

DRAFT ENVIRONMENTAL ASSESSMENT
WITH
UNSIGNED FINDING OF NO SIGNIFICANT IMPACT

REGULATING WORKS PROJECT
GRAND TOWER PHASE 5
CRAWFORD TOWHEAD AND VANCILL TOWHEAD
MIDDLE MISSISSIPPI RIVER MILES 74-67
UNION COUNTY, IL
CAPE GIRARDEAU COUNTY, MO

DECEMBER 2013



**US Army Corps
of Engineers**
St. Louis District

U.S. Army Corps of Engineers, St. Louis District
Regional Planning and Environment Division North
1222 Spruce St.
St. Louis, MO 63103-2833

TABLE OF CONTENTS

Contents

TABLE OF CONTENTS.....	i
1. Purpose of and Need for Action.....	1
2. Alternatives Including the Proposed Action.....	4
3. Affected Environment.....	12
Physical Resources.....	12
Biological Resources	14
Socioeconomic Resources	17
Historic and Cultural Resources	17
4. Environmental Consequences.....	22
Physical Resources.....	22
Biological Resources	24
Socioeconomic Resources	30
Historic and Cultural Resources	31
Cumulative Impacts	31
Mitigation.....	36
5. Relationship of Proposed Action to Environmental Requirements	36
6. List of Preparers.....	37
7. Literature Cited.	37
DRAFT FINDING OF NO SIGNIFICANT IMPACT (FONSI).....	42
Appendix A. Summary of Research on the Effects of River Training Structures on Stages	
Appendix B. Biological Assessment	
Appendix C. Correspondence	
Appendix D. Clean Water Act Section 404(b)(1) Evaluation	
Appendix E. Distribution List	

1. Purpose of and Need for Action

The U.S. Army Corps of Engineers (USACE) St. Louis District (District) is responsible for providing a safe and dependable 9-foot deep and not less than 300-foot wide navigation channel, with additional width in the bends as required, on the Middle Mississippi River (MMR). The MMR is defined as that portion of the Mississippi River that lies between the confluences of the Ohio and Missouri rivers (Figure 1). This is achieved through the authorized Regulating Works Project. The Regulating Works Project consists of bank stabilization and sediment management to ensure adequate navigation depth and width. Project improvements are achieved through the construction of river training structures, revetment, rock removal, and construction dredging. The Regulating Works Project is maintained through dredging and any needed maintenance to already constructed features. The long-term goal of the Regulating Works Project, as authorized by Congress, is to alleviate or eliminate the amount of annual maintenance dredging and the occurrence of vessel accidents through the construction of river training structures to provide a sustainable navigation channel and reduce federal expenditures. Since the 1970s various environmental laws, regulations, and policies have resulted in considering the environment in the design and construction of the Regulating Works Project.

The Regulating Works, Grand Tower Phase 5 (Crawford and Vancill Towheads) Construction Project is needed to address repetitive channel maintenance dredging issues in the project area. Frequent dredging has been required in order to address channel depth, width, and alignment issues. Without dredging, there are five locations between river miles (RM) 67 and 74 where shoaling occurs, which can result in impacts to navigation. Placement of rock river training structures would provide a sustainable alternative to repetitive maintenance dredging. Construction of the Grand Tower Phase 5 Project is proposed to begin in 2014.

The planning of specific construction projects for the Regulating Works Project, such as this Grand Tower Phase 5 Project, requires extensive coordination with the U.S. Fish and Wildlife Service, Missouri Department of Conservation, Illinois Department of Natural Resources, and multiple navigation industry groups.

Prior Reports

This site-specific Environmental Assessment (EA) is tiered off of the 1976 Environmental Impact Statement (1976 EIS) covering the District's Regulating Works Project – *Mississippi River between the Ohio and Missouri Rivers (Regulating Works)*, (USACE 1976). The 1976 EIS was recently reviewed by the District to determine whether or not the document should be supplemented. The District has concluded that the Regulating Works Project has not substantially changed since 1976 but that there are significant new circumstances and information on the potential impacts of the Regulating Works Project on the resources, ecosystem and human environment to warrant the preparation of a Supplemental EIS (SEIS). The Grand Tower Phase 5 EA will incorporate any new information and circumstances relevant to the impacts of the action on the environment to the greatest extent possible. Should the analyses undertaken as part of the SEIS process reveal any new impacts on the resources, ecosystem and human environment not accounted for in this EA, measures will be taken within our authority to avoid, minimize, and/or compensate for the impacts during that process as appropriate. Information on the SEIS can be found in the Notice of Intent that was published in

the Federal Register on December 20, 2013. The Notice of Intent can be found at the following link:

<https://www.federalregister.gov/articles/2013/12/20/2013-30347/intent-to-prepare-a-draft-supplemental-environmental-impact-statement-for-the-middle-mississippi>

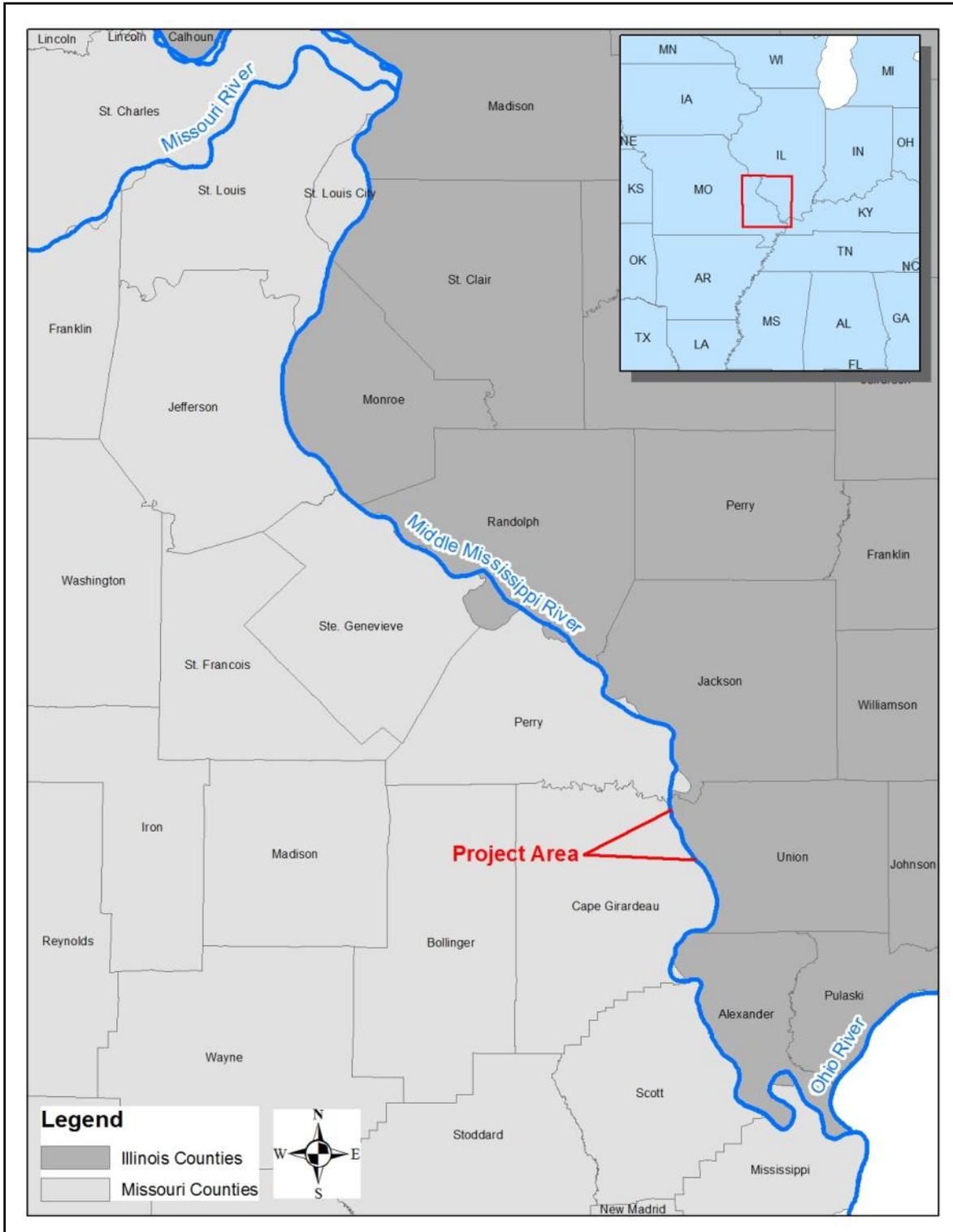


Figure 1. Project location within the Middle Mississippi River, Miles 74 to 67.

2. Alternatives Including the Proposed Action

This section describes the alternatives or potential actions that were considered as ways to address the issues with maintaining the depth, width, and alignment of the navigation channel at the Grand Tower Phase 5 Project site shown in Figure 2.

Alternative 1: No Action Alternative. The No Action Alternative consists of not constructing any new river training structures in the project area but continuing to maintain the existing river training structures. Dredging would continue as needed to address the shoaling issue in the project area to fulfill the project's navigation purpose.

Alternative 2: Proposed Action. The Proposed Action is located in the Crawford and Vancill Towhead reaches of the Mississippi River, RM 74 to 67 as shown in Figures 3 and 4. The Crawford Towhead portion includes the construction of two chevrons and the extension of one dike between RM 74 and 72. The Vancill Towhead portion is located between RM 70.0 and 67.0 and includes construction of 3 weirs, 3 diverter dikes (S-dikes), repair of dike 67.8, revetment at dike 67.3 and the shortening of dikes 67.3 and 67.1 Table 1 includes a description of the Proposed Action.

Table 1. Features associated with the Proposed Action.

Crawford Towhead		
Proposed Feature	Feature Description	Rationale
Construct Chevron 73.65L	Construct 300ft x 300ft chevron. Top elevation of the chevron will be 339.75 ft. (+18.5 LWRP).	Needed to constrict the navigation channel and promote habitat diversity.
Extend Dike 72.9L	Extend existing dike 300 feet. Top elevation of the chevron will be 339.5 ft. (+18.5 LWRP)	Needed to maintain contraction width in the navigation channel.
Construct Chevron 72.55L	Construct 300ft x 300ft chevron. Top elevation of the chevron will be 338.75 ft. (+18.5 LWRP)	Needed to constrict the navigation channel and promote habitat diversity.
Vancill Towhead		
Proposed Feature	Feature Description	Rationale
Construct Weir 69.15R	Construct Weir 800 feet long. Top elevation of the weir will be 304.1 ft. (-15 feet LWRP).	Needed to increase the energy at Vancill Towhead (between RM 68.0 and RM 67.0).
Construct Weir 68.95R	Construct Weir 800 feet long. Top elevation of the weir will be 304.0 ft. (-15 feet LWRP).	Needed to increase the energy at Vancill Towhead (between RM 68.0 and RM 67.0).
Construct Weir 68.75R	Construct Weir 800 feet long. Top elevation of the weir will be 303.9 ft. (-15 feet LWRP).	Needed to increase the energy at Vancill Towhead (between RM 68.0 and RM 67.0).
Construct Diverter Dike 68.10L (S-dike)	Construct Diverter Dike 750 feet long. Top elevation of the dike will be 336.5 ft.(+18 feet LWRP).	Needed to constrict main channel and improve aquatic habitat.
Construct Diverter Dike 67.80L (S-dike)	Construct Diverter Dike 750 feet long. Top elevation of the dike will be 336.3 ft. (+18 feet LWRP)	Needed to constrict main channel and improve aquatic habitat.
Construct Diverter Dike 67.50L (S-dike)	Construct Diverter Dike 750 feet long. Top elevation of the dike will be 336.25 ft. (+18 feet LWRP)	Needed to constrict main channel and improve aquatic habitat.
Repair Dike 67.80L	Repair Dike (350 feet). Top elevation of the dike will be 336.5 ft. (+18 feet LWRP).	Needed to maintain contraction width in the main channel.
Shorten Dike 67.30L	Shorten Dike 660 feet. Top elevation of the dike will be 336.25 ft. (+18 feet LWRP).	Needed to allow formation of a secondary side channel in concert with S-dikes.
Shorten Dike 67.10L	Shorten Dike 300 feet. Top elevation of the dike will be 336.15 ft. (+18 feet LWRP).	Needed to allow formation of a secondary side channel in concert with S-dikes.
Place Revetment 67.3L	Place 320 ft. of revetment where dike attaches to riverbank. (+18 feet LWRP)	To prevent erosion of the riverbank downstream of the dike.

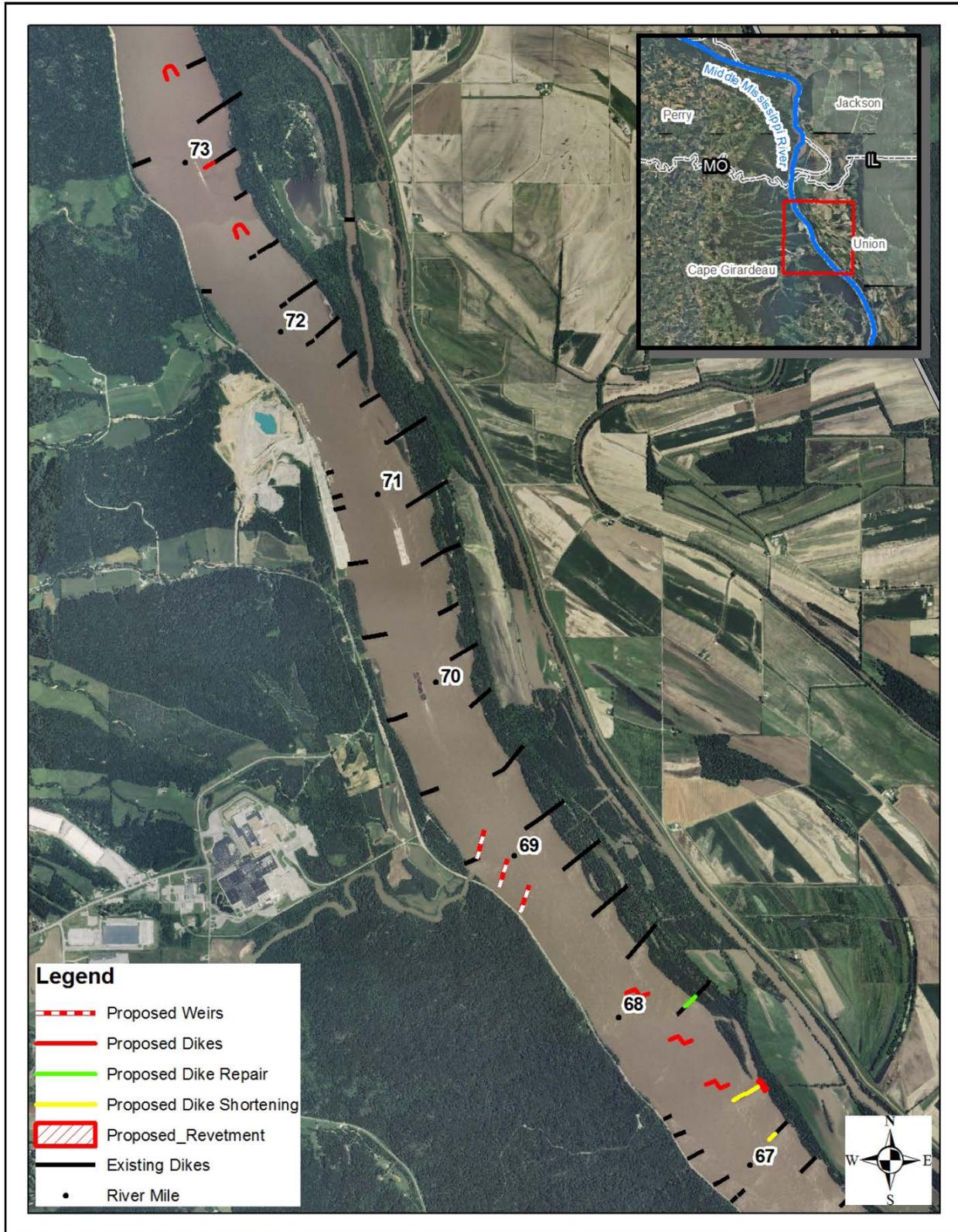


Figure 2. Features associated with the Proposed Action at Grand Tower Phase 5 Project area.

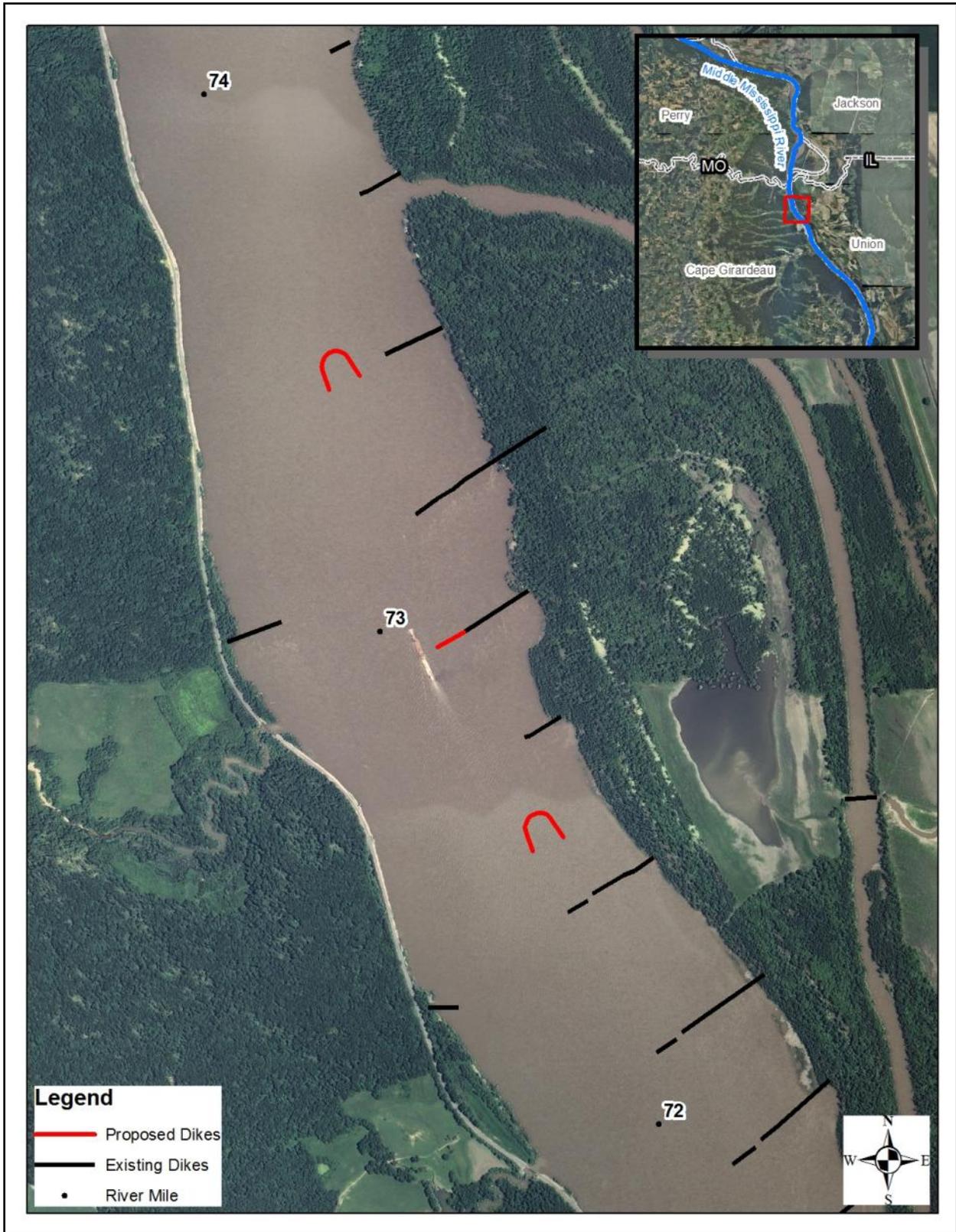


Figure 3. Features associated with the Proposed Action, Crawford Towhead.

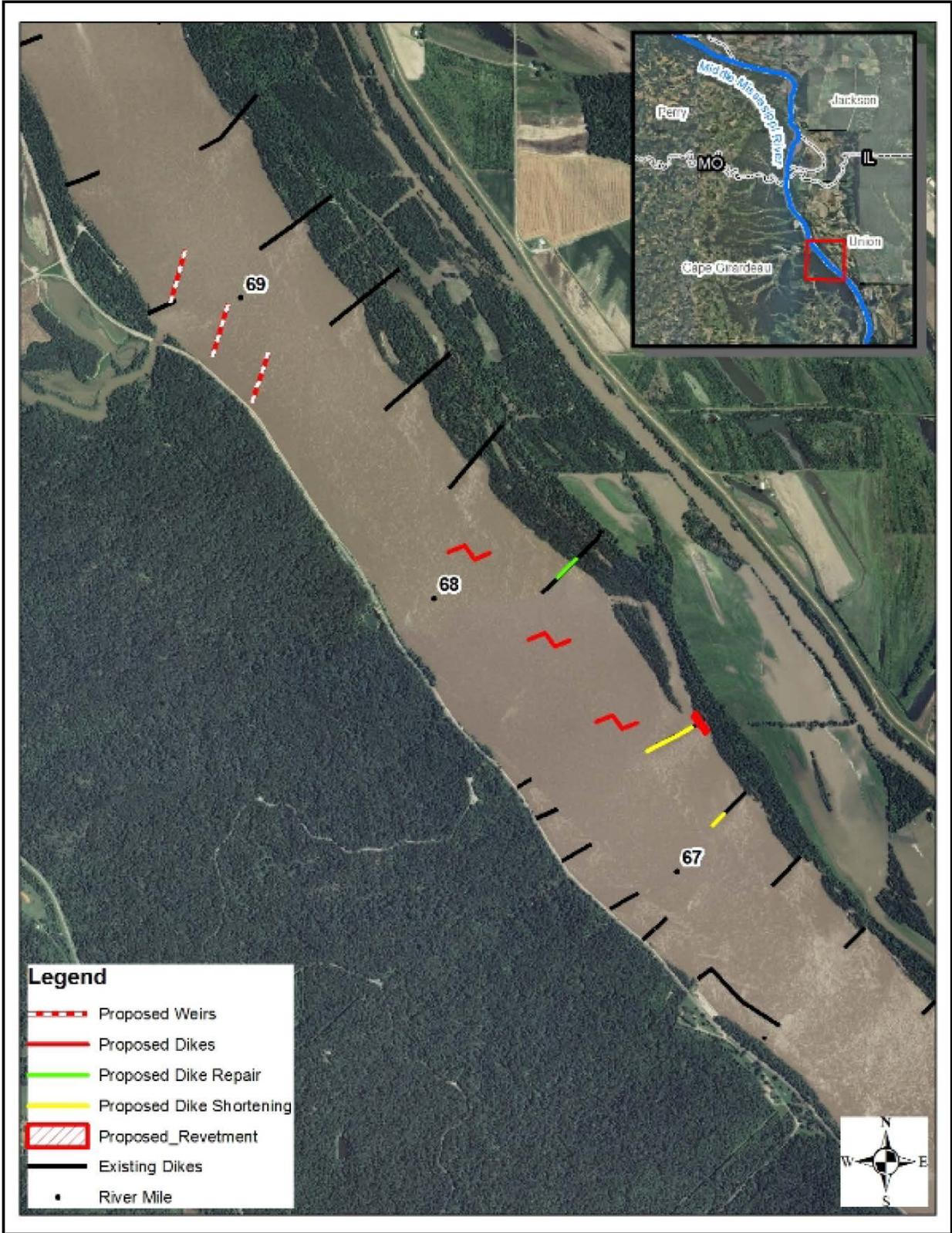


Figure 4. Features associated with the Proposed Action, Vancill Towhead.

Development of Alternatives. In order to develop potential alternatives to address the navigation channel problems in the Vancill Towhead area, the District utilized a Hydraulic Sediment Response model (HSR model). An HSR model is a small-scale physical sediment transport model used by the District to replicate the mechanics of river sediment transport. HSR models allow the District to develop multiple configurations of river training structures for addressing the specific objectives of the project in question in a cost-effective and efficient manner. To date, HSR models have been used in over 50 river engineering studies to solve complex sediment transport problems. Monitoring of the approximately 20 constructed projects, including detailed bathymetric analysis, has demonstrated the predictive capability of HSR models.

The process of alternatives development using an HSR model starts with the District calibrating the model to replicate project site conditions. Various configurations of river training structures are then applied to the model to determine their efficacy in addressing the needs of the project. For the Vancill Towhead area, 37 different configurations of river training structures and revetment were modeled to determine the best combinations for reducing the need for dredging, improving the navigation channel alignment and minimizing negative environmental impacts. Extensive coordination with navigation and natural resource agency partners was conducted during the modeling of alternatives to ensure that their concerns were incorporated into the project design. Ultimately all partner concerns were satisfactorily resolved and a consensus was reached on an acceptable Alternative. Alternative 33 (Alternative 2 described above) was determined to provide the best results for the project. Detailed information on the Alternatives development process, partner agency coordination, and alternatives eliminated from further consideration can be found in the on-line HSR model study report for Vancill Towhead:

http://mvs-wc.mvs.usace.army.mil/arec/Reports_HSR_Model.html

In accordance with the 2000 O&M Biological Opinion Reasonable and Prudent Measures with implementing Terms and Conditions, the requirement at Vancill Towhead was to improve aquatic habitat by increasing the flow and sediment transport through the Vancill Towhead side channel and along the left descending bank. However, the distance between the thalweg (main flow) and the side channel entrance and left bank made the task challenging. Therefore, the approach taken in the recommended alternative was to create a secondary side channel with river training structures known as diverter dikes or “S-dikes”. River engineers at the Applied River Engineering Center have found that S-dike structures not only redistribute flow and sediment, but have the ability to control the energy coming off of the right side or the left side of the structure. S-dike structures are useful for creating secondary side channels because they angle upstream to capture water from the main channel and direct it towards the area of interest, while providing enough roughness and constriction to maintain a navigable channel. There is minimal erosion along the riverbank because an eddy forms at the S-dike’s downstream tip. Figure 5 below shows a drawing of how the structure works. As flow and sediment hit the structure, depending on the orientation of the dike, a portion of the flow and sediment will be taken from the main source of flow towards a lower energy area on the opposite side of the dike (USACE 2012). Overall, Alternative 33 would maintain the navigation channel, reduce the frequency of dredging, and improve the quality and quantity of aquatic habitat at Vancill Towhead.

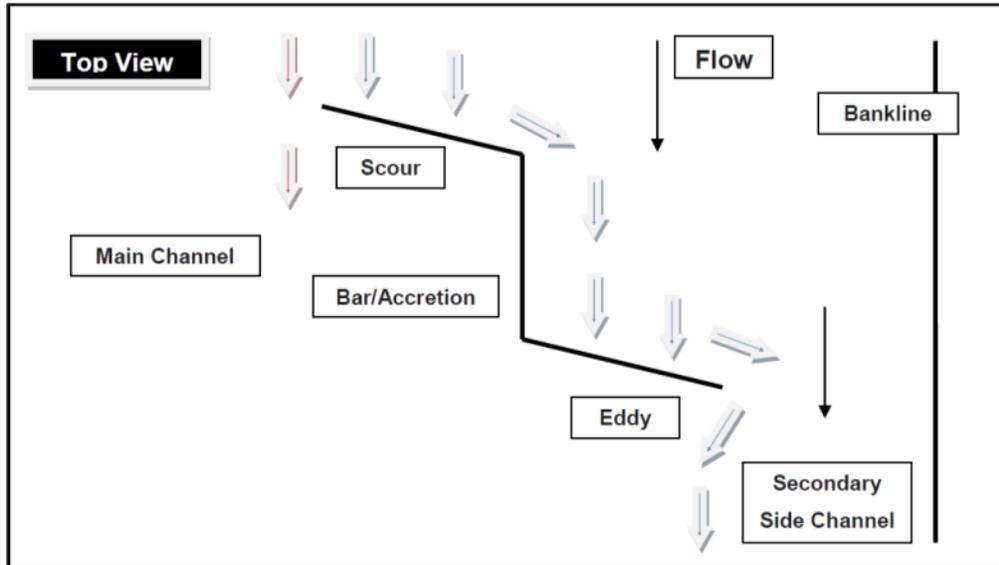


Figure 5 – S-Dike Flow Pattern

No HSR investigation was completed for Crawford Towhead since the bathymetry was uncomplicated. Hydraulic engineers developed the initial design alternatives, which were then discussed with the River Resources Action Team (RRAT) members during the 2009 RRAT trip and the May 2013 RRAT Executive meeting. The final design included two chevrons and a dike extension that met the project objectives while incorporating the environmental concerns of the RRAT. USACE has constructed numerous chevrons and weirs in the MMR, and a model would have been an unnecessary expense because engineering judgment was all that was necessary to predict the effects of the structures in this location. The proposed Crawford Towhead structures would result in a reduction in shoreline erosion, improved navigation conditions for commercial river traffic, and the improvement of aquatic habitat.

Summary of Environmental Consequences

The impacts of each Alternative on the resources, ecosystem and human environment are covered in detail in Section 4, Environmental Consequences. Table 2 below provides a summary and comparison of the impacts of each Alternative by resource category.

Table 2. Summary and Comparison of Impacts of the No Action Alternative and the Proposed Action.

Comparison Criteria	No Action Alternative	Proposed Action
Achievement of project objectives	Does not reduce the need for repetitive maintenance dredging in the Project Area, and, therefore, does not meet the project objectives.	Is expected to reduce the amount of repetitive maintenance dredging in the Project Area, thereby meeting project objectives.
Impacts on River Stages	No impacts anticipated.	No impacts anticipated at average and high flows. At low flows, current trend of decreasing stages expected to continue.
Impacts on Water Quality	Localized, temporary increase in suspended sediment concentrations at discharge sites.	Localized, temporary increase in suspended sediment concentrations during construction activities.
Impacts on Air Quality	Minor, local, ongoing impacts due to use of dredging equipment.	Temporary, minor, local impacts to air quality due to one-time use of construction equipment.
Impacts on Fish and Wildlife	Entrainment of fish and macroinvertebrates at dredge locations. Avoidance of dredge and disposal areas by mobile organisms. Loss of fish and macroinvertebrates at disposal sites.	Avoidance of sites during construction. No conversion of aquatic habitat to terrestrial. Increased fish and macroinvertebrate use of structure locations due to increased bathymetric, flow, and substrate diversity. Uncertain impacts on fish and macroinvertebrates at inside bend opposite of proposed bendway weir locations.
Impacts on Threatened and Endangered Species	Impacts are consistent with those addressed in the USFWS 2000 Programmatic Biological Opinion .	Impacts are consistent with those addressed in the USFWS 2000 Programmatic Biological Opinion.
Impacts on Navigation	Continued requirement for periodic maintenance dredging at rates similar to recent history.	Reduction in the amount and frequency of periodic maintenance dredging in the project area.
Impacts on Historic and Cultural Resources	Impacts to historic and cultural resources unlikely.	Impacts to historic and cultural resources unlikely.

3. Affected Environment

This section presents details on the historic and existing conditions of resources within the project area that would potentially be affected by project-related activities. The section is broken into four resource categories: physical resources, biological resources, socioeconomic resources, and historic and cultural resources. This section does not address impacts of the Alternatives, but provides a background against which Alternatives can be compared in Section 4, Environmental Consequences.

Physical Resources

River Stages - Rated gages, locations where both discharge and stage is collected and combined to create a rating curve, are good sources of long term stage and discharge data. Only three rated gages exist on the MMR: St. Louis, Chester and Thebes. Due to backwater effects from the Ohio River the gage at Thebes is not a good indicator of changes in stage over time. Throughout the period of record the two agencies that have been responsible for the collection of gage data on the MMR are USACE and U.S. Geological Survey (USGS). The USGS has been the primary agency responsible for stream gaging since 1933. Due to discrepancies in methodology and instrumentation used by USACE and USGS it is impossible to analyze the entire period of record with confidence; therefore only data collected by the USGS will be used here to describe the changes in stage for fixed discharges over time (Watson et al. 2013a; Watson et al. 2013b; Huizinga 2009; Munger et al. 1976).

Stages have been decreasing over time for flows below 200,000 cfs at the St. Louis gage (see Figure 6 below). For other in-bank flows between 200,000 cfs and 500,000 cfs there has been no change over time. There is a slight upward but statistically insignificant trend for stages at the overbank flow of 700,000 cfs. Stages at Chester for lower in-bank flows up to 200,000 cfs have decreased with time. There was no change in stages at flows of 200,000 cfs and 400,000 cfs. There was a slightly increasing trend at 300,000 cfs. For overbank flows of 500,000 cfs and 700,000 cfs, there were slight increasing trends observed at the Chester gage.

In general, at both the St. Louis and Chester gages there has been a decrease in stage over time for lower flows, no change in stages over time for flows between midbank and bankfull, and a slight increase in stages for high overbank flows (Huizinga 2009). Huizinga (2009) and Watson et al. (2013a) attributed the slight increase in out of bank flows to the construction of levees and the disconnection of the river from the floodplains. Both Watson et al. (2013a) and Huizinga (2009) observed a shift occurring in the out of bank flows in the mid-1960s and attributed it to the completion of the Alton to Gale levee system which paralleled the entire Middle Mississippi River. At these high flows navigation structures are submerged by 7 to 10 feet.

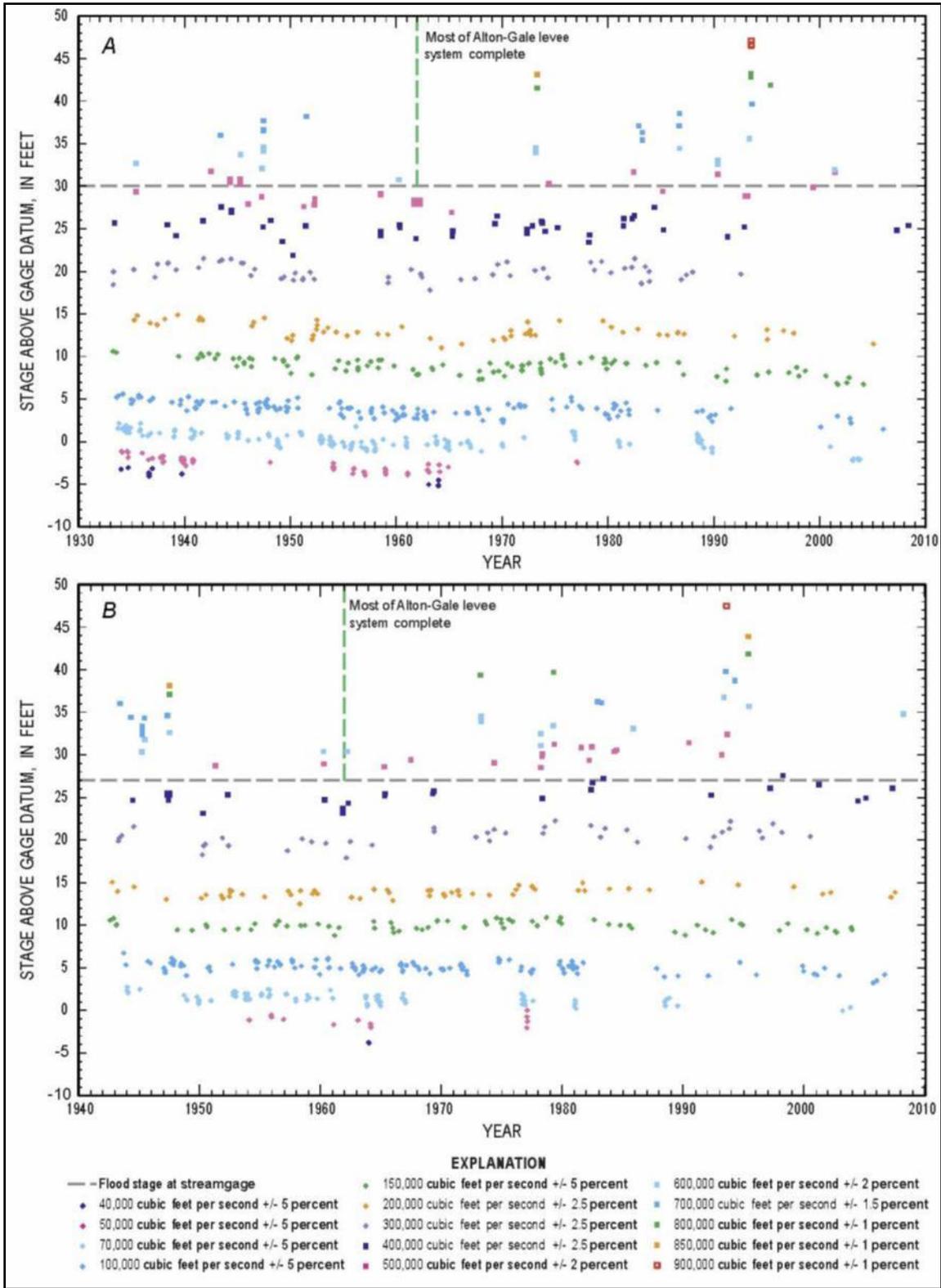


Figure 6. Stage for a given discharge range with time from measurements made at the streamgages at (A) St. Louis, Missouri, and (B) Chester, Illinois, on the Middle Mississippi River (from Huizinga 2009).

Water Quality – Consideration of water quality encompasses a wide range of physical, hydrologic, and biological parameters. Watershed influences, including tributary streams, point and non-point pollution sources, flow alteration due to navigation structures, and drought and flood events all influence water quality. Variations in land use practices, cover types, and watershed area will determine the level and type of sediment, nutrient, and contaminant inputs into the Mississippi River and its tributaries. The Mississippi River has a long history of water quality impairment due to contamination from industrial, residential, municipal, and agricultural sources. Recent changes in wastewater treatment laws and technologies, regulation of point source discharges, and changes in public awareness have contributed to overall improvements in water quality.

Section 303(d) of the Clean Water Act requires states to generate lists of impaired water bodies every two years. Impaired water bodies are those that do not meet state water quality standards for the water bodies' designated uses. On the 2012 303(d) list for Illinois, the Mississippi River in the vicinity of the project area was listed as impaired for fish consumption due to mercury and PCB contamination, impaired for public and food processing water supplies due to manganese concentration, and impaired for primary contact recreation due to fecal coliform bacteria contamination. The Mississippi River is not on the 2012 303(d) list for Missouri.

Illinois has fish consumption advisories for the Mississippi River for channel catfish (one meal per week), common carp (one meal per week), and sturgeon (one meal per month) due to PCB contamination. Missouri has fish consumption advisories for the Mississippi River for shovelnose sturgeon (1 per month) due to PCB and chlordane contamination, and for flathead catfish, blue catfish, channel catfish, and common carp (1 per week) due to PCB, chlordane, and mercury contamination.

Air Quality – The Clean Air Act requires the Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards for six criteria air pollutants: ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. EPA regulates these pollutants by developing human health-based or environmentally-based permissible pollutant concentrations. EPA then publishes the results of air quality monitoring, designating areas as meeting (attainment) or not meeting (nonattainment) the standards. Cape Girardeau County, Missouri and Union County, Illinois are designated as attainment areas for all six criteria air pollutants (USEPA 2013).

Biological Resources

Fish and Wildlife – The changes in fish and wildlife habitat in the Mississippi River Basin that have occurred over the past 200 years are well documented. Many studies have analyzed the historic changes in habitat in the Mississippi River Basin from pre-colonization times to present day (e.g., Simons et al. 1974; UMRBC 1982; Theiling et al. 2000; WEST 2000; and Heitmeyer 2008). A variety of actions have impacted the makeup of the Mississippi River basin since colonization including urbanization, agriculture, levee construction, dam construction, and river training structure placement. Many of the changes in the Middle Mississippi River planform are attributable to improvements made for navigation including river training structure placement and associated sedimentation patterns.

An analysis of changes in river planform in the MMR was recently conducted by the District (Brauer et al. 2005; Brauer et al. 2013). The analysis utilized historic and modern maps, surveys, and aerial photography to calculate changes through time in planform width, channel width, channel surface area, side channel width, etc. The analysis demonstrates that the MMR went through a period of planform widening in the mid-nineteenth century followed by a period of planform narrowing from the end of the nineteenth century through the mid-twentieth century. The period of narrowing corresponded to the widespread use of river training structures and bank protection for navigation improvements. The first training structures were mainly permeable wooden structures which focused the river's energy into the main channel by reducing the velocities between the structures, causing sediment to deposit in channel border areas. This sediment deposition caused a significant narrowing effect on the channel. Since 1968, however, the channel width appears to have reached dynamic equilibrium with very little change (see Figure 7 below). In the 1960s, USACE began constructing impermeable dikes primarily out of stone. The use of impermeable dikes reduced the rate of deposition between the structures when compared to the previously used permeable structures. Another change was the reduction of the design elevation of dike fields. Unlike in the past, the area between the structures did not fill with sediment, grow vegetation and become part of the floodplain. In the 43 years between 1968 and 2011 the average planform width remained relatively steady with a net reduction in average planform width of 167 feet. This was the result of the changes in structure material and elevation.

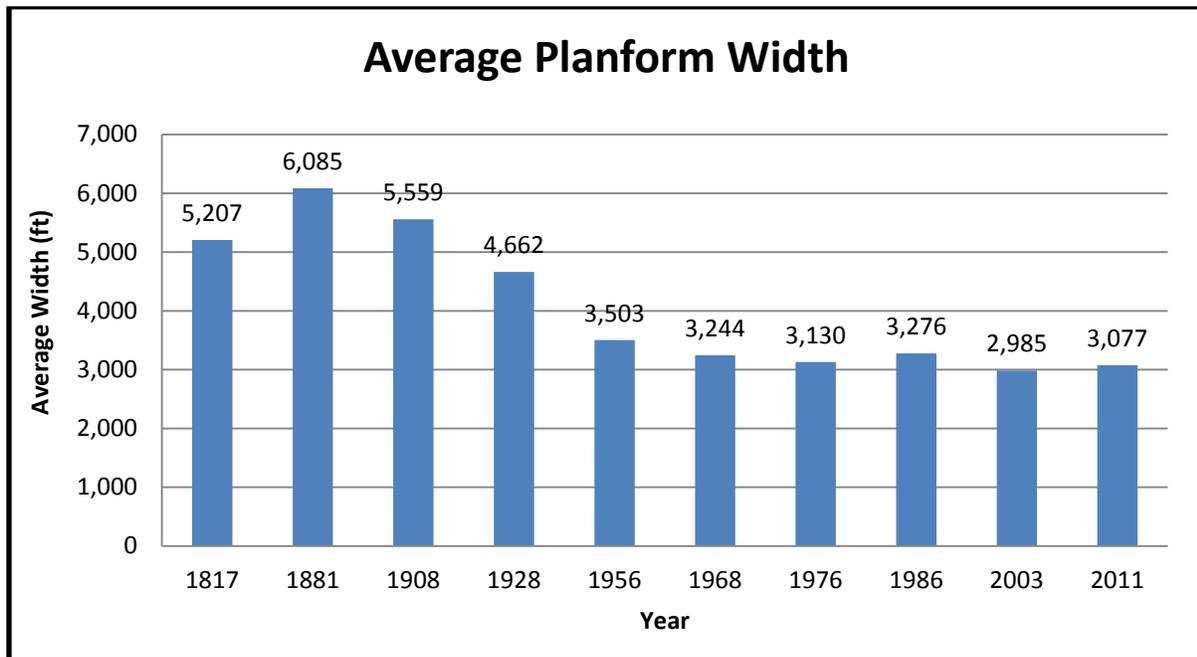


Figure 7. Average planform width of the MMR from 1817 to 2011.

In response to natural resource agency partner concerns about the potential impacts of traditional dikes on fish and wildlife habitat, the St. Louis District began to experiment with innovative dike configurations that attempt to achieve the navigational objectives of a safe and dependable navigation channel in an environmentally sensitive manner. The District has designed and

implemented many different dike configurations including notched dikes, rootless dikes, L-dikes, W-dikes, chevron dikes, multiple roundpoint structures, etc. The intent of the innovative dike designs is to provide bathymetric and flow diversity compared with the traditional structures constructed since the 1960s while maintaining the function of deepening the navigation channel. The District currently builds very few traditional wing dike structures in the MMR.

