US Army Corps of Engineers®

A Review of the Lower Mississippi River Potamology Program

MRG&P Report No. 1 • March 2014

MRG&P
Mississippi River Geomorphology & Potamology Program

Report prepared for the Mississippi River Commission

Mississippi River Geomorphology
and Potamology Program

MRG&P Report No. 1
March 2014

A Review of the Lower Mississippi Potamology Program

David S. Biedenharn, Wayne A. Stroupe,
and John H. Brooks

Biedenharn Group, LLC
Vicksburg, MS 39180

Final report

Abstract

Mississippi River potamology (the science of rivers) advances understanding of how natural and man-made factors combine to impact river morphology regarding present and future flood damage reduction, navigation, environmental restoration, and coastal wetland projects. The US Army Corps of Engineers (USACE) has conducted numerous potamology studies dating from the 1800s to modern times. Major studies were often the result of floods and follow-on beneficial projects. The epic 1927 flood fostered the first official USACE *Potamology Investigations* that resulted in more than 70 reports. The 1973 flood drove additional USACE potamology studies (T-1 and P-1 reports). However, funding, staffing, and interest in potamology studies waned, becoming almost nonexistent in recent times. The 2011 Mississippi River flood renewed interest in potamology. Lessons learned and projects implemented from USACE's 1940s–1980s potamology studies helped pass the record-setting 2011 flows. This report is the first in the USACE Mississippi Valley Division's (MVD) new Mississippi River Geomorphology and Potamology (MRG&P) Program that is focused on advancing potamology. This document provides a short historical review of USACE Mississippi River potamology studies, includes an initial bibliography of USACE potamology reports, and makes recommendations to expand USACE potamology expertise that will have short- and long-term national implications.

Contents

Figures

Figures

Preface

The research documented in this report was conducted as part of the Mississippi River Geomorphology and Potamology (MRG&P) Program. The MRG&P is sponsored by Headquarters, US Army Corps of Engineers (USACE), and is managed by the USACE Mississippi Valley Division (MVD) in Vicksburg, Mississippi. The MRG&P Technical Director was Dr. Barbara Kleiss, and the Program Manager was Freddie Pinkard.

The MVD Commander was BG Peter A. DeLuca. The MVD Director of Programs was Edward Belk.

The Mississippi River Commission (MRC) provided Mississippi River engineering direction and policy advice. The Commission members were BG DeLuca, USACE; the Honorable Sam E. Angel; the Honorable R. D. James; the Honorable Norma Jean Mattei, Ph.D.; RDML Gerd F. Glang, National Oceanic and Atmospheric Administration (NOAA); BG Margaret W. Burcham, USACE; and COL John S. Kem, USACE.

This report was prepared by David Biedenharn, Wayne Stroupe, and John Brooks of the Biedenharn Group. The Biedenharn Group is a consulting firm that specializes in river engineering, erosion control, flood control, stream restoration, watershed studies, environmental studies, regional sediment management, potamology studies, hydraulic and sediment modeling, geomorphic studies, and channel design.

Peer reviewers were Dr. Ty Wamsley, Chief, Flood and Storm Protection Division, and Dr. Loren Wehmeyer, Chief, River Engineering Branch, Costal Hydraulics Laboratory, US Army Engineer Research Development Center.

Points of Contact

David Biedenharn, Ph.D.
Author, Biedenharn Group
biedenharngroup@yahoo.com

Barb Kleiss, Ph.D.
MRG&P Technical Director, USACE MVD
Barbara.A.Kleiss@usace.army.mil

Freddie Pinkard
MRG&P Sr. Program Manager, USACE MVK
Freddie.Pinkard@usace.army.mil

Summary

Potamology, the science of rivers, is critical to the understanding of how natural factors (e.g., floods, droughts, subsidence) combine with man-made projects (e.g., levees, floodways, channel improvements) to impact the historical, current, and future Mississippi River morphology. This important knowledge aids in effective management of the river basin for flood damage reduction, navigation, environmental restoration, and coastal wetland loss.

The US Army Corps of Engineers (USACE) has vast amounts of historical Mississippi River data and unpublished studies from the 1800s to modern times, covering many different river locations. This includes hydrographic surveys, sediment sampling, velocity and current measurements, boring data, flow data, bed form data, geologic information, water surface slopes, and geomorphic assessments. These data provide a historical perspective of the river and improve the knowledge base. Unfortunately, some of this information has been lost, and much of the data are not cataloged and only exist in hard copy in disparate locations.

Floods are catalysts for major river projects and potamology studies. The devastating 1927 flood led to creating meander cutoffs in the 1930s, which helped launch the first official USACE *Potamology Investigations* in 1946. More than 70 reports were produced, exploring the complex relationships impacting the river and how it adjusts over time (the river is still responding to the cutoffs made more than 75 years (yr) ago). The 1973 flood produced river stages up to 5 feet (ft) higher than anticipated in some locations, showing a potential for significant flood capacity reduction. This alarming situation drove additional USACE potamology studies, the T-1 and P-1 report series, which advanced existing river potamology. However, funding, staffing, and interest in potamology studies subsequently ebbed, becoming almost non-existent in recent times.

The 2011 Mississippi River flood fostered a renewed interest in potamology. The lessons learned and recommendations implemented from the 1940s–1980s USACE potamology studies helped pass the record-setting flows of the 2011 flood. The USACE Mississippi Valley Division (MVD) initiated the

Mississippi River Geomorphology and Potamology (MRG&P) Program to revive and advance potamology studies.

This report provides a short historical review of USACE Mississippi River potamology studies, includes an initial bibliography of USACE potamology reports and papers, and makes recommendations to expand USACE potamology expertise that will have short- and long-term national implications.

Unit Conversion Factors

Multiply	By	To Obtain
feet	0.3048	meters
miles (US statute)	1,609.347	meters

1 Introduction

The Mississippi River and Tributaries (MR&T) Project is a complex, comprehensive water resources project authorized by the 1928 Flood Control Act following the devastating 1927 flood. The MR&T Project provides flood damage reduction within the alluvial valley and navigation improvement of the Lower Mississippi River (LMR). The LMR extends from Cairo, Illinois, to the Gulf of Mexico, a distance of approximately 1,000 miles. The primary elements of the MR&T Project include levees, floodways and diversion structures, tributary basin improvements and channel improvement features such as meander cutoffs, bank stabilization, dikes, and dredging. The historical, present, and future morphology of the LMR reflects an integration of all these features in combination with natural factors: floods and droughts, hurricanes, tectonic activity, geologic outcrops, climatic variability, subsidence, and sea level rise. Understanding how these various factors affect the short- and long-term morphology of the LMR is a complex challenge for the river engineers and scientists responsible for managing this system for flood damage reduction, navigation, habitat restoration, and reduction of the loss of coastal marshes and wetlands in Louisiana. Much of the knowledge about the morphologic character of the LMR was gained through the US Army Corps of Engineers (USACE) Potamology Program, which began in the early 1930s in recognition of the need to develop a better understanding of the underlying principles responsible for the behavior of the river.

2 Objectives

The objectives of this study were to document the evolution of the program and the types of studies conducted, conduct a data search to locate historic potamology data and reports, and assess the utility of the data for future river studies.

3 Historical Potamology Program

The word *potamology* has its root in the Greek word *potamos* and is defined as the scientific study of rivers or the science of rivers. Over the years, the focus of the USACE Potamology Program evolved as new demands and challenges arose. However, by the early to mid-1980s, the program basically ceased to exist. In this section, the history of the Potamology Program is described.

3.1 Pre-Potamology Studies

The Mississippi River is the third largest river system in the world; it is the largest navigable river system in the world; and it is an incredible economic engine and economic advantage for the United States. Industry and agriculture depend on its transportation infrastructure; it is a source of water and recreation for millions of citizens; and it is a vital ecosystem and environmental treasure. At times, it can show the brute force of nature through devastating floods. The Mississippi River was used throughout history by Native Americans for transportation. The first river structures were levees constructed by European settlers above New Orleans in the early 1700s.

The US Army Corps of Topographic Engineers became involved early on in river operations—there are discharge records of the river dating back to 1817. Other information documents were produced through the 1800s, including the seminal *Physics and Hydraulics of the Mississippi River* 1876 report by CPT A. A. Humphreys and LT H. L. Abbot, which is considered as the beginning of hydraulic engineering on the river. At the time, it was also widely considered as the final report on river engineering. Since then, the Mississippi River has shown that any potamology or river engineering study should only be considered interim as the river is constantly changing, forcing evolving USACE efforts to advance understanding and knowledge of river processes.

