32, as described below.

In-situ SVE Treatment of Potentially Mobile Source Area at AT-Q32 - This component includes a soil vapor extraction (SVE) system to address the potential mobile source area near the barge ramp (Figure 10). The conceptual SVE system includes the following components: pilot test; a horizontal soil vapor extraction well; thermal oxidation unit with a propane fuel tank; vapor phase carbon adsorption system; liquid phase carbon adsorption system for knockout drum liquids; three vapor phase monitoring points; and O&M of the SVE system. The feasibility study description of Alternative QC3 included surface water sampling and/or sediment sampling during pre-design to determine whether SVE is warranted. This aspect of QC3 has been deleted and the SVE system is included in QC3 with no contingency based on sampling.

Alternative QC4:

- **RCRA Subtitle C Designed Cap Over Identified Waste Areas**
- **Shoreline Erosion Protection**
- **Institutional and Access Controls**

Estimated Capital Cost: $38,000,000
Estimated Present Worth O&M Cost: $1,200,000
Estimated Present Worth Cost: $40,000,000
Estimated Construction Timeframe: 1 to 2 years

This alternative is similar to Alternative QC2 above, except the cap is a RCRA subtitle C designed cap, as shown on Figure 10. The area to be capped under this alternative is the area where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 10.

Site Q South and Q South Ponds
Alternative QS2:

- **Removal of Intact Drums at AT-Q35**
- **35 IAC § 724 Compliant Cap Over Identified Risk Areas**
- **Institutional and Access Controls**

Estimated Capital Cost: $1,900,000
Estimated Present Worth O&M Cost: $130,000
Estimated Present Worth Cost: $2,000,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." The additional component of Alternative QS2 is described below. This alternative includes a 35 IAC § 724 compliant cap over identified risk areas, as shown on Figure 11. The area to be capped under this alternative is the area exceeding acceptable risk levels as identified in the RI (URS, 2008a) and shown on Figure 11. Capping Site Q South will mitigate contaminant transport via run-off to the Site Q South Ponds. Since implementation of the interim groundwater remedy, there are no on-going ecological risks in the Mississippi River from the Site. The interim groundwater remedy has thus reduced the potential for flooding from the Mississippi River to further impact the Site Q South Ponds.

Removal of Intact Drums at AT-Q35 - This alternative includes removal of intact drums located in the previously excavated RI trench AT-Q-35. The location of this former trench will be identified and re-excavated to the same dimensions (e.g., length, width, depth) as previously excavated. Any intact drums identified within the trench will be removed, placed in over pack drums, and treated/disposed off-site in accordance with EPA and Illinois EPA regulations. If intact drums are visible in the trench, the trench will be expanded to remove them to a maximum dimension of 2,500 square feet. Following removal of any intact drums, the excavated area will be backfilled with the soil removed from the trench and clean soil, and appropriately covered.

Alternative QS3:

- **Removal of Intact Drums at AT-Q35**
- **35 IAC § 724 Compliant Cap Over Identified Waste Areas**
- **Institutional and Access Controls**

Estimated Capital Cost: $4,300,000
Estimated Present Worth O&M Cost: $200,000
Estimated Present Worth Cost: $4,500,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." Removal of intact drums is described under QS2 above. This alternative includes a 35 IAC § 724 compliant soil cap over identified waste areas. The area to be capped under this alternative is the area where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 12.

Alternative QS4:

- **RCRA Subtitle C Designed Cap Over Identified Waste Areas**
- **Institutional and Access Controls**

Estimated Capital Cost: $8,400,000
Estimated Present Worth O&M Cost: $320,000
Estimated Present Worth Cost: $8,700,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered covers were described under "Common Elements." This alternative includes a RCRA subtitle C designed cap over identified waste areas, as shown on Figure 12. The area to be capped under this alternative is the area where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 12.

Site R
Alternative R2:

- **35 IAC § 724 Compliant Soil Cap Over Entire Site**
- **Institutional and Access Controls**

Estimated Capital Cost: $1,700,000
Estimated Present Worth O&M Cost: $310,000
Estimated Present Worth Cost: $2,000,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered covers were described under "Common Elements." This alternative includes a 35 IAC § 724 compliant soil cap over the entire site, as shown on Figure 13. The area to be capped under this alternative is the area where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 13.

An engineered soil cap is currently present at Site R and is expected to meet the minimum 24-inch cover requirement over the entire area to be covered. However, a pre-design investigation will be required to document the thickness and condition of the existing soil cover. The objective of this pre-design is to ensure that a minimum of 2 feet of compacted clay soil exists over the former landfill area, not including the slurry wall spoils materials placed on top of Site R during the GMCS construction.