The fish community in the project area is expected to be typical of the Middle Mississippi River fish community in general. Fish community monitoring (Stone Dike Alterations Project Study) was conducted in the Trail of Tear reach vicinity, RM 68.5 – RM 64.5, from July 2005 to June 2008 (Caswell 2008). Of the 59 species of fish collected in the main channel border areas and wing dikes, the most commonly encountered native species included gizzard shad (*Dorosoma cepedianum*), channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), flathead catfish (*Pylodictis olivaris*), freshwater drum (*Aplodinotus grunniens*), emerald shiner (*Notropis atherinoides*), red shiner (*Cyprinella lutrensis*), river shiner (*N. blennioides*), smallmouth buffalo (*Ictiobus bubalus*), black buffalo (*I. niger*), channel shiner (*N. wickliffi*), shortnose gar (*Lepisosteus platostomus*), bluegill (*Lepomis macrochirus*), shoal chub (*Macrhybopsis hyostoma*), and river carpsucker (*Carpionodes carpio*). These species accounted for approximately 85% of the fish captured, by number. Emerald shiner accounted for 25 percent of the fish captured, by number. Also included in the collection were 4 species of non-native fish including common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), and bighead carp (*Hypophthalmichthys nobilis*). These species accounted for approximately 9% of the fish captured, by number, with the vast majority being common carp. Silver carp were likely under-represented in the collection due to the sampling methodologies employed. The area sees some commercial and recreational fishing pressure. Commercial fishermen typically target common carp, bigmouth and smallmouth buffalo, catfish, freshwater drum, and recently silver carp. Recreational fishermen typically target catfish.

Macroinvertebrates are an important part of the river ecosystem as they serve as a food source for a variety of fish and wildlife species. Common macroinvertebrate fauna encountered in the MMR consist of a variety of oligochaete worms, flies, mayflies, caddisflies, and stoneflies. Sampling by Battle et al. (2007) near Cape Girardeau, Missouri showed densities of macroinvertebrates in fine substrates downstream from wing dikes ranging from approximately 3,700 to 11,700 individuals per square meter. Sixty-eight taxa were collected from fine sediments with the dominant groups being oligochaete worms, midges, and mayflies. Densities on rocks on the upstream side of wing dikes ranged from 57,800 to 163,000 individuals per square meter. Fifty taxa were collected from rock substrate with the dominant group being caddisflies.

Macroinvertebrates were also collected from rock surfaces in bendway weir fields in the MMR at RM 164 near Oakville, Missouri (Ecological Specialists 1997a) and at RM 30 near Commerce, Missouri (Ecological Specialists 1997b). Twenty-nine taxa were collected at RM 164 with caddisflies being the overwhelmingly dominant group; midges were also abundant. Density averaged 14,662 individuals per square meter. Thirty-four taxa were collected at RM 30 with caddisflies again the overwhelmingly dominant group; midges were present but not as abundant as at RM 164. Density averaged 16,240 individuals per square meter. Sampling conducted in

sand substrate at a nearby bendway without weirs (RM 20) yielded 7 taxa and 965 individuals per square meter with oligochaete worms being the overwhelmingly dominant group.

Threatened and Endangered Species - According to U.S. Fish and Wildlife Service database queries on October 21, 2013, four federally threatened or endangered species could potentially be found in the project area (Cape Girardeau County, Missouri and Union County, IL). The four species, federal protection status, and habitat can be found in Table 3. No critical habitat is located in the project area.

Species	Federal Status	Habitat
Indiana bat (<i>Myotis sodalis</i>)	Endangered	Hibernacula: Caves and mines; Maternity and foraging habitat: small stream corridors with well developed riparian woods; upland and bottomland forests
Least tern (interior population) (<i>Sterna antillarum</i>)	Endangered	Large rivers - nest on bare alluvial and dredge spoil islands
Pallid sturgeon (<i>Scaphirhynchus albus</i>)	Endangered	Mississippi and Missouri Rivers
Decurrent false aster (<i>Boltonia decurrens</i>)	Threatened	Disturbed alluvial soils. (Cape Girardeau Co. only)

Socioeconomic Resources

Navigation

The MMR is a critically important navigation corridor that provides for movement of a wide variety of commodities of local, national, and international importance. Approximately 106 million tons of cargo passed through the MMR in 2011, the most recent year with data available (USACE 2013). Food and farm products (37 million tons), coal (26 million tons), crude materials (14 million tons), fertilizers (12 million tons), and petroleum products (10 million tons) accounted for the majority (93%) of shipments in 2011.

Repetitive channel maintenance dredging occurs regularly in the project area between RM 74 and 67 (see Figures 8, 9 and 10). This area has required dredging 18 times since 2000 at an average cost of \$368,000 per dredging event.

Historic and Cultural Resources

The Grand Tower Reach of the Mississippi River has narrowed considerably in the past one hundred and fifty years. The location of the Missouri bank, being a bluff line, has remained largely unchanged. The Illinois floodplain, however, has accreted westward largely due to the growth and incorporation of various towheads. The locations of all the proposed structures were in the Mississippi River 1881. In the late nineteenth century, however, Vancill towhead formed, and in 1904 USACE constructed a hurdle (closure structure) across its eastern chute to connect it

to the Illinois floodplain. Consequently, by 1909 the effective river bankline had shifted to approximately today's location. Any cultural resources that might be adversely affected by the placement of revetment must post-date the development of Vancill towhead.

During the summer of 1988 when the Mississippi River was at one of its lowest levels on record, the St. Louis District Corps of Engineers conducted an aerial survey of exposed wrecks between Saverton, Missouri, and the mouth of the Ohio River. The nearest wrecks to the project area were sighted about five and a half miles away, both upstream and downstream. During the 2012 low water event, a wreck was reported within the project area, but on the right bank, opposite the proposed structures and behind an existing dike (67.2R).

As part of a 2003 USACE study, archival research documented over seven hundred wrecks in the Middle Mississippi and two vessels are recorded as having been wrecked at Vancill landing. The first is the Sultana recorded as either abandoned between 1844 and 1852 according to one source, or wrecked on June 12, 1851 according to another. The second wreck is the Walk in the Water recorded as abandoned between 1846 and 1855. A local resident, however, reported that his father told him it was the Paw-Paw, which broke up in the winter ice of 1865 (Southeast Missourian, 7 January 2011).

The story of the Paw-Paw is not entirely clear. County Court records indicate that the boat bought by Willis Vancil (sic) et al. for use as a transport was the "Steam ferry boat Jennie 'D' lying at Cape Girardeau, Mo., and was used for ferrying from Cape Girardeau to points opposite at the Illinois Shore..." (Southeast Missourian, 7 September 1999). In 1868, however, Vancils (sic) did pay \$1,200 for, "the wreck and Machinery of the Steamer Paw Paw, now lying at Cape Girardeau Mo." It is possible that they bought the equipment to renovate and repair the Jennie 'D.' According to "Way's Packet Directory" the Paw Paw was a center-wheel steamboat built in St. Louis in 1862 and sold to Samuel Vencil (sic) at Mound City, Illinois, on August 17th, 1865 and dismantled soon thereafter. Regardless of its identify, the wreck will not be affected by the Grand Tower Phase 5 project.

High-resolution multi-beam surveys were conducted of the project area river bed on June 4, 2012, June 21, 2012 or October 23, 2013 (depending on the river section). No topographic anomalies suggesting wrecks are visible on the resulting bathymetric map.

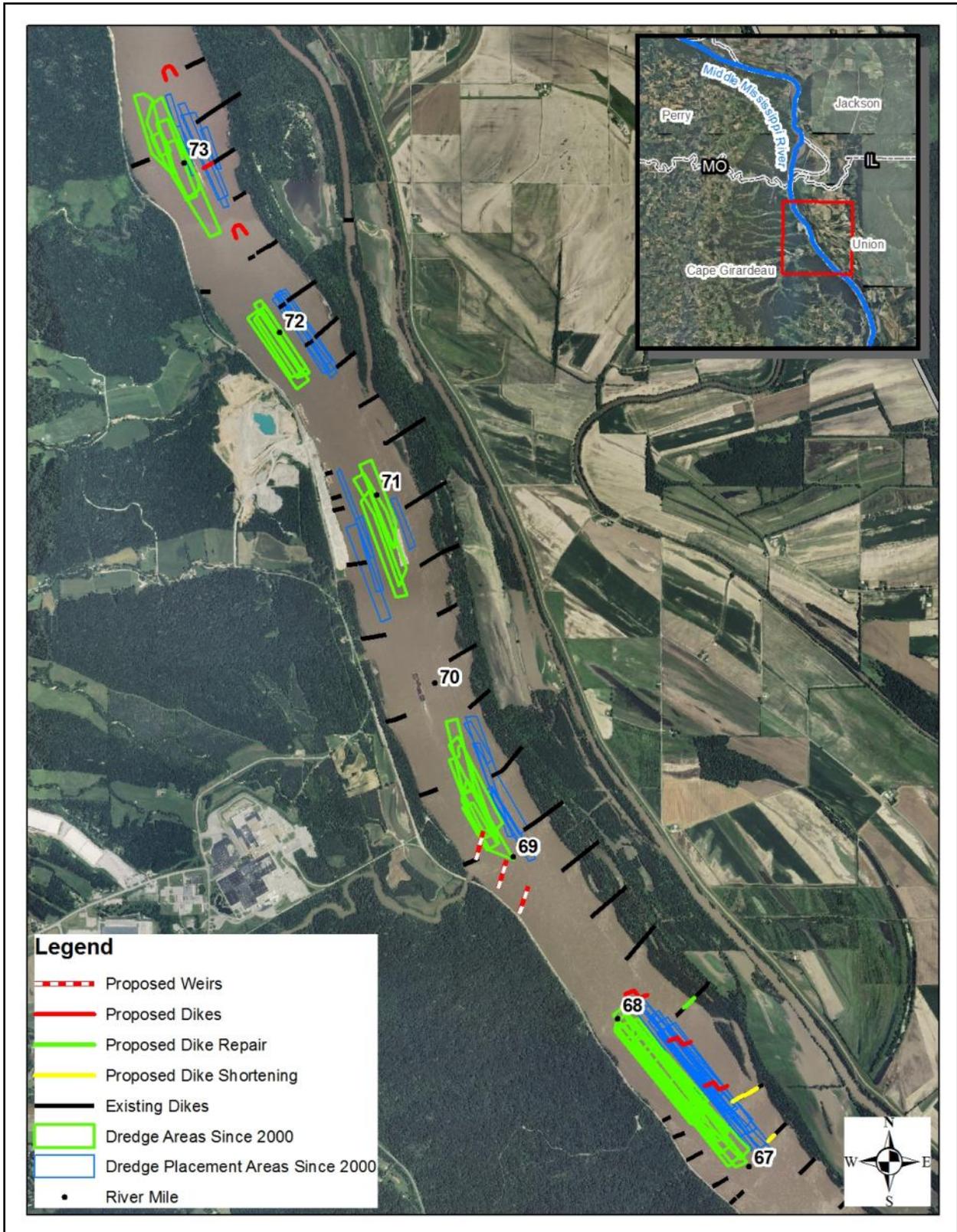


Figure 8. Repetitive dredging areas in the vicinity of the Grand Tower Project since 2000.

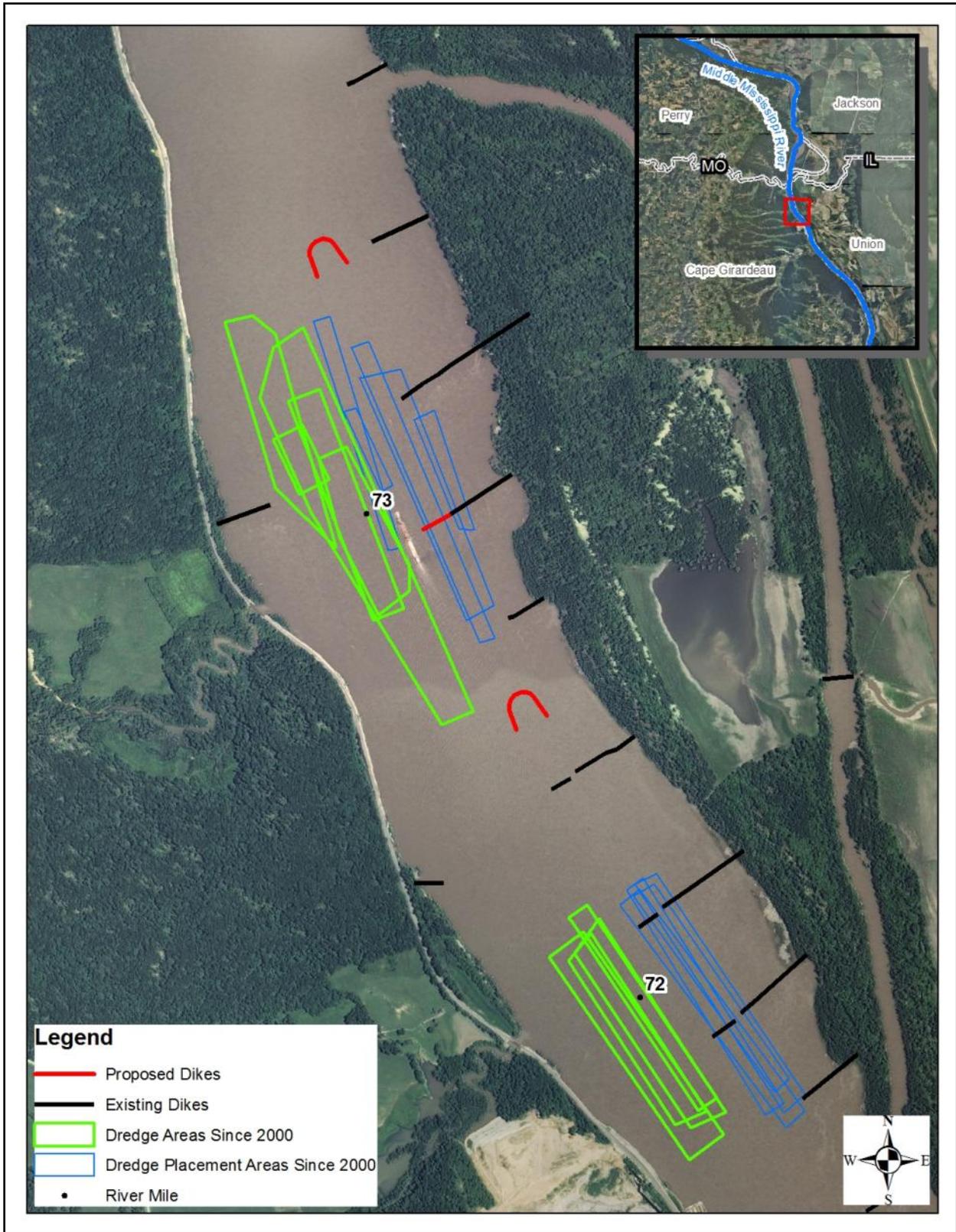


Figure 9. Repetitive dredging areas in the vicinity of Crawford Towhead since 2000.

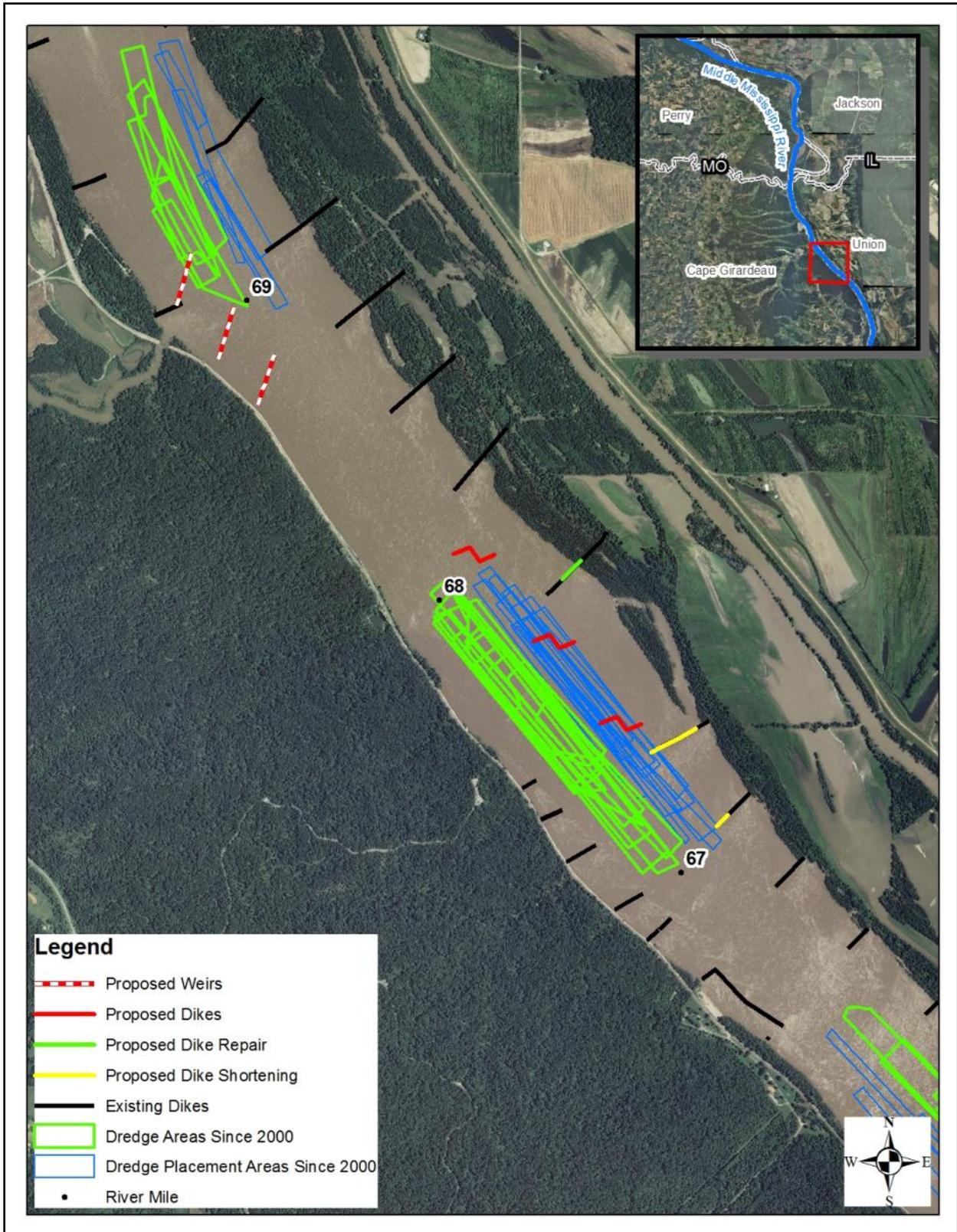


Figure 10. Repetitive dredging areas in the vicinity of Vancill Towhead since 2000.

4. Environmental Consequences

The Environmental Consequences Section of this report details the impacts of the Alternatives on the resources, ecosystem and human environment. The section is organized by resource, in the same order in which they were covered in Section 3, Affected Environment. Within each resource category, impacts will be broken out by Alternative. The No Action Alternative consists of not constructing any new river training structures in the project area but continuing to maintain the existing river training structures. Dredging would continue at levels similar to recent history as needed to address the shoaling issue in the project area. The Proposed Action consists of the Grand Tower Phase 5 Regulating Works Project which includes the Crawford and Vancill Towhead areas. The Crawford Towhead project area includes the construction of two chevrons and the extension of one dike between RM 74 and 72. The Vancill Towhead Project area is located between RM 70.0 and 67.0 and includes construction of 3 weirs, 3 diverter dikes (S-dikes), repair of dike 67.8, revetment at dike 67.3 and shortening of dikes 67.3 and 67.1 (USACE 2012).

Physical Resources

River Stages

Impacts of the No Action Alternative on Stages – Stages in the vicinity of the project area and the Middle Mississippi River would be expected to be similar to current conditions under the No Action Alternative.

Impacts of the Proposed Action on Stages – With implementation of the Proposed Action, stages at average and high flows both in the vicinity of the project area and on the Middle Mississippi River are expected to be similar to current conditions. An abundance of research has been conducted analyzing the impacts of river training structures on water surfaces dating to the 1940s. This research has analyzed historic gage data, velocity data, and cross sectional data. Physical and numerical models have also been used to determine the effects of dikes on water surfaces. It should be noted that some published research supports the contention that river training structures raise flood heights. A summary of research on the effects of river training structures on flood heights can be found in Appendix A. Based on an analysis of this research by USACE and other external reviewers, the District has concluded that river training structures do not affect water surface elevations at higher flows.

With respect to water surface elevations at low flows, analysis of the data shows a trend of decreasing stages over time. This decrease could be a result of river training structure placement and/or a decrease in the sediment load in the river due to construction of reservoirs on Mississippi River tributaries (Huizinga 2009). The same conclusion regarding decreasing stages at low flows was reached in the 1976 Regulating Works EIS (USACE 1976). The 1976 EIS concluded that, as a result of stage decreases, many of the remaining side channels in the MMR might be lost at some point in the future due to sedimentation. While much research has been performed on the impacts of river training structures at high flows, similar research has not been performed on the impacts at low flows. However, since the 1976 EIS, there has been an increasing recognition of the importance of side channel habitat on the MMR and increased emphasis on side channel restoration. Through the District's Biological Opinion Program (http://mvs-wc.mvs.usace.army.mil/arec/Bio_Op.html), Avoid and Minimize Program (<http://mvs-wc.mvs.usace.army.mil/arec/AM.html>), innovative river training structure design,

and other restoration initiatives, side channel restoration and preservation on the MMR has occurred and will continue to occur for the foreseeable future, resulting in a substantial preservation of the side channels that existed in 1976. While the Proposed Action may have some effect on water surface elevations at lower flows resulting in some impact to side channels, these impacts are being minimized through other USACE programs, which have currently seen success in restoring and preserving side channels affected by river training structures.

Water Quality

Impacts of the No Action Alternative on Water Quality – Periodic dredging activities would continue to cause re-suspension of river sediments at the point of discharge, causing turbidity, increased suspended sediment concentration, and decreased light penetration. The impact would be localized and would dissipate quickly. Dredged sediments in the area are typically sand with little associated fines and would, therefore, not be expected to release contaminants into the water column at concentrations that alone or in combination with other contaminants would cause toxic effects to aquatic organisms.

Impacts of the Proposed Action on Water Quality – Construction activities would cause temporary increases in turbidity and suspended sediment concentrations in the immediate vicinity of the structure locations. The impact would be localized and would dissipate quickly. Sediments in the area are typically sand with little associated fines and would, therefore, not be expected to release contaminants into the water column at concentrations that alone or in combination with other contaminants would cause toxic effects to aquatic organisms.

The proposed structures are designed to change the sedimentation patterns in the project area, and would result in some minor temporary changes in the suspended sediment concentration in the immediate area. Limestone material used for construction could potentially affect local water chemistry (e.g., alkalinity, hardness, and pH). However, given the prevalence of limestone in the watershed geology and the quick dissipation of any associated fine materials in the water column, the impact is likely to be negligible.

The District is currently in the process of obtaining authorization for the project under sections 404 and 401 of the Clean Water Act. All permits necessary for completion of the project will be obtained prior to project implementation.

Air Quality

Impacts of the No Action Alternative on Air Quality – Air quality in the vicinity of the project area would be expected to be similar to current conditions. Equipment used for repetitive dredging activities would generate emissions on an occasional, ongoing basis from the use of petroleum products. Impacts would be minor and local in nature.

Impacts of the Proposed Action on Air Quality – Air quality in the vicinity of the project area would be expected to be similar to current conditions. Equipment used for construction activities would generate emissions from the use of petroleum products, but impacts would be temporary, minor, and local in nature.

Biological Resources

Fish and Wildlife

Impacts of the No Action Alternative on Fish and Wildlife – Periodic maintenance dredging and dredged material disposal operations would have the potential to affect fish and wildlife resources through direct removal of individual organisms (entrainment) at the dredge cut site. The degree to which fish and wildlife resources are impacted is largely a factor of the density of the organisms in the area of the dredge cut at the time of dredging operations. Macroinvertebrate densities tend to increase with greater sediment stability, lower water velocities, and higher silt and organic matter concentrations (Galat et al. 2005). Given the shifting nature of the sediments, high water velocities, and low silt concentrations in the main channel of the MMR, the area is not ideal habitat for colonization by bottom-dwelling macroinvertebrates (Koel and Stevenson 2002; Sauer 2004), but likely provides habitat for low densities to exist. Various fish species likely utilize the habitat as well and could be impacted at dredge sites. USACE's Engineer Research and Development Center published a Technical Note in 1998 that summarized existing literature regarding potential impacts to aquatic organisms from dredging operations (Reine and Clarke 1998). Fish entrainment rates varied widely among species and studies and were reported as ranging from <0.001 to 0.594 fish/cubic yard of material dredged.

The St. Louis District recently contracted a dredge monitoring study for the Chain of Rocks East Canal Levee Project (Blodgett 2010). The project involved the use of sand dredged from the main channel of the MMR for construction of a seepage berm on the Chain of Rocks Canal Levee. Because there was concern that dredging operations could entrain endangered pallid sturgeon in the project area, monitoring of dredged material was conducted to quantify impacts of dredging operations on the fish community. A total of approximately 800,000 cubic meters of material was dredged during the project, and fish entrainment monitoring was conducted during approximately 15% of the operation. No pallid sturgeon were captured during the study. Nine shovelnose sturgeon and 38 other fish representing 6 species were captured during the study.

Aside from direct impacts from dredge entrainment, fish and wildlife could also be impacted directly by disposal of dredged material. Organisms in the vicinity of the disposal area could be affected by changes in water quality including increased suspended solids and could be covered by settling sediments. Increased suspended solids in the water column could cause abrasion of body and respiratory surfaces. Most mobile organisms in the vicinity of the disposal location, however, would likely avoid the area during dredging operations. Changes in water quality would be short-lived and localized in extent.

Recovery of fish and wildlife resources at the dredge and disposal location occurs over a period of weeks, months, or years, depending on the species in question (USACE 1983). Areas with unstable sediment such as those in the main channel of the MMR are much more likely to have associated fish and wildlife species more adapted to physically stressful conditions and, therefore, would be more likely to withstand stresses imposed by dredging and disposal and recover more quickly (USACE 1983).

In summary, the amount of dredging going forward would remain similar to what has been experienced recently. Dredging impacts would include potential entrainment of aquatic species as well as behavioral changes associated with noise and turbidity levels. Some mortality of

individual fish and invertebrates would be anticipated. Overall impacts to the fish and invertebrate communities in the project area would be expected to be localized, minor, and short-term in nature.

Impacts of the Proposed Action on Fish and Wildlife

Dike Effects – The hydrodynamics around river training structures are complex and vary greatly depending upon the type of training structure in question and where it is located within the river channel. A traditional wing dike constructed perpendicular to flow and tied in to the river bank would be expected to deepen the adjacent navigation channel, cause a scour hole to develop at the dike tip, and cause sediment accretion downstream from the structure near the river bank. Shields (1995) studied 26 groups of traditional dikes in the Lower Mississippi River and determined that the aquatic volume and area of associated low-velocity habitat (important aquatic habitat) were reduced by 38% and 17%, respectively. Most of the changes occurred shortly after construction, and after initial adjustment, habitat area and volume fluctuated about a condition of dynamic equilibrium. As detailed in Section 3 above, dike construction on the MMR has, historically, caused a narrowing of the river planform over time due to this sediment accretion process followed by growth of terrestrial vegetation. However, the analysis of changes in river planform in the MMR recently conducted by the District (Brauer et al. 2005; Brauer et al. 2013) demonstrates that channel widths in the MMR appear to have reached a state of dynamic equilibrium where very little conversion to terrestrial habitat is occurring subsequent to river training structure placement. In addition, innovative structures such as the proposed diverter dikes are intended to provide bathymetric diversity, flow refuge, and split flow conditions that differ from traditional wing dikes. Based on the Vancill Towhead HSR model study and District experience with similar river training structures, the S-dikes are expected to create a secondary channel to improve aquatic habitat. River engineers at the Applied River Engineering Center have found that S-dike structures not only redistribute flow and sediment, but have the ability to control the energy coming off of the right side or the left side of the structure. S-dike structures are useful for creating secondary side channels because they angle upstream to capture water from the main channel and direct it towards the area of interest, while providing enough roughness and constriction to maintain a navigable channel. The S-dike causes minimal erosion along the bankline because an eddy is formed at its tip (USACE 2012).

After construction, the following changes may occur in the Vancill reach. The three bendway weirs would reduce scouring along the outside bend between RM 69.20 to RM 68.60. The thalweg would be located along the RDB instead of crossing over towards the LDB between RM 68.50 to RM 67.50. Due to the S-dike structures, the constriction of the channel would result in less deposition from RM 68.00 to RM 67.00. The navigation channel may deepen (from -7 feet to -12 feet LWRP) and widen (from 0 feet to 1200 feet). More flow would occur along the LDB. Flow and sediment transport would occur behind the S-Dike structures. The secondary side channel would extend further downstream to RM 66.75 creating more shallow water habitats. The channel would also deepen (from -15 feet to -25 feet LWRP) between RM 67.00 and RM 66.30 along the RDB (near the boat ramp location). Higher velocities would occur along the RDB where most of the flow is concentrated. Slower velocities would occur around the S-dike structures and downstream from them (USACE 2012). This scenario would indicate that while the bar at RM 67.5 would be reduced, these structures would create more aquatic habitat

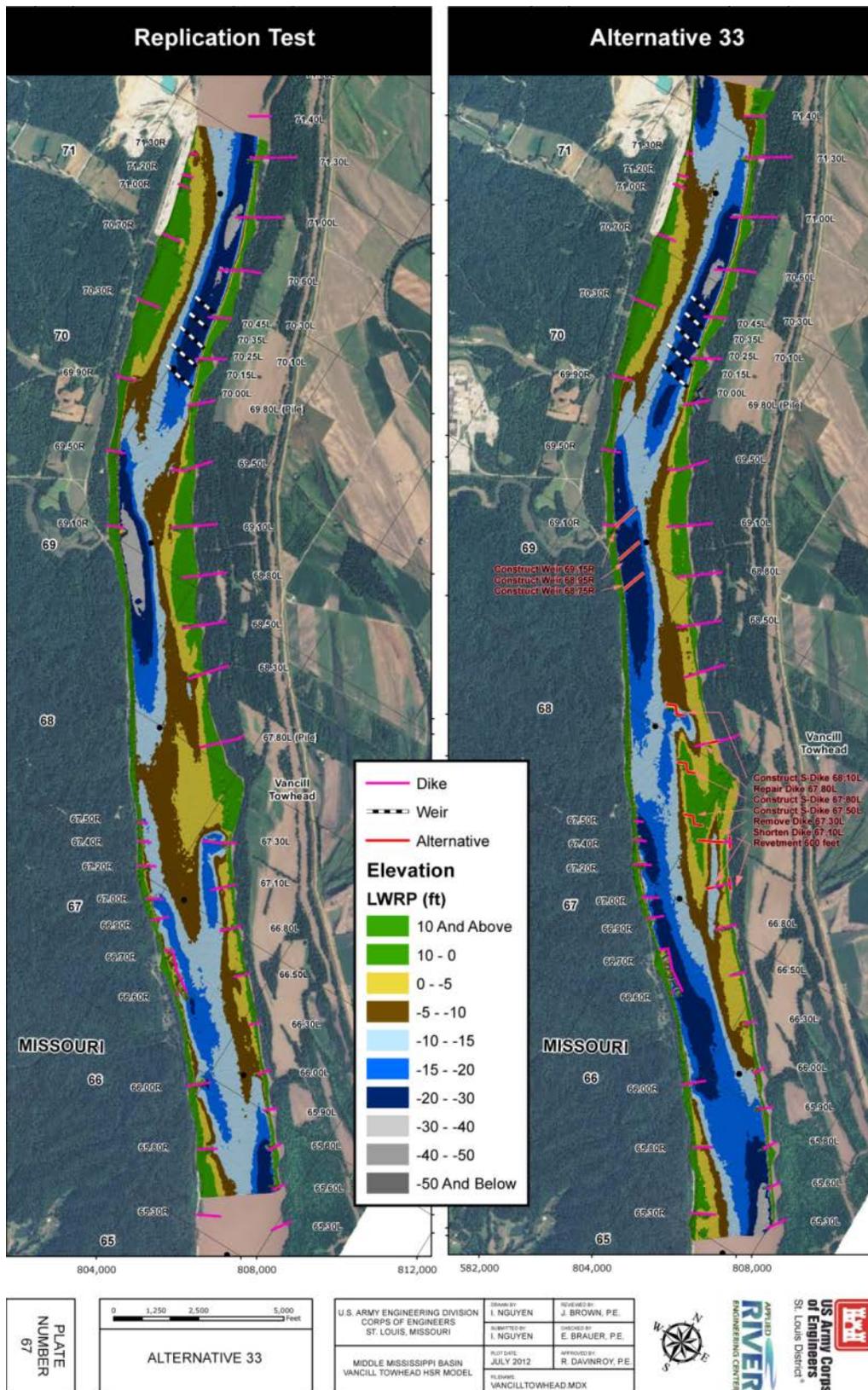


Figure 11 – A Visual Depiction of the Impacts of the Proposed Action in the Project Area.

diversity that would be beneficial to the river's fisheries as shown in Figure 11.

Regardless of the specific configuration of the river training structures utilized, rock structures can provide improved habitat for fish by providing areas of reduced flow, a more diverse substrate, and additional cover. In addition, they can provide more suitable substrate for a wide variety of benthic organisms. Barko et al (2004) found that species richness was greatest at wing dikes in the Middle Mississippi River for both adult and age-0 fishes when compared with main channel borders. However, they did find differences in species composition. Cyprinidae, Clupeidae, and Centrarchidae were more abundant in wing dike physical habitat, while Catostomidae and Ictaluridae were more abundant in main-channel border physical habitat. Hartman and Titus (2009) studied dikes and reference sites on the Kanawha River, West Virginia and found that fish used dikes as much as or more than sites without dikes and that differences in taxonomic composition occurred. A study of larval fish use of dike structures on the Kanawha River found significantly higher capture rates of larval fish at dike sites than at reference sites (Niles and Hartman 2009). The difference in capture rates was attributed to reduced velocities provided by dikes. On the Upper Mississippi River, Madejczyk et al. (1998) found that fish abundance and diversity measures differed little among channel border habitat types in Pool 6, but significantly larger fish were present at locations with structure (wing dikes, woody snags) than at sites with bare shorelines. Riprapped shorelines had fish assemblages different from those in river sections containing only instream artificial rocky structures. Similar results were found in Pool 24 by Farabee (1986) where revetted main channel border sites had higher fish abundance than natural shorelines and larger revetment stone supported larger numbers of fish than small, tightly packed revetment stone. On the Lower Mississippi River, Pennington et al. (1983) found that the number of fish species taken from natural and revetted banks were similar. However, the relative abundance of individual species was different in the two habitats.

Limited sampling conducted by the St. Louis District at an offset dike field in the MMR (USACE 2012) showed an increase in bathymetric, flow, and sediment diversity from pre-construction to post-construction and showed similar fish community composition pre- and post-project. Schneider (2012) investigated fish community and habitat changes associated with chevron dike construction in the MMR St. Louis harbor and found increased fish use and increased habitat diversity associated with chevron dikes as compared to pre-construction conditions and open water control sites.

Chevrons, dike structures designed as a blunt-nosed arch shape, have typically been used to redistribute flow and sediment to maintain the navigation channel. The chevrons will use the energy of the river to redistribute water flow, but unlike traditional dikes that create a unidirectional deflection, they create a split flow. The riverside bank of the chevron directs flow to maintain the navigation channel while the other side directs flow toward the riverbank. Not only do chevrons divert river flow toward the main channel similar to a wingdam, they also create several different types of river habitat, with variable depth and flow velocities. During high water events, river flows overtopping the structures would create a large scour hole just downstream of the structure's apex. After the flows drop below the crest of the structure, the scour hole formed at high flow becomes an area of deep slack water. This environment is conducive to the needs of overwintering fish, and provides the ideal conditions for a juvenile and larval fish nursery. The uneven rock structure would provide good escape cover and foraging

habitat for young fish. These structures have been proven to be effective at promoting bathymetric diversity, including a low velocity habitat behind the chevron itself.

In summary, the proposed construction is not expected to result in a loss of aquatic habitat due to sedimentation and conversion to terrestrial habitat. The structures are expected to increase bathymetric, flow, and sediment diversity in the immediate vicinity of the structures. Fish response to these changes in habitat is difficult to predict quantitatively, but, based on prior studies, fish use of the area may increase after construction related disturbance ends.

Bendway Weir Effects - Bendway weirs are designed to reduce dredging requirements in river bends by controlling point bar development (Davinroy 1990). They consist of a series of low-level submerged dikes (top elevation 15 feet below the low water reference plane) constructed around the outer edge of a river bend. Each bendway weir is angled 30 degrees upstream of perpendicular to divert flow, in progression, toward the inner bank. The result is hydraulically controlled point bar development, reduced erosion of the outside bank, and a wider and safer navigation channel.

While providing benefits for navigation and channel maintenance, bendway weirs also provide complex habitat for macroinvertebrate and fish communities. Extreme main channel water depths found at outside bends without bendway weir fields are thought to be of little fisheries value (Baker et al. 1991). The bendway weir fields themselves provide a more heterogeneous environment than the surrounding homogenous sand substrate, resulting in greater species richness and diversity of benthic invertebrates (Ecological Specialists, Inc. 1997a, 1997b).

Hydroacoustic surveys of fishes were conducted by Kasul and Baker (1996) in four river bends of the Middle Mississippi River between Cairo, Illinois, and Cape Girardeau, Missouri (RM 2-50). Comparisons of fish density based on the hydroacoustic surveys suggested that bendway weirs increased the local abundance of fishes in affected areas of the river channel more than two-fold when compared to bends without weirs.

While the presumed benefits of bendway weir fields on fish communities at outside bends are acknowledged by natural resource agency partners, there is also concern that there may be an associated negative impact on fish communities at the adjacent inside bend point bar. The effects of bendway weirs on point-bar fishery habitat were studied on the Lower Mississippi River (Schramm et al. 1998) by comparing the changes in late-falling and low-river stage electrofishing catch rates of prevalent fishes before (1994) and after (1996) installation of bendway weirs at Victoria Bend relative to the changes in catch rates of the same fishes at Rosedale Bend, a nearby reference site without bendway weirs. Large interyear variation in catch rates was observed and, for most prevalent species, catch rates declined from 1994 to 1996 in sandbar habitats. However, significant declines in catch rates of prevalent species at Victoria Bend relative to changes in catch rates at the reference site were only noted for gizzard shad. Conversely, catch rates of goldeye, channel catfish, and flathead catfish at sandbar habitat during late-falling river stage significantly declined from 1994 to 1996 at Rosedale Bend while catch rates remained similar at Victoria Bend. Based on this limited study, the bendway weirs appeared to reduce gizzard shad abundance but, at certain river stages, may have improved habitat conditions for threadfin shad, goldeye, channel catfish, and flathead catfish.

In order to attempt to address resource agency partner concerns about the potential impacts of bendway weir fields on inside bend point bar habitat, the District completed a study in 2011 entitled “*Analysis of the Effects of Bendway Weir Construction on Channel Cross-Sectional Geometry*” (USACE 2011). The study utilized bathymetric data collected before and after weir construction at 21 bendways in the MMR and one in Pool 24. The bathymetric data were used to analyze the cross-sectional changes in channel bed geometry associated with the bendway weirs. Area, width, wetted perimeter, and slope were compared pre- to post-weir installation. The inner bend longitudinal slope was of particular interest due to concerns that the slopes were increasing, threatening shallow water habitat. The study showed that channel width at Low Water Reference Plane (LWRP) increased for 77% of the cross sections with an average increase of approximately 330 ft. The average slope decreased for 59% of all cross sections, with an average decrease of 1.27 ft. per 100 ft. The study concluded that bendway weirs are largely achieving their primary goal of widening the navigable portion of the channel without a serious detrimental effect on inside bar slopes.

The proposed placement of three bendway weirs in the project area is expected to improve fish and macroinvertebrate habitat in the outside bend by providing substrate diversity, flow refuge, and increased macroinvertebrate colonization surface area. The impacts on fish and macroinvertebrate habitat on the inside bend opposite the bendway weirs are uncertain. Studies to date do not provide conclusive results for predicting fish or macroinvertebrate community response to bendway weir placement at adjacent inside bends.

Revetment Effects – The proposed revetment is designed to prevent the continued erosion and migration of the associated bankline in the project area. Preventing bankline erosion could have a minor negative impact on the fish community in the area. Bankline erosion frequently leads to woody debris inputs to the system. Woody debris is an important habitat component in the MMR, providing nutrient inputs, macroinvertebrate colonization substrate, and habitat diversity for fish and wildlife resources. Although woody debris inputs through bankline erosion would be prevented, woody debris would still enter the system from the project area during overbank flow events.

Similar to rock dike structures, revetment can improve fish habitat by providing substrate diversity, additional cover, and more suitable substrate for a wide variety of benthic macroinvertebrate colonization (Beckett et al. 1983; Bingham 1982; Dardeau et al. 1995; Fischenich 2003; Nord and Schmulbach 1973; Payne et al. 1989; White et al. 2010). Farabee (1986) studied fish at two revetted and two natural main channel border sites in Pool 24 over a 3-year period. Although the number of species at each bankline type were similar, total fish collected was greater on banklines with revetments, especially where larger stone was present.

In summary, the proposed revetment is likely to reduce the amount of beneficial woody debris entering the system from the project area through bankline erosion. However, woody debris would continue to enter the system during overbank flow events, and revetment would benefit fish and wildlife by providing rock substrate.

Threatened and Endangered Species

A programmatic (Tier I) consultation (USACE 1999), conducted under Section 7 of the Endangered Species Act, considered the systemic impacts of the operation and maintenance of the 9-Foot Channel Navigation Project on the Upper Mississippi River System and addressed listed species as projected 50 years into the future (USFWS 2000). The consultation did not include individual, site specific project effects or new construction. It was agreed that site specific project impacts and new construction impacts would be handled under separate Tier II consultation. Although channel structure impacts were covered under the Tier I consultation, other site and species specific impacts could occur. As such, the Grand Tower Phase V (Crawford and Vancill Towheads) Project required Tier II consultation. Accordingly, the District completed Tier II Biological Assessments for Vancill and Crawford Towheads that described the potential impacts on federally threatened and endangered species.

As outlined in the Biological Assessments and associated USFWS correspondence (Appendix B) the determination has been made that the Proposed Action is not likely to adversely affect Indiana bat, least tern, spectaclecase mussel, sheepsnose mussel, and decurrent false aster. With respect to pallid sturgeon, although adverse impacts associated with the proposed action have been avoided and minimized to the greatest extent possible and design modifications have been incorporated to provide habitat benefits, exact impacts remain unclear. However, the potential adverse effects of the project on pallid sturgeon are consistent with those anticipated in the programmatic Biological Opinion and the District has implemented the Reasonable and Prudent Measures and Terms and Conditions prescribed therein as appropriate for the project. Thus, the determination has been made that no significant impacts to pallid sturgeon are anticipated.

Although the bald eagle was removed from the federal list of threatened and endangered species in 2007, it continues to be protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act (BGEPA). The BGEPA prohibits unregulated take of bald eagles, including disturbance. The U.S. Fish and Wildlife Service developed the National Bald Eagle Management Guidelines (USFWS 2007) to provide landowners, land managers, and others with information and recommendations regarding how to minimize potential project impacts to bald eagles, particularly where such impacts may constitute disturbance. No bald eagle nest trees are known to occur in the immediate vicinity of the project area at this time. If any nest trees are identified in the project area, the National Bald Eagle Management Guidelines will be implemented to minimize potential project impacts and appropriate coordination with the U.S. Fish and Wildlife Service will be conducted.

Socioeconomic Resources Navigation

Impacts of the No Action Alternative on Navigation – With the No Action Alternative, periodic maintenance dredging activities would be expected to continue at a rate similar to recent history. Dredging costs in the project area over the past 12 years have averaged approximately \$550,000 per year. These expenditures would be expected to continue in the future.

Impacts of the Proposed Action on Navigation – Implementation of the Proposed Action is expected to reduce the amount and frequency of dredging necessary in the project area. The estimated cost of the Proposed Action is \$4,000,000.

Historic and Cultural Resources

Impacts of the No Action Alternative on Historic and Cultural Resources – Continued dredging operations under the No Action Alternative would not be anticipated to impact any known historic and cultural resources in the project area. Any undocumented historic and cultural resources that may have existed in the project area likely would have been destroyed by previous dredging activities. Future maintenance dredging under the No Action Alternative would likely occur in the same locations as previous dredging, and, therefore, would be unlikely to impact undocumented historic and cultural resources.

Impacts of the Proposed Action on Historic and Cultural Resources – All construction and modification work on the river structures will be carried out via barge, without recourse to land access; therefore, any effects are limited to submerged cultural resources. Primary among these are historic period shipwrecks. The continual river flow and associated sedimentary erosion, deposition, and reworking make it highly unlikely that any more ephemeral cultural material remains on the river bed.

