# DRAFT ENVIRONMENTAL ASSESSMENT

# WITH

# UNSIGNED FINDING OF NO SIGNIFICANT IMPACT

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## REGULATING WORKS PROJECT
## DOGTOOTH BEND PHASE 5
## MIDDLE MISSISSIPPI RIVER MILES 40.0-20.0
## ALEXANDER COUNTY, IL
## MISSISSIPPI AND SCOTT COUNTIES, MO

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**DECEMBER 2013**

US Army Corps
of Engineers
St. Louis District

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# 1. Purpose of and Need for Action

The U.S. Army Corps of Engineers St. Louis District (District) is responsible for providing a safe and dependable navigation channel, 9 feet deep and not less than 300 feet wide, 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, Dogtooth Bend Phase 5 Construction Project (Dogtooth Bend Phase 5 Project) is needed to address repetitive channel maintenance dredging issues in the project area. Frequent dredging has been required in the area in order to address channel depth, width, and alignment issues. Construction of river training structures would provide a sustainable alternative to repetitive maintenance dredging. Construction of the Dogtooth Bend Phase 5 Project is proposed to begin in 2014.

The planning of specific construction projects for the Regulating Works Project, including the Dogtooth Bend Phase 5 Project, requires extensive coordination with resource agency partners and the navigation industry. The U.S. Fish and Wildlife Service (USFWS), Missouri Department of Conservation (MDC), Illinois Department of Natural Resources (IDNR), and multiple navigation industry groups were involved in the planning of the Dogtooth Bend Phase 5 Project.

**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 human environment to warrant the preparation of a Supplemental EIS (SEIS). The Dogtooth Bend Phase 5 Project EA will incorporate any new information and circumstances relevant to the impacts of the action on the human environment to the greatest extent possible. Should the analyses undertaken as part of the SEIS process reveal any new impacts on the 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**

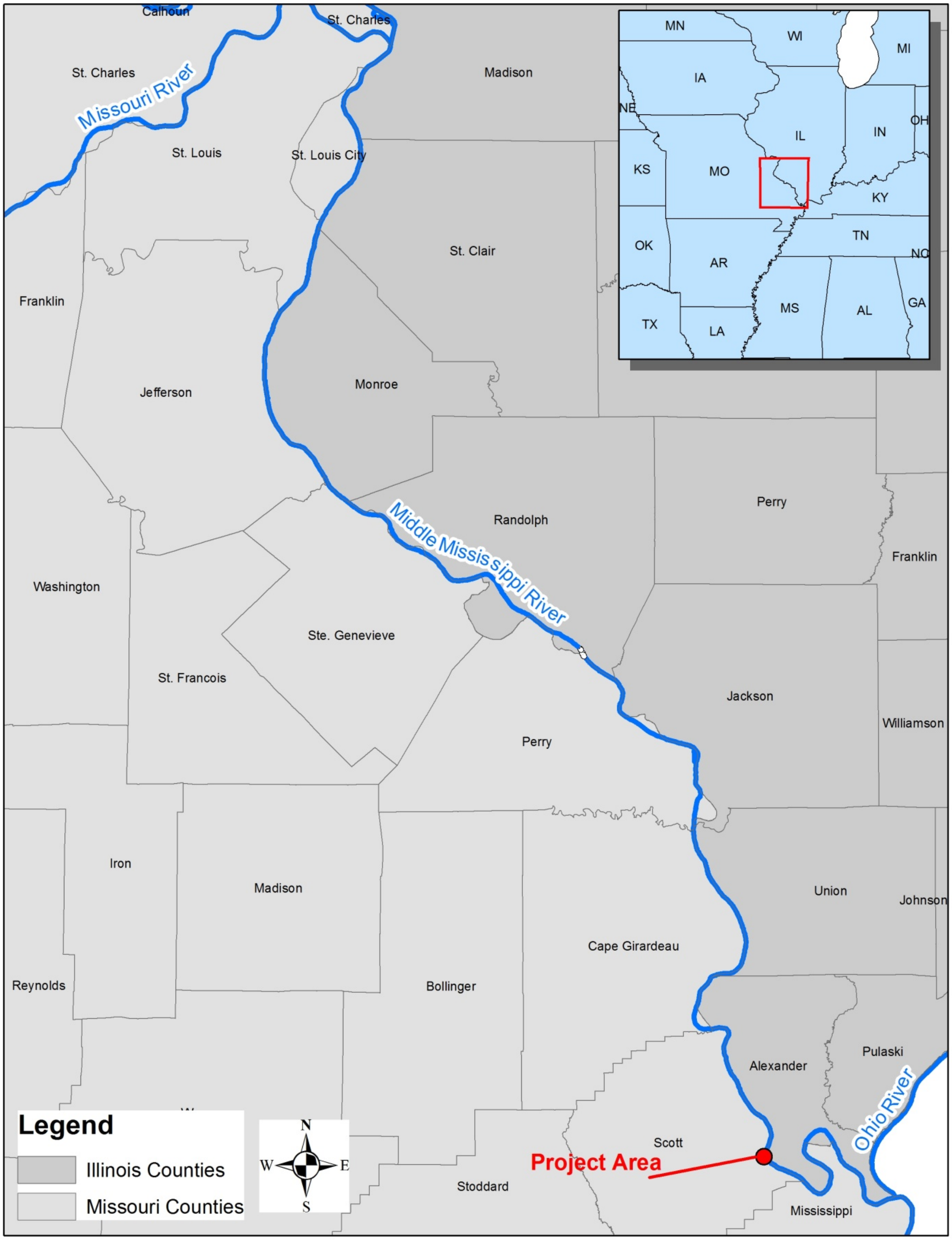


**Figure 1. Project location within the MMR**

## 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 Dogtooth Bend Phase 5 Project site. The primary biological goal of the project is to minimize negative impacts to the environmental features within the reach and specifically to maintain existing physical conditions in the side channel. Alternatives will be described and their environmental impacts and usefulness in achieving the project objectives will be compared.

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 consists of construction of two bendway weirs near river mile (RM) 34.0, four bendway weirs near RM 32.0, a dike at RM 31.6 and two bendway weirs near RM 31.0 (Table 1, Figure 2).

**Table 1. Features associated with the Proposed Action.**

| Location by river mile | Work to be completed | Potential Physical Results (from Hydraulic Sediment Response Model) |
|---|---|---|
| 34.2 (L) | Construct bendway weir 600 feet long<br>-Top elevation of the Weir will be 277.5 (-20 feet Low Water Reference Plane). | The proposed bendway weirs at RM 34.2, 34.1, 32.5, and 32.2 (L) improved the width of the channel at RM 34.00, and reduced the sedimentation in the channel between RM 31.9-31.6. Dike 31.6 (R) provided more constriction to the channel, thus, contributing to the sediment reduction. Weirs 30.8 & 30.7(R) helped the flow transition from the crossing into the bend at RM 31.00. The design alternative also showed great improvement in the channel depth between RM 29.00 - 27.20 although there was some slight sedimentation. The channel was also wider along the bendway weir field between RM 30.6 - 29.15 without affecting Bumgard Island or its side channel. |
| 34.1 (L) | Construct bendway weir 600 feet long<br>-Top elevation of the weir will be 277.25 | |
| 32.5 (L) | Construct bendway weir 400 feet long<br>-Top elevation of the weir will be 281.1 (-15 feet Low Water Reference Plane). | |
| 32.4 (L) | Construct bendway weir 500 feet long<br>-Top elevation of the weir will be 281.0 | |
| 32.3 (L) | Construct bendway weir 650 feet long<br>-Top elevation of the weir will be 280.9 | |
| 32.2 (L) | Construct bendway weir 500 feet long<br>-Top elevation of the weir will be 280.8 | |
| 31.6 (R) | Construct Dike 300 ft long<br>-Top elevation of the dike will be 310.4 (+15 feet Low Water Reference Plane). | |
| 30.8 (R) | Construct bendway weir 160 ft long<br>-Top elevation of the weir will be 274.75 (-20 feet Low Water Reference Plane). | |
| 30.7(R) | Construct bendway weir 162 ft long<br>-Top elevation of the weir will be 274.65 | |

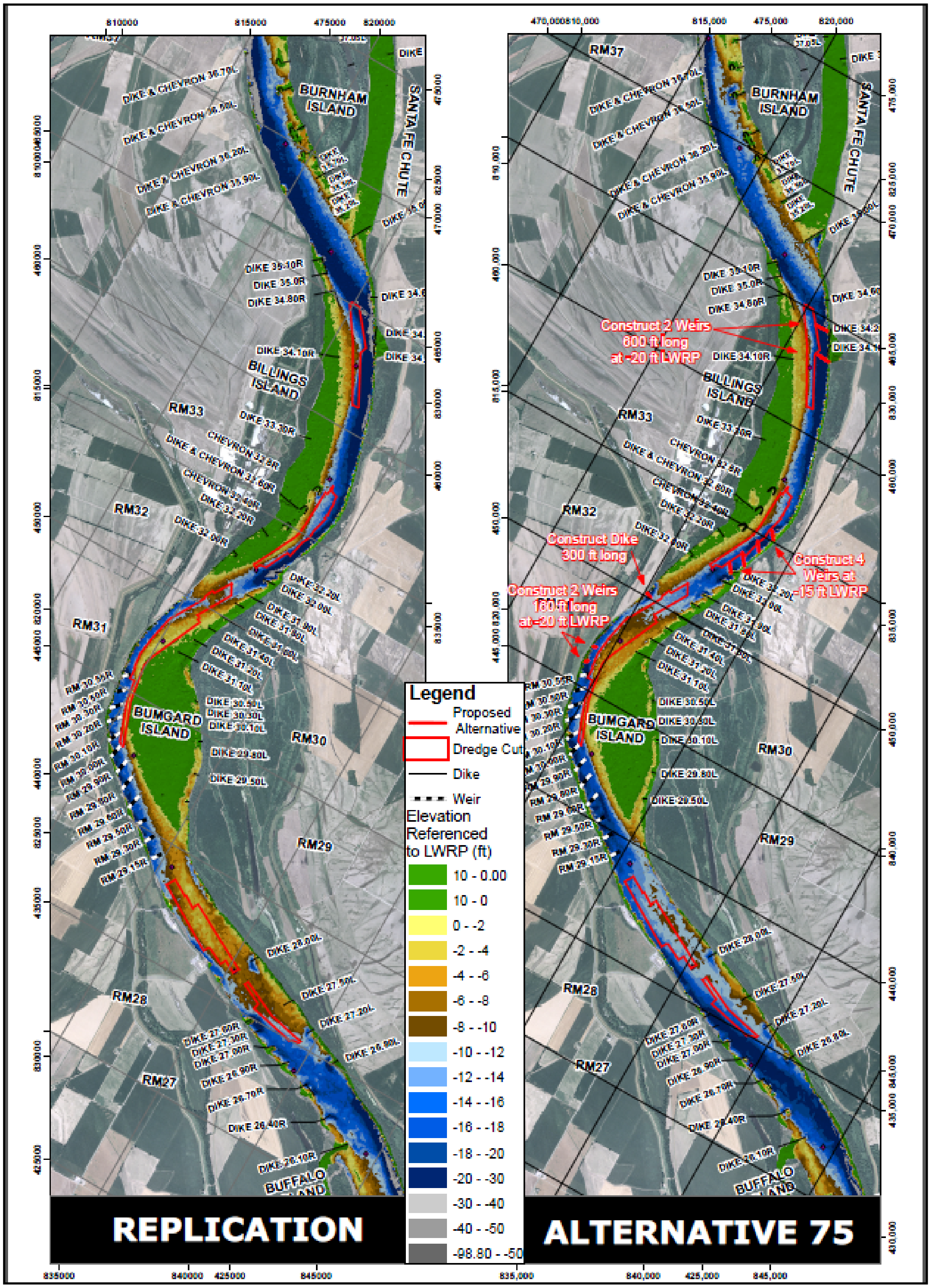


**Figure 2. Features associated with the Proposed Action.**

*Development of Alternatives*. In order to develop potential alternatives to address the navigation channel problems in the Dogtooth Bend Phase 5 Project 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. 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. 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. 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 effectiveness in addressing the needs of the project. For the Dogtooth Bend Phase 5 Project, the District utilized the Bumgard Island HSR model study. The Bumgard Island HSR model study analyzed 85 different configurations of bendway weirs, dikes, chevrons and W-dikes to determine the best combinations to reduce the need for dredging, improve navigation channel alignment, and minimize environmental impacts. Several alternatives showed a reduction in deposition that occurs at the dredging locations between RM 34.50 - 27.00 but did not completely eliminate the problem. Other alternatives showed that dredging was completely eliminated but raised concerns regarding environmental features in the reach, particularly impacts to the downstream island and side channel.

In a meeting with the MDC, IDNR, the USFWS (Fisheries and Ecological Services), and industry groups on 19 September, 2013, and after many prior group discussions with resource agencies and industry, it was agreed upon that "Alternative 75" achieved the best balance of the study's goals and was the recommended alternative. Resource agency concerns about potential impacts to the Bumgard Island "complex" (e.g., pallid sturgeon and least tern habitat) also guided the alternative analysis. Concerns included, (1) potential impacts to flows in the existing side channel which could affect pallid sturgeon habitat, (2) potential impacts to the large gravel bar on the upper half of the island and the lower half of the island that provides a diversity of gradual sloping banks and shallow water habitat (limiting habitat in the Mississippi), which has been documented as being used by young of year pallid sturgeon, and (3) an overall reduction in the size of the island. Alternative 75 showed reduction in sedimentation between RM 34.50 - 27.00 while appearing to avoid impacts to Bumgard Island and its side channel. Note that while there was a reduction in sedimentation, the bendway weirs will not completely eliminate the need to dredge at RM 33.00 or RM 28.00.

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, see Bumgard Island at:

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

**Summary of Environmental Consequences**
The impacts of each Alternative on the human environment are covered in detail in Chapter 4, Environmental Consequences. Table 2 below provides a summary of the impacts of each Alternative by resource category.

**Table 2. Summary of impacts of the No Action and the Proposed Action.**

| | 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 reducing federal expenditures and meeting project objectives. |
| **Impacts on 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 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

**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 the Corps of Engineers 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 the Corps 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 (Figure 3). 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 MMR. At these high flows navigation structures are submerged by 7 to 10 feet.

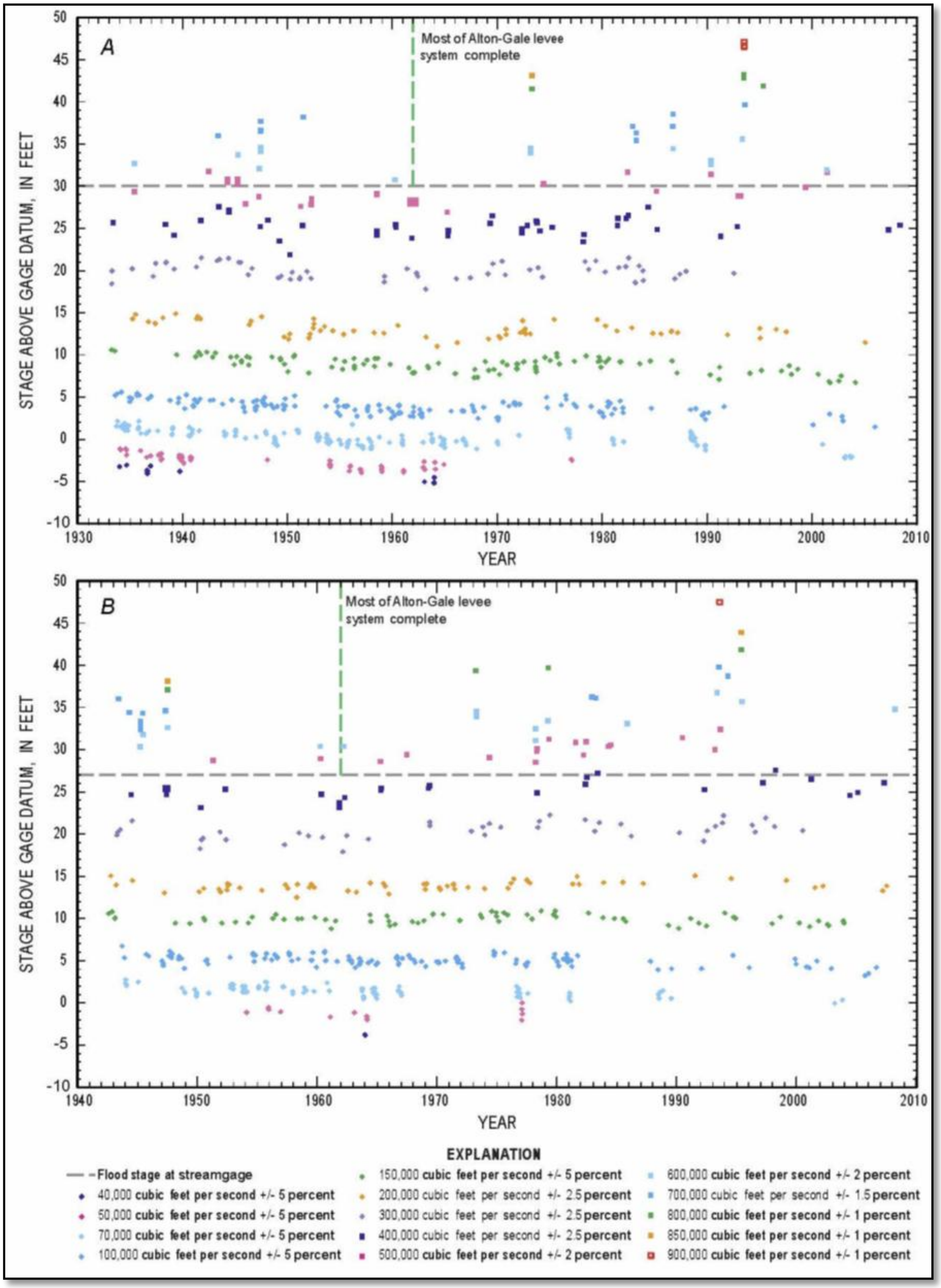


**Figure 3. Stage for a given discharge range with time from measurements made at the streamgages at (A) St. Louis, Missouri, and (B) Chester, Illinois, on the MMR (from Huizinga 2009).**

**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 polychlorinated biphenyls (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. Scott and Mississippi Counties, Missouri and Alexander 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 (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 MMR 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 4 below). In the 1960s, the Corps 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.

