Alternative Financing Evaluation

Upper Mississippi River Inland Waterway Summary Report

Iowa Department of Transportation

Ames, Iowa

April 2019

Executive Summary

<u>*Background & Objectives*</u>

In April 2013, the Iowa Department of Transportation (Iowa DOT) U.S. Inland Waterway Modernization Reconnaissance Study (Reconnaissance Study) was completed. Since publication of this 2013 study, significant legislation, study, and discussion have occurred involving the inland waterway system, along with five additional years of U.S. Army Corps of Engineers' (USACE) operation and maintenance of the waterway. Several recommendations of the Reconnaissance Study have come to fruition, including passage of the Water Resources Reform and Development Act (WRRDA) bills and the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN).

The Iowa DOT continues to collaborate with USACE to enhance the performance of the Upper Mississippi River (UMR) lock and dam (L&D) system. As part of this ongoing collaboration, the Iowa DOT conducted this Alternative Financing Evaluation of the UMR Inland Waterway infrastructure to (1) develop a long-term vision for the waterway that serves stakeholders' needs and (2) identify feasible investment strategies for the waterway that recognize the opportunities created by WRRDA 2014 and WIIN 2016. Of special interest are the revised contributed funds programs for USACE water resources projects, such as the UMR Inland Waterway's L&D system.

This study provides an update to support a long-term vision document that informs UMR Inland Waterway stakeholders of the purpose, direction, and benefits of (1) improving the reliability of the existing L&Ds through ongoing maintenance and rehabilitation and (2) undertaking new capital improvements such as mooring cells and new 1,200-foot locks to upgrade the system's ability to successfully meet the waterborne transportation needs of the UMR region into the foreseeable future.

This study discusses three L&D system upgrade pilot projects for improving the efficiency, reliability, and capacity of the existing system and investigates the implementation of alternative financing scenarios. The alternative financing scenarios include: (1) revenue that provides full project funding or (2) offsetting funds to existing cost-sharing methods that provide a new source of funds. The recent Water Resources Development Act (WRDA) bills and pending federal infrastructure program initiatives have and will likely include provisions for enhanced non-federal stakeholder cost-sharing on federally authorized water resource civil works projects.

<u>*Pilot Project Scenarios*</u>

Micro Upgrade (Efficiency). An example of a small-scale navigation efficiency improvement (micro upgrade) to the UMR Inland Waterway that is a stand-alone pilot project and can easily be replicated at one or more sites is a mooring cell. A mooring cell is a more efficient and environmentally friendly place for tows approaching an L&D to moor (tie-off) while waiting for the lock to become available when another tow occupies the lock or navigation approach channel.

The Micro Upgrade pilot project scenario for this study consists of a mooring cell at Lock 14 that will provide notable time savings for upbound towboats at a design and construction cost of approximately $2 million.

System Reliability Improvements. A system reliability improvement pilot project would reset the design life and enhance the reliability of the lock chambers across the UMR system. The Major Rehabilitation Program is currently underfunded on the UMR and consists of reliability or efficiency improvements costing over $21 million that focus on facility life extensions, which are critical for system recapitalization and the long-term durability and sustainability of the facility.

The System Reliability pilot project scenario for this study includes major rehabilitation of 27 L&Ds across the UMR system, at a design and construction cost of $45 million each or approximately $1.22 billion for all 27 L&Ds.

Large-scale Upgrade. A large-scale navigation capacity and efficiency improvement project on the UMR Inland Waterway would expand lock capacity and improve lock efficiency. The Navigation and Environmental Sustainability Program (NESP) authorization includes several projects that meet this objective. A Large-scale Upgrade could construct one or more of the five UMR 1,200-foot locks that are authorized by WRDA 2007, and lock processing and delay times would be reduced with the elimination of double cut lockages,

Implementation of the USACE NESP authorization or components of NESP would be considered a Large-scale Upgrade for purposes of this study. In Fiscal Year 2019 (FY 2019), USACE is performing an economic update for NESP focusing on engineering reliability, forecasted barge traffic demands, barge transportation demand elasticity, transportation rates, and lock performance characteristics. Given the near term availability of this in-depth economic update of NESP, evaluation of a Large-scale Upgrade pilot project scenario was not included in this report.

Economic Analyses

The UMR Inland Waterway system contributes substantially to the economy of the five-state UMR area that includes Iowa, Illinois, Minnesota, Wisconsin, and Missouri, as well as the broader nation. The waterway system supports the movement of several different commodities, with corn and soybean shipments accounting for more than half of the goods moved by weight.

The economic impact of the inland waterway system is greater than just the commodities shipped. The analysis conducted for this study suggests that the waterway system currently supports more than 66,000 direct, indirect, and induced jobs in the five-state region. This contribution is expected to grow over 2.5 times by 2060, when the inland waterway system will contribute to more than 175,000 jobs in the region. Longer term, rising incomes around the world are likely to drive demand for more corn and soybean exports, which will lead to growth in shipments along the inland waterway system. The IEG analysis forecasts 2.3 percent growth in shipments annually over the next 40 years assuming stable trade policies and climate trends. In its current state, the UMR Inland Waterway system will be unable to support this growth. Long-term deferred maintenance has left the system in need of repair and improvement.

All three improvement scenarios exceed or are expected to break even at a 3 percent discount rate, which is similar to the current rate that USACE uses for economic analysis. The Micro Upgrade (mooring cell improvement) provides the highest return on investment, with a benefit-cost ratio of nearly 6.0 at a 3 percent rate (or 3.5 at a 7 percent discount). The System Reliability improvements have a lower benefit-cost ratio, but generate the highest benefits, with $2.1 billion in net benefits at a 3 percent discount rate (and nearly $1.5 billion at a 7 percent discount rate). While detailed evaluation is not included in this report, a Large-scale Upgrade scenario that is bundled with other improvements (as demonstrated in the USACE NESP authorization) is anticipated to break even at a 3 percent discount rate. The forthcoming USACE FY 2019 economic update for NESP will provide additional economic details regarding NESP, which would be considered a Large-scale Upgrade for purposes of this study.

While the benefit-cost analysis compared scenarios based on their project costs and generated benefits, the economic impact analysis provides an economic assessment of specific effects under various metrics such as employment, output, labor income, and gross regional product (value added). Across all metrics, the System Reliability improvements rank the highest because of the project scale and the value they provide to users system-wide. The Micro Upgrade generates a relatively small economic impact because it is an individual, small improvement (single mooring cell). Specific evaluation is not included in this report for a Large-scale Upgrade, and economic impacts would vary depending upon the breadth of potential Large-scale Upgrade improvements. If a small number of locks are improved compared to the System Reliability scenario, economic impacts would be expected to be less than the System Reliability scenario and less than if Large-scale Upgrades are bundled with other improvements as demonstrated in the USACE NESP authorization. USACE studies indicate that increasing large-scale improvements to five locks and bundling with other improvements offers overall positive benefits to the economy.

Governance and Financing Alternatives

Under current federal and state law, the inland navigation system is the primary responsibility of the federal government, with the responsibility of the system residing within USACE. Alternative governance and financing structures were evaluated to identify potential opportunities to enhance the engagement of project stakeholders to finance and construct improvements to the inland waterway system. The two most likely frameworks under existing authorities that could be used to implement UMR Inland Waterway system projects are:

1) Establishing a project partnership agreement using a contributed funds memorandum of agreement.
2) Constructing a project under Section 408 approvals with turn back to USACE.

Under existing authorities, Iowa DOT has the necessary authority to enter a project partnership agreement with USACE. In short, an agreement would be reached between Iowa DOT and USACE to implement a specific project or suite of projects. Iowa DOT would transfer funding to USACE to implement the requirements of the project partnership agreement. Planning, engineering, design, and construction of the project would be accomplished by USACE.

As an alternative, Iowa DOT could chose to make the navigation improvements. This can be accomplished by receiving a Section 408 approval from USACE. The Section 408 approval documents would describe the project requirements for alteration of a federal navigation project. Iowa DOT may have to provide some funds to USACE for its review and participation in the process. Iowa DOT would implement the project and then turn it back to USACE for incorporation into the navigation system.

Study Recommendations

A stakeholder engagement workshop was conducted for review of study results. Participants were asked to rank their preference for different performance factors. Overall, stakeholders prioritized efficiency and reliability over capacity improvements. In addition, stakeholders expressed interest in seeing separable elements of NESP implemented while funding is sought for the overall program.

The benefit-cost analysis demonstrated that relatively low-cost improvements with very high BCRs could improve the efficiency and reliability of the system when compared with new 1,200-foot lock construction. Additionally, the system reliability improvements demonstrated a positive BCR in the study.

The results of the study and stakeholder engagement have identified recommendations to continue to focus on and drive improvements to the UMR system. Recommendations are described below:

Action	Benefits
Specific Recommendations for Iowa	
Use a State-Federal P2 project partnership agreement (PPA) and/or contributed funds to implement the Micro Upgrade scenario of a mooring cell at L&D 14. While not necessary, this agreement could be completed as a pilot project under Section 5014 under WRRDA 2014, should USACE complete the necessary guidance.	Demonstrates progress on implementing navigation system improvements and the importance of non-federal/federal partnerships in moving these improvements forward, provides high return on minimal investment (high BCR), and can be easily replicated.
Establish a regional cooperative working group with other UMR states to expand and promote the Micro Upgrade scenario concepts across the UMR region.	Leverages additional small investments in a low cost and environmentally beneficial way to improve the efficiency of the UMR waterway.
Update State of Iowa port authority statutes to provide the ability to enter into USACE partnership agreements and develop financing tools for navigation system improvements.	Provides the opportunity to create a special purpose unit of government that is inherently vested in promoting an improved navigation system.
Evaluate an additional economic scenario that focuses on new markets, technologies, and innovation in the uses for transporting goods on the UMR, such as container traffic or new commodities.	Current economic analysis focuses on expansion of existing commodities only. Consideration of the potential new uses could potentially improve the benefit cost ratios or modify the desired improvements.

Action	Benefits
Federal/Regional Recommendations	
Encourage Congress, the Administration, and USACE to fund and complete necessary implementation guidance for WRRDA 2014 Section 2004a, Inland Waterways Construction Bonds Study; Section 2004b, Potential Revenue Sources for Inland and Intracoastal Waterways Infrastructure; and Section 5014, Water Infrastructure Public Private Partnership Program.	Provides the necessary study and recommendations to Congress to move forward with the previously authorized programs for using new sources of revenue and partnerships on USACE related water resource programs.
Explore implementation of portions of NESP as separable elements or a split delivery model, specifically the first increment of mooring cells identified in NESP alternative 4.	Allow NESP to gain traction and move forward on navigation and environmental improvements. The use of the split delivery model has proven successful in moving forward USACE flood risk reduction programs such as the Fargo-Moorhead Diversion project.
Engage with regional stakeholders to consider establishment of a broader UMR port or navigation authority to promote UMR navigation improvements.	Provides for an Upper UMR commission or authority to advocate for navigation improvements, similar to the Mississippi River Commission which is responsible for inspecting and reporting to Congress on the condition of the of the lower river.

Contents

Figures

Tables

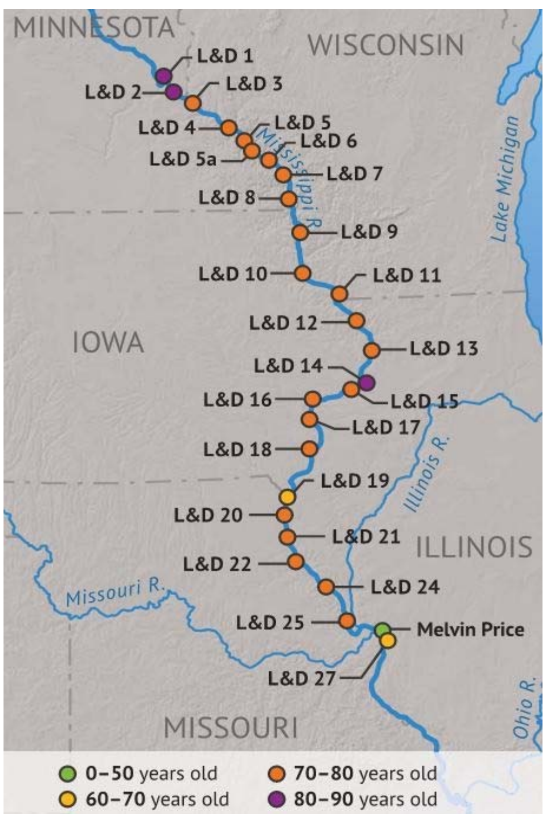
Appendices

1.0 Project Background

In April 2013, the Iowa Department of Transportation (Iowa DOT) U.S. Inland Waterway Modernization Reconnaissance Study (Reconnaissance Study) was completed. Since publication of this study, significant legislation, study, and discussion have occurred involving the inland waterway system, along with five additional years of U.S. Army Corps of Engineers' (USACE) operation and maintenance of the waterway. Several recommendations of the Reconnaissance Study have come to fruition, including passage of the Water Resources Reform and Development Act (WRRDA) bills and the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN). WRRDA 2014 contained two sections—Section 2004 a/b and Section 5014—that, if funded, would advance alternative financing for improvements to inland waterways. WIIN 2016 Section 1153 expanded USACE's ability to use contributed funds, material, or labor to advance waterway projects.

Iowa DOT continues to collaborate with USACE to enhance the performance of the Upper Mississippi River (UMR) lock and dam (L&D) system (Figure 1). As a part of this ongoing collaboration, the Iowa DOT conducted this Alternative Financing Evaluation of the UMR Inland Waterway infrastructure to (1) develop a long-term vision for the waterway that serves the UMR stakeholders' needs and (2) identify feasible investment strategies for the waterway that recognize the opportunities created by WRRDA 2014 and WIIN 2016. Of special interest are the revised contributed funds programs for USACE water resources projects such as the UMR L&D system (Figure 1).

Figure 1: UMR Inland Waterway System



2.0 Objective

The current Administration and Congress are working on infrastructure spending bills. The White House's *Fact Sheet – 2018 Budget: Infrastructure Initiative* specifically addresses reforming the laws that govern the Inland Waterways Trust Fund and providing for additional revenue by encouraging the use of USACE contributed/advanced funding authorities. The Administration proposes to leverage USACE's authority to enter into such contributed funds agreements to take advantage of an innovative approach to delivering projects. As of the public date of this study, Congress has passed the Water Resources Development Act (WRDA) 2018 and the FY2019 Energy and Water Development appropriations bill. Specific funding for developing guidance related to WRRDA 2014 Sections 2004a, 2004b, and 5014 has yet to be provided as of the date of this study.

Given the ongoing infrastructure initiative discussion by the Administration and Congress, the State of Iowa and other partner States recognize a unique opportunity to capitalize on the momentum of the 2013 Reconnaissance Study and to develop specific feasible funding and implementation alternatives that address governance, financing, construction, and operation of navigation infrastructure improvements to create lasting and sustainable value for the UMR Inland Waterway.

This study provides an infrastructure update to support a long-term vision document that informs UMR Inland Waterway stakeholders of the purpose, direction, and benefits of improving the reliability of the existing L&D system and undertaking new capital improvements—such as mooring cells or new 1,200-foot locks—to upgrade the system's ability to successfully meet the waterborne transportation needs of the UMR region into the foreseeable future.

3.0 Infrastructure Update

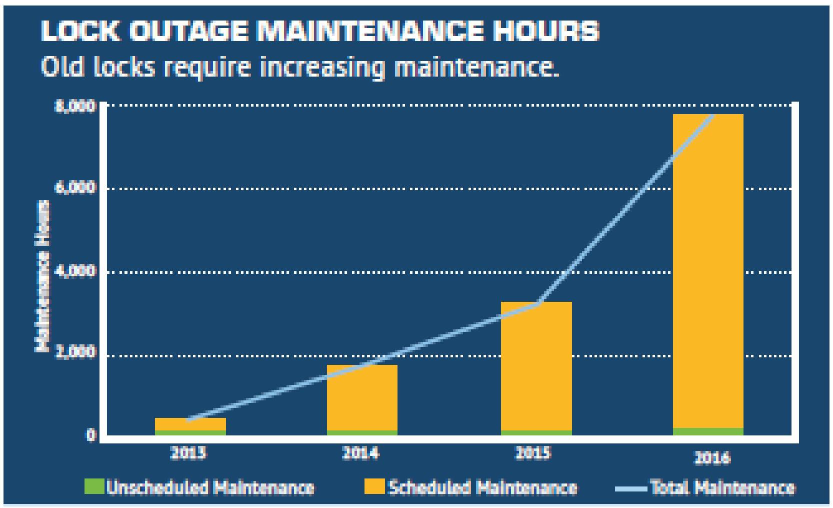
The UMR Inland Waterway is a vital part of our national inland navigation system and the Midwest economy. It also represents a valuable ecological resource. The UMR Inland Waterway includes 27 L&Ds spanning from Minneapolis, Minnesota to St. Louis, Missouri. The 750 miles of 9-foot navigation channel created by the L&Ds allows waterway traffic to move from one pool to another, providing an integral regional, national, and international transportation network.

The 9-foot navigation channel and associated L&D system was largely constructed in the 1930s. The system consists primarily of 600-foot lock chambers, which do not accommodate today's modern tows without forcing the tows to split and pass through the lock in two operations. This locking procedure requires uncoupling barges at midpoint, which doubles lockage times and exposes deckhands to an increased risk for accidents. A combination of age, use, and single-lock chambers is also affecting the system's reliability and efficiency and its ability to provide acceptable levels of performance to meet the expanding transportation needs of the Upper Midwest economy.

The wear-and-tear of over 80 years of traffic, barge impacts, freeze-and-thaw cycles, and recurring flooding has taken a toll on the UMR Inland Waterway in the form of steady deterioration of the L&D components. Lock operating machinery and electrical components become outdated, with no available replacement parts as the end of their design life approaches. Thousands of cycles of L&D gate loadings fatigue the strength of the steel gates. The freeze-and-thaw cycles and barge strikes deteriorate concrete to unacceptable and unsafe conditions, and the underlying foundation components that support the L&Ds are demonstrating increasing levels of unreliable performance.

L&D scheduled maintenance projects have slowed the rate of unscheduled outages; however, the system continues to have increased risks of major service interruptions if the underlying deficiencies are not addressed by major rehabilitation projects (Figure 2). Otherwise, the deficiencies will continue to be addressed using a "fix-as-it-fails" strategy as the years progress. As shown in Figure 2, the level of maintenance performed increased from less than 1,000 maintenance hours in 2013 to almost 8,000 maintenance hours in 2016.

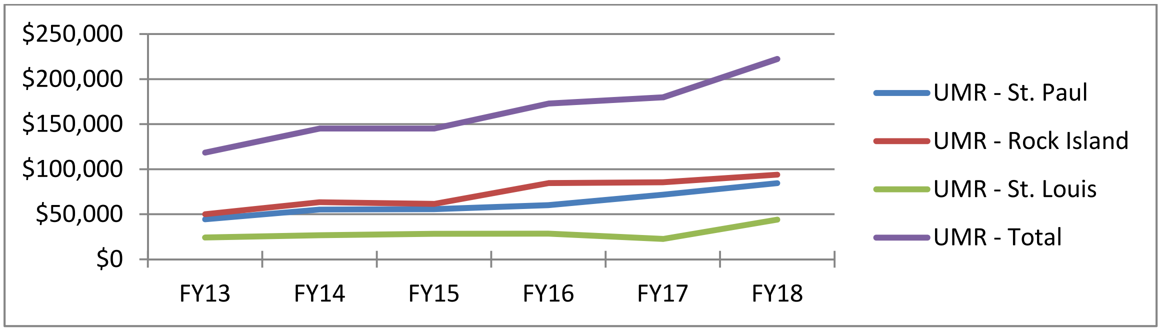
Figure 2: UMR Lock Outage Maintenance Hours, Fiscal Years 2013 to 2016



In recent years, USACE has revised its operations and maintenance (O&M) funding system to prioritize risk reduction—in other words, keep the system operating as reliably as possible based on available funding levels. However, recurring problems and outages continue to plague the system, requiring a robust funding stream to keep the L&Ds performing at an acceptable level of service reliability.

For the fiscal years (FY) 2013 to 2017 period that was evaluated, the UMR Waterway's O&M funding has been on an upward trend. A variety of factors likely exist for this favorable trend, with a primary one being that UMR L&D major maintenance projects have ranked high in USACE's move to risk-informed prioritization of discretionary O&M budget packages. For the 27 L&Ds on the UMR Inland Waterway system, O&M funding was $118.5 million in FY 2013, and has steadily increased to $179.6 million in FY 2017 and $222.4 million for FY 2018 (Figure 3).

Figure 3: UMR Inland Waterway O&M Funding, Fiscal Years 2013 to 2018



Note: $ in 1,000

Modernization of the UMR Inland Waterway for efficient accommodation of modern tow configurations remains unfunded, including such Congressionally authorized programs as the Navigation and Environmental Sustainability Program (NESP). NESP provides for improvements in the capacity of the waterway to meet future traffic demands in an economical and efficient manner. NESP improvements range from small improvements, such as adding mooring cells that increase the efficiency of the existing system, to large measures, such as the addition of 1,200-foot locks at five of the UMR lock sites. NESP projects also provide for comparable improvements on the ecologic resources of the river through a variety of ecosystem restoration projects.

One of the impediments to funding NESP is the relatively low benefit-cost ratio (BCR) of the entire program. However, separable elements of NESP may provide significantly higher BCR values with more likelihood of receiving funding appropriations. In addition, the recent WRDAs of 2014 and 2016 have provided opportunities for non-federal interests to advance inland waterway projects.

The concept of identifying separable elements from NESP and several WRRDA 2014 and WIIN 2016 sections—including those related to use of non-federal funds, public-private partnership arrangements, and non-federal implementation of pilot projects—provided the groundwork for evaluating project scenarios and governance and financing alternatives in this study.

4.0 Pilot Project Scenarios

This section discusses three L&D system upgrade pilot projects for improving the efficiency, reliability, and capacity of the existing system with the implementation of alternative financing scenarios. The alternative financing can be (1) revenue that provides full project funding or (2) offsetting funds to existing cost-sharing methods that provide a new source of funds. The recent WRDA bills and pending federal infrastructure program initiatives have and will likely include provisions for enhanced non-federal stakeholder cost-sharing on federally authorized water resource civil works projects.

Micro Upgrade (Efficiency). An example of a small-scale navigation efficiency improvement (micro upgrade) to the UMR Inland Waterway that is a stand-alone pilot project and can easily be replicated at one or more sites is a mooring cell (Figure 4). A mooring cell is a more efficient and environmentally friendly place for tows approaching an L&D to moor (tie-off) while waiting for the lock to become available when another tow occupies the lock or navigation approach channel. The Micro Upgrade pilot project scenario for this study consists of a mooring cell at Lock 14 that will provide notable time savings for upbound towboats at a design and construction cost of approximately $2 million.

Figure 4: Typical Mooring Cell

Source: USACE

System Reliability Improvements. A system reliability improvement pilot project would reset the design life and enhance the reliability of the lock chambers across the UMR system. The Major Rehabilitation Program is currently underfunded on the UMR and consists of reliability or efficiency improvements costing over $21 million that focus on facility life extensions, which are critical for system recapitalization and the long-term durability and sustainability of the facility. Major rehabilitation projects, in essence, serve to reset the design life of an L&D facility and extend the reliable service life of the infrastructure. Past UMR major rehabilitation projects have included replacing lock operating machinery, upgrading and replacing the L&D’s electrical power and control systems, performing mass concrete repairs (see Figure 5), resurfacing and armoring the lock chamber concrete, painting, repairing gates, emptying and filling valve repairs, making dewatering improvements, installing lock bubbler systems for ice management, providing scour protection, and making general safety improvements. Currently, major rehabilitation projects must be economically justified by a supporting BCR and must be documented in an approved Rehabilitation Evaluation Report. No such reports have been completed and approved on the UMR Inland Waterway in the past 15 years, resulting in no new construction starts in recent years.

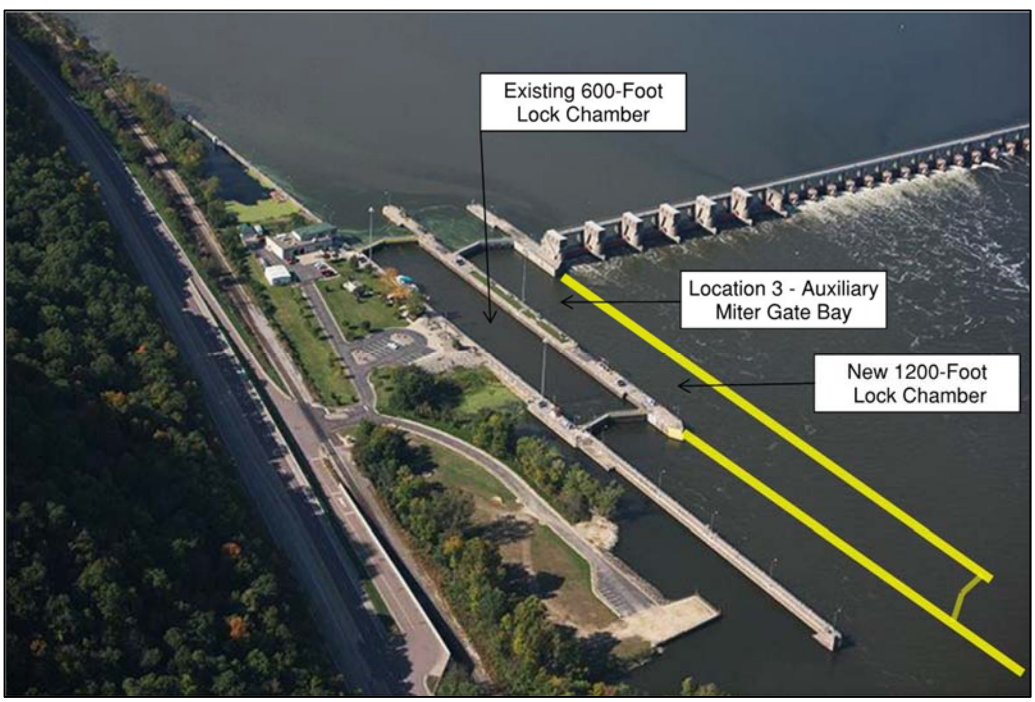
The System Reliability pilot project scenario for this study includes major rehabilitation of 27 L&Ds across the UMR system, at a design and construction cost of $45 million each or approximately $1.22 billion for all 27 L&Ds.

Figure 5: Major Rehabilitation Example – Chamber Concrete Rehabilitation

Source: USACE Rock Island District

Large-scale Upgrade. A large-scale navigation capacity and efficiency improvement project on the UMR Inland Waterway would expand lock capacity and improve lock efficiency. The NESP authorization includes several projects that meet this objective. A large-scale upgrade could construct one or more of the five UMR 1,200-foot locks that are authorized by WRDA 2007 with the construction of the expanded 1,200-foot lock in the auxiliary miter gate bay adjacent to the existing 600-foot lock chamber (see Figure 6). Lock processing and delay times would be reduced with the elimination of double cut lockages.

Figure 6: Large-Scale Upgrade Example – UMR L&D 22 with 1,200-foot Lock



5.0 Economics Background

The inland waterways are a strategic asset to the nation, enabling the United States to significantly increase economic output in both domestic and international markets and to move important national defense resources and other supplies in large quantities. Over the next 20 years, economists at the University of Illinois at Chicago estimate that inland navigation will increase by more than 35 percent nationally, based on existing trends.[1] This estimate does not include potential increases in consumption of U.S. farm products internationally, which IEG included in its estimates for the UMR. U.S. waterways transport more than 60 percent of the nation's grain exports, about 22 percent of domestic petroleum and petroleum products, and 20 percent of the coal used in electricity generation.[2]

To remain competitive internationally, the United States economy relies on an efficient, low-cost transportation network for movement of its domestic and export commodities. Under the assumption that shippers fully pass costs and savings along to consumers, USACE estimated both shippers and consumers saved approximately $20.37 per ton in 2014 compared with other modes, which equates to $12.3 billion.[3]

5.1 Investment Gap

A 2016 American Society of Civil Engineers study examined the detrimental future economic impacts arising from a projected investment gap for U.S. inland waterways. Across the United States, the projected investment gap ($43 billion from 2016 through 2040) may result in 440,000 fewer jobs in 2025 and almost 1.2 million fewer jobs in 2040 than would otherwise be expected with modernization improvements.[4] By 2025, the United States will have lost almost $800 billion in gross domestic product if the investment gap is not addressed, while the cumulative impact through 2040 is expected to be almost $2.8 trillion in gross domestic product.[5]

Similarly, a 2016 study commissioned by the U.S. Department of Agriculture shows the effects of an L&D closure on grain transportation. If Mississippi L&D 25 was unavailable for the 2024 to 2025 marketing year, the reduced economic activity would reach nearly $2 billion.[6] For the harvest season alone (September to November), the disruption would cost $933 million (or a 40 percent decrease) if L&D 25 were unavailable.[7]

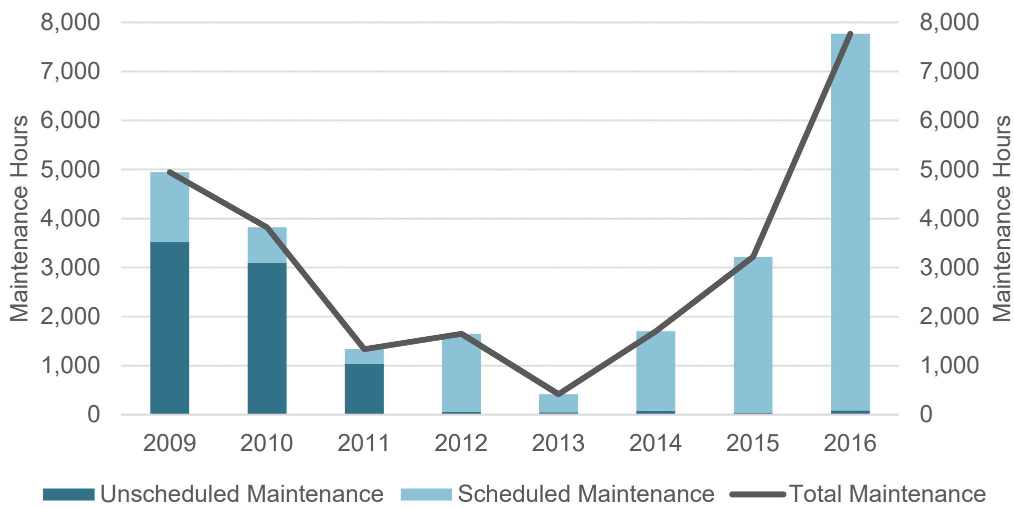
[1] Ginsburg, Robert and Dirks, Lise. "An Analysis of the Illinois Maritime Transportation System." 2017. https://utc.uic.edu/wp-content/uploads/Illinois-Maritime-Transportation-System-Report-__Final-Report-8302017.pdf
[2] Ibid.
[3] U.S. Army Corps of Engineers. "Inland Waterways Users Board 29th Annual Report – To the Secretary of the Army and the United States Congress." 2016. http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983
[4] American Society of Civil Engineers. "Failure to Act: The Impact of Infrastructure Investment on America's Economic Future." 2016. https://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf
[5] Ibid.
[6] Yu, T. E, B. C. English, and R. J. Menard, Department of Agricultural and Resource Economics, University of Tennessee. "Economic Impacts Analysis of Inland Waterways Disruption on the Transport of Corn and Soybeans. Staff Report #AE16-08." 2016. https://www.ams.usda.gov/sites/default/files/media/EconomicImpactsAnalysisInlandWaterwaysSummary.pdf
[7] Ibid.

5.2 Lock Maintenance

When an L&D reaches a state of poor repair, waterborne traffic must stop to allow for more frequent scheduled maintenance. Although such anticipated or scheduled delay imposes some costs on industries that rely on waterborne commodities, an even greater cost is imposed when an unscheduled delay occurs. Unscheduled delays interrupt business operations for entire supply chains dependent on waterborne shipments. However, with adequate investment in maintenance and infrastructure modernization, these delays can be minimized.

Through an analysis of USACE data for UMR[8] locks, closures excluding weather-related delays[9] were shown to have increased at an average of 47 percent per year since 2012, as shown in Figure 7. When weather-related and other delays are included, closures not related to maintenance activities typically account for between 66 and 96 percent of total closure hours.[10]

Figure 7: Upper Mississippi River L&D Maintenance Hours



Source: USACE, Navigation Data Center – Public Lock Detailed Unavailability Report
https://data.navigationdatacenter.us/Locks/Public-Lock-Unavailability-Detailed-Report/p3mn-gzqj/data

6.0 Economic Analysis

With the goal of understanding the economic impacts of the UMR Inland Waterway system on the five-state area (Iowa, Illinois, Minnesota, Wisconsin, and Missouri), an economic assessment was conducted. The assessment took into account various industry reports and

[8] L&Ds selected include 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 25.
[9] Selected delay reasons include: inspection or testing lock, lock hardware or equipment malfunction, maintaining lock or lock equipment, repairing lock or lock hardware.
[10] Other closure reasons include: accident or collision in lock, bridge, or other structure (railway, pontoon, swing, etc.); collision or accident (not tow or not in lock); debris; debris in lock recess or lock chamber; environmental (i.e., fish, animals, oil spills, hydrilla); flood; fog; grounding; ice on lock or lock equipment; ice on or around tow; interference by other vessel(s); lightning; unused for other reason (Coast Guard river closing, etc.); low water, rain, river current, or outdraft condition; sleet or hail; snow; tow accident or collision; tow detained by Coast Guard or USACE; tow malfunction or breakdown; tow staff occupied with other duties; wind; other.

included an economic impact analysis and BCA. This section summarizes the economic analysis.

6.1 Commodity Forecast

Table 1 summarizes the IEG forecasts, by commodity, for the entire five-state area under a current, business-as-usual scenario. These tons represent shipments anywhere along the UMR. The commodity forecasts represent commodity flows that originate or terminate within the study area and are not measured at a specific point in the system. Corn and soybean shipments are expected to increase faster than other shipments over the long term as farmers react to shifts in U.S. ethanol policy and more crops are directed to the export market. Specifically, ethanol production is projected to remain stable, freeing any gains in corn yields for export. Global demand for soybeans is anticipated to remain strong and tied closely to overall population growth in developing countries.

Table 1: Commodity Forecasts for UMR, in Thousands of Short Tons

Commodity	2018	2030	2040	2050	2060	Average Annual Growth (2018–2060)
Corn	11,192	19,706	26,758	32,410	43,162	3.3%
Soybeans	6,765	9,038	11,350	14,151	17,535	2.3%
Animal Feed, Prep.	1,342	1,477	1,735	1,998	2,268	1.3%
Nitrogenous Fertilizer	547	974	1,061	1,044	1,026	1.5%
Cement and Concrete	1,470	2,071	2,579	3,085	3,592	2.2%
Crude Petroleum	874	1,023	1,039	986	957	0.2%
Oilseeds NEC.	1,294	1,251	1,452	1,604	1,772	0.8%
Fertilizer and Mixes NEC.	947	956	945	929	913	–0.1%
Other Commodities*	5,622	5,872	5,961	6,051	6,142	0.2%
Total	30,053	42,369	52,879	62,257	77,366	2.3%

Source: IEG forecasts

* Other commodities include coal lignite, limestone, sand and gravel, residual fuel oil, potassic fertilizers, iron and steel scrap, vegetable oils, asphalt and tar, petroleum coke, and distillate fuel oil.

The economic impact analysis described in subsequent sections used this baseline commodity forecast for the Micro Upgrade and System Reliability scenarios.

6.2 Benefit-Cost Analysis

The BCA compared the upgrade scenarios described earlier to determine whether the proposed improvements are cost-effective. BCA is a conceptual framework that quantifies, in monetary terms, as many of the costs and benefits of a project as possible. Benefits represent the extent to which stakeholders affected by the project are benefited. BCA is typically a forward-looking exercise, which means that the analysis anticipates the benefits of a project or proposal over its entire life cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational considerations.

The BCA produces several important measures to assess the cost-effectiveness of a proposed scenario. A scenario must be able to provide benefits to stakeholders while being able to cover program costs. Benefits realized from improvements represent costs currently incurred by the system that are internalized by carriers, and ultimately passed on to shippers or end consumers. Improvements made to the inland waterway system will benefit carriers, who may pass along cost savings to producers, who, in turn, may pass along the savings to consumers.

Table 2 summarizes the BCA results for each upgrade scenario. Relative to the other scenarios, the Micro Upgrade scenario yields the highest discounted BCR of 3.52, while the System Reliability scenario shows a BCR of 1.25. Conversely, the System Reliability scenario yields the largest net present value (NPV) of $368 million compared with the $6.2 million NPV for the Micro Upgrade scenario (single mooring cell). While detailed evaluation of a Large-scale Upgrade scenario is not included in this report, a Large-scale upgrade that is bundled with other improvements (as demonstrated in the USACE NESP authorization) is anticipated to break even at a 3 percent discount rate. The forthcoming USACE FY 2019 economic update for NESP will provide additional economic details regarding NESP, which would be considered a Large-scale Upgrade for purposes of this study.

The Micro Upgrade scenario has significantly lower total benefits, costs, and NPV because it only includes a single mooring cell at one location. While the results would not be directly scalable by the number of additional locations/locks (i.e., installing mooring cells at all UMR locks), propagation of the micro concept across the applicable UMR locations would likely result in total benefits, costs, and NPV an order of magnitude higher than a single mooring cell.

Table 2: Summary of the Benefit-cost Analysis, by Upgrade Scenario, Discounted at 7%, Millions of 2018 $

Scenario	Total Discounted Benefits	Total Discounted Costs*	Net Present Value	Benefit-cost Ratio
Micro Upgrade: Mooring Cell	$8.7	$2.5	$6.2	3.52
System Reliability	$1,854.0	$1,487.0	$368.0	1.25

* Includes 3 percent annual operating and maintenance costs.

6.3 Economic Impact Analysis

The economic impact analysis sought to quantify the contributions to the regional economy as a result of transporting commodities along the inland waterway system. Typically, economic impacts are measured by industry output, gross regional product (GRP), and employment. While output is the broadest measure of economic activity and refers to the total volume of sales, GRP is the value companies add within a region. This value added is calculated as the difference between the amount a company spends to acquire a product or service and its value at the time it is sold to other users. GRP adds up the value added across all companies and industries and includes employee compensation, taxes on production and imports less subsidies, and gross operating surplus.

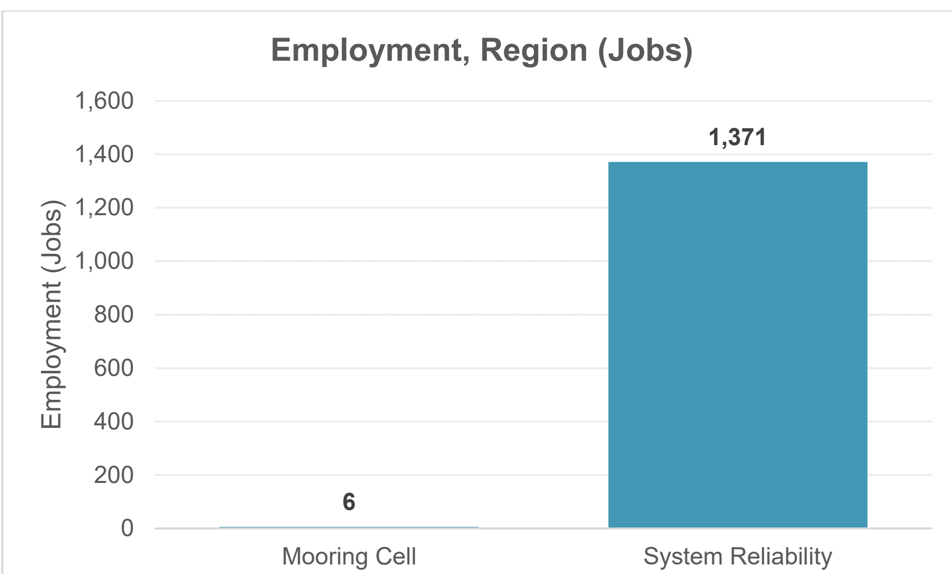
Figures 8 to 11 compare the economic impact analysis results. System Reliability improvements generate the largest economic impacts because of the sheer scale of the upgrades. The Micro

Upgrade has significantly lower economic impacts because it only includes a single mooring cell at one location. While the results would not be directly scalable by the number of additional locations/locks (i.e., installing mooring cells at all UMR locks), propagation of the micro concept across the applicable UMR locations would likely result in economic impacts an order of magnitude higher than a single mooring cell.

Specific evaluation is not included in this report for a Large-scale Upgrade, and economic impacts would vary depending upon the breadth of potential Large-scale Upgrade improvements. If a small number of locks are improved compared to the System Reliability scenario, economic impacts would be expected to be less than the System Reliability scenario and less than if Large-scale Upgrades are bundled with other improvements as demonstrated in the USACE NESP authorization. The forthcoming USACE FY 2019 economic update for NESP will provide additional economic details regarding NESP, which would be considered a Large-scale Upgrade for purposes of this study.

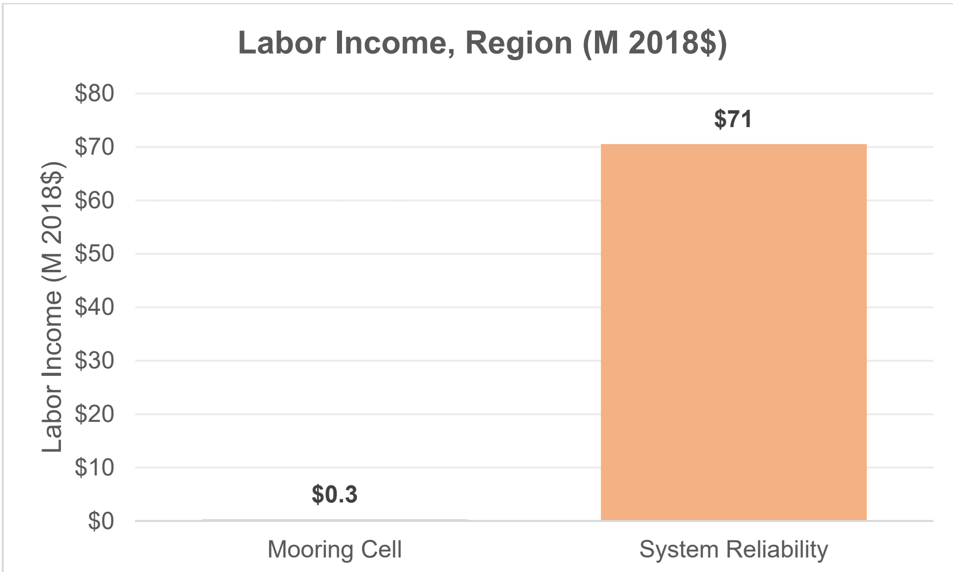
All scenarios are mutually exclusive and have independent utility. In other words, scenarios do not consider the presence or construction of other upgrades so they can be evaluated and assessed independently. While it may be possible that a Large-scale Upgrade is performed in tandem with a System Reliability improvement (or is constructed following a System Reliability upgrade), the analysis considered them separately and did not take into account potential benefits accruing from multiple projects undertaken simultaneously, in different phases, or in any other combination. Consequently, the results of this study are not directly comparable or in contrast to NESP studies performed by the USACE. Furthermore, the economic forecast did not include any new uses of the river, such as container traffic, new commodities, or new vessel technologies.

Figure 8: Results Comparison, Employment in Region (Jobs), Average per Year



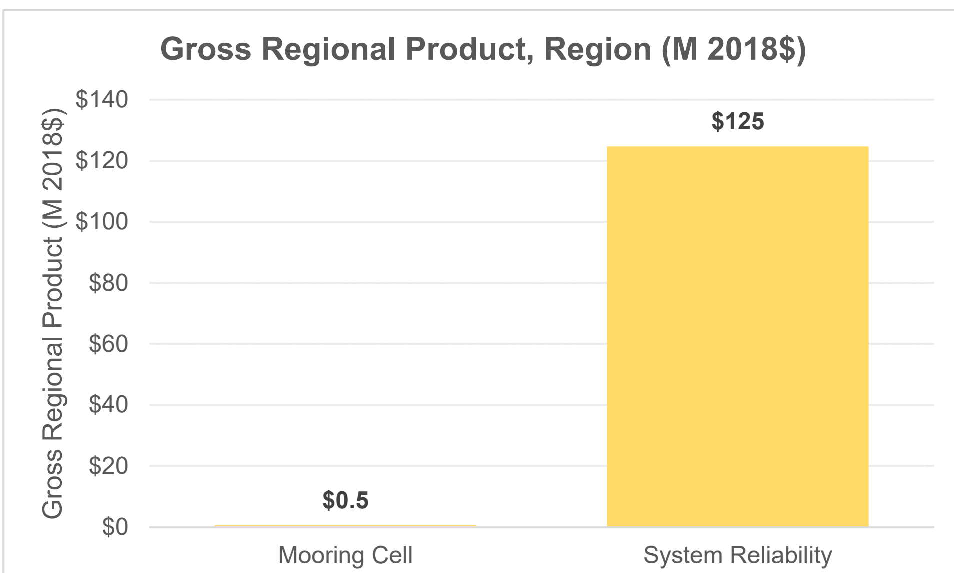
Source: HDR analysis of IMPLAN data

Figure 9: Results Comparison, Labor Income in Region (Millions 2018 $), Average per Year



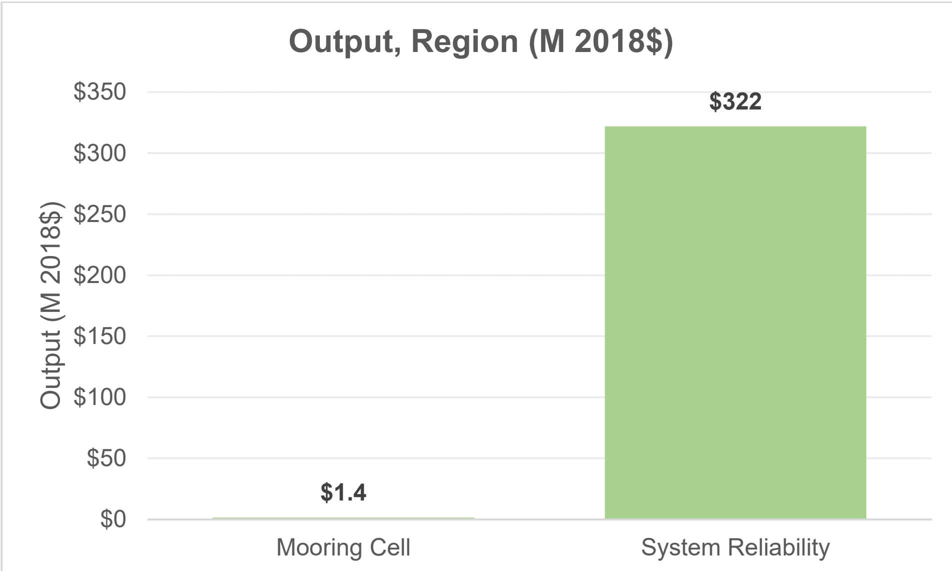
Source: HDR analysis of IMPLAN data

Figure 10: Results Comparison, Gross Regional Product in Region (Millions 2018 $), Average per Year



Source: HDR analysis of IMPLAN data

Figure 11: Results Comparison, Output in Region (Millions 2018 $), Average per Year



Source: HDR analysis of IMPLAN data

6.4 Economic Analysis Summary

The UMR Inland Waterway system contributes substantially to the economy of the five-state region that includes Iowa, Illinois, Minnesota, Wisconsin, and Missouri. The waterway system supports the movement of several different commodities, with corn and soybean shipments accounting for more than half of the goods moved by weight.

The economic impact of the inland waterway system is greater than just the commodities shipped. The analysis conducted for this study suggests that the waterway system currently supports more than 66,000 direct, indirect, and induced jobs in the five-state region. This contribution is expected to grow over 2.5 times by 2060, when the inland waterway system will contribute to more than 175,000 jobs in the region.

Commodities shipped by the waterway system are expected to grow substantially over the next 40 years because of shifts in demand for corn and soybeans domestically and internationally. Specifically, ethanol production is projected to remain stable, freeing any gains in corn yields for export, and global demand for soybeans is anticipated to remain strong and tied closely to overall population growth in developing countries. Longer term, rising incomes around the world are likely to drive demand for more corn and soybean exports, which will lead to growth in shipments along the inland waterway system. The IEG analysis forecasts 2.3 percent growth in shipments annually over the next 40 years.

In its current state, the UMR Inland Waterway system will be unable to support this growth. Long-term deferred maintenance has left the system in need of repair and improvement. This study considered three potential future scenarios for improving the conditions of the inland waterway system:

- Micro Upgrade (Mooring Cell)
- System Reliability Improvements
- Large-scale Upgrade

All three improvement scenarios exceed or are anticipated to break even (benefits equal or exceed costs) at a 3 percent discount rate, which is similar to the current rate that USACE uses for economic analysis. The Micro Upgrade (mooring cell improvement) provides the highest return on investment, with a BCR of nearly 6.0 at a 3 percent rate (or 3.5 at a 7 percent discount). The System Reliability improvements have a lower BCR, but generate the highest benefits with $2.1 billion in net benefits at a 3 percent discount rate (and nearly $1.5 billion at a 7 percent discount rate). While specific evaluation is not included in this report, a Large-scale Upgrade that is bundled with other improvements (as demonstrated in the USACE NESP authorization) is anticipated to break even at a 3 percent discount rate. The forthcoming USACE FY 2019 economic update for NESP will provide additional economic details for NESP, which would be considered a Large-scale Upgrade for purposes of this study.

While the benefit-cost analysis quantitatively compares the Micro Upgrade and System Reliability Improvements scenarios based on their project costs and generated benefits, the economic impact analysis provides an economic assessment of specific effects under various metrics, such as employment, output, labor income, and GRP (value added). Across all metrics, the System Reliability improvements rank the highest because of the project scale and the value they provide to users system-wide. The Micro Upgrade generates very small economic impacts because of the relatively small improvement (single mooring cell). Specific evaluation is not included in this report for a Large-scale Upgrade, and economic impacts would vary depending upon the breadth of potential Large-scale Upgrade improvements. If a small number of locks are improved compared to the System Reliability scenario, economic impacts would be expected to be less than the System Reliability scenario and less than if Large-scale Upgrades are bundled with other improvements as demonstrated in the USACE NESP authorization.

7.0 Governance and Alternative Financing

Under current federal and State law, the inland navigation system is the primary responsibility of the federal government, with the responsibility of the system residing with USACE. Alternative governance and financing structures were evaluated to identify potential opportunities to enhance the engagement of project stakeholders to finance, construct, and maintain improvements to the inland waterway system. This analysis focused on three potential governance structures:

1) State-federal
2) State-authority-federal
3) State-authority-private-federal

Therefore, for the purposes of this study, the following definitions apply:

- State – refers to Iowa DOT
- Federal – refers to USACE
- Authority – refers to a port authority, as defined in Iowa Code Title 1 Chapter 28J, Port Authorities[11]
- Private – refers to a traditional public-private partnership (P3) concessionaire that would operate under some form of a design-build-finance-operate-maintain business model

This evaluation addressed in detail only organizational structures authorized under existing law for which guidance has been developed as of the date of this report. While pilot programs and other arrangements have been authorized, no official implementation guidance has been prepared to support developing a model agreement.

7.1 Potential Mississippi River Port Authority

7.1.1 Iowa Port Authorities and Assessment of Iowa Code 28J

The State of Iowa has one port authority established under Iowa Code Chapter 28J. The Southeast Iowa Regional Economic and Port Authority (SIREPA) is established in Lee County to create new economic development opportunities in Lee County and southeastern Iowa. Additionally, Iowa Code Chapter 28K provides for the creation of the Mid-America Port (MAP) Commission. The MAP Commission is a multi-state port commission that also includes representatives from Illinois and Missouri. It has broad powers to support development of port improvements that assist the commerce of the region. The MAP Commission encompasses 26 counties in Illinois (11), Missouri (9), and Iowa (6). The commission has acquired and optioned land and has installed the necessary infrastructure to assist in realizing the goals of establishing a tri-state foreign trade zone, an intermodal facility, bulk handling, and container-on-barge handling station. In their promotional materials, both the SIREPA and MAP Commission highlight the need to create P3s to advance their missions to grow the regional economy.

An initial assessment was completed of the applicability of Iowa Code Title 1 Chapter 28J and Iowa Code Title 1 Chapter 28K to form the basis of a port authority that could serve as a local project sponsor in a project partnership agreement with USACE. Sections of the code were identified that may require modification or enhancements to allow a port authority established under this code to use all the tools necessary to deliver inland waterway system improvements. A select summary of these sections of the code and suggested improvements include:

1) Chapter 28J Section 28J.1 Definitions – Cost (for allowing inland waterway navigation system improvement costs)
2) Chapter 28J Section 28J.2 Creation and powers of port authority – Reconcile with Section 28J.8 Area of jurisdiction for potentially allowing entities to be part of multiple port authorities
3) Chapter 28J Section 28J.3 Appropriation and expenditure of public funds – Expand contracting ability and allow for forms of alternative project delivery

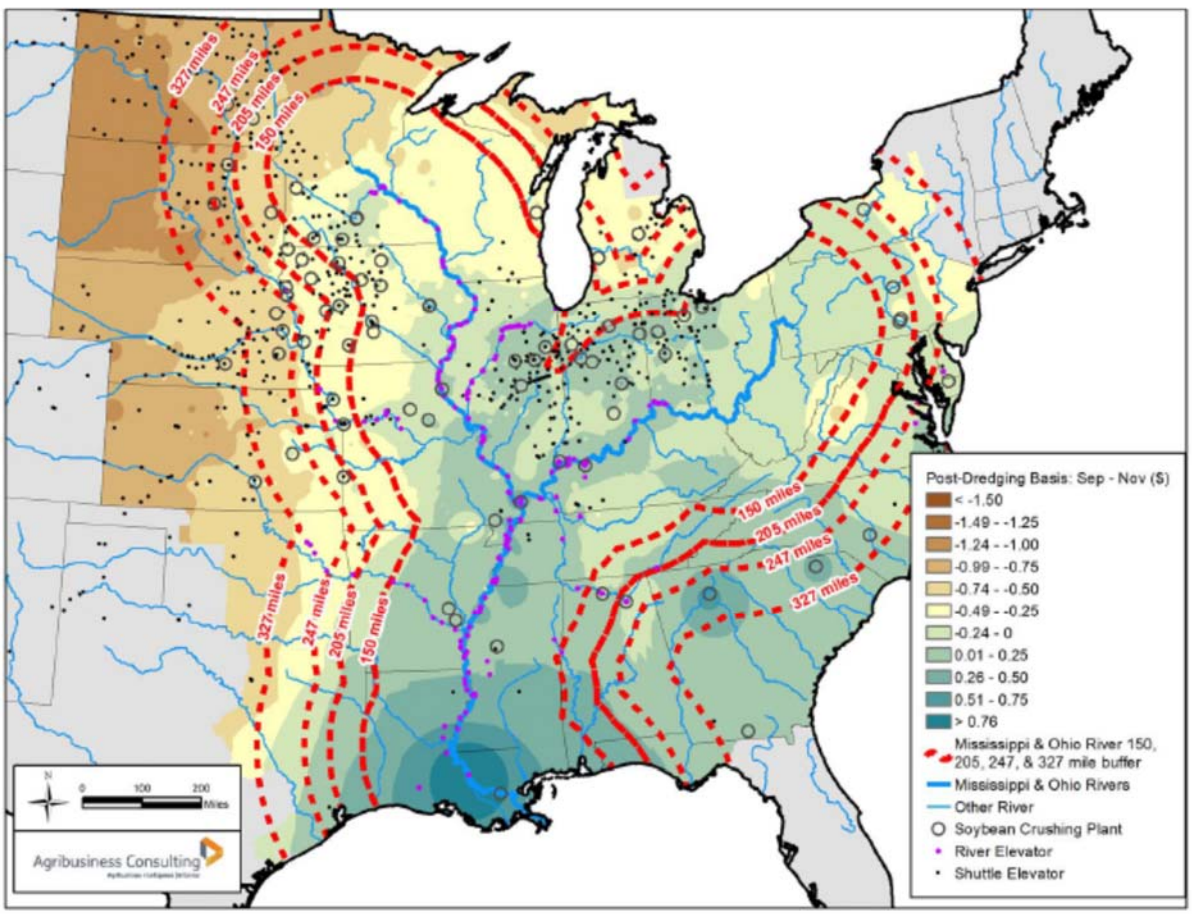
[11] *Southeast Iowa Regional Economic Development and Port Authority. 2016. "Partner Organizations." https://www.sirepa.org/partners.*

4) Chapter 28J Section 28J.8 Area of jurisdiction – Allow the same jurisdiction to be part of multiple port authorities in support of a potential broader regional port authority (using the previous precedent of the MAP Commission)
5) Chapter 28J Section 28J.9 Powers of port authority – Improving or operating facilities not owned by the port authority and the potential expansion of the ability to levy taxes

7.1.2 Geographic Boundaries of a Potential Port Authority

The geographic extent of a port authority could be established in several ways, with a potential option to involve those Iowa counties that are contiguous to the Mississippi River. A second option expands on the first option by using an economic capture zone of the UMR Inland Waterway system as the general geographic boundary for the port authority. As an example, if the 150-mile line (Figure 12) represents a reasonable grain export capture zone for the port authority, approximately the eastern half of Iowa could potentially be formed into a port authority for the purposes of creating a governance authority for the Iowa portion of the UMR Inland Waterway system.

Figure 12: Export Capture Zone for UMR Inland Waterway System



Source: IEG Presentation Slide Deck

7.1.3 Revenue Capture Models for a Port Authority

Under current federal law, inland waterway system improvements are financed by the federal treasury and the Inland Waterway Trust Fund. Port authorities under Iowa Code do not have independent taxing authority but rather receive funds from their sponsoring political subdivisions, which do have taxing authority. Port authorities can, however, charge various fees for use and rent of port authority facilities and can issue debt that is recovered from revenue generated by port authority projects. Port authorities typically raise revenue by charging rent and fees for facilities that they construct.

A regional port authority within the direct impact economic zone of the State of Iowa could capture revenue from a number of UMR Inland Waterway system stakeholders. There are a number of means to generate the additional revenue, including through a sales tax, a property tax, a fuel tax, water use fees, or other means. It was beyond the scope of this study to develop a specific taxing or revenue generation proposal. However, areas that were examined include:

1) Capturing fuel tax revenue from non-commercial use of the river
2) Modifying 33 United States Code 565 to charge tolls to non-commercial and recreational vessels
3) Assessing a fee for water appropriated from UMR
4) Exploring additional hydropower revenue and revenue capture to generate a dedicated source of funding
5) Collecting regional sales or property taxes from within the direct economic impact zone

7.2 State-Federal Governance Framework

The two most likely frameworks under existing authorities that could be used to implement UMR Inland Waterway system projects are:

1) Establishing a project partnership agreement using a contributed funds memorandum of agreement.[12]
2) Constructing a project under Section 408 approvals with turn back to USACE.

Under existing authorities, Iowa DOT has the necessary authority to enter a project partnership agreement with USACE. In short, an agreement would be reached between Iowa DOT and USACE to implement a specific project or suite of projects. Iowa DOT would transfer funding to USACE to implement the requirements of the project partnership agreement. Planning, engineering, design and construction of the project would be accomplished by USACE.

As an alternative, the Iowa DOT could chose to make the navigation improvements. This could be accomplished by receiving a Section 408 approval from USACE. The Section 408 approval documents would describe the project requirements for alteration of a federal navigation project. Iowa DOT may have to provide some funds to USACE for its review and participation in the

[12] U.S. Army Corps of Engineers. “Project Partnership Agreements.” http://www.usace.army.mil/Missions/Civil-Works/Project-Partnership-Agreements/.

process. Iowa DOT would implement the project and then turn it back to USACE for incorporation into the navigation system.

7.3 State-Port Authority-Federal Governance Framework

A port authority organized under the port authority code of Chapter 28J would have all the necessary qualifications to enter into an agreement with USACE subject to the potential limitations previously identified. The MAP Commission is an example of a regional, multi-state port authority that could serve as a model for a broader multi-state port authority over the UMR Inland Waterway system. Port authorities across the country often serve as facilitators and partners with private business to promote economic expansion of a region and serve as a catalyst for the transfer of goods and services across various modes of transportation.

A port authority could serve as a sponsor and a mechanism to foster additional public and private investment in the UMR Inland Waterway system and could generate revenue for its operation, maintenance, and improvement. A regional port authority can also target revenue capture from a larger subset of direct project beneficiaries. For example, the federal government cannot levy a property tax, whereas the port authority could be granted this power under State law.

7.4 State-Authority-Private-Federal Governance (P4) Framework

Under both federal and State law, several barriers exist to instituting a P4 concessionaire governance framework. However, if allowed, the minimum requirements of a potentially viable P3/P4 project that would attract private capital to the undertaking of an inland waterway system improvement include:

1) Ability to use alternative delivery methods such as design-build
2) Ability to implement operational and maintenance flexibility through long-term operation and maintenance contracts
3) Ability for the federal or local owner to generate revenue to make availability payments to the P3/P4 concessionaire
4) Ability for the P3/P4 concessionaire to charge user fees or tolls, or to generate other income from the project operation to provide the desired return on investment

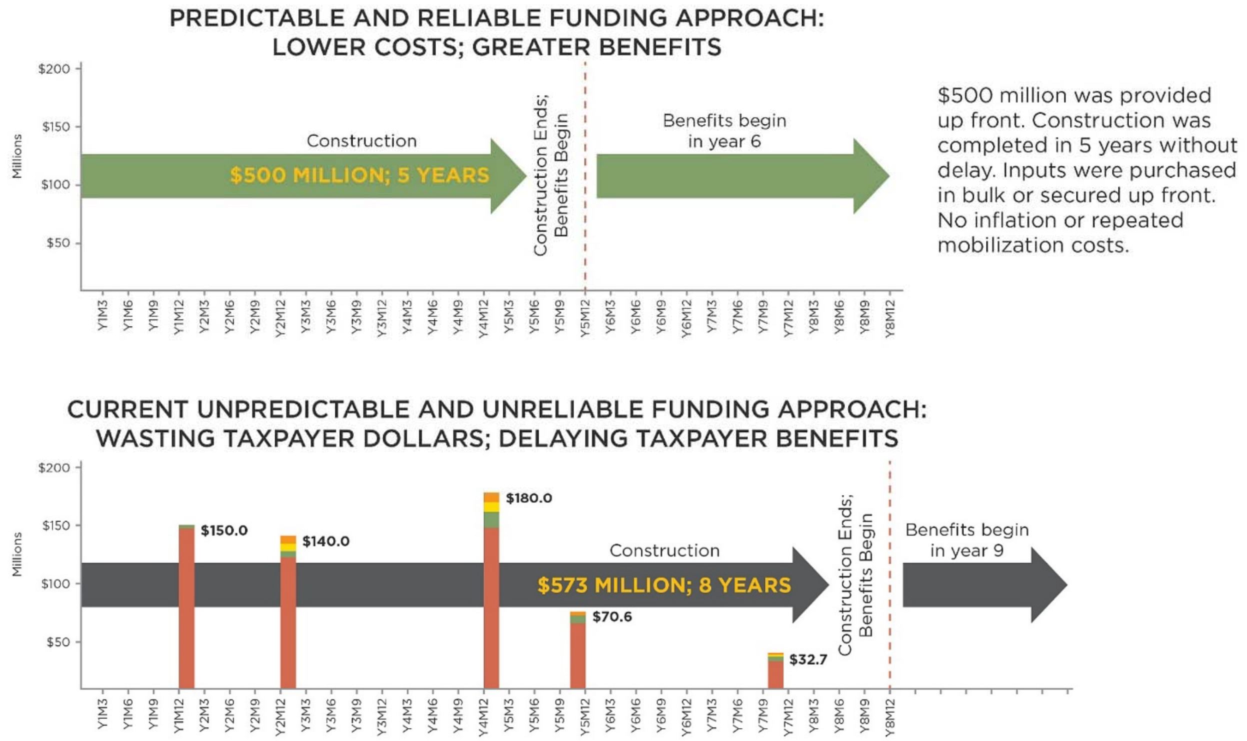
The lack of sufficient governmental guidance or laws makes creation of P4 governance model difficult. A P4 governance framework could assist with increasing the reliability of funding.

The Soy Transportation Coalition released a study in April 2018 entitled *Predictable Funding for Locks and Dams*.[13] The report highlighted the increased costs attributable to Congress's funding approach, which does not result in full and efficient construction funding. The current approach often results in both unrealized benefits and significant cost overruns. The report illustrates that

[13] *Soy Transportation Coalition. 2018. Predictable Funding for Locks and Dams. April.*

the same project could cost considerably less if it is funded in a consistent manner. Figure 13 summarizes the analysis.

Figure 13: Predictable Funding for Locks and Dams Summary Graphic



Time	Allocation	Inflation	Mobilization Costs	Piecemeal vs. Bulk Purchasing	Available for Construction
Year 2 Month 1	$150.0	$3.0			$147.0
Year 3 Month 1	$140.0	$5.6	$7.0	$7.0	$120.4
Year 5 Month 1	$180.0	$14.4	$9.0	$9.0	$147.6
Year 5 Month 12	$70.6	$7.1		$3.5	$60.0
Year 7 Month 11	$32.7	$4.4	$1.6	$1.6	$25.0
Total	$573.3	$34.5	$17.6	$21.2	$500.0

Inflation (2%)
Mobilization (5%)
Piecemeal vs. Bulk Purchasing (5%)
Available for Construction

Funded by the soybean checkoff.

Source: Soy Transportation Coalition. 2018. *A Recipe for Cost Overruns and Project Delays: STC Research Highlights Nation's Approach to Funding Locks and Dams*. http://www.soytransportation.org/newsroom/PressRelease_PredictableFundingForLocksAndDams%20_4-16-18.pdf.

A potential way to realize benefits sooner and to reduce costs of inefficient financing is to develop a P4 model that uses private capital to bridge the funding gaps from federal sources through a combination of lease arrangements, hydropower generation, loan guarantees, and collection of other fees or revenue. The port authority could serve as a back up to receipt of federal funding to provide a measure of certainty to the investors.

7.5 Correlation with NESP

This study has reconfirmed findings of the *UMR-IWW System Navigation Feasibility Study Final Integrated Feasibility Report and PEIS* (NESP Feasibility Study, USACE, September 2004). Specifically, that study called for the adaptive implementation of specific components of the recommended plan. These included mooring facilities and switch boats in the first increment, followed by construction of new 1,200-foot locks at seven locations along the UMR-Illinois Waterway (IWW) system, followed by continued study of the system to evaluate effectiveness. This study evaluated similar elements in considering the benefits of a single mooring cell at L&D 14 to improve upbound traffic efficiency and selected expansion of the lower three locks on the UMR. Unlike the NESP study, this study also considered the benefits of the major rehabilitation program to reduce both unscheduled and scheduled maintenance requirements along the system. In the NESP program, the major rehabilitation program was considered the baseline case (i.e. future without project scenario) and was assumed to be fully funded during the planning timeline of NESP. However, as history has shown, the major rehabilitation program has not been funded and, as this study demonstrated, the amount of scheduled and unscheduled maintenance delays continues to climb as the systems continue to age.

Elements such as mooring cells are eligible for construction funding under the O&M budget, and the major rehabilitation program is a stand-alone program that is funded through cost sharing between the Inland Waterway Trust Fund and the general fund. Therefore, a specific appropriation is not required for either of these programs. However, the significant amount of existing critical maintenance needs exhausts available maintenance funding, preventing new elements of the system (such as a mooring cell) from rising to the top of the priority list. Major rehabilitation funding is suffering from a significant backlog of needs, specifically attributed to the delays and cost overruns at the Olmsted Lock project, which used much of Inland Waterway Trust Fund source. With Olmsted nearing completion, more funding will become available for major rehabilitation projects; however, a significant backlog of needs remains.

The NESP Feasibility Study was intended to be implemented in increments. However, Congress, the Administration, and appropriators in the Office of Management and Budget have appeared to treat the NESP program similar to a single project appropriation for new start funding. Typically, new start construction funding is started and it is continued until the construction is complete. The significant cost of the seven new 1,200-foot locks drives down the BCR of the program and, therefore, discourages starting the incremental implementation. In the absence of earmarking, little chance exists that a low BCR project or program will be funded for new start construction funding.

Based on current budget scoring rules and earmarking prohibitions in Congress, it is unlikely that the NESP will be appropriated new start construction funding without breaking NESP into clearly defined separable elements that stand on their own merits relative to BCRs and other benefit indicators. Packaging all elements into a combined delivery program that includes small- and large-scale elements does not result in a program that appears destined for success in the appropriation process.

The 2018 Water and Energy Appropriation bill provided USACE approximately $1 million to update an economic analysis of the NESP study within 1 year of the enactment of the legislation. This budgeted amount is likely not enough for a full reassessment of the economics conducted as part of NESP, nor does the scope of the study entail looking at breaking NESP into separable elements for implementation. Rather, the economic analysis will focus on confirming or validating key assumptions used in the past analysis and the associated expected benefits. Additionally, based upon the limited budget, NESP project costs will likely be indexed based upon calendar year price level construction factors; and not recomputed based upon construction line items.

8.0 Upper Mississippi River Inland Waterway Summit

Iowa DOT hosted a multi-state, one-day summit for the UMR Inland Waterway study. The summit was held on June 8, 2018, in Bettendorf, Iowa, and consisted of two context-setting presentations and two breakout sessions.

Approximately 45 attendees participated in the workshop. Attendees included a variety of stakeholders, including representatives from state DOTs, USACE, elected officials, industries related to freight transportation, and special interest groups.

The workshop included an introduction from Iowa DOT Director Mark Lowe and the Iowa Economic Development Authority's Debi Durham, two presentations, one breakout session to identify and prioritize key issues, and one breakout session to identify financing and governance alternatives:

- Presentation #1: Present & Future Use of the System – focused on current state and funding of the UMR Inland Waterway system as well as a commodity flow forecast
- Presentation #2: Providing a Robust & Reliable System – presentation of three pilot scenarios and the associated economic impacts and benefit-cost analysis
- Breakout Session #1: Define Key Issues & Priorities – participants defined issues within navigation infrastructure, economics, governance, and alternative financing as they related to capacity, reliability, or efficiency. The group voted on the top priority items as follows:
    - Navigation
        - Capacity – all three levels (capacity, reliability, efficiency) important and need long-term maintenance and reliability
        - Reliability – major rehabilitation $/prioritization of projects
        - Efficiency – infrastructure along river (e.g., bridges with low clearance) that may need updating
    - Economics
        - Fully funding individual projects up front rather than segmented, yearly funding
        - Impact of traffic projections. Where we are today/going relative to multimodal?
        - Reliability continues to provide benefits, system needs to be reliable
    - Governance
        - Should other beneficiaries (state, local, private, or nonprofit) be added?
        - Private concessionaire/P3
        - Federal responsibility – interstate commerce and national security
    - Alternative financing
        - Hydropower
        - Focus on how trust fund is used
        - P3s – No clear definition of where money comes from

- Breakout Session #2: Governance & Alternative Financing – A brief presentation provided background on the current governance framework that guides today's financing options and possible financing options for discussion. Participants identified potential issues and voted on the most plausible ideas as follows:
  - Governance
    - Five-state coordination/compact (i.e., regional port authority concept)
    - Federal governance
    - Divestiture of low-use assets
  - Alternative financing
    - Hydropower
    - Charging for water use
    - Port authority

The summit concluded by thanking participants for their input and indicating that the input provided would be incorporated in recommendations for the UMR Inland Waterway study and provide Iowa DOT with direction on how to move forward with improvements to the UMR Inland Waterway.

9.0 Conclusions and Recommendations

9.1 Scope and Assumptions

Key clarifications that provide context for the current study are as follows:

- Infrastructure evaluations, economic analyses, and financing alternatives were developed using the most current and readily available data.
- Commodity forecasts and economic analyses were based on market, policy, and technology conditions at the time of the study. Impacts of unpredictable, yet potentially significant, influences such as new waterway users/uses/commodities, changes in trade/tariff and ethanol policy, or technology/innovation (e.g., container traffic or new vessel technology) were beyond the scope of this study.
- Governance and financing alternatives were focused on arrangements involving the State of Iowa only. Specific arrangements involving multiple states could be considered in future study phases.

9.2 Study Findings

The current study has found the following since the initial study in 2013:

1) Elements of WRRDA 2014 and the WIIN Act of 2016 have increased the potential flexibility for financing improvements to the UMR Inland Waterway System; however, implementation guidance has not been developed for several key alternative financing sections.
2) The implementation of risk-informed decision making for maintenance of the inland waterway has increased the amount of scheduled maintenance and may start to be reflected in reduced numbers associated with unscheduled lock closures and delays. This provides greater certainty to waterway users.

3) Commodity forecasts indicate increasing demands on the inland waterway for export of commodities to international markets. Analysis of past use, however, indicates that changes in trade policy (such as tariffs) or technologies (such as ethanol production) can alter forecasts.
4) Generally, broad support exists among stakeholders for implementation of efficiency and reliability improvements along the inland waterway. This stakeholder backing is supported by positive BCRs for these improvements.
5) Capacity improvements in the form of 1,200-foot locks were ranked lower in terms of support from stakeholders, and BCR calculations were not as favorable. However, this study did not extend lock expansion improvements to the number recommended by NESP nor bundle improvements as proposed in NESP.
6) Implementation of an initial pilot project in the form of a mooring cell upgrade at L&D 14 could be accomplished through a state-federal (Iowa DOT-USACE) arrangement using a project partnership agreement for contributed funds.
7) Alternative revenue concepts were explored at a high level, with some promise indicated in exploring additional hydropower production, leveraging fees for non-navigation water use, or enacting some form of regional tax based on increases in economic activity brought about by waterway improvements.
8) Existing Iowa laws for port authorities provide a framework to broaden authorities to serve as a local project sponsor for navigational improvements along the waterway.
9) Potential new uses of the inland waterway, including the advent of container vessels specifically designed and constructed for use on the waterway, are being considered.

9.3 Recommendations

The stakeholder engagement workshop results from this study prioritized efficiency and reliability over capacity improvements. In addition, the benefit-cost analysis demonstrated that relatively low-cost improvements with very high BCRs could improve the efficiency and reliability of the system and supports the concept of allowing split delivery of NESP improvements.

The results of this study suggest that the State of Iowa consider working with the appropriate stakeholders to promote federal legislation that would allow separable elements under NESP to be appropriated new start funding based on the merits of the individual elements. This would allow the small-scale efficiency elements such as mooring cells to be implemented through specific appropriations, given their high BCR, without competing for limited O&M funds. The major rehabilitation program has failed to maintain pace with the assumptions contained in the UMR System Feasibility Study's future without project alternative under NESP; therefore, the system's actual performance would fall short of the scenario represented in NESP. Consistent funding of the major rehabilitation program is needed to address the long term sustainability of the existing UMR lock and dam infrastructure and to stem increases in the amount of unscheduled and scheduled lock closures and maintenance required throughout the system to maintain operations.

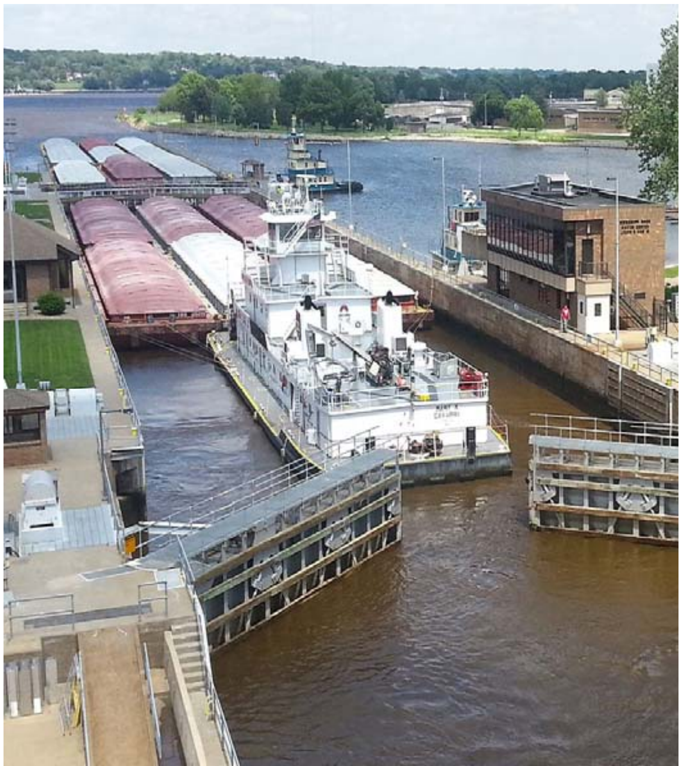
The results of the study and stakeholder engagement have identified recommendations to continue to focus on and drive improvements to the UMR system. Recommendations are shown in Table 3 below.