As with other training structures, construction of revetment would be conducted via barge, without recourse to land access. The placement of the rock, however, has the potential to damage or destroy any resource on the bankline. With all revetment segments, historical research was conducted on the proposed location. The proposed work was determined to be on recently accreted land. Recently accreted land is highly unlikely to contain deeply buried cultural resources. The revetment section is located on Vancill towhead, which formed at the end of the nineteenth century and is extremely unlikely to be the location of any cultural resources.

Given the features' construction method (with no land impact), the previous disturbance of the riverbed, the fact that all feature locations were within the river until the end of the nineteenth century, and the lack of any survey evidence for extant wrecks, it is our opinion that the proposed undertaking will have no significant effect on cultural resources. Both the Illinois and Missouri State Historic Preservation Officers (SHPO) concurred that the proposed actions would not affect listed or eligible historic properties. A copy of the correspondence is included in Appendix C. If, however, cultural resources were to be encountered during construction, all work would stop in the affected area and further consultation would take place.

Twenty-eight federally recognized tribes affiliated with the St. Louis District were consulted and no objections to the project were raised. A copy of the consultation letter is included in Appendix C.

Cumulative Impacts

Council on Environmental Quality (CEQ) regulations define cumulative impacts as “the impact on the environment which results from the incremental impact of the action when added to other

past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.” (40 CFR §1508.7). In order to assist federal agencies in producing better cumulative impact analyses, CEQ developed a handbook, “Considering Cumulative Effects under the National Environmental Policy Act” (CEQ 1997). Accordingly, the Grand Tower Phase 5 EA cumulative impact analysis generally followed the steps laid out by the handbook.

As summarized in Table 4 below, the cumulative impact analysis involved determining the incremental impact of the Project Alternatives on resources in the area in the context of all of the other past, present, and reasonably foreseeable future actions that might also impact each resource category. The analysis looked beyond the footprint of the project area and beyond the Middle Mississippi River to include impacts to the resources throughout the Upper Mississippi River watershed. Clearly the resources, ecosystem and human environment in the Middle Mississippi River and the Upper Mississippi River watershed has been, and will continue to be, significantly impacted by a wide range of stressors. The Regulating Works Project, in combination with the other stressors throughout the watershed, has had past impacts, both positive and negative, on the resources, ecosystem and human environment. However, this analysis is meant to characterize the incremental impact of the current action in the broader context of other actions affecting the same resources. Although past actions associated with the Regulating Works Project have impacted these resources, the current method of conducting business for the Project – involving partner agencies throughout the planning process, avoiding and minimizing impacts during the planning process, and utilizing innovative river training structures to provide habitat diversity while still providing benefits to the navigation system – has been successful in accomplishing the desired effect of avoiding significant environmental consequences. Although our understanding of the processes and stressors that bear upon the resources of the Middle Mississippi River continues to evolve, equilibrium in habitat conditions appears to have been reached. Accordingly, no significant impacts to the resources, ecosystem and human environment are anticipated for the Grand Tower Phase 5 Regulating Works Project.

Table 4. Summary of cumulative impacts.

Resource	Past Actions	Present Actions	Future Actions	No Action Alternative	Proposed Action
Stages	Flows and stages impacted by watershed land use changes, levee construction, mainline and watershed dam construction, consumptive water use, climate change	Continued impacts due to land use changes in watershed, consumptive water use, levee construction, climate change	Continued impacts due to land use changes in watershed, consumptive water use, levee construction, climate change	No impacts on stages anticipated	No impacts on stages anticipated at average and high flows. At low flows, current trend of decreasing stages expected to continue.
Water Quality	Increasing human populations and industrialization result in increased water quality problems. Establishment of Clean Water Act, NEPA, USEPA, state environmental agencies and associated regulations improve conditions.	Continued population growth and development result in increased potential for water quality impacts. Continued regulation enforcement and societal recognition prevent water quality degradation.	Continued regulation enforcement and societal recognition. Continued population growth and development result in increased potential for water quality impacts.	Localized, temporary increase in suspended sediment concentrations at dredge material discharge sites	Localized, temporary increase in suspended sediment concentrations during construction activities
Air Quality	Increasing human populations and industrialization result in deterioration of air quality. Establishment of Clean Air Act, NEPA, USEPA, air quality standards improve conditions. Attainment status in Project Area.	Continued population growth and development result in increased potential for air quality impacts. Continued regulation enforcement and societal recognition. Continued attainment status in Project Area.	Continued population growth and development result in increased potential for air quality impacts. Continued regulation enforcement and societal recognition. Continued attainment status in Project Area.	Occasional and ongoing minor and local impacts due to use of dredging equipment	Temporary, minor, local impacts to air quality due to one-time use of construction equipment

Table 4. (cont.)

Resource	Past Actions	Present Actions	Future Actions	No Action Alternative	Proposed Action
<p>Fish and Wildlife (including threatened and endangered species)</p>	<p>Transformation of river system from natural condition to pooled lock and dam system; in MMR, loss of floodplain habitat due to levees, agriculture, urbanization; loss of natural river habitat – loss of dynamic habitat due to river channel being stabilized with dikes/revetment; dredging impacts; USACE, other federal, state, and private habitat restoration and land mgmt programs implemented to try to reverse habitat loss; introduction of exotic species/reduced native species biomass; implementation of innovative river training structures to provide habitat diversity; recognition of T&E species through Endangered Species Act; listing of multiple T&E species in MMR; implementation of District Biological Opinion Program and Avoid and Minimize Program.</p>	<p>Maintenance of current habitat conditions due to maintenance of lock and dam system and maintenance of existing dikes/revetment; continued use of innovative river training structures to provide habitat diversity; habitat restoration and land mgmt through USACE, other federal, state, and private programs; habitat changes associated with recent and current innovative dike construction; maintenance of current floodplain habitat conditions due to continued agriculture use/ maintenance of existing levees/ urbanization; dredging impacts; native species continue to be impacted by exotic species; continued implementation of Biological Opinion Program and Avoid and Minimize Program.</p>	<p>Continued maintenance of habitat conditions due to maintenance of lock and dam system and maintenance of existing dikes/revetment; continued use of innovative river training structures to provide habitat diversity; continued habitat restoration and land mgmt through USACE, other federal, state, and private programs; maintenance of current floodplain habitat conditions due to continued agriculture use/ maintenance of existing levees/ urbanization; new exotic species likely to be introduced; continued implementation of Biological Opinion Program and Avoid and Minimize Program.</p>	<p>Entrainment of some fish and macroinvertebrates at dredge locations; avoidance of dredge and disposal areas by mobile organisms; some loss of fish and macroinvertebrates at disposal sites; may affect but not likely to adversely affect threatened and endangered species.</p>	<p>Avoidance of sites during construction; no conversion of aquatic habitat to terrestrial; increased fish and macroinvertebrate use of structure locations due to increased bathymetric, flow, and substrate diversity; Uncertain impacts on fish and macroinvertebrates at inside bend opposite of proposed bendway weir locations. May affect but not likely to adversely affect threatened and endangered species; Adversely affects pallid sturgeon but meets the requirements of the reasonable and prudent measures described in 2000 Biological Opinion.</p>

Table 4. (cont.)

Resource	Past Actions	Present Actions	Future Actions	No Action Alternative	Proposed Action
Navigation	1927 River and Harbor Act authorized USACE to provide 9-foot Navigation channel on MMR; USACE transformed free-flowing Mississippi River system into navigable waterway with 37 lock and dam complexes, some dredging, dikes, revetment; growth of port facilities and inland waterways and traffic throughout Mississippi River system provided for movement of commodities with local, national, and international importance	Operation of lock and dam system continues; traditional and innovative stone dike, revetment construction, rock removal, and dredging continue to provide safe and dependable navigation channel; navigation continues to be an important part of local / national / international transportation and commerce activities	Operation of lock and dam system continues; traditional and innovative stone dike, revetment construction, rock removal, and dredging continue to provide safe and dependable navigation channel; navigation continues to be an important part of local / national / international transportation and commerce activities	Continued requirement for periodic maintenance dredging at rates similar to recent history.	Reduction in the amount and frequency of periodic maintenance dredging in the project area.
Historic and Cultural Resources	Historic and cultural resources subjected to natural processes and manmade actions (e.g., erosion, floodplain development); recognition of importance of historic and cultural resources through National Historic Preservation Act (and others)	Historic and cultural resources continue to be impacted by human activities as well as natural processes; continued societal recognition of importance of historic and cultural resources	Historic and cultural resources continue to be impacted by human activities as well as natural processes; continued societal recognition of importance of historic and cultural resources	Impacts to historic and cultural resources unlikely.	No known historic resources would be affected. Impacts to unknown historic and cultural resources unlikely.

Mitigation

Mitigation measures are used to avoid, minimize, or compensate for adverse impacts to environmental resources. The Grand Tower Phase 5 Project has avoided and minimized adverse impacts throughout the project development process. No adverse impacts have been identified that would require compensatory mitigation.

5. Relationship of Proposed Action to Environmental Requirements

Federal Policy	Compliance Status
Bald Eagle Protection Act, 16 USC 668-668d	Full
Clean Air Act, 42 USC 7401-7542	Full
Clean Water Act, 33 USC 1251-1375	Partial 1*
Comprehensive Environmental Response, Compensation, and Liability Act, 42 USC 9601-9675	Full
Endangered Species Act, 16 USC 1531-1543	Full
Farmland Protection Policy Act, 7 USC 4201-4208	Full
Fish and Wildlife Coordination Act, 16 USC 661-666c	Full
Land and Water Conservation Fund Act, 16 USC 460d-461	Full
Migratory Bird Treaty Act of 1918, 16 USC 703-712	Full
National Environmental Policy Act, 42 USC 4321-4347	Partial 2*
National Historic Preservation Act, 16 USC 470 et seq.	Full
Noise Control Act, 42 USC 7591-7642	Full
Resource Conservation and Recovery Act, 42 USC 6901-6987	Full
Rivers and Harbors Act, 33 USC 401-413	Partial 1*
Water Resources Development Acts of 1986 and 1990	Full
Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898)	Full
Floodplain Management (EO 11988 as amended by EO 12148)	Full
Prevention, Control, and Abatement of Air and Water Pollution at Federal Facilities (EO 11282 as amended by EO's 11288 and 11507)	Full
Protection and Enhancement of Environmental Quality (EO 11991)	Full
Protection and Enhancement of the Cultural Environment (EO 11593)	Full
Protection of Wetlands (EO 11990 as amended by EO 12608)	Full
Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186)	Full

1* Required permits will be sought during document review

2* Full compliance after submission for public comment and signing of FONSI

6. List of Preparers

Name	Role	Experience
Mike Rodgers	Project Manager	12 years, hydraulic engineering
Jasen Brown	Project Manager	12 years, hydraulic engineering
Eddie Brauer	Engineering Lead	12 years, hydraulic engineering
Kip Runyon	Environmental Lead	16 years, biology
Francis Walton	EA Contributor and Threatened and Endangered Species	13 years, environmental compliance
Kevin Slattery	HTRW	15 years, environmental science
Mark Smith	Historic and Cultural Resources	20 years, archaeology
Danny McClendon	Regulatory	27 years, regulatory compliance and biology
Keli Broadstock	Legal Review	1 year USACE, 6 years private sector law

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DRAFT FINDING OF NO SIGNIFICANT IMPACT (FONSI)
GRAND TOWER PHASE 5 REGULATING WORKS
MIDDLE MISSISSIPPI RIVER MILES 74-67
UNION COUNTY, IL
CAPE GIRARDEAU COUNTY, MO

- I. In accordance with the National Environmental Policy Act, I have reviewed and evaluated the documents concerning the Regulating Works, Grand Tower Phase 5 Construction Project, Union County, Illinois and Cape Girardeau County, Missouri. As part of this evaluation, I have considered:
- a. Existing resources and the No Action Alternative.
 - b. Impacts to existing resources from the Proposed Action.
- II. The project alternatives have been studied for physical, biological, cultural, and socioeconomic effects. My evaluation of the project has resulted in the following conclusions:
- a. The project would address repetitive dredging conditions in the project area. This would be accomplished by placing revetment; constructing two chevrons, three diverter dikes (S-dikes), and three bendway weirs; and modifying four existing dikes.
 - b. No significant impacts to natural resources, fish and wildlife resources and federally threatened or endangered species are anticipated from this project. There would be no appreciable degradation to the physical environment (e.g., stages, air quality, and water quality) due to the project.
 - c. The proposed project would have no adverse effect upon historic properties or archaeological resources.
 - d. The "no action" alternative was evaluated and determined to be unacceptable as repetitive dredging expenditures would continue.
- III. Based on the evaluation and disclosure of impacts contained within the Environmental Assessment, I find no significant impacts to the human environment are likely to occur as a result of the proposed action. Therefore, an Environmental Impact Statement will not be prepared prior to proceeding with the proposed Regulating Works, Grand Tower Phase 5 Construction Project, Union County, Illinois and Cape Girardeau County, Missouri.

(Date)

CHRISTOPHER G. HALL
COL, EN Commanding

DRAFT ENVIRONMENTAL ASSESSMENT
WITH
UNSIGNED FINDING OF NO SIGNIFICANT IMPACT

REGULATING WORKS PROJECT
GRAND TOWER PHASE 5
CRAWFORD TOWHEAD AND VANCILL TOWHEAD
MIDDLE MISSISSIPPI RIVER MILES 74-67
UNION COUNTY, IL
CAPE GIRARDEAU COUNTY, MO

DECEMBER 2013

APPENDICES

Appendix A. Summary of Research on the
Effects of River Training Structures on Stages

With implementation of the Proposed Action, stages at average and high flows both in the vicinity of the project area and on the Middle Mississippi River are expected to be similar to current conditions. An abundance of research has been conducted analyzing the impacts of river training structures on water surfaces dating to the 1940s. This research has analyzed historic gage data, velocity data, and cross sectional data. Physical and numerical models have also been used to determine the effects of dikes on water surfaces. A summary of research on the topic is detailed below. Based on an analysis of this research by the Corps and other external reviewers, the District has concluded that river training structures do not affect water surface elevations at higher flows.

The first study specifically addressing the effect of river training structure construction on water surfaces was conducted during the extreme high water of June and July 1935 (Ressegieu 1952). This study was prompted by the differences in observed streamflow for equal stages following the transfer of streamgaging responsibility from the Corps to the United States Geological Survey (USGS) in March 1933. The study addressed the accuracy of the standard equipment and method of observation between the two agencies. Similar simultaneous streamflow studies were conducted between 1935 and 1948. In 1952, the results of all of the studies were analyzed and it was concluded that, on average, the discharges measured by the Corps generally exceeded those measured by the USGS by zero percent at mean stage to slightly more than ten percent at high stages. Another conclusion of Ressegieu (1952) was that “the reduction in floodway capacity was not an actual physical reduction but an apparent reduction caused by a discrepancy in the accuracy of measuring streamflow by older methods and equipment.” The conclusions by Ressegieu (1952) were analyzed along with new information and confirmed by Watson et al. (2013a)

The topic of the effect of dikes on flood heights was revisited in the 1960’s when it was determined through an analysis of changes in the stage/discharge relationship over time that “the contraction by permeable dikes has had a negligible effect on the increase in flood heights” (Monroe 1962). The change in stages for higher flows was attributed to the construction and raising of levees on the Middle Mississippi River.

Munger et al. (1976) studied the changes in hydraulics on the Mississippi River resulting from river confinement by levees and the construction of river training structures. As was the case in previous studies using gage data, the reliability of early discharge data collected by the Corps was brought into question. In a study of velocity, stage and discharge data, Munger et al. (1976) concluded that “generalizations about the effect of dikes on stage-discharge relations are not justified.” When examining cross section shape and velocity distributions at the St. Louis gage it was observed that there had been no striking changes in cross-section shape or velocity distributions at the section between 1942 and 1973.

Dyhouse (1985, 1995) found through numerical and physical modelling that published discharges for historic floods, including 1844 and 1903, were greatly overestimated. Dyhouse concluded that the use of early discharge data collected by the Corps including historic peak flood discharges in conjunction with streamflow measurements by the USGS will result in incorrect conclusions.

To update ongoing evaluations of the physical effects of river training structures, the Corps initiated a new study on the possible effect of these structures on water surfaces. This series of

studies included an analysis of past research, an analysis of the available gage data on the MMR, an analysis of historic measurement technique and instrumentation and its effect on the rating curve, specific gage analysis, numerical and physical modelling. In addition to the research conducted by the Corps, the St. Louis District engaged with external technical experts in the fields of river data collection, river engineering, geomorphology hydraulics and statistics.

In a review of historic streamflow data collected prior to the USGS, Watson & Biedenharn (2010) determined that pre-USGS data should be omitted for the following reasons (1) It has been confirmed through simultaneous measurement comparisons that there is much uncertainty in the historic data due to differences in methodology and equipment (2) there is much uncertainty with respect to the location of the discharge range (3) there is insufficient measured data at the higher flow ranges to produce reliable specific gage records (4) the homogeneous data set containing all discharges collected by the USGS provides an adequate long-term, consistent record of the modern-day river system including periods of significant dike construction.

In their analysis, Watson & Biedenharn (2010) studied the specific gage records at the three rated gages on the MMR: St. Louis, Chester and Thebes. The analysis for Thebes was omitted in this paper due to the effect of backwater from the Ohio River. For each streamgage studied, the specific gage record was analyzed and compared with a record of river training structure construction for a reach extending 20 river miles downstream. All data used in their study was collected by the USGS and retrieved from their website.

Bankfull stage at the St. Louis gage is +15 feet Low Water Reference Plane (LWRP) with a corresponding discharge of approximately 500,000 cfs. Flows below 400,000 cfs are contained within the top bank and flows above 700,000 cfs are well above the top-bank elevation. The time period 1933-2009 was studied. The top elevation of training structures in this reach was between +15 and +18 feet LWRP and all structures are completely submerged at discharges exceeding 280,000 cfs. In their analysis, Watson and Biedenharn (2010) found a statistically significant slightly decreasing trend in streamflows below 200,000 cfs. In streamflows between 300,000 cfs 500,000 cfs a statistically significant horizontal trend in stages was observed. At 700,000 cfs there was a trend in stages that was not statistically significant. The slight upward trend in stages at 700,000 cfs had considerable variability in the data and was strongly influenced by the 1993 flood.

Bankfull stage at the Chester gage is +27 feet LWRP with a corresponding discharge of approximately 420,000 cfs. The time period 1942-2009 was studied. The top elevation of navigation structures in this reach was +17 to +19 feet LWRP and all structures are completely submerged at discharges exceeding 280,000 cfs. The only statistically significant trend found was a statistically significant slightly decreasing trend for streamflows below 100,000 cfs. There was no trend for 200,000 and 400,000 cfs. There was a slightly increasing trend at 300,000 cfs. For both overbank flows, 500,000 cfs and 700,000 cfs, there were slight increasing trends.

After a closer examination of the specific gage trends it was apparent that the long term trends for both St. Louis and Chester were not continuous and there was a shift in stages that occurred in the early 1970's. When the record was broken into pre- and post-1973 sections different trends were observed. Prior to 1973 at all gages studied, there were no increasing trends for any of the flows. Post-1973 there were no increasing stage trends for within-bank flows at any of the gages. A slightly increasing stage trend occurred for overbank flows of 500,000 cfs and 700,000

cfs at the Chester gage. A majority of the construction of river training structures on the Middle Mississippi was performed prior to 1973.

In conjunction with the specific gage record, Watson & Biedenharn (2010) and Watson et al. (2013) analyzed the record of training structure construction including an analysis of the top elevation of the structures. The typical top elevation of the structures was between 10-16 feet below the top bank. Since the top elevation is so far below top-bank elevations, the most dramatic impacts of the structures should be in the low to moderate stages below top bank where the specific gage analysis revealed decreasing or no trends.

Watson & Biedenharn (2010) concluded that, “based on the specific gage records, there has been no significant increase in stages for within-bank flows that can be attributable to river training structure construction. Any increase in overbank flood stages may be the result of levees, floodplain encroachments, and extreme hydrologic events; and cannot be attributed to river training structures based solely on specific gage records.”

Huizinga (2009) conducted a specific gage analysis using the direct step method on only data collected by the USGS for the gages at St. Louis and Chester. Similar to Watson & Biedenharn (2010), an apparent decrease of stage with time for smaller, in bank discharges was observed at both the St. Louis and Chester gages. This decrease in stage was attributed to the construction of river training structures and/or a decrease in sediment load available for transport on the Mississippi River due to the construction of reservoirs on the main stem tributaries of the Mississippi River, particularly the Missouri River.

Huizinga (2009) found a slight increase in stage over time for higher flows at both St. Louis and Chester over the entire period of record. The transitional discharge was 400,000 cfs and 300,000 cfs for the St. Louis and Chester gages respectively. These discharges correspond to stages of +25 feet LWRP at St. Louis and +22 feet LWRP at Chester. At these stages the navigation structures are submerged by 7-10 feet. Huizinga (2009) attributed the slight increase in out of bank flows to the construction of levees and the disconnection of the river to the floodplains. Similar to Watson & Biedenharn (2010), Huizinga (2009) observed a shift occurring in the out of bank flows in the mid-1960s and attributed it to the completion of the Alton to Gale levee system which paralleled the entire Middle Mississippi River.

In an analysis of cross sectional data collected at the St. Louis and Chester gages it was found that although the shape of the cross section had changed, the cross sectional area for moderate (400,000 cfs) and high (600,000 cfs) flows remained relatively constant throughout the period of record. The construction of river training structures immediately upstream of the Chester gage provided a case study on the effect of the absence and construction of structures on the cross section over time. Prior to the construction of the structures, the channel thalweg repeatedly shifted between the left and right banks. Following the construction of the structures, the cross sections displayed much less variability. An overall stabilizing effect of the structures was seen on the cross section for discharges of 100,000 cfs and 400,000 cfs. The cross sectional area for the first and last measurements of the period of record remained similar despite the river training structure construction upstream for all discharges.

Huizinga (2009) conducted a study of all rating curves developed for St. Louis and Chester, including those developed prior to 1933 by the Corps. When comparing daily values from the

Corps from 1861-1927 to the original USGS rating in 1933 there appeared to be an abrupt change in the upper end of the ratings used before 1933. When these daily values developed by the Corps were “adjusted” to compensate for the overestimation of Corps discharge measurements detailed in the simultaneous discharge measurement studies between the Corps and USGS the adjusted daily discharge values plotted in line with the original USGS rating (A). This study is further evidence of the overestimation of early discharges.

The Iowa Institute of Hydraulic Research (IIHR) at the University of Iowa performed a series of hydrodynamic simulations of a recently constructed chevron field and dike extension using the United States Bureau of Reclamation Sedimentation and River Hydraulics Two-Dimensional (SRH-2D) modelling software (Pitrowski et al. 2012). Simulations studied the impact of the construction on water surfaces and the magnitude of natural variation on water surfaces. The results indicated that structures did not cause significant differences in reach-scale water surface elevations. The simulations also found that the differences in pre- and post- construction water surface elevations were less than the differences resulting from natural variability.

A physical sediment transport model at the University of Illinois, Urbana-Champaign was used to test the effect of submerged dikes and dike fields on water surfaces (Brauer 2013). The study tested flows and stages along a rating curve from ½ bankfull to a flow with a 0.5% annual chance exceedance. The study concluded that the magnitude of the effect of dikes on water surfaces was smaller than other variables that can influence the stage/discharge relationship and decreased with increasing flow/submergence. The study also found that there was no direct cumulative effect for up to four structures.

Other reach scale numerical and physical models studying the effect of river training structures on water surfaces include USACE (1996) which used a Hydrologic Engineering Center (HEC-2) model used to analyze pre- and post- construction water surface elevations for the Nebraska Point Dike field on the Lower Mississippi River. For each cross section analyzed, the dike field construction lowered water surface elevations and reduced overbank discharges for the 50%, 20%, and 10% annual chance exceedance events. Xia (2009) used an Adaptive Hydraulics Modeling (ADH) model to study the changes in water surface resulting from the construction of a dike field. In this fixed bed analysis, Xia found that changes in water surface elevation due to the dikes was greatest at average flows and decreased with increasing and decreasing river flow. Azinfar and Kells (2007) developed a multiple function model to predict the drag coefficient and backwater effect of a single spur dike in a fixed bed. This study concluded that increasing submergence levels resulted in a decreasing backwater effect.

In a moveable bed model study conducted to develop structural alternatives for a power plant on the Minnesota River, Parker et al. (1988) measured water surface changes from a baseline for a series of dikes and determined that construction of the structures had a negligible effect on flood stages compared to calibration values. Yossef (2005) used a 1:40 scale fixed bed physical model of the Dutch River Waal to study the morphodynamics of rivers with groynes including their effect on water surface. Yossef found that on the River Waal, the effect of groynes decreased with increasing submergence. It was also observed that the maximum possible water level reduction of the design flood (378,000 cfs) by lowering all of the groynes in the system was 0.06 meters.

There is research supporting the claims that dike construction has resulted in an increase in flood heights of up to 16 feet. The first study proposing this link was Stevens et al. (1975) who proposed that the combination of river training structures constricting the main channel and levees isolating the main channel from its floodplain resulted in increased stages for flood discharges. Through the use of historic streamgage data, Belt (1975) arrived at the same conclusion. The source data, methodology and analysis used by these studies were questioned by Stevens (1976), Dyhouse (1976) Strauser & Long (1976) and Westphal & Munger (1976).

By comparing the trends in stage and streamflow measurements for rivers with and without river training structures, Criss & Shock (2001) concluded that stages have increased over time on rivers due to the construction of river training structures.

Pinter et al. (2001) used specific gage analyses to study the changes in stage and discharge relationships on the Middle Mississippi River and concluded that the presence of river training structures has increased roughness and resulted in an increase in flood stages.

One limitation of specific gage analysis is that it can only be performed on gages with a discharge record. Jemberie et al. (2008) developed a refined specific gage approach to overcome this limitation by developing “synthetic discharges” at stage only gages. The synthetic discharges are created by interpolating discharge values at nearby gages to create a stage-discharge relationship at stage only gages. Jemberie et al. (2008) also formulated a continuous specific gage time series for large, rare discharges by using “enhanced interpolation.” The results of the refined specific gage study were that stages that correspond to flood discharges increased substantially at all stations consistent with what was documented by Pinter (2001).

Remo & Pinter (2007) used a 1-D unsteady Hydrologic Engineering Center River Analysis System (HEC-RAS) model (“retro-model”) to assess the magnitude and type of changes in flood stages associated with 20th century river engineering. The “retro-model” used historic hydrologic and geospatial pre-USGS data to establish baseline roughness conditions. The baseline was then compared to present day hydraulic conditions to determine the changes in roughness as a result of engineering modifications. The results from the “retro-model” showed an increase in flood stages similar to those observed by Pinter (2001) and Jemberie et al. (2008).

The increase in water surfaces found by Stevens et al. (1975), Belt (1975), Criss & Shock (2001), Pinter et al. (2001) and Jemberie et al. (2008) are all driven by the difference in measured discharges between the Corps and USGS. When the homogenous data set of only discharges collected by the USGS are used, the trends shown in the aforementioned studies is not seen. In Remo & Pinter (2007) the proposed link between river training structures and water surfaces is tied to an increase in channel roughness between the two time periods modeled. The increase in roughness found by Remo & Pinter (2007) was a consequence of using an inaccurate stage-discharge relationship (rating curve) developed using early Corps discharges and comparing it to a more accurate rating curve developed using USGS data.

As part of the updated analysis of the effect of river training structures on water surfaces, experts in river engineering and statistics from the Corps and other external experts including the USGS and academia studied all of the available research on the topic. There is an abundance of research conducted by the Corps and others spanning over 80 years on the topic. The conclusions of recent research proposing a link between river training structures and flood

heights relies on dubious assumptions, source data and methodology. The results of the analysis of existing research have led to the conclusion that river training structures do not have an impact on water surfaces for higher flows.

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Appendix B. Biological Assessment

**TIER II BIOLOGICAL ASSESSMENT:
GRAND TOWER
CRAWFORD TOWHEAD
VANCILL TOWHEAD
(GRAND TOWER PHASE V REGULATING WORKS)**

MRM 80.6 - 67

**OPERATION AND MAINTENANCE OF THE 9-FOOT NAVIGATION CHANNEL
ON THE
UPPER MISSISSIPPI RIVER SYSTEM**

**Planning and Environmental Branch
Regional Planning and Environmental Division North
U.S. Army Corps of Engineers
St. Louis District
Attn: Francis Walton
1222 Spruce Street
St. Louis, Missouri 63103-2833
Commercial Telephone Number: (314) 331-8102**

December 2012

Introduction

This tier II biological assessment is being prepared specifically for the Grand Tower, Crawford Towhead and Vancill Towhead regulating works projects (Grand Tower Phase V rock contract). The purpose of this BA is to assess the specific effects of the proposed actions at these respective sites on endangered species that may occur in these respective river reaches and to comply with the requirements of the Reasonable and Prudent Measures and implementing terms and conditions provided in the 2000 Biological Opinion for the Operation and Maintenance of the 9-Foot Navigation Channel on the Upper Mississippi River System. The work sites are located in the Middle Mississippi River Regional Corridor Reach 3 and 4, or the Stone Dike Alteration Report reaches 14 and 15 (Big Muddy and Trail of Tears respectively). Grand Tower is located in the MMRRC study's Crain's Reach (Assessment Reach 3), subarea Owl Creek (MRM 80.5-84.5). Crawford Towhead is located in the Big Muddy Reach (MRM 80-71). Vancill Towhead is located within the 8.5 mile Trail of Tears Reach (MRM 71-62.5). Crawford and Vancill towheads are located in the MMRRC's Hamburg Reach (Assessment Area 4).

Tier I of a two-tiered biological assessment for the Operation and Maintenance of the 9-Foot Navigation Channel on the UMRS was prepared by the U.S. Army Corps of Engineers in April 1999 (USACE 1999a). In April 2000, the U.S. Fish and Wildlife Service issued its Biological Opinion for the Operation and Maintenance of the 9-Foot Navigation Channel on the UMRS. The Service determined that the continued operation and maintenance of the project would jeopardize the continued existence of the pallid sturgeon (*Scaphirhynchus albus*) and the Higgins' eye pearly mussel (*Lampsilis higginsii*). Reasonable and prudent alternatives were provided, which would allow the continued operation and maintenance of the project while offsetting adverse impacts to the species and avoiding jeopardy. Incidental Take Statements with reasonable and prudent measures were also provided. In addition, the Service found that the project would result in incidental take for the least tern (*Sterna antillarum*) and the winged mapleleaf mussel (*Quadrula fragosa*). Incidental Take Statements with reasonable and prudent measures were provided. The Service also determined that the project would likely adversely affect the bald eagle (*Haliaeetus leucocephalus*) and the Indiana bat (*Myotis sodalis*). Incidental take was not anticipated for these species. The range of the gray bat (*Myotis grisescens*) also occurs in project area. However, this species was not discussed in the Biological Opinion (USFWS 2000).

Project Description

The Grand Tower project includes the construction of a dike at 80.6L. The Crawford Towhead project includes the construction of two chevrons and the extension of one dike between MRM 74 and 72. The Vancill Towhead project is located between Mississippi River miles 70.0 and 67.0 and includes construction of 3 weirs, 3 diverter (S-Dike) dikes, repair of dike 67.8, shortening of dike 67.3 and the removal of one wing dike at RM 67.3 (generally alternative 33 of the Vancill Towhead hydraulic sediment response model study) (USACE 2012). Figure 1 is a location and vicinity map of the study reaches. Figures 2 through 5 show the proposed actions. Specifically, the projects would involve the following actions in order to attain the desired conditions:

Grand Tower		
Project Action	Project Description	Rationale
Construct Dike 80.6L	Construct a 500 ft. upstream angled dike to an elevation of 340 ft NGVD.	To reduce shoaling and dredging in this reach.

Crawford Towhead		
Project Action	Project Description	Rationale
Chevron 73.65L	Construct 300ft x 300ft chevron. Top elevation of the chevron will be +18.5 LWRP.	Needed to constrict the navigation channel.
Extend Dike 72.9L	Extend existing dike 300 feet. Top elevation of the chevron will be +18.5 LWRP.	Needed to maintain contraction width in the navigation channel.
Chevron 72.55L	Construct 300ft x 300ft chevron. Top elevation of the chevron will be +18.5 LWRP.	Needed to maintain contraction width in the navigation channel.

Vancill Towhead		
Project Action	Project Description	Rationale
Construct Weir 69.15L	Construct weir 800 feet long Top elevation of the weir will be -15 feet LWRP	Needed to increase the energy at Vancill Towhead (between RM 68.0 and RM 67.0)
Construct Weir 68.95L	Construct weir 800 feet long Top elevation of the weir will be -15 feet LWRP	Needed to increase the energy at Vancill Towhead (between RM 68.0 and RM 67.0)
Construct Weir 68.75L	Construct Weir 800 feet long Top elevation of the weir will be -15 feet LWRP	Need to increase the energy at Vancill Towhead (between RM 68.0 and RM 67.0)
Construct Diverter Dike 68.10L (S-Dike)	Construct Diverter Dike 750 feet long Top elevation of the dike will be +18 feet LWRP	Needed to create secondary side channel
Construct Diverter Dike 67.80L (S-Dike)	Construct Diverter Dike 750 feet long Top elevation of the dike will be +18 feet LWRP	Needed to create secondary side channel

Vancill Towhead		
Project Action	Project Description	Rationale
Construct Diverter Dike 67.50L (S-Dike)	Construct Diverter Dike 750 feet long Top elevation of the dike will be +18 feet LWRP	Needed to create secondary side channel
Remove Dike 67.30L	Remove entire 950 feet of dike Top elevation of the dike will be +18 feet LWRP	Needed to connect the secondary side channel to the main channel
Repair Dike 67.80L	Restore Dike to 350 foot length Top elevation of the dike will be +18 feet LWRP	Needed to constrict the secondary side channel to the main channel
Shorten Dike 67.10L	Shorten dike 300 feet. Top elevation of the dike will be +18 feet LWRP	Needed to connect the secondary side channel to the main channel

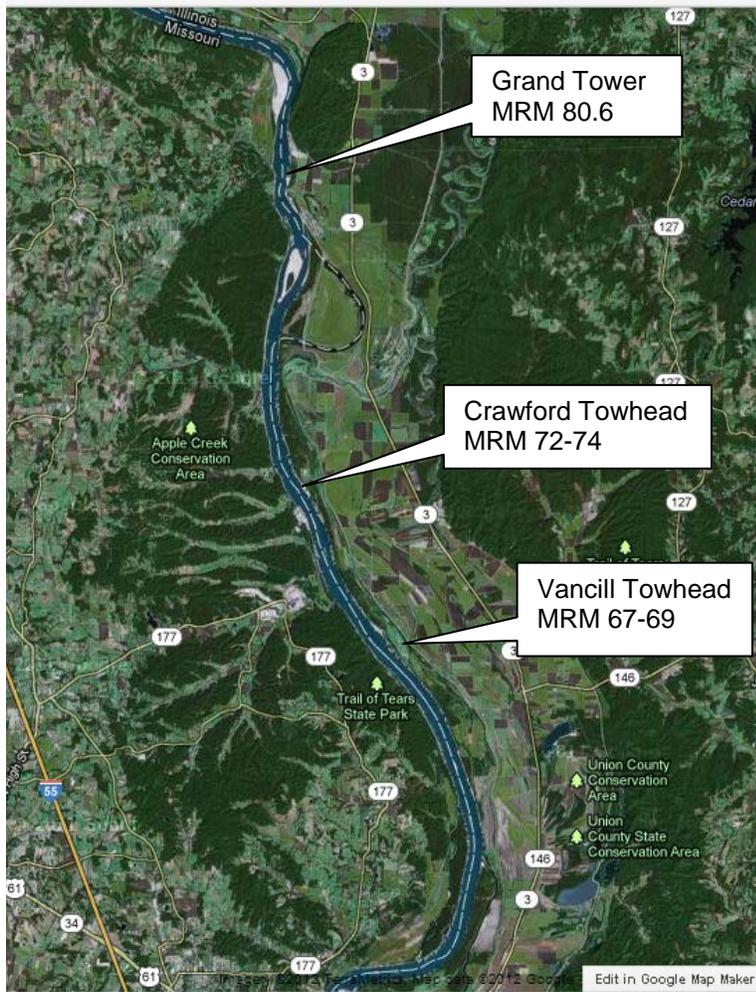


Figure 1 Project Locations

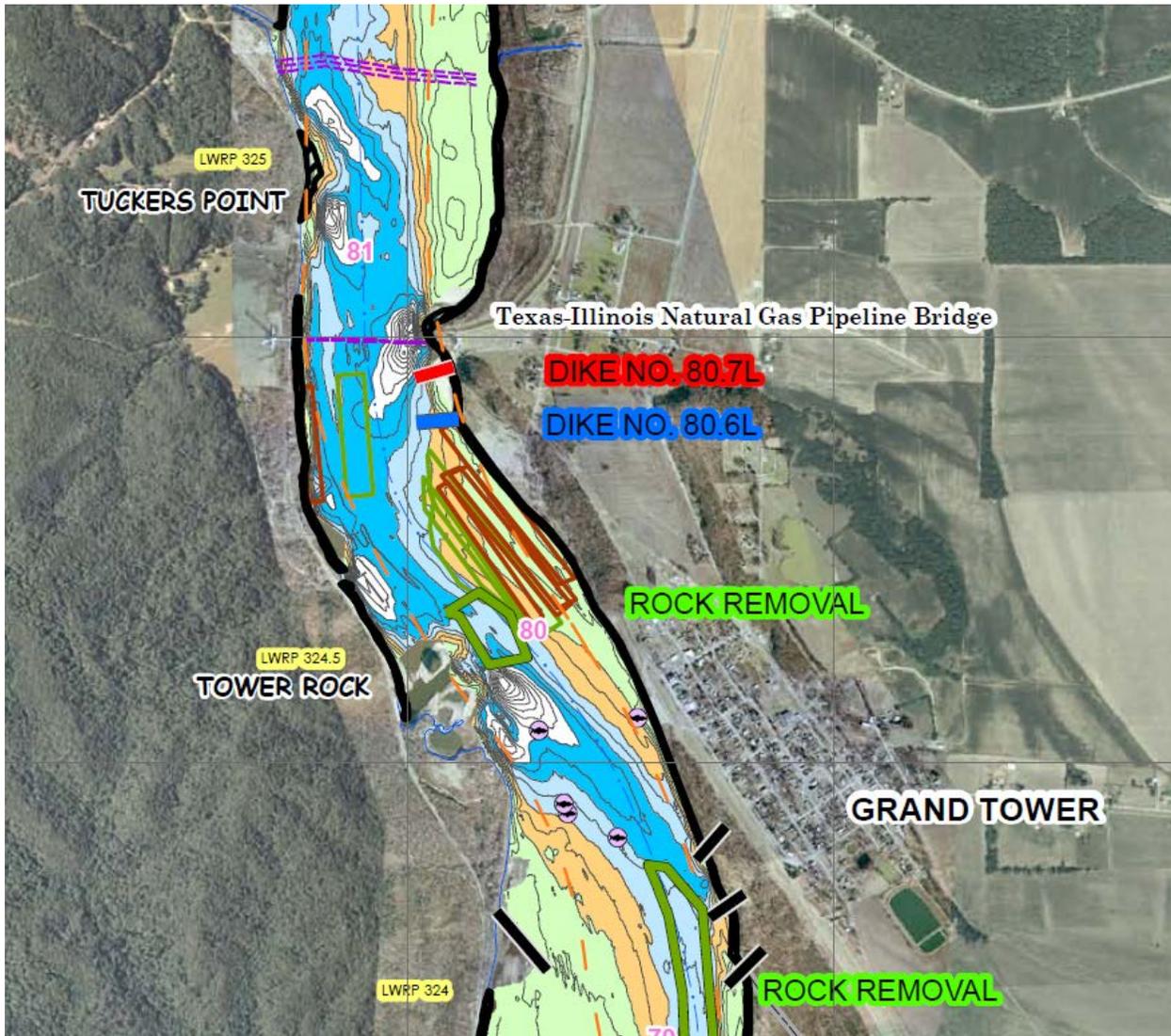


Figure 2 Grand Tower Dike 80.6L

Grand Tower Project Area Description

This project is located within a reach of the river that has been identified as important pallid sturgeon habitat due to the presence of crossover habitat and mid-channel bars. The dike location is just above Cottonwood Island which is recognized as important pallid sturgeon habitat.

The Missouri Department of Conservation requested in their FY 2009 coordination comments that proposed plans for dikes at 80.6L and 80.7L be left until last and should only be completed if absolutely necessary to alleviate the need to dredge this reach.

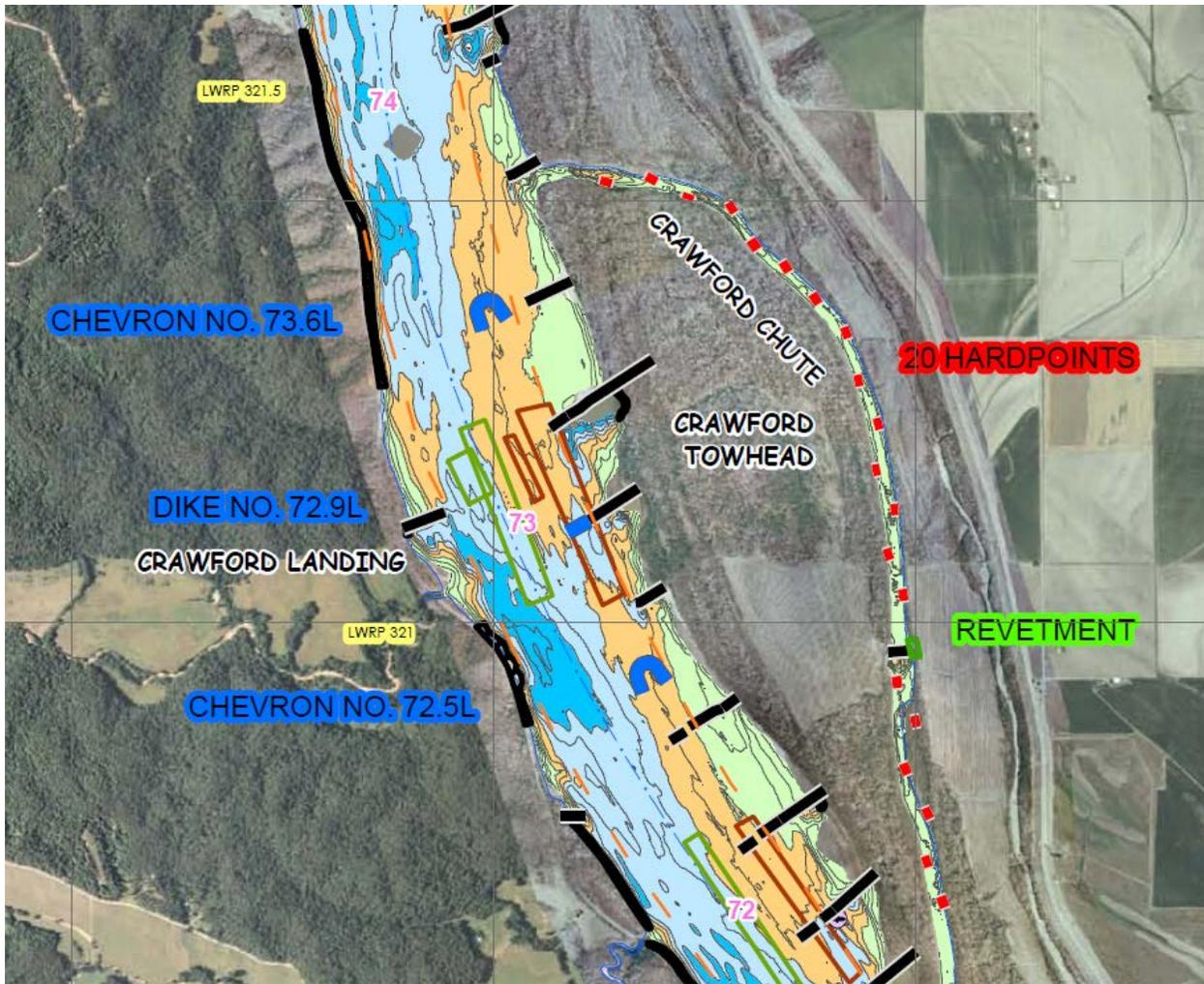


Figure 3 – Proposed Crawford Towhead Regulating Works Structures.