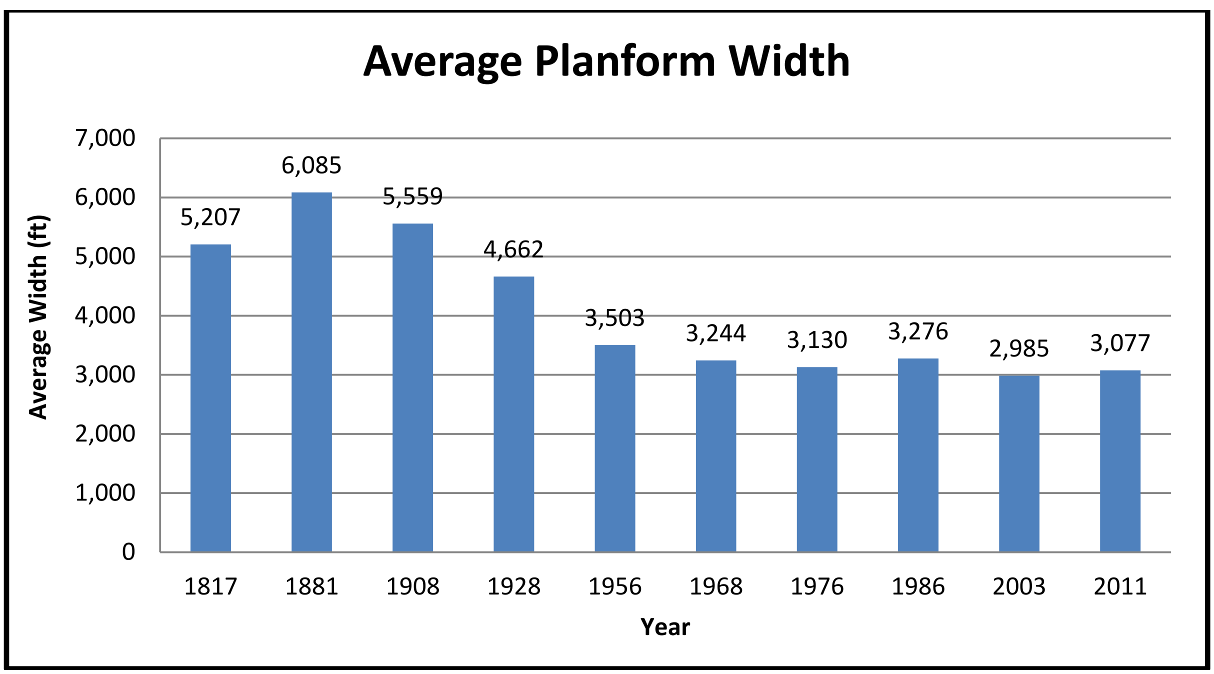


**Figure 4. Average planform width of the MMR from 1817 to 2011.**

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 MMR fish community in general. Fish community monitoring (Upper Mississippi River Restoration - Environmental Management Program Long Term Resource Monitoring Program) conducted in the vicinity (MMR miles 80 to 29) of the Dogtooth Bend Phase 5 Project in main channel border areas from 2000 to 2012 collected 89 species of fish. The most commonly encountered native species included gizzard shad (*Dorosoma cepedianum*), channel catfish (*Ictalurus punctatus*), freshwater drum (*Aplodinotus grunniens*), emerald shiner (*Notropis atherinoides*), smallmouth buffalo (*Ictiobus bubalus*), channel shiner (*N. wickliffi*), white bass (*Morone chrysops*), shortnose gar (*Lepisosteus platostomus*), blue catfish (*I. furcatus*), and river carpsucker (*Carpiodes carpio*). These species accounted for approximately 70% 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 11% 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 river mile 164 near Oakville, Missouri (Ecological Specialists 1997a) and at river mile 30 near Commerce, Missouri (Ecological Specialists 1997b). Twenty-nine taxa were collected at river mile 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 river mile 30 with caddisflies again the overwhelmingly dominant group; midges were present but not as abundant as at river mile 164. Density averaged 16,240 individuals per square meter. Sampling conducted in sand substrate at a nearby bendway without bendway weirs (river mile 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, nine federally threatened or endangered species could potentially be found in the project area (Mississippi and Scott Counties, Missouri, and Alexander County, Illinois). The nine species, federal protection status, and habitat can be found in Table 3. No critical habitat is located in the project area.

**Table 3. Federally listed threatened and endangered species potentially occurring in the project area.**

| **Species** | **Fed Status** | **Habitat** |
|---|---|---|
| Indiana bat (*Myotis sodalis)* | Endangered | Hibernacula in caves and mines; Maternity and foraging habitat - small stream corridors with well developed riparian woods; upland and bottomland forests |
| Gray bat *(Myotis grisescens)* | Endangered | Caves and mines; forages over rivers and reservoirs adjacent to forests |
| Northern long-eared bat (*Myotis septentrionalis*) | Candidate | Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests during spring and summer. |
| Least tern (interior population) (*Sternula antillarum*) | Endangered | Large rivers - nest on bare alluvial and dredge spoil islands |
| Pallid sturgeon (*Scaphirhynchus albus*) | Endangered | Mississippi and Missouri Rivers |
| Fat pocketbook pearly mussel (*Potamilus capax*) | Endangered | Large Rivers in slow-flowing water in mud and sand. |
| Sheepnose *(Plethobasus cyphyus)* | Endangered | Shallow areas in larger rivers and streams |
| Rabbitsfoot (*Quadrula cylindrical cylindrical*) | Threatened | Small to large rivers in sand and gravel |
| Decurrent false aster (*Boltonia decurrens*) | Threatened | Recently disturbed areas within wet prairies, shallow marshes, and shores of open rivers, creeks and lakes |

## 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.

Dredging in the Mississippi River is commonly used to provide required navigation dimensions of depth, width, alignment, or a combination thereof. In this project area repetitive channel maintenance dredging was required in four different areas along the reach (Figure 5). The sandbar located along the Right Descending Bank (RDB) near RM 35.00 to 31.80 has grown in size between RM 34.50 to 33.80 and RM 32.90 to 31.50. Bumgard Island, located along the Left Descending Bank (LDB) between RM 31.00 to 29.00, has also grown causing shoaling between RM 31.40 to 30.60. Downstream of Bumgard Island on the LDB, shoaling has occurred between RM 28.90 to 27.20. On average, dredging in this reach has been required nearly every year from 2001 to 2012. During this twelve year period, the following total estimates of dredge material quantities in cubic yards (cy) and costs were calculated:

- RM 34.50 to 33.80: 315,516 cy at a cost of $408,414
- RM 32.90 to 31.50: 946,670 cy at a cost of $2,328,255
- RM 31.40 to 30.60: 639,035 cy at a cost of $973,146
- RM 28.90 to 27.20: 1,201,738 cy at a cost of $1,930,945.

## Historic and Cultural Resources

The bankline of the Bumgard Reach has significantly changed in the past century and a half. The locations of seven of the in-water features were on land as late as 1908. Conversely, due to the Mississippi's migration most of the other feature locations were closer to the middle of the channel than they are now. It was not until the first quarter of the twentieth century that the shoreline stabilized near its current position. The construction of revetments and river regulating structures, including those used to close the western branch of the river (i.e., the Doolan Slough), were responsible for the stabilization. Any cultural resources located on land eroded prior to that stabilization would have been destroyed by the bankline recession and any shipwreck located there would post date it.

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 observed wreck to the project features was located approximately at river mile 33.5R within the reach. The wreck, however, was sighted on the opposite bank and downstream from the nearest feature (Weir 32.2L), while the nearest feature on the same bank is approximately two miles downstream.
The Bumgard Reach has been regularly dredged over the years, and it is likely that any unrecorded wreckage located in the path of those dredge events was destroyed and removed

during the process.  Most of the proposed structures are next to dredged channels, which probably resulted in channel slump and sediment reworking in these locations.

The river bed in the project area is surveyed every two to three years, with the latest survey having been completed on July 20, 2011, or June 21, 2012 (depending upon the river section). The single-beam survey was conducted with range lines spacing of 250 feet.  No topographic anomalies suggesting wrecks are visible on the resulting bathymetric map.  Where higher resolution multi-beam surveys were available, they were also examined, and no anomalies were visible.

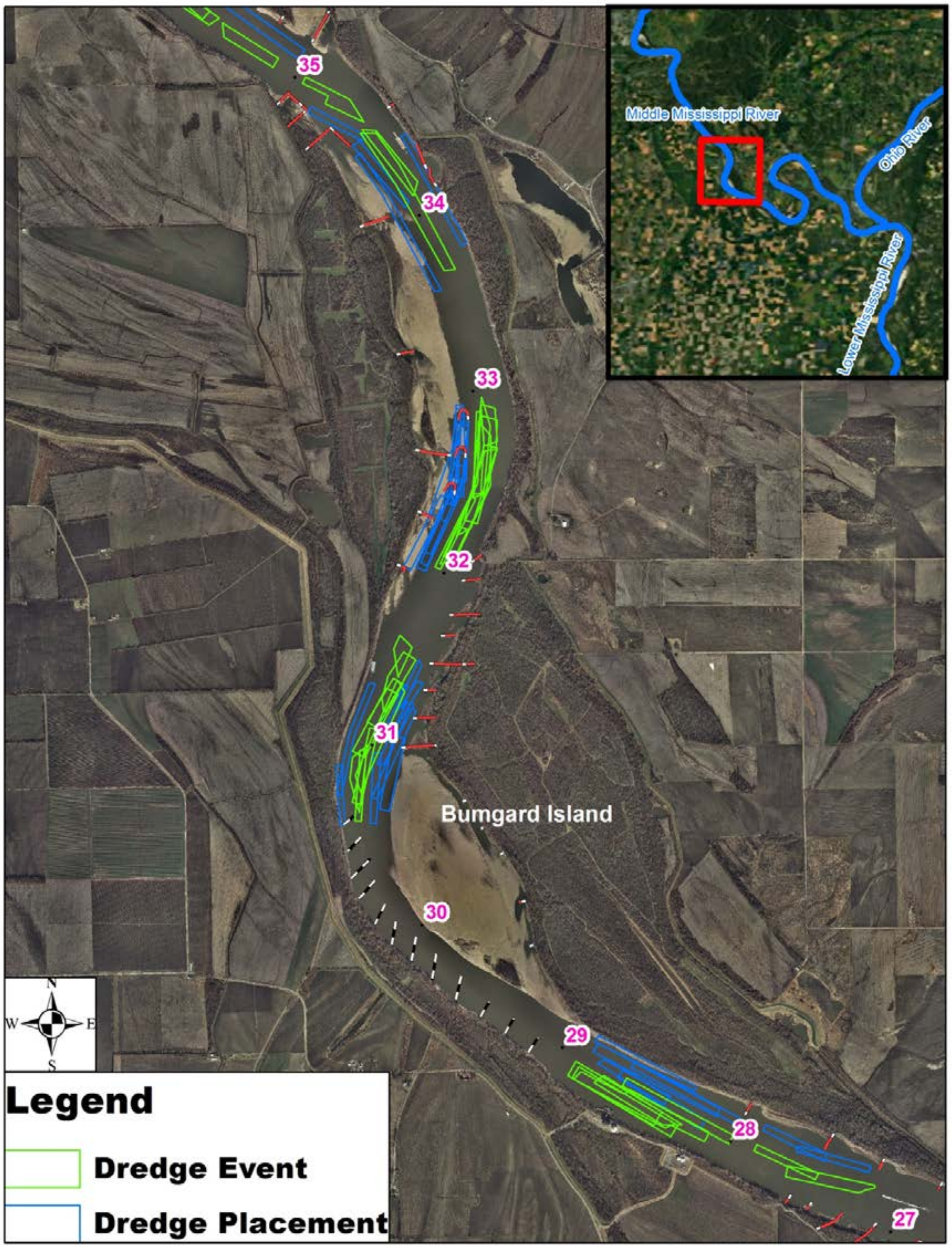


**Figure 5. Repetitive dredging areas in the vicinity of the project since 2000.**

# 4. Environmental Consequences

The Environmental Consequences Section of this report details the impacts of the Alternatives on the 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 construction of two bendway weirs near RM 34.00, four bendway weirs near RM 32.00, a dike at RM 31.60 and two bendway weirs near RM 31.00.

## Physical Resources

**Stages**

*Impacts of the No Action Alternative on Stages* – Stages in the vicinity of the project area and the MMR 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 MMR 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 the Corps 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, therefore, cause some minor temporary changes in the suspended sediment concentration in the 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 (Appendix D).

**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 dredging 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. The Corps' 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. Approximately 800,000 cubic meters of material was dredged during the project, and fish entrainment monitoring was conducted during roughly 15% of the operation. No pallid sturgeon were captured during the study. However, 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 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.

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 MMR for both adult and age-0 fishes when compared with main channel borders. However, they did find differences in species composition. 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 chevrons dikes as compared to pre-construction conditions and open water control sites.

In summary, the dike is not expected to result in a loss of aquatic habitat due to sedimentation and conversion to terrestrial habitat. The structure is expected to increase bathymetric, flow, and sediment diversity in the immediate vicinity of the project. 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 MMR between Cairo, Illinois, and Cape Girardeau, Missouri (River Miles 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 bendway 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 bendway 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-bendway 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 eight bendway weirs in the project area is expected to improve fish and macroinvertebrate habitat in the outside bend by providing substrate diversity, flow refugia, 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.

**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 District has prepared a Tier II Biological Assessment to determine the potential impacts of the project on federally threatened and endangered species. The Biological Assessment can be found at Appendix B.

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, gray bat, northern long-eared bat, fat pocketbook pearly mussel, sheepnose mussel, rabbitsfoot (mussel), and decurrent false aster. With respect to pallid sturgeon and the least tern, 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 and least tern 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 and least tern 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 $470,000 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 approximately $1,350,000.

## Historic and Cultural Resources

*Impacts of the No Action Alternative on Historic and Cultural Resources* – Continued dredging operations under the No Action Alternative are not 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 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.

Given the features' construction method (with no land impact), the recent age of the landform, and the lack of any survey evidence for extant wrecks or other significant cultural resources, it is the District's 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 Dogtooth Bend 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 MMR to include impacts to the resources throughout the Upper Mississippi River watershed. Clearly the human environment in the MMR 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 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 MMR continues to evolve, an equilibrium in habitat conditions appears to have been reached. Accordingly, no significant impacts to the human environment are anticipated for the Dogtooth Bend Phase 5 Construction Project.

## Mitigation

Mitigation measures are used to avoid, minimize, or compensate for adverse impacts to environmental resources. The Dogtooth Bend 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.

**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 greatly 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 |
|---|---|---|---|---|---|
| **Fish and Wildlife (including threatened and endangered species)** | 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 | 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 | 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 | 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 | 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. Resource agency concerns included, (1) potential impacts to flows in the existing side channel which could affect pallid sturgeon habitat, (2) potential impacts to the large gravel bar on the upper half of the island and the lower half of the island that provides a diversity of gradual sloping banks and shallow water habitat , which has been documented as being used by young of year pallid sturgeon, and (3) an overall reduction in the size of the island. |

**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 Nav 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. |

## 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 |
| Ken Cook | Environmental | 20 years, biology |
| 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 Robertson | Legal Review | 1 year USACE, 6 years private sector law |

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# DRAFT FINDING OF NO SIGNIFICANT IMPACT (FONSI)
## REGULATING WORKS PROJECT
## DOGTOOTH BEND PHASE 5
## MIDDLE MISSISSIPPI RIVER MILES 40.0-20.0
## ALEXANDER COUNTY, IL, MISSISSIPPI AND SCOTT COUNTIES, MO

I. In accordance with the National Environmental Policy Act, I have reviewed and evaluated the documents concerning the Regulating Works, Dogtooth Bend Phase 5 Construction Project, Alexander County, Illinois, and Scott and Mississippi Counties, 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 the construction of eight bendway weirs and one dike.

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. The Proposed Action has been coordinated with the appropriate resource agencies and the public, and there are no significant unresolved issues. Therefore, an Environmental Impact Statement will not be prepared prior to proceeding with the proposed Regulating Works, Dogtooth Bend Phase 5 Construction Project, Alexander County, Illinois and Mississippi and Scott Counties, Missouri.

________________________ __________________________________

(Date)

CHRISTOPHER G. HALL
COL, EN Commanding

# DRAFT ENVIRONMENTAL ASSESSMENT

# WITH

# UNSIGNED FINDING OF NO SIGNIFICANT IMPACT

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# REGULATING WORKS PROJECT
# DOGTOOTH BEND PHASE 5
# MIDDLE MISSISSIPPI RIVER MILES 40.0-20.0
# ALEXANDER COUNTY, IL
# MISSISSIPPI AND SCOTT COUNTIES, MO

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**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 lead 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

**APPENDIX B**
**TIER II BIOLOGICAL ASSESSMENT:**
**DOGTOOTH BEND PHASE 5**
**RIVER MILES 40-20**
**ALEXANDER COUNTY, ILLINOIS**
**SCOTT AND MISSISSIPPI COUNTIES, MISSOURI**
**ON THE**
**MIDDLE MISSISSIPPI RIVER SYSTEM**

**U.S. Army Corps of Engineers**
**St. Louis District**
**Environmental Branch (CEMVS-PM-E)**
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**December 2013**

## 1. Programmatic Endangered Species Compliance

A programmatic (Tier I) consultation(USACE 1999a), 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 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 may occur. As such, the Regulating Works, Dogtooth Bend Phase 5 Construction Project (Dogtooth Bend Phase 5 Project) requires a Tier II consultation.

## 2. Project Authority

The project is authorized under the Regulating Works Project that was authorized by River and Harbor Acts beginning in 1881. The project purpose is to provide 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 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 and maintenance dredging, and rock removal.

## 3. Project Need

The purpose of the Dogtooth Bend Phase 5 Project is to enhance the aquatic habitat diversity and flow dynamics within the reach, specifically the Bumgard Island project is located between Mississippi River miles (MRM) 34.2 and 30.7.

Dredging in the Mississippi River is commonly used to provide required navigation dimensions of depth, width, alignment, or a combination thereof. In the case of this study, repetitive channel maintenance dredging was required in four different areas along the reach (Figure 1). The sandbar located along the Right Descending Bank (RDB) near River Mile (RM) 35.00 to 31.80 has grown in size between RM 34.50 to 33.80 and RM 32.90 to 31.50. Bumgard Island, located along the Left Descending Bank (LDB) between RM 31.00 to 29.00, has also grown causing shoaling between RM 31.40 to 30.60. Downstream of Bumgard Island on the LDB, shoaling has occurred between RM 28.90 to 27.20. On average, dredging in this reach has been required nearly every year from 2001 to 2012. During this twelve year period, the following total estimates of dredge material quantities in cubic yards (cy) and costs were calculated:

- RM 34.50 to 33.80: 315,516 cy at a cost of $408,414
- RM 32.90 to 31.50: 946,670 cy at a cost of $2,328,255
- RM 31.40 to 30.60: 639,035 cy at a cost of $973,146
- RM 28.90 to 27.20: 1,201,738 cy at a cost of $1,930,945.