The beginning of official USACE potamology studies is directly tied to the decision by Mississippi River Commission (MRC) president BG Harley B. Ferguson in the early 1930s to implement a cutoff program on the Mississippi River. These initial efforts focused on the study of the alluvial processes and their application to the management of the river system. The

first MRC studies were conducted at the US Army Engineer Waterways Experiment Station (WES) during the period of 1932–1935. These studies focused on determining the most favorable alignment to stabilize the Mississippi River in connection with the initiation of the cutoff program.

Subsequent studies examined bed materials in the system, materials in transport, and meandering of alluvial channels. This work included model studies, field sampling, and surveys. The efforts were conducted in the late 1930s to the mid-1940s.

3.2 MRC Potamology Investigations

The first official MRC *Potamology Investigations* were initiated in the fall of 1946. These were the most extensive and comprehensive studies conducted at the time. The program examined meandering tendencies to develop modeling for future river projects, determined the causes of revetment failures to prevent future occurrences, investigated means of channel stabilization other than revetment, and developed and tested comprehensive plans to improve specific troublesome river reaches.

WES, under MRC control until 1949, conducted the majority of the early investigations with field assistance by the USACE Memphis, Vicksburg, and New Orleans Districts. The work included extensive field observations at several points on the Mississippi River, large-scale laboratory projects, soils studies, and instrumentation development and evaluation.

The program was fully funded only until 1951, but additional efforts by the MRC Potamology Board and others continued a reduced work load in the Potamology Investigation program until the last report was issued in 1977. A total of 71 reports were published under this program. (A listing of the reports is in Section 6.1 of the bibliography.)

The MRC Potamology Board was established in 1957. It consisted of representatives from the MRC; the Memphis, Vicksburg, and New Orleans Districts; and WES. Active until 1961, the Board helped foster completion of additional potamology investigations. The Board was re-established in 1963 and expanded to include the entire Lower Mississippi Valley Division (LMVD); a representative from the St. Louis District was added to the Board. In 1963, the MRC also established a Potamology Research Branch in the Engineering Division to coordinate studies recommended by the Potamology Board. The Board and the Branch were instrumental in

completing several investigations. The Board and Branch existed for two decades, but over time and reorganizations, they had ceased to be active functioning elements by the mid- to late-1970s. The USACE Committee on Channel Stabilization, established by the Chief of Engineers in 1962, was also instrumental in completing several studies impacting Mississippi River channel problems in the 1960s and early 1970s.

3.3 Potamology Early Years

Over the course of the mid- to late-1900s, potamology studies and programs evolved to meet new demands and challenges. In the 1930s and 1940s, the focus was on man-made cutoffs and their impact on the channel system. The spotlight moved to revetment failures and improved revetment construction and materials from the late 1940s to the early 1960s. From the 1960s to 1972, the focus shifted yet again as the MRC worked to develop the best ways to manage troublesome reaches of the river. These activities spawned research and investigative studies, providing much-needed information that advanced the understanding of the complex processes that nature and man-made structures combined to shape the river and how the river adjusted over time.

Crisis situations focus attention on problems. On the Mississippi River, the 1927 flood was such an event. The 1927 flood, not only a catalyst for MR&T, also drove efforts such as cutoffs and channel stabilization. The result made funding available to advance potamology knowledge. This investment and the efforts of dedicated staff accomplished the potamology studies of the 1930s through the late 1960s.

As with any crisis situation, knowledge and training prior to an event help provide the best response. Such was the case in 1927 when decades of preliminary work and research led to the MR&T—the policy, direction, and framework in this landmark legislation were not developed overnight. The same can be said for potamology studies over the years. These studies provided USACE with knowledge and also a generation of expert staff with the engineering expertise needed to help manage the river.

As is human nature, once the Mississippi experienced a comfortable period in river conditions (fewer major floods and somewhat stable average flows), many leaders believed that understanding of river behavior was sufficient for the current state. As such, interest, and more importantly, funding in potamology related studies waned.

3.4 1973 Flood and T-1/P-1

The 1973 Mississippi River flood was a wake up call for river science and engineering. The spring flood produced river stages that were higher (up to approximately 5 ft higher in some locations) than expected. These higher stages made it apparent that the actual stage-discharge relationships were several feet higher than the previous stage-discharge relationships used to establish levee grades and other flood control features. Therefore, the potential existed for a significant reduction in the flood capacity over a major portion of the LMR. To help address this critical issue, the President of the MRC - Division Engineer, LMVD, implemented two, new potamology study programs.

The *LMVD Potamology Study (T-1)* was initiated on 7 August 1974. This study was essentially a data assembly effort that provided a current snapshot of river conditions and information that focused on the nine major factors that impact river behavior. A separate T-1 Work Package covered each factor:

- Work Package 1 – Review of the Cutoff Program
- Work Package 2 – Inventory of Revetment and Dike Systems
- Work Package 3 – Geological Inventory
- Work Package 4 – Hydrology Factors
- Work Package 5 – Hydraulic Factors
- Work Package 6 – Inventory of Physical Characteristics
- Work Package 7 – Inventory of Levees
- Work Package 8 – Inventory of Dredging Activities
- Work Package 9 – Inventory of Sediment Data

The USACE Vicksburg District conducted work packages 1 and 5; the University of Missouri at Rolla for the USACE St. Louis District conducted work packages 2, 3, 4, 6, and 7; the USACE Memphis District compiled work package 8; and WES for the USACE New Orleans District completed work package 9. This effort assembled a large mass of data to feed follow-on studies to determine primary cause-and-effect relationships related to the Mississippi River. (Section 6.2 of the bibliography lists the reports.)

Building off the T-1 work packages, the LMVD Potamology Program (P-1) was developed. The P-1 Program focused on defining the cause-and-effect relationships that resulted in short- and long-term changes in the stage-discharge relationships in the LMR and developing improved design

concepts and construction criteria for channel stabilization. The program continued the advancement of the level of knowledge and understanding of Mississippi River behavior, allowing USACE to develop the most efficient and cost-effective flood damage reduction and navigation projects.

This program also expanded the USACE view of potamology with investigations of four major parameters: hydrology (highly variable stages), sedimentation (sediments on or near the channel bed scoured from one location and deposited downstream), channel geometry (variable alignment impacting flow and sediment transport), and man-made modifications (levees, cutoffs, revetments, and dikes).

P-1 report numbers 1–4 were published in 1981–82. Many questions still existed about how changes in suspended-sediment load as well as interrelations of other variables affect the regime of alluvial rivers. Publication of reports 5–7 was delayed until 1990–92 with the intent of including findings from follow-on efforts. However, anticipated funding for the follow-on efforts never materialized, and these final three reports were ultimately published with the existing data and findings. (Section 6.3 of the bibliography lists the reports.)

In the mid-1990s, the USACE MVD formed the River Engineering Study Team (REST) in an effort to revitalize potamology studies. The REST consisted of river engineers and scientists from the USACE division and district offices. The first meetings of the REST occurred on board the *M/V Mississippi* during the May 1995 river inspection trip. The purpose of the REST was to make recommendations, set priorities, plan, direct, and publish results from river engineering investigations on the LMR with an aim towards developing an understanding of the short- and long-term cause-and-effect relationships between the observed channel morphology and the channel improvement features. The REST proposed four broad study areas: analysis of hydraulic slope and vertical adjustments, channel geometry studies, sediment studies, and short- and long-term numerical modeling of channel morphology. Each of these study areas would consist of a number of individual sub-areas. Unfortunately, only a few REST studies were initiated, and within a few years, the REST team disbanded.

Although the REST no longer existed, the USACE districts did continue to conduct river engineering studies, generally aimed at specific troublesome reaches of the river. In 1995, the St. Louis District Hydraulics Branch

established the Applied River Engineering Center (AREC) with the intent to conduct applied river engineering studies on the Mississippi River in an office/laboratory environment. A key component of the AREC is the Hydraulic Sediment Response (HSR) model, which is a small-scale, physical sediment transport model used to replicate the mechanics of an actual river on an area the size of a normal table top. Since its conception, numerous river engineering studies have been conducted on the Mississippi.

3.5 Historical Potamology Data and Unpublished Reports

As discussed above, the publication of technical reports was a major accomplishment of the Potamology Program. However, perhaps equally important is the vast amount of historical data and unpublished studies that were conducted as part of the program. Typical types of data that were collected included detailed hydrographic surveys, sediment sampling (both suspended and bed material), velocity and current direction measurements, boring data, divided flow data, bed form data, geologic information, water surface slopes, and geomorphic assessments. Unfortunately, some of this information has already been lost, and most of the data and studies exist only in hard copy form in somewhat obscure locations in various offices and archive areas at the USACE district and division offices. Consequently, most of the current engineering staff at the USACE districts are unaware of these data. This is a massive set of data that represents an extremely valuable resource, which not only provides an historical perspective of the river, but more importantly, could be used to inform present-day and future efforts to understand the river system.

