INLAND AND INTRACOASTAL WATERWAYS

TWENTY-YEAR CAPITAL INVESTMENT STRATEGY

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Prepared By:

U.S. Army Corps of Engineers

Investment Program Action Team (IPAT)

This report was prepared in response to Section 2002 of the Water Resources Reform and Development Act of 2014. *This is a planning framework and does not take the place of the normal budget processes or commit the Government to future actions*. The information and findings in this report represent those of U.S. Army and the U.S. Army Corps of Engineers.

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Executive Summary

The U.S. Army Corps of Engineers (USACE or Corps) operates and maintains a network of waterborne transportation that facilitates efficient movement of goods within the U.S. These inland and intracoastal waterways support international trade that accounts for one-third of the U.S. Gross Domestic Product.[1] While the Nation depends on this world class network of locks, dams, structures, and channels, over 60 percent of the infrastructure was built over 50 years ago. Investment is needed for maintenance, rehabilitation and modernization to continue bringing the service and function for which it was originally designed as well as to meet future requirements. Current fiscal realities, coupled with areas of deteriorating infrastructure, suggest that a top-down, national capital investment strategy will better help the Corps strategically plan for and manage this infrastructure.

Authority

Title II, Subtitle A, Section 2002, (d) of the Water Resources Reform and Development Act of 2014 (WRRDA 2014) required, in part, for the Secretary of the Army, "*in coordination with the Users Board, to develop and submit to Congress a report describing a 20-year strategy for making capital investments on the inland and intracoastal waterways based on the application of objective, national project selection prioritization criteria.*" Further, this strategy "*is to take into consideration the 2010 CPBM and, to the extent practicable, propose improvements in all geographical areas of the IMTS and ensure efficient funding of inland waterways projects*."

What's in this Report

This report documents the resulting work of the Corps' Investment Program Action Team (IPAT) in meeting WRRDA 2014 requirements to develop a 20-year Capital Investment Strategy (CIS) for the inland and intracoastal waterways. Coordination with the Inland Waterways Users Board was proactive during the process, as described in Section 2.3. Section 3 of this report details the methodology used to make advances in objective analysis and selection and efficient project sequencing and scheduling. Detailed results with discussion are provided in Section 4 while Section 5 lays forth a strategy to update the CIS. Recommendations for future improvements in the CIS process are provided in Section 6. Section 6 also illustrates potential future revenues related to the Administration's FY 2017 budget proposal that "funds capital investments in the inland waterways within the limits of estimated revenues to the Inland Waterways Trust Fund under current law, and proposes a new user fee to increase revenue to this trust fund to enable a significant increase in funding for investments, while also proposing that a percentage of those revenues go toward maintenance of inland navigation projects." This report is a planning framework and does not take the place of normal budget processes or commit the Government to future actions.

[1] Brookings Institution. "A Bridge to Somewhere: Rethinking American Transportation for the 21st Century." 2008. http://www.brookings.edu/reports/2008/06_transportation_puentes.aspx.

Stakeholder Collaboration

Throughout the process, the IPAT and Corps Senior Leadership collaborated with inland navigation industry leaders and the Users Board via face-to-face meetings, briefings, and bi-weekly feedback conference calls. IPAT engaged industry leaders in the process beginning in January 2014, over two years before the issuance of this report. Critical information was exchanged as it developed and industry leaders provided valuable feedback that helped to shape the outcome.

Methodology for Analysis of Projects

The CIS was developed using a corporate-level, risk-informed process and methodology. These include asset management principles and analytical tools for assessing lock and dam project condition, reliability, and economic consequences of failure that have been developed and implemented since 2010. Having the tools in place to determine and compare exposure to risk across project sites in a consistent fashion results in a robust, defendable methodology that supports a national program, removing much of the subjectivity of the methods used prior to asset management. The methodology employs a series of "filters" to all of the navigation projects on the inland and intracoastal waterways so that the highest risk capital investment projects move forward for priority project sequencing and scheduling.

Project sequencing is based on a project's objective, detailed engineering, and economic decision documents, specifically the benefit to cost ratio of the identified work or other metric such as life safety, or in the absence of decision documents the 'operational risk exposure' of the project. There are three major considerations for scheduling projects in the CIS:

1) Meet the requirements of WRRDA 2014 for an *efficient funding* stream based on a *current risk-based cost estimate*;
2) Identify separable phases of construction that would allow flexibility in managing the Corps funding, the overall CIS schedule, and Inland Waterways Trust Fund (IWTF) balances for a more holistically-efficient program;
3) Maintain a minimum balance in the IWTF for contingencies.

The CIS recognizes the importance of major rehabilitations to maintain system reliability, so the strategy generally provides funding to address major rehabilitation projects but a specific target was not set in the CIS. **The schedule represents alternatives that could be used by decision makers but does not take the place of normal budget processes or commit the government to future actions**. The budget formulation and appropriation process will determine actual funding received by any project in a given year. The updates of the CIS will take into account the funding received and actual execution from the previous year. Overall, the process provides flexibility for addressing unforeseen circumstances and realities that a standard methodology could not be expected to capture and may supersede current planning priorities.