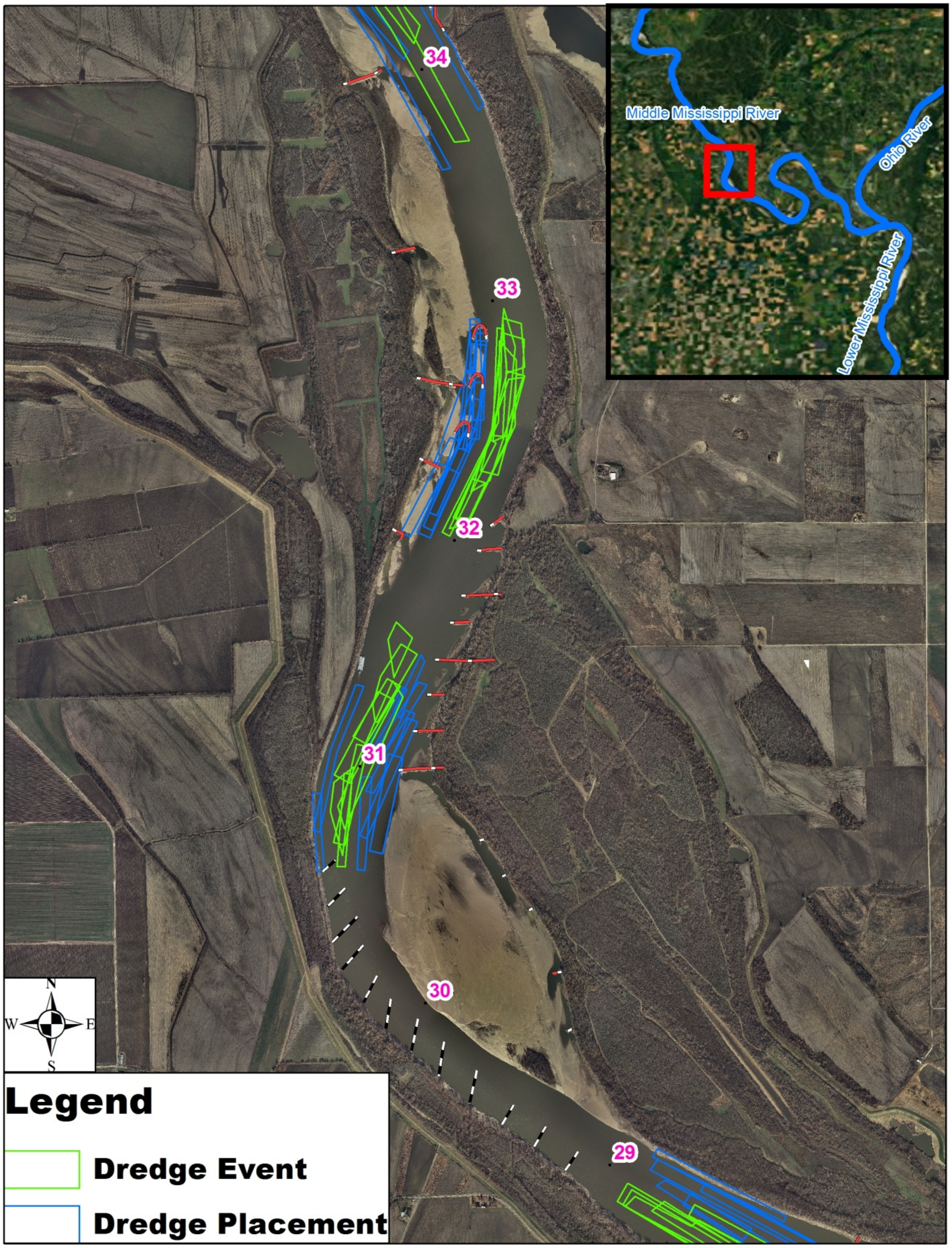


Figure 1. Repetitive dredging areas in the vicinity of the project since 2000.

The Proposed Action consists of construction of two bendway weirs near RM 34.00, four bendway weirs near RM 32.00, a dike at RM 31.60 and two bendway weirs near RM 31.00. (Table 1, Figure 2). Specifically, the Bumgard project would involve the following actions in order to attain the desired conditions:

**Table 1. Proposed Action and potential results.**

<table>
<tr><th>Location by river mile</th><th>Work to be completed</th><th>Potential Physical Results (from Hydraulic Sediment Response Model)</th></tr>
<tr><td>34.2 (L)</td><td>Construct bendway weir 600 feet long<br>-Top elevation of the Weir will be 277.5 (-20 Low Water Reference Plane).</td><td rowspan="9">The bendway weirs at RM 34.2, 34.1, 32.5, and 32.2 (L) improved the width of the channel at RM 34.00, and reduced the sedimentation in the channel between RM 31.9-31.6. Dike 31.6 (R) provided more constriction to the channel, thus, contributing to the sediment reduction. Weirs 30.8 & 30.7(R) helped the flow transition from the crossing into the bend at RM 31.00. The design alternative also showed great improvement in the channel depth between RM 29.00 - 27.20 although there was some slight sedimentation. The channel was also wider along the bendway weir field between RM 30.6 - 29.15 without affecting Bumgard Island or its side channel.</td></tr>
<tr><td>34.1 (L)</td><td>Construct bendway weir 600 feet long<br>-Top elevation of the weir will be 277.25</td></tr>
<tr><td>32.5 (L)</td><td>Construct bendway weir 400 feet long<br>-Top elevation of the weir will be 281.1 (-15 Low Water Reference Plane).</td></tr>
<tr><td>32.4 (L)</td><td>Construct bendway weir 500 feet long<br>-Top elevation of the weir will be 281.0</td></tr>
<tr><td>32.3 (L)</td><td>Construct bendway weir 650 feet long<br>-Top elevation of the weir will be 280.9</td></tr>
<tr><td>32.2 (L)</td><td>Construct bendway weir 500 feet long<br>-Top elevation of the weir will be 280.8</td></tr>
<tr><td>31.6 (R)</td><td>Construct Dike 300 ft long<br>-Top elevation of the dike will be 310.4 (+15 Low Water Reference Plane).</td></tr>
<tr><td>30.8 (R)</td><td>Construct bendway weir 160 ft long<br>-Top elevation of the weir will be 274.75 (-20 Low Water Reference Plane).</td></tr>
<tr><td>30.7(R)</td><td>Construct bendway weir 162 ft long<br>-Top elevation of the weir will be 274.65</td></tr>
</table>

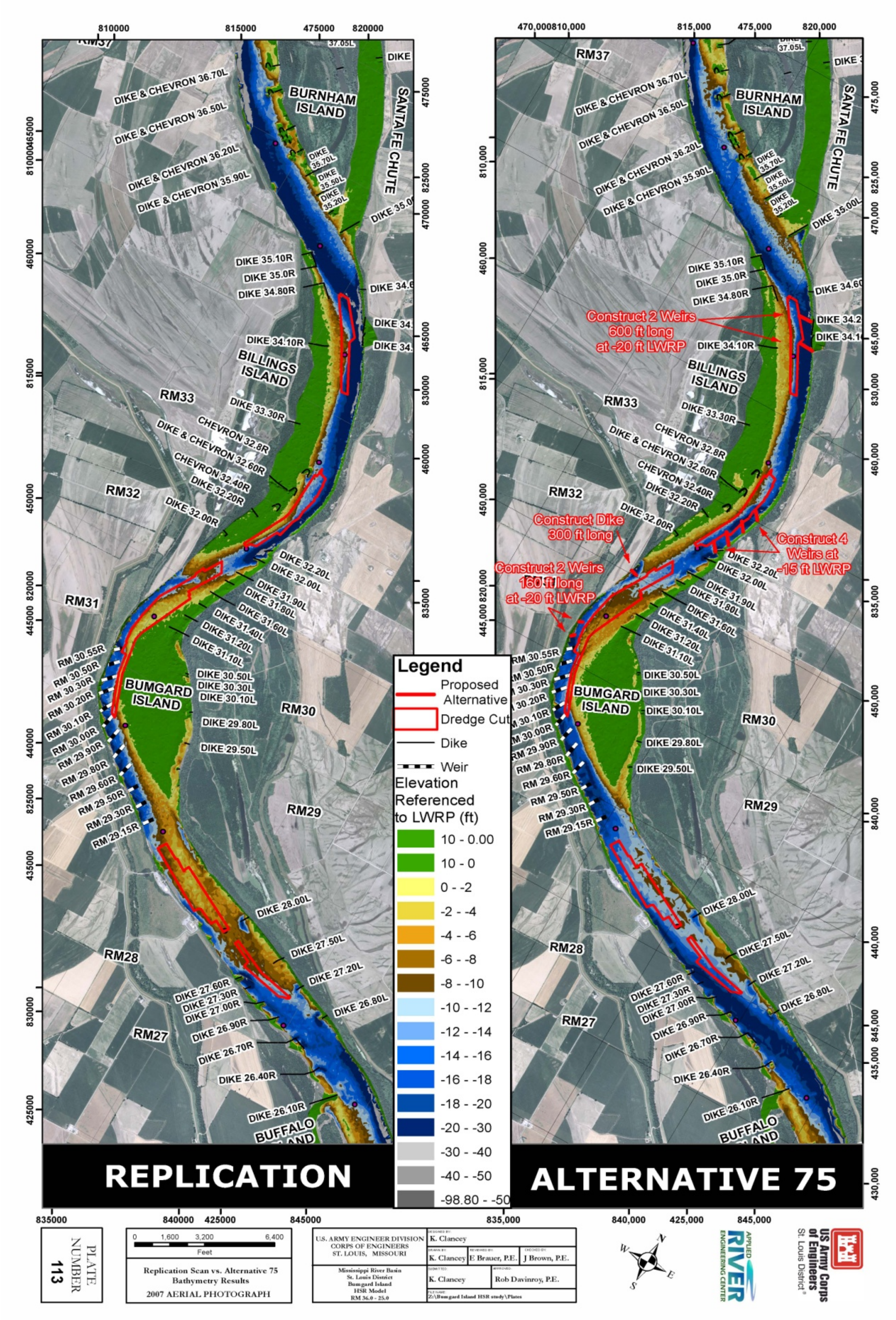


**Figure 2. Features associated with the Proposed Action**

**4. Species Covered in this Consultation:**

This species list is in agreement with the Mississippi and Scott Counties, Missouri, and Alexander County, endangered species lists posted on U.S Fish and Wildlife Service (USFWS) Region 3 IPaC website as of December 2013. https://ecos.fws.gov/ipac/

| **Species** | **Fed Status** | **Habitat** |
|---|---|---|
| Indiana bat (*Myotis sodalis)* | Endangered | Hibernacula in caves and mines; Maternity and foraging habitat - small stream corridors with well developed riparian woods; upland and bottomland forests |
| Gray bat *(Myotis grisescens)* | Endangered | Caves and mines; forages over rivers and reservoirs adjacent to forests |
| Northern long-eared bat (*Myotis septentrionalis*) | Candidate | Hibernates in caves and mines - swarming in surrounding wooded areas in autumn. Roosts and forages in upland forests during spring and summer. |
| Least tern (interior population) (*Sternula antillarum*) | Endangered | Large rivers - nest on bare alluvial and dredge spoil islands |
| Pallid sturgeon (*Scaphirhynchus albus*) | Endangered | Mississippi and Missouri Rivers |
| Fat pocketbook pearly mussel (*Potamilus capax*) | Endangered | Large Rivers in slow-flowing water in mud and sand. |
| Sheepnose *(Plethobasus cyphyus)* | Endangered | Shallow areas in larger rivers and streams |
| Rabbitsfoot (*Quadrula cylindrical cylindrical*) | Threatened | Small to large rivers in sand and gravel |
| Decurrent false aster (*Boltonia decurrens*) | Threatened | Recently disturbed areas within wet prairies, shallow marshes, and shores of open rivers, creeks and lakes |

## 5. Impact Assessment

The proposed project includes construction of eight weirs and one dike between river miles 34.0 and 31.0. Dikes and bendway weirs are prominent channel regulating features common in main channel habitats in the MMR. They are used to concentrate flow in the main channel in order to reduce the need for dredging. One of the goals of this project, and alternative selection, was to minimize adverse impacts to the sand island habitat on Bumgard Island.

As stated in the 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 (usually 15-20 ft. below the low water reference plane) generally constructed around the outer edge of a river bend. 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 down cutting throughout the bend" (USFWS 2000, USACE 2011).

**Indiana Bat –** The range of the Indiana bat 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 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).

Modification measures resulting in aquatic habitat improvement should contribute to the species' forage base. Dike and weir 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. 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, the proposed dike and weir construction "may affect but are not likely to adversely affect" the Indiana bat.

**Gray Bat –** The gray bat 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 would be impacted by the proposed action; therefore, this project would have "no effect" on the gray bat.

**Northern long-eared bat -** The northern long-eared bat is a federal candidate for listing as an endangered species throughout its range (Federal Register 2 October 2013). The northern long-eared bat is sparsely found across much of the eastern and north central United States, and all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and eastern British Columbia. Northern long-eared bats spend winter hibernating in large caves and mines. During summer, this species roosts singly or in colonies underneath bark, in cavities, in crevices of both live and dead trees. Foraging occurs in interior upland forests. Forest fragmentation, logging and forest conversion are major threats to the species. One of the primary threats to the northern long-eared bat is the fungal disease, white-nose syndrome, which has killed an estimated 5.5 million cave-hibernating bats in the Northeast, Southeast, Midwest and Canada. No caves or upland forests would be impacted by the proposed action; therefore, this project would have "no effect" on the northern long-eared bat.

**Least Tern –** The least tern is 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 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 and the construction of river engineering works adjust channel geometry according to varying sediment load and discharge. 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 exposed during the 15 May to 31 August period are potentially available to least terns (USACE 1999b). The size of nesting areas and the number of nests within a colony depend on water levels and the extent of associated sandbars (Sidle and Harrison 1990). Sandbars have a greater possibility of colonization by least terns if river levels remain low during the breeding season. Smith and Renken (1991) found that sites were more likely to be used by interior least terns in the Mississippi River Valley adjacent to Missouri if sites were continuously exposed for at least 100 days during the breeding season. A 1999 report (USACE 1999b) estimated that there were approximately 20,412 acres of nonvegetated sandbar habitat above the MMR low water reference plane (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) (Jones 2009, USFWS 2004). Some nesting attempts have also been made at Ellis Island (RM 202), however these are not considered to be reoccurring. While the Mississippi River appears to have a large amount of sandbar habitat, much of this habitat is not likely available to least terns for nesting and may not be located near suitable foraging habitats (USFWS 2009).

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).

As noted above, least terns are known to nest on Bumgard Island (Jones 2009, Keith McMullen St. Louis District USACE pers. comm.). In a meeting with the Missouri Department of Conservation (MDC), Illinois Department of Natural Resources (IDNR), the U.S Fish & Wildlife Service, Fisheries and Ecological Services (USFWS), and industry groups on 18 September, 2013, (and after many prior group discussions with the natural resource agencies and industry), a design for the placement of the rock structures was chosen to minimize the impacts to Bumgard Island and hence the least tern habitat. In order to comply with the programmatic Biological Opinion and implementation of the Reasonable and prudent Measures and Terms and Conditions prescribed therein (USFWS 2000), it was agreed upon that Alternative 75 achieved the best balance of the study's goals, including pre- and post construction monitoring, and was the recommended alternative.

However, it was also agreed upon that Alternative 75 could have some impacts to the Bumgard Island complex especially regarding side channel flows and loss of island habitat. Concerns were expressed that there could be possible decreases or increases in the amount of flow in the side channel that the model could not detect with the proposed alternatives. Under present conditions flow is maintained in the side channel for most of the year making it accessible to fish and keeping the island isolated from the bank - important components of least tern habitat. The combination of the proposed weirs and dike in the model have shown a slight reduction in the size of the island and a loss of the shallow water habitat on the downstream end of the island.

As the recommended course of action, Alternative 75 would be proposed for construction during late FY14 or early FY15, pending completion of required environmental compliance review. The reach would be physically monitored prior to and extensively after construction, to evaluate hydrologic and geomorphic changes. After the river has had time to react to the structures, the group would evaluate the reach again to determine if adverse changes to side channel flows and/or losses to island habitat were taking place. If so, a re-evaluation of the alternatives would be required. Details of the hydraulic sediment response model (HSR) that led to the formation and analysis of alternatives can be found at:

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

Although adverse impacts to the least tern associated with this project have been avoided and minimized to the greatest extent possible and design modifications have been incorporated to provide habitat benefits, the least tern may still be adversely affected by the project. However, the adverse effects of the project on the least tern 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.

**Pallid Sturgeon –** The estimated population of pallid sturgeon in the MMR ranges between 4900 and 1600 individuals (Garvey et al. 2009). Pallid sturgeon are very rare relative to shovelnose sturgeon in the MMR (a 1:82 ratio), whereas at Baton Rouge, Louisiana the ratio is 1:6. Threats to population recovery of pallid sturgeon include limited rearing and nursery habitat and loss of mature female adults. Pallids apparent non-reproductive habitat includes wing dikes with sandy substrate, and areas with contrasting flow velocities, complexes of island point bars, and side channels. During low water as in late summer, pallids are found more in the main channel. Reproductive habitat includes the Chain of Rocks area, known gravel bars in the MMR, tributary confluences and side channels (Peterson and Herzog 1999, Garvey et al. 2009).

According to Garvey et al. (2009), adult pallid habitat for foraging and holding station in flow in the MMR is adequate and related primarily to the wing dike areas, although all habitats have been occupied. Hypothetically, some wing dikes may mimic natural depositional areas adjacent to the main channel. Pallid sturgeon need main channel conditions, island areas that provide an ecotone between flow with deposition. These areas cause an accumulation of insects and small insectivorous fish that facilitate foraging, growth and ultimately reproductive condition. The availability and quality of reproductive habitat for spawning and production of offspring in the MMR is unknown (Sheehan and Heidinger 2001, Garvey et al. 2009). If adult pallid sturgeon densities increase, wing dikes creating preferred habitat will likely become limited and habitat restoration that creates needed main-channel conditions should be a priority (Garvey et al. 2009).

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 altering 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). Confinement and simplification of the main channel likely reduce habitat features such as instream islands and side channels (Garvey et al. 2009).

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/weir scale. By completing regulating works projects with incorporated modifications and limitations to increase habitat diversity at the scale of the dike/weir field, long-term beneficial effects for pallid sturgeon should result. The creation of scour holes 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 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 dike placement, are predicted to be beneficial to pallid sturgeon.

As above for the least tern, in a meeting with the MDC, IDNR, the USFWS, and industry groups on 18 September, 2013, (and after many prior group discussions with the natural resource agencies and industry), a design for the placement of the rock structures was chosen to minimize the impacts to the Bumgard Island complex including adjacent and localized pallid sturgeon habitat. In order to comply with the programmatic Biological Opinion and implementation of the Reasonable and prudent Measures and Terms and Conditions prescribed therein (USFWS 2000), it was agreed upon that Alternative 75 achieved the best balance of the study's goals, including pre- and post construction monitoring, and was the recommended alternative.

However, as mentioned above for the least tern, it was also agreed upon that Alternative 75 could also potentially cause some adverse impacts to the Bumgard Island complex, especially regarding side channel flows which currently provides suitable habitat for the pallid sturgeon. Concerns were expressed that there could be possible decreases or increases in the amount of flow in the side channel that the model could not detect with the proposed alternatives. Under present conditions flow is maintained in the side channel for most of the year making it accessible to fish and keeping the island isolated from the bank. The island complex also provides a variety of habitats that are used not only by adult and juvenile pallid sturgeon, but also many other species. There is a large gravel bar on the upper half of the island and the lower half of the island that provides a diversity of gradual sloping banks and shallow water habitat (limiting habitat in the Mississippi), which has been documented as being used by young of year pallid sturgeon. The combination of the proposed weirs and dike in the model has shown a slight reduction in the size of the island and a loss of the shallow water habitat on the downstream end of the island.

As the recommended course of action, Alternative 75 would be proposed for construction during late FY14 or early FY15, pending completion of required environmental compliance review. The reach would be physically monitored prior to and extensively after construction, to evaluate hydrologic and geomorphic changes. After the river has had time to react to the structures, the group would evaluate the reach again to determine if adverse changes to side channel flows and/or losses to island habitat were taking place. If so, a re-evaluation of the alternatives would be required. Details of the hydraulic sediment response model (HSR) that led to the formation and analysis of alternatives can be found at:

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

Although adverse impacts to pallid sturgeon associated with this project have been avoided and minimized to the greatest extent possible and design modifications have been incorporated to provide habitat benefits, pallid sturgeon may still be adversely affected by the project. However, the adverse effects of the project on the 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.

**Fat pocketbook pearlymussel -** The fat pocketbook pearly mussel is listed as endangered has has only been found occasionally within the Mississippi River, although currently there are no known viable populations (USFWS 1989). Collection records suggest that this mussel prefers lotic habitat with firm substrate (USFWS 1989). Because of its rarity and preferred habitat which does not normally exist within the construction area the project would have "no effect" on the fat pocketbook pearlymussel.

