REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release or
Threatened Release of Hazardous Substances in Region 5

FINAL FOCUSED FEASIBILITY STUDY FOR RIVERBANK AND FLOODPLAIN SOILS

Velsicol Chemical Corporation Superfund Site,
Operable Unit 3
St. Louis, Gratiot County, Michigan
WA Nos. 174-RICO-0532 and 236-RICO-0532/
Contract No. EP-S5-06-01

February 2022

PREPARED FOR

U.S. Environmental Protection Agency

PREPARED BY

ch2m

F I N A L

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Contents

Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
BERA	baseline ecological risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
DDT	dichlorodiphenyl trichloroethane
dw	dry weight
EPA	U.S. Environmental Protection Agency
FP	floodplain
FPS	former plant site
FFS	focused feasibility study
HBB	hexabromobenzene
GRA	general response action
LOAEL	lowest observable adverse effects level
MATC	maximum allowable toxicant concentration
MCC	Michigan Chemical Corporation
mg/kg	milligram per kilogram
MSU-WTL	Michigan State University-Wildlife Toxicology Laboratory
NCP	National Contingency Plan
NOAEL	no observable adverse effects level
O&M	operations and maintenance
OU	operable unit
PBB	polybrominated biphenyl
PRG	preliminary remediation goal
RAO	remedial action objective
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
site	Velsicol Chemical Corporation Superfund Site
TRIS	tris (2,3-dibromopropyl) phosphate
Velsicol	Velsicol Chemical Corporation
Weston	Weston Solutions of Michigan, Inc.

SECTION 1

Introduction

This focused feasibility study (FFS) report has been prepared for the Velsicol Chemical Corporation Superfund Site (site) Operable Unit (OU) 3 for the U.S. Environmental Protection Agency (EPA) in accordance with Work Assignment Numbers 174-RICO-0532 and 236-RICO-0532 under Contract No. EP-S5-06-01.

This document summarizes the remedial action objectives (RAOs) and general response actions (GRAs) and technologies presented in the Remedial Alternatives Screening Report (CH2M 2020b), and further evaluates each alternative retained from the Remedial Alternatives Screening Report in accordance with the National Contingency Plan (NCP). The FFS also includes cost estimates for each alternative and presents the recommended alternative.

1.1 Site Location and Operable Unit Boundaries

The site is in St. Louis, Michigan, and presently includes four OUs (Figure 1-1). OU1 addresses the 52-acre former plant site (FPS) and the nearby residential properties. Remedial action is ongoing at OU1. OU2 included the sediments and fish in the lower and middle basins of the St. Louis impoundment of the Pine River, which runs along the western and northern edge of the FPS. The remedial action for OU2 was completed in 2006. OU3 includes the section of the Pine River and adjacent riverbank and floodplain soils downstream of the St. Louis hydroelectric dam (St. Louis dam) within Floodplain (FP) 0.5, FP-1, and FP-1.1; while the athletic fields are within OU3, these areas have been remediated under a previous time-critical removal action and are markedly different habitat than the other three floodplains. OU4 includes the remainder of the river (including adjacent riverbank and floodplain soils) to the confluence with the Chippewa River.

Prior to completion of the OU3 RI report (CH2M 2020), OU3 included the sediments in the Pine River and floodplain soils from the St. Louis impoundment downstream to the Pine River's confluence with the Chippewa River near Midland, Michigan. Based on the conclusions of the RI report, EPA elected to split the downstream area into two OUs. Splitting OU3 into OU3 and OU4 was based on the findings and conclusion of the remedial investigation (RI) report, which indicated that the contaminant concentrations associated with the former Velsicol site downstream of the St. Louis dam decreases rapidly downstream of FP-1.1.

This report evaluates remedial alternatives for OU3 (riverbank and floodplain soils only). Based on the findings of the RI report, development of remedial alternatives for in-stream surface water and sediment within OU3 was not warranted. A separate FFS will be prepared for OU4.

1.2 Background

Industrial operations occurred at the Velsicol FPS beginning in the mid-1800s, continuing until 1977. Historical operations at the site included a lumber mill, oil refinery, salt processing plant, and chemical manufacturing plant. In 1935, Michigan Chemical Corporation (MCC) purchased the property and operated a chemical manufacturing business. MCC manufactured a wide variety of products at the FPS from 1936 through 1977, including various salts; magnesium oxide; rare earth chemicals; fire retardants, including polybrominated biphenyls [PBB]; tris (2,3-dibromopropyl) phosphate (TRIS); and pesticides DDT and 1,2-dibromo-3-chloropropane. In 1965, Velsicol Chemical Corporation gained a controlling interest in MCC. In 1977, production operations were terminated, and MCC initiated demolition and decommissioning of the facility in 1978.

1.3 Previous Operable Unit 3 Remedial Actions

Based on the findings of RI activities conducted at the St. Louis High School athletic fields in January 2015, a time-critical removal action was conducted in late summer 2015. Approximately 1 foot of soil was removed from two areas totaling approximately 2.8 acres. The sample locations removed during the time-critical removal action are denoted in the figures presented at the end of this document.

1.4 Focused Feasibility Study Process

The FFS process follows EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988 [herein referred to as the EPA RI/FS Guidance]) and other relevant guidance. To facilitate comprehensive interaction with stakeholders, the FFS process is divided into the following steps:

1. Develop RAOs and GRAs for each medium of interest.
2. Identify volumes of media to which GRAs may be applied.
3. Identify and screen technologies applicable to each media.
4. Identify chemical-, location-, and action-specific applicable or relevant and appropriate requirements (ARARs).
5. Identify and evaluate technology process options, with respect to effectiveness, implementability, and relative cost, to select a representative process for each technology type to be retained for further consideration.
6. Assemble the selected representative technologies into alternatives that represent a range of treatment and containment combinations.
7. Perform an initial screening of alternatives based on effectiveness, implementability, and relative cost.
8. Perform a detailed and comparative evaluation of alternatives that were carried through the screening step. These alternatives are further refined, as appropriate, and analyzed in detail with respect to specific evaluation criteria presented in the NCP.

To select an appropriate remedy, the NCP specifies nine evaluation criteria as a basis for conducting a detailed analysis. The criteria are categorized into the following three groups:

- Threshold Criteria
  - Overall protection of human health and the environment
  - Compliance with ARARs
- Primary Balancing Criteria
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume through treatment
  - Short-term effectiveness
  - Implementability
  - Cost
- Modifying Criteria
  - State acceptance
  - Community acceptance

The threshold criteria must be satisfied for an alternative to be retained for detailed evaluation. The primary balancing criteria are used to balance the tradeoffs between alternatives during detailed

evaluation. The modifying criteria are formally considered after the detailed evaluation and public comments have been received on the FFS report.

1.5 Document Organization

This document is organized as follows:

- **Section 1, Introduction:** Summarizes the purpose and organization of this document and provides the site history.
- **Section 2, Physical Site Setting and Conceptual Site Model:** Presents a physical description of OU3, summarizes the nature and extent of the contamination, and presents the conclusions of the human health and ecological risk assessments for OU3.
- **Section 3, Remedial Action Objectives and Preliminary Remediation Goals:** Presents draft RAOs, the associated preliminary remediation goals (PRGs), and remediation target areas.
- **Section 4, Applicable or Relevant and Appropriate Requirements:** Provides a preliminary list of chemical-, location-, and action-specific ARARs for the alternatives developed.
- **Section 5, Technology Screening:** Presents potential remedial technologies that may address contaminated floodplain soils and riverbank soils in OU3.
- **Section 6, Alternative Development and Screening:** Screens potential remedial alternatives to address the impacted media (riverbank and floodplain soils) within OU3.
- **Section 7, Detailed and Comparative Evaluation:** Includes a more detailed description of the retained alternatives to inform the cost estimate, summarize the evaluation criteria, and present the detailed and comparative evaluations performed in accordance with the NCP.
- **Section 8, Summary:** Summarizes the key findings of the screening evaluations performed within this technical document.
- **Section 9, References:** Lists the references consulted in developing this document.

SECTION 2

Physical Site Setting and Conceptual Site Model

2.1 Site Setting

This section presents an overview of the physical characteristics of the site and surrounding area.

2.1.1 Land Use

Land use in the vicinity of OU3 is a mixture of commercial (light industrial), residential, and agricultural. Floodplains are predominantly located on residential or agricultural properties, except the floodplains on the St. Louis High School athletic fields. Land use is expected to remain the same into the future (Weston Solutions of Michigan, Inc. [Weston] 2011).

2.1.2 Topography

The approximate elevation of the City of St. Louis is 738 feet above mean sea level. The topography of Gratiot County (and the OU3 area) is characterized as gently rolling hills with occasional ridges and elevations ranging from approximately 685 to 705 feet above mean sea level (Michigan Department of Natural Resources 2014).

2.1.3 Geology and Soil Types

The surficial geology of the St. Louis area is characterized by glacial moraines, till and outwash plains, and outwash channels. Glacial deposits in the St. Louis area are composed of end moraine medium-textured glacial till (Farrand and Bell 1982). The glacial till is described as gray, grayish brown, or reddish brown, unsorted glacial debris. The matrix is composed predominantly of loam and silt loam with variable amounts of cobbles and boulders. Small areas of coarser or finer-textured till and small areas of outwash are also included in the deposits. The deposits occur in narrow linear belts of hummocky relief marking former pauses in ice sheet movement. The thickness of glacial deposits is highly variable and ranges from 50 to 500 feet (U.S. Department of Agriculture, Soil Conservation Service 1979). Local well logs and boring logs prepared from previous investigations on the FPS document the thickness of glacial deposits on the upstream end of OU3 as ranging from approximately 260 to 280 feet.

Soils in the OU3 area are generally classified as loamy sand, sandy loam, or loam (Natural Resources Conservation Service 2013).

2.1.4 Hydrology

The Velsicol site is located within the Pine River Watershed. Many small creeks, streams, and agricultural and storm drainage ditches are present throughout the Pine River Watershed and provide a significant source of surface water influx. The headwaters of the Pine River are in southeast Mecosta County; from there, the river flows southeast through southwest Isabella County and northeast Montcalm County before continuing through Gratiot County where it turns to the northeast, flowing through Alma and St. Louis. The Pine River flows to the northeast through Gratiot County and intersects the Chippewa River in Midland County (approximately 30 miles northeast of the FPS). The Chippewa River then flows to the east and merges with the Tittabawassee River, which discharges into the Saginaw River. The Saginaw River flows to the north and discharges into Saginaw Bay (Weston 2011).

2.1.5 Pine River Sediment Characteristics

From the St. Louis dam downstream to the confluence with the Chippewa River, the Pine River is generally straight and free of sharp bends or meanders. Releases of stored water and the relatively straight river channel immediately downstream of the dam result in a relatively high-energy environment in the OU3 area. As a result, few soft sediment deposits have been observed downstream of the dam. The area immediately below the dam is mainly sand deposits with pockets of gravel, cobbles, and boulders.

Weston documented that the average water depth in OU3 was approximately 1.5 to 2.0 feet, and the average flow velocity was approximately 2.0 feet per second. The current in OU3 is usually slow unless there is a storm or water is released from the St. Louis dam. In those instances, the water levels rise very quickly (sometimes 3 to 4 feet in an hour), producing swift river currents. The water in OU3 is usually very turbid and warm (Weston 2011).

2.1.6 Ecological Setting

The area surrounding OU3 encompasses a wide range of diverse habitats, including farmland, wetlands, and floodplains. The bank and floodplain area surrounding OU3 consists of predominantly woodlands and is vegetated by scrub-shrub and deciduous trees.

Terrestrial habitats include woodlands, riparian edge vegetation strips, shrub areas, grass and field areas, agricultural field areas, landscaped areas, and residential areas along the shores of the Pine River.

Aquatic habitats include the water column and river bottom, wetlands along the river, riparian edge areas and shoreline, and floodplains where inundation is frequent or of long duration. The Pine River is a warmwater fishery supporting a wide range of fish species, including smallmouth bass, carp, suckers, and several species of minnows. Many species of mammals, birds, insects, and plants are also present within the Pine River ecosystem (Weston 2011).

2.2 Conceptual Site Model

This section presents the conceptual site model documented in the RI report (CH2M 2020).

2.2.1 Contaminant Sources and Release Pathways

The FPS, or OU1, of the Velsicol site has been used for industrial activities since the mid-1800s, including a lumber mill, oil refinery, salt processing plant, and chemical manufacturing plant, as stated in Section 1.2. MCC purchased the property in 1935 and operated a chemical manufacturing business until 1977. In 1965, Velsicol Chemical Corporation gained a controlling interest in MCC. In 1977, production operations were terminated, and MCC initiated demolition and decommissioning of the facility in 1978. Buildings were largely removed, although some building and storage foundations remain in the subsurface.

MCC manufactured a wide variety of chemical products at the FPS, including various salts, magnesium oxide, and rare earth chemicals. Production also included pesticides (DDT) and multiple specialty compounds used as fire retardants, namely, hexabromobenzene (HBB), PBB, and TRIS. Site structures consisted of manufacturing buildings, laboratories, storage facilities, aboveground and underground chemical storage tanks, buried piping, railroad sidings, lagoons, and parking areas. Many raw materials for the manufacturing processes were shipped to the FPS via rail or truck, and brines were extracted for use as process makeup water from two bedrock wells on and near the FPS.

Early site investigations documented that pesticides and specialty chemicals, including DDT, PBB, and HBB, were released to the environment at OU1, indicating that the FPS is the primary source of DDT, PBB, and HBB to the Pine River.

2.2.2 Extent of Contaminated Media

Figure 2-1 presents the total DDT concentrations in near-surface floodplain and riverbank soils, as well as sediments, to illustrate the nature and extent of site-related contamination (CH2M 2020). Total DDT concentrations are greatest in riverbank and floodplain soils in the first 1.5 to 2 miles downstream of the St. Louis dam (between the dam and FP-1.2 and FP-1.3).

The highest concentrations of total DDT in riverbank soils are observed in samples collected between the dam and FP-1, and concentrations typically increase with depth (Figure 2-2 series).

2.2.3 Contaminant Fate and Transport

DDT, PBB, and HBB originally impacted surface soils due to spills or leaks at the FPS. Contaminant transport through surface water runoff and historical discharge of process wastewater potentially containing dense nonaqueous phase liquid directly into the adjacent Pine River contaminated sediment retained within OU2. Although OU2 has been successfully remediated, during facility operations and in the time that followed plant closure, particulate-based transport and deposition of site contaminants to downstream areas of the site continued.

The RI documented that site-related contaminants were either not detected or were present at very low concentrations in surface water, indicating that contaminants likely bound to particulate matter, which eventually deposited in floodplain areas after storm events or in areas of the river where water velocity was lower. Dense nonaqueous phase liquid that seeped into surface water likely adsorbed to organic matter and fine-grained sediment.

DDT, PBB, and HBB have low solubility in water, a high affinity for organic matter, and are expected to remain bound to soils, sediments, and other particulate matter with minimal desorption into the water column. Transport of chemicals of concern (COCs) in the Pine River and associated floodplains is primarily the result the physical transport of particulate matter (sediment, soils, and organic matter) with sorbed site-related COCs. During periods of high precipitation when flooding occurs, sediment- or bank soil-sorbed contaminants were transported into the floodplain along the banks of the river. Once in the floodplains, the contaminated sediments become integrated into the floodplain soils. Due to the relatively thick vegetation in many floodplains, as well as the low-energy environment (currents are low and the areas depositional), the particulates, once deposited, are unlikely to be resuspended and transported downstream.

The channel of the Pine River is relatively high energy, and the riverbed is composed primarily of sandy gravel, cobbles, a few boulders, and sporadic, localized deposits of finer sediments such as silts and sands. Sediments in these localized deposits may have the potential to be resuspended and redeposited. The riverbank soils may be susceptible to erosion, and the elevated concentrations at depth in the farthest upstream reaches may represent a potential secondary source of site-related COCs to the river and the downstream floodplains.

Biological transport is also an important pathway in the Pine River and associated floodplains because of the highly lipophilic nature of DDT, PBB, and HBB. These chemicals are known to be recalcitrant and readily bioaccumulate in aquatic organisms promoting biomagnification in higher trophic levels.

2.2.4 Summary of Site Risk

The OU3 RI report (CH2M 2020) included an updated ecological risk assessment (Appendix F) and an updated human health risk assessment (Appendix G). Sections 2.2.4.1 and 2.2.4.2 summarize the potentially unacceptable site risks.

2.2.4.1 Human Health Risk

The human health risk assessment identified risk from total DDT for the recreational angler (adult and child) consuming Pine River bottom-feeding fish (common carp and forage fish) because it exceeds a target-organ hazard index greater than 1. Other receptors evaluated included residents, recreational users, and students and coaches, and no unacceptable risks to these receptors were identified in the human health risk assessment.

2.2.4.2 Ecological Risk

Total DDT and HBB exceeded EPA Region 5 ecological screening values (EPA 2003), suggesting potential unacceptable risk to lower-trophic-level receptors—soil invertebrates and plants—in all four floodplain areas evaluated in OU3. While the concentrations of total DDT generally decreased downstream, the magnitude and frequency of exceedance varied among floodplains. Food-web modeling indicated potential risk from total DDT in floodplain soils to both bird and mammalian receptors. Based on the Michigan State University-Wildlife Toxicology Laboratory (MSU-WTL) study, as reported in Appendix B of the baseline ecological risk assessment (BERA; Appendix F to the RI) (CH2M 2020), multiple effects are seen in the floodplains located within OU3.

SECTION 3

Remedial Action Objectives and Preliminary Remediation Goals

This section presents the RAOs and calculated risk-based PRGs for the site and describes how the remediation target areas were established. The RAOs are a general description of cleanup expectations and provide the basis for developing numeric PRGs, where appropriate. Numeric PRGs were used to estimate the cleanup extent needed to achieve the RAOs (the remediation target area).

3.1 Remedial Action Objectives

The RI concluded that the riverbank soils are potentially an ongoing source of contamination to the ecosystem and downstream area; additionally, the BERA found multiple ecological risks associated with floodplain soils in OU3. Therefore, the following RAOs are proposed to address contaminated floodplain and riverbank soils in OU3:

- Reduce risk associated with site-related COCs by reducing human and ecological receptors exposure to COCs in floodplain and riverbank soils.
- Control the potential secondary sources of site-related COCs by limiting resuspension into the water column and downstream transport of floodplain and riverbank soils.

It is anticipated that achieving these RAOs will reduce the contribution of site-related COCs in fish tissue over time. Sediment is not a focus of this FFS because minimal sediment is present within OU3, and fine sediment moves through the system over time and is diluted to lower concentrations.

3.2 Preliminary Remediation Goals

PRGs are preliminary estimated numeric values for chemical concentrations in environmental media above which the risk to receptors is unacceptable. The risks associated with the site are summarized in Section 2.2.4; the complete human health and ecological risk assessments are presented in the RI report (CH2M 2020).

PRGs can be based on one of the following three types of concentrations:

1. Risk-based concentrations (RBCs) at specific target risk or hazard levels
2. Federal or state ARARs
3. Background levels

A soil PRG was selected from a series of RBCs assumed to be protective of the various exposure scenarios and ecological receptors common to the Pine River floodplain habitat. The floodplain habitat supports a complex soil invertebrate community, as well as various avian and small mammal communities. The overall goal is to select a soil PRG that provides reasonable protectives of the communities present in the Pine River floodplain habitat.

Numerous exposure scenarios and ecological receptors found in the Pine River floodplain were evaluated in the BERA presented in the RI. The BERA used conservative modeling to assess risk to ecological receptors. For the FFS, the RBCs were derived from the site-specific data generated by a MSU-WTL field study that directly quantified DDT, PBB, and HBB, in floodplain soils and biota and compare those to simultaneously measured individual and population health metrics of key components of the ecosystem such as soil invertebrates, small mammals, and birds. The MSU-WTL study was evaluated in the BERA and included in Appendix B of the BERA (CH2M 2020). Use of site-specific data

rather than modeled data is desirable since it directly measures adverse effects of either representatives of the community, as in the case of birds, or the community as a whole for soil invertebrates.

RBCs for ecological receptors in the floodplain were based on no observable adverse effects levels (NOAELs), lowest observable adverse effects levels (LOAELs), and the maximum allowable toxicant concentration (MATC). The MATC is the geometric mean of the NOAEL and LOAEL and represents the concentration where adverse effects might be seen. The NOAELs were set at the average soil concentration of total DDT where no adverse effects were seen and the LOAEL as the next highest average total DDT concentration where adverse effects were seen for the various receptors.
The adverse effects included measures of survival, growth, and reproductions. MSU-WTL reported mean total DDT soil concentrations ranging from 8.1 milligrams per kilogram (mg/kg) dry weight (dw) to 0.228 mg/kg (dw) in the study areas. The results of the biological sampling indicate impacts to all measures with a no effect concentration being between 1 mg/kg (dw) total DDT and 0.288 mg/kg (dw). Based on the MSU-WTL data, overall RBCs for the full range of ecological receptors ranged from 0.23 mg/kg total DDT to 7.8 mg/kg total DDT (Figure 3-1).

The FFS goal is to select a PRG that will provide protection of the soil invertebrate, avian, and small mammal communities that use the Pine River floodplain habitat. There are many sources of uncertainty in the BERA and the MSU-WTL study such as the representativeness of the soil concentrations and variance in the biological measurements of effects. These uncertainties are inherent in the calculation of RBCs whether from the field studies or the modeled approach used for the residential clean-up.

Considering the habitats and ecological communities present and the uncertainty inherent in the site-specific data, a proposed PRG value of 1 mg/kg total DDT (Figure 3-1) was selected. The PRG balances protectiveness of ecological communities against the uncertainty in the calculation of each RBC evaluated. The PRG will be protective of most birds, small mammals, and soil invertebrates that make up the floodplain community.

A PRG value of 1 mg/kg total DDT (Figure 3-1) is less than the 5 mg/kg total DDT (EPA 2011) PRG used for the residential property clean-up portion of OU1. However, differences between the residential properties and the natural floodplains habitats support the use of different PRGs. The residential properties are maintained lawns and gardens that provide limited habitat for small mammal and avian communities. The PRG of 5 mg/kg selected for the residential property clean-up was protective of avian wildlife and was based on RBCs for robin reproduction that ranged from 2 to 9 mg/kg total DDT in soil (Figure 3-1). Shrews are the most sensitive small mammals potentially present in the floodplain areas with RBCs ranging from 0.23 mg/kg total DDT to 0.98 mg/kg total DDT based on the field studies. The northern short-tailed shrew uses both disturbed and undisturbed habitats, including grasslands, old fields, fencerows, marshy areas, deciduous and coniferous forests. Its preferred habitats are those which are moist with leaf litter or thick plant cover (Kutra 1995), therefore the northern short-tailed shrew is not expected to inhabit the residential lawns and gardens. The PRG of 1 mg/kg total DDT is justified for the floodplains to be protective of the more diverse receptor community expected to be present.