Crawford Towhead

The 2012 Stone Dike Alteration Report stated the opportunity for habitat improvement is rated as high for the LDB MRM 73 towhead chute. This Big Muddy dikes subarea (MRM 71-80) is foraging habitat for least terns and habitat for pallid sturgeon. There are pallid sturgeon locations at RM 69.5, 69.6, 69.8, 70.3, 71.8, 77.1, 78.2, 78.7, 79.5, and 79.8 especially around Cottonwood Island. Cottonwood Chute, including its substrate, is one of the most valuable habitat areas for the pallid sturgeon in the MMR.

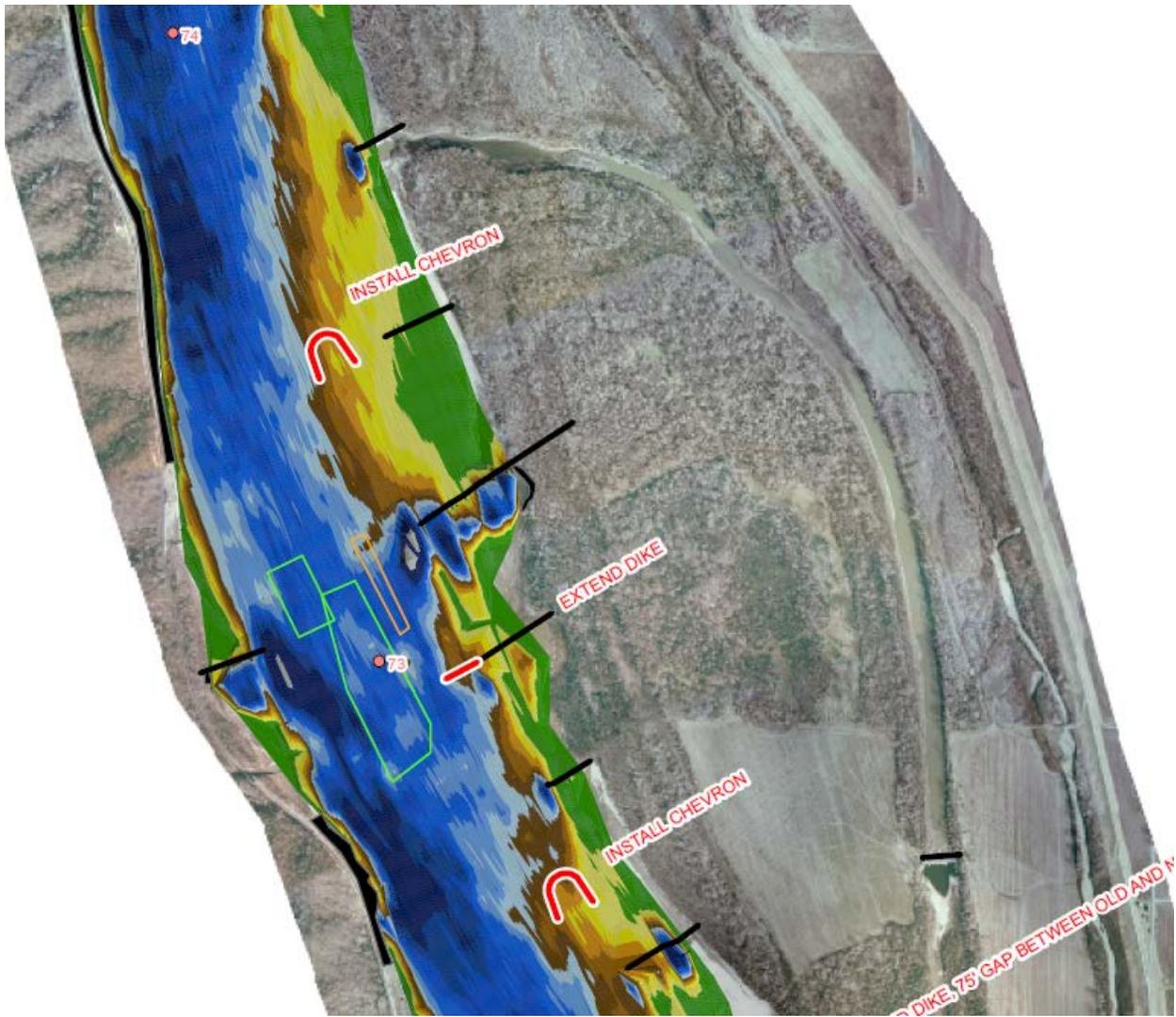


Figure 4 – Crawford Towhead – Shows Effects of Proposed Structures on Model Bathymetry

Vancill Towhead

The Vancill Towhead hydraulic sediment response study reach is bordered by Cape Girardeau County in Missouri and Union County in Illinois and includes a 7-mile stretch of the Mississippi River, between RM 72.00 to RM 65.00. Vancill Towhead, located along the left descending bank (LDB) of the Mississippi River between RM 67.60 to RM 67.30, covers an area of 11.4 acres.

Figure 5 is a 2010 aerial photograph illustrating the planform and nomenclature of the Middle Mississippi River between RM 72.00 and RM 65.00. Adjacent to Vancill Towhead, surveys show adequate navigation depths. However, in reality, the channel shoals considerably. The surveys reflect the channel being artificially maintained by dredging. Repetitive dredging location in the Vancill Towhead reach that is being addressed by this HSR model, between river mile RM 68.0 and RM 67.0 generally takes place in the middle of the river channel and disposal is generally along the left descending bank (LDB) side of the channel (Nguyen 2012).

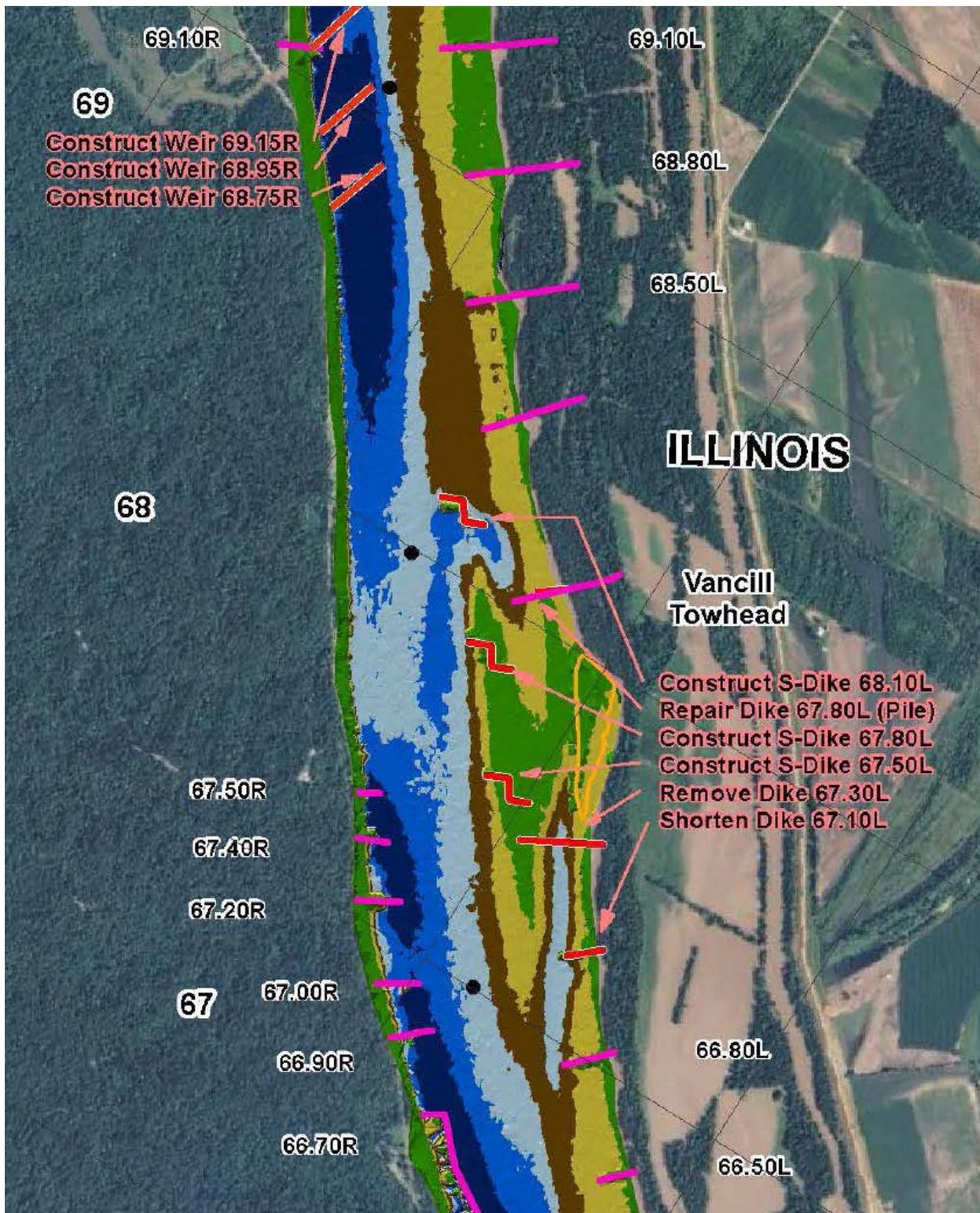


Figure 5 – Proposed Construction at Vancill Towhead: The graphic also shows the effects of the proposed project on channel bathymetry.

Phase V Construction

Construction of the projects will be accomplished during 2013 when there is sufficient water depth. Construction will include placing rock from a barge directly onto the river bank or substrate. For dike removal and shortening, the rock will be removed by backhoe and placed on a barge and relocated to a new site.

Phase V Operation and Maintenance

When necessary, damages to the rock structures may require additional rock. This will be accomplished in a method similar to construction, but the rock will be placed on an existing rock structure.

Phase V Conservation Measures

Construction of the diverter dikes and the modification of dikes at the entrance and exit of the Vancill Towhead side channel should increase flow, connectivity and habitat diversity within the side channel.

Species Covered in this Consultation:

The U.S. Fish and Wildlife Service's endangered species website was accessed on 4 December 2012 to determine what listed species may occur within the project area. Those species are included in Table 1.

Species	Fed Status	Habitat
Indiana bat (<i>Myotis sodalis</i>)	Endangered	Hibernacula: Caves and mines; Maternity and foraging habitat: small stream corridors with well developed riparian woods; upland and bottomland forests. (Jackson, Union, Cape Girardeau, Perry)
Gray bat (<i>Myotis grisescens</i>)	Endangered	Caves and mines; rivers & reservoirs adjacent to forests. (Jackson)
Least tern (interior population) (<i>Sterna antillarum</i>)	Endangered	Large rivers - nest on bare alluvial and dredge spoil islands. (Jackson, Union, Cape Girardeau, Perry)
Pallid sturgeon (<i>Scaphirhynchus albus</i>)	Endangered	Mississippi and Missouri Rivers, (Jackson, Union, Cape Girardeau, Perry)
Grotto sculpin (<i>Cottus</i> sp.)	Proposed as Endangered	Cave and surface streams. (Perry)

Table 1 - Listed Species in Project Area (Cape Girardeau and Perry Counties, Missouri and Union and Jackson Counties, Illinois)

Decurrent false aster (<i>Boltonia decurrens</i>)	Threatened	Disturbed alluvial soils. (Cape Girardeau)
Spectaclecase (<i>Cumberlandia monodonta</i>)	Endangered	Medium to large rivers with low to high gradients, and include shoals and riffles with slow to swift currents over coarse sand and gravel
Sheepnose (<i>Plethobasus cyphus</i>)	Endangered	Shallow areas in larger rivers and streams. Bourbeuse, Gasconade (Osage Fork), Meramec, and Mississippi Rivers

Effects Analysis

The proposed project includes constructing bendway weirs, chevrons, and dikes.

Gray Bat – The gray bat (*Myotis grisescens*) is listed as endangered and occurs in several Illinois and Missouri counties where it inhabits caves both summer and winter. This species forages over rivers and reservoirs adjacent to forests. No caves or concrete culverts would be impacted by the proposed action; therefore, this project would have “no effect” on the gray bat.

Indiana Bat – The range of the Indiana bat (*Myotis sodalis*) includes much of the eastern half of the United States, including Missouri and Illinois. Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females emerge from hibernation in late March or early April to migrate to summer roosts. During the summer, the Indiana bat frequents the corridors of small streams with well-developed riparian woods, as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, and over farm ponds in pastures. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A maternity colony may include from one to 100 individuals. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. Some males remain in the area near the winter hibernacula during summer months, but others disperse throughout the range of the species and roost individually or in small numbers in the same types of trees as females.

Disturbance and vandalism, improper cave gates and structures, natural hazards such as flooding or freezing, microclimate changes, land use changes in maternity range, and chemical contamination are the leading causes of population decline in the Indiana bat (USFWS 2000, 2004). To avoid impacting this species, tree clearing activities should not occur during the period of 1 April to 30 September.

Modification measures resulting in aquatic habitat improvement should contribute to the species’ forage base. Wing dike alteration and construction is anticipated to be primarily performed by river-based equipment and has minimal potential to affect Indiana bats because forested habitats would not be affected. Additionally, creation of secondary channels and associated island or shallow water habitat and scour holes through dike notching and construction is expected to provide bathymetric diversity necessary to provide habitat for a range of aquatic species and life stages. Islands which become naturally reforested over time would be expected to contribute to long-term forest species diversity and structural diversity beneficial to forest-dwelling bats, including the Indiana bat (USFWS 2004).

This project would not result in the destruction of any riparian habitat and construction is generally scheduled to occur in the winter months when Indiana bats are not present. Thus, wing dike modification and the construction of weirs, "S" dikes and chevrons to create diverse aquatic habitats "may affect but is not likely to adversely affect" the Indiana bat.

Least Tern – The interior population of the least tern (*Sterna antillarum*) is characterized as a colonial, migratory waterbird, which resides and breeds along the Mississippi River during the spring and summer. Least terns arrive on the Mississippi River from late April to mid-May. Reproduction takes place from May through August, and the birds migrate to the wintering grounds in late August or early September (USACE 1999b). Sparsely vegetated portions of sandbars and islands are typical breeding, nesting, rearing, loafing, and roosting sites for least terns along the Middle Mississippi River (MMR). Nests are often at higher elevations and well removed from the water's edge, a reflection of the fact that nesting starts when river stages are relatively high (USACE 1999b). In alluvial rivers, sandbars are dynamic channel bedforms. Individual sandbars typically wax and wane over time as fluvial processes adjust channel geometry according to varying sediment load and discharge, the construction of river engineering works, and other influences. There is limited data on site fidelity for Mississippi River least terns. Given the highly dynamic bed and planform of the historic river, ability to return to previously used colony sites is not likely a critical life history requirement. The availability of sandbar habitat to least terns for breeding, nesting, and rearing of chicks from 15 May to 31 August is a key variable in the population ecology of this water bird. Only portions of sandbars that are not densely covered by woody vegetation and that are emergent during the 15 May to 31 August period are potentially available to least terns (USACE 1999b). A 1999 report (USACE 1999b) estimated that there were approximately 20,412 acres of non-vegetated sandbar habitat above the MMR low water reference point (LWRP). About 4,975 acres (111 ac/RM) were located between the Mouth of the Ohio and Thebes Gap (RM 0-45) and 15,437 acres (103 ac/RM) between Thebes Gap and the Mouth of the Missouri River (RM 45-195). Currently, reoccurring nesting is known at Marquette Island (RM 50.5), Bumgard Island (RM 30), and Brown's Bar (RM 24.5-23.5) (USFWS 2004). Some nesting attempts have also been made at Ellis Island (RM 202), however these are not considered to be reoccurring.

Least terns are almost exclusively piscivorous (Anderson 1983), preying on small fish, primarily minnows (Cyprinidae). Prey size appears to be a more important factor determining dietary composition than preference for a particular species or group of fishes (Moseley, 1976; Whitman, 1988, USACE 1999b). Fishing occurs close to the nesting colonies and may occur in both shallow and deep water, in main stem river habitats or backwater lakes or overflow areas. Radiotelemetry studies have shown that terns will travel up to 2.5 miles to fish (Sidle and Harrison, 1990, USACE 1999b). Along the Mississippi River, individuals are commonly observed hovering and diving for fish over current divergences (boils) in the main channel, in areas of turbulence and eddies along natural and revetted banks, and at "run outs" from floodplain lakes where forage fish may be concentrated (USACE 1999b).

According to the Service, existing wing dikes have the ongoing effect of altering natural river habitat processes, thereby reducing the quality, quantity, and diversity of habitat in the MMR. The Service asserts that continued disruption of natural processes will affect least terns by (1) reducing the availability of bare sandbar nesting habitat; (2) reducing the availability of foraging habitat; and (3) reducing the abundance of forage food (USFWS 2000).

Wing dikes are prominent channel regulating features common in main channel habitats. They are used to concentrate flow in the main channel in order to reduce the need for dredging. Wing dams are usually constructed in groups called dike fields. These areas are depositional zones that often fill from the bank outward toward the channel. Notching dikes, lowering their profile, adding trails, or altering their angle to the channel are some actions that can be used to increase habitat diversity through the creation of new scour holes, sandbars, and flow refugia. When wing dike alteration is done on the dike field level, or in association with new structure placements, new side channels, islands, and off-channel areas can be created (USFWS 2004). This project involves constructing "S" dikes, weirs, chevrons and modifying

dikes. Habitat diversity in the area should be increased by the creation of secondary channels. The weirs will reduce the possibility of point bar development and shallow feeding areas.

Thus, the project "may affect but is not likely to adversely affect" the least tern.

Pallid Sturgeon – It is the position of the U.S. Fish and Wildlife Service (2000) that over time, channel training structures have adversely affected pallid sturgeon by affecting the quality and quantity of habitats in the MMR to which the species is adapted (e.g., braided channels, irregular flow patterns, flood cycles, extensive microhabitat diversity, and turbid waters). According to the Service, this loss of habitat has reduced pallid sturgeon reproduction, growth, and survival by (1) decreasing the availability of spawning habitat; (2) reducing larval and juvenile pallid sturgeon rearing habitat; (3) reducing the availability of seasonal refugia; and (4) reducing the availability of foraging habitat (USFWS 2000). Additionally, some authors believe that loss of habitat contributes to the hybridization of pallid and shovelnose sturgeon (Carlson et al. 1985, Keenlyne et al. 1993, Campton et al. 1995, USFWS 2000). The Service also asserts that these habitat changes have also reduced the natural forage base of the pallid sturgeon, and is another likely contributing factor in its decline (Mayden and Kuhajda 1997, USFWS 2000). The Service states that channel training structures have also altered the natural hydrograph of the MMR by contributing to higher water surface elevations at lower discharges than in the past and to a downward trend in annual minimum stages (Simons et al. 1974, Wlosinski 1999, USFWS 2000). Thus, as a result, previously aquatic habitats are now dry at low discharges (Wlosinski 1999). According to the Service, this has potentially reduced the availability of pallid sturgeon spawning habitat through the loss of habitat complexity (USFWS 2000).

As stated in the USFWS 2000 Biological Opinion "bendway weirs were developed to inhibit point-bar establishment in bends and channel crossings and to reduce the need for dredging in these areas. They consist of a series of submerged dikes (15 ft. below the LWRP) generally constructed around the outer edge of a river bend. In recent years, bendway weirs have also been utilized in other depositional areas in the MMR. Each dike is angled 30 degrees upstream of perpendicular to divert flow, in progression, towards the inner bank. The result is hydraulically controlled point bar development and reduced channel downcutting throughout the bend."

Also the 2000 USFWS Biological Opinion offers "In general terms, the results of various studies indicate that fish redistribute across the channel cross-section from the inside bank to the outside bank as a result of bendway weirs (USFWS 2000). This is most likely in response to increases in macroinvertebrate abundance (Ecological Specialists, Inc. 1997) and the low velocity fields that develop behind each weir. Bendway weirs also cause channel bottom aggradation along the outside bend, which may have some benefit by reducing water level fluctuations in adjacent side channels. This benefits pallid sturgeon by (1) increasing the availability of larval and juvenile rearing habitat; (2) increasing the availability of seasonal refugia; and (3) increasing substrate diversity, which influences macroinvertebrate production, thus, increasing the natural forage base of pallid sturgeon."

In addition, the 2000 USFWS Biological Opinion states "While the above beneficial effects of bendway weirs are noted, the effect of bendway weirs on inside bend point bar habitat is unclear." (USFWS 2000). As stated previously, bendway weirs control point bar development and are also being utilized to address other depositional areas. Bendway weirs also increase water velocities along the inside bend by redirecting channel flow. Shallow water, low slope, sandbar habitat is thought to be important to juvenile pallid sturgeon, and perhaps, other life stages. According to Sheehan et al. (1998) pallid sturgeon exhibited a positive selection for downstream island tips (depositional areas) in terms of habitat use versus availability. As existing sandbar habitat continues to accrete and revert to woody vegetation, aquatic sandbar habitat will continue to decline in quantity. Thus, bendway weirs likely reduce larval and juvenile rearing habitat and feeding habitat for all life stages." However, a study completed in 2011 by the St. Louis District Hydrologic and Hydraulics Section entitled "*Analysis of the Effects of Bendway Weir Construction on Channel Cross-Sectional Geometry*" (USACE 2011) concluded that "The average slope decreased for 59 percent of all cross sections, with an average decrease of 1.27 ft. per 100 ft. The 10 ft vertical segment slopes were roughly even between decreases and increases, with ~70% of the slope

changes falling with natural variation as defined by the study methodology. These results indicate the bendway weirs are largely achieving their primary goal of widening the navigable portion of the channel without a serious detrimental effect on the inside bar slope.”

Wing dikes are prominent channel regulating features common in main channel habitats. They are used to concentrate flow in the main channel in order to reduce the need for dredging. Wing dams are usually constructed in groups called dike fields. These areas are depositional zones that often fill from the bank outward toward the channel. Notching dikes, lowering their profile, adding trails, or altering their angle to the channel are some actions that can be used to increase habitat diversity through the creation of new scour holes, sandbars, and flow refugia. When wing dike alteration is done on the dike field level, or in association with new structure placements, new side channels, islands, and off-channel areas can be created (USFWS 2004).

Wing dam and dike fields within the MMR are currently utilized by pallid sturgeon (Sheehan and Heidinger 2001, USACE 2005). Deep scour holes that develop in association with wing dams provide seasonal refugia, particularly during winter. Pallid sturgeon also utilize the sand bar habitat that accretes between wing dikes and chevron dikes. Although their preference for this habitat is poorly understood, at a minimum it is believed these areas provide important foraging habitat (USFWS 2004). Though outside the project area, the Carterville Fisheries Research Office recently collected juvenile sturgeon in high concentrations over the flooded sandbar on the western shore of Rockwood Island between RM 102 and 101. Juvenile sturgeon were also collected from Liberty Chute below the rock closing structure at RM 101.1, and juvenile shovelnose were collected within Liberty Chute (USACE 2005). Juvenile sturgeon were also collected over flooded portions of the Mile 100 Islands during the spring of 2005 (USACE 2005). While the 2000 Biological Opinion RPA identified modification of channel training structures as a medium priority for pallid sturgeon, wing dam/dike alterations are critical to improving habitat diversity in the MMR for a wide range of species (USFWS 2004).

Thus, “S” dike construction and dike modifications should result in the diversification of aquatic habitats, including formation of secondary channels and shallow water habitats beneficial to the pallid sturgeon. The rock dike substrate provides habitat for epilithic macroinvertebrates that are capable of colonizing in very high densities and providing an important food source for fish (USFWS 2000).

Construction activities may result in short-term adverse effects for pallid sturgeon. Activities that impact any existing deepwater habitat may result in displacement of pallid sturgeon. Disruption of existing sand bar habitat may impact foraging habitat. However, these adverse effects are expected to occur at a local, individual dike scale. The creation of scour holes and side channel and associated island or shallow water habitat through dike construction is expected to create additional larval/juvenile rearing habitat and seasonal refugia, and improve forage food production (USFWS 2004).

The 2012 Stone Dike Alteration study noted that the Vancill study reach includes known foraging habitat for least terns and habitat for pallid sturgeon. There are known pallid sturgeon locations at RM 70.5L, 70.3R, 69.8L, 69.5L, 62.8 and 63.2. In the pre-HSR study discussion, the US Fish and Wildlife Service (USFWS) stated that in the reach being studied, there was a gravel bar along the right descending bank (RDB) at river mile RM 70.3. He also noted that some pallid sturgeon were found at the downstream end of the Vancill Towhead bar (Corps 2012).

It is the position of the St. Louis District that short-term adverse impacts that may occur are limited, and the long-term impacts associated with reduced dredging and increased habitat diversity, which is expected as a consequence of river training structure modification and weir placement, are predicted to be beneficial to pallid sturgeon. Thus, this project should result in the diversification of aquatic habitats, including formation of secondary channels and shallow water habitats beneficial to fish in general. Thus the project “may affect but is not likely to adversely affect” the pallid sturgeon.

Decurrent false aster – The decurrent false aster is presently known from scattered floodplain localities from the confluence of the Mississippi River with the Illinois River south to Madison County, Illinois (USFWS 1990a). Its natural habitat was lake shores and stream banks with abundant light. Populations presently grow in natural habitat, but are more common in disturbed lowland areas where

they appear to be dependent on human activity for survival (USFWS 1990). Because this species is not known to occur in the project area, the project “may affect, but is not likely to adversely affect” the decurrent false aster.

Sheepnose mussel – The sheepnose is listed as a federally endangered species and occurs in the Meramec River in Jefferson, Missouri. This species inhabits gravel and mixed sand and gravel habitats in medium to large rivers.

The sheepnose is thought to be extant in five pools (3, 5, 15, 20 and 22) and in very low numbers. In the upper Mississippi River, the sheepnose is an example of a rare species becoming rarer. Despite the discovery of juvenile recruitment in Mississippi River Pool 7, the sheepnose population levels in the upper Mississippi River appear to be very small and of questionable long-term viability given the threats outlined below. The sheepnose and other mussel populations in the upper Mississippi River are seriously threatened by zebra mussels. Even if some level of sheepnose recruitment was documented, the status of this species in the Mississippi is highly jeopardized, with imminent extirpation a distinct possibility (USFWS 2003). This project could potentially benefit this species by providing some of its necessary habitat features, i.e. shallow shoal habitats and flow refugia. This project “may affect, but not likely to adversely affect the sheepnose mussel.

Spectaclecase – This federally endangered mussel is “known to occur in the Meramec River and may potentially occur in the Mississippi River north of Monroe County, Illinois” (USFWS undated). The spectaclecase is a large mussel attaining 9 to 10 inches in length. Its shell is greatly elongated, compressed, and relatively thin. Its historical distribution includes 45 rivers found in much of the Mississippi River basin, Ohio River system, Cumberland and Tennessee River basins, and part of the lower Mississippi River basin in Arkansas. In Cummings and Mayer (1992), the range for this species as displayed in Illinois and Missouri includes the middle and upper Mississippi River, Illinois River, and an area south of the Missouri River corresponding largely with the Ozark highlands. A distribution map by Oesch (1995) also shows two records from the Mississippi River near Clarksville, Missouri. However, in an assessment of the status of population viability at known locations of occurrence across its range, USFWS (undated) considered all spectaclecase populations in the Mississippi River in Illinois and Missouri to be either extirpated or “non-viable or unknown.” None were classified as having “some evidence of viability.”

Habitat destruction and degradation are the chief causes of imperilment, including reservoir construction, channelization, chemical contamination, mining, and sedimentation. Habitats are found in medium to large rivers with low to high gradients, and include shoals and riffles with slow to swift currents over coarse sand and gravel. Substrates sometimes consist of mud, cobble, and boulders (USFWS 2011).

The spectaclecase is not known to exist in any nearby locations. The proposed construction “may affect, but is not likely to adversely affect” the spectaclecase mussel.

Grotto sculpin - The **grotto sculpin** (*Cottus* sp.) is a candidate species that is found in cave streams. No cave streams will be impacted by this project; therefore, this project will have “no effect” on this species.

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United States Department of the Interior



U.S. FISH AND WILDLIFE SERVICE
Marion Illinois Sub-Office (ES)
8588 Route 148
Marion, Illinois 62959
(618) 997-3344

February 22, 2013

Colonel Christopher G. Hall
U.S. Army Corps of Engineers
St. Louis District
1222 Spruce Street
St. Louis, Missouri 63103-2833

Attn: Francis Walton

Dear Colonel Hall:

Thank you for your letter dated December 20, 2012, requesting review of the Tier II Biological Assessment (BA) prepared for the Grand Tower, Crawford Towhead, and Vancill Towhead Regulating Works Projects. The Grand Tower Regulating Works Project was previously coordinated in a Tier II BA dated August 8, 2005, and in a response letter from the Service dated September 8, 2005, thus that project will not be addressed in this letter. The Crawford Towhead Regulating Works Project was partially addressed by a Tier II BA dated October 1, 2009, and in a subsequent response letter from the Service dated May 20, 2010. The Service recommends that a separate BA be developed to address the remaining portion of the Crawford Towhead Regulating Works Project. The remainder of this letter addresses the Vancill Towhead Regulating Works Project located in Union County, Illinois and Cape Girardeau County, Missouri.

The proposed Vancill Towhead project involves construction of 3 weirs, 3 diverter (S-Dike) dikes, repair of a dike, shortening of a dike, and the removal of one wing dike between approximate Upper Mississippi River miles 67.0 and 70.0. The Tier II Biological Assessment for this project was prepared in order to comply with the requirements of the 2000 Biological Opinion for Operation and Maintenance of the 9-Foot Navigation Channel on the Upper Mississippi River System. The 2000 Biological Opinion was prepared as a result of the programmatic consultation under Section 7 of the Endangered Species Act of 1973, as amended, which evaluated the effects of operation and maintenance of the 9-foot navigation channel on federally listed threatened and endangered species.

The Tier II Biological Assessment evaluated the impacts of the proposed project on the endangered gray bat (*Myotis grisescens*), endangered Indiana bat (*Myotis sodalis*), endangered least tern (*Sterna antillarum*), endangered pallid sturgeon (*Scaphirhynchus albus*), endangered spectaclecase mussel (*Cumberlandia monodonta*), endangered sheepsnose mussel (*Plethobasus cyphus*), threatened decurrent false aster (*Boltonia decurrens*), and proposed as endangered

grotto sculpin (*Cottus sp.*). The Corps had determined that the proposed project will have no effect on the gray bat and grotto sculpin. This precludes the need for further action on this project as required under Section 7 of the Endangered Species Act of 1973, as amended, for the gray bat and grotto sculpin. The Corps has determined that the proposed project is not likely to adversely affect the Indiana bat, least tern, spectaclecase mussel, sheepnose mussel, and decurrent false aster. Based on the location and description of the proposed project, the Service concurs that the proposed project is not likely to adversely affect the Indiana bat, least tern, spectaclecase mussel, sheepnose mussel, and decurrent false aster.

The purpose of constructing the proposed project is to inhibit point-bar establishment and eliminate channel crossings, thus reducing the need for channel maintenance dredging. Our concern is that the proposed construction is likely to reduce/remove habitats utilized by larval and juvenile pallid sturgeon. Information in the BA indicates that the construction of “S” dikes and dike modifications is expected to form secondary channels and shallow water habitat that will provide additional larval/juvenile rearing habitat and seasonal refugia, and improve forage food production which should result in long-term beneficial effects for pallid sturgeon. Thus, the Corps has determined that the proposed project is not likely to adversely affect the pallid sturgeon. It is unclear to the Service whether these river training structure modifications (with resulting hydro-geomorphologic changes) and the reduction in channel maintenance dredging can fully compensate for the project impacts. Thus, the Service does not concur that the proposed project is not likely to adversely affect the pallid sturgeon. However, the Service concurs that the proposed project, as designed, meets the requirements of the Reasonable and Prudent Measures with implementing Terms and Conditions described in the 2000 Biological Opinion. Should this project be modified, or new information indicate listed or proposed species may be affected, consultation or additional coordination with this office, as appropriate, should be initiated.

An additional concern with the proposed project is that it falls within the “control” reach for the Navigation and Ecosystem Sustainability Program (NESP), Herculaneum Side Channel Restoration Project. Due to the limited funding for NESP, discussion has occurred about utilizing the Herculaneum reach as a “control” reach for this project. The Service recommends that a monitoring plan be developed to evaluate this project and utilize data previously collected for the Herculaneum Side Channel Restoration Project.

Thank you for the opportunity to provide comment on the Tier II Biological Assessment. For additional coordination, please contact me at (618) 997-3344, ext. 345.

Sincerely,

/s/ Matthew T. Mangan

Matthew T. Mangan
Biologist in Charge

cc: IDNR (Atwood)
MDC (Herzog, Sternburg)

**TIER II BIOLOGICAL ASSESSMENT
CRAWFORD TOWHEAD
MRM 74 – 72
UNION COUNTY, ILLINOIS
CAPE GIRARDEAU COUNTY, MISSOURI
ON THE
MIDDLE MISSISSIPPI RIVER SYSTEM**

**Planning and Environmental Branch
Regional Planning and Environmental Division North
U.S. Army Corps of Engineers
St. Louis District
Attn: Francis Walton
1222 Spruce Street
St. Louis, Missouri 63103-2833
Commercial Telephone Number: (314) 331-8102**

August 2013

**TIER II BIOLOGICAL ASSESSMENT
CRAWFORD TOWHEAD
MRM 74 - 72
UNION COUNTY, ILLINOIS
CAPE GIRARDEAU COUNTY, MISSOURI**

1. Programmatic Endangered Species Compliance

A programmatic (Tier I) consultation, conducted under Section 7 of the Endangered Species Act, considered the systemic impacts of the operation and maintenance of the 9-Foot Channel Navigation Project on the Upper Mississippi River System and addressed listed species as projected 50 years into the future (U.S. Fish and Wildlife Service 2000). The consultation did not include individual, site specific project effects or new construction. It was agreed that site specific project impacts and new construction impacts would be handled under a separate Tier II consultation. Although channel structure impacts were covered at the program and ecosystem level under the Tier I consultation, other site and species specific impacts may occur. As such, the Crawford Towhead project requires a Tier II consultation.

2. Project Authority

The project is authorized under the Regulating Works Project that was authorized by the River and Harbor Acts of 1910, 1927, and 1930. The project provides a safe and dependable navigation channel. It consists of a navigation channel 9-feet deep and not less than 300 feet wide with additional width in the bends, from the mouth of the Ohio River to the mouth of the Missouri River, a distance of approximately 195 miles. Project improvements are achieved by means of dikes, revetment, construction dredging, and rock removal. Crawford Towhead is located in the Big Muddy Reach (MRM 80-71).

3. Project Need

The purpose of the Crawford Towhead project is to increase flow in the navigation channel to reduce the need for dredging and enhance the aquatic habitat diversity within the reach. The 2012 Stone Dike Alteration Report stated the opportunity for habitat improvement is rated as high for the LDB MRM 73 towhead chute. Figure 1 shows the project area.

The Crawford Towhead project includes the construction of two chevrons and the rootless dike extension between MRM 74 and 72. Specifically, the Crawford Towhead project would involve the following actions in order to attain the desired conditions:

Crawford Towhead		
Project Action	Project Description	Rationale
Chevron 73.65L	Construct 300 ft x 300 ft chevron. Top elevation of the chevron will be +18.5 LWRP.	Needed to constrict the navigation channel.
Rootless Dike 72.9L	Place 300 foot rootless dike. Top elevation of the chevron will be +18.5 LWRP.	Needed to maintain contraction width and improve bathymetric diversity.
Chevron 72.55L	Construct 300 ft x 300 ft chevron. Top elevation of the chevron will be +18.5 LWRP.	Needed to maintain contraction width in the navigation channel.

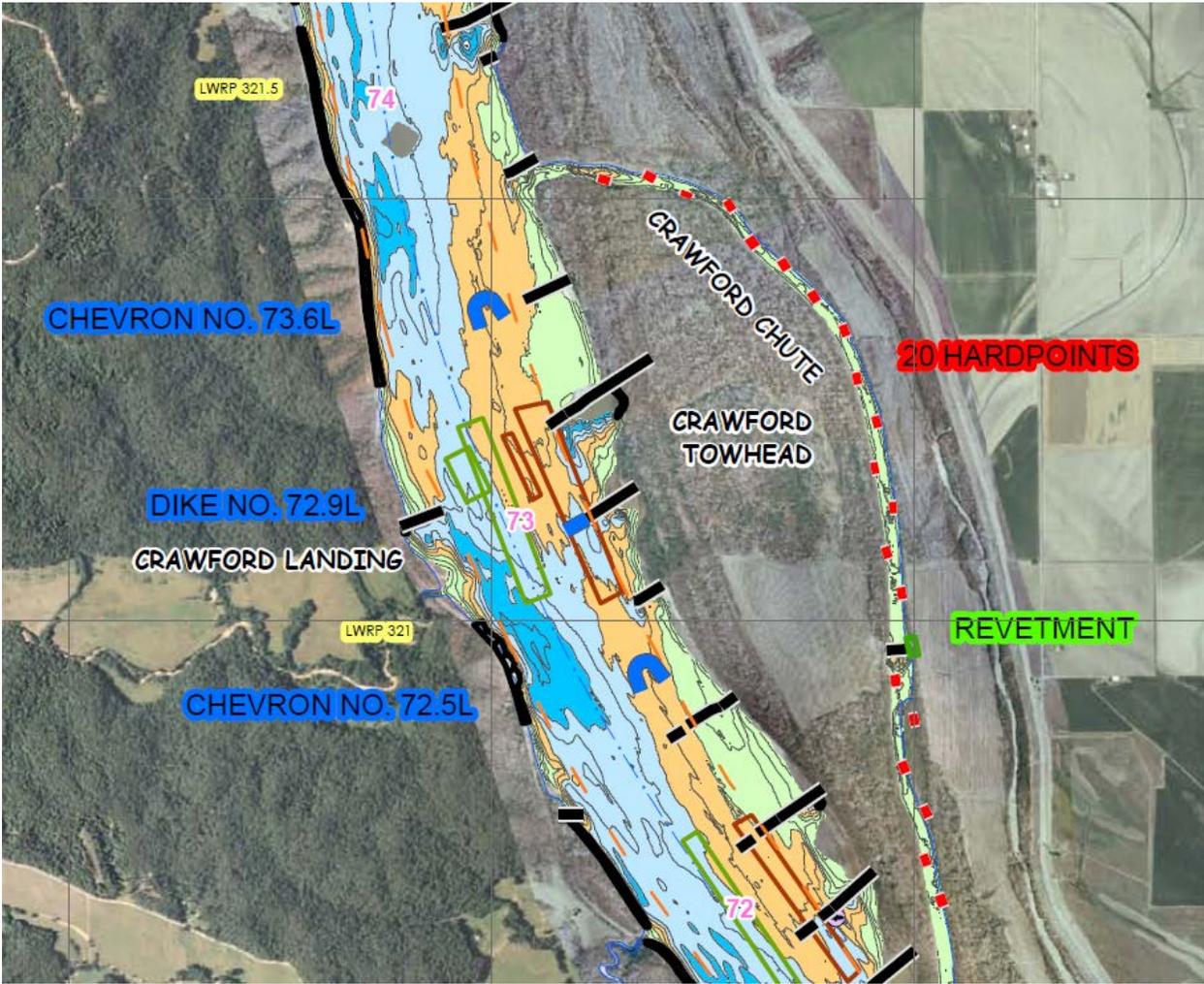


Figure 1

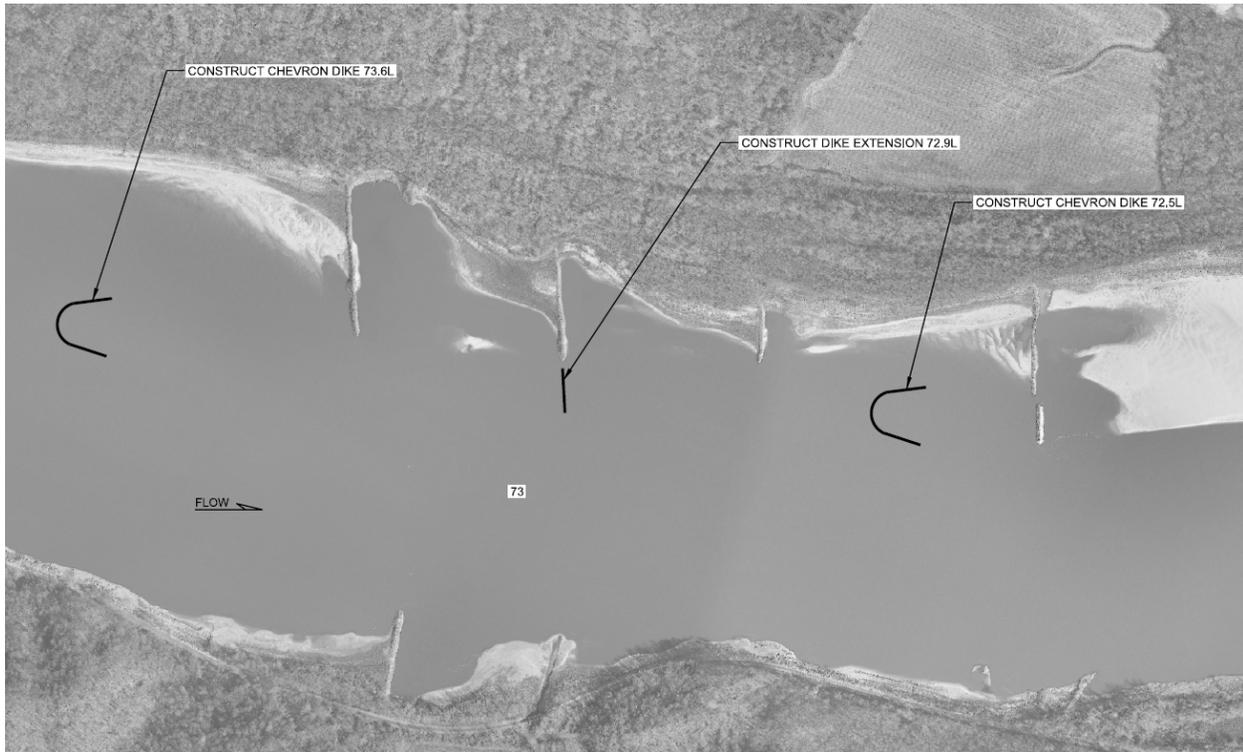


Figure 2 – Crawford Towhead

4. Species Covered in this Consultation:

A list of species that are likely to occur within the Crawford Towhead project area (Union Co. Illinois; Cape Girardeau, Missouri) was obtained from the U.S. Fish and Wildlife Service Region 3 website on August 5, 2013. Those species are included in Table 1.

This Big Muddy dikes subarea (MRM 71-80) is foraging habitat for least terns and habitat for pallid sturgeon. There are pallid sturgeon locations at RM 69.5, 69.6, 69.8, 70.3, 71.8, 77.1, 78.2, 78.7, 79.5, and 79.8 especially around Cottonwood Island. Cottonwood Chute, MRM 77 to 80, including its substrate, is one of the most valuable habitat areas for the pallid sturgeon in the MMR.

Table 1 - Listed Species in Project Area		
Species	Federal Status	Habitat
Indiana bat (<i>Myotis sodalis</i>)	Endangered	Hibernacula: Caves and mines; Maternity and foraging habitat: small stream corridors with well developed riparian woods; upland and bottomland forests
Least tern (interior population) (<i>Sterna antillarum</i>)	Endangered	Large rivers - nest on bare alluvial and dredge spoil islands
Pallid sturgeon (<i>Scaphirhynchus albus</i>)	Endangered	Mississippi and Missouri Rivers

Table 1 - Listed Species in Project Area		
Decurrent false aster (<i>Boltonia decurrens</i>)	Threatened	Disturbed alluvial soils. (Cape Girardeau)

5. Impact Assessment

Introduction: The proposed project includes constructing two chevrons and a rootless dike extension. Dikes and wing dams are prominent channel regulating features common in main channel habitats in the Middle Mississippi River. They are used to concentrate flow in the main channel in order to reduce the need for dredging. Chevron dikes were designed to divert flow into a portion of the navigation channel impacted by sediment accumulation on the point bar at a river bend where the river channel splits.

See Figure 3 for a graphic that shows the expected deposition and scour patterns at the Crawford Towhead project area.