**Sheepnose mussel –** The sheepnose is listed as a federally endangered species and occurs in the Meramec River in Jefferson County, Missouri. This species inhabits gravel and mixed sand and gravel habitats in medium to large rivers (USFWS 2003).

The sheepnose is thought to be extant in five pools (3, 5, 15, 20 and 22) 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 is unlikely to adversely affect" the sheepnose mussel.

**Rabbitsfoot -** The rabbitsfoot is listed as federally threatened (SSFWS 2009). It is primarily an inhabitant of small to medium sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity and in moderately compacted gravel and sand substrate. It has also been documented in mixed cobble and gravel substrate. It feeds on the bottom of a stream, lake, or pond but rarely burrows into the substrate. In small streams, this species is associated with bars or gravel and cobble near fast current, and it has also been found in eddies along the periphery of midstream currents. Spawning occurs between May and July. Threats include siltation, drainage, pollution, zebra mussels, impoundments, livestock, and poor water quality. This species is not known historically to occur in the Mississippi River; therefore, this project will have "no effect" on the rabbitsfoot mussel.

**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 from the project area, the project "may affect, but is not likely to adversely affect" the decurrent false aster.

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## Appendix C. Correspondence

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

REPLY TO
ATTENTION OF:

August 16, 2013

Engineering and Construction Division
Curation and Archives Analysis Branch

COPY

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

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.

- **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 | Alexander | IL |
| | | 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.**

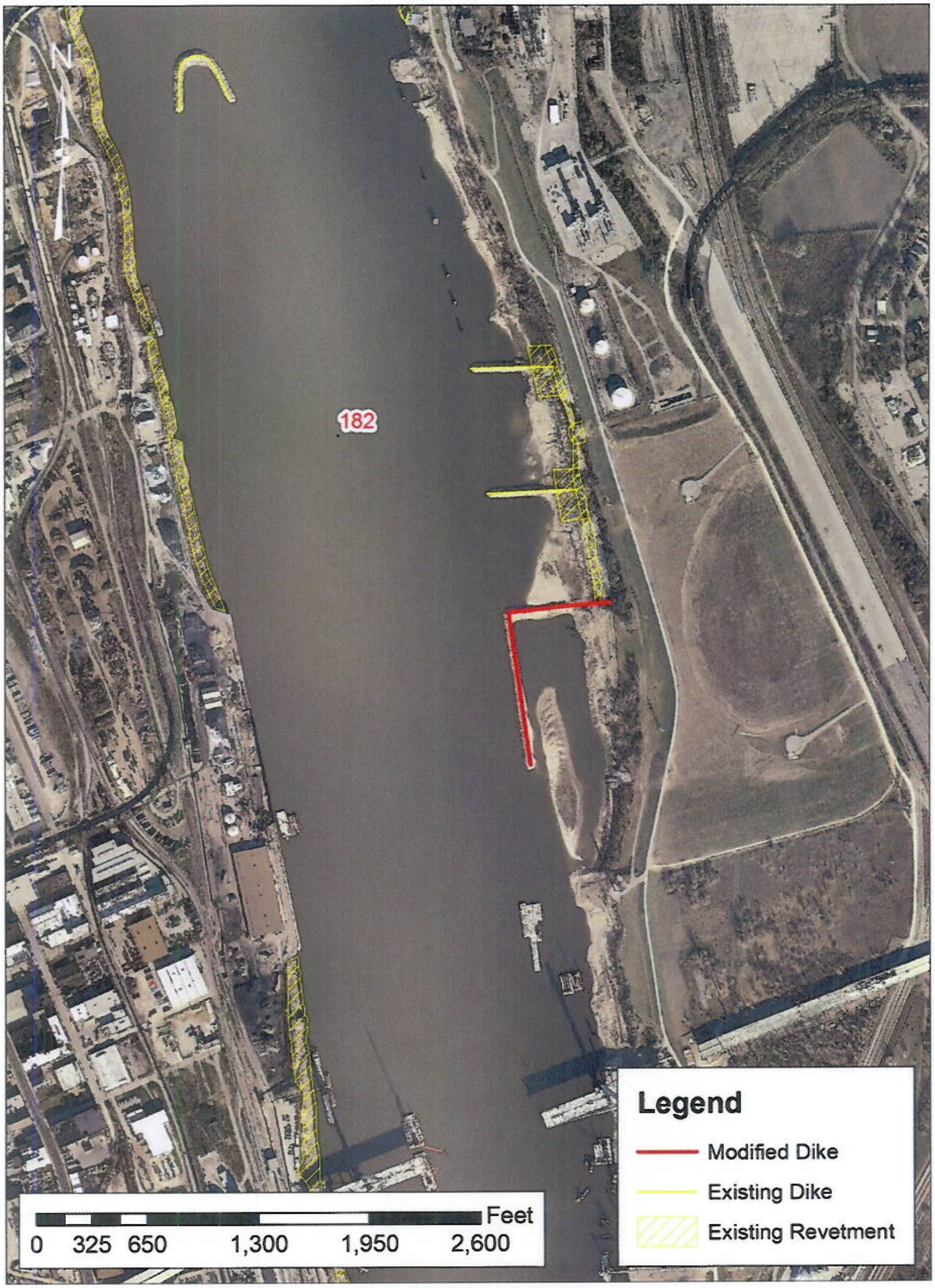


**Figure 2. Location of Dike 181.7L in St. Louis Harbor.**

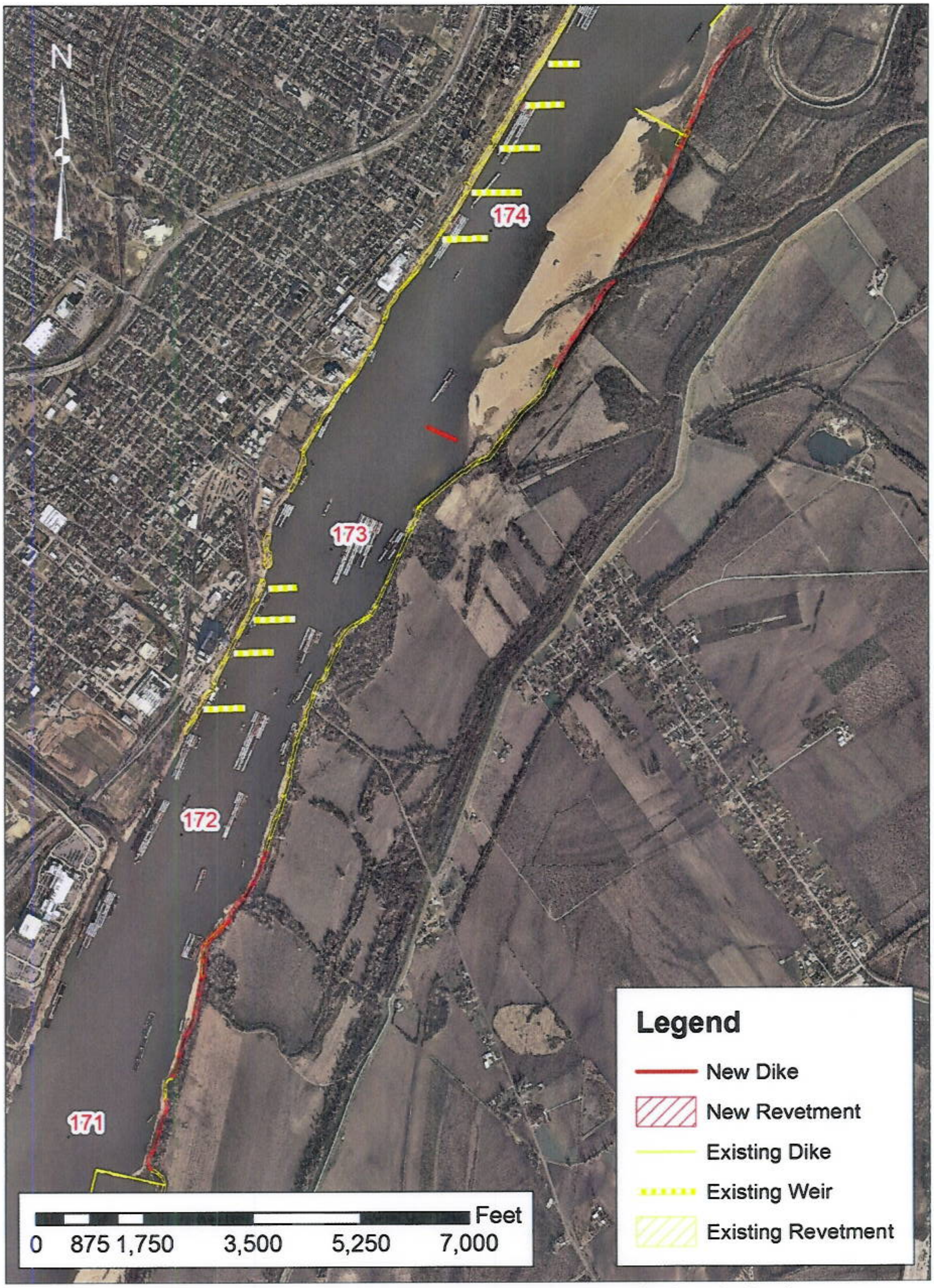


**Figure 3. Location of proposed work in St. Louis harbor.**

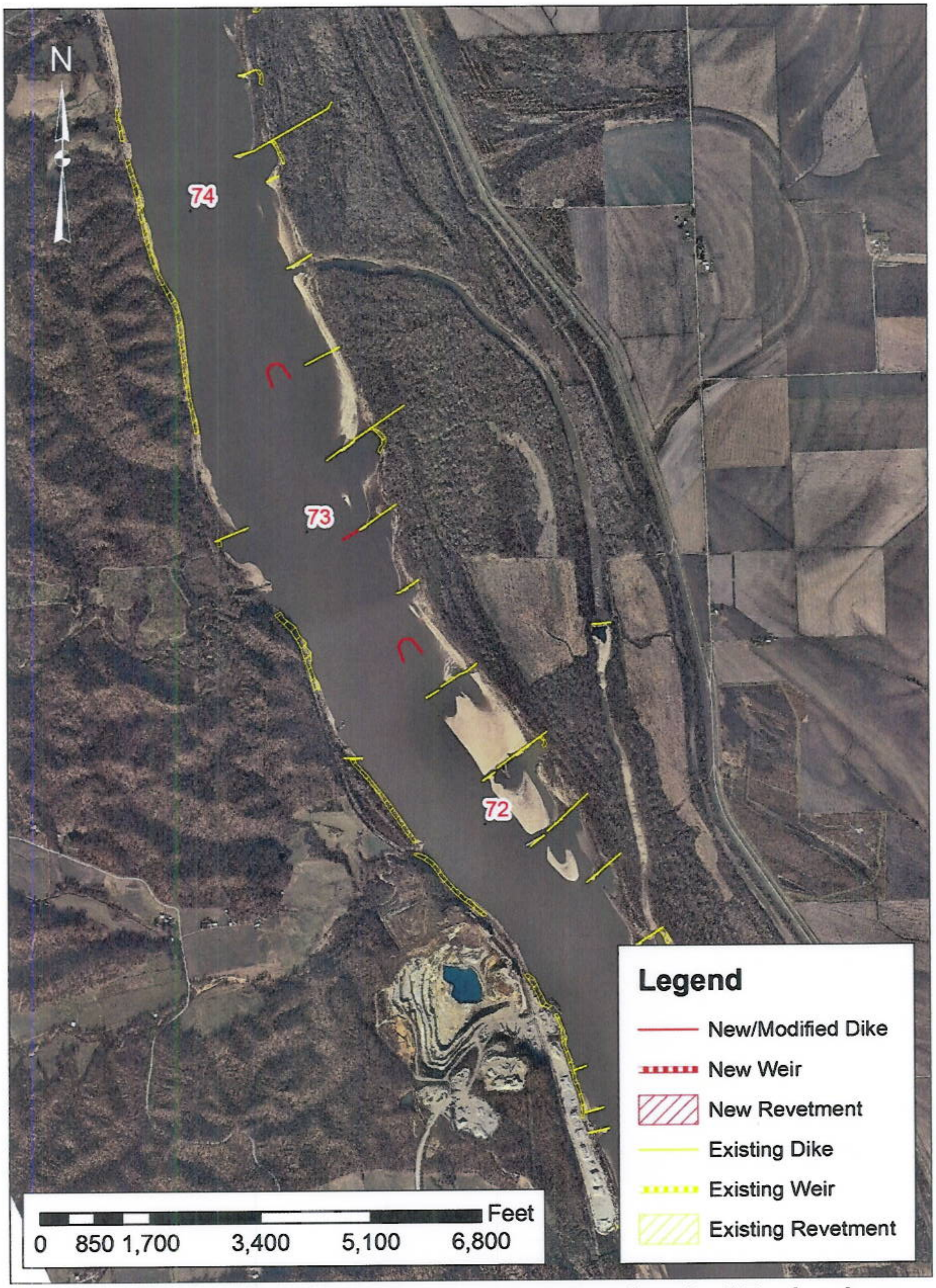


**Figure 4. Location of proposed work at Crawford Towhead.**


**Figure 5. Location of proposed work at Vancil Towhead.**

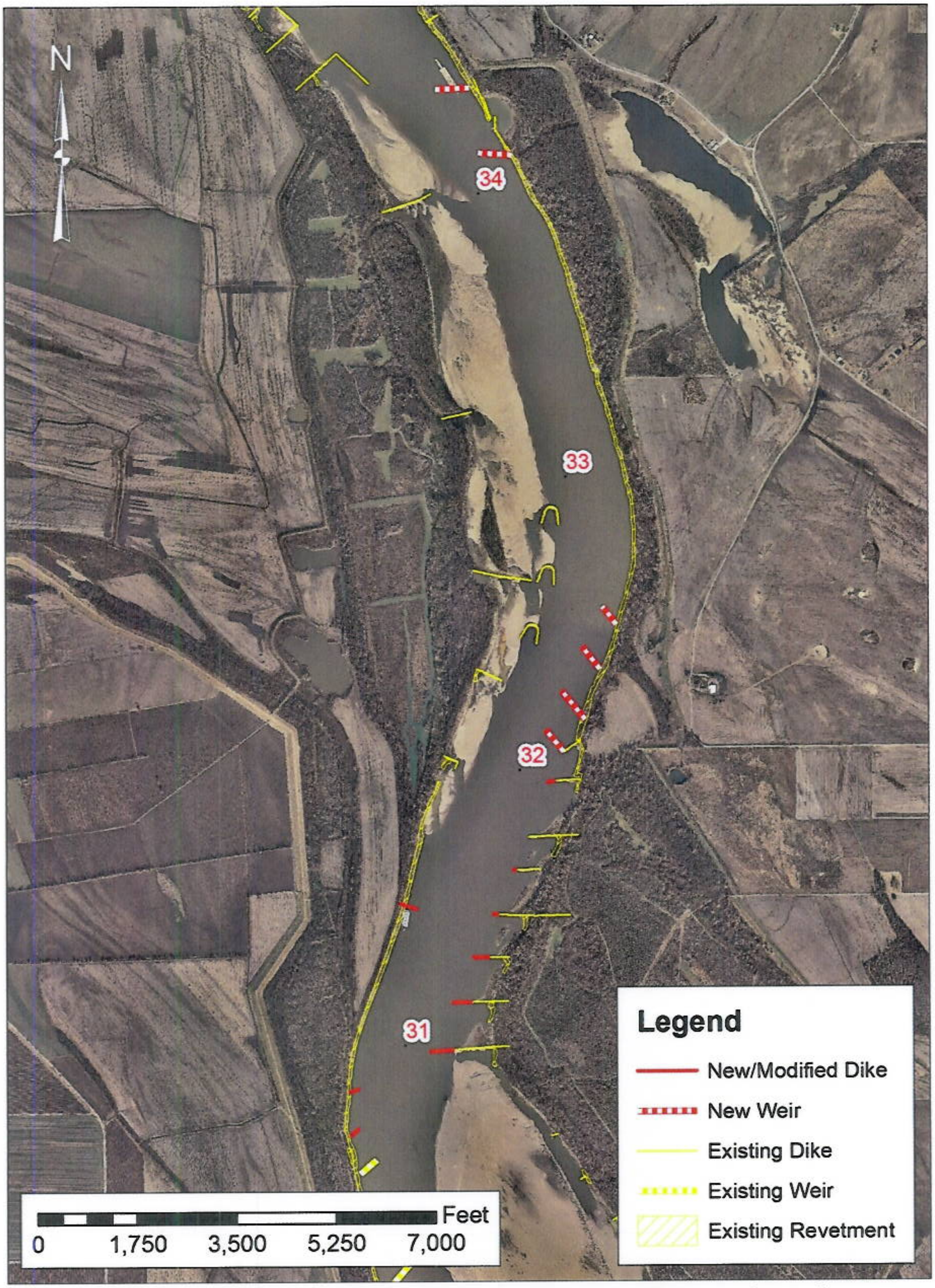


**Figure 6. Location of proposed work at Bumgard reach.**

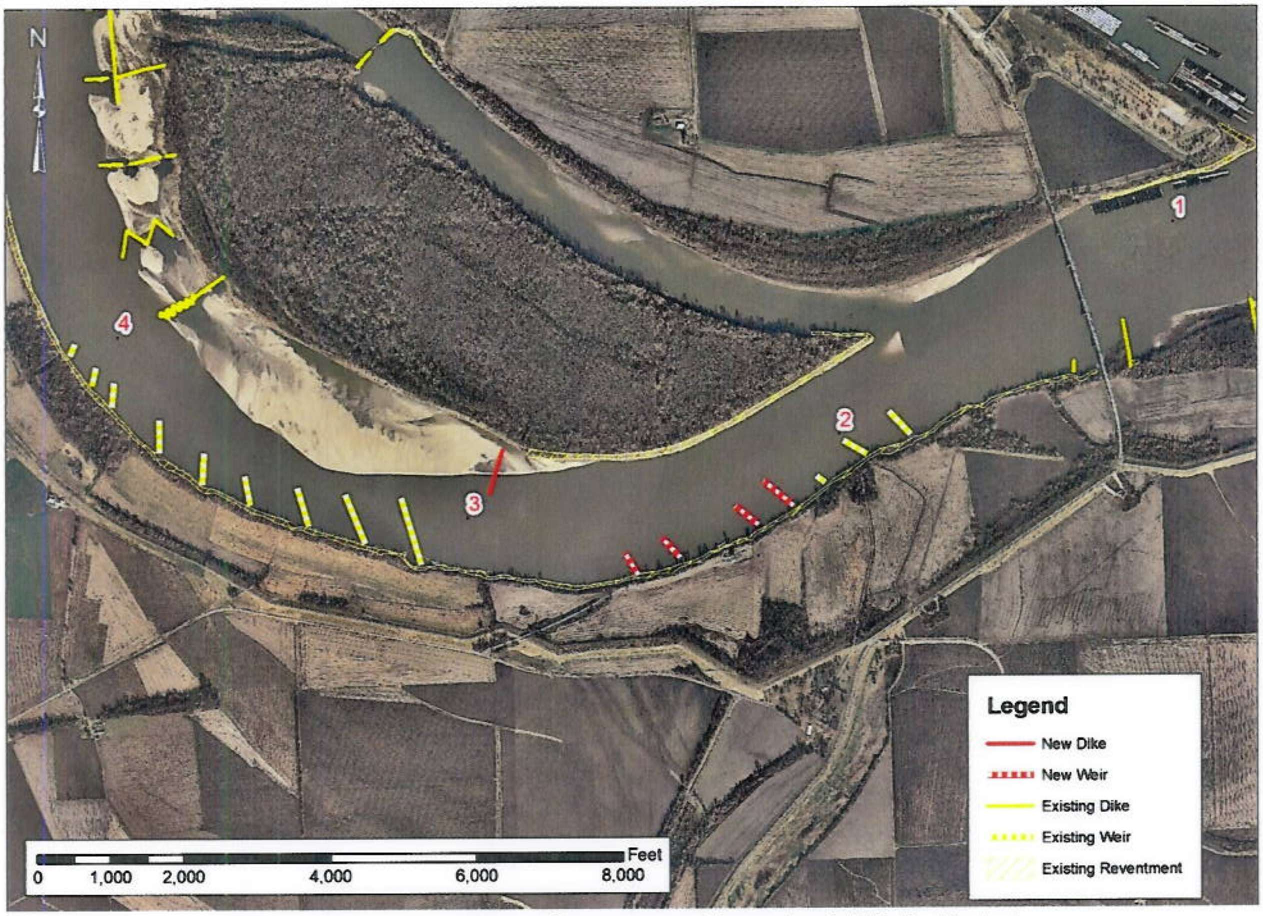


**Figure 7. Location of proposed work at Birds Point.**

**SAME LETTER SENT**
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Miami, Oklahoma 74355

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Quapaw, Oklahoma 74363

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

REPLY TO
ATTENTION OF:

August 16, 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: Dogtooth Bend Phase 5: River Training Structures

Dear Ms. Haaker:

The United States Army Corps of Engineers (USACE) is presently planning the construction, or modification, of fifteen river training structures in the Bumgard reach of the Mississippi River between river miles 35 and 30 (Figure 1). The structures comprise the Dogtooth Bend Phase 5 Project. 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. For the Upper Mississippi above St. Louis, the primary mechanism implemented to achieve this goal was the lock-and-dam system built in the 1930s and 1940s. The use of river training structures such as wing dikes, however, continued to be valuable in the maintenance of an open river navigation channel.