The following examples demonstrate the utility of the historical potamology data. Within the Vicksburg District, 25 potamology reaches were established for detailed potamology studies. These reaches covered the entire district and ranged in length from approximately 4 miles to 19 miles with an average of approximately 12 miles. These reaches were hydrographically surveyed annually (and sometimes several times a year) from the early 1970s to the late 1980s. In addition to the hydrographic surveys, gages were established at approximately 1-mile increments on both the left and right banks in each reach to measure water surface elevations during the survey period. Floats were used to determine current and direction. Suspended sediment and bed material data were also intermittently collected.

Figures 1–3 show examples of the surveys taken in May 1977, May 1978, and March 1979 for the Ajax Bar Reach. This is a relatively short reach extending from approximately River Mile 485 to 480.

These are just three examples of the many surveys of this reach and were selected to illustrate the changes during three distinctly different river stage conditions. The "STUDY GAGE DATA" box at the top of each figure shows the date and water surface elevation at each of the study gages located in the reach. The stage readings (referenced to mean sea level) at the approximate mid-point of the reach were about 80 ft in 1977, 95 ft in 1978, and 100 ft in 1979. Also shown on these surveys are the float positions at 30-second (sec) intervals. Although not shown in these figures, there are also bed form profiles that were obtained along the float profile path. Thus, these potamology surveys provide detailed bathymetry information, longitudinal water surface slopes, lateral water surface slopes (super elevation), bed form profiles, and current direction and velocities at numerous points in time and different hydrologic conditions. This type of data can be extremely valuable in assessing the morphological character of the river, particularly in response to varying hydrologic regimes and channel improvement features such as dikes and revetments. Another potential use of these data is in the calibration and interpretation of two-dimensional (2D) numerical models.

Another example of the utility of the historical potamology data is provided by the recent MVD study that addressed gravel bar habitats on the river.[1] Through this study, it was discovered that the Vicksburg District's Potamology Program had conducted repetitive bed material samples (sometimes several times a year) throughout the district for the period 1966–1973. This significant data source provided valuable insight into the dynamics of the bed material changes in the river. Again, this type of data could be extremely valuable to future geomorphic investigations and numerical model studies.

[1] Killgore, K. J., J. J. Hoover, P. Hartfield, R. A. Fischer, W. T. Slack, A. B. Harrison, D. Biedenharn, and B. Kleiss. 2014. *Conservation Plan for the Interior Least Tern Pallid Sturgeon, and Fat Pocketbook Mussel in the Lower Mississippi River* (Endangered Species Act, Section 7 (a) (1)). Vicksburg, MS: US Army Corps of Engineers, Mississippi Valley Division.

Figure 1. Ajax Bar Reach potamology survey in May 1977.

Figure 2. Ajax Bar Reach potamology survey in May 1978.

Figure 3. Ajax Bar Reach potamology survey in March 1979.

4 Future Considerations

The record-setting 2011 Mississippi River flood again stirred interest in potamology-related studies. This time, interest was not driven by problems or failures; it was how the system safely and successfully passed the record flows of this epic event. Just as the 1973 flood was a wakeup call, the 2011 flood should be an equally important benchmark to understand the reasons for the difference in river response to the two floods. The lessons learned from the potamology studies of the late 1940s–1980s, and implemented in the river since the 1973 flood, worked when put to the ultimate test of the 2011 flood. However, USACE realized it had basically lost a generation of continued potamology advancement along with the experienced staff possessing that important knowledge.

While Mississippi River flood damage reduction and navigation issues continue to be a major emphasis of USACE activities, especially on the lower river, there are new demands, interests, and economic focus areas championed by the public, river users, and stakeholders. Environmental restoration, conservation, recreation, coastal land loss and erosion, water quality and supply (surface and aquifer), and other basin-wide and localized issues require attention.

Environmental factors, such as habitat development, fisheries enhancement, threatened and endangered species, invasive species, water quality, etc., are now major considerations in USACE site-specific projects and system-wide management strategies. Environmental challenges are the impetus for many new Mississippi River studies, with associated funding required.

In the last two decades, there has been an increased environmental activity concerning habitat development related to USACE dikes in the river. Notches installed on the bankside of dikes to increase habitat development provide additional recreational opportunities as well. During the MRC Low Water Inspection stop in Vicksburg, Mississippi, on 21 August 2013, the President of the MRC conducted a ceremonial signing of the MVD/ERDC report *Conservation Plan for the Interior Least Tern, Pallid Sturgeon, and Fat Pocketbook Mussel in the Lower Mississippi River* with representatives of the US Fish and Wildlife Service (USFWS) and ERDC. Besides featuring

remarkable interagency cooperation between USACE and USFWS, the report featured the previously discussed major potamology/geomorphology element.

Over the past few decades, the traditional historical USACE focus has moved from site-specific projects at a lock, revetment, or dike field location to a system-wide view of the river. When such planning and management strategies involve the third largest river basin in the world, which is continually changing and evolving due to natural factors and numerous navigation, flood, and environmental projects, this is a very daunting task that demands the most advanced information for critical short- and long-term decisions. While there are numerous records of previous potamology studies, it is readily apparent that overall knowledge and understanding of all aspects of river science and engineering are essential for such an important national resource and economic engine as the Mississippi River.

5 The Way Ahead

Waiting for an event similar to the 1973 flood event to react to is not in the best interest of the engineering and environmental community. The 2011 flood proved the immense value of advanced river science and knowledge, staff expertise, and the best-designed projects to safely handle what could otherwise have been a disaster of epic proportions in the LMR.

Today, advanced data technologies, instrumentation, sampling, and modeling capabilities are being used in other USACE efforts with great success. The same emphasis should be applied to morphological and environmental related studies on the Mississippi River. With the complex requirements in navigation, flood risk reduction, and environmental restoration, all with multiple stakeholders, future Mississippi River management will require the most advanced knowledge available—the simple projects have already been done; the most complex challenges lie ahead.

The USACE has also lost a generation of experienced staff with potamology skills and expertise. This is due to various impacts including hiring reductions, funding constraints, and changes in mission focus. This staff expertise cannot be imported overnight but must be fostered and grown by hiring and supporting capable engineers and scientists, providing training and mentoring, supporting intra- and interagency cooperation, and other innovative practices. A readily available cadre of skilled professionals is required to pass corporate knowledge and ideas to those following and to those leading as well. A revitalized Potamology Program will keep USACE staff immersed, and interested, in understanding the morphologic processes that drive the economically and environmentally important Mississippi River system. Advances in knowledge and understanding of Mississippi River potamology will aid in current and future development of more cost-effective and environmentally sound designs, management, and operational strategies for this national resource.

This effort will have both short-term (fewer than 20 yr) and long-term (20 to 200 yr) implications and emphasis. Some river projects could use potamology knowledge implementation today. On the other hand, the river is still responding to the cutoffs initiated more than 75 yr ago.

Decisions made and implemented in the near future could have positive (or adverse) impacts for centuries.

Suggestions to consider for the future include the following:

- Re-establish, with MRC assisting the MVD, a potamology-type program for the Mississippi River to ensure incorporation of the best planning and management practices from an engineering, scientific, and environmental perspective for the complex and diverse demands of the 21st century and beyond.
- Re-establish an MRC/MVD Potamology Board or similar group with direct oversight with the goal to coordinate actions to help re-establish potamology expertise and staff, foster specific projects, and liaison with districts, stakeholders and public, and others.
- Assist in developing a river engineering staff or in-house capability within the MVD districts. This would involve such actions as
  - establishing on-the-job training for specific studies (e.g., sediment transport, divided flow, bed materials, hydraulics, geologic, surveys, modeling),
  - conducting workshops, seminars, webinars, etc. (i.e., topics listed above),
  - collaborating with a local university (possibly through the ERDC Graduate Institute) for classes and credits leading to advanced degrees, and
  - encouraging and rewarding publication of study results in peer-reviewed engineering and scientific journals to enhance and promote USACE and MVD capabilities.
- Assist in implementation, funding, and execution of specific potamology studies.
- Partner with interested stakeholders (i.e., federal, state, and local agencies; public interest organizations; wildlife-recreation/tourism-environmental organizations) for shared expertise, training, support, and potential funding opportunities.
- Index, digitize, and make available as many historical potamology reports, technical papers, surveys, etc., as possible.

