# REMEDIAL MEASURES WORK PLAN
# FOR SHEET PILE BARRIER AND BANK STABILIZATION
# ALONG THE GREAT MIAMI RIVER
# CHEVRON CINCINNATI FACILITY
# HOOVEN, OHIO

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**Project #: 500-018-010**

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# 1.0 INTRODUCTION

This document is submitted in fulfillment of the requirements of Section VI.11.g of the Administrative Order on Consent (Docket RCRA-05-2007-001) that was agreed to between Chevron U.S.A, Inc. (Chevron) and Region 5 of the United States Environmental Protection Agency (USEPA) on November 1, 2006. Pursuant to the Order, Chevron submitted a written evaluation of options for stabilizing the Great Miami River (River) bank (*Evaluation of Engineering Options along the Great Miami River, Chevron Cincinnati Facility*) on December 28, 2006. USEPA reviewed the engineering options evaluation and provided written comments in a March 27, 2007 letter. Chevron revised the options evaluation per USEPA comments and submitted a revised report along with a response to comments letter on May 1, 2007. USEPA reviewed the revised engineering options evaluation and on June 11, 2007 provided correspondence indicating that they concurred with the preferred remedy outlined in the report.

The agreed upon River bank stabilization activities, described herein, comprise a component of the final groundwater remedy to address LNAPL and groundwater contamination associated with historical refining activities conducted at the Chevron Cincinnati Facility. Throughout the course of assessment activities conducted along the west bank of the River, multiple small scale erosion events have been observed particularly in the area east of monitoring well series MW-85S, where localized spotting was first observed. In this area, exposed portions of the smear zone have been observed during low river stages, providing evidence that sheening on the Great Miami River is due to erosion (*Update to Site Conceptual Model and Summary of Remedial Decision Basis, June 2005*). Upon evaluating a variety of bank stabilization engineering alternatives, a multifaceted approach was selected that serves to protect the west bank, restore the floodplain function of the bank, and prevent the potential release of LNAPL constituents to the River. This approach includes implementation of a minimally exposed sheet pile barrier wall, a low-sloping bench with flood-tolerant vegetation, relocation of the Hooven Ditch, and targeted sediment removal. Each of these elements is discussed in greater detail in pertinent sections that follow.

While the Engineering Options Evaluation contained conceptual-level details of the preferred bank stabilization elements and construction activities, this Remedial Measures Work Plan (Work Plan) provides more detailed descriptions of the remedy elements, construction activities, design basis, as well as other remedy design considerations. This Work Plan was originally submitted to USEPA on December 6, 2007. The Work Plan was subsequently revised based on USEPA comments and teleconference discussion, and on August 25, 2008, USEPA approved the revised Work Plan pending concurrence from the Ohio State Historical Preservation Office regarding a Cultural Resources Management Investigation Report for the work area, and issuance of a Permit by the U.S. Army

Corps of Engineers (ACE) to perform work in the River Floodway. A copy of the USEPA approval letter is included in Appendix G.

The final Work Plan is contained herein and is organized as follows:

Project Description and Remedy Design Elements - Section 2: This section provides a brief description and rationale of all the remedy design elements. More detailed explanations of design and construction for key remedy elements are provided in Section 3.

Design and Construction - Section 3: The sheet pile barrier and low-sloping bench general design rationale and construction techniques are described in Section 3.

Hydraulic Modeling & Floodplain Effects - Section 4: All of the remedy elements are subject to erosive forces over a range of flows of the Great Miami River. A site-specific HEC-RAS (Hydrologic Engineering Centers River Analysis System) model was created to evaluate the stability of the remedy elements and optimize their design. The model was also used to evaluate the project with respect to flood elevations and develop strategies for any required floodplain mitigation. A discussion of this modeling is provided in Section 4.

Wetlands Delineation & Endangered Species Assessment - Section 5: Results of a wetlands delineation and endangered & threatened species assessment conducted in the project area are presented in Section 5 along with measures to mitigate impacts to potential sensitive species.

Pollution Prevention - Section 6: Construction in riparian zones has the potential to negatively impact surface water. Erosion Control / Storm Water Pollution Prevention Plan requirements and a Contingency Plan to minimize this potential are described in Section 6.

Performance Monitoring - Section 7: A summary of the framework, purpose, and scope of each element included as part of the proposed performance monitoring program are provided in Section 7. The *Performance Monitoring Plan, Sheet Pile Barrier along Great Miami River, Chevron Cincinnati Facility, Hooven, Ohio* is included as Appendix A.

# 2.0 PROJECT DESCRIPTION AND REMEDY DESIGN ELEMENTS

The remedy as described in this section will be constructed at the Chevron Cincinnati Facility. The former refinery is located east of the Community of Hooven, Ohio, in Whitewater Township. The primary objective of this project is to provide long-term stabilization and isolation of refinery-related subsurface contaminants that have potential to adversely influence surface water quality in the Great Miami River. The project area lies adjacent to the west bank of the Great Miami River and extends along the bank approximately 1,800 feet. Portions of the project area will extend into the River channel including excavation of material from areas east of the River. A location and vicinity map is provided on Sheet 1. The proposed barrier alignment and location of the remedy elements are illustrated on Sheet 3.

