East Chicago
WATERWAY MANAGEMENT DISTRICT

Feasibility Study Report

Grand Calumet River and Indiana Harbor Canal in the Grand Calumet River Area of Concern

East Chicago, Indiana

Prepared by:

TETRA TECH

Project No. 103S3132

TETRA TECH

June 12, 2015

Mr. Fernando Trevino
Executive Director
East Chicago Waterway Management District
4444 Railroad Avenue
East Chicago, IN 46312

Subject: Feasibility Study Report
Grand Calumet River and Indiana Harbor Canal
East Chicago, Indiana

Dear Mr. Trevino:

Tetra Tech is submitting the enclosed Feasibility Study (FS) Report for the Grand Calumet River and Indiana Harbor Canal in East Chicago, Indiana.

If you have any questions regarding the FS report, please call me at (312) 201-7781.

Sincerely,

James Wescott

James Wescott
Project Manager

Enclosure

cc: Diana Mally, USEPA

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FEASIBILITY STUDY

GRAND CALUMET RIVER AND INDIANA HARBOR CANAL
EAST CHICAGO, INDIANA

Prepared for
East Chicago Waterway Management District
4444 Railroad Avenue
East Chicago, Indiana 46312

Date Prepared	:	June 12, 2015
Prepared by	:	Tetra Tech
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ACRONYMS

AVS	Acid volatile sulfide
AOC	Area of Concern
BUI	Beneficial Use Impairment
CARE	Citizens Advisory for the Remediation of the Environment
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of concern
CSO	Combined sewer overflow
DRO	Diesel Range Organics
CWA	Clean Water Act
ECSD	East Chicago Sanitary District
ECWMD	East Chicago Waterway Management District
FEPA	U.S. Environmental Protection Agency
FS	Feasibility study
GCR	Grand Calumet River
GLLA	Great Lakes Legacy Act
GRA	General Response Action
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IHC	Indiana Harbor Canal
IJC	International Joint Commission
LGC	Lake George Canal
NPDES	National Pollutant Discharge Elimination System
NEPA	National Environmental Policy Act
MCL	Maximum contaminant level
µg/L	Micrograms per liter
µmoles/g	Micromoles per gram
µmoles/goc	Micromoles per gram organic carbon
mg/kg	Milligrams per kilogram
MNR	Monitored natural recovery
NAPL	Non-Aqueous Phase Liquids
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and maintenance
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PEC	Probable effects concentration
PRG	Preliminary remediation goal
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
SOW	Scope of work
SEM	Simultaneously extracted metals
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture

1.0 INTRODUCTION

Tetra Tech prepared this feasibility study (FS) for the East Chicago Waterway Management District (ECWMD) as a component of a planned Great Lakes Legacy Act (GLLA) project. This study presents the evaluation of remedial alternatives for the Grand Calumet River (GCR) and the Indiana Harbor Canal (IHC), including the Lake George Canal (LGC) in East Chicago, Indiana. Specifically, Tetra Tech developed remedial alternatives to address contaminants of concern (COC) associated with sediment in the project area.

This report (1) establishes site-specific remedial action objectives (RAO) protective of human health and the environment for GCR and IHC, (2) proposes general response actions to satisfy those RAOs, (3) screens remedial technologies and process options to ensure only applicable technologies are retained, and (4) develops remedial alternatives from retained remedial technologies and process options. In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) remedial alternatives are then evaluated against nine criteria. This report also includes estimated areas and volumes of contaminated sediment.

The report is organized into seven major sections. Section 1 provides a summary of historical activities that have occurred at the GCR and IHC project area. Section 2 discusses the identification of RAOs and areas and volumes of sediment requiring remediation for GCR and IHC. Section 3 provides screening of remedial technology types and process options. Section 4 provides the remedial alternatives. Section 5 provides detailed analysis of alternatives. Section 6 provides comparative evaluation of remedial alternatives. The conclusions are presented in Section 7 and references are located in Section 8. Figures and tables follow Section 8.

1.1 GCR AND IHC SITE BACKGROUND AND HISTORY

The following sections provide a description of the GCR and IHC, and a brief summary of historical activities that have been conducted in the project area. More detailed information can be found in the remedial investigation (RI) report for the site (Tetra Tech 2015a).

1.1.1 Site Description

The GCR is composed of two east-west oriented branches that meet at the southern end of the IHC. The East Branch of the GCR originates at the GCR lagoons, located east of the U.S. Steel facility in Gary, Indiana. From the headwaters, the East Branch flows west for about 10 miles to reach its confluence with the IHC and the West Branch of the GCR. The West Branch extends 6 miles from the IHC to the confluence with the Little Calumet River in northeastern Illinois. The GCR system is connected to Lake Michigan by the IHC and Indiana Harbor. The IHC extends a distance of approximately 4 miles north from the confluence of the East and West branches of the GCR to Indiana Harbor. The LGC is a 2-mile branch of the IHC that extends east-west from Calumet Avenue in Hammond, Indiana, to its junction with the IHC.

The project area is shown in Figure 1-1 and includes portions of the GCR, IHC, and LGC and is defined as follows:

- GCR Junction: A 1.3-mile section of the GCR from Kennedy Avenue (east) to Indianapolis Boulevard (west)
- IHC: A 1.5-mile non-navigable section of the IHC from the junction with the GCR north to Columbus Drive (U.S. Route 12)
- LGC: A 1.4-mile section of the LGC from Calumet Avenue (west) to Indianapolis Boulevard (east)

The land surrounding the river is primarily industrial and commercial, interspersed with residential areas. The GCR basin has a long history of industrial activity. This section of the GCR and IHC is highly industrialized, with numerous historical and current industrial facilities, and discharges from the adjacent East Chicago Sanitary District (ECSD). The primary COCs are polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), heavy metals (primarily lead), and oil and grease. The land around the project area is one of the most heavily industrialized areas in the United States. Industries that operate or have operated in the area include steel mills, lead smelters, foundries, chemical plants, packing plants, a distillery, a concrete and cement fabricator, oil refineries, and milling and machining companies.

1.1.2 Site History

The overall GCR and IHC were designated as an area of concern (AOC) by the International Joint Commission (IJC) in 1987. The area was found impaired in all 14 beneficial uses evaluated by the IJC:

1. Restrictions on fish and wildlife consumption
2. Tainting of fish and wildlife flavor
3. Degraded fish and wildlife populations
4. Fish tumors or other deformities
5. Bird or animal deformities or reproductive problems
6. Degradation of benthos
7. Restrictions on dredging activities

8. Eutrophication or undesirable algae
9. Restrictions on drinking water consumption or taste and odor problems
10. Beach closings
11. Degradation of aesthetics
12. Added costs to agriculture and industry
13. Degradation of phytoplankton and zooplankton
14. Loss of fish and wildlife habitat

Since its original designation, two beneficial use impairments (BUIs) have been removed: added costs to agriculture and industry in 2011 (Item 12) and restrictions on drinking water consumption or taste and odor problems in 2012 (Item 9).

Since 2002, several sediment removal and capping projects have occurred within the GCR AOC as shown on Figure 1-2. The first significant sediment removal project occurred on the U.S. Steel property on the East Branch GCR between 2002 and 2005. Approximately 788,000 cubic yards of sediment was hydraulically dredged and placed in a confined disposal facility (CDF) on the USS Gary Works property.

Remedial work on the West Branch GCR began in 2009 between Columbia Avenue and Calumet Avenue, also called Reach 3. This section was substantially completed in 2010. In 2011, Reaches 4 and 5 to the west of Reach 3 began. Reach 4 is between Calumet Avenue and Sohl Avenue and Reach 5 runs from Sohl Avenue west to Hohman Avenue. Approximately 55,000 cubic yards of sediment was mechanically excavated and disposed in a commercial landfill as a result of remedial action on Reaches 3 to 5. After dredging, approximately 13.5 acres of Reactive Core Mat® with activated carbon was placed over the remaining sediment followed by an armor layer of sand and gravel. Remedial work on Reaches 4 and 5 was substantially complete in 2012.

Work on Reaches 1 and 2 of the West Branch GCR began in 2011. This section between Indianapolis Boulevard and Columbia Avenue is also known as the Roxana section because it includes restoration of the 20-acre Roxana Marsh. Approximately 122,000 cubic yards of sediment was hydraulically dredged from the river and an additional 110,000 cubic yards of sediment was mechanically excavated from Roxana Marsh. All of the sediment was disposed in a commercial landfill. After dredging, an adsorptive layer consisting of sand and organoclay covering approximately 20 acres was placed over the remaining sediment in the river followed by an armor layer of sand and gravel. Construction on Reaches 1 and 2 was substantially complete in 2012.

Remedial activities moved to Reaches 4A and 4B on the East Branch GCR in 2013. Reaches 4A and 4B covers the river between Cline Avenue and Kennedy Avenue and includes a 40-acre marsh on the south side of the river. As with the Roxana section, the river was hydraulically dredged and the marsh mechanically excavated. Approximately 350,000 cubic yards of sediment were removed and disposed at a commercial landfill. After dredging, an adsorptive layer consisting of sand and organoclay covering approximately 35 acres was placed over the remaining sediment in the river followed by an armor layer of sand and gravel. Construction on this section was substantially complete in May 2015.

With the completion of Reaches 4A and 4B, all of the rivers sections upstream of the project area will have been addressed except for a section of the East Branch between Cline Avenue and the U.S. Steel project. A Focused Feasibility Study for this section, commonly called the Gary section since it lies within the municipal limits of Gary, Indiana, was recently completed by the Gary Sanitary District. The schedule for a design and eventual remedial action on this section is currently under review. The Reach 4A and 4B project included a sedimentation basin on the downstream side of the Gary section at Cline Avenue to mitigate any future sediment releases into areas of the GCR already remediated or the current project area.

Downstream of the project area, dredging of the navigation channel by Chicago District United States Corps of Engineers (USACE) began in 2012 after an almost 40 year hiatus. Sediment is removed to set elevations within the navigation channel and disposed in a CDF on the north side of the LGC. The CDF is owned by the ECWMD and operated by the Chicago District. Dredging is strictly for navigational purposes and there are no environmental goals associated with this dredging.

1.2 REMEDIAL INVESTIGATION SUMMARY

This section summarizes the sampling activities and describes site geology, hydrogeology, and the nature and extent of contamination as presented in the RI report (Tetra Tech 2015a). The remedial investigation for the GCR, IHC, and LGC is based on a scope of work (SOW) issued by the ECWMD (ECWMD 2013) and the Chicago District (USACE 2014). The SOW outlined the following requirements for the RI:

- Characterization of chemical and geotechnical characteristics of sediment in the GCR, IHC, and LGC
- Pore water sampling and groundwater flow measurements to evaluate chemical contamination in sediment pore water as well as hydraulic gradients at the bottom of each water body.
- Soil characterization of upland areas including both chemical contamination and classification of soils following the Unified Soil Classification System (USCS) in upland areas that may be considered as support or staging areas during future remedial actions. The areas included an area southwest of the junction of the East and West Branches of the GCR and an area south of the LGC and immediately west of Indianapolis Boulevard.

- Examination of ongoing sources of contamination in the project area including storm water outfalls that may contribute to the contaminant loading in the project area during storm events.

1.2.1 Site Geology

The GCR and IHC is a low to medium velocity, high-turbidity river. The LGC section has a small channel on the west, upstream end, but is essentially a dead end. The GCR is approximately 70 to 100 feet wide. The West Branch is 2 to 3 feet deep while the East Branch, which has a slightly higher surface water velocity, is 3 to 7 feet deep. The IHC widens to 100 to 120 feet and the depth is similar to the East Branch with deeper scour pools on the downstream side of several bridges. The streambed in the GCR and IHC consists primarily of sand, with clay/silt fractions up to 50 percent in certain areas. The LGC is approximately 200 feet wide and has more silt than sand. The topography of the land adjacent to the project area is generally flat (slopes of 0 to 2 percent) with gentle slopes toward the water.

During the RI, Tetra Tech collected sediment cores along with additional sediment probing in the 3 sections of the project to evaluate the depth of sediment present. Based on the investigation, highly organic sediment within the project area ranged from 2 to 20 feet thick. Sediment in the GCR is approximately 8 to 10 feet thick. The IHC shows a similar profile at the south end near the junction with the GCR, then transitions to a thinner layer about 4 feet thick over a relatively clean sand before the sediment thickness increases again near Columbus Drive and the beginning of the navigation channel. Sediment thickness in the LGC is quite thick, approximately 10 to 20 feet.

Surficial geology immediately surrounding the project, based on the United States Department of Agriculture (USDA) Web Soil Survey (Tetra Tech 2015b), changes throughout the extent of the study area. The soil types surrounding the project area are mostly Urban Land with Houghton Muck in the wetland areas adjacent to the GCR.

1.2.2 Site Hydrogeology

Surface water run-off drains into the project area and then flows north and east into Lake Michigan. Numerous storm water outfalls are located within the project area, primarily in the main section of the IHC. The outfall for the ECSD wastewater treatment plant is located on the West Branch GCR near Indianapolis Boulevard. This outfall is also permitted as one of three combined sewer outfalls (CSOs) for the district. A second CSO is located on the East Branch GCR near Cline Avenue and the third is located on the IHC near Canal Street north of the project area. Seiche caused by wind or atmospheric pressure changes can cause the water in the project area to reverse and flow from Lake Michigan into the GCR.

During the RI, temporary monitoring wells were installed in three clusters within the West Branch GCR to determine whether gaining or losing stream conditions were present at each location. The river is typically a gaining stream, meaning groundwater flows up through the sediment into the river. Surface water and ground water levels were measured on two separate days in December 2014, once in January 2015, and then continuously for six weeks from March 10 to April 22 to provide a snapshot of hydrologic conditions and to assess the relationship between groundwater and surface water. Static water levels in the temporary monitoring wells appeared to be relatively stable, generally varying less than 1.0 foot during the measurement events. Over the same gauging period, the water surface elevation varied by approximately 1.0 foot.

1.2.3 Nature and Extent of Contamination

This section describes the contamination in sediment and sediment pore water at the project site and summarizes sampling conducted during the RI. The GCR and IHC site was divided into six exposure areas for RI (see Figures 1-3 to 1-5), listed below:

- GCR-East: this exposure area includes the approximately 3,500 linear foot section of the GCR from Kennedy Avenue to the junction with the West Branch.
- GCR-West: this exposure area includes the approximately 3,400 linear foot section of the GCR from the junction with the East Branch to Indianapolis Boulevard.
- IHC: this exposure area includes the 7,100 linear foot section of the IHC from the junction with the GCR to Columbus Drive.
- LGC-East: this exposure area includes the approximately 2,150 linear foot section of the LGC from Indianapolis Boulevard to the CSX Railroad Bridge.
- LGC-Middle: this exposure area includes the approximately 2,250 linear foot section of the LGC from the CSX Railroad Bridge to the Land Bridge.
- LGC-West: this exposure area includes the approximately 2,500 linear foot section of the LGC from the Land Bridge to Calumet Avenue.

1.2.3.1 Sediment and Sediment Pore Water Characterization

A total of 65 surficial sediment and 110 subsurface sediment samples were collected from the project area. In addition, eleven sediment pore water samples were collected either from surface sediment or well clusters within the river. Sediment and pore water data were compared to risk-based goals established for the GCR (Tetra Tech, 2005) as well as contaminant levels identified in other investigation efforts conducted adjacent to the current project area.

The primary COCs in the GCR AOC are PAH compounds. The total concentrations of the sixteen priority PAH compounds established by EPA in both the surface and subsurface sediments are provided in Figures 1-6 to 1-11.

To assess the potential impact of metal bioavailability, surficial sediment samples were analyzed to determine their acid volatile sulfide (AVS) and simultaneously extracted metals (SEM) concentrations reported at micromoles per gram (µmoles/g) of sediment. EPA reported that toxicity is not likely when the combination of metals and organic carbon result in ≤ 130 µmoles/goc (EPA, 2005a). For those sediments where the results are between 130 µmoles/goc and 3,000 µmoles/goc they may have adverse biological effects, and those > 3,000 µmoles/goc adverse effects are expected.

Surface sediment samples were evaluated using the toxicity characteristic leaching procedure (TCLP) to verify whether any sediment would be classified as a hazardous waste upon removal. No sediment samples exceeded the TCLP criteria; therefore, it is expected that material dredged during the remedial action would not be managed as a hazardous waste.

Exposure Area GCR-East

The RI results were compared to historical samples collected from the East Branch Reaches 4A and 4B in 2011 (Battelle, 2011) immediately to the east and upstream of the project area. The surficial sediment concentration of the 16 priority PAH contamination (Figure 1-6) appears consistent with the Battelle results (total PAH concentration of between 0 and 500 milligrams per kilogram [mg/kg]). Subsurface sediment was not evaluated upstream by Battelle. Subsurface sediment in the GCR-East section (Figure 1-7) is also between 0 and 500 mg/kg, except for one sample result of 654 mg/kg.

The total concentration of the 16 priority PAHs in the sediment pore water were less than 1 microgram per liter (µg/L), which is less than the pore water concentrations observed upstream. Pore water concentrations in Reach 4A varied between 46 and 1,162 µg/L.

PCB concentrations in the surface sediment upstream of GCR-East range between 0 and 5 mg/kg. PCBs in the surficial sediment detected during the RI are between 1 and 10 mg/kg and less than 5 mg/kg in the subsurface sediment except for one result of 6.38 mg/kg.

Metal bioavailability did not exceed the 3,000 µmoles/goc threshold level. One sample point at the junction in GCR-East exceeded the 130 µmoles/goc threshold level with a 140 µmoles/goc value.

Exposure Area GCR-West

The RI results in GCR-West were compared to historical samples collected from the West Branch Reaches 1 and 2 in 2010 (Tetra Tech, 2010) immediately to the west and upstream of the project area. The surficial sediment concentration of the 16 priority PAH contamination (Figure 1-6) appears slightly lower than the previous results in the upstream section. The surface sediment in GCR-West did not exceed 100 mg/kg, while the concentration in Reach 1 immediately upstream exceeded 1,000 mg/kg. The lower concentration may be partly the result of capping operations conducted in Reaches 1 and 2 in 2012 that inadvertently covered parts of the GCR-West area.

Total PAH concentrations in the subsurface sediment (Figure 1-7) was also consistent with higher levels of impact seen in Reach 1. Subsurface sediment in the GCR-West was in the 500-1,000 mg/kg range with a single location over 4,000 mg/kg. Subsurface sediment in Reach 1 was also in the 1,000 mg/kg range with pockets of higher concentrations.

The total concentration of the 16 priority PAHs in the sediment pore water ranged from less than one µg/L to 843 µg/L, which is similar to the pore water concentrations observed upstream. Pore water concentrations in Reach 1 varied between 9 and 913 µg/L.

PCB concentrations in the surface and subsurface sediment upstream of GCR-West were generally less than 1 mg/kg with most results reported as non-detect in the subsurface sediment. PCB concentrations in Reach 1 were also mostly non-detect results.

Metal bioavailability did not exceed the 3,000 µmoles/goc threshold level. One sample point exceeded the 130 µmoles/goc threshold level with a 236 µmoles/goc value.

Visible sheens were observed throughout this exposure area during the RI activities.

Exposure Area IHC

The RI results in the IHC were compared to the downstream results of the current RI as well as historical results from further downstream. The surficial sediment concentration of the 16 priority PAH contamination (Figure 1-8) ranged from 3 to 43 mg/kg, with the highest values immediately downstream of 151st Avenue and at Columbus Drive where the IHC transitions from a non-navigation to navigation channel. Subsurface sediment results (Figure 1-9) showed the same general pattern with the PAH concentration peaking at 631 mg/kg near 151st Avenue and then declining farther north.

The total concentration of the 16 priority PAHs in the sediment pore water was less than 1 µg/L, which is similar to the pore water concentrations observed upstream.