Table 3: Study Recommendations for Action and Associated Benefits

Action	Benefits
Specific Recommendations for Iowa	
Use a State-Federal P2 project partnership agreement (PPA) and/or contributed funds to implement the Micro Upgrade scenario of a mooring cell at L&D 14. While not necessary, this agreement could be completed as a pilot project under Section 5014 under WRRDA 2014, should USACE complete the necessary guidance.	Demonstrates progress on implementing navigation system improvements and the importance of non-federal/federal partnerships in moving these improvements forward, provides high return on minimal investment (high BCR), and can be easily replicated.
Establish a regional cooperative working group with other UMR states to expand and promote the Micro Upgrade scenario concepts across the UMR region.	Leverages additional small investments in a low cost and environmentally beneficial way to improve the efficiency of the UMR waterway.
Update State of Iowa port authority statutes to provide the ability to enter into USACE partnership agreements and develop financing tools for navigation system improvements.	Provides the opportunity to create a special purpose unit of government that is inherently vested in promoting an improved navigation system.
Evaluate an additional economic scenario that focuses on new markets, technologies, and innovation in the uses for transporting goods on the UMR, such as container traffic or new commodities.	Current economic analysis focuses on expansion of existing commodities only. Consideration of the potential new uses could potentially improve the benefit cost ratios or modify the desired improvements.
Federal/Regional Recommendations	
Encourage Congress, the Administration, and USACE to fund and complete necessary implementation guidance for WRRDA 2014 Section 2004a, Inland Waterways Construction Bonds Study; Section 2004b, Potential Revenue Sources for Inland and Intracoastal Waterways Infrastructure; and Section 5014, Water Infrastructure Public Private Partnership Program.	Provides the necessary study and recommendations to Congress to move forward with the previously authorized programs for using new sources of revenue and partnerships on USACE related water resource programs.
Explore implementation of portions of NESP as separable elements or a split delivery model, specifically the first increment of mooring cells identified in NESP alternative 4.	Allow NESP to gain traction and move forward on navigation and environmental improvements. The use of the split delivery model has proven successful in moving forward USACE flood risk management programs such as the Fargo-Moorhead Diversion project.
Engage with regional stakeholders to consider establishment of a broader UMR port or navigation authority to promote UMR navigation improvements.	Provides for an Upper UMR commission or authority to advocate for navigation improvements, similar to the Mississippi River Commission which is responsible for inspecting and reporting to Congress on the condition of the of the lower river.

Appendix A

Infrastructure Update Report



Alternative Financing Evaluation

Upper Mississippi River Inland Waterway Infrastructure Update

Iowa Department of Transportation

Ames, Iowa

April 2019

Executive Summary

The Upper Mississippi River Waterway is a vital part of our national inland navigation system and the Midwest economy; and also serves as a valuable ecological resource. The Waterway includes 27 locks and dams spanning from Minneapolis, Minnesota to St. Louis, Missouri. The 750 miles of 9-foot navigation channel created by the locks and dams allow waterway traffic to move from one pool to another providing an integral regional, national and international transportation network. The 9-foot Navigation Channel Lock and Dam system was largely constructed in the 1930's. The system consists primarily of 600-foot lock chambers, which do not accommodate today's modern tows without splitting and passing through the lock in two operations. This locking procedure requires uncoupling barges at midpoint, which triples lockage times and exposes deckhands to increased risk for accidents.

The wear-and-tear of 80+ years of traffic, barge impacts, freeze/thaw cycles and recurrent flooding has taken a toll on the UMR Waterway in the form of steady deterioration of the lock and dam components. Lock operating machinery and electrical components become outdated with no available replacement parts as the end of their design life approaches; thousands upon thousands of cycles of lock and dam gate loadings fatigue the strength of the steel gates; freezing, thawing and barge strikes deteriorate concrete to unacceptable and unsafe conditions; and the underlying foundation components that support the locks and dams are demonstrating increasing levels of unreliable performance. Lock and dam scheduled maintenance projects have slowed the rate of unscheduled outages; however, the system continues to have increased risks of major service interruptions if the underlying deficiencies are not addressed by Major Rehabilitation projects. Otherwise, the deficiencies will continue to be addressed using a fix-as-it-fails strategy as the years progress.

In recent years, the US Army Corps of Engineers has revised their Operations and Maintenance (O&M) funding prioritizations to a risk-informed prioritization of maintenance needs to keep the system operating as reliable as current funding provides. However, recurring problems and outages continue to plague the system, requiring a robust funding stream to keep the locks and dams performing at an acceptable level of service reliability.

Modernization of the UMR Waterway for efficient accommodation of modern tow configurations remains unfunded, including such congressionally authorized programs as the Navigation and Environmental Sustainability Program (NESP). NESP provides for improvements in the capacity of the waterway to meet future traffic demands in an economical and efficient manner. NESP improvements range from small improvements, such as adding mooring cells that increase the efficiency of the existing system, to large measures, such as the addition of 1200-foot locks at five of the UMR lock sites. NESP projects also provide for comparable improvements on the ecologic resources of the river through a variety of ecosystem restoration projects.

Recent changes in Water Resource Development Acts of 2014 and 2016 have provided opportunities for non-federal interests to advance inland waterway projects. Several WRRDA 2014 and WIIN 2016 sections, including those related to use of non-federal funds, public-private partnership arrangements, and non-federal implementation of pilot projects, will be further investigated as the Iowa DOT UMR Waterway study progresses.

Contents

Figures

Tables

1.0 Project Background

In April of 2013, the Iowa Department of Transportation's (Iowa DOT) U.S. Inland Waterway Modernization Reconnaissance Study (Reconnaissance Study) was completed. Since publication of this study, significant legislation, study and discussion have occurred involving the inland waterway system, along with five additional years of U.S. Army Corps of Engineers' (USACE) operation and maintenance of the waterway. Several recommendations of the Reconnaissance Study have come to fruition, including passage of the Water Resources Reform and Development Acts (WRRDA) bills and the Water Infrastructure Improvements for the Nation Act of 2016 (WIIN). WRRDA 2014 contained two sections, Section 2004 a/b and Section 5014 which, if funded, would advance Inland Waterways alternative financing. WIIN 2016 Section 1153 expanded the USACE's ability to utilize contributed funds, material or labor to advance waterway projects.

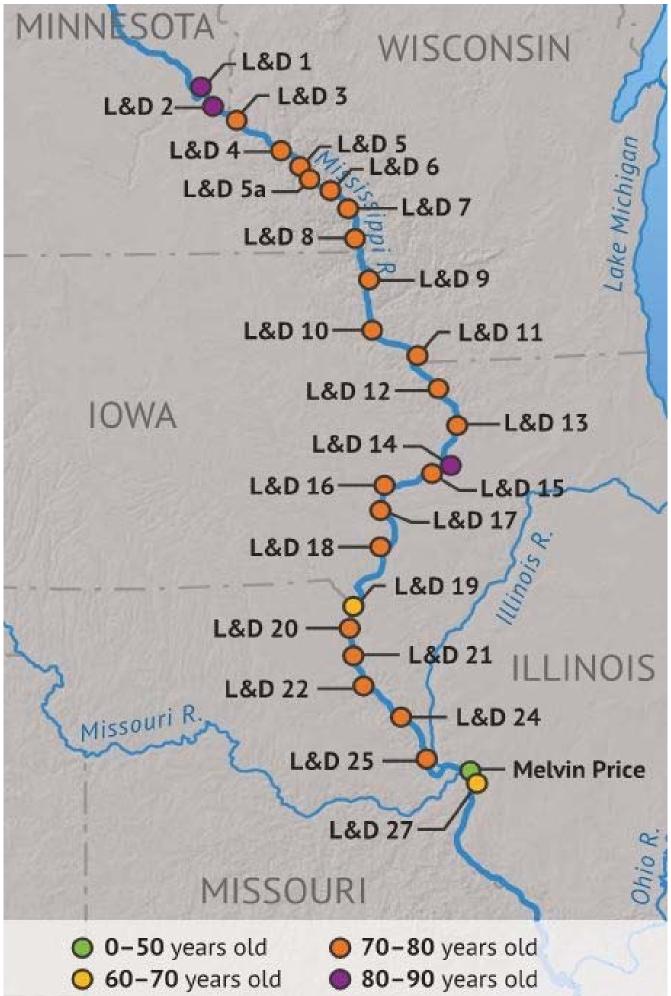
The Iowa DOT is continuing to collaborate with the USACE to enhance the performance of the Upper Mississippi River (UMR) lock and dam (L&D) system, see Figure 1. As a part of these collaboration activities, the Iowa DOT is undertaking an Alternative Financing Evaluation of the UMR Inland Waterway Infrastructure to support the development of long term vision for the waterway that serves the UMR stakeholders' needs and to identify feasible investment strategies for the waterway that recognizes the opportunities created by the WRRDA 2014 and WIIN 2016. Of special interest are the revised contributed funds programs for USACE water resources projects such as the UMR Waterway's L&D system.

2.0 Objective

The current Administration and Congress are working on infrastructure spending bills. The White House's Fact Sheet – 2018 Budget: Infrastructure Initiative specifically addresses reforming the laws that govern the Inland Waterways Trust Fund and providing for additional revenue by encouraging the use of USACE contributed/advanced funding authorities. The Administration proposes to leverage the Corps' authorities to enter into such contributed funds agreements to take advantage of this innovative approach to delivering projects. As of mid-April 2018, Congressional debate is on-going per the Administration's infrastructure initiatives. The State of Iowa and other partner States recognize a unique opportunity may exist to capitalize on the momentum of the 2013 Reconnaissance Study, and develop specific feasible funding and implementation alternatives that address governance, financing, construction and operation of navigation infrastructure improvements to create lasting and sustainable value to the UMR Waterway.

The objective of this report is to provide an infrastructure update to support a long term vision document that serves as a guide to inform UMR Waterway stakeholders of the purpose, direction and benefits of improving the reliability of the existing L&Ds and undertaking new capital improvements such as mooring cells or new 1,200-foot locks to upgrade the system's ability to successfully meet the waterborne transportation needs of the UMR region into the foreseeable future.

Figure 1: UMR Waterway System



3.0 U.S. Inland Waterway Modernization Reconnaissance Study, 2013

The 2013 study established and quantified the vital importance of the UMR Waterway to the United States economy as it enables the efficient movement of goods and services. The study also identified the current issues and condition of the waterways, with focus on the UMR system. Key findings of the 2013 study included:

1. No increase in current funding plans will result in loss of economic benefits.
2. Leveraging increased funding from traditional sources is the only practical short term option to address the constrained funding.
3. A partial divestiture of the waterway system where low traffic volumes exist should be further examined.
4. Public-private partnerships to upgrade and operate elements of the waterway system are feasible only if a dedicated revenue source is found.

5. Revenue bonding would infuse capital for improvements and capture benefits sooner; however, a study is needed to determine that the benefits outweigh the borrowing costs.
6. Augmenting traditional waterway funding with state/local funding would not be a stand-alone solution, rather part of a more comprehensive solution that includes expanded user fees and federal appropriations.

4.0 USACE's Inland Waterway Funding Process

USACE programs and projects, including the Inland Navigation Business Line for L&Ds, are funded through the annual federal appropriations process. The annual process begins with the Administration's development of the President's budget recommendations, which are submitted to Congress and serve as baseline for the Congressional appropriations. With the submittal of the President's budget recommendation, Congress begins working on a number of appropriations bills that fund the Government for the upcoming fiscal year.

The Administration's formulation of the President's budget recommendation begins with federal agencies, including the USACE. Throughout almost two years, the USACE develops a budget recommendation which it submits to the Office of Management and Budget (OMB) for assessment, refining and inclusion into the President's budget recommendation. The USACE budget formulation is an interactive process starting at the USACE District level and involving USACE Divisions and Headquarters. USACE Headquarters reviews the budget requests initiated at the districts and consolidated at each respective division office; and then develops a comprehensive USACE budget request that is forwarded to the Assistant Secretary of the Army for Civil Works (ASA). The ASA's office reviews the budget request, makes adjustments and submits a USACE budget proposal to the OMB. OMB then adjusts and finalizes the ASA's budget request into the President's budget recommendation.

Congress funds the USACE's civil works activities through the Energy and Water (E&W) Development Appropriations acts, which can provide for more or less funding than requested in the President's budget. Congressional subcommittees will review the President's request, hold hearings as they determined needed on the budget, and markup the E&W Development Appropriations bill. Once a subcommittee agrees to the bill, it moves to the Committee on Appropriations, where it can again be marked up.

Congress can allocate additional funding to USACE programs and projects without identifying specific projects. The actual decision-making process for where the additional funding allocations go is an OMB responsibility based primarily upon expressed capabilities included in the ASA's budget, and the additional funding is allocated via "work plans" to USACE Divisions and Districts.

USACE has a number of budget accounts, three of which fund civil works activities such as navigation L&Ds. These three funding accounts are: General Investigations (GI), Construction General (CG), and Operations and Maintenance (O&M). The GI account funds planning and feasibility studies, which are undertaken to determine the need, engineering feasibility, cost, economic benefits, and environmental and cultural compliance of potential projects. The CG account funds the final engineering design, construction and construction management activities for civil works projects. O&M funds address the ongoing operation and the maintenance activities of existing projects, such as the daily L&D operations, utility costs, channel dredging, and component repairs.

USACE's O&M account has been an increasing share of the agency's budget, while the CG account has mostly flat-lined. The reasons behind this is primarily due to Congress and past Administration's efforts to limit funding for new capital infrastructure, or "new starts," and focus funding on activities that address aging infrastructure while only completing already started new projects. This focus has been especially true on the UMR Waterway as no new CG starts have occurred on the UMR L&D system since the Major Rehabilitation projects at Lock and Dam 11 in 2003, and Locks and Dams 19 and 27 in 2004. For nationwide reference, the only USACE inland waterway CG new starts since 2004 have been Major Rehabilitation projects at Markland and Emsworth Locks and Dams on the Ohio River System and Lockport Pool on the Illinois Waterway in 2007. Over the past 15 years, a majority of the USACE's CG inland waterway budget has been directed to the continuing new construction at the Ohio River System's Olmsted, Lower Monongahela, Kentucky and Chickamauga projects, especially the Olmsted Lock and Dam construction site.

5.0 UMR Waterway Funding Trends, 2013 - 2018

The UMR Waterway funding received from the three O&M, GI and CG accounts for the past five years, FY 2013 – FY 2017, along with the FY 2018 President's budget recommendation has been provided to HDR by the USACE – Rock Island District. This funding data includes the three UMR Districts of St. Louis, Rock Island and St. Paul. Funding data for the same period was also obtained for the IWW system. The FY 2018 Omnibus bill approved in March 2018 did not result in any revisions to the UMR or IWW systems' O&M budgets. FY 2018 USACE Work Plans and Supplemental budgets may revise the Omnibus funding, with release of these project budgets scheduled for on or before May 22, 2018.

5.1 Operations & Maintenance, O&M

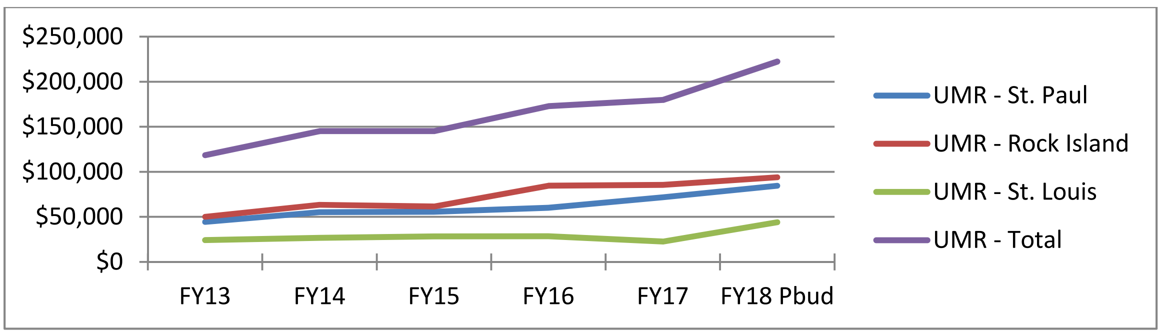
The O&M funding account includes the Routine O&M and Major Maintenance (MM) O&M funds that are received with no breakout provided in the USACE data. Routine O&M funds the day-to-day operation of the navigation system; the hired labor USACE L&D staff, utilities to operate, normal L&D maintenance activities, routine channel dredging, and river training structure (wingdams, jetties) maintenance. In general, it takes about $3 million annually for the Routine O&M of a typical individual UMR L&D facility.

MM O&M funding can be included in the President's budget recommendation or through Congressional action, however, in recent years a significant component of allocated MM funding comes through the additional funding "work plans." MM funds a range of L&D repair or replacement type projects that exceed the thresholds of routine O&M. For example, in the past five years, the Rock Island District has been replacing original lock miter gates with newly fabricated gates with MM funds. Another example is the installation of the downstream lock bulkhead slots that are needed to dewater the UMR lock chambers for inspections, maintenance activities and repair work is also being funded with MM funds.

For the FY 2013 – FY 2017 period that was evaluated, the UMR's waterway O&M funding has been on an upward trend. A variety of factors likely exist for this favorable trend with a primary one being that UMR L&D MM projects have been ranking high in USACE's move to risk-informed prioritization of discretionary O&M budget packages. For the 29 L&Ds on the UMR Waterway system, O&M funding was $118.5 million in FY 2013 and has steadily increased to $179.6 million in FY 2017; and is in the President's budget at $222,388 million for FY 2018, see **Figure 2**. For reference, the eight L&Ds on the IWW Waterway system, O&M funding has mostly been steady over this same five year timeframe as shown in

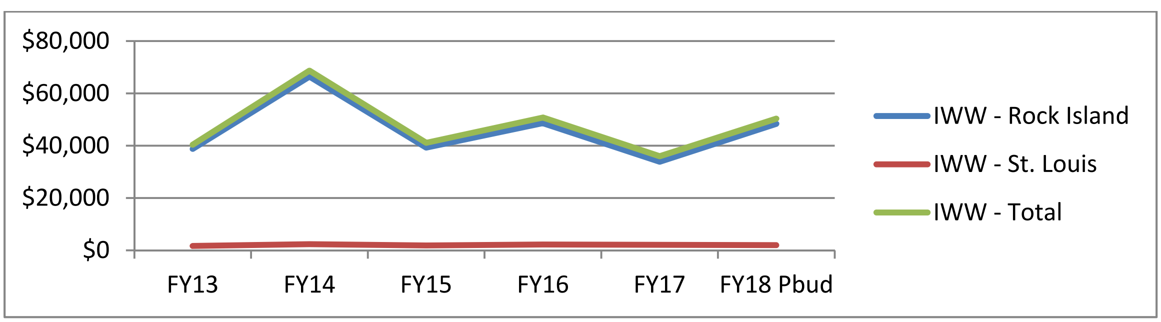
Figure 3. The exception is FY 2014 when the Marseilles Lock and Dam received supplemental O&M funds to repair dam gate damage from an April 2013 barge accident. These O&M trend lines may change in future FYs as MM projects on the IWW and other USACE waterways become higher risk-informed prioritized projects than the incomplete UMR projects. Total UMR and IWW O&M fund values are shown in **Figure 4**.

Figure 2: UMR Waterway O&M Funding, FY13 – FY18



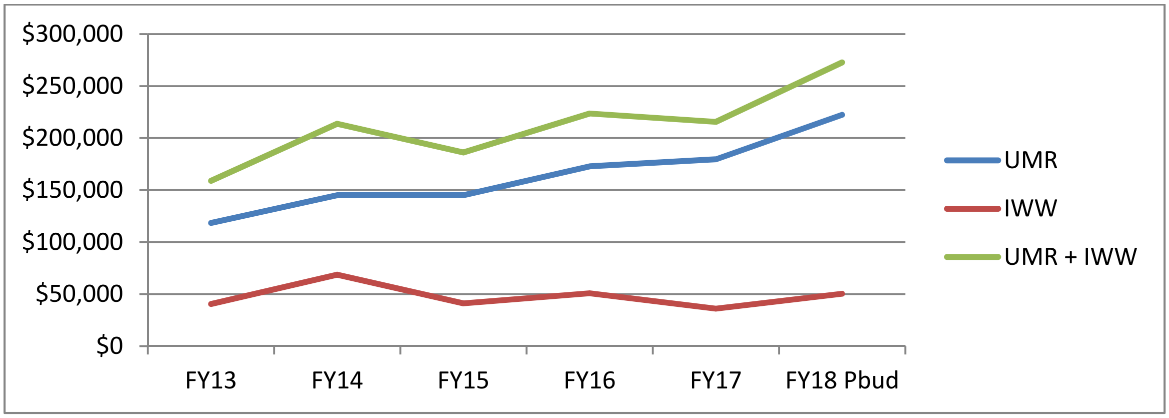
$ in 1,000

Figure 3: IWW Waterway O&M Funding, FY13 – FY18



$ in 1,000

Figure 4: UMR + IWW Waterway O&M Funding, FY13 – FY18



$ in 1,000

5.2 General Investigations, GI

GI funding accounts are used for planning, feasibility and to conduct preconstruction engineering and design (PED) work. No GI funding has been appropriated for UMR Waterway projects in the five year FY 2013 – FY 2017 period, nor are any GI funds included in the FY 2018 President's budget. The last GI funding provided for the UMR was for the UMR and IWW's NESP when funding from FY 2002 through FY 2010 was provided by Congressional "earmark." PED activities included the formulation and preliminary design of approximately 30 navigation efficiency and ecosystem restoration projects on the UMR and IWW. These activities included the initial designs for new 1,200-foot lock chambers at UMR Locks 22 and 25, and at the IWW LaGrange Lock. The NESP program has been suspended since 2011 due to a lack of GI appropriations to fund additional navigation and ecosystem improvement work.

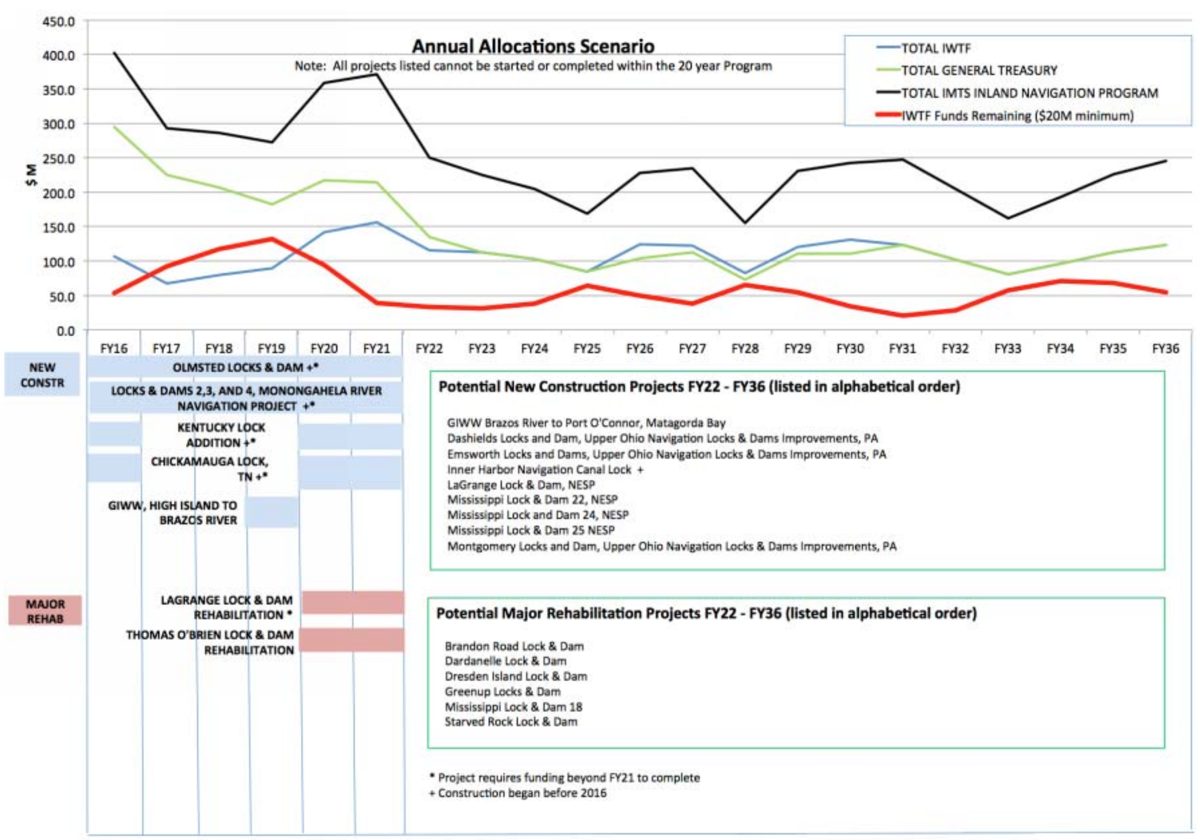
5.3 Construction General, CG

CG funding accounts are used for the construction and often the final design of multi-phase design and construction projects. No CG funding has been appropriated for UMR Waterway projects in the five year FY 2013 – FY 2017 period, nor are any CG funds included in the FY 2018 President's budget. Consequently, for the UMR and IWW NESP program, no CG funds have ever been appropriated for the program.

CG funding for the USACE's inland navigation system has been governed since 1986 by the WRDA 1986 Act. Under the 1986 Act, O&M of the system is the full responsibility of the federal government through USACE. New construction and Major Rehabilitation projects are equally (50 percent-50 percent) cost-shared between the federal government and commercial users of the inland system through the Inland Waterway Trust Fund (IWTF). The IWTF is supported by a tax on barge fuel. From 1994 through 2014, this tax was $0.20 per gallon of fuel and averaged about $85 million per year in tax revenue. The bulk of the funding over this timeframe went to the Ohio River Olmsted Lock and Dam project. In WRRDA 2014, the IWF fuel tax was raised to $0.29 per gallon. The FY 2015 and FY 2016 IWTF revenues based upon the new $0.29 per gallon tax have been $97.9 million and $110.9 million respectively, or about a $20 million increase (24 percent) from previous averages. WRRDA 2014 also revised the cost-sharing for the Olmsted Lock and Dam project to 85 percent federal and 15 percent IWTF for the remaining construction of that project. The projected state of the IWTF is shown in **Figure 5**.

No CG construction or Major Rehabilitation projects have been funded with Federal CG or IWTF revenues on the UMR L&D system in over 14 years. The last funded Major Rehabilitation project in the Rock Island District was Lock 19 in 2003 which was subsequently completed in 2008. As recommended in the USACE's Inland and Intracoastal Waterways – Twenty-Year Capital Investment Strategy report dated March 2016 and as shown in **Figure 5**, no UMR Waterway Major Rehabilitation projects are projected until after FY 2022 (UMR Lock and Dam 18).

Figure 5: Projected Baseline State of Inland Waterway Trust Fund, FY16 – FY36



** USACE Inland and Intracoastal Waterways – Twenty-Year Capital Investment Strategy, March 2016*

6.0 UMR Inland Waterway Infrastructure Update

6.1 Progress since the 2013 Reconnaissance Study

The Iowa DOT's 2013 "*U.S. Inland Waterway Modernization Reconnaissance Study*" identified a number of priority UMR waterway projects in the Rock Island and St. Paul districts. The O&M funding provided for the UMR over the FY 2013 – FY 2017 budgets have provided for USACE to address many of these projects.

For the Rock Island District (UMR Locks and Dams 11-22), the following list of priority projects were identified in the 2013 Reconnaissance Study and their current status is listed in **Table 1**.

Table 1: Rock Island District Priority Navigation Projects in 2013

Work / Project	Funding Account	Status
UMR Lock Miter Gates @ 3 Locks	O&M	Complete
UMR Bulkhead Slots @ 7 Locks	O&M	Complete
UMR Dam 18 – Concrete Repairs	O&M	Under Contract
UMR Lock 19 – Concrete Repairs	O&M	Not Funded
UMR L&D 15, 21 & 22 – Dam Gate Repairs	O&M	Dam 22 Under Contract, Dams 15 & 21 in Design
IWW LaGrange Lock – Major Rehab	CG/IWTF	Potential for FY18 Work Plan
IWW LaGrange Lock – Major Maintenance	O&M	Potential for FY18 Work Plan
IWW LaGrange Lock – Replace Miter Gates	O&M	Complete
IWW Peoria Lock – Replace Miter Gates	O&M	Complete
IWW – Joliet Channel Wall Repairs	O&M	Not Funded
IWW Dresden Dam – Replace Gates	O&M	Under Contract
IWW O'Brien Lock – Major Maintenance	O&M	Complete
IWW O'Brien Lock – Major Rehab	CG/IWTF	Not Funded

For the St. Paul District (UMR Locks and Dams USAF – 10), the following list of priority projects were identified in the 2013 Study and their current status is listed in **Table 2**.

Table 2: St. Paul District Priority Navigation Projects in 2013

Work / Project	Funding Account	Status
UMR Lock & Dam 9 – Winter Maintenance	O&M	Complete
UMR Lock & Dam 1 – Dam Scour Repair	O&M	Under Contract
UMR Locks 4 & 6 – Tow Haulage Repair	O&M	Under Contract
UMR Dams 8, 9 & 10 – Pier House Roofs	O&M	Complete
USAF & USLF – Electrical Repair	O&M	Complete
UMR Locks & Dams 3-10 – Permanent Bulkheads for Aux Chamber	O&M	L&D 7 Complete L&D 2 & 5 Funded
UMR Dams 3, 5A & 10 – Dam Bulkhead Repairs & Painting	O&M	Not Funded
UMR Dam 5 – Dam Gates Painting	O&M	Not Funded
UMR Lock 2 – Miter Gate Replacement	O&M	Under Contract
UMR Dam 5A – Dam Painting	O&M	Not Funded
UMR Lock and Dam 4 – Concrete Repairs	O&M	Complete
UMR Lock 7 – Guidewall Crib Repairs	O&M	Complete

6.2 UMR Waterway Priority of Maintenance (POM) Projects

In recent years, the funding decisions on the backlog of identified maintenance needs on the USACE inland waterway system has transitioned to a prioritization process that is based upon risk-informed decision making. Through use of new Asset Management tools, O&M funding is being targeted from a more corporate posture to the infrastructure with the highest risk and probability of failure in alignment with impact costs to navigation (risk = probability of failure x consequences of failure). Through this focused O&M funding model, as highlighted earlier, UMR Waterway funding has been increasing within Rock Island District due to the overall condition and needs (risks of failure) of L&D structures. On the UMR Waterway, each USACE District develops a list of maintenance projects along with supporting risk-informed data that are then screened through the Asset Management tools for prioritization of funding. These maintenance lists are referred to as the Priority of Maintenance (POM) lists. These POM projects typically support L&D component life extensions and reliability as MM projects; whereas Major Rehabilitation projects focus more on significant facility life extensions and efficiency improvements. Although targeted MM funding for component replacement increases near term reliability, facility life extensions are critical for system long term durability and sustainability.

The prioritized list of POM projects for the UMR and IWW waterways as developed in FY 2017 is listed below in **Table 3**. Brief project descriptions along with the range of funding requirement are also provided.

Table 3: UMR Prioritization of Maintenance, FY 2017 Top 10

FY17 POM Ranking	District	Waterway	Project Name	Work Package Title	Work Package Description	Range of Funding Requirement
0.1	MVR	Mississippi	Lock No. 18	Lock 18 – chamber dewatering & maintenance repairs	Installing lock bulkheads & dewatering the lock for maintenance on critical components. Dewatering is necessary to perform maintenance that cannot be done in the wet.	$5M-$10M
1	MVS	Mississippi	Lock No. 27	Lock 27– lift gate counterweight basket modifications	Structural modification to lift gate counterweight baskets to eliminate interference issues.	$100K-$1M
2	MVS	Mississippi	Lock No. 27	Lock 27 – lift gate hoisting chain rehab	Fabrication of new design for hoisting chain rollers.	$1M-$5M
3	MVS	Mississippi	Lock No. 25	Lock 25 – miter gate anchorage replacement (4)	Miter gate anchorages are high risk of failure from fatigue. Original anchorages not designed for fatigue; due to the number of load cycles are at or near their design life. Also, quoin adjustment issues have increased loading on the anchorages.	$5M-$10M
4	MVP	Mississippi	Lock No. 10	Lock 10 – miter gate replacement	Design & fabricate four new miter gate leafs for the main lock chamber including new diagonals & anchor bars.	$5M-$10M

FY17 POM Ranking	District	Waterway	Project Name	Work Package Title	Work Package Description	Range of Funding Requirement
5	MVR	Mississippi	Lock No. 20	Locks 20, 21, & 22 – replace embedded anchorages	Replace miter gate anchorages for all miter gates on the chambers at Locks 20, 21 & 22.	$1M-$5M
6	MVS	Mississippi	Lock No. 24	Lock 24 – miter gate anchorage replacement	Replace miter gate anchorages for all miter gates on the chambers at Lock 24.	$5M-$10M
7	MVP	Mississippi	Lock No. 5a	Lock 5A – miter gate replacement	Design & fabricate 4 new miter gate leafs for the main lock chamber.	$5M-$10M
8	MVR	Illinois	Dresden Island	Dresden Island – valve pits, culverts & bull gear housings	Repair lock valve pits & anchorages, culverts & sector gear housings.	$5M-$10M
9	MVR	Mississippi	Lock No. 15	Lock 15 – replace upstream monolith bullnose	Replace upstream guidewall bullnose. Embedded & broken components will be replaced with new (kevel rail, armor, check post, hand rails, etc.)	$1M-$5M
10	MVP	Mississippi	Lock No. 5	Lock 5 – auxiliary chamber closure	Permanent closure system of the auxiliary lock chambers that provides a walkway from the I-wall to the riverwall.	$M-$5M

6.3 Continuing Challenges since the 2013 Reconnaissance Study

The Major Rehabilitation and MM Programs for the L&Ds on the UMR Waterway have been ongoing since 1975. Major Rehabilitation consists of reliability or efficiency improvements that focus on facility life extensions that are critical for system recapitalization, and long term durability and sustainability. Major Rehabilitation projects serve to reset the design life of an L&D facility. Major Rehabilitation projects must significantly extend the physical life, demonstrate a benefit-to-cost ratio greater than 1:1, exceed $21 million (FY17) in project costs and extend across two or more construction years. Projects that do not meet these criteria can be funded out of the O&M budgets as MM projects.

Historically USACE Districts have taken one of two approaches to L&D Major Rehabilitation projects. The first approach focuses on one L&D facility and rehabilitating all the components that are at or nearing unpredictable performance (at or near the end of their design life). The second approach is where similar components are rehabilitated or replaced throughout a district's assigned L&Ds. The following discussion will focus on the first approach which is the approach the Rock Island District has taken for Major Rehabilitation projects as the approach aligns with current Major Rehabilitation Program guidance. Current guidance specifically states that a Major Rehabilitation project must be at one specific L&D facility; and not across two or more facilities. However, a revision of the Major Rehabilitation guidance to allow for the improvement of specific L&D components across two or more facilities would provide some much needed flexibility in the program. For example, a Major Rehabilitation project that focused on the replacement of lock miter gates across several facilities would have resulted in significant improvements in system reliability using CG and IWTF funds instead of O&M funds.

A L&D Major Rehabilitation project at a Rock Island facility has the objective to repair, rehabilitate or replace all components that are identified to be at or near the end of their design life (typically assumed to be 50 years) or would have unpredictable performance within the next 25-year planning horizon. Then, on a 25-year cycle an L&D facility would be re-scheduled for another Major Rehabilitation project to once again address components that are at or nearing unpredictable performance. **Table 4** shows the Rock Island District's initial Major Rehabilitation projects completed and the targeted second Major Rehabilitation schedule based upon the 25-year cycle approach. It is apparent that the district is not tracking with their desired 25-year cycle approach to Major Rehabilitation of the UMR Waterway L&Ds as no targeted second round projects have been approved. Hence the need for continuing increases in O&M expenditures to address critical conditional and reliability risks at the UMR L&Ds.

Table 4: UMR Lock & Dam Major Rehabilitation Program

Facility	Initial Major Rehabilitation*	Targeted Second Major Rehabilitation**
Lock & Dam 22	1987	2012
Lock & Dam 21	1988	2013
Lock & Dam 20	1989	2014
Lock 19	2003	2028
Lock & Dam 18	1990	2015
Lock & Dam 17	1991	2016
Lock & Dam 16	1992	2017
Lock & Dam 15	1993	2018
Lock & Dam 14	1998	2023
Lock & Dam 13	1994	2019
Lock & Dam 12	1999	2024
Lock & Dam 11	2002	2027

* Completed

** Not Funded – No Major Rehabilitation Evaluation Report

6.4 NESP Navigation Improvements

The USACE's NESP is a long-term program of navigation improvements and ecological restoration for the UMR that is planned to be implemented inclemently over a 50-year period through integrated, adaptive management. The NESP program is an outcome from a USACE 10-year planning study that was completed in 2004. USACE's three UMR districts of St. Louis, Rock Island and St. Paul conducted the *Upper Mississippi River – Illinois Waterway System Navigation Feasibility Study* to determine the best way to manage the UMR Waterway in a manner which balances economic, environmental, social, and political needs. This study took a systems approach, since changes in one part of the system may have an impact elsewhere in the system.

The locks that help tows navigate the Mississippi and Illinois Rivers are antiquated – increasing costs, safety risks and lost market opportunities. From an ecological perspective, the floodplain is degraded, islands are eroded, backwaters are filled and the rivers' natural flows have been disrupted. The study determined the location and appropriate sequencing of needed navigation improvements and ecosystem projects on the two rivers and prioritized these capital investments for the first half of the next century. The study also included a system-wide environmental assessment leading to the completion of a system Environmental Impact Statement (EIS).

The 80 year-old UMR navigation system experiences some of the longest lockage delays in the country due to single, undersized 600-feet lock chambers (most tows are 1,200 feet in length), and downtime for repair of aged gates, machinery and other components. Current lock delays average four to five hours in the lower reach of the system. Historically, a lack of funding for L&D rehabilitation and MM activities has increased the risk of component failures and lock closures; however, the past five years' risks associated with aging lock miter gates and the inability to dewater many of the lock chambers has been addressed through MM funding, see **Table 1** and **Table 2** above. However, with no Major Rehabilitation projects occurring on the UMR, MM will be an on-going need as various components deteriorate and near failure.

The 2004 feasibility study's 1st increment recommendations included the following efficiency and capacity improvements on the UMR:

- Mooring cells at six UMR sites – L&Ds 12, 14, 18, 20, 22 and 24
  Mooring cells at one IWW site – LaGrange Lock & Dam
- Switchboats at five UMR sites – L&Ds 20, 21, 22, 24 and 25
- New 1,200-foot locks at five UMR L&Ds – L&Ds 20, 21, 22, 24 and 25
- New 1,200-foot locks at two IWW L&Ds – Peoria and LaGrange L&Ds
- Site-specific environmental mitigation associated with above projects

No CG construction funds for NESP projects have been appropriated since the WRDA 2007 authorization. If funded, construction of ecosystem restoration projects and small-scale navigation projects (mooring cells) could start in approximately one to two years following receipt of construction funds. This timeline is based on the integration of existing Upper Mississippi River Restoration (UMRR) ecosystem projects into NESP and leveraging the previously completed Lock 14 mooring cell Environmental Assessment (EA) with an expedited updating of the EA and Finding of No Significant Impact (FONSI) documents completed in 2000 and signed in 2001 respectively. Large-scale improvements (1,200-foot locks) would require a longer design and permitting interval with first components starting within approximately three years after receipt of engineering and construction funds.

Two primary issues that have delayed federal construction funding appropriations are:

- The NESP navigation projects would be CG funded and subject to 50 percent - 50 percent cost-sharing with the IWTF. Due to limited funding in both the USACE navigation programs and the IWTF, the funding prioritizations have been on completing the already started new L&D projects on the Ohio River system. Current USACE Inland and Intracoastal Waterways – Twenty-Year Capital Investment Strategy recommendations, based upon completing these Ohio River projects first, would dictate that NESP navigation funding would not occur until after 2022 at the earliest, see **Figure 5**.

- The NESP navigation projects' benefit-to-cost ratios (BCR) have not exceeded a BCR threshold of 2.5. The current USACE listed BCR for the new UMR 1,200-foot locks is 1.3. Past Administrations have declined to recommend funding for any NESP navigation projects primarily due to the NESP projects not exceeding a BCR threshold of 2.5.

7.0 Alternative Project Delivery and Financing

Since completion of the 2013 Reconnaissance Study, two water resources bills have been enacted. The WRRDA 2014 and WIIN 2016 bills included legislation for a range of alternative project delivery methods for USACE water resources projects including alternative financing scenarios, enhanced contributed funds programs and pilot programs for private-public partnerships. Several WRRDA 2014 and WIIN 2016 sections are highlighted at this time and will be further investigated as the Iowa DOT UMR Waterway study progresses:

- WRRDA 2014:
  - Section 1014(a): Non-federal entities can conduct water resources projects specially authorized by Congress.
  - Section 1015: Expands contributed funds authority to allow USACE to accept funds from states and other non-federal interests, including toward authorized projects on the inland waterways.
  - Section 1043(b): Non-federal implementation of pilot programs for construction of water resources projects.
  - Section 2004(a/b): Provides for a study on the potential benefits and implications of authorizing the issuance of federally tax-exempt bonds in the IWTF.
  - Section 5014: Pilot program for public-private partnerships in developing water infrastructure.
  - Sections 5021-5035: Authorizes USACE to provide assistance to carry out pilot projects that allow non-federal entities to obtain loans as a supplemental source of financing Civil Works projects including inland waterways.
- WIIN 2016:
  - Section 1126: Allows non-federal interests to fund USACE technical assistance to feasibility studies being undertaken by the non-federal interest pursuant to Section 203 of WRDA 1986.
  - Section 1153: Expands authorizations for USACE to accept materials, services and funds contributed by a non-federal entity for the purpose of repairing, restoring, replacing or maintaining a water resources project.

USACE has not advanced Section 1043(b), 2004(a/b), 5014 or 5021-5035 claiming in their implementation guidance that since Congress has not provided specific appropriations for this work, no activities are authorized to advance these authorizations. Therefore, only Section 1015 of WRRDA 2014 has implementation guidance and provides the most applicable path forward for UMR Waterway improvements using contributed funds. Under Section 1015, a project would continue to be implemented as a typical USACE civil works project. A key consideration is that contributed funds can be accepted only after Congress provides new start federal funds to initiate construction. For waterway projects that could be implemented under the O&M program, this consideration could be addressed within USACE O&M program funds. However, for CG funded improvement projects such as a Major Rehabilitation project or a NESP 1,200-foot lock addition, new start CG appropriation would be required. Therefore, while WRRDA 2014 provides includes increased potential flexibility to utilize alternative financing to advance inland waterway projects, the USACE administration and congress have failed to appropriate the necessary funds to advance these WRRDA provisions.

The long-standing 33 USC Section 408 authority provides for USACE to grant permission for a non-federal entity to alter an existing civil works project provided the alteration will not be injurious to the public interest and will not impair the project's usefulness. Under a Section 408 permission, a UMR Waterway stakeholder would plan, design and construct a stand-alone project such as a mooring cell with non-federal funds; and then turn the improvement over to USACE to operate and maintain as a component of the existing UMR 9-Foot Channel Navigation project.

8.0 Three Pilot Project Scenarios

A companion Iowa DOT alternative financing scenarios report discusses three lock and dam system upgrade pilot projects for improving the reliability, capacity, and efficiency of the existing system with the implementation of alternative financing scenarios. The alternative financing can be (1) revenue that provides full project funding or (2) offsetting funds to existing cost-sharing methods that provide a new source of funds.

Micro Upgrade. A small-scale navigation efficiency improvement (micro upgrade) to the UMR Waterway that is a stand-alone pilot project and can easily be replicated at one or more sites is a mooring cell. A mooring cell is a more efficient and environmentally friendly place for tows approaching a lock and dam to moor (tie-off) while waiting for the lock to become available when another tow occupies the lock or navigation approach channel. A pilot project that installs a mooring cell at Lock 14 will provide notable time savings for up-bound towboats at a design and construction cost of approximately $2 million.

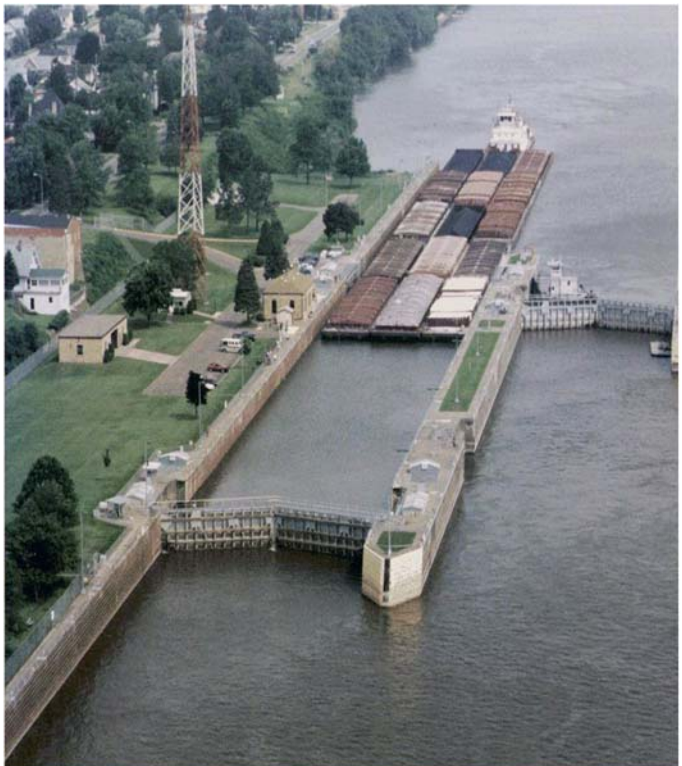
System Reliability Improvements. A system reliability improvement pilot project would reset the design life and enhance the reliability of the existing lock chambers. The Major Rehabilitation Program is currently underfunded on the UMR and consists of reliability or efficiency improvements costing over $21 million per project that focus on facility life extensions that are critical for system recapitalization and the long-term durability and sustainability of the facility. Major rehabilitation projects, in essence, serve to reset the design life of a lock and dam facility and extend the reliable service life of the infrastructure. Past UMR major rehabilitation projects have included replacing lock operating machinery, upgrading and replacing the lock and dam's electrical power and control systems, performing mass concrete repairs, resurfacing and armoring the lock chamber concrete, painting, repairing gates, emptying and filling valve repairs, making dewatering improvements, installing lock bubbler systems for ice management, providing scour protection, and making general safety improvements. Currently, major rehabilitation projects must be economically justified by a supporting benefit-cost ratio and documented in an approved Rehabilitation Evaluation Report (RER). No RERs have been completed and approved on the UMR Waterway in the past 15 years—resulting in no new construction starts in recent years.

Large-scale Upgrade. A large-scale navigation capacity and efficiency improvement project on the UMR Waterway would expand lock capacity and improve lock efficiency. The NESP authorization includes several projects that meet this objective, and a large-scale upgrade could construct one or more of the five UMR 1,200-foot locks that are authorized by WRDA 2007, thereby reducing lock processing and delay times with the elimination of double cut lockages.

Implementation of new lock components of USACE's NESP program would be considered a Large-scale Upgrade for purposes of this study. In Fiscal Year 2019 (FY 2019), USACE is performing economic update for NESP focusing on engineering reliability, forecasted barge traffic demands, barge transportation demand elasticity, transportation rates, and lock performance characteristics. Given the near term availability of this in-depth economic update of NESP, evaluation of a Large-scale Upgrade pilot project scenario was not included in this report.

Appendix B

System Upgrade Pilot Project Scenarios Report



Alternative Financing Evaluation

Upper Mississippi River Inland Waterway System Upgrade Pilot Project Scenarios

Iowa Department of Transportation

Ames, Iowa

April 2019

Executive Summary

The Upper Mississippi River (UMR) Waterway is a vital part of our national inland navigation system and the Upper Midwest economy and serves as a valuable ecological resource. The waterway includes 27 locks and dams spanning from Minneapolis, Minnesota, to St. Louis, Missouri. The 750 miles of 9-foot navigation channel created by the locks and dams allow waterway traffic to move from one pool to another, providing an integrated regional, national, and international transportation network. The 9-foot Channel Navigation Project, including the lock and dam system, was largely constructed in the 1930s. The system consists primarily of 600-foot lock chambers that do not accommodate today's modern tows without forcing the tows to split and pass through the lock in two operations. A combination of age, use, and single-lock chambers is also affecting the system's reliability and efficiency and its ability to provide acceptable levels of performance to meet the expanding transportation needs of the Upper Midwest economy.

Modernization of the UMR Waterway for efficient accommodation of modern tow configurations remains unfunded, including such congressionally authorized programs as the UMR Navigation and Environmental Sustainability Program (NESP). The NESP provides for systemic improvements in the waterway's capacity to meet future traffic demand. NESP improvements range from small improvements, such as adding mooring cells that increase the efficiency of the existing system, to large measures, such as adding 1,200-foot lock chambers at five of the UMR lock sites. NESP projects also provide for comparable improvements of the river's ecologic resources through a variety of ecosystem restoration projects. The NESP restoration projects would be of similar scope as the current Upper Mississippi River Restoration (UMRR) ecosystem projects with the implementation of the NESP program likely then supplanting the UMRR program.

Recent Water Resource Development Acts (WRDAs) are providing opportunities for non-federal interests to advance inland waterway projects. Several Water Resources Reform and Development Act (WRRDA) 2014 and WRDA 2016 sections relate to the use of non-federal funds, public-private partnerships, and non-federal implementation of pilot projects. Neither, the USACE administration nor Congress has appropriated funds to develop guidance for many of the alternative financing provisions. Therefore, for inland navigation projects, guidance only exists for the acceptance of voluntary contributions of funds or services under existing U.S. Army Corps of Engineers authorities such as Section 1015(b) of WRRDA 2014 – Contributed Funds (33 United States Code [USC] 701h); Section 1024 of WRRDA 2014, as amended by Section 1153 of the Water Infrastructure Improvements for the Nation Act 2016 (33 USC 2325a), Section 408 (33 USC 408), Section 204 (33 USC 2232), and Advanced Funds (33 USC 701h-1).

This report discusses three lock and dam system upgrade pilot project scenarios for improving the reliability, capacity, and efficiency of the existing system with the implementation of alternative financing scenarios. The alternative financing can be (1) revenue that provides full project funding or (2) offsetting funds to existing cost-sharing methods that provide a new source of funds. The recent WRDA bills and pending federal infrastructure program initiatives have and will likely include provisions for enhanced non-federal stakeholder cost-sharing on federally authorized water resource civil works projects.

Micro Upgrade. A small-scale navigation efficiency improvement (micro upgrade) to the UMR Waterway that is a stand-alone pilot project and can easily be replicated at one or more sites is a mooring cell. A mooring cell is a more efficient and environmentally friendly place for tows approaching a lock and dam to moor (tie-off) while waiting for the lock to become available when another tow occupies the lock or navigation approach channel. A pilot project that installs a mooring cell at Lock 14 will provide notable time savings for upbound towboats at a design and construction cost of approximately $2 million.

System Reliability Improvements. A system reliability improvement pilot project would reset the design life and enhance the reliability of the lock chambers. The Major Rehabilitation Program is currently underfunded on the UMR and consists of reliability or efficiency improvements costing over $21 million that focus on facility life extensions that are critical for system recapitalization and the long-term durability and sustainability of the facility. Major rehabilitation projects, in essence, serve to reset the design life of a lock and dam facility and extend the reliable service life of the infrastructure. Past UMR major rehabilitation projects have included replacing lock operating machinery, upgrading and replacing the lock and dam's electrical power and control systems, performing mass concrete repairs, resurfacing and armoring the lock chamber concrete, painting, repairing gates, emptying and filling valve repairs, making dewatering improvements, installing lock bubbler systems for ice management, providing scour protection, and making general safety improvements. Currently, major rehabilitation projects must be economically justified by a supporting benefit-cost ratio and documented in an approved Rehabilitation Evaluation Report (RER). No RERs have been completed and approved on the UMR Waterway in the past 15 years—resulting in no new construction starts in recent years.

Large-scale Upgrade. A large-scale navigation capacity and efficiency improvement project on the UMR Waterway would expand lock capacity and improve lock efficiency. The NESP authorization includes several projects that meet this objective, and a large-scale upgrade could construct one or more of the of the five UMR 1,200-foot locks that are authorized by WRDA 2007,thereby reducing lock processing and delay times with the elimination of double cut lockages.

Implementation of new lock components of USACE's NESP program would be considered a Large-scale Upgrade for purposes of this study. In Fiscal Year 2019 (FY 2019), USACE is performing economic update for NESP focusing on engineering reliability, forecasted barge traffic demands, barge transportation demand elasticity, transportation rates, and lock performance characteristics. Given the near term availability of this in-depth economic update of NESP, evaluation of a Large-scale Upgrade pilot project scenario was not included in this report.

Contents

Figures

Tables

Attachments

1.0 Project Background

In April 2013, the Iowa Department of Transportation (Iowa DOT) completed the *U.S. Inland Waterway Modernization Reconnaissance Study* (Reconnaissance Study). Since publication of this study, significant legislation, additional study, and discussion have occurred involving the inland waterway system—along with 5 additional years of U.S. Army Corps of Engineers' (USACE) operation and maintenance of the waterway. Several recommendations of the Reconnaissance Study have come to fruition, including passage of Water Resources Reform and Development Act (WRRDA) bills and the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 (Water Resource Development Act [WRDA] 2016). WRRDA 2014 included Section 1015, which can advance inland waterway alternative financing through contributed funds. WIIN 2016 Section 1153 expanded USACE's ability to use contributed funds, material, or labor to advance waterway projects.

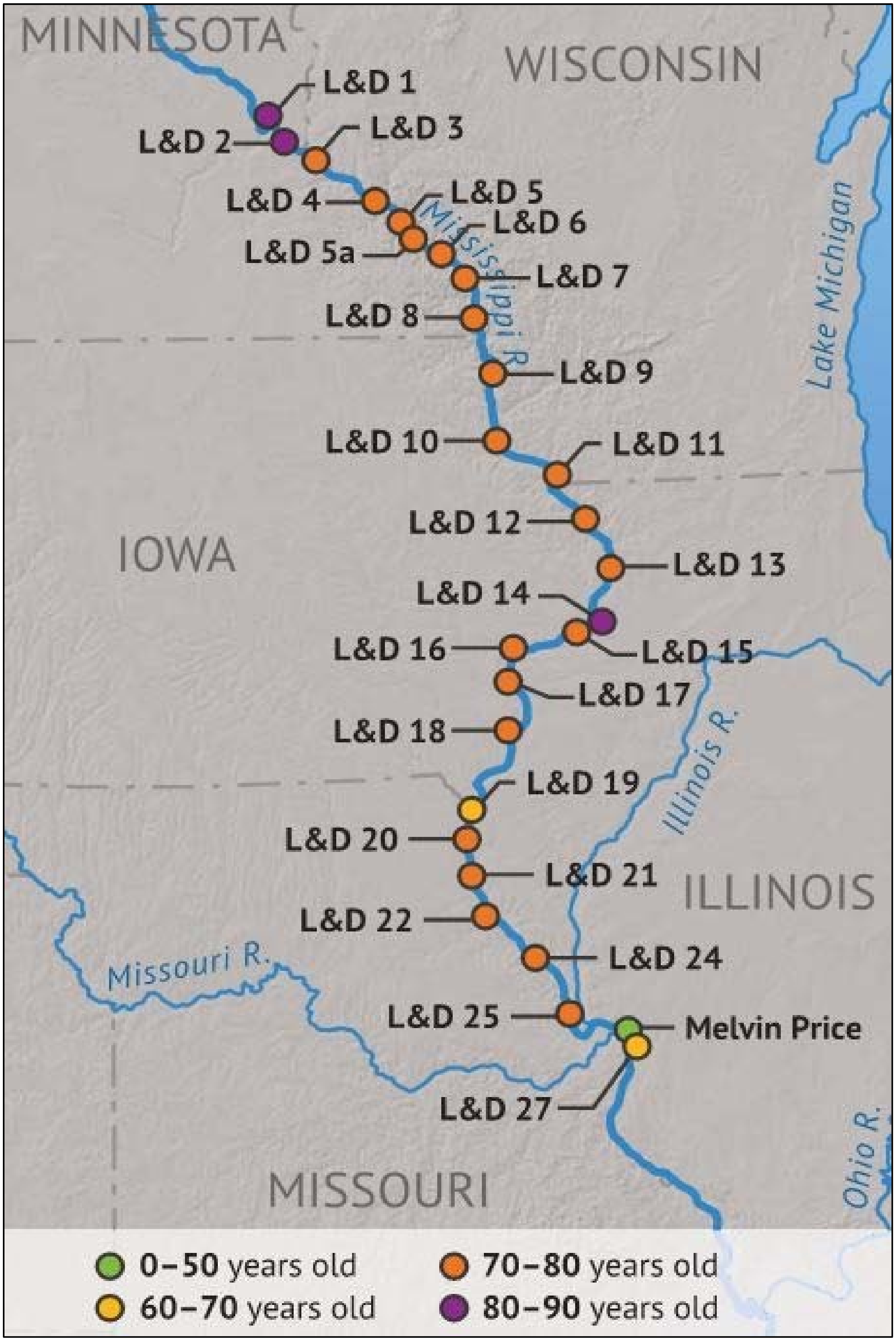
The Iowa DOT is continuing to collaborate with USACE to enhance the performance of the Upper Mississippi River (UMR) Lock and Dam (L&D) system (Figure 1). As a part of these collaboration activities, the Iowa DOT is undertaking an Alternative Financing Evaluation of the UMR Inland Waterway Infrastructure to develop a long-term vision for the waterway that serves UMR stakeholders' needs and to identify investment strategies for the waterway that recognize the opportunities created by WRRDA 2014 and WIIN 2016. Of special interest are the revised contributed funds programs for USACE water resources projects, such as the UMR Waterway's L&D system.

As a component of the Alternative Financing Evaluation of the UMR Inland Waterway Infrastructure, an Infrastructure Update report was prepared in January 2018. The report provided an update on the past 5-year time period since the 2013 Reconnaissance Study. It described the condition of the UMR L&D infrastructure to support a long-term vision document that can inform UMR Waterway stakeholders of the purpose, direction, and benefits of improving the reliability of the existing L&Ds and undertaking new capital improvements to upgrade the system's ability to successfully meet the waterborne transportation needs of the UMR region into the foreseeable future.

2.0 Objective

The Administration and Congress are currently working on infrastructure spending bills. The White House's 2018 Fact Sheet for its infrastructure initiative specifically addresses reforming the laws that govern federal infrastructure such as inland waterways and providing for additional revenue. The State of Iowa and other partner States recognize a unique opportunity may exist to capitalize on the momentum of the 2013 Reconnaissance Study and to develop specific feasible funding and implementation alternatives that address governance, financing, construction and operation of navigation infrastructure improvements to create lasting and sustainable value for the UMR Waterway.

Figure 1: UMR Waterway Lock and Dam System



This report presents two system upgrade pilot project scenarios that maximize an array of benefits to the UMR Waterway system, as follows:

- Micro Upgrade – a single project that can be replicated that improves the efficiency of the locking process, reduces towboat fuel consumption, and/or reduces navigation-related impacts on the environment.
- System Reliability Improvements – a scenario of projects that increase the reliability of the locks on the existing system to remain in service and that provide for a sustainable river transportation system by extending the life of the existing L&D infrastructure.

3.0 Pilot Project: Micro Upgrade

3.1 Mooring Cells

A small-scale navigation efficiency improvement (micro upgrade) to the UMR Waterway that is a stand-alone project and can easily be replicated at one or more sites is a mooring cell. A mooring cell is a more efficient and environmentally friendly place for tows approaching an L&D to moor (tie-off) while waiting for the lock to become available when another tow occupies the lock or navigation approach channel. A mooring cell can be especially beneficial at sites where navigation channel conditions necessitate a tow waiting area to be located a mile or more away from the lock. The lock approach times increase as a tow waits for the other tow to clear the lock and also clear the approach channel to the lock. Mooring cells are typically located adjacent to the main navigation channel and are constructed of sheet-piling that has been driven into circular cells and filled with earth and/or concrete, as shown in Figure 2.

Figure 2: Typical Mooring Cell

Source: USACE

A mooring cell provides the greatest approach time savings for exchange approaches. For an exchange approach (tow approaching a lock being exited by a tow going in the opposite direction), the typical exchange point location is where the stern of the exiting tow passes the stern of the approaching tow. While exchange points can occur in the channel, they most often occur in areas where the tow waiting to lock can tie off or push into the bank. Note that exchange approach locations and times can vary considerably because of changing site, weather, and river conditions, along with the widely variable capabilities of the crews and tows operating on the system.

Without a mooring facility for a tow to tie-off on while waiting, towboats must move in close to shore and ground their barges, tie-off to bankline trees, or maintain engine power in the waiting area to hold position against the river currents. With a mooring cell installed at the proper location, tows can move closer to the lock to wait and can tie-off on the cell, thereby minimizing sediment re-suspension by allowing their engines to run at idling speeds rather than at power to hold position. The mooring cell also limits erosion and habitat destruction caused by towboats grounding themselves or tying off to the shoreline.

The USACE 2004 report, *Upper Mississippi River (UMR) – Illinois Waterway (IWW) System Navigation Feasibility Study System Navigation Study* (System Navigation Study), recommended mooring facilities as improvements that can be implemented at selected locks to reduce barge traffic delays and congestion without incurring the major construction costs of new or modified lock chambers. The installation of mooring facilities on the UMR Waterway was subsequently authorized under WRDA 2007. The WRDA language allows for the changes of mooring projects to consider "other alternative locations that are economically and environmentally feasible." Additionally, while the System Navigation Study advanced the use of mooring buoys at some sites, towing industry comments received during UMR Navigation and Ecosystem Sustainability Program (NESP) working group meetings deemed the buoys unsafe for deckhands involved in tying off. The buoys were also regarded as time-consuming for tows to position themselves along a floating, unstable target. The results of a comprehensive USACE industry survey in the fall of 2005 further recognized the unanimous recommendation for use of permanent mooring cells rather than less costly, but poorly performing, mooring buoys.

The history of adding mooring cells to the UMR 9-Foot Channel Navigation Project extends prior to the 2004 System Navigation Study. Mooring cells were originally identified as an avoid and minimize (A&M) measure to mitigate cumulative impacts on the UMR aquatic ecosystem as a result of the increased navigation traffic predicted to result from the Mel Price L&D project. The Mel Price project replaced the existing L&D 26 facility and included a 1,200-foot lock chamber and a second 600-foot chamber, with the new L&D placed in service in 1990. Of note, an Environmental Assessment (EA) entitled *Mooring Cell Construction, Pool 15, Mississippi River Mile 491.9, Scott County, Iowa, Rock Island County, Illinois* (USACE, 2000) provided regulatory clearance to construct a mooring cell in the L&D 14 upbound approach (downstream Pool 15). The Lock 14 mooring cell was one of several A&M measures identified in an earlier report entitled *Design Memorandum No. 24 – Avoid and Minimize Measures* (USACE, 1992).

The System Navigation Study's recommendations for adding mooring facilities and the WRDA 2007 authorization for mooring facilities included the lock sites listed in Table 1.

Table 1: UMR and IWW Mooring Sites – System Navigation Study

Site	Pool Location
Lock & Dam 12	Lower pool (upbound approach)
Lock & Dam 14 (2 mooring cells)	Lower pool
Lock & Dam 18	Lower pool
Lock & Dam 20	Upper pool (downbound approach)
Lock & Dam 22	Upper and lower pools
Lock & Dam 24	Upper pool
IWW LaGrange Lock & Dam	Upper pool

Source: System Navigation Study, Engineering Appendix (USACE, 2004)

USACE has established the NESP as the design and construction program to implement the authorized UMR and IWW navigation improvements. Subsequent to the System Navigation Study being published in 2004, the St. Louis and Rock Island Districts performed NESP predesign activities to advance the implementation of navigation efficiency improvements related to mooring cell facilities. This mooring facilities work was performed in 2005 to 2007 and was "shelved" when the NESP planning funding that USACE was receiving stopped. The mooring facilities study work is partially captured in an unpublished draft initial design documentation report.

Because the original mooring facilities location identification work in the System Navigation Study was over 10 years old, the NESP mooring facilities study involved screening the System Navigation Study's list, which was performed by USACE and the Mississippi River Pilots Association in 2005. At the working group meeting, three sites were dropped from the list and five sites were added to arrive at an updated recommended mooring facility list of 10 project sites. This updated recommended mooring cell location list is shown in Table 2. The mooring sites are listed in order of priority as identified by the working group. USACE has not updated this list since it was developed in 2008.

Table 2: Recommended UMR and IWW Mooring Sites – NESP Mooring Report

Site	Pool Location	Priority
Lock & Dam 14	Lower pool (upbound approach)	1
IWW LaGrange Lock & Dam	Upper pool (downbound approach)	2
Lock & Dam 24	Upper pool	3
Lock & Dam 15	Lower pool	4
Lock & Dam 11	Upper pool	5
Lock & Dam 19	Lower pool	6
Lock & Dam 21	Lower pool	7
Lock & Dam 18	Lower pool	8
Lock & Dam 20	Lower pool	9
Lock & Dam 24	Lower pool	10

Source: USACE Mooring Cell UMR Working Group (USACE, 2008 – unpublished NESP Mooring Design Documentation Report)

3.2 Micro Upgrade Pilot Project Scenario: Lock 14 Mooring Cell

The micro upgrade system pilot project scenario will be based on the L&D 14 lower pool mooring cell, which is identified as the highest-priority mooring cell project by USACE's NESP. The project costs and time-saving improvements associated with this UMR navigation improvement will be based on the data listed in the System Navigation Study's supporting documentation.

A mooring cell of approximately 31 feet in diameter would be constructed of steel sheet-piling and filled with concrete. The typical design of the mooring cell planned for L&D 14 is shown on Figure 4. The chosen site is approximately 1.4 miles downstream of L&D 14 at River Mile (RM) 491.9, near the left descending bank below Illiniwek State Park and adjacent to Hampton, Illinois (Figure 3). This site was selected over an upstream site at RM 492.5 because the downstream RM 491.9 site was determined to have the least environmental impacts during construction of the mooring cell. The North American Datum (NAD 27) Illinois West State Plane coordinates for the RM 491.9 location are X = 431818.9, Y = 1781850.5.

A tow will generally moor its head on the cell and hold the stern of the vessel steady until its turn to use the lock and approach channel. The cell location must allow a passing tow enough clearance to safely pass the moored waiting tow as it enters the passing zone downstream of the lock.

Figure 3: Location of Lock 14 Mooring Cell at River Mile 491.9

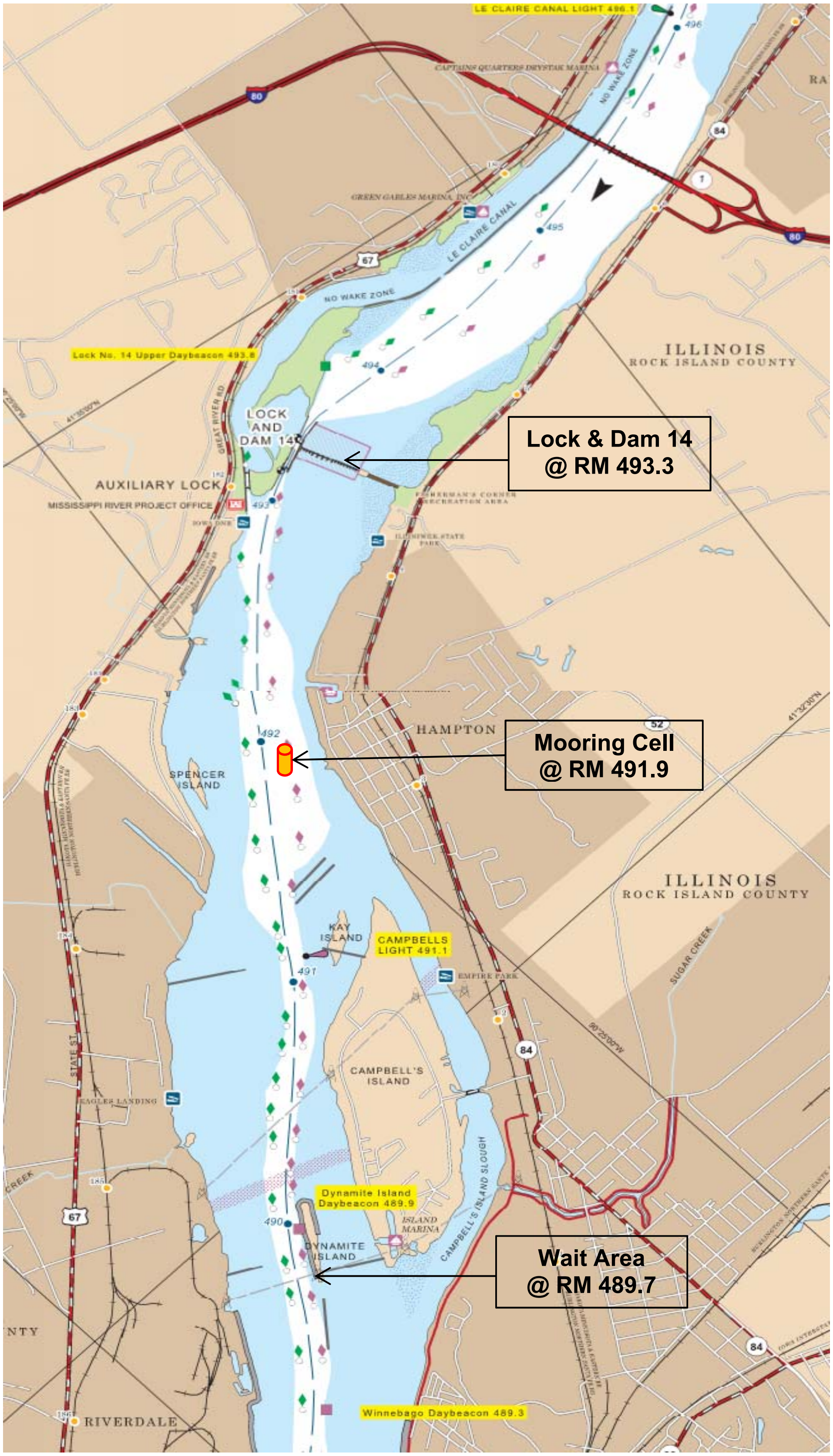
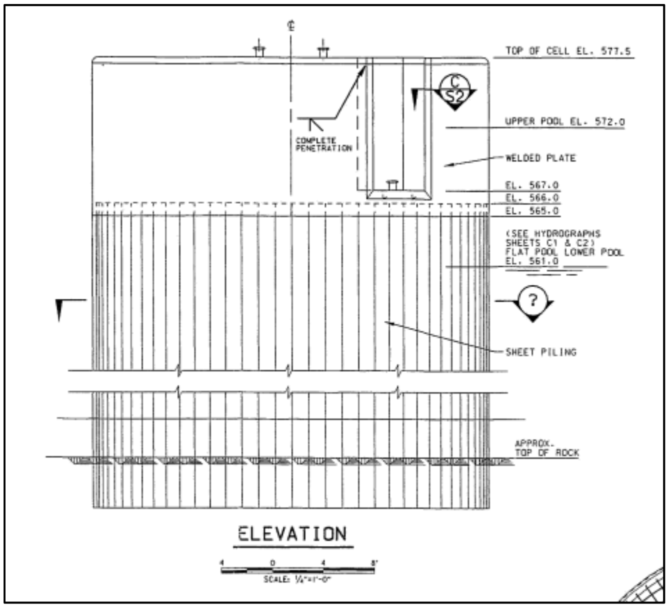


Figure 4: Elevation View of Lock 14 Mooring Cell



Source: USACE

3.3 Project Costs

The estimated project cost for the installation of a Lock 14 mooring cell at RM 491.9 was developed by USACE in the System Navigation Study. This estimate was then updated in the NESP mooring facilities work to an October 2006 price level using USACE's Civil Works Construction Cost Index System (CWCCIS). The October 2006 cost estimate is shown in Table 3, and these project costs have been updated to February 2018 price levels using the CWCCIS index factor shown in the table. In general, all UMR recommended mooring cells located in the lower pool upbound approach to a lock would have a similar $1.93 million project cost. Mooring cells located in the upper pool downbound approach to a lock would have a higher project cost because of the greater channel depths of the upper pool in the immediate reach upstream of the navigation dam.

Table 3: Project Cost Estimate for Lock 14 Mooring Cell

Item	Project Cost ($) (Oct. 2006)[a]	CWCCIS Factor	Project Cost ($) (Feb. 2018)
Riprap	24,000	1.33	31,900
Excavation	38,000	1.33	50,500
Steel sheet piling	112,500	1.33	149,600
Metal work	436,100	1.33	580,000
Mooring cell hardware	17,000	1.33	22,600
Lighting	5,200	1.33	6,900
Concrete and reinforcing	268,000	1.33	356,400
Painting	25,800	1.33	34,300

Item	Project Cost ($) (Oct. 2006)[a]	CWCCIS Factor	Project Cost ($) (Feb. 2018)
Project subtotal	926,600	—	1,232,200
Contingencies (25%)	231,600	—	308,100
Project subtotal with contingencies	1,158,200	—	1,540,300
Planning, engineering, and design (15%)	173,800	—	231,000
Construction management (10%)	115,800	—	154,000
Project total	$1,447,800	—	$1,925,300

[a] *Source: USACE*

3.4 Time Savings Improvements

Installing adjacent mooring cells benefits transit times if the cells are placed to enable tows to moor closer to the lock while waiting for the lock and approach channel to clear of a passing tow. At L&D 14, the lock is located at RM 493.3 and upbound tows currently wait at RM 489.7, or 3.6 miles downstream. The installation of a mooring cell at RM 491.9 moves the wait area 2.2 miles closer to Lock 14 at a location 1.4 miles downstream of the lock (Figure 4).

An upbound 15-barge tow has an average speed of approximately 4 miles per hour (mph), which equates to 33 minutes to travel the 2.2 miles, and the wait time for a downbound tow to transit the 2.2 miles is 22 minutes based on an average downstream speed of 6 mph. Thus, the maximum time savings is 55 minutes based on a maximum queuing time of upbound and downbound exchange lockage tows. These time savings numbers align with the System Navigation Report's Engineering Appendix, Table A-24 (USACE, 2004), with mooring cell improvements that list the maximum travel time savings for a mooring cell at RM 492.5 for an upbound tow on an exchange double lockage at twice 37 minutes, or 74 minutes because of the ability to transit 2.8 miles closer to the lock. As the Lock 14 Mooring Cell EA dictated, the mooring cell would be located at RM 491.9, or 0.6 mile farther downstream from the lock, and the maximum time savings are linearly estimated at 58 minutes for the upbound tow with a wait area 2.2 miles closer to Lock 14 as compared with the 55-minute estimate presented above. The System Navigation Study Engineering Appendix then applies a 35 percent factor to these maximum time savings to account for typical non-simultaneous timing of exchange lockages, and that when river conditions allow, experienced tow pilots will transit closer to the lock to wait than the RM 489.7 waiting area, thereby arriving at an estimated mean time savings of 35 percent of the 55 minutes, or 19 minutes for the upbound waiting tow on exchange double lockages. The System Navigation Study Engineering Appendix estimates the time savings for single lockage tows at approximately 50 percent of the double tow time savings, or 9 minutes for a RM 491.9 mooring cell.

The percentages of UMR tow configurations in the L&D 14 reach listed in the System Navigation Study are shown in Table 4. The percentage of tow exit and approach types (exchange or turnback) and the associated mean time savings related to a Lock 14 mooring cell are also listed in Table 4. These percentages and time savings can be applied to an array of

Lock 14 traffic projections and tow delay costs to arrive at annual time saving totals and economic benefits associated with the mean time savings.

For example, Lock 14 traffic in 2016 totaled 2,460 commercial lockages, of which approximately 27 percent would have been single lockages with 64 percent of these being exchange lockages with the time savings associated with only the upbound tow or 212 single exchange upbound tows. At a singles exchange mean time savings of 9.4 minutes, the estimated annual time savings is 1,998 minutes, or 33 hours. Likewise, approximately 73 percent of the total 2,460 lockages would have been double lockages with 64 percent of these double lockages being exchange lockages with time savings associated with the upbound tow or 575 double exchange upbound tows. At a double exchange mean time savings of 19.2 minutes, the estimated annual time savings is 11,033 minutes, or 184 hours. Thus, an annual estimated total time savings of 33 hours for singles plus 184 hours for doubles totaling 217 hours, or 9 days, of time savings related to a Lock 14 lower pool mooring cell would have resulted in the 2016 navigation year.