Alternative R3:

- **RCRA Subtitle C Designed Cap Over Entire Site**
- **Institutional and Access Controls**

Estimated Capital Cost: $8,9000,000
Estimated Present Worth O&M Cost: $290,000
Estimated Present Worth Cost: $9,200,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." This alternative is similar to Alternative R2 above, except the cap is a RCRA subtitle C designed cap, as shown on Figure 13. The area to be capped under this alternative is the area where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 13.

Site S

Alternative S2:

- **35 IAC § 724 Compliant Soil Cap Over Entire Site**
- **Institutional and Access Controls**

Estimated Capital Cost: $230,000
Estimated Present Worth O&M Cost: $92,000
Estimated Present Worth Cost: $320,000
Estimated Construction Timeframe: 1 to 2 years

Institutional controls and engineered caps were described under "Common Elements." This alternative includes a 35 IAC § 724 compliant soil cap over the entire site, as shown on Figure 14. The area to be capped under this alternative is the area where industrial waste was identified in the RI (URS, 2008a), as shown on Figure 14.

Alternative S3:

- **In-Situ SVE Treatment of Potentially Mobile Source Areas**
- **35 IAC § 724 Compliant Soil Cap Over Entire Site**
- **Institutional and Access Controls**

Estimated Capital Cost: $800,000
Estimated Present Worth O&M Cost: $240,000
Estimated Present Worth Cost: $1,000,000
Estimated Construction Timeframe: 1 to 2 years

This alternative includes the components of Alternative S2 above, and in-situ SVE treatment of potentially mobile source areas, as described below. This alternative includes a 35 IAC § 724 compliant soil cap over the entire site, as shown on Figure 14.

In-situ SVE Treatment of Potentially Mobile Source Areas - The conceptual design of this SVE system at Site S is similar to the SVE system described for Alternative QC3 except that vertical extraction wells will be used rather than a horizontal extraction well. Design details for the SVE system will be based on pilot testing completed during the remedial design.

Alternative S4:

- **RCRA Subtitle C Designed Cap Over Entire Site**
- **Institutional and Access Controls**

Estimated Capital Cost: $570,000
Estimated Present Worth O&M Cost: $ 92,000
Estimated Present Worth Cost: $660,000
Estimated Construction Timeframe: 1 to 2 years

This alternative is similar to Alternative S2 above, except the cap is a RCRA Subtitle C cap over the entire site, as shown on Figure 14.

2.10 – Comparative Analysis of Alternatives

As required by CERCLA, nine criteria were used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. This section of the Record of Decision summarizes the performance of each alternative against the nine criteria and notes how they compare to the other options under consideration.

The nine evaluation criteria fall into three groups: threshold criteria, primary balancing criteria, and modifying criteria. Threshold criteria, which include overall protection of human health and the environment and compliance with ARARs, are requirements that each alternative must meet in order to be eligible for selection. Primary balancing criteria, which include long-term effectiveness and permanence, reduction of toxicity, mobility, or volume of contaminants through treatment, short-term effectiveness, implementability, and cost, are used to weigh major trade-offs among alternatives. Modifying criteria include state/support agency acceptance and community acceptance, and are assessed after public comment is received on the Proposed Plan. In the final balancing of trade-offs between alternatives, upon which the final remedy selection is based, modifying criteria are of equal importance to the balancing criteria. The nine evaluation criteria are discussed below.

2.10.1 - Overall Protection of Human Health and the Environment

This criterion assesses how well the alternatives achieve and maintain protection of human health and the environment.

This evaluation criterion assesses whether each remedial alternative protects human health and the environment. This assessment focuses on how an alternative achieves protection over time and indicates how each source of contamination would be minimized, reduced, or controlled through treatment, engineering, or institutional controls. The evaluation of the degree of overall protection associated with each alternative is based largely on the exposure pathways and scenarios set forth in the baseline human health risk assessment (HHRA).

The "No Action" Alternatives O1, P1, QN1, QC1, QS1, R1 and S1 are not protective of human health or the environment because they do not meet the RAOs developed for the affected soils and waste at Sites O, O North, P, Q North, Q Central, Q South, R, or S; are not protective of human health and the environment; and do not comply with the ARARs identified for each of these sites. Because Alternatives O1, P1, QN1, QC1, QS1, R1 and S1 are not protective of human health and the environment, they are eliminated from consideration under the remaining eight criteria.

The engineered caps included in Alternatives O2, O3, O4, P2, P3, P4, QN2, QN3, QN4, QN5, QC2, QC3, QC4, QS2, QS3, QS4, R2, R3, S2, S3, and S4 achieve the RAO for surface and subsurface soil and the RAO for waste and leachate. These engineered caps, in conjunction with the institutional controls, minimize the potential for human exposure to COCs at the fill area and prevent erosion of the fill areas.