The sheet pile barrier and bank stabilization project consists of a set of engineering measures that serve to both stabilize the west bank and prevent contaminant migration to the Great Miami River. For bank stability, a "natural channel design" is employed which consists of multiple elements that collectively act to reshape the long term flow behavior of the Great Miami River in the project area and restore the stabilizing benefits that a floodplain provides to a river bank. Prevention of contaminant migration is addressed both with the additional "clean buffer" created as part of the redirected river channel and a partially penetrating, sealed sheet pile barrier wall. Principal components of the project consist of 1) a protective steel sheet pile barrier wall, 2) a low-sloping bench with flood tolerant vegetation, 3) relocation of the Hooven Ditch, and 4) removal of soils north of the barrier (SWMU-10 berm) and sediments from the channel east of the opposing bank. A discussion of the implementation and rationale of each of these elements and other activities performed as part of the project is provided below.

## 2.1 SHEET PILE BARRIER WALL

A partially penetrating steel sheet pile barrier wall (“barrier”) will be installed on the River side of the low-sloping bench in order to provide initial stability to the re-contoured bank and immature vegetation, as well as prevent potential LNAPL migration and mitigate dissolved-phase contaminant flux to the Great Miami River. To prevent contaminant migration directly through the wall, the joint interlocks between steel piles will be sealed with a water-swelling sealant prior to driving. Sheet piles will be installed such that the top of the piles are, for the most part, coincident with the re-contoured ground surface and out of view. A more detailed discussion of the sheet pile design and construction is provided in Sections 3.1 – 3.4.

## 2.2 LOW-SLOPING BENCH WITH FLOOD-TOLERANT VEGETATION

The existing bank will be re-contoured to create a low-sloping bench as shown on Sheet 2. Flood-tolerant vegetation (e.g., willow, dogwood, alder, buttonbush, etc.) will be planted over the entire bench area (Sheet 6) and temporarily stabilized using turf reinforcement mats. While existing bank vegetation consists of mature trees with large root structures, the average root mass elevation is such that river water gradually undercuts the tree roots resulting in large scale sloughing of both tree and existing bank. The establishment of new flood-tolerant vegetation at the level of the proposed bench would allow for root structures to take hold that are less susceptible to undercutting, and upon maturation, provide long-term, natural bank stability.

The low-sloping bench serves as a floodplain for the project area. By allowing high flows to spread out over this bench, the depth of flow through the bend is reduced, which in turn reduces the shear stress available to erode the toe of the bank. As they return to the main channel, these over bank flows can also counteract secondary flows through the bend, which should further reduce erosion.

## 2.3 HOOVEN DITCH REALIGNMENT

Prior to driving sheet piles, the Hooven Ditch will be realigned to the north of the upstream tie-in of the barrier (Sheet 2). In its current location, the Hooven Ditch passes through portions of the upper-most smear zone en route to the Great Miami River, and relocation of the ditch is necessary to allow the flow to bypass the barrier. The vertical alignment of the re-located Ditch was chosen to provide a buffer of clean soils between the surface waters and the smear zone. A plan, profile, and typical cross-section of the re-routed Hooven Ditch are presented on Sheet 7.

## 2.4 HORIZONTAL AIR SPARGE PIPING

Horizontal air sparge lines will be placed on the existing river bed prior to moving bed material for cofferdam construction and sheet pile driving (Sheet 8). The air sparge piping serves as a contingency in the event that contaminants are detected in the hyporheic zone (the region beneath and lateral to a stream bed, where there is mixing of shallow groundwater and surface water) above screening standards. Details of the monitoring methods and plan are discussed in Section 7.0. In the event that such an exceedance is detected, the mechanical infrastructure to deliver compressed air to the appropriate portions of the system would be installed at a location consistent with site development requirements. In contrast to conventional air sparge system piping installed vertically and screened beneath the core of contamination, the current configuration would produce more of a "bubble curtain" creating a region of increased aerobic microbial activity that would accelerate biodegradative processes and reduce dissolved-phase contaminant concentrations.  If after completion of barrier and bank stabilization construction activities an exceedance of applicable surface water standards occurs in the hyporheic zone at a location distant from the any of the horizontal sparge lines, conventional vertical air sparge points will be installed at appropriate locations.  The design and basis for the air sparge piping are discussed in Section 3.6.