6 Potamology Bibliography

A bibliography of USACE Mississippi River potamology reports is provided in this report. Although by no means completely comprehensive, this bibliography does show the USACE historical interest and leadership in Mississippi River potamology studies and profiles the ebb and flow of potamology related funding. It is also important to emphasize that there is a considerable amount of other potamology data that exist in the USACE districts and division. For instance, as part of this study, the authors located a wealth of data in the MVD Headquarters attic, at two locations at the Vicksburg District harbor facilities, and in the national archives in Kansas City. Unfortunately, the majority of these data are not indexed, digitized, or readily available.

The USACE MVD website (http://www.mvd.usace.army.mil/Missions/MississippiRiverScienceTechnology/MSRiverGeomorphologyPotamology/FieldData/HistoricStudies.aspx) has links to the reports listed in the bibliography that are currently digitized. Efforts are underway to add more reports and potamology information to the website as hard copy items are located and digitized.

The bibliography is divided into the following 14 sections:

1. MRC Potamology Investigations Reports
2. LMVD Potamology Program (T-1)
3. LMVD Potamology Program (P-1)

(Sections 4–9 are potamology reports and papers cited in the previous potamology investigation reports.)

4. US Army Engineer Waterways Experiment Station (WES);
5. USACE, MRC/LMVD/MVD
6. USACE, Vicksburg District (MVK)
7. USACE, Memphis District (MVM)
8. USACE, Rock Island (MVR) and St. Paul (MVP) Districts
9. USACE Missouri River Division (MRD) and MRD Districts
10. Geological Reports prepared for the MRC (authored by H. N. Fisk, MRC consultant)

11. US Army Engineer Waterways Experiment Station (WES) potamology related reports
12. USACE Committee on Channel Stabilization reports
13. SECTION 32 Program: Streambank Erosion Control Evaluation and Demonstration (funded by Office, Chief of Engineers, USACE Headquarters)
14. St. Anthony Falls Laboratory Reports Related to Mississippi River Potamology

6.1 MRC Potamology Investigations Reports

(All reports in the 6.1 section were produced by the US Army Engineer Waterways Experiment Station (WES) (now the US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC) unless otherwise noted.)

- 1-1. *Instructions and Outline for Potamology Investigations.* November 1947.
- 1-2. *Outline of Plans for the Potamology Investigations*. December 1947.
- 2-1. *Preliminary Flume Tests of Mississippi Revetment*, (1st Interim Report). October 1947.
- 2-2. *Preliminary Tests of Mississippi River Dikes, Bank Stabilization Model.* June 1950.
- 2-3. *Preliminary Tests of Experimental Baffles, Bank Stabilization Model.* September 1951.
- 2-4. *Preliminary Flume Tests of Mississippi Revetment* (2nd Interim Report). November 1951.
- 2-5. *Investigation of Bank Stabilization, Miller Bend, Mississippi River*. April 1953.
- 2-6. *Verification of Bank-Stabilization Model.* July 1953.
- 3-1. *Interim Report on Investigation of Sand-Asphalt Revetment*. July 1948.
- 4-1. *Investigation of 110-Volt Echo Sounder*. July 1948 (Revised May 1950).
- 5-1. *Geological Investigation of Reid Bedford Caving Area*. July 1947.

- 5-2. *Field Investigation of Reid Bedford Bend Revetment, Mississippi River: Volume 1 – Text; Volume 2 – Plates; Volume 3 – Appendix A: Soils Investigation*. June 1948.
- 5-3. *Triaxial Tests on Sands, Reid Bedford Bend, Mississippi River*. May 1950.
- 5-4. *Piezometer Observations at Reid Bedford Bend and Indicated Seepage Forces*. May 1950.
- 5-5. *Standard Penetration Tests, Reid Bedford Bend, Mississippi River*. May 1950.
- 5-6. *Undisturbed Sand Sampling and Cone Sounding Tests, Reid Bedford Bend Revetment, Mississippi River*. May 1951.
- 7-1. *Soils Investigation, Bauxippi-Wyanoke Revetment*. June 1951.
- 8-1. *Hardscrabble Bend, Mississippi River, Revetted Bank Failure; Soils Investigation*. June 1950.
- 9-1. *Bank Caving Investigations, Kempe Bend Revetment, Mississippi River; Soils Investigations*. November 1951.
- 10-1. *Preliminary Development of Instruments for the Measurement of Hydraulic Forces Acting in a Turbulent Stream*. June 1948.
- 10-2. *Turbulence in the Mississippi River*. May 1950.
- 10-3. *Evaluation of Instruments for Turbulence Measurements 1948-1949*. March 1951.
- 10-4. *Evaluation of Instruments for Turbulence Measurements 1949-1950*. April 1951.
- 11-0. *Resume of Conference Initiating Potamology Investigations*. February 1947.
- 11-1. *Report of Conference on Potamology Investigations - 15 March 1948*. March 1948.
- 11-2. *Report of First Potamology Conference with Hydraulics Consultants – 9-10 December 1948*. December 1948.
- 11-3. *Minutes of Conference on Soil Studies, Potamology Investigation – 18 April 1949*. April 1949.
- 11-4. *Report of Second Potamology Conference with Hydraulics Consultants – 23-24 May 1949*. May 1949.

- 11-5. *Minutes of Conference with Soils Consultants, Stability of Mississippi River Banks –5 and 8 October 1949*. October 1949.
- 11-6. *Report of Conference on Potamology Investigations –6-7 October 1949 (2 Volumes)*. April 1951.
- 11-7. *Minutes of Conference on Soil Aspects of Potamology Program – 17-18 June 1950*. October 1950.
- 11-8. *Minutes of Conference on Potamology Program –5 April 1951*. April 1951.
- 12-1. *Density Changes of Sand Caused by Sampling and Testing*. June 1952.
- 12-2. *Summary Report of Soils Studies*. October 1952.
- 12-3. *Verification of Empirical Method of Determining Slope Stability*. April 1954.
- 12-4. *Verification of Empirical Method of Determining Slope Stability – 1954 Data*. June 1955.
- 12-5. *A Review of the Soils Studies*. June 1956.
- 12-6. *Verification of Empirical Method of Determining Slope Stability – 1955 Data*. July 1956.
- 12-7. *Verification of Empirical Method for Determining Slope Stability – 1956 Data*. June 1957.
- 12-8. *Verification of Empirical Method for Determining Riverbank Stability – 1957 Data*. January 1959.
- 12-9. *Verification of Empirical Method for Determining Riverbank Stability – 1958 Data*. September 1959.
- 12-10. *Verification of Empirical Method for Determining Riverbank Stability – 1959 Data*. December 1960.
- 12-11. *Verification of Empirical Method for Determining Riverbank Stability – 1960 Data*. December 1961.
- 12-12. *Verification of Empirical Method for Determining Riverbank Stability – 1961 Data*. October 1962.
- 12-13. *Verification of Empirical Method for Determining Riverbank Stability – 1962 Data*. W. E. Strohm and W. K. Caldwell. September 1964.

- 12-14. *Verification of Empirical Method for Determining Riverbank Stability – 1963 Data*. W. E. Strohm and W. K. Caldwell. April 1965.
- 12-15. *Geological Influences on Bank Erosion along Meanders of the Lower Mississippi River*. E. L. Krinitzsky. September 1965.
- 12-16. *Methods of Preventing Flow Slides*. D. C. Banks and W. E. Strohm. October 1965.
- 12-17. *Verification of Empirical Method for Determining Riverbank Stability – 1964 Data*. W. K. Caldwell. May 1966.
- 12-18. *Verification of Empirical Method for Determining Riverbank Stability – 1965 Data*. W. K. Caldwell and C. C. Calhoun. December 1967.
- 12-19. *Verification of Empirical Method for Determining Riverbank Stability – 1966 Data*. C. C. Calhoun. July 1968.
- 12-20. *Verification of Empirical Method for Determining Riverbank Stability – 1967 Data*. C. C. Calhoun and C. P. Flanagan. April 1969.
- 12-21. *Verification of Empirical Method for Determining Riverbank Stability – 1968 and 1969 Data*. V. H. Torrey. October 1972.
- 12-22. *Verification of Empirical Method for Determining Riverbank Stability – 1970 and 1971 Data*. V. H. Torrey and A. R. Gann. April 1976.
- 13-1. *Bank Caving Investigations, Huntington Point Revetment, Mississippi River; Field Investigation*. June 1952.
- 14-1. *Goodrich Landing Revetment, Mississippi River, Field Investigation*. June 1952.
- 15-1. *Bank Caving Investigations, Free Nigger Point and Point Menoir, Mississippi River; Soils Investigation*. May 1952.
- 16-1. *Development of Operating Technique for and Verification of Channel-Meander Model*. September 1953.
- 17-1. *Hydrographic and Hydraulic Investigations of Mississippi Revetments; Field Investigations*. April 1954.
- 18-1. *Rotary Cone Penetrometer Investigations*. June 1962.
- 18-2. *Verification of Cone Criteria for Determining Riverbank Stability*. W. E. Strohm and L. Devay. June 1965.