PCB concentrations in the surface sediment ranged from non-detect to 81 mg/kg with the same distribution pattern as the PAHs with the highest concentration downstream of 151st Avenue and another small peak at Columbus Drive. The PCB concentration over 50 mg/kg is the highest seen outside the USS Gary Works property and will require special handling and disposal if removed. The sediment area exceeding 50 mg/kg is approximately 300 linear feet of the IHC. No subsurface samples exceeded 50 mg/kg with a 44 mg/kg value 3 to 4 feet below the 81 mg/kg hotspot.

Metal bioavailability did not exceed the 3,000 µmoles/goc threshold level. Four out of nine sample point exceeded the 130 µmoles/goc threshold level with a low of 149 µmoles/goc and a high of 1,503 µmoles/goc. The relatively high number of exceedances in this segment is partially the result of low organic carbon. The higher velocities in the IHC flush out much of the organic matter, leaving a higher sand mix than in the GCR upstream.

Exposure Area LGC-East

The surficial sediment concentration of the 16 priority PAH contamination (Figure 1-10) ranged from 17 to 211 mg/kg. Subsurface sediment (Figure 1-11) ranged from 32 to 924 mg/kg, with the average of 470 mg/kg.

No sediment pore water samples were collected in this segment.

PCB concentrations in the surface sediment ranged from non-detect to 6.84 mg/kg and non-detect to 28.33 mg/kg in the subsurface sediment. The higher concentrations were generally located along the north side of LGC-East in an area recently dredged to the navigation depth.

Metal bioavailability did not exceed the 130 µmoles/goc threshold level.

This segment also had the highest concentrations of diesel range organics (DRO), ranging from 1,600 to 47,000 mg/kg. The higher concentrations of DRO within this segment were on the south bank in an area not recently dredged.

Visible sheens were observed throughout this exposure area during the RI activities.

Exposure Area LGC-Middle

The surficial sediment concentration of the 16 priority PAH contamination (Figure 1-10) ranged from 14 to 58 mg/kg. Subsurface sediment (Figure 1-11) ranged from non-detect to 764 mg/kg.

The total concentration of the 16 priority PAHs in the sediment pore water was less than 1 µg/L, which is similar to the pore water concentrations observed upstream.

PCB concentrations in the surface sediment ranged from 1.06 to 1.61 mg/kg and non-detect to 4.06 mg/kg in the subsurface sediment.

Metal bioavailability did not exceed the 130 µmoles/goc threshold level.

This segment also had the highest concentrations of oil and grease, ranging from 72,600 to 90,100 mg/kg. This is 5 to 20 times the concentrations seen in other exposure areas within the GCR and IHC.

Visible sheens were observed throughout this exposure area during the RI activities.

Exposure Area LGC-West

The surficial sediment concentration of the 16 priority PAH contamination (Figure 1-10) ranged from 53 to 62 mg/kg. Subsurface sediment (Figure 1-11) ranged from not detected to 398 mg/kg.

No sediment pore water samples were collected in this segment.

PCB concentrations were not detected in any of the surface or subsurface sediment.

Metal bioavailability did not exceed the 130 µmoles/goc threshold level.

This segment had the highest concentration of phenol, ranging from 10.0 to 11.1 mg/kg. This is 2 to 3 times the concentrations seen in other exposure areas within the GCR and IHC.

Only three sample points are located in LGC-West based on the initial expectation that the area would be relatively free of impacted sediment. Additional sampling would be recommended prior to implementation of a final remedy for this area to further delineate the sediment thickness and the composition of the native material below the expected removal elevation.

2.0 REMEDIAL ACTION OBJECTIVES, REGULATORY REQUIREMENTS, AND QUANTITIES

This section identifies RAOs, regulatory requirements, and estimated areas and volumes of sediment to be addressed at the project site.

2.1 REMEDIAL ACTION OBJECTIVES

The overall remedial goal for this project is to remove the 12 remaining GCR AOC BUIs, thus allowing the AOC to be delisted. To address the risks to aquatic receptors associated with direct exposure to contaminated sediments, the following RAOs were established: minimize or prevent exposure to sediments that are sufficiently contaminated to pose intermediate or high risks, respectively, to the microbial or benthic invertebrate communities and that would affect the prey base for fish; and minimize or prevent exposure to pore waters that are sufficiently contaminated to pose intermediate or high risks, respectively, to aquatic plant, benthic invertebrate, or fish communities (particularly for fish species that use sediment substrates for spawning).

To achieve RAOs associated with BUIs, it was necessary to establish a preliminary remediation goal (PRG) that represent concentrations of contaminants in sediments that would allow removal of the BUIs. The results of the various assessments of sediment injury that have been conducted indicated that contaminated sediments in the GCR AOC pose unacceptable risks to benthic invertebrates, fish, and aquatic-dependent wildlife. These assessments identified the primary contaminant of concern in the GCR AOC as PAH compounds. A PRG for total PAH concentration of 27 mg/kg dry weight in sediment or sediment pore water was developed largely using matching sediment chemistry and sediment toxicity data from the West Branch GCR (Tetra Tech, 2005).

Only some of the twelve BUIs are directly associated with contaminated sediment. Removal of some BUIs may not require a numerical PRG, such as “Restrictions on Dredging Activities”. Dredging for both navigational and environmental purposes has been occurring within the GCR AOC for several years as discussed in Section 1.1.2.

Progress toward delisting some BUIs may also be achieved without meeting the numerical PRG. Dredging sediment to increase the water depth or covering impacted sediment can minimize or prevent exposure to whole sediments and pore waters that are sufficiently contaminated to pose intermediate or high risks, respectively, to microbial life, aquatic plant or fish communities (particularly for fish species that use sediment substrates for spawning and/or early rearing), sediment-probing bird associated with ingestion of sediments during feeding activities, and human health associated with direct contact with sediments during primary contact recreation (swimming or wading) or maintenance activities (e.g., maintenance utility workers).

As an example, adverse metal bioavailability to aquatic life can be addressed by removing direct contact with the impacted sediment by covering the sediment with a thin layer of inert material such as sand. Implementing potential remedies that do not achieve a PRG may also be required in parts of the project area adjacent to the navigation channel since the navigation channel does not have a PRG.

2.2 REGULATORY REQUIREMENTS

In addition to the overall project goal of removing BUIs, compliance with applicable regulations and permitting requirements and approvals must also be achieved during remedial actions.

While there are numerous regulations that are potentially applicable, the most substantive requirements are likely to be associated with permitting and regulatory compliance for waste characterization and disposal; work in open water, in navigable waters, in wetlands, and along shorelines; discharge of water resulting from remediation processes; and compliance with the National Environmental Policy Act (NEPA).

There are numerous regulations that are potentially applicable; given the current understanding of the site, there are key potential requirements associated with permitting and regulatory compliance for the following:

- Waste characterization and disposal, which is regulated under the Toxic Substances Control Act (TSCA) and Resource Conservation and Recovery Act (RCRA);
- Work in open water, in navigable waters, in wetlands, and along shorelines, which must comply with specific statutes of the Clean Water Act (CWA) and specific statutes of Indiana Department of Environmental Management (IDEM) and Indiana Department of Natural Resources (IDNR);
- Discharge of water resulting from remediation processes, which is regulated under the CWA and will likely require National Pollutant Discharge Elimination System (NPDES) permitting; and
- Evaluation of the potential environmental and cultural effects of remediation under NEPA.

2.3 GENERAL RESPONSE ACTIONS

General Response Actions (GRA) were evaluated to identify actions that are both implementable and likely to result in progress toward delisting the GCR AOC. EPA guidance identifies removal, containment, in situ treatment, and monitored natural recovery (MNR) as the four main GRAs applicable for sediment remediation (EPA 2005b). The definition and evaluation of GRAs included major factors affecting their relevance. Primary among these was the ability to achieve removal of BUIs. Other factors include site hydrodynamic regime, sediment grain size distribution, current and future land and water use, site access and resources, and permitting/land ownership requirements.

The evaluation concluded the following:

- MNR is incapable of removing BUIs as a stand-alone GRA for the site within a reasonable timeframe.
- Containment and *in situ* treatment using an adsorptive cap is capable of removing BUIs and has been the preferred option on previous remedial action phases on the GCR. Containment alone may be a standalone option for areas with lower total PAH concentrations.
- Removal (with disposal) is capable of removing BUIs. This GRA is subject to uncertainties associated with volume of material to be removed and the presence of utilities within the removal foot print. Disposal options are limited to offsite disposal because onsite disposal options are subject to schedule constraints and uncertainties associated with permitting requirements, land ownership issues, and issues related to long-term operations. Material handling and handling of waste streams will be affected by grain size distribution, access for sediment dewatering and volume of material.

All GRAs were carried forward into technology screening where the evaluation of GRAs and factors affecting their implementation were considered as part of the evaluation of technology screening criteria.

2.4 AREAS AND VOLUMES THAT REQUIRE REMEDIATION

This section discusses the areas and volumes of sediment that would require remediation. Areas and volumes are based on data collected during the RI. The volume of sediment to be potentially removed from the GCR and IHC was calculated for each exposure area. During the RI, sediment depth was measured at sampling locations throughout the project area. The sediment depth in the LGC-East section is limited to the navigation channel elevation. The sediment surface elevation as well as the width and length of the river or channel was also measured. To calculate the volumes, the approximate length of each exposure area was determined and multiplied by the average depth of contaminated sediment and average river width in that exposure area. Table 2-1 shows the estimated amount of sediment per exposure area that would require cleanup based on results of the RI.

TABLE 2-1. EXPOSURE AREA DIMENSIONS AND VOLUMES

Exposure Area	Approximate Length (feet)	Average River Width (feet)	Approximate Area (square feet)	Average Sediment Depth (feet)	Estimated Volume (cubic yards)
GCR-East	3,500	90	315,000	8	93,333
GCR-West	3,400	80	272,000	10	100,740
IHC	7,100	110	781,000	8	231,407
LGC-East	2,150	85	182,750	10	67,865
LGC-Middle	2,250	220	495,000	10	183,333
LGC-West	2,500	280	700,000	6	155,555

3.0 DEVELPOMENT AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

This section identifies remedial technology types and process options that are potentially applicable to the entire GCR and IHC project area. These process options are then evaluated for effectiveness, implementability, and cost for employment in the six exposure areas.

The effectiveness of each process option was evaluated against other options within the same technology type in accordance with Title 40 Code of Federal Regulations (CFR) Part 300.430(e)(7)(i). The evaluation focused on the following factors:

- Potential effectiveness of a process option for contaminated sediment and in meeting the RAOs
- Potential impact on human health and the environment during implementation of a process option
- Reliability and performance of a process option over time, considering conditions at the project area.

The implementability evaluation considered both the technical and the institutional feasibility of implementing each remedial technology type and process option in the project area. Institutional aspects considered in the detailed evaluation included permit requirements, available treatment capacity at off-site facilities, available equipment, available on-site space, and skilled labor requirements. Some remedial technology types are proven and readily available, but others are in the research and development stages. Insufficiently developed remedial technology types are generally screened out in accordance with 40 CFR 300.430 (c)(7)(ii).

Each process option was evaluated to assess whether its cost was high, low, or comparable with other process options for the same remedial technology type, in accordance with 40 CFR 300.430 (e)(7)(iii).

However, cost was considered the least important criterion at this stage of evaluation. The screening evaluated relative capital and operation and maintenance (O&M) costs instead of detailed estimates.

Remedial technology types and process options that are not considered suitable for implementation in all six exposure areas at the GCR and IHC site were eliminated from further consideration based on information obtained during the RI. Process options associated with each GRA for sediment are discussed below.

3.1 NO ACTION

There are no process options for the no action GRA. With no action, initial conditions would be the same as are described in the RI report (Tetra Tech 2015a), and nothing would be done to alter those conditions. Natural recovery, if any, would go unnoticed because sediment would not be monitored.

Under the current and future conditions, contaminants in sediment pose an unacceptable risk in certain exposure areas. Therefore, this option would not be effective in achieving the RAOs for sediment. No action has no associated capital or O&M costs.

As required by the NCP, no action is retained to serve as a baseline that can be used to compare other remedial alternatives.

3.2 MONITORED NATURAL RECOVERY

MNR would include monitoring of natural processes and establishment of institutional controls as process options. MNR is an alternative in which contaminant concentrations are monitored with no other actions to assess natural attenuation of contaminants by physical, chemical, and biological processes. Mechanisms by which natural processes could decrease the potential for exposure to contaminants at a site include biodegradation and mixing of contaminated sediments with (and/or burial by) clean sediments, which can reduce exposure levels at the sediment surface. An additional process option could be considered as part of MNR; this is enhancement using a thin layer of sand or clean sediment as an advancement of natural burial processes. MNR typically includes institutional controls put in place to allow natural processes to occur undisturbed and to limit the potential for exposure to contaminants, primarily through restrictions to land use, river use, or site access.

MNR is unlikely to achieve the PRG of 27 mg/kg within an acceptable timeframe based on current concentrations and the site setting. PAH compounds are relatively stable compounds that degrade very slowly. Moreover, as a primary method of remediation, MNR requires monitoring and maintenance, acceptance of long-term responsibility/liability, and permitting. As such, the implementability of MNR as an alternative is limited by the feasibility of resolving such issues within the project schedule and of resolving long-term responsibility for site monitoring and maintenance.

For these reasons, the process options associated with MNR are not considered for further evaluation.

3.3 REMOVAL

The following process options are associated with the removal GRA:

- Removal
- Dewatering
- Water Management and Treatment
- Transportation and Disposal

3.3.1 Removal

Removal of sediment can be completed either in wet or dry conditions. Dredging refers to sediment removal in wet conditions. That is, sediment is removed while the river is flowing. Sediment may be dredged mechanically or hydraulically. Mechanical dredging uses a clamshell or excavator bucket to dig out the sediment. The dredging equipment is placed on a floating platform to access sediment under the water. The mechanical dredge requires significant overhead clearance in order to reach and extract the sediment from the water. As the sediment is removed, it is placed in barges for temporary storage and transport to the shore where the sediment is removed by another piece of equipment. The sediment is then physically moved to a dewatering area.

Hydraulic dredging uses an auger or cutter head suction to remove the sediment. Because the hydraulic dredges auger or cutter head is permanently below the water surface, the dredge requires less overhead clearance. Sediment is then transported as a slurry to a dewatering area by a pump co-located on the dredge platform and possibly augmented by additional booster pumps if the dewatering area is beyond the distance of a single pump.

Excavation refers to sediment removal in dry conditions. Excavation equipment and handling is similar to mechanical dredging. Temporary barriers, such as sheet pile or reinforced fabric, is used to establish an excavation zone. Water in the excavation zone is pumped out. Crane mats or other temporary surfaces are placed into the excavation zone allowing access to the excavation equipment.

Mechanical dredging would be effective for most but not all of the sediment targeted for removal. Sediment in the LGC-West exposure area has a very high water content. Maintaining material in the bucket during removal will likely be difficult. Implementation of mechanical dredging is adversely impacted by infrastructure in the project area, such as numerous bridges that cross the waterways. Because site access is not available on several segments of the waterway, off-loading of sediment cannot be accomplished. The cost of mechanical dredging is competitive with other forms of removal.

Hydraulic dredging is effective for all of the sediment targeted for removal. Because the sediment slurry is transported to the dewatering area via pipe line, bridges and other infrastructure do not impede the movement of the material. Hydraulic dredging has been implemented on two previous phases of work on the GCR with similar site conditions. The cost of hydraulic dredging is comparable to other forms of removal.

Mechanical excavation faces similar issues with effectives as mechanical dredging. The volume of flow and flooding issues associated with the installation of temporary barriers within several sections of the project area make implementation of mechanical excavation impossible. The cost of mechanical excavation is equivalent to other forms of sediment removal.

Effectiveness and implementation issues eliminate the two mechanical removal (excavation and dredging) process options from consideration. Hydraulic dredging is the only removal process option suitable for all six exposure areas.

3.3.2 Dewatering

Sediment removed by hydraulic means is transported as a slurry to a dewatering area in preparation for final disposal. Sediment can be dewatered using either geotextile tubes or filter presses. Geotextile tubes are fabric containers that are filled with the sediment slurry through filling ports in the fabric. The sediment is passively dewatered as the water flows through the fabric and the sediment particles are retained in the tubes. Many geotextile tubes are often required to dewater sediment. The tubes are placed on a lined dewatering pad to contain the water separated from the sediment.

Filter presses are active dewatering systems that use pressure to separate the water from the sediment particles. Filter presses are used in fixed-volume and batch operations. Multiple filter presses are required to allow the hydraulic dredging operation to continue as the dewatered sediment is removed from individual presses. The presses can be temporary equipment mounted on a tractor-trailer, or semi-permanent located in a building.

Dewatering using geotextile tubes is an effective method used on previous phases of work on the GCR. Dewatering with geotextile tubes can be implemented in conjunction with typical hydraulic dredges and land expected to be available for a dewatering pad. Cost to use geotextile tubes is reasonable.

Filter presses can be an effective dewatering method, although the batch operation and active mechanical operation present a potential constraint to the hydraulic dredge feed. Filter presses can be implemented for the scale of project anticipated on the GCR and IHC, most likely using tractor-trailer mounted equipment. Cost for dewatering is expected to be significantly more than using geotextile tubes.

Both geotextile tubes and filter presses are effective means that can be implemented at the project site. The significant cost disadvantage for filter presses eliminates this process option.

3.3.3 Water Management and Treatment

Hydraulic dredging generates a large volume of waste water that needs to be treated prior to discharge. This water can be treated and discharged into a sewer for additional treatment prior to discharge, or treated and discharged directly back into the waterway. Both of these process options have been used on previous phases on the GCR and have relied upon construction of a temporary water treatment plant at the sediment dewatering location.

The anticipated sediment dewatering areas are all within the limits of the ECSD. Treated water from the dewatering operation sent to the ECSD would be treated to meet the ECSD pre-treatment requirements, and then pumped into the nearest sewer for conveyance to the ECSD wastewater treatment plant. This is an effective option. Although implemented in the past, the previous experience recorded several exceedances for cyanide, one parameter on the ECSD pre-treatment list. Additional treatment may be required to be fully compliant. Depending on the dewatering location, sewer capacity may not be sufficient to convey the volume of water generated from the hydraulic operation to the ECSD plant. The ECSD charges a pre-treatment fee to accept wastewater for treatment. This cost is charged by the gallon, and because the dredging operation will generate millions of gallons of water the expense is anticipated to be in the hundreds of thousands of dollars.

Treating wastewater for direct discharge to a local waterway requires a temporary NPDES discharge permit. The temporary wastewater treatment plant would be equipped to meet the permit discharge requirements. The anticipated chemical composition of the water from sediment in the GCR and IHC has been shown in bench scale studies to meet the expected permit requirements after a treatment. Technically the treatment can be implemented, and based on previous experience with IDEM issuance of a discharge permit for this phase should be feasible. The cost to construct and operate a plant for direct discharge is equivalent to one discharging to the ECSD.

Pre-treating wastewater and conveying it to the ECSD for final treatment and discharge is expected to be more difficult to implement and more costly because of the ECSD regulatory and financial requirements. On-site treatment of sediment wastewater with direct discharge is effective, easier to implement, and less expensive.

3.3.4 Transportation and Disposal

Sediment removed from the waterway can be disposed of in place, or transported to an off-site licensed landfill for disposal. Both options are used locally, but only off-site disposal has been used on previous

GLLA projects. The CDF operated by the Chicago District maintains sediment removed from the navigation channel.

On-site disposal can be an effective option as demonstrated by the CDF currently in operation on the LGC in East Chicago. The sediment dewatering area would be converted to a landfill after the sediment is sufficiently dry. However, this process option would be very difficult to implement for several reasons. First, the land areas under consideration for sediment dewatering all have alternate future uses. Second, establishing a local landfill for the removed sediment would require permits as well as local stakeholder approval. Achieving both of these requirements is very unlikely. In place disposal would require the import of sufficient fill material to cover the sediment. There would also be a long-term O&M cost for the in-place disposal site.