## 2.5 EXCAVATION OF NON-PROJECT AREA SOILS AND SEDIMENTS

Soils and sediments will be excavated from target locations both north of the barrier and from portions of the "Island" channel (Sheet 2).  Hydraulic modeling was performed to evaluate the benefit of removing material from multiple locations in order to offset an increase to the 100-yr flood elevation.  From this modeling, the areas identified as providing the greatest reduction in flood elevations are as follows:

- Portions of the channel on the east side of the Island (Area A1 and A2 on Sheet 2).  Results of hydraulic modeling indicate that increasing flood channel capacity will increase river flow through this area reducing upstream flood elevations and shear stress along the proposed barrier wall.
- The high berm around the SWMU-10 remediation area (Area B on Sheet 2).  During high flows, this berm may constrict the channel potentially resulting in increased shear stress along the proposed barrier wall alignment.  The affects of this constriction are supported by the results of the hydraulic model.

In addition Area C was identified as a location of potential supplemental borrow material removal.  To minimize potential sediment release to the River, channel excavation activities will be conducted during periods of low water when the channel is dry.  During the excavation of both areas, accepted construction storm water pollution prevention best management practices (BMPs) will be employed.

# 3.0 DESIGN AND CONSTRUCTION

As the remedy involves a set of unique elements, a variety of construction techniques are utilized. This section discusses the configuration, design basis, and construction methods for particular project elements.

## 3.1 SHEET PILE BARRIER WALL LOCATION

The planned location of the barrier is largely dictated by the contaminant (smear zone) morphology and groundwater flow conditions. The wall is positioned to prevent both dissolved-phase and LNAPL migration to the Great Miami River. A discussion of the horizontal and vertical configuration and an explanation of contaminant mitigation are provided below.

### 3.1.1 LATERAL ALIGNMENT

In general, the lateral wall alignment is positioned approximately 10 feet into the River beyond the lateral extent of the smear zone, as defined by the zero-thickness contour on the smear zone thickness contour map (Sheet 8). The alignment allows for a clean “buffer” of soil between the contaminated zone and the wall.

A thin (typically less than one-foot thick) fingerlike projection of smear was observed north of the north tie-in of the wall. However, these impacts do not appear to emanate from the LNAPL source zone which is situated approximately 200 feet inland. This thin zone of impacts is not in an area of active bank erosion and does not present a threat of release of impacts to the River, so it is not targeted as a component of the remedial activities described in this work plan. If the isolated impacts in this area are ever targeted for remediation in the future, excavation of these impacts would be more cost effective than extending the barrier an additional 500 feet. Therefore, the wall ties back into the existing bank at a location north of and encompassing the smear zone encroaching on the west bank of the Great Miami River.

The wall alignment extends a distance greater than 10 feet downstream of the southern extent of the observed smear zone. The creation of additional clean fill between the smear zone and wall at the downstream end addresses the general groundwater flow direction and propensity for southerly dissolved-phase contaminant transport over time.

### 3.1.2 VERTICAL ALIGNMENT

For the barrier portions parallel to the River (i.e., not including tie-ins angling back to the bank), the top of barrier elevation is set at 472 ft-msl at the north and is lowered to 471 ft-msl at the south utilizing consistent 30-ft long piles. The top of wall elevation was set approximately one foot above the maximum top-of-smear elevation along a top-of-bank transect (Sheet 5). As groundwater flow is generally parallel to the River and the wall is partially penetrating in a highly prolific aquifer, the potential for contaminants emanating from the west bank to migrate laterally and mound up over the top of the wall is low. If a condition exists in which the inland groundwater elevation is higher than the surface water elevation in the River (potentially the case after a flood and subsequent drop in river stage), groundwater flow may be temporarily directed from the west bank toward the River in which case it will follow a long, circuitous path beneath the bottom of the wall.

At the upstream tie-in point, the wall alignment angles approximately 45 degrees into the existing bank. The top of wall elevation at the beginning of the tie-in is approximately 472 ft-msl and increases to approximately 474 ft-msl at the top of bank. At the downstream tie in point, the wall turns at an angle approximately 45 degrees into the existing bank and increasing from 471 ft-msl to 480 ft-msl at the top of bank.

### 3.1.3 CAPTURE OF RESIDUAL CONTAMINANTS

The primary objective of the remedial measures consists of stabilizing the River bank to prevent erosion of LNAPL-impacted soils. In place of designing an engineering control solely to prevent erosion of the impacted river bank, design modifications were made that address the long-term potential for LNAPL sheening due to bank storage effects and dissolved-phase contaminant transport concerns. The effectiveness of the remedy to address these contaminant-transport mechanisms is discussed in the following sections.

#### 3.1.3.1 PREVENTING LNAPL MIGRATION

The LNAPL plume is considered stable and LNAPL in the River bank area is not present at sufficient thicknesses (i.e., generally not measurable) to mobilize as a result of local LNAPL gradients. However, in the existing bank configuration, sheening may occur as a result of out-of-bank discharge events. A rapid decrease in river stage (particularly following a flood or precipitation event) results in temporary groundwater gradients directed toward the River. During such events, occasional sheening on the River has been observed.