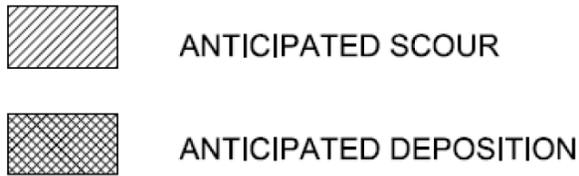


Figure 3 – Anticipated Deposition and Scour Patterns at Proposed Chevrons and Rootless Dike Extension MRM 72-74

Indiana Bat – The range of the Indiana bat (*Myotis sodalis*) includes much of the eastern half of the United States, including Missouri and Illinois. Indiana bats migrate seasonally between winter hibernacula and summer roosting habitats. Winter hibernacula include caves and abandoned mines. Females emerge from hibernation in late March or early April to migrate to summer roosts. During the

summer, the Indiana bat frequents the corridors of small streams with well-developed riparian woods, as well as mature upland forests. It forages for insects along stream corridors, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, and over farm ponds in pastures. Females form nursery colonies under the loose bark of trees (dead or alive) and/or cavities, where each female gives birth to a single young in June or early July. A maternity colony may include from one to 100 individuals. A single colony may utilize a number of roost trees during the summer, typically a primary roost tree and several alternates. Some males remain in the area near the winter hibernacula during summer months, but others disperse throughout the range of the species and roost individually or in small numbers in the same types of trees as females.

Disturbance and vandalism, improper cave gates and structures, natural hazards such as flooding or freezing, microclimate changes, land use changes in maternity range, and chemical contamination are the leading causes of population decline in the Indiana bat (USFWS 2000, 2004). To avoid impacting this species, tree clearing activities should not occur during the period of 1 April to 30 September.

Modification measures resulting in aquatic habitat improvement should contribute to the species' forage base. Rootless dike extension and chevron construction is anticipated to be primarily performed by river-based equipment and has minimal potential to affect Indiana bats because forested habitats would not be affected. Additionally, creation of secondary channels and associated island or shallow water habitat and scour holes through rootless dike extension and chevron construction is expected to provide bathymetric diversity necessary to provide habitat for a range of aquatic species and life stages. Islands which become naturally reforested over time would be expected to contribute to long-term forest species diversity and structural diversity beneficial to forest-dwelling bats, including the Indiana bat (USFWS 2004).

This project would not result in the destruction of any riparian habitat and construction is scheduled to occur in the winter months when Indiana bats are not present. Thus, construction of the chevrons and rootless dike extension "may affect but is not likely to adversely affect" the Indiana bat.

Least Tern – The interior population of the least tern (*Sterna antillarum*) is characterized as a colonial, migratory waterbird, which resides and breeds along the Mississippi River during the spring and summer. Least terns arrive on the Mississippi River from late April to mid-May. Reproduction takes place from May through August, and the birds migrate to the wintering grounds in late August or early September (USACE 1999). Sparsely vegetated portions of sandbars and islands are typical breeding, nesting, rearing, loafing, and roosting sites for least terns along the Middle Mississippi River (MMR). Nests are often at higher elevations and well removed from the water's edge, a reflection of the fact that nesting starts when river stages are relatively high (USACE 1999). In alluvial rivers, sandbars are dynamic channel bedforms. Individual sandbars typically wax and wane over time as fluvial processes adjust channel geometry according to varying sediment load and discharge, the construction of river engineering works, and other influences. There is limited data on site fidelity for Mississippi River least terns. Given the highly dynamic bed and planform of the historic river, ability to return to previously used colony sites is not likely a critical life history requirement. The availability of sandbar habitat to least terns for breeding, nesting, and rearing of chicks from 15 May to 31 August is a key variable in the population ecology of this waterbird. Only portions of sandbars that are not densely covered by woody vegetation and that are emergent during the 15 May to 31 August period are potentially available to least terns (USACE 1999). A 1999 report (USACE 1999) estimated that there were approximately 20,412 acres of non-vegetated sandbar habitat above the MMR low water reference point (LWRP). About 4,975 acres (111 ac/RM) were located between the Mouth of the Ohio and Thebes Gap (RM 0-45) and 15,437 acres (103 ac/RM) between Thebes Gap and the Mouth of the Missouri River (RM 45-195). At the time of the report, reoccurring nesting was known at Marquette Island (RM 50.5), Bumgard Island (RM 30), and Brown's Bar (RM 24.5-23.5) (USFWS 2004). Some nesting attempts had also been made at Ellis Island (RM 202), however these were not considered to be reoccurring.

Least terns are almost exclusively piscivorous (Anderson 1983), preying on small fish, primarily minnows (Cyprinidae). Prey size appears to be a more important factor determining dietary composition than preference for a particular species or group of fishes (Moseley, 1976; Whitman, 1988, USACE 1999). Fishing occurs close to the nesting colonies and may occur in both shallow and deep water, in main stem river habitats or backwater lakes or overflow areas. Radiotelemetry studies have shown that terns will travel up to 2.5 miles to fish (Sidle and Harrison, 1990, USACE 1999). Along the Mississippi River, individuals are commonly observed hovering and diving for fish over current divergences (boils) in the main channel, in areas of turbulence and eddies along natural and revetted banks, and at "run outs" from floodplain lakes where forage fish may be concentrated (USACE 1999, Niles and Hartman 2009).

According to the Service, existing wing dikes have the ongoing effect of altering natural river habitat processes, thereby reducing the quality, quantity, and diversity of habitat in the MMR. The Service asserts that continued disruption of natural processes will affect least terns by (1) reducing the availability of bare sandbar nesting habitat; (2) reducing the availability of foraging habitat; and (3) reducing the abundance of forage food (USFWS 2000).

This project involves constructing a rootless dike extension within a dike field and two chevrons. Wing dikes are prominent channel regulating features common in main channel habitats. They are used to concentrate flow in the main channel in order to reduce the need for dredging. Wing dams are usually constructed in groups called dike fields. These areas are depositional zones that often fill from the bank outward toward the channel. When wing dike alteration is done on the dike field level, or in association with new structure placements, new side channels, islands, and off-channel areas can be created (USFWS 2004). Habitat diversity in the area should be increased by the creation of secondary channels, along with deep scour holes and shoaling within the dike fields, especially with the effect of the rootless dike as shown on Figure 3.

By completing regulating works projects at a local scale, long-term beneficial effects for least tern should accrue from the incorporation of structure modifications resulting in the creation of additional side channels and sandbars. Such activities may create additional nesting and rearing habitat and improve forage food production.

Thus dike and chevron construction should result in the diversification of aquatic habitats, including formation of secondary channels and shallow water habitats beneficial to the least tern, as well as fish in general (the species' forage base), and "may affect but are not likely to adversely affect" the least tern.

It is anticipated that the project will be completed prior to least tern nesting.

Pallid Sturgeon (*Scaphirhynchus albus*) - The U.S. Fish and Wildlife Service (2000) has held the position that over time, channel training structures have adversely affected pallid sturgeon by affecting the quality and quantity of habitats in the MMR to which the species is adapted (e.g., braided channels, irregular flow patterns, flood cycles, extensive microhabitat diversity, and turbid waters). According to the Service, this loss of habitat has reduced pallid sturgeon reproduction, growth, and survival by (1) decreasing the availability of spawning habitat; (2) reducing larval and juvenile pallid sturgeon rearing habitat; (3) reducing the availability of seasonal refugia; and (4) reducing the availability of foraging habitat (USFWS 2000). Additionally, some authors believe that loss of habitat contributes to the hybridization of pallid and shovelnose sturgeon (Carlson et al. 1985, Keenlyne et al. 1993, Campton et al. 1995, USFWS 2000), although a study by Hartfield and Kuhajda (Hartfield et al. 2009) disputes that conclusion. Hartfield and Kuhajda's review found no evidence of any direct link between habitat modification and hybridization in species of *Scaphirhynchus*. The Service also asserts that these habitat changes have also reduced the natural forage base of the pallid sturgeon, and is another likely contributing factor in its decline (Mayden and Kuhajda 1997, USFWS 2000). The Service states that channel training structures have also altered the natural hydrograph of the MMR by contributing to higher water surface elevations at lower discharges than in the past and to a downward trend in annual minimum stages (Simons et al. 1974, Wlosinski 1999, USFWS 2000). Thus, as a result, previously aquatic habitats are

now dry at low discharges (Wlosinski 1999). According to the Service, this has potentially reduced the availability of pallid sturgeon spawning habitat through the loss of habitat complexity (USFWS 2000).

Wing dam and dike fields within the MMR are currently utilized by pallid sturgeon, including the project study area between Mississippi River miles 90.0-67.0 (Sheehan and Heidinger 2001, USACE 2005). Deep scour holes that develop in association with wing dams and rootless dikes provide seasonal refugia, particularly during winter. Pallid sturgeon also utilize the sand bar habitat that accretes between wing dikes. Although their preference for this habitat is poorly understood, at a minimum it is believed these areas provide important foraging habitat (USFWS 2004). Though outside the project area, the Carterville Fisheries Research Office has collected juvenile sturgeon in high concentrations over the flooded sandbar on the western shore of Rockwood Island between RM 102 and 101. Juvenile sturgeon were also collected from Liberty Chute below the rock closing structure at RM 101.1, and juvenile shovelnose were collected within Liberty Chute (USACE 2005). Juvenile sturgeon were also collected over flooded portions of the Mile 100 Islands during the spring of 2005 (USACE 2005). The rock dike substrate provides habitat for epilithic macroinvertebrates that are capable of colonizing in very high densities and providing an important food source for fish (USFWS 2000).

Chevron dikes were designed to divert flow into a portion of the navigation channel impacted by sediment accumulation on the point bar at a river bend where the river channel splits. The dikes divert flow into the main channel by presenting the hydraulic appearance of a solid object without isolating the side channel with a closing structure. Flow between the structures maintains a permanent side channel connection, which provides important off-channel habitat for fishes. The rock dike substrate provides habitat for epilithic macroinvertebrates that are capable of colonizing in very high densities and providing an important food source for fish (USFWS 2000). As shown in Figure 2, chevron dikes also create habitat heterogeneity and appear to increase invertebrate abundance and diversity (Ecological Specialist, Inc. 1997, USFWS 2000) and provide useful and valuable habitat for a large variety of riverine fishes (Atwood 1997, USFWS 2000). According to Sheehan et al. (1998), pallid sturgeon exhibit a strong preference for downstream island tips. Over the long-term, construction of chevrons in the MMR would likely benefit pallid sturgeon by improving habitat diversity, including restoration of shallow water sandbar or island tip habitat. This project involves the construction of two chevron dikes which would be configured to maintain flow between the chevron structure and the adjacent shoreline and which should promote the formation of a scour hole, and shoaling area, sandbar, or island.

Construction activities may result in short-term adverse effects for pallid sturgeon. Activities that impact any existing deepwater habitat may result in displacement of pallid sturgeon. Disruption of existing sand bar habitat may impact foraging habitat. However, these adverse effects are expected to occur at a local, individual dike scale. By completing regulating works projects with incorporated modifications to increase habitat diversity at the scale of the dike field, long-term beneficial effects for pallid sturgeon should result. The creation of scour holes and side channel and associated island or shallow water habitat through dike extension and chevron construction is expected to create additional larval/juvenile rearing habitat and seasonal refugia, and improve forage food production (USFWS 2004).

It is the position of the St. Louis District that short-term adverse impacts that may occur are insignificant, and the long-term impacts associated with reduced dredging and increased habitat diversity, which is expected as a consequence of river training structure construction and modification, are predicted to be beneficial to pallid sturgeon. Thus, rootless wing dike extension and chevron dike construction would result in the creation of diverse aquatic habitats that would be beneficial to fish in general, and "may affect but is not likely to adversely affect" the pallid sturgeon.

Decurrent false aster – The decurrent false aster is presently known from scattered floodplain localities from the confluence of the Mississippi River with the Illinois River south to Madison County, Illinois (USFWS 1990). Its natural habitat was lakeshores and stream banks with abundant light. Populations presently grow in natural habitat, but are more common in disturbed lowland areas where they appear to be dependent on human activity for survival (USFWS 1990). Because this species is not known to occur in the project area, the project should have “no affect” on the decurrent false aster.

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United States Department of the Interior



U.S. FISH AND WILDLIFE SERVICE
Marion Illinois Sub-Office (ES)
8588 Route 148
Marion, Illinois 62959
(618) 997-3344

August 9, 2013

Colonel Christopher G. Hall
U.S. Army Corps of Engineers
St. Louis District
1222 Spruce Street
St. Louis, Missouri 63103-2833

Attn: Francis Walton

Dear Colonel Hall:

Thank you for your email dated August 8, 2013, requesting review of the Tier II Biological Assessment prepared for the Crawford Towhead Regulating Works Project located in Union County, Illinois and Cape Girardeau County, Missouri. The proposed project involves constructing two chevrons and a rootless dike extension between approximate Upper Mississippi River (UMR) miles 72.0 and 74.0. Previous work for this project included the construction of three rootless dike extensions between UMR miles 71.9 and 72.4. The Tier II Biological Assessment was prepared in order to comply with the requirements of the 2000 Biological Opinion for Operation and Maintenance of the 9-Foot Navigation Channel on the Upper Mississippi River System. The 2000 Biological Opinion was prepared as a result of the programmatic consultation under Section 7 of the Endangered Species Act of 1973, as amended, which evaluated the effects of operation and maintenance of the 9-foot navigation channel on federally listed threatened and endangered species.

The Tier II Biological Assessment evaluated the impacts of the proposed project on the Indiana bat (*Myotis sodalis*), endangered least tern (*Sterna antillarum*), endangered pallid sturgeon (*Scaphirhynchus albus*), and decurrent false aster (*Boltonia decurrens*). The Corps has determined that the proposed project will have no effect on the decurrent false aster. This precludes the need for further action on this project as required under Section 7 of the Endangered Species Act of 1973, as amended, for the decurrent false aster. The Corps has determined that the proposed project is not likely to adversely affect the Indiana bat and least tern. Based on the location and description of the proposed project, the Service concurs that the proposed project is not likely to adversely affect the Indiana bat and least tern.

The purpose of constructing the proposed project is to increase flow in the navigation channel and inhibit point-bar establishment, thus reducing the need for channel maintenance dredging. Our concern is that the proposed construction is likely to reduce/remove habitats utilized by larval and juvenile pallid sturgeon. Information in the BA indicates that the construction of the

chevrons and dike extension are expected to create scour holes, secondary channels, and shallow water habitat that will provide additional larval/juvenile rearing habitat and seasonal refugia, and improve forage food production which should result in long-term beneficial effects for pallid sturgeon. Thus, the Corps has determined that the proposed project is not likely to adversely affect the pallid sturgeon. It is unclear to the Service whether these river training structure modifications (with resulting hydro-geomorphologic changes) and the reduction in channel maintenance dredging can fully compensate for the project impacts. Thus, the Service does not concur that the proposed project is not likely to adversely affect the pallid sturgeon. However, the Service concurs that the proposed project, as designed, meets the requirements of the Reasonable and Prudent Measures with implementing Terms and Conditions described in the 2000 Biological Opinion.

Should this project be modified, or new information indicate listed or proposed species may be affected, consultation or additional coordination with this office, as appropriate, should be initiated. Thank you for the opportunity to provide comment on the Tier II Biological Assessment. For additional coordination, please contact me at (618) 997-3344, ext. 345.

Sincerely,

/s/ Matthew T. Mangan

Matthew T. Mangan
Biologist in Charge

cc: IDNR (Atwood)
MDC (Herzog, Sternburg)

Appendix C. Correspondence



Illinois Historic
Preservation Agency

1 Old State Capitol Plaza, Springfield, IL 62701-1512

FAX (217) 782-8161

www.illinoishistory.gov

Union County

Grand Tower to Ware

New Construction or Modification, Grand Tower Phase 5

Between Upper Mississippi River Miles 75 and 66

IHPA Log #010102413

November 6, 2013

Michael K. Trimble, Ph.D., Chief
Department of the Army
St. Louis District, Corps of Engineers
Curation and Archives Analysis Branch (EC-Z)
1222 Spruce St.
St. Louis, MO 63103-2833

Dear Chief Trimble:

We have reviewed the documentation submitted for the referenced project in accordance with 36 CFR Part 800.4. Based upon the information provided, no historic properties are affected. We, therefore, have no objection to the undertaking proceeding as planned.

Please retain this letter in your files as evidence of compliance with section 106 of the National Historic Preservation Act of 1966, as amended. This clearance remains in effect for two years from date of issuance. It does not pertain to any discovery during construction, nor is it a clearance for purposes of the Illinois Human Skeletal Remains Protection Act (20 ILCS 3440).

If you have any further questions, please contact me at 217/785-5027.

Sincerely,

Anne E. Haaker
Deputy State Historic
Preservation Officer



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT CORPS OF ENGINEERS
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

REPLY TO
ATTENTION OF:

October 22, 2013

Engineering and Construction Division
Curation and Archives Analysis Branch (EC-Z)

Ms. Anne E. Haaker
Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
Old State Capitol
Springfield, Illinois 62701
Subject: Grand Tower Phase 5: River Training Structures

Dear Ms. Haaker:

The United States Army Corps of Engineers (USACE) is presently proposing the construction or modification of three structures off the Crawford Towhead and ten structures off the Vancil Towhead between river miles 74 and 67 in the Mississippi River. These works comprise the Grand Tower Phase 5 Project (Figure 1). We are contacting your office to initiate consultation under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), and its implementing regulation 36 CFR 800.

Background

In 1866 the Federal Government allocated funding for the creation of a 4-foot channel between Minneapolis and St. Louis. This channel was subsequently deepened when Congress authorized USACE to create a 4.5-foot channel in 1878 and then, in 1907, a 6-foot channel from the confluence of the Mississippi and Missouri rivers to Minneapolis. These works were achieved using a system of wing and closing dams in conjunction with river dredging. Wing dams constrict the flow of a river thereby speeding its current to provide bed-scour in the main river channel. Closing dams blocked off side channels and chutes to similarly control water flow.

In 1927 Congress ordered USACE to study the feasibility of a 9-foot channel on the Upper Mississippi. On July 3, 1930, an amended Rivers and Harbors Act was signed by President Hoover authorizing the creation of the channel. The St. Louis District accomplishes this mission in the Middle Mississippi River (MMR) in part through its Regulating Works Program. The Regulating Works Program utilizes resistive and re-directive measures to maintain bank stability and ensure adequate navigation depth. The resistive measures primarily consist of revetments while the re-directive measures consist of river training structures.

There are a number of types of river training structures including wing dikes, bendway weirs, and chevrons. As noted, wing dikes redirect the river's own energy to manage

sediment distribution within the river channel to provide adequate depth for navigation. While the original dikes of the nineteenth century had been largely pile structures, by the middle of the twentieth century many had been converted to stone-fill types. First constructed in 1989, submerged bendway weirs widen the navigation channel in river bends by creating a favorable redistribution of current velocities and sediments. A more-recent development is the chevron built in the river itself. Chevrons create and promote split flows rather than unidirectional deflections as from normal dikes, and provide more diverse aquatic habitats.

The long-term goal of the Regulating Works Program is to provide a safe and dependable navigation channel in an environmentally sensitive manner and to minimize the amount of annual maintenance dredging that is required in the river, thereby providing a more cost-effective navigation channel and reducing costs to taxpayers.

Project

It is proposed that three structures be modified or constructed on the Crawford Towhead (Figure 2) and ten structures be modified or constructed on the Vancil Towhead (Figure 3). Ten of the structures are located in Union County, Illinois, and three are in Cape Girardeau County, Missouri (Table 1).

Table 1

Localized Reach	Work	Category	County	State
Crawford Towhead (RM 75-71)	Chevron 73.6L	New	Union	IL
	Dike Extension 72.9L	Modify	Union	IL
	Chevron 72.5L	New	Union	IL
Vancil Towhead (RM 70-66)	Weir 69.15R	New	Cape Girardeau	MO
	Weir 68.95R	New	Cape Girardeau	MO
	Weir 68.75R	New	Cape Girardeau	MO
	Diverter Dike 68.10L	New	Union	IL
	Diverter Dike 67.80L	New	Union	IL
	Diverter Dike 67.50L	New	Union	IL
	Repair Dike 67.80L	Modify	Union	IL
	Shorten Dike 67.30L	Modify	Union	IL
	Shorten Dike 67.10L	Modify	Union	IL
	600 feet Revetment	New	Union	IL

Potential Effects on Cultural Resources

Dikes, Chevrons and Weirs

All construction and modification work on the river training structures will be carried out via barge, without recourse to land access; therefore, any effects are limited to submerged cultural resources. Primary among these are historic period shipwrecks. Given the continual river flow and associated sedimentary erosion, deposition, and

reworking, it is highly unlikely that any more ephemeral cultural material remains on the river bed.

Shipwrecks

During the summer of 1988 when the Mississippi River was at its lowest level on record, the St. Louis District Corps of Engineers conducted an aerial survey of exposed wrecks between Saverton, Missouri, and the mouth of the Ohio River. The nearest wrecks to the project area were sighted about five-and-one-half miles away, both upstream and downstream. During the 2012 low water event, a wreck was reported within the project area, but on the right bank, opposite the proposed structures and behind an existing dike (67.2R) (Figures 3 and 4). On nineteenth century maps the location is identified as Vancill (sic) landing.

As part of a 2003 USACE study, archival research documented over seven hundred wrecks in the Middle Mississippi and two vessels are recorded as having been wrecked at Vancil landing. The first is the *Sultana*, recorded as either abandoned between 1844 and 1852, according to one source, or wrecked on 6/12/1851, according to another. The second wreck, the *Walk in the Water*, is recorded as abandoned between 1846 and 1855. A local resident, however, has stated that his father told him it was the *Paw-Paw*, which broke up in the winter ice of 1865 (*Southeast Missourian*, 7 January 2011).

The story of the *Paw-Paw* is not entirely clear. County Court records indicate that the boat bought by Willis Vancil et al. for use as a transport was the “Steam ferry boat *Jennie ‘D’* lying at Cape Girardeau, Mo., and used ferrying from Cape Girardeau to points opposite at the Illinois Shore” (*Southeast Missourian*, 7 September 1999). In 1868, however, Vancil did pay \$1,200 for, “the wreck and Machinery of the Steamer *Paw Paw*, now lying at Cape Girardeau Mo.” It is possible that they bought the equipment to renovate and repair the *Jennie ‘D.’* According to “Way’s Packet Directory” the *Paw Paw* was a center-wheel steamboat built in St. Louis in 1862 and sold to Samuel Vencil (sic) at Mound City, Illinois, on August 17, 1865, and dismantled soon thereafter. Regardless of its identify, the wreck will not be affected by the Grand Tower Phase 5 project.

The river bed in the project area is regularly surveyed every two-to-three years, with the latest survey having been completed in 2013. The single-beam survey was conducted with range lines spacing of approximately two hundred feet. No topographic anomalies suggesting wrecks are visible on the resulting bathymetric map (Figures 5 and 6). Where higher resolution multi-beam surveys were available (e.g., Figures 7 and 8), they were also examined, and no anomalies were visible.

Revetment

River revetments can potentially have adverse affects on cultural resources. As with other training structures they are conducted via barge, without recourse to land access. The placement of the rock, however, has the potential to adversely affect any resource

on the bankline. Approximately six hundred linear feet of revetment is planned, of which 150 feet is reinforcement to an existing revetment area and the remainder is associated with an existing dike. Historical research has been conducted on the proposed location to determine if it is on recently accreted land or cut-banks in an existing, older, landform. Recently accreted land is highly unlikely to contain deeply buried cultural resources.

The Grand Tower Reach of the Mississippi River has narrowed considerably in the past one hundred and fifty years. Being a bluff, the location of the Missouri bank has remained largely unchanged. The Illinois floodplain, however, has accreted significantly westward mainly due to the growth and incorporation of various towheads. The locations of all the proposed structures were well within the Mississippi River in 1881 (Figures 9 and 10). In the late nineteenth century, however, Vancil towhead formed, and in 1904 USACE constructed a hurdle across its eastern chute to connect it to the Illinois floodplain (Chief of Engineers 1905:1600). Consequently by 1909 the effective river bankline had shifted to approximately today's location (Figures 11 and 12). Any cultural resources that might be adversely affected by the placement of revetment must post-date the development of Vancil towhead.

Given the features' construction method (with no land impact), the previous disturbance of the riverbed, the fact that all feature locations were within the river until the end of the nineteenth century, and the lack of any survey evidence for extant wrecks, it is our opinion that the proposed undertaking will have no significant effect on cultural resources.

If you have any questions or comments, please feel free to contact me at (314) 331-8466 or Dr. Mark Smith at (314) 331-8831 (e-mail: mark.a.smith4@usace.army.mil).

Sincerely yours,

Michael K. Trimble, Ph.D.
Chief, Curation and Archives Analysis Branch

Enclosure

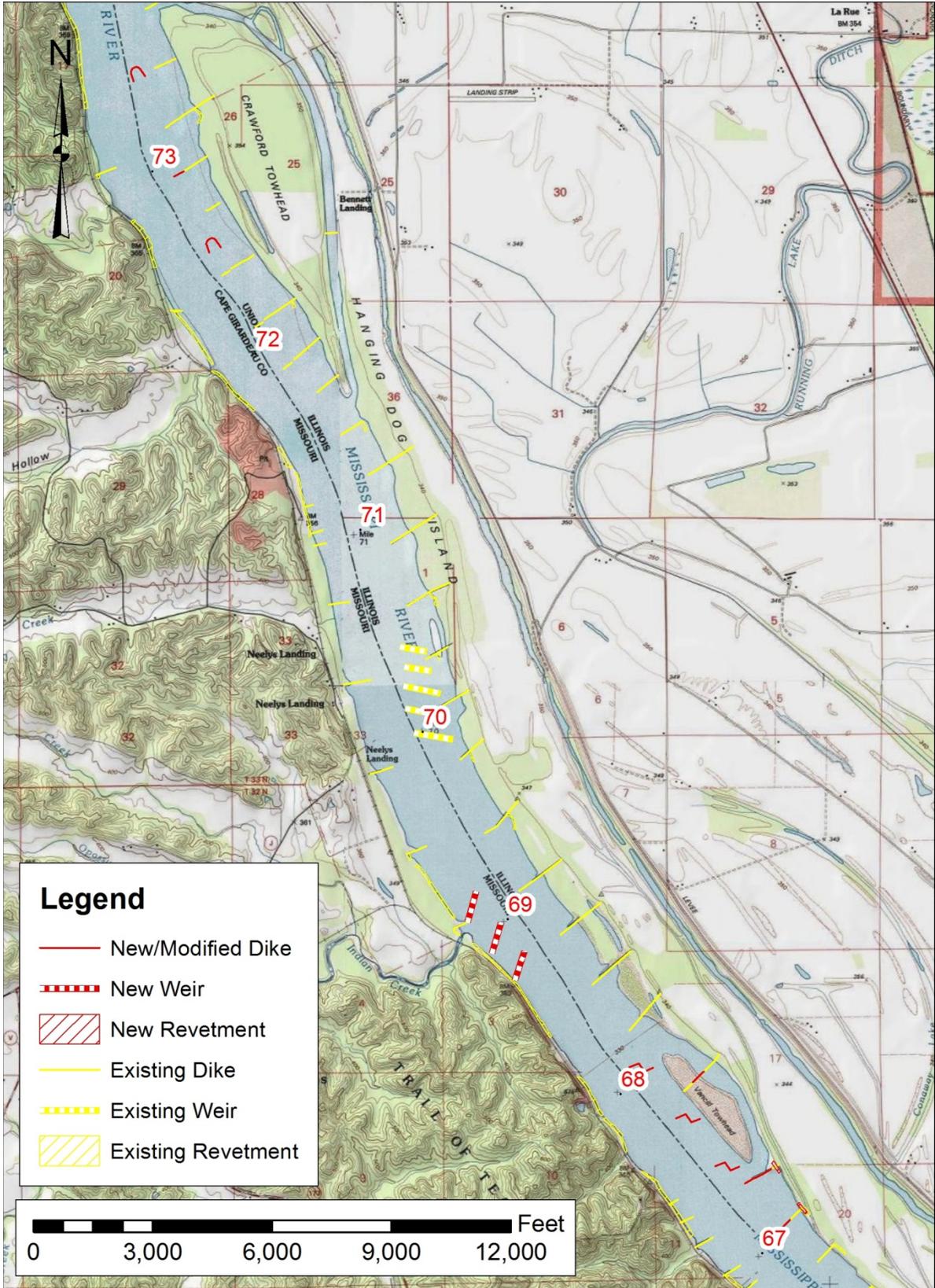


Figure 1. Project features superimposed on 7.5' USGS quad map (Neelys Landing, Wolf Lake, Cape Girardeau NE and Ware).

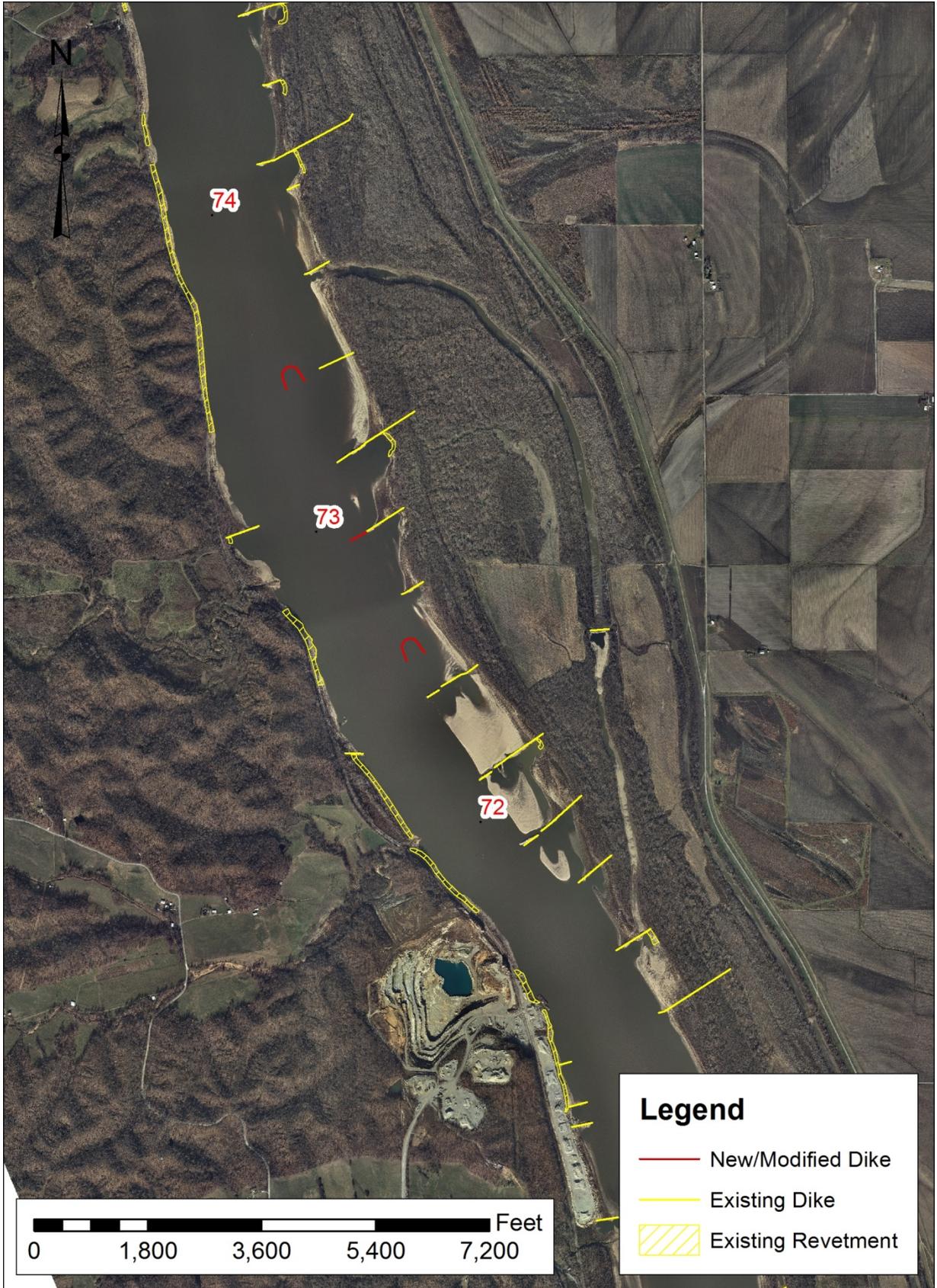


Figure 2. Project features at Crawford Towhead (imagery 2012).



Figure 3. Project features at Vancil Towhead (imagery 2012).



Figure 4. View looking north of wreck located south of Dike 67.2R.

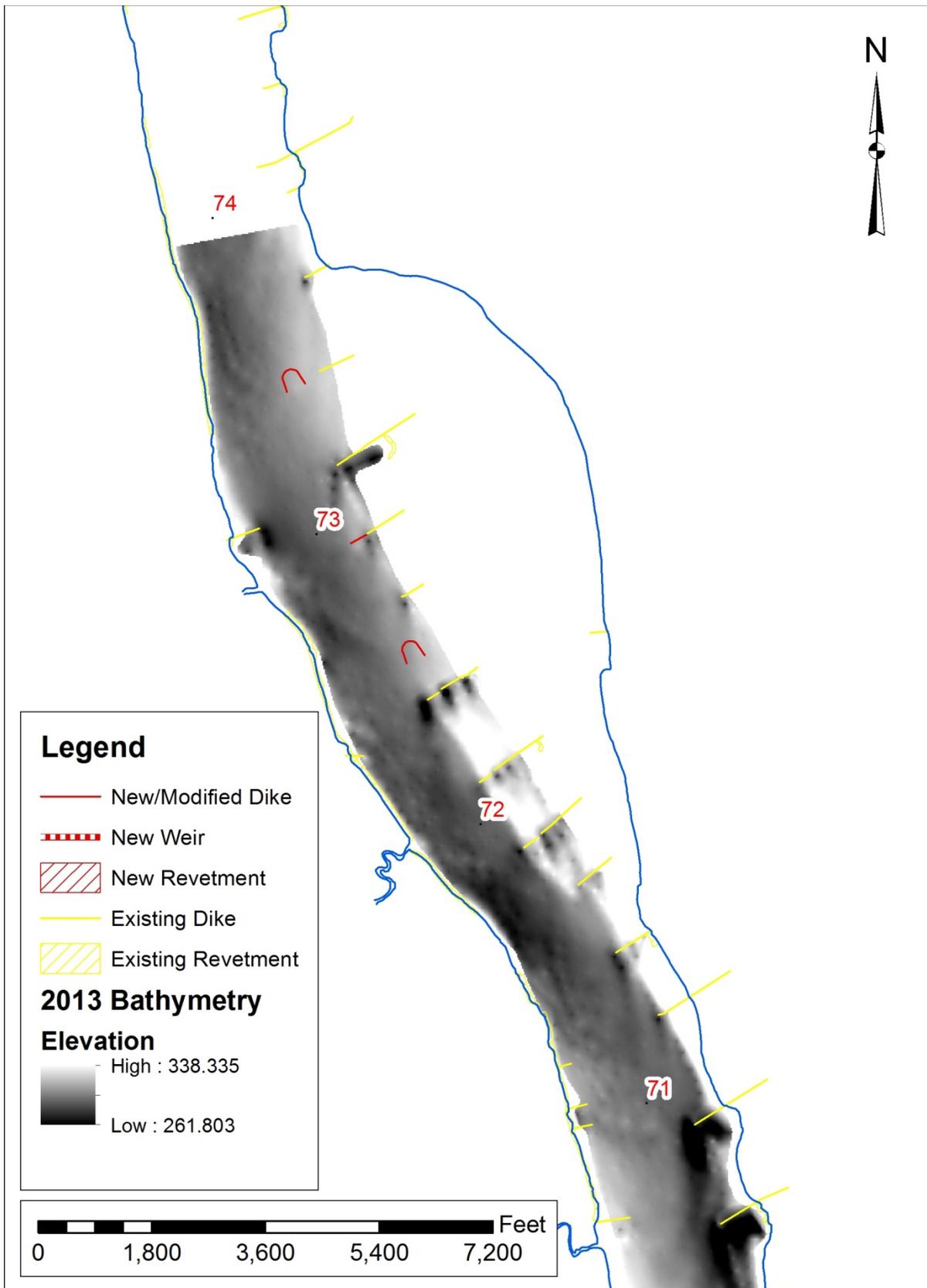


Figure 5. 2013 single-scan bathymetry of Crawford Towhead.

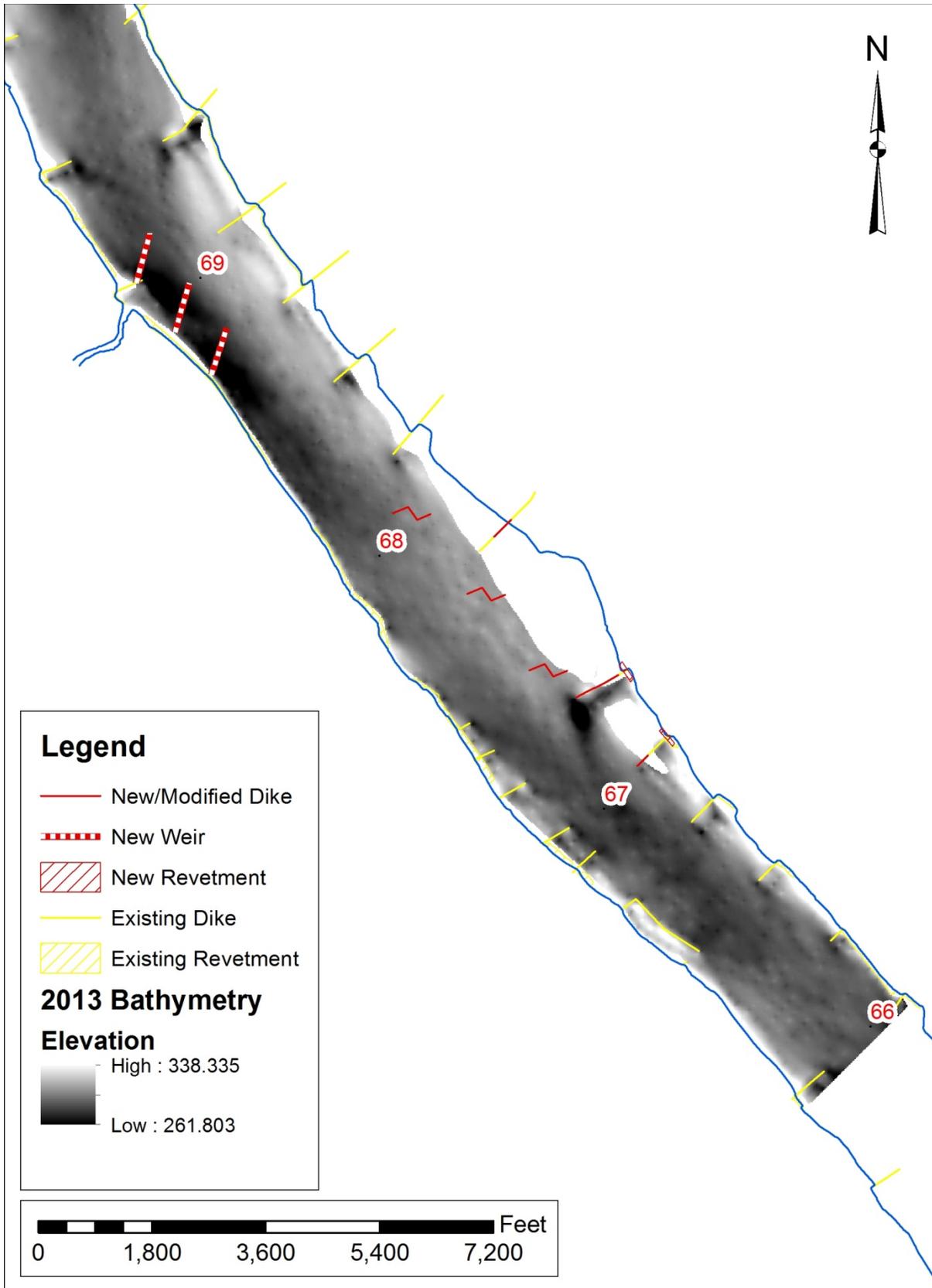


Figure 6. 2013 single-scan bathymetry of Vancil Towhead.

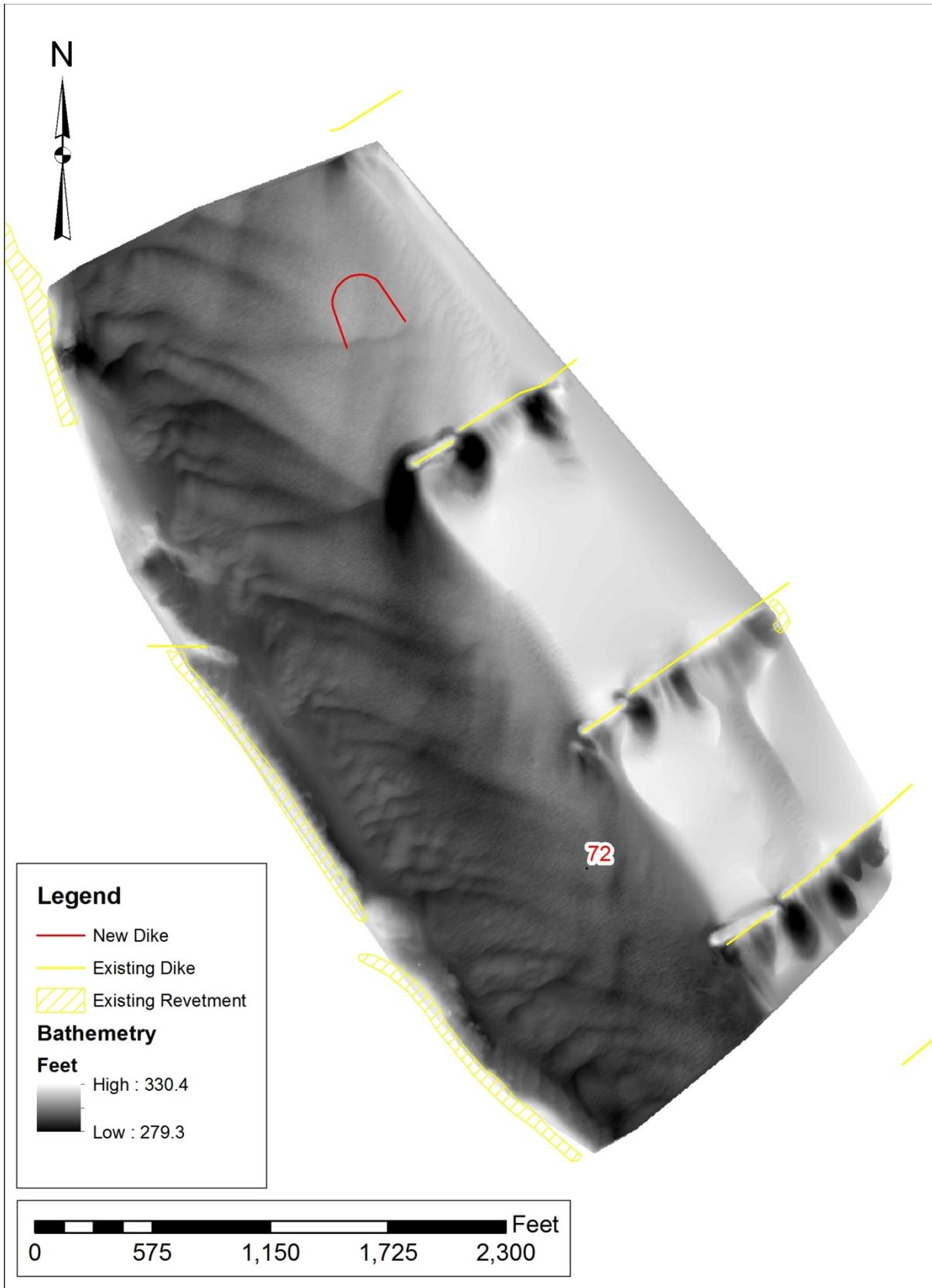


Figure 7. 2012 multi- scan bathymetry of Crawford Towhead.