3.3 Remediation Footprint Determination

The remediation footprint was established using the proposed ecological PRG of 1 mg/kg for total DDT for riverbank and floodplain soils. The footprint presented in Figure 3-2 is based on the data set presented in the RI report (CH2M 2020) and considers the total DDT concentrations in riverbank and floodplain soils in FP-0.5, FP-1, and FP-1.1, as well as the geomorphology of OU3 (specifically, the footprint for riverbank soils has been informed by where exposed banks are present). Since this area of the Pine River is relatively dynamic, the predesign investigation associated with any selected alternative

will need to include activities to verify the depth of contamination, soil types, and structure of the riverbank.

For purposes of the FFS, it has been assumed that the average bank height is approximately 5 feet. The length of riverbank to be addressed is approximately 2,500 linear feet on the northern bank and approximately 3,650 linear feet on the southern bank (Figure 3-2). The footprint for the three floodplains is approximately 4.9 acres (0.3 acre in FP-0.5; 2.6 acres in FP-1; and 2 acres in FP-1.1).

SECTION 4

Applicable or Relevant and Appropriate Requirements

Remedial actions must protect public health and the environment and address risks identified in the human health and ecological risk assessments. Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. ARARs are required to be complied with unless one of the waivers in the NCP is invoked. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements and adequately protect public health and the environment.

ARARs are grouped into three types: chemical-specific, location-specific, and action-specific. To-be-considered factors are nonpromulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs unless they are included in the Record of Decision. In many circumstances, however, such factors will be considered, along with ARARs, in determining the level of cleanup required to protect human health and the environment. Table 4-1 lists potential ARARs, along with ARAR-specific status analysis relative to remediation for the floodplain and riverbank soils in OU3.

4.1 Chemical-Specific ARARs

Chemical-specific ARARs include laws and requirements that establish health- or risk-based numerical values or methodologies for environmental contaminant concentrations or discharge.

4.2 Location-Specific ARARs

Location-specific ARARs are requirements that relate to the geographical position of the site. Examples of location-specific ARARs include state and federal laws and regulations that apply to the protection of wetlands, construction in floodplains, and protection of endangered species in streams or rivers.

4.3 Action-Specific ARARs

Action-specific ARARs regulate the specific type of action, the technology under consideration, or the management of regulated materials. Action-specific ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are triggered by the remedial activities selected to accomplish a remedy. For this remedy, alternatives include containment, excavation, backfill, restoration, and offsite disposal or some combination of those options.

SECTION 5

Technology Screening

The identification and screening of potential remedial technologies and process options for OU3 comprised the following steps:

1. Identify GRAs that can accomplish the RAOs.
2. Establish the process for initial screening of potential remedial technologies and evaluation criteria.
3. Identify and screen potential remedial technology process options for effectiveness, implementability, and relative cost.

5.1 General Response Actions

GRAs are broad categories of action that, except for the No Action Alternative, can be expected to accomplish RAOs and may be used in combination with one another. The No Action Alternative is included because it is required by the NCP (*Code of Federal Regulations* Title 40, Section 300.430(e)) as a baseline alternative against which all other alternatives are compared.

For each GRA, several possible remedial technologies may exist. They can be further broken down into process options. The technologies and process options are then screened based on several criteria, defined in Section 5.2. The technologies and process options remaining after screening are assembled into preliminary alternatives, which are summarized in Section 6. Table 5-1 lists the relevant GRAs, including No Action, appropriate for consideration at OU3.

5.2 Technology and Alternative Screening Process and Evaluation Criteria

Technology screening was conducted following EPA RI/FS guidance (EPA 1988). Potential remedial technologies and process options were screened according to the following three established criteria:

- Technical effectiveness
- Implementability
- Relative Cost

The following subsections further define how these criteria are applied.

5.2.1 Technical Effectiveness

The technical effectiveness of a technology or process option was evaluated based on its ability to meet the RAOs under the conditions and limitations present at the site. The technical effectiveness criterion was used to determine which remedial technologies would be effective based on the nature and extent of contamination, site characteristics, and other engineering considerations. The NCP (*Code of Federal Regulations* Title 40, Section 300.430 [e] [7] [i]) defines effectiveness as the "degree to which an alternative reduces toxicity, mobility, or volume through treatment, minimizes residual risks and affords long-term protection, complies with ARARs, minimizes short-term impacts, and how quickly it achieves protection." Remedial technologies that are not likely to be effective for controlling the secondary sources of site COCs or reducing human health and ecological risk within an acceptable timeframe were not retained for further evaluation.

5.2.2 Implementability

"Implementability" refers to the relative degree of difficulty anticipated in implementing a technology or process option under the regulatory and technical constraints posed at the site. Implementability is evaluated in terms of the technical and administrative feasibility of constructing, operating, and maintaining the technology/process option, as well as the availability of services and materials. Technical feasibility refers to the ability to construct, reliably operate, and comply with regulatory requirements during implementation of the technology/process option. Technical feasibility also refers to the future operation, maintenance, and monitoring after the technology/process option has been completed. Administrative feasibility refers to the ability to coordinate with and obtain approvals and permits from regulatory agencies. Availability of services and materials may include the availability and capacity of treatment, storage, and disposal services; the availability of bulk materials; and the requirements for and availability of specialized equipment and technicians. Remedial technologies that cannot be implemented at the site were screened out and not retained for further evaluation.

5.2.3 Cost

The primary purpose of the cost-screening criterion is to allow for a comparison of relative costs associated with the technologies/process options. The cost criterion addresses costs to implement the technology/process option and long-term costs to operate and maintain the remedy. At this stage of the process, the cost criterion is qualitative and generally used for comparative purposes only. In limited cases, technologies were screened out based on disproportionately higher costs, in conjunction with implementability and effectiveness considerations. Engineering or construction cost estimates are not prepared at this stage of the FFS process.

5.3 Remedial Technology Screening

The potential remedial technology types and process options applicable to OU3 may have slight differences depending on whether riverbank or floodplain soils are being addressed; however, the process options are expected to be similar enough that GRAs and technology screening are applicable to remediation requirements in both locations. Table 5-2 identifies, describes, and screens the remedial technologies and process options. A representative subset of remedial technologies and process options retained after screening will be used to develop conceptual alternatives and the associated cost estimate.

SECTION 6

Alternative Development and Screening

This section evaluates the three remedial alternatives assembled against the screening criteria defined in Section 5.

6.1 Remedial Alternative Descriptions

6.1.1 Alternative 1 – No Action

Alternative 1 consists of taking no action and contaminated soils remain in place at the site. The NCP requires that a No Action Alternative is retained as a baseline for comparison to the other approaches. No capital or operations and maintenance (O&M) costs are associated with Alternative 1. However, the NCP requires 5-year site reviews as long as hazardous substances remain at the site at concentrations that preclude unlimited use and unrestricted exposure.

6.1.2 Alternative 2 – Removal and Backfill/Cover or Riverbank Stabilization of OU3 Floodplain and Riverbank Soils

Alternative 2 consists of excavating floodplain and riverbank soils with total DDT concentrations greater than the 1-mg/kg risk-based PRG. Excavated soil will be disposed of offsite at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. The floodplains will be backfilled with clean soils to the existing grade and revegetated. The riverbank will be stabilized using various methods (to be determined during design) to prevent further erosion.

The main components of Alternative 2 are listed as follows:

- Additional surveying and sampling would be needed to completely delineate the footprint for riverbank soils (including the removal depth) and to confirm the removal depth in FP-0.5, FP-1, and FP-1.1 and the athletic fields.
- The entire OU3 footprint defined in Section 3.3 would be addressed under this alternative.
- For purposes of the FFS, it has been assumed that the riverbank soils would require a removal thickness of approximately 2 feet, and the average bank height would be 5 feet along the entirety of the northern and southern banks identified in Figure 3-2.
- The floodplain soils would be removed to an average depth of 1.5 feet.
- The floodplains would need to be cleared of vegetation prior to excavation. The FFS assumes that the vegetation would be disposed of offsite.
- Soil would be transported and disposed of at a permitted RCRA Subtitle D landfill. It is assumed the soils would not be characterized as RCRA hazardous.
- Floodplains would be backfilled with clean soil, graded, and plantings would be established.
- The riverbank would be stabilized using hardened shorelines, rootwads, grading, and vegetation.
- Access roads and staging areas would have equipment removed, would be regraded (as needed), and would be seeded to prevent soil erosion.

Additional assumptions will be developed and included in the FFS report to support cost estimates for the detailed analysis.

6.1.3 Alternative 3 – Containment of OU3 Floodplain and Riverbank Soils

Alternative 3 consists of containing floodplain and riverbank soils with total DDT concentrations greater than the 1-mg/kg risk-based PRG. The floodplains would be cleared of vegetation, graded, and then capped with approximately 1 foot of clean soil and revegetated. Areas of exposed and erodible riverbank with soils greater than 1-mg/kg total DDT would be stabilized using various methods (to be determined during design) to prevent further erosion.

The main components of Alternative 3 are as follows:

- Additional surveying and sampling would be needed to completely delineate the footprint for riverbank soils.
- The entire OU3 footprint defined in Section 3.3 would be addressed under this alternative.
- The floodplains would need to be cleared of vegetation prior to cap or cover placement. The FFS assumes that the vegetation will be disposed of offsite.
- The floodplains would be revegetated with appropriate plantings.
- The riverbank would be stabilized using multiple methods, including, but not limited to, hardened shorelines, rootwads, grading, and vegetation.
- Access roads and staging areas would have equipment removed, would be regraded (as needed), and would be seeded to prevent soil erosion.

6.2 Remedial Alternative Screening

The three alternatives are initially screened against the following criteria (defined in Section 5.2):

- Technical effectiveness
- Implementability
- Relative Cost

Table 6-1 shows the screening evaluation. Alternative 3 was determined to have low implementability and low and uncertain effectiveness for the riverbank soils and is therefore not retained for the detailed analysis.

SECTION 7

Detailed and Comparative Evaluations

The detailed analysis of alternatives presents the relevant information needed to compare the remedial alternatives assembled for this FFS. A detailed evaluation of each alternative compared to each of the NCP evaluation criteria is included in Table 7-1. This section defines the NCP evaluation criterial and presents the results of the comparative analysis based on effectiveness, implementability, and cost.

7.1 Evaluation Process and Criteria

In accordance with the NCP (40 CFR 300), remedial actions must:

- Be protective of human health and the environment.
- Attain ARARs or provide grounds for invoking a waiver of ARARs that cannot be achieved.
- Be cost effective.
- Use permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practicable.
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element.

In addition, the NCP emphasizes long-term effectiveness and related considerations, including the following:

- The long-term uncertainties associated with land disposal
- The goals, objectives, and requirements of the Solid Waste Disposal Act
- The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity toward bioaccumulation
- The short- and long-term potential for adverse health effects from human exposure
- The long-term maintenance costs
- The potential for future remedial action costs if the selected remedial action fails
- The potential threat to human health and the environment associated with excavation, transportation, disposal, or containment

Provisions of the NCP require that each alternative be evaluated against the nine criteria listed in 40 CFR 300.430(e)(9). The criteria were published in the March 8, 1990, *Federal Register* (55 FR 8666) to provide grounds for comparison of the relative performance of the alternatives and to identify their advantages and disadvantages. This approach is intended to provide sufficient information to adequately compare the alternatives and to select the most appropriate alternative for implementation at the site as a remedial action. The following three subsections define the nine NCP criteria.

The detailed alternatives analysis includes the following steps:

- A detailed evaluation of each alternative against seven of the nine NCP criteria (community acceptance and state acceptance criteria are evaluated after the FFS stage).
- A comparative analysis using the same criteria to identify key differences between alternatives. The detailed analysis discussed below presents the significant components of each alternative, the assumptions used, and the uncertainties associated with the assessment.

7.1.1 NCP Threshold Criteria

To be eligible for selection, an alternative must meet the threshold criteria described in the following subsections, or in the case of compliance with ARARs, must justify that a waiver is appropriate. An alternative not meeting these criteria, or where a waiver is not justified, is not acceptable.

7.1.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates whether an alternative can protect human health and the environment and draws on the analyses performed for other evaluation criteria, particularly long-term effectiveness and permanence and short-term effectiveness. Evaluation of overall protection of human health and the environment offered by each alternative includes the following:

- Determining whether an alternative achieves adequate protection.
- Considering how site risks associated with each exposure pathway are either eliminated, reduced, or controlled through treatment, engineering, or institutional controls.
- Determining if an alternative will result in any unacceptable short-term or cross-media effects.

7.1.1.2 Compliance with ARARs

This criterion determines whether an alternative meets the substantive portions of the federal and state ARARs defined in Section 4. Under CERCLA, permits are not required for actions conducted onsite; however, the alternative must meet the substantive requirements of the associated ARARs.

CERCLA authorizes the waiver of an ARAR with respect to a remedial alternative if any of the following conditions exist (EPA 1988):

- The alternative is an interim measure that will become part of a total remedial action that will attain the ARAR.
- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.
- Compliance with the requirement is technically impracticable from an engineering perspective.
- The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method.
- With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state.
- For Superfund-financed response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund monies to respond to other sites.

7.1.2 NCP Balancing Criteria

Alternatives meeting the threshold criteria are further evaluated using the five primary balancing criteria outlined in the following subsections. Unlike the threshold criteria, the five balancing criteria weigh the tradeoffs between alternatives. If appropriate, a high rating on one balancing criterion can compensate for a low rating on another.

7.1.2.1 Long-Term Effectiveness and Permanence

Assessment against this criterion evaluates the long-term effectiveness of alternatives in maintaining consistent protection of human health and the environment. A key component of this evaluation is to

consider the extent and effectiveness of controls that may be required to manage risk posed by treatment residuals and/or untreated waste. The long-term effectiveness of an alternative considers the following:

- **Magnitude of residual risk** assesses the residual risk remaining from untreated waste or treatment residuals at the conclusion of the remedial activities.
- **Adequacy and reliability of controls** evaluates the capability and suitability of controls, if any, used to manage treatment residuals or untreated wastes that remain at the site.

7.1.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies resulting in the permanent and significant reductions of toxicity, mobility, or volume of the hazardous substances as their principal element. This preference is satisfied when treatment reduces the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. Evaluation of this criterion considers the following six factors:

- The treatment processes that the remedy will employ and the materials they will treat
- The amount of hazardous materials that will be destroyed or treated (including how the principal threat(s) will be addressed)
- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (order of magnitude)
- The degree to which the treatment is irreversible
- The type and quantity of treatment residuals remaining following treatment
- Whether the alternative satisfies the statutory preference for treatment as a principal element

Of particular importance in evaluating this criterion is the assessment of whether treatment reduces principal threats, including the extent of toxicity, mobility, or volume reduction either alone or in combination.

Traditionally, this evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies resulting in the permanent and significant reductions of toxicity, mobility, or volume of the hazardous substances as their principal element. This has particularly been the case for sites containing principal-threat wastes; however, the soil being addressed in OU3 has never been nor is currently considered a principal-threat waste. Further, the removal, containment, and in situ treatment remedies considered herein can be effectively applied (EPA 1999, 2005).

7.1.2.3 Short-term Effectiveness

This criterion assesses the effects of an alternative during construction and implementation prior to meeting the project RAOs. Evaluation of the potential effects on human health and the environment during alternative implementation considers the following factors:

- **Protection of the community during remedial actions** addresses any risk resulting from the remedy implementation. Examples include dust from excavations, transportation of hazardous materials, and air-quality impacts.
- **Protection of workers during remedial actions** assesses threats potentially posed to workers and the effectiveness and reliability of protective measures needed.

- **Environmental impacts** consider the environmental impacts potentially resulting from the construction and implementation of the alternative and assesses the reliability of available mitigation measures for preventing or reducing those impacts.
- **Time to achieve RAOs** includes an estimate of the time required to achieve protection for either the entire site or individual elements associated with specific site areas or threats.

7.1.2.4 Implementability

The implementability criterion assesses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required. The following factors are considered:

- **Technical feasibility**, which includes the following:
  - **Construction and operation** consider the technical difficulties and unknowns associated with a technology.
  - **Reliability of technology** focuses on the likelihood that technical problems associated with the implementation will result in schedule delays.
  - **Ease of undertaking additional remedial action** includes a discussion of how difficult it would be to implement future remedial actions.
  - **Monitoring considerations** addresses the ability to monitor the effectiveness of the remedy and includes an evaluation of exposure risk should monitoring be insufficient to detect a failure.
- **Administrative feasibility** assesses the activities required to coordinate with other offices and agencies (for example, access, right-of-way).
- **Availability of services and materials** includes an evaluation of the availability of appropriate offsite treatment, storage capacity, and disposal services; necessary equipment and specialists; services and materials (including the potential for competitive bidding); and the availability of prospective technologies.

7.1.2.5 Cost

This criterion includes all the engineering, construction, and O&M costs incurred over the life of the project. The evaluation of cost consists of three principal components:

- **Capital costs** include direct (construction) and indirect (non-construction and overhead) costs. Equipment, labor, and materials required for the installation of the remedy are direct costs. Indirect costs consist of those expenses related to the engineering, financial, and other services necessary to complete the remedy installation but are not part of the actual installation or construction activities.
- **O&M costs** refers to post-construction expenditures required to ensure continued effectiveness of the remedial action. Components of annual O&M costs include auxiliary materials, monitoring expenses, equipment or material replacement, and 5-year review reporting.
- **Present-worth analysis** is a method of evaluating expenditures such as construction and O&M costs that occur over different lengths of time. This allows costs for remedial alternatives to be compared by discounting all costs to the year that the alternative is implemented. The present worth of a project represents the amount of money, which if invested in the initial year of the remedy and disbursed as needed, would be sufficient to cover all costs associated with the remedial action. The cost evaluation includes a present-worth analysis using a discount rate of 3.5 percent. The year 2020 was used as the base year for calculating both undiscounted and present-value costs.

The level of detail required to analyze each alternative with respect to the cost criterion depends on the nature and complexity of the site, the types of technologies and alternatives considered, and other project-specific considerations. The analysis is conducted in sufficient detail to understand the significant aspects of each alternative and to identify the uncertainties associated with the evaluation.

The cost estimate has been developed in accordance with EPA guidance (EPA 2002) for comparing the alternatives. The final costs of the selected remedy will depend on actual labor and material costs, competitive market conditions, final project scope, the implementation schedule, and other variables. The cost estimates are order-of-magnitude estimates with an intended accuracy range of +50 to –30 percent. The range applies only to the alternative as described in this report and does not account for changes in the scope.

7.1.3 NCP Modifying Criteria

The two modifying criteria are state acceptance and community acceptance. Evaluation of these criteria typically occurs after receipt of state and public comments on the proposed plan.

7.2 Detailed Evaluation

Table 7-1 presents the detailed analysis of Alternatives 1 and 2 against the NCP criteria.

7.3 Comparative Evaluation

This section explains the relative performance of alternatives against the two threshold and five balancing criteria as described in the NCP and detailed in Table 7-1. Table 7-2 summarizes the comparative analysis and presents each remedial alternative with rankings of its relative performance to each of the five balancing criteria.

7.3.1 Overall Protection of Human Health and the Environment

Alternative 1, No Action Alternative, would not provide overall protection of the environment and would not achieve the RAOs for OU3; therefore, it does not meet this threshold criterion. The No Action Alternative was retained for comparison as required by the NCP. Contaminated soil would remain onsite and would continue to pose a potential risk to human health and the environment. In addition, there is potential for contaminated soils to be resuspended and transported downstream.

Alternative 2 meets this criterion since contaminated soil with DDT concentrations above the PRG will be removed and disposed offsite, and any residuals, if present, would be isolated below the backfill in the floodplains or channel armoring of the riverbank. The excavation of contaminated soil will also limit the resuspension and downstream transport of floodplain and river bank soils and will also likely reduce the contribution of site-related COCs in fish tissue over time.

7.3.2 Compliance with ARARs

Under Alternative 1, no action is taken; therefore, the ARARs identified in Section 4 are not applicable. Alternative 2 will meet the substantive requirements of the ARARs identified in Section 4.

7.3.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of the alternatives is evaluated in terms of the magnitude of residual risk and the adequacy and reliability of controls. Alternative 1 would not result in any change in risk associated with contaminated soil.

Alternative 2 would provide a high level of effectiveness and permanence, as the contaminated soils within the floodplains and river banks will be removed, to the extent possible. Areas where soil with

DDT concentration greater than the remedial goals is left in place and will be isolated under clean backfill within the floodplain areas or under armoring within the river banks. The RAOs would be met at the conclusion of the remedy.

7.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 does not include a treatment component; therefore, this criterion is not applicable.

Alternative 2 is rated moderate for this criterion because the solidification of any wet excavated material may be expected to reduce the mobility of total DDT. This treatment is considered irreversible if the material is placed in a controlled landfill.

7.3.5 Short-term Effectiveness

No action would be taken under Alternative 1; therefore, this criterion is not applicable.

Alternative 2 has a low to moderate ranking for short-term effectiveness. Since the contaminated soil would be removed, there are greater potential exposures for workers to contact the soil. However, the potential risks to workers can generally be mitigated and controlled through industry standard best management practices. The remedial activities would potentially pose risks to the community from construction equipment, dust, noise, and transport of excavated contaminated soils through the community. In addition, the remedial activities would result in substantial environmental impacts to wetlands due to tree removal and clearing and grubbing activities. The river banks will also be substantially impacted due to clearing and grubbing activities, and it is unlikely that restoration activities will restore the river banks to their original condition considering the existing slopes are steep and vegetation in the remediation areas is mature. It is anticipated that the river banks will be restored with a more gradual slope and armored to prevent erosion.

7.3.6 Implementability

No action would be taken under Alternative 1; therefore, this criterion is readily implemented and rated high.

Alternative 2 is rated moderate. Although soil excavation is an established, field-proven technology and the equipment and personnel to perform this type of work are available, the equipment would need to be scaled accordingly to access the work areas and minimize impacts to private properties. In addition, access to the areas requiring remediation is often through private property, particularly along the river banks. Access constraints could impact the ability to complete the work efficiently if the excavation is not continuous since it would require relocating equipment and additional access points to the river bank. In addition, large trucks for hauling the excavated contaminated soil and the backfill material will have to access the excavation areas through private properties, which can pose challenges and may cause damage to the private properties that will require repair.

7.3.7 Cost

Since no action would be taken under Alternative 1, there is no cost to implement it.

Based on estimated total costs (present value basis), Alternative 2 would cost $6.7 million to implement. Appendix A contains a detailed cost estimate. Table 7-3 details the assumptions used to develop the cost estimate. The cost estimate was prepared to compare the relative cost of the alternative using information available at the time of the estimate and has a range of -30 to +50 percent. The final cost of the project will depend on numerous factors, including actual labor and material costs, competitive market conditions, implementation schedule, and field conditions. As a result, the final project costs will vary from the estimate presented herein.

SECTION 8

Summary

Alternative 1 (No Action) and Alternative 2 (Removal and Backfill/Cover or Riverbank Stabilization of OU3 Floodplain and Riverbank Soils) were retained for detailed analysis. Alternative 2 is the preferred alternative to address the OU3 riverbank and floodplain soils.