Table 4: UMR Lock 14 Mooring Cell Estimated Time Savings

Type of Lockage	Tow Configuration (%)*	Tow Exit/Approach Types (%)*	Approach Mean Time Savings (minutes)	Exit Mean Time Savings (minutes)	Total Mean Time Savings* (minutes)
Single Lockages	27%	—	—	—	—
Single Exchange Lockages	—	64%	5.6	3.8	9.4
Single Turnback Lockages	—	36%	0.0	0.0	0.0
Double Lockages	73%	—	—	—	—
Double Exchange Lockages	—	64%	11.5	7.7	19.2
Double Turnback Lockages	—	36%	0.0	0.0	0.0

Source: System Navigation Study, Engineering Appendix – Addendum C (USACE, 2004)
** Time savings are realized by the upbound tow in an exchange lockage.*

3.5 Project Timeline

The project timeline for a mooring cell project as funding becomes available will require verifying the selected RM locations, preparing plans and specifications, performing quality assurance/ quality control (QA/QC) reviews, ensuring environmental compliance, and advertising and constructing the project. Based on a new mooring cell project with no past predesign or environmental compliance activities, the timeline to construction award is estimated at 18 months followed by a 12-month construction period, for a total of 2.5 years to being placed into service. For a Lock 14 mooring cell at RM 491.9, past project activities can be leveraged to reduce this timeline to an estimated 12 months to construction award and then a 12-month construction period, for a total of 2 years to being placed into service. A typical mooring cell project plan is listed in Table 5 and a Lock 14 mooring cell project timeline schedule is shown, along with a timeline for other UMR mooring cells.

Table 5: Project Timeline for a Mooring Cell

Project Plan	Lock 14 Mooring Cell[a]	Other UMR Mooring Cells
Project kick-off meeting	Month 1	Month 1
Verify mooring cell location	Month 2	Month 2
Obtain borings and channel surveys	Months 3–4	Months 3–4
Prepare plans and specifications	Months 3–6	Months 3–8
QA/QC reviews	Months 5–7	Months 5–9
Finalize construction contract documents	Months 8–9	Months 10–12
Prepare environmental assessment	Months 2–8	Months 2–13
Environmental assessment agency and public review	Months 9–10	Months 14–16
Environmental assessment finding of no significant impact	Month 11	Month 17
Advertise and award construction contract	Month 12	Months 18
Construction	Months 13–24	Months 19–30

[a] *Existing Mooring Cell Environmental Assessment at Lock 14 Updated*

3.6 Environmental Compliance

The Lock 14 mooring cell was one of several navigation A&M measures identified in an earlier report entitled *Design Memorandum No. 24 – Avoid and Minimize Measures* (USACE, 1992). Subsequent to this 1992 report, USACE prepared an EA entitled *Mooring Cell Construction, Pool 15, Mississippi River Mile 491.9, Scott County, Iowa, Rock Island County, Illinois*" (USACE, 2000) to advance the project toward implementation. The EA was completed in 2000 and provided regulatory clearance for USACE to construct a mooring cell in the L&D 14 upbound approach (downstream Pool 15) at RM 491.9. The signed *Findings of Compliance or Noncompliance with the Restrictions on Discharge,* dated June 19, 2001, is in Attachment A. This findings document stated the proposed mooring cell actions are in compliance with Section 404(1)(b) of the Clean Water Act, as amended. The EA states that short-term impacts, attributed to construction of the mooring cell, are expected to be offset by the long-term benefits of avoiding and minimizing navigation impacts on the area from upbound tows waiting to lock through Lock 14.

In coordination with USACE's Rock Island District, given the 18 years since the previous EA compliance activities, the installation of the Lock 14 mooring cell would require updating the 2000 EA and the 2001 Findings of Compliance. Items such as the federal Endangered Species Act (ESA) list have been revised and mussel populations may have moved over the years. However, the information in the existing EA could be leveraged, resulting in a shorter environmental compliance timeline than typical, and the update could potentially be a supplement to the 2000 EA versus a new EA. The Rock Island District would make this EA determination once the project is reactivated based on evaluations of the existing documentation, revisions to original designs, and updates to prevailing ESA lists and resident populations. Typical environmental compliance timelines for projects of a similar scope requiring an EA are 12 to 18 months. Based on the previous environmental coordination, the Lock 14 mooring cell EA could be updated in a 9- to 12-month period upon receipt of funding, with the timeline mostly concurrent with the preparation of the project's construction plans and specifications. A draft project schedule is listed in Table 5.

3.7 Pilot Project Financing Scenarios for a Lock 14 Mooring Cell

Operation and Maintenance (O&M) Funds: A Lock 14 mooring cell can be designed and constructed under USACE Major Maintenance O&M funding as an improvement to the UMR 9-foot Channel Navigation Project. However, to receive Major Maintenance funding, the mooring cell would need to be a prioritized project under USACE's Prioritization of Maintenance asset management decision process. Other critical backlog maintenance items would continue to be prioritized ahead of this navigation efficiency improvement.

Construction General Funds: A Lock 14 mooring cell is a WRDA 2007 authorized NESP project, thus a new start appropriation of Construction General (CG) funds in conjunction with cost-sharing from the Inland Waterway Trust Fund (IWTF) could be used to design and construct the mooring cell as a NESP project. This would require a congressional appropriation and Inland Waterways User Board funding actions. Currently, the Inland Waterways Users Board (IWUB) has not identified the funding of small-scale improvements such as mooring cells in its out-year funding recommendations for L&D improvements on the inland waterways system.

Alternative Financing: USACE's ability to enter into alternative financing arrangements, such as public-private partnerships (P3s) or public-public-private partnerships (P4s), to repair or improve the inland navigation system is currently limited to accepting voluntary contributions of funds or services under existing USACE authorities such as Section 1015(b) of WRRDA 2014 – Contributed Funds (33 United States Code [USC] 701h); Section 1024 of WRRDA 2014, as amended by Section 1153 of WIIN 2016 (33 USC 2325a); Section 408 (33 USC 408); Section 204 (33 USC 2232); and Advanced Funds (33 USC 701h-1). The extent and type of the proposed work determines the applicability of each of these authorities.

Section 1015 – Contributed Funds Pursuant to 33 USC 701h. Federal design, construct, operate, maintain. Contributed funds are funds voluntarily provided by states, political subdivisions, and federally recognized Indian tribes with no repayment or credit afforded for *any* contributed funds obligated by government. The contributed funds can be accepted for planning, design, construction, and O&M for water resources projects. Using contributed funds, USACE completes the design and/or construction of the proposed work using funds provided by non-federal entity. The potential scope of work is limited to existing USACE authorities and could include projects authorized in WRDA 2007 (NESP – new 1,200-foot locks, mooring cells, switch boats, and ecosystem restoration), lock and dam repair work ("recapitalization" through O&M or major rehabilitation), and any channel work (including mooring cells) under the UMR 9-foot Channel Navigation project. Key considerations are as follows:

- Contributed funds are an established USACE authority that has existing implementation guidance, see Attachment B for Implementation Guidance for Section 1015 of WRRDA 2014.
- USACE has not advanced WRRDA 2014 Sections 1043(b), 2004 (a/b), 5014 or 5021-5035 claiming that since Congress has not provided specific appropriations for this work, no activities are authorized to advance these authorizations.
- Section 1015 contributed funds can be accepted only after Congress provides new start federal funds to initiate preconstruction engineering/design (PED) and construction. Acceptance of non-federal materials and services is not included in Section 1015 authorities.
- Negotiations may not be initiated until the Assistant Secretary of the Army (Civil Works) has submitted the draft notification letters to the Office of Management and Budget for clearance.
- Government and non-federal entity prepares memorandum of agreement (MOA). A 33 USC 701h model memorandum of agreement for O&M dredging is provided in Attachment C.
- Completion of congressional notification is required prior to approving the MOA.
- As typical USACE civil works planning, design, permitting and construction processes are involved, alternative financing under Section 1015 contributed funds represents the most simplified project implementation scenario.
- A contributed funds approach that implements a recommended NESP project could be favorably viewed as a private-public partnership that advances towards a more comprehensive implementation of NESP navigation and ecosystem improvements.

The following examples provide additional details regarding the key consideration on acceptance of contributed funds only after new start funds have been provided by Congress. For a Lock 14 mooring cell, the Rock Island District could use O&M funds under the original 1930's UMR 9-foot Channel Navigation project to initiate construction activities and therefore could accept contributed funds for any remaining portion of project funding needed. A possible consideration would be O&M funding for updating the Lock 14 mooring cell EA and contributed funding for the remainder of the design and construction. Under the contributed funds scenario, USACE would design and construct the mooring cell under their typical civil works project processes; and incorporate the new mooring cell into their UMR 9-foot Channel Navigation project O&M program.

A source of contributed funds from the State of Iowa could potentially be the Federal Highway Administration's National Highway Freight Program (NHFP), The NHFP is a program to improve the efficient movement of freight on the National Highway Freight Network (NHFN). Starting in FY 2018, the use of NHFP funds must be identified in a freight investment plan included in the State's freight plan. Specific to NHFP as contributed funds for an inland navigation freight improvement project, a State may use up to 10% of its total NHFP apportionment each year for freight intermodal projects. Any surface transportation project to improve the flow of freight into and out of a freight intermodal or freight rail facility is an eligible project. A mooring cell project on the UMR Waterway facilitates the efficient transfer and interchange of freight commodities to/from truck and rail with barges. The use of NHFP funds for such a project represents an investment in transportation infrastructure and operational improvements that strengthen economic competitiveness, reduces congestion, reduces the cost of freight transportation and increases productivity. A state cost-matching requirement is involved per the use of NHFP funds.

Section 1153. Non-federal design, construct, maintain. WIIN 2016 Section 1153 modified Section 1024 of WRRDA 2014 to authorize the Secretary to accept and use materials, services, or funds contributed by a non-federal public entity, a nonprofit entity, or a private entity to repair, restore, replace, or maintain a water resources project in any case in which the District Commander determines that (1) there is a risk of adverse impacts on the functioning of the project for the authorized purposes of the project; and (2) acceptance of the materials and services or funds is in the public interest. Using Section 1153 authority, a non-federal entity would design and construct proposed work using its funds. Key considerations are as follows:

- Section 1153 allows for non-federal contributions in the form of materials and services, in addition to monetary funds.
- Section 1153 typically applies to non-federal contributions on an existing USACE project such as dredging of a small boat harbor.
- Section 1153 USACE implementation guidance, dated September 28, 2017, is provided in Attachment D. The Attachment C MOA would also be applicable to Section 1153 contributed materials, services or funds.

Section 408. Non-federal design, construct, maintain. The authority to grant permission for temporary or permanent alterations is contained in Section 14 of the Rivers and Harbors Act of 1899 and codified in 33 USC 408 (Section 408). Section 408 allows private, public, tribal, or other federal entities to make alterations to, or temporarily or permanently occupy or use, any USACE federally authorized civil works project. Section 408 authorizes the Secretary of the Army to grant permission for the alteration if the Secretary determines that the activity will not be injurious to the public interest and will not impair the project's usefulness. The Section 408 authority would allow the non-federal entity to design, construct, operate, and maintain the proposed work using its funds after obtaining necessary permission to alter the federal project under Section 408. Potential scope would be limited to repairs, alterations, additions, or improvements to existing USACE facilities that do not significantly change the existing project's authorized purpose, scope, or functions. The addition of a Lock 14 mooring cell would be considered a Section 408 improvement to the existing UMR 9-foot Channel Navigation project.

A Section 408 alteration is commonly related to a City desiring to alter a completed federal civil works flood risk management levee project for access or utility reasons. These federal levee projects are typically designed and constructed by USACE and owned and operated by a local sponsor (City). However, a Section 408 alteration can also be permitted on a federally owned and operated project. An example is USACE's Red Rock Dam, which is currently undergoing a Section 408 alteration by a non-federal entity, Missouri River Energy Services, to construct and operate a hydropower facility at the existing dam. Another relevant Section 408 example is the City of Des Moines pursuing a Section 408 alteration to improve USACE's Southeast

Des Moines – Southwest Pleasant Hill Red Rock Remedial Works Levee system. This levee system is owned and operated by USACE to protect areas of southeast Des Moines from Lake Red Rock flood storage and Des Moines River flooding. The levee system needs improvements in order to be recertified under the Federal Emergency Management Agency's National Flood Insurance Program. Given a lack of USACE authority and funding to perform these improvements, the City is undertaking the levee improvements under the Section 408 authority. The City will design and construct the levee improvement alterations with local funding—with USACE retaining the overall ownership and O&M responsibilities for the levee system including the City's proposed Section 408 alterations.

Under the City of Des Moines' example, a pilot project alternative funding scenario would be a non-federal entity, perhaps the State of Iowa, requesting a UMR 9-foot Channel Navigation Project Section 408 permission to install a Lock 14 mooring cell. The mooring cell would be designed and constructed by the non-federal entity and would be reviewed and approved by USACE, then turned over to USACE for ownership and O&M responsibilities under the UMR 9-foot Channel Navigation Project.

Key considerations are as follows:

- Section 408 is an established USACE authority that has existing implementation guidance.
- A requester has the responsibility to acquire all other permissions or authorizations required by federal, state, and local laws or regulations, including any required permits from the USACE Regulatory Program (Section 10/404/103 permits).
- A proposed alteration pursuant to Section 408 must meet current USACE design and construction standards. However, a requester is not required to bring those portions or features of the existing USACE project that are not affected by the alteration up to current USACE design standards.
- The Section 408 requestor would have the lead on project coordination, planning, design, permitting and construction of the mooring cell improvement. Significant coordination with USACE through the Section 408 processes would be involved; along with the coordination of impacts to and allowance of navigation traffic during the construction phase.
- Depending on availability of program funding, the requestor may need to provide funding to USACE for their Section 408 project coordination and reviews.

Section 204. Non-Federal design, construct. Section 204 authorizes non-federal interests to undertake construction of certain water resources development projects, with potential credit or reimbursement of the federal share of that construction, subject to several requirements. Key considerations are as follows:

- Section 204 provides that a water resource development project to be constructed by non-federal interests must have a completed feasibility report and Chief's report.
- Section 204 provides that construction is subject to approval of the plans for the project by the Secretary, who must determine whether the project is feasible, economically justified, and environmentally acceptable.
- Prior to constructing the project, the non-federal interest must obtain any permit or approval required for the project under federal or state law and must ensure that a final environmental impact statement (EIS) or EA, as appropriate, for the project has been filed.
- Section 204 requires an executed agreement between the non-federal interest and the Secretary prior to the initiation of construction and is applicable for projects when potential reimbursement from federal funds is involved. Thus, for a mooring cell, major rehabilitation or 1,200-foot lock project, if stakeholder reimbursement of contributed funds is not involved, Section 204 is not the most applicable alternative financing authority.

Advanced Funds. Federal design, construct, operate, maintain. Advanced funds are non-federal funds voluntarily provided by states, political subdivisions, and federally recognized Indian tribes as an advance of the federal share or in the absence of federal funding, with the potential for repayment or credit. The advanced funds can be accepted for planning, design, construction, and O&M for water resources projects. Using advanced funds, USACE completes the design and/or construction of the proposed work using funds from the non-federal entity. The potential scope of work is limited to existing USACE authorities and could include projects authorized in WRDA 2007 Title VII (NESP – new 1,200-foot locks, mooring cells, switch boats, and ecosystem restoration), lock and dam repair work ("recapitalization" through O&M or major rehabilitation), and any necessary channel work. Key considerations are as follows:

- Advanced funds is an established USACE authority that has existing implementation guidance and is applicable for projects when reimbursement from the federal share is involved to align final cost-matching percentages.
- Advanced funds does not require new start federal funds to initiate construction.
- MOA negotiations will not be initiated unless the Assistant Secretary of the Army (Civil Works) and Office of Management and Budget have approved and congressional notification has occurred.
- USACE policy is not to accept advanced funds for work that is inconsistent with Administration policy or budget priorities.
- Government and non-federal entity prepare an MOA documenting work and conditions.

4.0 Pilot Project: System Reliability Improvements

4.1 Lock and Dam Major Rehabilitation Program

A pilot project scenario that provides for a sustainable UMR river transportation system by extending the design life of the existing navigation infrastructure and enhancing the service reliability of the waterway's lock system is reestablishing USACE's Major Rehabilitation Program on the waterway through an alternative financing scenario. The Major Rehabilitation Program was a very successful L&D recapitalization program on the UMR from the 1980s to 2004. Since 2004, no new major rehabilitation projects have been approved on the UMR Waterway.

The Major Rehabilitation Program is USACE's program for undertaking major improvements to its portfolio of civil works infrastructure facilities such as hydropower plants and navigation L&Ds. Major rehabilitation projects are funded under USACE's CG budget appropriations with inland navigation project costs shared 50-50 with the IWTF. The Major Rehabilitation Program works in conjunction with USACE's Major Maintenance Program, which is funded under USACE's O&M budget appropriations. Major maintenance projects are then prioritized under USACE's risk-informed priority of maintenance asset management process.

For inland navigation projects, the Major Maintenance Program focuses on projects costing under $21 million (fiscal year [FY] 2017 index) with component-specific projects that support L&D repairs such as repairing or replacing a miter gate or installing lock dewatering bulkhead slots. On the other hand, the Major Rehabilitation Program consists of reliability or efficiency improvements costing over $21 million that focus on facility life extensions that are critical for system recapitalization and the facility's long-term durability and sustainability. Major rehabilitation projects in essence serve to reset the design life of an L&D facility and extend the reliable service life of the infrastructure.

Past UMR L&D major rehabilitation projects have included replacing lock operating machinery, upgrading and replacing the L&D's electrical power and control systems, making mass concrete repairs, resurfacing and armoring the lock chamber concrete (see Figure 5), painting, making L&D gate repairs, emptying and filling valve repairs, making dewatering improvements, installing lock bubbler systems for ice management, adding scour protection, and making general safety improvements. Major rehabilitation projects must be economically justified by a supporting benefit-cost ratio and must be documented in an approved Rehabilitation Evaluation Report (RER).

Figure 5: UMR Lock 12 – Chamber Concrete Rehabilitation

Source: USACE Rock Island District

The Major Rehabilitation Program guidance identifies two categories of facility improvements: reliability and efficiency improvements. A reliability improvement is defined as:

- A restoration consisting of structural work on a USACE facility intended to improve the reliability of an existing structure, the result of which will be a deferral of capital expenditures to replace the structure. By program definition, a rehabilitation project must be at an individual facility and not across a system of sites.
- Rehabilitation will be considered as an alternative when it can significantly extend the physical life of the feature and can be economically justified by a benefit-cost analysis. The work must extend over at least two full construction seasons and require an indexed value of capital outlays, currently indexed at $21.5 million (FY 2019) for inland navigation projects.

An efficiency improvement is defined as:

- An improvement that will enhance operational efficiency of major project components. Operational efficiency will increase outputs beyond the original project design.
- Efficiency improvements will require an indexed value of capital outlays currently indexed at $2.1 million (FY 2019).

4.2 Reliability Upgrade Pilot Project Scenario – Major Rehabilitation of Locks and Dams

The Major Rehabilitation and Maintenance Programs for the L&Ds on the UMR Waterway have been ongoing since the late 1970s. Historically, the USACE Districts took one of two approaches to packaging L&D major rehabilitation projects. The first approach focused on one L&D facility and rehabilitating the components that are at or nearing unpredictable performance (at or near the end of the design life). The second approach was where similar components are rehabilitated or replaced throughout a district's assigned L&Ds. The following discussion will focus on the first approach, which is the approach the Rock Island District has taken for major rehabilitation projects, noting the approach continues to align with current Major Rehabilitation

Program guidance. The current guidance specifically states that a major rehabilitation project must be at one specific L&D facility—not across two or more facilities. However, a revision of the major rehabilitation guidance to allow for the improvement of specific L&D components across two or more facilities would provide some flexibility in the program. For example, a major rehabilitation project that focused on the replacement of lock miter gates across several facilities would have resulted in significant improvements in system reliability using CG and IWTF funds instead of O&M funds.

An L&D major rehabilitation project at a Rock Island District site has the objective to rebuild, rehabilitate, or replace all components that are at or near the end of their design life (typically assumed to be 50 years) or that could have unpredictable reliability and unacceptable performance within the planning horizon. Then, on a 25- to 50-year cycle, an L&D facility would be rescheduled for another major rehabilitation project to once again address components that are at or nearing unpredictable reliability and performance. Table 6 shows the UMR major rehabilitation projects that have been completed and the project costs (actual price levels).

Note that several of the L&D sites are approaching a timeframe where their rehabilitation projects were completed 30 years ago. As highlighted in the Infrastructure Update (Iowa DOT, 2018), in recent years the O&M-funded Major Maintenance Program has addressed many critical high-priority repair and replacement needs related to the reliable operation and performance of the lock through the risk-informed priority of maintenance budgeting process. Critical needs such as replacing lock miter gates and installing lock dewatering bulkhead slots have been completed throughout the St. Louis and Rock Island Districts' based sites. The replacement of miter gates on the St. Paul District-based locks is ongoing.

Table 6: UMR Lock & Dam Major Rehabilitation Program

Site	Placed Into Service	Major Rehabilitation Years[a]	Project Cost[b] ($ millions)
Locks 27	1964	2008	34.0
Mel Price Lock & Dam	1990	—	—
Lock & Dam 25	1939	1994–2001	25.9
Lock & Dam 24	1940	1996–2007 (stages)	70.0
Lock & Dam 22	1939	1987–1990	15.1
Lock & Dam 21	1938	1987–1990	14.6
Lock & Dam 20	1935	1986–1994	43.7
Lock 19	1957	2003–2007	28.0
Lock & Dam 18	1937	1988–1993	15.0
Lock & Dam 17	1939	1988–1993	14.9
Lock & Dam 16	1937	1991–1994	17.8
Locks & Dam 15	1934	1993–1996	19.2
Lock & Dam 14	1940	1996–2000	30.6
Lock & Dam 13	1939	1993–1997	22.5
Lock & Dam 12	1938	2000–2004	37.2

Site	Placed Into Service	Major Rehabilitation Years[a]	Project Cost[b] ($ millions)
Lock & Dam 11	1937	2002–2008	40.3
Lock & Dam 10	1937	1991–2005 (stages)	25.9
Lock & Dam 9	1940	1993–2004 (stages)	28.2
Lock & Dam 8	1938	1992–2002 (stages)	25.9
Lock & Dam 7	1940	1993–2005 (stages)	32.2
Lock & Dam 6	1938	1991–2002 (stages)	25.9
Lock & Dam 5A	1938	1992–2002 (stages)	24.4
Lock & Dam 5	1939	1990–2001 (stages)	36.1
Lock & Dam 4	1938	1989–2003 (stages)	30.0
Lock & Dam 3	1940	1988–2003 (stages)	32.7
Lock & Dam 2	1930	1987–2003 (stages)	32.5
Lock & Dam 1	1932	1983–2002 (stages)	56.2

[a] *Source: System Navigation Study, Engineering Appendix – Table A-6 (USACE, 2004)*
[b] *Project costs represent actual totals that are not adjusted for price levels.*

4.3 Project Costs

The earlier major rehabilitation projects—Locks 20, 21, and 22—were initiated over 30 years ago. Within a 20-year planning horizon, these rehabilitation projects will be approaching and exceeding a 50-year rehabilitation design life. A recapitalization of the UMR L&D system will once again be needed to ensure a sustainable UMR river transportation system by extending the design life of the existing navigation infrastructure. A typical UMR L&D project undertaken during the initial cycle of major rehabilitation had an average cost range of approximately $20 million to $40 million. Using the USACE CWWIS price level indexing from 1990 to 2018 yields a cost inflation factor of 2.17. Thus, in a few years, an approximate doubling of a typical rehabilitation project cost to a range of $40 million to $80 million can be projected, or an average of approximately $60 million per site. These high-level estimates align with the System Navigation Study's Engineering Appendix – Addendum E – With-Project Condition rehabilitation cost estimates.

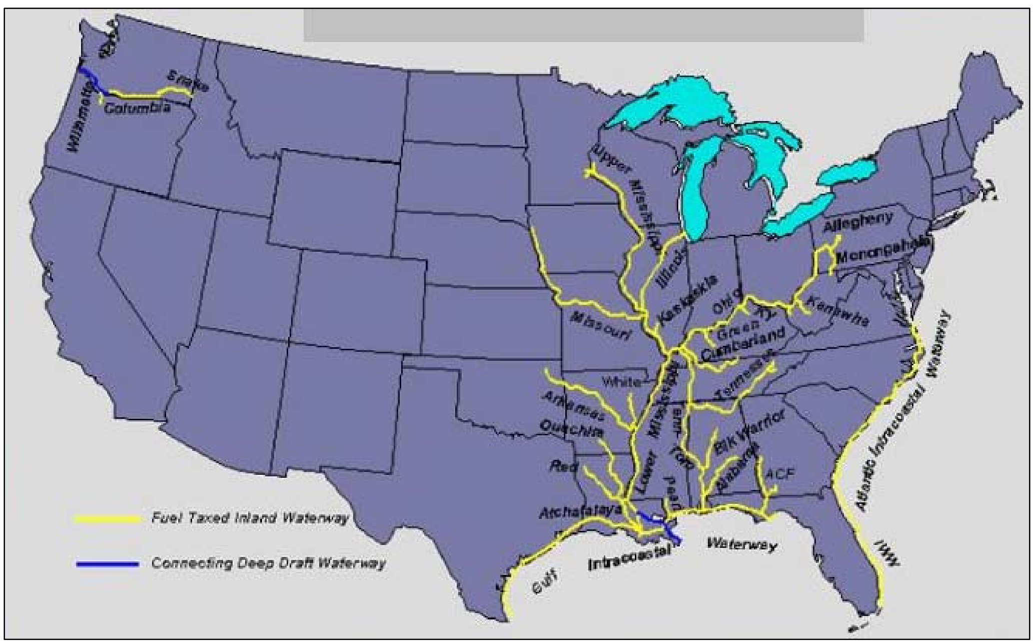
The distribution of rehabilitation costs between the lock components and the dam components for the projects listed in Table 6 heavily focused on the lock versus the dam. On average, the rehabilitation costs were approximately 75 percent lock and 25 percent dam. In the pilot project scenario for major rehabilitation of the system, based on current conditional needs, the distribution of costs are estimated to be a 50 percent lock and 50 percent dam because the dam operating machinery and gate replacements will likely be a part of the scope of work; these components were mostly not included in the first cycle of major rehabilitation.

Historically, the Table 6 list of UMR L&D major rehabilitation projects included a mixed funding stream, with work funded by both O&M major maintenance and CG major rehabilitation accounts. Based on recent major maintenance funding levels on the UMR Waterway, a scenario assumption is made that 25 percent of the approximately $60 million per site estimate will be addressed with O&M major maintenance projects, or $15 million. Thus, a funding need of $45 million will remain for the major rehabilitation work.

WRDA 1986 established the current cost-sharing arrangement for USACE inland navigation major rehabilitation projects. Rehabilitation projects are equally (50-50) cost-shared between the federal government and commercial users of the inland system through the IWTF. The IWTF is supported by a tax on barge fuel. From 1994 to 2014, this tax was $0.20 per gallon of fuel and averaged about $85 million per year in tax revenue. In WRDDA 2014, the IWTF fuel tax was raised to $0.29 per gallon. This $0.09 increase, in conjunction with increasing traffic volume, has increased annual IWTF tax revenues by approximately 33 percent to $114 million. Figure 6 shows the nation's fuel taxed inland waterways.

An advisory board, the IWUB, was established to monitor the IWTF revenue and to make recommendations to USACE and to Congress on L&D investment priorities. The IWUB is established under Section 302 of Public Law 99-662. The 11-member IWUB represents all geographic areas on the fuel-taxed inland waterways system. The makeup of the board also reflects a balanced industry focus, including stakeholder and carrier members from companies of different sizes and the transport of different commodities. The IWUB meets four times per year at meeting sites around the nation.

Figure 6: Fuel Taxed Inland Waterways



Source: USACE

The UMR Waterway has a total of 29 L&Ds, of which 27 remain active locks. To undertake a Major Rehabilitation Program that roughly aligns with the 15-year timeline of the initial UMR rehabilitation projects would require undertaking two L&D project per year over a 15-year period. The scope of work would be based on long-term rehabilitation needs as identified by ongoing USACE periodic inspections and conditional assessments and are anticipated to reflect the previous major rehabilitation projects that included replacing operating machinery, upgrading and replacing the L&D's electrical power and control systems, making guidewall foundation repairs, making mass concrete repairs, resurfacing and armoring the lock chamber concrete, painting, repairing gates, emptying and filling valve repairs, making dewatering improvements, adding ice management systems, adding scour protection, and making general safety improvements.

4.4 Economic Considerations

The L&D rehabilitation work would be scoped and economic justification provided in an RER prepared by the responsible USACE District. All rehabilitation work would need to satisfy USACE planning guidance principles related to benefit-cost ratios. A funding stream associated with this project scenario would be approximately $45 million per site, or $90 million per year at two sites per year. Under current cost-sharing legislation, costs would be 50 percent federal government and 50 percent IWTF, or $45 million per year. This level of IWTF investment on the UMR represents approximately 40 percent of the fund's annual revenues. This percentage is likely not sustainable over a 15-year period given other inland waterway investment needs across the fuel taxed system.

4.5 Project Timeline

A major rehabilitation project is initiated by completing a Major RER by the responsible District, obtaining USACE headquarters approval of the report, and obtaining "new start" engineering design and construction funding. The RER preparation includes the engineering reliability assessments for a L&D facility, development of cost estimates, the benefit-cost analyses that provide the economic justifications for the work, and the environmental compliance documentation. An RER is funded under a USACE District's O&M funding account and typically takes 2 years to complete. The RER approval process through USACE Division and headquarters offices will involve a third year.

The engineering design and construction phases of a major rehabilitation project are funded from the USACE navigation business line's CG funds at 50-50 cost-sharing with the IWTF. The CG/IWTF funding queue for major rehabilitation projects in recent years on the UMR and IWW Waterways has exceeded 10 years because of the limited funds available each year, primarily because of the Olmsted Lock and Dam project on the Ohio River. However, for this pilot project scenario, a CG/IWTF funding queue of 2 years is assumed. The engineering design (including preparation of the construction plans and specifications) and the advertisement and award of the construction contract timeline are typically 2 years. The construction period is then 3 years based on a scenario of two contract phases of construction: one contract for the lock rehabilitation work and a second contract for the dam work. The 10-year project timeline is summarized in Table 7.

Table 7: Project Timeline for a Lock and Dam Major Rehabilitation Project

Project Activity	Year
Major RER	1–2
Environmental compliance	2
USACE headquarters approval of RER	3
CG/IWTF funding queue	4–5
Plans and specifications	6–7
Advertise and award construction contract	7
Construction	8–10

4.6 Environmental Compliance

L&D major rehabilitation projects on the UMR Waterway would require preparation of an EA, or possibly an EIS, depending on the level of environmental impacts, to comply with the National Environmental Policy Act and other environmental laws and regulations. If placement of dredged or fill material is involved, USACE would need to apply for Section 401 water quality certification permits through the appropriate state. Coordination with the U.S. Fish and Wildlife Service would be required under the Endangered Species Act and Fish and Wildlife Coordination Acts. USACE would also have to comply with the National Historic Preservation Act. Any project impacts on wetlands, fish, or wildlife may require mitigation. The EA could be prepared concurrent with the timeline for the 2-year Major RER preparation project activity (see Table 7).

4.7 Pilot Project Financing Scenarios for Major Rehabilitation

15-year Scenario: A pilot project that introduces a third source of revenue for major rehabilitation projects on the UMR would significantly enhance the ability to fund projects. For example, a UMR five-state stakeholder coalition that provides a third component of funding could potentially facilitate a sustainable funding stream. The five states would be those that border the Mississippi River and that enjoy the transportation benefits provided by a reliable and sustainable L&D system. These states are Missouri, Illinois, Iowa, Wisconsin, and Minnesota. Reallocating cost-shared responsibilities across three funding sources could, for example, be a 33.3 percent – 33.3 percent – 33.3 percent scenario. Annual costs for a 15-year Major Rehabilitation Program would be approximately $30 million for each entity, at $15 million per each of the two annual sites. Table 8 shows the associated funding stream based on two project starts per year. No annual inflation is included in the 15-year project timeline.

Table 8: Financing Scenarios for UMR Lock & Dam Major Rehabilitation

Site	Initial Major Rehabilitation Years	Years	Funding ($ millions)	Cost-Sharing[a] 33%/33%/33% ($ million)	Cost-Sharing[a] 50%/25%/25% ($ million)
Lock 27	2008	11–12	45	15/15/15	22.5/11.2/11.2
Mel Price L&D	—	9–10	45	15/15/15	22.5/11.2/11.2
Lock & Dam 25	1994–2001	5–6	45	15/15/15	22.5/11.2/11.2
Lock & Dam 24	1996–2007	6–7	45	15/15/15	22.5/11.2/11.2
Lock & Dam 22	1987–1990	1–2	45	15/15/15	22.5/11.2/11.2
Lock & Dam 21	1987–1990	1–2	45	15/15/15	22.5/11.2/11.2
Lock & Dam 20	1986–1994	2–3	45	15/15/15	22.5/11.2/11.2
Lock 19	2003–2007	14–15	45	15/15/15	22.5/11.2/11.2
Lock & Dam 18	1988–1993	2–3	45	15/15/15	22.5/11.2/11.2
Lock & Dam 17	1988–1993	3–4	45	15/15/15	22.5/11.2/11.2
Lock & Dam 16	1991–1994	3–4	45	15/15/15	22.5/11.2/11.2
Locks & Dam 15	1993–1996	4–5	45	15/15/15	22.5/11.2/11.2
Lock & Dam 14	1996–2000	5–6	45	15/15/15	22.5/11.2/11.2
Lock & Dam 13	1993–1997	4–5	45	15/15/15	22.5/11.2/11.2
Lock & Dam 12	2000–2004	6–7	45	15/15/15	22.5/11.2/11.2
Lock & Dam 11	2002–2008	7–8	45	15/15/15	22.5/11.2/11.2
Lock & Dam 10	1991–2005	7–8	45	15/15/15	22.5/11.2/11.2
Lock & Dam 9	1993–2004	8–9	45	15/15/15	22.5/11.2/11.2
Lock & Dam 8	1992–2002	8–9	45	15/15/15	22.5/11.2/11.2
Lock & Dam 7	1993–2005	9–10	45	15/15/15	22.5/11.2/11.2
Lock & Dam 6	1991–2002	10–11	45	15/15/15	22.5/11.2/11.2
Lock & Dam 5A	1992–2002	10–11	45	15/15/15	22.5/11.2/11.2
Lock & Dam 5	1990–2001	11–12	45	15/15/15	22.5/11.2/11.2
Lock & Dam 4	1989–2003	12–13	45	15/15/15	22.5/11.2/11.2
Lock & Dam 3	1988–2003	12–13	45	15/15/15	22.5/11.2/11.2
Lock & Dam 2	1987–2003	13–14	45	15/15/15	22.5/11.2/11.2
Lock & Dam 1	1983–2002	13–14	45	15/15/15	22.5/11.2/11.2
		Scenario totals	$1,215	$405/$405/$405	$607/$304/$304
		Annual totals	$90	$30/$30/$30	$45/$22.5/$22.5

[a] *Federal % / IWTF % / Stakeholder %*

The IWUB, in its 2017 annual report, has recommended that the new lock construction and Major Rehabilitation Programs' cost-sharing responsibilities be revised from the current 50 percent federal – 50 percent IWTF to 75 percent federal – 25 percent IWTF. In WIIN 2016, Congress revised the cost sharing for the construction of ports to be deepened to depths between 45 and 50 feet from 50 percent federal – 50 percent non-federal to a new 75 percent federal – 25 percent non-federal formula. This change was made to bring the cost-sharing formula into alignment with current economic and competitive conditions. The IWUB 2017 report states that if the same change were made for the inland waterways—revising that cost-sharing formula to 75 percent federal and 25 percent IWTF—many new L&D projects could be completed over the next 20 years. The IWUB strongly supports such a change for the inland waterways because it would expedite the construction initiation and completion of these lock and dam modernization investments, minimize the costs necessary to complete these projects, and result in the delivery of the projects' intended national economic development benefits far earlier than could be achieved without the cost-share change.

A second pilot financing scenario could be keeping the federal cost-sharing allocation at the current 50 percent and revising the IWTF to 25 percent, with stakeholder alternative funding providing for the remaining 25 percent. Annual costs for a 15-year program would be approximately $45 million federal and $22.5 million each for the IWTF and stakeholders based on two project starts per year. Table 8 also lists this financing scenario.

27-year Scenario: An alternative scheduling scenario would be to schedule one major rehabilitation "new start" each year for the 27 UMR Waterway L&Ds, or a 27-year scenario. The scheduling of major rehabilitation would start toward the downstream UMR L&Ds, starting at around a 40-year cycle (1987 to 2027) since the last rehabilitation on these high traffic volume locks and working in general upstream at one new rehabilitation project per year for the next 27 years. Note that the cycle of major rehabilitation would be around 60 years for the upstream lower traffic volume L&Ds that receive less cycles of lock use. Major maintenance projects would continue to address critical component reliability issues under the priority of maintenance program in the interim. Under a 27-year scenario pilot project that introduces a third source of revenue for major rehabilitation projects, an equal one-third each cost-sharing program would result in an approximately $15 million annual cost for each of the cost-sharing partners: the federal government, the IWTF, and the five-state stakeholder entity. Alternatively, with the 50 percent – 25 percent – 25 percent allocation, $22.5 million annually for the federal government and $11.25 million annually each for the IWTF and stakeholder entity. Based on the Table 7 project timeline of 7 years to start of construction for a major rehabilitation project, the RER effort should be started in 2020 under this scenario.

Alternative Financing: The alternative financing for the major rehabilitation 15- or 27-year pilot project scenarios could have stakeholder cost-sharing investments conveyed as contributed funds under the provisions in the authorities outlined in Paragraph 3.7. As with a mooring cell project, Section 1015 contributed funds is the most applicable alternative financing authority. USACE could not accept contributed funds for a new Major Rehabilitation project until there has been congressionally provided new start CG federal PED or construction appropriations. However, a Major Rehabilitation type project could be more readily undertaken on the UMR Waterway as a Major Maintenance project performed under the existing UMR 9-foot Channel Navigation project; where contributed funds could be accepted based upon an O&M allocation of funds towards the project. As an O&M funded project however, IWTF matching funds would not be involved.

The Section 408 alternative financing option (design, permitting and construction to be performed by the 408 applicant) is a theoretically feasible option, but not easily accomplished. A Section 408 project would not be applicable for the major rehabilitation cost-sharing scenarios outlined in earlier in Section 4.7 as a 408 alteration project is 100 percent non-federal applicant funded. Additionally, the 408 applicant would have the sole responsibility for the design and construction rehabilitation activities on the lock and dam structure. This non-direct USACE involvement would be a challenging endeavor for an active navigation lock and the associated commercial traffic impacts. An assumption would be that USACE accomplishes a RER type report that provides the recommended scope of rehabilitation work involved and the 408 applicant then determines the extent of the work that they will fund and undertake. Upon completion of the Section 408 alterations (rehabilitation), the project would be re-assumed by USACE for normal on-going federal O&M activities. As typical USACE civil works planning, design, permitting and construction processes are involved, as stated earlier, alternative financing under Section 1015 contributed funds represents a more straight-forward project implementation scenario.

4.8 Governance

WRDA 1986 established the IWUB as a federal advisory committee to give commercial navigation users a strong voice in the investment decision-making they support with the cost-sharing inland waterway fuel tax revenue. The IWUB's principal responsibility is to recommend to Congress, the Secretary of the Army (Civil Works), and the USACE the prioritization of new inland navigation construction and major rehabilitation projects. A UMR stakeholders' governance model would be to leverage the current IWUB advisory board by establishing a subcommittee for administering the UMR state/local revenue, and to provide input and make recommendations to USACE, the IWUB, and Congress regarding L&D investments on the UMR Waterway. The IWUB meets quarterly at locations across the nation, and the UMR stakeholders coalition could have representatives at these quarterly meetings to provide UMR perspectives and project recommendations.

5.0 Pilot Project: Large-scale Upgrade

5.1 1,200-foot Lock Chambers

The over 80-year-old UMR navigation system experiences some of the longest lockage delays in the country because of single, undersized 600-feet lock chambers that must lock modern tows that are 1,200 feet in length. Current lockage delays average 4 to 5 hours in the lower reach of the system. Numerous studies have reported that the UMR navigation system has marginally adequate capacity for current traffic volumes on the lower reaches of the UMR, L&Ds 20 to 25. The system will become overly congested as a growing economy, expanding grain exports, and enlargement of the Panama Canal drives up the nation's needs for economical transportation of goods and products.

USACE's NESP is a long-term program of navigation improvements and ecological restoration for the UMR that is proposed to be implemented inclemently over a 50-year period through integrated, adaptive management. The objective of the NESP is to improve efficiency and capacity of the nationally significant UMR and IWW Waterways while protecting, preserving, and enhancing the structure, diversity, and function of this nationally significant ecosystem. NESP's goal is the implementation of an integrated, dual-purpose plan to ensure the economic and environmental sustainability of the UMR.

The NESP is an outcome from a USACE 10-year planning study that was completed in 2004. USACE's three UMR Districts of St. Louis, Rock Island, and St. Paul conducted the System Navigation Study to determine the best way to manage the UMR Waterway in a manner that balances economic, environmental, social, and political needs. This study took a systems approach, since changes in one part of the system may have an impact elsewhere in the system. Under the study, USACE investigated the feasibility of navigation improvements to eight locks and 348 miles of the IWW and 29 locks and 854 miles of the UMR concurrently with the feasibility of ecosystem enhancement and restoration on both rivers.

The 2004 System Navigation Study's first increment recommendations included the capacity improvements of adding new 1,200-foot locks at seven UMR and IWW L&D sites. These seven sites included UMR L&Ds 20, 21, 22, 24, and 25 (there is no L&D 23) and IWW Peoria and LaGrange L&Ds. These recommended navigation lock improvements were subsequently included in WRDA 2007, thus providing the federal authorization for these projects. The new UMR 1,200-foot locks would be built adjacent to the existing 600-foot chambers in the auxiliary lock mite gate bays and would provide for single lockages of full 15 barge tows. The feasibility study's estimated project costs (2004 price levels) for the new 1,200-foot locks was $2 billion, or an average of $286 million per lock. The System Navigation Study evaluated several locations within the existing L&Ds to place a new 1,200-foot lock chamber, and the auxiliary bay location was the most optimal. The auxiliary bay location is commonly referred to as Location 3. Figure 7 shows the auxiliary miter gate bay location for a 1,200-foot lock chamber. A 1,200-foot lock configuration that extends the existing 600-foot chamber has less expensive construction costs, but the impacts of extended closures on existing river traffic were significant and were determined to be unacceptable.

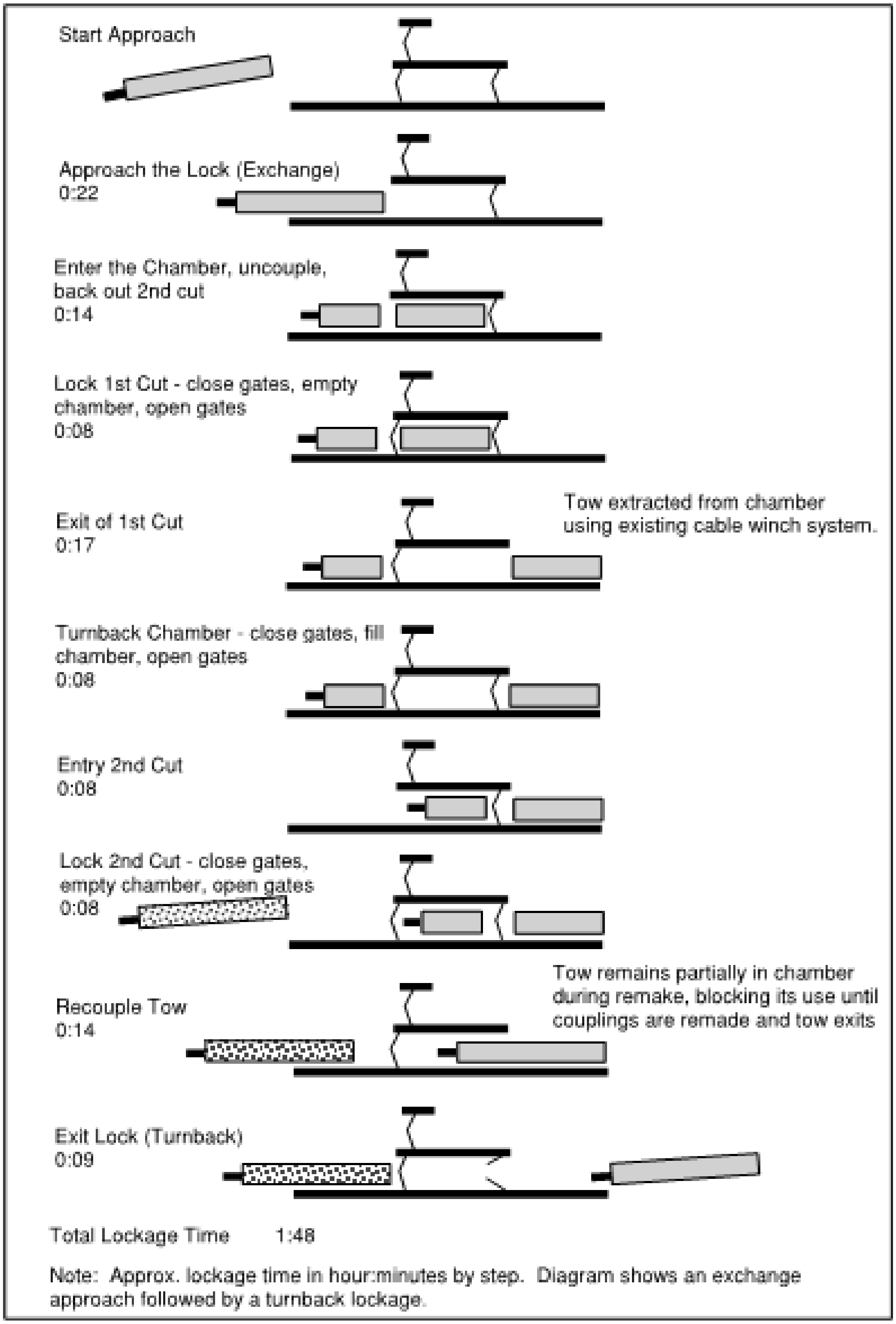
Figure 7: UMR Lock and Dam 22 – Auxiliary Miter Gate Bay with 1,200-foot Lock

Adding a 1,200-foot lock also has redundancy benefits associated with two lock chambers at one site. The likelihood of a system shutdown attributable to both locks being closed at once is very small when compared with the scheduled maintenance closures and risks of unscheduled closures related to a single lock. The redundancy gives a much higher degree of reliability to this reach of the UMR Waterway. The only time that both locks would not be available is during flood events. Because the new lockwalls will be at the same elevation as the existing lock, both locks would be closed at the same time because of inundation.

5.2 Time Savings Improvements

Lock performance is the lock's ability to process tows. For most of the UMR Waterway locks, a double lockage is required because of the 600-foot lock chambers. The steps of a double lockage are shown in Figure 8.

Figure 8: Double Lockage Steps – Downbound at an Existing 600-foot Lock



Source: USACE – System Navigation Study – Engineering Appendix (2004)
Note: Total lockage time of 1:48 hours assumes typical lock approach time shown of 22 minutes.

Constructing a 1,200-foot lock eliminates a number of the lockage steps currently required for a double lockage, resulting in a significant reduction in lock transit times. The primary time savings are attributable to the elimination of the uncoupling of a 15-barge tow into a first and second cut, lock turnback times for the second cut, and recoupling of the tow. The lock upgrades also have lock approach improvements, resulting in additional minutes of savings that vary between L&D sites.

The average lockage times shown in the 2004 System Navigation Study include the lock approach to the lower/upper guidewall, the locking process, and the exit off the upper/lower guidewall. Based on a Location 3 Type R lock, the System Navigation Study indicates total average time savings of up to 1 hour could be realized at particular L&D sites.

5.3 NESP Economic Update in FY 2019

Implementation of a new lock component(s) under USACE's NESP program would be considered a Large-scale Upgrade for purposes of this study. In Fiscal Year 2019 (FY 2019), USACE is performing economic update for NESP focusing on engineering reliability, forecasted barge traffic demands, barge transportation demand elasticity, transportation rates, and lock performance characteristics. Given the near term availability of this in-depth economic update of NESP, the evaluation of a Large-scale Upgrade pilot project scenario was not included in this report.

Attachment A

Lock 14 Mooring Cell – Findings of Compliance

SECTION 3 - FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

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

B. Aside from **No Federal Action,** only two alternatives were considered. These alternatives involved construction at two different locations: RM 491.9 (Site 2) and RM 492.5 (Site 1). It was determined that construction at RM 491.9 (Site 2) would be the least environmentally damaging of the three alternatives. (For evaluation of practicable alternatives, refer to the EA Sections III, VI, and V.)

C. The project is not anticipated to induce toxic substances into nearby waters or result in appreciable increases in existing levels of toxic materials. Therefore, Section 307 of the Clean Water Act will not be exceeded.

D. No significant impact to Federal or State listed endangered species would result from the proposed actions. No marine sanctuaries would be impacted.

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

F. Construction of a mooring cell in the main channel is considered to be beneficial and has been proposed as an "avoid and minimize" measure by the U.S. Fish and Wildlife Service.

G. Potential adverse impacts on the aquatic ecosystem would be minimized by using chemically inert, uncontaminated fill material.

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

19 June 2001
Date

William J. Bayles
Colonel, U.S. Army
District Engineer

LTC EN
Acting Dist Eng

Attachment B

Implementation Guidance for Section 1015 of WRRDA 2014

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P

FEB 1 1 2015

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Implementation Guidance for Sections 1015 and 1023 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), Contributed Funds

1. Section 1015 of WRRDA 2014 (Enclosure 1) amends the contributed funds authority codified in 33 U.S.C. 701h. It expands this authority to allow the U.S. Army Corps of Engineers (USACE) to accept voluntarily contributed funds from states and political subdivisions as well as from other non-Federal interests. It clarifies that the authority to accept and expend contributed funds applies as well to authorized projects on the inland waterways. Further, section 1015 requires notification of both the Authorization and Appropriations Committees and changes the timing to require notification prior to the acceptance of the contributed funds. In addition, section 1015 includes a separate provision that authorizes USACE to accept funds to operate a hurricane barrier project to support recreational activities at or in the vicinity of the project; guidance on this provision will be issued separately. A copy of 33 U.S.C. 701h is enclosed.

2. Section 1023 of WRRDA 2014 amends Section 902 of the Water Resources Development Act of 1986 (WRDA 1986) (Enclosure 2), as amended (33 U.S.C. 2280) to provide that USACE may accept contributed funds to carry out any authorized water resources development project that has exceeded its maximum cost. A copy of 33 U.S.C. 2280 is enclosed.

3. Applicability. This guidance is applicable to all HQUSACE elements, major subordinate commands (MSC), districts, laboratories and field operating activities (FOA) having Civil Works functions. This guidance supersedes the guidance in ER 1165-2-30, Acceptance and Return of Required, Contributed or Advanced Funds, dated 30 October 1998, as it pertains to Contributed Funds; CECW-P Memorandum, subject: Contributed Funds, dated 2 July 2007; and CECW-PB Memorandum, subject: Implementation Guidance for Section 111 of the FY12 Energy and Water Development Appropriations Act, Contributed Funds, dated 2 April 2012.

4. Policies.

a. Contributed Funds are those funds above any statutorily required non-Federal cost share provided voluntarily by states, or a political subdivision thereof, or other non-Federal interests, with no credit or repayment authorized for such funds for authorized work that is being undertaken by USACE. "states" means the several states, the District of Columbia, the commonwealths, territories, and possessions of the United States, and Federally recognized Tribes. Non-Federal interests is defined in section 221 of the Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b) and means a legally constituted public body or a nonprofit entity with the consent of the affected local government.

b. While 33 U.S.C. 560 provides separate contributed funds authority related to authorized navigation projects, 33 U.S.C. 701h is a comprehensive authority covering all project purposes. The authority in 33 U.S.C. 701h and this guidance, including the requirement for Committee notification, will be used for all proposals involving contributed funds, except for those proposals traditionally considered voluntary contributions for recreation and environmental protection and restoration pursuant to section 203 of WRDA 1992 (33 U.S.C. 2325) and the Challenge Partnership Program pursuant to section 225 of WRDA 1992 (33 U.S.C. 2328). Proposals for the acceptance of contributions pursuant to sections 203 and 225 of WRDA 1992 should continue to follow the guidance and procedures set forth in ER 1130-2-500.

c. The authority in 33 U.S.C. 701h allows for the acceptance and expenditure of contributed funds for the study, design, construction, and operation and maintenance of Federally authorized water resources development studies and projects, including studies and projects in the Continuing Authorities Program (CAP) and studies and projects on the inland waterways. It does not provide for the acceptance of contributed funds related to environmental infrastructure assistance.

d. 33 U.S.C. 701h provides for the acceptance of contributed funds to be expended "in connection with funds appropriated by the United States."

(1) General Rule: To meet the above requirement, there are two main points at which appropriated funds must have been provided: 1) initiation of the feasibility study with Investigations or Mississippi River & Tributaries (Investigations) (MR&T (I)) funds, and 2) initiation of project construction with Construction or Mississippi River and Tributaries (Construction) (MR&T (C)) funds. Once there has been the initial provision of Investigations or MR&T (I) funds, contributed funds may be accepted throughout the study and design of a project. Once there has been the initial provision of Construction or MR&T (C) funds, contributed funds may be accepted throughout the construction and operation and maintenance of a project.

(2) Special Cases:

(a) For a CAP project, once Federal funds have been provided to initiate the study, contributed funds may be accepted for further study, design, construction, and operation and maintenance of the project.

(b) For water supply storage reallocation studies, the following will apply:

(i) For studies that will be funded with Operation or Maintenance (O&M) or Mississippi River and Tributaries (MR&T (M)) funds only, contributed funds may be accepted even if Federal funds have not been provided for the study.

(ii) For studies initiated using O&M or MR&T (M) funds, after which it is determined that the study will continue on a cost shared basis using Investigations or MR&T (I) funds, Investigations or MR&T (I) funds must have been provided for the cost shared portion of the study before contributed funds may be accepted.

(iii) For studies that will be funded with Investigations or MR&T (I) funds only, Investigations or MR&T (I) funds must have been provided before contributed funds may be accepted.

(iv) Existing planning and budgetary guidance will be followed when determining whether to fund a water supply reallocation study under O&M, MR&T (M), Investigations or the MR&T (I) account. See Appendix E of ER 1105-2-100 for planning guidance on funding reallocation of storage studies.

e. Notwithstanding that a project has exceeded its maximum cost under Section 902 of WRDA 1986, contributed funds may be accepted to carry out the project if the use of such funds does not increase the Federal share of the cost of the project. The maximum Federal share of the cost of the project will be determined based on the Section 902 amount on the date of execution of the Project Partnership Agreement (PPA), or the amendment to the PPA, that provides for the acceptance of the contributed funds.

f. The acceptance of contributed funds does not change the requirement that the study, design, construction, and operation and maintenance must be undertaken in accordance with Federal laws, regulations, and policies.

g. In general, Federal participation in cost shared periodic renourishment of hurricane and storm damage reduction projects is limited to a maximum of 50 years. During this period of Federal participation, contributed funds may be accepted in addition to the non-Federal cost share to undertake periodic renourishment. At the end of the period of Federal participation, the non-Federal sponsor is solely responsible for any additional periodic renourishment as part of its operation and maintenance responsibilities although USACE may undertake such work on behalf of the non-Federal sponsor if the non-Federal sponsor pays all costs of such work.

h. A Memorandum of Agreement (MOA) will be used for the acceptance of contributed funds in the following scenarios: (1) maintenance dredging for which there is no non-Federal cost share; (2) a water supply reallocation study for which there is no non-Federal cost share; (3) a cycle of periodic nourishment that otherwise would be cost shared except that the project's non-Federal sponsor is providing all funds needed for such cycle of nourishment;

and (4) any other proposal involving contributed funds where no non-Federal cost share is required. Model MOAs involving the acceptance of contributed funds are being developed and will be posted on the PPA web page as they are finalized.

i. Except for a cycle of periodic renourishment as described in paragraph 4.h., when the proposal involves contributed funds that are in addition to a required non-Federal cost share, language regarding contributed funds will be included in the cost sharing agreement for the work or in an amendment to such agreement if there is already an executed cost sharing agreement for the work. Check with HQUSACE (CECW-PC and Office of Counsel) for samples of language required in the cost sharing agreement.

5. Procedures for Implementation.

a. In response to an inquiry from a potential contributor, a district may explain generally the policies and procedures for the acceptance of contributed funds and may provide a copy of a draft contributed funds agreement. The district may not initiate negotiations until the Assistant Secretary of the Army (Civil Works) (ASA(CW)) has submitted the draft notification letters to the Office of Management and Budget (OMB) for clearance.

b. Current CECW-I procedures for Committee notification will be followed. To initiate the Committee notification process, the district must submit the following information through the MSC to the applicable HQUSACE Regional Integration Team (RIT). After receipt of the required information, the RIT will coordinate the draft Committee notification letters and other information within HQUSACE (at a minimum with Office of Counsel, CECW-PC, and the applicable Business Line Manager). After receipt of concurrence from the reviewers, the RIT will provide the following? documents to CECW-IF for transmittal to ASA(CW) for approval, coordination with OMB and Committee notification.

(1) The 4 draft Committee notification letters and the Sample letters for contributed funds are posted on the PPA web page. For projects subject to Section 902 of WRDA 1986, the Committee notification letters will also specify if the project exceeds its maximum cost under Section 902;

(2) A letter from the contributor stating: the amount contributing; its understanding that no repayment or credit for contributed funds is authorized; and its understanding that acceptance of such funds will not constitute or imply any commitment to budget or appropriate funds for the project in the future;

(3) If the contributor is a nonprofit entity, a letter from the affected local government documenting its consent of the contributor providing funds for use on the study or project;

(4) An information paper which describes: (a) project authorization history and the status of project implementation, including any existing cost share agreements and

responsibilities for implementation; (b) brief summary describing that contributor qualifies as one of the entities described in paragraph 4.a. of this guidance; (c) description of work to be performed with the contributed funds; (d) estimated cost of such work; (e) rationale of why accomplishment of such work is advantageous in the public interest; (f) discussion of any impact on other work in the district for which funds have been appropriated by Congress; and (g) identification of the appropriate agreement that will be needed for the acceptance of these contributed funds, and whether a model contributed funds MOA agreement is available; and

(5) If the contributed funds are proposed for use on a water supply storage reallocation study, documentation of the waiver to conduct the reallocation study is required from the USACE Dam Safety Officer in accordance with Chapter 24 of ER 1110-2-1156.

c. When ASA(CW) submits the draft Committee notification letters to OMB for clearance, CECW-IF will notify the RIT, which will then notify the MSC and district that the district can begin negotiations of the agreement. Negotiations of the agreement can be initiated once the district is notified of ASA(CW) submittal of the draft letters to OMB, and review of the draft agreement package can be undertaken prior to completion of Committee notification. However, the agreement cannot be formally approved for execution until Committee notification has been completed.

d. Following completion of Committee notification and acknowledgment, CECW-IF will notify the RIT, which will then notify the MSC and district that Committee notification has been completed.

e. If an approved model MOA will be used, the district will submit the draft agreement package to the MSC for approval by the MSC Commander. Any questions on whether the agreement is consistent with law or policy need to be raised to the applicable RIT. For any MOAs that contains substantive deviations from the model language, the district will follow the submission procedures and requirements in paragraph 5.f. of this guidance. For MOAs that follow the model language, the materials to be provided with a request for approval must include:

(1) The draft agreement that has been negotiated with the contributor and includes all necessary project specific information;

(2) The model agreement used to draft the agreement;

(3) Certificate of Legal Review signed by district counsel specifying whether the use of the model agreement is appropriate and legally sufficient based on the facts of the particular contributed funds proposal; and

(4) If the contributed funds are to be used for construction activities, documentation that all necessary environmental coordination and documentation has been completed - see

Section VIII.d. of the PPA Checklist for a list of necessary environmental coordination requirements.

f. If there is no model agreement applicable to the particular contributed funds proposal or the proposed MOA contains substantive deviations from the model language, the district will submit the draft agreement package through the MSC to the RIT for approval by the Director of Civil Works. The materials provided with the request must include:

(1) The draft agreement that has been negotiated with the contributor and includes all necessary project specific information;

(2) A detailed explanation of deviations from the applicable model or sample and detailed rationale for such deviations;

(3) Certificate of Legal Review signed by district counsel specifying whether the agreement is appropriate and legally sufficient based on the facts of the particular contributed funds proposal;

(4) If the contributed funds are to be used for construction activities, documentation that all necessary environmental coordination and documentation has been completed - see Section VIII.d. of the PPA Checklist for a list of necessary environmental coordination requirements; and

(5) Copy of non-Federal interest's written request and district's information paper.

6. After completing work undertaken with contributed funds, resolving any claims or appeals, and completing a final accounting, a district is authorized to refund any contributed funds not obligated.

7. 33 U.S.C 701h also authorizes USACE, while carrying out construction or maintenance of a Federal project, to undertake additional work that is not part of the cost shared Federal project if a non-Federal interest pays all costs associated with such additional work. Some examples of additional work include dredging of non-Federal berthing areas, channels, and slips and the placement or disposal of sand at a site other than the least cost environmentally acceptable alternative. This additional work does not involve the acceptance of contributed funds as that term is used in this memorandum. In addition, these proposals are not subject to the requirement for Committee notification associated with the acceptance of contributed funds.

a. Provisions dealing with dredging of non-Federal berthing areas, channels, and slips are already included in the Navigation Model PPA approved in 2004. In addition, amendment of an executed PPA to add provisions on additional work is considered a non-substantive deviation. As stated in the implementation memo for the Navigation Model, approval of amendments for non-substantive deviations is delegated to the MSC Commander and may not be further delegated. In those cases where there is no executed PPA for the project, an MOA for the dredging of non-Federal berthing areas, channels, and slips may be used. In such cases, the district must submit the MOA, along with the information listed in paragraph 5.f. of this guidance, through the MSC to the RIT for approval by the Director of Civil Works. Once a model MOA for dredging of non-Federal berthing areas, channels, and slips is approved, the district will follow the procedures for review and approval of the MOA in paragraph 5.e. of this guidance.

b. Proposals for sand placement or other additional work must be submitted by the district through the MSC to the RIT for approval by the Director of Civil Works. The district must submit the MOA, along with the information listed in paragraph 5.f. of this guidance. Once models are developed for sand placement and other additional work, the district will follow the procedures for review and approval of the MOA in paragraph 5.e. of this guidance.

8. This guidance will be incorporated into ER 1165-2-30 when it is updated.

Encls

STEVEN L. STOCKTON, P.E.
Director of Civil Works

DISTRIBUTION:
COMMANDERS,
GREAT LAKES AND OHIO RIVER DIVISION, CELRD
MISSISSIPPI VALLEY DIVISION, CEMVD
NORTH ATLANTIC DIVISION, CENAD
NORTHWESTERN DIVISION, CENWD
PACIFIC OCEAN DIVISION, CEPOD
SOUTH ATLANTIC DIVISION, CESAD
SOUTH PACIFIC DIVISION, CESPD
SOUTHWESTERN DIVISION, CESWD

33 U.S.C. § 701h, with section 1015 of WRRDA 2014 revisions

The Secretary of War [Secretary of the Army] is authorized to receive from States and political subdivisions thereof and other non-Federal interests, such funds as may be contributed by them for work, which includes planning and design, to be expended in connection with funds appropriated by the United States for any authorized water resources development study or project, including a project for navigation on the inland waterways, whenever such work and expenditure may be considered by the Secretary of War [Secretary of the Army], on recommendation of the Chief of Engineers, as advantageous in the public interest, and the plans for any reservoir project may, in the discretion of the Secretary of War [Secretary of the Army], on recommendation of the Chief of Engineers, be modified to provide additional storage capacity for domestic water supply or other conservation storage, on condition that the cost of such increased storage capacity is contributed by local agencies and that the local agencies agree to utilize such additional storage capacity in a manner consistent with Federal uses and purposes: *Provided,* That the Secretary is authorized to receive and expend funds from a State or political subdivision thereof, and other non-Federal interests or private entities, to operate a hurricane barrier project to support recreational activities at or in the vicinity of the project, at no cost to the Federal Government, if the Secretary determines that operation for such purpose is not inconsistent with the operation and maintenance of the project for the authorized purposes of the project: *Provided further,* That when contributions made by States and political subdivisions thereof and other Federal interests, are in excess of the actual cost of the work contemplated and properly chargeable to such contributions, such excess contributions may, with the approval of the Secretary of War [Secretary of the Army], be returned to the proper representatives of the contributing interests: *Provided further*, That the term "States" means the several States, the District of Columbia, the commonwealths, territories, and possessions of the United States, and Federally recognized tribes: *Provided further*, That the term "non-Federal interest" has the meaning given that term in section 221 of the Flood Control Ac t of 1970 (42 U.S.C. 1962d-5b).[1]

---

[1]Section 1015(b) of WRRDA 2014 provides: Notification for Contributed Funds.--Prior to accepting funds contributed under section 5 of the Act of June 22, 1936 (33 U.S.C. 701h), the Secretary shall provide written notice of the funds to the Committee on Environment and Public Works and the Committee on Appropriations of the Senate and the Committee on Transportation and Infrastructure and the Committee on Appropriations of the House of Representatives.

Section 902 of WRDA 1986, with section 1023 of WRRDA 2014 revisions (33 U.S.C. 2230)

SECTION 902. MAXIMUM COST OF PROJECTS

(a) In general. In order to insure against cost overruns, each total cost set forth with respect to a project for water resources development and conservation and related purposes authorized to be carried out by the Secretary in this Act or in a law enacted after the date of the enactment of this Act [enacted Nov. 17, 1986], including the Water Resources Development Act of 1988, or in an amendment made by this Act or any later law with respect to such a project shall be the maximum cost of that project, except that such maximum amount--

(1) may be increased by the Secretary for modifications which do not materially alter the scope or functions of the project as authorized, but not by more than 20 percent of the total cost stated for the project in this Act, in any later law, or in an amendment made by this Act or any later law; and

(2) shall be automatically increased for--

(A) changes in construction costs applied to unconstructed features (including real property acquisitions, preconstruction studies, planning, engineering, and design) from the date of enactment of this Act [enacted Nov. 17, 1986] or any later law (unless otherwise specified) as indicated by engineering and other appropriate cost indexes; and

(B) additional studies, modifications, and actions (including mitigation and other environmental actions) authorized by this Act or any later law or required by changes in Federal law.

(b) Contributions by non-federal interests. Notwithstanding subsection (a), in accordance with section 5 of the Act of June 22, 1936 (33 U.S.C. 701h), the Secretary may accept funds from a non-Federal interest for any authorized water resources development project that has exceeded its maximum cost under subsection (a), and use such funds to carry out such project, if the use of such funds does not increase the Federal share of the cost of such project.

Attachment C

33 USC 701h Model Memorandum of Agreement per Section 1015 of WRRDA 2014

MODEL MOA
TO RECEIVE AND EXPEND FUNDS PURSUANT TO 33 U.S.C. 701h FOR O&M DREDGING
WHERE SUCH DREDGING IS A FEDERAL EXPENSE; BOTH FEDERAL AND CONTRIBUTED FUNDS WILL BE USED; AND CONTRIBUTOR PROVIDES ALL FUNDS NEEDED FOR WORK ABOVE THE AMOUNT OF FEDERAL FUNDS AVAILABLE

May 4, 2015

APPLICABILITY:

The attached model MOA is one of several MOA Models to receive and expend funds pursuant to 33 U.S.C. 701h. This model should be used only for O&M dredging that is a Federal expense; there are some Federal funds available but not enough for Corps to award a reasonable dredging contract; and the Contributor provides ALL remaining funds needed in excess of the available Federal funds to perform the dredging and related activities (engineering and design work, environmental coordination, S&A, etc).

Each model MOA to receive and expend funds pursuant to 33 U.S.C. 701h fits a specific set of circumstances. The other MOA Models currently available are posted on the Project Partnership Agreement (PPA) Web page. If none of the models posted are applicable, the Project Delivery Team should consult with the appropriate HQ RIT for guidance/assistance in drafting the agreement.

NOTES/DRAFTING TIPS:

FORMAT. - Remove the cover pages, notes section, all bold type references to notes, and any bold type text from the MOA prior to processing for approval.

BLANKS. – There are several locations where information specific to the work to be performed is required to fill in a blank. All blanks must be filled in, except the date in the first paragraph, prior to processing the MOA for approval. Including the information required to fill in a blank is not considered a deviation from the model.

CONTRIBUTOR'S REPRESENTATIVE. – Insert the title of the Contributor's representative signing the MOA. Do not include the name, only the title. The title used in this location must match the title used on the signature page. Further, it should be preceded by "the" or "its", as appropriate, to match the title of the Contributor's representative. (Example: the Mayor or its Executive Director)

PARAGRAPH 12. – OBLIGATIONS OF FUTURE APPROPRIATIONS.

Paragraph 12 is optional and should only be included in the MOA if the Contributor specifically requests this language and District Counsel determines, by written legal opinion identifying the specific statutes or constitutional provisions, that the Contributor meets the Federal statutory criteria for inclusion of this paragraph. See Section 221 of the Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b).

The information to be added in the first three blanks of the first sentence of Paragraph 2 must identify the legislative body that makes the appropriations. (Example: Legislature of the State of Ohio or City Counsel of the City of Cleveland)

The information to be included in the fourth - sixth blanks of the first sentence of Paragraph 2 must identify the specific citation to the constitutional or statutory limitation on committing future appropriations. (Example: Article 16 Section 12 of the Constitution of the State of Arkansas)

If this paragraph is deleted, renumber the remaining paragraph. Renumbering the paragraph is not a deviation from the model.

CERTIFICATE OF AUTHORITY. - The attorney signing the Certificate of Authority must be the principal legal officer of the Contributor and is certifying that the Contributor's representative signing the MOA has the authority to obligate the Contributor. Do not forget to fill in the name in the first line prior to execution of the MOA.

PREPARING MOA FOR SIGNATURE.

When printing the MOA for execution: 1) remove the cover pages and any bold type text from the MOA; 2) ensure that the appropriate information has been included in all blanks in the MOA and the Certificate of Authority; 3) ensure that there are no page breaks which allow half empty pages; and 4) use the following format for District Engineer's signature block. Correct rank in 2nd line as necessary.

Name
Colonel, U.S. Army District Engineer

Before signature by the District Engineer, the district must ensure that the Contributor signs and dates a minimum of two copies of the MOA and that the Certificates of Authority are signed and dated by the appropriate people. The date on the first page should be filled in by the District Engineer, not the Contributor.

The Government should retain one copy of the fully executed MOA. All other copies should be provided to the Contributor. A photocopy or a pdf file (as determined by the MSC and the appropriate HQ RIT) of the fully executed MOA should be provided to the MSC and appropriate HQ RIT within 7 days after execution of MOA.

MEMORANDUM OF AGREEMENT BETWEEN
THE DEPARTMENT OF THE ARMY AND
[FULL NAME OF CONTRIBUTOR] FOR MAINTENANCE DREDGING OF **[FULL NAME OF THE PROJECT]**

This MEMORANDUM OF AGREEMENT (hereinafter the "MOA") is entered into this_day of_,_ ______, by and between the Department of the Army (hereinafter the "Government"), represented by the U.S. Army Engineer, ______ District (hereinafter the "District Engineer"), and the **[FULL NAME OF THE CONTRIBUTOR]** (hereinafter the "Contributor"), represented by **[SEE NOTE - 3]**.

WITNESSETH, THAT:

WHEREAS, the **[FULL NAME OF THE PROJECT]** (hereinafter the "Project") was constructed pursuant to **[CITE AUTHORITY, INCLUDING SECTION NUMBER AND PUBLIC LAW NUMBER]**;

WHEREAS, the amount of Federal funds available for maintenance dredging of the Project is insufficient to award any dredging contracts;

WHEREAS, the Contributor considers it to be in its own interest to contribute funds voluntarily to be used by the Government in conjunction with the Federal funds available to perform maintenance dredging of the Project (hereinafter the "Maintenance Work"); and

WHEREAS, the Government is authorized pursuant to 33 U.S.C. 701h to receive and expend funds to be used for the Maintenance Work.

NOW, THEREFORE, the Government and Contributor agree as follows:

The Contributor shall provide to the Government funds to pay all costs associated with the Maintenance Work, including the costs of environmental compliance, supervision and administration, and engineering and design, in excess of the Federal funds available for such Maintenance Work. The current estimate of costs associated with the Maintenance Work is $______and $__of Federal funds are available; therefore, the estimate of funds to be provided by the Contributor is $_______. While the Government will endeavor to limit costs associated with the Maintenance Work under this MOA to the current estimate, the Contributor acknowledges that the actual costs for the Maintenance Work may exceed this estimated amount due to claims or other unforeseen circumstances and that the Contributor is responsible for all costs, including any claims, related to the Maintenance Work in excess of the Federal funds available for such Maintenance Work.

Within_(______) calendar days of execution of this MOA, the Contributor shall provide to the Government the sum of $______, which is the current estimate of funds to be required from the Contributor. If at any time the Government determines that additional funds are needed, the Government shall notify the Contributor in writing of the amount, and no later than thirty (30) calendar days from receipt of such notice, the Contributor shall provide to the Government the full amount of the additional funds.

The Contributor shall provide the funds to the Government by delivering a check payable to "FAO, USAED_______" to the District Engineer or providing an Electronic Funds Transfer of such funds in accordance with procedures established by the Government.

The Government shall not commence any Maintenance Work until all applicable environmental laws and regulations have been complied with, including, but not limited to, the National Environmental Policy Act of 1969 (42 U.S.C. 4321–4347) and Section 401 of the Clean Water Act (33 U.S.C. 1341).

The Government shall provide the Contributor with quarterly reports of obligations for the Maintenance Work. The first such report shall be provided within thirty (30) calendar days after the final day of the first full quarter of the Government fiscal year following receipt of funds pursuant to this MOA. Subsequent reports shall be provided within thirty (30) calendar days after the final day of each succeeding quarter until the Government concludes the Maintenance Work.

Upon conclusion of the Maintenance Work and resolution of all relevant claims and appeals, the Government shall conduct a final accounting of the costs of such work and furnish the Contributor with written notice of the results of such final accounting. Such final accounting shall in no way limit the Contributor's responsibility to pay for costs associated with the Maintenance Work, including contract claims or any other liability that may become known after the final accounting. If the costs of the Maintenance Work exceed the sum of the Federal funds and the amount of funds provided by the Contributor, the Contributor shall provide the required additional funds within thirty (30) calendar days of such written notice by delivering a check payable to "FAO, USAED___" to the District Engineer or providing an Electronic Funds Transfer of such funds in accordance with procedures established by the Government. If the costs of the Maintenance Work are less than the sum of the Federal funds and the amount of funds provided by the Contributor, the Government shall refund the excess to the Contributor within thirty (30) calendar days of such written notice.

No credit or repayment is authorized, nor shall be provided, for any funds provided by the Contributor and obligated by the Government for the Maintenance Work.

Nothing herein shall constitute, represent, or imply any commitment to budget or appropriate funds for the Project in the future; and nothing herein shall represent, or give rise to, obligations of the United States.

The Contributor shall hold and save the Government free from all damages arising from the Maintenance Work, except for damages due to the fault or negligence of the Government or its contractors.

In the exercise of their respective rights and obligations under this MOA, the Government and the Contributor each act in an independent capacity, and neither is to be considered the officer, agent, or employee of the other.

Notices.

Any notice, request, demand, or other communication required or permitted to be given under this MOA shall be deemed to have been duly given if in writing and either delivered personally or mailed by first-class, registered, or certified mail, as follows:

If to the Contributor:

[RECIPIENT'S TITLE & ADDRESS]

If to the Government:

[RECIPIENT'S TITLE & ADDRESS]

A party may change the recipient or address to which such communications are to be directed by giving written notice to the other party in the manner provided in this paragraph. Any notice, request, demand, or other communication made pursuant to this paragraph shall be deemed to have been received by the addressee at the earlier of such time as it is actually received or seven (7) calendar days after it is mailed.

Nothing in this MOA shall constitute, nor be deemed to constitute, an obligation of future appropriations by the___of the__of_____, where creating such an obligation would be inconsistent with_ _______of the_________of_____.

This MOA may be modified or amended only by written, mutual agreement of the parties.

IN WITNESS WHEREOF, the parties have executed this MOA as of the day, month, and year first above written.