There are a number of types of river training structures including dikes, revetments, bendway weirs, and chevrons. As noted, 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. Revetments are structures placed along the river bank to stabilize or protect the bank from erosion. They are usually constructed out of stone, but a variety of other materials have been used including concrete-mat, willow mattresses, and gabions. First constructed in 1989, submerged bendway weirs widen the navigation channel in rivers bends by creating a favorable redistribution of current velocities and sediments. A more-recent development are chevrons built in the river itself. Chevrons create and promote split flows rather than unidirectional deflections and provide more diverse aquatic habitats. River training structures continue to be constructed, as they provide a more cost-effective and environmentally friendly solution for moving sediment through the river system than dredging alone.

*Project*

It is proposed that six of the existing river training structures in the Bumgard Reach of the Mississippi River be modified and an additional nine be constructed (Figure 1). Six of the new structures would be located in Alexander County, Illinois, and three would be in Scott County, Missouri (Table 1).

Table 1.

| Feature | Type | County | State |
|---|---|---|---|
| Weir 34.20L | New | Alexander | IL |
| Weir 34.10L | New | Alexander | IL |
| Weir 32.50L | New | Alexander | IL |
| Weir 32.40L | New | Alexander | IL |
| Weir 32.3L | New | Alexander | IL |
| Weir 32.2L | New | Alexander | IL |
| Shorten Dike 32.0L | Modify Existing | Alexander | IL |
| Extend Dike 31.8L | Modify Existing | Alexander | IL |
| Extend Dike 31.6L | Modify Existing | Alexander | IL |
| Dike 31.6R | New | Scott | MO |
| Extend Dike 31.4L | Modify Existing | Alexander | IL |
| Extend Dike 31.2L | Modify Existing | Alexander | IL |
| Extend Dike 31.1L | Modify Existing | Alexander | IL |
| Weir 30.80R | New | Scott | MO |
| Weir 30.70R | New | Scott | MO |

*Potential Effects on Cultural Resources*

All the river training structures are constructed 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. All new dikes and weirs will be connected to existing stone revetments.

The bankline of the Bumgard Reach has significantly changed in the past century and a half (see Figure 2). The locations of seven of the in-water features were on land as late as 1908 (Figure 3). Conversely, due to the Mississippi's migration most of the other feature locations were closer to the middle of the channel than they are now. It was not until the first quarter of the twentieth century that the shoreline stabilized near its current position. The construction of embankments and other river regulating structures as well as the closure of the western branch of the river (i.e., the Doolan Slough) were responsible for the stabilization. Any cultural resources located on land eroded prior to that stabilization would have been destroyed by the bankline recession and any shipwreck located there would post date it.

*Possible 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 observed wreck to the project features was located approximately at river mile 33.5R within the reach. The wreck, however, was sighted on the opposite bank and downstream from the nearest feature (Weir 32.2L), while the nearest feature on the same bank is approximately two miles downstream.

Most of the proposed structures are next to dredged channels, which probably resulted in channel slump and sediment reworking in the locations (Figure 4). The Bumgard Reach has been regularly dredged over the years, and it is likely that any unrecorded wreckage located in the path of those dredge events was destroyed and removed during the process. While exact location information is not available for dredging events prior to 1979, USACE has been conducting such activities to deepen the navigation channel of the Middle Mississippi since 1896 (Manders and Rentfro 2011:61).

The river bed in the project area is surveyed every two to three years, with the latest survey having been completed on July 20, 2011, or June 21, 2012 (depending upon the river section). The single-beam survey was conducted with range lines spacing of 250 feet. No topographic anomalies suggesting wrecks are visible on the resulting bathymetric map (Figures 5–7). Where higher resolution multi-beam surveys were available (e.g., Figure 8), they were also examined, and no anomalies were visible.

Given the features' construction method (with no land impact), the previous disturbance of the riverbed, the channel migration recorded for the location in 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

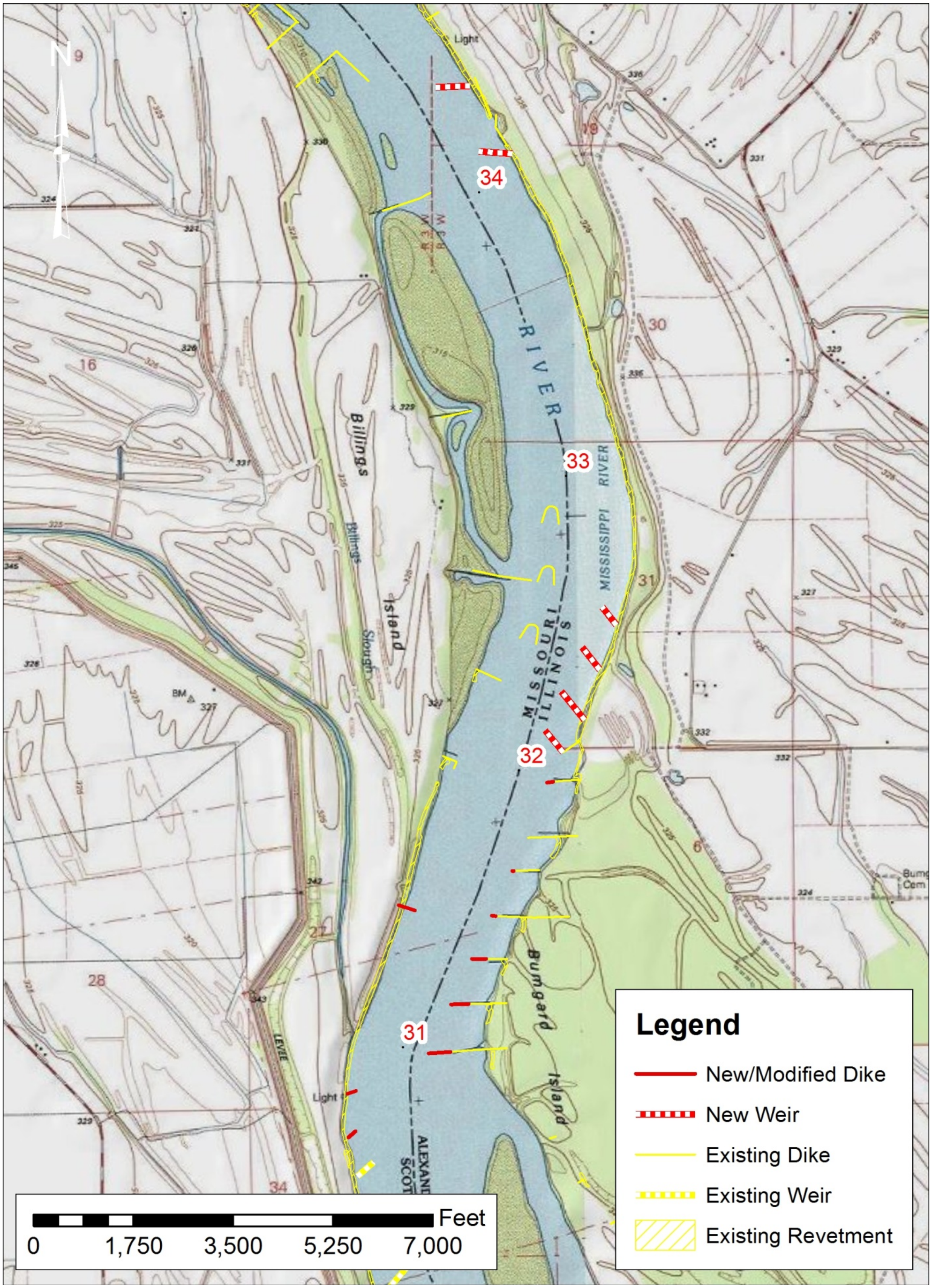
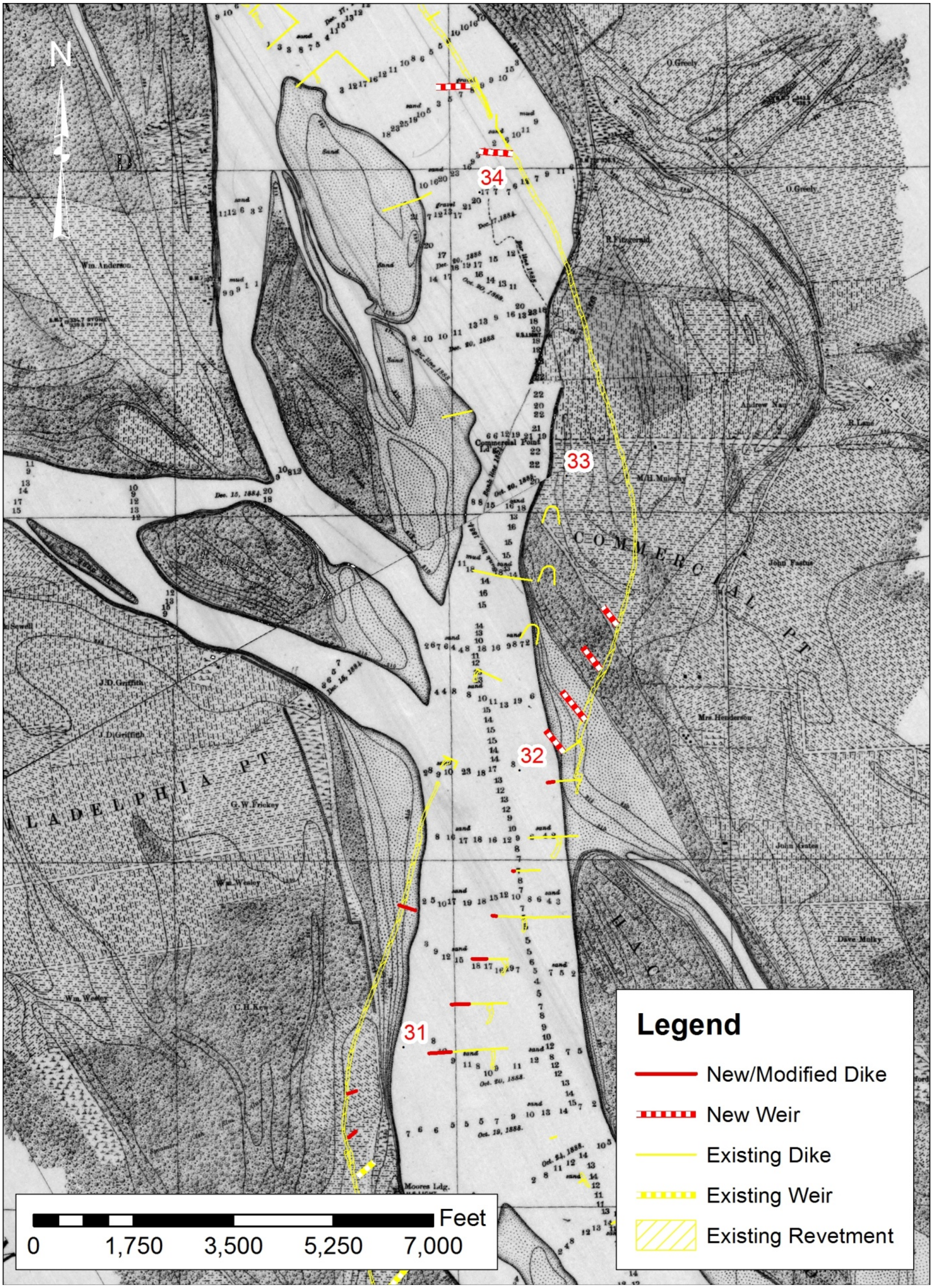



Figure 1. Proposed features superimposed on 7.5' USGS quad maps (Thebes SW and Cache).

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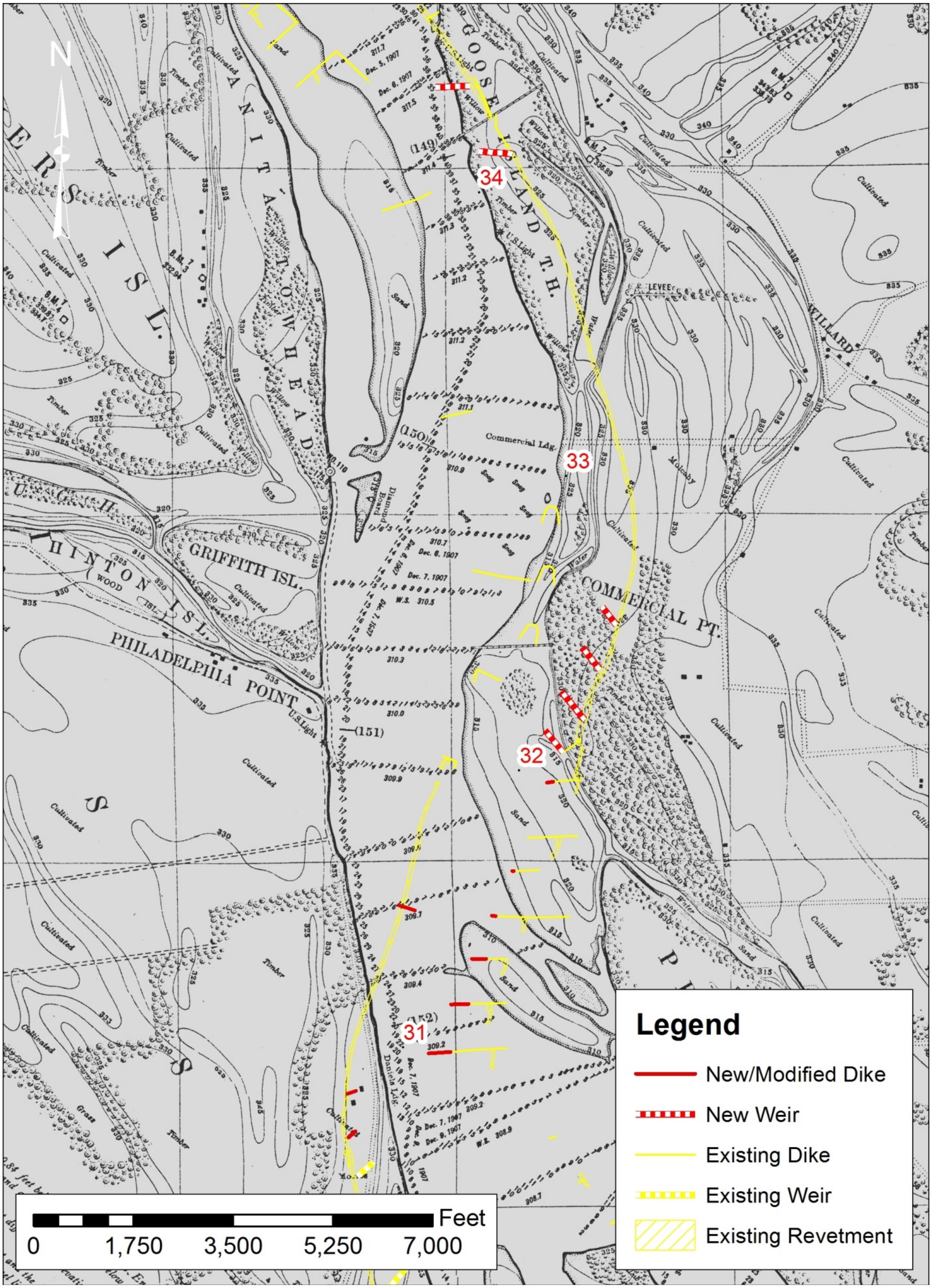


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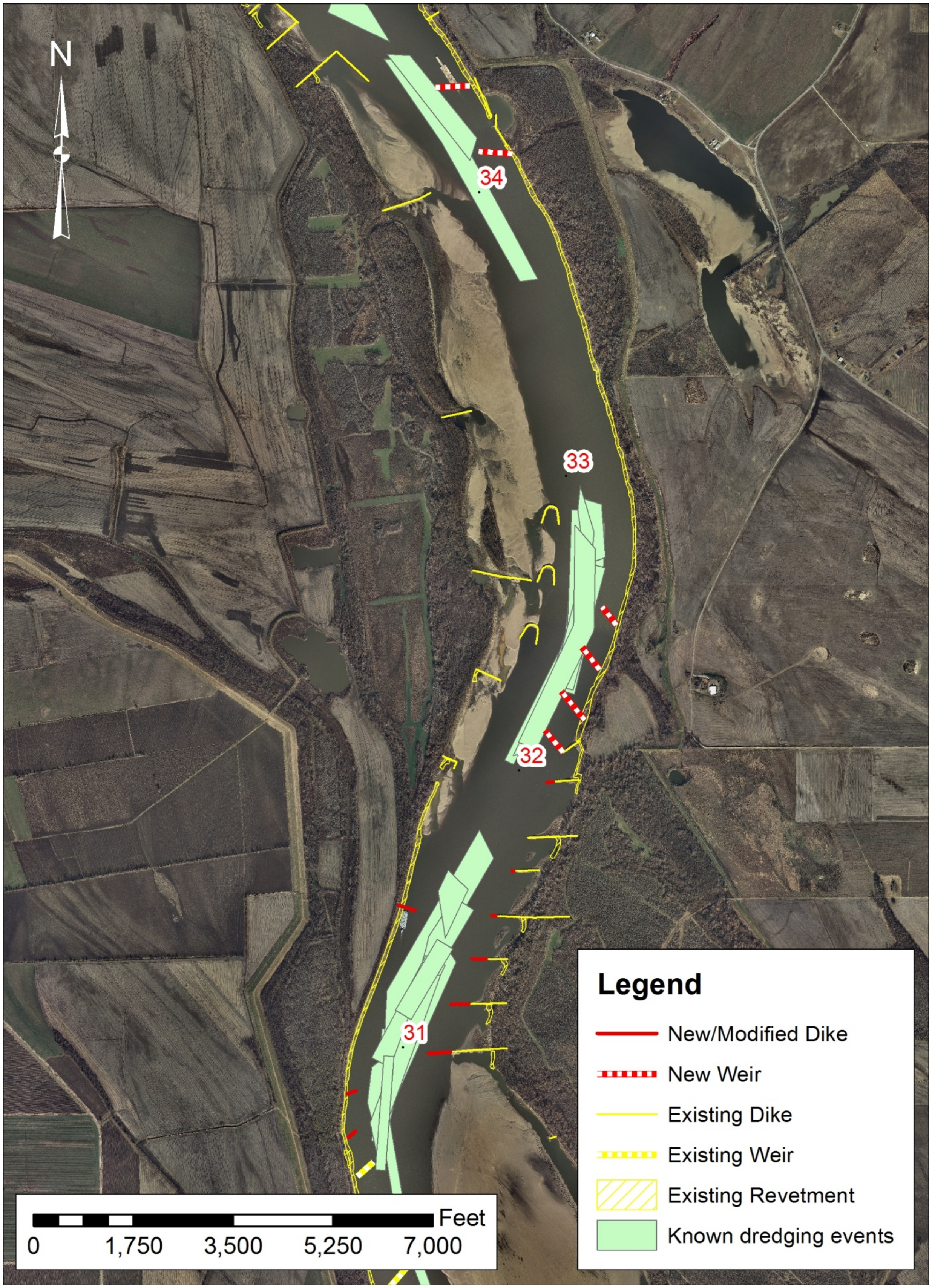