The current remedy design will mitigate this out-of-bank discharge phenomenon as a result of the lateral and vertical barrier alignment. The lateral barrier alignment, situated approximately 10 feet beyond the lateral extent of smear, creates a clean buffer zone of soil which diminishes the magnitude of surface-to-bank charging and subsequent out-of-bank discharge of groundwater. The partially penetrating (i.e., hanging) barrier will be installed such that the top of wall extends above and below the vertical extents of the smear zone as observed along an upper bank alignment (Sheet 5). The wall at this elevation will prevent sheening on the River by impeding the flow of surface water directly into and out of the LNAPL-impacted soils. The proposed top and bottom elevations of the barrier (Sheets 3 - 4) intersect the direct pathway between impacted soils and the River and limit out-of-bank surface water discharge to the upper, non-impacted portions of the bank.

#### 3.1.3.2 MITIGATING DISSOLVED-PHASE CONTAMINANT FLUX

Since groundwater flow is predominantly parallel to or inboard from the River, concern regarding this pathway is focused on the localized and short-duration periods when rapidly dropping river levels can lead to flow of bank-stored groundwater back into the River. The reconfigured bank and wall alignment establish a new river edge at least 10 feet beyond the smear zone and will therefore contribute toward this goal. Because groundwater flow rates are generally much higher in the horizontal than the vertical dimension, contaminants are much less likely to persist along a flow path that requires vertical as well as horizontal migration.

For the current barrier depth and alignment during the short-duration and infrequent events when river-ward groundwater flow is possible, the minimum flow path from the smear zone to the River will be increased to about 65 feet, and a vertical dimension to this minimum flow path will be added. These impediments to contaminant migration serve to increase the residence time of dissolved-phase contamination allowing for biodegradative processes to reduce contaminant concentrations before reaching the River. The low-sloping bench with flood-tolerant vegetation provides protection to upper portions of the River bank, and the wall need not extend to the top of the existing bank to stabilize the upper (non-impacted) bank regions. Instead, the wall was lowered to a level that impedes contaminant transport to a greater extent.

## 3.2 SHEET PILE BARRIER WALL STRUCTURAL DESIGN

The wall alignment requires that the selected steel sheet pile section have sufficient structural capacity to resist unequal lateral loading conditions applied against the wall from the land side if the soil and riprap on the River side of the wall is removed by river flow. The planned construction has a top of wall elevation ranging from 471 - 472 ft-msl, which is nearly coincident with the re-contoured ground and riverbed surface except at the south end of the wall where several feet of wall will extend vertically above the riverbed. Therefore, the majority of the wall does not have to support a lateral load and the steel sheet pile section was selected based on driving the section into native granular materials. The steel sheet pile section was also selected to have sufficient strength to resist the lateral loading exerted by the landside granular soils with 12 feet of the wall acting as a cantilever. As the wall only partially penetrates highly permeable soils, substantial lateral loading resulting from both high water and low water conditions is not anticipated.

Based on these requirements, the Roll Form Group EZ88 or equivalent sheet pile section illustrated on Sheet 5 was selected. This sheet pile section has the structural capacity to support the unequal loading conditions which apply to the wall. This sheet pile section is also sufficient for the driving conditions. Steel sheet pile sizing calculations are included in Appendix C.

### 3.3 EARTHEN COFFERDAM CONSTRUCTION

Pile driving activities will be conducted from north to south along the alignment. The first set of piles installed at the north end will act as a dam to block flow entering the project area through the side channel. Thus, the first construction activity serves to reduce flow through the project area and the propensity for off-site sediment transport. As the site gravel bar is typically above the River elevation for approximately the northern two-thirds of the barrier, pile driving will continue along the proposed alignment utilizing track-mounted pile driving equipment staged on the site gravel bar in this area.

As the water depth becomes deeper along the southern third of the barrier alignment, gravel material will first be placed to create a cofferdam / work platform in this area with a top elevation slightly higher than the current surface water level (typically 467 ft-msl). This earthen cofferdam serves a dual purpose of blocking sediment transport from the project area and allowing pile driving to proceed using track-driven pile driving equipment in this area. The earthen cofferdam / work platform will be constructed utilizing existing material from the site river gravel bar and imported clean gravel (if needed). The approximate side slope of this portion of the cofferdam will be 2H:1V. The river side of the cofferdam will be covered with filter fabric and a minimum of two feet of large dimension (Ohio DOT Class A) riprap to prevent erosion of the fill material and mitigate downstream transport of suspended sediments. The cofferdam will be constructed in sections, working downstream progressively. The downstream earthen cofferdam will cross the downstream end of the side channel passing through the construction area, serving as a block for suspended sediments / turbid waters from entering downstream portions of the River.