- Additional data collection will need to be performed during the remedial design phase to address existing data gaps. Preliminary design considerations include, but are not limited to: Obtaining property access agreements to complete the predesign sampling along the river banks and identify potential limitations to access and excavation during construction.
- Physical characterization and topographic survey of the river banks.
- Additional delineation sampling within floodplains and river banks.
- Waste characterization sampling to determine disposal requirements.
- Wetlands delineation in floodplains.
- Land survey needs:
  - Prior to predesign sampling activities to identify floodplain boundaries and sample locations.
  - Post-sampling to document final soil sample locations to help establish excavation limits during the remedial design and document the delineated wetlands.
  - Topographic survey to help determine anticipated excavation and disposal volumes.
- Identifying permit equivalencies and applicable consultations and documentation required to complete them.

SECTION 8

References

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Tables

Table 4-1. Preliminary Applicable or Relevant and Appropriate Requirements

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Regulation	Requirement	ARAR Status	Analysis
Chemical-specific ARARs or TBCs			
Federal			
Guidance on Use of Habitat Evaluation Procedures, and Suitability Index Models For CERCLA Application. U.S. Department of the Interior. PB88-100151. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. 1997. EPA/540/R-97/006 *Ecological Risk Assessment for Contaminated Sites*. Suter, G. W. II, R. A. Efroymson, B. E. Sample, and D. S. Jones. 2000. *Framework for Ecological Risk Assessment*. 1992. EPA/630/R-92/001. *Wildlife Exposure Factors Handbook*. Volume I of II. 1993. EPA/600/R-93/187a. *Guidelines for Ecological Risk Assessment*. 1998. EPA/630/R-95/002F.U.S. EPA Region 5, RCRA Ecological Screening Levels. www.epa.gov/reg5rcra/ca/ESL.pdf. August 2003. EPA Region 9. *Use of Congener and Homologue Analysis in Ecological Risk Assessments*. 1998.	Screening level processes and risk assessment guidance from EPA Region 5 and other EPA regions and federal programs. Screening levels represent a protective benchmark. An initial risk screen will identify those contaminants that exceed the benchmarks, which will be retained for additional analysis and allow the investigation to focus on areas likely to present an unacceptable risk.	TBC	Risk assessment processes and screening levels may be considered in development of preliminary remediation goals.
State			
NREPA, Part 201, Environmental Remediation, (MCL 324.20101-20142 *et seq.*)	Establishes cleanup criteria for sites of environmental contamination based on current and future land use. Regulates cleanup of releases of hazardous substances in concentrations that constitute a facility as that term is defined in Section 20101(o) of Act 451 to soil and groundwater. The remedial action implemented must meet generic or site-specific cleanup criteria; property cannot be transferred without notification of land use restrictions that apply to the site due to contamination. Actions leaving contamination in place must impose institutional controls to restrict activities that may interfere with the integrity of the remedial action and on activities that may result in unacceptable exposure. Substantive requirements of soil relocation provisions (Mich. Comp. Laws 324.20120c) apply to any movement of contaminated soils on-site. If soils are moved off-site, Part 201 applies outside the context of the remedy and any ARARs.	Relevant and Appropriate	Addresses the identification, risk assessment, evaluation, remediation, and long-term management of contaminated sites within Michigan. Identifies that response actions shall be protective of human health, safety, welfare and the environment of the state and identifies risk levels to be used in the development of those response actions.
Location-specific ARARs or TBCs			
Federal			
Migratory Bird Treaty Act of 1972 16 U.S.C. 703-712	Protects almost all species of native birds in the United States from unregulated taking. Taking, killing, or possessing migratory birds is unlawful with authorization from USFWS.	Applicable	The site is located within the Mississippi flyway. Trees, shrubs, structures, and equipment at the site may be habitat for protected migratory birds during the nesting season. Remediation work will require clearing of vegetation or relocation of structures that have the potential to support migratory bird nests. Disturbance to migratory birds and nests containing hatchlings or eggs will be minimized where possible and mitigated by clearing vegetation or demolition of structures prior to the nesting season, rescheduling work if possible to avoid disturbing nests, limiting removal to only those shrubs or structures absolutely necessary to support the work, or removing nests as they are being built, before they are inhabited. While CERCLA onsite actions are exempt from environmental permits (per CERCLA Section 121(e)(1)), EPA will seek concurrence with USFWS on the mitigation measures if disturbance to active nests cannot be avoided.

Table 4-1. Preliminary Applicable or Relevant and Appropriate Requirements

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Regulation	Requirement	ARAR Status	Analysis
33 U.S.C. 1344; 33 CFR 323 Clean Water Act, Section 404, Discharges of Dredged or Fill Material into Waters of the United States 33 U.S.C. 1341 State Certification of Water Quality 40 CFR Parts 230 33 CFR Parts 320–330	The NWP program authorizes a discharge into waters of the United States, contingent upon obtaining individual water quality certification or a case-specific water quality certification waiver. Authorizes specific activities required to affect the containment, stabilization, or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority. Discharges of dredged or fill materials are not permitted unless there is no practicable alternative that would have less adverse impact on the aquatic ecosystem. Any proposed discharge must avoid, to the fullest extent practicable, adverse effects, especially on aquatic ecosystems. Unavoidable impacts must be minimized, and impacts that cannot be minimized are to be mitigated.	Applicable	Excavation within a water of the United States, or placement of fill such as a cap, is considered a discharge of dredged material. NWP 38 imposes general conditions and requirements in the following areas that may relate to the proposed work: Navigation, Aquatic Life Movements, Migratory Bird Breeding Areas, Water Supply Intakes, Adverse Effects from Impoundments, Fills Within 100-Year Floodplains, Soil Erosion and Sediment Controls, Management of Water Flows, Removal of Temporary Fills, and Endangered Species. Requirements are likely to include measures to minimize re-suspension of sediments and erosion of sediments during excavation and water quality monitoring through Section 401 of the Clean Water Act. Compliance with substantive requirements in a Joint Permit-Equivalent Application may be required.
Fish and Wildlife Coordination Act 16 U.S.C. 661 et seq. 33 CFR 320 – 330 40 CFR 122.49	Protects fish and wildlife when federal actions result in the control or structural modification of a natural stream or body of water. Requires federal agencies to take into consideration the effect that water-related projects would have upon fish and wildlife and then take action to prevent loss or damage to these resources.	Applicable	Consultation with USFWS is strongly recommended to develop measures to prevent, mitigate, or compensate for project-related losses to fish and wildlife.
Section 10 of the Rivers and Harbors Act of 1899 33 CFR 320 – 330 33 U.S.C. 403 et seq.	Regulates the excavation or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any harbor, canal, lake, or channel of any navigable water and requires authorization by the U.S. Army Corps of Engineers.	Applicable	Triggered by dredging or disposal of dredged materials, excavation, filling, re-channelization, or any other modification of a navigable water of the U.S.
Endangered Species Act 16 U.S.C. 1531 et seq 50 CFR 402– Threatened and Endangered Species Protection	Requires that federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	Applicable	The presence of threatened and endangered species and habitats will be evaluated. USFWS will be consulted regarding proposed conservation measures for species for which there may be an adverse effect.
State			
NREPA, Part 17, Michigan Environmental Protection Act MCL 324.1706	Provides for the protection of natural resources.The protection of state resources prohibits any action that pollutes, impairs, or destroys the state's natural resources, due to any activities conducted at a site of environmental contamination.	Relevant and Appropriate	Applied in remedial investigation, remedial design, response activity and remedial action activities for the protection of the air, water, and other natural resources and the public trust in these resources from pollution, impairment, or destruction.
NREPA, Part 305, Natural Rivers MCL 324.30501-30515	Regulates activities within 500 feet of a designated natural river. The purpose of these zoning rules is to promote public health and prevent ecological damage due to unwise development or construction within a natural river district. The rules also protect the free- flowing conditions, fish and wildlife, water quality, and recreational values of natural rivers and adjoining land.	Applicable	Remedial action may take place within 500 feet of a designated natural river.
NREPA, Part 351, Wilderness and Natural Areas MCL 324.35101-35111	Enacted to designate, protect and preserve wilderness and natural areas. Prohibits removing, cutting, picking, or otherwise altering vegetation, except as necessary for appropriate public access, the preservation or restoration of a plant or wildlife species, or the documentation of scientific values and with written consent of the department, except as provided in subsection (2), granting an easement for any purpose.	Relevant and Appropriate	May be applied to environmental sites of contamination located in or near designated wilderness and natural areas.
NREPA, Part 365, Endangered Species Protection MCL 324.36501-36507 MAC: R 299.1021-1028	Establishes requirements for conservation, management, enhancement, and protection of species either endangered or threatened with extinction.	Applicable	The presence of threatened and endangered species and habitats will be evaluated. USFWS will be consulted regarding proposed conservation measures for species for which there may be an adverse effect. For the site – at a minimum, bald eagles, wood turtles, and lake cress will need to be protected.
NREPA Part 401, Wildlife Conservation. (MCL 324.40101-40120)	Regulates the taking, releasing, possessing, etc. of game and protected animals, including raptors; promotes wildlife conservation.	Relevant and Appropriate	Aquatic habitat is present in the Pine River. The purpose of the remedial action is to improve the environmental quality of the habitat by removing DDT, PPB, and PBB. The Michigan Features Inventory List will be evaluated, and MDNR may be consulted regarding potential adverse effects on species.

Table 4-1. Preliminary Applicable or Relevant and Appropriate Requirements

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Regulation	Requirement	ARAR Status	Analysis
NREPA, Part 411, Protection and Preservation of Fish, Game, and Birds, NREPA, and (MCL 324.41101-41103)	Regulates the protection and preservation of fish, game, and birds.	Relevant and Appropriate	May be applied to site remediation to protect and preserve fish, game, and birds; substantive requirements of Orders issued by the Natural Resources Commission of MDNR would apply to the taking or killing of regulated fish, game, or birds. The Michigan Features Inventory List identifies potential natural communities within Gratiot County. MDNR will be consulted regarding the project area.
NREPA Part 301 – Inland Lakes and Streams MCL 324.30101-30113	Lists operations that are prohibited and conditions for operations impacting lakes and streams, including mitigation.	Applicable	Regulates placement of structures, fill, or dredging in a river channel, streambed, or intermittent drainage ditch.
NREPA Park 303, Wetland Protection MCL 324.30301-324.30329	Provides protection and conservation of wetlands, including establishing rules regarding wetland uses and prohibitions on future use. Regulates dredging and removal of soil, placement of fill, construction, and drainage of surface water within wetlands.	Potentially Applicable	The presence of wetlands will be evaluated. If regulated wetlands will be disturbed, substantive requirements of these regulations will need to be complied with.
NREPA Part 413, Invasive Species MCL 324.41301-324.41325	Lists nonnative species that are prohibited or restricted in Michigan; provides authority and procedures for State Natural Resources Commission to add or delete from the list. Provides for a permit for introduction of genetically engineered organisms. Provides penalties for violations.	Applicable	For any proposed or required planting, the requirements of Part 413 will apply to the selection or introduction of plant species.
Action-specific ARARs or TBCs			
Federal			
Clean Water Act, Section 402 33 U.S.C. 1251 et seq	Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Section 402 establishes the NPDES to control point source discharges. Describes two levels of control: technology-based limits and water quality-based limits.	Potentially Applicable	The alternatives may include point-source discharges, depending on the means and methods to be used. Michigan has authorization for the NPDES program; refer to Michigan ARARs.
State			
NREPA Part 115, Solid Waste Management). (MCL 324.11501 *et seq.)* MAC: R 299.41 01 -4122 Formerly known as Act 641 (1978)	Addresses solid waste management and imposes geographic limitations on where nonhazardous solid waste can be disposed.	Relevant and Appropriate	Under the Resource Conservation and Recovery Act, soil is not considered a solid waste. Regulates the disposal of nonhazardous solid waste. Wastes to be generated are assumed to be not hazardous based on historical knowledge. Used for determining the process and type of disposal facility to which solid waste or contaminated media may be removed. Onsite aspects of the regulation, such as storing, characterizing the waste, and labeling it, would be ARARs. Note that ARARs end at the site boundary; therefore, full compliance is required offsite. It is anticipated that excavated sediment and soil will be disposed of in a commercial Resource Conservation and Recovery Act Subtitle D facility approved under the CERCLA Offsite Rule.

Table 4-1. Preliminary Applicable or Relevant and Appropriate Requirements

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Regulation	Requirement	ARAR Status	Analysis
Part 31, Water Resources Protection, of the NREPA, 1994 PA 451, as amended MCL 324.3101-3133	These rules address discharges to both surface waters and groundwater of the State. Part 31 prohibits direct or indirect discharge to ground or surface waters of the state that are or may become injurious to the environment or public health.	Applicable	The remedial action may result in the discharging of remediated and/or unremediated contamination into water of the State, i.e., groundwater, surface water, or any other water course; if so, the substantive requirements would be applicable.
Part 4: Water Quality Standards	Defines effluent guidelines based on actual water quality, receiving stream properties, and other appropriate water quality criteria. Provides criteria and standards for the National Pollutant Discharge Elimination System and effluent standards for toxic pollutants. This is the implementing statute for the federally delegated National Pollutant Discharge Elimination System program.		
Part 8: Water Quality Based Effluent Limits	Cites specific requirements for the discharge of bioaccumulative chemicals. Prevents concentrations in surface water or taste and odor-producing substances. Prevents acutely and chronically toxic substances from entering surface water based on LC50 toxicity criteria. Prevents degradation of water quality. Restricts levels of turbidity, color, oil films, floating solids, foams, settling, and suspended solids and deposits.		
Part 13: Floodplains and Floodways (R 323.1311-1329)	Regulates the alteration of a floodplain or floodway.		
Part 17 Soil Erosion and Sedimentation Control	Provides framework between the state and local enforcing agency to issue soil erosion and sedimentation control permits to persons seeking to conduct earth changes to one acre or more or within 500 feet of a water body of the state.		
Part 121, Liquid Industrial Wastes, of NREPA, 1994 PA 451, as amended. MCL 324.12103 Generator Duties	Regulates liquid industrial waste generators, transporters, and designated facilities. Transporters are required to be registered and permitted in accordance with the Hazardous Materials Transportation Act. Records are required to be kept by those who generate such waste, under Section 3a. Liquid industrial waste is defined as "any liquid waste, other than unpolluted water."	Applicable	Liquid industrial waste includes storm sewer cleanout residue and water from excavations. Liquid industrial waste that is generated will be managed in accordance with substantive requirements while onsite. ARARs end at the site boundary; therefore, full compliance with administrative and substantive requirements of MCL 324.12101 – 324.12118 would be adhered to for offsite transport and disposal.
NREPA 451 of 1994, Part 5, Spillage of Oil and Polluting Materials	Includes liquid waste in aboveground containers containing 1 percent or more of the polluting materials identified in the Water Bureau's Part 5, Spillage of Oil and Polluting Materials rules, and if the facility meets the threshold management quantity when stored outdoors.	Potentially Applicable	Potentially applicable depending on the means and methods selected for sediment dewatering and management of associated residuals. Storage and reporting requirements would need to be adhered to.
Part 91 (Soil Erosion and Sedimentation Control) of the NREPA R 323.1709 – Erosion and Sediment Control	Establishes requirements for the control of erosion and sedimentation during earth change operations.	Applicable	Applicable or for any disturbance within 500 feet of the water's edge of a lake or stream. Requires development of measures to minimize the erosion of soil and discharge of soils and sediment to nearby waters. Onsite CERCLA actions are exempt from administrative requirements such as administrative reviews and permitting; however, the substantive requirements will be met.
Part 55 (Air Pollution Control) of the NREPA R 336.1372(8)(b) – Control of Fugitive Dust	Establishes rules for prohibiting the emission of fugitive dust from certain activities in quantities that cause injurious effects to human health, animal life, plant life, or significant economic value, and/or property. Establishes common measures to mitigate the generation of fugitive dust during construction work.	Relevant and Appropriate	Regulation is for Priority I areas, whereas the site is in a Priority II area. Contaminated soil may become airborne. Measures such as wetting of airborne soil during excavation activities are often effective at controlling dust.
Part 201, Environmental Remediation, NREPA MCL 324.20114c, and 324.20121 MAC: R 299.1-299.50.	Part 201 provides for the identification, risk assessment, evaluation, remediation, and long-term management of contaminated sites within the State of Michigan. MCL 324.20114c and 324.20121 describe post-closure requirements and land use restrictions and covenants.	Potentially Applicable	Applicable if chemicals of concern remain onsite at levels above the selected cleanup criteria.

Notes:

ARAR = Applicable or Relevant and Appropriate Requirement

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR = *Code of Federal Regulations*
EPA = U.S. Environmental Protection Agency
MAC = Michigan Administrative Code
MCL = Michigan Compiled Laws
MDNR = Michigan Department of Natural Resources
NPDES = National Pollutant Discharge Elimination Program
NREPA = The Natural Resources and Environmental Protection Act
NWP = US Army Corp Nationwide Permit
TBC = to be considered
U.S.C. = United States Code
USFWS = U.S. Fish and Wildlife Service

Table 5-1. General Response Actions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

General Response Action	Description	Process Options Evaluated	Retained for Further Consideration
No Action	A baseline against which other remedial technologies are evaluated. The site is unchanged (i.e., no remedial activities would be implemented).	__	Yes
Institutional Controls	Administrative or legal controls, such as fish consumption advisories, waterway-use restrictions, site access restrictions, and environmental easements. The measures are intended to prevent or reduce human exposure to onsite contaminants by eliminating the amount of direct or indirect contact with contaminated soils.	Deed and land use restrictions	Yes
		Fish consumption advisories	Yes
Monitoring	Implement short- and/or long-term routine monitoring to record site conditions and concentration levels.	__	Yes
Monitored Natural Recovery	MNR relies on natural physical, chemical, and biological processes to isolate, destroy, or reduce the bioavailability or toxicity of contaminants.	MNR	No
Enhanced Natural Recovery	Enhanced Monitored Natural Recovery (or Enhanced Natural Recovery) includes some active measures to facilitate or accelerate ongoing natural recovery processes.	Thin layer capping	No
		Amended thin layer capping	No
Containment	Containment is used to minimize the risk of contaminant migration, as well as prevent direct-contact exposures. Containment involves the installation of a cap (e.g., low-permeability, sand, armor, reactive) and/or engineered shoreline/channel to isolate exposure to impacted soils and to reduce transportation of contaminated soils.	Reactive or absorptive cap	No
		Isolation cap	Yes
		Armored cap	Yes
Engineered Bank	An engineered bank can be designed to stabilize the riverbanks and prevent erosion.	Shoreline stabilization (multiple)	Yes
In Situ Treatment	In situ treatment (e.g., bioremediation, stabilization) involves treating contaminated soils in place by applying various physical or chemical methods to reduce chemical concentrations, mobility, or bioavailability.	Activated carbon	No

Table 5-1. General Response Actions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

General Response Action	Description	Process Options Evaluated	Retained for Further Consideration
Ex situ treatment	Ex situ treatments can be performed onsite or at an offsite treatment facility. The treatments are usually applied to meet final disposal requirements, reduce costs by generating material with less-stringent disposal requirements, create a beneficial-use product, or some combination of these.	Landfarming	No
		Stabilization and/or solidification	Yes
		Thermal destruction	No
		Thermal treatment	No
		Passive dewatering or dewatering additives	Yes
		Particle size segregation	No
		Soil washing	No
Removal	This response action involves removal of impacted soils (e.g., excavation) for treatment or disposal.	Mechanical excavation	Yes
Transportation and Disposal	Soils removed from the site are disposed of in a RCRA Subtitle C or Subtitle D landfill.	Transportation (truck/rail)	Yes
		Disposal in Subtitle C landfill	Yes
		Disposal in Subtitle D landfill	Yes

Note:

MNR = Monitored Natural Recovery

RCRA = Resource Conservation and Recovery Act

Table 5-2. Remedial Technology Screening

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Cost	Screening Comment
No Action						
None	None	Remedial actions would not be implemented. No action assumes the site would be unchanged.	Not Effective	Readily Implementable	Zero	No action is retained for further evaluation as a baseline for comparison with other alternatives in accordance with the National Contingency Plan.
Institutional Control						
Access and Use Restrictions	Deed and land use restrictions	Administrative or legal controls such as waterway use restrictions, site access restrictions, and environmental easements would be implemented. Institutional controls are typically used in conjunction with other remedy components and not as a stand-alone remedy.	Potentially effective at reducing human risk; not effective for ecological receptors	Readily Implementable	Low	Retained. Institutional controls alone would not be an effective technology. However, they can be a useful to mitigate human exposures to contaminants and can be readily combined with various technologies to enhance the overall effectiveness of a remedy. Therefore, they are retained for further evaluation in the focused feasibility study.
	Fish consumption advisories	Advisories on the frequency of consumption of fish from no consumption, to a limit of the number of fish to be consumed over a stipulated time period.	Low to moderate effectiveness	Readily Implementable	Low	Retained. Fishing advisories are already in place for the Pine River. Fish advisories would be used in conjunction with an active remedial approach and are retained for further evaluation. Restrictions related to site-related contaminants may over time, and changes would be based on long-term monitoring results. Advisories, if followed, would affect only human health exposure and risk.
Monitoring						
Monitoring	Construction, Post-remedy, and Long-term Monitoring	Implement short-and/or long-term routine monitoring to record site conditions and concentration levels.	Good – Not to be used as standalone technology.	Readily Implementable	Low	Retained. Critical to assess the effectiveness of all alternatives. It is not to be used as a standalone technology.
Monitored Natural Recovery						
Monitored Natural Recovery	Monitored Natural Recovery	MNR involves leaving the contaminated sediments in place and allowing natural processes (physical, chemical, and/or biological) to contain, destroy, alter, or reduce contaminant concentrations in sediments. Long-term monitoring is often a component of MNR and may include physical surveys, as well as chemical and biological sampling to assess the extent to which ongoing natural recovery occurs.	Not effective in OU3	Poor – Regulatory agency acceptance is also unlikely.	Low to moderate	Not retained. The riverbank soils in OU3 exhibit elevated concentrations of total DDT and are potentially ongoing secondary sources of contamination to the downstream area. The remedial investigation also documented that there does not appear to be significant recovery in the upstream floodplains over time.
Enhanced Natural Recovery						
Enhanced Natural Recovery	Thin layer capping	ENR is the application of thin layers of clean material over areas where natural recovery processes are already occurring or to facilitate recovery in areas where contaminated sediments have been removed. Long-term monitoring is often a component of ENR and may include physical surveys as well as chemical and biological sampling to assess the extent to which ongoing ENR occurs.	Not effective in OU3 for riverbank soils	Poor – Regulatory agency acceptance is also unlikely.	Low to moderate	Not retained. This technology would not be implementable or effective for the riverbank soils due to the steep nature of the bank. This technology could be effective for floodplain soils; however, given the markedly elevated total DDT concentrations in the OU3 floodplains, this alternative is not retained for OU3.
Enhanced Natural Recovery	Amended thin layer capping	Introduction of reactive amendments to a thin layer cap to reduce bioavailability.	Not effective in OU3 for riverbank soils	Poor – Regulatory agency acceptance is also unlikely.	Low to moderate	Not retained. This technology would not be implementable or effective for the riverbank soils due to the steep nature of the bank. This technology could be effective for floodplain soils; however, given the markedly elevated total DDT concentrations in the OU3 floodplains, this alternative is not retained for OU3.