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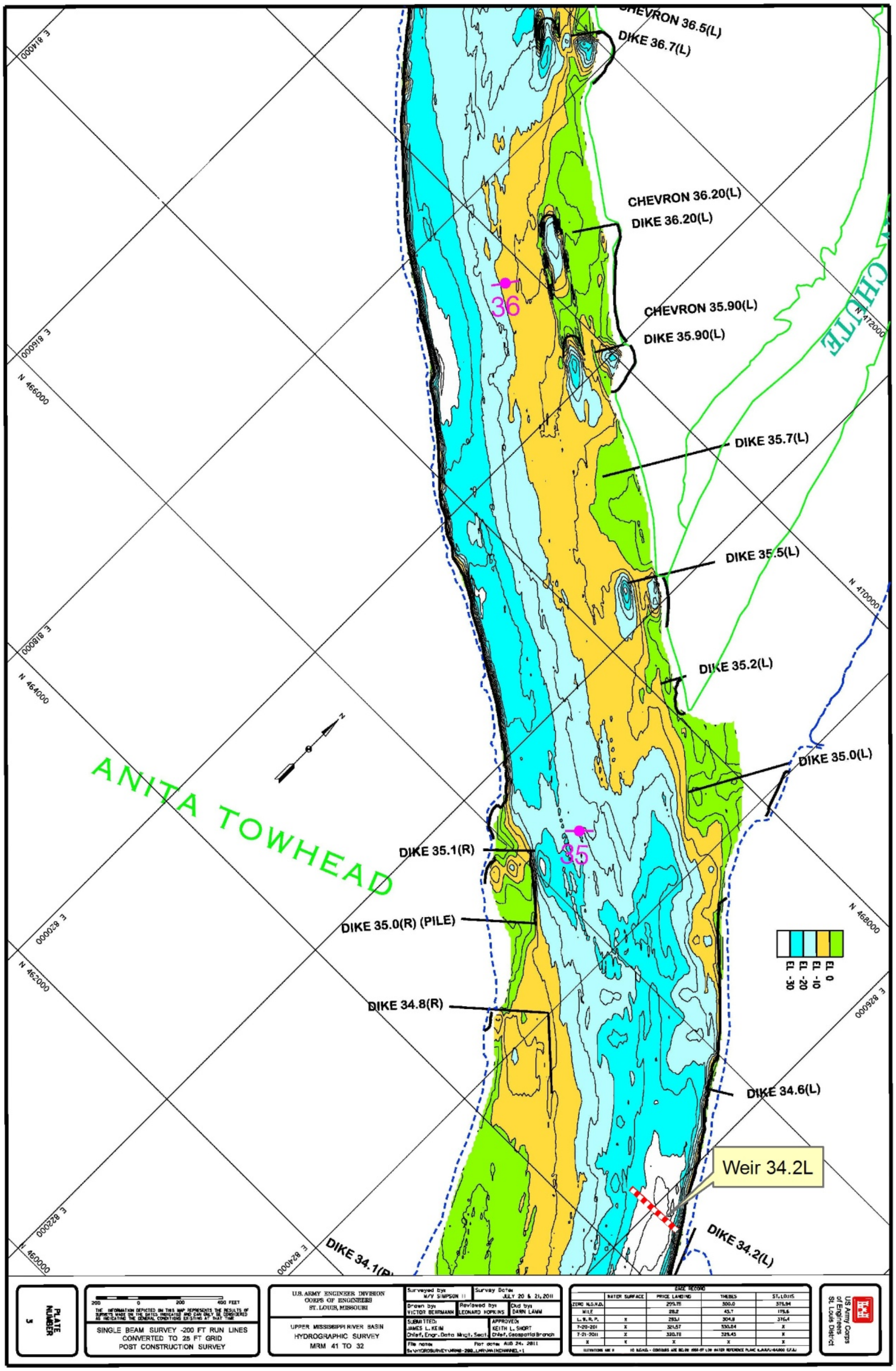


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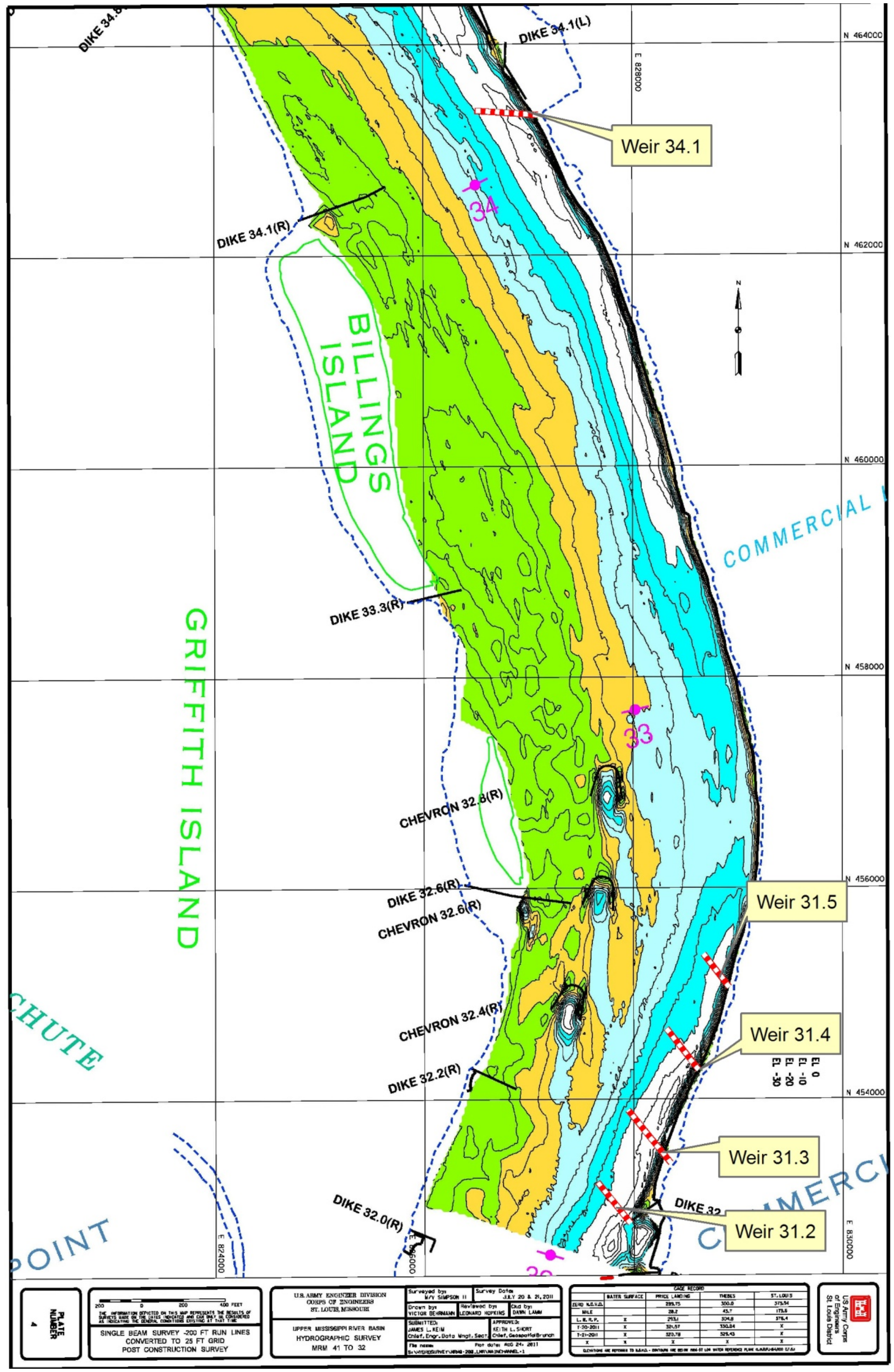


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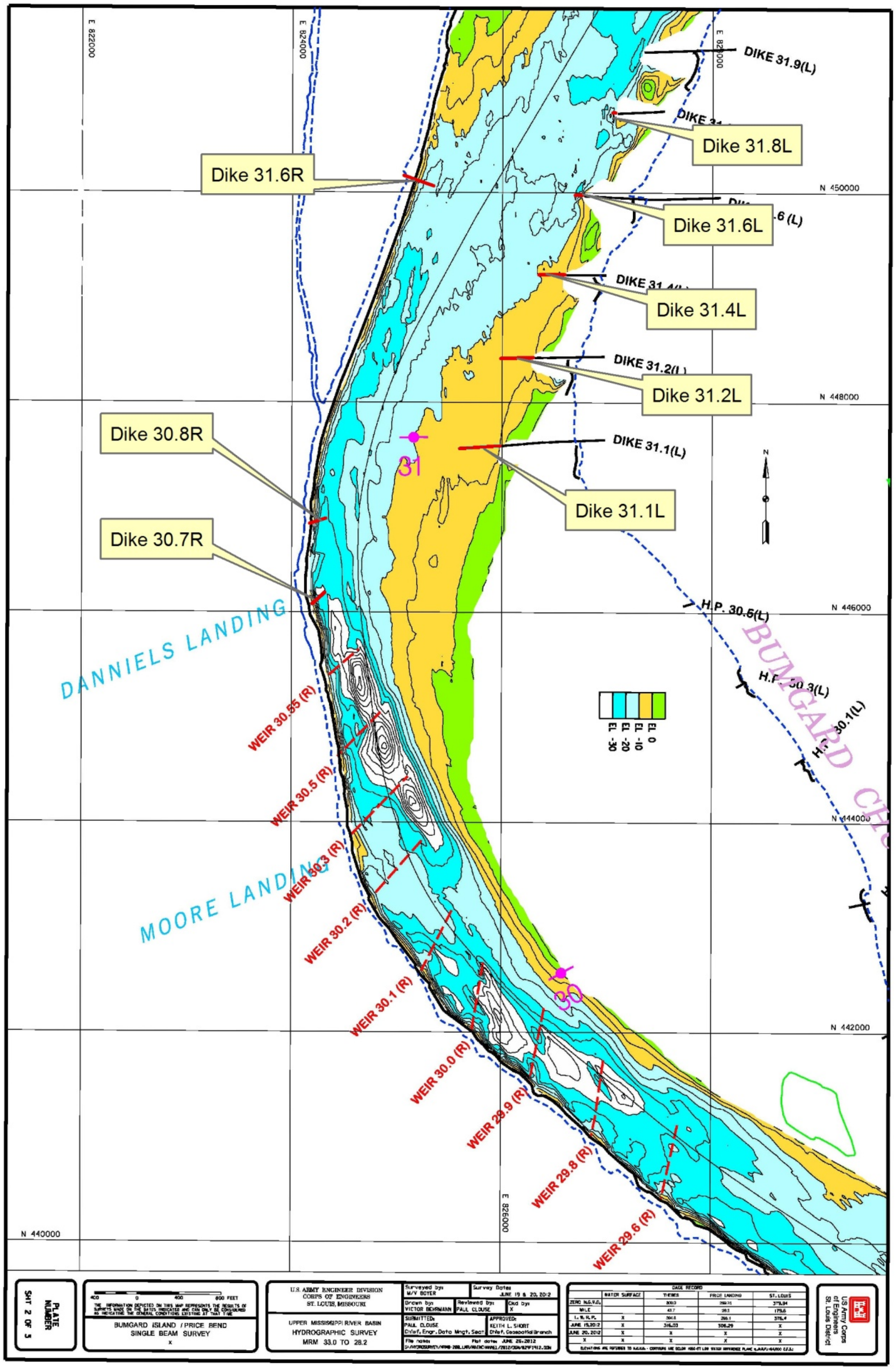


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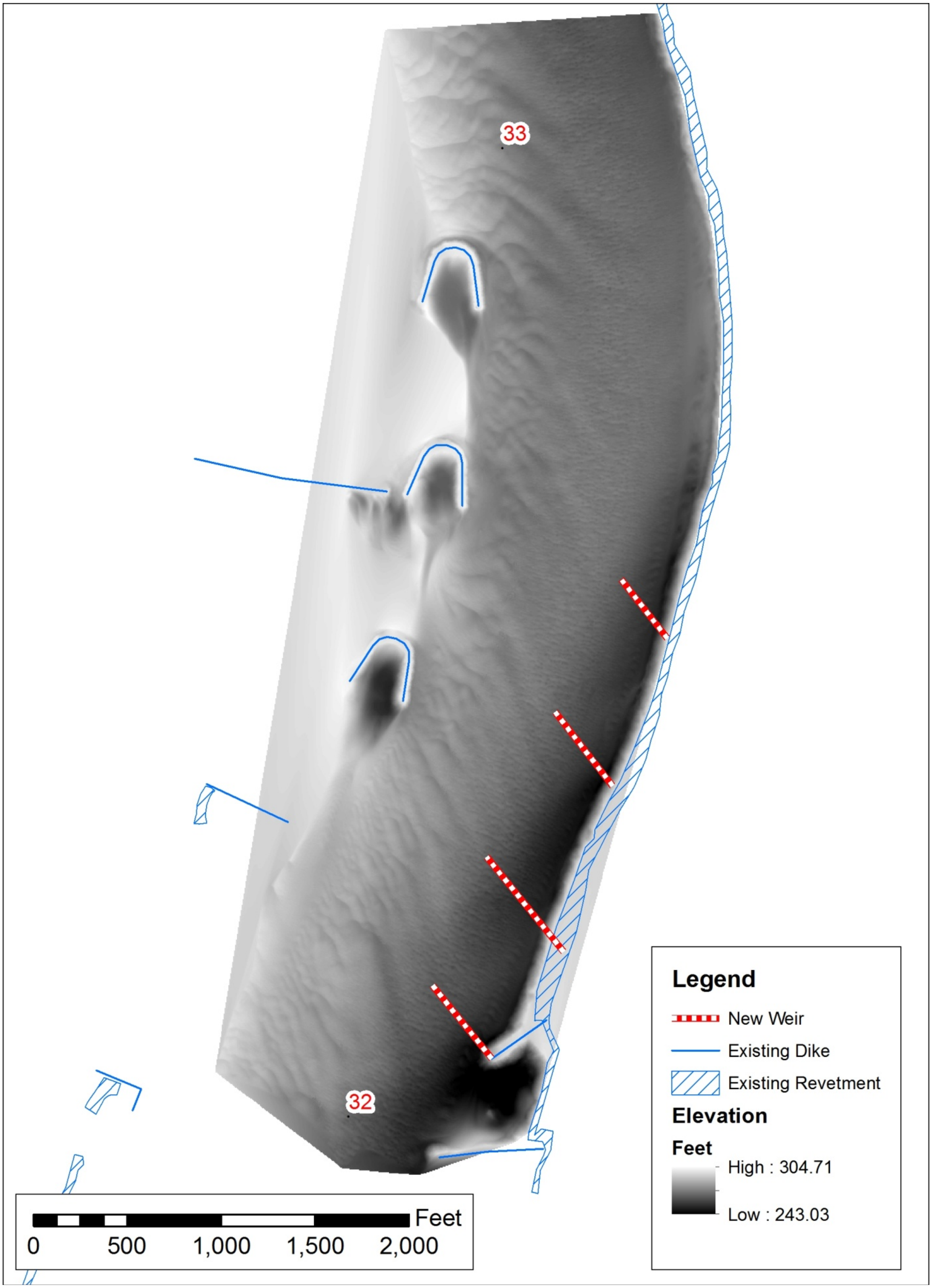



Figure 8. Proposed features (Weirs 31.5, 31.4, 31.3, and 31.2) shown on high resolution multi-beam survey model.

## References Cited

Manders, D., & B. Rentrfro (2011). *Engineers Far From Ordinary*. St. Louis: St. Louis District USACE.

Illinois Historic
Preservation Agency

FAX (217) 782-8161

1 Old State Capitol Plaza • Springfield, Illinois 62701-1512 • www.illinois-history.gov

Alexander County
East Cape Girardeau to Miller
New Construction or Modification, Dogtooth Bend Phase 5 River Training Structures
Between Upper Mississippi River Miles 30 and 35
IHPA Log #027081913

September 4, 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

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:

August 16, 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: Dogtooth Bend Phase 5: River Training Structures

Dear Ms. Deel:

The United States Army Corps of Engineers (USACE) is presently planning the construction, or modification, of fifteen river training structures in the Bumgard reach of the Mississippi River between river miles 35 and 30 (Figure 1). The structures comprise the Dogtooth Bend Phase 5 Project. 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. For the Upper Mississippi above St. Louis, the primary mechanism implemented to achieve this goal was the lock-and-dam system built in the 1930s and 1940s. The use of river training structures such as wing dikes, however, continued to be valuable in the maintenance of an open river navigation channel.

There are a number of types of river training structures including dikes, revetments, bendway weirs, and chevrons. As noted, 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. Revetments are structures placed along the river bank to stabilize or protect the bank from erosion. They are usually constructed out of stone, but a variety of other materials have been used including concrete-mat, willow mattresses, and gabions. First constructed in 1989, submerged bendway weirs widen the navigation channel in rivers bends by creating a favorable redistribution of current velocities and sediments. A more-recent development are chevrons built in the river itself. Chevrons create and promote split flows rather than unidirectional deflections and provide more diverse aquatic habitats. River training structures continue to be constructed, as they provide a more cost-effective and environmentally friendly solution for moving sediment through the river system than dredging alone.

*Project*

It is proposed that six of the existing river training structures in the Bumgard Reach of the Mississippi River be modified and an additional nine be constructed (Figure 1). Six of the new structures would be located in Alexander County, Illinois, and three would be in Scott County, Missouri (Table 1).

Table 1.

| Feature | Type | County | State |
|---|---|---|---|
| Weir 34.20L | New | Alexander | IL |
| Weir 34.10L | New | Alexander | IL |
| Weir 32.50L | New | Alexander | IL |
| Weir 32.40L | New | Alexander | IL |
| Weir 32.3L | New | Alexander | IL |
| Weir 32.2L | New | Alexander | IL |
| Shorten Dike 32.0L | Modify Existing | Alexander | IL |
| Extend Dike 31.8L | Modify Existing | Alexander | IL |
| Extend Dike 31.6L | Modify Existing | Alexander | IL |
| Dike 31.6R | New | Scott | MO |
| Extend Dike 31.4L | Modify Existing | Alexander | IL |
| Extend Dike 31.2L | Modify Existing | Alexander | IL |
| Extend Dike 31.1L | Modify Existing | Alexander | IL |
| Weir 30.80R | New | Scott | MO |
| Weir 30.70R | New | Scott | MO |

*Potential Effects on Cultural Resources*

All the river training structures are constructed 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. All new dikes and weirs will be connected to existing stone revetments.