Prior to transferring river gravel, a set of representative sediment samples of river gravel bar material will be collected and submitted for analysis of target VOCs, SVOCs, and metals. If analytical results indicate the borrow material is suitable for use as clean fill behind the barrier, river gravel will be transferred to create the cofferdam and work platform.

With the complete cofferdam and sheet pile barrier in place and tied back to the existing banks, the area between the proposed alignment and the existing bank will be filled with additional gravel material to establish a working platform above the elevation of the River. To complete the low-sloping bench, portions of the upper bank will be cut while other areas will be filled out. In this way, much of the native soils will be re-utilized in the project area. Additional clean soil will be imported (if necessary).

## 3.4 SHEET PILE BARRIER WALL CONSTRUCTION

Installation of the sheet pile barrier will be completed using standard sheet pile installation techniques with the exception of applying a sealant to the joints. The wall will be constructed with Roll Form Group EZ88 or equivalent sheet piling with a water-swelling sealant (Adeka Ultra Seal A-30 or equivalent) applied to the interlocking joints prior to driving. The A-30 sealant consists of a two-part mixture (resin and catalyst) that is applied to the female portion of the joint interlock. Individual piles are driven with the male side (or the side without sealant applied) leading to prevent accumulation of soil or debris in the interlock. Sheet piles will be driven vertically to depth by means of a hydraulic percussion hammer or vibratory hammer.

The first few sheet piles will be driven to 50% of their final depth and plumbed in both directions. A sheet pile driving frame will then be attached to the piles and a number of piles will be threaded together. These sheet piles will be driven to the top elevation of the frame and plumbed. The frame will then be moved along the path of the wall and the first piles driven to depth. The threading operation will be repeated iteratively and work will proceed along this portion of the wall. The wall will then be installed through the cofferdam using standard sheet pile installation techniques.

## 3.5 LOW-SLOPING BENCH WITH FLOOD-TOLERANT VEGETATION

With the geometric constraints of the barrier dictated by contaminant morphology, the low-sloping bench was designed to minimize the bench slope without disturbing the large 100-yr flood berm areas. In the process of creating the low-sloping bench, trees substantially below the proposed final grade will be felled. While the bench area could be created with even lower slope, doing so would require carving into the secondary flood berm and removing additional mature trees in this area.

Upon creation of the re-contoured bench, flood-tolerant vegetation will be planted as indicated on Sheet 6. Live stakes (e.g., willow, dogwood, alder, buttonbush, etc.) will be planted at a maximum density of two per square yard. Fiber matting will be applied to the staked area to provide initial stability until sufficient root mass density develops to stabilize the bank. If needed, after the third year of good growth, the live willows will be cut into sections and immediately driven back into the ground in areas of sparse vegetation. These harvested live roots will sprout new stems that grow quickly and stabilize sparse areas.

## 3.6 HORIZONTAL AIR SPARGE PIPING

The piping runs indicated on Sheet 8 consist of a bundle of two-inch diameter, schedule 80 PVC pipes (5 lines at the downstream segment and 3 lines at the upstream segment), each with a unique 100-ft screened interval for the horizontal section on the river bed. Small screened interval segments are preferred over a single large horizontal sparge line as differential water levels above the screened pipe may result in uneven air delivery. Dividing the screened interval into multiple smaller segments minimizes the problem of differential air delivery and allows for more targeted air delivery to a problem area.

Both ends of each horizontal sparge line terminate and are capped above the ground surface outside of the construction area. This allows for flexibility in the potential future location of mechanical equipment for delivering compressed air as well as possible flushing of sediments from individual lines, if needed.

Air sparge lines were strategically located to address areas of thicker smear in proximity to the barrier. As the predominant groundwater flow direction parallels the River and is toward the southern end of the barrier, significant air sparge piping was placed at the downstream end of the barrier.

# 4.0 HYDRAULIC MODELING & FLOODPLAIN EFFECTS

The design of this remedy involves minimizing the risk of contaminant transport to the Great Miami River and halting the erosion currently taking place along the west bank of the River, while also providing a solution that minimizes the effect to flood surface elevations. Because the River is currently eroding into the smear zone, the banks will need to be built-out to some degree to contain the smear zone, which will result in some loss of cross sectional area in the channel. However, the amount of channel constriction is reduced by incorporating the low-sloping bench in the remedy. The low-sloping bench will also reduce erosion by allowing high flows to spread out over the bank (dissipating shear stress) and provides a suitable surface to establish stabilizing vegetation. To further mitigate potential backwater effects caused by the stabilized bank, material will be excavated from the SWMU-10 berm in the overbank area north of the barrier wall, the side channel along the east side of the Chevron Island, and, if needed, the west side of the Chevron Islands, as described in Section 2.7.