Off-site disposal of dewatered sediment has been shown to be effective. Numerous landfills within a short commute are able to accept the non-hazardous sediment. A small amount of TSCA sediment would need to be sent to a more specialized facility, but more than one option in this category is also available within a reasonable distance. Sediment is typically loaded on to trucks equipped with liners to minimize contamination of the equipment. Use of traffic plans that designate preferred routes to the destined landfill reduce the potential for traffic accidents. The cost for off-site disposal is reasonable.

In place disposal of removed sediment is unlikely to be implemented. Off-site disposal at a permitted landfill is effective, has been implemented on all previous phases on the GCR, and is a reasonable cost.

3.4 CONTAINMENT

Containment and *in situ* treatment using an adsorptive media would cover existing sediment. This single process option incorporates several potential technologies used as the adsorptive media. Containment caps are used to physically isolate contaminated sediment. They are typically constructed of sand, but may also include other aggregate materials and clay. The cap would be thick enough to provide a suitable habitat for benthic organisms. It may also include armoring or a sacrificial layer to withstand erosion. A containment cap would effectively isolate sediment with low levels of contaminants.

A multilayer reactive cap is essentially a containment cap with a reactive layer consisting of adsorptive media. The reactive layer may degrade or sequester contaminants in the sediment and sediment pore water. Reactive media such as organoclay or activated carbon may be used to address this contamination. The reactive material may be loose aggregate or a component of a reactive core mat. The site conditions, such as water velocity and presence of non-aqueous phase liquids (NAPL), such as oil, will influence the specific reactive media selected. This type of containment has been used extensively on the GCR. A multilayer reactive cap would effectively contain both sediment and dissolved contaminants.

Containment systems with or without adsorptive media would have moderate implement ability, moderate to high capital cost, and low to moderate O&M costs. This process option is retained for further consideration.

3.5 SUMMARY OF RETAINED TECHNOLOGIES AND PROCSS OPTIONS

The sediment process options that have been retained are presented below.

- No Action
- Hydraulic dredging
- Dewatering using geotextile tubes
- Off-site disposal
- Containment cap with or without adsorptive media

These process options will be used to develop remedial alternatives to meet the remedial goal for the GCR and IHC.

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section describes the development of remedial alternatives for the six exposure areas in the GCR and IHC site. The alternatives included only the process options that merited further evaluation after the initial screening discussed in Section 3.0. Each alternative was developed to address the RAOs identified and to achieve the overall goal of removing the BUIs.

Alternatives developed for sediment at the GCR and IHC site include options that EPA could select, depending on the future status of the site. The alternatives for sediment were developed to provide a range of potential actions including (1) complete remediation of sediment where the sediment cleanup goal of BUI removal would be achieved; (2) a remedial action where some residual sediment above the cleanup goal would remain and would need to be managed (progress toward BUI removal); and (3) no remedial action. The alternatives for sediment apply to either cleanup goal ultimately selected by EPA.

This section also provides screening information with respect to the alternatives developed. The purpose of the alternative screening evaluation is to potentially reduce the number of alternatives that will undergo a more thorough and extensive analysis. Based on EPA guidance (EPA 1988), the criteria used during alternative screening includes the following:

- Effectiveness – the degree to which each alternative is protective of human health and the environment
- Implementability – the technical and administrative feasibility of constructing, operating, and maintaining each remedial alternative
- Cost – comparative estimates of capital and O&M costs

Each of the alternatives is described below and was assembled to accommodate different scenarios and to allow EPA flexibility. Uncertainties and limitations pertaining to sediment alternatives are also discussed.

Because site conditions and contaminant concentrations vary significantly between the different river segments, alternatives were developed for each of the six exposure areas, GCR-East, GCR-West, IHC, LGC-East, LGC-Middle, LGC-West.

4.1 GCR-EAST ALTERNATIVE 1: NO ACTION

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. Under the no action alternative, no material would be excavated, treated, or capped; therefore sediment would remain as-is.

4.1.1 Effectiveness

The no action alternative would not reduce the toxicity, mobility or volume of contamination at the GCR-East segment and therefore would not be protective of human health or the environment.

4.1.2 Implementability

Although this alternative would be easily implemented, the administrative feasibility of selecting this alternative is very low. It is unlikely that EPA or ECWMD would approve of this alternative because it would not provide a mechanism for ensuring adequate protection of human health and the environment.

4.1.3 Cost

No capital or O&M costs are associated with this alternative.

4.1.4 Decision

The no action alternative will be retained for detailed analysis because the NCP requires that it be used as a baseline for evaluating the performance of other remedial alternatives.

4.2 GCR-EAST ALTERNATIVE 2: REMOVAL, DEWATERING, AND OFF-SITE DISPOSAL

This alternative consists of removing the sediment to the depth shown in Table 2-1. Sediment would be pumped to a dewatering facility and then transported to an off-site landfill.

4.2.1 Effectiveness

This alternative would effectively protect human health as the contaminants in most of the sediment would be removed from the exposure area. Infrastructure under the sediment in select areas would require some sediment be managed in place.

4.2.2 Implementability

This alternative would be technically and administratively difficult to implement. Three petroleum product pipelines run under the exposure area. Sediment removal cannot occur near the pipeline, typically extending 25 to 50 feet on each side of the utility. Therefore, not all of the sediment can be removed.

4.2.3 Cost

This alternative has high capital and low O&M costs. Capital costs would include labor and equipment required to dredge the full depth of the impacted sediment, dewater the material, and ship it to an off-site landfill. O&M costs would consist of monitoring of sediment after removal.

4.2.4 Decision

Because existing utilities prevent the removal of all of the impacted sediment within the exposure area, this alternative is eliminated from further consideration.

4.3 GCR-EAST ALTERNATIVE 3: CONTAINMENT

Containment of sediment to meet the PRG requires a cap consisting of aggregate mixed with approximately 5 percent organoclay. The cap would be a multilayer cap with a sand and organoclay mix covered by an armor layer of larger aggregate. The approximate overall cap thickness is estimated at 18 inches, but the final thickness will be determined through additional modelling in the design phase.

4.3.1 Effectiveness

This alternative would be effective at protecting human health and the environment. Contaminated sediment would be contained, significantly reducing the potential for human and health and ecological exposure. This would also be effective in protecting the benthic community and other ecological receptors.

4.3.2 Implementability

This alternative would be technically and administratively easy to implement. Placement of containment material has been a success on other sections of the GCR, including over pipelines and other buried utilities. Access would be needed on specific portions of the GCR to stage the cap material.

O&M would include annual inspections of cap integrity and effectiveness and after major flooding events. Repair or replacement of damaged cap sections would likely be required.

4.3.3 Cost

Depending on the type of containment material, this alternative would have moderately high to high capital and moderate to high O&M costs, depending on the frequency of cap repairs.

4.3.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment, it is retained for further analysis.

4.4 GCR-EAST ALTERNATIVE 4: REMOVAL WITH CONTAINMENT

This alternative would consist of a combination of excavation and disposal of some of the impacted sediment (as described under GCR-East Alternative 2) and containment of the remaining sediment (as described under GCR-East Alternative 3). Removal would be limited to a single area of where contaminant concentrations are high within the exposure area or the sediment elevation is higher than the average in this exposure area.

Under this alternative for GCR-East, contaminated sediment in a small area that has a combination of relatively high contaminants and high surface elevation would be removed. After this isolated location is dredged, the containment cap would be installed over the entire exposure area.

4.4.1 Effectiveness

This alternative would be effective in protecting human health and the environment. The alternative would be protective of the benthic community and other ecological receptors.

4.4.2 Implementability

This alternative would be moderately easy to implement. This combination of activities has been successfully used on other sections of the river, but it does require the mobilization of two different sets of equipment.

4.4.3 Cost

Based on the volume of sediment to be excavated and the area to be capped, this alternative could have moderate to high capital costs and low O&M costs.

4.4.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment through excavation and capping, it is retained for further analysis.

4.5 GCR-WEST ALTERNATIVE 1: NO ACTION

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. Under the no action alternative, no material would be excavated, treated, or capped.

4.5.1 Effectiveness

The no action alternative would not be protective of human health or the environment.

4.5.2 Implementability

Although this alternative would be easily implemented, the administrative feasibility of selecting this alternative is very low. It is unlikely that EPA or ECWMD would approve of this alternative because it would not provide a mechanism for ensuring adequate protection of human health and the environment.

4.5.3 Cost

No capital or O&M costs are associated with this alternative.

4.5.4 Decision

The no action alternative will be retained for detailed analysis because the NCP requires that it be used as a baseline for evaluating the performance of other remedial alternatives.

4.6 GCR-WEST ALTERNATIVE 2: REMOVAL, DEWATERING, AND OFF-SITE DISPOSAL

This alternative would consists of removing the sediment to the depth shown in Table 2-1. Sediment would be pumped to a dewatering facility and then transported to an off-site landfill.

4.6.1 Effectiveness

This alternative would eventually effectively protect human health as the contaminants in the sediment would be removed from the exposure area.

4.6.2 Implementability

This alternative would be technically and administratively difficult to implement. One petroleum product pipeline runs under the exposure area. Sediment removal cannot occur near the pipeline, typically extending 25 to 50 feet on each side of the utility. Therefore, not all of the sediment can be removed.

4.6.3 Cost

This alternative has high capital and low O&M costs. Capital costs would include labor and equipment required to dredge the full depth of the impacted sediment, dewater the material, and ship it to an off-site landfill. O&M costs would consist of monitoring of sediment after removal.

4.6.4 Decision

Because existing utilities prevent the removal of all of the impacted sediment within the exposure area, this alternative is eliminated from further consideration.

4.7 GCR-WEST ALTERNATIVE 3: CONTAINMENT

Containment of sediment to meet the PRG requires a cap consisting of aggregate mixed with approximately 5 percent organoclay. The cap would be a multilayer cap with a sand and organoclay mix covered by an armor layer of larger aggregate. The approximate overall cap thickness is estimated at 18 inches, but the final thickness will be determined through additional modelling in the design phase.

4.7.1 Effectiveness

This alternative would be effective at protecting human health and the environment. Contaminated sediment would be contained, significantly reducing the potential for human and health and ecological exposure. This would also be effective in protecting the benthic community and other ecological receptors.

4.7.2 Implementability

This alternative would be technically difficult to implement. Sediment elevations and water depth in the West Branch GCR allow limited room for cap placement. Based on modelling the local watershed, placement of additional fill would likely cause flooding in the surrounding area.

O&M would include annual inspections of cap integrity and effectiveness and after major flooding events. Repair or replacement of damaged cap sections would likely be required.

4.7.3 Cost

Depending on the type of containment material, this alternative would have moderately high to high capital and moderate to high O&M costs, depending on the frequency of cap repairs.

4.7.4 Decision

Because this alternative would cause an increase in the water surface elevation and possibly result in local flooding during storm events, it is eliminated for further analysis.

4.8 GCR-WEST ALTERNATIVE 4: REMOVAL WITH CONTAINMENT

This alternative would consist of a combination of excavation and disposal of some of the impacted sediment (as described under GCR-West Alternative 2) and containment of the remaining sediment (as described under GCR-West Alternative 3). Under this alternative for GCR-West, the top two to four feet of contaminated sediment would be removed to allow for placement of the containment system, except over the petroleum product pipe line.

4.8.1 Effectiveness

This alternative would be effective in protecting human health and would be protective of the benthic community and other ecological receptors.

4.8.2 Implementability

This alternative would be moderately easy to implement. This combination of activities has been successfully used on other sections of the river, but it does require the mobilization of two different sets of equipment.

4.8.3 Cost

Depending on the volume of sediment to be excavated and the area to be capped, this alternative could have moderate to high capital costs and low O&M costs.

4.8.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment through excavation and capping, it is retained for further analysis.

4.9 IHC ALTERNATIVE 1: NO ACTION

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. Under the no action alternative, no material would be excavated, treated, or capped.

4.9.1 Effectiveness

The no action alternative would not be protective of human health or the environment.

4.9.2 Implementability

Although this alternative would be easily implemented, the administrative feasibility of selecting this alternative is very low. It is unlikely that EPA or ECWMD would approve of this alternative because it would not provide a mechanism for ensuring adequate protection of human health and the environment.

4.9.3 Cost

No capital or O&M costs are associated with this alternative.

4.9.4 Decision

The no action alternative will be retained for detailed analysis because the NCP requires that it be used as a baseline for evaluating the performance of other remedial alternatives.

4.10 IHC ALTERNATIVE 2: REMOVAL, DEWATERING, AND OFF-SITE DISPOSAL

This alternative would consists of removing the sediment to the depth shown in Table 2-1. Sediment would be pumped to a dewatering facility and then transported to an off-site landfill.

4.10.1 Effectiveness

This alternative would eventually effectively protect human health as the contaminants in the sediment would be removed from the exposure area.

4.10.2 Implementability

This alternative would be technically and administratively difficult to implement because of the number of bridges within the exposure area. Diver-assisted dredging could be used, but it is much more difficult and time-consuming than using the larger hydraulic dredge. Additionally, there are numerous pipelines running under the exposure area. Sediment removal cannot occur near the pipeline, typically extending 25 to 50 feet on each side of the utility. Therefore, not all of the sediment can be removed.

4.10.3 Cost

This alternative has high capital and low O&M costs. Capital costs would include labor and equipment required to dredge the full depth of the impacted sediment, dewater the material, and ship it to an off-site landfill. O&M costs would consist of monitoring of sediment after removal.

4.10.4 Decision

Because of existing infrastructure and utilities prevent the removal of all of the impacted sediment within the exposure area, this alternative is eliminated from further consideration.

4.11 IHC ALTERNATIVE 3: CONTAINMENT

Containment by capping in this exposure area would consist of a multi-layer cap consisting of an active layer covered by an armor layer. The active layer would consist of sand mixed with 5 percent organoclay armored by larger aggregate. The entire cap thickness would have to be at least 18 inches thick.

4.11.1 Effectiveness

This alternative would be effective at protecting human health and the environment. Contaminated sediment would be contained, significantly reducing the potential for human and health and ecological exposure. This would also be effective in protecting the benthic community and other ecological receptors.

4.11.2 Implementability

This alternative would be technically difficult to implement as placement of fill material will increase the water surface elevation by more than one foot, which may cause flooding.

O&M would include annual inspections of cap integrity and effectiveness and after major flooding events. Repair or replacement of damaged cap sections would likely be required.

4.11.3 Cost

Depending on the type of containment material, this alternative would have moderately high to high capital and moderate to high O&M costs, depending on the frequency of cap repairs.

4.11.4 Decision

Because this alternative would cause an increase in the water surface elevation and possibly result in local flooding during storm events, it is eliminated for further analysis.

4.12 IHC ALTERNATIVE 4: REMOVAL WITH CONTAINMENT

This alternative would consist of a combination of excavation and disposal of some of the impacted sediment (as described under IHC Alternative 2) and containment of the remaining sediment.

Under this alternative for IHC, two areas of sediment would be removed. The first is an approximately 1,750 foot section at the south end of the canal to remove an elevated area of PCBs. Approximately six feet of sediment would be removed in this area. The second area is approximately 400 feet long at the north end of the canal. This area also has a high PCB concentration that would be removed.

After dredging, a containment cap would be installed along the entire length of the canal. Because significant contaminant mass is removed in the two targeted areas, the containment system may not need to be as robust as described in IHC Alternative 3. The containment system will consist of sand mixed with activated carbon, covered by an armor layer.

4.12.1 Effectiveness

This alternative would be effective in protecting human health and the environment. The alternative would be protective of the benthic community and other ecological receptors.

4.12.2 Implementability

This alternative would be moderately easy to implement. This combination of activities has been successfully used on other sections of the river, but it does require the mobilization of two different sets of equipment.

4.12.3 Cost

Depending on the volume of sediment to be excavated and the area to be capped, this alternative could have moderate to high capital costs and low O&M costs.

4.12.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment through excavation and capping, it is retained for further analysis.

4.13 LGC-EAST ALTERNATIVE 1: NO ACTION

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. Under the no action alternative, no material would be excavated, treated, or capped.

4.13.1 Effectiveness

The no action alternative would not address contamination at the LGC-East segment and therefore would not be protective of human health or the environment.

4.13.2 Implementability

Although this alternative would be easily implemented, the administrative feasibility of selecting this alternative is very low. It is unlikely that EPA or ECWMD would approve of this alternative because it would not provide a mechanism for ensuring adequate protection of human health and the environment.

4.13.3 Cost

No capital or O&M costs are associated with this alternative.

4.13.4 Decision

The no action alternative will be retained for detailed analysis because the NCP requires that it be used as a baseline for evaluating the performance of other remedial alternatives.

4.14 LGC-EAST ALTERNATIVE 2: REMOVAL, DEWATERING, AND OFF-SITE DISPOSAL

This alternative would consists of removing the sediment to the depth shown in Table 2-1. Sediment would be pumped to a dewatering facility and then transported to an off-site landfill.

4.14.1 Effectiveness

This alternative would eventually effectively protect human health as the contaminants in the sediment would be removed from the exposure area.

4.14.2 Implementability

This alternative would be technically and administratively easy to implement. Removal by hydraulic dredging has been a success on other sections of the GCR. Access would be needed on the LGC to mobilize the hydraulic dredge and also dewater the sediment.

4.14.3 Cost

This alternative has high capital and low O&M costs. Capital costs would include labor and equipment required to dredge the full depth of the impacted sediment, dewater the material, and ship it to an off-site landfill. O&M costs would consist of monitoring of sediment after removal.

4.14.4 Decision

This alternative takes into account the complete removal of the sediment that is associated with several BUIs in the AOC. Therefore, this alternative is retained for further consideration.

4.15 LGC-EAST ALTERNATIVE 3: CONTAINMENT

Containment by capping in this exposure area would consist of a multi-layer cap consisting of an active layer covered by an armor layer. The active layer would consist of sand mixed with 5 percent organoclay armored by larger aggregate. The entire cap thickness would have to be at least 18 inches thick.

4.15.1 Effectiveness

This alternative would be somewhat effective at protecting human health and the environment. Contaminated sediment beneath the cap would be contained, but the adjacent navigation channel would not be capped. This would be effective in protecting the benthic community that reside in the cap material, but other ecological receptors that move beyond the capped area would encounter conditions found in the No Action alternative.

Prop wash from vessels using the navigation channel would also hinder the cap’s long term effectiveness. As discussed in the RI report (Tetra Tech, 2015a), the bathymetric survey indicates the sediment in the non-navigation section of the channel is disturbed by vessels turning in front of the CDF on the north side of LGC-East. Cap material placed on the sediment surface would potentially be moved and mixed with the underlying sediment, re-exposing the contaminated sediment to the environment.

4.15.2 Implementability

The geotechnical properties of some of the sediment in this exposure area may not possess sufficient shear strength to support a sand and gravel aggregate mix. Sediment cores collected from this exposure area showed pockets of low strength sediment. The cap material may flow into the underlying sediment rather than remaining over the sediment. This would not allow for complete coverage of the impacted sediment.

O&M would include annual inspections of cap integrity and effectiveness and after major flooding events. Repair or replacement of damaged cap sections would likely be required.

4.15.3 Cost

Depending on the type of containment material, this alternative would have moderately high to high capital and moderate to high O&M costs, depending on the frequency of cap repairs.

4.15.4 Decision

Because prop wash from vessels operating adjacent to the cap may disturb the sediment surface and rupture the cap, and sediment within parts of the exposure area may not possess sufficient strength to support the cap material, this alternative is eliminated from further consideration.

4.16 LGC-EAST ALTERNATIVE 4: REMOVAL WITH CONTAINMENT

This alternative would consist of a combination of excavation and disposal of some of the impacted sediment (as described under LGC-East Alternative 2) and containment of the remaining sediment (as described under LGC-East Alternative 3). The intent is to reduce the final surface elevation by 5 feet to reduce direct contact and reduce re-suspension caused by prop wash in the adjacent navigation channel. Approximately 7 feet of sediment would be removed and covered with a 2 foot armor layer.