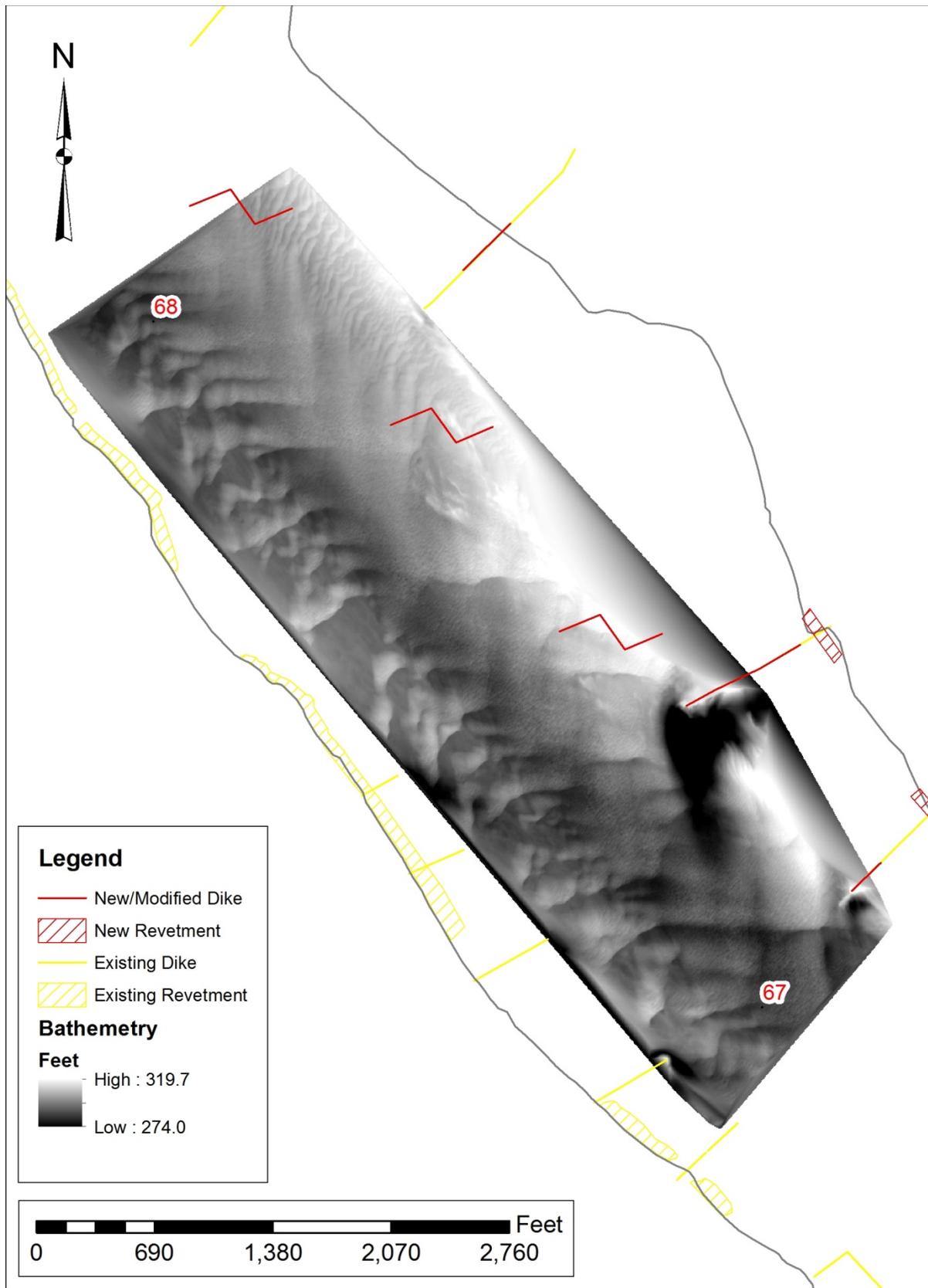


Figure 8. 2012 multi-scan bathymetry of Vancil Towhead.

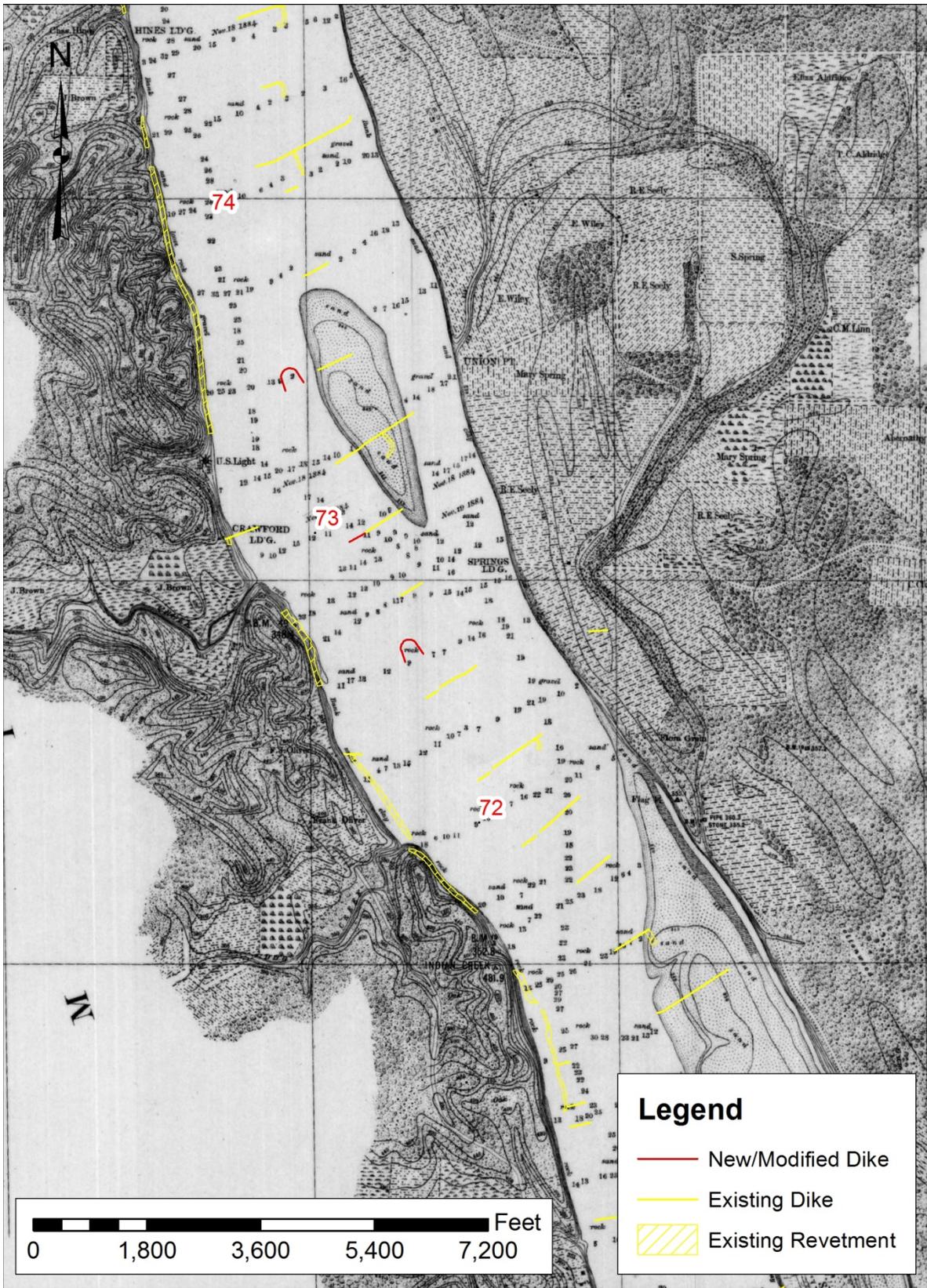


Figure 9. Project features superimposed on 1881 map of Crawford Towhead (Mississippi River Commission 1881).

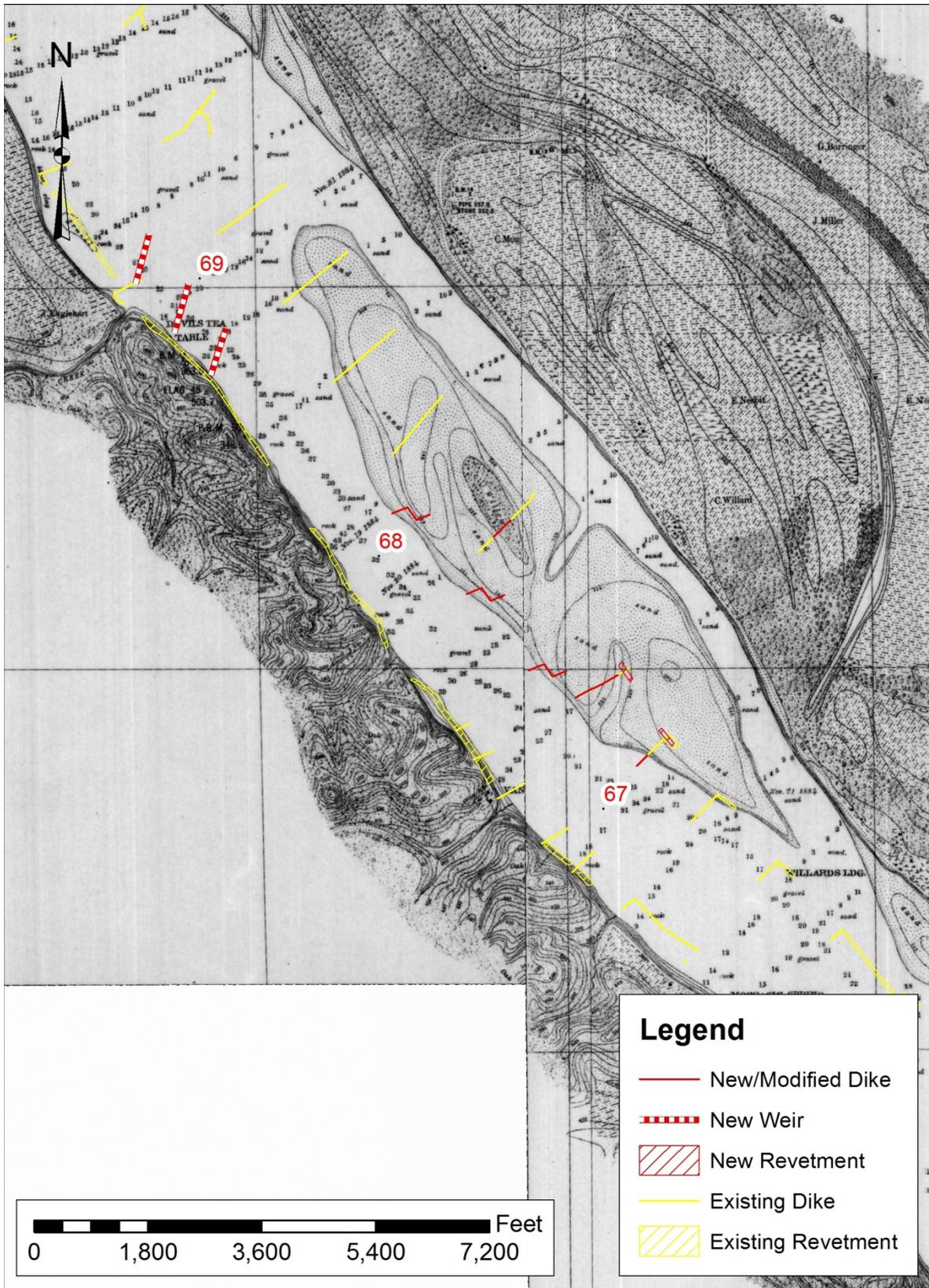


Figure 10. Project features superimposed on 1881 map of Vancil Towhead (Mississippi River Commission 1881).

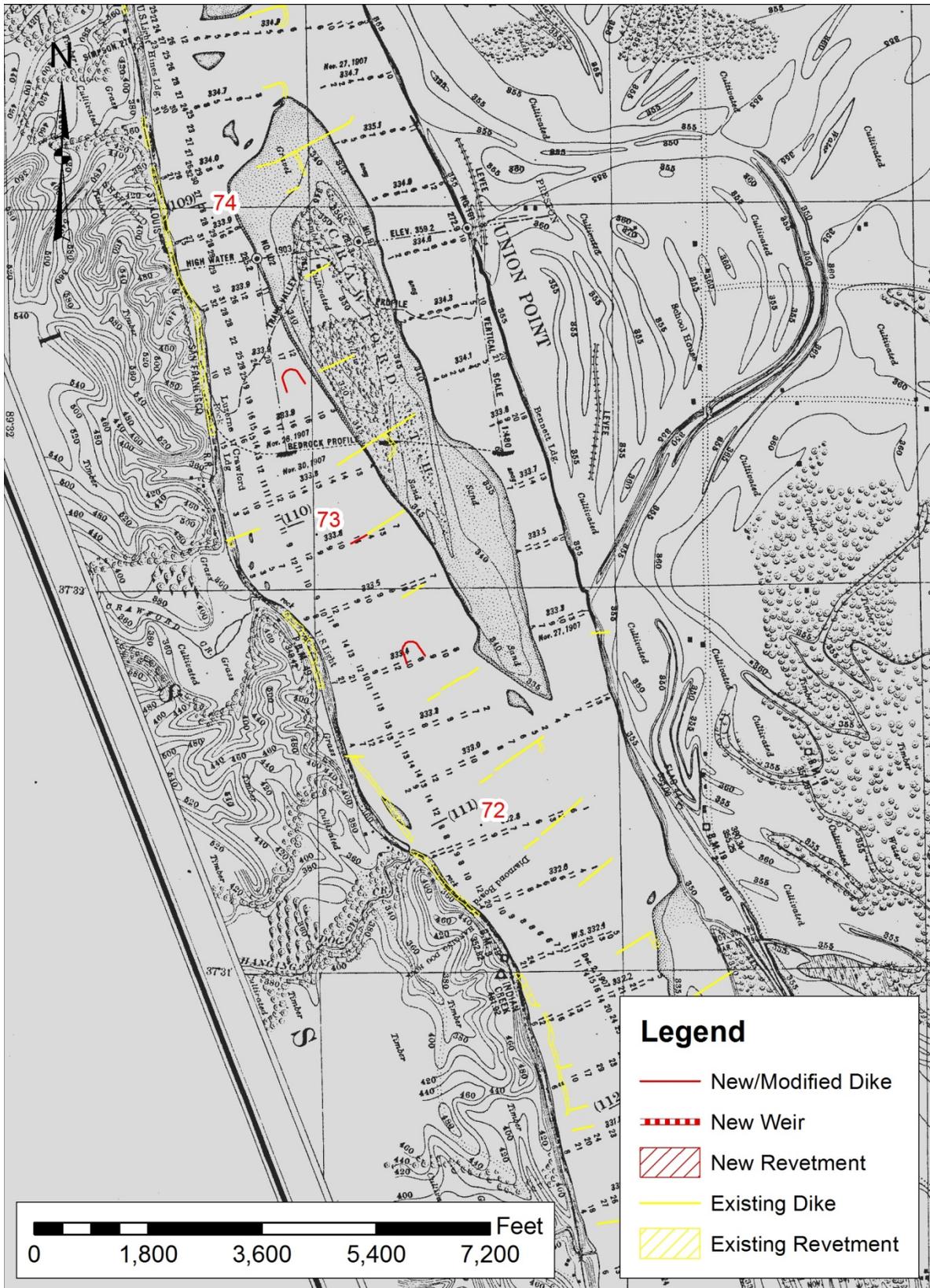


Figure 11. Project features superimposed on 1908 map of Crawford Towhead (Board of Examination and Survey of Mississippi River 1908).

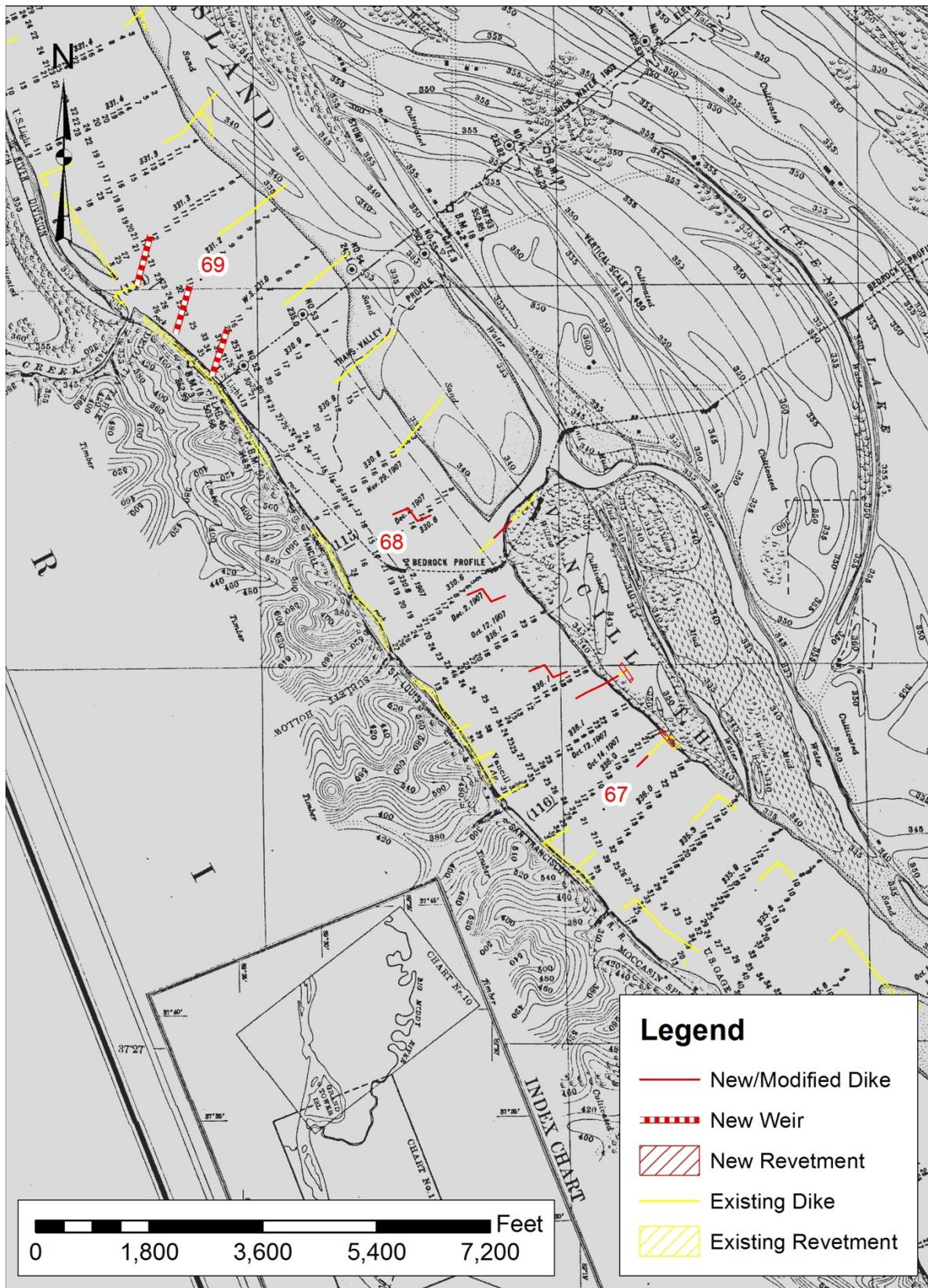


Figure 12. Project features superimposed on 1908 map of Vancil Towhead (Board of Examination and Survey of Mississippi River 1908).

References Cited

Board of Examination and Survey of the Mississippi River

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Detroit.

Chief of Engineers

1905 Annual Reports of the War. Volume VI. Report of the Chief of Engineers.
Washington D.C.

Mississippi River Commission

1881 Survey of the Mississippi River, Chart No.106.

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1993 Wolf Lake 7.5-minute Quadrangle map. Washington, D.C.

1993 Cape Girardeau NE 7.5-minute Quadrangle map. Washington, D.C.

1993 Ware 7.5-minute Quadrangle map. Washington, D.C.



Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

October 28, 2013

Michael K. Trimble, Ph.D.
Chief, Curation & Archives Analysis Branch
Corps of Engineers, St. Louis District
1222 Spruce Street
St. Louis, Missouri 63103-2833

Re: Grand Tower Phase 5 River Training Structures (COE) Cape Girardeau County, Missouri

Dear Dr. Trimble:

Thank you for submitting information about the above referenced project for our review pursuant to Section 106 of the National Historic Preservation Act (P.L. 89-665) and the Advisory Council on Historic Preservation's regulation 36 CFR Part 800, which require identification and evaluation of cultural resources.

We have reviewed the information provided concerning the above referenced project. We concur with your determination that the proposed Grand Tower Phase 5 River Training Structures Project will have **no adverse effect** on any properties that may be eligible for inclusion in the National Register of Historic Places.

Please be advised that, should project plans change, information documenting the revisions should be submitted to this office for further review and comment on possible effects to historic properties. In the event that cultural materials are encountered during project activities, all construction should be halted, and this office notified as soon as possible in order to determine the appropriate course of action.

If you have any questions, please write Judith Deel at State Historic Preservation Office, P.O. Box 176, Jefferson City, Missouri 65102 or call 573/751-7862. Please be sure to include the SHPO Log Number **(001-CG-14)** on all future correspondence or inquiries relating to this project.

Sincerely,

STATE HISTORIC PRESERVATION OFFICE

A handwritten signature in blue ink that reads "Mark A. Miles".

Mark A. Miles
Director and Deputy
State Historic Preservation Officer

MAM:jd

c Dr. Mark Smith, COE/SL



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT CORPS OF ENGINEERS
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

REPLY TO
ATTENTION OF:

October 22, 2013

Engineering and Construction Division
Curation and Archives Analysis Branch (EC-Z)

Ms. Judith Deel, Senior Archaeologist
Office of Historic Preservation
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102

Subject: Grand Tower Phase 5: River Training Structures

Dear Ms. Deel:

The United States Army Corps of Engineers (USACE) is presently proposing the construction or modification of three structures off the Crawford Towhead and ten structures off the Vancil Towhead between river miles 74 and 67 in the Mississippi River. These works comprise the Grand Tower Phase 5 Project (Figure 1). We are contacting your office to initiate consultation under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), and its implementing regulation 36 CFR 800.

Background

In 1866 the Federal Government allocated funding for the creation of a 4-foot channel between Minneapolis and St. Louis. This channel was subsequently deepened when Congress authorized USACE to create a 4.5-foot channel in 1878 and then, in 1907, a 6-foot channel from the confluence of the Mississippi and Missouri rivers to Minneapolis. These works were achieved using a system of wing and closing dams in conjunction with river dredging. Wing dams constrict the flow of a river thereby speeding its current to provide bed-scour in the main river channel. Closing dams blocked off side channels and chutes to similarly control water flow.

In 1927 Congress ordered USACE to study the feasibility of a 9-foot channel on the Upper Mississippi. On July 3, 1930, an amended Rivers and Harbors Act was signed by President Hoover authorizing the creation of the channel. The St. Louis District accomplishes this mission in the Middle Mississippi River (MMR) in part through its Regulating Works Program. The Regulating Works Program utilizes resistive and re-directive measures to maintain bank stability and ensure adequate navigation depth. The resistive measures primarily consist of revetments while the re-directive measures consist of river training structures.

There are a number of types of river training structures including wing dikes, bendway weirs, and chevrons. As noted, wing dikes redirect the river's own energy to manage sediment distribution within the river channel to provide adequate depth for navigation. While the original dikes of the nineteenth century had been largely pile structures, by the middle of the twentieth century many had been converted to stone-fill types. First constructed in 1989, submerged bendway weirs widen the navigation channel in river bends by creating a favorable redistribution of current velocities and sediments. A more-recent development is the chevron built in the river itself. Chevrons create and promote split flows rather than unidirectional deflections as from normal dikes, and provide more diverse aquatic habitats.

The long-term goal of the Regulating Works Program is to provide a safe and dependable navigation channel in an environmentally sensitive manner and to minimize the amount of annual maintenance dredging that is required in the river, thereby providing a more cost-effective navigation channel and reducing costs to taxpayers.

Project

It is proposed that three structures be modified or constructed on the Crawford Towhead (Figure 2) and ten structures be modified or constructed on the Vancil Towhead (Figure 3). Ten of the structures are located in Union County, Illinois, and three are in Cape Girardeau County, Missouri (Table 1).

Table 1

Localized Reach	Work	Category	County	State
Crawford Towhead (RM 75-71)	Chevron 73.6L	New	Union	IL
	Dike Extension 72.9L	Modify	Union	IL
	Chevron 72.5L	New	Union	IL
Vancil Towhead (RM 70-66)	Weir 69.15R	New	Cape Girardeau	MO
	Weir 68.95R	New	Cape Girardeau	MO
	Weir 68.75R	New	Cape Girardeau	MO
	Diverter Dike 68.10L	New	Union	IL
	Diverter Dike 67.80L	New	Union	IL
	Diverter Dike 67.50L	New	Union	IL
	Repair Dike 67.80L	Modify	Union	IL
	Shorten Dike 67.30L	Modify	Union	IL
	Shorten Dike 67.10L	Modify	Union	IL
	600 feet Revetment	New	Union	IL

Potential Effects on Cultural Resources

Dikes, Chevrons and Weirs

All construction and modification work on the river training structures will be carried out via barge, without recourse to land access; therefore, any effects are limited to submerged cultural resources. Primary among these are historic period shipwrecks.

Given the continual river flow and associated sedimentary erosion, deposition, and reworking, it is highly unlikely that any more ephemeral cultural material remains on the river bed.

Shipwrecks

During the summer of 1988 when the Mississippi River was at its lowest level on record, the St. Louis District Corps of Engineers conducted an aerial survey of exposed wrecks between Saverton, Missouri, and the mouth of the Ohio River. The nearest wrecks to the project area were sighted about five-and-one-half miles away, both upstream and downstream. During the 2012 low water event, a wreck was reported within the project area, but on the right bank, opposite the proposed structures and behind an existing dike (67.2R) (Figures 3 and 4). On nineteenth century maps the location is identified as Vancill (sic) landing.

As part of a 2003 USACE study, archival research documented over seven hundred wrecks in the Middle Mississippi and two vessels are recorded as having been wrecked at Vancil landing. The first is the *Sultana*, recorded as either abandoned between 1844 and 1852, according to one source, or wrecked on 6/12/1851, according to another. The second wreck, the *Walk in the Water*, is recorded as abandoned between 1846 and 1855. A local resident, however, has stated that his father told him it was the *Paw-Paw*, which broke up in the winter ice of 1865 (*Southeast Missourian*, 7 January 2011).

The story of the *Paw-Paw* is not entirely clear. County Court records indicate that the boat bought by Willis Vancil et al. for use as a transport was the “Steam ferry boat *Jennie ‘D’* lying at Cape Girardeau, Mo., and used ferrying from Cape Girardeau to points opposite at the Illinois Shore” (*Southeast Missourian*, 7 September 1999). In 1868, however, Vancil did pay \$1,200 for, “the wreck and Machinery of the Steamer *Paw Paw*, now lying at Cape Girardeau Mo.” It is possible that they bought the equipment to renovate and repair the *Jennie ‘D.’* According to “Way’s Packet Directory” the *Paw Paw* was a center-wheel steamboat built in St. Louis in 1862 and sold to Samuel Vencil (sic) at Mound City, Illinois, on August 17, 1865, and dismantled soon thereafter. Regardless of its identify, the wreck will not be affected by the Grand Tower Phase 5 project.

The river bed in the project area is regularly surveyed every two-to-three years, with the latest survey having been completed in 2013. The single-beam survey was conducted with range lines spacing of approximately two hundred feet. No topographic anomalies suggesting wrecks are visible on the resulting bathymetric map (Figures 5 and 6). Where higher resolution multi-beam surveys were available (e.g., Figures 7 and 8), they were also examined, and no anomalies were visible.

Revetment

River revetments can potentially have adverse affects on cultural resources. As with other training structures they are conducted via barge, without recourse to land access.

The placement of the rock, however, has the potential to adversely affect any resource on the bankline. Approximately six hundred linear feet of revetment is planned, of which 150 feet is reinforcement to an existing revetment area and the remainder is associated with an existing dike. Historical research has been conducted on the proposed location to determine if it is on recently accreted land or cut-banks in an existing, older, landform. Recently accreted land is highly unlikely to contain deeply buried cultural resources.

The Grand Tower Reach of the Mississippi River has narrowed considerably in the past one hundred and fifty years. Being a bluff, the location of the Missouri bank has remained largely unchanged. The Illinois floodplain, however, has accreted significantly westward mainly due to the growth and incorporation of various towheads. The locations of all the proposed structures were well within the Mississippi River in 1881 (Figures 9 and 10). In the late nineteenth century, however, Vancil towhead formed, and in 1904 USACE constructed a hurdle across its eastern chute to connect it to the Illinois floodplain (Chief of Engineers 1905:1600). Consequently by 1909 the effective river bankline had shifted to approximately today's location (Figures 11 and 12). Any cultural resources that might be adversely affected by the placement of revetment must post-date the development of Vancil towhead.

Given the features' construction method (with no land impact), the previous disturbance of the riverbed, the fact that all feature locations were within the river until the end of the nineteenth century, and the lack of any survey evidence for extant wrecks, it is our opinion that the proposed undertaking will have no significant effect on cultural resources.

If you have any questions or comments, please feel free to contact me at (314) 331-8466 or Dr. Mark Smith at (314) 331-8831 (e-mail: mark.a.smith4@usace.army.mil).

Sincerely yours,

Michael K. Trimble, Ph.D.
Chief, Curation and Archives Analysis Branch

Enclosure

SMITH
CEMVS-EC-Z

MALIN-BOYCE
CEMVS-EC-Z

PULLIAM
CEMVS-EC-Z

TRIMBLE
CEMVS-EC-Z

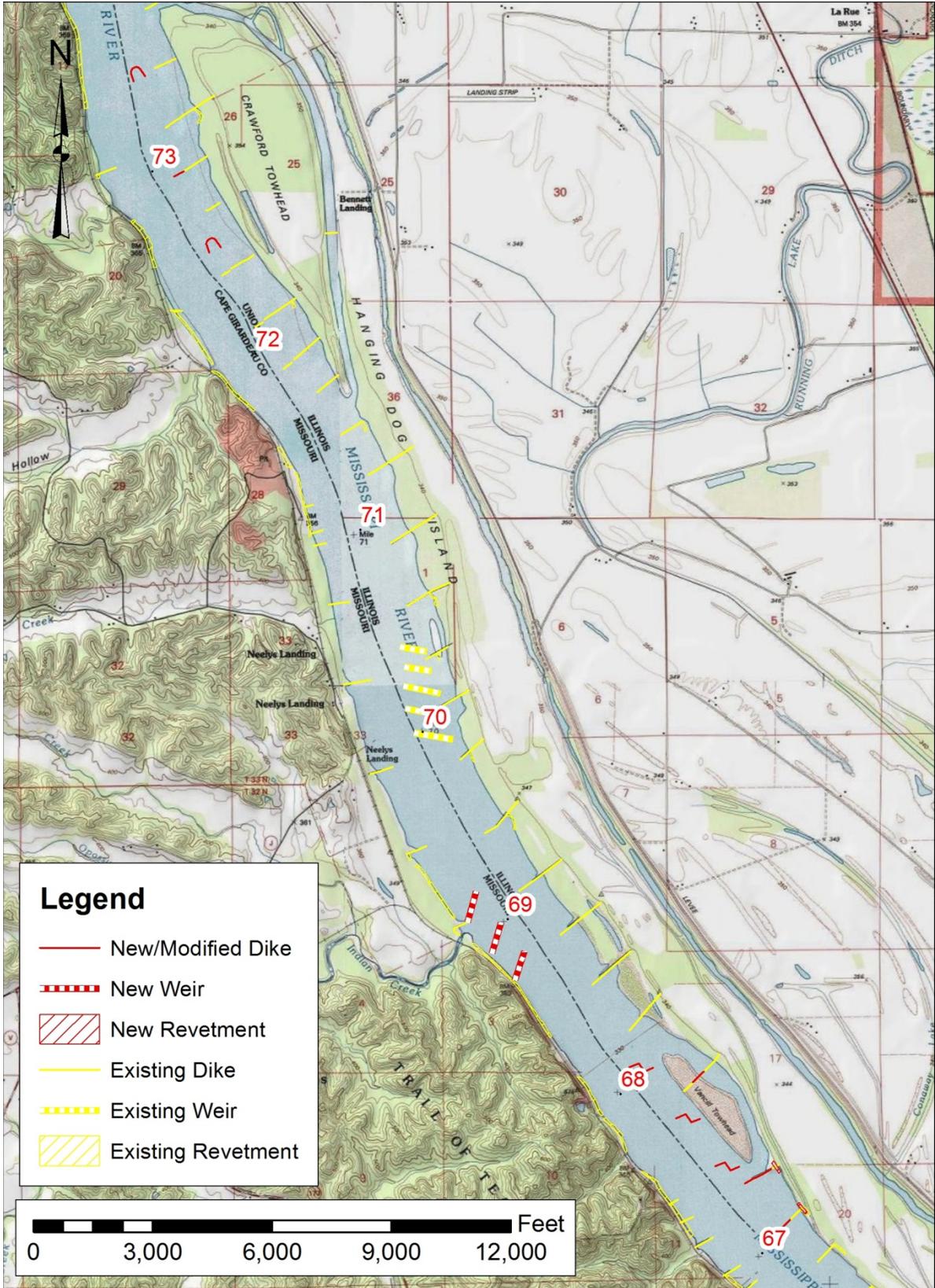


Figure 1. Project features superimposed on 7.5' USGS quad map (Neelys Landing, Wolf Lake, Cape Girardeau NE and Ware).

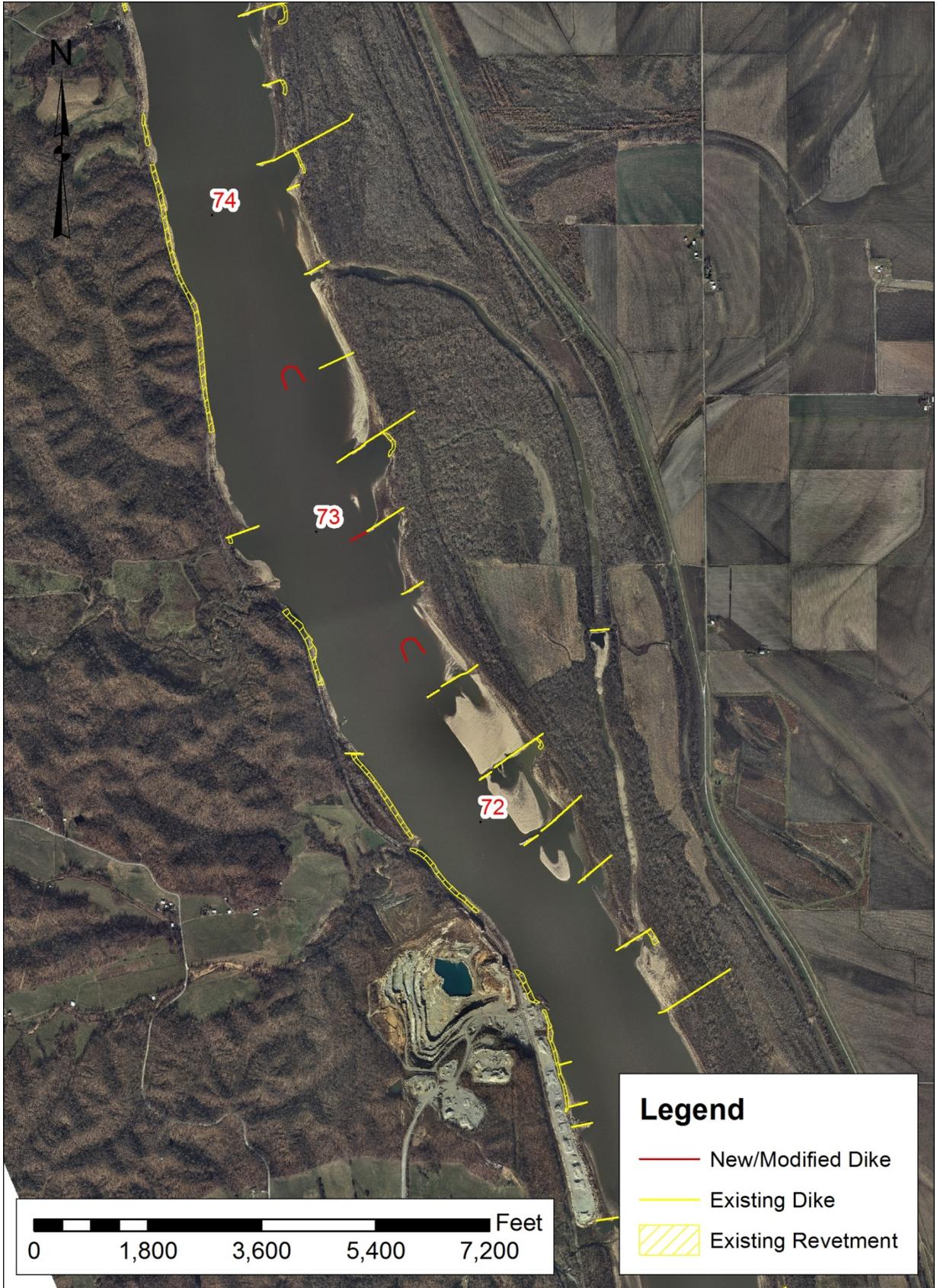


Figure 2. Project features at Crawford Towhead (imagery 2012).



Figure 3. Project features at Vancil Towhead (imagery 2012).



Figure 4. View looking north of wreck located south of Dike 67.2R.

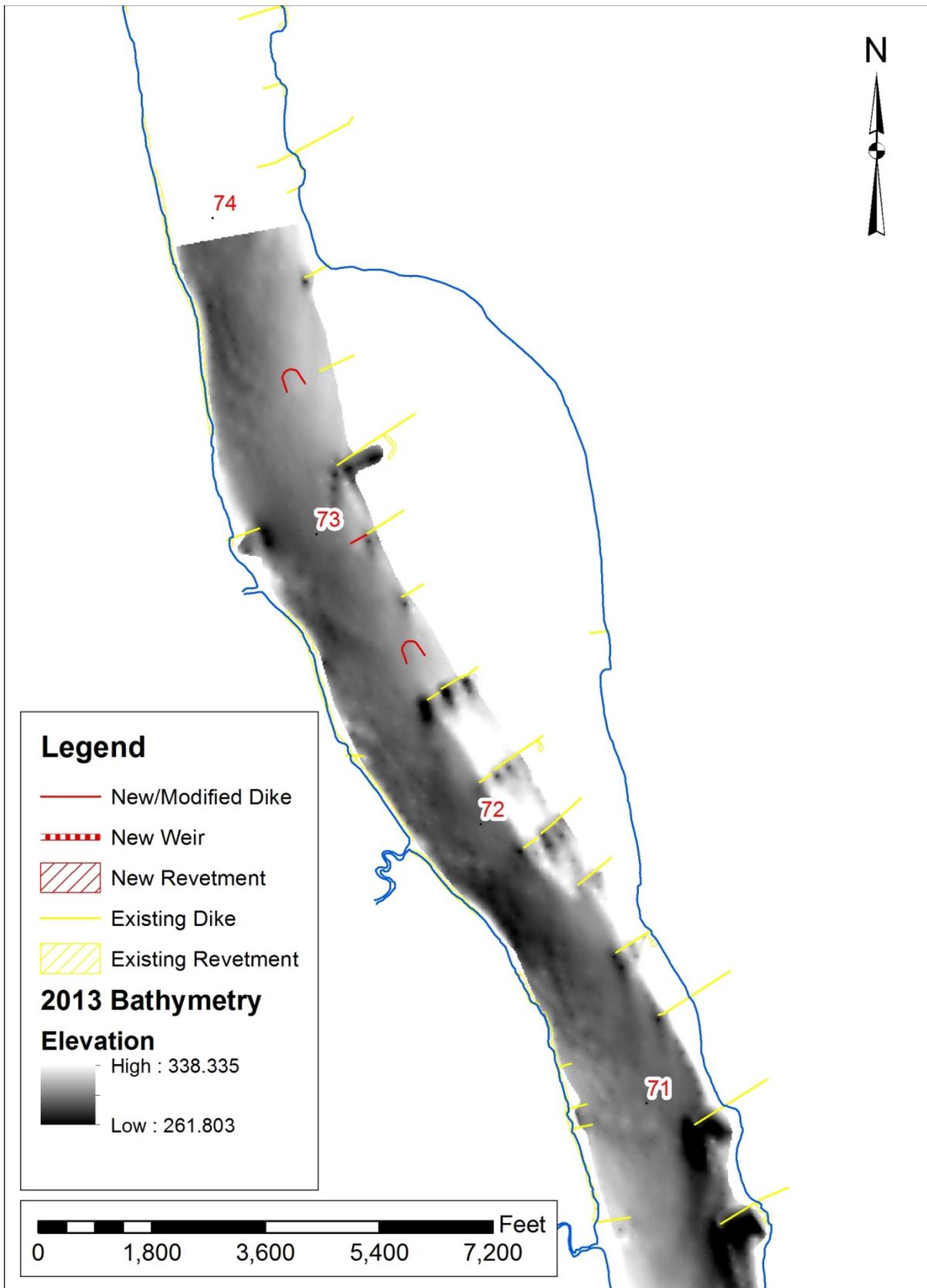


Figure 5. 2013 single-scan bathymetry of Crawford Towhead.

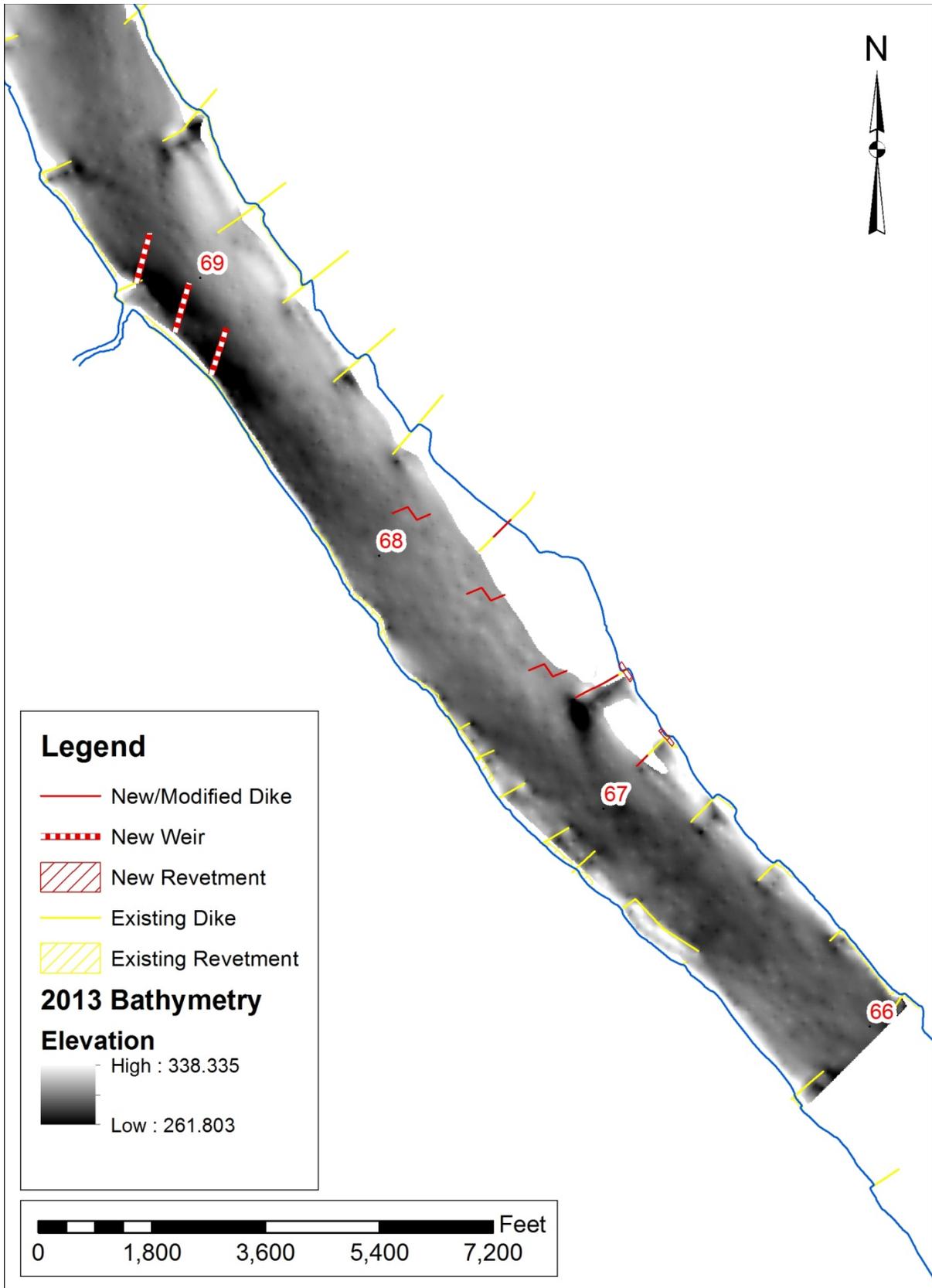


Figure 6. 2013 single-scan bathymetry of Vancil Towhead.