A step-backwater computer model (Hydrologic Engineering Centers River Analysis System or HEC-RAS) was developed by Fuller, Mossbarger, Scott and May Engineers, Inc (FMSM – Cincinnati, OH) to model flows in the Great Miami River through the project site. This model was used to evaluate the hydraulic forces acting on the various components of the remedy (including shear stresses and velocities near the barrier wall) and to analyze any changes to flood elevations that the remedy might cause. The final design of the bank and any additional flood mitigation was evaluated based on the results of this model. This Section briefly describes the development and usage of this model. Appendix B contains the complete model results and report.

## 4.1 MODEL DEVELOPMENT

The HEC-RAS model was based on the United States Army Corps of Engineers' (USACE) HEC-2 model used to develop the Flood Insurance Rate Mapping (FIRM) for the Great Miami River. This model was imported into the newer HEC-RAS software and trimmed to focus on a reach specific to the project site that extends from downstream of the bridges (downstream of the site) to the confluence with the Whitewater River (upstream of the site). This truncated model was then calibrated so that it produced results similar to the original HEC-2 model.

With the existing conditions HEC-RAS model calibrated, survey data collected in 2007 was used to add additional cross sections to refine the model along the proposed barrier wall alignment. The model was then re-calibrated so that the existing conditions model with the additional cross sections produced similar results as the existing conditions model without this refinement.

## 4.2 MODELING BARRIER WALL ALTERNATIVES

The refined existing conditions model was used to evaluate different design alternatives. Because HEC-RAS is based on step-backwater calculations between cross sections, evaluating design alternatives involved modifying cross sections to reflect the changes along the alignment of the barrier wall. For each alternative, the model was run to calculate various hydraulic parameters (water surface elevation, velocity, shear stress, etc.).

The location of the project along the outside of a bend in the River complicates the use of HEC-RAS in this situation. HEC-RAS is a one-dimensional model, which means that model output describes parameters averaged across each cross section (parameters from HEC-RAS that refer to a specific part of the channel are simply based on a partitioning of roughness to produce averaged values for a given subset of the cross section). Because of various components of bend hydraulics, velocities and shear stresses along the outside of the bend (where the barrier wall is located) are expected to be higher than the cross section averaged values provided by HEC-RAS.

There are various methods available for estimating the maximum velocity and shear stress along the outside of the bend, one of the simplest being simple empirical multiplication factors related to bend geometry provided by the USACE. For this project, bend hydraulics affect the design of riprap protection, scour estimation, and the details of vegetation establishment on the bench. The scour analysis and riprap sizing are discussed briefly in Section 4.3 and in detail in Appendix B and Appendix C. The vegetation treatment is described in Section 2.2 and Appendix D.

## 4.3 ESTIMATING AND PROTECTING AGAINST SCOUR

Critical to the stability of the barrier wall is protecting against scour at high flows. Should scour occur to a sufficient depth along the wall, it could undermine the stability of the entire bank. The latest version of HEC-RAS (Version 4.0) includes a module to estimate sediment transport and scour, which was used in the scour analysis of the Great Miami River. Like any other parameter from HEC-RAS, scour depth represents an average depth across each cross section. The details of applying this value to the outside of the bend, where scour is likely to be maximum, are described in Appendix B. Essentially, the geometry of the bend was used along with various sediment transport calculations to estimate maximum scour for the cross sections along the barrier wall.

To protect a sheet pile wall against scour, options include either driving the wall to a sufficient depth below the scour zone or protecting the channel bed from scouring with riprap armoring. Riprap protection was chosen for this project because of the uncertainties and cost of driving sheet piles to much greater depths. Calculations used to size riprap are included in Appendix C. Riprap will be installed along the barrier wall to the maximum depth practicable. At the toe of this riprap apron, additional stone will be placed so that it can "self-launch" into scour holes that may form along the newly constructed bank.

## 4.4 MODELING FLOOD HYDRAULICS

As per Hamilton County regulation, construction of this project cannot begin without a "No-Rise Certificate," issued by the County. The final HEC-RAS model was used to demonstrate that the sum of the activities included in this construction activity will not increase flood elevations from their existing levels. The alignment of the barrier wall must project into the River to sufficiently contain groundwater contamination. To mitigate the rise in flood elevation that this constriction causes, the project includes the following components:

- A low-sloping bench on top of the barrier wall to serve as a constructed floodplain
- Re-opening the side channel east of the Chevron Island
- Removal of portions of the SWMU-10 berm located in the floodplain
- Potentially borrowing material from the west side of the Chevron Island

Instead of using a graded slope to fill out the bank above the top of the barrier wall, the top of the barrier wall will be connected to the existing terrace west of the alignment with a gently sloping bench. This bench will maximize the cross section area along the barrier wall while preserving most of the existing large trees and other vegetation along the upper terrace. As it will be inundated by high flows, the bench itself will be protected by flood-tolerant vegetation, as described on Sheet 6 and in Appendix D. This bench will also allow high flows to spread out over a greater area, resulting in reduced shear stress acting to scour the channel along the barrier wall.