- 19-1. *Hydraulic Analysis of Mississippi River Channels, Miles 373 to 603, Fiscal Year 1964; Potamology Research Project No. 10*. M. G. Anding. USACE, Vicksburg District. September 1965.
- 19-2. *Resume of Research Studies of Hydraulic Characteristics of Mississippi River Channels; Interim Report FY 1967; Potamology Research Project 10*. P. W. Pierce and C. M. Elliott. USACE, Vicksburg District. April 1967.
- 19-3. *Hydraulic Characteristics of Mississippi River Channels; Interim Report FY 1970; Potamology Research Project No. 10*. M. G. Anding. USACE, Vicksburg District. June 1970.
- 20-1. *Effects of River Stages on Bank Stabilization; Analysis of Field Data; Potamology Research Project 1*. J. J. Franco. December 1965.
- 21-1. *Sand-Filled Bags as Dike Material; Potamology Research Project 9*. R. T. Easley. USACE, Memphis District. March 1967.
- 21-2. *Review of Past Experience with Contraction Works; Potamology Research Project 9*. J. G. Fairley and R. T. Easley. USACE, Memphis District. March 1967.
- 21-3. *Investigation of Existing Dike Systems; Potamology Research Project 9*. B. J. Littlejohn. USACE, Memphis District. June 1970.
- 21-4. *Use of Plastic Filter Cloth in Revetment Construction; Potamology Research Project 11*. J. G. Fairley, R. T. Easley, J. H. Bowman, and B. J. Littlejohn. USACE, Memphis District. June 1970.
- 21-5. *Use of Plastic Filter Cloth in Revetment Construction; Potamology Research Project 11*. B. J. Littlejohn. USACE, Memphis District. August 1977.

6.2 LMVD Potamology Program (T-1)

- *LMVD Potamology Program (T-1)*. USACE, Vicksburg District. (Work Packages 1 and 5). January 1976.
- *LMVD Potamology Study (T-1)*. University of Missouri-Rolla. P. R. Munger et al. (Work Packages 2-4, 6 and 7, prepared for USACE, St. Louis District). June 1976.
- *Documentation of LMVD Dredging Activities*. USACE, Memphis District. (Work Package 8). August 1976.

- *Inventory of Sediment Data*. USACE WES Technical Report M-77-1. *Inventory of Sediment Sample Collection Stations in the Mississippi River Basin*. M. P. Keown, E. A. Dardeau, Jr., and J. G. Kennedy. (Work Package 9, prepared for USACE, New Orleans District). March 1977.
- *Summary Report on the LMVD Potamology Program (T-1)*. (Work Packages 1–9). USACE, LMVD. December 1977.

6.3 LMVD Potamology Program (P-1)

- Report 1. *Characterization of the Suspended-Sediment Regime and Bed-Material Gradation of the Mississippi River Basin*, Volumes 1 and 2. M. P. Keown, E. A. Dardeau, Jr., and E. M. Causey. USACE Waterways Experiment Station (WES). August 1981.
- Report 2. *Phase 1 Investigation of Neotectonic Activity within the Lower Mississippi Valley Division*. S. A. Schumm, C. C. Watson, and A. W. Burnett. Water Engineering Technology, Inc. September 1982.
- Report 3. *Channel Stabilization Study*. R. Wells. USACE, Memphis District. December 1982.
- Report 4. *Analysis of Major Parameters Affecting the Behavior of the Mississippi River*. J. R. Tuttle and W. Pinner. USACE, Lower Mississippi Valley Division (LMVD). December 1982.
- Report 5. *Downward Trend in Mississippi River Suspended-Sediment Loads*. E. A. Dardeau, Jr. and E. M. Causey. USACE WES. July 1990.
- Report 6. *Impact of Changes in Suspended-Sediment Loads on the Regime of Alluvial Rivers*. D. S. Mueller and E. A. Dardeau, Jr. USACE WES. October 1990.
- Report 7. *Particle Size Distribution of Bed Sediments along the Thalweg of the Mississippi River, Cario, Ill., to Head of Passes, September 1989*. C. F. Nordin and B. S. Queen. Colorado State University. September 1992.

6.4 US Army Engineer Waterways Experiment Station (WES)

(Sections 6.4–6.9 are potamology reports and papers cited in previous investigation reports listed above.)

- Waterways Experiment Station (WES) Paper H. *Sediment Investigation on the Mississippi River and Its Tributaries Prior to 1930*. July 1930.
- WES Paper U. *Sediment Investigation on the Mississippi River and Its Tributaries 1930–1931*. December 1931.
- WES Paper I. *Experiment to Determine the Effects of Proposed Dredged Cutoffs on the Mississippi River*. April 1932.
- WES Paper 17. *Studies of River Bed Materials and Their Movement, with Special Reference to the Lower Mississippi River*. January 1935.
- WES Technical Memorandum (TM) 120-1. *Report on Sediment Investigations, Mississippi River Low Water of 1936*. April 1937.
- WES TM 120-2. *Transmittal of Report on Sediment Investigations, Mississippi River Low Water of 1939*. May 1940.
- WES TM 122-1, *Study of Materials in Suspension, Mississippi River*. February 1939.
- WES TM 158-1. *Study of Materials in Transport, Passes of the Mississippi River*. September 1939.
- WES TM 3-273. *Geological Investigation of Gravel Deposits in the Lower Mississippi Valley and Adjacent Uplands*. May 1949.
- WES (unnumbered). *A Laboratory Study of the Meandering of Alluvial Rivers, (Studies Conducted 1942-1944)*. J. F. Friedkin. May 1945.
- WES (unnumbered). *Fine Grained Alluvial Deposits and Their Effects on the Mississippi River Activity*. July 1947.
- WES (unnumbered). *Report on Conference of Sand-Asphalt Revetment*. 12 August 1948.
- WES TM 3-288. *Geological Investigation of Mississippi River Activity, Memphis, Tenn., to Mouth of the Arkansas River*. June 1949.
- WES TM 3-318. *Bank Caving Investigations, Morville Revetment, Mississippi River*. September 1950.
- WES TM 3-329. *Investigation of Mass Placement of Sand Asphalt for Underwater Protection of River Banks*. August 1951.
- ”Mississippi River Cutoffs.” G. H. Matthes. In *Proceedings, ASCE* 73(1):3–17. Paper 2329. January 1947.

- WES Miscellaneous Paper (MP) 3-9. *Potamology Barrel Samples*. August 1952.
- WES MP 3-10. *Torsion Shear Study*. August 1952.
- WES MP 3-12. *Study of Variability of Sand Deposits*. August 1952.
- WES MP 2-35. *Flume Investigation of Prototype Revetment*. September 1952.
- WES TM 3-362. *Investigation of Bituminous Cold Mixes for the Protection of Upper River Banks*. April 1953.
- WES Technical Report (TR) 3-436. *Review of Petrographic Studies of Bed Material, Mississippi River, Its Tributaries, and Offshore Areas of Deposition*. June 1956.
- WES TR 3-483. *Geology of the Mississippi River Deltaic Plain, Southeastern Louisiana, Volumes I and II*. C. R. Kolb and J. R. Van Lopik. July 1958.
- WES TR 3-601. *Distribution of Soils Bordering the Mississippi River from Donaldsonville to Head of Passes*. C. R. Kolb. June 1962.
- WES TR M-77-1. *Inventory of Sediment Sample Collection Stations in the Mississippi River Basin*. M. P. Keown, E. A. Dardeau, and J. G. Kennedy. March 1977. (Also listed as *Inventory of Sediment Data*. LMVD Potamology Program T-1, Work Package 9, prepared for USACE, New Orleans District.)
- WES Contract Report 3-81. *Feasibility Study of Improved Methods for Riverbank Stabilization*. Harza Engineering Co. November 1964.

6.5 USACE, US Army Corps of Engineers, Mississippi River Commission (MRC), Lower Mississippi Valley Division (LMVD) – Mississippi Valley Division (MVD) Reports

- Professional Paper No. 13. *Report Upon the Physics and Hydraulics of the Mississippi River*. A. A. Humphreys and H. L. Abbot. US Army Corps of Topographic Engineers. 1861.
- *Report on the Physics and Hydraulics of the Mississippi River*. A. A. Humphreys and H. L. Abbot. 1876.
- MRC. *Sediment Observations on the Mississippi River*. W. B. Ladue. 1904.