THE DEPARTMENT OF THE ARMY	**[FULL NAME OF CONTRIBUTOR]**
BY:____[SIGNATURE]_	BY:_____[SIGNATURE]______
[TYPED NAME]	**[TYPED NAME]**
[TITLE IN FULL]	**[TITLE IN FULL]**
DATE: ____________________	DATE: ____________________

Attachment D

Implementation Guidance for Section 1153 of WIIN 2016 (WRDA 2016)

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

CECW-P SEP 2 8 2017

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Implementation Guidance for Section 1153 of the Water Resources and Development Act of 2016 (WRDA 2016) Amending Section 1024 of the Water Resources Reform and Development Act of 2014 (WRRDA 2014), Authority to Accept and Use Materials, Services, or Funds

1. Section 1153 of WRDA 2016 amends Section 1024 of WRRDA 2014 to authorize the Secretary to accept and use materials, services, or funds contributed by a non-Federal public entity, a nonprofit entity, or a private entity for the purpose of repairing, restoring, replacing, or maintaining a water resources project if the District Commander determines that there is a risk of adverse impacts to the functioning of the project for the authorized purposes of the project and that acceptance of the materials, services, or funds is in the public interest. Section 1024, as amended, further provides that the Secretary may only use materials or services if they comply with all applicable laws and regulations that would apply if they were acquired by the Secretary. It further provides that such services must be supplementary to existing federal employees used to perform work that would not otherwise be accomplished as a result of funding or personnel limitations. Finally, it includes reporting requirements. Copies of Section 1024 of WRRDA 2014, as amended (33 U.S.C. 2325a) and Section 1153 of WRDA 2016 are enclosed.

2. In accordance with the guidance provided in this memorandum, District Commanders are delegated authority to accept services, materials, or funds contributed (referred to as "contributions") from a non-Federal public entity, nonprofit entity, or private entity (referred to as "contributor") for the purpose of repairing, restoring, replacing, or maintaining a water resources project, if the District Commander determines that there is a risk of adverse impacts to the functioning of the project for the authorized purposes of the project and that such acceptance and use is in the public interest. This authority may not be further delegated. The District Commander must provide written documentation of these determinations. In addition, there may be special circumstances, such as, for example, if dam safety issues are involved, where the district should coordinate with the entire vertical team before the district commander determines whether to accept the contribution.

a. This guidance applies to federally authorized water resources projects operated and maintained by the U.S. Army Corps of Engineers (Corps).

b. Materials, including equipment, must meet Corps standards, and be approved by the District Commander or his or her designated representative. Material handling, storage, and disposal shall comply with provisions of EM 385-1-1, Safety and Health

Requirements Manual. Materials intended as part of permanent repairs shall include a warranty that is transferable to Corps.

c. Services will not be accepted to displace Corps personnel. However, such services may supplement existing staff and may also include work that would not otherwise be accomplished because of Corps funding or personnel limitations. Services to be provided must be reviewed and approved by the District Commander.

d. Environmental compliance with all applicable laws must be completed before the initiation of repair, restoration, replacement or maintenance activities with contributions. The contributor must provide funds to the district to cover costs to complete any environmental compliance required for these activities.

e. Corps' acceptance and use of contributions under Section 1024, as amended, does not involve 33 U.S.C. 408.

f. The District Commander or his or her designated representative shall oversee the services provided to ensure that they are consistent with the plan approved by the district. The contributor bears responsibility if services provided are performed in a negligent manner.

g. Materials or services provided must comply with all applicable laws that would apply if such materials and services were acquired by the Secretary. Applicable Federal Laws and Regulations may include, but are not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (labor standards originally enacted as the Davis-Bacon Act, the Contract Work Hours and Safety Standards Act, and the Copeland Anti-Kickback Act); the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4630 and 4655) and the regulations contained in 49 CFR Part 24; Section 601 of the Civil Rights Act of 1964 (P.L. 88-352), as amended (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Army Regulation 600-7 issued pursuant thereto; Buy American Act (41 U.S.C. 8302); Clean Air Act (42 U.S.C. 7606; Clean Water Act (33 U.S.C. 1368; Jones Act (46 U.S.C. 55109); Shipping Act (46 U.S.C. 55109); Utilization of Small Business Act (15 U.S.C. 631, 644; and Equal Opportunity for Veterans Act (38 U.S.C. 4212). In addition, a list of related laws which may apply and must be satisfied when applicable, is set forth at 33 CFR Section 320.3. The District Commander should be prepared to provide copies of language used by the Corps in its standard contracts to serve as a guide for the contributor in developing its own contract.

h. If the existing real property interests are not sufficient for the performance of work involving contributions under Section 1024, as amended, the contributor will be required to undertake acquisition of additional real property interests in accordance with the applicable provisions of the Uniform Relocation Assistance and Real Property

Acquisition Policy Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 C.F.R. Part 24, or provide funds to the district to cover the costs associated with the acquisition of additional real property interests.

i. There will be no credit or repayment for contributions provided under Section 1024, as amended.

3 Procedure.

a. Prior to the acceptance of contributions under Section 1024, as amended, the district must develop a plan for use of the contributions. The plan must demonstrate that there is a risk of adverse impacts to the functioning of the project and that the acceptance of the contributions would be in the public interest. The plan must document in detail how use of the proposed contributions are in accordance with the operation and maintenance manual or related document that supports the operation, maintenance, repair, rehabilitation and replacement of the project. The plan will also document that the materials or services to be provided by the contributor meets the requirements of Engineer Manual 385-1-1 and other relevant Corps regulations and address, at a minimum, the following items:

(1) A defined scope of services will be provided by the contributor. The scope will describe how the contributions will serve to reduce risk of adverse impacts to the functioning of the project and help maintain a safe and reliable project. In addition the plan will identify whether additional real property interests need to be acquired to support the services to be provided and identify party responsible for acquisition.

(2) A listing of privately owned or leased vehicles, vessels, machinery, or other specialized equipment to be used by the contributor that comply with the requirements for inspection criteria, safety devices and operational aids, environmental considerations, operating rules, and guarding and safety devices.

(3) A listing of qualified contractors or employees of the contributor who are authorized to operate, for official use, government-owned or leased vehicles, vessels, machinery or other specialized equipment. Employees or contractors for the contributor must have the proper training, license, and/or experience in accordance with Corps operator permit policies and understanding of the safety requirements to the satisfaction of the District Commander before operating a government-owned or leased vehicle, vessel, or equipment. Government authorization policies apply to contractors or employees for each contributor.

(4) A security clearance for all contractors and employees for the contributor must be validated, when appropriate, as determined by the district commander. Individuals may be legal aliens (permanent residents) or foreign exchange students. Any non-U.S.

citizen must present his/her Visa (or passport if in the U.S.in tourist status from a visa-waiver country where visas are not required) or U.S. Permanent Resident Card INS Form 1-551 (formerly known as Alien Registration Receipt Card) for review and verification. Persons who have been convicted of a violent crime, sexual crime, arson, crime with a weapon, or sale or intent to distribute illegal drugs, or are an organized crime figure will not be utilized as volunteers. Persons awaiting trial or under indictment for any of the crimes listed above will not be utilized as a volunteer until the case has been resolved in the person's favor through the legal process. Use of civilian prison labor from the Federal Bureau of Prisons, and State and County Correctional Systems is beyond the scope of this authorization.

(5) An approved Accident Prevention Plan for each contributor.

b. The District Commander will document in writing the approval for accepting contributions under Section 1024, as amended. Template agreements for acceptance and use of contributions will be posted on the Corps Agreements website. Following District Counsel review and concurrence that the negotiated agreement is acceptable, the District Commander may approve and sign the agreement. The agreement must be fully executed prior to the acceptance of contributions from the contributor. Any proposed substantive deviations to the template agreements must be submitted through the MSC to the appropriate Headquarters Regional Integration Team (RIT) for resolution.

4. Within 30 days of accepting contributions under Section 1024, as amended, the District Commander will submit, through the MSC Commander, to the appropriate RIT, a report that includes a description of the activities undertaken using the contributions, including the costs associated with such activities, and a comprehensive description of how the activities were necessary for maintaining a safe and reliable water resources development project. CECW-I will consolidate the information from each RIT into a report, and by 30 October of the first fiscal year in which contributions are accepted under Section 1024, as amended, and by 30 October of each subsequent fiscal year, the Director of Civil Works, will transmit the draft annual report to the Assistant Secretary of the Army (Civil Works) for review and submission to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives by 1 February.

5. This guidance supersedes the implementation guidance for Section 1024 of WRRDA 2014, dated 8 June 2016. This guidance is in addition to and does not affect guidance relating to the acceptance of contributed funds pursuant to other authorizations, such as ER 1130-2-500 for voluntary contributions for Sections 203 and 225 of WRDA 1992 and the implementation guidance for Sections 1015 and 1023 of WRRDA 2014, dated 11 February 2015.

Encls

JAMES C DALTON, P.E.
Director of Civil Works

DISTRIBUTION:
COMMANDERS, REGIONAL BUSINESS AND PROGRAMS DIRECTOR
GREAT LAKES AND OHIO RIVER DIVISION, CELRD
MISSISSIPPI VALLEY DIVISION, CEMVD
NORTH ATLANTIC DIVISION, CENAD
NORTHWESTERN DIVISION, CENWD
PACIFIC OCEAN DIVISION, CEPOD
SOUTH ATLANTIC DIVISION, CESAD
SOUTH PACIFIC DIVISION, CESPD
SOUTHWESTERN DIVISION, CESWD

Section 1024 of WRRDA 2014, as amended by Section 1153 of WRDA 2016 (33 U.S.C. § 2325a). Authority to accept and use materials and services

(a) In general
Subject to subsection (b), the Secretary is authorized to accept and use materials, services, or funds contributed by a non-Federal public entity, a nonprofit entity, or a private entity to repair, restore, replace, or maintain a water resources project in any case in which the District Commander determines that--

(1) there is a risk of adverse impacts to the functioning of the project for the authorized purposes of the project; and (2) acceptance of the materials and services or funds is in the public interest.

(b) Limitation
Any entity that contributes materials or services under subsection (a) shall not be eligible for credit or reimbursement for the value of such materials or services.

(c) Additional requirements

(1) Applicable laws and regulations
The Secretary may only use materials or services accepted under this section if such materials and services comply with all applicable laws and regulations that would apply if such materials and services were acquired by the Secretary.

(2) Supplementary services
The Secretary may only accept and use services under this section that provide supplementary services to existing Federal employees, and may only use such services to perform work that would not otherwise be accomplished as a result of funding or personnel limitations.

(d) Report
Not later than February 1 of each year after the first fiscal year in which materials, services, or funds are accepted under this section, the Secretary shall submit to the Committee on Environment and Public Works of the Senate and the Committee on Transportation and Infrastructure of the House of Representatives an annual report that includes--(1) a description of the activities undertaken, including the costs associated with the activities; and (2) a comprehensive description of how the activities are necessary for maintaining a safe and reliable water resources project.

Section 1153 of WRDA 2016. Authority to Accept and Use Materials and Services.

Section 1024 of the Water Resources Reform and Development Act of 2014 (33 U.S.C. 2325a) is amended—

(1) by striking subsection (a) and inserting the following:

"(a) IN GENERAL.—Subject to subsection (b), the Secretary is authorized to accept and use materials, services, or funds contributed by a non-Federal public entity, a nonprofit entity, or a private entity to repair, restore, replace, or maintain a water resources project in any case in which the District Commander determines that—

"(1) there is a risk of adverse impacts to the functioning of the project for the authorized purposes of the project; and

"(2) acceptance of the materials and services or funds is in the public interest.";

(2) by redesignating subsection (c) as subsection (d);

(3) by inserting after subsection (b) the following:

"(c) ADDITIONAL REQUIREMENTS.—

"(1) APPLICABLE LAWS AND REGULATIONS.—The Secretary may only use materials or services accepted under this section if such materials and services comply with all applicable laws and regulations that would apply if such materials and services were acquired by the Secretary.

"(2) SUPPLEMENTARY SERVICES.—The Secretary may only accept and use services under this section that provide supplementary services to existing Federal employees, and may only use such services to perform work that would not otherwise be accomplished as a result of funding or personnel limitations."; and

(4) in subsection (d) (as redesignated by paragraph (2)) in the matter preceding paragraph (1)—

(A) by striking "Not later than 60 days after initiating an activity under this section," and inserting "Not later than February 1 of each year after the first fiscal year in which materials, services, or funds are accepted under this section,"; and

(B) by striking "a report" and inserting "an annual report".

Appendix C

Economic Analysis Report

Economic Analysis

Upper Mississippi River Inland Waterway
Iowa Department of Transportation

Ames, Iowa

April 2019

Contents

Attachments

Tables

Figures

1.0 Introduction

The inland waterways are a strategic asset to the nation, enabling the United States to significantly increase economic output in both domestic and international markets, and move important national defense resources and other supplies in large quantities. With the goal of understanding the economic impacts of the Upper Mississippi inland waterway system to the five-state area (Iowa, Illinois, Minnesota, Wisconsin, and Missouri), an economic assessment was conducted. The assessment took into account various industry reports and included an economic impact and benefit cost analysis (BCA). This report summarizes the economic analysis in support of the Upper Mississippi River (UMR) Inland Waterway Study.

2.0 Upgrade Scenarios

The study sought to identify scenarios that upgrade or improve the efficiency, reliability, and capacity of the existing system of locks and dams. These scenarios included:

- **Efficiency – Micro Upgrade**: A small scale, stand-alone navigation efficiency improvement project that may be replicated along the UMR. Installing a mooring cell at Lock and Dam 14 was selected for economic analysis.

- **Reliability – System Improvements**: Projects that improve the long-term durability and sustainability of the existing Locks and Dams on the UMR waterway. Major rehabilitation at UMR Locks and Dams 2 to 25 was selected for economic analysis.

- **Capacity – Large Scale Upgrade**: Major recapitalization projects that expand the ability of the existing UMR waterway Locks and Dams to meet future traffic demands. While detailed evaluation of a Large Scale Upgrade scenario is not included in this report, the forthcoming USACE FY 2019 economic update for NESP will provide additional economic details regarding NESP, which would be considered a Large Scale Upgrade for purposes of this study.

2.1 Micro Upgrade Scenario, Mooring Cell

Mooring cells provide for a more efficient and environmentally friendly location for tows to moor while waiting for the lock approach channel and lock chamber to become available. Thus, mooring cells provide for both time and fuel savings since lock approach times are reduced.

2.2 System Reliability Improvements Scenario

System reliability improvements enhance the long-term durability and sustainability of existing infrastructure by resetting its service life. The implementation of system-wide reliability improvements would reduce overall delay costs. These improvements may include (but are not limited to):

- Replacement of lock operating machinery;
- Upgrade and replacement of the lock and dam’s electrical power and control systems;
- Mass concrete repairs;
- Lock chamber concrete resurfacing and armoring;

- Miter gate repairs;
- Dewatering improvements;
- Installation of lock bubbler systems for ice management; and
- Scour protection.

2.3 Large Scale Upgrade Scenario

Existing 600-foot locks present inefficiencies for locking since typically sized tows must be split with each half carried separately through the lock. A lock that is enlarged to eliminate two segment lockings improves locking times and leads to switchboat time and fuel savings because the tow does not need to be broken into two and reassembled following the lockage. Thus, the implementation of 1,200-foot locks would greatly improve processing times, reduce delay, and promote efficiency. This improvement would create additional capacity to meet future traffic volumes in an efficient and reliable manner.

3.0 Freight Forecasts and Benefit Estimation (Informa Economics, IEG)

Informa Economics IEG (IEG) was engaged to provide tonnage forecasts for commodities transported along the UMR. The forecasts took into account necessary constraints, catchment areas, and market conditions to provide reasonable estimates of potential freight movements. To provide a context for forecasted commodity movements, the waterways system and its infrastructure, funding mechanisms, towboat and barge fleet profiles, and barge tow configurations were considered. Delay costs and forecasts were provided based on IEG discussions with barge operators, information compiled from the U.S. Army Corps of Engineers (USACE), and surveys conducted. This section provides a summary of the commodity forecasts. More information is provided in the IEG Upper Mississippi River Lock Review and Scenarios report in Attachment A.

3.1 Commodity Forecasts

Table 1 summarizes the IEG forecasts by commodity for the entire five-state area under a current, business as usual scenario. These tons represent shipments anywhere along the UMR. The commodity forecasts represent commodity flows that originate or terminate within the study area and are not measured at a specific point in the system. Corn and soybean shipments are expected to increase faster than other shipments over the long term as farmers react to shifts in U.S. ethanol policy and more crops are directed to the export market. The economic impact analysis described later in the report uses this baseline commodity forecast for the Micro Upgrade and System Reliability scenarios.

Table 1: Commodity Forecasts, UMR, in Thousands of Short Tons

Commodity	2018	2030	2040	2050	2060	Average Annual Growth (2018 - 2060)
Corn	11,192	19,706	26,758	32,410	43,162	3.3%
Soybeans	6,765	9,038	11,350	14,151	17,535	2.3%
Animal Feed, Prep.	1,342	1,477	1,735	1,998	2,268	1.3%
Nitrogenous Fertilizer	547	974	1,061	1,044	1,026	1.5%
Cement and Concrete	1,470	2,071	2,579	3,085	3,592	2.2%
Crude Petroleum	874	1,023	1,039	986	957	0.2%
Oilseeds NEC.	1,294	1,251	1,452	1,604	1,772	0.8%
Fertilizer and Mixes NEC.	947	956	945	929	913	-0.1%
Other Commodities*	5,622	5,872	5,961	6,051	6,142	0.2%
Total	30,053	42,369	52,879	62,257	77,366	2.3%

Source: IEG forecasts
* Other Commodities include coal lignite, limestone, sand and gravel, residual fuel oil, potassic fertilizers, iron and steel scrap, vegetable oils, asphalt and tar, petroleum coke, and distillate fuel oil.

3.1.1 Barge Fleet Profile

The barge fleet that transports cargo along the UMR primarily consists of open, covered, and tank barges. Each barge type is specifically suited to certain commodity types. As an example, covered barges largely transport commodities sensitive to weather including grain, salt, fertilizer, cement, and steel. Conversely, open barges are used to transport commodities less sensitive to climate conditions, such as coal, lumber, pulp wood, sand, and gravel. Tank barges transport bulk liquid commodities including crude and other petroleum products, and chemical products. The economic forecast does not include any new uses of the river such as container traffic or new vessel technologies.

3.1.2 Tow Configuration

Through discussion with barge operators, information compiled from USACE, and surveys conducted, IEG assessed the typical tow configuration that transports freight along the UMR. It was determined that a configuration consisting of 15 barges towed by a 5,000 horsepower (HP) engine was representative of UMR freight movements. It was further assumed that the 15-barge tow is evenly split between open and covered barges. Table 2 summarizes the assumed tow configuration and associated operations costs that informed subsequent delay cost calculations.

Table 2: Assumed Tow Configuration and Costs

Configuration	Daily Cost	Tow Configuration	Total Daily Cost	Total Hour Cost
Towboat (5,000 HP)	$8,950	1.0	$8,950	$373
Open (200' x 35' x 13/14')	$190	7.5	$1,425	$59
Covered (200' x 35' x 13/14')	$290	7.5	$2,175	$91
		Total Cost	$12,550	$523

Source: IEG
Note: Fuel cost is included in Towboat cost

3.2 Estimates and Quantification

IEG quantified annual costs attributable to barge delays, including delay/operations costs, switchboat and locking time savings, and environmental impacts. These estimations provide inputs into both the BCA and economic impact analysis (EIA). Table 3 provides a summary of the annual cost reductions for the Micro Upgrade and System Reliability scenarios while detailed tables are provided in Attachment A. The sections below summarize the general methodology used to derive these estimates.

Table 3: Annual Cost Reductions, Millions of 2017 $

Year	Micro Upgrade		System Reliability
	Operations Savings	Fuel Savings	Delay Savings
2018	$3.3 M	$2.7 M	$54.1 M
2030	$4.6 M	$5.5 M	$109.2 M
2040	$5.9 M	$9.3 M	$184.7 M
2050	$6.9 M	$14.8 M	$294.1 M
2060	$8.7 M	$24.9 M	$496.3 M

* Includes fuel cost savings

3.2.1 Annual Delay/Operations Costs

To calculate delays across UMR locks, IEG obtained 10-year average delays by lock through an assessment of USACE data, which established the 2017 baseline hours of delay. This baseline was grown by assuming that delay would grow constantly at a 3 percent annual rate over the study period. This value was chosen because tow delays along the UMR have increased just under 3 percent per year over the last 15 years. According to IEG, this is also within an industry-accepted range of about 2 percent to 4 percent annual growth in delay.

Total annual delay hours were determined by multiplying the average tow delay with the total number of tows (upbound and downbound). Annual delay barge costs were then calculated by multiplying the total annual delay hours by the hourly barge cost shown in Table 2 ($523 per hour).

3.2.2 Environmental Impacts

Avoided fuel consumption and its associated emissions reductions were calculated to assess potential environmental impacts stemming from infrastructure improvements.

Fuel consumption in gallons was estimated by multiplying total delay hours by a factor for towboat engine idling of 15 gallons per hour. The fuel consumption estimate was monetized using a fuel cost of $1.75 per gallon, a fuel cost provided by tank barge operators. Total tons of emissions were estimated from the fuel consumption estimate using the emission factors provided in Table 4. These calculations assume that barge operators continue to burn diesel fuel and do not switch to another fuel source such as liquid natural gas (LNG).

Table 4: Emissions Rates Used in Quantifying Environmental Impacts

Variable	Unit	Value
CO_2 Emissions	lbs./gallon	22.51
CO_4 Emissions	lbs./gallon	0.02
N_2O Emissions	lbs./gallon	0.0002

Source: IEG

4.0 Economics Background (Vision Report)

This section summarizes the economic role that the inland waterway system serves in the national freight framework and across the United States economy. The information provided comes from the Economics Vision Report developed earlier in the study. A complete copy of that report is provided in Attachment B.

4.1 Discussion

The inland waterways are a strategic asset to the nation, enabling the United States to significantly increase economic output in both domestic and international markets, and move important national defense resources and other supplies in large quantities. Over the next 20 years, economists at the University of Illinois at Chicago estimate that inland navigation will increase by more than 35 percent nationally based on existing trends.[1] This estimate does not include potential increases in consumption of US farm products internationally, which IEG included in its estimates for the UMR. The United States' waterways transport more than 60 percent of the nation's grain exports, about 22 percent of domestic petroleum and petroleum products, and 20 percent of the coal used in electricity generation.[2]

To remain competitive internationally, the United States economy relies on an efficient, low-cost transportation network for movement of its domestic and export commodities. Under the assumption that shippers fully pass costs and savings along to consumers, USACE estimated both shippers and consumers saved approximately $20.37 per ton in 2014 compared to other modes, which equates to $12.3 billion.[3]

4.1.1 Investment Gap

A 2016 American Society of Civil Engineers study examined the detrimental future economic impacts arising from a projected investment gap for United States inland waterways. Across the United States, the projected investment gap ($43 billion from 2016 through 2040) may result in 440,000 fewer jobs in 2025 and almost 1.2 million fewer jobs in 2040 than would otherwise be

---

[1] Ginsburg, Robert and Dirks, Lise. "An Analysis of the Illinois Maritime Transportation System." 2017. https://utc.uic.edu/wp-content/uploads/Illinois-Maritime-Transportation-System-Report-__Final-Report-8302017.pdf

[2] Ibid.

[3] United States Army Corps of Engineers. "Inland Waterways Users Board 29th Annual Report – To the Secretary of the Army and the United States Congress." 2016. http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983

expected with modernization improvements.[4] By 2025, the United States will have lost almost $800 billion in gross domestic product (GDP) if the investment gap is not addressed, while the cumulative impact through 2040 is expected to be almost $2.8 trillion in GDP.[5]

Similarly, a 2016 study commissioned by the U.S. Department of Agriculture shows the effects of a lock and dam closure on grain transportation. If Mississippi Lock and Dam 25 was unavailable for the 2024-25 marketing year, the reduced economic activity would reach nearly $2 billion.[6] For the harvest season alone (September to November), the disruption would cost $933 million (or a 40 percent decrease) if Lock and Dam 25 were unavailable.[7]

4.1.2 Lock Maintenance

When a lock or dam reaches a state of poor repair, waterborne traffic must stop to allow for more frequent scheduled maintenance. Although such anticipated or scheduled delay imposes some costs on industries that rely on waterborne commodities, an even greater cost is imposed when an unscheduled delay occurs. Unscheduled delays interrupt business operations for entire supply chains dependent on waterborne shipments. However, with adequate investment in maintenance and infrastructure modernization, these delays can be minimized.

Through analysis of USACE data for UMR[8] locks, closures excluding weather-related delays[9] were shown to have increased at an average of 47 percent per year since 2012 as shown in Figure 1. When weather-related and other delays are included, closures not related to maintenance activities typically account for between 66 and 96 percent of total closure hours.[10]

---

[4] American Society of Civil Engineers. "Failure to Act: The Impact of Infrastructure Investment on America's Economic Future." 2016.
https://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf

[5] Ibid.

[6] Yu, T. E, B. C. English, and R. J. Menard, Department of Agricultural and Resource Economics, University of Tennessee. "Economic Impacts Analysis of Inland Waterways Disruption on the Transport of Corn and Soybeans. Staff Report #AE16-08." 2016.
https://www.ams.usda.gov/sites/default/files/media/EconomicImpactsAnalysisInlandWaterwaysSummary.pdf

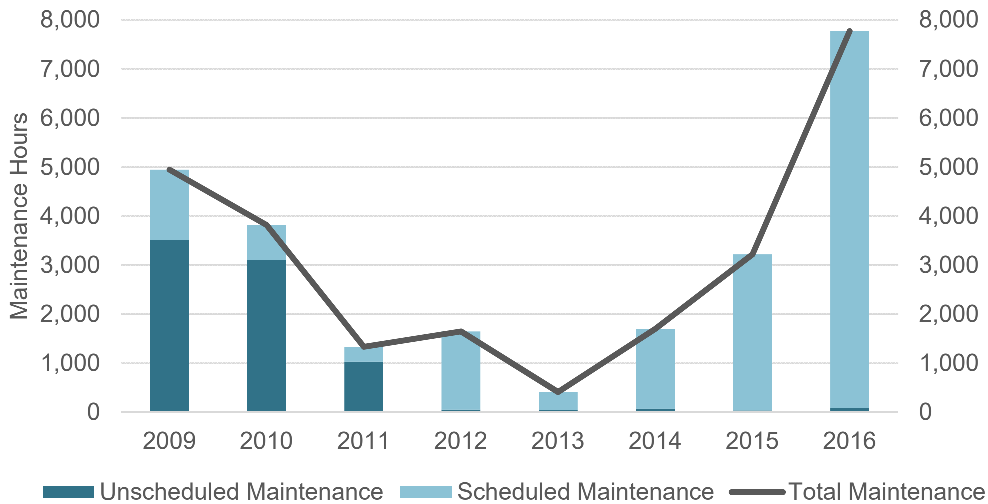
[7] Ibid.

[8] Locks and dams selected include: 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 25.

[9] Selected delay reasons include: inspection or testing lock, lock hardware or equipment malfunction, maintaining lock or lock equipment, repairing lock or lock hardware.

[10] Other closure reasons include: accident or collision in lock, bridge, or other structure (railway, pontoon, swing, etc.); collision or accident (not tow or not in lock); debris; debris in lock recess or lock chamber; environmental (i.e., fish, animals, oil spills, hydrilla); flood; fog; grounding; ice on lock or lock equipment; ice on or around tow; interference by other vessel(s); lightning; unused for other reason (Coast Guard river closing, etc.); low water, rain, river current, or outdraft condition; sleet or hail; snow; tow accident or collision; tow detained by Coast Guard or USACE; tow malfunction or breakdown; tow staff occupied with other duties; wind; other.

Figure 1: Upper Mississippi River Locks and Dams Maintenance Hours



Source: USACE, Navigation Data Center – Public Lock Detailed Unavailability Report
https://data.navigationdatacenter.us/Locks/Public-Lock-Unavailability-Detailed-Report/p3mn-gzqj/data

5.0 State Economic Profiles

The following sections profile the economy of each state to help describe the broader economics in the study area.

5.1 Comparative Discussion

While the majority of industry's contributions to Gross Regional Product (GRP) are relatively common across states, certain state industries rank higher in significance than others. Agriculture, forestry, fishing, and hunting contributed 5.6 percent to Iowa's real GRP in 2016, while the same set of industries in Illinois contributed only 0.8 percent. Iowa and Wisconsin's manufacturing industries account for a greater share (17.9 percent) than Minnesota (14.8 percent), Missouri (13.2 percent), and Illinois (12.7 percent). These findings are summarized in Table 5.

Table 5: GRP Share by Industry, 2016, with Top 5 Industries plus Agriculture

Industry	Iowa	Illinois	Minnesota	Missouri	Wisconsin
Finance, insurance, real estate, rental, and leasing	23.6%	22.6%	18.6%	18.4%	20.5%
Manufacturing	17.9%	12.7%	14.8%	13.2%	17.9%
Government	11.0%	9.34%	9.65%	11.8%	10.5%
Professional and business services	6.5%	14.0%	13.6%	13.1%	10.0%
Educational services, health care, and social assistance	7.5%	8.4%	10.2%	9.7%	9.5%
Agriculture, forestry, fishing, and hunting	5.6%	0.8%	2.1%	1.4%	1.9%
Real GRP (Billions of Chained 2009 $)	$162.5	$697.1	$300.6	$262.1	$276.5

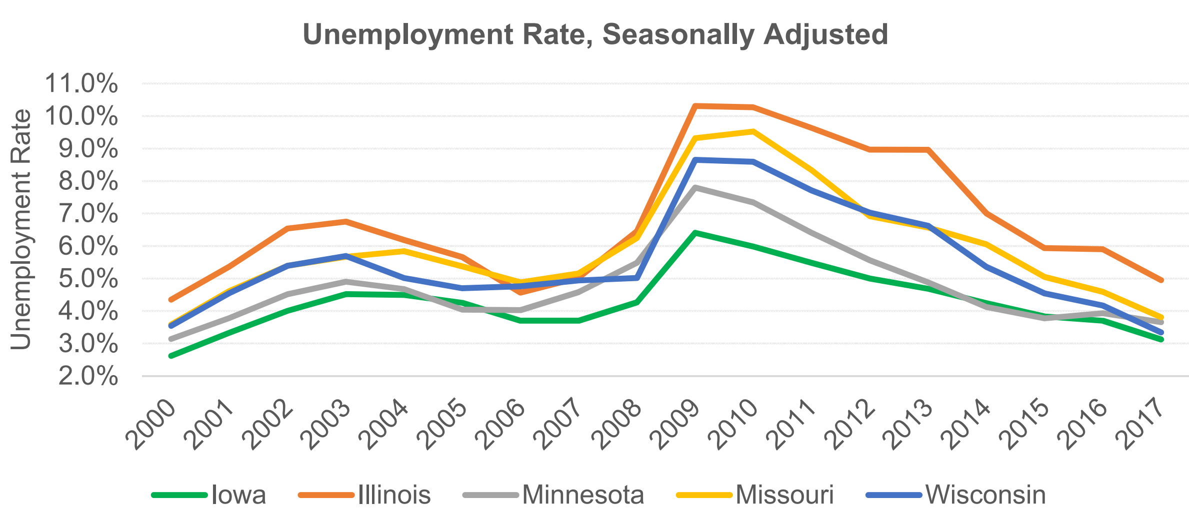
Source: Bureau of Economic Analysis. Regional Data, GRP and Personal Income.

The agriculture, construction,[11] and manufacturing industries are key industries using the inland waterway system across all states in the study area. These industries are expected to continue playing a large role on inland waterway shipments. Based upon Freight Analysis Framework data, combined waterborne tonnages from these industries for Illinois, Missouri, Minnesota, and Wisconsin are expected to grow between 1.1 and 1.5 percent (average annual growth rate, 2015 to 2025), while Iowa is forecast to experience a higher rate of 2.2 percent (average annual growth rate, 2015 to 2025).[12] As shown in Table 1, IEG estimates a larger annual growth rate (2.3 percent) for commodities shipped along the UMR from 2018 to 2060. This higher growth rate is because the Freight Analysis Framework considers neither the effect of US ethanol policy on corn exports nor the increase in corn and soybean exports due to increased spending power in other nations.

The bulk of waterborne tonnage in Iowa stems from the agriculture industry, which accounted for 80.3 percent of total Iowa tonnage shipped in 2015. This industry plays a significant, although smaller, role in Illinois (45.8 percent of total), and lesser roles in Missouri (23.5 percent of total), Minnesota (16.1 percent of total), and Wisconsin (1.5 percent of total).

Lastly, the unemployment rate for all states has been trending downward, with many states reaching the lowest levels in a decade (see Figure 2).

Figure 2: Study Area Unemployment Rate, Seasonally Adjusted



Source: Bureau of Labor Statistics. Local Area Unemployment Statistics.

[11] Share of GRP for the construction industry is smaller than the top 5 industries and, therefore, is not shown in Table 5.

[12] Forecasts obtained from the Freight Analysis Framework (FAF4) Database. Commodities mapped to industry based on: Cambridge Systematics. "FAF2 Data Disaggregation, Methodology and Results."

6.0 Benefit-Cost Analysis

The BCA compared the upgrade scenarios described earlier to determine whether the proposed improvements are cost effective. BCA is a conceptual framework that quantifies, in monetary terms, as many of the costs and benefits of a project as possible. Benefits represent the extent to which stakeholders affected by the project are made better off. BCA is typically a forward-looking exercise, which means that the analysis anticipates the benefits of a project or proposal over its entire life cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational considerations.

The BCA produces several important measures to assess the cost-effectiveness of a proposed scenario. A scenario must be able to provide benefits to stakeholders while being able to cover program costs. Benefits realized from improvements represent costs currently incurred by the system that are internalized by carriers, and ultimately passed on to shippers or end consumers. Improvements made to the inland waterway system will positively impact carriers, who may pass along cost savings to producers, who in turn may pass along the savings to consumers.

The benefit-cost results are summarized using two measures – net present value (NPV) and benefit-cost ratio (BCR). The NPV is calculated by subtracting the discounted scenario costs from the discounted benefits created by the scenario. This measure captures the net benefits created for society, after accounting for the scenario costs. This metric is useful to determine whether the scenario will generate returns in excess of cost across the study period. Scenarios can be compared by NPV to determine the one that provides the highest net benefits. However, a drawback in comparing scenarios by NPV is that scenarios requiring significant investments (i.e., larger scale scenarios) are likely to generate larger net benefits.

The second measure, BCR, accounts for the scale effect of investments. The BCR is calculated by dividing the scenario's discounted societal benefits by its discounted costs. The result measures the societal return on each dollar spent in scenario costs. A BCR of more than 1.0 indicates that for each dollar spent, more than one dollar worth of net benefits will be generated by the scenario. The BCR allows for a direct comparison between a larger and a smaller project by removing the potential effects of magnitude

The BCR and NPV take into account only benefits that can be quantified and monetized. Some benefits generated by a scenario might be difficult to quantify or monetize and would be excluded from the measures described above. It is important that the BCR and NPV be considered in conjunction with other criteria when judging a project's overall worth.

6.1 General Methodology

The USACE has a standard BCA methodology to assess the benefits of waterway projects. This study used a simpler calculation consistent with the commodity and impact forecasts for testing improvement scenarios and making comparisons. Since inland waterway improvements may compete with funding for other modes, such as rail and highway improvements, this study has adopted a BCA methodology consistent with standard U.S. Department of Transportation practices.

The BCA for each upgrade scenario took into account applicable benefits and project costs in current dollars [first quarter (Q1) 2018 $] for consistency and to allow for accurate comparisons. Based on the anticipated upgrade schedule for each alternative, construction costs were phased to ensure that appropriate costs were assigned to each project construction year. Each benefit stream was then compared against project costs with a BCA model to determine the BCR.

6.2 Assumptions

Annual operations and maintenance costs were assumed to be 3 percent of total capital expenditures. This is a standard assumption for operating and maintenance costs and it was held constant throughout the evaluation period. The resulting operating and maintenance costs are a conservative estimate because more operations and maintenance may be required as infrastructure components age, but they have been held constant in the analysis.

All previous costs were inflated to current dollars (Q1 2018 $) for consistency with the calculated benefits. Inflation values were obtained from the Civil Works Construction Cost Index System (CWCCIS).[13] Costs were phased to be consistent with the upgrade scenario schedules identified in the corresponding report to this study: *System Upgrade Pilot Project Scenarios*.

All benefits and costs occurring in future years were discounted using a 7 percent discount rate, which is consistent with U.S. Department of Transportation recommendations.[14] A discount rate of 3 percent was used as a sensitivity analysis consistent with previous U.S. Department of Transportation recommendations and generally aligns with the discount of 2.75 percent used by the USACE.[15]

6.3 Results Summary

Table 6 summarizes the BCA results for each upgrade scenario. Relative to the other scenarios, the Micro Upgrade scenario yields the highest discounted BCR of 3.52, while the system reliability scenario shows a BCR of 1.25. Conversely, the System Reliability scenario yields the largest NPV of $368 million compared to the $6.2 million NPV for the Micro Upgrade scenario.

While specific evaluation is not included in this report, a Large-scale Upgrade is expected to break even at a 3 percent discount rate when bundled with other improvements (as demonstrated in the USACE NESP authorization). The forthcoming USACE FY 2019 economic

---

[13] U.S. Army Corps of Engineers. "Civil Works Construction Cost Index System (CWCCIS)." March 31, 2017. https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1304.pdf

[14] U.S. Department of Transportation. "Benefit Cost Analysis Guidance for Discretionary Grant Programs." June 2018. https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/284031/benefit-cost-analysis-guidance-2018_0.pdf

[15] U.S. Army Corp of Engineers. "Economic Guidance Memorandum (EGM), 18-01, Federal Interest Rates for Corps of Engineers Projects for Fiscal Year 2018." October 20, 2017. https://planning.erdc.dren.mil/toolbox/library/EGMs/EGM18-01.pdf

update for NESP will provide additional economic details for NESP, which would be considered a Large-scale Upgrade for purposes of this study.

Table 6: Summary of the Benefit Cost Analysis, by Upgrade Scenario, Discounted at 7%, Millions of 2018 $

Scenario	Total Discounted Benefits	Total Discounted Costs*	Net Present Value	Benefit-Cost Ratio
Micro Upgrade: Mooring Cell	$8.7	$2.5	$6.2	3.52
System Reliability	$1,854	$1,487	$368	1.25

* Includes 3-percent annual operating and maintenance costs.

6.4 Micro Upgrade Scenario

6.4.1 Project Costs

Table 7 provides a high-level overview of the total construction costs for the Lock 14 project used in the BCA. A mooring cell at Lock 14 is expected to have $1.87 million in capital costs (Q1 2018 $). Including operation and maintenance costs, the total project costs total $4.2 million in undiscounted 2018$ (or $2.5 million discounted). An inflation factor of 1.29 was applied to October 2006 $ to obtain current dollar estimates. This inflation estimate differs slightly from the one included in the Three Pilot Projects report where slightly different inflation factors were used.

Table 7: Summary of Mooring Cell (Lock 14) Capital Costs

Cost Item	Oct. 2006 $	Q1 2018 $
Riprap	$24,000	$31,042
Excavation	$38,000	$49,150
Steel Sheet Piling	$112,500	$145,511
Metal Work	$436,100	$564,066
Mooring Cell Hardware	$17,000	$21,988
Lighting	$5,200	$6,726
Concrete and Reinforcing	$268,000	$346,640
Painting	$25,800	$33,371
Project Subtotal	$926,600	$1,198,494
Contingencies (25%)	$231,600	$299,559
Project Subtotal Incl. Contingencies	$1,158,200	$1,498,052
Planning, Engineering, and Design (15%)	$173,800	$224,798
Construction Management (10%)	$115,800	$149,779
Total Project Capital Costs	$1,447,800	$1,872,630

Source: Alternative Financing Evaluation: Upper Mississippi River Inland Waterway Three System Upgrade Pilot Scenarios

6.4.2 Project Schedule

Table 8 summarizes the intended project schedule with construction anticipated to begin approximately 12 months after project kick-off.

Table 8: Summary of Mooring Cell (Lock 14) Project Schedule

Project Activity	Schedule
Project Kick-off Meeting	Month 1
Verify Mooring Cell Location	Month 2
Obtain Borings and Channel Surveys	Months 3–4
Prepare Plans and Specifications	Months 3–6
QA/QC Reviews	Months 5–7
Finalize Construction Contract Documents	Months 8–9
Prepare Environmental Assessment	Months 2–8
Environmental Assessment Agency and Public Review	Months 9–10
Environmental Assessment Finding of No Significant Impact	Month 11
Advertise and Award Construction Contract	Month 12
Construction	Months 13–24

Source: Alternative Financing Evaluation: Upper Mississippi River Inland Waterway Three System Upgrade Pilot Scenario

6.4.3 BCA Results

Table 9 summarizes the results of the BCA for the micro upgrade scenario. The project is estimated to generate $38.8 million in undiscounted benefits. Once a discount rate of 7 percent is applied, project benefits total $8.7 million. When compared to a discounted total project cost (including the 3-percent annual operating and maintenance costs) of $2.5 million, the project yields a BCR of 3.52 and a NPV of $6.2 million at a 7 percent discount rate. Using a 3 percent discount rate, however, results in a BCR of 5.98 and a NPV of $15.4 million.

Table 9: Summary of Mooring Cell (Lock 14) BCA Results, Millions of 2018 $

BCA Metrics (2018 $)	Undiscounted	Discounted at 7%	Discounted at 3%
Operations Savings	$12.0	$3.3	$6.2
Fuel Savings	$26.8	$5.4	$12.3
Total Benefits (2018 $)	$38.8	$8.7	$18.5
Capital Costs	$1.9	$1.8	$1.8
Operations and Maintenance Costs	$2.3	$0.7	$1.3
Total Costs (2018 $)	$4.2	$2.5	$3.1
Net Present Value (NPV)		$6.2	$15.4
Benefit-Cost Ratio		3.52	5.98

6.5 System Reliability Improvements Scenario

6.5.1 Project Costs

Table 10 provides a high-level overview of the total construction costs for the project used in the system reliability scenario BCA. An inflation factor of 2.15 was applied to Q1 1990 $ to obtain current dollar estimates. This inflation estimate differs slightly from the one included in the Three Pilot Projects report where slightly different inflation factors were used.

Table 10: Summary of System Reliability Capital Costs

Cost Item	1990 $	Q1 2018 $
Average Cost per Lock	$30,000,000	$64,545,616

Source: Alternative Financing Evaluation: Upper Mississippi River Inland Waterway Three System Upgrade Pilot Scenarios

6.5.2 Project Schedule

Table 11 summarizes the assumed project schedule. Construction is anticipated to begin approximately 8 to 10 years following project initiation.

Table 11: Summary of System Reliability Project Schedule

Project Activity	Year
Major Rehabilitation Evaluation Report (RER)	1 to 2
Environmental Compliance	2
USACE Headquarters Approval of RER	3
Construction General (Federal)/Inland Waterway Trust Fund (CG/IWTF) Funding Queue	4 to 5
Plans and Specifications	6 to 7
Advertise and Award Construction Contract	7
Construction	8 to 10

Source: Alternative Financing Evaluation: Upper Mississippi River Inland Waterway Three System Upgrade Pilot Scenarios

6.5.3 BCA Results

Table 12 summarizes the results of the BCA for the system reliability upgrade scenario. The project is estimated to generate $9,131 million in undiscounted benefits. Once a discount rate of 7 percent is applied, project benefits total $1,854 million. When compared to a discounted total project cost of $1,486 million (including operating and maintenance costs), the project yields a BCR of 1.25 and a NPV of $368 million. Using a 3 percent discount rate results in a BCR of 2.00 and a NPV of $2.094 billon.

Table 12: Summary of System Reliability BCA Results, Millions of 2018 $

BCA Metrics (2018 $)	Undiscounted	Discounted at 7%	Discounted at 3%
Delay Cost Savings	$9,131	$1,854	$4,195
Total Benefits (2018 $)	$9,131	$1,854	$4,195
Capital Costs	$1,549	$1,164	$1,361
Operations and Maintenance Costs	$1,534	$322	$740
Total Costs (2018 $)	$3,083	$1,486	$2,101
Net Present Value (NPV)		$368	$2,094
Benefit-Cost Ratio		1.25	2.00

7.0 Economic Impact Analysis

The Economic Impact Analysis (EIA) sought to quantify the contributions to the regional economy as a result of transporting commodities along the inland waterway system. Typically, economic impacts are measured in terms of three measures: industry output, GRP, and employment. While output is the broadest measure of economic activity and refers to the total volume of sales, GRP is the value companies add within a region. This value added is calculated as the difference between the amount a company spends to acquire a product or service and its value at the time it is sold to other users. GRP adds up the value added across all companies and industries. It includes employee compensation, taxes on production and imports less subsidies, and gross operating surplus.

With respect to employment, two impact metrics were calculated for the economic impact analysis: labor income and jobs. Labor income includes employee compensation and proprietary income. Employee compensation consists of wage and salary payments as well as benefits (e.g., health, retirement, etc.) and employer-paid payroll taxes (e.g., employer side of social security, unemployment taxes, etc.). Proprietary income consists of payments received by self-employed individuals (e.g., farmers) and unincorporated business owners. The job impact measures the number of jobs created for a full year (i.e., job-years). A job-year is defined as one person employed for one year, whether part-time or full-time. The job impacts reflect the mix of full- and part-time jobs typical for each industry.

The results aid in understanding the economic importance of the inland waterway system for indicators including output, GRP, employment, and labor income.

7.1 General Methodology

Section 7.1.2 provides detailed information about the modeling software while the values that informed the basis of economic impacts are provided in Attachment A. In general, estimates of commodity value and delay savings were entered into an input-output model called IMPLAN (Impact Analysis for Planning) to obtain economic impacts.

The total value of commodities was run through the model to determine the impacts summarized in Section 7.2. Results for the upgrade scenario were obtained by running delay/operations and fuel costs, and switchboat/locking savings (tables provided in Attachment A) through IMPLAN. Results by upgrade scenario are provided in Section 7.3.

7.1.1 Contributions to the Economy

To determine the contributions to the economy, commodity forecasts were derived and monetized. Long-term price forecasts were leveraged from the best and most current publicly available sources including:

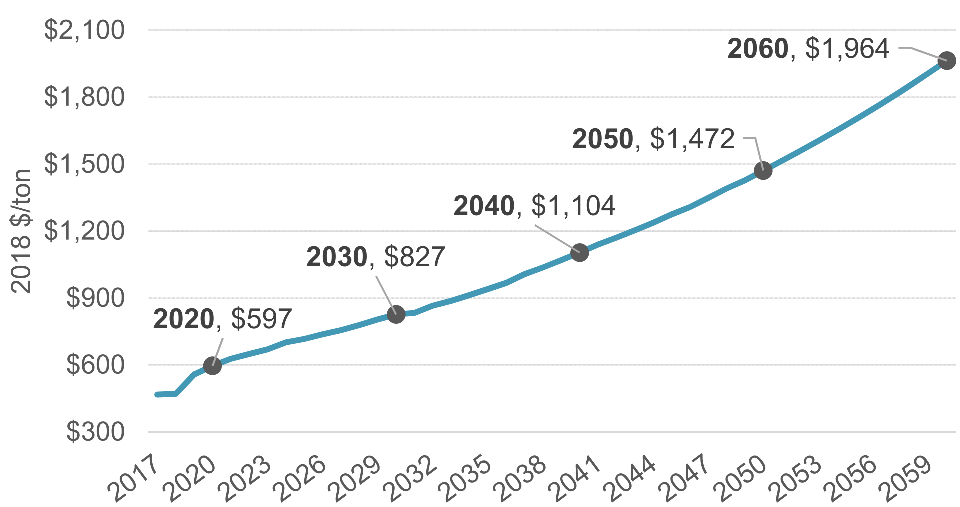
- U.S. Department of Agriculture;
- U.S. Energy Information Administration;
- Freight Analysis Framework database; and
- World Bank databank.

Table 13 summarizes the price forecasts by commodity and provides an average price which is weighted by commodity flows. This weighted average price shown in the final row of Table 13 is graphed over time in Figure 3. Both Table 13 and Figure 3 summarize the commodity price forecasts that informed input-output model calculations for economic contributions.

Table 13: Commodity Price Forecasts (2018 $/ton)

Commodity	Average Annual Growth (2018-2060)	2018	2030	2040	2050	2060
Alcohols	3.74%	$476	$1,134	$1,314	$1,712	$2,229
Animal Feed	0.18%	$453	$459	$467	$477	$488
Cement and Concrete	0.27%	$112	$116	$119	$123	$126
Corn	0.97%	$118	$132	$146	$161	$177
Crude Petroleum	4.52%	$372	$885	$1,255	$1,731	$2,379
Distillate Fuel Oil	3.38%	$820	$1,481	$2,013	$2,586	$3,306
Nitrogenous Fertilizer	2.41%	$193	$261	$329	$415	$524
Non-Metallic Minerals	0.24%	$99	$101	$105	$107	$109
Oilseeds	0.46%	$314	$332	$348	$364	$381
Other Commodities	1.30%	$696	$706	$854	$1,011	$1,197
Other Fertilizers	2.41%	$303	$410	$517	$652	$823
Petroleum Coke	0.27%	$71	$73	$75	$77	$79
Pig Iron	0.26%	$322	$339	$346	$352	$359
Soybeans	0.46%	$313	$331	$347	$363	$381
Weighted Average Forecast	3.46%	$471	$827	$1,104	$1,472	$1,964

Figure 3: Weighted Average Commodity Price Forecast (2018 $/ton)



7.1.2 Input-Output Model

IMPLAN is a widely recognized modeling tool for forecasting the economic impacts of investment projects, policies, and economic events on local, regional, state, and national economics. IMPLAN is an input-output model, meaning the values entered into the software (inputs) are translated into results (outputs) based on industry multipliers.

The IMPLAN system consists of a software package and data files that are updated every year. The data files include transaction information (intra-regional and import/export) on 517 private industry sectors [corresponding to four and five-digit North American Industry Classification System (NAICS) codes] and data on more than 20 economic variables, including employment, output, and value added. For this study, the IMPLAN system was populated with data available for Minnesota, Iowa, Illinois, Wisconsin, and Missouri in 2016.

Economic impact results are shown in terms of employment, labor income, output, and gross regional product, which are defined as:

- **Employment**: total number of part- and full-time jobs measured in job-years;
- **Labor Income**: income derived from employment;
- **Gross Regional Product**: value of all final (finished) goods and services; and
- **Output**: total gross value of goods and services.

Out of the 517 private industry sectors, Table 14 provides the top 5 industries based on employment (defined as the total number of part- and full-time jobs) for 2030. This year was selected since it is in the middle of the forecast period.

Table 14: Top Industries Across the Study Area, Employment (Jobs). 2030.

Industry	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Grain farming	11,294	596	13	11,903
Extraction of natural gas and crude petroleum	10,796	356	17	11,169
Support activities for agriculture and forestry	0	6,760	12	6,771
Oilseed farming	6,126	534	2	6,662
Wholesale trade	0	2,925	683	3,609

The majority (70 percent) of effects are direct, while indirect and induced account for the remaining 28 percent and 2 percent respectively. These effects are defined in the following paragraph. Since the commodity mix changes across the forecast period, the top industries vary in magnitude and in order. As an example, although grain farming is a top industry across the study period, wholesale trade is not a top industry in 2060 due to a change in the commodity mix.

IMPLAN provides impacts under varying level of effects, including direct, indirect, and induced effects. To ensure understanding of what these effects include, definitions are provided below:

- **Direct Effects**: initial economic effects of capital expenditures, transportation cost savings, and increased demand;

- **Indirect Effects**: additional economic activities from purchases of production inputs, goods, and services; and
- **Induced Effects**: extra economic activity from greater employment income and consumption.

Results were obtained from IMPLAN at the regional (study area) level. State-level results were obtained by using state tonnage shares relative to the region as estimated in the IEG commodity forecasts. These shares are shown in Table 15.

Table 15: State Tonnage-based Shares

State	Average Share
Minnesota	43.7%
Iowa	18.5%
Illinois	18.3%
Wisconsin	11.8%
Missouri	7.7%

Source: IEG forecasts

7.2 Baseline Contributions to the Economy

Tables 16 to 19 summarize the EIA results for the study area as a whole. The results capture the contributions to the regional economy as a result of transporting commodities along the inland waterway system.

Table 16: Employment Results (Jobs), Study Area

Impact Type	2018	2030	2060
Direct Effect	23,009	34,891	68,191
Indirect Effect	23,909	32,256	61,018
Induced Effect	19,757	25,579	46,272
Total Effect	66,675	92,726	175,481

The transportation of commodities is expected to support approximately 175,481 jobs in 2060, which represents an average annual growth of 2.3 percent from 2018.

Table 17: Labor Income Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$1,354.9	$1,701.1	$2,985.2
Indirect Effect	$1,441.4	$1,920.9	$3,569.1
Induced Effect	$934.5	$1,209.8	$2,188.4
Total Effect	$3,730.8	$4,831.8	$8,742.7

Similarly, labor income is expected to increase 2.1 percent annually from 2018 to 2060, which translates to approximately $119 million per year.

Table 18: Gross Regional Product Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$2,517.9	$3,003.1	$5,098.3
Indirect Effect	$2,576.6	$3,442.1	$6,430.8
Induced Effect	$1,659.5	$2,148.4	$3,886.2
Total Effect	$6,754.0	$8,593.6	$15,415.4

GRP represents the value of all finished goods and services in the economy. Table 18 shows the importance of UMR to the regional economy. Transportation of commodities along the UMR is anticipated to contribute $15.4 billion to the regional economy by 2060, and is expected to increase at an average annual growth rate of 2 percent throughout the study period (2018 to 2060). This aligns closely with the average annual growth rate of the commodity forecasts shown in Table 1, which is 2.3 percent.

A similar growth trend is realized when analyzing the output results across the region. Output is expected to grow approximately 2 percent per year during the study period, which results in a 2060 contribution of $40.3 billion (Table 19).

Table 19: Output Results (Millions 2018 $), Study Area.

Impact Type	2018	2030	2060
Direct Effect	$8,980.1	$11,673.5	$21,146.0
Indirect Effect	$5,007.2	$6,653.2	$12,361.4
Induced Effect	$2,879.8	$3,728.1	$6,743.6
Total Effect	$16,867.0	$22,054.8	$40,251.0

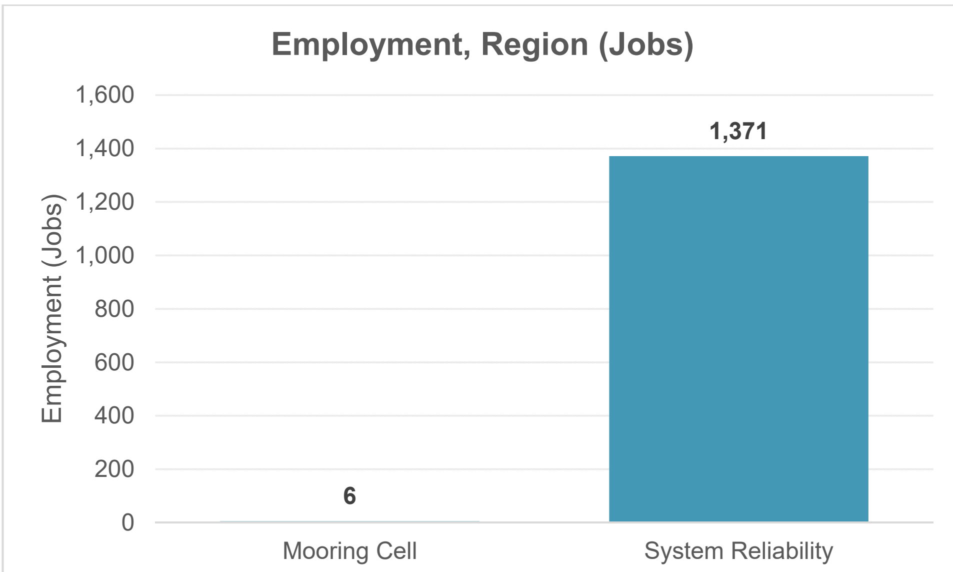
7.3 Upgrade Scenario Results

This section details the results for each upgrade scenario and metric. Figures 4 to 7 provide a visual comparison of the results. System reliability improvements generate the largest economic impacts due to the sheer scale of the upgrades. Specific evaluation is not included in this report for a Large-scale Upgrade, and economic impacts would vary depending upon the breadth of potential Large-scale Upgrade improvements. If a small number of locks are improved compared to the System Reliability scenario, economic impacts would be expected to be less than the System Reliability scenario and less than if Large-scale Upgrades are bundled with other improvements as demonstrated in the USACE NESP authorization. The forthcoming USACE FY 2019 economic update for NESP will provide additional economic details regarding NESP, which would be considered a Large-scale Upgrade for purposes of this study.

The Micro Upgrade has significantly lower economic impacts because it only includes a single mooring cell at one location. While the results would not be directly scalable by the number of additional locations/locks (i.e., installing mooring cells at all UMR locks), propagation of the micro concept across the applicable UMR locations would likely result in economic impacts an order of magnitude higher than a single mooring cell.

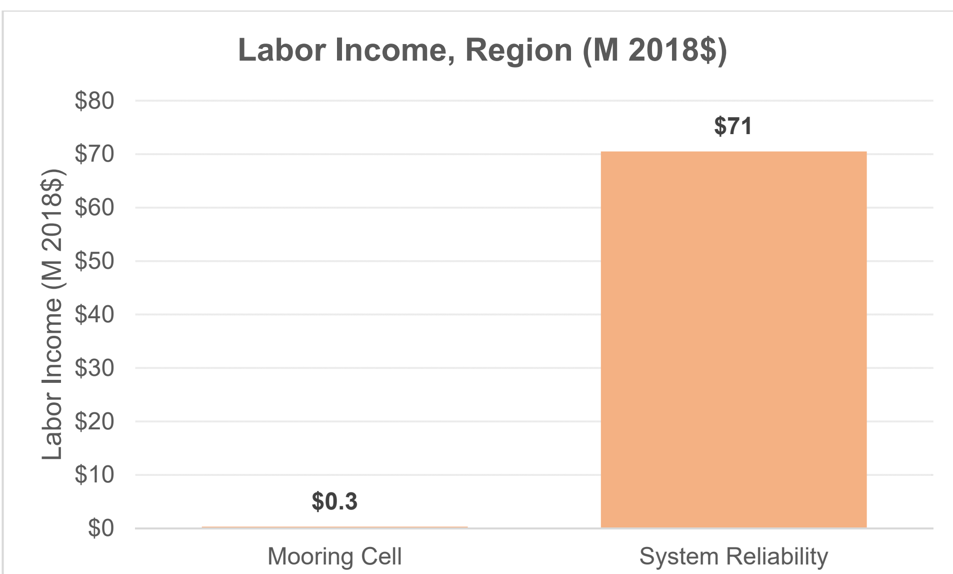
All scenarios are mutually exclusive and contain independent utility. In other words, scenarios do not consider the presence or construction of other upgrades so they can be evaluated and assessed independently. While it may be possible that certain upgrades are implemented simultaneously, the analysis considers them separately and does not take into account potential benefits accruing from multiple projects undertaken simultaneously, in different phases, or any other combination. Furthermore, the economic forecast does not include any new uses of the river such as container traffic or new vessel technologies.

Figure 4: Results Comparison, Employment (Jobs). Region, Average per Year



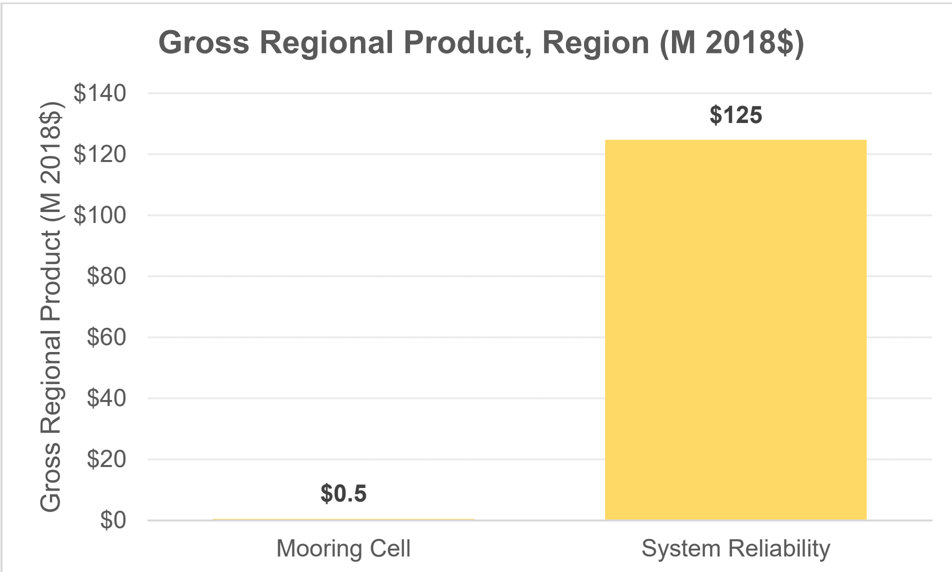
Source: HDR Analysis of IMPLAN Data

Figure 5: Results Comparison, Labor Income (Millions 2018 $). Region, Average per Year



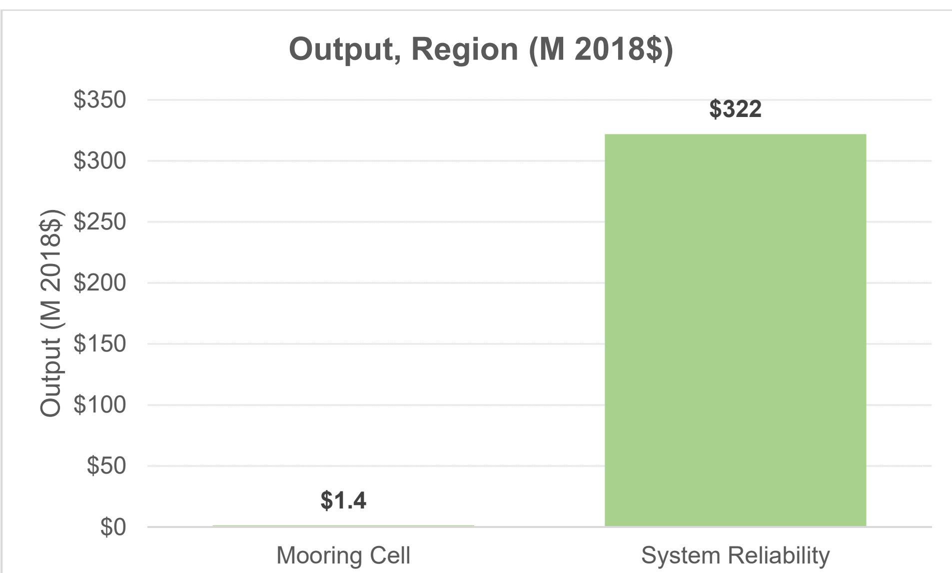
Source: HDR Analysis of IMPLAN Data

Figure 6: Results Comparison, Gross Regional Product (Millions 2018 $). Region, Average per Year



Source: HDR Analysis of IMPLAN Data

Figure 7: Results Comparison, Output (Millions 2018 $). Region, Average per Year



Source: HDR Analysis of IMPLAN Data

7.3.1 Micro Upgrade Scenario

Despite the relatively smaller investment dollars, the mooring cell alternative offers a high BCR and results in both efficiency and positive environmental outcomes. Tables 20 to 23 summarize the EIA results for the micro upgrade scenario.

Table 20: Mooring Cell Employment Results (Jobs), Study Area

Impact Type	2018	2030	2060
Direct Effect	0.8	1.2	3.7
Indirect Effect	0.8	1.3	4.3
Induced Effect	0.7	1.1	3.1
Total Effect	2.3	3.7	11.1

The mooring cell is expected to support 11 additional jobs (or $0.6 million in labor income) in 2060, representing 3.9 percent annual growth from 2018. The upgrade is further anticipated to contribute approximately $1.1 million and $2.7 million to GRP and output in 2060, respectively.

Table 21: Mooring Cell Labor Income Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$0.05	$0.07	$0.20
Indirect Effect	$0.05	$0.08	$0.24
Induced Effect	$0.03	$0.05	$0.15
Total Effect	$0.13	$0.20	$0.59

Table 22: Mooring Cell Gross Regional Product Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$0.09	$0.13	$0.35
Indirect Effect	$0.09	$0.14	$0.45
Induced Effect	$0.06	$0.09	$0.26
Total Effect	$0.23	$0.36	$1.06

Table 23: Mooring Cell Output Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$0.30	$0.48	$1.40
Indirect Effect	$0.17	$0.28	$0.86
Induced Effect	$0.10	$0.15	$0.46
Total Effect	$0.57	$0.91	$2.71

7.3.2 System Reliability Upgrade Scenario

Given the scale of improvements (including all locks and dams along the UMR), the system reliability scenario generates the largest economic impacts of the upgrade alternatives evaluated. With over 3,000 jobs and nearly $275 million in GRP generated through improvements by 2060, the implementation of reliability upgrades would generate substantial economic impacts (Tables 24 to 27). Should these improvements not be implemented, delay costs would continue to be borne by the system and future upgrades will be more costly due to escalation and other factors. Through the implementation of key system upgrades, these costs are no longer borne by the system and provide a source of economic benefits.

Table 24: System Reliability Upgrade Employment Results (Jobs), Study Area

Impact Type	2018	2030	2060
Direct Effect	135	287	1,155
Indirect Effect	140	275	1,127
Induced Effect	116	216	825
Total Effect	391	778	3,107

Table 25: System Reliability Upgrade Labor Income Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$7.9	$14.4	$52.4
Indirect Effect	$8.5	$16.2	$64.5
Induced Effect	$5.5	$10.2	$39.0
Total Effect	$21.9	$40.9	$155.9

Table 26: System Reliability Upgrade Gross Regional Product Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$14.8	$25.1	$88.1
Indirect Effect	$15.1	$29.2	$117.3
Induced Effect	$9.7	$18.2	$69.3
Total Effect	$39.6	$72.5	$274.6

Table 27: System Reliability Upgrade Output Results (Millions 2018 $), Study Area

Impact Type	2018	2030	2060
Direct Effect	$52.6	$97.6	$371.2
Indirect Effect	$29.4	$56.3	$224.3
Induced Effect	$16.9	$31.5	$120.2
Total Effect	$98.9	$185.4	$715.7

8.0 Conclusion

The Upper Mississippi inland waterway system contributes substantially to the economy of the five-state UMR area that includes Iowa, Illinois, Minnesota, Wisconsin, and Missouri. The waterway system supports the movement of several different commodities, with corn and soybean shipments accounting for more than half of the goods moved by weight.

The economic impact of the inland waterway system is greater than just the commodities shipped. The analysis conducted for this report suggests that the waterway system currently supports more than 66,000 direct, indirect, and induced jobs in the five-state region. This contribution is expect to grow over 2.5 times by 2060, when the inland waterway system will contribute to more than 175,00 jobs in the region.

Commodities shipped by the waterway system are expected to grow substantially over the next 40 years due to short-term shifts in demand for corn domestically and internationally as a result of adjustments in US ethanol policy. Longer term, rising incomes around the world are likely to drive demand for more corn and soybean exports, which will lead to growth in shipments along the inland waterway system. The IEG analysis forecasts 2.3 percent growth in shipments annually over the next 40 years.

In its current state, the Upper Mississippi inland waterway system will be unable to support this growth. Long-term deferred maintenance has left the system in need of repair and improvement. This study considered three potential future scenarios for improving the conditions of the inland waterway system:

- Micro Upgrade (Mooring Cell)
- System Reliability Improvements
- Large Scale Upgrade.

All three improvement scenarios exceed or are anticipated to breakeven (benefits equal or exceed costs) at a 3 percent discount rate, which is similar to the rate that USACE uses for economic analysis. Projects breakeven when the benefits equal or exceed the costs. The Micro Upgrade (mooring cell improvement) provides the highest return on investment with a benefit-cost ratio of nearly 6.0 at a 3 percent rate (or 3.5 at a 7 percent discount). The System Reliability Improvements have a lower benefit-cost ratio, but generate the highest benefits with $2.1 billion in net benefits at a 3 percent discount rate (and nearly $1.5 billion at a 7 percent discount rate). While detailed evaluation of a Large Scale Upgrade scenario is not included in this report, a Large-scale upgrade that is bundled with other improvements (as demonstrated in the USACE NESP authorization) is anticipated to break even at a 3 percent discount rate. The forthcoming USACE FY 2019 economic update for NESP will provide additional economic details regarding NESP, which would be considered a Large-scale Upgrade for purposes of this study

While the benefit-cost analysis quantitatively compares the Micro Upgrade and System Reliability Improvements scenarios based on their project costs and generated benefits, the economic impact analysis provides an economic assessment of specific effects under various metrics such as employment, output, labor income, and gross regional product (value added). Across all metrics, the System Reliability Improvements rank the highest due to project scale and the value they provide to users system-wide. The Micro Upgrade generates very small economic impacts due to the relatively small improvement. Specific evaluation is not included in this report for a Large-scale Upgrade, and economic impacts would vary depending upon the breadth of potential Large-scale Upgrade improvements. If a small number of locks are improved compared to the System Reliability scenario, economic impacts would be expected to be less than the System Reliability scenario and less than if Large-scale Upgrades are bundled with other improvements (as demonstrated in the USACE NESP authorization).

Attachment A

IEG Upper Mississippi River Lock Review and Scenarios Report

Informa Economics IEG
Agribusiness intelligence | informa

Upper Mississippi River Lock Review and Scenarios

Prepared for:

Iowa DOT and HDR

Informa Economics
Phone: 901.202.4600
www.informaecon.com

February 2018

Page Left Intentionally Blank

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

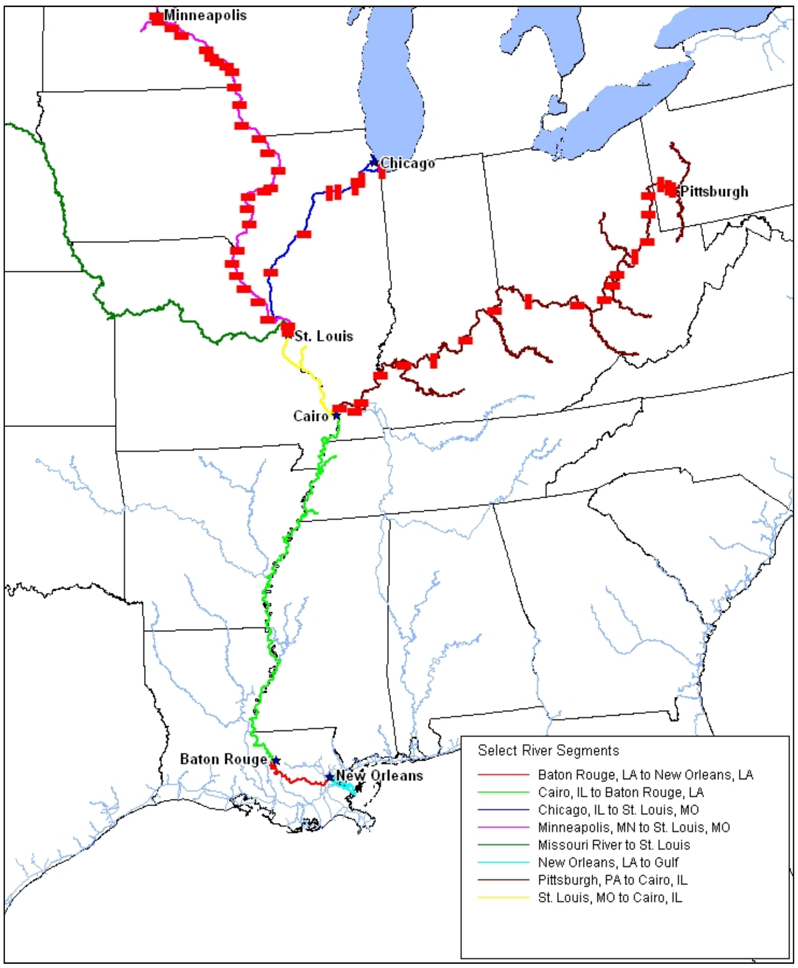
I. INLAND MISSISSIPPI RIVER SYSTEM

To establish a set of base understanding, IEG typically provides a general overview of the Inland Mississippi River System including a basic description of the waterways system, industry associations, ownership of the waterways system, description of the Inland Waterways Trust Fund and the Water Resources Development Act, operational challenges, government regulations, towboat profiles, barge profiles, and barge tow configurations.

US Mississippi River Inland River System comprises the navigable areas of the upper and lower Mississippi River, McClellan-Kerr Arkansas River, Ohio River Systems, Tennessee River, and Gulf Intracoastal Waterway and is important to the economy of the US.

The network of waterways extends along the Gulf of Mexico from Houston, TX to New Orleans, LA, up to Tulsa, OK; Kansas City, MO; Minneapolis, MN; Chicago, IL; Charleston, WV and Pittsburgh, PA as shown in Figure 1. The system is comprised of a series of locks and dams along the upper reaches of the navigation system. These locks and dams are important because they allow for the safe and efficient transit of the nation's commodities and products.

Figure 1: Major Navigable Inland River System and Waterway Segments



Notes: The eight river segments represent the main areas occupying river transport of corn, soybeans, and wheat.

Source: US Army Corps

The inland waterways are a critical component of the nation's freight transportation system, moving over $229 billion of coal and other bulk commodities in 2015. Vessel operators that transport these products via barge pay a $0.29-per-gallon fuel excise tax, which provides partial funding for new construction and major rehabilitation of navigation infrastructure, such as locks and dams, on the waterways. From 2005 through 2014, the fuel tax generated about $83 million in revenue per year. More than one half of all barge trips[1] traverse at least one lock.

The Corps is under a mandate to maintain at least a nine-foot draft on the main navigation channels. Because the lower Mississippi River is wider and larger than other segments of the Mississippi Inland Waterway System, the draft is typically much deeper, which allows barges on the lower Mississippi River to load heavier and enables larger tow configurations. The cost-per-ton is lowered with each additional ton loaded.

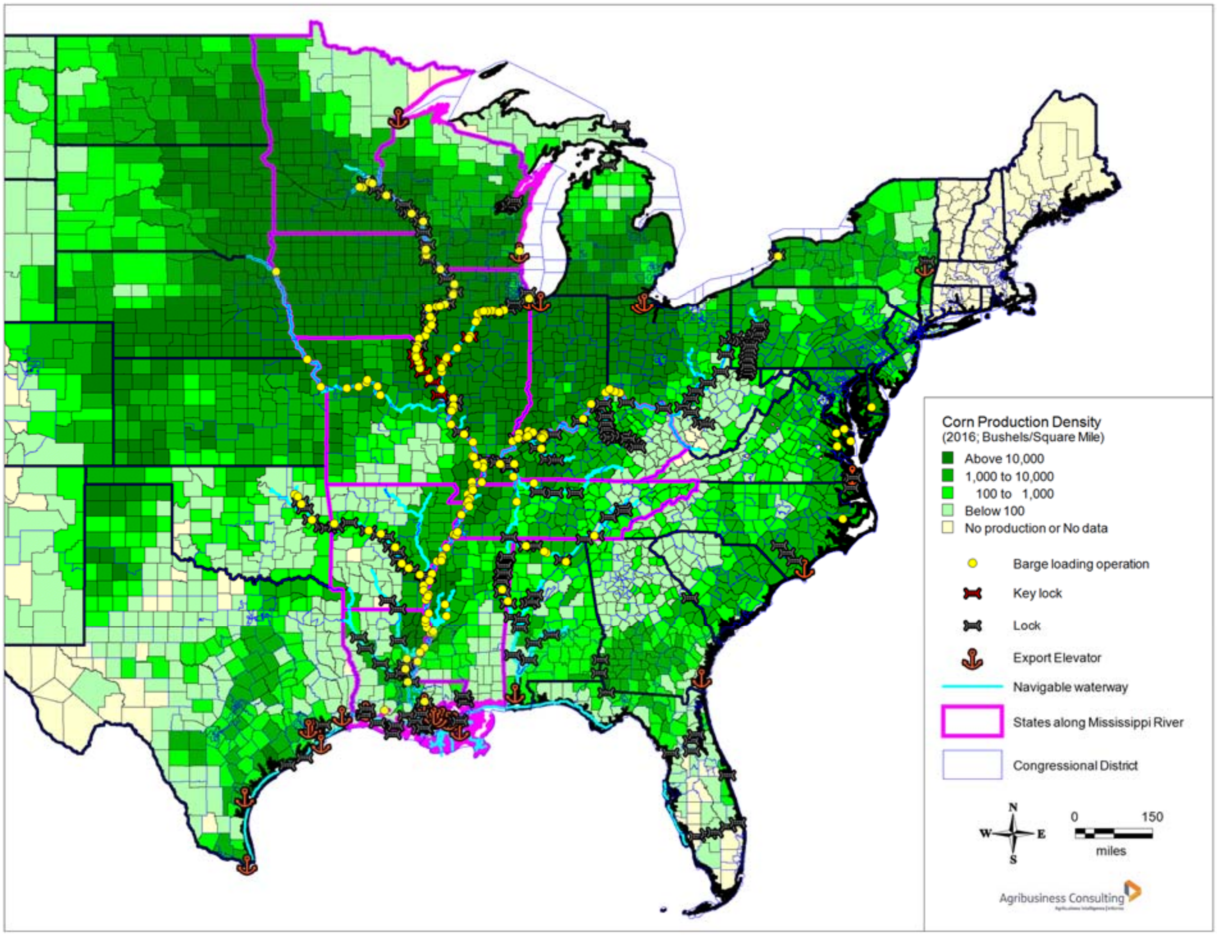
Dredging issues are a constant issue for all aspects of the waterways but have become a major concern for port dredging. Private terminals are responsible for their own dredging. Historically, public funds for public port dredging were supplemented by earmarks. Now that earmarks have been disallowed, funding public dredging projects is a major concern. The issue is causing heartburn for local governments who have always depended on earmarks. Many ideas are being floated to fund public port dredging, but the federal and state governments are reluctant to spend limited funds on ports.