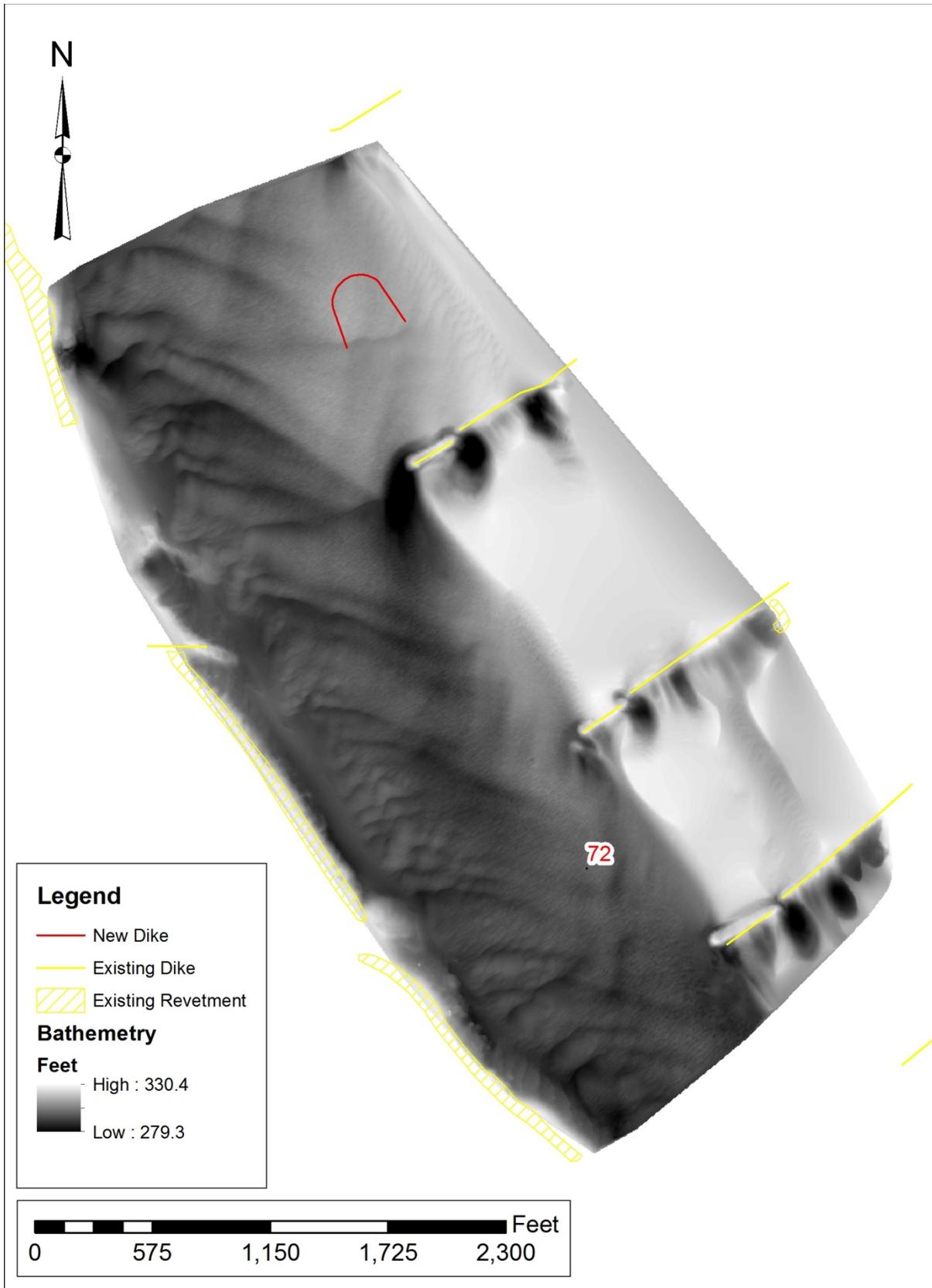


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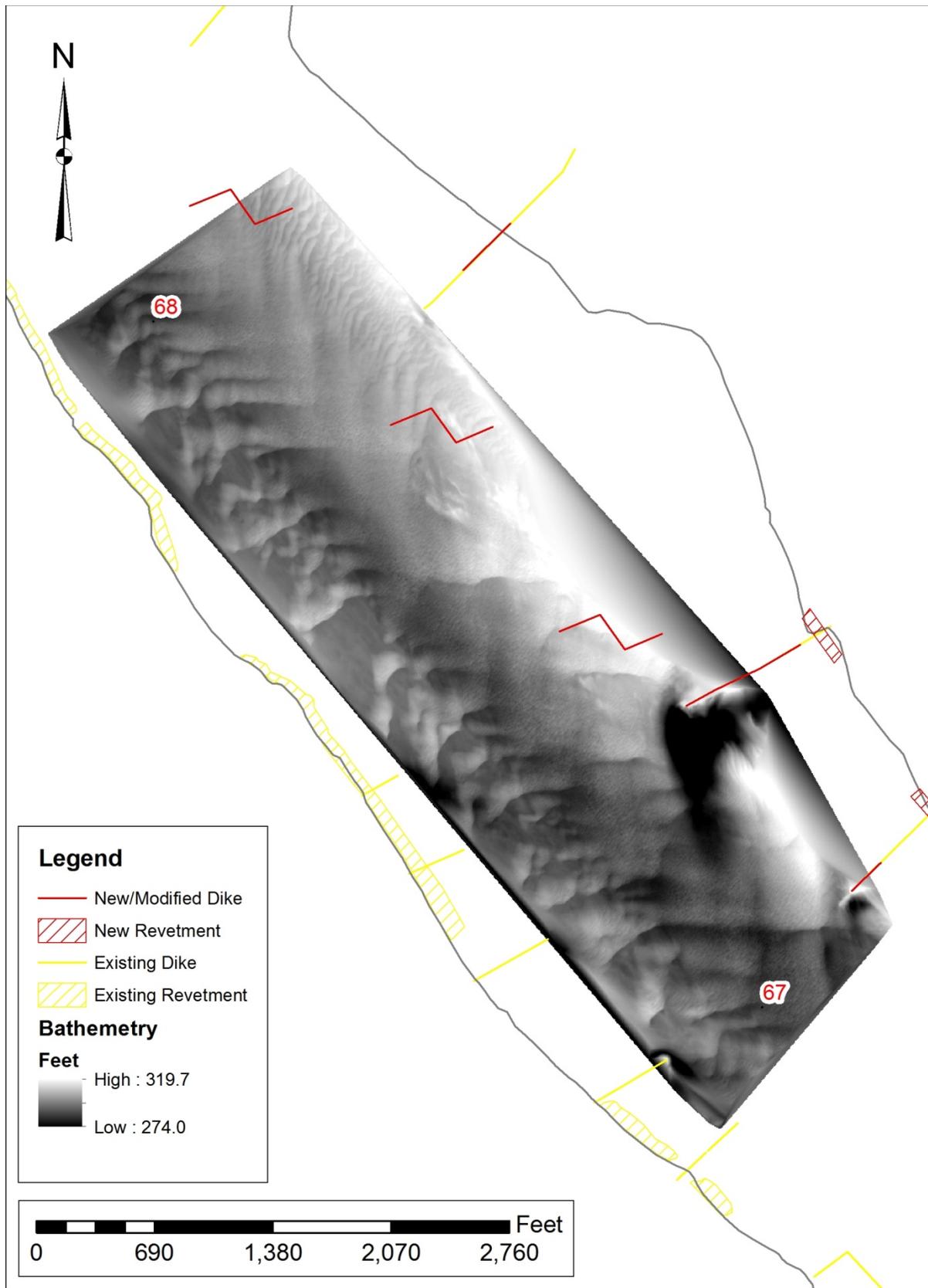


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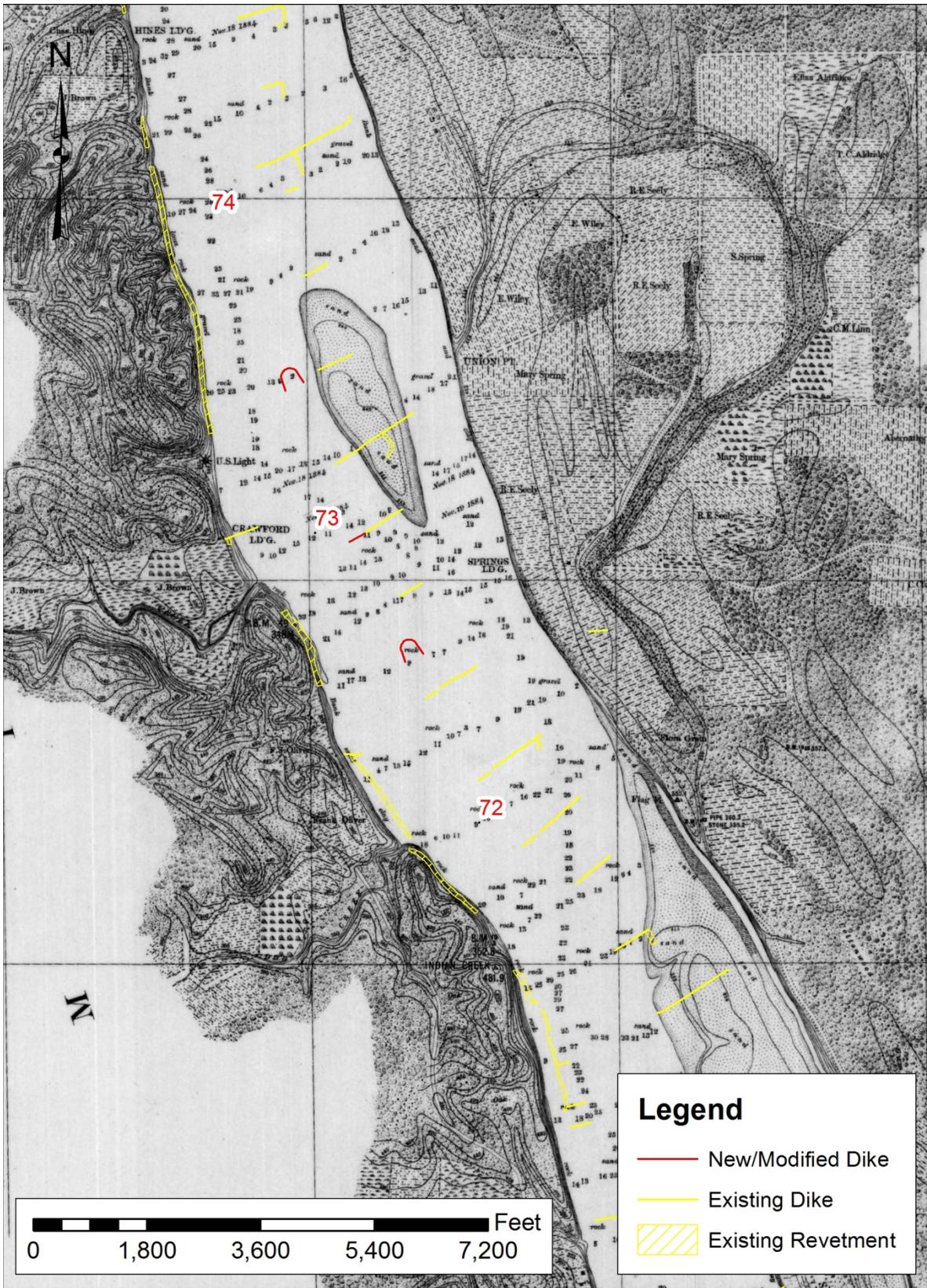


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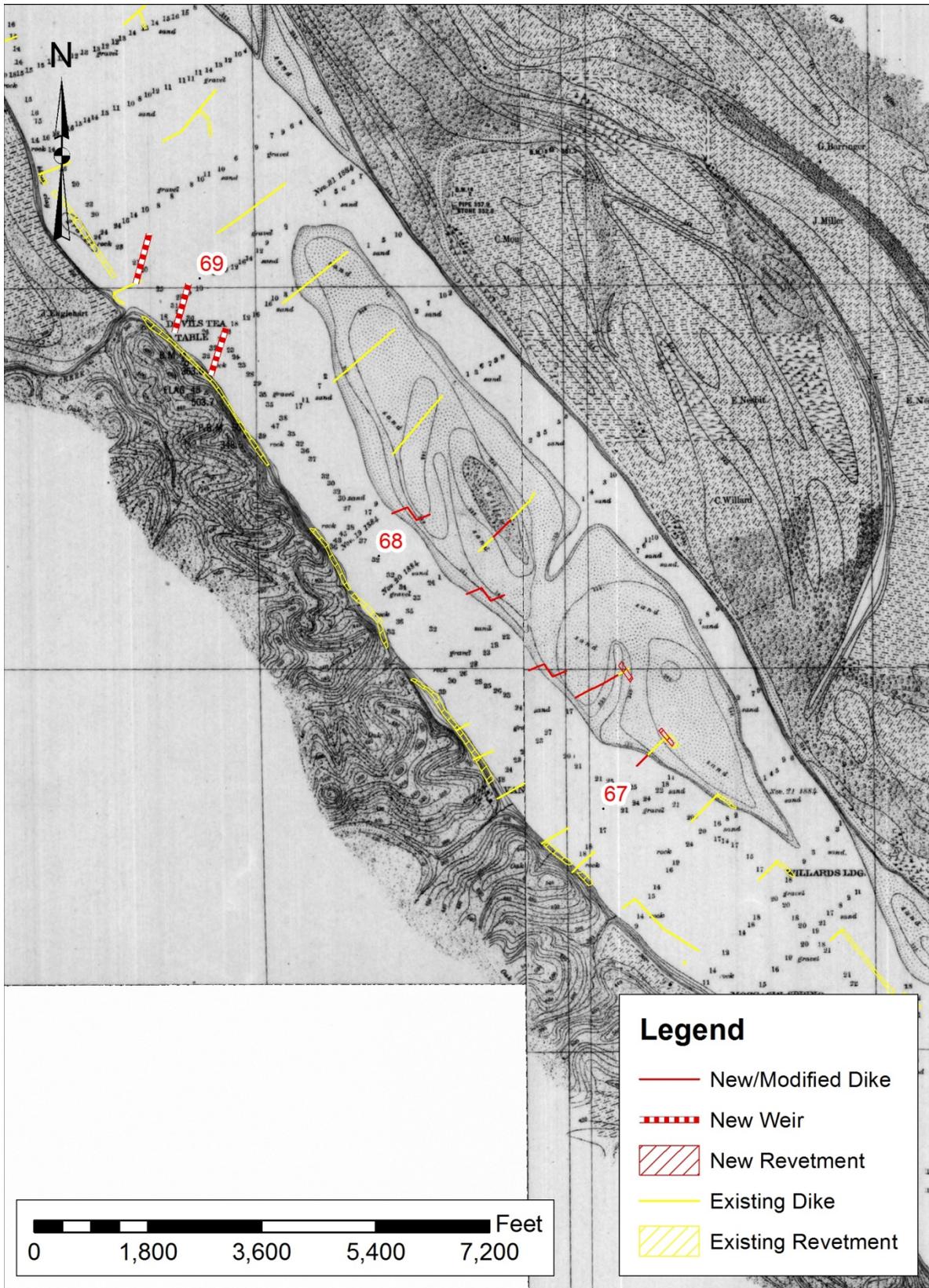


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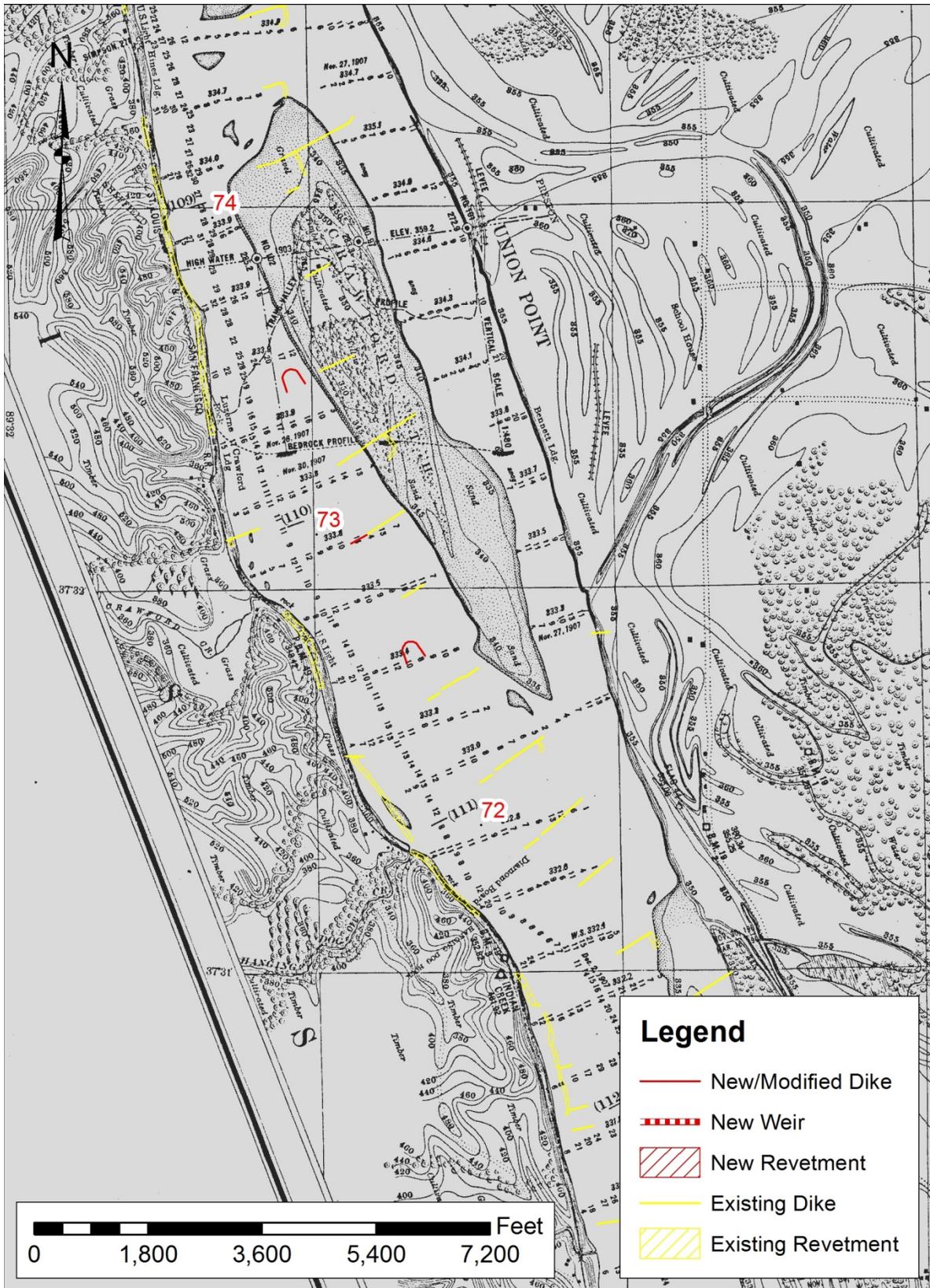


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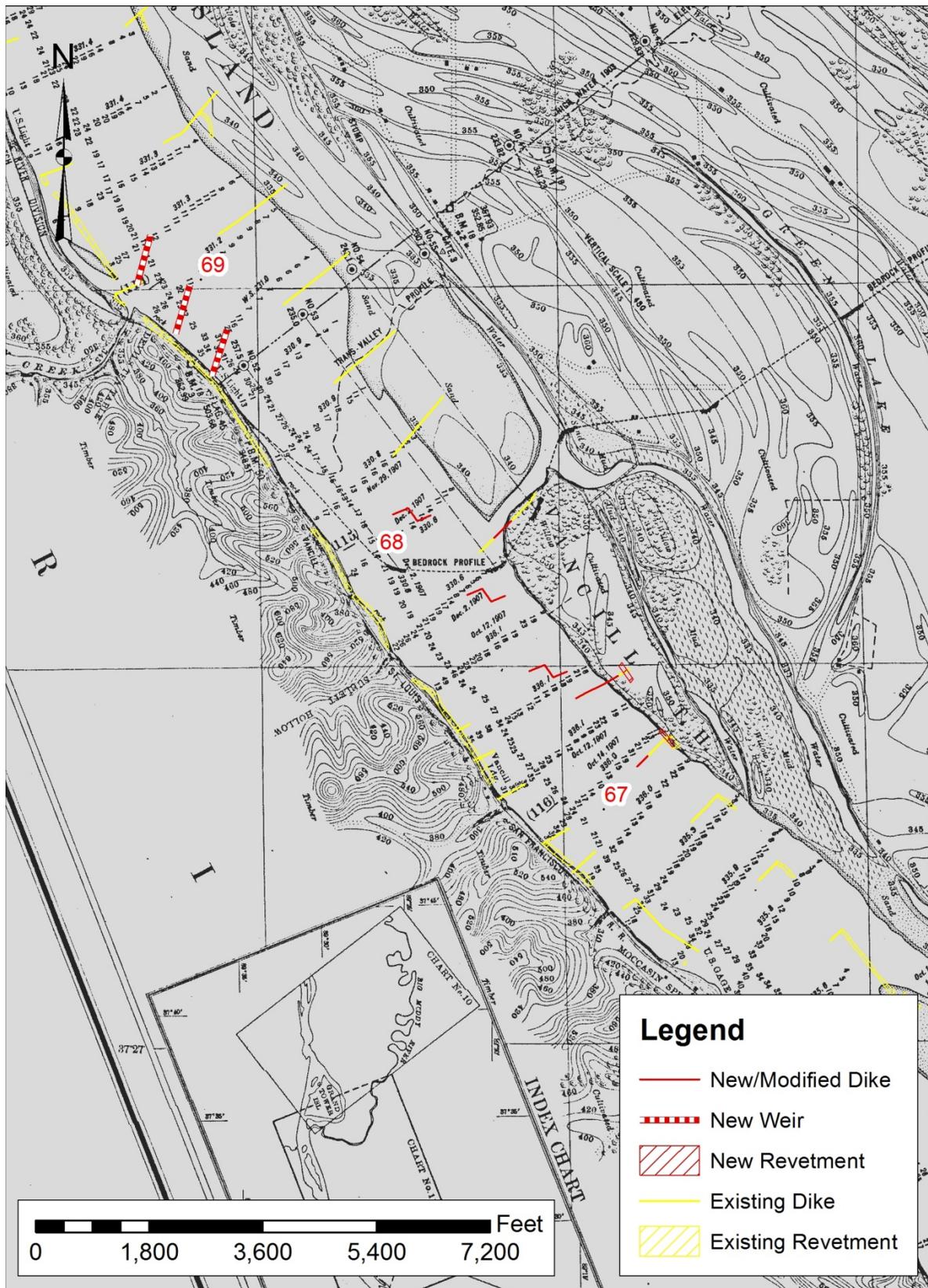


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1993 Ware 7.5-minute Quadrangle map. Washington, D.C.



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT CORPS OF ENGINEERS
1222 SPRUCE STREET
ST. LOUIS, MISSOURI 63103-2833

August 16, 2013

Engineering and Construction Division
Curation and Archives Analysis Branch

Ms. Glenna J. Wallace, Chief
Eastern Shawnee Tribe of Oklahoma
P.O. Box 350
Seneca, Missouri 64865

COPY

Dear Chief Wallace:

This letter addresses the construction of river training structures in four major areas of the middle Mississippi River. River training structures are used to help reduce sediment deposition in the navigation channel and to limit the need for dredging. The U.S. Army Corps of Engineers proposes adding, or modifying, twenty seven (27) training structures.

This project is located along the Mississippi River from St. Louis Harbor, located in St. Clair County, Illinois, south along the Mississippi River to the counties of Alexander located in Illinois, and Mississippi located in Missouri (see Figure 1). See Figures 2-7 for the location and structure types to be constructed on both the Illinois and Missouri sides of the Mississippi River. Federal monies have been received for the river training structures. The project areas are located on private land both in Missouri and Illinois. This federal action falls under Section 106 of the National Historic Preservation Act (NHPA), in conjunction with the National Environmental Policy Act (NEPA) and the Clean Water Act (CWA). This project is being implemented to improve navigation, reduce dredging in the channel, and enhance wildlife habitat along the river.

In 1866 the Federal Government allocated funding for a 4-foot navigation channel between Minneapolis and St. Louis. In 1878 this channel was deepened to a 4.5-foot channel, and in 1907 it was once again deepened to a 6-foot channel. This was achieved using a system of wing and closing dikes in conjunction with river dredging. On July 3, 1930, the Rivers and Harbors Act was amended, and the lock and dam system along the upper Mississippi River, from Minneapolis to St. Louis, was put in place. However, the middle and lower sections of the Mississippi River, below St. Louis, remains an open river navigation channel.

Training structures will be incorporated into the pre-existing system of structures already located along the river. There are numerous types of river structures including dikes, revetments, and bendway weirs. Below is a description of the different types of training structures proposed for this project. See Table 1 for the proposed location and type of structure to be constructed.

- **Wing dikes** are the oldest form of river training structure. They are constructed from the bankline into the river generally at a perpendicular angle to the current (see Figure 2 for an example). They redirect the river's own energy to manage sediment distribution within the river channel. While the original dikes of the nineteenth century were largely pile structures, by the middle of the twentieth century many had been converted to stone-fill types.
- **L-dikes** are shaped like an L with the shorter arm extending to the bank and the longer arm parallel with the current (see Figure 2 for an example). They are used to restrict sediment-carrying bottom currents from moving into the area between a series of dikes.
- **Rootless dikes** are wing dikes that are not connected to the shore (see Figure 3 for an example). The gap between the structure and the bank promotes habitat diversity.
- **Diverter (or S-) dikes** are in-stream structures useful in creating secondary side channels as they capture water from the main channel and direct it toward areas of interest, while still providing enough roughness and constriction to maintain a navigable channel (see Figure 5 for an example). They cause minimal erosion along the bankline because eddies are formed at their downstream tip.
- **Chevrons** are blunt nosed arch-shaped structures constructed parallel to the river flow (see Figure 4 for an example). Like other dikes they utilize the energy of the river to redistribute water flow, but unlike traditional dikes that create a unidirectional deflection, they create a split flow. The riverside bank of the chevron directs flow to maintain the navigation channel while the other side directs flow toward the near bank region. These structures have been proven to be effective at promoting environmental diversity, including a low velocity habitat behind the chevron itself.
- **Revetments** are structures placed along the river bank to stabilize or protect the bank from erosion (see Figure 3 for an example). They are usually constructed out of stone, but a variety of other materials have been used including concrete-mat, willow mattresses, and gabions.

COPY

- **Bendway weirs** are submerged rock structure that are positioned from the outside bankline of a river-bend and angled upstream toward the river flow (see Figure 7 for an example). These underwater structures extend directly into the navigation channel and shift the current away from the outside bankline. This controls channel scouring, and reduces riverbank erosion, resulting in a wider and safer navigation channel through the bend without the need for periodic dredging.

Impacts to potentially significant historic properties are not anticipated during this work. River training structures are constructed via barge, without recourse to land access; therefore, any impact is limited to submerged cultural resources. Primary among these are historic period shipwrecks. Given the continual river flow and associated sedimentary erosion, deposition, and reworking, it is highly unlikely that any more ephemeral cultural material remains on the river bed. USACE has conducted shipwreck surveys during times of historic low water levels and maintains a database of known shipwrecks for the middle Mississippi. All proposed locations for river training structures are compared to the database, as well as aerial imagery from low water years, to ensure historical shipwrecks are not adversely impacted.

River embankments can potentially have adverse affects on cultural resources. As with other training structures they are conducted via barge, without recourse to land access. The placement of the rock on the shoreline, however, has the potential to affect any resources on that shoreline. With all embankment features, historical research is conducted on the proposed location to determine if the area is on recently accreted land or cut-banks in an existing, older, landform. Recently accreted land is highly unlikely to contain deeply buried cultural resources. If appropriate, pedestrian and/or shovel test surveys will be conducted to investigate all proposed locations. Should an inadvertent discovery of human remains occur, then state law will be followed, and work will stop within the area of the discovery. Tribes will be notified, and any human remains will be treated with respect and dignity. The following Federally recognized tribes are being notified of this project.

Absentee-Shawnee Tribe of Oklahoma
Eastern Shawnee Tribe of Oklahoma
Shawnee Tribe
Cherokee Nation
United Keetoowah Band of Cherokee of
Oklahoma
Delaware Nation, Oklahoma
Delaware Tribe of Indians, Oklahoma
Citizen Potawatomi Nation
Forest County Potawatomi Community

Match-e-be-nash-she-wish Band of
Potawatomi of Michigan
Hannahville Indian Community
Nottawaseppi Band of
Huron Potawatomi
Pokagon Band of Potawatomi
Prairie Band Potawatomi Nation
Ho-Chunk Nation of Wisconsin
Winnebago Tribe of Nebraska
Iowa Tribe of Kansas and Nebraska
Iowa Tribe of Oklahoma
Kickapoo Traditional Tribe of Texas

Kickapoo Tribe of Oklahoma
Kickapoo Tribe of Indians of Kansas
Sac & Fox Nation of Oklahoma
Sac & Fox Nation of Missouri in Kansas
and Nebraska

Sac & Fox Tribe of the Mississippi
in Iowa
Miami Tribe of Oklahoma
Osage Nation of Oklahoma
Peoria Tribe of Oklahoma
Quapaw Tribe of Indians, Oklahoma

The U.S. Army Corps of Engineers, St Louis District is requesting you review the maps and information about this project and notify our office if you have any concerns such as a traditional cultural properties or sacred sites that are located within or near the construction sites. Please notify our office no later than October 4, 2013, if you have any areas of concern. If you have any questions regarding this matter, please contact Ms. Roberta L. Hayworth, Native American Coordinator directly at (314) 331-8833, or by electronic mail at roberta.l.hayworth@usace.army.mil. Thank you in advance for your timely review of this request.

Sincerely,



Michael K. Trimble, Ph.D.
Chief, Curation and Archives
Analysis Branch

COPY

Enclosures

Copy Furnished:
Mr. Joseph Blanchard

COPY

Major Reach	Localized Reach	Work	County	State
Mosethein-Ivory Landing Phase 4 (RM 195-154)	St Louis Harbor	Revetment RM 175-171	St. Clair	IL
		Raise Dike 181.7L	St. Clair	IL
		Dike 173.4L	St. Clair	IL
Eliza Point/Greenfield Bend Phase 3 (RM20-0)	Bird's Point (RM 4-0)	Rootless Dike 3.0L	Alexander	IL
		Weir 2.6R	Mississippi	MO
		Weir 2.5R	Mississippi	MO
		Weir 2.3R	Mississippi	MO
		Weir 2.2R	Mississippi	MO
Grand Tower Phase 5 (RM90-67)	Crawford Towhead (RM 75-71)	Chevron 73.6L	Union	MO
		Dike Extension 72.9L	Union	MO
		Chevron 72.5L	Union	MO
	Vancil Towhead (RM 70-66)	Weir 69.15R	Cape Girardeau	MO
		Weir 68.95R	Cape Girardeau	MO
		Weir 68.75R	Cape Girardeau	MO
		Diverter Dike 68.10L	Union	IL
		Diverter Dike 67.80L	Union	IL
		Diverter Dike 67.50L	Union	IL
		Repair Dike 67.80L	Union	IL
		Shorten Dike 67.30L	Union	IL
		Shorten Dike 67.10L	Union	IL
		600 feet Revetment	Union	IL
		Dogtooth Bend Phase 5 (RM 40-20)	Bumgard (RM 33-27)	Weir 34.20L
Weir 34.10L	Alexander			IL
Weir 32.50L	Alexander			IL
Weir 32.40L	Alexander			IL
Weir 32.3L	Alexander			IL
Weir 32.2L	Alexander			IL
Shorten Dike 32.0L	Alexander			IL
Extend Dike 31.8L	Alexander			IL
Extend Dike 31.6L	Alexander			IL
Dike 31.6R	Scott			MO
Extend Dike 31.4L	Alexander			IL
Extend Dike 31.2L	Alexander			IL
Extend Dike 31.1L	Alexander			IL
Weir 30.80R	Scott			MO
Weir 30.70R	Scott			MO

Table 1

Proposed FY 2014 river training structure projects

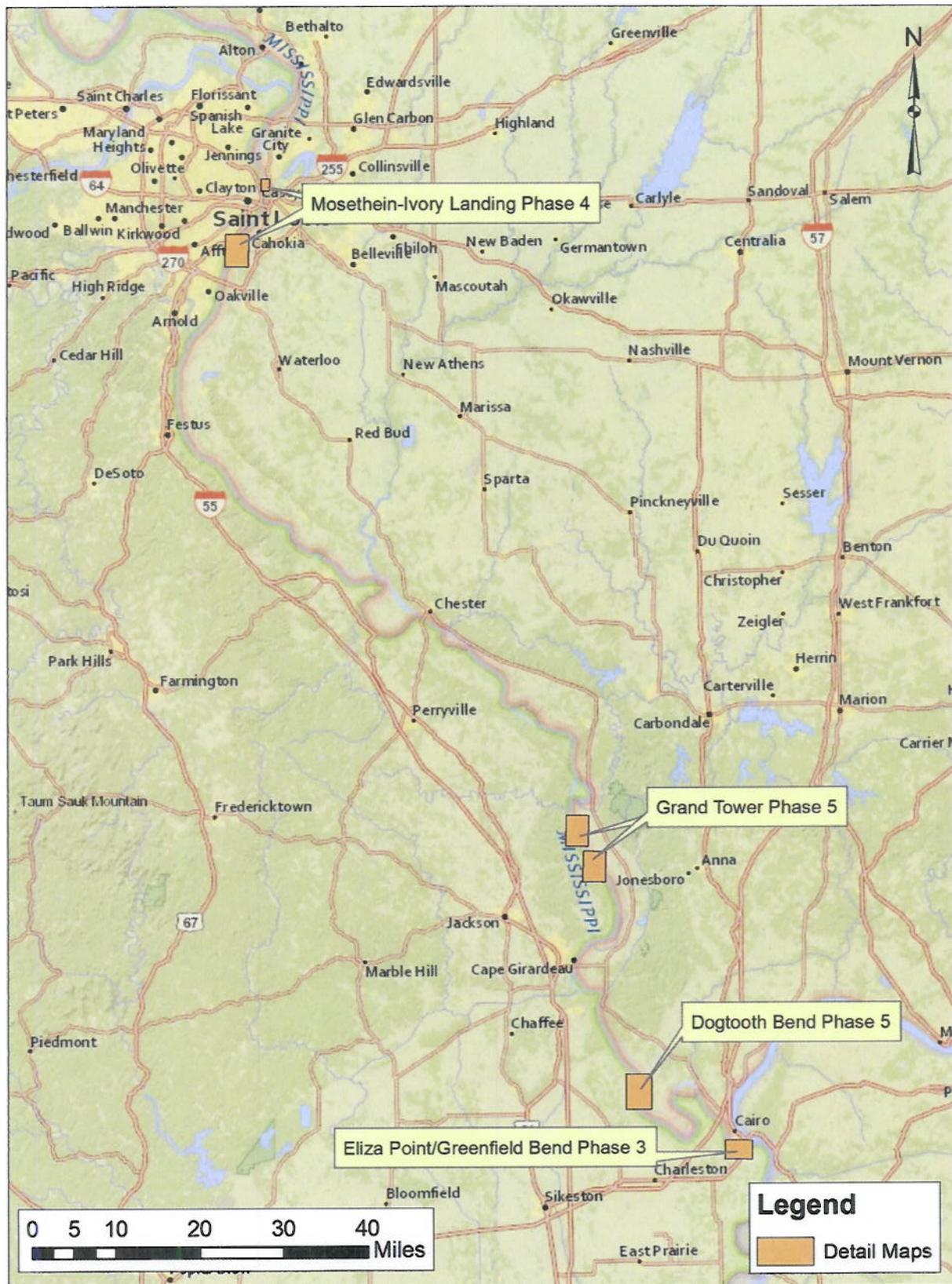


Figure 1. Location of proposed work.

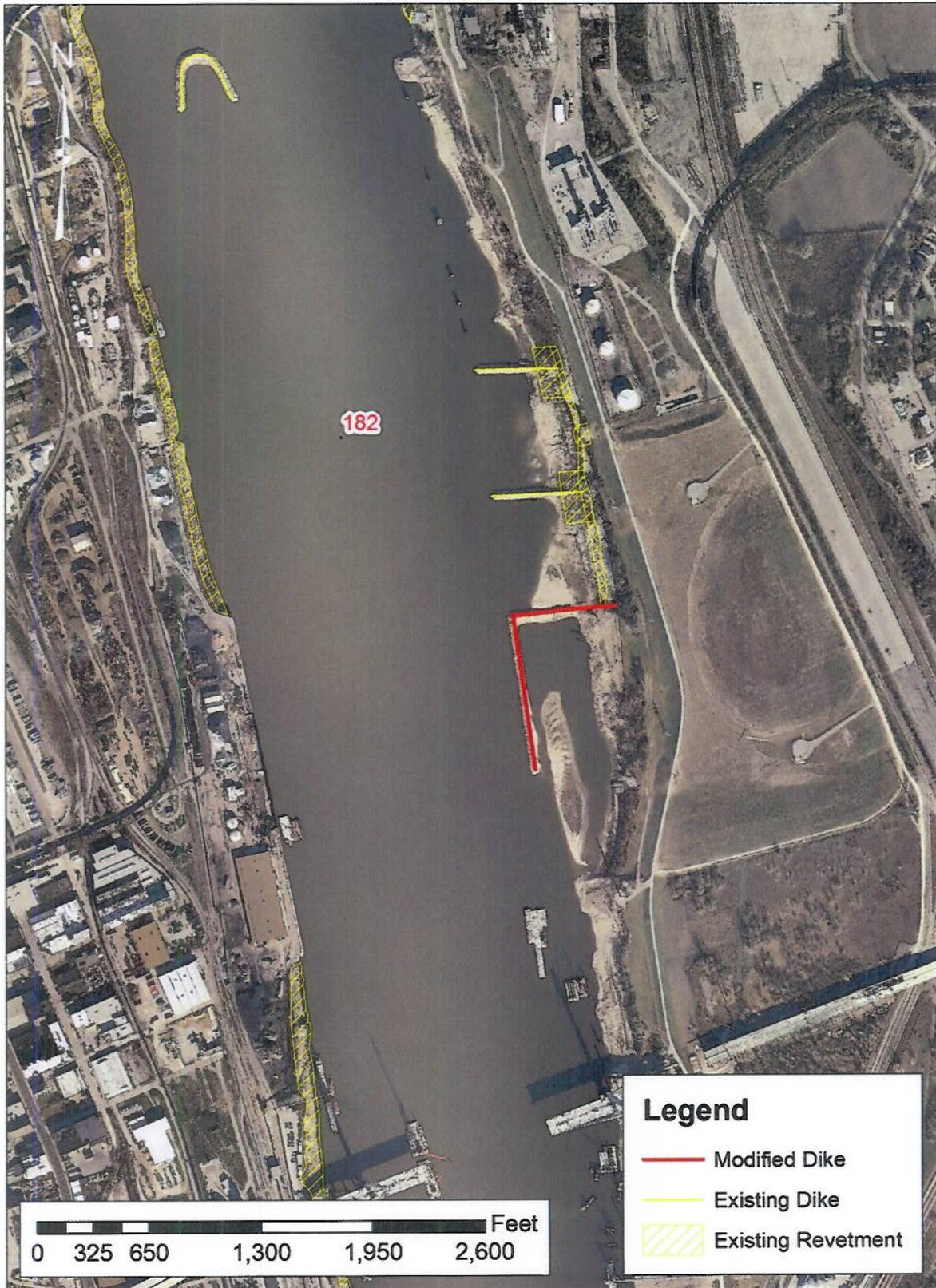


Figure 2. Location of Dike 181.7L in St. Louis Harbor.

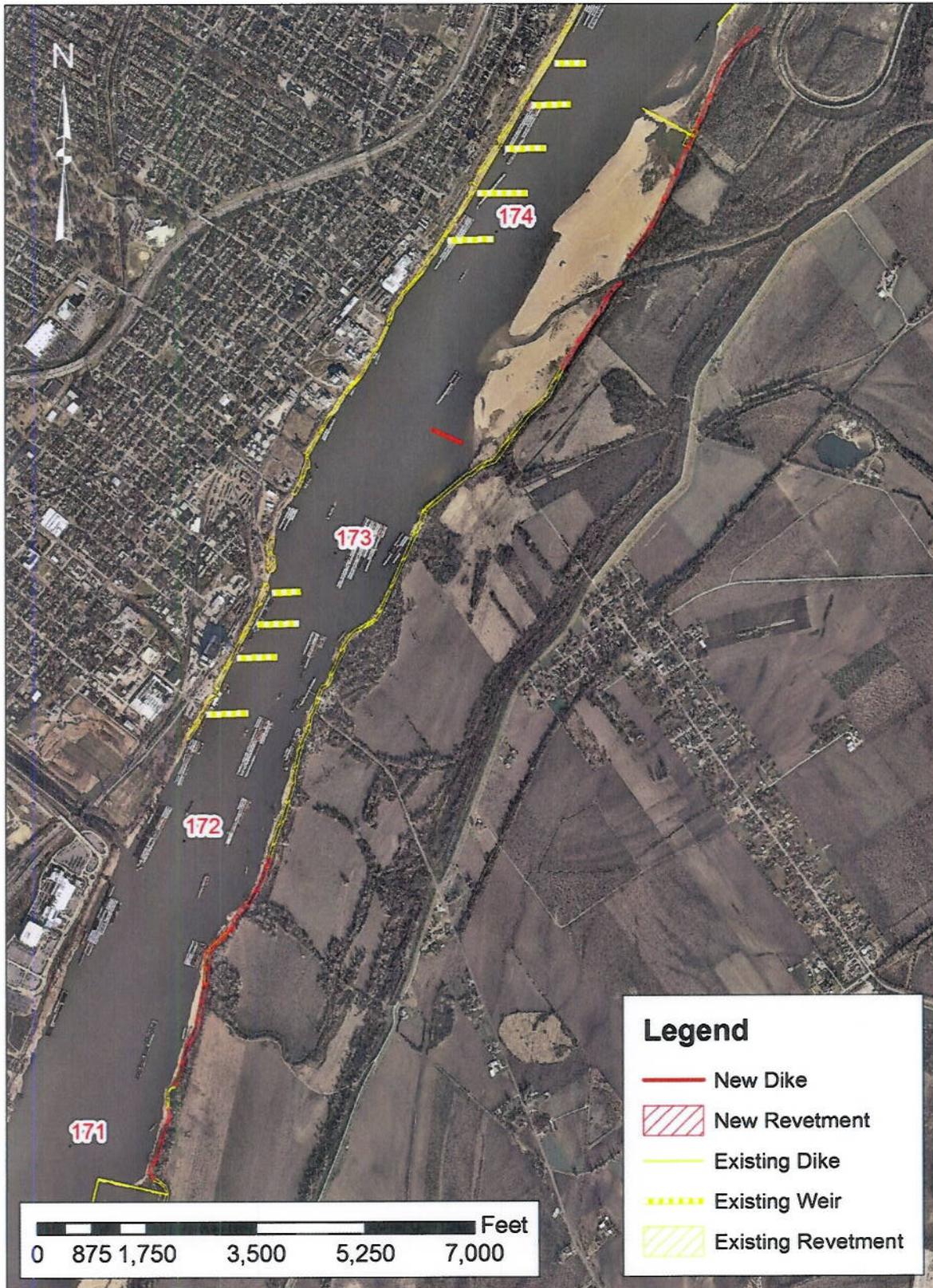


Figure 3. Location of proposed work in St. Louis harbor.