- *Mississippi River Flood Control*. Memorandum for Board of Engineers for Rivers and Harbors in Control of Mississippi River Floods. H. B. Ferguson. 1930.
- *Improvement of the Lower Mississippi River for Flood Control and Navigation* (3 Volumes). D. O. Elliott. MRC. 1 May 1932.
- *History of the Improvement of the Lower Mississippi River for Flood Control and Navigation 1932-1939*. H. B. Ferguson. Print 500, 1–40. 1940.
- MRC. *Results of Sediment Observations at Mayersville Range*. (unpublished). C. W. Schwiezer. 1934.
- *Geological Investigation of the Alluvial Valley of the Lower Mississippi*. H. N. Fisk. December 1944.
- Improvement of the Lower Mississippi River and Vicinity St. Louis, Mo. N. R. Moore. *Federal Interagency Sedimentation Conference*. Jackson, Miss. 1963.
- "Sediment Problems in St. Louis Harbor." J. R. Tuttle. In *Proceedings, Seminar on Sediment Transport in Rivers and Harbors*. USACE Hydrologic Engineering Center. Davis, Calif. 7–9 April 1970.
- *Improvement of the Lower Mississippi River and Tributaries 1931–1972*. N. R. Moore. MRC. November 1972.

6.6 US Army Corps of Engineers, Vicksburg District (MVK)

- *Mississippi River Flood Control by Dredging*. R. K. Stewart. 1945.
- *Mississippi River Dredging*. R. G. Lovett. Project Report (unpublished). 1947.
- *Channel Stabilization Work in the Vicksburg District*. Committee on Channel Stabilization, Symposium on Channel Stabilization Problems. TR-1, Vol 4, Chapter 1. February 1966.
- *Potamology Studies, Hydraulic Analysis of Mississippi River Channels*. Committee on Channel Stabilization, Symposium on Channel Stabilization Problems. TR-1, Vol. 4, Chapter 3. February 1966.
- *Evaluation of Dike Systems – Baleshed and Ajax Bar Reach (Mile 495.8-479.8 AHP); Study of Effects of Baleshed Landing Dike System*. Report No. 1-1. March 1966.

- *Special Study Report – Choctaw Bar Reach (Mile 555.8-567.0 AHP); Analysis of Channels and Probable Effects of Proposed Dikes*. Report No. 3-1. July 1967.
- *Evaluation of Dike Systems – Upper Greenville Reach (Mile 541.5-550.5 AHP); Hydraulic Analysis of Channels and Evaluation of Dike Systems*. Report No. 1–2. April 1968.
- "Influence of Geology on the Regimen of a River." B. R. Winkley. Preprint. 1078, *ASCE*, 1970.
- "Geometric Stability Analysis of an Alluvial River." B. R. Winkley and L. G. Robbins. In *Proceedings, Mississippi Water Resources Conference*. pp 75–102. 1970.
- "River Regulation with Aid of Nature." B. R. Winkley. *8th IDFC Congress*. 1972.
- "Metamorphis of a River: A Comparison of the Mississippi River Before and After Cutoffs." In *Proceedings, Mississippi Water Resources Conference* (supplemental report). 1973.
- "Potamology Data Collection on Lower Mississippi River." C. M. Elliott. *Journal, Waterways, Harbors and Coastal Engineering Division, ASCE* 96(WW3):601–622. August 1970.
- 300-1. *Suspended Sediment and Bed Material Studies on the Lower Mississippi River*. L. G. Robbins. USACE, Vicksburg District. August 1977.
- 300-2. *Man-Made Cutoffs on the Lower Mississippi River, Conception, Construction, and River Response*. B. R. Winkley. USACE, Vicksburg District. March 1977.

6.7 US Army Corps of Engineers, Memphis District (MVM)

- *Dredging in the Mississippi River Between Cairo and the Mouth of the Arkansas River for the Improvement of Navigation*. B. Somerville. February 1932.

6.8 US Army Corps of Engineers, Rock Island (MVR) and St. Paul (MVP) Districts

- *Report on Sedimentary Characteristics of the Upper Mississippi River*. USACE, St. Paul District. 1935.

- "Suspended Sediment Program of the Rock Island District Office, Corps of Engineers, US Army." T. L. Pewe. *Journal of Sedimentary Petrology* 16(3):97–109. 1946.

6.9 US Army Corps of Engineers, Missouri River Division (MRD) and Districts

- "The Importance of Fluvial Morphology in Hydraulic Engineering." E. W. Lane. In *Proceedings, ASCE.* Separate No. 745. 1955.
- *A Study of the Shape of Channels Formed by Natural Streams Flowing in Erodible Material.* E. W. Lane. 1957.
- *Potamology Investigations, Missouri River-Gavins Point to Omaha, Neb.* Historical Records Research. USACE, Omaha District (prepared by Water and Environmental Consultants, Inc.). May 1976.

6.10 US Geological Reports

(Authored by H. N. Fisk, MRC consultant.)

- *Reports on Possible Factors Contributing to Bank Erosion near Baleshed Towhead*. G. H. Matthes. MRC. 11 August 1941.
- *Application of Geological Studies to Underseepage Problems in the Lower Mississippi Valley*. MRC. 12 December 1941.
- *Geological Study of Underseepage Conditions at Elton Slough (La.).* MRC. 24 February 1942.
- *Geological Report on the Baton Rouge Underseepage Area*. MRC. 7 July 1942.
- *Geological Report on the Wilson Point Underseepage Area (River Mile 492 AHP) La.* MRC. 9 September 1942.
- *Geological Report on the Commerce Underseepage Area (Miss.).* MRC. 10 September 1942.
- *Geological Report on the Trotters Underseepage Area (Miss.).* MRC. 12 September 1942.
- *Geological Report on the Abandoned Carlisle Lake Meander Area near Homochitta, Miss. (River Mile 485 AHP).* MRC. 10 May 1943.

- *Preliminary Investigation of the Sediment Forming the Floor of the Channel of the Mississippi River Between Mile 270* and *281 B.C.* MRC. 12 May 1942.
- *Geological History of the Alluvial Valley of the Mississippi River*. MRC. 9 December 1942.
- *Summary of Observations on the Occurrence of Seepage Made During the Geological Investigation of Underseepage Sites*. MRC. November 1942.
- *Sediment Report, Warfield Point and Greenville Bend (River Mile 528 AHP)*. MRC. 12 June 1943.
- *Geological Report on Clay Plugs in the Vicksburg Engineer District*. MRC. 15 June 1943.
- *Geological Study of Sediments Adjacent to the American Cut-Off Revetment*. MRC. 16 July 1943.
- *Summary of the Geology of the Lower Alluvial Valley of the Mississippi River*. MRC. 30 October 1943.
- *Geological Investigation of Faulting at Vacherie, La.* MRC. 17 May 1943.
- *Geological Investigation of the Lower Alluvial Valley of the Mississippi River*. (Printed). MRC. 1 December 1944.
- *Geological Aspects of Increased Atchafalaya River Flow*. MRC. 9 July 1945.
- *Geological Investigation of the Sediments in the Palmyra Lake Area*. MRC. 20 May 1946.
- *Geological Investigation of the Sediments of the Wilson Point Area (La.)*. MRC. 30 May 1946.
- *Preliminary Report on Borings in the Alluvial Valley*. MRC. 2 October 1946.
- *Fine-Grained Alluvial Deposits and Their Effects on Mississippi River Activity*. MRC. 1 July 1947.
- *Geological Investigation, Reid Bedford Bank Caving Area (Madison Parish, La.)*. MRC. 25 July 1947.
- *Geological Investigation of Underseepage Sites in Memphis, Vicksburg, and New Orleans Engineer Districts*. WES. December 1947.

6.11 US Army Engineer Waterways Experiment Station (WES) Potamology Related Reports

(Listed by report type (i.e., Technical Manual - TM; Miscellaneous Paper - MP; Technical Report – TR; Contract Report - CR; Instructional Report - IR) not chronologically.)