The upper Mississippi River, Ohio River, Illinois River, Tennessee River and Arkansas River are subject to lock closures. According to US Army Corps of Engineers – St. Louis District, the nine-foot Channel Navigation Project includes 37 lock and dam sites (42 locks) on 1,200 river miles in Illinois, Iowa, Minnesota, Missouri and Wisconsin. Constructed largely in the 1930s, it extends from Minneapolis and St. Paul, MN on the Upper Mississippi River to its confluence with the Ohio River and up the Illinois Waterway to the T.J. O'Brien Lock in Chicago. For ports highly dependent on the locks and dams operating, the lack of maintenance is a real concern and makes it imperative that ports have access to other modes of transportation.

A modern 15-barge tow transports the equivalent of 1,050 semi tractor-trailer trucks (26,250 tons, 937,387 bushels of corn, or 240 rail cars). In 2015, the nine-foot channel project generated an estimated $3 billion of transportation cost-savings compared to its approximately $246 million operation and maintenance cost. The value of the expanded waterways system is tremendous to all who live near or ship to the expanded access.

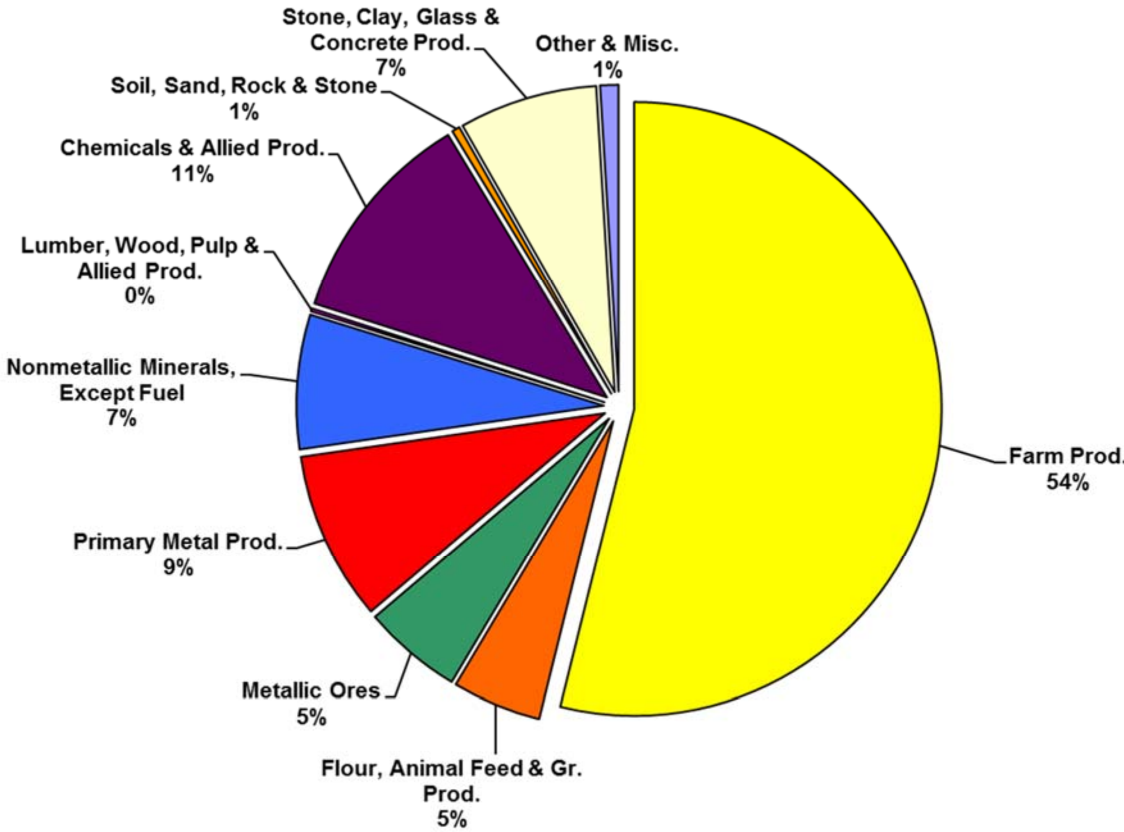
[1] Based on work prepared by the Tennessee Valley Authority for the Army Corps of Engineers using 2005 Waterborne Commerce Statistics Data.

Figure 2: Mississippi River System with Corn Production Density, Locks, Barge Loading Elevators, and Export Elevators



The Mississippi River System barge fleet that transports cargo is primarily covered barges, open barges and tank barges. Covered barges are used to transport climate sensitive cargoes such as grain, salt, fertilizer, cement, steel, and other similar products. Covered barges are reported as Jumbo (195’ & 200’ x 35’). Since 1996 covered barges have been built with deeper draft hulls of 13- and 14-feet, up from the 12 feet and lower draft limits. The deeper drafts allow for 15 percent more volume to be loaded.

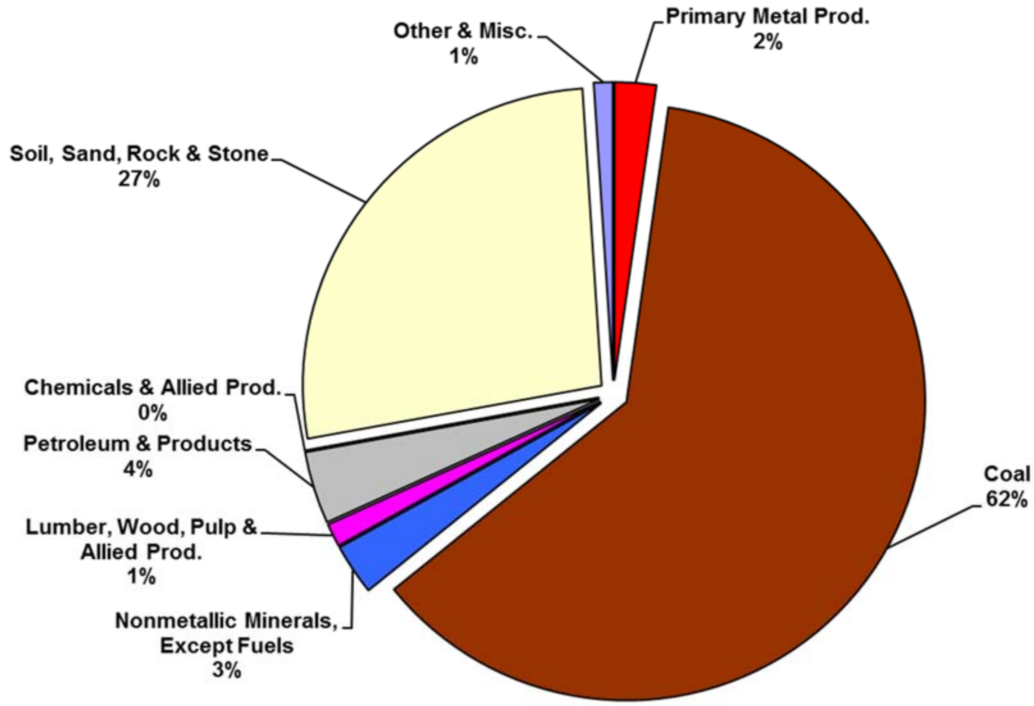
Figure 3: US Covered Barge Volume, 2015



Source: U.S. Army Corps of Engineers and IEG

The open barge fleet is used to haul coal, pulp wood, sand and gravel, and commodities that are less affected by the climate. There are three major open barge groupings: Standard 175’ x 26’; Stumbo 195’ x 26’; and Jumbo 195’ & 200’ x 35’.

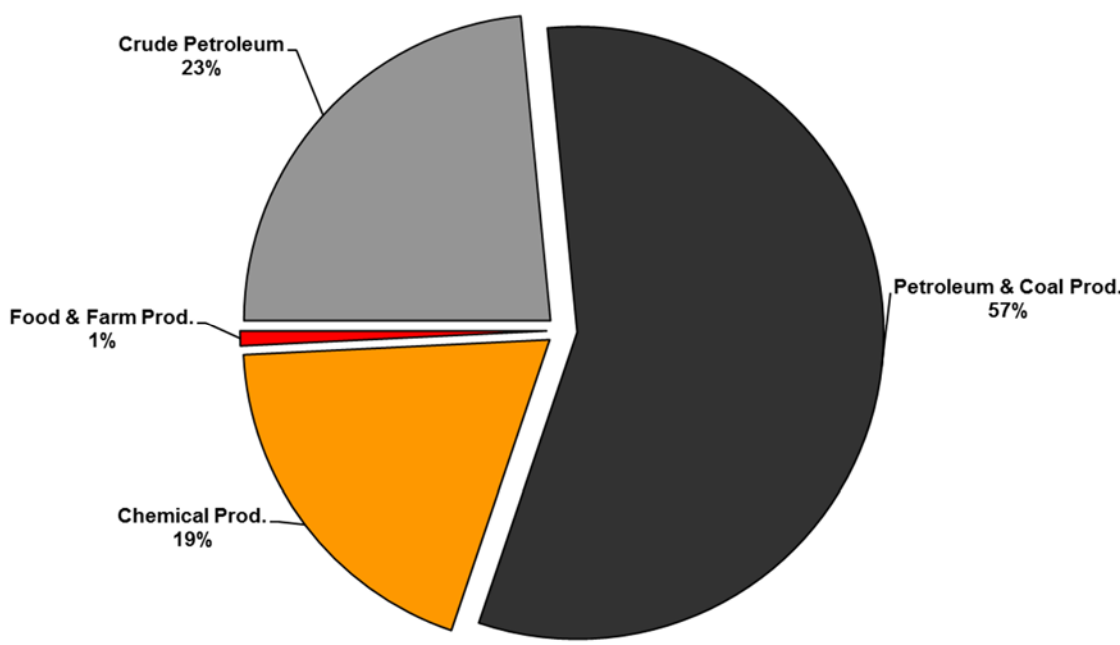
Figure 4: US Open Barge Volume, 2015



Source: U.S. Army Corps of Engineers and IEG

The tank fleet is comprised by four major types including a 10,000 barrel (small); Jumbo 195' & 200' x 35' or 10,000 to 20,000 barrel; semi-integrated unit tow of greater than 20,000 barrel (unit tow); and independent, specialty and all other tank barges (other).

Figure 5: US Tank Barge Volumes, 2015

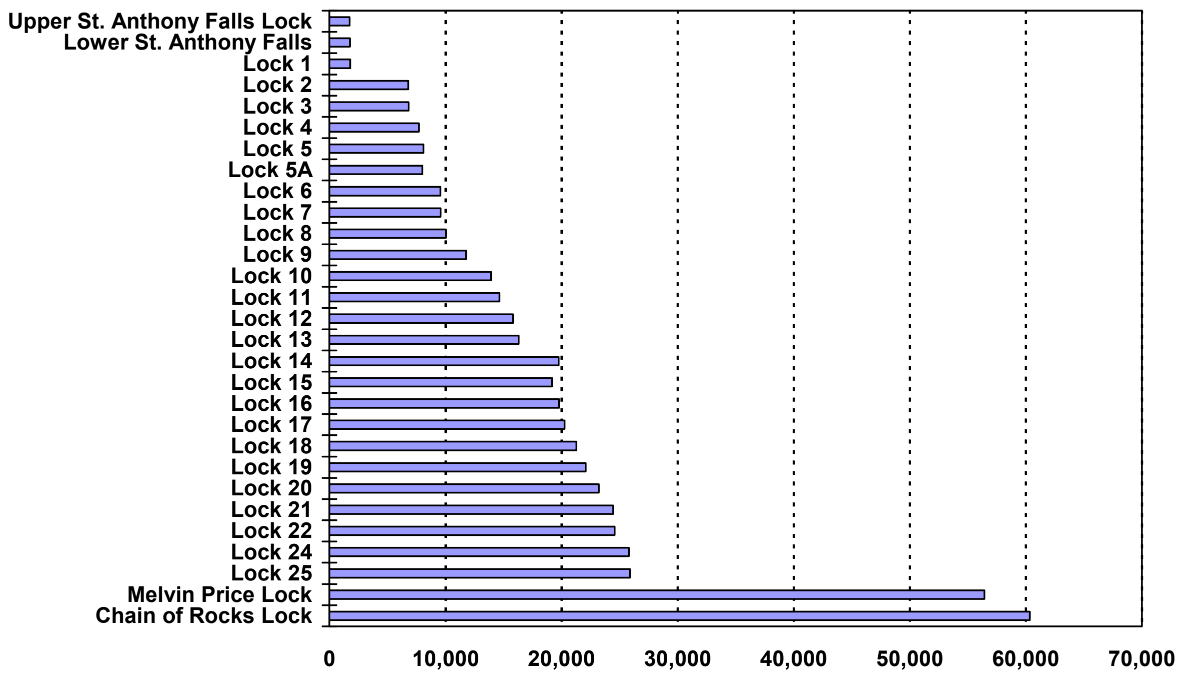


Source: U.S. Army Corps of Engineers and IEG

II. UPPER MISSISSIPPI RIVER SYSTEM

The US is a major agricultural exporting nation, which means most products flow downbound and add volume at each additional lock. Iowa is blessed with highly productive soil. The river provides a backbone for transporting products to Louisiana where they are transloaded onto ocean going vessels as shown in Figure 6. The Mississippi River System is connected and a small volume lock impacts higher volume locks.

Figure 6: Average Barge Lockings by Mississippi River Lock

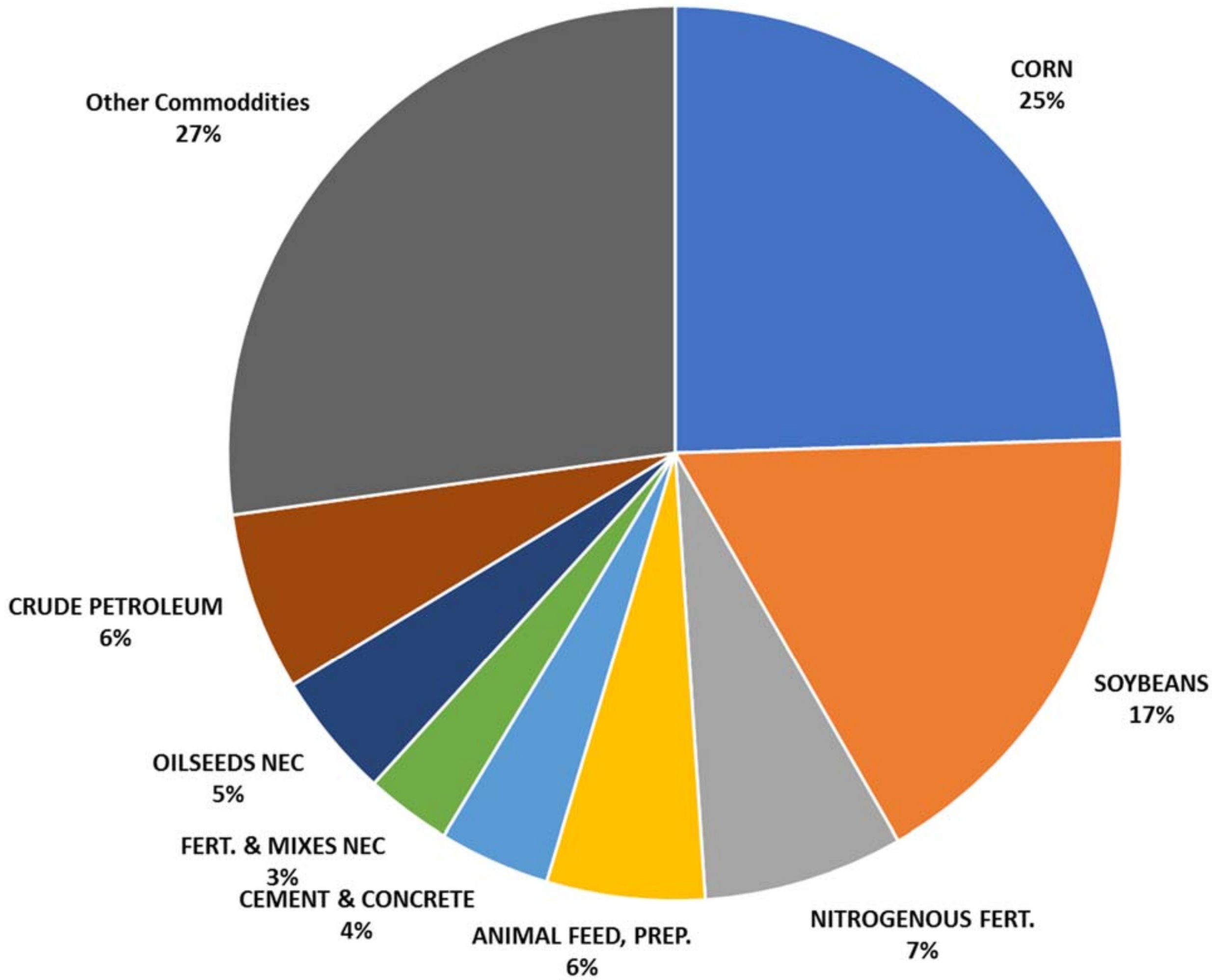


Note: Lockings include empties.

Source: Army Corps of Engineers, IEG

Corn, soybeans, animal feed and other oilseeds accounts for 53 percent of the total volume transported on the upper Mississippi River as shown in Table 7. An additional 10 percent are inputs for agricultural production. Cement is a major commodity for the Iowa region of the river. Approximately one quarter of barge movements are spread out over a 65 categories.

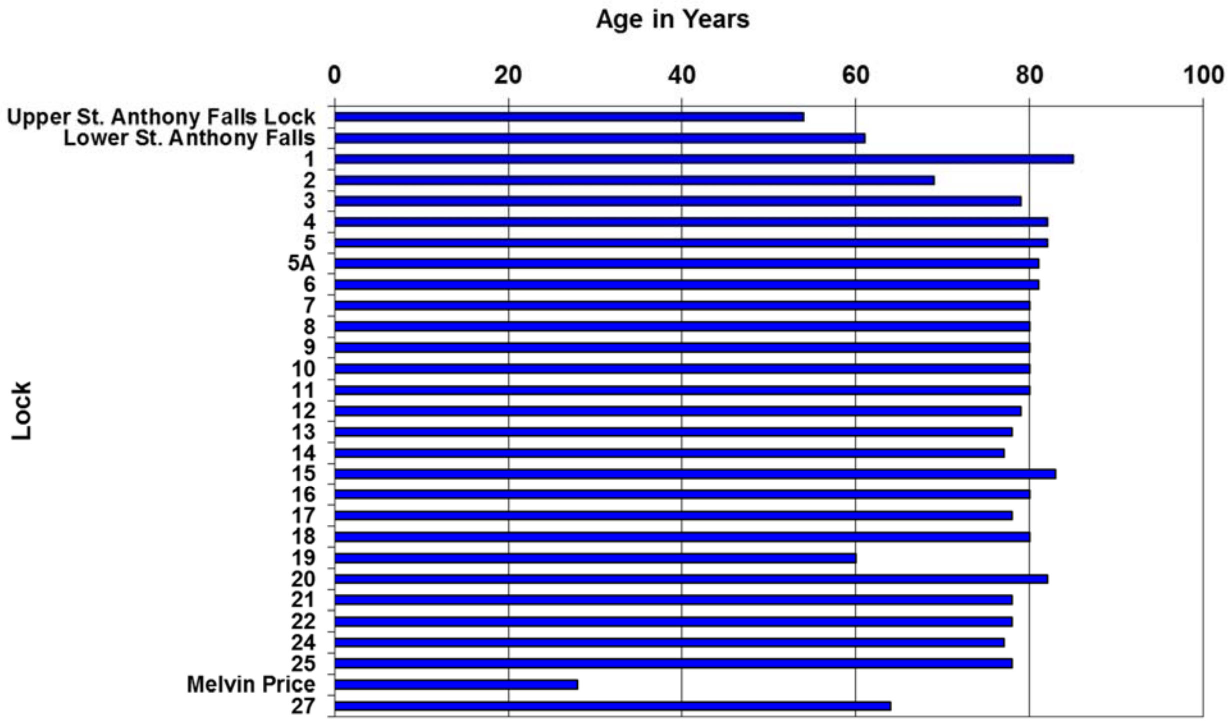
Figure 7: Upper Mississippi River Commodity Barge Movements



Source: U.S. Army Corps of Engineers and IEG

The locks on the upper Mississippi River were mostly built during the 1930s with an average age of 75 years. The 15 locks on the Mississippi River from the top of Iowa to the Mouth of the Missouri average 78 years. The age profile of the Mississippi River locks is shown in Figure 8 and Table 1.

Figure 8: Age Profile of Mississippi River Locks



Note: Lock and Dam 26 is also called Melvin Price
Source: US Army Corps of Engineers

Table 1: Descriptive Statistics for Upper Mississippi River Lock and Dams

			Location		Main Lock		Elevation (Feet)			
L/D	River	Mile	City	State	Width	Length	Upper Pool	Tailwater	Maximum Vertical Lift	Year of Operation
Upper St. Anthony Falls	UMR	853.9	Minneapolis	MN	56	400	799.2	750.1	49.1	1963
Lower St. Anthony Falls	UMR	853.3	Minneapolis	MN	56	400	750.1	725.1	25	1956
1	UMR	847.9	Minneapolis	MN	56	400	725.1	687.2	37.9	1932
2	UMR	815.2	Hastings	MN	110	600	687.2	675	12.2	1948
3	UMR	796.9	Welch	MN	110	600	675	667	8	1938
4	UMR	752.8	Alma	WI	110	600	667	660	7	1935
5	UMR	738.1	Minnesota City	MN	110	600	660	651	9	1935
5A	UMR	728.5	Fountain City	WI	110	600	651	645.5	5.5	1936
6	UMR	714.1	Trempealeau	WI	110	600	645.5	639	6.5	1936
7	UMR	702.5	La Cresent	MN	110	600	639	631	8	1937
8	UMR	679.2	Genoa	WI	110	600	631	620	11	1937
9	UMR	647.9	Lynxville	WI	110	600	620	611	9	1937
10	UMR	615	Guttenburg	IA	110	600	611	603	8	1937
11	UMR	583	Dubuque	IA	110	600	603	592	11	1937
12	UMR	556.7	Bellevue	IA	110	600	592	583	9	1938
13	UMR	522.5	Fulton	IL	110	600	583	572	11	1939
14	UMR	493.3	Pleasant Valley	IA	110	600	572	561	11	1940
15	UMR	483	Rock Island	IL	110	600	561	545	16	1934
16	UMR	457.2	Muscatine	IA	110	600	545	536	9	1937
17	UMR	437.1	New Boston	IL	110	600	536	528	8	1939
18	UMR	410.5	Gladstone	IL	110	600	528	518.2	9.8	1937
19	UMR	364.2	Keokuk	IA	110	1200	518.2	480	38.2	1957
20	UMR	343.2	Canton	MO	110	600	480	470	10	1935
21	UMR	324.9	Quincy	IL	110	600	470	459.5	10.5	1939
22	UMR	301.2	Saverton	MO	110	600	459.5	449	10.5	1939
24	UMR	273.4	Clarksville	MO	110	600	N/A	N/A	15*	1940
25	UMR	241.4	Winfield	MO	110	600	N/A	N/A	15*	1939
Melvin Price	UMR	200.5	Alton	IL	110	1200	N/A	N/A	24	1989
27	UMR	185.5	Granite City	IL	110	1200	N/A	N/A	N/A	1953

Source: US Army Corps of Engineers

The following profiles each of the 15 locks on the upper Mississippi River from Iowa to the Mouth of the Missouri River, quantifying the barge lockings and tow delays at these locks since 1993. Through this effort, the number of barge lockings and volume is summarized by lock.

A. Profile of Target Locks and Dams on UMR

The nine-foot Channel Navigation Project includes 29 lock and dam sites in Illinois, Iowa, Minnesota, Missouri and Wisconsin. The maintenance needs of this aging infrastructure have surpassed annual operations and maintenance funding. This limited funding has adversely affected reliability of the system and has primarily resulted in a fix as fail strategy, with repairs sometimes requiring days, weeks or months. Depending on the nature of a failure and extent of repairs, shippers, manufacturers, consumers and commodity investors can experience major financial consequences. Additionally, today's modern 1,200-foot long tows must be split and lock through in two operations within the project's 600-foot chambers. This procedure doubles and triples lockage times, increases costs and wear to lock machinery, and exposes deckhands to higher accident rates.

1. Lock 10 – Mississippi River (Guttenberg, Iowa)

The Lock and Dam 10 is located at Mississippi River Mile 615.0 in Guttenberg, Iowa. The main lock is located along the right descending bank and consists of one lock chamber 110 feet wide by 600 feet long with an upper pool elevation of 611 feet, a tailwater elevation of 603 feet, and a vertical lift of 8.0 feet. The movable dam consists of a concrete dam 763 feet long with four roller gates (20 feet high by 80 feet long), six non-submersible Tainter gates (20 feet high by 40 feet long), and two submersible Tainter gates (20 feet high by 40 feet long), and is located adjacent to the auxiliary lock. Completing the dam system is an earthen embankment approximately 4,600 feet long, located between the movable dam and high ground on the Wisconsin side of the river, with a concrete overflow spillway 1,200 feet long.

The Lock was put in operation in November 1937. Built under the supervision and direction of the Rock Island District, Lock and Dam 10 was transferred to St. Paul District's jurisdiction on October 1, 1939. The complex was completed at an estimated federal cost of $6,647,000.

(a) Lock Tonnage

In 2016 annual tonnage of 18.9 million increased by 32 percent over 2015 and reached the highest level since 2002. At 11.4 million tons, agriculture related commodities are the largest freight category and represented over 60 percent of total tonnage. Total loaded barges through the Lock were just shy of 12,000 with an additional 5,000 barges passing through empty.

Table 2: Lock 10 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	18,909,783	2011	13,158,081	2006	16,429,337	2001	16,523,414
2015	14,338,743	2010	13,914,432	2005	15,820,138	2000	19,956,214
2014	12,506,261	2009	13,800,501	2004	15,185,622	1999	22,005,796
2013	10,971,970	2008	11,851,569	2003	17,624,731	1998	19,417,877
2012	13,494,592	2007	15,642,174	2002	20,528,892	1997	18,321,573

Source: US Army Corps of Engineers

(b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was roughly half an hour at Lock 10. The percent of vessels delayed through the locks was 45 percent.

2. Lock 11 – Mississippi River (Dubuque, Iowa)

Lock and Dam 11 borders on the northern edge of Dubuque, Iowa, and is 583 miles above the confluence of the Mississippi and Ohio rivers. A complex of islands and sloughs extends threequarters of the way across the river from the Wisconsin shore. Lock dimensions are 110 feet wide by 600 feet long with additional provisions for an auxiliary lock. The maximum lift is 11 feet with an average lift of 9.4 feet. It takes approximately seven minutes to fill or empty the lock chamber. The movable dam has 13 submersible Tainter gates (20-feet high by 60-feet long) and three submersible roller gates (20-feet high by 100-feet long). The roller gates submerge eight feet. The dam system also includes a 3,540- foot long, curved, non-overflow, earth and sand-filled dike. It takes nine hours for water to travel from Lock and Dam 10, in Guttenberg, Iowa, to Lock and Dam 11.

Construction of Lock 11 began in February 1934 and was completed in August 1936. Construction of Dam 11 began in September 1935 and was completed in May 1937. The structure was placed in operation on September 14, 1937. Dams 11 and 18 were designed concurrently, and were the first dams in the Rock Island District to employ submersible, elliptical Tainter gates. They were also the first dams in the District to use submersible roller gates. The lock and dam elements of the complex were completed at a federal cost of $7,430,000.

a) Lock Tonnage

In 2016 annual tonnage of 18.9 million increased by 28 percent over 2015 and reached the highest level since 2002. At 11.39 million tons, agriculture related commodities are the largest freight category and represented over 60 percent of total tonnage. Total loaded barges through the Lock were 11,915 with an additional 5,074 barges passing through empty.

Table 3: Lock 11 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	18,903,366	2011	13,562,537	2006	17,048,863	2001	17,316,615
2015	14,746,202	2010	14,456,677	2005	16,347,999	2000	20,756,882
2014	13,154,371	2009	14,226,366	2004	15,769,587	1999	22,005,796
2013	11,609,540	2008	12,413,007	2003	18,276,060	1998	19,800,694
2012	13,863,116	2007	16,228,148	2002	20,943,649	1997	18,988,492

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow at Lock 11 was 0.48 of an hour. The percent of vessels delayed through the locks was 85 percent.

3. Lock 12 – Mississippi River (Bellevue, Iowa)

Lock and Dam 12 is 556.7 miles above the confluence of the Mississippi and Ohio rivers. The complex stretches across the river where the bluffs on the Iowa side are very close to the river; a complex of islands and sloughs extends nearly three-quarters of the way across the river from the Illinois side. Bellevue State Park occupies the high ground on the Iowa side, while the urbanized area of Bellevue extends to the government-owned property on the flat land below the bluff. The Lost Mound Unit of Upper Mississippi River National Wildlife and Fish Refuge occupies the islands, slough and small flat bottom areas on the Illinois side. Lock dimensions are 110 feet wide by 600 feet long with additional provisions for an auxiliary lock. The maximum lift is 9 feet with an average lift of 6 feet. It takes approximately 10 minutes to fill or empty the lock chamber. The movable dam consists of seven submersible Tainter gates (20 feet high by 64 feet long) and three submersible roller gates (20 feet high by 100 feet long). The dam system includes two, non-overflow, earth and sand-filled dikes; two transitional dikes; and a concrete-covered, ogee spillway, submersible earth and sand-filled dike. The foundation is set in sand, gravel and silt. It takes eight hours for water to travel from Lock and Dam 11, in Dubuque, Iowa, to Lock and Dam 12.

Construction of Lock 12 began in February 1934 and was completed in November 1935. Construction of Dam 12 began in September 1936 and was completed in July 1938. The structure was placed in operation on May 14, 1939. During the peak of construction, a maximum of 1,217 men were employed at one time. The lock and dam elements of the complex were completed at a federal cost of $5,581,000.

a) Lock Tonnage

In 2016 annual tonnage of 20.9 million increased by 30 percent over 2015 and reached the highest level since 2002. At 12.6 million tons, agriculture related commodities are the largest freight category and represented over 60 percent of total tonnage. Total loaded barges through the Lock were 13,193 with an additional 5,553 barges passing through empty.

Table 4: Lock 12 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	20,864,971	2011	14,326,574	2006	18,655,930	2001	19,098,873
2015	16,069,017	2010	15,300,161	2005	17,672,950	2000	22,280,448
2014	13,904,294	2009	15,164,599	2004	17,350,486	1999	24,426,919
2013	11,972,140	2008	13,299,444	2003	19,620,541	1998	21,352,999
2012	14,560,495	2007	17,681,771	2002	23,031,159	1997	20,333,558

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.63 of an hour at Lock 12. The percent of vessels delayed through the locks was 48 percent. Average delays in tow hours ran 1.28 during 2016.

4. Lock 13 – Mississippi River (Fulton, Illinois)

Lock and Dam 13 is 522.5 miles above the confluence of the Mississippi and Ohio rivers. The complex stretches across the river at a point where the bluffs on the Iowa side are very close to the river; islands and chutes dot the river beneath the bluffs. Eagle Point Nature Center occupies the high bluff immediately above the lock and dam. A dense group of sloughs and islands extend out from the Illinois shore. Lock dimensions are 110 by 600 feet with additional provisions for an auxiliary lock. The maximum lift is 11 feet with an average lift of 8.6 feet. It takes approximately 10 minutes to fill or empty the lock chamber. The movable dam consists of 10 submersible Tainter gates, 20-feet high by 64-feet long; and three submersible roller gates, 20-feet high by 100-feet long. The Tainter gates are elliptical. The dam system also includes three non-overflow earth and sand-filled dikes; two transitional dikes; and a submersible earth and sand-filled dike. It takes 10 hours for water to travel from Lock and Dam 12, in Bellevue, Iowa, to Lock and Dam 13.

Construction of Lock 13 began in July 1935 and was completed in December 1936. Construction on Dam 13 began in January 1937 and was completed in December 1938. The structure was placed in operation on May 13, 1939. Locks and Dams 13, 14 and 17 were designed and built concurrently. The lock site was inaccessible from the nearest highway which required the contractor to construct a dike road through the Illinois shore's sloughs, islands, and marshy bottom lands. A ferry had to be operated during construction of the dam and central control station. The lock and dam elements of the complex were completed at a federal cost of $7,503,000.

a) Lock Tonnage

In 2016 annual tonnage of 21.2 million increased by 30 percent over 2015 and reached the highest level since 2002. At 12.9 million tons, agriculture related commodities are the largest freight category and represented over 61 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 16 percent. During 2016, total loaded barges through the Lock were 13,378 with an additional 5,801 barges passing through empty.

Table 5: Lock 13 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	21,166,241	2011	14,545,373	2006	19,078,754	2001	19,277,553
2015	16,305,207	2010	15,551,521	2005	18,028,251	2000	22,722,882
2014	14,133,454	2009	15,543,114	2004	17,707,145	1999	24,803,042
2013	12,117,290	2008	13,595,495	2003	19,990,636	1998	21,633,824
2012	14,780,948	2007	18,030,735	2002	23,495,472	1997	20,582,592

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.64 of an hour or 38 minutes at Lock 13. The percent of vessels delayed through the locks was 56 percent. Average delays in tow hours ran 1.31 during 2016 or 79 minutes.

5. Lock 14 – Mississippi River (Pleasant Valley, Iowa)

Locks and Dam 14 is four miles below LeClaire, Iowa, and 493.3 miles above the confluence of the Mississippi and Ohio rivers. The site is also 3.6 miles below the head of the notorious, rock-bedded, Rock Island Rapids. The LeClaire Lock and the remains of the LeClaire Lateral Canal, built in 1921-1924 to bypass this treacherous stretch of river, are located along the Iowa shore. The main lock's dimensions are 110 by 600 feet. The dimensions of the LeClaire Lock, which is used as an auxiliary lock, are 80 by 320 feet, with a low-water depth of eight feet at the upper sill and seven feet at the lower sill. The main lock's maximum lift is 11 feet with an average lift of 9.8 feet. It takes approximately eight minutes to fill or empty the main lock. The movable dam has 13 non-submersible Tainter gates (20 feet high by 60 feet long) and four submersible roller gates (20 feet high by 100 feet long). The dam system also includes an earth and sand-filled dike. It takes nine hours for water to travel from Lock and Dam 13, in Fulton, Iowa, to Lock and Dam 14.

Construction of Lock 14 was begun in August 1935, and was completed on December 22, 1936. Construction of Dam 14 was begun in November 1936, and was completed in December 1938. The structure was placed in operation on June 14, 1939. The lock and dam elements of the complex were completed at a federal cost of $5,472,000.

a) Lock Tonnage

In 2016 annual tonnage of 23.5 million increased by 25 percent over 2015 and reached the highest level since 2003. At 14.1 million tons, agriculture related commodities are the largest freight category and represented 60 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 21 percent. During 2016, total loaded barges through the Lock were 15,229 with an additional 6,928 barges passing through empty.

Table 6: Lock 14 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	23,453,055	2011	17,012,596	2006	21,934,232	2001	24,264,635
2015	18,754,072	2010	17,737,023	2005	20,811,684	2000	28,328,486
2014	16,102,838	2009	17,921,487	2004	20,626,075	1999	30,839,734
2013	13,534,616	2008	15,612,451	2003	24,224,248	1998	27,061,431
2012	16,549,369	2007	20,653,317	2002	28,428,345	1997	25,544,711

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.65 of an hour or 39 minutes. The percent of vessels delayed through the locks was 59 percent. Average delays in tow hours ran 2.74 during 2016 or 164 minutes.

6. Lock 15 – Mississippi River (Rock Island, Illinois)

In the heart of the Quad Cities, Locks and Dam 15 is 483 miles above the confluence of the Mississippi and Ohio rivers. The complex stretches across the Mississippi River at one of its narrowest points at the foot of the Rock Island Rapids. The complex extends from the northwest tip of the Army's Arsenal Island on the Illinois side, to a small area of flat-bottom land on the Iowa side. A roadway and railroad bridge, joining Davenport and Rock Island, spans the site. The main lock is 110 feet wide by 600 feet long; the auxiliary lock is 110 by 360 feet. Both have a maximum chamber lift of 16 feet with an average of 13 feet and takes about seven minutes to fill or empty. Each lock gate weighs nearly 82 tons. The 1,203-foot-long movable dam is the largest roller dam in the world consisting of 11 nonsubmersible 100-foot-long roller gates with 11 control houses. Nine gates are 19 feet 4 inches in diameter and two are 16 feet 2 inches. It takes three hours for water to travel from Lock and Dam 14, in Pleasant Valley, Iowa, to Lock and Dam 15.

Construction on Lock 15 began on April 9, 1931, and was completed in December 1932. Construction on Dam 15 began in 1932 and was completed in May 1934. The structure was placed in operation on March 7, 1934. The lock and dam elements of the complex were completed at a federal cost of $7,480,000.

a) Lock Tonnage

In 2016 annual tonnage of 23.8 million increased by 24 percent over 2015 and reached the highest level since 2003, when 28.8 million tons passed through. At 14.4 million tons, agriculture related commodities are the largest freight category and represented 60 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 17 percent. During 2016, total loaded passing through the Lock were 15,131 with an additional 6,760 barges passing through empty.

Table 7: Lock 15 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	23,803,628	2011	17,250,083	2006	21,942,068	2001	24,708,731
2015	19,148,356	2010	17,923,333	2005	20,991,007	2000	28,753,278
2014	16,453,426	2009	18,274,953	2004	20,948,490	1999	31,209,760
2013	13,705,556	2008	15,635,867	2003	25,019,206	1998	27,168,117
2012	16,835,910	2007	20,880,043	2002	28,829,063	1997	25,826,822

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.69 of an hour or 41 minutes. The percent of vessels delayed through the locks was 68 percent. Average delays in tow hours ran 2.55 during 2016 or 153 minutes.

7. Lock 16 – Mississippi River (Illinois City, Illinois)

Lock and Dam 16 is about one mile upstream from Muscatine, Iowa, and 457.2 miles above the confluence of the Mississippi and Ohio rivers. The complex stretches across the river at a point where the valley is wide. The earthen embankment section of the dam straddles portions of Hog Island in the main channel. The lock dimensions are 110 feet wide by 600 feet long with additional provisions for an auxiliary lock. The maximum lift is nine feet with an average lift of 6.5 feet. It takes approximately seven minutes to fill or empty the lock chamber. The movable dam has 12 non-submersible Tainter gates (20 feet high and 40 feet long), three submersible Tainter gates of the same dimensions, and four non-submersible roller gates (20 feet high and 80 feet long). The dam system also includes a linear, concrete capped, ogee spillway; and a submersible earth and sand-filled dike. It takes eight hours for water to travel from Lock and Dam 15, in Davenport, Iowa, to Lock and Dam 16.

Construction on Lock 16 began on Nov. 17, 1933, and completed in February 1937. Construction on Dam 16 began in January 1935 and completed in February 1937. The structure was placed in operation on July 10, 1937. The lock and dam elements of the complex were completed at a federal cost of $3,682,000.

a) Lock Tonnage

In 2016 annual tonnage of 24.9 million increased by 25 percent over 2015 and reached the highest level since 2003, when 25.9 million tons passed through. At 15.5 million tons, agriculture related commodities are the largest freight category and represented 62 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 17 percent. During 2016, total loaded passing through the Lock were 15,738 with an additional 7,375 barges passing through empty.

Table 8: Lock 16 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	24,855,286	2011	18,085,452	2006	22,708,972	2001	26,451,754
2015	19,851,212	2010	18,453,809	2005	21,328,240	2000	30,583,395
2014	16,832,178	2009	19,417,486	2004	21,279,884	1999	33,139,184
2013	13,900,123	2008	16,494,518	2003	25,912,587	1998	28,790,247
2012	17,530,646	2007	21,589,027	2002	30,323,912	1997	27,405,115

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.60 of an hour or 36 minutes. The percent of vessels delayed through the locks was 80 percent. Average delays in tow hours ran 2.27 during 2016 or 136 minutes.

8. Lock 17 – Mississippi River (New Boston, Illinois)

Lock and Dam 17 is 437.1 miles above the confluence of the Mississippi and Ohio rivers. The complex stretches across a wide portion of river where there are several marshy islands. The Port Louisa National Wildlife Refuge and Odessa State Wildlife Management Area occupy the islands, marshes, and sloughs on the Iowa shore both upstream and downstream from the dam. The lock dimensions are 110 feet wide by 600 feet long with additional provisions for an auxiliary lock. The maximum lift is eight feet with an average lift of four feet. It takes approximately seven minutes to fill or empty the lock chamber. The movable dam has eight submersible Tainter gates (20 feet high by 64 feet long) and three submersible roller gates (20 feet high by 100 feet long). The dam system also includes one non-overflow earth and sand-filled dike; two transitional dikes; and a submersible earth and sand-filled dike. It takes six hours for water to travel from Lock and Dam 16 in Muscatine, Iowa, to Lock and Dam 17.

Construction on Lock 17 began on Aug. 7, 1935 and was completed in February 1937. Construction on Dam 17 began in February 1937 and was completed in January 1939. The structure was placed in operation on May 14, 1939. The lock and dam elements of the complex were completed at a federal cost of $4,164,000.

a) Lock Tonnage

In 2016 annual tonnage of 25.8 million increased by 26 percent over 2015 and reached the highest level since 2003, when 27.2 million tons passed through. At 16.1 million tons, agriculture related commodities are the largest freight category and represented 62 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 17 percent. During 2016, total loaded passing through the Lock were 16,319 with an additional 7,520 barges passing through empty.

Table 9: Lock 17 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	25,776,550	2011	18,918,020	2006	24,046,856	2001	27,451,332
2015	20,469,969	2010	19,513,395	2005	22,596,983	2000	31,375,823
2014	17,651,636	2009	20,519,517	2004	22,107,520	1999	34,170,210
2013	14,664,956	2008	17,338,830	2003	27,171,584	1998	29,922,523
2012	18,357,280	2007	22,843,570	2002	31,631,819	1997	28,104,179

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.83 of an hour or 50 minutes at Lock 17. The percent of vessels delayed through the locks was 64 percent. Average delays in tow hours ran 2.32 during 2016 or 139 minutes.

9. Lock 18 – Mississippi River (Gladstone, Illinois)

Lock and Dam 18 is 410.5 miles above the confluence of the Mississippi and Ohio rivers. The bottom lands on both shores are flat and punctuated by sloughs, marshes, and reefs. The river is dotted with low islands of various sizes. The Oquawka State Wildlife Refuge is adjacent to the lock and dam complex on the Illinois shore. The installation's esplanade interrupts a levee and functions as part of the Henderson River diversion that converted Turkey Island into an extension of the Illinois shore. Lock dimensions are 110 feet wide by 600 feet long with additional provisions for an auxiliary lock. Maximum lift is 9.8 feet with an average lift of 6.9 feet. It takes approximately 10 minutes to fill or empty the lock. The dam is composed of 14 submersible Tainter gates (20 feet high by 60 feet long) and three submersible roller gates (20 feet high by 100 feet long).

All gates submerge to a depth of eight feet. The dam includes a submersible earth and sand-filled dike, a non-overflow earth and sand-filled dike, and two transition dikes. It takes eight hours for water to travel from Lock and Dam 17, in New Boston, Illinois, to Lock and Dam 18.

Construction on Lock 18 began on Jan. 26, 1934, and was completed in April 1935. Construction on Dam 18 began in September 1935 and was completed in May 1937. The structure was placed in operation on September 8, 1937. The lock and dam elements of the complex were completed at a federal cost of $4,122,400.

a) Lock Tonnage

In 2016 annual tonnage of 27.2 million increased by 26 percent over 2015 and reached the highest level since 2003, when 28.4 million tons passed through. At 17.5 million tons, agriculture related commodities are the largest freight category and represented 64 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 16 percent. During 2016, total loaded passing through the Lock were 17,200 with an additional 8,285 barges passing through empty.

Table 10: Lock 18 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	27,192,132	2011	19,850,238	2006	25,262,995	2001	28,546,243
2015	21,606,967	2010	20,471,068	2005	23,602,042	2000	32,864,097
2014	18,583,677	2009	21,812,990	2004	23,015,891	1999	35,707,505
2013	15,258,710	2008	18,661,036	2003	28,366,984	1998	31,060,799
2012	19,486,067	2007	24,193,022	2002	32,951,597	1997	28,959,384

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 0.69 of an hour or 41 minutes. The percent of vessels delayed through the locks was 89 percent. Average delays in tow hours ran 1.73 during 2016 or 104 minutes.

10. Lock 19 – Mississippi River (Keokuk, Iowa)

Lock 19 is 364.2 miles above the confluence of the Mississippi and Ohio rivers. The lock, located on the Iowa shore, is 110 feet wide and 1,200 feet long, twice the size of the standard 9-Foot Channel Project lock. The upper lock gates consist of 23- foot high vertical lift gates, and the lower gates are miter gates, 53-feet 2-inches high. The lower lock gates are conventional miter gates, while the upper service gate is a submergible lift gate. Upstream from the upper service gate is a submergible vertical-lift guard gate which serves as an emergency gate in case of failure of the service gate. This gate also serves as a bridge in the roadway to the old dry dock, old lock, powerhouse and dam. The lock's land wall is 2,161 feet long, consisting of an upper 237-foot and lower 605-foot guide wall, and a 1,319- foot main lock wall. The river wall is 1,936 feet, which includes a 532-foot wall downstream of the lower gate pintles. Maximum lift is 38.2 feet with an average of 36.3 feet, the second highest on the Mississippi River. The highest lift of any lock on the River is at the Upper St. Anthony Falls in the St. Paul District. Filling the lock takes approximately 10 minutes; 9.25 minutes to empty.

It takes 12 hours for water to travel from Lock and Dam 18, in Gladstone, Ill., to Lock and Dam 19. Pool 19 is the longest of the nine-foot channel navigation system. An auxiliary lock, which was the original lock completed on June 12 1913, is 110 feet wide by 358 feet long. This lock is no longer in service. The dry dock, also no longer in use, measures 150 feet wide by 463 feet long. The dam, privately built in 1913, includes 119 rectangular sliding gates. The dam is privately owned and operated by Ameren Missouri. The US Army Corps of Engineers has no oversight or control of the dam's operation.

The lock opened on May 14, 1957. The complex was not built as part of the original 9-foot channel project. After the turn of the 19th century, the Mississippi River Power Company asked Congress for permission to build a dam across the River at Keokuk, Iowa. In 1905 Congress authorized the design and construction of the project. Construction began in 1910 and the completed lock was turned over to the federal government on June 12, 1913. The new lock was 110 feet wide by 400-feet long. The entire facility was constructed without government subsidy.

The new Lock 19 was completed at a cost of $13,500,000. The US Army Corps of Engineers and the Union Electric Company completed the entire complex at a federal cost of $37,909,000.

a) Lock Tonnage

In 2016 annual tonnage of 27.7 million increased by 30 percent over 2015 and reached the highest level since 2003, when 29.7 million tons passed through. At 19.2 million tons, agriculture related commodities are the largest freight category and represented 69 percent of total tonnage. Chemicals are the second largest commodity category through the Lock at 16 percent. During 2016, total loaded passing through the Lock were 17,514 with an additional 9,475 barges passing through empty.

Table 11: Lock 19 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	27,691,130	2011	20,521,750	2006	26,386,156	2001	30,109,392
2015	21,273,045	2010	21,353,305	2005	24,697,974	2000	34,097,581
2014	18,497,615	2009	23,060,379	2004	24,176,831	1999	35,803,139
2013	14,944,801	2008	19,275,225	2003	29,827,673	1998	31,335,013
2012	19,662,995	2007	25,504,854	2002	34,914,721	1997	29,652,859

Source: US Army Corps of Engineers

b) River Delays

Delays at Locks slow barge traffic. These delays occur for a number of reasons including lock maintenance, weather, low water, ice debris, unscheduled repair, etc. Processing time for each tow was 1.04 of an hour or 62 minutes. The percent of vessels delayed through the locks was 89 percent. Average delays in tow hours ran 0.91 during 2016 or 55 minutes.

11. Lock 20 – Mississippi River (Canton, Missouri)

Lock 20 is at Canton, MO 343 miles north of the confluence of the Ohio River and Mississippi River in Cairo, IL at river mile 343.2. The main lock is 600 feet in length and 110 feet in width. The maximum lift is 10.5 feet with an average lift is 5.3 feet. It takes approximately seven minutes to fill or empty the lock chamber. It takes six hours for water to travel from Lock and Dam 19, in Keokuk, Iowa, to Lock and Dam 20. The lock was put into operations in 1936. The lock and dam elements of the complex were completed at a federal cost of $3,363,500. Lock and Dam 20 was the first complex in the Rock Island District on the Upper Mississippi River to undergo major rehabilitation. Major rehabilitation work began in the late 1980s and was completed in 1991.

a) Lock Tonnage

A barge leaving Minneapolis would have traveled 511 river miles to reach Lock 20. Total tonnage through Lock 20 reached a 20 year low in 2013 or down 57.6 percent from 2002. Since 2013, tonnage has increased materially for three consecutive years and jumped 29.2 percent in 2016 from 2015. Agriculture related commodities represent the lion share of total tonnage. Farm Products reached nearly 20 million tons in 2016 accounting for 70 percent of all cargo.

Table 12: Lock 20 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	28,511,936	2011	20,828,408	2006	27,571,829	2001	31,089,774
2015	22,064,644	2010	21,861,365	2005	25,540,530	2000	35,015,410
2014	19,097,488	2009	23,910,675	2004	25,228,357	1999	36,512,515
2013	15,215,349	2008	20,080,492	2003	30,811,633	1998	32,021,440
2012	20,095,864	2007	26,423,478	2002	35,883,522	1997	30,452,345

Source: US Army Corps of Engineers

b) River Segment Pool Data

Downbound pooling on Lock 20 is not as significant compared to the two important locks directly to the east on the Illinois River that are more centrally located in the state. Pool tonnage has averaged a more modest 800 thousand tons over the past three years. In 2016, pool tonnage was 911 thousand tons and virtually unchanged compared to 2015.

c) River Delays

The average delay times at Lock 20 since 1993 has ranged from 5.17 hours in 1993 to low of 0.99 hours in 2005. Delays at Lock 20 have always exceeded one hour and have averaged 2.06 hours since 1993. In 2016 delays increased 60 percent year over year to 3.41 hours. Average processing time was 0.89 hours in 2016.

12. Lock 21 – Mississippi River (Quincy, Illinois)

Lock 21 is located at Quincy, IL, 325 miles north of the confluence of the Ohio River and Mississippi River in Cairo, IL at river mile 324.9. The main lock is 600 feet in length and 110 feet in width. The maximum lift is 10.5 feet with an average lift of 6.55 feet. It takes approximately seven minutes to fill or empty the lock chamber. It takes five hours for water to travel from Lock and Dam 20, in Canton, MO, to Lock and Dam 21. The lock was put into operation in 1938. The lock and dam elements of the complex were completed at a federal cost of $4,155,000.

a) Lock Tonnage

Over the last 20 years, annual tonnage has ranged from a low of 16.9 million tons in 2013 to a high of 37.9 million tons in 1999 as shown in Table 9. Total tonnage has increased three consecutive years and in 2016 reached its highest level since 2003. Total tonnage accelerated 26.9 percent in 2016 compared with 2015. Tonnage market share is dominated by grain products, which at 21.8 million tons represented nearly 71 percent of total volume.

Table 13: Lock 21 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	30,759,812	2011	22,220,636	2006	29,497,577	2001	32,874,457
2015	24,236,266	2010	23,431,362	2005	27,123,388	2000	36,449,116
2014	20,924,543	2009	25,623,076	2004	26,556,326	1999	37,863,139
2013	16,883,089	2008	21,939,658	2003	32,011,667	1998	33,734,539
2012	21,508,998	2007	28,546,672	2002	37,208,243	1997	31,980,194

Source: US Army Corps of Engineers

b) River Segment Pool Data

The river mile distance between Lock 21 and Lock 20 is 18 miles. This distance is comparable to the distance between Lock 20 and Lock 19, which is 21 miles; however, the pool level volumes, is much greater at Lock 20. Pool volumes have increased in each of last three years and totaled 1.76 million tons in 2016, representing a 10.8 percent increase over 2015.

c) River Delays

Delay time since 1993 has ranged from a low of 0.94 hours in 2009 to high of 3.15 hours in 1995. The average delay since 1993 is 1.62 hours on an annual basis. Delays increased 14.5 percent in 2016 from 2015 to 1.98 hours. Average processing time was 0.87 hours in 2016.

13. Lock 22 – Mississippi River (Saverton, Missouri)

Lock 22 is located at Saverton, MO, 301 miles north of the meeting of the Ohio River and Mississippi River in Cairo, IL at river mile 301.2. The main lock is 600 feet in length and 110 feet in width. The average lift is 7.5 feet. It takes approximately seven minutes to fill or empty the lock chamber. It takes seven hours for water to travel from Lock and Dam 21, in Quincy, IL, to Lock and Dam 22. The lock was put into operation in 1939.

a) Lock Tonnage

Lock tonnage has rebounded 85.1 percent since 2013 and in 2016 reached the highest-level dating back to 2003. Last year tonnage jumped 27.7 percent compared to 2015 as shown in Table 10. Agricultural related commodities constituted the major product group passing through Lock 22 at 70.4 percent of total tonnage in 2016.

Table 14: Lock 22 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	31,468,758	2011	22,475,759	2006	29,789,804	2001	33,315,392
2015	24,643,731	2010	23,643,750	2005	27,371,325	2000	36,812,642
2014	21,345,591	2009	26,043,486	2004	26,731,864	1999	38,074,304
2013	16,996,396	2008	22,264,425	2003	32,210,205	1998	34,086,190
2012	21,834,782	2007	28,908,447	2002	37,567,046	1997	32,418,424

Source: US Army Corps of Engineers

b) River Segment Pool Data

The pool level data is based on the 24-mile distance between Lock 22 and Lock 21. Pooling volumes are relatively immaterial on this stretch of the river and have averaged a meager 290 thousand tons over the past three years. In 2016, pool tonnage decreased 17.6 percent year over year to 266 thousand tons.

c) River Delays

Delay time since 1993 has ranged from a low of 1.28 hours in 2009 to a high of 6.60 hours in 1995. The average delay since 1993 is 2.98 hours on an annual basis. Delays increased 38.3 percent in 2016 from 2015 to 4.77 hours. Average processing time was 0.78 hours in 2016.

14. Lock 24 – Mississippi River (Clarksville, Missouri)

Lock 24 is located at Clarksville, MO, 273 miles north of the confluence of the Ohio River and Mississippi River in Cairo, IL at river mile 273.4. The lock is positioned 93.5 miles upstream of St. Louis and its 13,000-acre pool is 27.8 miles long. The main lock is 600 feet in length and 110 feet in width. The average lift is 15 feet. The lock was put into operation on May 12, 1940. A major rehab of Lock and Dam 24 was completed in 2005. This work consisted of replacing a large portion of the concrete in the lock chamber walls, walkways and work areas. Also, new gate and valve machinery was installed elevating the electrical components above the 1993 flood levels.

a) Lock Tonnage

Lock tonnage is up 84.0 percent since 2013 and in 2016 reached the highest-level dating back to 2003. In 2016 tonnage increased 26.7 percent compared to 2015 as shown in Table 11. Grain related commodities constituted the major product group passing through Lock 24 at 70.8 percent of total tonnage in 2016.

Table 15: Lock 24 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	31,827,450	2011	22,927,332	2006	31,026,288	2001	34,785,352
2015	25,111,442	2010	24,127,530	2005	28,932,976	2000	38,697,993
2014	21,785,226	2009	26,682,701	2004	27,883,604	1999	39,296,994
2013	17,295,846	2008	23,133,551	2003	33,761,938	1998	35,289,630
2012	22,426,843	2007	30,145,700	2002	38,862,614	1997	33,759,914

Source: US Army Corps of Engineers

b) River Segment Pool Data

The volume of downbound grain that entered the river in this pool has been more sporadic and ranged from 77 thousand tons to 578 thousand tons in recent years. The three-year average is approximately 300 thousand towns. In 2016 pooling volume increased 501 thousand tons over 2015.

c) River Delays

Delay time since 1993 has ranged from a low of 1.03 hours in 2011 to a high of 5.08 hours in 1995. The average delay since 1993 is 2.53 hours on an annual basis. Delays increased 1.11 hours to 2.99 hours in 2016. Average processing time was 0.96 hours in 2016.

15. Lock 25 – Mississippi River (Winfield, Missouri)

Lock 25 is located at Winfield, MO, 241 miles north of the convergence of the Ohio River and Mississippi River in Cairo, IL at river mile 241.4. The main lock is 600 feet in length and 110 feet in width. The average lift is 15 feet. It is the third southern-most dam in the system on the Upper Mississippi River. The pool length is 32 miles and accounts for

18,000 acres. The lock was put into operation on May 18, 1939. A $52 million major rehabilitation was completed at Lock and Dam 25 in 1999.

a) Lock Tonnage

Over the prior 20 years Lock 25 tonnage peaked in 1999 at 39.5 million tons and reached a low point at 17.3 million tons in 2013. Lock tonnage has increased materially since 2013 and was up 27.4 percent in 2016 to 31.8 million tons compared to 2015. Despite the substantial rebound in recent years, 2016 tonnage was still 19.7 percent below 1999 levels. Grain related products made up 70.9 percent of total tonnage in 2016.

Table 16: Lock 25 Annual Tonnage

Year	Tons	Year	Tons	Year	Tons	Year	Tons
2016	31,756,635	2011	23,033,059	2006	31,061,559	2001	34,855,844
2015	24,920,093	2010	24,117,099	2005	29,043,655	2000	39,161,898
2014	21,673,519	2009	26,926,504	2004	27,870,702	1999	39,536,830
2013	17,315,949	2008	23,244,934	2003	33,749,527	1998	35,440,234
2012	22,163,268	2007	30,204,744	2002	38,916,145	1997	33,714,880

Source: US Army Corps of Engineers

b) River Segment Pool Data

The downbound pool volume was negative in two of last three years and only 51 thousand tons positive in 2015. This indicates more corn is going off river than is coming onto the river in this segment. This is apparent as only a few barges are coming onto the river in this segment and continuing to travel south through lock 25.

c) River Delays

Delay time since 1993 has ranged from a low of 1.27 hours in 2005 to a high of 5.98 hours in 2012. The average delay since 1993 is 3.12 hours on an annual basis. Delays increased 1.27 hours to 4.79 hours in 2016. Average processing time was 1.06 hours in 2016.

II. STANDARD TOW CONFIGURATIONS AND SPEEDS

This section describes the assumptions and process used to estimate the impact of lock delays as measured by the Army Corps of Engineers. The magnitude of a delay varies by type of delay experienced. Delays experienced on the river system consist of a standard lock delay, scheduled lock repairs and unscheduled lock repairs. A standard lock delay is the mechanical effort of breaking a tow configuration into parts to enter the lock and then reassembling the tow configuration on the other side of the lock. The typical 15-barge tow operating on the upper Mississippi River is 1,200 feet in length. However, only three locks on the upper Mississippi River are 1,200 feet in length, the remaining locks are 400 or 600 feet in length. At those locks that are less than 1,200 feet, each 15-barge tow must be cut into two units and be locked through in two segments. The time required to accomplish this task varies by lock. During times of peak use, which is usually during crop harvest, the delays from outdated locks are magnified. A lock that is enlarged to eliminate two segment lockings improves locking times and leads to switch boat time savings.

Any mechanical structure will require maintenance to remain operational, and this is particularly true for locks and dams. The Corps will schedule lock closings during non-peak use to minimize impact on peak periods. Scheduled closures allow barge operators and shippers to reroute traffic or adjust traffic flows. This reduces delay times during periods of schedule maintenance. It stands to reason that a barge operator will not send a barge toward a lock when it knows the lock will be temporarily unavailable. The true cost of scheduled lock repairs is grossly underreported because the delays take place in other locations, before and after the lock closure, and at the terminal with the shipper.

It can also be expected that any mechanical structure will unexpectedly fail for many reasons. For locks and dams that are quite old, this is of concern. Unscheduled lock repairs are the most devastating because it is impossible to plan ahead. Thus, freight is stranded on the river and the receivers must rework their supply chain. Unexpected delays during harvest will result in the river being closed, which results in lower demand and lower cash grain bids. The lock delay costs only capture the cost to the barge operator waiting at the lock and not the cost to the entire system.

For this project, Informa Economics IEG used average towboat delays in terms of hours for each locking at each lock. The Corps provided the information on two types of delays, one that is a lock time delay (the time to lock through) and the time waiting to lock.

Based on discussions with barge operators, a standard tow configuration upriver from Lock 27 consists of a 4,200-horse power (HP) to 6,200HP towboat with 15 barges. The average speed, including regular locking times, is estimated to be 4.5 miles per hour (MPH). Informa Economics IEG assumed for the upper Mississippi River a tow configuration for a 5,000HP towboat with 15 barges traveling at an average speed of 4.5 MPH. The capacity of the dry barge is assumed to be 1,500 tons.

A standard tow configuration on the Ohio River consists of a 2,800HP to 6,800HP towboat with 15 barges. The average speed, including regular locking times, is estimated to be 4.5 MPH. Informa Economics IEG assumed in the analysis for the Ohio River a tow configuration of a 5,000HP towboat with 15 barges traveling at an average speed of 4.5 MPH.

A standard tow configuration from St. Louis, MO to Cairo, IL consists of a 6,000HP to 7,000HP towboat with 25 barges. The average speed is estimated to be 4.5 MPH (there are no locks downriver from St. Louis).

A standard tow configuration from Cairo to New Orleans consists of an 8,400HP towboat with 30 barges. The average speed, including regular locking times, is estimated to be 8 MPH. Informa Economics IEG assumed in the analysis a tow configuration of an 8,400HP towboat with 30 barges traveling at an average speed of 8 MPH.

A 5,000HP towboat with 15 barges is the tow configuration that is assumed to pass through the impacted locks and dams. The hourly cost for the tow configuration to idle is $12,550 per day or $523 per hour as shown in Table 17.

Table 17: Vessel Operating Cost for Idling 5,000HP Towboat with 15 Dry Barges

	Daily Cost	Tow Configuration	Total Daily Cost	Total Hour Cost
Towboat (5,000 HP)	$8,950	1.0	$8,950	$373
Open (200' x 35' x 13/14')	$190	7.5	$1,425	$59
Covered (200' x 35' x 13/14')	$290	7.5	$2,175	$91
Typical Tow Configuration			**$12,550**	**$523**

Source: Army Corps of Engineers and IEG

Based on Army Corps river segment data, 85 percent of the barges volume moves downstream, which requires over 80 percent of backhauls to be empty. This is a significant cost to the barge operator that will eventually be borne by the shipper.

III. SCENARIOS

A. Methodology

The cost impact to shippers is presented in this section. To prepare the results for this section, Informa Economics IEG used the volume provided by the Rock Island District of the Army Corps for the locks from the top of Iowa to the Mouth of the Missouri River, which was presented in the previous sections. Informa Economics IEG used information from several sources including towboat delay information from the Corps, vessel operating cost information from IEG's surveys of barge operators, and discussions with barge operators on typical tow configurations. The locks in question range from Upper and Lower St. Anthony Falls Lock to Lock 25. Lock 1 was closed to prevent the Asian carp from migrating north.

The ongoing and new construction projects that meet the new criteria and are included under all the funding scenarios are shown in priority order for FY 2016 through FY 2021.

1. Olmsted Locks and Dam (Ohio River)
2. Locks and Dams 2, 3, and 4, Monongahela River Navigation Project (Monongahela River)
3. Kentucky Lock Addition (Tennessee River)
4. Chickamauga Lock (Tennessee River)
5. Gulf Intracoastal Waterway (GIWW), High Island to Brazos River (GIWW)

Potential new construction projects for consideration for FY 2022 through FY 2036, listed in alphabetical order, include:

1. Dashields Locks and Dam, PA (Upper Ohio Navigation Locks & Dams Improvements)
2. Emsworth Locks and Dam, PA (Upper Ohio Navigation Locks & Dams Improvements)
3. GIWW, Brazos River to Port O'Connor, Matagorda Bay (GIWW)
4. Inner Harbor Navigation Canal Locks, LA
5. LaGrange Lock & Dam, Upper Mississippi River
6. Illinois Waterway System Navigation and Ecosystem Sustainability Program (NESP) (Illinois Waterway)
7. Lock & Dam 22, NESP (Mississippi River)
8. Lock & Dam 24, NESP (Mississippi River)
9. Lock & Dam 25, NESP (Mississippi River)
10. Montgomery Locks and Dam, PA (Upper Ohio Navigation Locks & Dams Improvements)

The major rehabilitation projects that meet all the criteria and included in all funding scenarios are shown in priority order for FY 2016 through FY 2021.

1. LaGrange Lock & Dam (Illinois Waterway)

2. Thomas O'Brien Lock & Dam (Illinois Waterway)

Potential major rehabilitation projects for consideration for FY 2022 through FY 2036 listed in alphabetical order include:

1. Brandon Road Lock & Dam (Illinois Waterway)
2. Dardanelle Lock & Dam (McClellan Kerr Arkansas River Navigation System
3. Dresden Island Lock & Dam (Illinois Waterway)
4. Greenup Locks & Dam (Ohio River)
5. Lock & Dam 18 (Mississippi River)
6. Starved Rock Lock & Dam (Illinois Waterway)

Of these eight projects, two have a Major Rehabilitation Evaluation Report (LaGrange and O'Brien), and the remaining six projects require a Major Rehabilitation Evaluation Report.

Table 18: Maximized Inland Waterways Trust Fund Scenario (million dollars)

Maximized IWTF Scenario ($M)
(All projects cannot be started or completed within the 20 year Program)

Division	District	Project Name (possible future)	Waterway	Lock / Dam / Channel	Authorized	Current Cost Estimate	Total Remaining Base Cost	Total Remaining Cost with escalation (assumes projects are efficiently funded through completion)	FY16 (Actual based on FY16 Work Plan)	FY17	FY18	FY19	FY20	FY21	FY22 - FY36 (Funding shown does not represent the total cost to complete all projects)
NEW CONSTRUCTION															
LRD	LRL	Olmsted Locks & Dam +*	Ohio	D	X	$3,096.0	$993.0	$1,026.9	$268	$225	$182	$133	$108	$83	$2,440
LRD	LRP	Locks & Dams 2, 3, and 4, Monongahela River Navigation Project +*	Monongahela	L/D	X	$1,661.0	$499.0	$527.4	$59	$67	$104	$121	$96	$36	
LRD	LRN	Kentucky Lock Addition +*	Tennessee	L	X	$828.6	$449.0	$488.7	$45		$54	$54	$75	$105	
LRD	LRN	Chickamauga Lock, TN +*	Tennessee	L	X	$828.9	$659.0	$789.1	$30						
SWD	SWG	GIWW, High Island to Brazos River	GIWW	C	X	$17.0	$0.0	$17.7		$18					
LRD	LRP	Dashields, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$800.7	$800.7	TBD	PED FUNDING FROM GI ACCOUNT $42M						
LRD	LRP	Emsworth, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$737.1	$737.1								
SWD	SWG	GIWW, Brazos River to Port O'Connor, Matagorda Bay	GIWW	C	X	$19.5	$19.5								
MVD	MVN	Inner Harbor Navigation Canal Lock, LA +	GIWW	L	X	TBD	TBD								
MVD	MVR	LaGrange Lock & Dam, NESP	Illinois	L	X	$357.7	$357.7								
MVD	MVR	Mississippi Lock & Dam 22, NESP	Mississippi	L	X	$372.9	$372.9								
MVD	MVS	Mississippi Lock & Dam 24, NESP	Mississippi	L	X	$434.0	$434.0								
MVD	MVS	Mississippi Lock & Dam 25, NESP	Mississippi	L	X	$543.1	$543.1								
LRD	LRP	Montgomery, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$782.3	$782.3								
MAJOR REHABILITATION															
MVD	MVR	LaGrange Lock & Dam Rehabilitation	Illinois	L	X	$72.60	$72.60	$75.7		$5	$58	$13			$511
MVD	MVR	Thomas O'Brien Lock & Dam Rehabilitation	Illinois	L	X	$46.5	$46.5	$51.2					$5	$46	
MVD	MVR	Brandon Road Lock & Dam Rehabilitation	Illinois	D		$68.50	$68.50	TBD							
SWD	SWL	Dardanelle Lock & Dam	MKARNS	D		TBD	TBD								
MVD	MVR	Dresden Island Lock & Dam Rehabilitation	Illinois	L		$50.0	$50.0								
LRD	LRH	Greenup Locks & Dam Rehabilitation	Ohio	L		$54.5	$54.5								
MVD	MVR	Mississippi Lock & Dam 18 Rehabilitation	Mississippi	D		$200.0	$200.0								
MVD	MVR	Starved Rock Lock & Dam Rehabilitation	Illinois	L		$30.0	$30.0								
Total Program/year FY16 through FY21. Average Total Program FY22 - FY36									$402	$315	$398	$320	$279	$270	$197

Notes:	#	Note	#	Note
	1	Remaining cost is based on the current cost estimate beginning in FY16.	7	Funding shown in FY22 - FY36 does not represent the total cost to complete all projects
	2	Assumes General Treasury funding is available to match IWTF funds	8	All projects cannot be started or completed within the 20 year Program
	3	Reports for Major Rehab projects other than LaGrange and O'Brien have not been completed. Costs for those without reports are ROM and require review and update by Districts	9	FY16 is actual funding provided including the work plan
	4	IWTF receipts are based on Department of Treasury estimates	10	FY17 President's Budget includes $225M for Olmsted. All other funding is efficient funding based on current cost estimates.
	5	Project with potential to receive funds within the next 5 years (FY17 - FY21) are shown in priotity order. Potential projects beyond 2021 are in alphabetical order.	+	Construction began before 2016
	6	The total remaining cost with escalation assumes that projects are efficiently funded to completion	*	Funding to complete project would be required beyond the 5 years shown
	Green cells include balancing of prior year PED costs funded within the GI account with construction funding			

Source: Army Corps of Engineers "Twenty Year Investment Strategy"

The following tables are the "nuts and bolts" of how the numbers were calculated. The starting point for this effort is an average tow delay of the past ten years. From that base level, tow delays were increased 2 percent annually from 2017 until 2025. Lock delays vary annually, but are trending higher as equipment ages. To account for older equipment, every sequential five years the lock delay was increased one percent. The forecast makes the implicit assumption the Army Corps will not run out of money and not be forced to not repair a lock. Lock 10 is the top of Iowa and Lock 25 is before the Mouth of the Missouri River.

Table 19: Assumed Average Tow Delay by Focus Lock (Hours)

Lock	2017	2027	2037	2047	2060
Average Tow Delay (Hours per Year)					
Lock 1	-	-	-	-	-
Lock 2	1.16	1.44	2.11	3.75	10.38
Lock 3	1.50	1.86	2.73	4.85	13.42
Lock 4	1.02	1.27	1.86	3.30	9.13
Lock 5	1.18	1.47	2.15	3.81	10.56
Lock 5 A	1.14	1.42	2.08	3.68	10.20
Lock 6	1.02	1.27	1.86	3.30	9.13
Lock 7	1.04	1.29	1.89	3.36	9.31
Lock 8	1.85	2.30	3.37	5.98	16.56
Lock 9	1.16	1.44	2.11	3.75	10.38
Lock 10	0.97	1.21	1.77	3.13	8.68
Lock 11	1.08	1.34	1.97	3.49	9.67
Lock 12	1.28	1.59	2.33	4.14	11.46
Lock 13	1.31	1.63	2.39	4.23	11.72
Lock 14	2.74	3.41	4.99	8.85	24.52
Lock 15	2.55	3.17	4.65	8.24	22.82
Lock 16	2.27	2.82	4.14	7.34	20.32
Lock 17	2.32	2.88	4.23	7.50	20.76
Lock 18	1.73	2.15	3.15	5.59	15.48
Lock 19	0.91	1.13	1.66	2.94	8.14
Lock 20	3.41	4.24	6.21	11.02	30.52
Lock 21	1.98	2.46	3.61	6.40	17.72
Lock 22	4.77	5.93	8.69	15.41	42.69
Lock 24	2.99	3.72	5.45	9.66	26.76
Lock 25	4.79	5.95	8.73	15.48	42.87
Total (Iowa to Mid Mississippi River)	**35.10**	**43.63**	**63.95**	**113.42**	**314.13**
Total (Minnesota to Mid Mississippi River)	**46.17**	**57.39**	**84.12**	**149.20**	**413.20**

Source: Army Corps of Engineers and IEG

The average number of tows locking downstream through a lock is derived from the total commodity volume reported at each lock. The number of tows is increased or decreased by projected volume on the upper Mississippi River. A large percentage of the upbound barges are empty but still have to go through the locks.

Table 20: Annual Number of Tows by Focus Lock (Downbound)

Lock	2017	2027	2037	2047	2060
Number of Barge Tows (Annual) (Downbound)					
Lock 1	-	-	-	-	-
Lock 2	385	612	777	934	1,235
Lock 3	382	608	772	927	1,226
Lock 4	422	672	853	1,025	1,355
Lock 5	423	672	854	1,025	1,356
Lock 5 A	422	672	853	1,025	1,355
Lock 6	509	810	1,029	1,236	1,634
Lock 7	509	809	1,028	1,234	1,632
Lock 8	549	873	1,109	1,332	1,762
Lock 9	603	960	1,219	1,464	1,936
Lock 10	713	1,135	1,441	1,731	2,289
Lock 11	713	1,134	1,440	1,730	2,288
Lock 12	787	1,252	1,590	1,910	2,526
Lock 13	798	1,270	1,613	1,938	2,562
Lock 14	885	1,407	1,787	2,147	2,839
Lock 15	898	1,428	1,814	2,179	2,881
Lock 16	937	1,491	1,894	2,275	3,009
Lock 17	972	1,547	1,964	2,360	3,120
Lock 18	1,026	1,632	2,072	2,489	3,292
Lock 19	1,044	1,662	2,110	2,535	3,352
Lock 20	1,075	1,711	2,173	2,610	3,451
Lock 21	1,160	1,846	2,344	2,816	3,723
Lock 22	1,187	1,888	2,398	2,881	3,809
Lock 24	1,200	1,910	2,425	2,914	3,853
Lock 25	1,198	1,906	2,420	2,907	3,844
Total (Iowa to Mid Mississippi River)	**14,594**	**23,218**	**29,486**	**35,421**	**46,838**
Total (Minnesota to Mid Mississippi River)	**18,798**	**29,906**	**37,979**	**45,624**	**60,329**

Source: Army Corps of Engineers and IEG

Total annual delay hours were computed by multiplying the number of tows (downbound and upbound) by the average tow delay.

Table 21: Annual Tow Delay Hours by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Delay Hours (Annual)					
Lock 1	-	-	-	-	-
Lock 2	892	1,765	3,285	6,999	25,632
Lock 3	1,146	2,266	4,219	8,988	32,917
Lock 4	861	1,704	3,171	6,756	24,742
Lock 5	997	1,972	3,670	7,821	28,640
Lock 5 A	963	1,904	3,544	7,550	27,651
Lock 6	1,039	2,055	3,824	8,148	29,840
Lock 7	1,058	2,092	3,894	8,297	30,383
Lock 8	2,031	4,017	7,477	15,931	58,340
Lock 9	1,400	2,768	5,152	10,977	40,201
Lock 10	1,384	2,736	5,093	10,852	39,741
Lock 11	1,540	3,045	5,669	12,078	44,233
Lock 12	2,015	3,984	7,416	15,801	57,864
Lock 13	2,092	4,136	7,699	16,405	60,076
Lock 14	4,847	9,586	17,844	38,019	139,230
Lock 15	4,579	9,055	16,855	35,911	131,512
Lock 16	4,256	8,417	15,667	33,381	122,244
Lock 17	4,511	8,921	16,605	35,380	129,567
Lock 18	3,549	7,018	13,062	27,832	101,923
Lock 19	1,901	3,759	6,997	14,908	54,597
Lock 20	7,334	14,504	26,997	57,522	210,651
Lock 21	4,594	9,085	16,912	36,033	131,957
Lock 22	11,323	22,392	41,680	88,807	325,223
Lock 24	7,178	14,196	26,425	56,302	206,185
Lock 25	11,474	22,692	42,238	89,995	329,574
Total (Iowa to Mid Mississippi River)	**72,576**	**143,525**	**267,158**	**569,226**	**2,084,577**
Total (Minnesota to Mid Mississippi River)	**82,964**	**164,067**	**305,394**	**650,694**	**2,382,923**

Source: Army Corps of Engineers and IEG

Ultimately, the increase in the barge operators cost will be borne by the shipper. The annual delay barge cost is the annual delay hours multiplied by the total cost of a barge idling. The barge operator is responsible for the crew and equipment expenses.