4.16.1 Effectiveness

This alternative would be somewhat effective in protecting human health and the environment. The alternative would be protective of the benthic community and other ecological receptors.

4.16.2 Implementability

This alternative would be moderately easy to implement. This combination of activities has been successfully used on other sections of the river, but it does require the mobilization of two different sets of equipment.

4.16.3 Cost

Depending on the volume of sediment to be excavated and the area to be capped, this alternative could have moderate to high capital costs and low O&M costs.

4.16.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment through excavation and capping, it is retained for further analysis.

4.17 LGC-MIDDLE ALTERNATIVE 1: NO ACTION

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. Under the no action alternative, no material would be excavated, treated, or capped.

4.17.1 Effectiveness

The no action alternative would not reduce the toxicity, mobility or volume of contamination at the LGC-Middle segment and therefore would not be protective of human health or the environment.

4.17.2 Implementability

Although this alternative would be easily implemented, the administrative feasibility of selecting this alternative is very low. It is unlikely that EPA or ECWMD would approve of this alternative because it would not provide a mechanism for ensuring adequate protection of human health and the environment.

4.17.3 Cost

No capital or O&M costs are associated with this alternative.

4.17.4 Decision

The no action alternative will be retained for detailed analysis because the NCP requires that it be used as a baseline for evaluating the performance of other remedial alternatives.

4.18 LGC-MIDDLE ALTERNATIVE 2: REMOVAL, DEWATERING, AND OFF-SITE DISPOSAL

This alternative consists of removing the sediment to the depth shown in Table 2-1. Sediment would be pumped to a dewatering facility and then transported to an off-site landfill.

4.18.1 Effectiveness

This alternative would effectively protect human health as the contaminants in the sediment would be removed from the exposure area.

4.18.2 Implementability

This alternative would be difficult to implement. Numerous petroleum pipe lines cross the exposure area making complete removal impossible.

4.18.3 Cost

This alternative has high capital and low O&M costs. Capital costs would include labor and equipment required to dredge the full depth of the impacted sediment, dewater the material, and ship it to an off-site landfill. O&M costs would consist of monitoring of sediment after removal.

4.18.4 Decision

Because existing utilities prevent the removal of all of the impacted sediment within the exposure area, this alternative is eliminated from further consideration.

4.19 LGC-MIDDLE ALTERNATIVE 3: CONTAINMENT

Containment in this exposure area would entail installation of a sheet pile retaining wall with containment material placed between the land bridge and the wall. Containment material would consist of several feet of sand mixed with sufficient organoclay to remove contaminants in the groundwater. The sheet pile wall would retain the containment system in this exposure area and prevent the material from flowing east into the navigation channel. The top of the sheet pile wall would be several feet below the low water surface elevation and would not restrict surface water flow.

4.19.1 Effectiveness

This alternative would be effective at protecting human health and the environment. Contaminated sediment would be contained, significantly reducing the potential for human and health and ecological exposure. This would also be effective in protecting the benthic community and other ecological receptors.

4.19.2 Implementability

This alternative would be technically and administratively easy to implement. Placement of containment material has been a success on other sections of the GCR. Access would be needed on the BP Whiting property to mobilize the cap placement equipment.

O&M would include annual inspections of cap integrity and effectiveness and after major flooding events. Repair or replacement of damaged cap sections would likely be required.

4.19.3 Cost

Depending on the type of containment material, this alternative would have moderately high to high capital and moderate to high O&M costs, depending on the frequency of cap repairs.

4.19.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment, it is retained for further analysis.

4.20 LGC-MIDDLE ALTERNATIVE 4: REMOVAL WITH CONTAINMENT

This alternative would consist of a combination of excavation and disposal of some of the impacted sediment (as described under LGC-Middle Alternative 2) and containment of the remaining sediment (as described under LGC-Middle Alternative 3). Removal would be limited to approximately 168,000 square feet outside of utility buffers. After this area is dredged, the containment cap would be installed over the exposure area west of the sheet pile wall.

4.20.1 Effectiveness

This alternative would be effective in protecting human health and the environment. The alternative would be protective of the benthic community and other ecological receptors.

4.20.2 Implementability

This alternative would be moderately easy to implement. This combination of activities has been successfully used on other sections of the river, but it does require the mobilization of two different sets of equipment.

4.20.3 Cost

As a combination of the two previous alternatives, the cost is approximately double either Removal or Containment. This alternative could have high capital costs and low O&M costs.

4.20.4 Decision

Because this alternative costs significantly more than other viable alternatives with no added effectiveness, it is eliminated from further analysis.

4.21 LGC-WEST ALTERNATIVE 1: NO ACTION

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. Under the no action alternative, no material would be excavated, treated, or capped.

4.21.1 Effectiveness

The no action alternative would be protective of human health or the environment.

4.21.2 Implementability

Although this alternative would be easily implemented, the administrative feasibility of selecting this alternative is very low. It is unlikely that EPA or ECWMD would approve of this alternative because it would not provide a mechanism for ensuring adequate protection of human health and the environment.

4.21.3 Cost

No capital or O&M costs are associated with this alternative.

4.21.4 Decision

The no action alternative will be retained for detailed analysis because the NCP requires that it be used as a baseline for evaluating the performance of other remedial alternatives.

4.22 LGC-WEST ALTERNATIVE 2: REMOVAL, DEWATERING, AND OFF-SITE DISPOSAL

This alternative would consists of removing the sediment to the depth shown in Table 2-1. Sediment would be pumped to a dewatering facility and then transported to an off-site landfill.

4.22.1 Effectiveness

This alternative would eventually effectively protect human health as the contaminants in the sediment would be removed from the exposure area.

4.22.2 Implementability

This alternative would be technically and administratively easy to implement. Removal by hydraulic dredging has been a success on other sections of the GCR. Access would be needed on to the BP Whiting facility property to place the dredge in this section of the LGC. Sediment would be pumped through a slurry line to the South Tank Farm outside the BP property for dewatering.

4.22.3 Cost

This alternative has high capital and low O&M costs. Capital costs would include labor and equipment required to dredge the full depth of the impacted sediment, dewater the material, and ship it to an off-site landfill. O&M costs would consist of monitoring of sediment after removal.

4.22.4 Decision

This alternative takes into account the complete removal of the sediment that is associated with several BUIs in the AOC. Therefore, this alternative is retained for further consideration.

4.23 LGC-WEST ALTERNATIVE 3: CONTAINMENT

Containment of sediment to meet the PRG requires a cap consisting of aggregate mixed with approximately 5 percent organoclay. The cap would be a multilayer cap with a sand and organoclay mix covered by an armor layer of larger aggregate. The approximate overall cap thickness is estimated at 18 inches, but the final thickness will be determined through additional modelling in the design phase.

4.23.1 Effectiveness

This alternative would be effective at protecting human health and the environment. Contaminated sediment would be contained, significantly reducing the potential for human and health and ecological exposure. This would also be effective in protecting the benthic community and other ecological receptors.

4.23.2 Implementability

This alternative would be technically difficult to implement because the sediment in this exposure area has an extremely high water content and minimal strength. Capping material placed on top of the sediment would flow through the top 6 feet and settle on the native soil below.

4.23.3 Cost

Depending on the type of containment material, this alternative would have moderately high to high capital and moderate to high O&M costs, depending on the frequency of cap repairs.

4.23.4 Decision

Because cap material would not contain the target sediment, this alternative is eliminated from further consideration.

4.24 LGC-WEST ALTERNATIVE 4: REMOVAL WITH CONTAINMENT

This alternative would consist of a combination of excavation and disposal of some of the impacted sediment (as described under LGC-West Alternative 2) and containment of the remaining sediment.

Under this alternative, six feet of sediment would be removed from the entire exposure area. After dredging, a containment cap consisting of sand would be installed along the entire length of LGC-West. The sand cap would contain low levels of COCs remaining in the sediment and provide a clean surface for benthic organisms.

4.24.1 Effectiveness

This alternative would be effective in protecting human health and the environment. The alternative would be protective of the benthic community and other ecological receptors.

4.24.2 Implementability

This alternative would be moderately easy to implement. This combination of activities has been successfully used on other sections of the river, but it does require the mobilization of two different sets of equipment.

4.24.3 Cost

This alternative could have moderate to high capital costs and low O&M costs.

4.24.4 Decision

Because this alternative effectively reduces exposure to and reduces migration of contaminated sediment through excavation and capping, it is retained for further analysis.

4.25 SUMMARY OF RETAINED ALTERNATIVES

Table 4-1 presents the alternatives for the six exposure areas that are retained and will be evaluated by a more detailed analysis.

TABLE 4-1. RETAINED ALTERNATIVES

Exposure Area	Alternative No.	Alternative Name
GCR-East	1	No Action
	3	Containment
	4	Removal with Containment
GCR-West	1	No Action
	4	Removal with Containment
IHC	1	No Action
	4	Removal with Containment
LGC-East	1	No Action
	2	Removal
	4	Removal with Containment
LGC-Middle	1	No Action
	3	Containment
LGC-West	1	No Action
	2	Removal
	4	Removal with Containment

5.0 DETAILED ANALYSIS OF ALTERNATIVES

This section presents a detailed analysis of the remedial alternatives described in Section 4.0. This analysis evaluates the alternatives and supports development of designs for the alternatives retained. The evaluation criteria, which are specified in Subsection 300.430(e)(9)(iii) of the NCP, address the statutory requirements in Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The alternative descriptions presented in this section provide a conceptual understanding of each alternative with a level of detail appropriate to evaluate each alternative and support cost assumptions presented in the FS. A description of the evaluation criteria and detailed evaluations of the alternatives based on these criteria are presented below.

5.1 DESCRIPTION OF EVALUATION CRITERIA

The nine evaluation criteria specified in the NCP are as follows:

- Overall protection of human health and the environment
- Compliance with local, state, and federal regulations
- Long-term effectiveness and permanence
- Reduction of the toxicity, mobility, or volume of contaminants through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

Remedial alternatives for the six exposure areas are analyzed in Sections 5.2 through 5.7, respectively, based on these criteria (with the exceptions discussed below). The results of the analysis are used to provide a comparative evaluation of the alternatives in Section 6.0.

5.1.1 Overall Protection of Human Health and the Environment

Alternatives were assessed to evaluate whether they can adequately protect human health and the environment in both the short and long term from unacceptable risks posed by hazardous substances, pollutants, or contaminants through their elimination, reduction, or control so as to achieve levels established during development of remediate goals in accordance with 40 CFR 300.430(e)(2)(i).

This assessment was based on the degree an alternative would eliminate, reduce, or control risks to human health and the environment through treatment, engineering, or institutional controls. The overall assessment of protection included other criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with local, state, and federal regulations.

5.1.2 Compliance with Local, State, and Federal Regulations

Each alternative was assessed to evaluate whether it would meet requirements under federal environmental laws and state environmental or facility citing laws.

5.1.3 Long-Term Effectiveness and Permanence

Alternatives were assessed in terms of the long-term effectiveness and permanence they would provide and the degree of certainty that the alternatives would prove successful. Factors that were considered, as appropriate, include the following: (1) the magnitude of residual risk associated with treated and untreated sediment that would remain after the conclusion of remedial activities, and (2) the adequacy and reliability of in situ and ex situ treatment systems and access controls needed to manage treated and untreated sediment.

5.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The degree that the alternatives would employ recycling or treatment that reduces the toxicity, mobility, or volume of contaminants in sediment was assessed, as was the way that treatment would be used to reduce the threats posed by the site. Factors considered, as appropriate, include the following: (1) the treatment or recycling process that an alternative would employ and the materials that would be treated; (2) the amounts of hazardous substances, pollutants, or contaminants that would be destroyed, treated, or recycled; (3) the degree of the expected reduction in contaminant toxicity, mobility, or volume that would result from treatment or recycling and the identification of the reduction that would occur; (4) the degree to which treatment would be irreversible; (5) the types and quantities of sediment contaminants that would remain after treatment, and their persistence, toxicity, mobility, and propensity to bioaccumulate; and (6) the degree to which treatment would reduce the inherent threats posed by contamination in sediment at the site.

5.1.5 Short-Term Effectiveness

The short-term effectiveness of alternatives were assessed by considering the following factors, as appropriate: (1) short-term risks that might be posed to the community during implementation of an alternative, (2) potential environmental impacts on workers during remedial activities and the effectiveness and reliability of protective measures, (3) potential environmental impacts of the remedial alternative and the effectiveness and reliability of mitigating measures that would be taken during implementation, and (4) the time required to implement the remedial alternative.

5.1.6 Implementability

The ease or difficulty of implementing the alternative was assessed by considering the following factors, as appropriate, for each alternative: (1) its technical feasibility, including technical difficulties and factors associated with construction and operation of the technology, the ease of undertaking additional remedial activities, and the ability to monitor the effectiveness of the remedy; (2) its administrative feasibility, including the need to coordinate with government offices and agencies and the ability and time required to obtain necessary approvals and permits from government agencies for off-site actions; (3) the availability of required services and materials, including the availability of adequate off-site treatment, storage, and disposal capacity and services; (4) the availability of necessary equipment, appropriate specialists, and any necessary additional resources; and (5) the availability of prospective technologies.

5.1.7 Cost

Cost estimates for the retained alternatives are presented in Appendix A. Capital costs are divided into direct and indirect costs. Direct capital costs include construction, equipment, and disposal costs. Indirect capital costs include engineering expenses, legal fees, license or permit costs, startup costs, and contingency allowances.

The cost estimates presented in this report were developed using quotations from various vendors, and Tetra Tech's experience with similar projects. The accuracy of the cost estimates is expected to be between +50 and -30 percent, which conforms to EPA guidelines (EPA 1988). After the capital and O&M costs have been estimated, the present net worth of implementing an alternative was calculated to convert costs over various time periods to a common base. Calculating the present net worth of implementing remedial alternatives allows the various alternatives to be compared on the basis of a single dollar figure that presents the costs of construction, operation, and maintenance of remedial alternatives throughout their planned life.

5.1.8 State Acceptance

This criterion considers the extent to which a given alternative is potentially acceptable to the state. Given the role of the ECWMD and the State of Indiana, it overlaps in part with criteria regarding permitting and regulatory acceptance. Preliminary analysis is provided here based on initial coordination and discussions.

5.1.9 Community Acceptance

This criterion considers the extent to which a given alternative is potentially acceptable to the project stakeholders and the local community. Several community outreach sessions have occurred with local stakeholders during the development of the proposed alternatives, including East Chicago landowners adjacent to the waterways and with the Citizens' Advisory for the Remediation of the Environment (CARE) committee.

5.2 DETAILED ANALYSIS OF GCR-EAST ALTERNATIVES

Three remedial alternatives for sediment contamination in GCR-East are described in Sections 5.2.1 through 5.2.3. Detailed analyses of the alternative are presented below.

5.2.1 Detailed Analysis of GCR-East Alternative 1: No Action

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. If no action occurred at the site, the sediment would be left "as is" without implementation of access controls, containment, removal, treatment, or other mitigating actions. The analysis of the no action alternative is included to provide a comparative baseline used to evaluate other alternatives as required by the NCP.

5.2.1.1 Overall Protection of Human Health and the Environment

GCR-East Alternative 1 would not eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be left "as is" because no action would occur. Hazardous substances in the sediment may continue to naturally volatilize, biodegrade, dilute, and attenuate over time; however, no monitoring or sampling would be conducted to demonstrate that GCR-East Alternative 1 is effective.

5.2.1.2 Compliance with Local, State, and Federal Regulations

GCR-East Alternative 1 would not comply with chemical-specific regulations. Under this alternative, sediment would not be monitored to evaluate whether it is being naturally restored to its unrestricted use.

5.2.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term, because it would leave contaminated sediments in place in the river and canal, and would not impact current exposure pathways for these contaminants. Although fish consumption advisories would remain in effect, the effectiveness of these advisories depends on effective communication and public responsiveness. While these advisories may decrease risk, they do not support removal of BUIs.

5.2.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in sediment would not be reduced by GCR-East Alternative 1 because the sediment would not be treated. Contaminant concentrations in the sediment might decrease over time as a result of degradation and attenuation; however, the degree of degradation and attenuation would not be monitored.

5.2.1.5 Short-Term Effectiveness

The No Action alternative would not create short-term impacts to human health or the environment. However, this alternative also would not address the current risks already associated with the presence of the contaminated material, in the short term or the long term.

5.2.1.6 Implementability

The No Action alternative would be highly implementable from a logistical and technical perspective, because it does not involve any remedial activities at the site.

5.2.1.7 Cost

There would be no financial costs associated with implementation of a No Action alternative that are calculable for this FS, though costs to industry would occur by not delisting the AOC.

5.2.1.8 State and Community Acceptance

The No Action alternative is not expected to be acceptable to stakeholders and the community, because it would not support the removal of BUIs in the AOC and would not meet the RAOs for the site.

5.2.2 Detailed Analysis GCR-East Alternative 3: Containment

Alternative 3 consists of placement of a layer of reactive material, such as organoclay, covered by an armor layer. The combined thickness of containment is typically 18 to 24 inches.

5.2.2.1 Overall Protection of Human Health and the Environment

GCR-East Alternative 3 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be covered by a cap that would cover the impacted sediment and absorb contaminants in the sediment pore water as in flows through the cap.

5.2.2.2 Compliance with Local, State, and Federal Regulations

GCR-East Alternative 3 would comply with all relevant regulations.

5.2.2.3 Long-Term Effectiveness and Permanence

The containment system designed for Alternative 3 would have a minimum life of 100 years.

5.2.2.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The mobility and volume of hazardous substances in sediment would be reduced to the PRG for at least 100 years.

5.2.2.5 Short-Term Effectiveness

There are no short term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. Traffic plan required to manage deliveries and disposal. The remedy can be implemented within 6 months of start.

5.2.2.6 Implementability

The containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.2.2.7 Cost

The expected cost for GCR-East Alternative 3 is approximately $6.2 million. Additional detail is provided in Appendix A.

5.2.2.8 State Acceptance

Containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.2.2.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of containment remedies. Potential community concerns are associated with safety during construction and projected life of the cap.

5.2.3 Detailed Analysis GCR-East Alternative 4: Removal and Containment

Alternative 4 consists of removal of 2,000 cubic yards of sediment from a relatively shallow area at the approximate midpoint of the exposure area. Sediment would be pumped to the South Tank Farm site owned by the ECWMD located on the south bank of the LGC. Following this targeted removal, the entire exposure area will be covered with a layer of reactive material consisting of 5 percent organoclay covered by an armor layer. The combined thickness of containment is typically 18 to 24 inches.

5.2.3.1 Overall Protection of Human Health and the Environment

GCR-East Alternative 4 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. A partial amount of sediment in this river segment would be removed and the remainder covered by a cap that would cover the impacted sediment and absorb contaminants in the sediment pore water as in flows through the cap.

5.2.3.2 Compliance with Local, State, and Federal Regulations

GCR-East Alternative 4 would comply with all relevant regulations.

5.2.3.3 Long-Term Effectiveness and Permanence

Some sediment would be permanently removed. The containment system designed to address the remaining sediment for Alternative 4 would have a minimum life of 100 years.

5.2.3.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would be reduced to the PRG for at least 100 years.

5.2.3.5 Short-Term Effectiveness

There are no short-term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 12 months of start.

5.2.3.6 Implementability

The removal and containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.2.3.7 Cost

The expected cost for GCR-East Alternative 3 is approximately $7.3 million. Additional detail is provided in Appendix A.

5.2.3.8 State Acceptance

Removal and containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.2.3.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past removal and containment remedies. Potential community concerns are associated with safety during construction and projected life of the cap.

5.3 DETAILED ANALYSIS OF GCR-WEST ALTERNATIVES

Two remedial alternatives for sediment contamination in GCR-West are described in Sections 5.3.1 and 5.3.2. Detailed analyses of the alternatives are presented below.