To mitigate increases in flood elevations, conveyance through the side channel east of the Chevron Island will be improved. As discussed in detail in Appendix B, reopening this channel will reduce flood surface elevations while improving flow conditions through the bridges downstream of the site. The majority of this side channel work will be done along the island-side of the channel so as not to disturb vegetation protecting the east bank of the River.

The east side of the SWMU-10 berm will be removed from the floodplain. Removal of residual sludge from SWMU-10 has been completed and the base of the SWMU has been backfilled back above the high-groundwater table, so the berm no longer serves any function relative to the former wastewater impoundment. Removal of this berm will increase the cross sectional area available for high flows, reducing flood surface elevations.

Finally, should additional clean fill material be needed to re-contour the bank along the barrier wall, some material may be excavated from the west side of the Chevron Island. If this is done, it will increase conveyance through the project area and concentrate flow away from the barrier wall, at least until longer-term geomorphic adjustments redistribute sediment in the channel.

Through these measures, it is not expected that this project will increase flood elevations. The results of the HEC-RAS model showing the existing and post-construction water surface elevations at the 100-year flood are provided in Appendix B.

# 5.0 WETLANDS DELINEATION AND ENDANGERED SPECIES ASSESSMENT

A wetland delineation and threatened and endangered species habitat assessment were conducted at the project site by Civil & Environmental Consultants, Inc. in June 2007. The areas investigated include the primary bank stabilization and barrier construction area (15.9 acres) as well as other locations at which excavation of river and bank sediments is under evaluation as described in Section 2.7. The Wetland Delineation Report is provided as Appendix E and the Endangered Species Habitat Assessment is provided as Appendix F.

The wetlands delineation report did not identify any wetlands in the primary construction or other potential excavation areas. The report did identify a set of potentially jurisdictional waters, only one of which (Hooven Ditch) would be altered as a result of primary (not including off-site excavation) construction activities. Remedy construction authorization with the U.S. Army Corps of Engineers (USACE) will be sought under a General Nationwide Permit 38 (Cleanup of Hazardous and Toxic Waste), the conditions of which do not limit the footage of allowable stream impact. In addition, the OEPA Draft Section 401 Certifications waive the limit on temporary and permanent footage impacts to streams for NWP 38. Thus, it is likely that alteration of the current Hooven Ditch alignment will be permissible based on current applicable regulations.

The threatened and endangered species habitat assessment documented the results of a federally-listed threatened and endangered species and federal candidate species habitat assessment in the same investigation area as performed for the wetlands delineation. The assessment found no occurrences of federally-listed endangered species within the investigation area and concluded that the remedy construction activities “may affect, but is not likely to adversely affect, the following federally-listed endangered and candidate species or their habitat: Indiana bat, running buffalo clover, and sheepnose mussel.” The assessment further recommends that potentially suitable Indiana bat roost trees be removed during the September 15 to April 15 time period so as not to disrupt potentially utilized bat habitats. Felling of trees would likely be performed during low-water conditions and can likely be coordinated within this window of time. In addition, a set of constructed bat roosts will be installed within the low-sloping bench area to replace potentially disturbed Indiana Bat habitats. The roosts will provide temporary habitats until natural succession of the inland forest replaces roost trees removed as part of construction activities.

# 6.0 POLLUTION PREVENTION

The selected construction contractor will implement construction practices and precautions designed to prevent pollution and the spread of subsurface contaminants during construction activities and mitigate offsite sediment release. These practices include the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) and maintenance of contingency equipment and materials during the construction project. Key elements of these practices and precautions are described in this Section.

Construction activities are not anticipated to unearth portions of the smear zone. The first primary activity consists of installing piles at the north end to limit side channel flow through the project area followed by an earthen cofferdam to block flow at the southern end of the project area. Therefore, it is not anticipated that earth work procedures will result in mobilization of petroleum impacted soils, or cause sheen to the River. Sheet piles will be driven along a lateral alignment beyond the extent of the smear zone, which should prevent mobilization to the River of exposed portions of smear caused by vibrations from sheet pile driving activities.

To minimize offsite sediment transport, cofferdams with geotextile fabric will be constructed (as discussed in Section 3.3) prior to other construction activities that may disturb the River bed or bank areas. The integrity and effectiveness of cofferdams to contain construction-related turbidity will be monitored during construction.

Wastes that may be generated during construction of the barrier are anticipated to include municipal-type wastes (paper, cardboard, food containers, etc.), scrap steel, and petroleum contaminated soil. Municipal-type wastes generated during construction will be managed at a permitted off-site landfill. Trimming and cutting of the sheet pile panels will be necessary during barrier material installation. Sheet pile trimmings too small to be incorporated into the wall will be collected for recycling as scrap metal. If petroleum contaminated soil is generated, it will be profiled and disposed at a permitted, offsite landfill.