The bankline of the Bumgard Reach has significantly changed in the past century and a half (see Figure 2). The locations of seven of the in-water features were on land as late as 1908 (Figure 3). Conversely, due to the Mississippi's migration most of the other feature locations were closer to the middle of the channel than they are now. It was not until the first quarter of the twentieth century that the shoreline stabilized near its current position. The construction of embankments and other river regulating structures as well as the closure of the western branch of the river (i.e., the Doolan Slough) were responsible for the stabilization. Any cultural resources located on land eroded prior to that stabilization would have been destroyed by the bankline recession and any shipwreck located there would post date it.

*Possible 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 observed wreck to the project features was located approximately at river mile 33.5R within the reach. The wreck, however, was sighted on the opposite bank and downstream from the nearest feature (Weir 32.2L), while the nearest feature on the same bank is approximately two miles downstream.

Most of the proposed structures are next to dredged channels, which probably resulted in channel slump and sediment reworking in the locations (Figure 4). The Bumgard Reach has been regularly dredged over the years, and it is likely that any unrecorded wreckage located in the path of those dredge events was destroyed and removed during the process. While exact location information is not available for dredging events prior to 1979, USACE has been conducting such activities to deepen the navigation channel of the Middle Mississippi since 1896 (Manders and Rentfro 2011:61).

The river bed in the project area is surveyed every two to three years, with the latest survey having been completed on July 20, 2011, or June 21, 2012 (depending upon the river section). The single-beam survey was conducted with range lines spacing of 250 feet. No topographic anomalies suggesting wrecks are visible on the resulting bathymetric map (Figures 5–7). Where higher resolution multi-beam surveys were available (e.g., Figure 8), they were also examined, and no anomalies were visible.

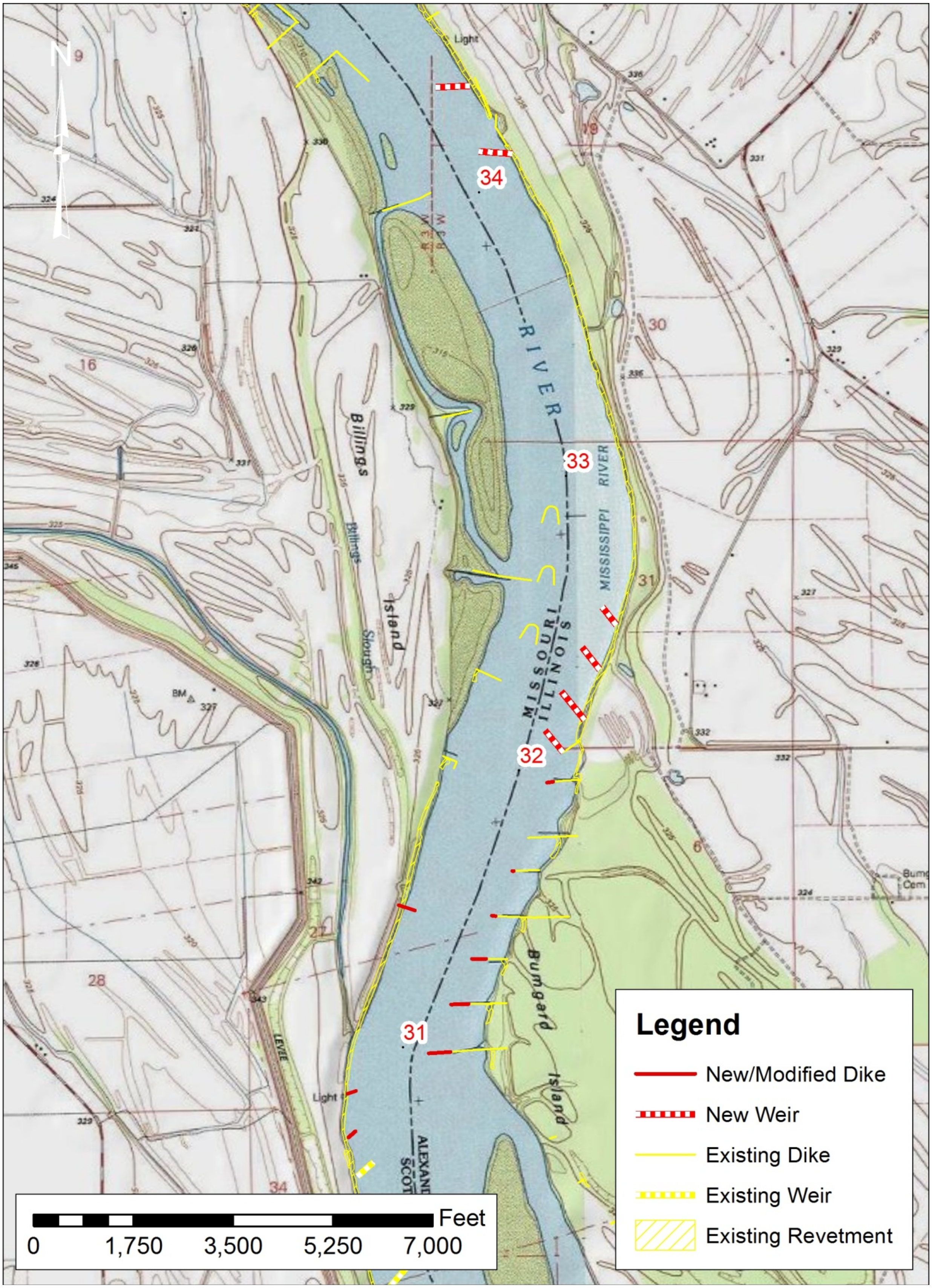
Given the features' construction method (with no land impact), the previous disturbance of the riverbed, the channel migration recorded for the location in the nineteenth century, and the lack of any survey evidence for extant wrecks, it is our opinion that the proposed undertaking will have no significant 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

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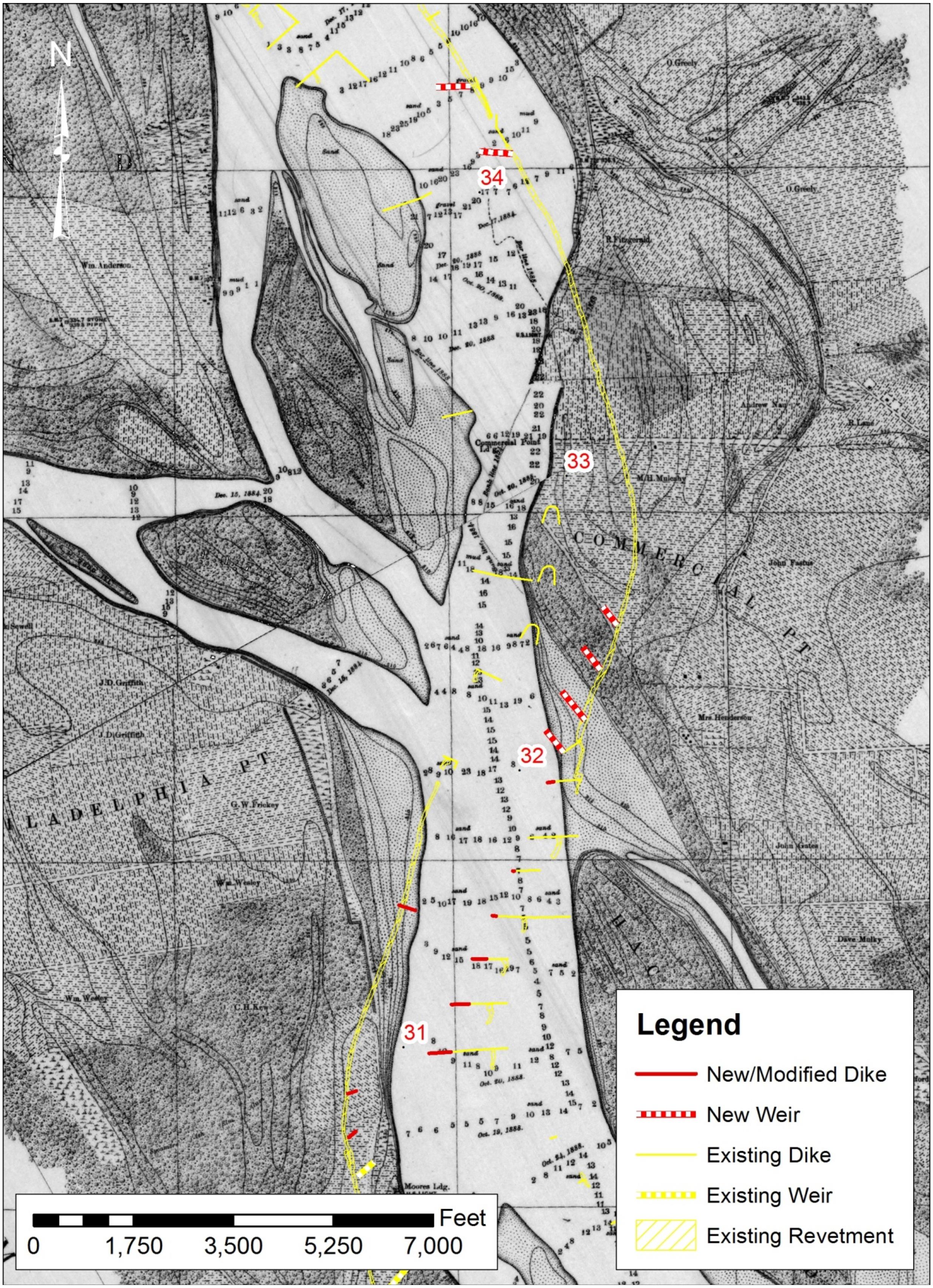


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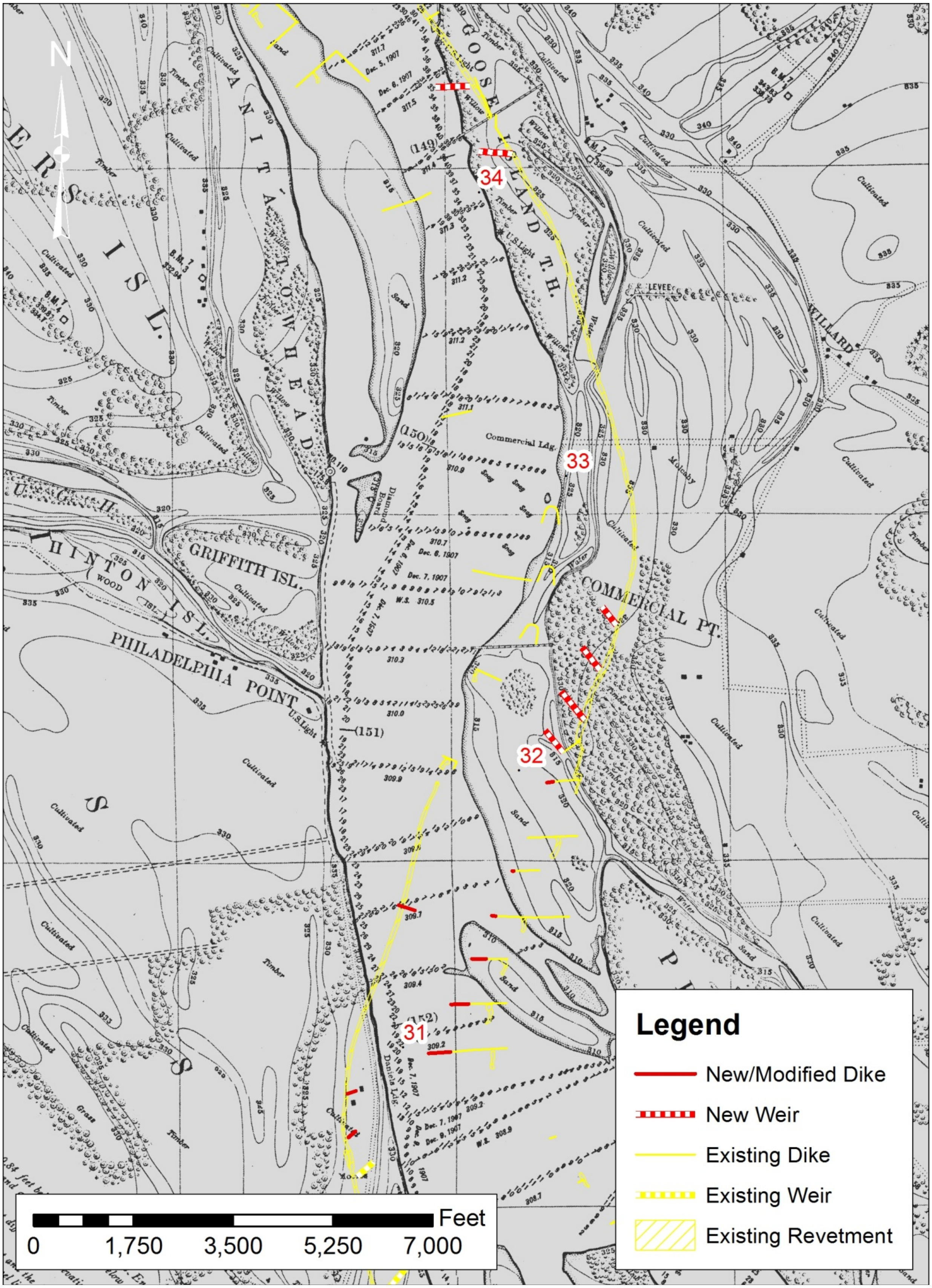


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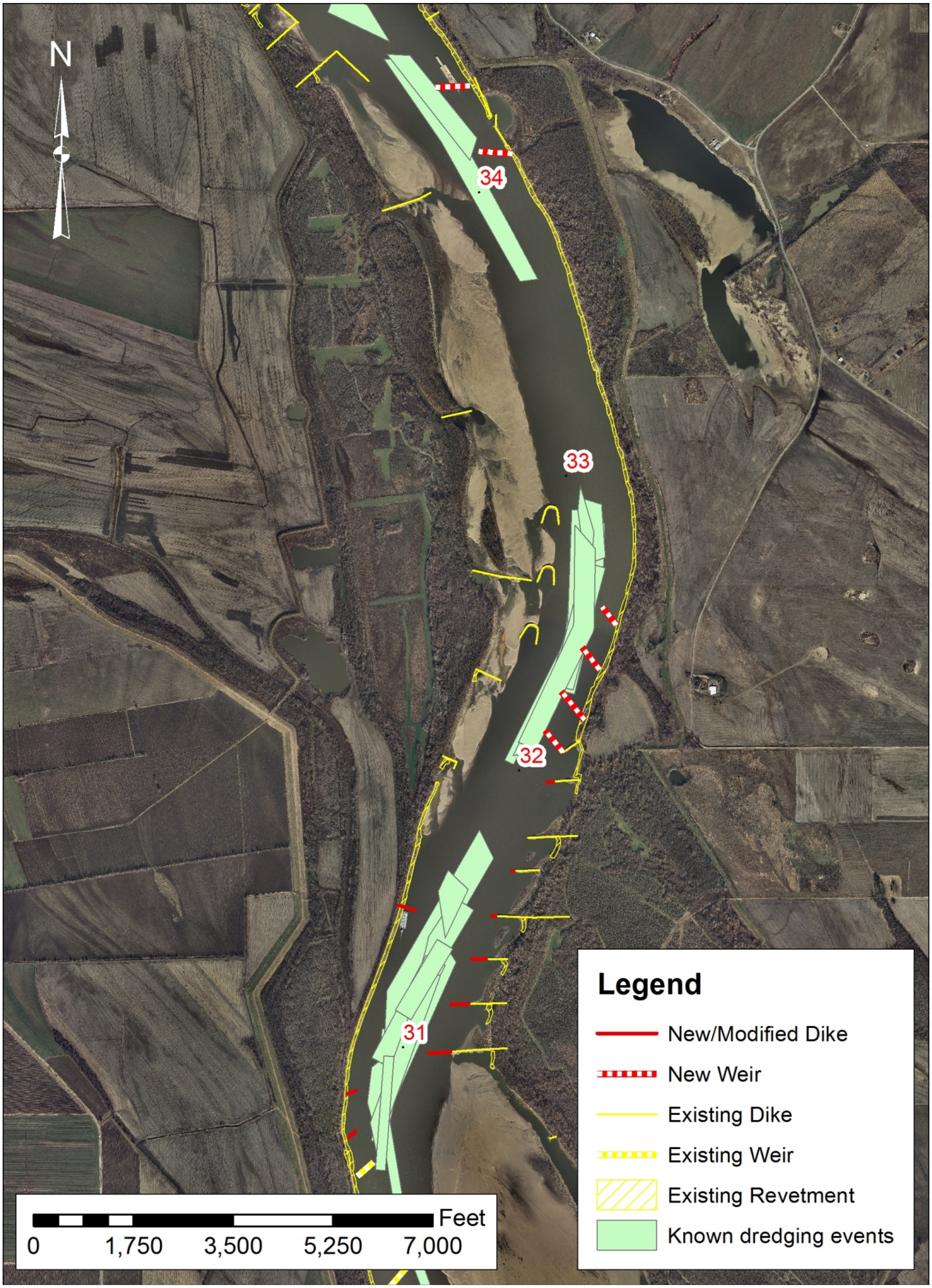


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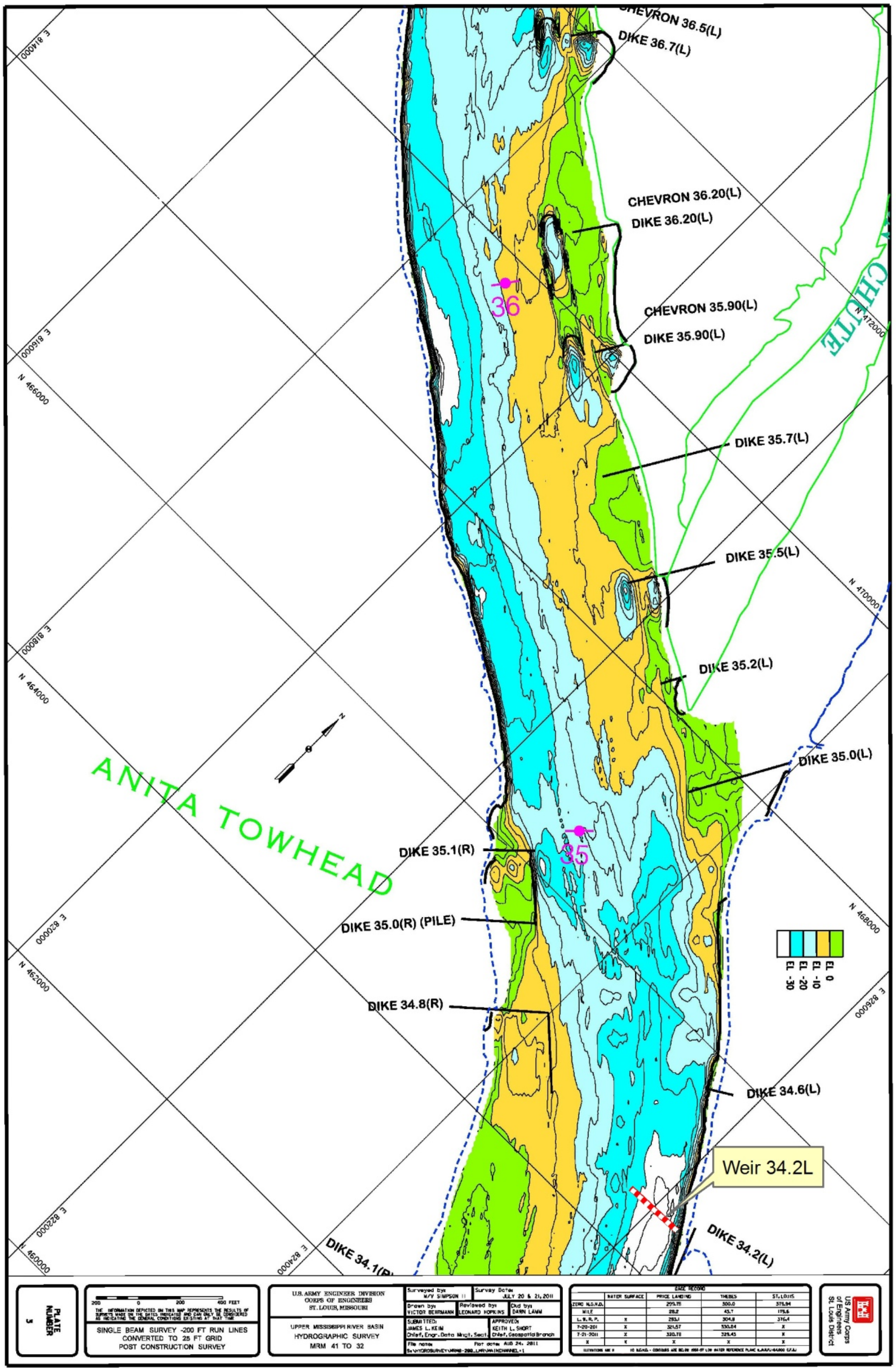