Table 5-2. Remedial Technology Screening

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Cost	Screening Comment
Containment						
Capping	Reactive or absorptive cap	Active cap amendments may be placed as separate layers or mixed with the isolation layer. Addition of active layers allows for a thinner cap (compared to an isolation layer alone) as the amendments increase the cap's adsorptive capacity. Long-term monitoring and maintenance activities are required for the long-term effectiveness of this remedial technology. Institutional controls would likely be needed.	Potentially effective	Moderate Implementability	Moderate to high	Not retained. Although several available reactive amendments would be effective in sequestering dissolved-phase hydrophobic organic compounds (i.e., total DDT) it is not expected that upward transport through a cap placed over the soils in OU3 would be a significant transport pathway.
Capping	Isolation cap	Sand or other clean natural materials, as well as engineered geocomposite materials, may be placed as separate layers or mixed with active materials to physically isolate contaminated soils, preventing the exposure of biota to contaminants. Long-term monitoring and maintenance activities are needed for the long-term effectiveness of this remedial technology. Institutional controls would likely be needed.	Effective	Moderate Implementability	Moderate	Retained. An isolation layer may be used as a standalone or in combination with other capping materials (e.g., reactive/adsorptive and armor) to address contaminated soils. In order to place a cap in the floodplains, vegetation will need to be removed and the area graded. The addition of the cap layer without removal of any existing soils will raise the elevation of the floodplain and could potentially require an ARAR waiver. Isolation capping components could also be incorporated into an engineered bank design to address riverbank soils.
Capping	Armored cap	Armoring can be used to stabilize cap materials, if needed. Armored caps generally consist of the placement of stone, gravel, or riprap over the primary capping material. Long-term monitoring and maintenance activities are required to ensure the long-term effectiveness of this remedial technology. Institutional controls would likely be needed.	Effective	Moderate Implementability	Moderate	Retained. While it is not anticipated that armoring would be required in the lower energy floodplains. Some form of armoring is anticipated to be required as part of a remedial alternative addressing the riverbank soils (i.e., an engineered bank). Armoring may be used to protect the underlying cap materials from hydrodynamic forces (e.g., river currents) within the channel and/or to stabilize the cap in sloped areas. Additional information such as bank heights and slopes, detailed soil types, and river current information would be needed to complete the design.
Bank Engineering and Shoreline Stabilization						
Engineered bank	Shoreline Stabilization	An engineered bank can be designed to stabilize the riverbanks and prevent erosion. There are numerous potential approaches to bank stabilization, including the use of hardened shorelines (e.g., riprap, gabion baskets), rootwads and boulders, sloping and vegetating shorelines, and structures to alter water flow (e.g., dikes, weirs, groins).	Effective	Moderate Implementability	Moderate to High	Retained. Riverbank soils in OU3 present an ongoing source of contamination to the Pine River. A bank engineered to stabilize the shoreline(s) would reduce the ongoing erosion. The bank could potentially be altered with or without removal of existing contaminated riverbank soils. Additional data, including detailed geomorphology, survey, and river flow data would be needed to design this element of a remedial alternative. It is also possible that different approaches may be used in different areas of the channel depending on the characteristics. Information is not available at this time to fully assess all the potential process options, and that is deferred to the remedial design.
In Situ Treatment						
Treatment	Adsorption (Activated Carbon)	This technology is based on mixing activated carbon (e.g., granular, AquaGate+PAC, SediMite TM) into the biologically active zone (typically the top 6 to 12 inches) to reduce the bioavailability of hydrophobic organic chemicals in soils or sediments. Granular activated carbon may be mixed into soils using large-scale equipment or may be dispersed on the surface and rely on biological to naturally mix the activated carbon into the top soil or sediment layers over an extended time period.	Not effective in OU3 for riverbank soils	Poor – Regulatory agency acceptance is also unlikely	Low to moderate	Not retained. Although activated carbon would be expected to be effective for site contaminants, treatment using this remedial technology as a standalone alternative for OU3 would not be effective for the riverbank soils. The riverbank soils in OU3 exhibit elevated concentrations of total DDT and are potentially ongoing secondary sources of contamination to the downstream area. The efficacy of activated carbon is dependent on the ability for it to stay where placed. This technology could be effective for floodplain soils; however, given the markedly elevated total DDT concentrations in the OU3 floodplains, this alternative is not retained for OU3.

Table 5-2. Remedial Technology Screening

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Cost	Screening Comment
Ex Situ Treatment						
Biological treatment	Landfarming	Landfarming involves mixing sediment contaminated with organic chemicals with nutrients, water, and amendments and placing the mixture in an engineered treatment unit.	Poor	Poor	Moderate	Not retained. The application of landfarming would require additional studies to evaluate its applicability to the contaminants and concentrations found in site sediments. This technology also requires a large amount of land space, which is unavailable at the site. Therefore, it is not retained for further evaluation.
Physical/chemical treatment	Stabilization and/or solidification (ex situ)	Cementing or stabilization agents are mixed with contaminated sediments to immobilize contaminants by fixing the chemicals by physical or chemical reactions.	Potentially effective	Readily implementable	Moderate	Retained. Stabilization and solidification techniques may be used to treat soils after excavation, to reduce their moisture content (if needed), and to prepare them for truck/rail transport to a disposal facility. The process would not reduce contaminant concentrations but could potentially reduce the leachability of some contaminants. This technology is retained for potential consideration as a component of a remedial alternative.
Thermal treatment	Thermal destruction	Thermal destruction technologies (e.g., Cement-Lock, cogeneration electrical plant, incineration) destroy organic contaminants by heating the waste at very high temperatures (greater than 1,400 degrees Celsius). Beneficial use products may result from the thermal process (e.g., cement replacement or as a partial replacement for sand in concrete, electricity production).	Effective	Poor implementability	High to very high	Not retained. Given the costs associated with thermal treatment and the availability of other effective remedial technology options, it is not retained for further evaluation.
Thermal treatment	Thermal desorption	Thermal desorption technologies heat soils to temperatures ranging between 90 and 540 degrees Celsius, and the contaminants are condensed and collected as a liquid, captured on activated carbon, and/or destroyed in an afterburner. The treated materials may be used as landfill cover or for other beneficial uses.	Potentially effective	Poor implementability	High to very high	Not retained. Given the costs associated with thermal desorption and the availability of other effective remedial technology options, it is not retained for further evaluation.
Dewatering	Passive dewatering or dewatering additives	Dewatering can be accomplished by passive or mechanical means. Passive dewatering uses passive drainage and evaporation to dry soils. Dewatering additives (e.g., polymers, hydrated lime, and ferric sulfate) can be added to the soils after removal to aid in the dewatering process.	Effective	Readily implementable	Low to moderate	Retained. Some degree of dewatering may be needed to remove water from excavated bank or floodplain soils prior to treatment and/or transport. This technology is retained as a potential alternative component.
Particle size segregation	Particle size segregation	Particle-size segregation uses vibrating or fixed screens, hydrocyclones, or gravity separation to segregate particle sizes in excavated soils. The segregated particles may be used for fill materials.	Low effectiveness	Poor implementability	Moderate	Not retained. Particle-size segregation would not be expected to be effective (or cost effective) for the floodplain soils, which may have a high organic content and generally fine grained.
Soil washing	Soil washing	Sediment washing is achieved by ex situ physical separation of fine and bulk sediment particles followed by chemical washing using a solvent to remove chemicals from sediment. It is assumed that chemicals sorb to the finer particles, which generally contain high levels of total organic carbon. The washed sediment may be used beneficially for fill materials.	Low effectiveness	Poor implementability	Moderate	Not retained. The effectiveness of this technology for reducing contaminant concentrations from the floodplain soils is unknown. Additionally, this technology would result in a large volume of wastewater to be treated, substantial equipment and energy use, and cost. Therefore, it is not retained for further evaluation.
Removal						
Excavation	Mechanical Excavation	Excavation includes the removal of soil using earthmoving equipment (e.g., excavator and backhoe) in dry conditions.	Effective	Implementable	Moderate to high	Retained. Excavation is the only viable approach for removal of floodplain and riverbank soils. The floodplains would need to be cleared of vegetation prior to excavation. Removal of riverbank soils will require additional design considerations (e.g., cut distances, required slopes, and access).

Table 5-2. Remedial Technology Screening

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Remedial Technology	Process Options	Descriptions	Effectiveness	Implementability	Cost	Screening Comment
Transportation and Disposal						
Transportation	Truck and/or rail	Excavated soils will require transport to a staging area and then to a treatment and disposal facility.	Effective	Readily implementable	Moderate	After removal, soils would need to be transported to a staging where they would be prepared for further treatment and/or disposal. These options are needed to support the overall remedy and are therefore retained as supporting components.
Offsite disposal	RCRA Subtitle C Landfill	Permanently dispose solid hazardous wastes in an RCRA-permitted landfill.	Good	Readily implementable	High	Retained. Disposal of excavated soils at an offsite, permitted disposal facility may be implemented in combination with some type of ex-situ treatment (e.g., dewatering and/or stabilization for truck/rail transport). The acceptability of the soils by the disposal facility would need to be evaluated in greater detail during the remedial design. This option is retained for further evaluation.
Offsite disposal	RCRA Subtitle D Solid Waste Landfill	Permanently dispose solid nonhazardous wastes in a RCRA-permitted landfill.	Good	Readily implementable	Moderate	Retained. Disposal of excavated soils at an offsite, permitted disposal facility may be implemented in combination with some type of ex-situ treatment (e.g., dewatering and/or stabilization for truck/rail transport). The acceptability of the soils by the disposal facility would need to be evaluated in greater detail during the remedial design. This option is retained for further evaluation.

Notes:

Shaded technologies are screened from further consideration in the assembly of remedial action alternatives.

Effectiveness is the ability to perform as part of an overall alternative that can meet the objective under conditions and limitations that exist onsite.

Implementability is the likelihood that the process could be implemented as part of the remedial action plan under the physical, regulatory, technical, and schedule constraints.

ENR = enhanced natural recovery

HDPE = high-density polyethylene

MNR = monitored natural recovery

RCRA = Resource Conservation and Recovery Act

Table 6-1. Remedial Alternative Screening

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Alternative	General Description	Effectiveness	Implementability	Cost	Screening Comment
Alternative 1 – No Action	No action would be taken; contaminated soils would remain in place at the site.	Not effective at reducing human or ecological risk or reducing ongoing sources	Readily Implementable	Low	Retained as baseline condition per National Contingency Plan.
Alternative 2 – Removal and Backfill/Cover or Riverbank Stabilization of OU3 Floodplain and Riverbank Soils	Floodplain and riverbank soils with total DDT concentrations greater than the 1 mg/kg risk-based preliminary remediation goal would be excavated. The soils will be disposed offsite at a Resource Conservation and Recovery Act Subtitle D landfill. The floodplains would be backfilled with clean soils to the existing grade and revegetated. The riverbank would be stabilized using various methods (to be determined during design) to prevent further erosion.	High effectiveness for reducing risk and mitigating ongoing sources.	Moderate Implementability	Moderate to High	Retained. Work in the floodplains can be performed using traditional earth-moving equipment. Equipment may need to be scaled accordingly to consider site access in some areas (i.e., Floodplain 0.5). Specialized equipment, such as amphibious excavators or “spider” or “walking” excavators may be needed to support the bank construction. Determining access location and obtaining all the required access agreements will be an implementability consideration. Removal of the riverbank soils above the 1 mg/kg preliminary remediation goal will mitigate the potential ongoing source of total DDT to the rest of the river. Removing the surface soils (approximately top 1.5 feet) in the floodplains will also immediately reduce ecological risk.
Alternative 3 – Containment of OU3 Floodplain and Riverbank Soils	The floodplains would be cleared of vegetation, graded, and then capped with approximately 1 foot of clean soil and revegetated. Areas of exposed and erodible riverbank with soils greater than 1 mg/kg total DDT would be stabilized using various methods (to be determined during design) to prevent further erosion.	Moderate to high effectiveness for reducing risk and mitigating ongoing sources.	Low to moderate Implementability	Moderate to High	Not retained. The general construction and access considerations listed for Alternative 2 are also applicable to the containment only alternative. The implementability of this alternative is lower because: (1) raising the elevation of the floodplains may require an applicable, relevant, and appropriate requirement waiver and may not be administratively viable, and (2) bank containment measures would likely require some removal and/or grading of existing material to be constructed. While capping the floodplains would mitigate ecological risks, capped areas would need to be monitored, maintained, and repaired when needed (i.e., mowed, kept free of large vegetation, holes filled in) in order to remain protectiveness. The effectiveness and implementability of containing or stabilizing the banks, without removal of the contaminated soils, is highly uncertain.

Notes:

Shaded technologies are screened from further consideration in the assembly of remedial action alternatives.

Effectiveness is the ability to perform as part of an overall alternative that can meet the objective under conditions and limitations that exist onsite.

Implementability is the likelihood that the process could be implemented as part of the remedial action plan under the physical, regulatory, technical, and schedule constraints.

mg/kg = milligram per kilogram

Table 7-1. Detailed Alternatives Evaluation

OU3 Focused Feasibility Study, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Alternative Description: Criterion	Alternative 1—No Action	Alternative 2: Removal and Backfill/Cover or Containment of OU3 Floodplain and Riverbank Soils
1. Overall protection of human health and the environment	Alternative does not meet threshold criterion. • RAOs would not be achieved. • Potential human health and ecological risks associated with contaminated soils would not be reduced or controlled. • Potential secondary sources would not be controlled.	Alternative 2 can meet criterion and would provide protection of human health and the environment, as follows: • RAO would be achieved upon completion of the remedy through excavation and replacement of contaminated soil that is exposed to human and ecological receptors. The excavation of contaminated soil will also limit the resusupension and downstream transport of floodplain and river bank soils. • Floodplain and river bank excavation areas will be based on total DDT concentrations in the soil and the geomorphology of OU3. • Achieving the RAO will also likely reduce the contribution of site-related COCs in fish tissue over time.
2. Compliance with ARARs	Not applicable because no remedial action is taken to address unacceptable risk.	Alternative can be designed to comply with substantive requirements of the ARARs.
3. Long-term effectiveness and permanence	—	Alternative is rated high with respect to long-term effectiveness and permanence.
(a) Magnitude of residual risks	Alternative would not result in any significant change in the ecological risks currently associated with the contaminated soil.	Alternative 2 would remove approximately 20,350 CY of contaminated soils with DDT concentrations above the PRG from the floodplains and river banks to the extent practicable. Excavated soils will be solidified, if needed, and disposed offsite. The floodplain areas will be backfilled to grade using uncontaminated fill and then seeded. River bank areas will not be backfilled but will be stabilized with rip rap. If residual areas of elevated DDT concentrations are present, they will be isolated under the backfill in the floodplains or the river bank armor. This remediation approach will mitigate human and ecological exposure to the contaminated soil.
(b) Adequacy and reliability of controls	Not applicable.	Excavation and backfilling/river bank stabilization are established technologies and can be implemented to meet the performance specifications anticipated for this alternative. Prior to placement, the backfill material for the floodplains will be analyzed to confirm it is uncontaminated. Preconstruction and post-excavation surveys will be conducted post-removal to confirm target removal depths are achieved. The vast majority of contaminated soil will be removed. While some isolated residuals may remain, those will be below armoring or backfill. No institutional controls or maintenance and monitoring will be required.
4. Reduction of toxicity, mobility, or volume through treatment	No treatment processes used.	This alternative is rated moderate for this criterion. While treatment is not a component of Alternative 2, the solidification of any wet excavated material would be expected to reduce the mobility of total DDT. This treatment is considered irreversible if the material is placed in a controlled landfill.

Table 7-1. Detailed Alternatives Evaluation

OU3 Focused Feasibility Study, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Alternative Description: Criterion	Alternative 1—No Action	Alternative 2: Removal and Backfill/Cover or Containment of OU3 Floodplain and Riverbank Soils
5. Short-term effectiveness	—	Alternative is rated low to moderate with respect to short-term effectiveness.
(a) Protection of workers during remedial action	Not applicable, no remedial actions taken.	Potential risks to workers would include physical hazards associated with general construction, potential exposure to and direct contact with contaminated soil, surface water, noise, odors, and dust. There would be no anticipated unusual or particularly risky worker activities or COC exposure scenarios. These would be mitigated through actions including the following: • Engineering controls and BMPs. • Compliance with appropriate health and safety plans and site management plans. • Use of appropriate personal protective equipment and appropriate health and safety monitoring procedures.
(b) Protection of community during remedial action	Not applicable, no remedial actions taken.	Areas for excavation will require access to multiple residential properties. Potential risks to the community would include increased levels of traffic from vehicles and trucks on local roads, excavation equipment traffic within private properties, exhaust emissions, dust, noise, and potentially odors during the soil removal, handling, and trucking. Engineering controls and BMPs can mitigate most potential risks and would include the following: • Access to the active work and support zones would be prohibited. • Notification of schedule for remedy implementation would be provided to the property owners and tenants. • Dust, noise, and odor levels would be monitored. • Work periods will be restricted to specific time frames during the week and is unlikely to occur during the weekend. Impacts would last for the duration of construction, which is anticipated to be 3 months.
(c) Environmental impacts of remedial action	Not applicable, no remedial actions taken.	Potential short-term risks to the environment during construction include localized effects on ecological habitat during construction. Environmental impacts to wetlands will be substantial. Vegetated areas will be disturbed to construct temporary access roads to mobilize equipment to the floodplains and river banks and for transportation of excavated material offsite. In addition, tree removal and clearing and grubbing will be required to complete excavation activities within the remediation areas. Contaminated soil will be excavated, to the extent possible, from the floodplains and river banks. The river banks will be stabilized with armor after excavation activities are complete. The floodplains will be backfilled with appropriate soil/fill material to be determined during design. After backfill placement, the floodplains and any other disturbed areas outside of the river banks will be hydroseeded. It is assumed that trees will not be replaced. If excavated soils are staged at the FPS, BMPs will be implemented to eliminate transport of contaminated soils and runoff offsite.

Table 7-1. Detailed Alternatives Evaluation

OU3 Focused Feasibility Study, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Alternative Description: Criterion	Alternative 1—No Action	Alternative 2: Removal and Backfill/Cover or Containment of OU3 Floodplain and Riverbank Soils
(d) Time until RAO is achieved	Not applicable, no remedial actions taken.	The RAO would be met following completion of construction and a restoration and maintenance period. The overall duration would likely be at a minimum 6 months, assuming 3 months for construction and a 3-month maintenance period. The actual duration may be longer due to construction start time, weather conditions, compliance with the migratory bird treaty act, duration to achieve acceptable restoration conditions, etc. The FFS assumes the minimum construction duration. Long-term maintenance and monitoring would not be required.
6. Implementability	Not applicable – no action taken.	Overall implementability of this alternative is moderate.
(a) Technical feasibility	Not applicable, no actions taken under this alternative.	Access to the areas requiring remediation is often through private property, so special consideration will need to be made to minimize disturbance/damage to the private properties. Alternative would be technically implementable barring access constraints to private properties. The equipment will need to be scaled accordingly to access and work within the remedial footprint, especially along the river banks. There is limited space for staging excavated soils near the remedial footprint. Therefore, if excavated soil is not hauled directly offsite, it will need to be trucked to the FPS for solidification (if required) and staging prior to offsite transportation. Further evaluation to determine the best strategy to truck excavated soils offsite (i.e. direct haul or stage at FPS) will be performed during the design stage.
(b) Administrative feasibility	Not applicable, no actions taken under this alternative.	There are no known substantive administrative challenges with this alternative. Coordination between regulatory agencies and private property owners would be required.
(c) Availability of services and materials	None needed.	Equipment and specialists required for implementation of this alternative are commercially available.
7. Total Cost		
Total Cost [Present Value]	$0	$6.7M
Range (-30 to +50 percent of undiscounted cost)	—	$4.7M to $10M

Notes:

- = not applicable

ARAR = Applicable or Relevant and Appropriate Requirement

BMP = Best Management Practices

COC = contaminant of concern

CY = cubic yard(s)

DDT = dichlorodiphenyltrichloroethane

FPS = Velsicol former plant site

M = million

PRG = preliminary remediation goal

RAO = remedial action objective

OU = operable unit

Table 7-2. Comparative Analysis of Alternatives

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

	Threshold Criteria			Balancing Criteria			Other Considerations		
Dredging and Capping Alternatives	**Overall Protection of Human Health and the Environment**	**Compliance with ARARs**	**Long-Term Effectiveness**	**Reduction of Toxicity, Mobility, or Volume**	**Short-Term Effectiveness**	**Implementability**	**Cost ($million) [a] Present Value Cost**	**Construction Duration (months)**	**Soil Removal Volume (cubic yards)**
Alternative 1—No Action	○	-	-	-	-	●	0	0	0
Alternative 2: Removal and Backfill/Cover or Containment of OU3 Floodplain and Riverbank Soils	●	●	●	◑	◔	◑	6.7	3 months, plus a 12-week maintenance period	20,350

Notes:

[a] See Table 7-3 and Appendix A for additional cost detail.

- = not applicable

ARAR = Applicable or Relevant and Appropriate Requirement

OU = operable unit

Legend:

Threshold Criteria:

○	Does not satisfy criterion
●	Satisfies criterion

Balancing Criteria:

○	Low
◔	Low to Moderate
◑	Moderate
◕	Moderate to High
●	High

Table 7-3. Conceptual Alternative Components and Cost Estimating Assumptions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Cost Component	Alternative 1: No Action	Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riverbank Soils
Construction Duration (does not include any shutdowns)	-	3 months, plus a 12-week maintenance period.
Remedial Design	-	Assume a percentage of total construction cost plus permitting and predesign testing. Percentage based on EPA's *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000), hereafter referred to as EPA FS Cost Guidance. The values used are as follows: • 20% for projects less than $100K • 15% for projects with total costs between $100K and $500K • 12% for projects between $500K and $2M • 8% for projects between $2M and $10M • 6% for projects greater than $10M
Predesign Sampling and Testing	-	• Additional sampling will be required to verify bank soil removal depth and to confirm soil removal depth in floodplains. The FFS assumes that the following activities will be required to complete the predesign sampling: • Additional access agreements will need to be obtained to complete the sampling along the river banks. • A survey will be completed prior to predesign sampling activities to identify floodplain boundaries as understood prior to predesign sampling and testing and to identify sample area and locations. Assume survey will be done using traditional land-surveying techniques. Survey will be completed by a surveyor licensed in the State of Michigan. • Predesign sampling will be performed to determine the area and depth of soil within the river banks that require excavation. Soils will be analyzed for total DDT, percent solids, moisture content, grain size, and parameters for landfill/disposal requirements. • Additional sampling within the floodplains will be performed to confirm soil excavation depths and better define the areas requiring excavation. Soils will be analyzed for total DDT, percent solids, moisture content, grain size, and parameters for landfill/disposal requirements. • A survey will be completed after predesign sampling activities are performed to document final soil sample locations (including elevation) within the floodplains and river banks to help establish excavation limits for the remedial design. Assume survey will be done using traditional land-surveying techniques. Survey will be completed by a surveyor licensed in the State of Michigan. • A topographic survey will be completed within the excavation limits to support the remedial design. Survey should also include top of river bank and edge of water elevations. Due to shallow water depths and swampy areas, assume survey will be done using traditional land-surveying techniques. Survey will be completed by a surveyor licensed in the State of Michigan.