- US Army Engineer Waterways Experiment Station (WES) Paper 15. *Model Studies for Channel Stabilization, Mississippi River*. January 1934.
- WES Technical Memorandum (TM) 4-4. *Study of Bed Load Movement in a Forked Flume*. March 1933.
- WES TM 17-1. *Analyses, Bed Load Samples from Cottonwood Bar*. March 1933.
- WES TM 61-1. *Model Experiment to Determine the Directive Energy of a River*. September 1935.
- WES TM 61-2. *Effect of Rate of Sand Feed on Developments in Directive Energy Flume*. September 1935.
- WES TM 61-3. *Consolidation and Grain Sorting in the Bed of the Directive Energy Flume*. September 1935.
- WES TM 61-4. *Effect of Rate of Sand Feed on Development in Directive Energy Flume*. October 1935.
- WES TM 62-1. *Comparison of Bed Materials from the Mississippi River with Those of Certain Tributaries*. 1934.
- WES TM 62-2. *Petrographic Character of Bed Materials from the Mississippi River, Cairo to the Gulf*. January 1935.
- WES TM 89-1. *Model Study of Plans for Channel Improvement of the Mississippi River at Memphis Depot*. May 1936.
- WES TM 89-2. *Model Study of Plans for Channel Improvement of the Mississippi River at Memphis Depot*. August 1936.
- WES TM 109-1. *Model Study of Plans for Channel Improvement at Dogtooth Bend, Mississippi River*. April 1938.
- WES TM 110-1. *Model Study of Plans for Channel Improvement at Swiftsure Towhead, Mississippi River*. December 1938.

- WES TM 112-1. *Model Study to Determine the Paths of Travel of Bed Load Material in the Channels Which Enclose Cow Island, Atchafalaya River*. September 1936.
- WES TM 114-1. *Model Study of Plans for Channel Improvement at Grand Tower Reach, Mississippi River*. August 1937.
- WES TM 2-356. *Plans for Elimination of Shoaling in the Vicinity of Head of Passes, Mississippi River, Hydraulic Model Investigation*. February 1953.
- WES TM 2-388. *Old River Control Structure Sediment Diversion, Hydraulic Model Investigation*. June 1954.
- WES TM 2-403. *Shoaling in Downstream Navigation Entrance to Chain of Rocks Canal, Mississippi River, Hydraulic Model Investigation*. April 1955.
- WES TM 2-429. *Hydraulic Capacity of Meandering Channels in Straight Floodways, Hydraulic Model Investigation*. March 1956.
- WES TM 3-288. *Geological Investigation of Mississippi River Activity, Memphis, Tenn., to Mouth of the Arkansas River*. June 1949.
- WES Mississippi Basin Model (MBM) 52-1. *Tests of Channel Realignment Near St. Joseph, Missouri*. October 1954.
- WES (Un-numbered). *Geological Investigation of the Atchafalaya Basin and the Problem of the Mississippi River Diversion: Volume 1 – Text, Volume 2 – Plates*. April 1952.
- WES (Un-numbered). *Mississippi River, Baton Rouge to Gulf of Mexico; Investigations and Data Collection for Model Study of Southwest Pass, Mississippi River; Prototype Investigation: Volume 1 – Text, Volume 2 – Plates*. April 1959.
- WES Miscellaneous Paper (MP) 2-155. *Comments on Shoaling Problem in Southwest Pass, Mississippi River*. February 1956.
- WES MP 2-349. *Summary of Best Plans for Reducing Shoaling, Southwest Pass, Mississippi River, Hydraulic Model Investigation*. July 1959.
- WES MP 2-860. *Laboratory Design of Dikes for River Regulation*. November 1966.
- WES MP 3-208. *Mississippi Valley Geology, Its Engineering Significance*. March 1957.

- WES MP 3-675. *Stratigraphic-Sedimentological Investigation of Mississippi River Bank Failure, Fort Jackson, La.* D. J. Stanlev. September 1964.
- WES MP 3-818. *Review of Needs for Geological Research in Fine-Grained Deposits of the Lower Mississippi Valley*. E. L. Krinitzsky. May 1966.
- WES MP H-70-1. *Investigation of Proposed Dike Systems on the Mississippi River: Report 1, Baleshed-Ajax Bar Reach; Hydraulic Model Investigation, April 1970*. J. J. Franco, T. J. Pokrefke, and J. E. Glover. *Report 2, New Madrid Bar Reach, Hydraulic Model Investigation*. T. J. Pokrefke and J. J. Franco. April 1970.
- WES MP H-70-2. *Insights Gained from River Sedimentation Models*. J. J. Franco. April 1970.
- WES MP H-71-2. *Hydraulic Models for Solution of River Training Problems*. J. E. Glover. January 1971.
- WES MP H-71-3. *Development of Alluvial Streams for Navigation*. J. J. Franco. January 1971.
- WES MP H-73-2. *Effective Hydraulic Roughness for Channels Having Bed Roughness Different from Bank Roughness; A State-of-the-Art Report*. R. G. Cox. February 1973.
- WES MP S-77-5. *Effects of the New Madrid Earthquake Series in the Mississippi Alluvial Valley*. R. T. Saucier. February 1977.
- WES MP HL-87-2. *A Numerical Model Analysis of Mississippi River Passes Navigation Channel Improvements: Report 1 – 55-Foot Channel Tests, June 1987; Report 2 – 45-Foot Channel Tests and Flow Diversion Schemes*. D. R. Richards and M. J. Trawle. September 1988; *Report 3 – Bank Breaching Without Supplement 2*. D. R. Richards and M. J. Trawle. September 1988. (there is no Report 4); *Report 5 – Three Dimensional Numerical Model Results*. D. R. Richards and D. P. Bach. September 1988.
- WES MP HL-88-7. *Jefferson Barracks Bridge: Moveable-Bed Model Study*. J. E. Foster. August 1988.
- WES MP HL-93-1. *Navigation Return Velocities in Island Reaches*. S. T. Maynord. April 1993.

- WES Technical Report (TR) 3-436. *Review of Petrographic Studies of Bed Material, Mississippi River, Its Tributaries, and Offshore Areas of Deposition*. June 1956.
- WES TR 3-483. *Geology of the Mississippi River Deltaic Plain, Southeastern Louisiana*. (2 Volumes). July 1958.
- WES TR 2-447. *Old River Low-Sill Control Structure; Hydraulic Model Investigation: Report 3 – Study of Overall Performance.* June 1959.
- WES TR 2-690. *Plans for Reducing Shoaling, Southwest Pass, Mississippi River; Hydraulic Model Investigation*. H. B. Simmons and H. J. Rhodes. August 1965.
- WES TR H-72-7. *Shoaling Conditions, St. Louis Harbor, Mississippi River, Hydraulic Model Investigation*. J. J. Franco. November 1972.
- WES TR H-73-1. *Channel Conditions, Devil's Island Reach, Mississippi River, Missouri and Illinois; Hydraulic Model Investigation*. J. J. Franco and C. D. McKellar. March 1973.
- WES TR Y-74-1. *Analysis and Assessment of the Mississippi River 9-Ft Channel Project Between St. Louis, Mo., and Cairo, Ill.* J. H. Johnson, R. C. Solomon, C. R. Bingham, B. K. Colbert, W. P. Emge, D. B. Mathis, and R. W. Hall. November 1974.
- WES TR M-74-5. *Computer-Calculated Geometric Characteristics of Middle-Mississippi River Side Channels: Volume 1 – Procedure and Results*. V. E. LaGarde and S. J. Winfrey. June 1974; *Volume 2 – Side-Channel Contour Maps*. V. E. LaGarde and S. J. Winfrey. June 1974.
- WES TR H-77-9. *Literature Survey and Preliminary Evaluation of Streambank Protection Methods*. M. P. Keown, N. R. Oswalt, E. B. Perry, and E. A. Dardeau. May 1977.
- WES TR GL-79-7. *Engineering Geology and Geomorphology of Streambank Erosion: Report 2, Yazoo River Basin Uplands, Mississippi.* October 1981*; Report 3, Application of Waterborne Geophysical Techniques in Fluvial Environments.* February 1982*; Report 4* (Supplement to Report 3). September 1982.
- WES TR HL-82-10. *Model-Prototype Comparison Study of Dike Systems, Mississippi River; Potamology Investigations*. J. J. Franco. May 1982.