5.3.1 Detailed Analysis of GCR-West Alternative 1: No Action

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. If no action occurred at the site, the sediment would be left "as is" without implementation of access controls, containment, removal, treatment, or other mitigating actions. The analysis of the no action alternative is included to provide a comparative baseline used to evaluate other alternatives as required by the NCP.

5.3.1.1 Overall Protection of Human Health and the Environment

GCR-West Alternative 1 would not eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be left "as is" because no action would occur. Hazardous substances in the sediment may continue to naturally volatilize, biodegrade, dilute, and attenuate over time; however, no monitoring or sampling would be conducted to demonstrate that GCR-West Alternative 1 is effective.

5.3.1.2 Compliance with Local, State, and Federal Regulations

GCR-West Alternative 1 would not comply with chemical-specific regulations. Under this alternative, sediment would not be monitored to evaluate whether it is being naturally restored to its unrestricted use.

5.3.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term, because it would leave contaminated sediments in place in the river and canal, and would not impact current exposure pathways for these contaminants. Although fish consumption advisories would remain in effect, the effectiveness of these

advisories depends on effective communication and public responsiveness. While these advisories may decrease risk, they do not support removal of BUIs.

5.3.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would not be reduced by GCR-West Alternative 1 because the sediment would not be treated. Contaminant concentrations in the sediment might decrease over time as a result of degradation and attenuation; however, the degree of degradation and attenuation would not be monitored.

5.3.1.5 Short-Term Effectiveness

The No Action alternative would not create short-term impacts to human health or the environment. However, this alternative also would not address the current risks already associated with the presence of the contaminated material, in the short term or the long term.

5.3.1.6 Implementability

The No Action alternative would be highly implementable from a logistical and technical perspective, because it does not involve any remedial activities at the site.

5.3.1.7 Cost

There would be no financial costs associated with implementation of a No Action alternative that are calculable for this FS, though costs to industry would occur by not delisting the AOC.

5.3.1.8 State and Community Acceptance

The No Action alternative is not expected to be acceptable to stakeholders and the community, because it would not support the removal of BUIs in the AOC and would not meet the RAOs for the site.

5.3.2 Detailed Analysis GCR-West Alternative 4: Removal and Containment

Alternative 4 consists of removal of 2 to 4 feet of sediment followed by placement of a layer of reactive material covered by an armor layer. Approximately 30,000 cubic yards of sediment would be removed from GCR-West prior to cap placement. Sediment would be pumped to the South Tank Farm for dewatering and off-site disposal. The containment cap would consist of aggregate mixed with 5 percent organoclay covered by an aggregate armor layer. The combined thickness of containment is typically 18 to 24 inches.

5.3.2.1 Overall Protection of Human Health and the Environment

GCR-West Alternative 4 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Extensive contaminant mass would be removed followed by remaining sediment in this river segment covered by a cap that would cover the impacted sediment and absorb contaminants in the sediment pore water as groundwater flows through the cap.

5.3.2.2 Compliance with Local, State, and Federal Regulations

GCR-West Alternative 4 would comply with all relevant regulations.

5.3.2.3 Long-Term Effectiveness and Permanence

Some sediment would be permanently removed. The containment system designed to address the remaining sediment for Alternative 4 would have a minimum life of 100 years.

5.3.2.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in sediment would be reduced to the PRG for at least 100 years.

5.3.2.5 Short-Term Effectiveness

There are no short-term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 12 months of start.

5.3.2.6 Implementability

The containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.3.2.7 Cost

The expected cost for GCR-West Alternative 4 is approximately $9.9 million. Additional detail is provided in Appendix A.

5.3.2.8 State Acceptance

Removal and containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.3.2.1 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past removal and containment remedies. Potential community concerns are associated with safety during construction and projected life of the cap.

5.4 DETAILED ANALYSIS OF IHC ALTERNATIVES

Two remedial alternatives for sediment contamination in the IHC are described in Sections 5.4.1 and 5.4.2. Detailed analyses of the alternatives are presented below.

5.4.1 Detailed Analysis of IHC Alternative 1: No Action

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. If no action occurred at the site, the sediment would be left "as is" without implementation of access controls, containment, removal, treatment, or other mitigating actions. The analysis of the no action alternative is included to provide a comparative baseline used to evaluate other alternatives as required by the NCP.

5.4.1.1 Overall Protection of Human Health and the Environment

IHC Alternative 1 would not eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be left "as is" because no action would occur. Hazardous substances in the sediment may continue to naturally volatilize, biodegrade, dilute, and attenuate over time; however, no monitoring or sampling would be conducted to demonstrate that IHC Alternative 1 is effective.

5.4.1.2 Compliance with Local, State, and Federal Regulations

IHC Alternative 1 would not comply with chemical-specific regulations. Under this alternative, sediment would not be monitored to evaluate whether it is being naturally restored to its unrestricted use.

5.4.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term, because it would leave contaminated sediments in place in the river and canal, and would not impact current exposure pathways for these contaminants. Although fish consumption advisories would remain in effect, the effectiveness of these

advisories depends on effective communication and public responsiveness. While these advisories may decrease risk, they do not support removal of BUIs.

5.4.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would not be reduced by IHC Alternative 1 because the sediment would not be treated. Contaminant concentrations in the sediment might decrease over time as a result of degradation and attenuation; however, the degree of degradation and attenuation would not be monitored.

5.4.1.5 Short-Term Effectiveness

The No Action alternative would not create short-term impacts to human health or the environment. However, this alternative also would not address the current risks already associated with the presence of the contaminated material, in the short term or the long term.

5.4.1.6 Implementability

The No Action alternative would be highly implementable from a logistical and technical perspective, because it does not involve any remedial activities at the site.

5.4.1.7 Cost

There would be no financial costs associated with implementation of a No Action alternative that are calculable for this FS, though costs to industry would occur by not delisting the AOC.

5.4.1.8 State and Community Acceptance

The No Action alternative is not expected to be acceptable to stakeholders and the community, because it would not support the removal of BUIs in the AOC and would not meet the RAOs for the site.

5.4.2 Detailed Analysis IHC Alternative 4: Removal and Containment

Alternative 4 consists of removal of 35,000 cubic yards of sediment from the southern and northern ends of the exposure areas followed by placement of a layer of reactive material covered by an armor layer. The combined thickness of containment is typically 18 to 24 inches. The south sediment removal area will include removal of 6,000 cubic yards of sediment with PCBs over 50 mg/kg, which is regulated as TSCA waste. The removal area will also serve as a sedimentation basin between the GCR and Indiana Harbor.

5.4.2.1 Overall Protection of Human Health and the Environment

IHC Alternative 4 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be permanently removed or covered by a cap that would cover the impacted sediment and absorb contaminants in the sediment pore water as in flows through the cap.

5.4.2.2 Compliance with Local, State, and Federal Regulations

HC Alternative 4 would comply with all relevant regulations.

5.4.2.3 Long-Term Effectiveness and Permanence

Some sediment would be permanently removed. The containment system designed to address the remaining sediment for Alternative 4 would have a minimum life of 100 years.

5.4.2.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would be reduced to the PRG for at least 100 years.

5.4.2.5 Short-Term Effectiveness

There are no short-term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 12 months of start.

5.4.2.6 Implementability

The containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.4.2.7 Cost

The expected cost for IHC Alternative 4 is approximately $15.0 million. Additional detail is provided in Appendix A.

5.4.2.8 State Acceptance

Removal and containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.4.2.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on previous acceptance of past removal and containment remedies. Potential community concerns are associated with safety during construction and projected life of the cap.

5.5 DETAILED ANALYSIS OF LGC-EAST ALTERNATIVES

Three remedial alternatives for sediment contamination in LGC-East are described in Sections 5.5.1 through 5.5.3. Detailed analyses of the alternatives are presented below.

5.5.1 Detailed Analysis of GCR-East Alternative 1: No Action

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. If no action occurred at the site, the sediment would be left “as is” without implementation of access controls, containment, removal, treatment, or other mitigating actions. The analysis of the no action alternative is included to provide a comparative baseline used to evaluate other alternatives as required by the NCP.

5.5.1.1 Overall Protection of Human Health and the Environment

LGC-East Alternative 1 would not eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be left “as is” because no action would occur. Hazardous substances in the sediment may continue to naturally volatilize, biodegrade, dilute, and attenuate over time; however, no monitoring or sampling would be conducted to demonstrate that LGC-East Alternative 1 is effective.

5.5.1.2 Compliance with Local, State, and Federal Regulations

LGC-East Alternative 1 would not comply with chemical-specific regulations. Under this alternative, sediment would not be monitored to evaluate whether it is being naturally restored to its unrestricted use.

5.5.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term, because it would leave contaminated sediments in place in the river and canal, and would not impact current exposure pathways for these contaminants. Although fish consumption advisories would remain in effect, the effectiveness of these

advisories depends on effective communication and public responsiveness. While these advisories may decrease risk, they do not support removal of BUIs.

5.5.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would not be reduced by LGC-East Alternative 1 because the sediment would not be treated. Contaminant concentrations in the sediment might decrease over time as a result of degradation and attenuation; however, the degree of degradation and attenuation would not be monitored.

5.5.1.5 Short-Term Effectiveness

The No Action alternative would not create short-term impacts to human health or the environment. However, this alternative also would not address the current risks already associated with the presence of the contaminated material, in the short term or the long term.

5.5.1.6 Implementability

The No Action alternative would be highly implementable from a logistical and technical perspective, because it does not involve any remedial activities at the site.

5.5.1.7 Cost

There would be no financial costs associated with implementation of a No Action alternative that are calculable for this FS, though costs to industry would occur by not delisting the AOC.

5.5.1.8 State and Community Acceptance

The No Action alternative is not expected to be acceptable to stakeholders and the community, because it would not support the removal of BUIs in the AOC and would not meet the RAOs for the site.

5.5.2 Detailed Analysis GCR-East Alternative 2: Removal

Alternative 2 consists of removal of approximately 10 feet of sediment from LGC-East. The final elevation in LGC-East will match the adjacent navigation channel.

5.5.2.1 Overall Protection of Human Health and the Environment

LGC-East Alternative 2 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. A significant mass of impacted sediment will be removed, the lower sediment elevation will reduce the potential for direct contact by humans and diving water fowl. The lower sediment surface will also reduce re-suspension caused by vessels maneuvering in the navigation channel.

5.5.2.2 Compliance with Local, State, and Federal Regulations

LGC-East Alternative 2 would comply with all relevant regulations.

5.5.2.3 Long-Term Effectiveness and Permanence

Direct contact with sediment would be reduced by increasing the distance between receptors. The LGC-East area does not receive much additional sediment from the upstream section of the LGC, so accumulation of new sediment is not expected. The sediment should not require additional dredging to maintain the design surface elevation. Additional sediment containment installed in LGC-Middle would also contribute to the long term effectiveness of this option.

5.5.2.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

A significant volume of impacted sediment is removed, approximately 68,000 cubic yards. Mobility of the sediment through re-suspension is also reduced because the new sediment surface is not as prone to prop wash.

5.5.2.5 Short-Term Effectiveness

There are no short term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 6 months of start.

5.5.2.6 Implementability

The removal alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.5.2.7 Cost

The expected cost for LGC-East Alternative 3 is approximately $8.2 million. Additional detail is provided in Appendix A.

5.5.2.8 State Acceptance

Removal and containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.5.2.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past removal and containment remedies. Potential community concerns are associated with safety during construction, management of the sediment prior to disposal off-site, and life expectancy of the containment.

5.5.3 Detailed Analysis LGC-East Alternative 4: Removal and Containment

Alternative 4 consists of removal of about 7 feet of sediment, or 47,600 cubic yards, followed by installation of an armor cap to isolate the remaining sediment and protect the surface from disturbance by prop wash in the adjacent navigation channel.

5.5.3.1 Overall Protection of Human Health and the Environment

LGC-East Alternative 4 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. A partial amount of sediment in this canal segment would be removed and the remainder covered by a cap that would cover the impacted sediment.

5.5.3.2 Compliance with Local, State, and Federal Regulations

LGC-East Alternative 4 would comply with all relevant regulations.

5.5.3.3 Long-Term Effectiveness and Permanence

The LGC-East area does not receive much additional sediment from the upstream section of the LGC. The cap would need to be monitored to ensure the cap is not disrupted by activity in the adjacent navigation channel. Additional sediment containment installed in LGC-Middle would also contribute to the long term effectiveness of this option.

5.5.3.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would be reduced to the PRG for a period less than 100 years.

5.5.3.5 Short-Term Effectiveness

There are no short term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 12 months of start.

5.5.3.6 Implementability

The removal and containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty. This option requires two separate pieces of equipment and expertise.

5.5.3.7 Cost

The expected cost for LGC-East Alternative 4 is approximately $8.5 million. Additional detail is provided in Appendix A.

5.5.3.8 State Acceptance

Removal and containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.5.3.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past removal and containment remedies. Potential community concerns are associated with safety during construction, management of the sediment prior to disposal off-site, and life expectancy of the containment.

5.6 DETAILED ANALYSIS OF LGC-MIDDLE ALTERNATIVES

Three remedial alternatives for sediment contamination in LGC-Middle are described in Sections 5.6.1 through 5.6.3. Detailed analyses of the alternatives are presented below.

5.6.1 Detailed Analysis of LGC Middle Alternative 1: No Action

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. If no action occurred at the site, the sediment would be left “as is” without implementation of access controls, containment, removal, treatment, or other mitigating actions. The analysis of the no action alternative is included to provide a comparative baseline used to evaluate other alternatives as required by the NCP.

5.6.1.1 Overall Protection of Human Health and the Environment

LGC-Middle Alternative 1 would not eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be left “as is” because no action would occur. Hazardous substances in the sediment may continue to naturally volatilize, biodegrade, dilute, and attenuate over time; however, no monitoring or sampling would be conducted to demonstrate that LGC-Middle Alternative 1 is effective.

5.6.1.2 Compliance with Local, State, and Federal Regulations

LGC-Middle Alternative 1 would not comply with chemical-specific regulations. Under this alternative, sediment would not be monitored to evaluate whether it is being naturally restored to its unrestricted use.

5.6.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term, because it would leave contaminated sediments in place in the river and canal, and would not impact current exposure pathways for these contaminants. Although fish consumption advisories would remain in effect, the effectiveness of these advisories depends on effective communication and public responsiveness. While these advisories may decrease risk, they do not support removal of BUIs.

5.6.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would not be reduced by LGC-Middle Alternative 1 because the sediment would not be treated. Contaminant concentrations in the sediment might decrease over time as a result of degradation and attenuation; however, the degree of degradation and attenuation would not be monitored.

5.6.1.5 Short-Term Effectiveness

The No Action alternative would not create short-term impacts to human health or the environment. However, this alternative also would not address the current risks already associated with the presence of the contaminated material, in the short term or the long term.

5.6.1.6 Implementability

The No Action alternative would be highly implementable from a logistical and technical perspective, because it does not involve any remedial activities at the site.

5.6.1.7 Cost

There would be no financial costs associated with implementation of a No Action alternative that are calculable for this FS, though costs to industry would occur by not delisting the AOC.

5.6.1.8 State and Community Acceptance

The No Action alternative is not expected to be acceptable to stakeholders and the community, because it would not support the removal of BUIs in the AOC and would not meet the RAOs for the site.

5.6.2 Detailed Analysis LGC-Middle Alternative 3: Containment

Alternative 3 consists of installation of a sheet pile barrier wall placed perpendicular to the canal followed by placement of approximately 6 feet of sand and gravel. Organoclay would be added to the aggregate mix to mitigate impacted ground water moving through the cap. The top of the sheet pile wall would be approximately 4 to 6 feet below the water surface to allow water from upstream to continue to flow unimpeded to the east.

5.6.2.1 Overall Protection of Human Health and the Environment

LGC-Middle Alternative 3 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Most of the sediment in this exposure area would be capped and exposure pathways reduced or eliminated. Some sediment in the exposure area near the railroad bridge would not be capped as this sediment is already at or below the navigation channel elevation and beyond direct contact for many receptors.

5.6.2.2 Compliance with Local, State, and Federal Regulations

LGC-Middle Alternative 3 would comply with all relevant regulations.

5.6.2.3 Long-Term Effectiveness and Permanence

The organoclay component in the containment would have a life of 100 years based on expected contaminant flow through the cap. The sheet pile wall would keep the cap in place and not allow material to flow to the east into exposure area LGC-East.

5.6.2.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The organoclay within the cap would reduce the toxicity and mobility of impacted pore water moving through the cap.

5.6.2.5 Short-Term Effectiveness

There are no short term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 6 months of start.

5.6.2.6 Implementability

The containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.6.2.7 Cost

The expected cost for LGC-Middle Alternative 3 is approximately $9.7 million. Additional detail is provided in Appendix A.

5.6.2.8 State Acceptance

Containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.6.2.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past containment remedies. Potential community concerns are associated with safety during construction and life expectancy of the containment.

5.7 DETAILED ANALYSIS OF LGC-WEST ALTERNATIVES

Three remedial alternatives for sediment contamination in LGC-West are described in Sections 5.7.1 through 5.7.3. Detailed analyses of the alternatives are presented below.

5.7.1 Detailed Analysis of LGC-West Alternative 1: No Action

The no action alternative provides a reference to evaluate other alternatives. Under Alternative 1, no action would be taken to remediate sediment under a remedial action. If no action occurred at the site, the sediment would be left "as is" without implementation of access controls, containment, removal, treatment, or other mitigating actions. The analysis of the no action alternative is included to provide a comparative baseline used to evaluate other alternatives as required by the NCP.

5.7.1.1 Overall Protection of Human Health and the Environment

LGC-West Alternative 1 would not eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. Sediment in this river segment would be left "as is" because no action would occur. Hazardous substances in the sediment may continue to naturally volatilize, biodegrade, dilute, and attenuate over time; however, no monitoring or sampling would be conducted to demonstrate that LGC-West Alternative 1 is effective.

5.7.1.2 Compliance with Local, State, and Federal Regulations

LGC-West Alternative 1 would not comply with chemical-specific regulations. Under this alternative, sediment would not be monitored to evaluate whether it is being naturally restored to its unrestricted use.

5.7.1.3 Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long term, because it would leave contaminated sediments in place in the river and canal, and would not impact current exposure pathways for these contaminants. Although fish consumption advisories would remain in effect, the effectiveness of these

advisories depends on effective communication and public responsiveness. While these advisories may decrease risk, they do not support removal of BUIs.

5.7.1.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would not be reduced by LGC-West Alternative 1 because the sediment would not be treated. Contaminant concentrations in the sediment might decrease over time as a result of degradation and attenuation; however, the degree of degradation and attenuation would not be monitored.

5.7.1.5 Short-Term Effectiveness

The No Action alternative would not create short-term impacts to human health or the environment. However, this alternative also would not address the current risks already associated with the presence of the contaminated material, in the short term or the long term.

5.7.1.6 Implementability

The No Action alternative would be highly implementable from a logistical and technical perspective, because it does not involve any remedial activities at the site.

5.7.1.7 Cost

There would be no financial costs associated with implementation of a No Action alternative that are calculable for this FS, though costs to industry would occur by not delisting the AOC.

5.7.1.8 State and Community Acceptance

The No Action alternative is not expected to be acceptable to stakeholders and the community, because it would not support the removal of BUIs in the AOC and would not meet the RAOs for the site.

5.7.2 Detailed Analysis LGC-West Alternative 2: Removal

Alternative 2 consists of removal of approximately 6 feet of sediment from LGC-West. The final elevation in LGC-East will match the adjacent navigation channel. The sediment in this area has an extremely high water content, so the final disposal volume is expected to be less per cubic yard removed.

5.7.2.1 Overall Protection of Human Health and the Environment

LGC-West Alternative 2 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. A significant mass of impacted sediment will be removed, the lower sediment elevation will reduce the potential for direct contact by humans and diving water fowl.

5.7.2.2 Compliance with Local, State, and Federal Regulations

LGC-West Alternative 2 would comply with all relevant regulations.