Table 7-3. Conceptual Alternative Components and Cost Estimating Assumptions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Cost Component	Alternative 1: No Action	Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riverbank Soils
		• A formal wetland delineation will be completed, and a technical report summarizing the results of the delineation will be prepared.
Permitting	-	Permits are not required under CERCLA, however the substantive requirements of the ARARs must be met and a permit equivalency may need to be prepared. Permit equivalencies are included under site work.
Performance Bond	-	Assume 2% of total construction cost.
Mobilization	-	Allowance included for mobilization. Assumes work would be completed within one construction season.
Pre-remediation Site Work and General Conditions	-	• Due to the limited amount of land area near the floodplains and river bank, the FFS assumes that the Former Plant Site will be available for use as a support area. Allowance included for: • Preparing the following plans, at a minimum: – Work Plan, including a Noise Control Plan and a Communication Plan. The Communication Plan will detail coordination with the City of St. Louis during excavation. – Health and Safety Plan – Compensatory Mitigation Plan if 1/10 of an acre or more of wetland will be lost – Environmental Protection Plan, including a Spill, Prevention, Control, and Countermeasures Plan – Contractor Quality Control Plan – Soil Erosion and Sedimentation Control Plan – Transportation and Disposal Plan – Air Monitoring Plan • Preparing administrative area (site trailer and offices, parking, sanitary facilities). Electric service is available at the Former Plant Site. A potable water connection is also available, but hookup would need to be coordinated with the City of St. Louis. • Establishing material laydown areas and temporary onsite storage areas. • Preparing erosion controls and implementing the Soil Erosion and Sedimentation Control Plan. • Installing additional fencing and traffic control in and around the staging area. • Constructing access roads to floodplains and river bank. Assumes 20,000 square feet of roadway (1,000 linear feet of road, 20 feet wide). Assumes access roads will be constructed by removing existing topsoil and placing laminated access mats. • Removing, processing, and disposing of vegetative matter and debris in work areas. • Confirm access agreements are in place for areas requiring remediation. Obtain additional access, as needed, for constructing access roads, accessing the river banks, etc.

Table 7-3. Conceptual Alternative Components and Cost Estimating Assumptions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Cost Component	Alternative 1: No Action	Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riverbank Soils
		• Establishing survey control points for remedy implementation and performing preconstruction survey. Assume survey will be done using traditional land-surveying techniques. Survey will be completed by a surveyor licensed in the State of Michigan. • Performing utility locate. • Performing Threatened and Endangered Species surveys. • Tree removal and clearing and grubbing within remediation areas and access road areas. Trees and vegetative debris should be stockpiled and disposed separately from excavated soils. Assumes trees will be chipped prior to being taken offsite. Assumes root balls will be chipped and taken offsite with contaminated soils.
Soil Excavation, Transport and Disposal	-	The FFS assumes the following: • Work will be performed in the summer/low-water season so excavated soils will not be saturated, and therefore will not require solidification prior to offsite disposal. Based on this assumption, water will not need to be diverted during construction activities within the river banks. – As a contingency, the FFS assumes that 10% of the excavated material will require solidification (2,100 CY). It is assumed that Portland cement will be used as a solidification agent. • Excavation will be performed with a small excavator. • Large sand bags (super sacks) and silt fencing will be used as a barrier along the river bank shoreline to prevent contaminated soil from getting in the river during river bank excavation. • Based on the remedial footprint presented in Section 3, the quantity assumptions are as follows. These quantities are based on the assumption that floodplains will be excavated to an average depth of 1.5 feet bgs. It is assumed that river banks will be excavated on a 1V:3H slope and that the average river bank height is approximately 5 feet. – Floodplain 0.5: 750 CY – Floodplain 1: 6,200 CY – Floodplain 1.1: 4,800 CY – North River Bank: 3,500 CY – South River Bank: 5,100 CY – Total: 20,350 CY • A removal production rate of 500-600 CY per day is assumed for the FFS. It is assumed that work will be performed 5 days per week with shutdown overnight. • Landfill disposal requirements will be tested for during pre-design activities and will be met during remediation. • All soil removed will be RCRA nonhazardous. Allowance included for: • Post-excavation survey to determine volume of material removed. Assume survey will be done using traditional land-surveying techniques. Survey will be completed by a surveyor licensed in the State of Michigan.

Table 7-3. Conceptual Alternative Components and Cost Estimating Assumptions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Cost Component	Alternative 1: No Action	Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riverbank Soils
		• Transportation and disposal. The FFS assumes that excavated soils will be direct-loaded and will not be staged at the FPS prior to disposal. It is assumed that the disposal facility will be located within 60 miles of the site. • Decontamination.
Placement of Backfill Within Floodplains	-	The FFS assumes that the floodplains will be restored to preconstruction elevations. It is assumed that the following backfill material will be used: • General backfill will be placed up to 6 inches below final grade. • Six inches of topsoil will be placed to meet final grade. • Based on the assumed excavation depths, it is assumed that 7,900 CY of general backfill material and 3,900 CY of topsoil will be required. • The FFS assumes that borrow sources will be located within 60 miles of the site. Allowance included for: • Compliance and continued compliance sampling for backfill materials. It is assumed that continued compliance samples will be collected every 1,000 CY of fill, per material. – Chemical testing for target compound list organics, target analyte list metals, PCBs and pesticides (general fill and topsoil) – Gradation testing (general fill and topsoil) – Fertility and salinity analyses (topsoil only) • Compaction testing. • Post-backfill survey to determine actual backfill volumes. Assume survey will be done using traditional land-surveying techniques. Survey will be completed by a surveyor licensed in the State of Michigan.
River Bank Stabilization	-	The FFS assumes that the river banks will not be backfilled, but that the 1V:3H slope from excavation activities will be stabilized after excavation is complete. It is assumed that the following material will be used: • Geotextile will be placed over the native soil. • Six inches of riprap bedding (assumed to be ½-inch gravel) will be placed over the geotextile. • Eighteen inches of armor (assumed to be 6-inch riprap) will be placed over the riprap bedding material. • The FFS assumes that borrow sources will be located within 60 miles of the site. • It is assumed that gradation and chemical testing will not be performed for this material. Instead, the borrow source will provide a materials sheet indicating that the material meets the specifications. • Based on the excavation sloping and length of river bank requiring stabilization, it is assumed that 1,800 CY of 0.5-inch gravel and 5,400 CY of 6-inch riprap will be required.

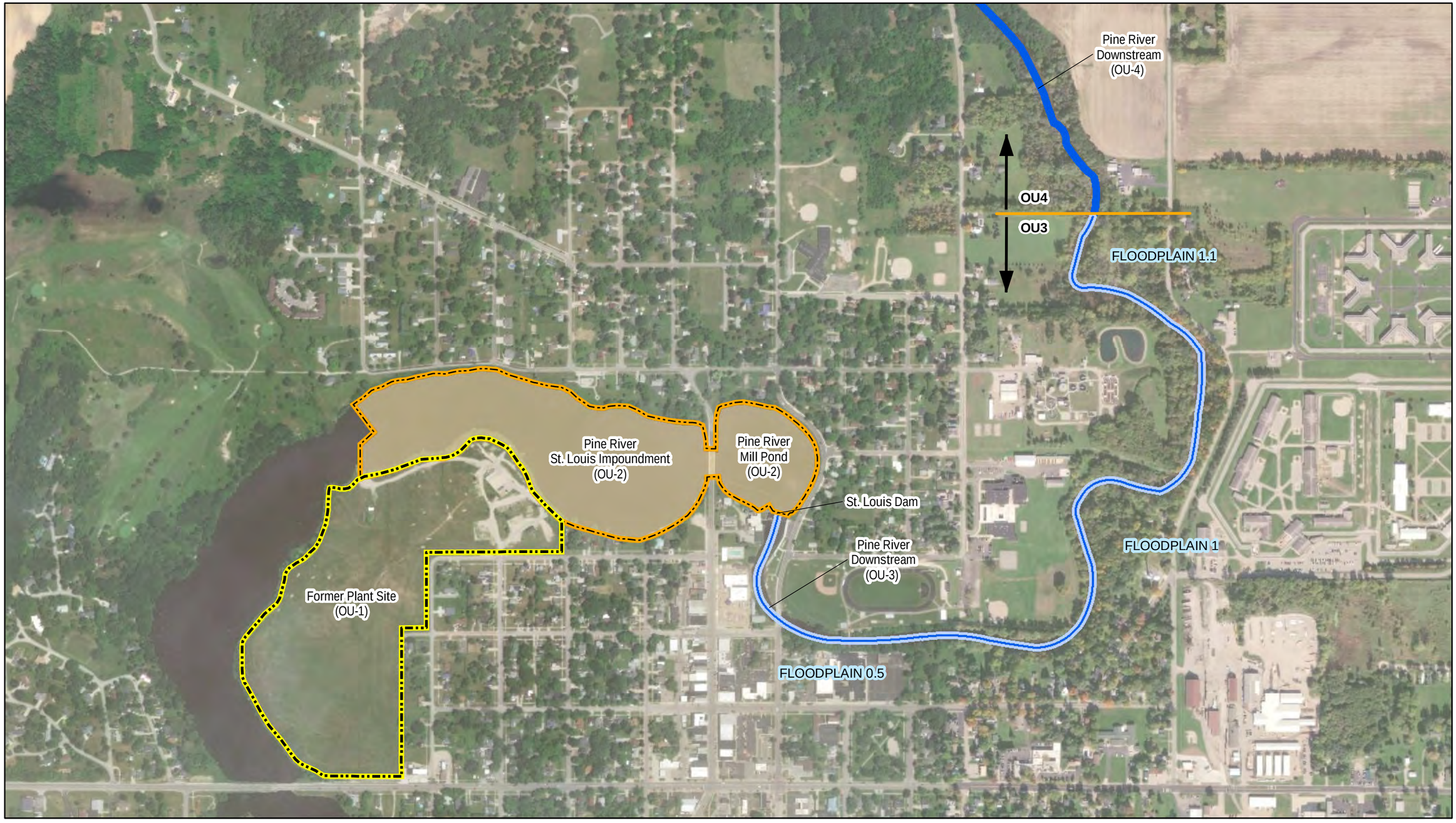
Table 7-3. Conceptual Alternative Components and Cost Estimating Assumptions

OU3 Focused Feasibility Study for Riverbank and Floodplain Soils, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Cost Component	Alternative 1: No Action	Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riverbank Soils
Waste Characterization Sampling	-	The FFS assumes 45 waste characterization sample will be collected, based on a minimum collection frequency of one sample per 500 CY of material excavated. Assume waste characterization analysis includes: full TCLP, PCBs, pH/corrosivity, and reactivity.
Monitoring During Construction	-	The FFS assumes that the following monitoring will be performed during construction: • Dust monitoring (particulate and DDT). • Turbidity or water quality monitoring. • River water level monitoring.
Habitat Restoration	-	The FFS assumes vegetation will recover following excavation and backfill activities. It is assumed that restoration within the floodplains will be performed as follows: • All areas will be hydroseeded with grasses and trees will not be replaced. • River water will be used for irrigation. • Restoration includes removal of access roads and regrading and seeding of access road areas. • Satisfactory stand will be achieved within a 12-week maintenance period.
Demobilization	-	Allowance included for demobilization. Includes removal of temporary facilities, utilities, and soil erosion and sedimentation control features. Includes final equipment decontamination.
5-Year Reviews	-	At EPA's direction, periodic costs for 5-Year Reviews are not included in the FFS.
PM, CM, Procurement, Submittals, and Engineering Support	-	Percentage of direct costs based on cost range per 2002 EPA Estimating guidance. Ranges are as follows: Project Cost — PM — CM Less than $100K — 10% — 15% $100K to $500K — 8% — 10% $500K to $2M — 6% — 8% $2M to $10M — 5% — 6% Greater than $10M — 5% — 6%
Contingency	-	Assume 20% for scope and 5% for bid.

ARAR = Applicable or Relevant and Appropriate Requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CM = construction management
CY = cubic yard
EPA = U.S. Environmental Protection Agency
FFS = focused feasibility study
PCB = polychlorinated biphenyl
PM = project management
TCLP = toxicity characteristic leaching procedure

Figures



Legend

- Former Plant Site (OU-1)
- Pine River - St. Louis Impoundment (OU-2)
- Pine River (OU3)
- Pine River (OU4)

N

0 300 600

Feet

Figure 1-1
Study Areas and Operable Units
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

ch2m

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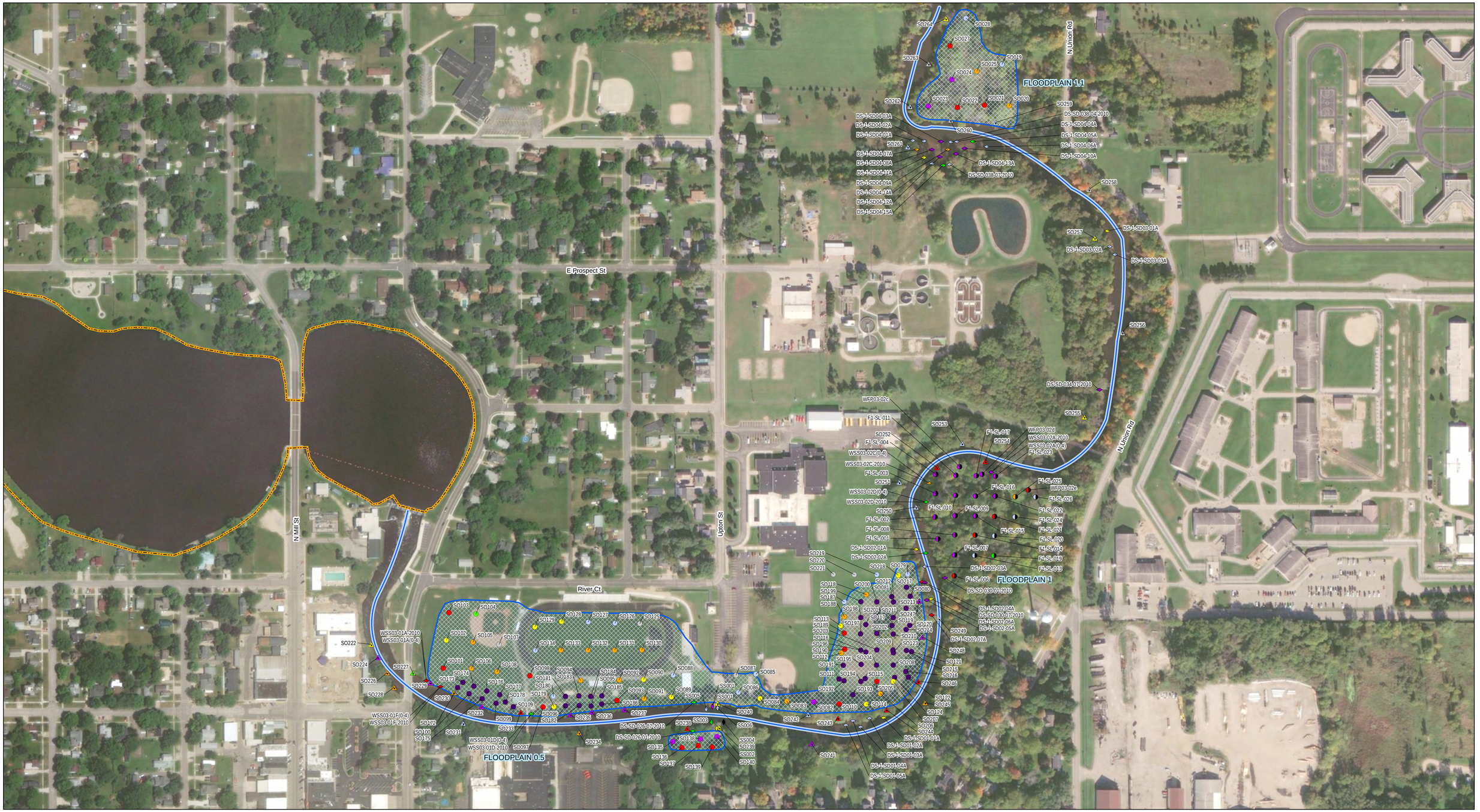

Legend

Total DDT Concentration Ranges
- ND
- >70
- 70-400
- 400-1000
- 1000-2000
- 2000-5000
- >5000

Designated Sample Type
- BAR Sediment Sample
- BAR Floodplain Sample
- RI Sediment Sample
- RI River Bank Sample
- RI Floodplain Sample
- Pine River OU3
- Approximate OU2 Boundary
- Floodplain Extent

Note:
All results are in µg/kg

N

0 170 340 Feet

Figure 2-1
OU3 Area Surface Floodplain Soils, Riverbank Soils, and Sediment Total DDT Concentrations
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

ch2m.

Note:
All results are in µg/kg

FIGURE 2-2A
Total DDT in Riverbank Soils (0-2 inches)
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

GIS Server: \\Brooksidefiles\gis_share2\ENBG\00_Proj\E\EPA\Velsicol_SuperfundSite\Reports\2020\OU3_Feasibility_Study\Maps\Report\Figure 2-2A_TotalDDT_in_RiverBankSoils_0to2inches.mxd, Date Saved: 2/20/2020 1:40:40 PM, User Name: mpetersh

Note:
All results are in µg/kg

FIGURE 2-2B
Total DDT in Riverbank Soils (2-6 inches)
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

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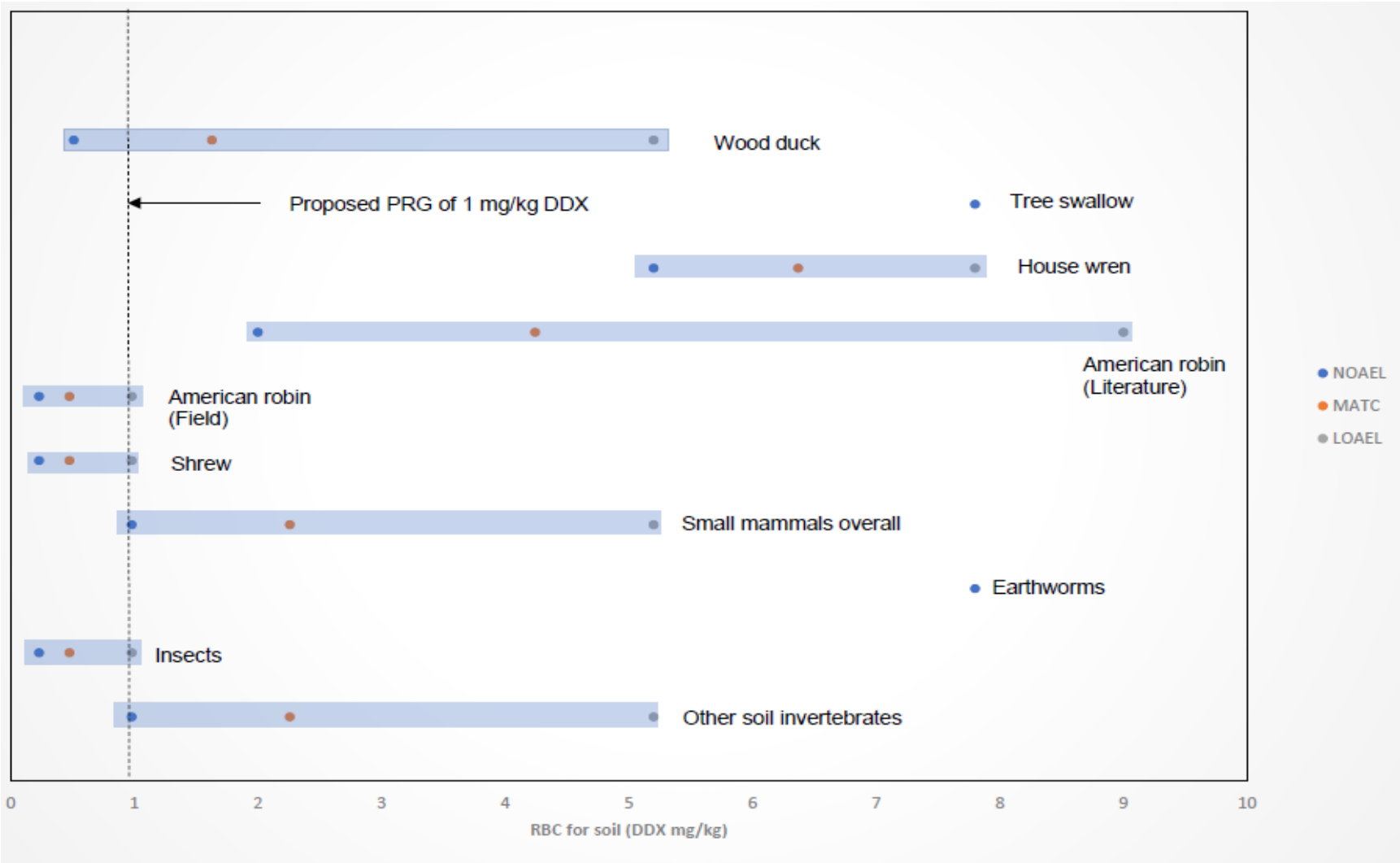
0 500 1,000
Feet

N

Note:
All results are in µg/kg

FIGURE 2-2C
Total DDT in Riverbank Soils (6-12 inches)
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