- WES TR HL-82-11. *Summary Report: Model-Prototype Comparison Study of Dike Systems, Mississippi River; Potamology Investigations*. J. J. Franco. May 1982.
- WES TR GL-83-5. *Surface and Subsurface Geologic Conditions along Selected Reaches of the Mississippi River from Rosedale, Miss., to Lake Providence, La*. September 1983.
- WES TR E-83-2. *Fishes of Selected Aquatic Habitats on the Lower Mississippi River*. C. H. Pennington, J. A. Baker, and C. L. Bond. January 1983.
- WES TR E-83-4. *Larval Fish of Selected Habitats on the Lower Mississippi River*. J. V. Conner, C. H. Pennington, and T. R. Bosley. February 1983.
- WES TR E-83-14. *Evaluating Change in Dike Field Fishes with Community Information Indices*. H. N. Polovino, M. P. Farrell, and C. H. Pennington. June 1983.
- WES TR E-84-3. *Fish of Two Dike Pools in the Lower Mississippi River*. R. W. Nailon and C. H. Pennington. March 1984.
- WES TR E-84-4. *Environmental Guidelines for Dike Fields*. C. W. Burch, P. R. Abell, M. A. Stevens, et al. September 1984.
- WES TR HL-85-2. *Buck Island Reach, Mississippi River, Hydraulic Model Investigation*. C. R. Nickles, T. J. Pokrefke, Jr., and J. E. Glover. March 1985.
- WES TR HL-86-1. *Mississippi River Passes Physical Model Study: Report 2 – Shoaling and Hydraulic Investigations in Southwest Pass; Hydraulic Model Investigation*. H. A. Benson and R. A. Boland, Jr. January 1986.
- WES TR E-86-5. *Environmental Effects of Dikes and Revetments on Large Riverine Systems*. M. B. Sandheinrich and G. J. Atchison. June 1986.
- WES TR E-86-12. *Water Quality, Macroinvertebrates, Larval Fishes, and Fishes of the Lower Mississippi River – A Synthesis*. D. C. Beckett and C. H. Pennington. September 1986.
- WES TR HL-87-1. *A Mathematical Study of the Impact of Salinity Intrusion on Deepening the Lower Mississippi River Navigation Channel*. B. H. Johnson, M. B. Boyd, and G. H. Keulegan. April 1987.

- WES TR HL-87-6. *Fine Grained Sediments: An Annotated Bibliography of Their Dynamic Behavior in Aquatic Systems*. A. Teeter, S. Hodges, and C. Coleman. September 1987.
- WES TR GL-87-13. *Geological Investigation of the Mississippi River Deltaic Plain: Land Loss and Land Accretion* (Series of 3 Reports). Report 1. J. R. May and L. D. Britsch. July 1987; Report 2. J. B.Dunbar, M. R. Blaes, S. E. Dueitt, and J. R. May. January 1994; Report 3. J. B.Dunbar, M. R. Blaes, S. E. Dueitt, J. R. May and K. W. Stroud. March 1995.
- WES TR GL-88-9. *Retrogressive Failure of Sand Deposits of the Mississippi River, Report 1: Field Investigations, Laboratory Studies, and Analysis of Hypothesized Failure Mechanism*. Victor Torrey III, J. B. Dunbar, and R. W. Peterson. June 1988; *Report 2: Empirical Evidence in Support of the Hypothesized Failure Mechanism and Development of Levee Safety Flow Slide Monitoring System*. V. H. Torrey. June 1988.
- WES TR HL-88-28. *Total Sediment Load Measurement Using Point-Source Suspended-Sediment Data*. J. J. Ingram. December 1988.
- WES TR GL-90-2. *Land Loss Rates, Report 1: Mississippi River Deltaic Plain*. L. D. Britsch and E. B. Kemp III. April 1990.
- WES TR GL-90-12. *Geomorphic Investigation of Davis Pond, La*. L. D. Britsch and J. B. Dunbar. August 1990.
- WES TR HL-90-20. *Dredging Alternatives Study, Cubits Gap, Lower Mississippi River: Report 1 – TABS-1 Numerical Model Investigation*. R. R. Copeland. January 1991; *Report 2 – TABS-2 Numerical Model Investigation, Volumes 1 and II*. H. J. Lin, W. D. Martin, and D. R. Richards. November 1990.
- WES TR HL-92-6. *Lower Mississippi River, Tarbert Landing to East Jetty Sedimentation Study; Numerical Model Investigation*. R. R. Copeland and W. A. Thomas. June 1992.
- WES Contract Report (CR) Y-74-1. *Evaluation of Three Side Channels and the Main Channel Border of the Middle Mississippi River as Fish Habitat*. Missouri Department of Conservation. D. V. Ragland. March 1974.
- WES CR Y-74-2. *Geomorphology of the Middle Mississippi River*. Colorado State University. D. B. Simmons, S. A. Schum, and M. A. Stevens. July 1974.

- WES CR HL-93-1. *Velocity and Scour Prediction in River Bends*. C. R. Thorne and S. R. Circa March 1993.
- WES Instruction Report (IR) HL-85-1. *User's Manual for the Generalized Computer Program System: Open Channel Flow and Sedimentation, TABS-2, Main Text*. W. A. Thomas and W. H. McAnnally, Jr. July 1985.
- WES IR HL-85-1. *User's Manual for the Generalized Computer Program System: Open Channel Flow and Sedimentation, TABS-2, Main Text and Appendices A-O*. (loose-leaf publication). W. A. Thomas and W. H. McAnnally, Jr. August 1985.

6.12 USACE Committee on Channel Stabilization Reports

- USACE Committee on Channel Stabilization, Report 2. *Review of Research on Channel Stabilization of the Mississippi River, 1931-1962*. J. B. Tiffany. September 1963.
- USACE Committee on Channel Stabilization, Report 12. *Mississippi River and Tributaries Project: Problems Relating to Changes in Hydraulic Capacity of the Mississippi River*. E. B. Madden. August 1974. (Errata Sheet 1, December 1974)

6.13 SECTION 32 Program: Streambank Erosion Control Evaluation and Demonstration

(Funded by Office, Chief of Engineers, Headquarters, USACE)

- *Evaluation of Existing Bank Protection: Field Inspection of Sites in St. Paul and Rock Island Districts*. M. P. Keown. Work Unit 2, Inspection Report 2. November 1977.
- *Hydraulic Research: Model Demonstration of the Effects of Propeller Wash on the Bed of an Alluvial River*. S. T. Maynord. Work Unit 3, Research Report 1. November 1977.
- *Research on Soil Stability and Identification of Causes of Streambank Erosion; Investigation of a Grid for Bank Protection*. A. C. Spivey, Jr. and C. R. Styron III. Work Unit 4, Investigation Report 3. November 1979.

6.14 St. Anthony Falls Laboratory Reports Related to Mississippi River Potamology

- *Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams*. M. E. Nelson and P. C. Benedict. Report E, Federal Interagency Sedimentation Project. 1946.
- *Project Report 21, Mississippi Revetment Studies*. Saint Anthony Falls Hydraulic Laboratory. June 1951.
- *Project Report 28, Mississippi Revetment Studies – Tests on Double Layer of Articulated Concrete Mattress*. Saint Anthony Falls Hydraulic Laboratory. May 1952.
- *Report No. 14, Determination of Fluvial Sediment Discharge*. Saint Anthony Falls Hydraulic Laboratory; Subcommittee on Sedimentation, Interagency Committee on Water Resources. 1963.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
March 2014	MRG&P Report	1927-2014

4. TITLE AND SUBTITLE

A Review of the Lower Mississippi River Potamology Program

5a. CONTRACT NUMBER
N/A

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)

David S. Biedenharn, Wayne A. Stroupe, and John H. Brooks

5d. PROJECT NUMBER
N/A

5e. TASK NUMBER
N/A

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Biedenharn Group, LLC
Vicksburg, MS 39180

8. PERFORMING ORGANIZATION REPORT NUMBER

MRG&P Report No. 1

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

US Army Corps of Engineers, Mississippi Valley Division

10. SPONSOR/MONITOR'S ACRONYM(S)

MVD

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

1

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Report series: MRG&P (Mississippi River Geomorphology & Potamology)

14. ABSTRACT

Mississippi River potamology (the science of rivers) advances understanding of how natural and man-made factors combine to impact river morphology regarding present and future flood damage reduction, navigation, environmental restoration, and coastal wetland projects. The US Army Corps of Engineers (USACE) has conducted numerous potamology studies dating from the 1800s to modern times. Major studies were often the result of floods and follow-on beneficial projects. The epic 1927 flood fostered the first official USACE *Potamology Investigations* that resulted in more than 70 reports. The 1973 flood drove additional USACE potamology studies (T-1 and P-1 reports). However, funding, staffing, and interest in potamology studies waned, becoming almost nonexistent in recent times. The 2011 Mississippi River flood renewed interest in potamology. Lessons learned and projects implemented from USACE's 1940s–1980s potamology studies helped pass the record-setting 2011 flows. This report is the first in the USACE Mississippi Valley Division's (MVD) new Mississippi River Geomorphology and Potamology (MRG&P) Program that is focused on advancing potamology. This document provides a short historical review of USACE Mississippi River potamology studies, includes an initial bibliography of USACE potamology reports, and makes recommendations to expand USACE potamology expertise that will have short- and long-term national implications.

15. SUBJECT TERMS

Potamology
River engineering
River morphology
Mississippi River
Geomorphology
River science

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** Loren Wehmeyer
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
Unclassified	Unclassified	Unclassified	None	46	601-634-2923

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. 239.18