## 6.1 CONTINGENCY PLAN

Potential sources of pollution associated with the construction of the barrier in and near the River channel include sedimentation associated with the placement of fill material and the release of petroleum hydrocarbons to surface water resulting from disturbance of petroleum-contaminated soils or sediments within or adjacent to the River channel. To prevent sedimentation and increases in turbidity, only clean granular fill material will be used to construct cofferdams.

Soils containing high percentages of clay or silt will not be placed in the River channel in areas that are outside the control of the cofferdams. Cofferdams and work platforms will be constructed in a stepwise fashion. Cofferdams will be built out from the bank and extended a limited distance downstream. Work platform fill materials will then be placed behind the cofferdam in the resulting back water and the cofferdam will be extended an additional distance. River water displaced from areas behind completed cofferdam sections will be allowed to return to the River.

To further protect against adverse effects to river water quality during barrier construction, a full-time inspection program will be implemented during in-stream and near shore construction activities. The inspector will on a daily basis monitor the River for evidence of sedimentation, hydrocarbon sheens, and other adverse conditions that could be related to barrier construction activities. The following contingency measures will also be practiced:

1. <u>Maintain the availability of contingency equipment and materials during construction.</u> The following contingency equipment and materials will be available on site during barrier construction activities:

   - Backhoe
   - Reserves of clean, granular fill material
   - Geotextile filter fabric and anchors
   - Floating oil booms
   - Oil sponges

2. <u>Cease and/or alter construction activities.</u> The inspector will direct the construction contractor to slow or stop work in the event that significant sheening or turbidity is observed and will determine which construction activity(ies) resulted in the condition. The inspector will then continue to monitor the condition. If sheening or turbidity persists, the inspector will direct the contractor to take measures to control and/or eliminate the condition. These measures may include deployment of oil booms and/or sponges, installation of geotextile filter fabric and anchors, and/or placement of temporary cofferdams. After the condition has been eliminated or controlled, the inspector and contractor will work to devise alternative construction techniques to prevent recurrence.

# 7.0 REMEDY INSPECTION, MONITORING & MAINTENANCE

The proposed scope and schedule for remedy inspection, performance monitoring and maintenance activities are provided in the *Performance Monitoring Plan, Sheet Pile Barrier along Great Miami River, Chevron Cincinnati Facility, Hooven, Ohio* included as Appendix A. The performance monitoring plan has been prepared to fulfill the requirements of Section VI.12.a. of the Administrative Order on Consent (Docket RCRA-05-2007-001) and specifies the requirements for operation, maintenance, and monitoring of components related to the stabilization of the west bank of the Great Miami River. The performance monitoring plan shall be incorporated into the *Operation, Monitoring, and Maintenance (OMM) Plan for the Final Groundwater Remedy* (Chevron 2007b) by reference.

The specific elements included in the remedy performance monitoring program include:

1. Visually inspecting the condition of exposed portions of the sheet piles, rip rap, fill material, river bank, and flood tolerant vegetation

2. Visually monitoring for the presence of sheens, if LNAPL impacts encroach upon the barrier

3. Evaluating groundwater, hyporheic water, and surface water elevations via manual gauging and automated pressure transducers

4. Collecting groundwater, hyporheic water, and surface water samples for laboratory analysis of the constituents of concern and natural attenuation indicators

Through execution of each of these elements, Chevron will be able to assess the condition and effectiveness of the remedy over time including:

- Monitoring of the physical state of the various remedy components

- Defining a maintenance and rehabilitation schedule for the system components, if needed

- Assessing remedy performance to prevent discharge of LNAPL into the River due to potential instability of impacted bank soils

- Evaluating remedy performance to prevent migration of dissolved phase impacts to the River above Ohio EPA surface water standards

- Monitoring vertical and horizontal hydraulic gradients along the containment system

- Estimating biodegradation pathways for dissolved phase impacts should they encroach upon the partially penetrating barrier wall

- Providing an early warning for potential releases to the River prior to impacting human health or ecological receptors

The performance monitoring plan includes a comprehensive description of the location and methods for installation of the monitoring components, frequency, and procedures for completion of routine monitoring events, as well as protocols and schedule for completion of data validation, reduction, and reporting activities.

**SHEETS**

**SHEET PILE BARRIER AND BANK STABILIZATION ALONG THE GREAT MIAMI RIVER**

**APPENDICES**

# APPENDIX A

# PERFORMANCE MONITORING PLAN

## APPENDIX B

## REPORT OF FLOODPLAIN AND SCOUR ANALYSIS

# APPENDIX C

# STEEL SHEET PILE AND RIPRAP SIZING CALCULATIONS

**APPENDIX D**

**RIPRARIAN BANK LIVE STAKES SPECIFICATIONS**

**APPENDIX E**

**WETLAND DELINEATION REPORT**

# APPENDIX F

## THREATENED AND ENDANGERED SPECIES HABITAT ASSESSMENT

# APPENDIX G

# USEPA CORRESPONDENCE