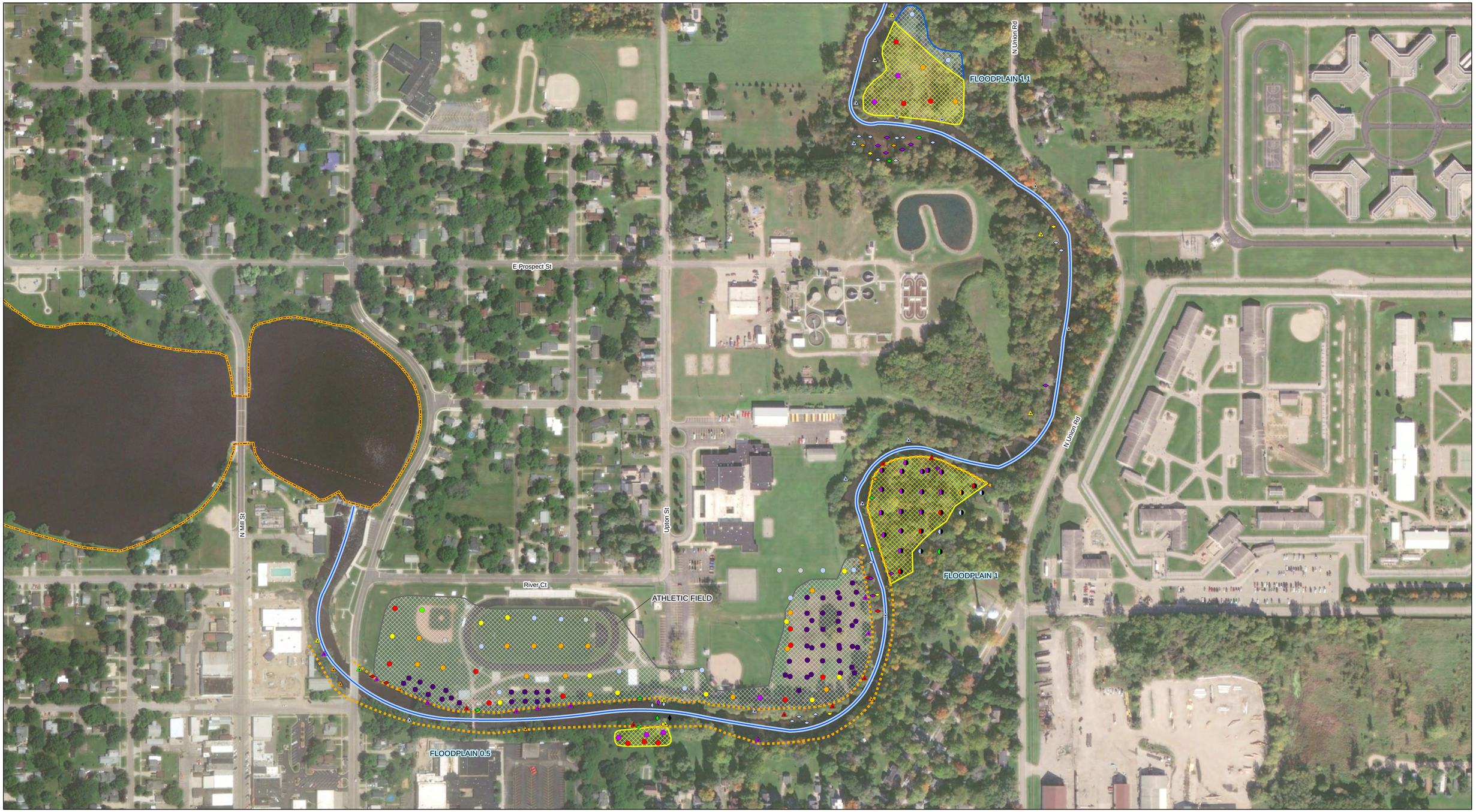
GIS Server: \\Brooksidefiles\gis_share2\ENBG\00_Proj\E\EPA\Velsicol_SuperfundSite\Reports\2020\OU3_Feasibility_Study\Maps\Report\Figure 2-2C_TotalDDT_in_RiverBankSoils_6to12inches.mxd, Date Saved: 2/20/2020 1:46:34 PM, User Name: mpetersh



Notes:
mg/kg – milligram per kilogram DDX - sum of DDD, DDE and DDT isomers
LOAEC - lowest- observable-adverse-effects-concentration
NOAEC - no-observable-adverse-effects-concentration
MATC - maximum allowable toxicant concentration
PRG – preliminary remediation goal

Figure 3-1
Total DDX RBCs Protective of Ecological Resources
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

ch2m



Legend

Total DDT Concentration Ranges
- ND
- >70
- 70-400
- 400-1000
- 1000-2000
- 2000-5000
- >5000

Designated Sample Type
- BAR Sediment Sample
- BAR Floodplain Sample
- RI Sediment Sample
- RI River Bank Sample
- RI Floodplain Sample
- Pine River OU3
- Approximate OU2 Boundary
- Floodplain Extent
- Remediated Floodplain Area

Notes:
1. See Figure 2-1 for Sample IDs.
2. Athletic Field Floodplain Area remediated as part of 2015 time-critical removal action and is not part of this footprint. Banks along this area are included in this remedial footprint.
3. All results are in µg/kg

N

0 170 340 Feet

Figure 3-2
Preliminary Remediation Footprint
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

ch2m

Legend

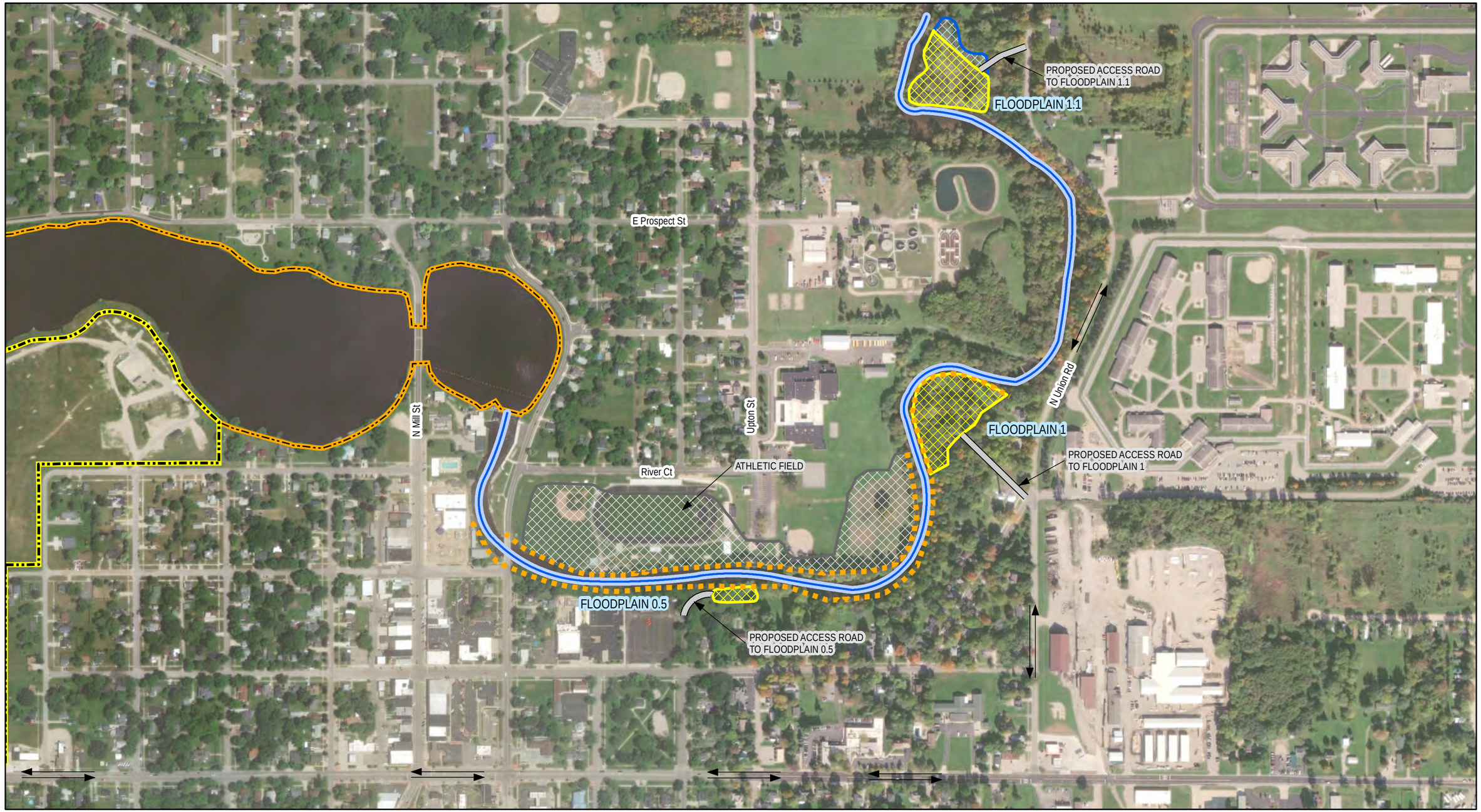
Truck Routes to/from OU3 and FPS

N

0 150 300 Feet

FIGURE 3-3
Proposed Site Layout
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

GIS Server: \\dc1vs01\GISProj\E\EPA\Velsicol_SuperfundSite\Reports\2020\OU3_Feasibility_Study\Maps\Report\06012020_Revisions\Figure 3-3_ProposedFPSStagingArea_rev.mxd, Date Saved: 6/1/2020 2:50:50 PM, User Name: mpetersh



Legend

- Proposed Access Road
- Bank Soils Removal Area
- Pine River OU3
- Approximate OU1 Boundary
- Approximate OU2 Boundary
- Remediated Floodplain Area
- 2020 Floodplain Removal Area
- Floodplain Extent
- Truck Routes to/from OU3 and FPS

Note:
Athletic Field Floodplain Area remediated as part of 2015 time-critical removal action and is not part of this footprint. Banks along this area are included in this remedial footprint.

N

0 450 900 Feet

Figure 3-4
Proposed Access Road Locations
OU3 Focused Feasibility Study
Velsicol Chemical Corporation Superfund Site
Saint Louis, Michigan

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Appendix A
Detailed Cost Estimate

Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riv — COST ESTIMATE SUMMARY

Site: OU3
Location: St. Louis, Gratiot County, Michigan
Phase: Feasibility Study
Base Year: 2020
Date: June 2, 2020

Description: Excavating floodplain and riverbank soils with total DDT concentrations greater than the 1-mg/kg risk-based PRG. Excavated soil will be disposed of offsite at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. The floodplains will be backfilled with clean soils to the existing grade and revegetated. The riverbank will be stabilized using various methods (to be determined during design) to prevent further erosion.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
1 Predesign Sampling and Testing					
Access Agreement Support	1	LS	$15,000.00	$15,000	
Predesign Sampling					
Technician	500	HR	$110.00	$55,000	5 people x 2 weeks
Airfare	4	EA	$300.00	$1,200	
Vehicle	28	DY	$100.00	$2,800	2 vehicles
Per Diem - Hotel	48	DY	$96.00	$4,608	
Per Diem - Meals	48	DY	$55.00	$2,640	
Per Diem - Travel Day	8	DY	$41.25	$330	
Daily Consumables	10	DY	$250.00	$2,500	
Analytical - Design					
DDT	100	EA	$140.00	$14,000	
Percent Solids (D-4318)	100	EA	$75.00	$7,500	
Moisture Content (D-2216)	100	EA	$20.00	$2,000	
Grain Size (D-422)	100	EA	$120.00	$12,000	
Analytical - Waste Characterization					
SVOCs by SW846 8270	45	EA	$92.00	$4,140	
VOCs by SW846 8260	45	EA	$44.00	$1,980	
Total RCRA Metals by SW846 6010/6020	45	EA	$35.00	$1,575	
TCLP VOCs	45	EA	$69.00	$3,105	
TCLP SVOCs	45	EA	$92.00	$4,140	
TCLP metals	45	EA	$75.00	$3,375	
Herbicides by SW-846 8151A	45	EA	$80.00	$3,600	
Pesticides by SW-846 8081B	45	EA	$70.00	$3,150	
pH/Corrosivity	45	EA	$12.00	$540	
Reactivity	45	EA	$25.00	$1,125	
Surveying					
Flood Plain Boundary	3	DY	$2,200.00	$6,600	
Sample Locations	3	DY	$2,200.00	$6,600	
Topographic Survey	5	DY	$2,200.00	$11,000	
Wetland Delineation	2	DY	$2,200.00	$4,400	
Survey Report	1	LS	$1,000.00	$1,000	
Wetland Delineation					
Biologist	112	HR	$115.00	$12,880	2 staff x 1 week duration for delineation
Airfare	2	EA	$300.00	$600	
Vehicle	6	DY	$100.00	$600	
Per Diem - Hotel	10	DY	$96.00	$960	
Per Diem - Meals	8	DY	$55.00	$440	
Per Diem - Travel Day	4	DY	$41.25	$165	
Daily Consumables	5	DY	$25.00	$125	
Wetland Delineation Report	80	HR	$130.00	$10,400	Assumed average rate
Permitting	1	LS	$80,000.00	$80,000	Permits are not required under CERCLA, however the substantive requirements of the ARARs must be met and a permit equivalency may need to be prepared. Permit equivalencies are included under site work
SUBTOTAL				$282,078	
2 Performance Bond					
Performance and Payment Bond/Insurance	2.5%		$4,042,051.96	$101,051	Based off of total construction cost. 2% for P&P bond, 0.5% for insurance
SUBTOTAL				$101,051	
3 Mobilization/Demobilization					
Mobilization	1	LS	$30,900.00	$30,900	mobilize staff and equipment
SUBTOTAL				$30,900	
4 Pre-remediation Site Work and General Conditions					
Work Plans					Contractor plans - assumed average billing rate for plan preparation
Work Plan	150	HR	$130.00	$19,500	
Health and Safety Plan	24	HR	$130.00	$3,120	
Compensatory Mitigation Plan	40	HR	$130.00	$5,200	
Environmental Protection Plan	80	HR	$130.00	$10,400	Includes Spill, Prevention, Control and Countermeasures Plan
Contractor Quality Control Plan	80	HR	$130.00	$10,400	
Soil Erosion and Sedimentation Control Plan	60	HR	$130.00	$7,800	
Transportation and Disposal Plan	40	HR	$130.00	$5,200	
Air Monitoring Plan	60	HR	$130.00	$7,800	
Establish Field Office/Laydown Area	1	LS	$13,300.00	$13,300	assumed 5,000 sf
Silt Fence	4,910	LF	$7.00	$34,370	Installed around excavation perimeter, along temporary access road. Includes maintenance and removal
Sandbag Diversion	6,150	LF	$29.00	$178,350	Installed during bank stabilization.
Temporary Fencing	3,520	LF	$21.00	$73,920	Installed around excavation areas and the bank stabilization area
Temporary Access Road	20,000	SF	$2.08	$41,600	Assumes 20,000 square feet of roadway (1,000 linear feet of road, 20 feet wide) - 3 separate locations. Assumes access roads will be cleared and laminated access mats used
Vegetation Reduction/Tree Removal	1	LS	$26,867.00	$26,867	Assumed 3 days for crew to remove vegetation/trees within temporary access road alignment and excavation footprint. Vegetation to be chipped on site and left as mulch. Root balls to be removed and hauled to staging area for disposal.
Clearing and Grubbing	5	AC	$4,424.00	$22,120	
Surveying - Establish Control Points	2	DY	$2,200.00	$4,400	
Utility Locate	2	DY	$1,400.00	$2,800	
Threatened and Endangered Species Survey					
Biologist	56	HR	$115.00	$6,440	1 person x 1 week for site visit and visual survey
Airfare	1	EA	$300.00	$300	
Vehicle	6	DY	$100.00	$600	
Per Diem - Hotel	5	DY	$96.00	$480	
Per Diem - Meals	4	DY	$55.00	$220	
Per Diem - Travel Day	2	DY	$41.25	$83	
Threatened and Endangered Species Survey Tech Memo	200	HR	$130.00	$26,000	Average billing rate used
SUBTOTAL				$501,270	

Alternative 2: Removal and Backfill/Cover or Engineered Channel Containment of OU3 Floodplain and Riv — COST ESTIMATE SUMMARY

Site: OU3
Location: St. Louis, Gratiot County, Michigan
Phase: Feasibility Study
Base Year: 2020
Date: June 2, 2020

Description: Excavating floodplain and riverbank soils with total DDT concentrations greater than the 1-mg/kg risk-based PRG. Excavated soil will be disposed of offsite at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. The floodplains will be backfilled with clean soils to the existing grade and revegetated. The riverbank will be stabilized using various methods (to be determined during design) to prevent further erosion.

5 Soil Excavation, Transport and Disposal						
Excavation and Direct Load for Offsite Disposal		20,350	CY	$34.00	$691,900	Assumed 300 cy/shift production - Direct load for offsite disposal
Stabilization		2,100	CY			As a contingency, the FS assumes that 10% of the excavated material will require solidification
Portland Cement Purchase		178	TN	$115.00	$20,470	
Portland Cement Delivery		178	TN	$21.07	$3,750	
Stabilization		2,100	CY	$15.00	$31,500	
Transportation and Disposal - Non Haz Soil		30,525	TN	$45.00	$1,373,625	Assumed disposal facility within 60 miles distance
Surveying						
Post Excavation Survey for Volume Payment		2	DY	$2,200.00	$4,400	
Survey Report		1	LS	$1,000.00	$1,000	
	SUBTOTAL				$2,126,645	
6 Placement of Backfill Within Floodplains						
General Backfill		7,900	CY	$62.00	$489,800	Purchase, place and compact. Placed up to 6 inches below final grade
Topsoil		3,900	CY	$74.00	$288,600	Purchase, place and compact. 6 inches to match final grade
Analytical - Clean Fill		14	EA	$645.00	$9,030	1 set per 1,000 cy import
Compaction Testing						Included in unit rate for general backfill
Surveying						
Post Backfill Survey for Volume Payment		3	DY	$2,200.00	$6,600	
Survey Report		1	LS	$1,000.00	$1,000	
	SUBTOTAL				$795,030	
7 River Bank Stabilization						
Geotextile		97,033	SF	$1.00	$97,033	Includes purchase, deliver and placement
Rip Rap Bedding		1,800	CY	$50.00	$90,000	1/2" gravel
Rip Rap Armoring		5,400	CY	$58.00	$313,200	6" rip rap
	SUBTOTAL				$500,233	
8 Monitoring During Construction						
Dust Monitoring		3	MTH	$2,565.00	$7,695	3 each during excavation and backfill x 3 months. Equipment rental only - labor is captured in contractor jobsite supervision.
Water Quality and Turbidity Monitoring		1	MTH	$1,995.00	$1,995	3 stations to be used for real time grab samples during excavation and backfill along the river bank. Equipment rental only - labor is captured in contractor jobsite supervision
	SUBTOTAL				$9,690	
9 Habitat Restoration						
Access Road Removal		20,000	SF	$1.00	$20,000	
Hydroseed		5	AC	$3,500.00	$17,500	hydroseed with native seed mix - trees will not be replaced
Maintenance Period		12	WK	$2,032.00	$24,384	water 3 times/week
	SUBTOTAL				$61,884	
10 Demobilization						
Demobilization		1	LS	$16,400.00	$16,400	
	SUBTOTAL				$16,400	
11 Final Construction Completion Report						
Final Construction Completion Report		1	LS	$50,000.00	$50,000	
	SUBTOTAL				$50,000	
	TOTAL				**$4,475,181**	
Contingency		25%		$4,475,181	$1,118,800	Scope and bid contingency
	TOTAL				**$5,593,981**	
Project Management		5%		$5,593,981	$279,700	EPA 2000, p. 5-13, $2M - $10M
Remedial Design		8%		$5,593,981	$447,500	EPA 2000, p. 5-13, $2M - $10M
Construction Management		6%		$5,593,981	$335,600	EPA 2000, p. 5-13, $2M - $10M
Total Capital Costs					**$6,656,781**	
				+50%	**$9,985,172**	
				-30%	**$4,659,747**	

Note:
For definitions, refer to the Acronyms and Abbreviations section in the FS.

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 10				Land Item	SCHEDULE: 1 100						
Description =	Mobilization			Unit =	LS	Takeoff Quan:		1.000	Engr Quan:		1.000
10	**Mob/Setup Office Trailer**			**Quan:**	**1.00 LS**	**Hrs/Shft:**		**10.00 Cal: 510 WC: CCISP**			
5FT01	Field Office Delivery	1.00	1.00 EA		1,200.000			1,200			1,200
5FT02	Field Office Installation	1.00	1.00 EA		800.000			800			800
5FT20	Conex Trailer	1.00	1.00 EA		1,795.000			1,795			1,795
9OUELEC	Electric Service - Install	1.00	1.00 LS		2,500.000			2,500			2,500
$6,295.00					[ ]			6,295			6,295
								6,295.00			6,295.00
20	**Mob Equipment**			**Quan:**	**12.00 LOADHrs/Shft:**			**10.00 Cal: 510 WC: CCISP**			
ZZZ	***CUSTOM CREW***		60.00 CH		**Prod:**	**5.0000 HU**		Lab Pcs: 1.00	Eqp Pcs:		2.00
8TRKHW15	Peterbilt 349W Cab/Cha	1.00	60.00 HR		47.027			2,822			2,822
8TRKHW30	Lowbed Trailer Drop 4	1.00	60.00 HR		23.274			1,396			1,396
TDTRD	Transport Driver	1.00	60.00 MH		24.450	2,998					2,998
$7,216.44	5.0000 MH/LOAD		60.00 MH		[134.475]	2,998		4,218			7,216
0.2000 Units/Hr	2.0000 Un/Shift		0.2000 Unit/MH			249.87		351.51			601.37
30	**Mob Supplies**			**Quan:**	**14.00 LOADHrs/Shft:**			**10.00 Cal: 510 WC: CCISP**			
ZZZ	***CUSTOM CREW***		70.00 CH		**Prod:**	**5.0000 HU**		Lab Pcs: 1.00	Eqp Pcs:		2.00
8TRKHW15	Peterbilt 349W Cab/Cha	1.00	70.00 HR		47.027			3,292			3,292
8TRKHW30	Lowbed Trailer Drop 4	1.00	70.00 HR		23.274			1,629			1,629
TDTRD	Transport Driver	1.00	70.00 MH		24.450	3,498					3,498
$8,419.18	5.0000 MH/LOAD		70.00 MH		[134.475]	3,498		4,921			8,419
0.2000 Units/Hr	2.0000 Un/Shift		0.2000 Unit/MH			249.87		351.51			601.37
=====> Item Totals:	**10 - Mobilization**										
$21,930.62	130.0000 MH/LS		130.00 MH		[3496.35]	6,496		6,295	9,139		**21,931**
21,930.620	1 LS					6,496.49		6,295.00	9,139.13		21,930.62
BID ITEM = 20				Land Item	SCHEDULE: 1 100						
Description =	Establish Field Office/Laydown Area			Unit =	LS	Takeoff Quan:		1.000	Engr Quan:		1.000
10	**Grade Surface**			**Quan:**	**5,000.00 SF**	**Hrs/Shft:**		**10.00 Cal: 510 WC: CCISP**			
ZZZ	***CUSTOM CREW***		5.00 CH		**Prod:**	**0.5000 S**		Lab Pcs: 2.50	Eqp Pcs:		1.50
8GRDR014	Grader Cat 14M 259 HP	1.00	5.00 HR		125.149			626			626
8LDRW950	Loader Cat 950H 4CY	0.50	2.50 HR		61.191			153			153
LGEN	Laborer-General	1.00	5.00 MH		19.650	189					189
OPLDR6	Op Eng 2- Loader <6Y	0.50	2.50 MH		32.920	165					165
OPMG	Op Eng - Motor Grader	1.00	5.00 MH		32.920	330					330
$1,462.26	0.0025 MH/SF		12.50 MH		[0.076]	684		779			1,462
1,000.0000 Units/Hr	10,000.0000 Un/Shift		400.0000 Unit/MH			0.14		0.16			0.29
20	**Place Geotextile Fabric - Lower Layer**			**Quan:**	**5,000.00 SF**	**Hrs/Shft:**		**10.00 Cal: 510 WC: CCISP**			
ZZZ	***CUSTOM CREW***		5.00 CH		**Prod:**	**0.5000 S**		Lab Pcs: 5.00	Eqp Pcs:		2.00
2EG42A	8 oz Non Woven Ge@106%	1.00	2.00 ROLL		437.000		926				926
8FORK02	Forklift Cat TH220B 7K	1.00	5.00 HR		28.922			145			145
8TRKGS10	Flatbed Truck 15K 200H	1.00	5.00 HR		24.684			123			123
LFORMN	Laborer-Foreman	1.00	5.00 MH		21.620	201					201
LGEN	Laborer-General	3.00	15.00 MH		19.650	566					566
OPLDR6	Op Eng 2- Loader <6Y	1.00	5.00 MH		32.920	330					330
$2,291.13	0.0050 MH/SF		25.00 MH		[0.125]	1,097	926	268			2,291
1,000.0000 Units/Hr	10,000.0000 Un/Shift		200.0000 Unit/MH			0.22	0.19	0.05			0.46
30	**Purchase/Deliver Aggregate**			**Quan:**	**93.00 CY**	**Hrs/Shft:**		**10.00 Cal: 510 WC: CCISP**			
2AA18	3/4" Aggregate Ba@106%	1.00	140.00 TN		12.000		1,781				1,781
5TRKAG	Deliver Aggregate	1.00	10.50 HR		110.000			1,155			1,155
$2,935.80					[ ]		1,781	1,155			2,936
							19.15	12.42			31.57