5.7.2.3 Long-Term Effectiveness and Permanence

There is no indication that the exposure area is receiving any additional source material from the drainage channel inlet at Calumet Avenue. Dredging the impacted sediment should be a relatively permanent solution.

5.7.2.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

A significant volume of impacted sediment is removed; approximately 155,000 cubic yards.

5.7.2.5 Short-Term Effectiveness

There are no short-term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 6 months of start.

5.7.2.6 Implementability

The removal alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.7.2.7 Cost

The expected cost for LGC-West Alternative 3 is approximately $11.9 million. Additional detail is provided in Appendix A.

5.7.2.8 State Acceptance

Removal is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.7.2.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past containment remedies. Potential community concerns are associated with safety during construction and management of the sediment prior to disposal off-site.

5.7.3 Detailed Analysis LGC-West Alternative 4: Removal and Containment

Alternative 4 consists of removal of about 6 feet of sediment as in Alternative 2 followed by installation of a sand cap to isolate the remaining sediment and provide a clean surface for benthic organisms.

5.7.3.1 Overall Protection of Human Health and the Environment

LGC-West Alternative 4 would eliminate, reduce, or control risks to human health or the environment posed by contaminated river sediment. A significant mass of impacted sediment will be removed, the lower sediment elevation will reduce the potential for direct contact by humans and diving water fowl.

5.7.3.2 Compliance with Local, State, and Federal Regulations

LGC-West Alternative 4 would comply with all relevant regulations.

5.7.3.3 Long-Term Effectiveness and Permanence

Removal of 6 feet of sediment eliminates a majority of the contaminant mass in the exposure area. Placement of the containment system in LGC-West adds additional long-term effectiveness by addressing any residual impact in the native material.

5.7.3.4 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous substances in soil would be reduced.

5.7.3.5 Short-Term Effectiveness

There are no short-term risks associated with implementation of this alternative. Temporary storm water controls are required during construction. A traffic plan is required to manage deliveries and disposal. The remedy can be implemented within 6 months of start.

5.7.3.6 Implementability

The removal and containment alternative has been used extensively on the GCR and can be implemented with moderate difficulty.

5.7.3.7 Cost

The expected cost for LGC-West Alternative 4 is approximately $15.3 million. Additional detail is provided in Appendix A.

5.7.3.8 State Acceptance

Removal and containment is expected to be acceptable to the state, as all activities would comply with applicable regulations and necessary permits.

5.7.3.9 Community Acceptance

This alternative is also expected to be acceptable to stakeholders and the community, based on past acceptance of past containment remedies. Potential community concerns are associated with safety during construction, management of the sediment prior to disposal off-site, and life expectancy of the sand cover.

6.0 COMPARITIVE ANALYSIS OF ALTERNATIVES

Alternatives for each of the six exposure areas are compared to each other below. Three exposure areas, GCR-East, IHC, and LGC-Middle have only two alternatives each, including the No Action Alternative. Since the No Action Alternative does not make any progress toward removing the BUIs in the GCR AOC, the remaining alternative in GCR-West, IHC, and LGC-Middle are the default options. Alternatives for the remaining three exposure areas are compared below based on the nine evaluation criteria. The discussion only covers criteria were there is a difference between the available alternatives, not including the No Action Alternative.

6.1 COMPARATIVE ANALYSIS OF GCR-EAST ALTERNATIVES

6.1.1 Implementability

Alternative 1 is the easiest to implement since nothing is done. Alternative 3 is the next easiest since only placement of a containment system within this exposure area is completed. Alternative 4 requires the mobilization and operation of the hydraulic dredge to remove a small volume of sediment.

Alternative 1 (No Action) > Alternative 3 (Containment) > Alternative 4 (Removal and Containment)

6.1.2 Cost

There is no cost to implement Alternative 1. Alternative 3 at $6.2 million is approximately $1.1 million less than Alternative 4 at $7.3 million with no significant enhancement in any of the other eight evaluation criteria.

Alternative 1 (No Action) > Alternative 3 (Containment) > Alternative 4 (Removal and Containment)

6.1.3 Summary of Analysis for GCR-East

With or without additional dredging in GCR-East, the containment system composed on organoclay mixed with aggregate is sufficient to meet the PRG for this exposure area. Alternative 3 is easier to implement to meet the ROA and can do so at less cost.

Alternative 3 (Containment) > Alternative 4 (Removal and Containment) > Alternative 1 (No Action)

6.2 COMPARATIVE ANALYSIS OF LGC-EAST ALTERNATIVES

6.2.1 Long-Term Effectiveness and Permanence

Alternative 2 removes sediment to the approximate navigation depth. Because this branch of the IHC is essentially a dead end, little additional sedimentation within this exposure area is anticipated. Even with the armor layer, the containment component of Alternative 4 is susceptible to breach by prop wash from vessels operating in the adjacent navigation channel.

Alternative 2 (Removal) > Alternative 4 (Removal and Containment) > Alternative 1 (No Action)

6.2.2 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Alternative 2 reduces the volume of impacted sediment in the exposure area by 68,000 cubic yards while Alternative 4 removes 47,600 cubic yards. Alternative 4 reduces contaminant mobility by capping the remaining sediment to reduce re-suspension. Alternative 2 reduces by removing sufficient material to provide a final sediment elevation where prop wash is greatly reduced. Neither alternative addresses reduction of toxicity. There is no reduction with Alternative 1.

Alternative 2 (Removal) > Alternative 4 (Removal and Containment) > Alternative 1 (No Action)

6.2.3 Implementability

Alternative 1 is the easiest to implement since nothing is done. Alternative 2 requires mobilization and operation of the hydraulic dredge. Alternative 4 requires the additional mobilization and operation of the cap placement equipment.

Alternative 1 (No Action) > Alternative 2 (Removal) > Alternative 4 (Removal and Containment)

6.2.4 Cost

There is no cost to implement Alternative 1. Alternative 2 at $8.2 million is slightly less than Alternative 4 at $8.6 million.

Alternative 1 (No Action) > Alternative 2 (Removal) ~ Alternative 4 (Removal and Containment)

6.2.5 Summary of Analysis for LGC-East

Alternative 2 is superior to less sediment removal and containment contained in Alternative 4. Alternative 2 moves a greater mass of contaminants, is easier to implement, and has greater long-term permanence than Alternative 4. Both Alternative 2 and 4 are better than the No Action alternative.

Alternative 2 (Removal) > Alternative 4 (Removal and Containment) > Alternative 1 (No Action)

6.3 COMPARATIVE ANALYSIS OF LGC-WEST ALTERNATIVES

6.3.1 Long-Term Effectiveness and Permanence

The additional containment added in Alternative 4 addresses any residual impact that may be present in the native sediment.

Alternative 4 (Removal and Containment) > Alternative 2 (Removal) > Alternative 1 (No Action)

6.3.2 Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Addition of the sand cap reduces mobility of the residual impact in the remaining sediment.

Alternative 4 (Removal and Containment) > Alternative 2 (Removal) > Alternative 1 (No Action)

6.3.3 Implementability

Alternative 1 is the easiest to implement since nothing is done. Alternative 2 requires mobilization and operation of the hydraulic dredge. Alternative 4 requires the additional mobilization and operation of the cap placement equipment.

Alternative 1 (No Action) > Alternative 2 (Removal) > Alternative 4 (Removal and Containment)

6.3.4 Cost

There is no cost to implement Alternative 1. Alternative 2 at $11.8 million is less than Alternative 4 at $14.9 million.

Alternative 1 (No Action) > Alternative 2 (Removal) > Alternative 4 (Removal and Containment)

6.3.5 Summary of Analysis for LGC-West

Alternative 2 removes a significant amount of volume and costs about $3 million less than Alternative 4. Alternative 4 has the capability to address any residual impact left in the sediment and potentially provide greater long term success, but the residual impact is expected to be low even without the added containment. As discussed in Section 1.2.3, only three samples points are located in this fairly large area. Additional sampling may be warranted to evaluate the amount of impact below the planned 6 foot removal. Higher levels of residual impact, or a thicker sediment face, would require a re-evaluation of the remedial alternatives.

Alternative 2 (Removal) > Alternative 4 (Removal and Containment) > Alternative 1 (No Action)

7.0 CONCLUSION

A detailed comparative analysis of remedial alternatives for the GCR and IHC area of the GCR AOC was performed. The project area was divided into six exposure areas and a preferred alternative selected for each, provided in Table 7.1.

TABLE 7-1. RECOMMENDED ALTERNATIVES

Exposure Area	Alternative No.	Alternative Name	Cost
GCR-East	3	Containment	$6,194,763
GCR-West	4	Removal with Containment	$9,933,030
IHC	4	Removal with Containment	$15,071,187
LGC-East	2	Removal	$8,190,930
LGC-Middle	3	Containment	$9,652,396
LGC-West	2	Removal	$11,894,119
		Total Cost to Implement	$60,936,425

Each of the selected alternatives either meet or make significant progress toward fulfilling the ultimate RAO, which is to remove the BUIs from the GCR AOC. All of the approaches have been previously implemented in the GCR AOC, and there is positive state and community support for these remedies.

8.0 REFERENCES

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FIGURES

(11 Sheets)

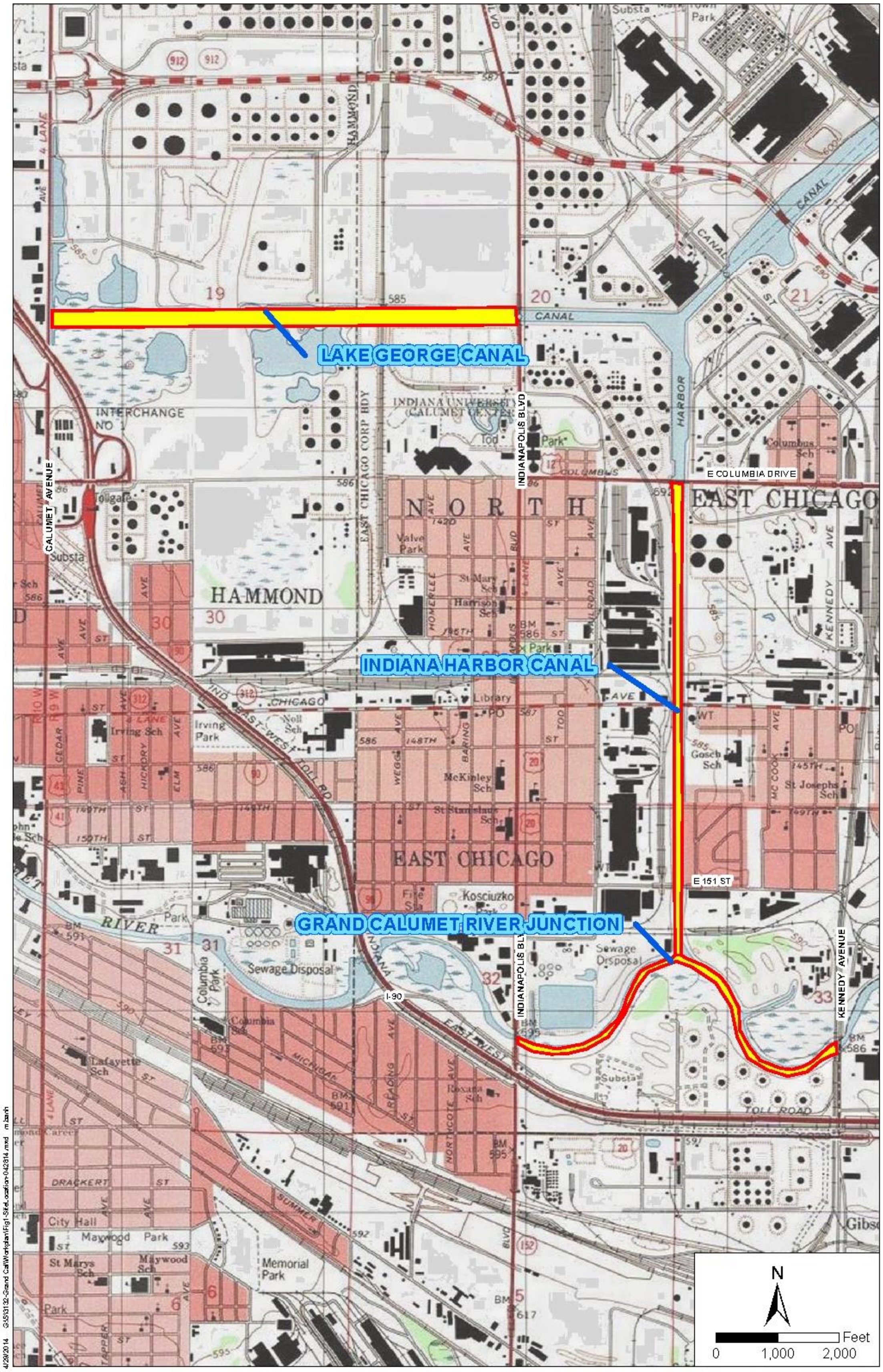
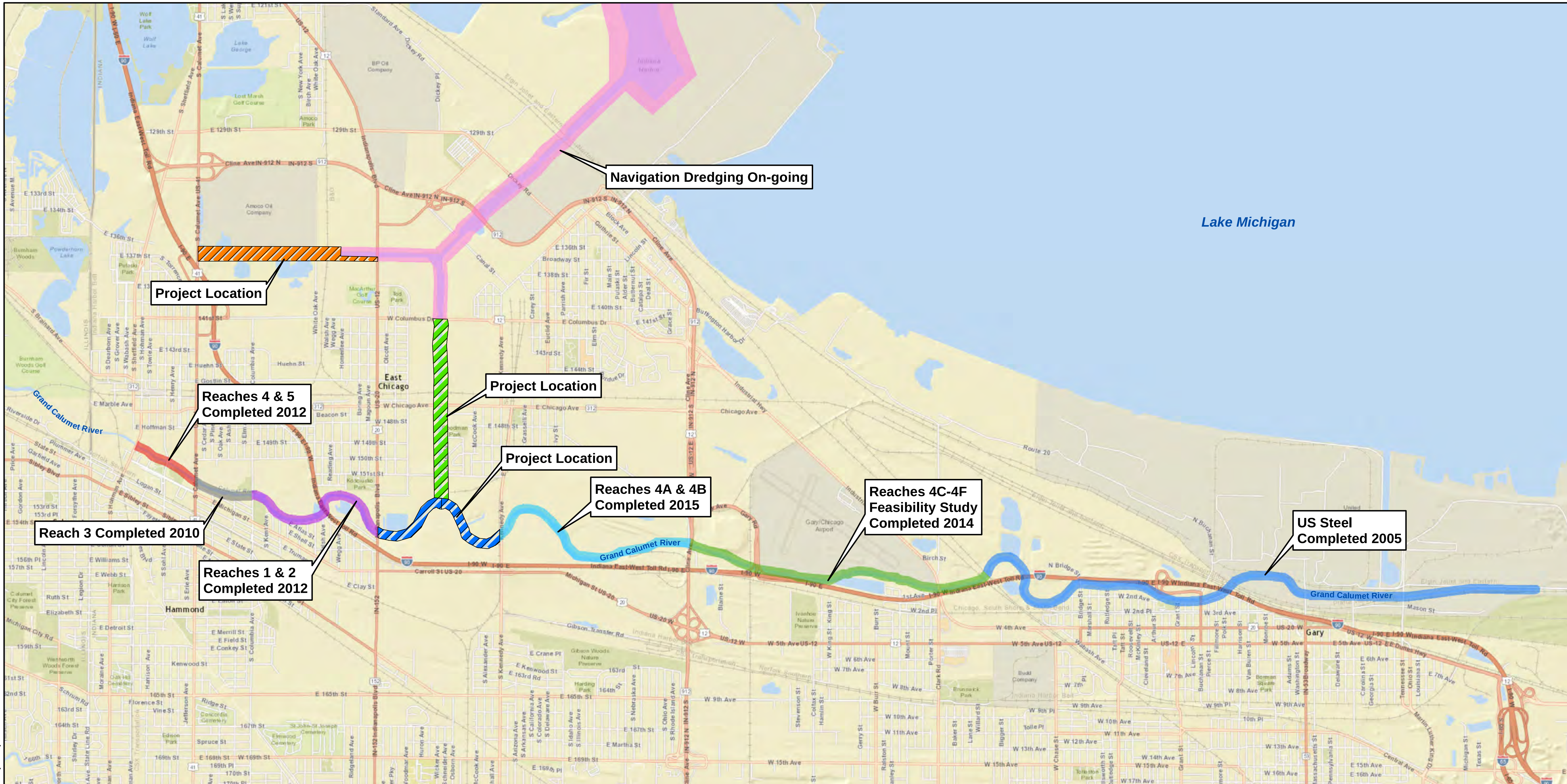


Figure 1-1. Site Location Map



Legend

- Grand Calumet River East and West Exposure Areas
- Indiana Harbor Canal Exposure Area
- Lake George Canal West, Middle, and East Exposure Areas

ECWMD – East Chicago Waterway Management District

N

0 2,500 5,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-2
RECENT DREDGING ACTIVITY

TETRA TECH

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Legend

GCR Project Area

Dividing line between GCR West and East Exposure Areas

GCR - Grand Calumet River
ECWMD – East Chicago Waterway Management District

N

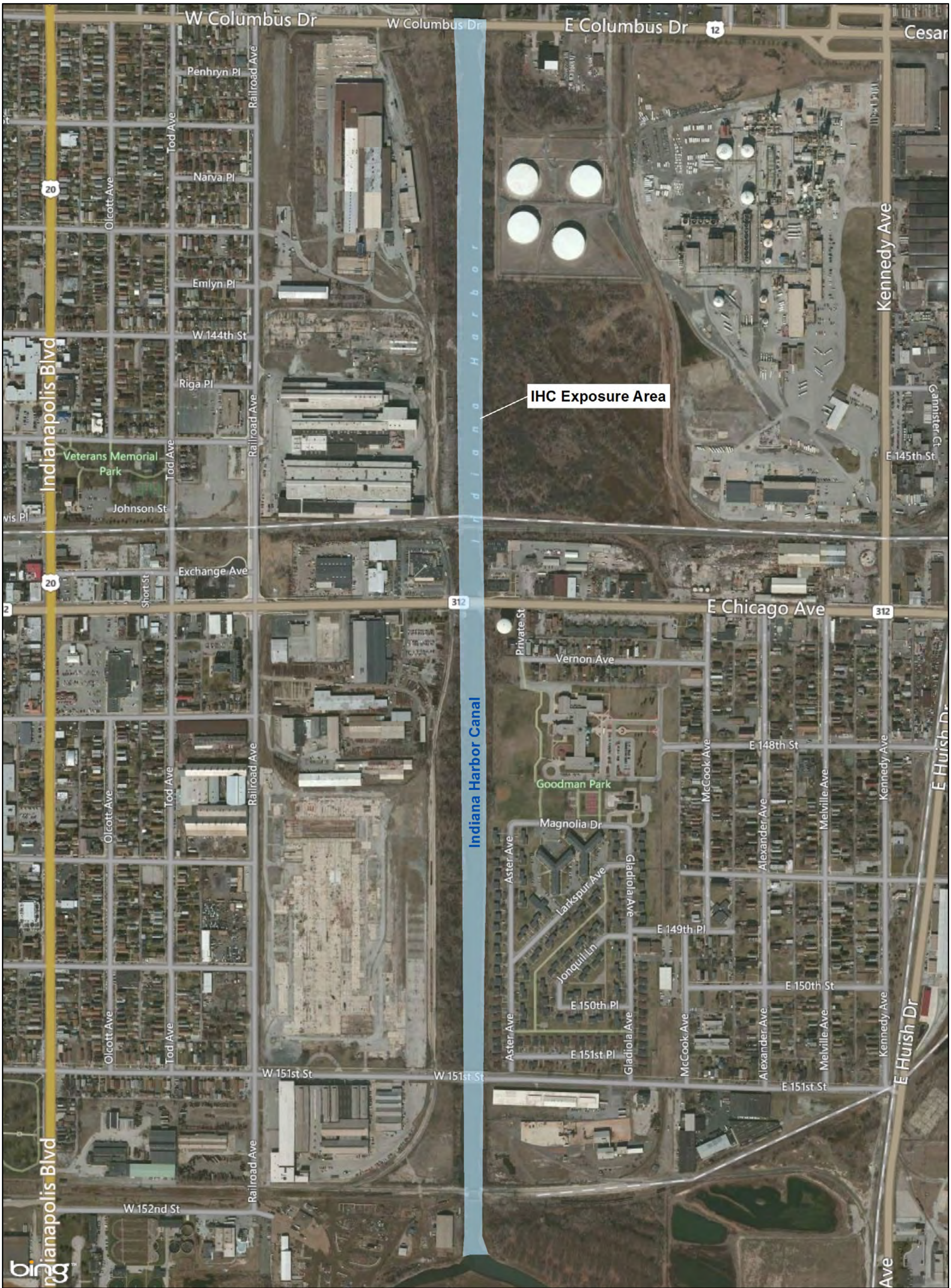
0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-3
GRAND CALUMET RIVER EXPOSURE AREAS