Table 22: Annual Delay Barge Cost by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Tow Configuration Delay Costs (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 466,658	$ 922,852	$ 1,717,799	$ 3,660,058	$ 13,403,603
Lock 3	$ 599,272	$ 1,185,107	$ 2,205,961	$ 4,700,171	$ 17,212,628
Lock 4	$ 450,454	$ 890,806	$ 1,658,150	$ 3,532,966	$ 12,938,174
Lock 5	$ 521,414	$ 1,031,136	$ 1,919,360	$ 4,089,518	$ 14,976,341
Lock 5 A	$ 503,400	$ 995,512	$ 1,853,049	$ 3,948,231	$ 14,458,929
Lock 6	$ 543,262	$ 1,074,341	$ 1,999,781	$ 4,260,870	$ 15,603,852
Lock 7	$ 553,153	$ 1,093,902	$ 2,036,191	$ 4,338,447	$ 15,887,950
Lock 8	$ 1,062,127	$ 2,100,438	$ 3,909,761	$ 8,330,400	$ 30,506,996
Lock 9	$ 731,887	$ 1,447,363	$ 2,694,126	$ 5,740,287	$ 21,021,666
Lock 10	$ 723,521	$ 1,430,817	$ 2,663,328	$ 5,674,666	$ 20,781,356
Lock 11	$ 805,296	$ 1,592,535	$ 2,964,348	$ 6,316,041	$ 23,130,152
Lock 12	$ 1,053,466	$ 2,083,309	$ 3,877,877	$ 8,262,468	$ 30,258,218
Lock 13	$ 1,093,724	$ 2,162,923	$ 4,026,070	$ 8,578,218	$ 31,414,534
Lock 14	$ 2,534,794	$ 5,012,749	$ 9,330,744	$ 19,880,716	$ 72,805,733
Lock 15	$ 2,394,286	$ 4,734,884	$ 8,813,525	$ 18,778,693	$ 68,769,985
Lock 16	$ 2,225,550	$ 4,401,195	$ 8,192,396	$ 17,455,273	$ 63,923,452
Lock 17	$ 2,358,878	$ 4,664,861	$ 8,683,186	$ 18,500,983	$ 67,752,975
Lock 18	$ 1,855,590	$ 3,669,571	$ 6,830,550	$ 14,553,632	$ 53,297,269
Lock 19	$ 993,973	$ 1,965,658	$ 3,658,882	$ 7,795,861	$ 28,549,445
Lock 20	$ 3,835,075	$ 7,584,152	$ 14,117,162	$ 30,078,981	$ 110,153,089
Lock 21	$ 2,402,379	$ 4,750,888	$ 8,843,317	$ 18,842,169	$ 69,002,442
Lock 22	$ 5,920,941	$ 11,709,112	$ 21,795,372	$ 46,438,695	$ 170,064,465
Lock 24	$ 3,753,754	$ 7,423,334	$ 13,817,814	$ 29,441,170	$ 107,817,344
Lock 25	$ 6,000,158	$ 11,865,771	$ 22,086,978	$ 47,060,010	$ 172,339,800
Total (Iowa to Mid Mississippi River)	**$ 37,951,386**	**$ 75,051,759**	**$ 139,701,549**	**$ 297,657,574**	**$ 1,090,060,260**
Total (Minnesota to Mid Mississippi River)	**$ 43,383,013**	**$ 85,793,216**	**$ 159,695,726**	**$ 340,258,522**	**$ 1,246,070,399**

Source: Army Corps of Engineers and IEG

Adding a 1,200-foot lock has redundancy benefits associated with two lock chambers at one site. The likelihood of a system shutdown attributable to both locks being closed at once is very small when compared with the scheduled maintenance closures and risks of unscheduled closures related to a single lock. The redundancy gives a much higher degree of reliability to this reach of the UMR.

The annual switch boat hours are the average switch boat time per tow multiplied by the total number of tows. On average, carrier and lock masters stated splitting a tow increased the throughput time by 20 to 25 minutes. Also reduces the approach time and exit time. Splitting a tow also increases the odds of an accident that will harm a crew member and/or damage the lock. Those cost are not included in the analysis.

In “Iowa DOT UMP Inland Waterways” report, on a three lock pilot, the average time to transit the locks were reduced between 50 percent and 55 percent. The Annual Switch Boat and Locking Time Savings is the reduced Average Processing Time by lock by 50 percent. It is assumed the Averaging Processing Time will increase by two percent for the first ten years and increase one percent every five years going forward.

Table 23: Annual Switch Boat and Lockings Hours by Focus Lock (Hours)

Lock	2017	2027	2037	2047	2060
Total Switchboat and Lockings Cost Savings (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 76,435	$ 151,157	$ 281,364	$ 599,492	$ 2,195,418
Lock 3	$ 51,937	$ 102,709	$ 191,183	$ 407,348	$ 1,491,761
Lock 4	$ 86,116	$ 170,301	$ 316,999	$ 675,420	$ 2,473,474
Lock 5	$ 79,538	$ 157,292	$ 292,784	$ 623,825	$ 2,284,527
Lock 5 A	$ 92,732	$ 183,384	$ 341,351	$ 727,306	$ 2,663,487
Lock 6	$ 114,511	$ 226,454	$ 421,523	$ 898,124	$ 3,289,047
Lock 7	$ 114,354	$ 226,143	$ 420,943	$ 896,890	$ 3,284,528
Lock 8	$ 172,237	$ 340,612	$ 634,015	$ 1,350,876	$ 4,947,080
Lock 9	$ 154,580	$ 305,693	$ 569,018	$ 1,212,388	$ 4,439,921
Lock 10	$ 179,015	$ 354,017	$ 658,968	$ 1,404,041	$ 5,141,779
Lock 11	$ 178,955	$ 353,897	$ 658,744	$ 1,403,565	$ 5,140,034
Lock 12	$ 259,251	$ 512,689	$ 954,321	$ 2,033,342	$ 7,446,358
Lock 13	$ 267,169	$ 528,348	$ 983,468	$ 2,095,442	$ 7,673,779
Lock 14	$ 300,660	$ 594,578	$ 1,106,749	$ 2,358,114	$ 8,635,717
Lock 15	$ 323,933	$ 640,602	$ 1,192,418	$ 2,540,647	$ 9,304,174
Lock 16	$ 294,126	$ 581,656	$ 1,082,695	$ 2,306,864	$ 8,448,033
Lock 17	$ 421,954	$ 834,447	$ 1,553,242	$ 3,309,443	$ 12,119,605
Lock 18	$ 370,045	$ 731,793	$ 1,362,162	$ 2,902,314	$ 10,628,646
Lock 19	$ 567,985	$ 1,123,233	$ 2,090,790	$ 4,454,778	$ 16,313,968
Lock 20	$ 500,472	$ 989,721	$ 1,842,269	$ 3,925,263	$ 14,374,817
Lock 21	$ 527,795	$ 1,043,756	$ 1,942,850	$ 4,139,567	$ 15,159,627
Lock 22	$ 484,102	$ 957,349	$ 1,782,012	$ 3,796,874	$ 13,904,642
Lock 24	$ 602,609	$ 1,191,706	$ 2,218,244	$ 4,726,342	$ 17,308,470
Lock 25	$ 663,901	$ 1,312,914	$ 2,443,862	$ 5,207,057	$ 19,068,913
Total (Iowa to Mid Mississippi River)	**$ 5,941,973**	**$ 11,750,704**	**$ 21,872,793**	**$ 46,603,653**	**$ 170,668,564**
Total (Minnesota to Mid Mississippi River)	**$ 6,884,412**	**$ 13,614,449**	**$ 25,341,973**	**$ 53,995,323**	**$ 197,737,807**

Source: Army Corps of Engineers and IEG

The annual switch boat cost savings is the annual switch boat hours multiplied by the total cost of an idling tow.

Table 24: Annual Switch Boat Barge Cost Savings by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Switchboat Cost Savings (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 80,458	$ 128,005	$ 162,559	$ 195,282	$ 258,222
Lock 3	$ 79,903	$ 127,122	$ 161,437	$ 193,934	$ 256,440
Lock 4	$ 88,324	$ 140,520	$ 178,452	$ 214,374	$ 283,467
Lock 5	$ 88,375	$ 140,601	$ 178,555	$ 214,498	$ 283,631
Lock 5 A	$ 88,316	$ 140,506	$ 178,435	$ 214,353	$ 283,440
Lock 6	$ 106,522	$ 169,471	$ 215,218	$ 258,542	$ 341,870
Lock 7	$ 106,376	$ 169,238	$ 214,923	$ 258,186	$ 341,401
Lock 8	$ 114,825	$ 182,681	$ 231,993	$ 278,693	$ 368,517
Lock 9	$ 126,187	$ 200,758	$ 254,951	$ 306,273	$ 404,985
Lock 10	$ 149,180	$ 237,338	$ 301,405	$ 362,077	$ 478,776
Lock 11	$ 149,129	$ 237,257	$ 301,302	$ 361,954	$ 478,613
Lock 12	$ 164,604	$ 261,877	$ 332,569	$ 399,514	$ 528,279
Lock 13	$ 166,981	$ 265,659	$ 337,371	$ 405,283	$ 535,907
Lock 14	$ 185,021	$ 294,361	$ 373,820	$ 449,070	$ 593,806
Lock 15	$ 187,787	$ 298,761	$ 379,408	$ 455,782	$ 602,682
Lock 16	$ 196,084	$ 311,960	$ 396,171	$ 475,919	$ 629,309
Lock 17	$ 203,352	$ 323,523	$ 410,855	$ 493,559	$ 652,635
Lock 18	$ 214,519	$ 341,290	$ 433,418	$ 520,664	$ 688,476
Lock 19	$ 218,456	$ 347,553	$ 441,371	$ 530,219	$ 701,110
Lock 20	$ 258,671	$ 411,533	$ 522,622	$ 627,826	$ 830,176
Lock 21	$ 242,665	$ 386,068	$ 490,283	$ 588,977	$ 778,806
Lock 22	$ 310,322	$ 493,708	$ 626,979	$ 753,189	$ 995,944
Lock 24	$ 276,196	$ 439,415	$ 558,031	$ 670,361	$ 886,421
Lock 25	$ 300,634	$ 478,295	$ 607,406	$ 729,676	$ 964,853
Total (Iowa to Mid Mississippi River)	**$ 3,223,599**	**$ 5,128,596**	**$ 6,513,011**	**$ 7,824,071**	**$ 10,345,792**
Total (Minnesota to Mid Mississippi River)	**$ 4,102,885**	**$ 6,527,499**	**$ 8,289,535**	**$ 9,958,206**	**$ 13,167,765**

Source: Army Corps of Engineers and IEG

The following tables are the combination of the delays and switch boat savings that would occur if the locks were completely repaired and expanded to 1,200 feet.

Table 25: Locking Time Delay and Switch Boat Savings per Tow by Focus Lock (Hours)

Lock	2017	2027	2037	2047	2060
Time Per Tow Annual (Delay and Switchboat & Lockings Savings)					
Lock 1	-	-	-	-	-
Lock 2	2.70	3.36	4.92	8.72	24.16
Lock 3	3.26	4.05	5.94	10.53	29.18
Lock 4	2.43	3.02	4.43	7.85	21.75
Lock 5	2.72	3.38	4.96	8.79	24.34
Lock 5 A	2.70	3.36	4.92	8.72	24.16
Lock 6	2.47	3.07	4.50	7.98	22.11
Lock 7	2.51	3.12	4.57	8.11	22.46
Lock 8	4.30	5.34	7.83	13.90	38.48
Lock 9	2.81	3.49	5.12	9.08	25.15
Lock 10	2.42	3.01	4.41	7.82	21.66
Lock 11	2.64	3.28	4.81	8.53	23.63
Lock 12	3.19	3.97	5.81	10.31	28.55
Lock 13	3.26	4.05	5.94	10.53	29.18
Lock 14	6.13	7.62	11.17	19.81	54.86
Lock 15	5.79	7.20	10.55	18.71	51.82
Lock 16	5.14	6.39	9.36	16.61	46.00
Lock 17	5.47	6.80	9.97	17.68	48.95
Lock 18	4.15	5.16	7.56	13.41	37.14
Lock 19	2.86	3.56	5.21	9.24	25.60
Lock 20	7.71	9.58	14.05	24.91	69.00
Lock 21	4.83	6.00	8.80	15.61	43.23
Lock 22	10.32	12.83	18.80	33.35	92.36
Lock 24	6.94	8.63	12.64	22.43	62.11
Lock 25	10.64	13.23	19.39	34.38	95.22
Total (Iowa to Mid Mississippi River)	**81.49**	**101.29**	**148.47**	**263.33**	**729.30**
Total (Minnesota to Mid Mississippi River)	**107.39**	**133.49**	**195.66**	**347.03**	**961.09**

Source: Army Corps of Engineers and IEG

Table 26: Combined Annual Time Delay and Switch Boat Savings by Focus Lock (Hours)

Lock	2017	2027	2037	2047	2060
Total Time Annual (Delay and Switchboat & Lockings Savings)					
Lock 1	-	-	-	-	-
Lock 2	1,039	2,054	3,823	8,146	29,831
Lock 3	1,245	2,463	4,584	9,767	35,769
Lock 4	1,026	2,029	3,777	8,048	29,472
Lock 5	1,149	2,273	4,230	9,014	33,009
Lock 5 A	1,140	2,254	4,196	8,941	32,744
Lock 6	1,258	2,488	4,630	9,866	36,130
Lock 7	1,277	2,524	4,699	10,012	36,665
Lock 8	2,361	4,668	8,689	18,514	67,801
Lock 9	1,695	3,352	6,240	13,296	48,691
Lock 10	1,726	3,413	6,353	13,537	49,574
Lock 11	1,882	3,722	6,929	14,763	54,063
Lock 12	2,510	4,964	9,241	19,689	72,104
Lock 13	2,603	5,147	9,580	20,412	74,751
Lock 14	5,422	10,723	19,960	42,528	155,745
Lock 15	5,198	10,280	19,135	40,770	149,305
Lock 16	4,819	9,529	17,737	37,792	138,400
Lock 17	5,318	10,517	19,576	41,709	152,744
Lock 18	4,256	8,417	15,667	33,382	122,249
Lock 19	2,987	5,907	10,995	23,428	85,795
Lock 20	8,291	16,396	30,520	65,028	238,141
Lock 21	5,604	11,081	20,627	43,949	160,947
Lock 22	12,249	24,223	45,088	96,068	351,813
Lock 24	8,331	16,475	30,667	65,340	239,284
Lock 25	12,744	25,202	46,912	99,953	366,041
Total (Iowa to Mid Mississippi River)	**83,939**	**165,997**	**308,987**	**658,348**	**2,410,956**
Total (Minnesota to Mid Mississippi River)	**96,129**	**190,102**	**353,857**	**753,952**	**2,761,067**

Source: Army Corps of Engineers and IEG

Table 27: Combined Barge Cost and Savings by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Cost Savings (Delay and Switchboat Savings) (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 543,093	$ 1,074,008	$ 1,999,162	$ 4,259,550	$ 15,599,021
Lock 3	$ 651,209	$ 1,287,816	$ 2,397,145	$ 5,107,519	$ 18,704,389
Lock 4	$ 536,570	$ 1,061,108	$ 1,975,149	$ 4,208,386	$ 15,411,649
Lock 5	$ 600,952	$ 1,188,428	$ 2,212,144	$ 4,713,343	$ 17,260,868
Lock 5 A	$ 596,132	$ 1,178,896	$ 2,194,400	$ 4,675,537	$ 17,122,416
Lock 6	$ 657,773	$ 1,300,795	$ 2,421,304	$ 5,158,994	$ 18,892,899
Lock 7	$ 667,506	$ 1,320,045	$ 2,457,135	$ 5,235,338	$ 19,172,478
Lock 8	$ 1,234,364	$ 2,441,049	$ 4,543,776	$ 9,681,276	$ 35,454,076
Lock 9	$ 886,467	$ 1,753,056	$ 3,263,144	$ 6,952,675	$ 25,461,587
Lock 10	$ 902,536	$ 1,784,834	$ 3,322,295	$ 7,078,707	$ 25,923,134
Lock 11	$ 984,251	$ 1,946,431	$ 3,623,092	$ 7,719,605	$ 28,270,186
Lock 12	$ 1,312,717	$ 2,595,998	$ 4,832,199	$ 10,295,810	$ 37,704,577
Lock 13	$ 1,360,893	$ 2,691,270	$ 5,009,538	$ 10,673,660	$ 39,088,314
Lock 14	$ 2,835,454	$ 5,607,327	$ 10,437,493	$ 22,238,830	$ 81,441,450
Lock 15	$ 2,718,219	$ 5,375,485	$ 10,005,943	$ 21,319,340	$ 78,074,159
Lock 16	$ 2,519,676	$ 4,982,850	$ 9,275,091	$ 19,762,137	$ 72,371,485
Lock 17	$ 2,780,833	$ 5,499,309	$ 10,236,428	$ 21,810,426	$ 79,872,580
Lock 18	$ 2,225,636	$ 4,401,364	$ 8,192,712	$ 17,455,946	$ 63,925,915
Lock 19	$ 1,561,958	$ 3,088,892	$ 5,749,671	$ 12,250,639	$ 44,863,413
Lock 20	$ 4,335,546	$ 8,573,873	$ 15,959,431	$ 34,004,243	$ 124,527,906
Lock 21	$ 2,930,175	$ 5,794,644	$ 10,786,167	$ 22,981,736	$ 84,162,070
Lock 22	$ 6,405,043	$ 12,666,460	$ 23,577,384	$ 50,235,570	$ 183,969,107
Lock 24	$ 4,356,363	$ 8,615,040	$ 16,036,058	$ 34,167,511	$ 125,125,814
Lock 25	$ 6,664,059	$ 13,178,685	$ 24,530,840	$ 52,267,068	$ 191,408,714
Total (Iowa to Mid Mississippi River)	**$ 43,893,359**	**$ 86,802,463**	**$ 161,574,342**	**$ 344,261,228**	**$ 1,260,728,823**
Total (Minnesota to Mid Mississippi River)	**$ 50,267,425**	**$ 99,407,666**	**$ 185,037,699**	**$ 394,253,845**	**$ 1,443,808,207**

Source: Army Corps of Engineers and IEG

B. Micro Upgrade

Mooring cells are an efficient and environmentally friendly place for tows approaching a lock and dam to moor (park) while waiting for the lock to become available due to another tow occupying the lock or navigation approach channel. Beneficial at sites where navigation channels conditions necessitate a tow waiting area to be located a mile or more away from the lock. Also limits erosion and habitat destruction caused from towboats grounding themselves on or tying off to the shoreline.

Mooring cells are largely used in fleeting service and must be approved by the Army Corps of Engineers. Free fleeting service would be appreciated by the barge industry; especially during times of unscheduled closures, but publicly financed mooring cells does have issues. A fee will have to be charged to maintain the facility. Any fee structure of a public asset requires government oversight. Like a public port, the facility could be leased to a service provider, but that would cost the carrier money.

The idea needs to be explored because it does have economic, environmental and safety benefits. In "Iowa DOT UMP Inland Waterway: report, an example for time savings that a mooring cell for Lock 14 would achieve is provided. Using the actual data for Lock 14 as a templet for the other locks, provides the time estimates for Table 28.

Table 28: Total Mooring Time Operations Savings (annual)

Lock	2017	2027	2037	2047	2060
Total Mooring Time Operations Savings (Annual)					
Lock 1	-	-	-	-	-
Lock 2	106	169	214	258	341
Lock 3	105	168	213	256	338
Lock 4	117	185	235	283	374
Lock 5	117	185	236	283	374
Lock 5 A	116	185	235	283	374
Lock 6	141	224	284	341	451
Lock 7	140	223	283	341	450
Lock 8	151	241	306	368	486
Lock 9	166	265	336	404	534
Lock 10	197	313	398	478	632
Lock 11	197	313	397	477	631
Lock 12	217	345	439	527	697
Lock 13	220	350	445	535	707
Lock 14	244	388	493	592	783
Lock 15	248	394	500	601	795
Lock 16	259	411	523	628	830
Lock 17	268	427	542	651	861
Lock 18	283	450	572	687	908
Lock 19	288	458	582	699	925
Lock 20	297	472	599	720	952
Lock 21	320	509	647	777	1,027
Lock 22	327	521	662	795	1,051
Lock 24	331	527	669	804	1,063
Lock 25	330	526	668	802	1,061
Total (Iowa to Mid Mississippi River)	**4,026**	**6,406**	**8,135**	**9,773**	**12,923**
Total (Minnesota to Mid Mississippi River)	**5,186**	**8,251**	**10,478**	**12,588**	**16,645**

Source: Army Corps of Engineers and IEG

Multiplying the time saving to the idling cost of a tow times the total number of upward tows provides potential cost saving if mooring cells were built. The higher volume locks would have the most benefit.

Table 29: Total Mooring Cell Operations Savings (annual)

Lock	2017	2027	2037	2047	2060
Total Mooring Cell Operations Savings (Annual)					
Lock 1	-	-	-	-	-
Lock 2	55,496	88,292	112,125	134,696	178,109
Lock 3	55,113	87,682	111,351	133,766	176,879
Lock 4	60,922	96,923	123,087	147,864	195,521
Lock 5	60,957	96,980	123,158	147,950	195,634
Lock 5 A	60,916	96,914	123,075	147,850	195,503
Lock 6	73,473	116,893	148,447	178,329	235,805
Lock 7	73,373	116,732	148,243	178,084	235,481
Lock 8	79,200	126,004	160,017	192,229	254,185
Lock 9	87,038	138,473	175,853	211,251	279,338
Lock 10	102,897	163,704	207,894	249,743	330,235
Lock 11	102,862	163,648	207,823	249,658	330,123
Lock 12	113,536	180,630	229,389	275,565	364,380
Lock 13	115,175	183,238	232,701	279,544	369,642
Lock 14	127,619	203,035	257,843	309,746	409,578
Lock 15	129,526	206,070	261,697	314,376	415,700
Lock 16	135,249	215,174	273,259	328,265	434,066
Lock 17	140,262	223,150	283,387	340,432	450,155
Lock 18	147,965	235,405	298,950	359,128	474,876
Lock 19	150,680	239,725	304,436	365,718	483,591
Lock 20	155,146	246,830	313,460	376,559	497,925
Lock 21	167,378	266,290	338,173	406,247	537,181
Lock 22	171,236	272,428	345,967	415,610	549,562
Lock 24	173,187	275,533	349,911	420,347	555,826
Lock 25	172,802	274,920	349,132	419,412	554,589
Total (Iowa to Mid Mississippi River)	**2,105,518**	**3,349,780**	**4,254,021**	**5,110,350**	**6,757,430**
Total (Minnesota to Mid Mississippi River)	**2,712,005**	**4,314,673**	**5,479,379**	**6,582,369**	**8,703,886**

Source: Army Corps of Engineers and IEG

Assuming an idling 5,000HP towboat burns 15 gallons per hour, eliminating idling while waiting would save in 2017 between 13 thousand gallons of fuel to 172 thousand depending on the lock and efficiency gains two thousand gallons to five thousand gallons as shown in Table 30. If the locks are not repaired, the number of unscheduled repairs will continue to increase and become more expensive. If all the locks had mooring cell options, over one million gallons of fuel could be saved annually on the Upper Mississippi River.

Table 30: Mooring Cell Fuel Consumption Savings

Lock	2017	2027	2037	2047	2060
Total Mooring Cell Delay Fuel Savings (Gallons) (Annual)					
Lock 1	-	-	-	-	-
Lock 2	14,978	29,005	52,492	108,853	389,595
Lock 3	18,771	36,510	66,473	138,663	498,823
Lock 4	14,669	28,333	51,095	105,586	376,743
Lock 5	16,705	32,360	58,590	121,553	435,212
Lock 5 A	16,188	31,337	56,686	117,497	420,366
Lock 6	17,691	34,171	61,622	127,340	454,365
Lock 7	17,972	34,727	62,661	129,558	462,505
Lock 8	32,739	63,866	116,743	244,474	882,392
Lock 9	23,491	45,490	82,326	170,721	611,025
Lock 10	23,706	45,739	82,362	169,943	605,591
Lock 11	26,051	50,377	90,995	188,339	672,964
Lock 12	33,476	64,942	117,818	244,916	878,417
Lock 13	34,678	67,300	122,164	254,087	911,737
Lock 14	76,372	149,616	275,051	579,169	2,100,200
Lock 15	72,396	141,733	260,325	547,690	1,984,609
Lock 16	67,720	132,422	242,839	510,125	1,846,112
Lock 17	71,688	140,214	257,208	540,471	1,956,424
Lock 18	57,472	112,015	204,512	427,776	1,542,468
Lock 19	32,835	63,262	113,689	234,117	832,820
Lock 20	114,461	224,634	413,946	873,625	3,174,053
Lock 21	73,714	143,919	263,373	552,146	1,994,762
Lock 22	174,756	343,694	635,130	1,344,028	4,894,108
Lock 24	112,645	220,844	406,405	856,585	3,108,712
Lock 25	177,073	348,259	643,586	1,361,960	4,959,520
Total (Iowa to Mid Mississippi River)	**1,149,043**	**2,248,968**	**4,129,403**	**8,684,976**	**31,462,499**
Total (Minnesota to Mid Mississippi River)	**1,322,248**	**2,584,768**	**4,738,091**	**9,949,221**	**35,993,525**

Source: Army Corps of Engineers and IEG

An idling 5,000HP towboat waiting on a lock in 2017 costs between $20 thousand to $300 thousand depending on the lock as shown in Table 31. If all the locks had mooring cell options, two million dollars of fuel could be saved annually on the Upper Mississippi River.

Table 31: Mooring Cell Fuel Savings

Lock	2017	2027	2037	2047	2060
Mooring Cell Delay Fuel Savings (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 26,212	$ 50,759	$ 91,861	$ 190,494	$ 681,791
Lock 3	$ 32,850	$ 63,893	$ 116,327	$ 242,660	$ 872,939
Lock 4	$ 25,671	$ 49,583	$ 89,417	$ 184,775	$ 659,301
Lock 5	$ 29,235	$ 56,631	$ 102,533	$ 212,718	$ 761,621
Lock 5 A	$ 28,328	$ 54,839	$ 99,200	$ 205,620	$ 735,641
Lock 6	$ 30,960	$ 59,799	$ 107,839	$ 222,844	$ 795,138
Lock 7	$ 31,451	$ 60,773	$ 109,657	$ 226,726	$ 809,383
Lock 8	$ 57,294	$ 111,766	$ 204,300	$ 427,829	$ 1,544,187
Lock 9	$ 41,109	$ 79,608	$ 144,071	$ 298,762	$ 1,069,293
Lock 10	$ 41,485	$ 80,044	$ 144,133	$ 297,401	$ 1,059,785
Lock 11	$ 45,589	$ 88,159	$ 159,240	$ 329,593	$ 1,177,687
Lock 12	$ 58,583	$ 113,648	$ 206,182	$ 428,602	$ 1,537,230
Lock 13	$ 60,686	$ 117,775	$ 213,787	$ 444,653	$ 1,595,540
Lock 14	$ 133,651	$ 261,828	$ 481,339	$ 1,013,545	$ 3,675,350
Lock 15	$ 126,693	$ 248,032	$ 455,569	$ 958,457	$ 3,473,066
Lock 16	$ 118,510	$ 231,738	$ 424,969	$ 892,719	$ 3,230,696
Lock 17	$ 125,455	$ 245,374	$ 450,115	$ 945,824	$ 3,423,743
Lock 18	$ 100,577	$ 196,027	$ 357,895	$ 748,609	$ 2,699,319
Lock 19	$ 57,461	$ 110,708	$ 198,955	$ 409,705	$ 1,457,435
Lock 20	$ 200,306	$ 393,109	$ 724,406	$ 1,528,844	$ 5,554,593
Lock 21	$ 129,000	$ 251,858	$ 460,903	$ 966,255	$ 3,490,834
Lock 22	$ 305,822	$ 601,464	$ 1,111,478	$ 2,352,049	$ 8,564,688
Lock 24	$ 197,129	$ 386,477	$ 711,208	$ 1,499,024	$ 5,440,247
Lock 25	$ 309,878	$ 609,453	$ 1,126,275	$ 2,383,429	$ 8,679,161
Total (Iowa to Mid Mississippi River)	**$ 2,010,825**	**$ 3,935,695**	**$ 7,226,455**	**$ 15,198,709**	**$ 55,059,374**
Total (Minnesota to Mid Mississippi River)	**$ 2,313,933**	**$ 4,523,344**	**$ 8,291,659**	**$ 17,411,136**	**$ 62,988,669**

Source: Army Corps of Engineers and IEG

The fuel burned releases carbon dioxide, methane and other pollutants into the air. In 2017, if all the locks had mooring cell options, 15 thousand tons of carbon dioxide and an additional 15 tons of methane carbon dioxide equivalent would be removed from air. Methane carbon dioxide equivalent is the amount of methane released times 25, which is the impact methane has on the environment versus carbon dioxide. By 2060, the amount will climb to over 800 thousand tons without action being taken. At some point before 2060, the industry will likely adopt or be forced to adopt a lower emission fuel, such as liquid natural gas.

Table 32: Mooring Cell Carbon Dioxide Savings

Lock	2017	2027	2037	2047	2060
Carbon Dioxide Delay Savings (Tons) (Annual)					
Lock 1	-	-	-	-	-
Lock 2	169	326	591	1,225	4,385
Lock 3	211	411	748	1,561	5,614
Lock 4	165	319	575	1,188	4,240
Lock 5	188	364	659	1,368	4,898
Lock 5 A	182	353	638	1,322	4,731
Lock 6	199	385	694	1,433	5,114
Lock 7	202	391	705	1,458	5,205
Lock 8	368	719	1,314	2,751	9,931
Lock 9	264	512	927	1,921	6,877
Lock 10	267	515	927	1,913	6,816
Lock 11	293	567	1,024	2,120	7,574
Lock 12	377	731	1,326	2,756	9,886
Lock 13	390	757	1,375	2,860	10,261
Lock 14	860	1,684	3,096	6,518	23,637
Lock 15	815	1,595	2,930	6,164	22,336
Lock 16	762	1,490	2,733	5,741	20,777
Lock 17	807	1,578	2,895	6,083	22,019
Lock 18	647	1,261	2,302	4,814	17,360
Lock 19	370	712	1,280	2,635	9,373
Lock 20	1,288	2,528	4,659	9,832	35,723
Lock 21	830	1,620	2,964	6,214	22,450
Lock 22	1,967	3,868	7,148	15,126	55,081
Lock 24	1,268	2,486	4,574	9,641	34,987
Lock 25	1,993	3,920	7,243	15,328	55,817
Total (Iowa to Mid Mississippi River)	**12,932**	**25,311**	**46,475**	**97,746**	**354,097**
Total (Minnesota to Mid Mississippi River)	**14,881**	**29,090**	**53,325**	**111,974**	**405,092**

Source: Army Corps of Engineers, Environmental Protection Agency and IEG

Table 33: Mooring Cell Methane Carbon Dioxide Equivalent Savings

Lock	2017	2027	2037	2047	2060
Methane (Carbon Dioxide Equivalent) Delay Savings (Tons) (Annual)					
Lock 1	-	-	-	-	-
Lock 2	0.17	0.34	0.61	1.26	4.51
Lock 3	0.22	0.42	0.77	1.60	5.77
Lock 4	0.17	0.33	0.59	1.22	4.36
Lock 5	0.19	0.37	0.68	1.41	5.04
Lock 5 A	0.19	0.36	0.66	1.36	4.87
Lock 6	0.20	0.40	0.71	1.47	5.26
Lock 7	0.21	0.40	0.73	1.50	5.35
Lock 8	0.38	0.74	1.35	2.83	10.21
Lock 9	0.27	0.53	0.95	1.98	7.07
Lock 10	0.27	0.53	0.95	1.97	7.01
Lock 11	0.30	0.58	1.05	2.18	7.79
Lock 12	0.39	0.75	1.36	2.83	10.17
Lock 13	0.40	0.78	1.41	2.94	10.55
Lock 14	0.88	1.73	3.18	6.70	24.31
Lock 15	0.84	1.64	3.01	6.34	22.97
Lock 16	0.78	1.53	2.81	5.90	21.37
Lock 17	0.83	1.62	2.98	6.26	22.64
Lock 18	0.67	1.30	2.37	4.95	17.85
Lock 19	0.38	0.73	1.32	2.71	9.64
Lock 20	1.32	2.60	4.79	10.11	36.74
Lock 21	0.85	1.67	3.05	6.39	23.09
Lock 22	2.02	3.98	7.35	15.56	56.65
Lock 24	1.30	2.56	4.70	9.91	35.98
Lock 25	2.05	4.03	7.45	15.76	57.40
Total (Iowa to Mid Mississippi River)	**13.30**	**26.03**	**47.79**	**100.52**	**364.15**
Total (Minnesota to Mid Mississippi River)	**15.30**	**29.92**	**54.84**	**115.15**	**416.60**

Source: Army Corps of Engineers, Environmental Protection Agency and IEG

C. System Reliability Improvements

Lock and Dam Major Rehabilitation Program consists of reliability or efficiency improvements costing over $21 million that focus on facility life extensions that are critical for system recapitalization, and the long term durability and sustainability of the facility. Major Rehabilitation projects in essence serve to reset the design life of a lock and dam. Past projects have included replacement of lock operating machinery, upgrading and replacement of the lock and dam's electrical power and control systems, mass concrete repairs, lock chamber concrete resurfacing and armoring, painting, lock and dam gate repairs, emptying and filling valve repairs, dewatering improvements, installation of lock bubbler systems for ice management, scour protection and general safety improvements.

The scenario covers the cost savings if all the critical maintenance is accomplished. The Corps will schedule lock closings during non-peak use to minimize impact on peak periods. Scheduled closures allow barge operators and shippers to reroute traffic or adjust traffic flows. This reduces delay times during periods of schedule maintenance. It stands to reason that a barge operator will not send a barge toward a lock when it knows the lock will be temporarily unavailable. The true cost of scheduled lock repairs is grossly underreported because the delays take place in other locations, before and after the lock closure, and at the terminal with the shipper.

It can also be expected that any mechanical structure will unexpectedly fail for many reasons. For locks and dams that are quite old, this is of concern. Unscheduled lock repairs are the most devastating because it is impossible to plan ahead. Thus, freight is stranded on the river and the receivers must rework their supply chain. The lock delay costs only capture the cost to the barge operator waiting at the lock and not the cost to the entire system. For example, a manager having to reroute delivery of an input required to keep the factory operational. If logistics issues continue, the factory will eventually either close or relocate.

A well-functioning lock and dam system would reduce fuel consumption and improve air quality as shown in the Mooring Cell scenario. The major difference is the increase in dependability and cost saving from the total tow configuration costs versus only fuel savings. A very well run locking system on the Upper Mississippi River would save carriers $43 million in 2017. If left unchecked, by 2060 the cost will explode to $1.2 billion.

Table 34: Annual Delay Barge Cost by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Tow Configuration Delay Costs (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 466,658	$ 922,852	$ 1,717,799	$ 3,660,058	$ 13,403,603
Lock 3	$ 599,272	$ 1,185,107	$ 2,205,961	$ 4,700,171	$ 17,212,628
Lock 4	$ 450,454	$ 890,806	$ 1,658,150	$ 3,532,966	$ 12,938,174
Lock 5	$ 521,414	$ 1,031,136	$ 1,919,360	$ 4,089,518	$ 14,976,341
Lock 5 A	$ 503,400	$ 995,512	$ 1,853,049	$ 3,948,231	$ 14,458,929
Lock 6	$ 543,262	$ 1,074,341	$ 1,999,781	$ 4,260,870	$ 15,603,852
Lock 7	$ 553,153	$ 1,093,902	$ 2,036,191	$ 4,338,447	$ 15,887,950
Lock 8	$ 1,062,127	$ 2,100,438	$ 3,909,761	$ 8,330,400	$ 30,506,996
Lock 9	$ 731,887	$ 1,447,363	$ 2,694,126	$ 5,740,287	$ 21,021,666
Lock 10	$ 723,521	$ 1,430,817	$ 2,663,328	$ 5,674,666	$ 20,781,356
Lock 11	$ 805,296	$ 1,592,535	$ 2,964,348	$ 6,316,041	$ 23,130,152
Lock 12	$ 1,053,466	$ 2,083,309	$ 3,877,877	$ 8,262,468	$ 30,258,218
Lock 13	$ 1,093,724	$ 2,162,923	$ 4,026,070	$ 8,578,218	$ 31,414,534
Lock 14	$ 2,534,794	$ 5,012,749	$ 9,330,744	$ 19,880,716	$ 72,805,733
Lock 15	$ 2,394,286	$ 4,734,884	$ 8,813,525	$ 18,778,693	$ 68,769,985
Lock 16	$ 2,225,550	$ 4,401,195	$ 8,192,396	$ 17,455,273	$ 63,923,452
Lock 17	$ 2,358,878	$ 4,664,861	$ 8,683,186	$ 18,500,983	$ 67,752,975
Lock 18	$ 1,855,590	$ 3,669,571	$ 6,830,550	$ 14,553,632	$ 53,297,269
Lock 19	$ 993,973	$ 1,965,658	$ 3,658,882	$ 7,795,861	$ 28,549,445
Lock 20	$ 3,835,075	$ 7,584,152	$ 14,117,162	$ 30,078,981	$ 110,153,089
Lock 21	$ 2,402,379	$ 4,750,888	$ 8,843,317	$ 18,842,169	$ 69,002,442
Lock 22	$ 5,920,941	$ 11,709,112	$ 21,795,372	$ 46,438,695	$ 170,064,465
Lock 24	$ 3,753,754	$ 7,423,334	$ 13,817,814	$ 29,441,170	$ 107,817,344
Lock 25	$ 6,000,158	$ 11,865,771	$ 22,086,978	$ 47,060,010	$ 172,339,800
Total (Iowa to Mid Mississippi River)	**$ 37,951,386**	**$ 75,051,759**	**$ 139,701,549**	**$ 297,657,574**	**$ 1,090,060,260**
Total (Minnesota to Mid Mississippi River)	**$ 43,383,013**	**$ 85,793,216**	**$ 159,695,726**	**$ 340,258,522**	**$ 1,246,070,399**

Source: Army Corps of Engineers and IEG

D. Large Scale Upgrade

The scenario explores the benefits of building a new, modern set of 1,200 foot locks. A 1,200 foot lock would not have to be split in two and would dramatically reduce delays from scheduled and unscheduled maintenance.

Critical maintenance has a direct impact on passing traffic or maintaining pool levels. Funding critical repairs would be a major improvement, but the funding will continue to be a serious issue because the locks are often over 75 years old, which means identifying and correcting all the problems is unrealistic. At some point in time, the locks need to be modernized. The following is an explanation of the major maintenance funding and why new modern locks are a very good idea. In short, the increasing number of unexpected lock failures is draining money from critical maintenance required to reduce the frequency of unexpected lock failures in the future.

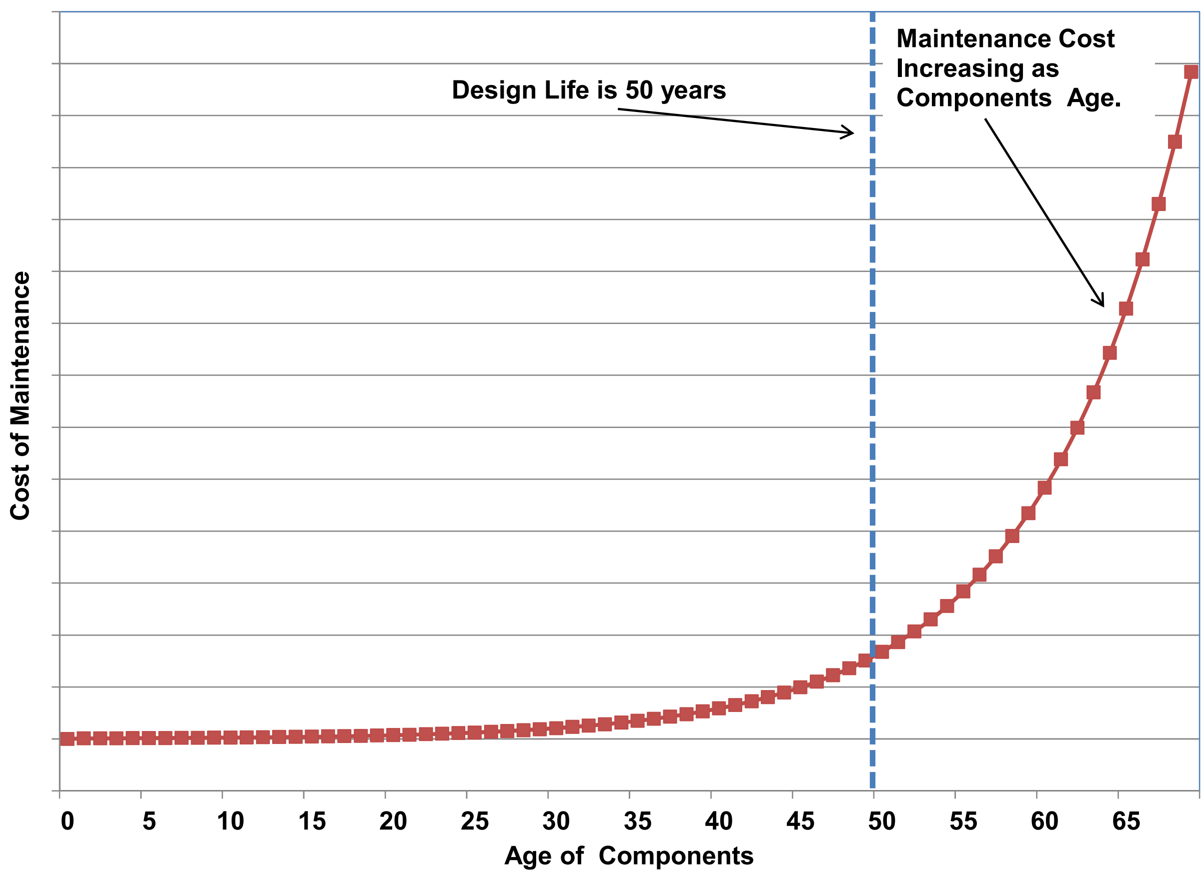
The operations and maintenance (O&M) budget for the inland navigation system is funded through the Civil Works budget. United States Army Corps of Engineers (Corps) develop program requirements that are reviewed by Secretary of the Army and submitted to the Office of Management Budget (OMB). The Civil Works budget is part of the President's budget that is approved by the US Congress. The Corps original budget requests are unknown.

Figure 9: Federal Budget Cycle

The Administration gives budget guidance to the Corps to include projects that are a priority to the administration but the OMB bases the budget primarily on the previous year without accounting for the new projects. During Congressional hearings, the Congressional and Senate budget can add money back into the budget for projects. The end result of this process is the O&M funding levels for navigation are known but which routine maintenance is being funded and at what level is the funding is unknown. Efforts to keep operating fully funded effectively results in funding cuts for maintenance.

Lock and dam project maintenance costs are based on a lifespan of 50 years as demonstrated in Figure 10. The cost pattern is for illustrative purposes. As the lock and dam ages however, the rate of maintenance cost increases in a non-linear manner, yet the annual increases in O&M budget is primarily based on OMB's total federal budget baseline. With the O&M costs increasing faster than the baseline, routine critical maintenance is being deferred to the next year, which increases the probability of failure and in turn, expense.

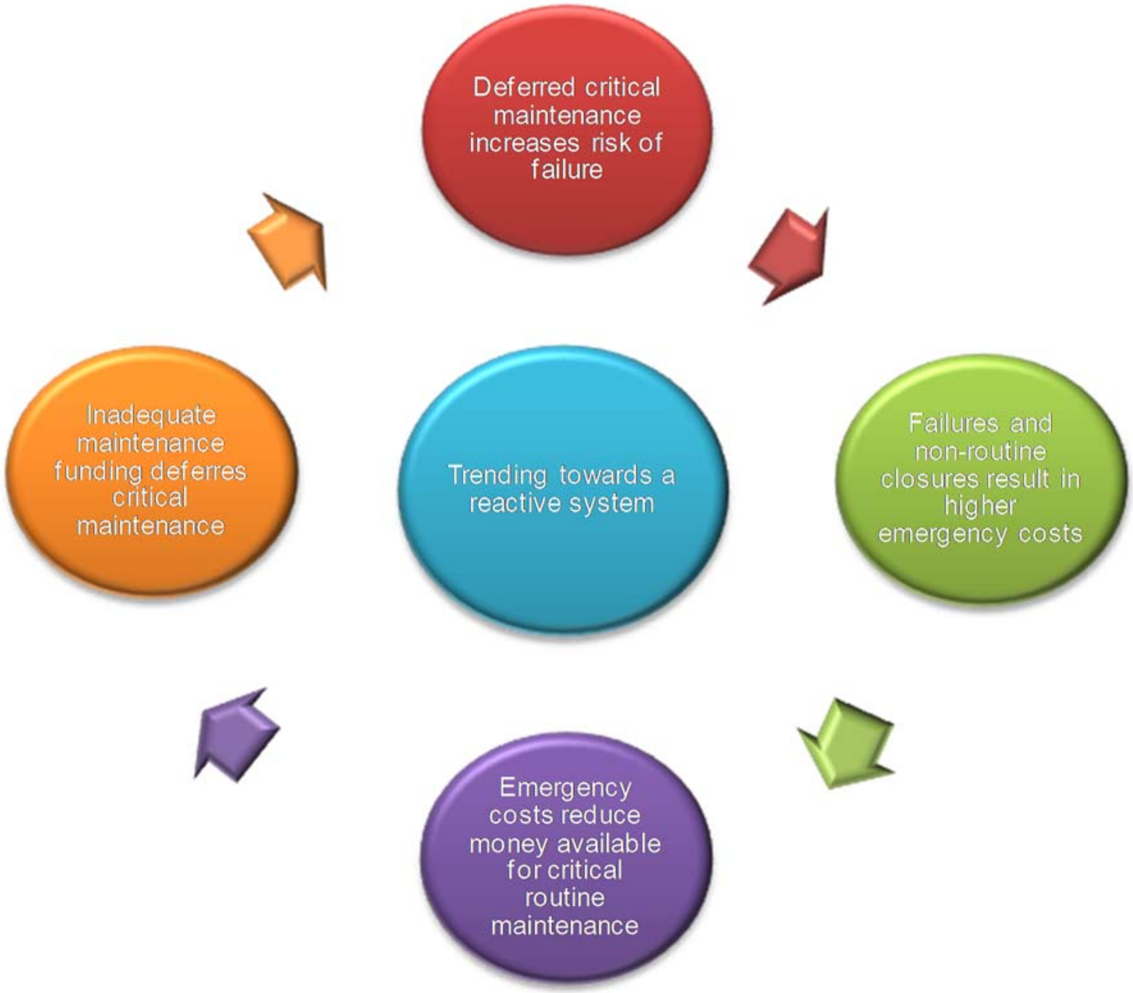
Figure 10: Maintenance Cost versus Age of Component



Source: IEG

The combination of rising maintenance costs, pet projects and increasing emergency or reprogramming of funds to cover emergencies reduces spending on routine maintenance and expands the deferred critical maintenance as characterized in Figure 11. Critical maintenance has a direct impact on passing traffic or maintaining pool levels. The deferred critical maintenance increases the risk of system failures, which is expanding. These failures increase costs unexpectedly. A system failure is deemed an emergency and the money to fix the emergency failure reduces money available for scheduled critical routine maintenance. The funding approach for O&M is resulting in a growing deferred critical maintenance that is "feeding" on itself. Eventually, the Corps management of the lock and dam system, for example, will become completely reactive to the next non-routine maintenance requirement or emergency under the current situation.

Figure 11: Current Operations and Maintenance Funding Situation



Source: IEG

1. Low Impact (Rail Matches Barge Rates)

Adding a 1,200-foot lock has redundancy benefits associated with two lock chambers at one site. The likelihood of a system shutdown attributable to both locks being closed at once is very small when compared with the scheduled maintenance closures and risks of unscheduled closures related to a single lock. The redundancy gives a much higher degree of reliability to this reach of the UMR.

The annual switch boat hours are the average switch boat time per tow multiplied by the total number of tows. On average, carrier and lock masters stated splitting a tow increased the throughput time by 20 to 25 minutes. Also reduces the approach time and exit time.

In "Iowa DOT UMP Inland Waterways" report, on a three lock pilot, the average time to transit the locks were reduced between 50 percent and 55 percent. The Annual Switch Boat and Locking Time Savings is the reduced Average Processing Time by lock by 50 percent. It is assumed the Averaging Processing Time will increase by two percent for the first ten years and increase one percent every five years going forward.

Splitting a tow also increases the odds of an accident that will harm a crew member and/or damage the lock. Working out on deck, the crew is exposed to the dangerous of getting in the bite of a line, slippery conditions from water, ice or commodities, heavy lifting, the risk of falling overboard or being crushed between the tug and the dock, and other serious hazards. Those cost are partially included in the analysis through crew insurance costs. The damage done to locks is not included.

The cost of increased time required to transit a lock in 2017 ranged between $80 thousand and $600 thousand. The total added expense in 2017 for the Upper Mississippi River is $7 million and if the trend continues, will increase to almost $200.

Table 35: Annual Switch Boat and Lockings Barge Savings by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Switchboat and Lockings Cost Savings (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 76,435	$ 151,157	$ 281,364	$ 599,492	$ 2,195,418
Lock 3	$ 51,937	$ 102,709	$ 191,183	$ 407,348	$ 1,491,761
Lock 4	$ 86,116	$ 170,301	$ 316,999	$ 675,420	$ 2,473,474
Lock 5	$ 79,538	$ 157,292	$ 292,784	$ 623,825	$ 2,284,527
Lock 5 A	$ 92,732	$ 183,384	$ 341,351	$ 727,306	$ 2,663,487
Lock 6	$ 114,511	$ 226,454	$ 421,523	$ 898,124	$ 3,289,047
Lock 7	$ 114,354	$ 226,143	$ 420,943	$ 896,890	$ 3,284,528
Lock 8	$ 172,237	$ 340,612	$ 634,015	$ 1,350,876	$ 4,947,080
Lock 9	$ 154,580	$ 305,693	$ 569,018	$ 1,212,388	$ 4,439,921
Lock 10	$ 179,015	$ 354,017	$ 658,968	$ 1,404,041	$ 5,141,779
Lock 11	$ 178,955	$ 353,897	$ 658,744	$ 1,403,565	$ 5,140,034
Lock 12	$ 259,251	$ 512,689	$ 954,321	$ 2,033,342	$ 7,446,358
Lock 13	$ 267,169	$ 528,348	$ 983,468	$ 2,095,442	$ 7,673,779
Lock 14	$ 300,660	$ 594,578	$ 1,106,749	$ 2,358,114	$ 8,635,717
Lock 15	$ 323,933	$ 640,602	$ 1,192,418	$ 2,540,647	$ 9,304,174
Lock 16	$ 294,126	$ 581,656	$ 1,082,695	$ 2,306,864	$ 8,448,033
Lock 17	$ 421,954	$ 834,447	$ 1,553,242	$ 3,309,443	$ 12,119,605
Lock 18	$ 370,045	$ 731,793	$ 1,362,162	$ 2,902,314	$ 10,628,646
Lock 19	$ 567,985	$ 1,123,233	$ 2,090,790	$ 4,454,778	$ 16,313,968
Lock 20	$ 500,472	$ 989,721	$ 1,842,269	$ 3,925,263	$ 14,374,817
Lock 21	$ 527,795	$ 1,043,756	$ 1,942,850	$ 4,139,567	$ 15,159,627
Lock 22	$ 484,102	$ 957,349	$ 1,782,012	$ 3,796,874	$ 13,904,642
Lock 24	$ 602,609	$ 1,191,706	$ 2,218,244	$ 4,726,342	$ 17,308,470
Lock 25	$ 663,901	$ 1,312,914	$ 2,443,862	$ 5,207,057	$ 19,068,913
Total (Iowa to Mid Mississippi River)	**$ 5,941,973**	**$ 11,750,704**	**$ 21,872,793**	**$ 46,603,653**	**$ 170,668,564**
Total (Minnesota to Mid Mississippi River)	**$ 6,884,412**	**$ 13,614,449**	**$ 25,341,973**	**$ 53,995,323**	**$ 197,737,807**

Source: Army Corps of Engineers and IEG

The combined cost savings per lock in 2017 ranges from $500 thousand to over $6 million. Not surprisingly, the longer the locks are not repaired, the higher the annual cost. By 2036, only Lock & Dam 22, Lock & Dam 24, and Lock & Dam 25 have a chance to be funded under the latest budget. No upper Mississippi Locks are being considered for major rehabilitation.

Table 36: Combined Barge Cost and Savings by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Cost Savings (Delay and Switchboat Savings) (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 543,093	$ 1,074,008	$ 1,999,162	$ 4,259,550	$ 15,599,021
Lock 3	$ 651,209	$ 1,287,816	$ 2,397,145	$ 5,107,519	$ 18,704,389
Lock 4	$ 536,570	$ 1,061,108	$ 1,975,149	$ 4,208,386	$ 15,411,649
Lock 5	$ 600,952	$ 1,188,428	$ 2,212,144	$ 4,713,343	$ 17,260,868
Lock 5 A	$ 596,132	$ 1,178,896	$ 2,194,400	$ 4,675,537	$ 17,122,416
Lock 6	$ 657,773	$ 1,300,795	$ 2,421,304	$ 5,158,994	$ 18,892,899
Lock 7	$ 667,506	$ 1,320,045	$ 2,457,135	$ 5,235,338	$ 19,172,478
Lock 8	$ 1,234,364	$ 2,441,049	$ 4,543,776	$ 9,681,276	$ 35,454,076
Lock 9	$ 886,467	$ 1,753,056	$ 3,263,144	$ 6,952,675	$ 25,461,587
Lock 10	$ 902,536	$ 1,784,834	$ 3,322,295	$ 7,078,707	$ 25,923,134
Lock 11	$ 984,251	$ 1,946,431	$ 3,623,092	$ 7,719,605	$ 28,270,186
Lock 12	$ 1,312,717	$ 2,595,998	$ 4,832,199	$ 10,295,810	$ 37,704,577
Lock 13	$ 1,360,893	$ 2,691,270	$ 5,009,538	$ 10,673,660	$ 39,088,314
Lock 14	$ 2,835,454	$ 5,607,327	$ 10,437,493	$ 22,238,830	$ 81,441,450
Lock 15	$ 2,718,219	$ 5,375,485	$ 10,005,943	$ 21,319,340	$ 78,074,159
Lock 16	$ 2,519,676	$ 4,982,850	$ 9,275,091	$ 19,762,137	$ 72,371,485
Lock 17	$ 2,780,833	$ 5,499,309	$ 10,236,428	$ 21,810,426	$ 79,872,580
Lock 18	$ 2,225,636	$ 4,401,364	$ 8,192,712	$ 17,455,946	$ 63,925,915
Lock 19	$ 1,561,958	$ 3,088,892	$ 5,749,671	$ 12,250,639	$ 44,863,413
Lock 20	$ 4,335,546	$ 8,573,873	$ 15,959,431	$ 34,004,243	$ 124,527,906
Lock 21	$ 2,930,175	$ 5,794,644	$ 10,786,167	$ 22,981,736	$ 84,162,070
Lock 22	$ 6,405,043	$ 12,666,460	$ 23,577,384	$ 50,235,570	$ 183,969,107
Lock 24	$ 4,356,363	$ 8,615,040	$ 16,036,058	$ 34,167,511	$ 125,125,814
Lock 25	$ 6,664,059	$ 13,178,685	$ 24,530,840	$ 52,267,068	$ 191,408,714
Total (Iowa to Mid Mississippi River)	**$ 43,893,359**	**$ 86,802,463**	**$ 161,574,342**	**$ 344,261,228**	**$ 1,260,728,823**
Total (Minnesota to Mid Mississippi River)	**$ 50,267,425**	**$ 99,407,666**	**$ 185,037,699**	**$ 394,253,845**	**$ 1,443,808,207**

Source: Army Corps of Engineers and IEG

The fuel burned releases carbon dioxide, methane and other pollutants into the air. In 2017, if all the locks were new, 15 thousand tons of carbon dioxide and an additional 16 tons of methane carbon dioxide equivalent would be removed from air. Methane carbon dioxide equivalent is the amount of methane released times 25, which is the impact methane has on the environment versus carbon dioxide. By 2060, the amount will climb to over 900 thousand tons without action being taken. At some point before 2060, the industry will likely adopt or be forced to adopt a lower emission fuel, such as liquid natural gas.

Table 37: New Lock Carbon Dioxide Savings

Lock	2017	2027	2037	2047	2060
Total Combined Carbon Dioxide Savings (Tons) (Annual)					
Lock 1	-	-	-	-	-
Lock 2	175	347	645	1,375	5,036
Lock 3	210	416	774	1,649	6,039
Lock 4	173	343	638	1,359	4,976
Lock 5	194	384	714	1,522	5,573
Lock 5 A	192	381	708	1,509	5,528
Lock 6	212	420	782	1,666	6,099
Lock 7	215	426	793	1,690	6,190
Lock 8	399	788	1,467	3,126	11,446
Lock 9	286	566	1,053	2,245	8,220
Lock 10	291	576	1,073	2,285	8,369
Lock 11	318	628	1,170	2,492	9,127
Lock 12	424	838	1,560	3,324	12,173
Lock 13	439	869	1,617	3,446	12,619
Lock 14	915	1,810	3,370	7,180	26,293
Lock 15	878	1,735	3,230	6,883	25,206
Lock 16	813	1,609	2,994	6,380	23,364
Lock 17	898	1,775	3,305	7,041	25,786
Lock 18	719	1,421	2,645	5,635	20,638
Lock 19	504	997	1,856	3,955	14,484
Lock 20	1,400	2,768	5,152	10,978	40,203
Lock 21	946	1,871	3,482	7,419	27,171
Lock 22	2,068	4,089	7,612	16,218	59,393
Lock 24	1,406	2,781	5,177	11,031	40,396
Lock 25	2,151	4,255	7,920	16,874	61,795
Total (Iowa to Mid Mississippi River)	**14,171**	**28,023**	**52,163**	**111,142**	**407,015**
Total (Minnesota to Mid Mississippi River)	**16,228**	**32,093**	**59,738**	**127,281**	**466,120**

Source: Army Corps of Engineers, Environmental Protection Agency and IEG

Table 38: New Lock Methane Carbon Dioxide Equivalent Savings

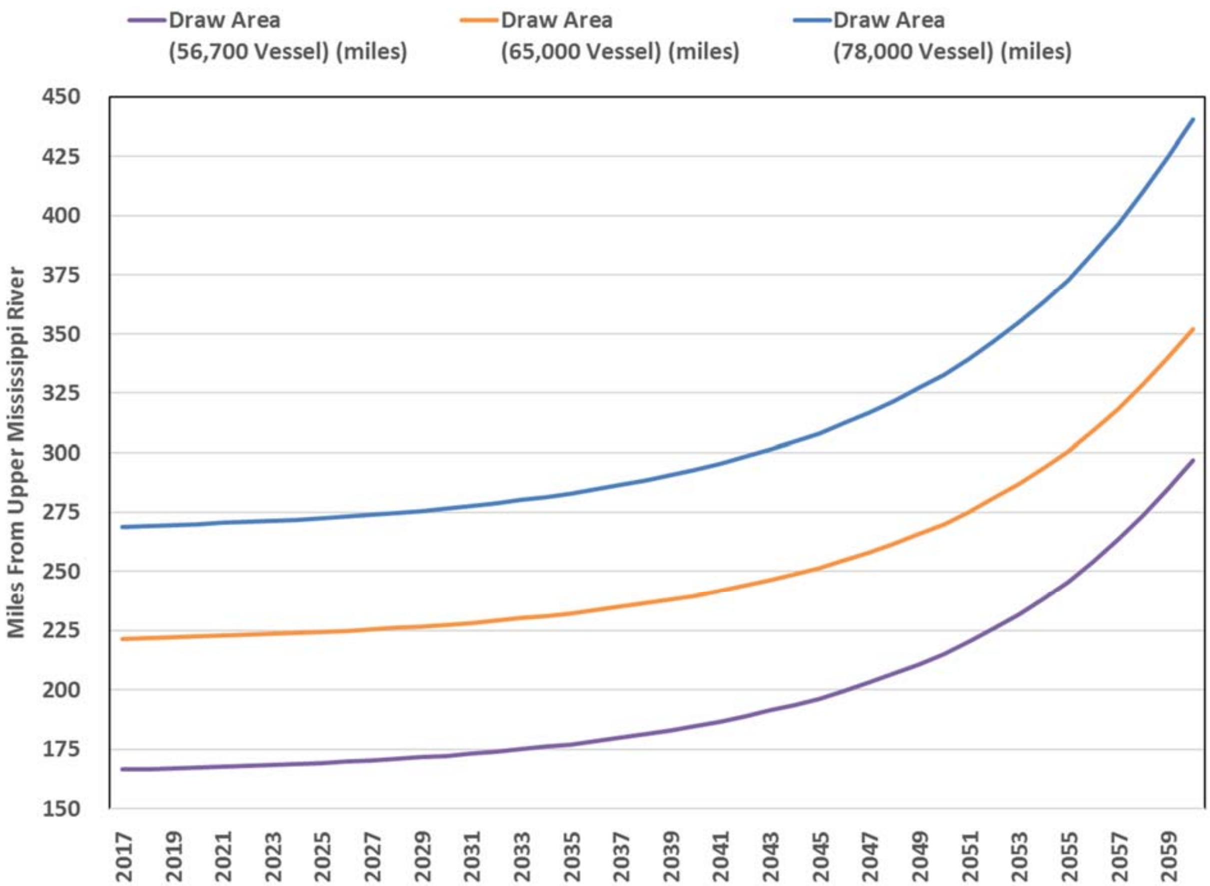
Lock	2017	2027	2037	2047	2060
Total Combined Methane (Carbon Dioxide Equivalent) Savings (Tons) (Annual)					
Lock 1	-	-	-	-	-
Lock 2	0.2	0.4	0.7	1.4	5.2
Lock 3	0.2	0.4	0.8	1.7	6.2
Lock 4	0.2	0.4	0.7	1.4	5.1
Lock 5	0.2	0.4	0.7	1.6	5.7
Lock 5 A	0.2	0.4	0.7	1.6	5.7
Lock 6	0.2	0.4	0.8	1.7	6.3
Lock 7	0.2	0.4	0.8	1.7	6.4
Lock 8	0.4	0.8	1.5	3.2	11.8
Lock 9	0.3	0.6	1.1	2.3	8.5
Lock 10	0.3	0.6	1.1	2.4	8.6
Lock 11	0.3	0.6	1.2	2.6	9.4
Lock 12	0.4	0.9	1.6	3.4	12.5
Lock 13	0.5	0.9	1.7	3.5	13.0
Lock 14	0.9	1.9	3.5	7.4	27.0
Lock 15	0.9	1.8	3.3	7.1	25.9
Lock 16	0.8	1.7	3.1	6.6	24.0
Lock 17	0.9	1.8	3.4	7.2	26.5
Lock 18	0.7	1.5	2.7	5.8	21.2
Lock 19	0.5	1.0	1.9	4.1	14.9
Lock 20	1.4	2.8	5.3	11.3	41.3
Lock 21	1.0	1.9	3.6	7.6	27.9
Lock 22	2.1	4.2	7.8	16.7	61.1
Lock 24	1.4	2.9	5.3	11.3	41.5
Lock 25	2.2	4.4	8.1	17.4	63.5
Total (Iowa to Mid Mississippi River)	**14.57**	**28.82**	**53.64**	**114.30**	**418.58**
Total (Minnesota to Mid Mississippi River)	**16.69**	**33.00**	**61.43**	**130.90**	**479.36**

Source: Army Corps of Engineers, Environmental Protection Agency and IEG

2. High Impact (Rail Maintains Current Tariffs)

In the high impact scenario, it is assumed the railroads will refocus resources to regions that do not compete with the river. Currently, the average vessel loaded out of the Center Gulf is 56,700 tons and is trending towards 65,000 tons. The lower Mississippi River is authorized to be lowered to 50 feet from 45 feet. Assuming a truck capacity of 26 tons and $3 per loaded mile, the natural draw area is 150 miles, 205 miles and 247 miles, respectively. Time delay reductions combined with switching and locking improvements from 1,200 foot locks increases the draw area from the UMR. As volume increases, the benefits of new locks increase. The end result is as vessel loadings increase and new locks are built, the UMR draw area increases from 166 miles to 441 miles. This pull volume towards the river for export and away from rail to PNW and domestic locations.

Figure 12: Upper Mississippi River Draw Area



Source: IEG

The cost of increased time required to transit a lock in 2017 ranged between $80 thousand and $600 thousand. The total added expense in 2017 for the Upper Mississippi River is $7 million and if the trend continues, will increase to over $280.

Table 39: Annual Switch Boat and Lockings Barge Savings by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Switchboat Cost Savings (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 76,437	$ 165,548	$ 342,783	$ 803,885	$ 3,138,594
Lock 3	$ 51,938	$ 112,488	$ 232,917	$ 546,231	$ 2,132,639
Lock 4	$ 86,118	$ 186,515	$ 386,197	$ 905,700	$ 3,536,107
Lock 5	$ 79,539	$ 172,268	$ 356,696	$ 836,514	$ 3,265,985
Lock 5 A	$ 92,733	$ 200,843	$ 415,865	$ 975,276	$ 3,807,751
Lock 6	$ 114,513	$ 248,015	$ 513,537	$ 1,204,334	$ 4,702,059
Lock 7	$ 114,356	$ 247,674	$ 512,831	$ 1,202,679	$ 4,695,599
Lock 8	$ 172,240	$ 373,041	$ 772,415	$ 1,811,448	$ 7,072,402
Lock 9	$ 154,582	$ 334,798	$ 693,229	$ 1,625,744	$ 6,347,361
Lock 10	$ 179,019	$ 387,722	$ 802,814	$ 1,882,739	$ 7,350,745
Lock 11	$ 178,958	$ 387,590	$ 802,542	$ 1,882,100	$ 7,348,251
Lock 12	$ 259,256	$ 561,502	$ 1,162,641	$ 2,726,596	$ 10,645,398
Lock 13	$ 267,174	$ 578,651	$ 1,198,149	$ 2,809,869	$ 10,970,522
Lock 14	$ 300,665	$ 651,187	$ 1,348,342	$ 3,162,097	$ 12,345,718
Lock 15	$ 323,939	$ 701,593	$ 1,452,712	$ 3,406,863	$ 13,301,353
Lock 16	$ 294,131	$ 637,034	$ 1,319,038	$ 3,093,374	$ 12,077,404
Lock 17	$ 421,962	$ 913,894	$ 1,892,300	$ 4,437,775	$ 17,326,325
Lock 18	$ 370,052	$ 801,466	$ 1,659,509	$ 3,891,838	$ 15,194,833
Lock 19	$ 567,995	$ 1,230,175	$ 2,547,189	$ 5,973,604	$ 23,322,634
Lock 20	$ 500,481	$ 1,083,951	$ 2,244,419	$ 5,263,555	$ 20,550,401
Lock 21	$ 527,805	$ 1,143,130	$ 2,366,955	$ 5,550,925	$ 21,672,375
Lock 22	$ 484,111	$ 1,048,496	$ 2,171,008	$ 5,091,393	$ 19,878,234
Lock 24	$ 602,620	$ 1,305,166	$ 2,702,466	$ 6,337,756	$ 24,744,385
Lock 25	$ 663,912	$ 1,437,915	$ 2,977,334	$ 6,982,369	$ 27,261,135
Total (Iowa to Mid Mississippi River)	**$ 5,942,079**	**$ 12,869,470**	**$ 26,647,416**	**$ 62,492,854**	**$ 243,989,714**
Total (Minnesota to Mid Mississippi River)	**$ 6,884,535**	**$ 14,910,659**	**$ 30,873,884**	**$ 72,404,663**	**$ 282,688,211**

Source: Army Corps of Engineers and IEG

The combined cost savings per lock in 2017 ranges from $500 thousand to over $6 million. Not surprisingly, the longer the locks are not repaired, the higher the annual cost. By 2036, only Lock & Dam 22, Lock & Dam 24, and Lock & Dam 25 have a chance to be funded under the latest budget. No upper Mississippi Locks are being considered for major rehabilitation. Eventually, the cost will balloon to over $2 billion annually.

Table 40: Combined Barge Cost and Savings by Focus Lock

Lock	2017	2027	2037	2047	2060
Total Cost Savings (Delay and Switchboat Savings) (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 543,103	$ 1,176,263	$ 2,435,560	$ 5,711,815	$ 22,300,537
Lock 3	$ 651,221	$ 1,410,427	$ 2,920,418	$ 6,848,893	$ 26,740,007
Lock 4	$ 536,579	$ 1,162,134	$ 2,406,305	$ 5,643,206	$ 22,032,668
Lock 5	$ 600,963	$ 1,301,577	$ 2,695,034	$ 6,320,326	$ 24,676,333
Lock 5 A	$ 596,142	$ 1,291,137	$ 2,673,416	$ 6,269,629	$ 24,478,400
Lock 6	$ 657,784	$ 1,424,642	$ 2,949,852	$ 6,917,918	$ 27,009,503
Lock 7	$ 667,518	$ 1,445,724	$ 2,993,504	$ 7,020,290	$ 27,409,193
Lock 8	$ 1,234,386	$ 2,673,458	$ 5,535,639	$ 12,982,042	$ 50,685,550
Lock 9	$ 886,483	$ 1,919,962	$ 3,975,457	$ 9,323,142	$ 36,400,174
Lock 10	$ 902,552	$ 1,954,765	$ 4,047,521	$ 9,492,144	$ 37,060,007
Lock 11	$ 984,268	$ 2,131,748	$ 4,413,979	$ 10,351,553	$ 40,415,379
Lock 12	$ 1,312,741	$ 2,843,159	$ 5,887,022	$ 13,806,096	$ 53,902,890
Lock 13	$ 1,360,918	$ 2,947,502	$ 6,103,072	$ 14,312,772	$ 55,881,097
Lock 14	$ 2,835,505	$ 6,141,191	$ 12,715,899	$ 29,821,008	$ 116,429,620
Lock 15	$ 2,718,268	$ 5,887,277	$ 12,190,145	$ 28,588,024	$ 111,615,704
Lock 16	$ 2,519,720	$ 5,457,260	$ 11,299,755	$ 26,499,904	$ 103,463,095
Lock 17	$ 2,780,882	$ 6,022,889	$ 12,470,942	$ 29,246,543	$ 114,186,747
Lock 18	$ 2,225,675	$ 4,820,411	$ 9,981,103	$ 23,407,433	$ 91,389,214
Lock 19	$ 1,561,986	$ 3,382,980	$ 7,004,770	$ 16,427,412	$ 64,137,244
Lock 20	$ 4,335,624	$ 9,390,178	$ 19,443,222	$ 45,597,760	$ 178,026,506
Lock 21	$ 2,930,227	$ 6,346,343	$ 13,140,684	$ 30,817,204	$ 120,319,049
Lock 22	$ 6,405,157	$ 13,872,414	$ 28,724,102	$ 67,363,047	$ 263,004,321
Lock 24	$ 4,356,441	$ 9,435,264	$ 19,536,577	$ 45,816,693	$ 178,881,282
Lock 25	$ 6,664,178	$ 14,433,407	$ 29,885,688	$ 70,087,171	$ 273,640,067
Total (Iowa to Mid Mississippi River)	**$ 43,894,142**	**$ 95,066,788**	**$ 196,844,481**	**$ 461,634,765**	**$ 1,802,352,221**
Total (Minnesota to Mid Mississippi River)	**$ 50,268,322**	**$ 108,872,111**	**$ 225,429,666**	**$ 528,672,027**	**$ 2,064,084,584**

Source: Army Corps of Engineers and IEG

The extra draw area increases the value of a large scale improvement by over $620 million annually by 2060. It should be noted that the river is the low cost transportation mode to dry bulk products. The railroads will either have to lose market share or lower its tariff. Either option is very important to shippers. Currently, shippers in North Dakota and Canada Prairies are complete price takers when dealing with the railroads. The reality is the optionality the river provides creates a tremendous amount of benefit that to local economies that is not captured.

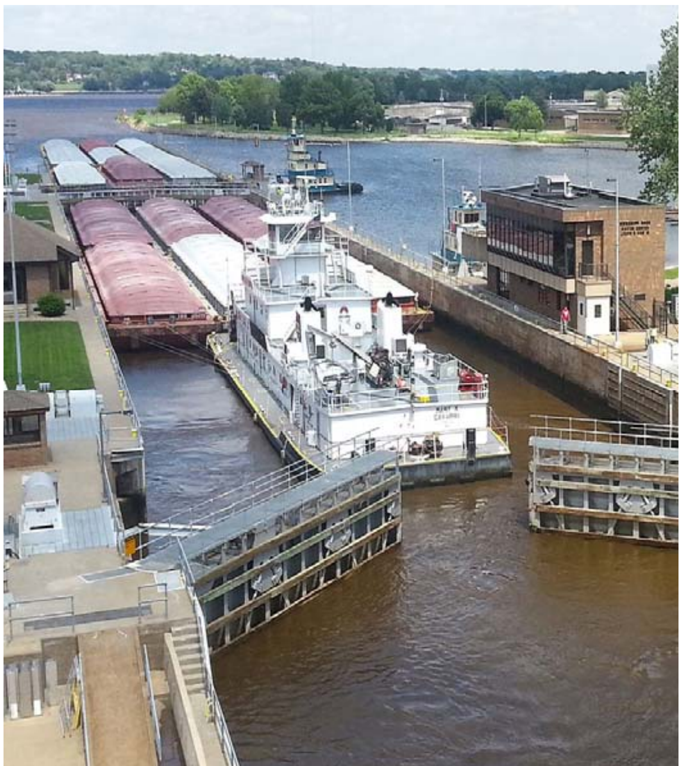
Table 41: Combined Barge Cost and Savings by Focus Lock (High Minus Low)

Lock	2017	2027	2037	2047	2060
Difference Cost Savings (Delay and Switchboat Savings) (Annual)					
Lock 1	$ -	$ -	$ -	$ -	$ -
Lock 2	$ 10	$ 102,255	$ 436,398	$ 1,452,265	$ 6,701,516
Lock 3	$ 12	$ 122,611	$ 523,274	$ 1,741,374	$ 8,035,618
Lock 4	$ 10	$ 101,026	$ 431,156	$ 1,434,821	$ 6,621,019
Lock 5	$ 11	$ 113,148	$ 482,890	$ 1,606,982	$ 7,415,465
Lock 5 A	$ 11	$ 112,241	$ 479,017	$ 1,594,093	$ 7,355,984
Lock 6	$ 12	$ 123,847	$ 528,548	$ 1,758,924	$ 8,116,604
Lock 7	$ 12	$ 125,679	$ 536,369	$ 1,784,953	$ 8,236,714
Lock 8	$ 22	$ 232,408	$ 991,863	$ 3,300,766	$ 15,231,473
Lock 9	$ 16	$ 166,906	$ 712,313	$ 2,370,467	$ 10,938,587
Lock 10	$ 16	$ 169,931	$ 725,225	$ 2,413,437	$ 11,136,872
Lock 11	$ 18	$ 185,317	$ 790,886	$ 2,631,947	$ 12,145,193
Lock 12	$ 23	$ 247,161	$ 1,054,823	$ 3,510,287	$ 16,198,314
Lock 13	$ 24	$ 256,232	$ 1,093,534	$ 3,639,112	$ 16,792,783
Lock 14	$ 51	$ 533,865	$ 2,278,405	$ 7,582,179	$ 34,988,170
Lock 15	$ 49	$ 511,791	$ 2,184,202	$ 7,268,685	$ 33,541,544
Lock 16	$ 45	$ 474,409	$ 2,024,664	$ 6,737,767	$ 31,091,611
Lock 17	$ 50	$ 523,580	$ 2,234,515	$ 7,436,117	$ 34,314,166
Lock 18	$ 40	$ 419,047	$ 1,788,391	$ 5,951,487	$ 27,463,298
Lock 19	$ 28	$ 294,088	$ 1,255,098	$ 4,176,773	$ 19,273,831
Lock 20	$ 77	$ 816,305	$ 3,483,792	$ 11,593,517	$ 53,498,600
Lock 21	$ 52	$ 551,699	$ 2,354,517	$ 7,835,468	$ 36,156,979
Lock 22	$ 114	$ 1,205,954	$ 5,146,718	$ 17,127,478	$ 79,035,214
Lock 24	$ 78	$ 820,224	$ 3,500,519	$ 11,649,182	$ 53,755,468
Lock 25	$ 119	$ 1,254,722	$ 5,354,849	$ 17,820,103	$ 82,231,354
Total (Iowa to Mid Mississippi River)	**$ 783**	**$ 8,264,324**	**$ 35,270,139**	**$ 117,373,538**	**$ 541,623,398**
Total (Minnesota to Mid Mississippi River)	**$ 897**	**$ 9,464,446**	**$ 40,391,966**	**$ 134,418,182**	**$ 620,276,377**

Source: Army Corps of Engineers and IEG

Attachment B

Economics Background and Context Report



Economics Background and Context

Upper Mississippi River Inland Waterway Infrastructure

Iowa Department of Transportation

Ames, Iowa

April 2019

Contents

Figures

Tables

Appendices

1.0 Introduction

The inland waterways are a strategic asset to the nation, enabling the United States to significantly increase economic output in both domestic and international markets, and move important national defense resources and other supplies in large quantities. The United States economy relies on an efficient and low cost transportation network for movement of its domestic and export commodities. In particular, United States export commodities depend on the transportation network to offset higher wage levels and costs of production when compared with international competitors. Over the next 20 years economists estimate that inland navigation will increase by more than 35 percent.[1] The United States' waterways transport more than 60 percent of the nation's grain exports, about 22 percent of domestic petroleum and petroleum products and 20 percent of the coal used in electricity generation.[2] According to data compiled by ASCE, United States inland waterways delivered more than 575 million tons of cargo in 2015, valued at $229 billion. Investment in inland waterways provides substantial economic benefits for both shippers and consumers. U.S. Army Corps of Engineers (USACE) have estimated that every dollar invested in United States waterways results in approximately 11 dollars in future benefits, over the lifecycle of the project and beyond. Furthermore, it was estimated that shippers and consumers saved on average $20.37 per ton due to shipping efficiencies arising from inland waterway transportation.[3]

This background report provides updated statistics from the 2013 report and a review of the literature since that report was published. It is intended that excerpts from this report will be included in the Vision Report.