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 20				Land Item	SCHEDULE: 1 100						
Description =	Establish Field Office/Laydown Area			Unit = LS	Takeoff Quan: 1.000				Engr Quan:		1.000
40	**Aggregate Surface**			**Quan: 93.00 CY**	**Hrs/Shft: 10.00**		**Cal: 510**		**WC: CCISP**		
ZZZ	***CUSTOM CREW***		6.00	CH	**Prod: 6.0000 CH**			Lab Pcs: 4.00		Eqp Pcs:	3.00
8BDZR07	Bulldozer Cat D7R XR	1.00	6.00	HR	111.330				668		668
8COMPACRT4	Compactor Dynapac CP27	1.00	6.00	HR	62.250				373		373
8TRKWTR04	On Road Water Truck DS	1.00	6.00	HR	51.439				309		309
LGEN	Laborer-General	1.00	6.00	MH	19.650	226					226
OPDZ9	Op Eng 3- Dozer to D9	1.00	6.00	MH	32.920	396					396
OPROLL	Op Eng - Rollers	1.00	6.00	MH	32.920	396					396
TDWT	Water Truck Driver	1.00	6.00	MH	24.120	297					297
$2,665.63	0.2580 MH/CY		24.00	MH	[7.779]	1,316			1,350		2,666
15.5000 Units/Hr	155.0000 Un/Shift		3.8750	Unit/MH		14.15			14.52		28.66
=====> **Item Totals:**	**20**	**- Establish Field Office/Laydown Area**									
$9,354.82	61.5000 MH/LS		61.50	MH	[1727.29]	3,096	2,707	1,155	2,397		**9,355**
9,354.820	1 LS					3,095.79	2,707.24	1,155.00	2,396.79		9,354.82
BID ITEM = 30				Land Item	SCHEDULE: 1 100						
Description =	Silt Fence			Unit = LF	Takeoff Quan: 4,910.000				Engr Quan:		4,910.000
10	**Silt Fence - Install**			**Quan: 4,910.00 LF**	**Hrs/Shft: 10.00**		**Cal: 510**		**WC: CCISP**		
ZZZ	***CUSTOM CREW***		35.07	CH	**Prod: 1,400.0000 US**			Lab Pcs: 5.00		Eqp Pcs:	2.00
31EC100	Silt Fence w/stak@106%	1.00	52.00	ROLL	51.950			2,863			2,863
8BHLD426	BHL Cat 420E 1.25CY	1.00	35.07	HR	35.853				1,257		1,257
8TRKGS10	Flatbed Truck 15K 200H	1.00	35.07	HR	24.684				866		866
LFORMN	Laborer-Foreman	1.00	35.07	MH	21.620	1,410					1,410
LGEN	Laborer-General	3.00	105.21	MH	19.650	3,967					3,967
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	35.07	MH	32.920	2,315					2,315
$12,678.40	0.0357 MH/LF		175.35	MH	[0.892]	7,692		2,863	2,123		12,678
140.0057 Units/Hr	1,400.0570 Un/Shift	*	28.0011	Unit/MH		1.57		0.58	0.43		2.58
20	**Silt Fence - Maintenace**			**Quan: 1,000.00 LF**	**Hrs/Shft: 10.00**		**Cal: 510**		**WC: CCISP**		
ZZZ	***CUSTOM CREW***		2.00	CH	**Prod: 2.0000 CH**			Lab Pcs: 5.00		Eqp Pcs:	2.00
8BHLD426	BHL Cat 420E 1.25CY	1.00	2.00	HR	35.853				72		72
8TRKGS10	Flatbed Truck 15K 200H	1.00	2.00	HR	24.684				49		49
LFORMN	Laborer-Foreman	1.00	2.00	MH	21.620	80					80
LGEN	Laborer-General	3.00	6.00	MH	19.650	226					226
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	2.00	MH	32.920	132					132
$559.71	0.0100 MH/LF		10.00	MH	[0.25]	439			121		560
500.0000 Units/Hr	5,000.0000 Un/Shift		100.0000	Unit/MH		0.44			0.12		0.56
30	**Silt Fence - Remove**			**Quan: 4,910.00 LF**	**Hrs/Shft: 10.00**		**Cal: 510**		**WC: CCISP**		
ZZZ	***CUSTOM CREW***		32.73	CH	**Prod: 1,500.0000 US**			Lab Pcs: 5.00		Eqp Pcs:	2.00
8BHLD426	BHL Cat 420E 1.25CY	1.00	32.73	HR	35.853				1,173		1,173
8TRKGS10	Flatbed Truck 15K 200H	1.00	32.73	HR	24.684				808		808
LFORMN	Laborer-Foreman	1.00	32.73	MH	21.620	1,316					1,316
LGEN	Laborer-General	3.00	98.20	MH	19.650	3,703					3,703
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	32.73	MH	32.920	2,160					2,160
$9,160.44	0.0333 MH/LF		163.66	MH	[0.832]	7,179			1,981		9,160
150.0153 Units/Hr	1,500.1528 Un/Shift	*	30.0012	Unit/MH		1.46			0.40		1.87
=====> **Item Totals:**	**30**	**- Silt Fence**									
$22,398.55	0.0710 MH/LF		349.01	MH	[1.775]	15,310		2,863	4,225		**22,399**
4.562	4910 LF					3.12		0.58	0.86		4.56
BID ITEM = 35				Land Item	SCHEDULE: 1 100						
Description =	Sandbag Diversion			Unit = LF	Takeoff Quan: 6,150.000				Engr Quan:		6,150.000

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 35				Land Item	SCHEDULE: 1 100						
Description =	Sandbag Diversion			Unit = LF	Takeoff Quan: 6,150.000				Engr Quan:		6,150.000
10	**Fill Bags**			**Quan: 1.00 LS**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
2AS08	Bank Sand@106%	1.00	20.00 TN		13.000		276				276
31EC138	Sand Bags - Empty@106%	1.00	4.00 EA		0.500			2			2
7EQUIP12	Sand Bag Filling @106%	1.00	1.00 WK		500.000			530			530
8LDRSS216	==> Skid Steer Cat 216B 14	1.00	20.00 HR		22.111				442		442
LFORMN	==> Laborer-Foreman	1.00	20.00 MH		21.620	804					804
LGEN	==> Laborer-General	1.00	20.00 MH		19.650	754					754
OPBOB	==> Op Eng - Bobcat/Skidstee	1.00	1.00 MH		28.030	60					60
$2,868.00	41.0000 MH/LS		41.00 MH		[938.77]	1,618	276	532	442		2,868
			0.0244 Unit/MH			1,618.06	275.60	532.12	442.22		2,868.00
20	**Install Diversion**			**Quan: 6,150.00 EA**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		123.00 CH		**Prod: 500.0000 US**		Lab Pcs: 7.00		Eqp Pcs: 3.00		
8EXC008	Excavator Cat 320 (19.	1.00	123.00 HR		63.151				7,768		7,768
8TRKGS05	Boom Truck 28,000# Cap	1.00	123.00 HR		67.099				8,253		8,253
8TRKGS10	Flatbed Truck 15K 200H	1.00	123.00 HR		24.684				3,036		3,036
LFORMN	Laborer-Foreman	1.00	123.00 MH		21.620	4,945					4,945
LGEN	Laborer-General	4.00	492.00 MH		19.650	18,553					18,553
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	123.00 MH		32.920	8,118					8,118
OPLIFT	Op Eng 4- Boom Tk <10T	1.00	123.00 MH		28.030	7,357					7,357
$58,029.91	0.1400 MH/EA		861.00 MH		[3.546]	38,973			19,057		58,030
50.0000 Units/Hr	500.0000 Un/Shift	*	7.1429 Unit/MH			6.34			3.10		9.44
30	**Remove Diversion**			**Quan: 6,150.00 LF**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		123.00 CH		**Prod: 500.0000 US**		Lab Pcs: 7.00		Eqp Pcs: 3.00		
8EXC008	Excavator Cat 320 (19.	1.00	123.00 HR		63.151				7,768		7,768
8TRKGS05	Boom Truck 28,000# Cap	1.00	123.00 HR		67.099				8,253		8,253
8TRKGS10	Flatbed Truck 15K 200H	1.00	123.00 HR		24.684				3,036		3,036
LFORMN	Laborer-Foreman	1.00	123.00 MH		21.620	4,945					4,945
LGEN	Laborer-General	4.00	492.00 MH		19.650	18,553					18,553
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	123.00 MH		32.920	8,118					8,118
OPLIFT	Op Eng 4- Boom Tk <10T	1.00	123.00 MH		28.030	7,357					7,357
$58,029.91	0.1400 MH/LF		861.00 MH		[3.546]	38,973			19,057		58,030
50.0000 Units/Hr	500.0000 Un/Shift	*	7.1429 Unit/MH			6.34			3.10		9.44
=====> Item Totals:	**35 - Sandbag Diversion**										
$118,927.82	0.2866 MH/LF		1,763.00 MH		[7.244]	79,564	276	532	38,556		**118,928**
19.338	6150 LF					12.94	0.04	0.09	6.27		19.34
BID ITEM = 40				Land Item	SCHEDULE: 1 100						
Description =	Temporary Fencing			Unit = LF	Takeoff Quan: 3,520.000				Engr Quan:		3,520.000
10	**Temporary Fencing**			**Quan: 3,520.00 LF**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		44.00 CH		**Prod: 800.0000 US**		Lab Pcs: 4.00		Eqp Pcs: 1.00		
31EC126	Metal Tee Posts@106%	1.00	36.00 EA		7.430			284			284
31EC134	Safety Fence (100@106%	1.00	360.00 EA		117.900			44,991			44,991
8TRKGS10	Flatbed Truck 15K 200H	1.00	44.00 HR		24.684				1,086		1,086
LFORMN	Laborer-Foreman	1.00	44.00 MH		21.620	1,769					1,769
LGEN	Laborer-General	3.00	132.00 MH		19.650	4,978					4,978
$53,106.93	0.0500 MH/LF		176.00 MH		[1.108]	6,747		45,274	1,086		53,107
80.0000 Units/Hr	800.0000 Un/Shift	*	20.0000 Unit/MH			1.92		12.86	0.31		15.09
=====> Item Totals:	**40 - Temporary Fencing**										
$53,106.93	0.0500 MH/LF		176.00 MH		[1.108]	6,747		45,274	1,086		**53,107**
15.087	3520 LF					1.92		12.86	0.31		15.09

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 60				Land Item	SCHEDULE: 1 100						
Description =	Temporary Access Road			Unit = SF	Takeoff Quan: 20,000.000				Engr Quan:		20,000.000
10	**Clear Alignment**			**Quan: 1,000.00 LF**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		13.33	CH	**Prod: 75.0000 UH**			Lab Pcs: 4.00	Eqp Pcs:		3.00
8BDZR03LGP	Bulldozer Cat D3K2 LGP	1.00	13.33	HR	44.669				595		595
8LDRW930	Loader Cat 930H 2.6 CY	1.00	13.33	HR	47.917				639		639
8TRKHW10	Rear Dump 12 cy (6X4 1	1.00	13.33	HR	72.964				973		973
LGEN	Laborer-General	1.00	13.33	MH	19.650	503					503
OPDZ9	Op Eng 3- Dozer to D9	1.00	13.33	MH	32.920	880					880
OPLDR6	Op Eng 2- Loader <6Y	1.00	13.33	MH	32.920	880					880
TDED	End Dump Driver	1.00	13.33	MH	26.410	631					631
$5,099.49	0.0533 MH/LF		53.32	MH	[1.641]	2,893			2,207		5,099
75.0188 Units/Hr	* 750.1875 Un/Shift		18.7547	Unit/MH		2.89			2.21		5.10
20	**Materials**			**Quan: 1.00 LS**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
5CM01	8' x 16' Access Mat (16 wk r	4.00	640.00	EA	16.450			10,528			10,528
5CM02	Freight In	1.00	1.00	LS	1,120.000			1,120			1,120
$11,648.00					[ ]			11,648			11,648
								11,648.00			11,648.00
30	**Access Mat Installation**			**Quan: 20,000.00 SF**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		40.00	CH	**Prod: 4.0000 S**			Lab Pcs: 5.00	Eqp Pcs:		2.00
8TRKGS05	Boom Truck 28,000# Cap	1.00	40.00	HR	67.099				2,684		2,684
8TRKGS10	Flatbed Truck 15K 200H	1.00	40.00	HR	24.684				987		987
LFORMN	Laborer-Foreman	1.00	40.00	MH	21.620	1,608					1,608
LGEN	Laborer-General	3.00	120.00	MH	19.650	4,525					4,525
OPLIFT	Op Eng 4- Boom Tk <10T	1.00	40.00	MH	28.030	2,392					2,392
$12,197.13	0.0100 MH/SF		200.00	MH	[0.239]	8,526			3,671		12,197
500.0000 Units/Hr	5,000.0000 Un/Shift		100.0000	Unit/MH		0.43			0.18		0.61
=====> **Item Totals:**	**60 - Temporary Access Road**										
$28,944.62	0.0126 MH/SF		253.32	MH	[0.321]	11,419		11,648	5,878		**28,945**
1.447	20000 SF					0.57		0.58	0.29		1.45
BID ITEM = 70				Land Item	SCHEDULE: 1 100						
Description =	Vegetation Reduction			Unit = LS	Takeoff Quan: 1.000				Engr Quan:		1.000
10	**Vegetation Reduction**			**Quan: 3.00 DY**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		30.00	CH	**Prod: 10.0000 HU**			Lab Pcs: 6.00	Eqp Pcs:		4.00
5TRKED	Trucking - End Dump	1.00	30.00	HR	92.000			2,760			2,760
7EQUIP02	Skid Steer Mower @106%	1.00	3.00	WK	750.000			2,385			2,385
8EXC007	Excavator Cat 315D L (	1.00	30.00	HR	59.955				1,799		1,799
8EXC017	Thumb Attachment 50HTN	1.00	30.00	HR	13.013				390		390
8LDRSS226	Skid Steer Cat 226B 15	1.00	30.00	HR	23.382				701		701
8WOOD2	Wood Chipper Bandit 20	1.00	30.00	HR	38.001				1,140		1,140
LFORMN	Laborer-Foreman	1.00	30.00	MH	21.620	1,206					1,206
LGEN	Laborer-General	3.00	90.00	MH	19.650	3,394					3,394
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	30.00	MH	32.920	1,980					1,980
OPLDR6	Op Eng 2- Loader <6Y	1.00	30.00	MH	32.920	1,980					1,980
$17,735.44	60.0000 MH/DY		180.00	MH	[1610.51]	8,560		5,145	4,031		17,735
0.1000 Units/Hr	1.0000 Un/Shift		0.0167	Unit/MH		2,853.30		1,715.00	1,343.51		5,911.81
20	**Disposal**			**Quan: 3.00 LOAD**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
31DFEXCLD	Excavation Dump Fee-load	1.00	3.00	LD	70.000			210			210
5TRKED	Trucking - End Dump	1.00	6.00	HR	92.000			552			552
$762.00					[ ]			762			762
								254.00			254.00
=====> **Item Totals:**	**70 - Vegetation Reduction**										
$18,497.44	180.0000 MH/LS		180.00	MH	[4831.53]	8,560		5,907	4,031		**18,497**

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 70				Land Item	SCHEDULE: 1 100						
Description =	Vegetation Reduction			Unit =	LS	Takeoff Quan:		1.000	Engr Quan:		1.000
18,497.440	1 LS					8,559.91		5,907.00	4,030.53		18,497.44
BID ITEM = 80				Land Item	SCHEDULE: 1 100						
Description =	Clearing and Grubbing			Unit =	AC	Takeoff Quan:		5.000	Engr Quan:		5.000
10	**Clear/Grub/Stockpile**				**Quan: 5.00 AC**	**Hrs/Shft: 10.00**		**Cal: 510**	**WC: CCISP**		
ZZZ	***CUSTOM CREW***		25.00	CH	**Prod: 2.0000 US**			Lab Pcs: 4.00	Eqp Pcs: 3.00		
5TRKED	Trucking - End Dump	1.00	10.00 HR		92.000			920			920
8EXC008	Excavator Cat 320 (19.	1.00	25.00 HR		63.151				1,579		1,579
8LDRSS216	Skid Steer Cat 216B 14	1.00	25.00 HR		22.111				553		553
8WOOD2	Wood Chipper Bandit 20	1.00	25.00 HR		38.001				950		950
LFORMN	Laborer-Foreman	1.00	25.00 MH		21.620	1,005					1,005
LGEN	Laborer-General	1.00	25.00 MH		19.650	943					943
OPBOB	Op Eng - Bobcat/Skidsteer	1.00	25.00 MH		28.030	1,495					1,495
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	25.00 MH		32.920	1,650					1,650
$9,094.67	20.0000 MH/AC		100.00 MH		[562.212]	5,093		920	3,082		9,095
0.2000 Units/Hr	2.0000 Un/Shift	*	0.0500 Unit/MH			1,018.62		184.00	616.31		1,818.93
30	**Load and Haul for Disposal**				**Quan: 10.00 EA**	**Hrs/Shft: 10.00**		**Cal: 510**	**WC: CCISP**		
ZZZ	***CUSTOM CREW***		20.00	CH	**Prod: 2.0000 HU**			Lab Pcs: 2.00	Eqp Pcs: 1.00		
31DFEXCLD	Excavation Dump Fee-load	1.00	10.00 LD		120.000			1,200			1,200
5TRKED	Trucking - End Dump	1.00	20.00 HR		92.000			1,840			1,840
8LDRW930	Loader Cat 930H 2.6 CY	1.00	20.00 HR		47.917				958		958
LFORMN	Laborer-Foreman	1.00	20.00 MH		21.620	804					804
OPLDR6	Op Eng 2- Loader <6Y	1.00	20.00 MH		32.920	1,320					1,320
$6,122.36	4.0000 MH/EA		40.00 MH		[119.988]	2,124		3,040	958		6,122
0.5000 Units/Hr	5.0000 Un/Shift		0.2500 Unit/MH			212.40		304.00	95.83		612.24
=====> Item Totals:	**80 - Clearing and Grubbing**										
$15,217.03	28.0000 MH/AC		140.00 MH		[802.188]	7,217		3,960	4,040		**15,217**
3,043.406	5 AC					1,443.43		792.00	807.98		3,043.41
BID ITEM = 100				Land Item	SCHEDULE: 1 100						
Description =	Excavation and Direct Load for Offsite D			Unit =	CY	Takeoff Quan:		20,350.000	Engr Quan:		20,350.000
10	**Excavation and Direct Load for Offsite D**				**Quan: 23,403.00 CY**	**Hrs/Shft: 10.00**		**Cal: 510**	**WC: CCISP**		
ZZZ	***CUSTOM CREW***		780.10	CH	**Prod: 300.0000 US**			Lab Pcs: 8.00	Eqp Pcs: 4.00		
31TA02	Tarp Rack Rental@106%	1.00	16.00 WKLY		425.000			7,208			7,208
8EXC008	Excavator Cat 320 (19.	1.00	780.10 HR		63.151				49,264		49,264
8LDRSS216	Skid Steer Cat 216B 14	1.00	780.10 HR		22.111				17,249		17,249
8LDRW930	Loader Cat 930H 2.6 CY	1.00	780.10 HR		47.917				37,380		37,380
8TRKWTR04	On Road Water Truck DS	1.00	780.10 HR		51.439				40,128		40,128
LFORMN	Laborer-Foreman	1.00	780.10 MH		21.620	31,362					31,362
LGEN	Laborer-General	3.00	2,340.30 MH		19.650	88,253					88,253
OPBOB	Op Eng - Bobcat/Skidsteer	1.00	780.10 MH		28.030	46,659					46,659
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	780.10 MH		32.920	51,486					51,486
OPLDR6	Op Eng 2- Loader <6Y	1.00	780.10 MH		32.920	51,486					51,486
TDWT	Water Truck Driver	1.00	780.10 MH		24.120	38,658					38,658
$459,132.43	0.2666 MH/CY		6,240.80 MH		[7.281]	307,904		7,208	144,020		459,132
30.0000 Units/Hr	300.0000 Un/Shift	*	3.7500 Unit/MH			13.16		0.31	6.15		19.62
20	**Moves**				**Quan: 4.00 EA**	**Hrs/Shft: 10.00**		**Cal: 510**	**WC: CCISP**		
ZZZ	***CUSTOM CREW***		16.00	CH	**Prod: 4.0000 HU**			Lab Pcs: 7.00	Eqp Pcs: 3.00		
8EXC008	Excavator Cat 320 (19.	1.00	16.00 HR		63.151				1,010		1,010
8LDRSS216	Skid Steer Cat 216B 14	1.00	16.00 HR		22.111				354		354
8TRKWTR04	On Road Water Truck DS	1.00	16.00 HR		51.439				823		823
LFORMN	Laborer-Foreman	1.00	16.00 MH		21.620	643					643
LGEN	Laborer-General	3.00	48.00 MH		19.650	1,810					1,810