Alternatives O2, O3, O4, QC2, QC3, QC4, QS2, QS3, QS4, R2, R3, S2, S3, and S4 achieve the soil vapor RAO. Results of the vapor intrusion HHRA indicate that concentrations of COCs found in soil vapor do not pose an unacceptable risk to human receptors in existing buildings at Site O, Q Central, R, and S. Alternatives P2, P3, P4, QN2, QN3, QN4, and QN5 achieve the soil vapor RAO through the vapor mitigation component of these alternatives. O2, O3, O4, P2, P3, P4, QN2, QN3, QN4, QN5, QC2, QC3, QC4, QS2, QS3, QS4, R2, R3, S2, S3, and S4 include institutional controls that will prevent construction of new buildings on the source areas without vapor controls.

2.10.2 - Compliance with Applicable or Relevant and Appropriate Requirements

This criterion assesses how the alternatives comply with regulatory requirements. Federal and state regulatory requirements that are either applicable or relevant and appropriate are known as ARARs. Only state requirements that are more stringent than federal requirements are ARARs. There are three different categories of ARARs: chemical-specific, action-specific, and location-specific ARARs.

Landfill Closure/Post-Closure

Alternatives O2, O3, O4, P2, P3, P4, QN2, QN3, QN4, QN5, QC2, QC3, QC4, QS2, QS3, QS4, R2, R3, S2, S3, and S4 can be designed and implemented to comply with ARARs relating to closure and post-closure requirements for landfills, specifically 35 IAC § 724, which contain the standards for owners and operators of hazardous waste treatment, storage, and disposal facilities, and 35 IAC § 807 for Alternatives P2, P3, and P4, which contain standards for solid waste landfills. Although the 35 IAC § 807 standards for solid waste landfills are relevant to Sauget Area 2, they are not appropriate at Site O, O North, Q North, Q Central, Q South, R, and S because the hazardous waste landfill requirements of 35 IAC § 724 are better suited to Site conditions. However, Site P was operated as a permitted municipal solid waste landfill and as a result, the requirements of 35 IAC § 807 are applicable to closure and post-closure.

The engineered caps in Alternatives O2, O3, QN2, QN5, QC2, QC3, QS2, QS3, R2, S2, and S3 all comply with 35 IAC § 724.410's performance standards of functioning with minimal maintenance, promoting drainage, and minimizing erosion of the cap, and could accommodate settling and subsidence so that the cap's integrity is maintained. However, 35 IAC § 724.410's performance standard for providing long-term minimization of migration of liquids (including the RCRA Subtitle C designed cap proposed in Alternatives O4, QN3, QN4, QC4, QS4, R3, and S4) is not appropriate for Sites O, O North, Q North, Q Central, Q South and Site R because of the following:

Site O and O North:

- Groundwater data from the shallow hydraulic unit (SHU) indicated relatively minor impacts at Site O.
- Impacted groundwater at Site O is intercepted and treated by the GMCS and does not reach, or discharge, to the Mississippi River.

- The area of potential human health and ecological risk identified at Site O would be addressed by the cover included in the Selected Remedy for Site O: Alternative O2.
- No principal threat materials were identified at Site O.

Site Q North:

- Impacted groundwater from Site Q North-Dogleg is intercepted and treated by the GCMS and does not reach, or discharge, to the Mississippi River.
- Due to the proximity of Site Q North to the River and documented groundwater fluctuation based on the rising and falling River levels, installation of any type of cover to minimize infiltration would not address flushing effects from the rising and falling water table.

Site Q Central:

- No TCLP[15] samples collected during the RI failed TCLP.
- Groundwater data from the SHU indicated relatively minor impacts at Site Q Central.
- Due to the proximity of Site Q North to the River and documented groundwater fluctuation based on river levels, installation of any type of cover to minimize infiltration would not address flushing effects from the rising and falling water table.
- No principal threat wastes were identified at Site Q Central.

Site Q South:

- Area of principal threat wastes at Site Q South will be addressed by removing the intact drums in the Selected Remedy for Site Q South.
- Groundwater data from the SHU indicated relatively minor impacts at Site Q South.

Site R:

- Site R is currently covered with approximately 5 feet of compacted clay.
- Impacted groundwater from Site R is intercepted and treated by the GMCS.

Polychlorinated Biphenyls (PCB) Regulation of Remediation Waste

As mentioned in Section 2.2, previous removal actions conducted by EPA at Site Q Central and Site Q South already have removed principal threat wastes by excavating and disposing off-Site approximately 3,271 drums and 14,000 tons of high-level polychlorinated biphenyls (PCB) contaminated soil. The remaining areas containing PCBs at the Sauget Area 2 Site are the disposal areas at Sites O, P, Q, R, and S. These disposal areas contain municipal and industrial waste materials, including crushed or partially crushed drums, drum fragments, debris, and miscellaneous trash. Collectively, Sites O, P, Q, R, and S contain an estimated 4.5 million

[15] Toxicity Characteristic Leaching Procedure (TCLP) is a soil sample extraction method for chemical analysis employed as an analytical method to simulate leaching through a landfill. The testing methodology is used to determine if a waste is characteristically hazardous.