TETRA TECH

6/11/2015 G:\S\3132-Grand Cal\mxd\2015-05\Fig1-3-GCR-ExposureAreas.mxd



LEGEND

IHC Project Area

IHC - Indiana Harbor Canal
ECWMD – East Chicago Waterway Management District

N

0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-4
INDIANA HARBOR CANAL EXPOSURE AREA

TETRA TECH

Legend

LGC Project Areas

Dividing line between West, Middle and East LGC Exposure Areas

LGC - Lake George Canal
ECWMD – East Chicago Waterway Management District

N

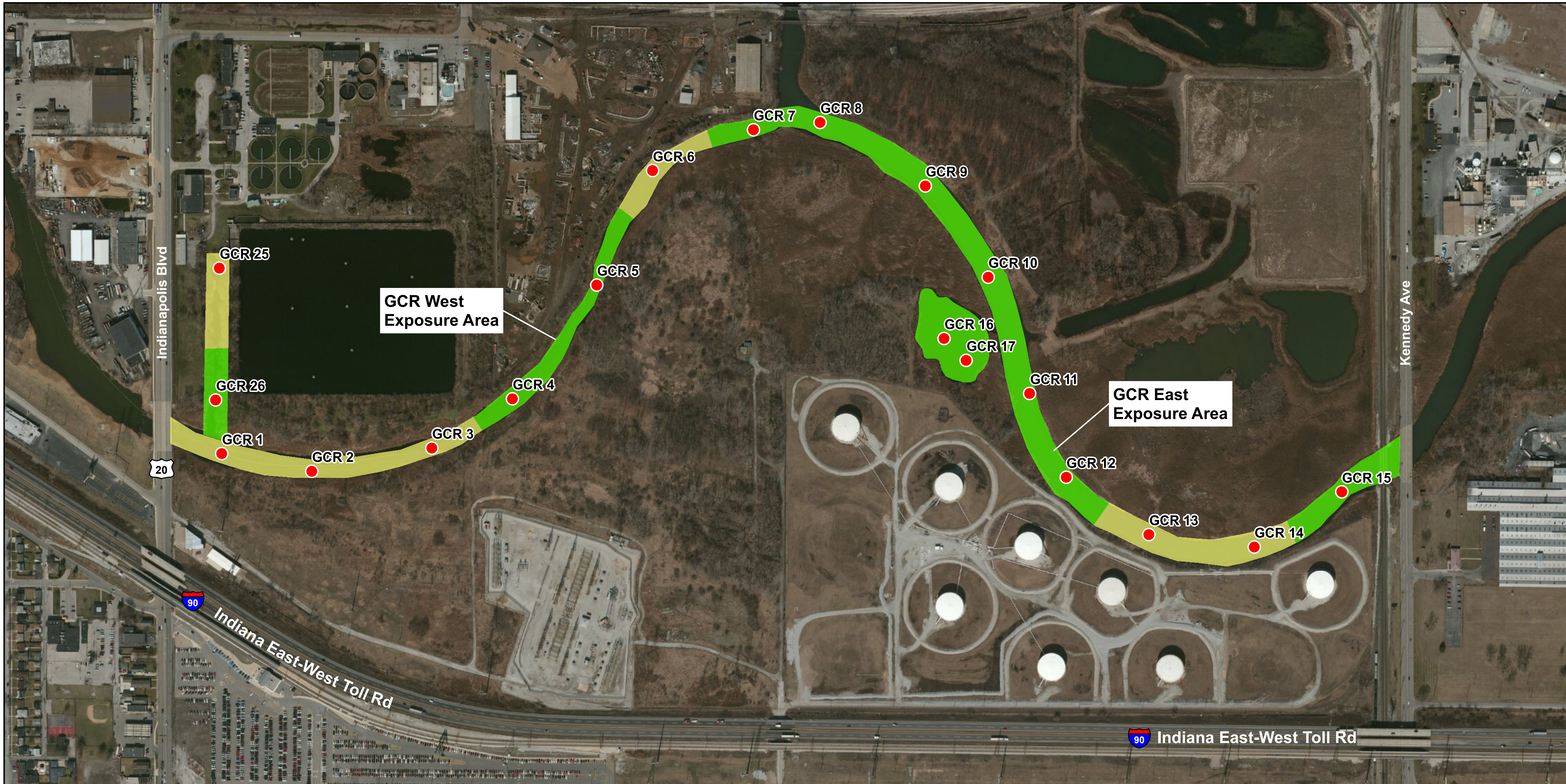
0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-5
LAKE GEORGE CANAL
EXPOSURE AREAS

TETRA TECH

6/9/2015 G:\S\3132-Grand Cal\mxd\2015-05\Fig1-5-LGC-ExposureAreas.mxd



Legend

● Surface Sediment Sample Location

Total 16 PPAH

- > 27 and < or = 50 mg/kg
- 51 - 500 mg/kg
- 501 - 1,000 mg/kg
- > 1,000 mg/kg

PPAH - Priority Polycyclic Aromatic Hydrocarbons
GCR - Grand Calumet River
ECWMD – East Chicago Waterway Management District

N

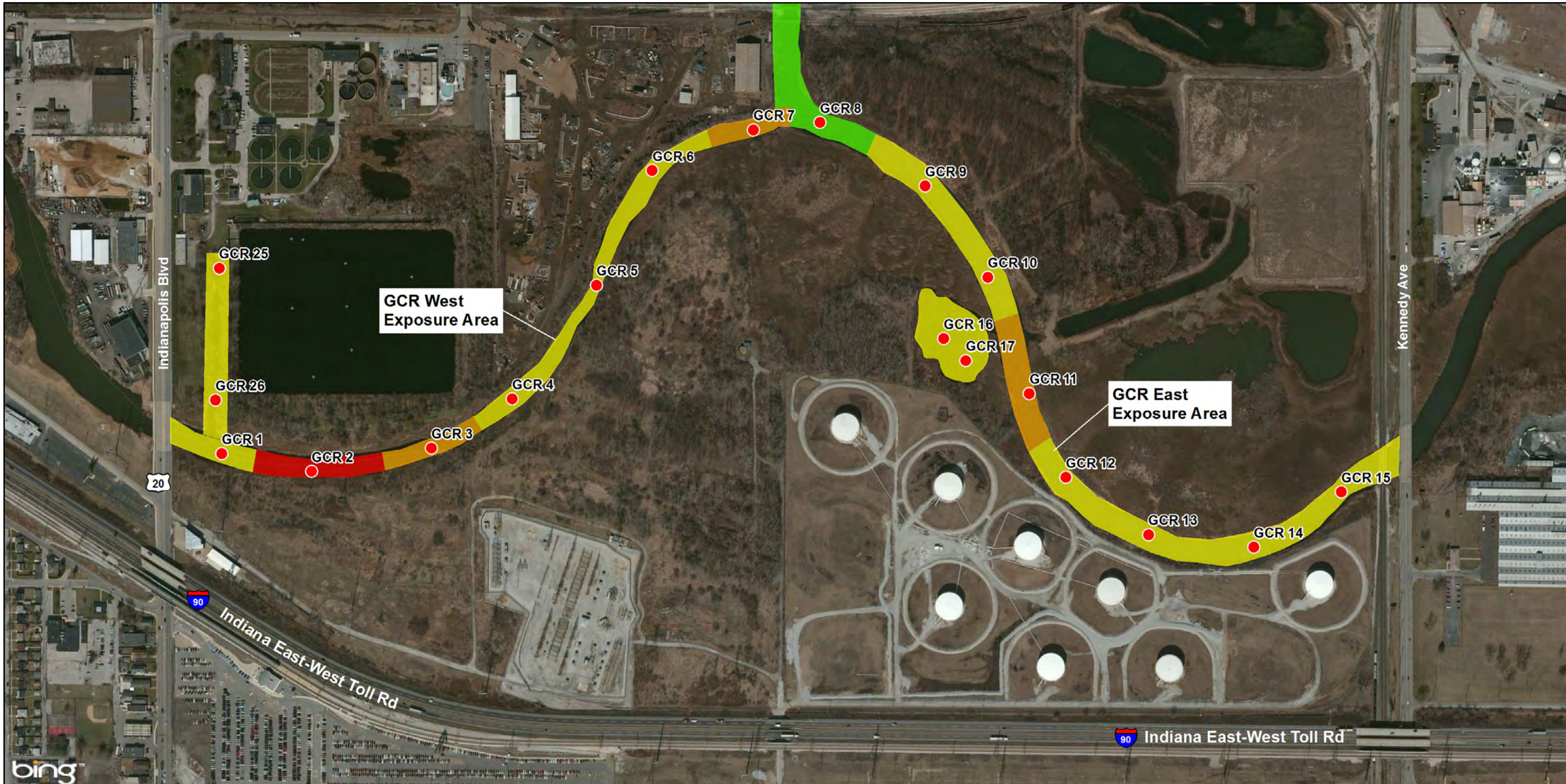
0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-6
GRAND CALUMET RIVER JUNCTION REACH SURFICIAL SEDIMENT TOTAL 16 PPAH

TETRA TECH

6/12/2015 G:\S3132-Grand Cal\mxd\2015-05\Fig1-6-GCR-SurficalTotalPPAH.mxd



Legend

- Surface Sediment Sample Location

Total 16 PPAH

- > 27 and < or = 50 mg/kg
- 51 - 500 mg/kg
- 501 - 1,000 mg/kg
- > 1,000 mg/kg

PPAH - Priority Polycyclic Aromatic Hydrocarbons
GCR - Grand Calumet River
ECWMD – East Chicago Waterway Management District

N

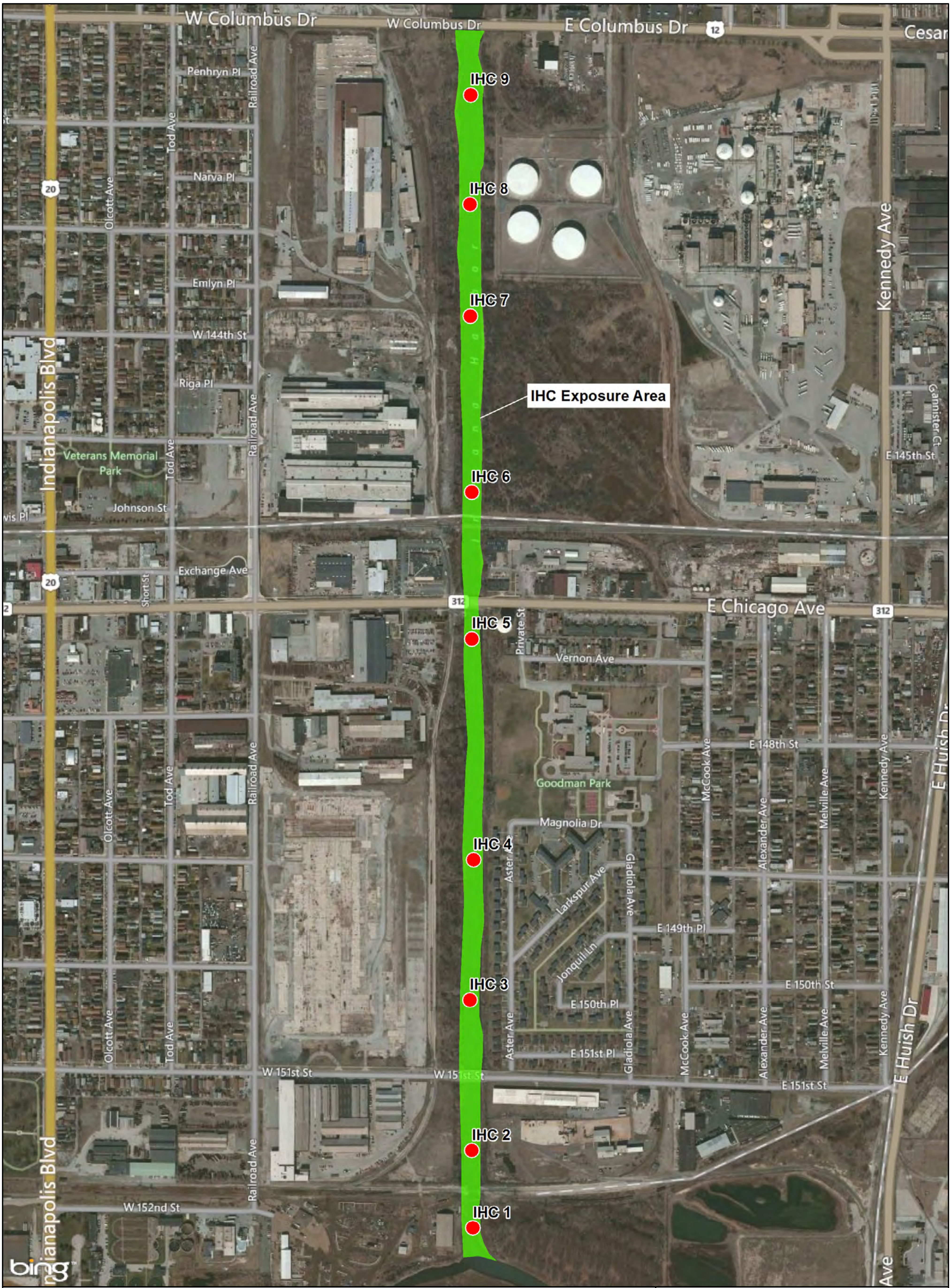
0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-7
GRAND CALUMET RIVER JUNCTION REACH SUBSURFICIAL SEDIMENT TOTAL 16 PPAH

TETRA TECH

6/9/2015 G:\S\3132-Grand Cal\mxd\2015-05\Fig1-7-GCR-SubsurficalTotalPPAH.mxd



LEGEND

Surface Sediment Sample Location

Total 16 PPAH

- > 27 and < or = 50 mg/kg
- 51 - 500 mg/kg
- 501 - 1,000 mg/kg
- > 1,000 mg/kg

PPAH - Priority Polycyclic Aromatic Hydrocarbons
IHC -Indiana Harbor Canal
ECWMD – East Chicago Waterway Management District

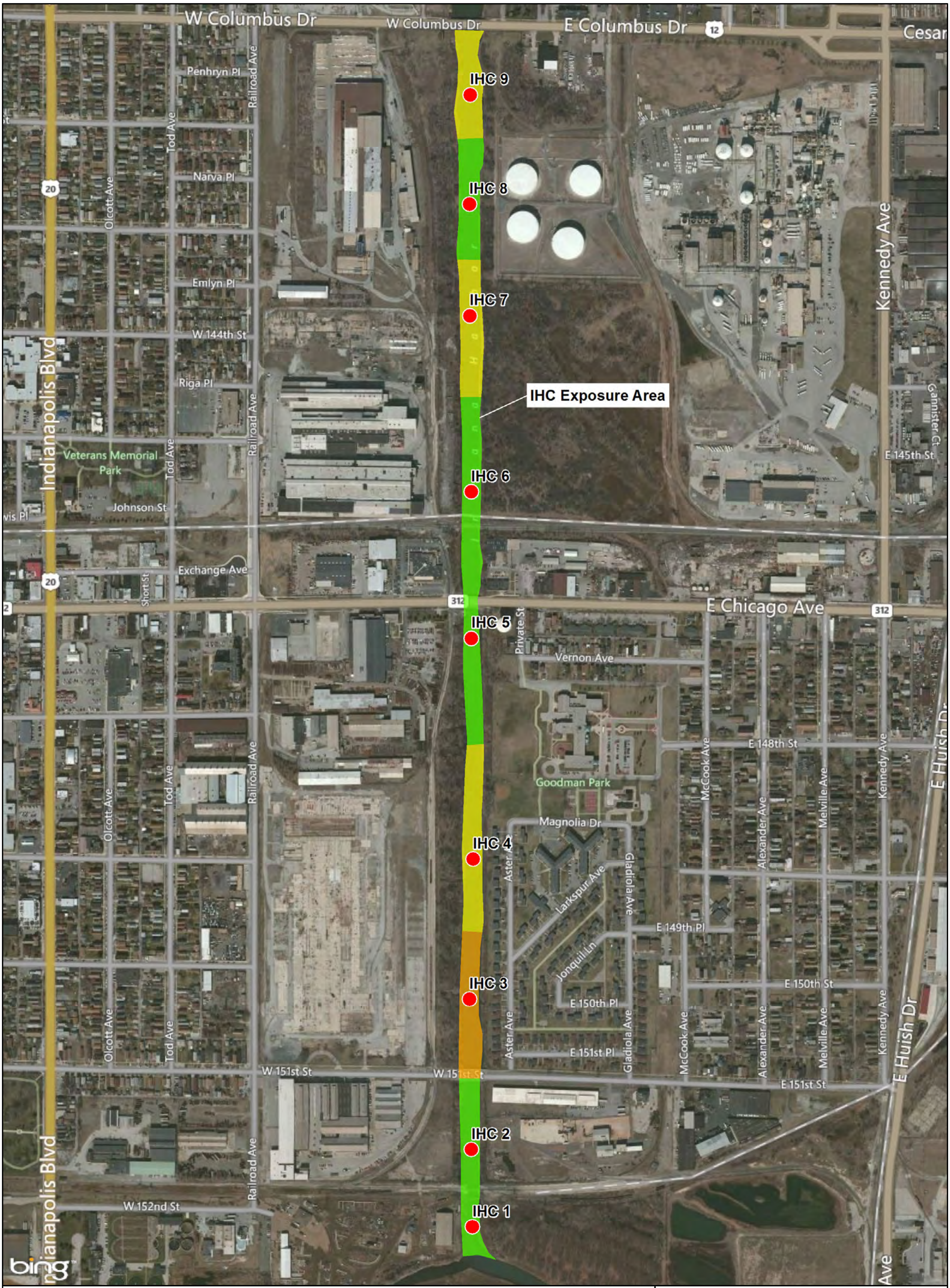
N

0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-8
INDIANA HARBOR CANAL SURFICIAL SEDIMENT TOTAL 16 PPAH

TETRA TECH



LEGEND

Surface Sediment Sample Location

Total 16 PPAH

- > 27 and < or = 50 mg/kg
- 51 - 500 mg/kg
- 501 - 1,000 mg/kg
- > 1,000 mg/kg

PPAH - Priority Polycyclic Aromatic Hydrocarbons
IHC -Indiana Harbor Canal
ECWMD – East Chicago Waterway Management District

N

0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-9
INDIANA HARBOR CANAL SUBSURFICIAL SEDIMENT TOTAL 16 PPAH

TETRA TECH

Legend

● Surface Sediment Sample Location

Total 16 PPAH

- > 27 and < or = 50 mg/kg
- 51 - 500 mg/kg
- 501 - 1,000 mg/kg
- > 1,000 mg/kg

PPAH - Priority Polycyclic Aromatic Hydrocarbons
LGC - Lake George Canal
ECWMD – East Chicago Waterway Management District