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 100				Land Item	SCHEDULE: 1 100						
Description =	Excavation and Direct Load for Offsite D			Unit =	CY	Takeoff Quan:	20,350.000		Engr Quan:		20,350.000
OPBOB	Op Eng - Bobcat/Skidsteer	1.00	16.00 MH		28.030	957					957
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	16.00 MH		32.920	1,056					1,056
TDWT	Water Truck Driver	1.00	16.00 MH		24.120	793					793
$7,446.36	28.0000 MH/EA		112.00 MH		[728.815]	5,259			2,187		7,446
0.2500 Units/Hr	2.5000 Un/Shift		0.0357 Unit/MH			1,314.80			546.79		1,861.59
=====> **Item Totals:**	**100 - Excavation and Direct Load for Offsite D**										
$466,578.79	0.3121 MH/CY		6,352.80 MH		[8.516]	313,163		7,208	146,208		**466,579**
22.928	20350 CY					15.39		0.35	7.18		22.93
BID ITEM = 110				Land Item	SCHEDULE: 1 100						
Description =	Stabilization			Unit =	CY	Takeoff Quan:	2,100.000		Engr Quan:		2,100.000
20	**Processing**			**Quan:**	**2,100.00 CY**	**Hrs/Shft:**	**10.00**	**Cal: 510**	**WC: CCISP**		
ZZZ	***CUSTOM CREW***		50.00 CH		**Prod:**	**5.0000 S**	Lab Pcs:	4.00	Eqp Pcs:		8.00
8AGGPL18	Conveyor 170 TPH, 18"x	1.00	50.00 HR		22.621			1,131			1,131
8AGGPL42	Vib Griz Feeder 42"x20	1.00	50.00 HR		22.171			1,109			1,109
8AGGPL74	Port Surge Bin 15cy 40	2.00	100.00 HR		9.861			986			986
8AGGPL76	Port. Pugmill 48' x 6'	1.00	50.00 HR		33.533			1,677			1,677
8EXC009	Excavator Cat 320D (21	1.00	50.00 HR		66.177			3,309			3,309
8LDRW930	Loader Cat 930H 2.6 CY	1.00	50.00 HR		47.917			2,396			2,396
8TRKPU55	Leased 4x4, 3/4 Ton Ga	1.00	50.00 HR		15.723			786			786
9STGEN	Sm Tools - General	1.00	43.38 MH		2.500			108			108
LFORMN	Laborer-Foreman	1.00	50.00 MH		21.620	2,010					2,010
LGEN	Laborer-General	1.00	50.00 MH		19.650	1,886					1,886
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	50.00 MH		32.920	3,300					3,300
OPLDR6	Op Eng 2- Loader <6Y	1.00	50.00 MH		32.920	3,300					3,300
$21,997.15	0.0952 MH/CY		200.00 MH		[2.805]	10,496		108	11,393		21,997
42.0000 Units/Hr	420.0000 Un/Shift		10.5000 Unit/MH			5.00		0.05	5.43		10.47
=====> **Item Totals:**	**110 - Stabilization**										
$21,997.15	0.0952 MH/CY		200.00 MH		[2.805]	10,496		108	11,393		**21,997**
10.475	2100 CY					5.00		0.05	5.43		10.47
BID ITEM = 120				Land Item	SCHEDULE: 1 100						
Description =	General Backfill			Unit =	CY	Takeoff Quan:	7,900.000		Engr Quan:		7,900.000
10	**General Backfill**			**Quan:**	**9,085.00 CY**	**Hrs/Shft:**	**10.00**	**Cal: 510**	**WC: CCISP**		
ZZZ	***CUSTOM CREW***		302.83 CH		**Prod:**	**300.0000 US**	Lab Pcs:	6.00	Eqp Pcs:		4.00
2AB02	Embankment Fill@106%	1.00	9,085.00 CY		12.000		115,561				115,561
4QC01	QC Compaction Testing	1.00	60.00 HR		140.000					8,400	8,400
5TRKAAG	Haul Aggregate	1.00	11,809.80 TN		6.000			70,859			70,859
8BDZR04LGP	Bulldozer Cat D4K2 LGP	1.00	302.83 HR		52.923				16,027		16,027
8COMPACV02	Compactor Cat CP-323C	1.00	302.83 HR		35.332				10,700		10,700
8LDRW930	Loader Cat 930H 2.6 CY	1.00	302.83 HR		47.917				14,511		14,511
8TRKWTR04	On Road Water Truck DS	1.00	302.83 HR		51.439				15,577		15,577
LFORMN	Laborer-Foreman	1.00	302.83 MH		21.620	12,175					12,175
LGEN	Laborer-General	1.00	302.83 MH		19.650	11,420					11,420
OPDZ9	Op Eng 3- Dozer to D9	1.00	302.83 MH		32.920	19,986					19,986
OPLDR6	Op Eng 2- Loader <6Y	1.00	302.83 MH		32.920	19,986					19,986
OPROLL	Op Eng - Rollers	1.00	302.83 MH		32.920	19,986					19,986
TDWT	Water Truck Driver	1.00	302.83 MH		24.120	15,007					15,007
$350,194.52	0.1999 MH/CY		1,816.98 MH		[6.019]	98,560	115,561	70,859	56,814	8,400	350,195
30.0003 Units/Hr	300.0033 Un/Shift	*	5.0001 Unit/MH			10.85	12.72	7.80	6.25	0.92	38.55
=====> **Item Totals:**	**120 - General Backfill**										
$350,194.52	0.2299 MH/CY		1,816.98 MH		[6.922]	98,560	115,561	70,859	56,814	8,400	**350,195**
44.328	7900 CY					12.48	14.63	8.97	7.19	1.06	44.33

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 130				Land Item	SCHEDULE: 1 100						
Description = Topsoil					Unit = CY	Takeoff Quan: 3,900.000			Engr Quan: 3,900.000		
10	**Topsoil**				**Quan: 3,900.00 CY**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
ZZZ	***CUSTOM CREW***			97.50 CH	**Prod: 400.0000 US**		Lab Pcs: 6.00		Eqp Pcs: 2.00		
2AB04	Topsoil@106%	1.00	4,680.00 CY		35.000		173,628				173,628
8LDRSS226	Skid Steer Cat 226B 15	1.00	97.50 HR		23.382				2,280		2,280
8LDRW930	Loader Cat 930H 2.6 CY	1.00	97.50 HR		47.917				4,672		4,672
LFORMN	Laborer-Foreman	1.00	97.50 MH		21.620	3,920					3,920
LGEN	Laborer-General	3.00	292.50 MH		19.650	11,030					11,030
OPLDR6	Op Eng 2- Loader <6Y	2.00	195.00 MH		32.920	12,870					12,870
$208,399.39	0.1500 MH/CY		585.00 MH		[4.026]	27,820	173,628		6,952		208,399
40.0000 Units/Hr	400.0000 Un/Shift	*	6.6667 Unit/MH			7.13	44.52		1.78		53.44
=====> **Item Totals:**	**130**	**- Topsoil**									
$208,399.39	0.1500 MH/CY		585.00 MH		[4.026]	27,820	173,628		6,952		**208,399**
53.436	3900 CY					7.13	44.52		1.78		53.44
BID ITEM = 140				Land Item	SCHEDULE: 1 100						
Description = Geotextile					Unit = SF	Takeoff Quan: 97,033.000			Engr Quan: 97,033.000		
10	**Geotextile**				**Quan: 97,033.00 SF**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
ZZZ	***CUSTOM CREW***			71.87 CH	**Prod: 13,500.0000 US**		Lab Pcs: 6.00		Eqp Pcs: 2.00		
2EG58	8 oz Non Woven Ge@106%	1.00	24.00 ROLL		437.000		11,117				11,117
8LDRW014	Loader Cat IT14G 1.7 C	1.00	71.88 HR		36.110				2,596		2,596
8TRKGS10	Flatbed Truck 15K 200H	1.00	71.88 HR		24.684				1,774		1,774
LFORMN	Laborer-Foreman	1.00	71.88 MH		21.620	2,890					2,890
LGEN	Laborer-General	4.00	287.51 MH		19.650	10,842					10,842
OPLDR6	Op Eng 2- Loader <6Y	1.00	71.88 MH		32.920	4,744					4,744
$33,962.88	0.0044 MH/SF		431.27 MH		[0.108]	18,476	11,117		4,370		33,963
1,350.1183 Units/Hr	13,501.1827 Un/Shift	*	224.9936 Unit/MH			0.19	0.11		0.05		0.35
=====> **Item Totals:**	**140**	**- Geotextile**									
$33,962.88	0.0044 MH/SF		431.27 MH		[0.108]	18,476	11,117		4,370		**33,963**
0.350	97033 SF					0.19	0.11		0.05		0.35
BID ITEM = 150				Land Item	SCHEDULE: 1 100						
Description = Rip Rap Bedding					Unit = CY	Takeoff Quan: 1,800.000			Engr Quan: 1,800.000		
10	**Rip Rap Bedding**				**Quan: 1,800.00 CY**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
ZZZ	***CUSTOM CREW***			45.00 CH	**Prod: 400.0000 US**		Lab Pcs: 4.00		Eqp Pcs: 2.00		
2AA40	1/2" Gravel@106%	1.00	2,808.00 TN		12.000		35,718				35,718
5TRKAAG	Haul Aggregate	1.00	2,808.00 TN		6.000			16,848			16,848
8LDRSS226	Skid Steer Cat 226B 15	1.00	45.00 HR		23.382				1,052		1,052
8LDRW930	Loader Cat 930H 2.6 CY	1.00	45.00 HR		47.917				2,156		2,156
LFORMN	Laborer-Foreman	1.00	45.00 MH		21.620	1,809					1,809
LGEN	Laborer-General	1.00	45.00 MH		19.650	1,697					1,697
OPLDR6	Op Eng 2- Loader <6Y	2.00	90.00 MH		32.920	5,940					5,940
$65,220.18	0.1000 MH/CY		180.00 MH		[2.946]	9,446	35,718	16,848	3,208		65,220
40.0000 Units/Hr	400.0000 Un/Shift	*	10.0000 Unit/MH			5.25	19.84	9.36	1.78		36.23
=====> **Item Totals:**	**150**	**- Rip Rap Bedding**									
$65,220.18	0.1000 MH/CY		180.00 MH		[2.946]	9,446	35,718	16,848	3,208		**65,220**
36.233	1800 CY					5.25	19.84	9.36	1.78		36.23
BID ITEM = 160				Land Item	SCHEDULE: 1 100						
Description = Rip Rap Armoring					Unit = CY	Takeoff Quan: 5,400.000			Engr Quan: 5,400.000		

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 160				Land Item	SCHEDULE: 1 100						
Description =	Rip Rap Armoring				Unit = CY	Takeoff Quan:	5,400.000	Engr Quan:	5,400.000		
10	**Rip Rap Bedding**				**Quan: 5,400.00 CY**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
ZZZ	***CUSTOM CREW***			154.28 CH	**Prod: 350.0000 US**	Lab Pcs: 4.00	Eqp Pcs: 2.00				
2AR20	4" Rip Rap@106%	1.00	8,424.00 TN		15.000		133,942				133,942
5TRKAAG	Haul Aggregate	1.00	8,424.00 TN		6.000			50,544			50,544
8EXC004	Excavator Cat 311 (10.	1.00	154.29 HR		37.390				5,769		5,769
8LDRSS226	Skid Steer Cat 226B 15	1.00	154.29 HR		23.382				3,608		3,608
LFORMN	Laborer-Foreman	1.00	154.29 MH		21.620	6,203					6,203
LGEN	Laborer-General	1.00	154.29 MH		19.650	5,818					5,818
OPEXC3	Op Eng 3- Backhoe to 3Y	1.00	154.29 MH		32.920	10,183					10,183
OPLDR6	Op Eng 2- Loader <6Y	1.00	154.29 MH		32.920	10,183					10,183
$226,249.12	0.1142 MH/CY		617.16 MH		[3.366]	32,387	133,942	50,544	9,376		226,249
35.0013 Units/Hr	350.0130 Un/Shift	*	8.7498 Unit/MH			6.00	24.80	9.36	1.74		41.90
=====> Item Totals:	**160**	**- Rip Rap Armoring**									
$226,249.12	0.1142 MH/CY		617.16 MH		[3.366]	32,387	133,942	50,544	9,376		**226,249**
41.898	5400 CY					6.00	24.80	9.36	1.74		41.90
BID ITEM = 170				Land Item	SCHEDULE: 1 100						
Description =	Access Road Removal				Unit = SF	Takeoff Quan:	20,000.000	Engr Quan:	20,000.000		
30	**Access Mat Removal**				**Quan: 20,000.00 SF**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
ZZZ	***CUSTOM CREW***			30.00 CH	**Prod: 3.0000 S**	Lab Pcs: 5.00	Eqp Pcs: 2.00				
5CM03	Freight Out	1.00	1.00 LS		1,120.000			1,120			1,120
8TRKGS05	Boom Truck 28,000# Cap	1.00	30.00 HR		67.099				2,013		2,013
8TRKGS10	Flatbed Truck 15K 200H	1.00	30.00 HR		24.684				741		741
LFORMN	Laborer-Foreman	1.00	30.00 MH		21.620	1,206					1,206
LGEN	Laborer-General	3.00	90.00 MH		19.650	3,394					3,394
OPLIFT	Op Eng 4- Boom Tk <10T	1.00	30.00 MH		28.030	1,794					1,794
$10,267.84	0.0075 MH/SF		150.00 MH		[0.179]	6,394		1,120	2,753		10,268
666.6667 Units/Hr	6,666.6667 Un/Shift		133.3333 Unit/MH			0.32		0.06	0.14		0.51
=====> Item Totals:	**170**	**- Access Road Removal**									
$10,267.84	0.0075 MH/SF		150.00 MH		[0.179]	6,394		1,120	2,753		**10,268**
0.513	20000 SF					0.32		0.06	0.14		0.51
BID ITEM = 180				Land Item	SCHEDULE: 1 100						
Description =	Dust Monitoring				Unit = MTH	Takeoff Quan:	3.000	Engr Quan:	3.000		
10	**Dust Monitoring**				**Quan: 3.00 MTH**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
7EQUIP20	Dust Monitor pDR-@106%	3.00	9.00 MTH		600.000			5,724			5,724
=====> Item Totals:	**180**	**- Dust Monitoring**									
$5,724.00					[ ]			5,724			**5,724**
1,908.000	3 MTH							1,908.00			1,908.00
BID ITEM = 185				Land Item	SCHEDULE: 1 100						
Description =	Water Quality and Turbidity Monitoring				Unit = MTH	Takeoff Quan:	1.000	Engr Quan:	1.000		
10	**Water Quality and Turbidity Monitoring**				**Quan: 1.00 MTH**	**Hrs/Shft: 10.00**	**Cal: 510**	**WC: CCISP**			
31MATMISC	Misc Calibration @106%	1.00	1.00 LS		150.000			159			159
7EQUIP10	Turbidity Meter@106%	1.00	1.00 MTH		450.000			477			477
7EQUIP11	YSI Water Quality@106%	1.00	1.00 MTH		800.000			848			848
$1,484.00					[ ]			1,484			1,484
								1,484.00			1,484.00

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 185				Land Item	SCHEDULE: 1		100				
Description =	Water Quality and Turbidity Monitoring			Unit = MTH	Takeoff Quan: 1.000			Engr Quan: 1.000			
=====> **Item Totals: 185 - Water Quality and Turbidity Monitoring**											
$1,484.00					[ ]			1,484			**1,484**
1,484.000			1 MTH					1,484.00			1,484.00
BID ITEM = 190				Land Item	SCHEDULE: 1		100				
Description =	Maintenance Period			Unit = WK	Takeoff Quan: 12.000			Engr Quan: 12.000			
10	**Watering**			**Quan: 36.00 EA**	**Hrs/Shft: 8.00 Cal: 508 WC: CCISP**						
ZZZ	***CUSTOM CREW***		288.00 CH		**Prod: 1.0000 SU**			Lab Pcs: 1.00	Eqp Pcs:	2.00	
8TRKPU55	Leased 4x4, 3/4 Ton Ga	1.00	288.00 HR		15.723			4,528		4,528	
8TRKWTR02	Water Tank and Trailer	1.00	288.00 HR		5.680			1,636		1,636	
LGEN	Laborer-General	1.00	288.00 MH		19.650	10,229				10,229	
$16,392.74		8.0000 MH/EA	288.00 MH		[157.2]	10,229		6,164		16,393	
0.1250 Units/Hr		1.0000 Un/Shift	0.1250 Unit/MH			284.13		171.22		455.35	
=====> **Item Totals: 190 - Maintenance Period**											
$16,392.74		24.0000 MH/WK	288.00 MH		[471.6]	10,229		6,164		**16,393**	
1,366.062		12 WK				852.39		513.67		1,366.06	
BID ITEM = 200				Land Item	SCHEDULE: 1		100				
Description =	Demobilization			Unit = LS	Takeoff Quan: 1.000			Engr Quan: 1.000			
10	**Demob Office Trailer**			**Quan: 1.00 LS**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
5FT03	Field Office Removal	1.00	1.00 EA		800.000			800		800	
5FT04	Field Office Return	1.00	1.00 EA		800.000			800		800	
5FT12	Break Trailer Remove	1.00	1.00 EA		250.000			250		250	
5FT13	Break Trailer Return	1.00	1.00 EA		718.000			718		718	
$2,568.00					[ ]			2,568		2,568	
								2,568.00		2,568.00	
20	**Demob Equipment**			**Quan: 15.00 LOAD**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		75.00 CH		**Prod: 5.0000 HU**			Lab Pcs: 1.00	Eqp Pcs:	2.00	
8TRKHW15	Peterbilt 349W Cab/Cha	1.00	75.00 HR		47.027			3,527		3,527	
8TRKHW30	Lowbed Trailer Drop 4	1.00	75.00 HR		23.274			1,746		1,746	
TDTRD	Transport Driver	1.00	75.00 MH		24.450	3,748				3,748	
$9,020.55		5.0000 MH/LOAD	75.00 MH		[134.475]	3,748		5,273		9,021	
0.2000 Units/Hr		2.0000 Un/Shift	0.2000 Unit/MH			249.87		351.50		601.37	
=====> **Item Totals: 200 - Demobilization**											
$11,588.55		75.0000 MH/LS	75.00 MH		[2017.13]	3,748		2,568	5,273		**11,589**
11,588.550		1 LS				3,747.98		2,568.00	5,272.57		11,588.55
BID ITEM = 999				Land Item	SCHEDULE: 1		100				
Description =	Contractor Indirects			Unit = LS	Takeoff Quan: 1.000			Engr Quan: 1.000			
10	**Home Office Support**			**Quan: 4.00 MTH**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
X100	==> Project Manager	1.00	320.00 MH		55.000	23,531				23,531	
X102	==> Admin	1.00	160.00 MH		22.000	4,706				4,706	
X104	==> Accounting	1.00	64.00 MH		32.000	2,738				2,738	
X108	==> Project Controls	1.00	64.00 MH		36.000	3,080				3,080	
X110	==> Staff Engineer	1.00	80.00 MH		42.000	4,492				4,492	
$38,548.39		172.0000 MH/MTH	688.00 MH		[7208]	38,548				38,548	
			0.0058 Unit/MH			9,637.10				9,637.10	
20	**Project Support**			**Quan: 3.00 MTH**	**Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						

Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Material	Constr Matl/Exp	Equip Ment	Sub-Contract	Total
BID ITEM = 999				Land Item	SCHEDULE: 1 100						
Description =	Contractor Indirects			Unit = LS	Takeoff Quan: 1.000				Engr Quan:		1.000
ZZZ	***CUSTOM CREW***		660.00	CH	**Prod: 220.0000 HU**			Lab Pcs: 2.25		Eqp Pcs:	0.00
7EQUIP01	Truck Rental@106%	2.25	6.75 MTH		1,200.000			8,586			8,586
X116	Project Superintendent	1.00	660.00 MH		50.480	44,542					44,542
X118	Project Engineer	1.00	660.00 MH		40.860	36,057					36,057
X120	Site Safety Officer	0.25	165.00 MH		31.250	6,878					6,878
$96,063.15	495.0000 MH/MTH		1,485.00 MH		[21813.55]	87,477		8,586			96,063
0.0045 Units/Hr	0.0455 Un/Shift		0.0020 Unit/MH			29,159.05		2,862.00			32,021.05
30	**Field Office**			**Quan:**	**3.00 MTH Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
5FT05	Field Office Rental(24'x60')	1.00	3.00 MTH		542.600			1,628			1,628
5FT20	Conex Trailer	1.00	1.00 EA		1,795.000			1,795			1,795
9OMOSUP	Field Office Supplies	1.00	3.00 MO		2,000.000			6,000			6,000
9OMUDUM	Dumpster - Unit Months	1.00	3.00 MO		275.000			825			825
9OMUPTL	Portable Toilets-Unit Month	2.00	6.00 MO		75.000			450			450
9OMUPW	Potable Water Service-Month	1.00	3.00 MO		150.000			450			450
$11,147.80					[ ]			11,148			11,148
								3,715.93			3,715.93
40	**Support Equipment**			**Quan:**	**1.00 LS Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
ZZZ	***CUSTOM CREW***		1,056.00	CH	**Prod: 1,056.0000 HU**			Lab Pcs: 0.00		Eqp Pcs:	0.00
31MAU023	Surveying Supplie@106%	1.00	1.00 LS		10,000.000			10,600			10,600
31SU09	Topcon GPS Base +@106%	1.00	1.00 EA		17,650.000			18,709			18,709
31SU10	GPS Rover@106%	1.00	1.00 EA		5,200.000			5,512			5,512
$34,821.00					[ ]			34,821			34,821
0.0009 Units/Hr	0.0095 Un/Shift							34,821.00			34,821.00
50	**Small Tools**			**Quan:**	**1.00 LS Hrs/Shft: 10.00 Cal: 510 WC: CCISP**						
2*TH	Small Tools@106%	1.00	15,922.04 LBHR		1.500		25,316				25,316
60	**Safety Supplies - General**			**Quan:**	**1.00 LS Hrs/Shft: 8.00 Cal: 508 WC: CCISP**						
3*TH	Safety Supplies@106%	1.00	15,922.04 LBHR		0.500			8,439			8,439
=====> **Item Totals:**	**999 - Contractor Indirects**										
$214,335.06	2,173.0000 MH/LS		2,173.00 MH		[94272.65]	126,026	25,316	62,993			**214,335**
214,335.060	1 LS					126,025.54	25,316.04	62,993.48			214,335.06
$1,920,772.05	***** Report Totals *****		15,922.04 MH			795,153	498,265	297,092	321,863	8,400	**1,920,772**

>>> indicates Non Additive Activity

------Report Notes:------

The estimate was prepared with TAKEOFF Quantities.

This report shows TAKEOFF Quantities with the resources.

Bid Date: Owner: Engineering Firm:

Estimator-In-Charge:

JOB DOES NOT HAVE NOTES

* on units of MH indicate average labor unit cost was used rather than base rate.

[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens

In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%

------Calendar Codes------

410 4 Nights @ 10 hrs/night

508 5 days @ 8hrs/day

509 5 days @ 9 hrs/day

510 5 days @ 10hrs/day (Default Calendar)

608 6 Days @ 8 hrs/day

610 6 Days @ 10 hrs/day