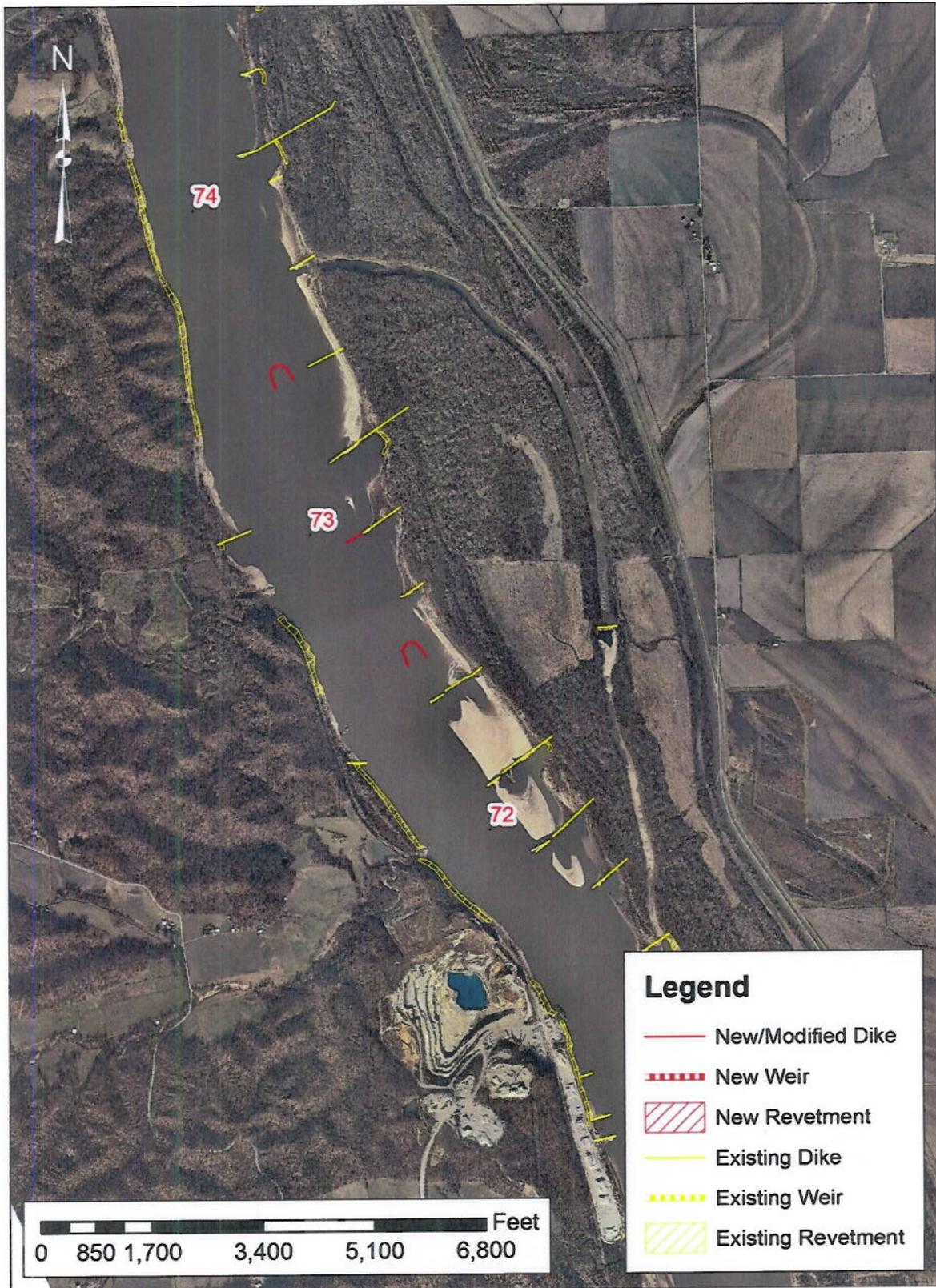


Figure 4. Location of proposed work at Crawford Towhead.



Figure 5. Location of proposed work at Vancil Towhead.

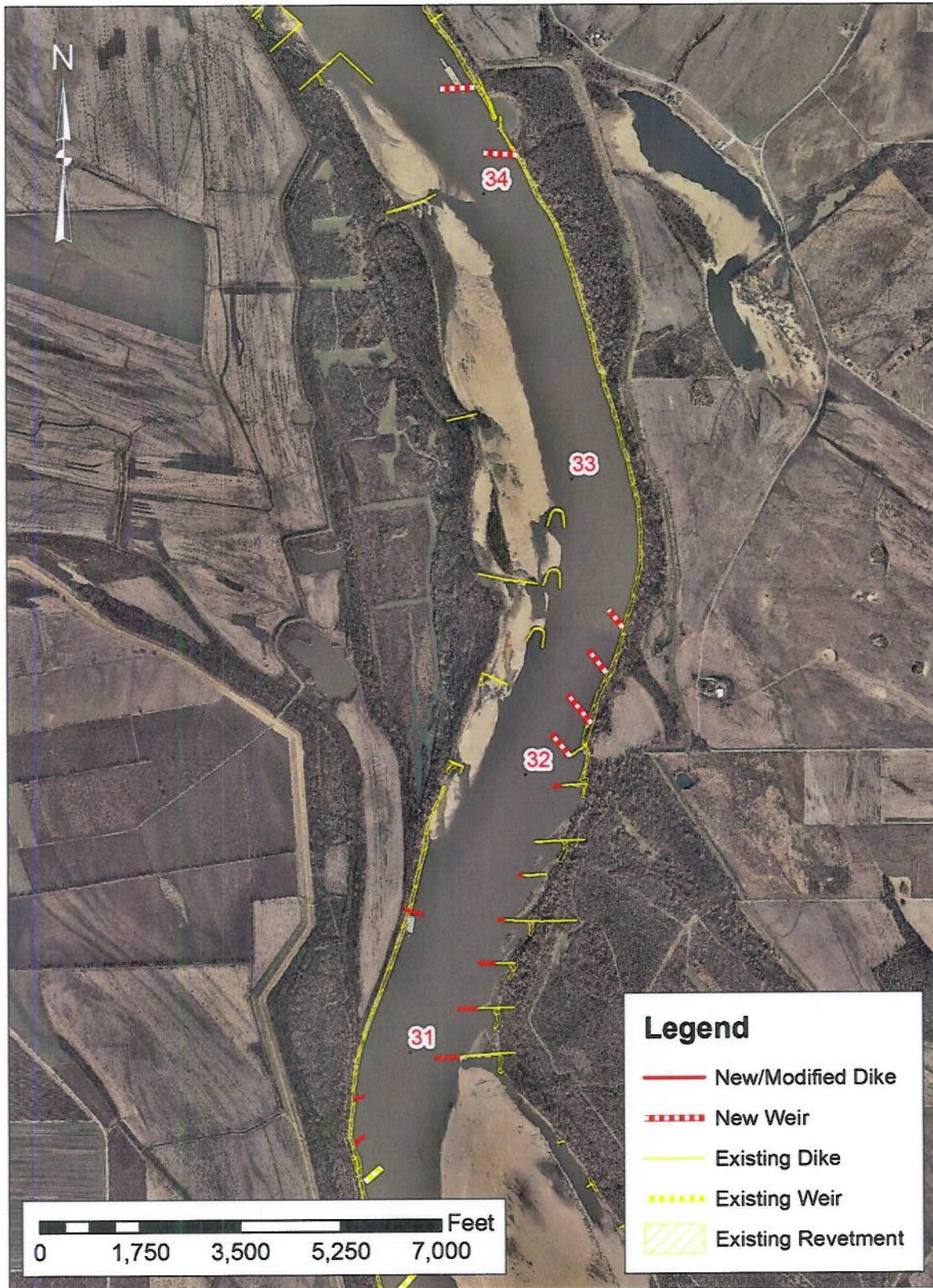


Figure 6. Location of proposed work at Bumgard reach.

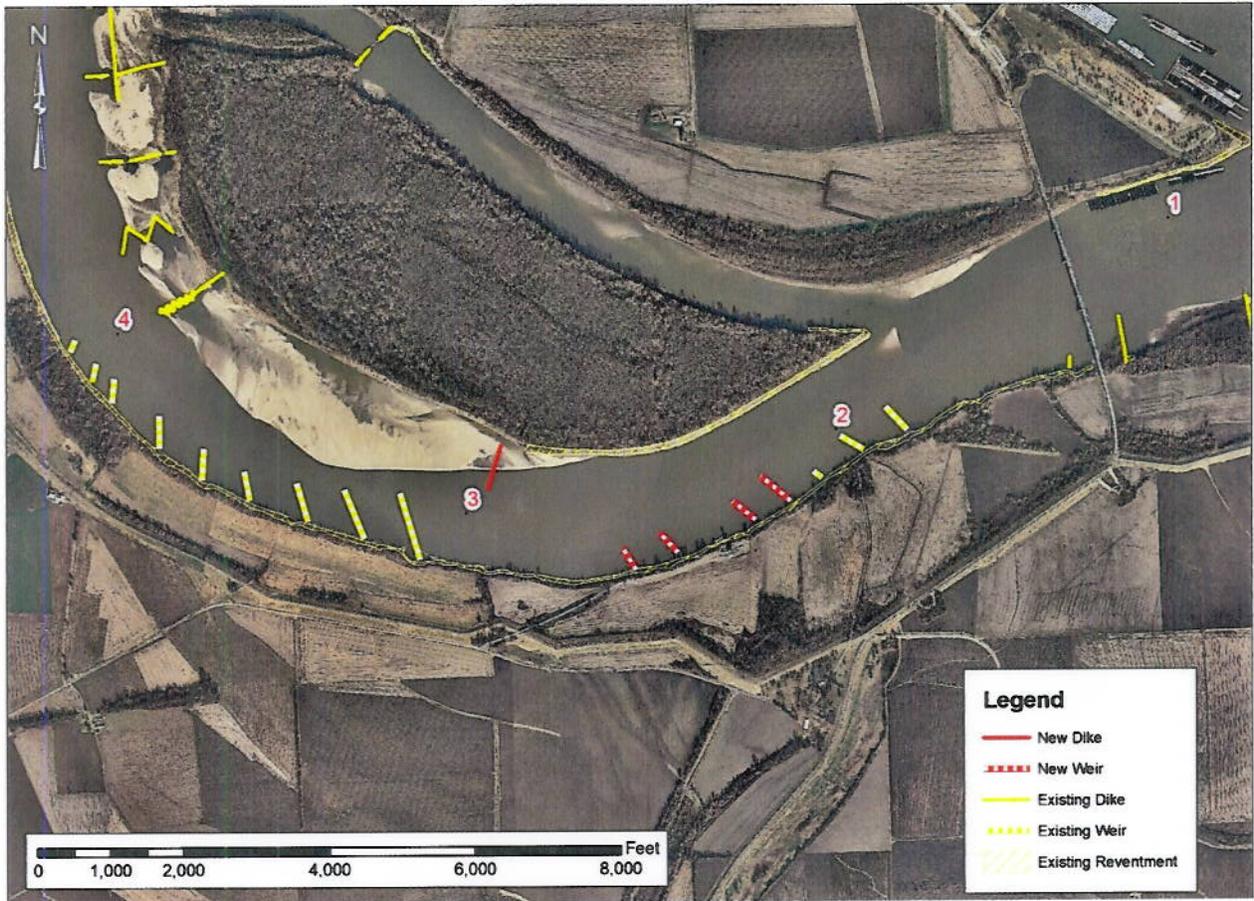


Figure 7. Location of proposed work at Birds Point.

**SAME LETTER SENT
TRIBAL CHAIRPERSONS**

Ms. Edwina Butler-Wolfe Governor
Absentee-Shawnee Tribe
of Indians of Oklahoma
2025 S. Gordon Cooper Drive
Shawnee, Oklahoma 74810-9381

Ms. Glenna J. Wallace, Chief
Eastern Shawnee Tribe of Oklahoma
P.O. Box 350
Seneca, Missouri 64865

Mr. Ron Sparkman, Chairman
Shawnee Tribe
P.O. Box 189
Miami, Oklahoma 74355

Mr. Bill John Baker, Principal Chief
Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465

Mr. George Wickliffe, Chief
United Keetoowah Band of Cherokee
Indians of Oklahoma
P.O. Box 746
Tahlequah, Oklahoma 74464

Mr. Kerry Holton, President
Delaware Nation, Oklahoma
P.O. Box 825
Anadarko, Oklahoma 73005

Ms. Paula Pechonick, Chief
Delaware Tribe of Indians
170 N. Barbara
Bartlesville, Oklahoma 74006

Mr. John Barrett, Chairman
Citizen Potawatomi Nation, Oklahoma
1601 S. Gordon Cooper Drive
Shawnee, Oklahoma 74801

Mr. Harold Frank, Chairman
Forest County Potawatomi
Community, Wisconsin
P.O. Box 340
Crandon, Wisconsin 54520

Mr. D.K. Sprague, Chairman
Match-e-be-nash-she-wish Band of
Potawatomi Indians of Michigan
P.O. Box 218
Dorr, Michigan 49323

Mr. Kenneth Meshigand, Chairman
Hannahville Indian Community, Michigan
N14911 Hannahville Blvd. Rd.
Wilson, Michigan 49896-9728

Mr. Homer Mandoka, Chairman
Nottawaseppi Huron Band of
Potawatomi, Michigan
2221—1 ½ Mile Road
Fulton, Michigan 49052

Mr. Matthew Wesaw, Chairman
Pokagon Band of Potawatomi Indians,
Michigan and Indiana
P.O. Box 180
Dowagiac, Michigan 49047

Mr. Steve Ortiz, Chairman
Prairie Band Potawatomi Nation
Government Center
16281 Q Road
Mayetta, Kansas 66509

Mr. Jon Greendeer, President
Ho-Chunk Nation of Wisconsin
W 9814 Airport Road
Black River Falls, Wisconsin 54675

Mr. John Blackhawk, Chairman
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, Nebraska 68071

Mr. Tim Rhodd, Chairman
Iowa Tribe of Kansas and Nebraska
3345 Thrasher Road # 8
White Cloud, Kansas 66094

Ms. Janice Rowe-Kurak, Chairwoman
Iowa Tribe of Oklahoma
Route 1, Box 721
Perkins, Oklahoma 74059

Mr. Juan Garza, Chairman
Kickapoo Traditional Tribe of Texas
HC 1, Box 9700
Eagle Pass, Texas 78853

Mr. John Berrey, Chairman
Quapaw Tribe of Indians
P.O. Box 765
Quapaw, Oklahoma 74363

Mr. Tony Salazar, Chairman
Kickapoo Tribe of Oklahoma
P.O. Box 70
McCloud, Oklahoma 74851

Mr. Steve Cadue, Chairman
Kickapoo Tribe of Indians of the
Kickapoo Reservation in Kansas
P.O. Box 271
Horton, Kansas 66439

Mr. George Thurman, Principal Chief
Sac & Fox Nation, Oklahoma
920883 S. Hwy. 99
Building A
Stroud, Oklahoma 74079

Mr. Michael Dougherty, Chairman
Sac & Fox Nation of Missouri in
Kansas and Nebraska
305 N. Main Street
Hiawatha, Kansas 66434

Mr. Frank Blackcloud, Chairman
Sac & Fox Tribe of the
Mississippi in Iowa
349 Meskwaki Road
Tama, Iowa 52339

Mr. Thomas E. Gamble, Chief
Miami Tribe of Oklahoma
P.O. Box 1326
202 S. Eight Tribes Trail
Miami, Oklahoma 74355

Mr. John D. Red Eagle, Principal Chief
The Osage Nation
P.O. Box 779
Pawhuska, Oklahoma 74056

Mr. John Froman, Chief
Peoria Tribe of Indians of Oklahoma
P.O. Box 1527
118 S. Eight Tribes Trail
Miami, Oklahoma 74355

**SAME LETTER SENT
TRIBAL REPRESENTATIVE:**

Mr. Joseph Blanchard
Tribal Historic Preservation Officer
Absentee-Shawnee Tribe
of Indians of Oklahoma
2025 Gordon Cooper Drive
Shawnee, Oklahoma 74810-9381

Ms. Robin DuShane
Eastern Shawnee Tribe of Oklahoma
P.O. Box 350
Seneca, Missouri 64856

Ms. Kim Jumper
Shawnee Tribe
P.O. Box 189
Miami, Oklahoma 74355

Dr. Richard Allen
Cherokee Nation
P.O. Box 948
Tahlequah, Oklahoma 74465

Ms. Lisa Larue-Baker
United Keetoowah Band of Cherokee
Indians of Oklahoma
2450 S. Muskogee Avenue
Tahlequah, Oklahoma 74464

Ms. Tamara Francis Fourkiller
Delaware Nation, Oklahoma
P.O. Box 825
Anadarko, Oklahoma 73005

Dr. Bryce Obermeyer
Delaware Tribe of Indians
Tribal Historic Preservation Office
Roosevelt Hall, Room 212
1200 Commercial Street
Emporia, Kansas 66801

Ms. Kelli Mosteller
Tribal Historic Preservation Officer
Citizen Potawatomi Nation, Oklahoma
1601 S. Gordon Cooper Dr.
Shawnee, Oklahoma 74801

Ms. Melissa Cook
Tribal Historic Preservation Officer
Forest County Potawatomi,
Community, Wisconsin
Cultural Center, Library & Museum
8130 Mishkoswen Drive, P.O. Box 340
Crandon, Wisconsin 54520

Mr. Todd Williamson
Match-e-be-nash-she-wish Band
of Pottawatomi Indians of Michigan
P.O. Box 218
Dorr, Michigan 49323

Mr. Earl Meshigaud
Hannahville Indian Community,
Michigan
N 14911 Hannahville Road
Wilson, Michigan 49896

Mr. John Rodwan
Nottawaseppi Huron Band of
Potawatomi, Michigan
2221-1&1/2 Mile Road
Fulton, Michigan 49052

Mr. Mike Zimmerman
Tribal Historic Preservation Officer
Pokagon Band of Potawatomi Indians,
Michigan and Indiana
P.O. Box 180
58620 Stink Road
Dowagiac, Michigan 49047

Ms. Jancita Warrington
Prairie Band Potawatomi Nation
Government Center
16281 Q Road
Mayetta, Kansas 66509

Mr. William Quackenbush
Tribal Historic Preservation Officer
Ho-Chunk Nation of Wisconsin
P.O. Box 667
Black River Falls, Wisconsin 54615

Ms. Emily DeLeon
Winnebago Tribe of Nebraska
Little Priest Tribal College
P.O. Box 270
Winnebago, Nebraska 68071

Mr. F. Martin Fee
Tribal Historic Preservation Officer
Iowa Tribe of Kansas and Nebraska
3345 Thrasher Road
White Cloud, Kansas 66094

Mr. Kent Collier
Kickapoo Tribe of Oklahoma
P.O. Box 70
McCloud, Oklahoma 74851

Ms. Curtis Simon
Kickapoo Tribe of Indians of the
Kickapoo Reservation in Kansas
1107 Goldfinch Road
Horton, Kansas 66439

Ms. Sandra Massey
Sac & Fox Nation, Oklahoma
920883 S. Hwy. 99
Building A
Stroud, Oklahoma 74079

Mr. Edmore Green
Sac & Fox Nation of Missouri
in Kansas and Nebraska
305 North Main Street
Hiawatha, Kansas 66434

Mr. Jonathan Buffalo
Sac & Fox Tribe of the Mississippi
in Iowa
349 Meskwaki Road
Tama, Iowa 52339

Mr. George Strack
Tribal Historic Preservation Officer
Miami Tribe
P.O. Box 1236
202 S. Eight Tribes Trail
Miami, Oklahoma 74355

Dr. Andrea Hunter
Historic Preservation Office
The Osage Nation
627 Grandview
Pawhuska, Oklahoma 74056

Mr. Frank Hecksher
Peoria Tribe of Indians of Oklahoma
118 S. Eight Tribes Trail
P.O. Box 1527
Miami, Oklahoma 74355

Ms. Jean Ann Lambert
Tribal Historic Preservation Officer
Quapaw Tribe of Indians
P.O. Box 765
Quapaw, Oklahoma 74363

Appendix D. Clean Water Act Section 404(b)(1) Evaluation

**REGULATING WORKS PROJECT
GRAND TOWER PHASE 5
MIDDLE MISSISSIPPI RIVER MILES 74-67
UNION COUNTY, IL
CAPE GIRARDEAU COUNTY, MO**

DECEMBER 2013

**APPENDIX D
CLEAN WATER ACT
SECTION 404(b)(1) Evaluation**

CONTENTS

1. PROJECT DESCRIPTION.....	1
A. Location.	1
B. General Description.	1
C. Authority and Purpose.....	1
D. General Description of the Fill Material.....	1
E. Description of the Proposed Placement Site.....	2
F. Description of the Placement Method.	3
2. FACTUAL DETERMINATIONS.....	3
A. Physical Substrate Determinations.....	3
B. Water Circulation, Fluctuation, and Salinity Determinations.....	4
C. Suspended Particulate/Turbidity Determinations.....	5
D. Contaminant Determinations.....	5
E. Aquatic Ecosystem and Organism Determinations.....	5
F. Proposed Placement Site Determinations.....	6
G. Determinations of Cumulative Effects on the Aquatic Ecosystem.....	7
H. Determinations of Secondary Effects on the Aquatic Ecosystem.....	7
3. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON PLACEMENT.....	7

**APPENDIX D
CLEAN WATER ACT
SECTION 404(b)(1) Evaluation**

1. PROJECT DESCRIPTION

A. Location. The Grand Tower Phase 5 Regulating Works Project is located in the Middle Mississippi River (MMR) between river miles 74 and 67 in Cape Girardeau County, Missouri and Union County, Illinois near the town of Grand Tower, Illinois. This area includes the Crawford and Vancill Towheads. The MMR is defined as that portion of the Mississippi River that lies between its confluences with the Ohio and Missouri rivers.

B. General Description. The U.S. Army Corps of Engineers St. Louis District is proposing to construct the Grand Tower Phase 5 Project as part of its Regulating Works Project. The Regulating Works Project utilizes bank stabilization and sediment management to maintain bank stability and ensure adequate navigation depth and width. Bank stabilization is achieved by revetments, while sediment management is achieved by river training structures, i.e. dikes. The Grand Tower Phase 5 Project is designed to address repetitive dredging and unsafe navigation conditions in the project area. The Proposed Action includes the construction of two chevrons and the extension of one dike in the Crawford Towhead between RM 74 and 72. The Vancill Towhead project is located between RM 70.0 and 67.0 and includes construction of 3 weirs, 3 diverter dikes (S-dikes), repair of dike 67.8, revetment at 67.3 and shortening of dikes 67.3 and 67.1 (USACE 2012).

C. Authority and Purpose. The Middle Mississippi River Regulating Works Project is specifically and currently authorized pursuant to the Rivers and Harbors Acts beginning in 1881. These authorize USACE to provide, as a minimum, a 9-foot deep by 300-foot wide navigation channel at low river levels corresponding to 40,000 cubic feet per second discharge.

The purposes of this project are to reduce the need for repetitive channel maintenance dredging in the project area, thereby providing a sustainable, safe and dependable navigation channel.

D. General Description of the Fill Material.

Fill material would include quarry run limestone consisting of graded "A" stone. Size requirements for graded "A" stone are shown below. Stone (35,000 tons) required for the project would be obtained from commercial stone quarries in the vicinity of the project area capable of producing stone which meets USACE specifications.

GRADED "A" STONE	
Stone Weight (LBS)	Cumulative % Finer by Weight
5000	100
2500	70-100
500	40-65
100	20-45
5	0-15
1	0-5

E. Description of the Proposed Placement Site.

The proposed project would consist of the following:

Table 1. Proposed Action Grand Tower Phase 5 Regulating Works Project

Proposed Feature	Feature Description
Crawford Towhead	
Construct Chevron 73.65L	Construct 300ft x 300ft chevron. Top elevation of the chevron will be +18.5 LWRP.
Extend Dike 72.9L	Extend existing dike 300 feet. Top elevation of the chevron will be +18.5 LWRP.
Construct Chevron 72.55L	Construct 300ft x 300ft chevron. Top elevation of the chevron will be +18.5 LWRP.
Vancill Towhead	
Construct Weir 69.15R	Construct Weir 800 feet long Top elevation of the weir will be -15 feet LWRP
Construct Weir 68.95R	Construct Weir 800 feet long Top elevation of the weir will be -15 feet LWRP
Construct Weir 68.75R	Construct Weir 800 feet long Top elevation of the weir will be -15 feet LWRP
Construct Diverter Dike 68.10L (S-dike)	Construct Diverter Dike 750 feet long Top elevation of the dike will be +18 feet LWRP
Construct Diverter Dike 67.80L (S-dike)	Construct Diverter Dike 750 feet long Top elevation of the dike will be +18 feet LWRP
Construct Diverter Dike 67.50L (S-dike)	Construct Diverter Dike 750 feet long. Top elevation of the dike will be +18 feet LWRP.
Repair Dike 67.80L	Repair Dike (350 foot of length). Top elevation of the dike will be +18 feet LWRP.
Shorten Dike 67.30L	Shorten Dike 660 feet. Top elevation of the dike will be +18 feet LWRP.
Shorten Dike 67.10L	Shorten Dike 300 feet. Top elevation of the dike will be +18 feet LWRP.
Place Revetment 67.3L	Place 320 ft. of revetment where dike attaches to riverbank.

F. Description of the Placement Method.

Placement of material would be accomplished by trackhoe or dragline crane. Stone would be transported to placement sites by barges. All construction would be accomplished from the river and all work would be performed below ordinary high water.

2. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

- I. **Elevation and Slope.** There would be an immediate change in substrate elevation and slope over the areal extent of the structure placement locations. The bendway weirs would consist of a rock mound of uniform shape along the outside bend extending into the navigation channel. The top elevation of the weirs would be 304 feet (-15 LWRP). Side slopes would be approximately 1 vertical on 1.5 horizontal. After placement, sediment would be captured between the underwater weirs raising the channel depth along the outside bend; however, the elevation of the bendway weirs and associated trapped sediments would remain at 304 feet allowing for passage of barge traffic even during low river stages. A small portion of the opposite point bar would be eroded as the currents shift away from the outside bend. The slope of the opposite point bar would be expected to remain similar to existing conditions.

Dikes are usually built perpendicular to the river flow and vary considerably in height and length. The extended or restored stone dikes at RM 72.9 (339.5 ft - +18.5 LWRP) and RM 67.8 (336.5 ft - +18 LWRP) will redirect the river's own energy to provide a variety of effects including managing the sediment response distribution within the channel to deepen the channel and provide adequate depth for navigation.

Chevrons, dike structures designed as a blunt nosed arch shape, have typically been used to redistribute flow and sediment to maintain the navigation channel. The chevrons will use the energy of the river to redistribute water flow, but unlike traditional dikes that create a unidirectional deflection, they create a split flow. The riverside bank of the chevron directs flow to maintain the navigation channel while the other side directs flow toward the riverbank. These structures have been proven to be effective at promoting bathymetric diversity, including a low velocity habitat behind the chevron itself. Chevrons will be placed at RM 73.65 and 72.55 at approximately 339.75 ft. and 339.2 ft. (+18.5 LWRP) respectively.

River engineers at the Applied River Engineering Center have found that S-Dike structures not only redistribute flow and sediment, but have the ability to control the energy coming off of the right side or the left side of the structure. S-Dike structures are useful for creating secondary side channels because they angle upstream to capture water from the main channel and direct it towards the area of interest, while providing enough roughness and constriction to maintain a navigable channel. The S-dike will cause minimal erosion along the bankline because an eddy is formed at its tip. As flow and sediment hit the structure,

depending on the orientation of the dike, a portion of the flow and sediment will be taken from the main source of flow towards a lower energy area on the opposite side of the dike. (USACE 2012)

The S-dike or diverter dike would consist of a rock mound of uniform shape in the main channel border near RM 67.5. The top elevation of the S-dikes would be 336.5 feet (+18 LWRP). Side slopes would be approximately 1 vertical on 1.5 horizontal.

- II. **Sediment Type.** The project site is located entirely within the existing channel of the Middle Mississippi River. The Middle Mississippi River channel is comprised mainly of sands with some gravels, silts, and clays. The stone used for construction would be Graded “A” Stone.
- III. **Fill Material Movement.** No bank grading or excavation would be required for the installation of structures. Draglines and/or trackhoes would pull rock from floating barges and place the material into the river. Fill materials would be subject to periodic high flows which may cause some potential movement and dislodging of stone from the structures. This may result in the need for minor repairs; however, no major failures are likely to occur.
- IV. **Physical Effects on Benthos.** Material placement should not significantly affect benthic organisms. Shifting sediments at structure placement sites likely harbor low densities of oligochaetes, chironomids, caddisflies, and turbellaria. High densities of hydropsychid caddisflies and other macroinvertebrates would be expected to colonize the large limestone rocks after construction. Fish would temporarily avoid the area during construction. Greater use of the project location by fish is expected after construction due to the expected increase in densities of macroinvertebrates.
- V. **Actions Taken to Minimize Impacts.** Best Management Practices for construction would be enforced.

B. Water Circulation, Fluctuation, and Salinity Determinations

- I. **Water.** Some sediments (mostly sands) would be disturbed when the rock used for construction is deposited onto the riverbed. This increased sediment load would be local and minor compared to the natural sediment load of the river, especially during high river stages.
- II. **Current Patterns and Circulation.** The bendway weirs would redirect the swift currents away from the outside bend, toward the opposite point bar, allowing for a wider and safer navigation channel. Current patterns shifting toward the opposite point bar would cause a small portion of the point bar to be eroded. The chevron dikes would create split flow conditions at river stages below the structure’s top elevation of 339.5 feet (LWRP +18.5). The S-dike would direct flow toward a secondary channel and chute at Vancill Towhead.

- III. **Normal Water Level Fluctuations.** The structures would have no discernible effects on normal water level fluctuations or overall river stages.
- IV. **Actions Taken to Minimize Impacts.** Best Management Practices for construction would be enforced.

C. Suspended Particulate/Turbidity Determinations

- I. **Expected Changes in Suspended Particles and Turbidity Levels in Vicinity of Placement Site.** Increases in suspended particulates and turbidity due to construction activities are expected to be greatest within the immediate vicinity of the rock structures. The increased sediment load would be local and minor compared to the natural sediment load of the river. This would cease soon after construction completion.
- II. **Effects on Chemical and Physical Properties of the Water Column**
 - a. Light Penetration. There would be a temporary reduction in light penetration until sediments suspended as part of project activities settled out of the water column.
 - b. Dissolved Oxygen. No adverse effects expected.
 - c. Toxic Metals and Organics. No adverse effects are expected.
 - d. Aesthetics. Aesthetics of work sites are likely to be adversely affected during construction, but are expected to return to normal after construction.
- III. **Effects on Biota.** The project would likely result in some short-term displacement of biota in the immediate vicinity of construction activities due to temporary decreases in water quality and disturbance by construction equipment. Long-term beneficial effects should occur as macroinvertebrates colonize new rock substrate and fish utilize macroinvertebrate prey resources.
- IV. **Actions Taken to Minimize Impacts.** Impacts are anticipated to be minimized by the use of clean, physically stable, and chemically non-contaminating limestone rock for project construction.

D. Contaminant Determinations. It is not anticipated that any contaminants would be introduced or translocated as a result of project activities.

E. Aquatic Ecosystem and Organism Determinations

- I. **Effects on Plankton.** The project could have a temporary, minor effect on plankton communities in the immediate vicinity of the project area. This would cease after construction completion.
- II. **Effects on Benthos.** Shifting sediments at structure placement sites likely harbor low densities of oligochaetes, chironomids, caddisflies, and turbellaria.

Construction activities would eliminate some of these organisms. High densities of hydropsychid caddisflies and other macroinvertebrates would be expected to colonize the large limestone rocks after construction. Fish would be expected to temporarily avoid the area during construction. Greater utilization of the project location by fish is expected after construction due to the expected increase in densities of macroinvertebrates. Fish habitat is expected to improve at the structure placement sites due to improved flow, bathymetry, and prey resource conditions. The impacts on fish and macroinvertebrate habitat on the inside bend opposite the weirs are uncertain. Studies to date do not provide conclusive results for predicting fish or macroinvertebrate community response to weir placement at adjacent inside bends.

- III. **Effects on Nekton.** Nekton would be temporarily displaced during construction activities, but would return shortly after project completion. Greater utilization of the project area by fish may occur after construction due to the expected increase in densities of macroinvertebrates and areas of improved flow and bathymetry.
- IV. **Effects on Aquatic Food Web.** Temporary reductions in macroinvertebrate and fish communities during construction in the relatively small project area should not significantly impact the aquatic food web in the Middle Mississippi River. Improvements in lower trophic levels (macroinvertebrates) subsequent to project completion should benefit the aquatic food web.
- V. **Effects on Special Aquatic Sites.** There are no special aquatic sites within the project area.
- VI. **Threatened and Endangered Species.** Presence of, or use by, endangered and threatened species is discussed in the Environmental Assessment and Biological Assessments. No significant adverse impacts to threatened and endangered species are expected to result from this project.
- VII. **Other Wildlife.** The project would likely result in some very localized, short-term displacement of wildlife in the immediate vicinity of construction activities. Displacement would end immediately after construction completion.
- VIII. **Actions Taken to Minimize Impacts.** Best Management Practices for construction would be enforced.

F. Proposed Placement Site Determinations

- I. **Mixing Zone Determinations.** The fill material is inert and would not mix with the water. The lack of fine particulate typically contained in rock fill and main channel sediments indicates negligible chemical or turbidity effects resulting from the proposed action.
- II. **Determination of Compliance with Applicable Water Quality Standards.** Section 401 water quality certifications would be obtained from the states of

Illinois and Missouri. All other permits necessary for the completion of the project would be obtained prior to project implementation.

- III. **Potential Effects on Human Use Characteristics.** The proposed project would have no adverse impact on municipal or private water supplies; water-related recreation; aesthetics; or parks, national and historic monuments, national seashores, wilderness areas, research sites or similar preserves. During construction the area would not be available for recreational and commercial fishing.

G. Determinations of Cumulative Effects on the Aquatic Ecosystem. Dikes, chevron dikes and bendway weirs have been used extensively throughout the Lower, Middle, and Upper Mississippi River System to provide a safe and dependable navigation channel. S-dikes are a new type of dike structure. Due to concerns from natural resource agency partners about the potential cumulative impacts of river training structures, and other actions within the watershed, on the aquatic ecosystem, the St. Louis District has been utilizing innovative river training structures such as chevron and rootless dikes to increase habitat diversity in the Middle Mississippi River while still maintaining the navigation channel. The District conducts extensive coordination with resource agency and navigation industry partners to ensure that implementation of each project is accomplished effectively from an ecological and navigation viewpoint. Although minor short-term construction-related impacts to local fish and wildlife populations are likely to occur, no significant cumulative impacts on the aquatic ecosystem are identified for the Grand Tower Phase 5 Project.

H. Determinations of Secondary Effects on the Aquatic Ecosystem. No adverse secondary effects would be expected to result from the proposed action.

3. FINDINGS OF COMPLIANCE OR NON-COMPLIANCE WITH THE RESTRICTIONS ON PLACEMENT

A. No significant adaptations of the 404(b)(1) guidelines were made relative to this evaluation.

B. Alternatives that were considered for the proposed action included:

1. No Action Alternative - The No Action Alternative consists of not constructing any new river training structures in the project area but continuing to maintain the existing river training structures. Dredging would continue as needed to address the shoaling issue in the project area.
2. Proposed Action - The Proposed Action consists of the Crawford Towhead project and the Vancill Towhead Project. The Crawford Towhead project includes the construction of two chevrons and the extension of one dike between RM 74 and 72. The Vancill Towhead project is located between RMs 70.0 and 67.0 and includes construction of 3 bendway weirs, 3 diverter (S-Dike) dikes, repair of dike 67.8, revetment at dike 67.3 and shortening of dikes 67.3 and 67.1 (generally

Alternative 33 of the Vancill Towhead Hydraulic Sediment Response (HSR) Model Investigation) (USACE 2012).

C. Certification under Section 401 of the Clean Water Act would be obtained from the Missouri Department of Natural Resources and the Illinois Environmental Protection Agency prior to project implementation.

D. The proposed fill activity is in compliance with Applicable Toxic Effluent Standards of Prohibition under Section 307 of the Clean Water Act.

E. No significant impact to threatened or endangered species is anticipated from this project. Prior to construction, full compliance with the Endangered Species Act would be documented.

F. No municipal or private water supplies would be affected by the proposed action, and no degradation of waters of the United States is anticipated.

G. The project is situated along an inland freshwater river system. No marine sanctuaries are involved or would be affected by the proposed action.

H. The materials used for construction would be chemically and physically stable and non-contaminating.

I. The proposed construction activity would not have a significant adverse effect on human health and welfare, recreation and commercial fisheries, plankton, fish, shellfish, wildlife, or special aquatic sites. No significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems are expected to result. The proposed construction activity would have no significant adverse effects on aquatic ecosystem diversity, productivity, and stability. No significant adverse effects on recreational, aesthetic, and economic values would occur.

J. No other practical alternatives have been identified. The proposed action is in compliance with Section 404(b)(1) of the Clean water Act, as amended. The proposed action would not significantly impact water quality and would improve the integrity of an authorized navigation system.

(Date)

CHRISTOPHER G. HALL
COL, EN Commanding

Appendix E. Distribution List

The following individuals and organizations received a hard copy mailing of the Public Notice:

Governor Jay Nixon
P.O. Box 720
Jefferson City, MO 65102

Russell Bradley
Kickapoo Tribe in Kansas
Chairman
1107 Goldfinch Road
Horton, KS 66439

Honorable Blaine Luetkemeyer
1118 Longworth HOB
Washington, DC 20515

Advisory Council on Historic
Preservation
1100 Pennsylvania Avenue NW, Suite
803
Old Post Office Building
Washington, DC 20004

Raymond Hopkins
RIAC/ARTCO
P.O. Box 2889
St. Louis, MO 63111

Honorable Ann Wagner
301 Sovereign Court, Suite 201
Ballwin, MO 63011

US Coast Guard Marine Safety Office
Commanding Officer
225 Tully Street
Paducah, KY 42003

Leon Campbell, Chairman
Iowa Tribe of Kansas and Nebraska
3345B Thrasher Road
White Cloud, Kansas 66094

Nick Nichols
City of St. Louis Port Authority
1520 Market Street
St. Louis, MO 63103

Hoppies Marine
P.O. Box 44
Kimmwick, MO 63053

The Osage Nation
Assistant Chief Scott Bighorse
627 Grandview
P.O. Box 779
Pawhuska, Ok 74056

MDNR Division of State Parks
Planning and Development
PO Box 176
Jefferson City, MO 65102

Senator Gary Forby
903 West Washington, Suite 5
Benton, IL 62812

Kelly Isherwood
5072 Oak Tree Lane
House Springs, MO 63051

Mike Larson
MDNR
Land Reclamation Program
Jefferson City, MO 65102

Honorable John M. Shimkus
15 Professional Park Drive
Maryville, IL 62062

Rose M. Schulte
2842 Chadwick Dr.
St. Louis, MO 63121

Jack Norman
906 N. Metter Avenue
Columbia, IL 62236

Timothy V. Johnson, M.C.
IL15
202 N. Prospect Rd., Suite 203
Bloomington, IL 61704

Environmental Coordinator
Planning and Compliance Office
Natural Park Service, Midwest Region
601 Riverfront Drive
Omaha, NE 68102-4226

Anne Haaker
IL State Historic Preservation Office
Springfield, IL 62701

Yvonne Homeyer
Webster Groves Nature Society
1508 Oriole Lane
St. Louis, MO 63144

Honorable Claire McCaskill
5850 A Delmar Blvd
St. Louis, MO 63112

Pat Malone
IDNR Natural Resource Review
1 Natural Resource Way
Springfield, IL 62702

Honorable Lacy Clay
6830 Gravois
St. Louis, MO 63116

Representative Ed Schieffer
Missouri House of Representatives
201 West Capitol Avenue
Jefferson City, MO 65101-6806

Honorable Roy Blunt
United States Senator
2502 Tanner Drive – Suite 208
Cape Girardeau, MO 63703

Donald Rea
City of St. Louis
Water Division
10450 Riverview Drive
St. Louis, MO 63137

Nellie Keo
Kickapoo Tribe in Kansas
Land/NAGPRA Office
1107 Goldfinch Road
Horton, KS 66439

Joseph Standing Bear Schranz
Midwest Soaring
5158 S. Mobile Avenue
Chicago, IL 60638

Great Rivers Environ. Law Center
705 Olive Street, Ste. 614
St. Louis, MO 63101

Mike Diedrichsen
IDNR Natural Resource Review
1 Natural Resource Way
Springfield, IL 62702

Representative Daniel Beiser
528 Henry Street
Alton, IL 62002-2611

Senator John Jones
2929 Broadway
Suite 5
Mt. Vernon, IL 62864

Dave Schulenburg
US EPA
Wetland and Watersheds Section
WW16J
77 W. Jackson Boulevard
Chicago, IL 60604-3590

Senator Larry Bomke
307 Capitol Building
Springfield, IL 62706

Honorable Aaron Schock
235 S. Sixth Street
Springfield, IL 62701

Honorable Sam Graves
906 Broadway
P.O. Box 364
Hannibal, MO 63401

Southern Illinois Sand Company
P.O. Box 262
Chester, IL 62233

David Jones
Environmental Director
Nottawaseppi Huron Band of
Potawatomi
2221 1-1/2 Mike Road
Fulton, MI 49052

Governor Pat Quinn
Office of the Governor
207 State House
Springfield, IL 62706

Honorable William Enyart
23 Public Square
Belleville, IL 62220

Honorable Richard Durbin
525 South 8th Street
Springfield, IL 62703-1601

Senator Mark Kirk
Springfield Senate Office
607 East Adams, Suite 1520
Springfield, IL 62701

Honorable Rodney Davis
2004 Fox Drive
Champaign, IL 61820

Russell Cissell
1075 LeSieur
Portage des Sioux, MO 63373

Patrick J. Lamping
Executive Director
The Jefferson County Port Authority
PO Box 603
Hillsboro, MO 63050

Fay Houghton
Land Management Director
Winnebago Tribe of Nebraska
P.O. Box 687
Winnebago, NE 68071

Mr. Ed Schieffer
183 Thornhill Cemetery Road
Troy, MO 63379

Senator Dale Righter
88 Broadway Avenue, Suite 1
Mattoon, IL 61938-4597

Senator James Clayborne Jr.
Kenneth Hall State Office Building
#10 Collinsville Avenue
East St. Louis, IL 62201

Honorable Jason Smith
2502 Tanner Drive, Suite 205
Cape Girardeau, MO 63703

The following individuals and organizations received e-mail notification of the Public Notice:

Adams, R.
Adrian, D.
Amato, Joel
Andria, Kathy
Atwood, Butch
Bacon, T.
Barnes, Robert
Bax, Stacia
Beardslee, Tom
Bellville, Colette
Bensman, Jim
Boaz, Tracy
Boehm, Gerry
Brandom, Ellen
Brescia, Chris
Brown, Danny
Brown, Doyle
Buan, Steve
Buffalo, Jonathan
Burlingame, Chuck
Byer, J. R.
Caito, J.
Campbell-Allison, Jennifer
Carney, Doug
Clements, Mark
Coder, Justin S.
Crowley, Steve
Cruse, Lester
Darst, E. B.
Deel, Judith
Dewey, Dave
Dock Hardware and Marine Fabrication
Dodd, Harold
Dorothy, Olivia
Dougherty, Mark
Duncan, Cecil
Ebey, Mike
Elmestad, Gary
Enos, Tim
Erickson, Tom
Fabrizio, Christi
Favilla, Christy
Foster, Bill
Goldstein, Jeff

Genz, Greg
Glenn, S.
Goode, Peter
Goodwin, Bill
Greer, Courtney
Gross, Andrea
Hammond, Cheryl
Hanke Terminals
Hanneman, M.
Hansen, Rick
Hansens Harbor
Harding, Scott
Held, Eric
Henleben, Ed
Herschler, Mike
Herzog, Dave
Hilburn, Craig
Hogan-Smith, Shelly
Howard, Chuck
Hubertz, Elizabeth
Hughes, Shannon
Hunter, Andrea
Hussell, B.
Illinois Corn Growers Association
Illinois Department of Natural Resources
Illinois Environmental Protection Agency
Jamison, Larry
Johnson, Erick
Johnson, Frank
Johnson, Tom
Knowles, Kim
Knuth, Dave
Lauer, Steve
Leary, Alan
Leipus, Ed
Leiser, Ken
Lensing, Brian
Lipeles, Maxie
Louis Marine
Mangan, Matthew
Mannion, Clare
Mauer, Paul
Melgin, Wendy
Miller, Kenneth
Miller, Melissa
Missouri Corn Growers Association

Missouri Department of Conservation
Missouri Department of Natural Resources
Muench, Lynn
Muir, T.
Nelson, Lee
Nelson, Rick
Novak, Ron
O'Carroll, J.
Overbey, Dan
Paurus, Tim
Pehler, Kent
Phillip, C.
Pinter, Nicholas
Pivor, Jeremy
Pondrom, Gary
Poplewell, Mickey
Porter, Jason
Red, Chief John
Reichert, Joe
Reitz, Paul
Reuters Chicago
Rickert, Ron
Roark, Bev
Rodenberg, V.
Rowe, Kelly
Samet, Melissa
Sauer, Randy
Schieffer, Ed
Shepard, Larry
Shoulberg, J.
Slay, Glen
Smith, David
Southeast Missouri Regional Port Authority
Southern Illinois Transfer
Spath, Robert
Stahlman, Bill
Staten, Shane
Sternburg, Janet
Stevens, Mark
Stout, Robert
Streight, Tom
Teah, Philip
Todd, Brian
Tow Inc.
Tyson, J.
Urban, David

U.S. Coast Guard Marine Safety Office
U.S. Environmental Protection Agency Region 7
Weber, Angie
Welge, Owen
Werner, Paul
Wilmsmeyer, Dennis
York Bridge Co.
Zupan, T.