N

0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-10
LAKE GEORGE CANAL
SURFICIAL SEDIMENT TOTAL 16 PPAH

TETRA TECH

G:\S\3132-Grand Cal\mxd\2015-05\Fig1-10-LGC-SurficalTotalPPAH.mxd
6/11/2015

Legend

- Surface Sediment Sample Location

Total 16 PPAH

- > 27 and < or = 50 mg/kg
- 51 - 500 mg/kg
- 501 - 1,000 mg/kg
- > 1,000 mg/kg

PPAH - Priority Polycyclic Aromatic Hydrocarbons
LGC - Lake George Canal
ECWMD – East Chicago Waterway Management District

N

0 500 1,000 Feet

ECWMD GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL GRAND CALUMET RIVER AREA OF CONCERN EAST CHICAGO, INDIANA

FIGURE 1-11
LAKE GEORGE CANAL
SUBSURFICIAL SEDIMENT TOTAL 16 PPAH

TETRA TECH

6/11/2015 G:\S\3132-Grand Cal\mxd\2015-05\Fig1-11-LGC-SubsurficalTotalPPAH.mxd

APPENDIX A

(Nine Cost Tables)

Table A-1
GCR-East Alternate 3: Containment
Estimated Cost for Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	750,000.00	$750,000
	Mobilization/Demobilization Subtotal				**$750,000**
2	**Site Preparation**				
	Temporary Facilities	4	Month	20,000.00	$80,000
	Access and Staging Area on Buckeye North Terminal	1	Lump Sum	175,000.00	$175,000
	River Access	1	Lump Sum	10,000.00	$10,000
	Temporary Fencing	15,800	Linear Feet	12.00	$189,600
	Security	16	Week	3,000.00	$48,000
	Site Preparation Subtotal				**$502,600**
3	**Place Containment (Multilayer Cap)**				
	Sand and Gravel Aggregate Mix	30000	Ton	20.00	$600,000
	Organoclay (AquaGate or Equivalent)	650	Ton	1,900.00	$1,235,000
	Place 9-inch Active Layer (5% Organoclay)	315000	Square Feet	4.00	$1,260,000
	Place 12-inch Armor Layer (Sand & Gravel Mix)	315000	Square Feet	2.50	$787,500
	Quality Control	50	Day	2,500.00	$125,000
	Place Containment (Multilayer Cap) Subtotal				**$4,007,500**
	Capital Cost Subtotal				**$5,260,100**
4	**Bid Bond**	1	Percent	0.025	**$131,503**
	Construction Cost Subtotal				**$5,391,603**
5	**Engineering Oversight**				
	Engineering Oversight	4	Month	60,000.00	$240,000
	Engineering Oversight				**$240,000**
6	**Contingency**	1	Percent	0.1	**$563,160**
7	**Total GCR-East Alternative 3 Cost**				**$6,194,763**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density 1 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-2
GCR-East Alternate 4: Removal with Containment
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	1,250,000.00	$1,250,000
	Mobilization/Demobilization Subtotal				**$1,250,000**
2	**Site Preparation**				
	Temporary Facilities	5	Month	20,000.00	$100,000
	Access and Staging Area on Buckeye North Terminal	1	Lump Sum	350,000.00	$350,000
	River Access	1	Lump Sum	10,000.00	$10,000
	Temporary Fencing	15,800	Linear Feet	12.00	$189,600
	Security	20	Week	3,000.00	$60,000
	Site Preparation Subtotal				**$709,600**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	5180	Square Feet	3.00	$15,540
	Hydraulic Dredging of Sediment	2000	Cubic Yards	30.00	$60,000
	Sediment Slurry Header	1	Lump Sum	15,000.00	$15,000
	Geotextile Tubes	300	Linear Feet	40.00	$12,000
	Polymer	4000	Pound	2.50	$10,000
	Dewatering Management	7	Day	4,000.00	$28,000
	Waste Water Treatment Plant	1	Lump Sum	11,250.00	$11,250
	Dredging, Dewatering and Water Treatment Subtotal				**$151,790**
4	**Sediment Transportaion and Disposal**				
	Sediment Transportaion and Disposal	2000	Ton	37.50	$75,000
	Sediment Transportaion and Disposal Subtotal				**$75,000**
5	**Place Containment (Multilayer Cap)**				
	Sand and Gravel Aggregate Mix	30000	Ton	20.00	$600,000
	Organoclay (AquaGate or Equivalent)	650	Ton	1,900.00	$1,235,000
	Place 9-inch Active Layer (5% Organoclay)	315000	Square Feet	4.00	$1,260,000
	Place 12-inch Armor Layer (Sand & Gravel Mix)	315000	Square Feet	2.50	$787,500
	Quality Control	50	Day	2,500.00	$125,000
	Place Containment (Multilayer Cap) Subtotal				**$4,007,500**
	Capital Cost Subtotal				**$6,193,890**
6	**Bid Bond**	1	Percent	0.025	**$154,847**
	Construction Cost Subtotal				**$6,348,737**
7	**Engineering Oversight**				
	Engineering Oversight	5	Month	60,000.00	$300,000
	Engineering Oversight				**$300,000**
8	**Contingency**	1	Percent	0.1	**$664,874**
9	**Total GCR-East Alternative 4 Cost**				**$7,313,611**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density 1 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-3
GCR-West Alternate 4: Removal with Containment
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	1,250,000.00	$1,250,000
	Mobilization/Demobilization Subtotal				**$1,250,000**
2	**Site Preparation**				
	Temporary Facilities	5	Month	20,000.00	$100,000
	Access and Staging Area on Buckeye North Terminal	1	Lump Sum	350,000.00	$350,000
	River Access	1	Lump Sum	10,000.00	$10,000
	Temporary Fencing	15,800	Linear Feet	12.00	$189,600
	Security	20	Week	3,000.00	$60,000
	Site Preparation Subtotal				**$709,600**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	77000	Square Feet	3.00	$231,000
	Hydraulic Dredging of Sediment	30000	Cubic Yards	30.00	$900,000
	Sediment Slurry Header	1	Lump Sum	223,000.00	$223,000
	Geotextile Tubes	4300	Linear Feet	40.00	$172,000
	Polymer	60000	Pound	2.50	$150,000
	Dewatering Management	30	Day	4,000.00	$120,000
	Waste Water Treatment Plant	1	Lump Sum	165,000.00	$165,000
					$1,961,000
4	Sediment Transportaion and Disposal				
	Sediment Transportaion and Disposal	30000	Ton	37.50	$1,125,000
	Sediment Transportaion and Disposal Subtotal				**$1,125,000**
5	**Place Containment (Multilayer Cap)**				
	Sand and Gravel Aggregate Mix	26000	Ton	20.00	$520,000
	Organoclay (AquaGate or Equivalent)	565	Ton	1,900.00	$1,073,500
	Place 9-inch Active Layer (5% Organoclay)	272000	Square Feet	4.00	$1,088,000
	Place 12-inch Armor Layer (Sand & Gravel Mix)	272000	Square Feet	2.50	$680,000
	Quality Control	44	Day	2,500.00	$110,000
	Place Containment (Multilayer Cap) Subtotal				**$3,471,500**
	Capital Cost Subtotal				**$8,517,100**
6	**Bid Bond**	1	Percent	0.025	**$212,928**
	Construction Cost Subtotal				**$8,730,028**
7	**Engineering Oversight**				
	Engineering Oversight	5	Month	60,000.00	$300,000
	Engineering Oversight				**$300,000**
8	**Contingency**	1	Percent	0.1	**$903,003**
9	**Total GCR-West Alternative 4 Cost**				**$9,933,030**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density 1 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-4
IHC Alternate 4: Removal with Containment
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	$500,000.00	$500,000
	Mobilization/Demobilization Subtotal				**$500,000**
2	**Site Preparation**				
	Temporary Facilities	7	Month	$20,000.00	$140,000
	River Access	1	Lump Sum	$20,000.00	$20,000
	Security	26	Week	$3,000.00	$78,000
	Site Preparation Subtotal				**$238,000**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	91000	Square Feet	$3.00	$273,000
	Hydraulic Dredging of Sediment	35000	Cubic Yards	$30.00	$1,050,000
	Sediment Slurry Header	1	Lump Sum	$265,000.00	$265,000
	Geotextile Tubes	5000	Linear Feet	$40.00	$200,000
	Polymer	70000	Pound	$2.50	$175,000
	Dewatering Management	35	Day	$4,000.00	$140,000
	Waste Water Treatment Plant	1	Lump Sum	$195,000.00	$195,000
					$2,298,000
4	**Sediment Transportaion and Disposal**				
	Sediment Transportaion and Disposal (TSCA)	6000	Ton	$175.00	$1,050,000
	Sediment Transportaion and Disposal (non-TSCA)	46500	Ton	$37.50	$1,743,750
	Sediment Transportaion and Disposal Subtotal				**$2,793,750**
5	**Place Containment (Multilayer Cap)**				
	Sand and Gravel Aggregate Mix	75700	Ton	$20.00	$1,514,000
	Activated Carbon (AquaGate or Equivalent)	326	Ton	$650.00	$211,900
	Place 9-inch Active Layer (1% Activated Carbon)	781000	Square Feet	$4.00	$3,124,000
	Place 12-inch Armor Layer (Sand & Gravel Mix)	781000	Square Feet	$2.50	$1,952,500
	Quality Control	130	Day	$2,500.00	$325,000
	Place Containment (Multilayer Cap) Subtotal				**$7,127,400**
	Capital Cost Subtotal				**$12,957,150**
6	**Bid Bond**	1	Percent	0.025	**$323,929**
	Construction Cost Subtotal				**$13,281,079**
7	**Engineering Oversight**				
	Engineering Oversight	7	Month	$60,000.00	$420,000
	Engineering Oversight				**$420,000**
8	**Contingency**	1	Percent	0.1	**$1,370,108**
9	**Total IHC Alternative 4 Cost**				**$15,071,187**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density 1 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-5
LGC-East Alternative 2: Removal
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	$1,000,000.00	$1,000,000
	Mobilization/Demobilization Subtotal				**$1,000,000**
2	**Site Preparation**				
	Temporary Facilities	5	Month	$20,000.00	$100,000
	Access and Staging Area South Tank Farm	1	Lump Sum	$250,000.00	$250,000
	River Access	1	Lump Sum	$10,000.00	$10,000
	Security	20	Week	$20,000.00	$400,000
	Site Preparation Subtotal				**$760,000**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	175000	Square Feet	$3.00	$525,000
	Hydraulic Dredging of Sediment	68000	Cubic Yards	$30.00	$2,040,000
	Sediment Slurry Header	1	Lump Sum	$500,000.00	$500,000
	Geotextile Tubes	9750	Linear Feet	$40.00	$390,000
	Polymer	136000	Pound	$2.50	$340,000
	Dewatering Management	63	Day	$4,000.00	$252,000
	Waste Water Treatment Plant	1	Lump Sum	$375,000.00	$375,000
					$4,422,000
4	**Sediment Transportaion and Disposal**				
	Sediment Transportaion and Disposal (non-TSCA)	68000	Ton	$37.50	$2,550,000
	Sediment Transportaion and Disposal Subtotal				**$2,550,000**
	Capital Cost Subtotal				**$6,972,000**
5	**Bid Bond**	1	Percent	0.025	**$174,300**
	Construction Cost Subtotal				**$7,146,300**
6	**Engineering Oversight**				
	Engineering Oversight	5	Month	$60,000.00	$300,000
	Engineering Oversight				**$300,000**
7	**Contingency**	1	Percent	0.1	**$744,630**
8	**Total LGC-East Alternative 2 Cost**				**$8,190,930**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density 1 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-6
LGC-East Alternative 4: Removal with Containment
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	$1,300,000.00	$1,300,000
	Mobilization/Demobilization Subtotal				**$1,300,000**
2	**Site Preparation**				
	Temporary Facilities	5	Month	$20,000.00	$100,000
	Access and Staging Area South Tank Farm	1	Lump Sum	$250,000.00	$250,000
	River Access	1	Lump Sum	$10,000.00	$10,000
	Security	20	Week	$20,000.00	$400,000
	Site Preparation Subtotal				**$760,000**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	122500	Square Feet	$3.00	$367,500
	Hydraulic Dredging of Sediment	47600	Cubic Yards	$30.00	$1,428,000
	Sediment Slurry Header	1	Lump Sum	$500,000.00	$500,000
	Geotextile Tubes	6800	Linear Feet	$40.00	$272,000
	Polymer	95200	Pound	$2.50	$238,000
	Dewatering Management	53	Day	$4,000.00	$212,000
	Waste Water Treatment Plant	1	Lump Sum	$195,000.00	$195,000
					$3,212,500
4	**Sediment Transportaion and Disposal**				
	Sediment Transportaion and Disposal	54000	Ton	$37.50	**$2,025,000**
	Sediment Transportaion and Disposal Subtotal				**$2,025,000**
5	**Place Containment (Containment Cap)**				
	Gravel Aggregate	20000	Ton	50.00	$1,000,000
	Place Containment (Containment) Subtotal				**$1,000,000**
	Capital Cost Subtotal				**$7,297,500**
	Bid Bond				**$182,438**
	Construction Cost Total				**$7,479,938**
6	**Engineering Oversight**				
	Engineering Oversight	5	Month	$60,000.00	$300,000
	Engineering Oversight				**$300,000**
7	**Contingency**	1	Percent	0.1	**$777,994**
8	**Total LGC-East Alternative 4 Cost**				**$8,557,931**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Removal of 7 feet of sediment followed by 2 foor armor cap
4. Geotextile Tube 7 cubic yards sediment/linear foot
5. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
6. Dewatered sediment bulk density 1 ton/cubic yard
7. Capping production 6,250 square feet/day

Table A-7
LGC-Middle Alternative 3: Containment
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	$600,000.00	$600,000
	Mobilization/Demobilization Subtotal				**$600,000**
2	**Site Preparation**				
	Temporary Facilities	5	Month	$20,000.00	$100,000
	Access and Staging Area West of RailRaod Bridge	1	Lump Sum	$125,000.00	$125,000
	River Access west of Railroad Bridge	1	Lump Sum	$10,000.00	$10,000
	Security	8	Week	$3,000.00	$24,000
	Site Preparation Subtotal				**$259,000**
3	**Sheet Pile Wall Installation**				
	Sheet Pile Wall Installation	6600	Square Feet	$50.00	$330,000
	Sheet Pile Wall Installation Subtotal				**$330,000**
4	**Place Containment (Multilayer Cap)**				
	Sand and Gravel Aggregate Mix	154000	Ton	$20.00	$3,080,000
	Organoclay (AquaGate or Equivalent)	962	Ton	$1,600.00	$1,539,200
	Place 9-inch Active Layer (5% Organoclay)	462000	Square Feet	$3.50	$1,617,000
	Place 60-inch Armor Layer (Sand & Gravel Mix)	462000	Square Feet	$1.50	$693,000
	Quality Control	60	Day	$2,500.00	$150,000
	Place Containment (Multilayer Cap) Subtotal				**$7,079,200**
	Capital Cost Subtotal				**$8,268,200**
5	**Bid Bond**	1	Percent	0.025	**$206,705**
	Construction Cost Subtotal				**$8,474,905**
6	**Engineering Oversight**				
	Engineering Oversight	5	Month	$60,000.00	$300,000
	Engineering Oversight				**$300,000**
7	**Contingency**	1	Percent	0.1	**$877,491**
8	**Total LGC-Middle Alternative 3 Cost**				**$9,652,396**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density 1 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-8
LGC-West Alternative 2: Removal
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	$500,000.00	$500,000
	Mobilization/Demobilization Subtotal				**$500,000**
2	**Site Preparation**				
	Temporary Facilities	5	Month	$20,000.00	$100,000
	Access and Staging Area South Tank Farm	1	Lump Sum	$100,000.00	$100,000
	River Access west of Railroad Bridge	1	Lump Sum	$10,000.00	$10,000
	Security	24	Week	$20,000.00	$480,000
	Site Preparation Subtotal				**$690,000**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	220000	Square Feet	$3.00	$660,000
	Hydraulic Dredging of Sediment	155555	Cubic Yards	$30.00	$4,666,650
	Sediment Slurry Header	1	Lump Sum	$355,000.00	$355,000
	Geotextile Tubes	22300	Linear Feet	$40.00	$892,000
	Polymer	311110	Pound	$2.50	$777,775
	Dewatering Management	135	Day	$4,000.00	$540,000
	Waste Water Treatment Plant	1	Lump Sum	$200,000.00	$200,000
					$8,091,425
4	**Sediment Transportaion and Disposal**				
	Sediment Transportaion and Disposal (non-TSCA)	26000	Ton	$37.50	$975,000
	Sediment Transportaion and Disposal Subtotal				**$975,000**
	Capital Cost Subtotal				**$10,256,425**
5	**Bid Bond**	1	Percent	0.025	**$256,411**
	Construction Cost Total				**$10,512,836**
6	**Engineering Oversight**				
	Engineering Oversight	5	Month	$60,000.00	$300,000
	Engineering Oversight				**$300,000**
7	**Contingency**	1	Percent	0.1	**$1,081,284**
8	**Total LGC-West Alternative 2 Cost**				**$11,894,119**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density .16 ton/cubic yard
6. Capping production 6,250 square feet/day

Table A-9
LGC-West Alternative 4: Removal and Containment
Estimated Cost of Remediation

Item No.	Item	Quantity	Unit	Unit Cost (2015$)	Estimated Cost (2015$)
1	**Mobilization/Demobilization**				
	Mobilization/Demobilization	1	Lump Sum	$750,000.00	$750,000
	Mobilization/Demobilization Subtotal				**$750,000**
2	**Site Preparation**				
	Temporary Facilities	7	Month	$20,000.00	$140,000
	Access and Staging Area South Tank Farm	1	Lump Sum	$100,000.00	$100,000
	River Access west of Railroad Bridge	1	Lump Sum	$10,000.00	$10,000
	Security	24	Week	$20,000.00	$480,000
	Site Preparation Subtotal				**$730,000**
3	**Dredging, Dewatering and Water Treatment**				
	Dewatering Pad Construction	220000	Square Feet	$3.00	$660,000
	Hydraulic Dredging of Sediment	155555	Cubic Yards	$30.00	$4,666,650
	Sediment Slurry Header	1	Lump Sum	$355,000.00	$355,000
	Geotextile Tubes	22300	Linear Feet	$40.00	$892,000
	Polymer	311110	Pound	$2.50	$777,775
	Dewatering Management	135	Day	$4,000.00	$540,000
	Waste Water Treatment Plant	1	Lump Sum	$200,000.00	$200,000
					$8,091,425
4	**Sediment Transportaion and Disposal**				
	Sediment Transportaion and Disposal (non-TSCA)	26000	Ton	$37.50	**$975,000**
	Sediment Transportaion and Disposal Subtotal				**$975,000**
5	**Place Containment (Multilayer Cap)**				
	Sand and Gravel Aggregate Mix	38900	Ton	$20.00	$778,000
	Place 12-inch Containment Layer (Sand & Gravel Mix)	700000	Square Feet	$2.50	$1,750,000
	Quality Control	50	Day	$2,500.00	$125,000
	Place Containment (Multilayer Cap) Subtotal				**$2,653,000**
	Capital Cost Subtotal				**$13,199,425**
6	**Bid Bond**				**$329,986**
	Construction Cost Total				**$13,529,411**
7	**Engineering Oversight**				
	Engineering Oversight	7	Month	$60,000.00	$420,000
	Engineering Oversight				**$420,000**
8	**Contingency**	1	Percent	0.1	**$1,394,941**
9	**Total LGC-West Alternative 4 Cost**				**$15,344,352**

Assumptions:

1. Mobilization costs for dredging and/or capping occurs all at one time with total cost distributed among exposure areas.
2. Dredging production 1,200 cubic yards/day
3. Geotextile Tube 7 cubic yards sediment/linear foot
4. Waste water treatment plant and sediment slurry header cost occurs all at one time with total cost distributed among exposure areas.
5. Dewatered sediment bulk density .16 ton/cubic yard
6. Capping production 6,250 square feet/day