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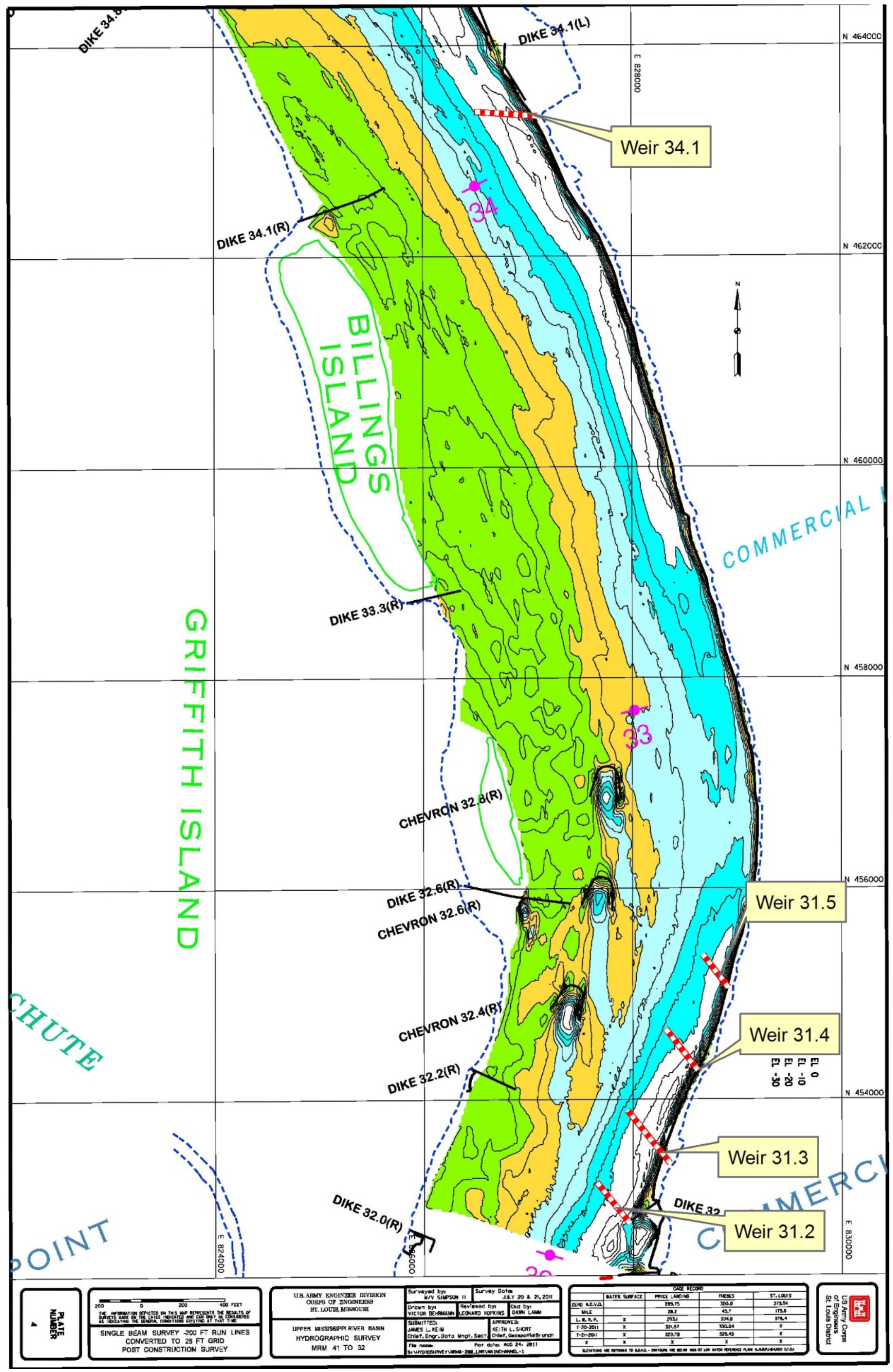


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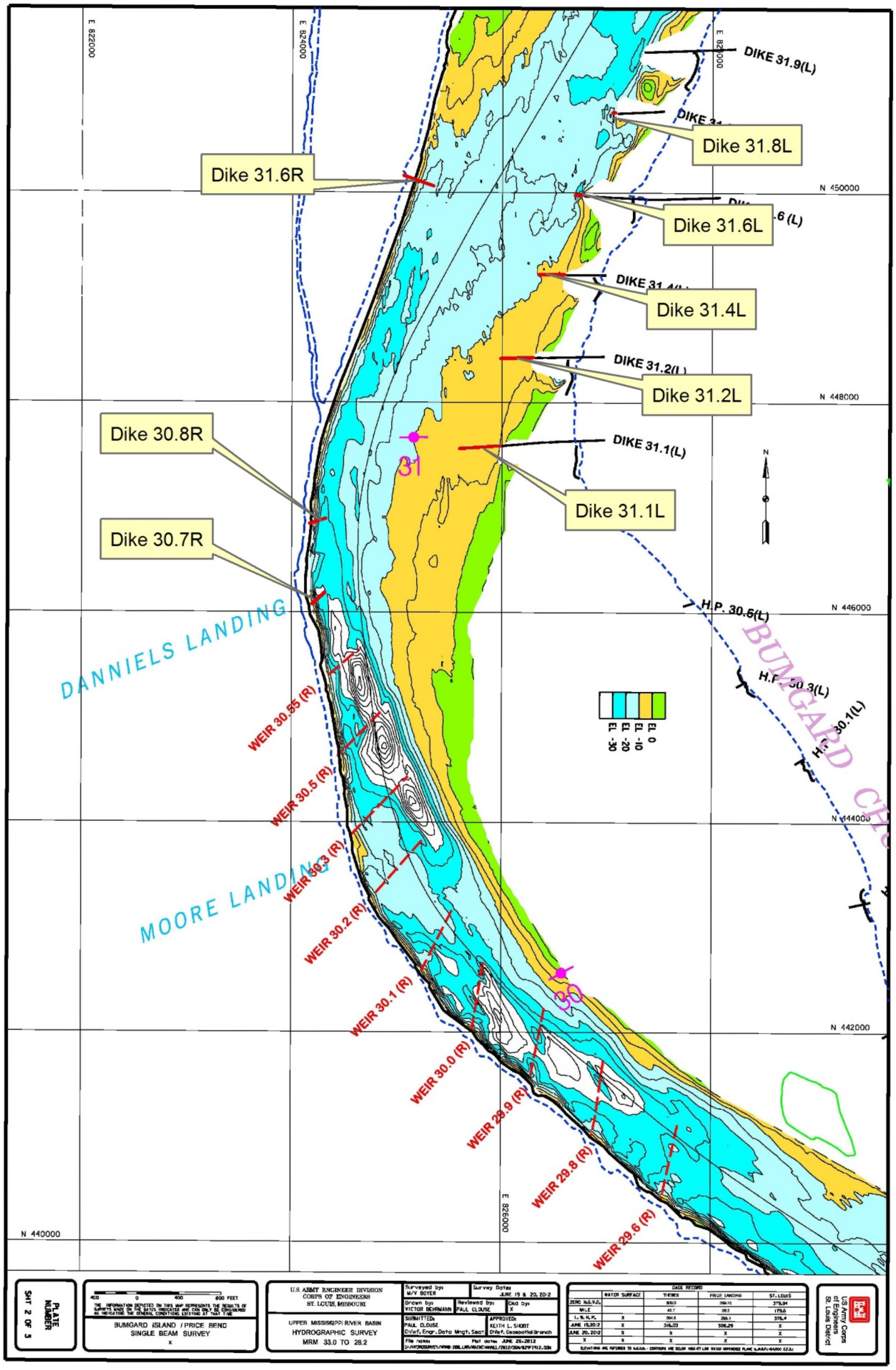


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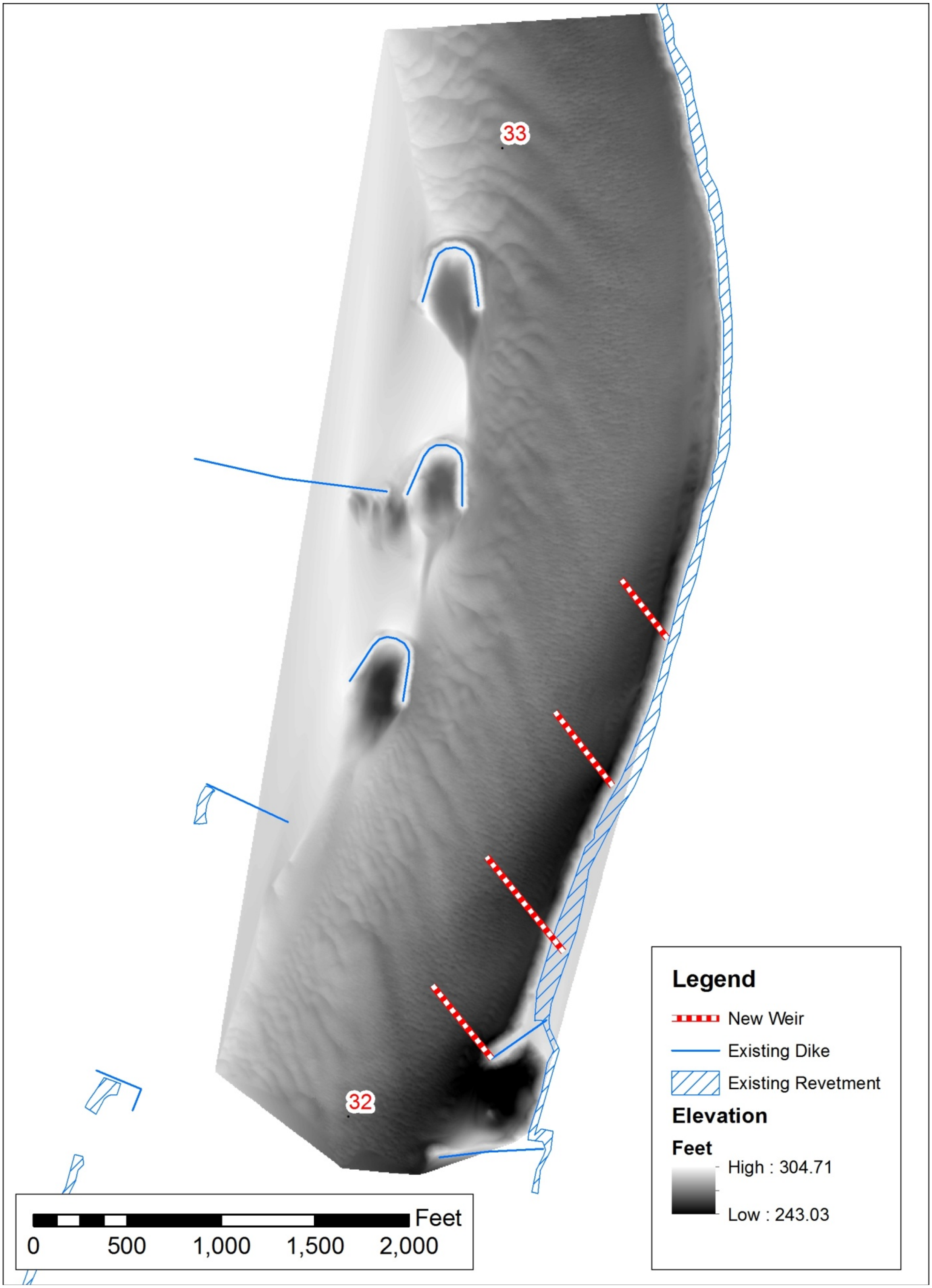


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## References Cited

Manders, D., & B. Rentrfro (2011). *Engineers Far From Ordinary*. St. Louis: St. Louis District USACE.

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

August 23, 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: Dogtooth Bend Phase 5 River Training Structures (COE) Scott 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 Dogtooth Bend Phase 5 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 (**011-ST-13**) on all future correspondence or inquiries relating to this project.

Sincerely,

STATE HISTORIC PRESERVATION OFFICE

Mark A. Miles
Director and Deputy
State Historic Preservation Officer

MAM:jd

c Dr. Mark Smith, COE/SL

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

# REGULATING WORKS PROJECT
# DOGTOOTH BEND PHASE 5
# MIDDLE MISSISSIPPI RIVER MILES 40-20
# ALEXANDER COUNTY, IL
# MISSISSIPPI AND SCOTT COUNTIES, MO

## DECEMBER 2013

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

**CONTENTS**

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

## 1. PROJECT DESCRIPTION

**A. Location.** The Dogtooth Bend Phase 5 Regulating Works Project is located in the Middle Mississippi River (MMR) between river miles 40.0 and 20.0 in Scott and Mississippi Counties, Missouri and Alexander County, Illinois, roughly 3.5 miles downstream of Commerce, Missouri. The MMR is defined as that portion of the Mississippi River that lies between the confluences of the Ohio and Missouri rivers.

**B. General Description.** The Corps of Engineers St. Louis District is proposing to construct Dogtooth Bend Phase 5 as part of its Regulating Works Program. The Regulating Works Program 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, e.g., dikes and weirs. The Dogtooth Bend Phase 5 project is designed to address repetitive dredging in the area. The Proposed Action consists of construction of two weirs near RM 34.00, four weirs near RM 32.00, a dike at RM 31.60 and two weirs near RM 31.00.

**C. Authority and Purpose.** The Middle Mississippi River Regulating Works Program is specifically and currently authorized pursuant to Rivers and Harbors Acts beginning in 1881. These authorize USACE to provide a 9-foot-deep by minimum of 300-foot-wide navigation channel at low river levels.

The purposes of this project are to reduce the need for repetitive channel maintenance dredging in the project area.

**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) used 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:

| Location by mile | Work to be completed | Potential Physical Results (from Hydraulic Sediment Response Model) |
|---|---|---|
| 34.2 (L) | Construct Weir 600 feet long -Top elevation of the Weir will be 277.5 | The proposed bendway weirs at RM 34.2, 34.1, 32.5, and 32.2 (L) improved the width of the channel at RM 34.00, and reduced the sedimentation in the channel between RM 31.9-31.6. Dike 31.6 (R) provided more constriction to the channel, thus, contributing to the sediment reduction. Weirs 30.8 & 30.7(R) helped the flow transition from the crossing into the bend at RM 31.00. The design alternative also showed great improvement in the channel depth between RM 29.00 - 27.20 although there was some slight sedimentation. The channel was also wider along the bendway weir field between RM 30.6 - 29.15 without affecting Bumgard Island or its side channel. |
| 34.1 (L) | Construct Weir 600 feet long -Top elevation of the Weir will be 277.25 | |
| 32.5 (L) | Construct Weir 400 feet long -Top elevation of the Weir will be 281.1 | |
| 32.4 (L) | Construct Weir 500 feet long -Top elevation of the Weir will be 281.0 | |
| 32.3 (L) | Construct Weir 650 feet long -Top elevation of the Weir will be 280.9 | |
| 32.2 (L) | Construct Weir 500 feet long -Top elevation of the Weir will be 280.8 | |
| 31.6 (R) | Construct Dike 300 ft long -Top elevation of the Trail Dike will be 310.4 | |
| 30.8 (R) | Construct Weir 160 ft long -Top elevation of the Weir will be 274.75 | |
| 30.7(R) | Construct Weir 162 ft long -Top elevation of the Weir will be 274.65 | |

## 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. 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. A 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.

The dike would consist of a rock mound of uniform shape along the RDB. The top elevation of the dike would be 310.4. Side slopes would be approximately 1 vertical on 1.5 horizontal. After placement, sediment patterns in the immediate vicinity of the structure would change with scour occurring off the tip of the dike. Areas immediately downstream of the dike would experience some areas of accretion and some areas of scour.

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 anticipated.

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 utilization 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. Stone used for construction will be of sufficient size to withstand periodic high flows. 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.

**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 dike would cause scour on the navigation channel side and along the adjacent bankline.

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. Hydraulic Sediment Response model was conducted in cooperation with natural resource agencies and other stakeholders to evaluate hydrologic changes that minimize adverse impacts.

**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. Hydraulic Sediment Response model was conducted in cooperation with natural resource agencies and other stakeholders. Stone used for construction will be of sufficient size to minimize turbidity.

**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 Assessment. 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. Hydraulic Sediment Response model was conducted in cooperation with natural resource agencies and other stakeholders to evaluate alternatives that minimize impacts to existing fauna. Pre- and post-construction monitoring will be conducted to evaluated effects on fish and wildlife.

**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 and bendway weirs have been used extensively throughout the Lower, Middle, and Upper Mississippi River System to provide a safe and dependable navigation channel. 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 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 Dogtooth Bend 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 construction of two weirs near RM 34.00, four weirs near RM 32.00, a dike at RM 31.60 and two weirs near RM 31.00.

**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

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

Anne Haaker
IL State Historic Preservation Office
Springfield, IL 62701

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

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

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

Honorable Blaine Luetkemeyer
1118 Longworth HOB
Washington, DC 20515

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

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

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

Kelly Isherwood
5072 Oak Tree Lane
House Springs, MO 63051

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

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

Mike Larson
MDNR
Land Reclamation Program
Jefferson City, MO 65102

Honorable Lacy Clay
6830 Gravois
St. Louis, MO 63116

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

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

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

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

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

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

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

Jack Norman
906 N. Metter Avenue
Columbia, IL 62236

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

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

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

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

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

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

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

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

Russell Cissell
1075 LeSieur
Portage des Sioux, MO 63373

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

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

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

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

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

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

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

Honorable William Enyart
23 Public Square
Belleville, IL 62220

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

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

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

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

Senator Larry Bomke
307 Capitol Building
Springfield, IL 62706

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

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

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

Honorable Rodney Davis
2004 Fox Drive
Champaign, IL 61820

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

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

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
Popplewell, 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.