2.0 Literature Review Summary

This literature review summarizes the key findings of studies since the 2013 report was published. The purpose of this section is not to endorse these reports, but rather to make the reader aware of the conclusions of these other studies in the context of the inland waterway system. The studies noted are conducted for a variety of different purposes, have a different geographic focus, and therefore use different assumptions and methods in quantifying economic impacts resulting in a range of impacts reported. For example, some studies look at the economic impacts of lost economic output without the system while others examine the net economic benefits that could result from system improvements. Therefore these summaries should be viewed within this context.

- A 2016 American Society of Civil Engineers (ASCE) study examined the detrimental future economic impacts arising from a projected investment gap for United States inland waterways. Across the United States, the projected investment gap ($43 billion from 2016 through 2040) may result in 440,000 fewer jobs in 2025 and almost 1.2 million fewer jobs in 2040 than would otherwise be expected with modernization

---

1 *Ginsburg, Robert and Dirks, Lise. "An Analysis of the Illinois Maritime Transportation System." 2017.* https://utc.uic.edu/wp-content/uploads/Illinois-Maritime-Transportation-System-Report-__Final-Report-8302017.pdf

2 *Ibid.*

3 *United States Army Corps of Engineers. "Inland Waterways Users Board 29th Annual Report – To the Secretary of the Army and the United States Congress." 2016.* http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983

improvements.[4] By 2025, the United States will have lost almost $800 billion in GDP, while the cumulative impact through 2040 is expected to be almost $2.8 trillion of GDP.[5]

- Similarly, a 2016 study commissioned by the U.S. Department of Agriculture (USDA) shows the effects of a lock and dam (L&D) closure upon grain transportation. If Mississippi L&D 25 was unavailable for the 2024/25 marketing year, the reduced economic activity would reach nearly $2 billion.[6] For harvest season alone, the disruption would cost $933 million (or 40 percent decrease) if L&D 25 was unavailable from September to November of the 2024/25 marketing year.[7] A decline in economic surplus in the corn and soybean sector due to L&D 25 closure could cause a decrease of more than 7,000 jobs, $1.3 billion in labor income and about $2.4 billion of economic activity (total industry output) annually.[8] A similar unavailability at LaGrange Lock and Dam would result in a reduction of almost 5,500 jobs, $891 million in labor income and $1.8 billion of economic activity (total industry output) annually.[9]

- In efforts to estimate total economic impacts from closure of key locks, a 2017 study performed by the Center for Transportation Research at the University of Tennessee estimated lost output from the closure of the LaGrange Lock and Dam (Illinois River) and L&D 25 (Upper Mississippi River). The closure of LaGrange would result in 24,447 lost jobs, $1.46 billion in incomes, and $5.19 billion in regional output.[10] Similarly, an unplanned closure of Mississippi L&D 25 would result in 24,250 lost jobs, $1.57 billion in incomes, and $5.24 billion in regional output. Either closure would threaten the United States' primary path for corn and soybean exports and affect commerce in 132 counties in 18 states, and cost shippers nearly $1.7 billion in additional transportation costs.[11] Closures also severely discourage users from returning to the system and strongly impact farming-dependent incomes, which results in the economy reaching a lower steady-state output.

- Lastly, the Illinois Chamber of Commerce estimated, through an economic impact and cluster analysis, which 22 counties and four states would directly benefit from improvements to the Illinois River system. All scenarios examined by the study increased economic potential, business activity, and ultimately the workforce due to shipper cost savings. The State economy is impacted by an estimate annual increase in output ranging from $27 million to $69 million, as well as an initial increase in

---

4 *American Society of Civil Engineers. "Failure to Act: The Impact of Infrastructure Investment on America's Economic Future." 2016.* https://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf

5 *Ibid.*

6 *Yu, T.E, B.C. English and R.J. Menard, Department of Agricultural and Resource Economics, University of Tennessee. "Economic Impacts Analysis of Inland Waterways Disruption on the Transport of Corn and Soybeans. Staff Report #AE16-08." 2016.* https://www.ams.usda.gov/sites/default/files/media/EconomicImpactsAnalysisInlandWaterwaysSummary.pdf

7 *Ibid.*

8 *Ibid.*

9 *Ibid.*

10 *Center for Transportation Research, The University of Tennessee. "The Impacts of Unscheduled Lock Outages." 2017.* http://waterwayscouncil.org/wp-content/themes/waterways/images/NWF_lock_outage_2017.pdf

11 *Ibid.*

employment from 106 to 270 jobs.[12] Benefits are further experienced by states who trade with Illinois, specifically Iowa, Wisconsin, Missouri, and Louisiana. The measured impacts of output and employment range up to $8.4 million annually, generating 24 new jobs.[13]

3.0 Lock Volumes

3.1 Lock Data and Charts

The figures below summarize yearly tonnage passing through each lock along the Upper Mississippi River system, as well as the average tow delay[14] and processing times[15]. A key finding is that processing times are relatively constant while average tow delays are variable across all locks. Thus, tow delays experienced are largely the result of delays prior to lockage.

Food and farm products consistently encompass the majority of volumes (approximately 62 percent on aggregate across all locks) while chemicals and related products accounted for over 16 percent of total 2016 tonnage. The source for all charts is the U.S. Army Corps of Engineers' Lock Performance Monitoring System (LPMS) [17] developed to collect an array of lock performance data across the nation's inland navigation system of locks and dams. The LPMS data sets are summarized by waterway system and then by locks within each system. LPMS data includes the number and types of vessels and lockages, number of cuts, lock delay and processing times, number of tows delayed, total tonnage, tonnage by commodity, and number of barges. Data is also collected on scheduled and unscheduled lock outages. The LPMS data entries occur at each lock field site and are compiled at the USACE's Navigation Data Center. As with all data sets, the accuracy, completeness and consistency of the inputted data determine the overall precision of the LPMS information.

The compilation of LPMS data summaries may yield a number of anomalies in year-over-year comparisons and reporting between USACE districts. As an example, the UMR Waterway locks in the St. Paul District are officially closed during the winter months (mid-December to mid-March) and reported as scheduled closures in the LPMS system. In contrast, the UMR Waterway locks in the St. Louis and Rock Island Districts are not closed in the winter months and periods of lock unavailability due to ice are reported as unscheduled closures in the LPMS system. Similarly, maintenance closures in the St. Louis and Rock Island Districts typically are scheduled during the winter months when impacts to navigation are minimal and these closures are often reported in LPMS as scheduled closures. Thus, when significant outliers occur in the

---

12 *Economic Development Research Group, Prepared for the Illinois Chamber of Commerce Foundation. "Final Report: An Economic Impact and Cluster Analysis of Illinois River Lock and Dam Facilities for Beneficial Users." 2016.* http://ilchamber.org/wp-content/uploads/2011/08/IL-River-Economic-Impact-and-Cluster-Analysis-Report-Aug-2016-.pdf

13 *Ibid.*

14 *Delay time is defined as "the difference between the Arrival Time and the Start of Lockage time of the first cut; where a cut is one single movement of a vessel and/or commodities through the chamber. Average delay is calculated as the total number of minutes all vessels were delayed divided by the number of vessels, and includes the delay time of those vessels still in the queue." U.S. Army Corps of Engineers, Lock Performance Monitoring System. "Lock Queue Report."* http://corpslocks.usace.army.mil/lpwb/f?p=121:3:0::NO:::

15 *Processing times are defined as "the time spent traversing the lock from the first cuts' start of lockage time to the last cuts' end of lockage time." U.S. Army Corps of Engineers, Lock Performance Monitoring System. "Lock Queue Report."* http://corpslocks.usace.army.mil/lpwb/f?p=121:3:0::NO:::

17 *U.S. Army Corps of Engineers, Navigation Data Center. "Lock Use, Performance, and Characteristics."* http://www.navigationdatacenter.us/lpms/lpms.htm

data sets, they are typically related to anomalies in the consistency of the field lock site data inputs.

A significant variance in year-over-year comparison at a specific lock may be related to a lengthy lock reliability closure event during the primary navigation season, but more typically the closure is related to an act of nature such as a Mississippi River flood event inundating the lock and an unscheduled closure of the lock to navigation traffic. For example, Figure 18 shows the Lock 17 Delay and Process Times for the years 2000 – 2016. Year 2014 shows a significant spike in Average Tow Delays as compared to other years. An inspection of the LPMS data finds that Lock 17 was closed due to Mississippi River flooding from June 27th thru July 14th, a period of 18 days. For tows in lock queue at Lock 17 during this flood related closure, the LPMS data can be reporting a significant interval of tow delays thereby possibly influencing the annual Average Tow Delay being compiled in LPMS. Thus, long-term trends in the data typically provide the most meaningful interpretation of the data rather than year-over-year comparisons.

Agriculture is a crucial component to economies along the Mississippi River system. As mentioned, food and farm products (including corn, grain, soybean, wheat, and other agricultural commodities) account for over 60 percent of total tonnage shipped along the Mississippi River. USACE studies estimated that the closure of key locks, namely L&D 25, would result in a decline in economic surplus in the corn and soybean sector estimated at a loss of 7,000 jobs and $2.4 billion of lost economic activity.[18] As noticed by the charts below, certain locks experience sudden and sharp increases in average tow delay. Average tow delays generally follow the same trend as the volume of loaded barges. In other words, increases in barge traffic typically coincide with increases in average tow delays. Outliers, or statistical anomalies, are present in certain locks which may be explained by exogenous factors.[19] Due to variations in the reporting of maintenance and closure hours across USACE districts, the specific cause of these outliers are not explained in the underlying datasets.

---

[18] *United States Army Corps of Engineers. "Inland Waterways Users Board 29th Annual Report – To the Secretary of the Army and the United States Congress." 2016.* http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983

[19] *Exogenous factors include: tow accident damage, tow failure, persistent weather issues (ice, flood, rain, fog etc.), and inconsistent data reporting amongst districts. Certain weather-related issues occur solely in certain years which helps explain certain spikes in tow delays.*

3.2 Lock Data

Figure 1: Mississippi Lock 9, Usage Statistics

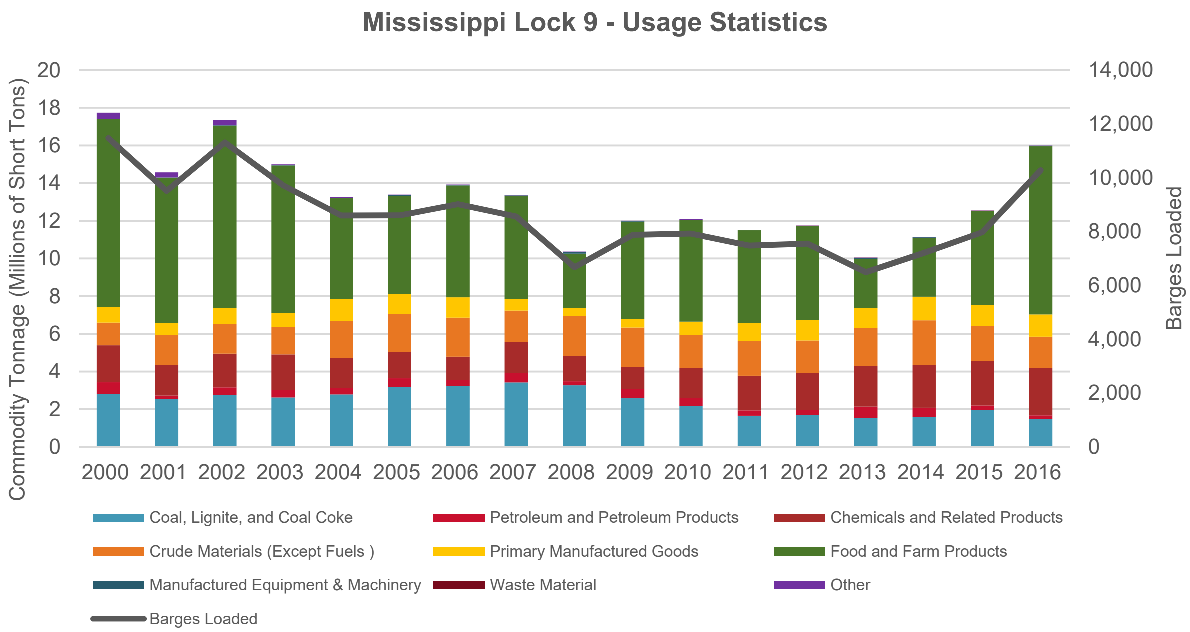


Figure 2: Mississippi Lock 9, Delay and Processing Times

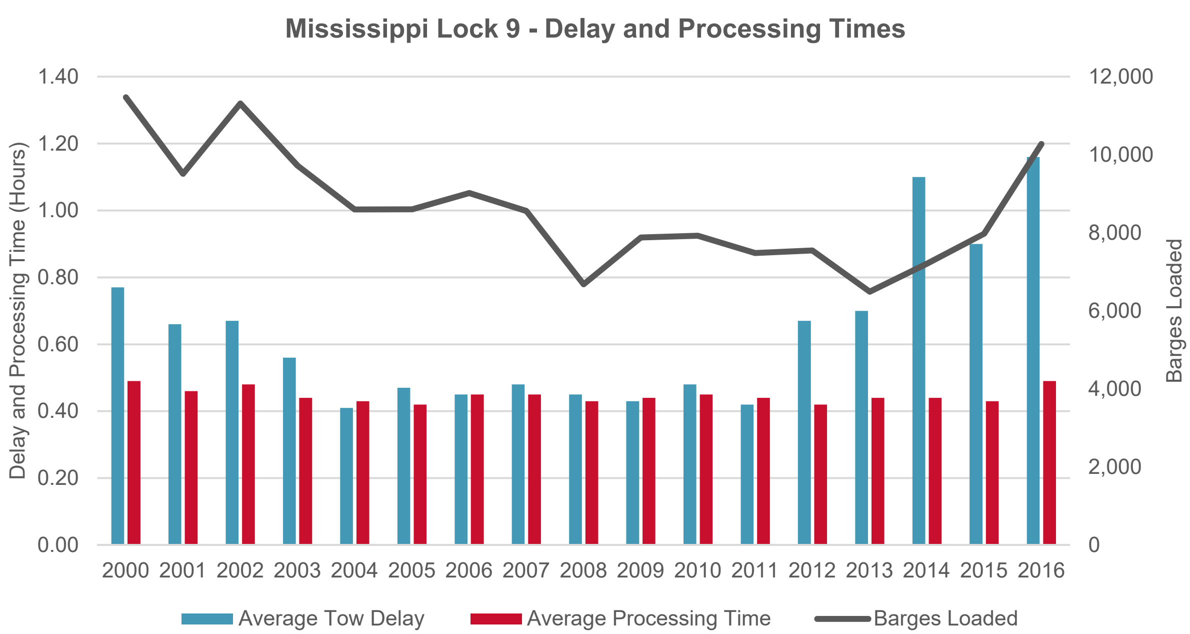


Figure 3: Mississippi Lock 10, Usage Statistics

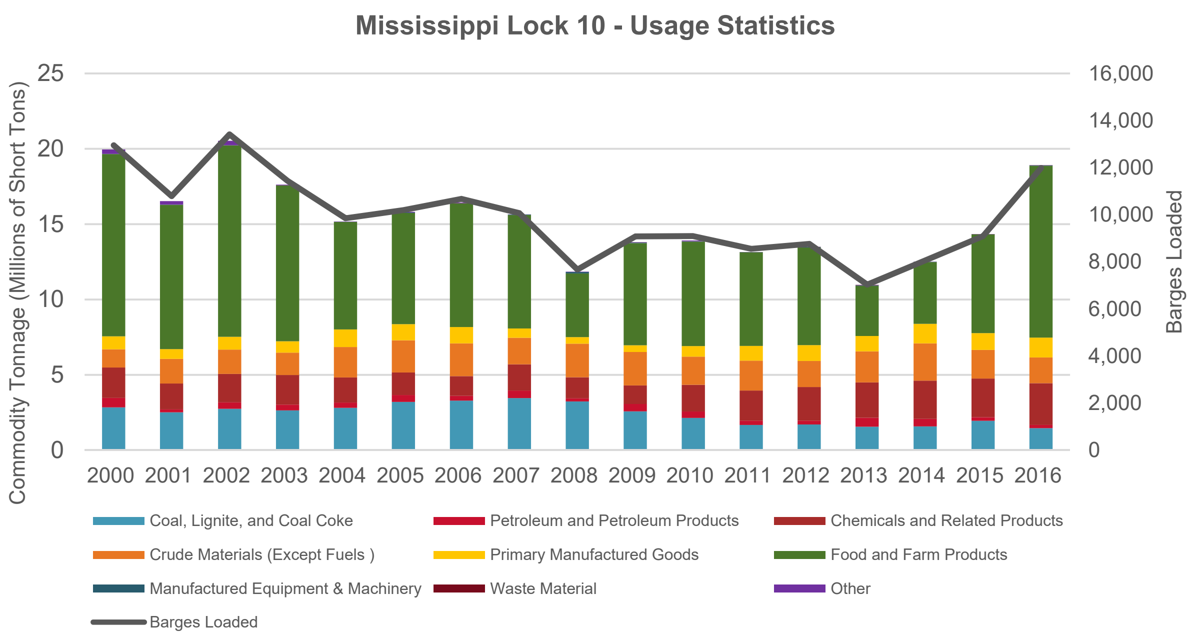


Figure 4: Mississippi Lock 10, Delay and Processing Times

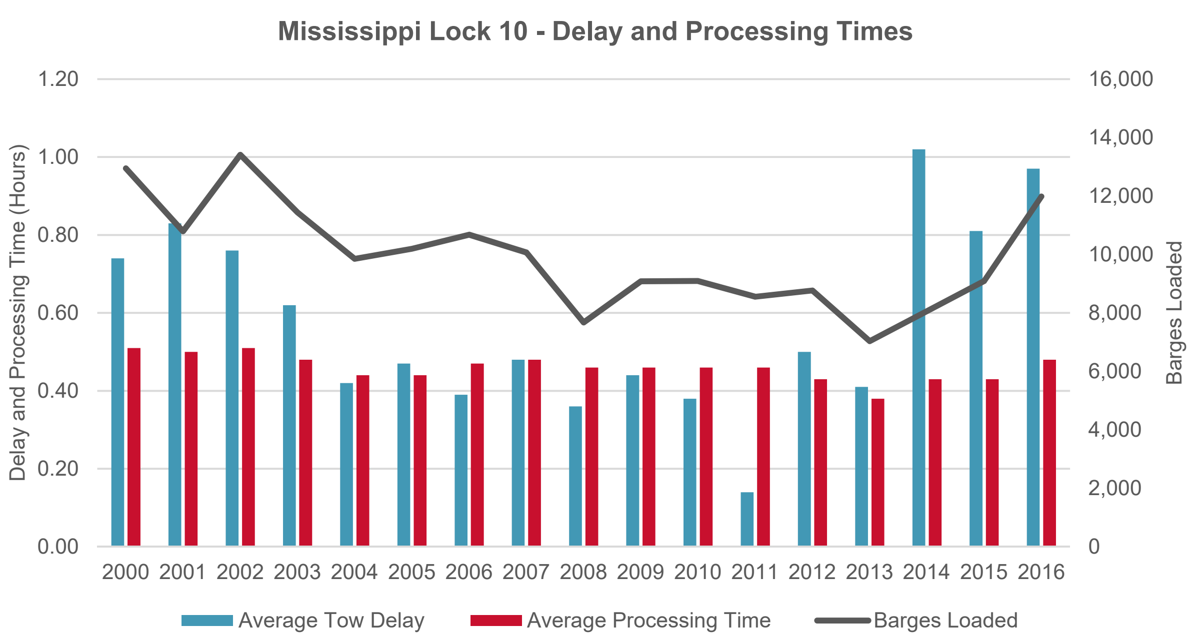


Figure 5: Mississippi Lock 11, Usage Statistics

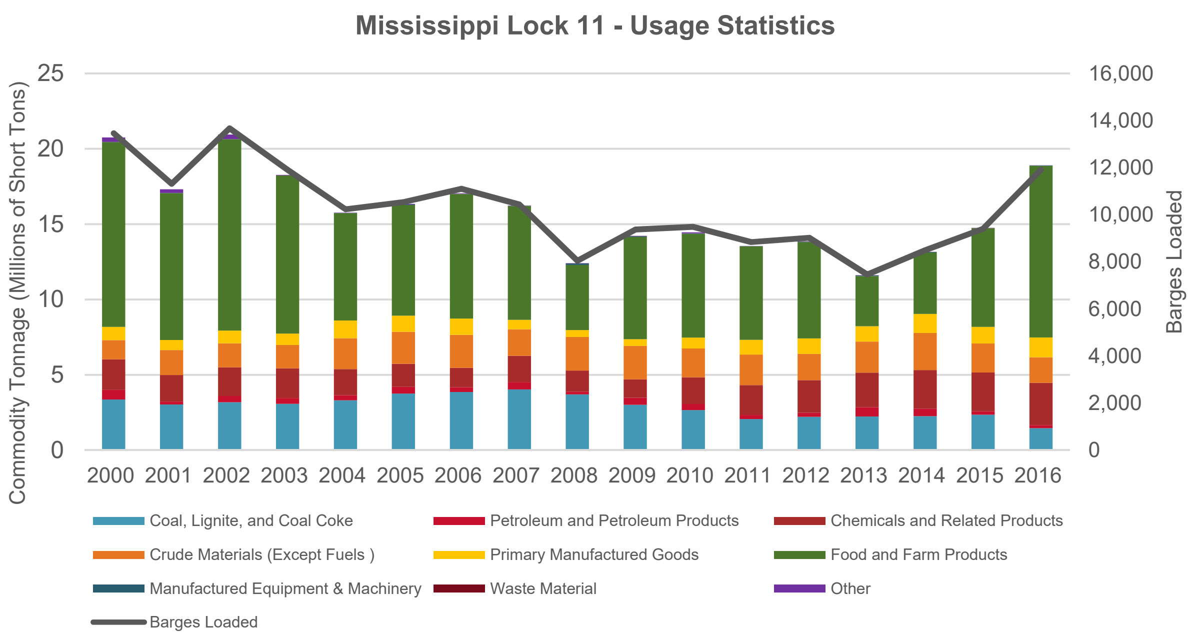
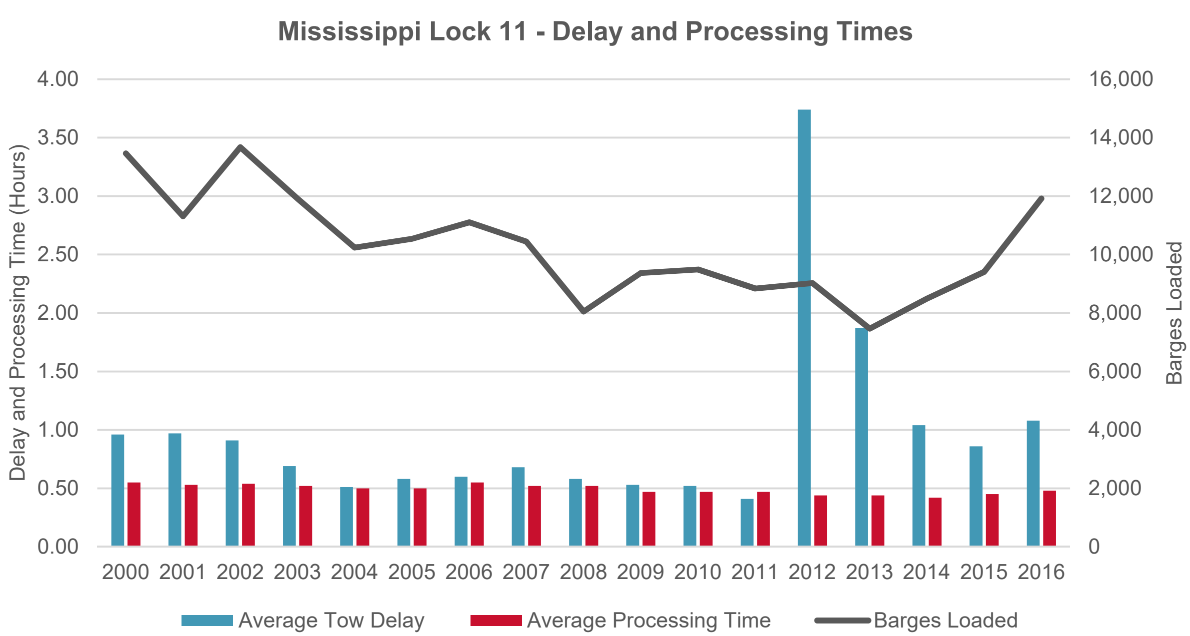


Figure 6: Mississippi Lock 11, Delay and Processing Times[20]



[20] *LPMS data includes an unscheduled lock closure from 1/1/2012 – 2/29/2012 for ice on lock or lock equipment.*

Figure 7: Mississippi Lock 12, Usage Statistics

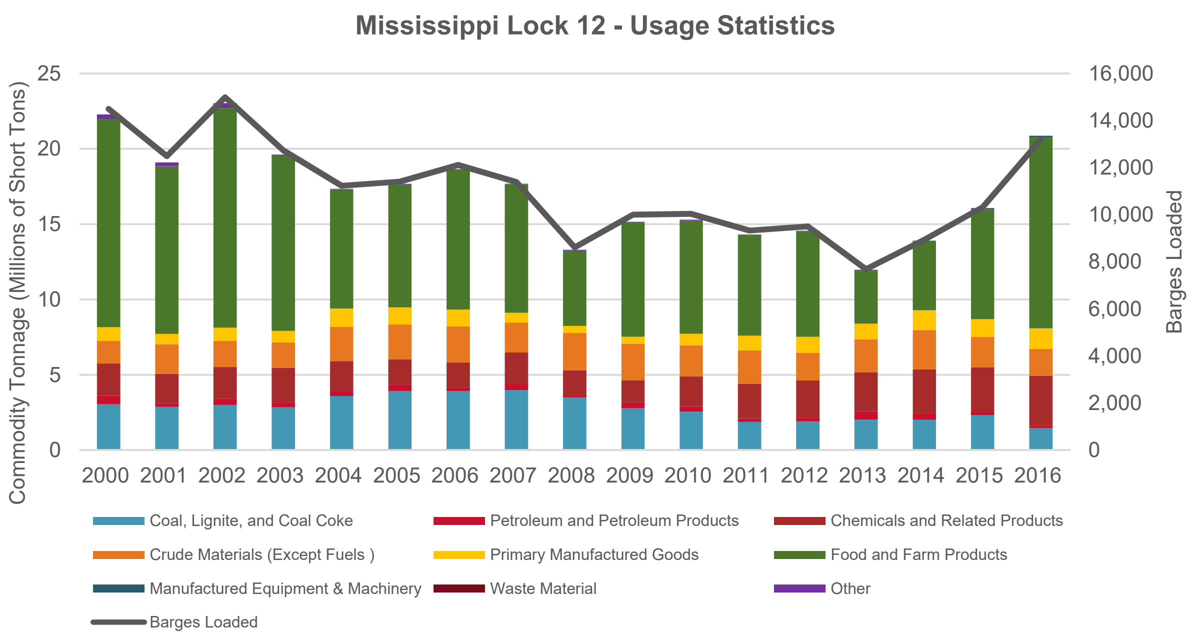


Figure 8: Mississippi Lock 12, Delay and Processing Times

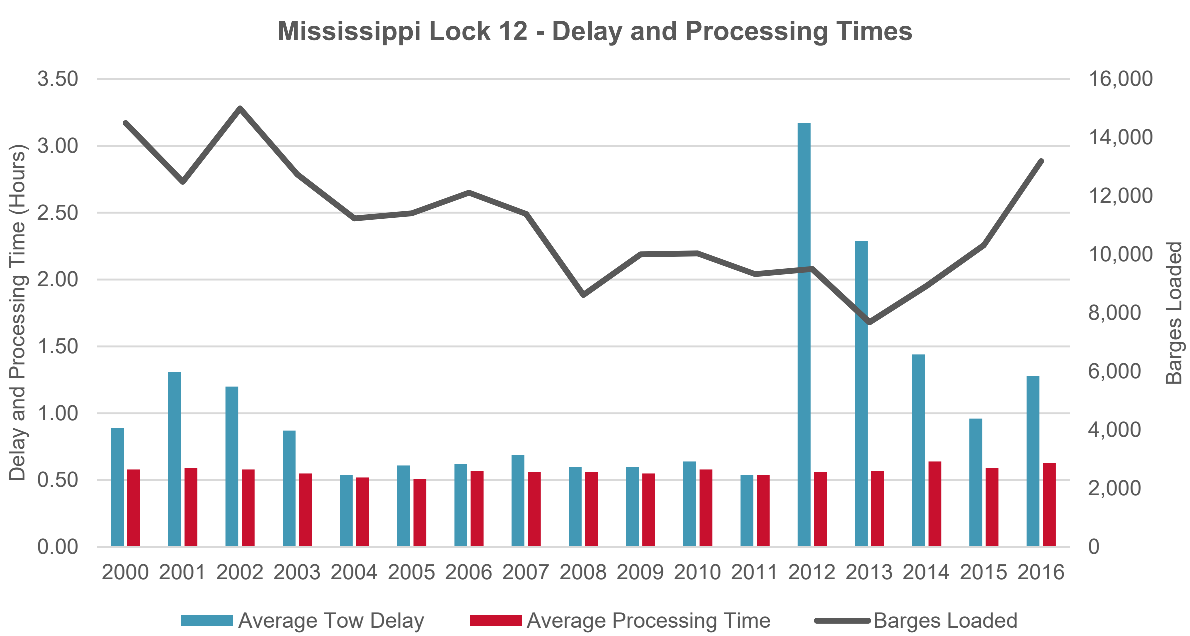


Figure 9: Mississippi Lock 13, Usage Statistics

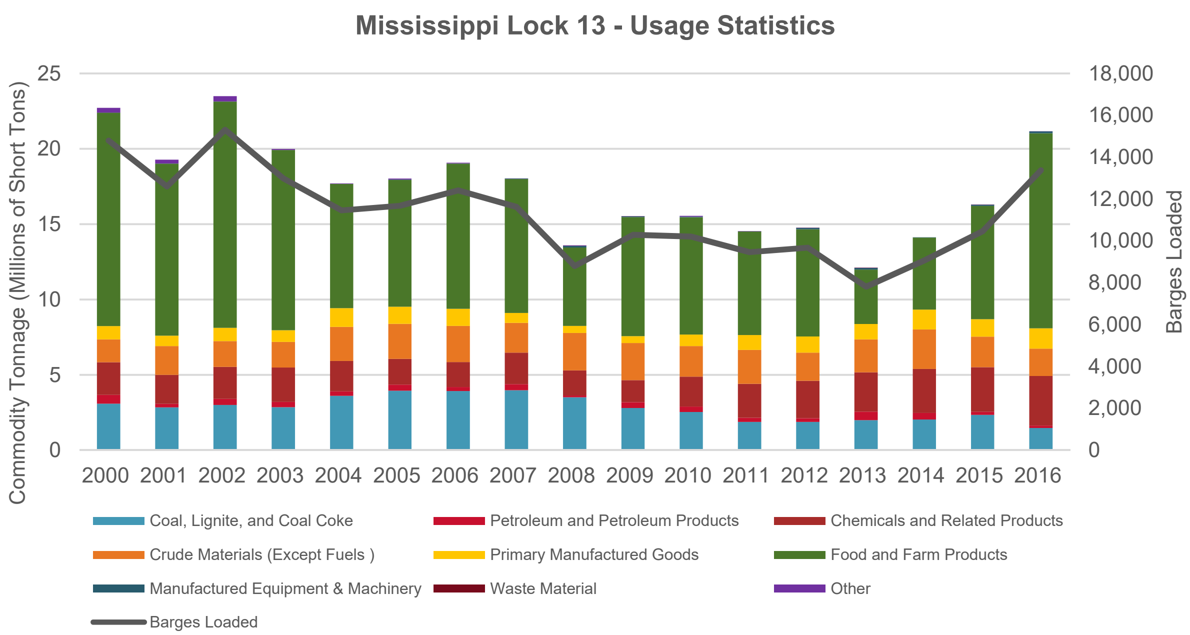


Figure 10: Mississippi Lock 13, Delay and Processing Times

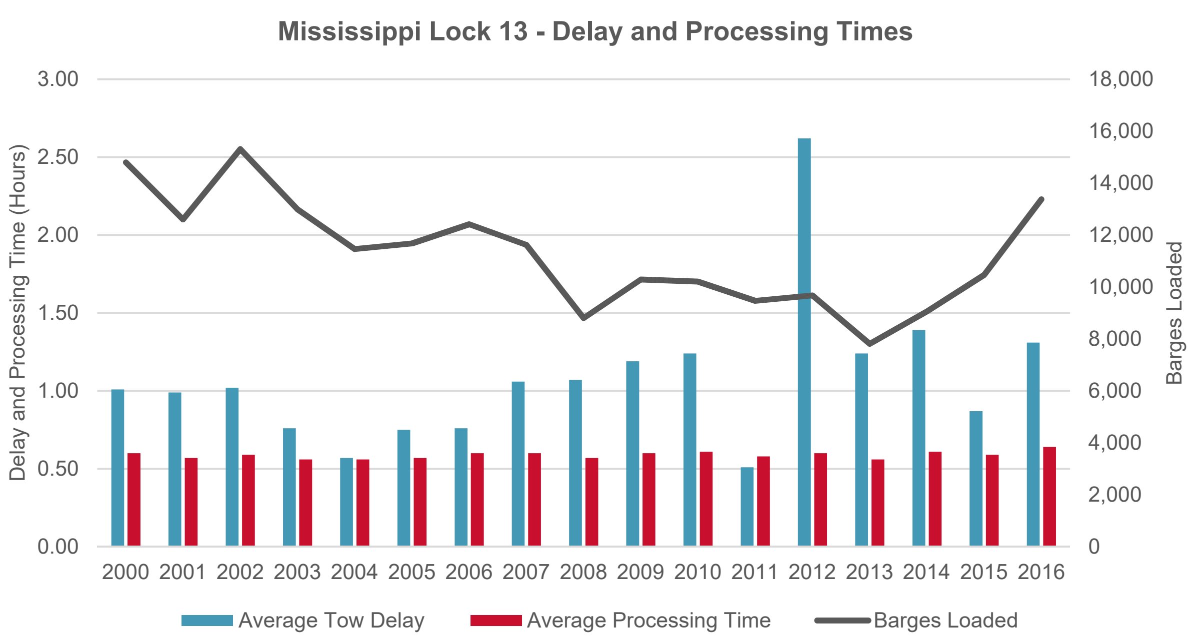


Figure 11: Mississippi Lock 14, Usage Statistics

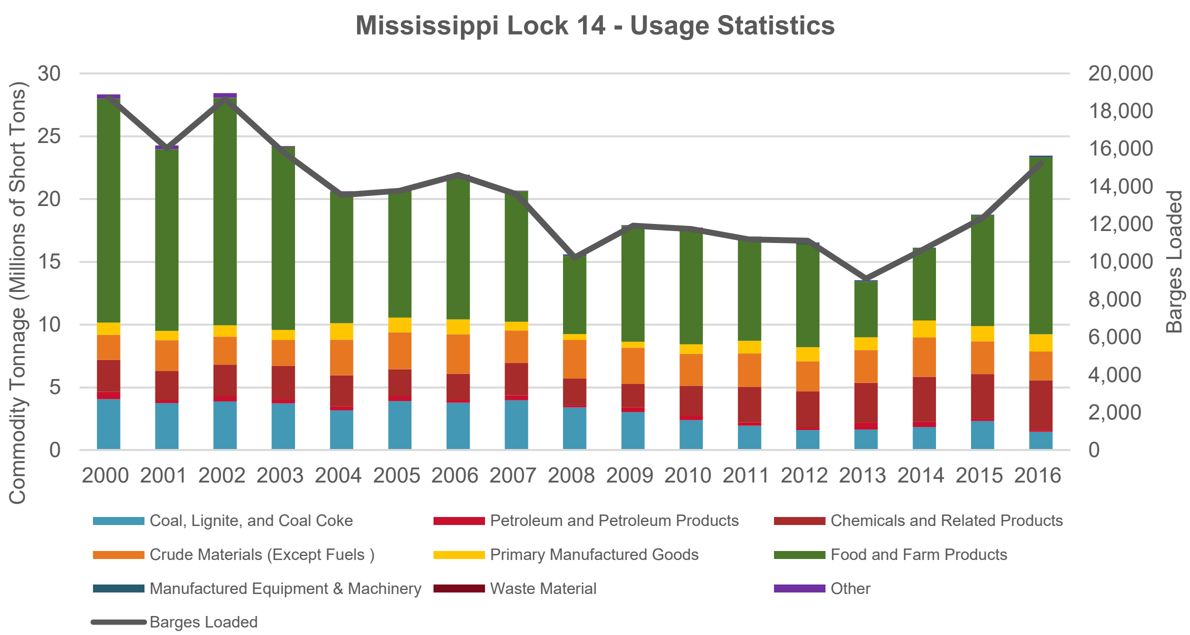


Figure 12: Mississippi Lock 14, Delay and Processing Times

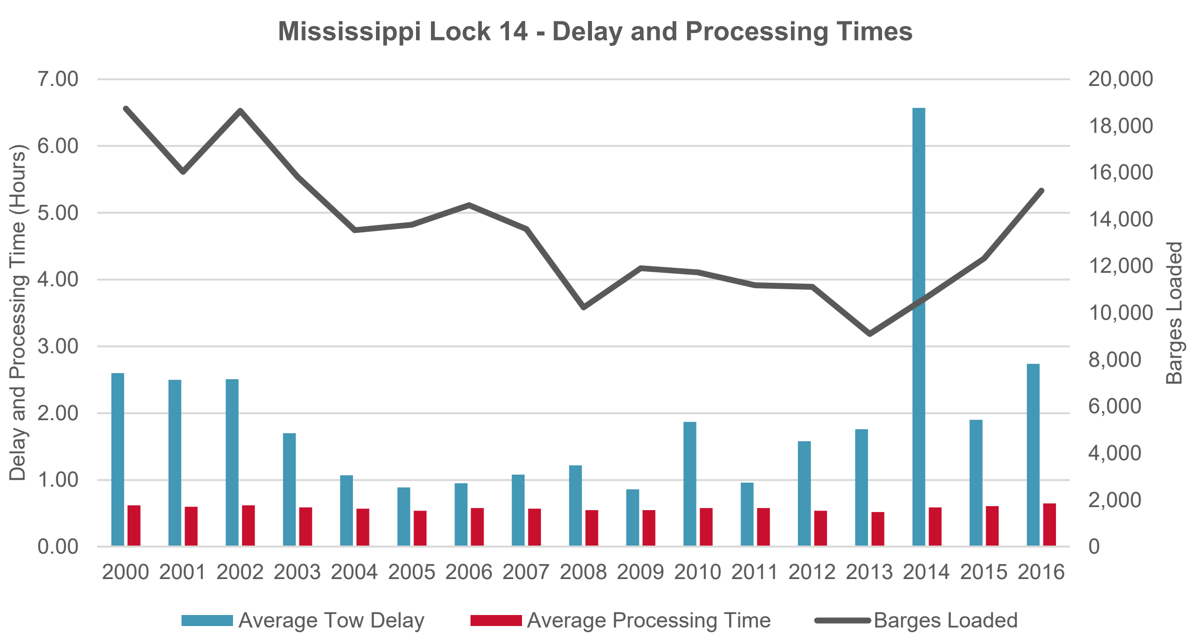


Figure 13: Mississippi Lock 15, Usage Statistics

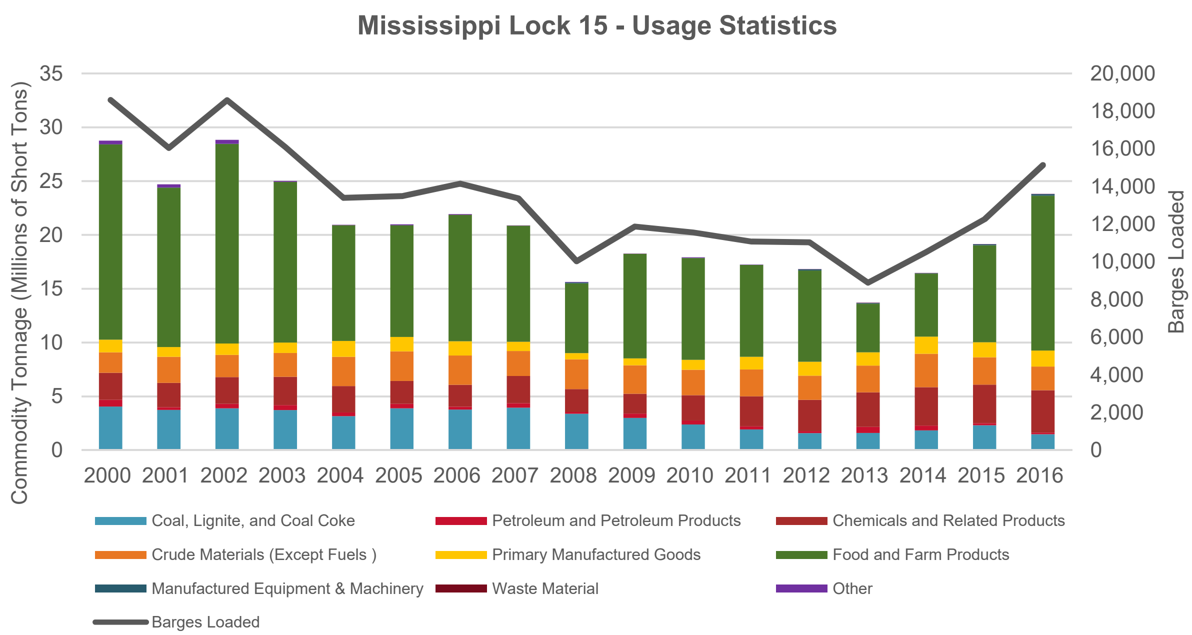


Figure 14: Mississippi Lock 15, Delay and Processing Times

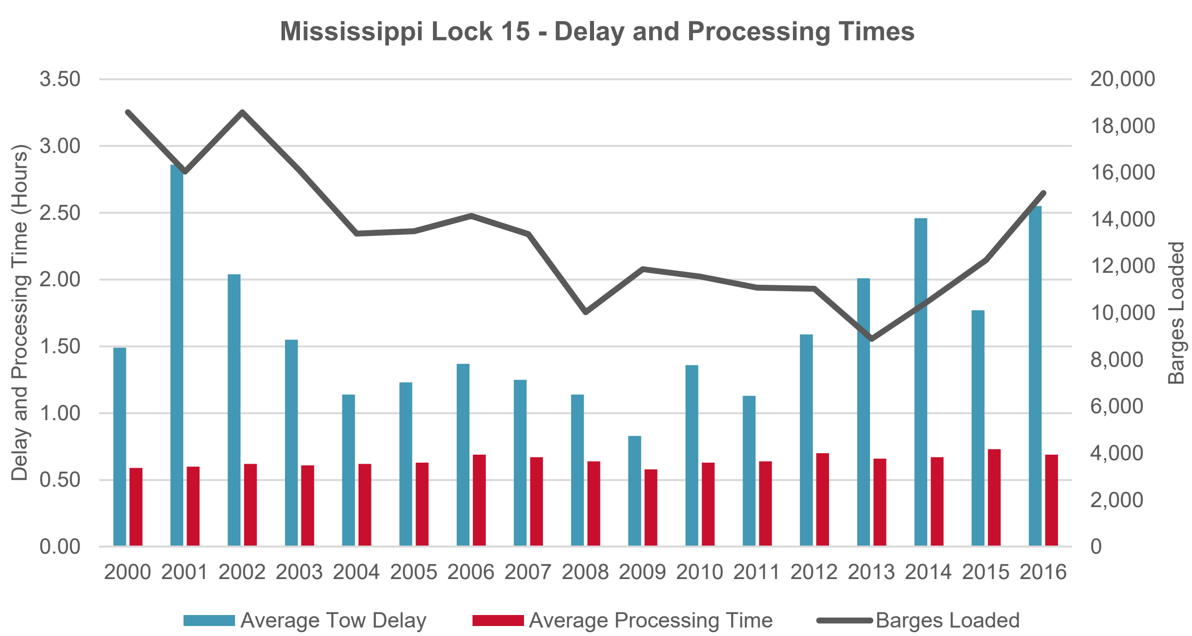


Figure 15: Mississippi Lock 16, Usage Statistics

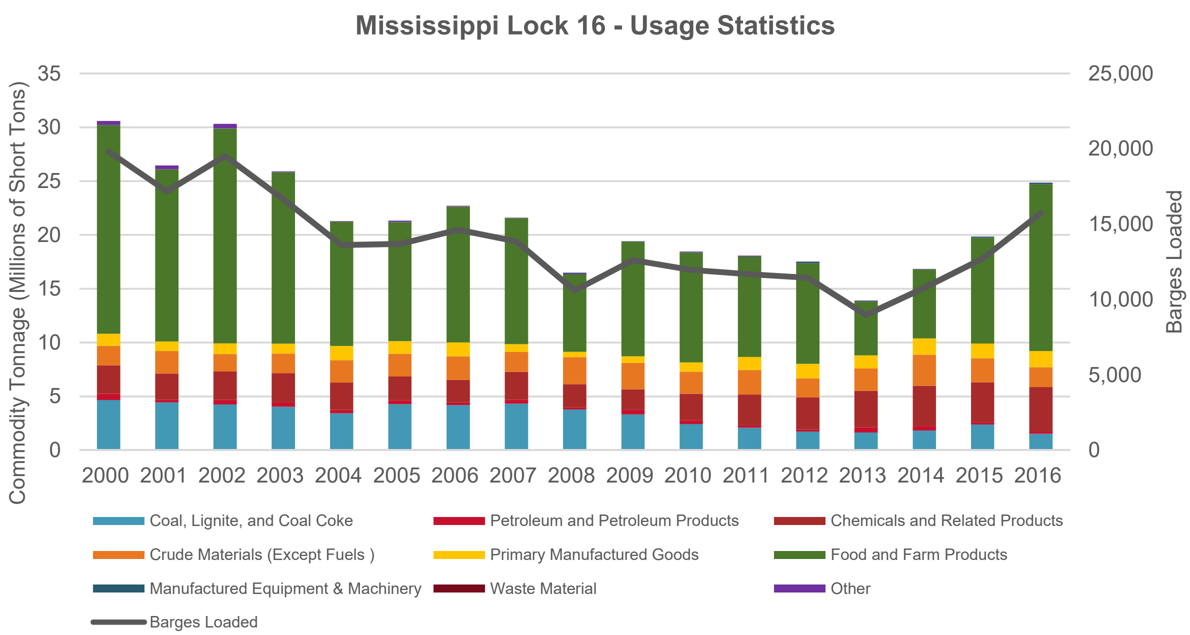


Figure 16: Mississippi Lock 16, Delay and Processing Times

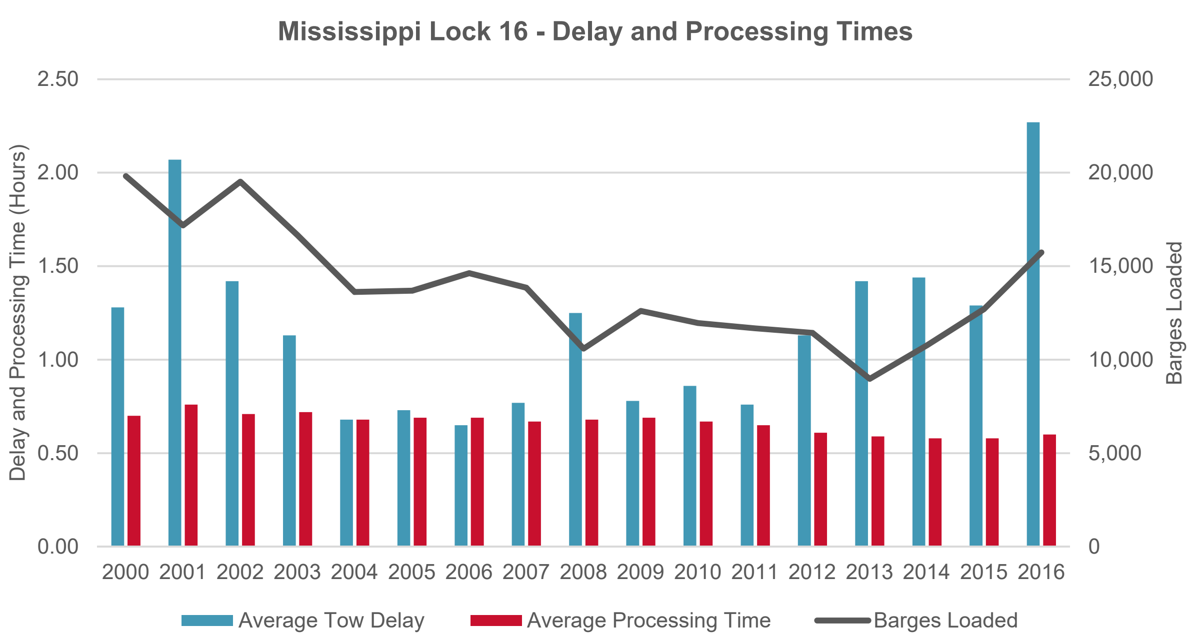


Figure 17: Mississippi Lock 17, Usage Statistics

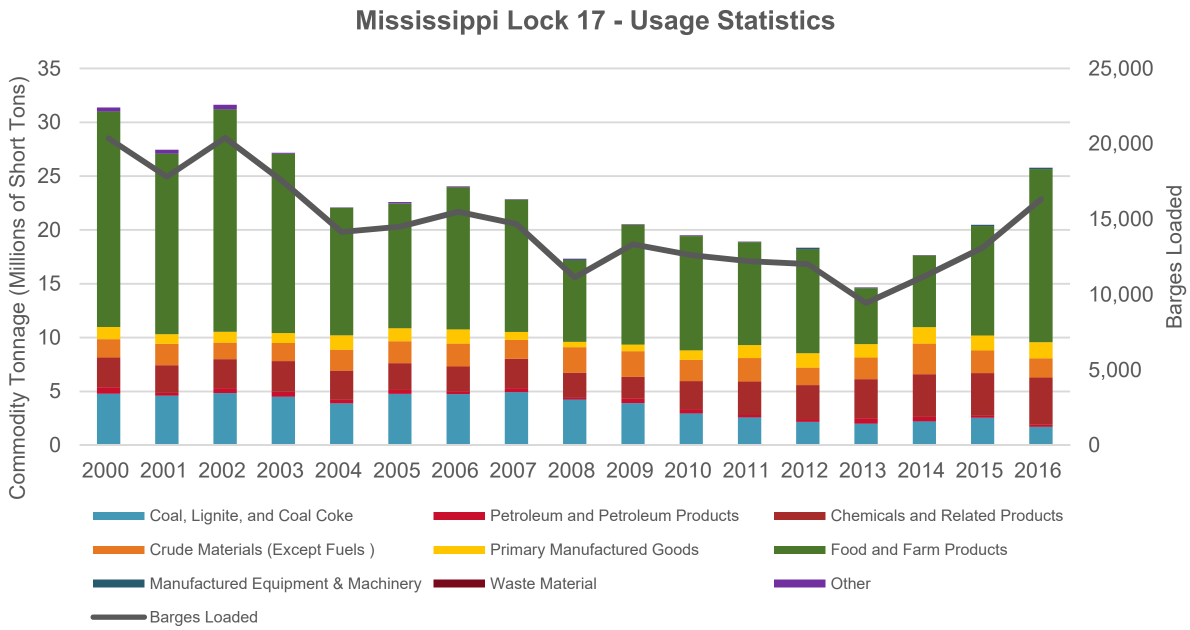


Figure 18: Mississippi Lock 17, Delay and Processing Times

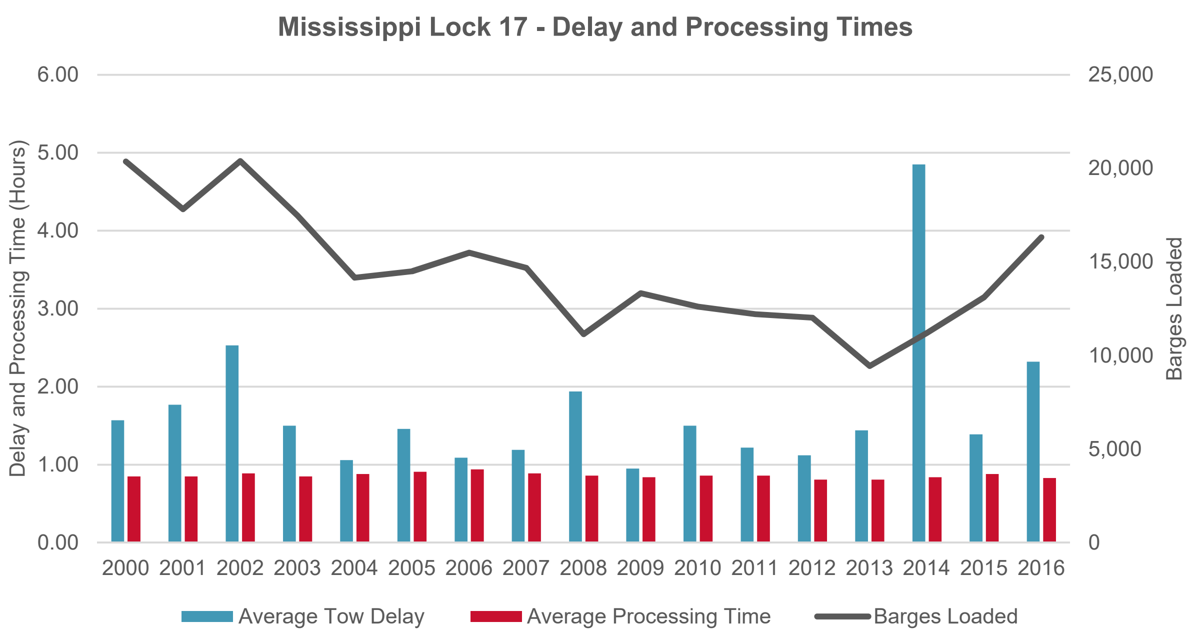


Figure 19: Mississippi Lock 18, Usage Statistics

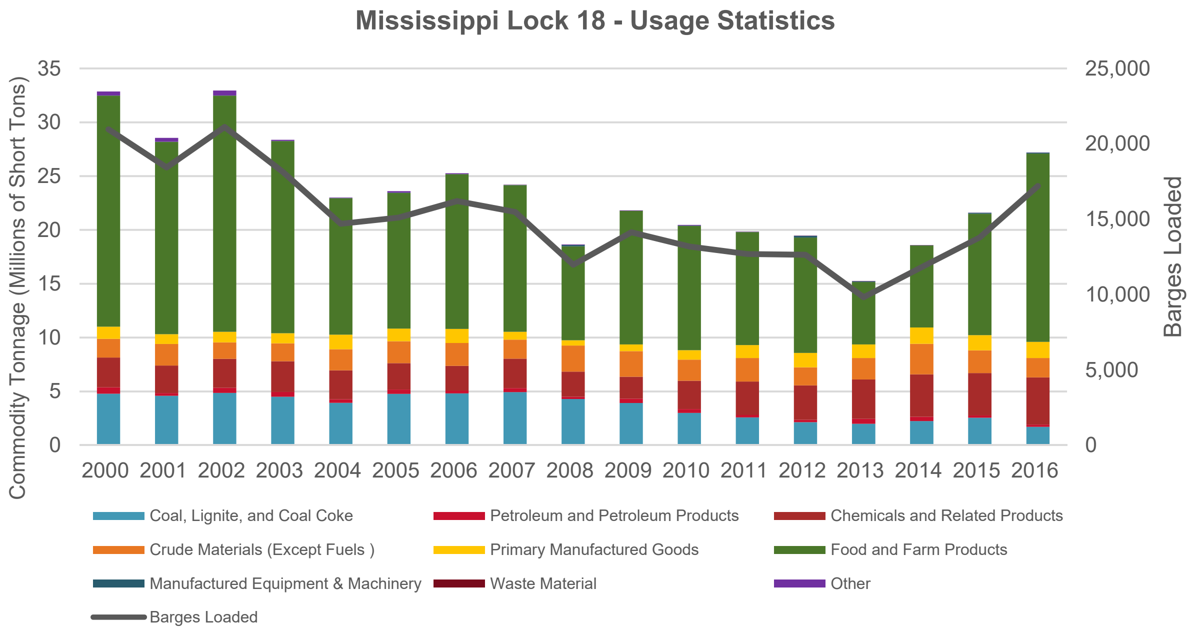


Figure 20: Mississippi Lock 18, Delay and Processing Times

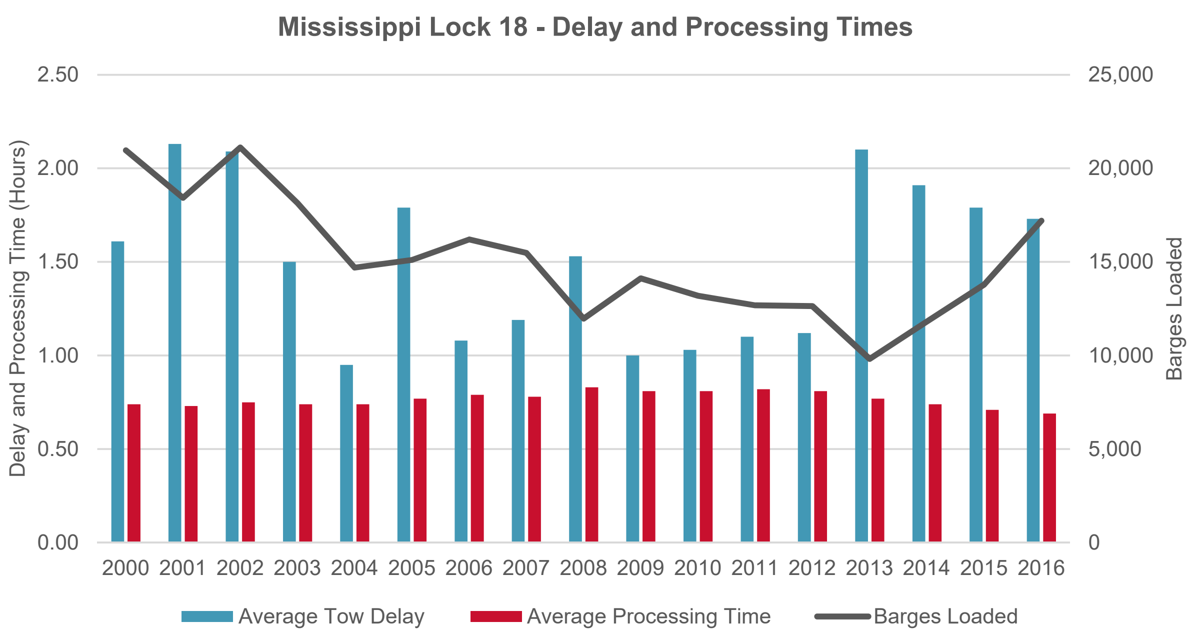


Figure 21: Mississippi Lock 19, Usage Statistics

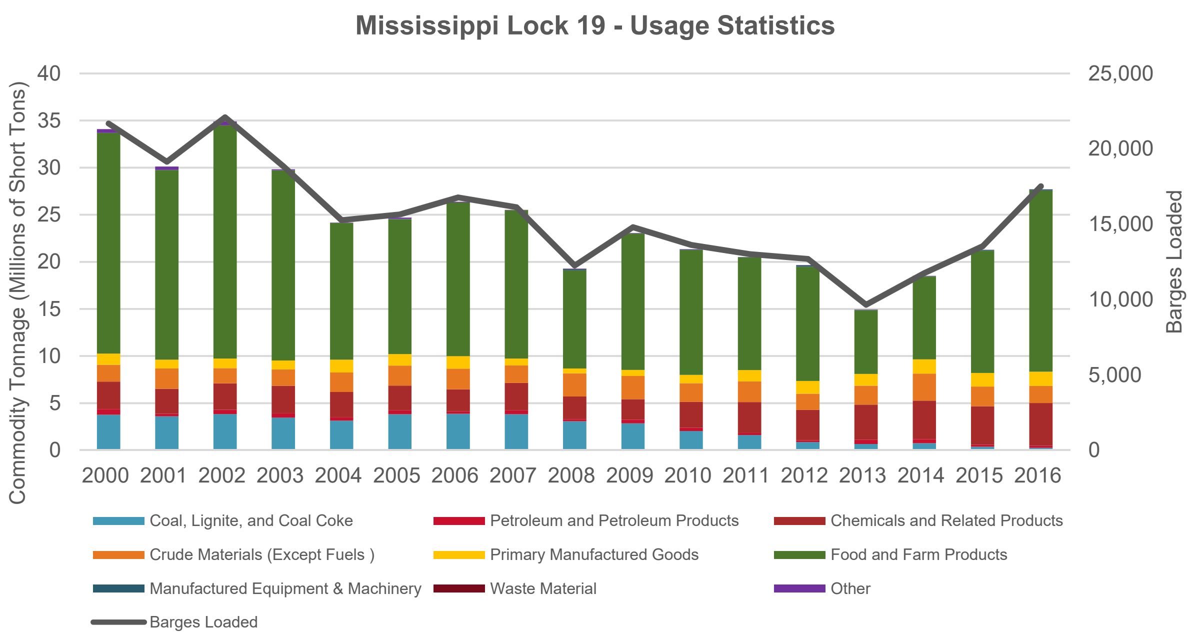


Figure 22: Mississippi Lock 19, Delay and Processing Times

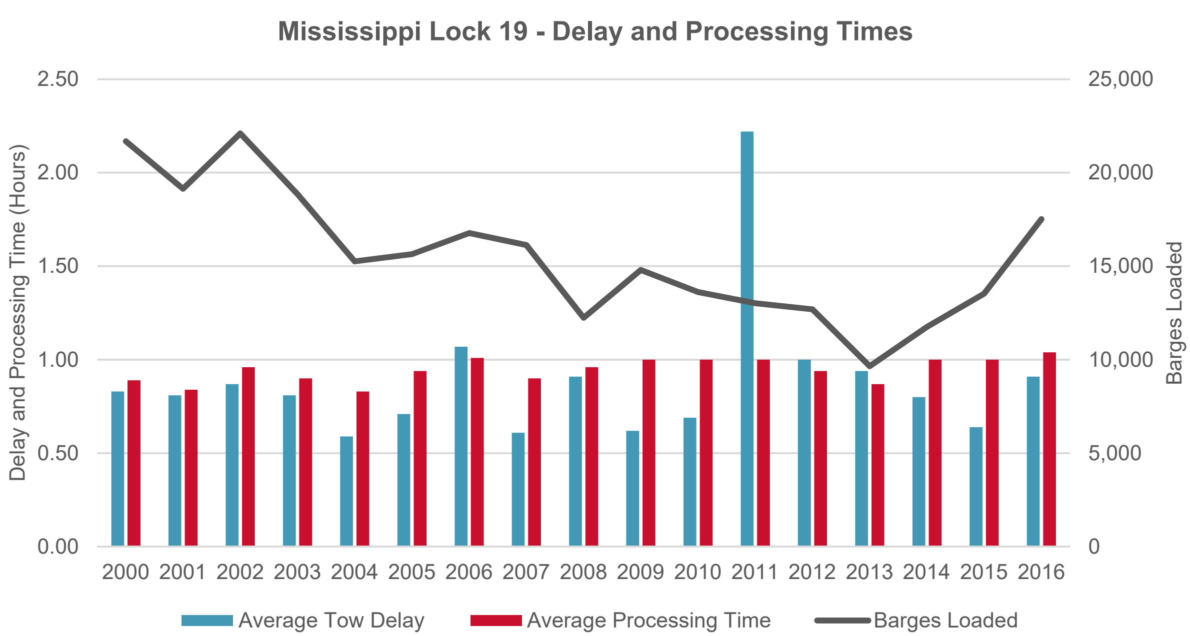


Figure 23: Mississippi Lock 25, Usage Statistics

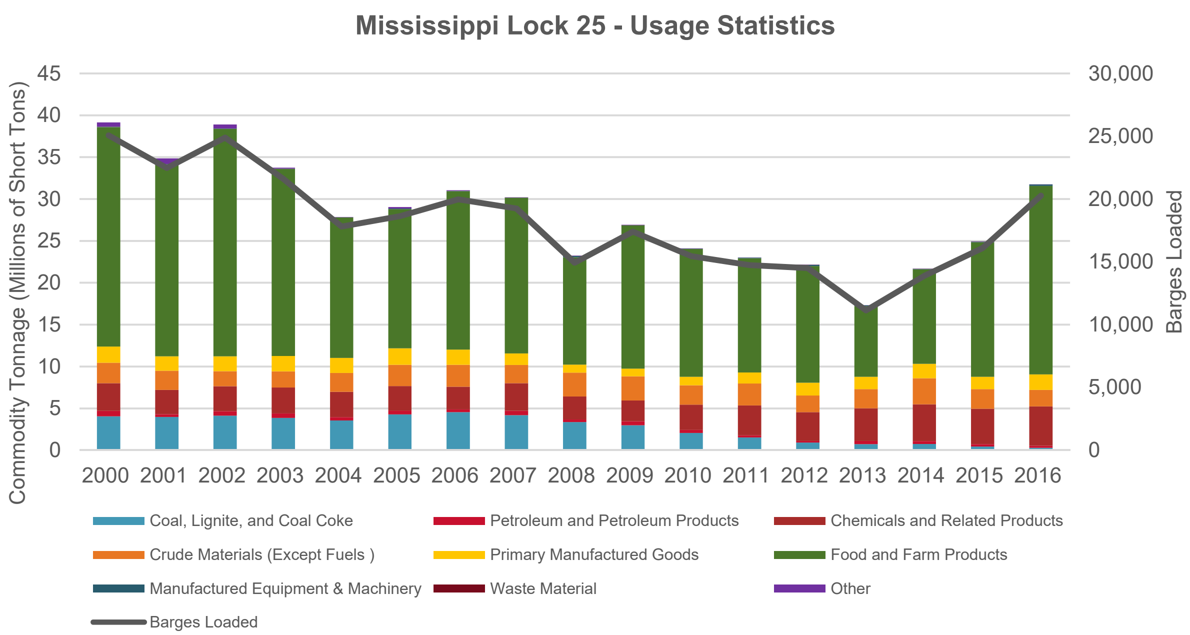


Figure 24: Mississippi Lock 25, Delay and Processing Times

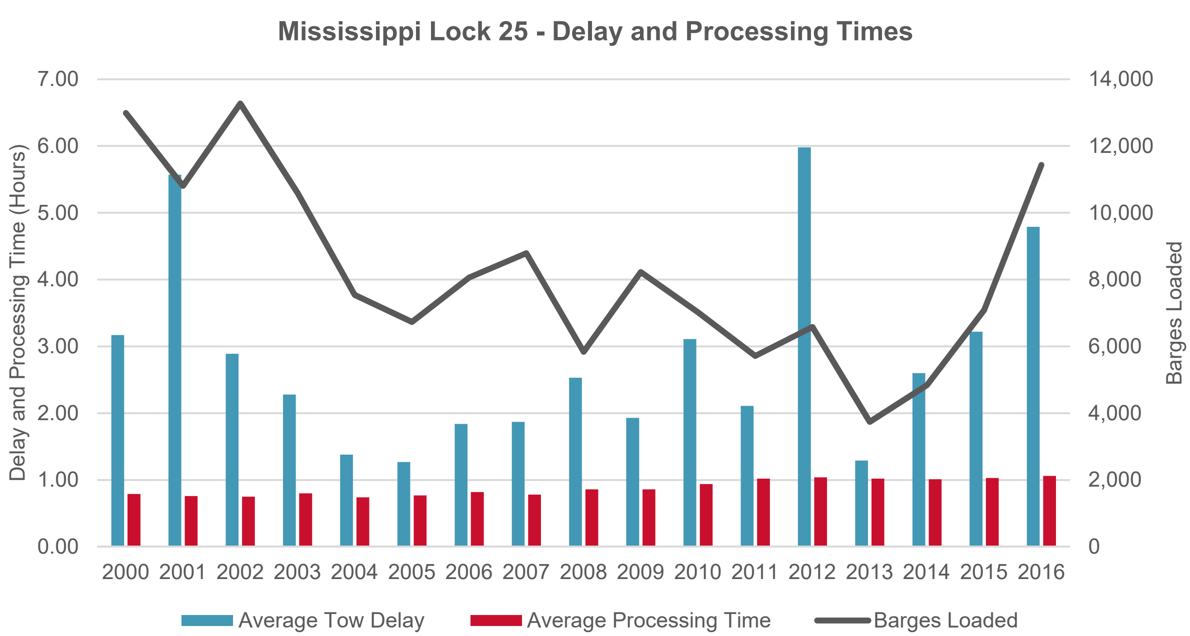


Figure 25: Mississippi River Usage Statistics (Locks 1 – 27)

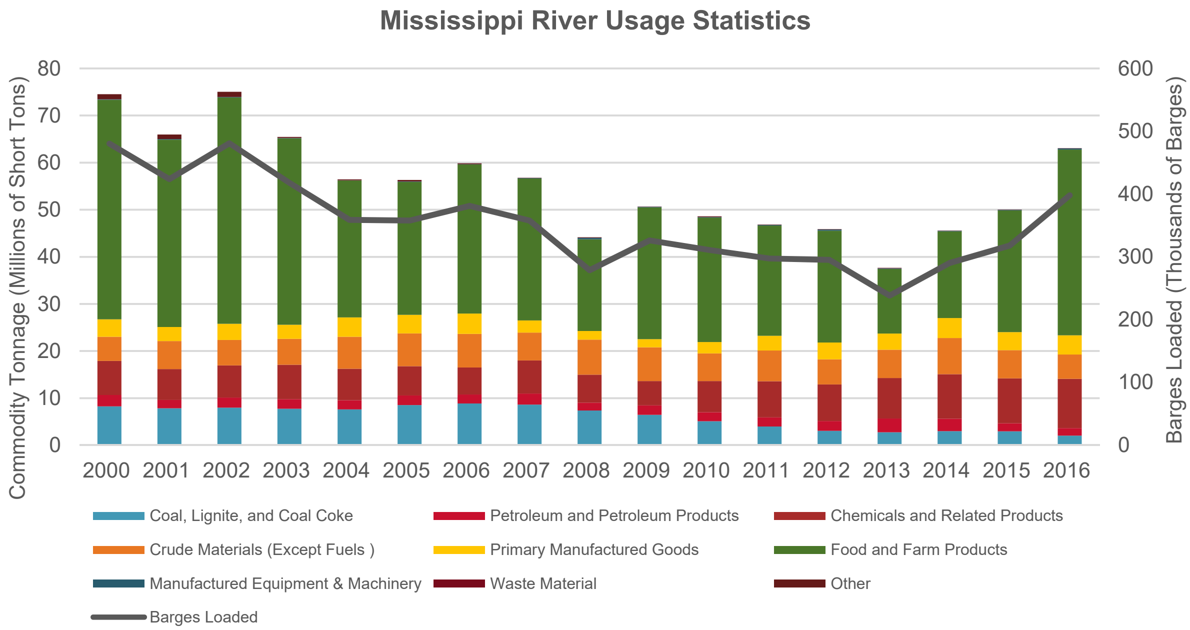
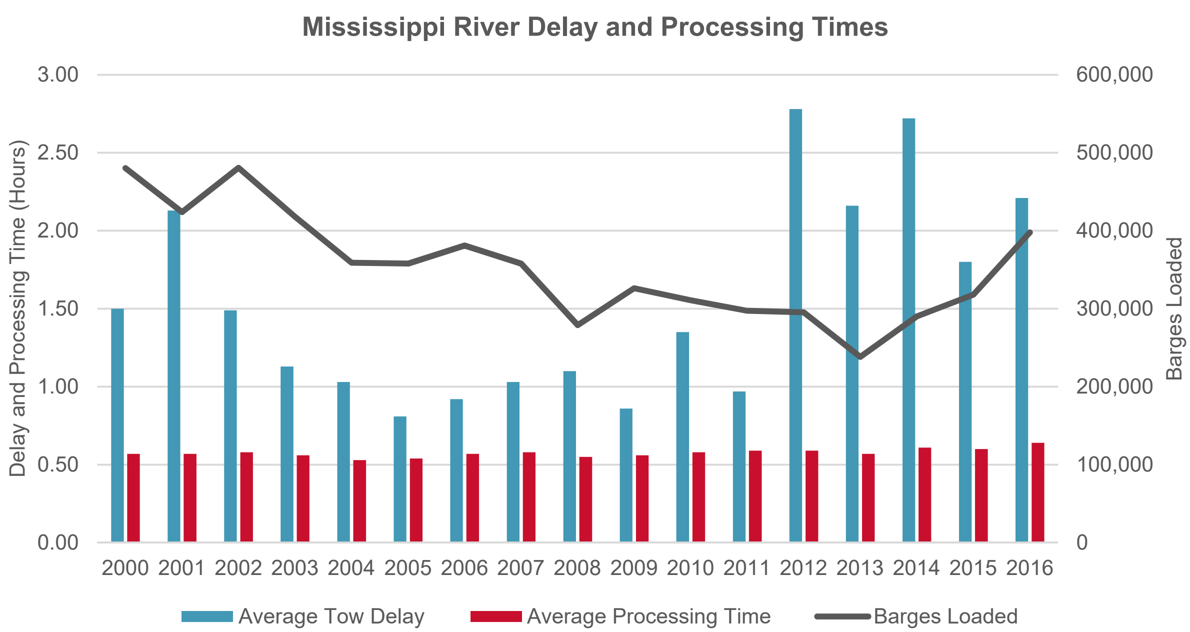


Figure 26: Mississippi River Statistics (Locks 1 – 27)



The volume of loaded barges along the Mississippi River system has been on a general upwards trend since 2013, reflected in a 19 percent average annual rate of growth (AAGR). This growth has largely been driven by food and farm products (42.2 percent AAGR, 62 percent of total 2016 tonnage), and chemicals and related products (6.8 percent AAGR, 16 percent of total 2016 tonnage).

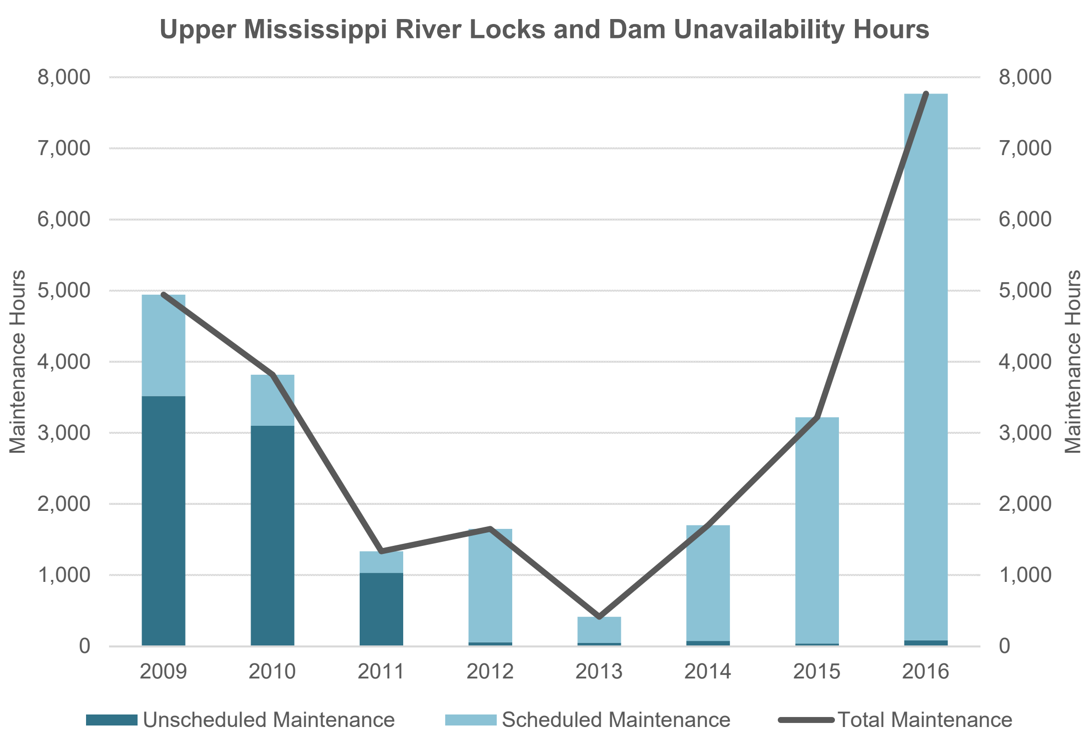
Average tow delays have increased yearly by approximately 18 percent since 2011, while processing times have remained relatively constant with 2 percent yearly growth.

3.3 Lock Maintenance

When a lock or dam reaches a state of poor repair, waterborne traffic must stop to allow for more frequent scheduled maintenance. Although such anticipated or scheduled delay imposes some level of cost on industries that rely on waterborne commodities, an even greater cost is imposed when an unscheduled delay occurs. Unscheduled delays interrupt business operations for entire supply chains dependent on waterborne shipments. While certain issues including weather and other exogenous factors are unable to be mitigated, adequate investment will provide the opportunity to minimize delays related to underfunded maintenance.

Figure 27 summarizes unavailability hours for the Upper Mississippi River system[21]. The data solely captures data related to lock inspection and testing, malfunctions, maintenance, and repairs in order to isolate and identify the underlying unavailability trend.[22] As shown, scheduled unavailabilities account for the majority of total hours particularly since 2012 ranging from 89 percent to 99 percent.

Figure 27: Yearly Upper Mississippi River Locks and Dam Unavailability Hours (Locks 9 – 19, 25)



---

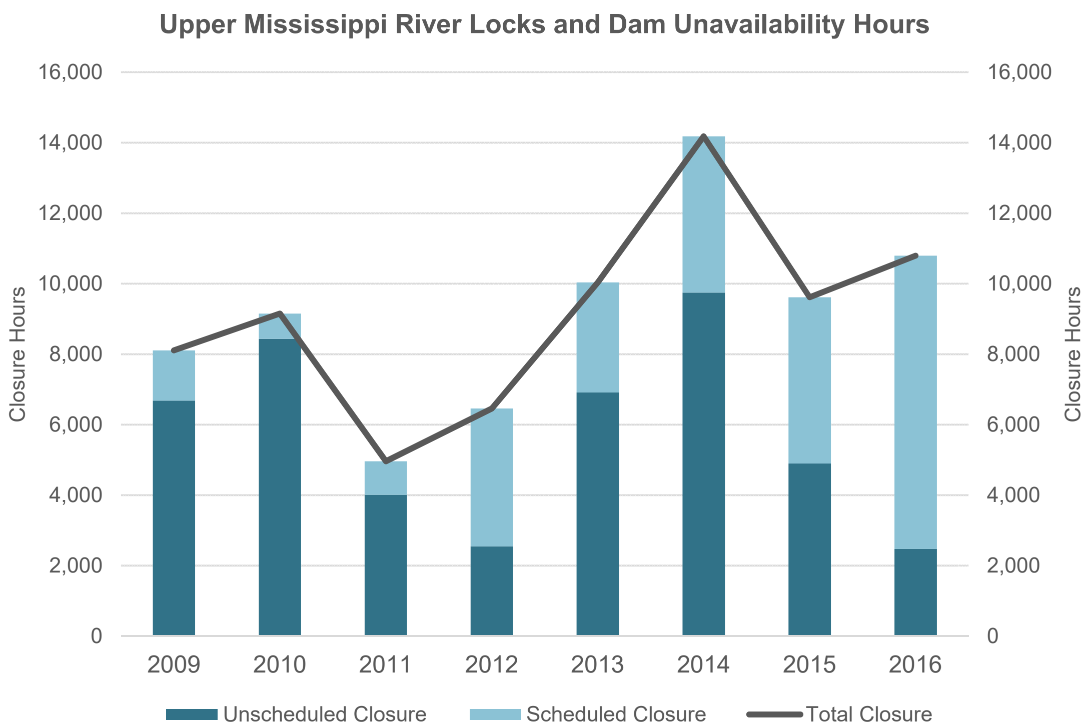
[21] *Locks selected include: Lock and dam 9, lock and dam 10, lock and dam 11, lock and dam 12, lock and dam 13, lock and dam 14, lock and dam 15, lock and dam 16, lock and dam 17, lock and dam 18, lock and dam 19, lock and dam 25*

[22] *Selected delay reasons include: Inspection or testing lock, lock hardware or equipment malfunction, maintaining lock or lock equipment, repairing lock or lock hardware*

Source: U.S. Army Corps of Engineers (USACE), Navigation Data Center – Public Lock Detailed Unavailability Report https://data.navigationdatacenter.us/Locks/Public-Lock-Unavailability-Detailed-Report/p3mn-gzqj/data

Conversely, **Figure 28** captures total unavailability hours which include maintenance as well as other closure reasons including weather (winter, floods, fog, etc.), collisions, and tow-related malfunctions.[23] Unavailability occurrences not related to maintenance activities typically account for between 66 percent and 96 percent of total closure hours.

Figure 28: Yearly Upper Mississippi River Locks and Dam Unavailability Hours (Locks 9 – 19, 25)



4.0 Export Growth Trends

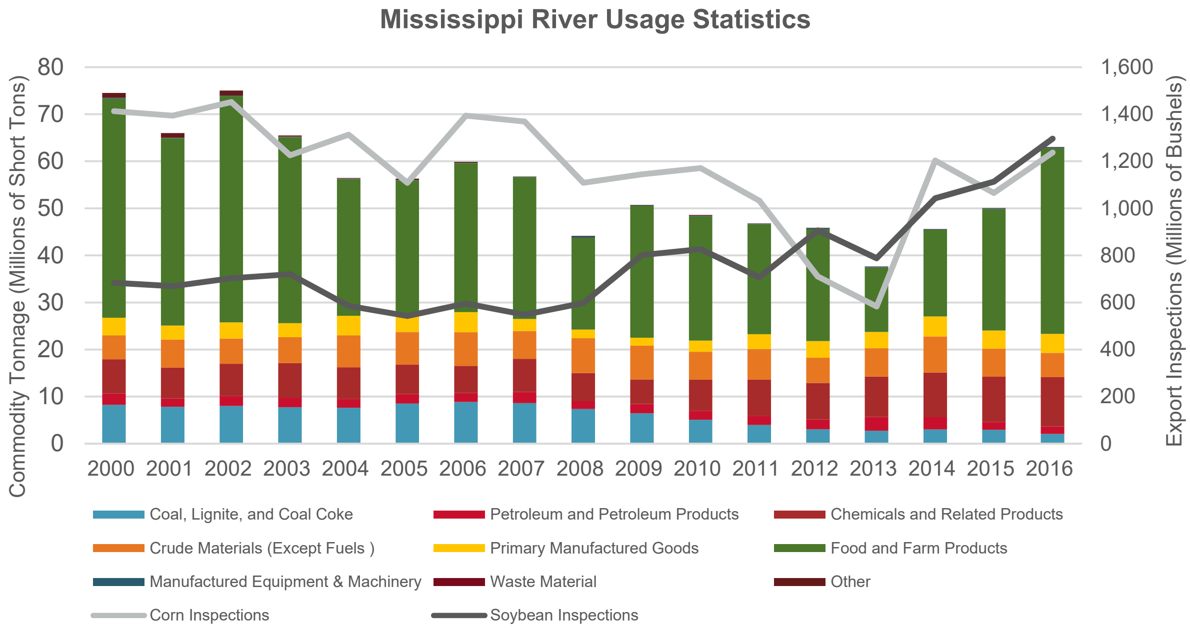
Increased volumes of food and farm products are largely explained by increased export growth. **Figure 29** below illustrates the volume of export inspections with regards to total barge tonnage by commodity. Soybean inspection trends closely follow fluctuations in food and farm products, particularly since 2010. This similarity is reflected in similar five-year average growth rates, where inspections grew approximately 9 percent per year (AAGR, 2012-2016) as compared to

---

[23] *Other closure reasons include: Accident or collision in lock, bridge or other structure (i.e. railway, pontoon, swing, etc.), collision or accident (not tow or not in lock), debris, debris in lock recess or lock chamber, environmental (i.e. fish, animals, oil spills, hydrilla), flood, fog, grounding, ice on lock or lock equipment, ice on or around tow, interference by other vessel(s), lightning, unused for other reason (i.e. Coast Guard river closing, etc.), low water, rain, river current or outdraft condition, sleet or hail, snow, tow accident or collision, tow detained by Coast Guard or USACE, tow malfunction or breakdown, tow staff occupied with other duties, wind, other*

14 percent (AAGR, 2012-2016) for food and farm products. Grain export inspection data was obtained from the U.S. Department of Agriculture.[24]

Figure 29: Mississippi River, Usage Statistics (Locks 1 – 27)



Corn export inspections weakly explain increased food and farm growth due to ethanol policy. The expansion of the ethanol industry, in tandem with Corn Belt expansion, created supply chain imbalances. In addition, the sharp decrease experienced in 2012 (31 percent decrease from 2011 volumes) was due to drought which further distorted steady-state export levels. Currently, increased crop yields have grown faster than the expansion in ethanol plant consumption resulting in volumes available for export. Corn and wheat exports, from the Center Gulf, are expected to increase approximately 49 percent.[25]

The Panama Canal expansion further helps explain increased volumes in 2016. In particular, however, the Canal is expected to result in increased future grain shipments from the United States Midwest to Asia Pacific markets. Reduced transportation costs, due to improved logistics flows, and access to larger markets will strongly benefit Midwest agricultural exports.[26] Common commodities, such as grain and soybean, largely benefit from the implementation of improved infrastructure and cost-effectiveness. USACE estimated that both shippers and consumers save approximately $20.37 per ton on average, due to efficiencies arising from inland waterway transportation.[27] Future shipments may benefit from the Canal's third lane which supports the

[24] *U.S. Department of Agriculture, Grain Transportation Report Datasets. "Table 16: Grain Inspections for Export by Port Region." https://www.ams.usda.gov/services/transportation-analysis/gtr-datasets*

[25] *HDR Consultation with Informa Economics*

[26] *GlobeCon Freight Systems, Inc. "What the Panama Canal Expansion Could Mean for Shipping." http://www.globeconfreight.com/blog/panama-canal-expansion-mean-shipping/*

[27] *United States Army Corps of Engineers. "Inland Waterways Users Board 29th Annual Report – To the Secretary of the Army and the United States Congress." 2016. http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983*

larger 'Neopanamax' vessels; however, dredging of the Mississippi River would be necessary.[28] It should be noted that supply chain effects are gradual and thus full effects of the expansion will be realized in the medium to long term. **Table 1** summarizes commodity tonnage destined for Asia Pacific Markets. Overall, there is an increase in export volume shown by a 24 percent year-over-year growth from 2016 to 2017. Data was obtained from the Panama Canal database.[29]

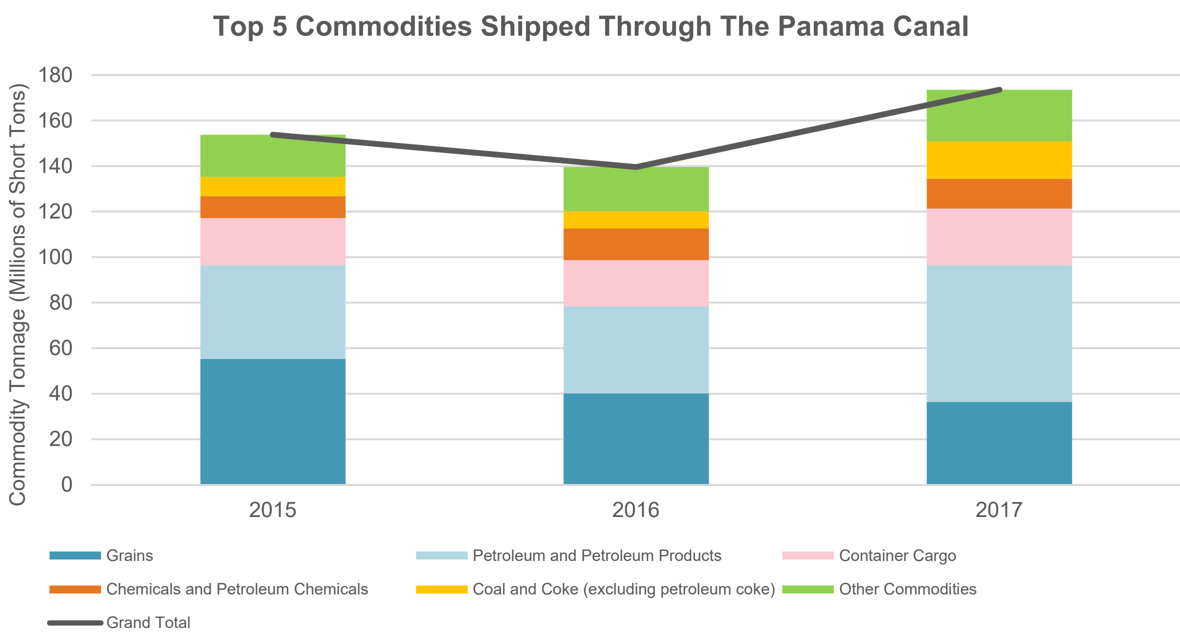
Table 1: Principal Commodities Shipped Through the Panama Canal, Millions of Short Tons

Commodities	Atlantic to Pacific			
	2015	2016	2017	% of Total, 2016
Grains	55.3	40.1	36.4	28.7%
Petroleum and Petroleum Products	41.2	38.3	60.1	27.4%
Container Cargo	20.6	20.3	24.8	14.5%
Chemicals and Petroleum Chemicals	9.6	14.0	13.1	10.0%
Coal and Coke (excluding petroleum coke)	8.51	7.47	16.5	5.4%
Nitrates, Phosphates and Potash	4.58	4.49	6.16	3.2%
Unclassified	1.80	3.89	4.24	2.8%
Miscellaneous	3.06	2.88	2.61	2.1%
Ores and Metals	2.24	2.06	3.20	1.5%
Machinery and Equipment	2.02	1.90	1.82	1.4%
Other Agricultural Commodities	1.11	1.25	1.11	0.9%
Miscellaneous Hazardous Cargo	1.16	1.07	1.08	0.8%
Lumber and Products	1.05	0.64	0.57	0.5%
Manufactures of Iron and Steel	0.60	0.69	0.86	0.5%
Animal / Vegetable Oils and Fats	0.47	0.38	0.66	0.3%
Canned and Refrigerated Foods	0.16	0.10	0.20	0.1%
Minerals, miscellaneous	0.19	0.14	0.20	0.1%
Grand Total	154	140	174	-
Year-Over-Year % Growth	-	-9.2%	24.3%	-

[28] *AGFAX. "2016 U.S. Soybean Crop Will Cruise Expanded Panama Canal." http://agfax.com/2016/09/29/2016-u-s-soybean-crop-will-cruise-expanded-panama-canal/*

[29] *Canal de Panama, Transit Statistics. "Principal Commodities Shipped Through the Panama Canal." https://www.pancanal.com/eng/op/transit-stats/*

Figure 30: Top 5 Commodities Shipped Through the Panama Canal[30]



The top five commodities shipped through the Panama Canal in 2016 were grains (29 percent of total tonnage), petroleum and petroleum products (27 percent), container cargo (14 percent), chemicals and petroleum chemicals (10 percent) and coal and coke (5 percent). Coal experienced a strong rebound in 2017, nearly doubling 2015 levels. Petroleum and petroleum product cargo increased 57 percent from 2016, while container volumes increased by 22 percent.

4.1 Container on Barge

While world container volumes have rapidly increased in tandem with global trade, very few containers travel the United States inland waterways system. **Figure 31** summarizes containerized volumes for the Ports of Houston and New Orleans which grew 5 percent and 6 percent per year, respectively.

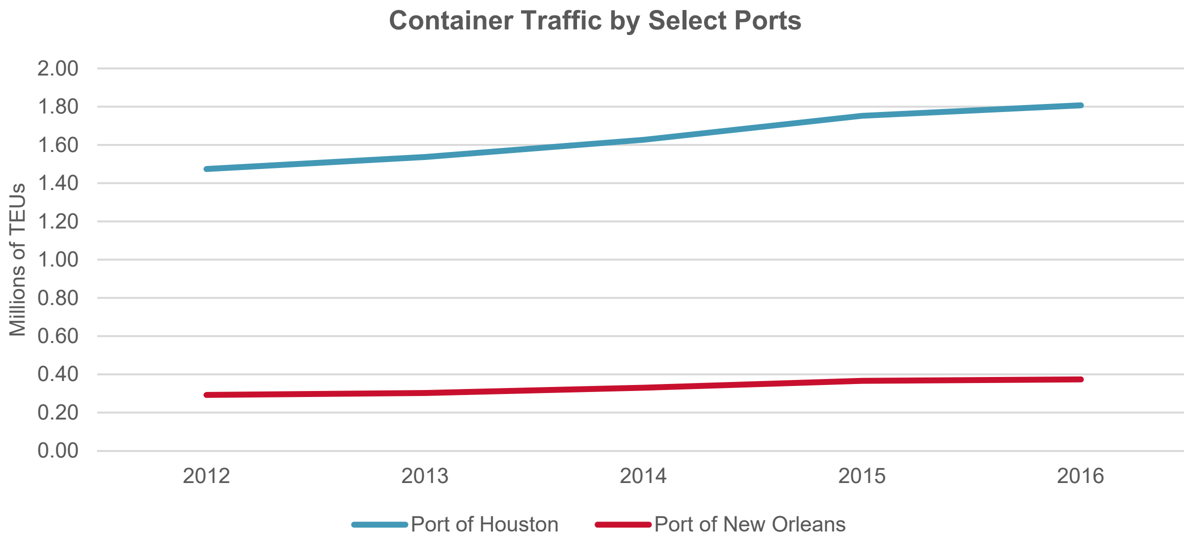
Since inbound containerized commodities are largely time sensitive to shippers, they have predominantly been shipped by rail over longer distances due to delivery time reliability.[31] While container on barge data is fairly limited, historical volumes show the low of the Mississippi River for transporting containers and containerized goods.

---

30 *'Other Commodities' include: Nitrates, Phosphates and Potash; Unclassified; Miscellaneous; Ores and Metals; Machinery and Equipment; Other Agricultural Commodities; Miscellaneous Hazardous Cargo; Lumber and Products; Manufactures of Iron and Steel; Animal/Vegetable Oils and Fats; Canned and Refrigerated Foods; Minerals, miscellaneous*

31 *The Waterways Journal. "Container on Barge" http://www.uppermon.org/news/waterways%20journal/WJ-Container_on_Barge-14Oct13.html*

Figure 31: Container Traffic by Select Ports

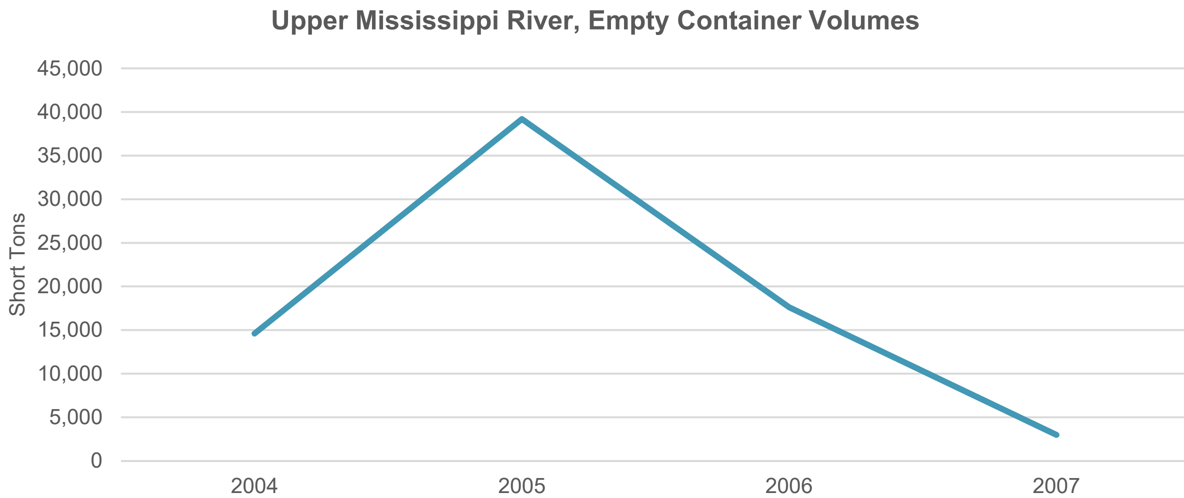


Source: U.S. Army Corps of Engineers, Navigation Data Center – Waterborne Container Traffic
http://www.navigationdatacenter.us/wcsc/containers.htm

Historical movements of containers have solely been the internal/domestic movement of empties. **Figure 32** shows the empty container volumes during 2004 through 2007. With increasing highway congestion, container-on-barge (COB) services will serve a key role in reducing truck highway congestion and providing a cost efficient alternative of transporting containers to ports for export, particularly for dry-bulk goods. In the past year, the U.S. Maritime Administration (MARAD) has provided funding for five various COB projects in the attempt to further develop containerized shipping along the Mississippi River, showing the willingness of transportation planners to explore alternative transportation options.[32] The projects include short-distance shuttle services and planning efforts to introduce COB shipments from Chicago to the Port of New Orleans.

[32] *United States Maritime Administration. "Maritime Administration Awards $4.85 Million in Grants for Marine Highway Projects." https://www.marad.dot.gov/newsroom/news_release/2016/maritime-administration-awards-4-85-million-in-grants-for-marine-highway-projects/*

Figure 32: Upper Mississippi River, Empty Container Volumes



Source: U.S. Army Corps of Engineers, Navigation Data Center – Waterborne Commerce of the United States http://www.navigationdatacenter.us/data/datawcus.htm

5.0 Justification for Investment

Inland waterways are vital to the United States' agriculture industry, as 60 percent of grain exports are moved by barge. Similarly, in the energy sector, more than 22 percent of domestic petroleum and petroleum products and 20 percent of coal used to generate electricity are moved on the inland waterways. The system further supports more than half a million jobs.

In order to remain competitive internationally, the United States economy relies on an efficient and low cost transportation network for movement of its domestic and export commodities. Under the pretense that shippers fully pass costs and savings along to consumers, USACE estimated both shippers and consumers saved approximately $20.37 per ton in 2014 compared to other modes, which equates to $12.3 billion.[33] Taking into account that about $1 billion FY14 USACE funding was allocated to inland navigation, this saving represents a net national economic benefit of more than $11 billion and an 11-to-1 return on investment (ROI).[34] In other words, every dollar invested in the United States inland waterways system, produced 11 dollars in net economic benefits over the project lifecycle and beyond. Benefits accrue from transportation and supply chain efficiencies, sustained employment, and growth in supporting industries. The inland waterways are a strategic asset to the nation, enabling the United States to significantly increase economic output in both domestic and international markets, and move important national defense resources and other supplies in large quantities.

[33] *United States Army Corps of Engineers. "Inland Waterways Users Board 29th Annual Report – To the Secretary of the Army and the United States Congress." 2016.* http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983

[34] *Ibid.*

A

Detailed Literature Review

P3 Studies

American Society of Civil Engineers, Alternative Financing for Waterways Infrastructure. 2017. https://www.asce.org/uploadedFiles/News_Articles/alt_finance_report_final.pdf

Revenue Generation

Implement the ability and framework to create and assess new user fees, allowing for cost-recovery associated with infrastructure and service delivery. This policy would be aligned to the revised Office of Management and Budget (OMB) Circular A-25 that specifically calls for both the self-sustainability of public institutions and the need for enabling private sector participation in the provision of these services.

Ring-Fencing

Steps should be taken to allow the revenues to be collected and retained for project-specific purposes. Funds may be deposited in a legally established revolving trust fund (remains subjected to the restrictions of the Anti-Deficiency Act[35]) or into an escrow account (transfer of funds would require legislative authorization) held by either the non-federal sponsor or the private partner. Congress may occasionally grant an agency a limited exemption from the Anti-Deficiency Act by giving the agency "contract authority," thereby allowing agencies to enter binding contracts even though they do not have sufficient funds available for obligation.

Budget Scoring and Contact Term

Allow for distinction between lease arrangements/capital leases and various forms of P3, as well as the flexibility to apply different scorekeeping methodologies to each. Establishment of a multiyear contracting authority would further allow for the facilitation of Federal P3 projects, mitigation of contracting and appropriation risk, and for flexible repayment opportunity.

Budgetability/Prioritization

Consider additional criterion, not currently applied, within existing project prioritization framework including risk transfer valuation, return on Federal investment (ROFI), public benefits from accelerated project implementation, and forgone costs.

Other Considerations

Expand scope of the Water Resources Reform and Development Act (§5014, WRRDA 2014) to explicitly include operations and maintenance expenditures, as well as lifecycle rehabilitation costs.

Increase dedicated funding streams for P3 pilot programs to ensure effectiveness and continuation.

---

[35] The Anti-Deficiency Act prohibits an agency from entering into a contract that would obligate more money than the agency has available in the revolving fund for its use.

Harvard Kennedy School, Tapping Private Financing and Delivery to Modernize America's Federal Water Resources. 2017. *http://ash.harvard.edu/files/ash/files/hks_ashcenter_federal_water_resources_report_web.pdf*

Policy and legislation-related constraints need to be alleviated and crafted such that P3s for water infrastructure are enabled and the framework is in place for both user-pay and budget-based payment structures.

1. Enabling User-pay P3 for Federal Projects
    a. Revenue Generation: Allow for the implementation of user fees. Legislation may be modeled on Title 23 exemptions for federal highways (imposition of tolls).
    b. Ring-Fencing and Trust Funds: Establish a dedicated revolving P3 fund for water resource projects. Under 31 U.S.C. 1516, the fund would be exempted from standard appropriations rules and made available for individual projects. The proposed fund would also require a limited exemption from the Anti-Deficiency Act, allowing eligible federal water resource agencies to enter into binding contracts on the basis of future revenues. Similarly, consideration should be given to the creation of a non-federal dedicated revolving fund to enable the use of alternative project delivery and finance – may be pursued in a similar manner with the Direct Funding authority granted by Section 2406 of the Energy Policy Act of 1992 for the Bonneville Power Administration (BPA). Finally, consideration could be given to legislative reforms to existing federal water resource trust funds (such as the Inland Waterways Trust Fund (IWTF), Harbor Maintenance Trust Fund (HMTF), and Reclamation Fund), to dedicate a portion of revenues for project delivery and finance purposes.
    c. Viability Gap Funding (VGF): It is recommended that federal water resource agencies collaborate with Treasury, USDA, EPA, and others to develop a broad-based VGF program for federally-sponsored water resource project executed under a P3 structure. Federal aid programs should be coupled with expanded access to federal credit programs to ensure equitable access to private sector financing.
2. Enabling Budget-based P3 for Federal Projects
    a. Budget Scoring: Distinguish P3 arrangements from capital leases for federally sponsored water resource projects by instituting a new budget scoring regime for civil works projects based on the risk-reward methodology (as per global standards set forth in European System of Accounts (ESA) 95).
    b. Continuing Contract Authority: Secure specific multiyear contracting authority (e.g., 62 Comp. Gen. 569 (1983)), to allow federal agencies involved in federal water resource P3s to enter into a multiyear contract without requiring obligations of the full contract amount at the time of contract award.
    c. Budget Prioritization: Federal water resource agencies should develop a policy framework for budget prioritization of Federal P3 projects addressing issues not currently considered in traditional benefit cost analysis (BCA calculations, such as ROFI, Value-for-Money, accelerated benefits, and risk transfer.

   d. Application of Performance-Based Contracting to Water Resources: The application of Memorandum M-98-13 should be expanded to explicitly include improvements in O&M efficiencies for federal water resources. Clearly distinguish between capital leases and P3 projects.
3. Policy Framework for Non-Federal P3
   a. Enabling Legislation and Technical Assistance: Federal agencies should provide support and technical assistance to non-federal sponsors of water resource projects who are seeking to develop or explore alternative finance and delivery structures.
   b. Federal Funding and Prioritization Criteria: Federal agencies should formalize a policy framework for the budget prioritization of P4 projects. This should also include mechanisms to ensure equitable access by rural and poorer communities to alternative finance and delivery approaches.
4. P3/P4 Enabling Framework
   a. Congressional 302(b) appropriations ceilings for P3: Additional funding should be made available to support a P3 pilot program. Said funding should be additive to Budget Committee 302(b) ceilings.
   b. Legislative Shortfalls: Address shortfalls and omissions in existing legislation to more broadly enable P3.
   c. Federal Credit Programs/Infrastructure Bank: In the event that a national infrastructure bank is created, a credit window should be made available for federally sponsored water resource projects. Fully federal water resource projects, such as inland waterways, should also be eligible for credit support. Additionally, the Water Infrastructure Finance and Innovation Act (WIFIA) should be expanded to allow for the financing of fully federal water resource projects, when executed under a P3 arrangement.

Economic Impact Studies

Iowa DOT, U.S. Inland Waterway Modernization: A Reconnaissance Study. 2013.
https://iowadot.gov/systems_planning/pdf/FINALCombinedReport.pdf

The Mississippi River system is vital to the economy of the United States as it provides an efficient and low cost transportation network for movement of its domestic and export commodities. In particular, United States export commodities depend on the transportation network to offset higher wage levels and costs of production in order to remain competitive in international markets.

If the inland waterway system remains chronically underfunded, recent studies by the American Society of Civil Engineers (2012) show that by 2020 the lost value of exports will be $270 billion and will rise to almost $2 trillion by 2040. Approximately $1.3 trillion in business sales will be lost by 2020, rising to $7.8 trillion by 2040. The cumulative loss in national GDP will be approximately $700 billion by 2020 and reach $4 trillion by 2040. It is projected that such a reduction in production, income, and spending will result in 738,000 fewer jobs in 2020, and that by 2040 the job losses will grow to almost 1.4 million. These are jobs lost due to the lack of

United States competitiveness in global trade and because the nation's households and businesses will be spending more for commodities that arrive by marine ports and are transported to market via inland waterways.

National Waterways Foundation, Inland Navigation in the United States: An Evaluation of Economic Impacts and the Potential Effects of Infrastructure Investment. 2014. *http://www.nationalwaterwaysfoundation.org/documents/INLANDNAVIGATIONINTHEUSDECEMBER2014.pdf*

In 2012, the inland waterways system transported approximately 565 million tons of freight valued at $214 billion. Yearly, it is estimated that 0.5 billion tons of freight are moved approximately 450 miles on average. The study examines an abandonment scenario to estimate economic impacts – i.e. the costs incurred by system users if they were forced to consider the "next best transportation alternative." With this method, the study seeks to capture the full economic impacts of the inland waterways system.

It is shown that the system undergoes transitory economic losses as it gravitates towards a new, albeit lower, steady state. In year one, it is estimated that job losses would total nearly 550,000 with $29 billion in lost income. Job losses in year 10 are roughly 400,000 showing that the economy begins to recover from the damage caused by increased transportation costs. Full recovery is not achieved, however, particularly in counties served by waterways. It is estimated that 350,000 jobs would be permanently lost. Furthermore, the present value (over 10 years) of lost output effects total $1 trillion.

Taking into account study-identified improvements to modernize the system, first year construction effects total approximately $2.2 billion increasing to $3.9 billion by 2020. Following construction, first year navigation benefits total over 9,000 jobs. In total, over 30 years including both construction and navigation benefits, nearly 350,000 job-years of full-time employment are created due to waterway modernization, with a present value of incomes totaling over $14 billion.

Transportation Research Board, Funding and Managing the U.S. Inland Waterways System: What Policy Makers Need to Know. 2015. *http://www.trb.org/Main/Blurbs/172741.aspx*

The inland waterways system moves 6-7 percent of all domestic cargo (measured in terms of ton-miles), moving mostly coal, petroleum and petroleum products, food and farm products, chemicals and related products, and crude materials. Water transportation contributes approximately $15 billion in value added to United States GDP, as compared to $15 billion from pipeline, $30 billion from rail, and $120 billion from truck transportation.

Lost transportation time due to delays and lock outages is a significant cost to shippers. System-wide, about 80 percent of lost transportation time is attributable to delays. In 2013, 49 percent of tows in were delayed across the 10 highest-tonnage locks, on average, with 3.8 hours of average delay. It is estimated that approximately 20 percent of lost transportation time could be addressed with more targeted O&M resources which would improve navigation performance.

Suggestions

Study recommends the implementation of a sustainable and well-executed funding strategy that targets particular segments of the inland waterways system since freight movements are highly concentrated – nearly half of system ton-miles are moved on six major corridors: Upper and Lower Mississippi River, the Illinois River, the Ohio River, the Columbia River system, and the Gulf Intracoastal Waterway.

It is further recommended that the system become increasingly reliant on user-fees which would provide necessary revenue for adequate maintenance, rehabilitation, and overall efficiency. Efficiency is achieved by charging user-fees directly related to the service provided and when the funds are used to recover O&M costs. In the long-run, properly structured user-fees may also provide sufficient revenue for lifecycle rehabilitation and replacement as necessary. It is suggested that user-fee funds be an addition to an existing fuel tax structure in order to encompass a full comprehensive funding approach. A revolving trust fund for maintenance would also help ensure that all new funds collected are dedicated to inland navigation. Rules and conditions for managing the fund would be set by Congress if such a fund were authorized.

Develop and implement a project ranking system and asset management program in order to better prioritize projects based upon service needs of the system, and ascertain the necessary funding levels to maintain reliable freight service. In order to improve the efficiency of resource allocation, it is recommended that USACE make publicly available records of rehabilitation dates and standardized delay data to allow policy makers full information regarding system performance and reliability. This allows for data-driven and rational investment decisions based upon system requirements. Overall, an increase in publicly-reported performance metrics and supporting data will allow for enhanced understanding of system needs and bottlenecks, allowing for targeted efforts to alleviate delays and congestion.

Illinois Chamber of Commerce Foundation, An Economic Impact and Cluster Analysis of Illinois River Lock and Dam Facilities for Beneficial Users. 2016. *http://ilchamber.org/wp-content/uploads/2011/08/IL-River-Economic-Impact-and-Cluster-Analysis-Report-Aug-2016-.pdf*

The effects of new investments in the Illinois River system result in a broad range of economics impacts including industries and workers throughout the state, especially the 22 counties adjacent to and bisected by the Illinois River System. All scenarios examined by the study increased economic potential, business activity, and ultimately the workforce due to shipper cost savings. The State economy is impacted by an estimate annual increase in State output ranging from $27 million to $69 million, as well as an initial increase in employment from 106 to 270 jobs.

Benefits are further experienced by states who trade with Illinois, specifically Iowa, Wisconsin, Missouri, and Louisiana. The measured impacts of output and employment range up to $8.4 million annually, generating 24 new jobs.

Businesses benefitting from the Waterway represent approximately 47 percent of all employment in the study area; those businesses pay an estimated $102.5 billion in annual wages to their employees.

USACE, USACE Inland Waterways Users Board, 29th Annual Report. 2016. *http://www.iwr.usace.army.mil/Portals/70/docs/IWUB/annual/IWUB_Annual_Report_2016_Final.pdf?ver=2017-03-06-072634-983*

According to data compiled by the USACE, internal waterways traffic in 2014 moved 604 million tons of commodities valued at approximately $232 billion. Under the pretense that shippers fully pass costs along to consumers, both shippers and consumers saved approximately $20.37 per ton compared to other modes, which equates to $12.3 billion." Taking into account that about $1 billion FY14 USACE funding was allocated to inland navigation, this saving represents a net national economic benefit of more than $11 billion and an 11-to-1 ROI.

A 2016 study commissioned by the U.S. Department of Agriculture (USDA) shows the effects of a lock and dam (L&D) closure upon grain transportation. If Mississippi L&D 25 was unavailable for the 2024/25 marketing year, the reduced economic activity would reach nearly $2 billion. For harvest season alone, the disruption would cost $933 million (or 40 percent decrease) if L&D 25 was unavailable from September to November of the 2024/25 marketing year. A decline in economic surplus in the corn and soybean sector due to L&D 25 closure could cause a decrease of more than 7,000 jobs, $1.3 billion in labor income and about $2.4 billion of economic activity (total industry output) annually. A similar unavailability at LaGrange Lock and Dam would result in a reduction of almost 5,500 jobs, $891 million in labor income and $1.8 billion of economic activity (total industry output) annually.

American Society of Civil Engineers, Failure to Act: Closing the Infrastructure Investment Gap for America's Economic Future. 2016. *https://www.infrastructurereportcard.org/wp-content/uploads/2016/05/2016-FTA-Report-Close-the-Gap.pdf*

The projected investment gap ($43 billion from 2016 through 2040) may result in 440,000 fewer jobs in 2025 and almost 1.2 million fewer jobs in 2040 than would otherwise be expected with modernization improvements. By 2025, the nation will have lost almost $800 billion in GDP, while the cumulative impact through 2040 is expected to be almost $2.8 trillion of GDP.

American Society of Civil Engineers, Infrastructure Report Card – Inland Waterways. 2017. *https://www.infrastructurereportcard.org/cat-item/inland-waterways/*

United States inland waterways delivered more than 575 million tons of cargo in 2015, valued at $229 billion. The system further supports more than half a million jobs. Inland waterways are vital to the United States' agriculture industry, as 60 percent of grain exports are moved by barge. Similarly, in the energy sector, more than 22 percent of domestic petroleum and petroleum products and 20 percent of coal used to generate electricity are moved on the inland waterways.

The average delay per lockage nearly doubled from 2000 to 2014 from 64 minutes to 121 minutes. In 2014, approximately 49 percent of vessels experienced delays. Construction as well as lifecycle rehabilitation costs are shared on a 50-50 basis by the federal government and users through the Inland Waterways Trust Fund (IWTF). IWTF is supported by a 29 cents per gallon barge fuel tax, which was increased by 9 cents in 2015 in order to increase investment in the system. ASCE recommends that USACE have contract authority for projects in order to ensure timely project delivery. Consistently fund waterways projects at authorized levels and ensure that the IWTF continues to be appropriated. It is further recommended that appropriations for operations and maintenance costs are increased yearly in order to repair decaying infrastructure. Alternative funding and delivery methods, including P3, is recommended when appropriate. To aid in measuring benefits from infrastructure improvements, develop and implement a standardized method for measuring delays occurring along the inland waterways system.

Center for Transportation Research, The University of Tennessee: The Impacts of Unscheduled Lock Outages. 2017. *http://waterwayscouncil.org/wp-content/themes/waterways/images/NWF_lock_outage_2017.pdf*

LaGrange Lock and Dam (Illinois River)

Unplanned closure would cost shippers nearly $1.7 billion in additional transportation costs and lead to a $2.1 billion loss in farming-related and dependent incomes. An unplanned closure would also threaten the United States' primary path for corn and soybean exports and affect commerce in 135 counties in 18 states.

The closure would result in 24,447 lost jobs and $1.46 billion in incomes, in addition to $5.19 billion in lost regional output.

Table 2.8 – Economic Impacts Attributable to LaGrange Lock & Dam

State	Total Avoided Costs	Total Attributable Output*	Total Attributable Incomes	Total Attributable Employment
AL	8,585,416	26,606,843	6,670,962	122
AR	5,472,911	17,780,146	5,696,683	85
FL	1,276,983	5,649,432	1,375,936	22
IA	226,791	736,392	235,656	4
IL	1,243,665,137	3,426,146,930	1,026,346,801	17,402
IN	43,902,241	84,503,180	22,852,538	514
KY	12,675,954	23,702,809	6,346,627	146
LA	270,539,494	1,167,512,015	282,873,239	4,341
MN	2,865,943	9,817,876	3,113,238	46
MO	6,600,766	22,416,232	7,070,986	107
MS	5,127,185	12,368,762	3,024,100	61
OH	11,597,985	22,885,763	6,225,594	143
OK	3,670,326	9,086,768	2,248,871	44
PA	4,905,791	9,622,725	2,599,492	57
TN	6,280,104	12,578,755	3,409,044	76
TX	72,471,408	329,172,070	80,083,765	1,228
WI	592,709	1,962,373	630,398	9
WV	3,545,102	6,212,449	1,666,667	38
TOTAL	$1,704,002,248	$5,188,761,521	$1,462,470,596	24,447

* Output is the total value of all regional sales.

Lock and Dam 25 (Upper Mississippi River)

Unplanned closure would cost shippers nearly $1.6 billion in additional transportation costs and discourage 80 percent of users from returning to the system. An unplanned closure would also threaten the United States' primary path for corn and soybean exports and affect commerce in 132 counties in 17 states.

The closure would result in 24,250 lost jobs and $1.57 billion in incomes, in addition to $5.24 billion in lost regional output. Trucking to alternative waterway locations would mean an additional 500,000 loaded truck trips per year and an additional 150 million truck miles in the affected states.

Table 2.9 – Economic Impacts Attributable to Lock & Dam 25

State	Total Avoided Costs	Total Attributable Output *	Total Attributable Incomes	Total Attributable Employment
AL	2,793,743	8,658,018	2,170,769	40
AR	6,801,464	22,096,288	7,079,557	106
FL	-	-	-	-
IA	369,628,309	1,200,184,825	384,076,031	5,763
IL	340,595,456	938,299,258	281,079,727	4,766
IN	2,812,857	5,414,196	1,464,183	33
KY	2,371,176	4,433,870	1,187,206	27
LA	211,309,773	911,906,412	220,943,268	3,391
MN	379,834,042	1,301,199,232	412,608,844	6,147
MO	130,893,626	444,515,357	140,218,116	2,123
MS	4,737,495	11,428,678	2,794,254	56
OH	2,182,266	4,306,163	1,171,402	27
OK	2,073,890	5,134,410	1,270,708	25
PA	848,134	1,663,618	449,411	10
TN	1,253,866	2,511,435	680,639	15
TX	24,780,404	112,554,967	27,383,324	420
WI	79,374,813	262,798,466	84,422,032	1,266
WV	3,226,594	5,654,293	1,516,926	35
TOTAL	$1,565,517,907	$5,242,759,485	$1,570,516,397	24,250

* Output is the total value of all regional sales.

Upper Mississippi River System, State Impacts *http://waterwayscouncil.org/waterways-system/*

The impacts reported below are state-level and thus may not be extrapolated. Jobs supported take into account both direct and indirect employment which vary by state and economic region.

Iowa

http://waterwayscouncil.org/wp-content/uploads/2014/03/Iowa_USChamb_Waterway_StateFactSheet_071613a.pdf

Water transportation (waterways and ports) supports approximately 26,000 jobs and contributes $4.3 billion to the state economy ($2.3 billion direct business revenue, $1.5 billion personal income, and $473 million in local purchases).

Illinois

http://waterwayscouncil.org/wp-content/uploads/2013/09/Illinois.pdf

Supports approximately 48,195 jobs and contributes $6.4 billion to the state economy. ($3.4 billion direct business revenue, $2.5 billion personal income, and $470 million in local purchases).

Missouri

http://waterwayscouncil.org/wp-content/uploads/2013/09/Missouri.pdf

Supports approximately 24,285 jobs and contributes $4 billion to the state economy. ($2 billion direct business revenue, $1.5 billion personal income, and $427 million in local purchases).

Minnesota

http://waterwayscouncil.org/wp-content/uploads/2013/09/Minnesota.pdf

Supports approximately 12,045 jobs and contributes $2 billion to the state economy. ($1 billion direct business revenue, $728 million personal income, and $208 million in local purchases).

Wisconsin

http://waterwayscouncil.org/wp-content/uploads/2013/09/Wisconsin.pdf

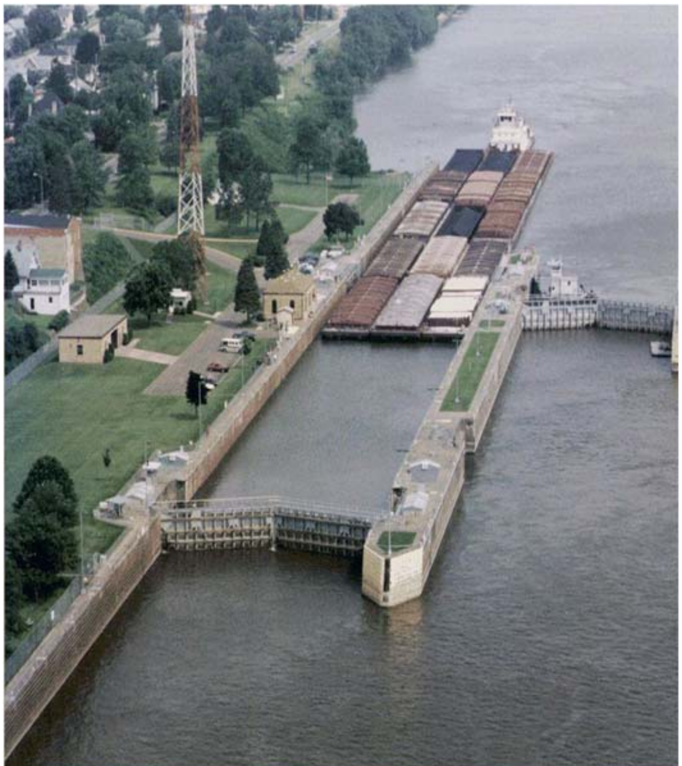
Supports approximately 26,850 jobs and contributes $4.9 billion to the state economy. ($2.3 billion direct business revenue, $1.9 billion personal income, and $661 million in local purchases).

Summary Table

State	Jobs Supported	Direct Business Revenue ($B)	Personal Income ($B)	Local Purchases ($B)	Total Revenue Impact ($B)
Iowa	26,000	$2.3	$1.5	$0.5	$4.3
Illinois	48,195	$3.4	$2.5	$0.5	$6.4
Missouri	24,285	$2.0	$1.5	$0.4	$3.9
Minnesota	12,045	$1.0	$0.7	$0.2	$1.9
Wisconsin	26,850	$2.3	$1.9	$0.7	$4.9
Total	137,375	$11.0	$8.1	$2.2	$21.4

Appendix D

Governance and Financing Review Report



Governance and Financing Review

Upper Mississippi River Inland Waterway

Iowa Department of Transportation

Ames, Iowa

April 2019

Contents

Figures

Tables

1.0 Introduction

Task 3.0 addresses development of Governance Framework Alternatives. The task consists of two subtasks: Task 3.1 and Task 3.2. Task 3.1 defines the role and function of the primary stakeholders, and Task 3.2 presents organizational options that incorporate those stakeholders in a variety of potential organizational frameworks. Selection of the appropriate primary stakeholders is dependent on assuming that certain organizational structures will be used to advance governance of the waterway. The Scope of Work envisioned the evaluation of the following three potential governance arrangements:

1) State-Federal
2) State-Authority-Federal
3) State-Authority-Private-Federal

Therefore, for the purposes of Task 3.0, HDR is assuming that the following definitions apply:

- State – refers to the Iowa Department of Transportation (Iowa DOT)
- Federal – refers to the United States Army Corps of Engineers (USACE)
- Authority – refers to a Port Authority, as defined in Iowa Code Title 1 Chapter 28J, Port Authorities[1]
- Private – refers to a traditional public private partnership (P3) concessionaire that would operate under a design-build-finance-operate-maintain business model

2.0 Scope of the Analysis

The report addresses in detail only organizational structures authorized under existing law for which guidance has been developed as of May 2018. While pilot programs and other arrangements have been authorized, there is no official implantation guidance prepared to support developing a model agreement. The governance framework is based on an analysis of the proposed Water Resource Development Act (WRDA) 2018 as of May 6, 2018. It is not likely that the WRDA bill will be passed within the project schedule.

3.0 Chartering Guidance for a Potential Mississippi River Port Authority Created Under Iowa Code 28J

HDR has completed an initial assessment of the applicability of Iowa Code Title 1 Chapter 28J and Iowa Code Title 1 Chapter 28K Mid-America Port Commission to form the basis of a port authority that could serve as a local project sponsor in a project partnership agreement with USACE. HDR has identified sections of the code that may require modification or enhancements to allow a port authority established under this code to use all the tools necessary to deliver inland waterway system improvements. A select summary of these sections of the code include:

[1] Southeast Iowa Regional Economic Development and Port Authority. 2016. “Partner Organizations.” https://www.sirepa.org/partners.

1) Chapter 28J Section 28J.1 Definitions

   In this section of the code, item a through item i outline allowable costs of a port authority. Given the specificity of these items, an item j may need to be added to specifically allow costs associated with inland waterway navigation system improvements.

2) Chapter 28J Section 28J.2 Creation and powers of port authority

   This section would have to be reconciled with Section 28J.8 Area of jurisdiction. Section 28J.8.2 indicates that "A political subdivision that has created a port authority or joined an existing port authority shall not be included in any other port authority." Therefore, if a larger regional port authority were created under this code, modification to these provisions would likely be required.

3) Chapter 28J Section 28J.3 Appropriation and expenditure of public funds – dissolution

   Specifically, Section 28J.3.3 references the contracting for public improvements. Those references refer to Iowa Code Chapter 26, which governs public bidding. Chapter 26 requires the use of the design-bid-build model for construction. Therefore, if a port authority were established to help finance and construct inland waterway system improvements, it would be limited in its contracting ability and unable to use various forms of alternative project delivery such as design-build or some form of P3 contracting structure. The legislation is not clear whether a design-bid-build model would need to be used by USACE as its contracting method, should a port authority contribute funds to USACE. The contractual discussion is addressed in Chapter 28J Section 28J.9.18 and provides additional details and clarification of contracting powers that can be exercised by a port authority.

4) Chapter 28J Section 28J.8 Area of jurisdiction

   The prohibition of a county having more than one port authority may limit the geographical area of a broader regional port authority. However, this restriction was modified in Chapter 28K to form the Mid-America Port Commission. Lee County, Iowa, is in both the Southeast Iowa Regional and Economic Port Authority (SIREPA) and the Mid-America Port Commission.

5) Chapter 28J Section 28J.9 Powers of port authority

   There are several sub-sections to the Powers of the port authority that may require clarity to support a port authority undertaking an inland waterway system improvement. These include the following:

   a. Chapter 28J Section 28J.9.5 "Straighten, deepen, and improve any channel, river, stream, or other watercourse or way which may be necessary or proper in the development of the facilities of the port authority." The definition of the facilities of the port authority could be interpreted to mean only those facilities owned by the port authority. Thus, it is not clear if there is sufficient authorization in the code that would allow the port authority to participate in improving or operating USACE navigation facilities.

b. Chapter 28J Section 28J.9.10 “Enjoy and possess the same legislative and executive rights, privileges, and powers granted cities under chapter 364 and counties under chapter 331, including the exercise of police power but excluding the power to levy taxes.” While a port authority has many of the same powers as cities and counties, the port authority can only receive tax revenue dedicated for its use from the member governments that joined together to form the port authority.

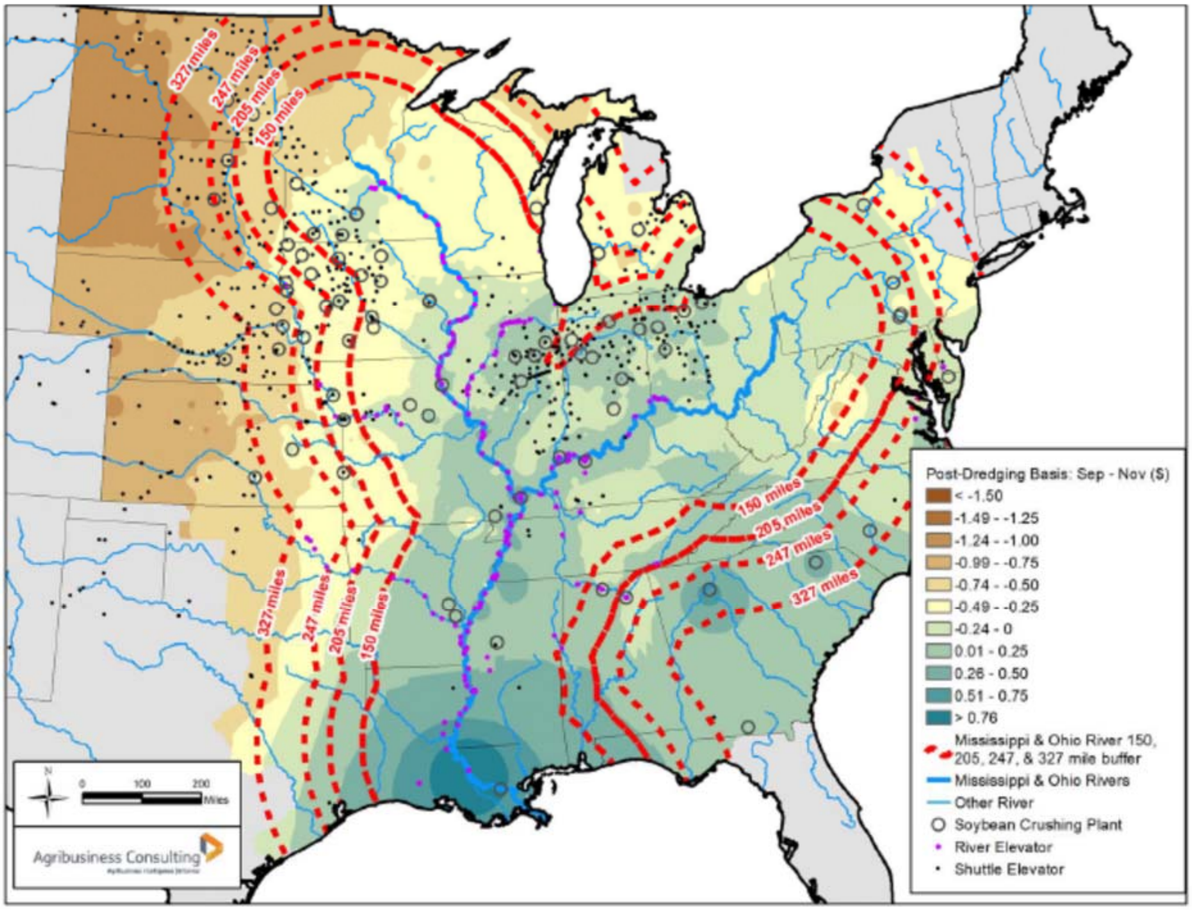
4.0 Establishing Geographic Boundaries of a Potential Port Authority

The geographic extent of a port authority could be established several ways, with a potential option to involve those Iowa counties that are contiguous to the Mississippi River. A second option expands on the first option by using an economic capture zone of the Upper Mississippi River (UMR) inland waterway system as the general geographic boundary for the port authority. As an example, if the 150-mile line (Figure 1) represents a reasonable grain export capture zone for the port authority, approximately the eastern half of Iowa could potentially be formed into a port authority for the purposes of creating a governance authority for the Iowa portion of the UMR inland waterway system.

4.1 Existing Port Authorities in Iowa

The State of Iowa has one port authority established under Iowa Code Chapter 28J. The SIREPA was established in Lee County to create new economic development opportunities in Lee County and southeast Iowa. Additionally, Iowa Code Chapter 28K provides for the creation of the Mid-America Port Commission. The Mid-America Port Commission is a multi-state port commission and includes representatives from Illinois and Missouri. The commission has broad powers to support development of port improvements that assist commerce of the region. The commission encompasses 26 counties in Illinois (11), Missouri (9), and Iowa (6). The commission has acquired and optioned land and has installed the necessary infrastructure to assist in realizing the goals of establishing a tri-state foreign trade zone, an intermodal facility, bulk handling, and a container on barge handling station. Both the SIREPA and Mid-America Port Commission highlight the need to create P3s to advance their missions to aid in growing the regional economy.

Figure 1: Export Capture Zone for Inland Waterway System



Source: IEG Presentation Slide Deck

4.2 Revenue Capture Models for a Port Authority

Under current federal law, inland waterway system improvements are financed by the federal treasury and the Inland Waterway Trust Fund. Port authorities under Iowa Code do not have independent taxing authorities but rather receive funds from their sponsoring political subdivisions, which do have taxing authority. Port authorities can, however, charge various fees for use and rental of port authority facilities and can issue debt that is recovered from revenue generated by port authority projects. Port authorities typically raise revenue by charging rent and fees for facilities that they construct. It would seem logical that a port authority could bond and construct lock improvements and then subsequently charge tolls or fees to recover costs associated with borrowing and with construction, operation, and maintenance of the improved facility. However, under 33 United States Code (USC) 565, tolling is specifically prohibited and the control of the facility must remain under the authority of the Secretary of the Army and the Chief of Engineers, as follows:

> Any person or persons, corporations, municipal or private, who desire to improve any navigable river, or any part thereof, at their or its own expense and risk may do so upon the approval of the plans and specifications of said proposed

> improvement by the Secretary of the Army and Chief of Engineers of the Army. The plan of said improvement must conform with the general plan of the Government improvements, must not impede navigation, and no toll shall be imposed on account thereof, and said improvement shall at all times be under the control and supervision of the Secretary of the Army and Chief of Engineers. (33 USC 565)

Therefore, other alternative forms of revenue generation would need to be identified and enacted unless the federal law prohibiting tolling is modified to allow the generation of revenue for a port authority.

4.2.1 Fuel Taxes

The Inland Waterway Trust Fund tax was established in 1978 and is a self-reported user tax by vessel operators working the inland waterway system. Users of the inland waterway system are taxed on the actual fuel consumed in the process of propulsion on the nation's inland waterway systems. The *Inland Waterway Fuel Tax*[2] report indicated that the inland waterway users were in generally good compliance with self reporting the tax. Vessels that use the inland waterway system that are not transporting cargo are exempt from the inland waterway system user fuel tax. These vessels include recreational and commercial craft that primarily convey passengers or their vehicles. These users pay other taxes and licensing fees, but this revenue goes to other non-navigation purposes or comes back through the United States Treasury general fund. Any existing local or state tax paid by any waterway users is also used for non-navigation purposes at the local and state level.

4.2.2 Other Systematic Fees or Taxes

A regional port authority within the direct impact economic zone of the State of Iowa could capture revenue from a number of UMR inland waterway system stakeholders. The economic analysis demonstrates the significant economic impact the waterway has on the State of Iowa and the region. This economic activity generates revenue to the United States Treasury, which is matched with the Inland Waterway Trust Fund to implement rehabilitation or new capital improvements to the waterway. However, at current rates of funding, it will take many decades to fully realize the benefits of a modernized inland waterway system.

Generating additional revenue to expedite the construction of the UMR inland waterway system improvements would result in benefits being realized earlier and an increase in economic output. The Inland Waterways User Board's July 24, 2017, report to Congress on the Inland Waterway Trust Fund (IWTF) refers to the need for "full and efficient" appropriations to ensure appropriate project execution levels. There are a number of means to generate the additional revenue through a sales tax, a property tax, a fuel tax, water use fees, or other means. It was beyond the scope of this study to develop a specific taxing or revenue generation proposal. However, areas that were examined include:

[2] Government Accounting Office. July 2016. *Inland Waterway Fuel Tax*.

1) Capturing fuel tax revenue from non-commercial use of the river.

   USACE tracks the number of commercial vessels, non-commercial vessels, and recreational vessels that lock through each of the locks on the UMR inland waterway system. Using 2016 data, non-commercial and recreational vessels accounted for 20.5 percent of the total lockage on the UMR inland waterway system. Of the total 115,769 lockage throughout the entire UMR inland waterway system, 23,707 were non-commercial or recreational lockage. While a barge vessel can inflict a heavier load on a lock through collision and impact loads, the exercise of the lock facility for non-commercial and recreational vessels adds to the wear and fatigue of these systems. The data illustrate a steady use of the locks by non-commercial and recreational users. Exact data on the amount of fuel consumed by these vessels is not available. However, a reasonable estimate is that these vessels consume 200 gallons of fuel each year based on four day trips a year at 50 gallons per trip. This estimate is supported by a 2015 Federal Highway Administration report entitled *Off-Highway and Public-Use Gasoline Consumption Estimation Models Used In the Federal Highway Administration*, which indicates that recreational boats on average consume 117 gallons of gas annually. At $0.29 per gallon, capturing recreational vessel gas tax revenue would amount to an additional $1,375,000 to the IWTF.

2) Modifying 33 USC 565 to charge tolls to non-commercial and recreational vessels.

   When 33 USC 565 was passed in 1902 and updated in 1947, the volume of non-commercial and recreational vessels on the river was not as high as the volume today. As previously indicated, 20.5 percent of the total lockage (in 2016) is from vessels other than commercial vessels, which are required to pay the IWTF fuel tax. As an example, there were 22,568 recreational vessel lockages representing 53,242 recreational vessels and 1,139 non-commercial lockages representing 1,205 non-commercial vessels. An example of a non-commercial vessel that is not considered recreational is a tour or dinner cruise vessel, where recreational vessels are typically personal water craft for leisure or fishing. These vessel owners do not directly contribute to the operation and maintenance costs for use of these facilities (other than through general federal taxes). Allowing tolling and fees or special licensing for vessels that routinely use the UMR inland waterway system could generate additional matching funds for use in UMR inland waterway system improvements.

   It is unclear how willingly recreational and non-commercial users would pay. At $15 per lockage per vessel, the toll would raise around $840,000. At $50 per lockage per vessel, the toll would raise around $2,800,000. At $150 per lockage per vessel, the toll would raise around $8,400,000. However, it is likely that there is a cost at which the recreational users would just avoid the lockage and either remain in their pool of origin or go by land via trailer to the next pool. The values provided are for illustrative purposes to give a general range of revenue that could be generated.

3) Assessing a fee for water appropriated from UMR.

According to the Upper Mississippi River Basin Association, more than 7 billion gallons of water are withdrawn from surface water sources each day in the 60 counties that border the navigable UMR. The navigable UMR as defined by the Upper Mississippi River Basin Association is considered from Lock and Dam 1 in Minneapolis, Minnesota, to near Cape Girardeau, Missouri. It extends below the last lock on the UMR inland waterway system to the confluence with the Ohio River. More than 80 percent of this water is used as cooling water for energy production and is returned to the river. The pools created by the lock and dam system provide benefits for cooling and a level pool for water supply intakes and some storage during times of drought and low flow along the river. Along this stretch, the river provides water to 23 public water suppliers serving a combined population of 2.8 million people. The City of Ames, Iowa, published a 2017 report evaluating water use and rates for communities greater than 10,000 in population within Iowa.[3] The median rate paid by potable water users is $0.006 per gallon.[3] The Ames report identified 280 million gallons per day of potable water production within the State of Iowa, with an annual sale of water in the range of $626 million.[3] There is potential for revenue generation for river maintenance and capital needs by valuing the water used along the navigable portion of the river. Table 1 summarizes potential revenue for different per-gallon water rates, assuming the rate would be applied to the full 7 billion gallons of water withdrawn each day.

Table 1: Potential Revenue for Different Water Fee

Water Fee ($/gallon)	Potential Annual Revenue ($ millions)	Percentage Increase in Median Water Rate
0.00001/gallon	$25.55	0.17
0.0001/gallon	$255.50	1.7
0.001/gallon	$2,555.00	17.0
0.01/gallon	$25,550.00	167.0

Currently, power and industrial facilities operate on water appropriation permits and do not directly pay for water use to a utility system or state agencies for raw water.

Arguments that counter water users being assessed additional fees for use in UMR inland waterway system maintenance include that the lock and dam pool system is not necessary for the potable and industrial water supply needs. The Mississippi River provides sufficient base flow to meet the needs, and adjustments in intakes and operations for cooling could accommodate a modification of the lock and dam system. Also, some of the power facilities use the river for the delivery of coal and could switch to rail delivery or modify the facility to use an alternative fuel if water fees were burdensome.

[3] City of Ames, Iowa. 2017. *2017 Water Rate Report, Iowa Cities 10,000 population or higher*.

4) Exploring additional hydropower revenue and revenue capture to generate a dedicated source of funding.

   The USACE Hydropower Analysis Center prepared the *Hydropower Resource Assessment at Non-Powered USACE Sites* (July 2013). The essence of the report was to evaluate the feasibility and benefit-cost ratio of developing hydropower at locations that are currently not powered. The report used standard USACE benefit-cost ratio methodologies and assumptions to estimate the amount of feasible hydropower on non-powered USACE dams. The potential hydropower generation was divided by USACE districts. The St. Paul, Rock Island, and St. Louis Districts have a total of 34 dams in their districts that currently do not have a power station. Of these, 14 were considered feasible relative to hydropower production using the USACE criteria contained in the report. Assuming these 14 dams were developed for hydropower, they could generate 2,928,051 megawatt hours (MWh). The United States Energy Information Administration published the average retail prices for 2016 by state.[4] The average retail price for Minnesota, Wisconsin, Iowa, Illinois, and Missouri was $0.0967 per kilowatt hour (KWh).[4] This totals more than $283 million dollars annually of potential hydropower revenue at the retail level, with an average benefit-cost ratio of 1.35 using USACE methodologies.[4]

   The USACE assumptions in cost of construction and turbine efficiency used historical information at the time of the study (2013). Many advances in turbine technology are lowering the cost of installation and maintenance and are enhancing output. These new technologies may result in decreasing costs, enhanced generation, and improved viability of sites not considered feasible in the 2013 USACE study. The hydropower industry has well documented the many barriers to further development of hydropower at existing dam sites. The combination of Federal Energy Regulatory Commission licensing, Section 408 permitting, obtaining power purchase agreements for wholesale power, and subsidies for other renewable energy sources create costly barriers that negatively affect the return on investment calculation. However, hydropower development, with streamlining of regulatory barriers, could provide an opportunity for P3 implementation along the UMR inland waterway system. A port authority structure could issue debt combined with private financing and a design-build-operate-maintain contract. Net power revenues could be shared to pay back the debt and finance the operator. A portion of the net revenue could be ring fenced to maintain the dam portion of the locks. Ring fencing hydropower revenue for dam improvements would free other IWTF dollars to focus on lock and navigation improvements.

The economic value of the inland waterway system is enhanced through new technologies and markets, dramatically improving the benefit-cost ratio for improvements.

In general, economic projections and calculation of benefit-cost ratios build their future scenarios based on analysis of historical trends and assumptions over the design life of the

[4] United States Energy Information Administration. 2018. “State Electricity Profiles.” https://www.eia.gov/electricity/state.

project. The original design of the lock and dam system was based on 1930s, 600-foot tows. Now, the modern 1,200-foot tows require double cuts and delays to progress through the UMR inland waterway system. Next-generation vessels that transport containers could greatly enhance the economic value of the waterway and potentially alter the required improvements to enhance economic value.

At the 14th Annual Waterways Symposium, held on November 8 to 10, 2017, a presentation by American Patriot Holdings entitled *Creating Inland Innovation Utilizing Container on Vessel* is an example of the type of change in river use that could alter the benefit side of the equation relative to the UMR inland waterway system. The presentation discussed the development of the Gateway container terminal in Plaquemines Parish, Louisiana, and the implementation of next-generation frame barges that increase container carrying capacity, increase upriver speed, and reduce passing impacts on other barges and fleeting areas over traditional container on barge concepts. The proposal calls for a container port in St. Louis to move both empty and full containers to and from market. The company indicates that it is researching a smaller, more nimble vessel designed to navigate the UMR and Illinois River inland waterway systems locks and bridges. In this scenario, reliability and speed may be more important than locking capacity.

Federal planning often has limits in its assumptions. A locally or regionally developed vision for the UMR inland waterway system that forecasts potential new markets, uses, and economic models could be used to challenge the current federal benefit-cost ratio and support investments to expedite the realization of economic benefits.

5.0 State-Federal Governance Framework

The two most likely frameworks under existing authorities that could be used to implement UMR inland waterway system projects are:

1) Establishing a project partnership agreement using a contributed funds memorandum of agreement.[5]

   While there has not been a project-partnership agreement between a local project sponsor and USACE for an inland navigation project, one could be developed. Currently, USACE does not have published guidance for such an agreement; however, other agreements for flood control, dredging, and harbor maintenance do exist as templates. At a minimum, any sponsor entering into an agreement with USACE must have the legal and financial capacity to fulfill the requirements of the partnership agreement that Iowa DOT or an appropriately chartered port commission would fulfill. Under this model, the State of Iowa, through the DOT, would complete an agreement and provide funding to USACE for specified purposes of improving or maintaining aspects of the inland waterway system.

[5] United States Army Corps of Engineers. "Project Partnership Agreements." http://www.usace.army.mil/Missions/Civil-Works/Project-Partnership-Agreements/.

2) Constructing a project under Section 408 approvals with turn back to USACE.

   As indicated under 33 USC 565, Iowa DOT (or port authority) could implement all or a portion of any navigation improvement within the UMR inland waterway system. The State could design and construct the improvement using non-federal funding and apply for permission to construct the project under Section 408 approvals. Once the project is completed, a project partnership agreement could be established to turn the assumption of operation and maintenance of the constructed works back to USACE.

6.0 State-Port Authority-Federal Governance Framework

A port authority organized under the port authority code of Chapter 28J would have all the necessary qualifications to enter into an agreement with USACE subject to the potential limitations previously identified. The Mid-America Port Commission is an example of a regional, multi-state port authority that could serve as a model for a broader multi-state port authority over the UMR inland waterway system. Port authorities across the country often serve as facilitators and partners with private business to promote economic expansion of a region and serve as a catalyst for the transfer of goods and services across various modes of transportation.

A port authority could serve as a sponsor and a mechanism to foster additional public and private investment in the UMR inland waterway system that could generate revenue for its operation, maintenance, and improvement. Tolling, fuel taxes, hydropower, water fees, and enhanced economic values are all ways to capture potential revenue for UMR inland waterway system investments. Development of a broader economic zone around the UMR inland waterway system could be used to capture a portion of sales tax and other loading or unloading fees. As an example, if a new use, such as container on vessel, could be expanded to transport empty and full containers, the benefits of a more reliable, expanded and efficient waterway would increase and therefore boost the benefit-cost ratio. The new use may require plan reformulation because the improvements to the waterway used traditional barge traffic with lock operations to meet their needs. A different set of alternatives may be required to capture the potential value of hydropower and new vessel types using the UMR inland waterway system. A regional port authority could serve as a local project sponsor to USACE for such a study because it could focus on developing the land base and intermodal infrastructure necessary to support these uses. A regional port authority can also target revenue capture from a larger subset of direct project beneficiaries. For example, the federal government cannot levy a property tax, whereas the port authority could be granted this power under State law.

7.0 State-Authority-Private-Federal Governance (P4) Framework

As outlined earlier, under both federal and State law, several barriers exist to instituting a P4 concessionaire governance framework. However, if allowed, the minimum requirements of a potentially viable P3 project that would attract private capital to the undertaking of an inland waterway system improvement include:

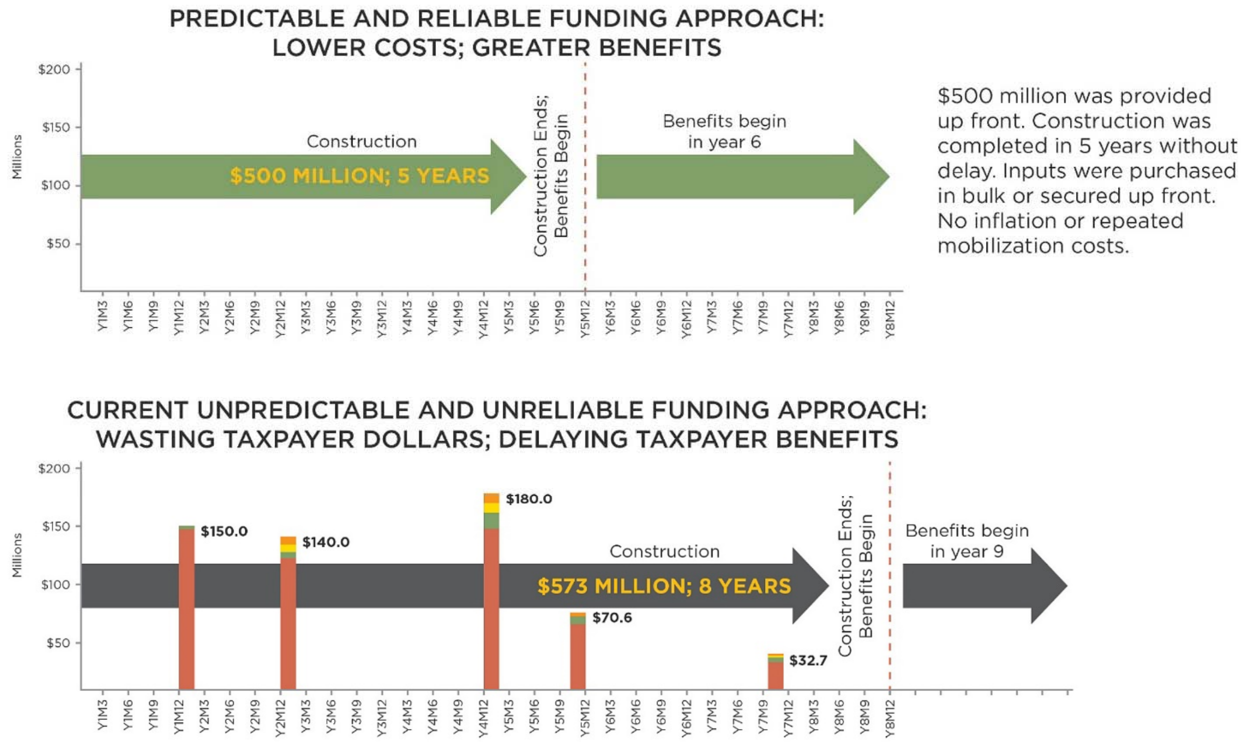
1) Ability to use alternative delivery methods such as design-build
2) Ability to implement operational and maintenance flexibility through long-term operation and maintenance contracts
3) Ability for the federal or local owner to generate revenue to make availability payments to the P3 concessionaire
4) Ability for the P3 concessionaire to charge user fees or tolls, or to generate other income from the project operation to provide the desired return on investment

The lack of sufficient governmental guidance or laws makes creation of a specific governance model difficult.

A P4 governance framework could assist with increasing the reliability of funding. The Soy Transportation Coalition released a study in April 2018 entitled *Predictable Funding for Locks and Dams*.[6] The report highlighted the increased costs attributable to Congress's funding approach, which does not result in full and efficient construction funding. The current approach often results in both unrealized benefits and significant cost overruns. The report illustrates that the same project can cost considerably more if it is not funded in a consistent manner. Figure 2 summarizes the analysis.

[6] Soy Transportation Coalition. 2018. *Predictable Funding for Locks and Dams*. April.

Figure 2: Predictable Funding for Locks and Dams Summary Graphic



Time	Allocation	Inflation	Mobilization Costs	Piecemeal vs. Bulk Purchasing	Available for Construction
Year 2 Month 1	$150.0	$3.0			$147.0
Year 3 Month 1	$140.0	$5.6	$7.0	$7.0	$120.4
Year 5 Month 1	$180.0	$14.4	$9.0	$9.0	$147.6
Year 5 Month 12	$70.6	$7.1		$3.5	$60.0
Year 7 Month 11	$32.7	$4.4	$1.6	$1.6	$25.0
Total	$573.3	$34.5	$17.6	$21.2	$500.0

- Inflation (2%)
- Mobilization (5%)
- Piecemeal vs. Bulk Purchasing (5%)
- Available for Construction

Funded by the soybean checkoff.

Source: Soy Transportation Coalition. 2018. *A Recipe for Cost Overruns and Project Delays: STC Research Highlights Nation's Approach to Funding Locks and Dams*.
http://www.soytransportation.org/newsroom/PressRelease_PredictableFundingForLocksAndDams%20_4-16-18.pdf.

A potential way to realize benefits sooner and to address demonstrated costs of inefficient financing is to develop a P4 model that uses private capital to bridge the funding gaps from federal sources through a combination of lease arrangements, hydropower generation, loan guarantees, and collection of other fees or revenue. The port authority could serve as a back up to receipt of federal funding to provide a measure of certainty to the investors.