In accordance with WRRDA 2014, the CIS plan assumes efficient funding when practicable for projects already under construction and those potential future projects.

Results, the Twenty-Year Capital Investment Strategy

The CIS plan depends on the funding available to invest in the Nation's inland navigation infrastructure. Funding is variable and dependent on the receipts in the IWTF and the annual appropriations provided to the Corps. The evaluation includes development of three different funding scenarios, taking into account program variables, to illustrate the relationship between available funds and work that can be accomplished.

Table ES 1. Summary of Funding Scenarios

Scenario	Description	Summary
Baseline	The Inland Navigation Program (IWTF and General Treasury funds) total is limited to $250 million per year	▪ Four ongoing construction projects could be completed ▪ Four new construction projects (including two channel projects) could be completed ▪ Two new construction projects would be in progress ▪ Seven major rehabilitation projects could be completed ▪ IWTF balance builds to $240 million while Olmsted Locks and Dam is under construction, then slowly declines by approximately $5 million per year ▪ With almost the same investment, less work is completed under the Baseline scenario by not taking advantage of the reduced cost share requirements for the Olmsted Locks and Dam
Annual Allocations	General Treasury funding is limited to $220 million per year and annual appropriations will continue to provide additional programmatic funding beyond the President's Budget for inland navigation projects	▪ Four ongoing construction projects could be completed ▪ Four new construction projects (including two channel projects) could be completed ▪ Two new construction projects would be in progress ▪ Seven major rehabilitation projects could be completed ▪ IWTF balance builds to $130 million while Olmsted Locks and Dam is under construction, then remains between $20 million and $70 million for the remainder of the 20 year CIS period ▪ With current projections for the IWTF revenues the Annual Allocations Scenario is very similar to the Maximized IWTF Scenario
Maximized IWTF	Funding available in the Inland Navigation Program is only limited by the IWTF funds available	▪ Four ongoing construction projects could be completed ▪ Five new construction projects (including two channel projects) could be completed ▪ One new construction project would be in progress ▪ Seven major rehabilitation projects could be completed ▪ IWTF balance builds to $80 million while Olmsted Locks and Dam is under construction, then remains between $20 million and $70 million for the remainder of the 20 year CIS period ▪ If additional IWTF revenues would be available, there would be a more distinct difference between the Annual Allocations Scenario and Maximized IWTF Scenarios

Each possible funding scenario results in a variation of the schedule for inland navigation construction throughout the next 20 years, and beyond. Projects are scheduled based on the available funding identified for each scenario. Given the uncertainties of the program **only the first five years of investment are provided in detail in the CIS.**

A comparison of the scenarios is shown in the table below. It is worth noting that due to effects of inflation, project costs differ by scenario. A comparison set of projects, based on only those projects that could be completed in the Baseline scenario costing $4,740 million, costs $110 million less under the Annual Allocations scenario and $145 million less under the Maximized IWTF scenario. This represents a minimum savings and it may increase as projects in the Baseline scenario are completed later and even beyond the CIS twenty year planning window.

Table ES 2. Comparison of Scenarios

Comparison of Baseline, Annual Allocations, and Maximized IWTF Funding Scenarios ($M)			
	Baseline	Annual Allocations	Maximized IWTF
New Construction Investment	$4,239	$4,302	$4,304
Major Rehabilitation Investment	$638	$636	$637
Total 20 Year Program	$4,877	$4,938	$4,941
Maximum Inland Navigation Program Funding ($M) (after 2016)	$250	$370	$400
Average Annual Inland Navigation Program Funding ($M)	$230	$235	$235
Maximum IWTF Balance ($M)	$240	$130	$80

Strategic Review and Update

WRRDA 2014 specifies that the Corps should submit updates to the 20-year CIS at least once every five years. In order to effectively manage the investment strategy and efficiently prepare periodic reports, the IPAT team developed a strategy for annual reevaluation of the CIS based on new information and continued advancement in the analysis tools.

The Capital Investment Strategy is a planning framework and does not take the place of the normal budget processes or commit the Government to future actions. The information and findings in this report represent those of U.S. Army and the U.S. Army Corps of Engineers.

1. Overview and Introduction

The U.S. Congress, starting in 1824 with the General Survey, and the Rivers and Harbors Acts, has commissioned the U.S. Army Corps of Engineers (USACE or Corps) to develop and maintain a network of waterborne transportation that facilitates efficient movement of goods within the U.S. These inland and intracoastal waterways support international trade that accounts for one-third of the U.S. Gross Domestic Product.[2] The Corps has continued to serve a major role in inland and intracoastal waterways since our nation's early history and will continue to have a pivotal role in the future. The Corps' navigation mission is to provide safe, reliable, efficient, effective, and environmentally sustainable waterborne transportation for the movement of commerce, national security needs, and water-based recreation. This section provides an overview of the inland waterways and describes the purpose and goals of the report.

1.1 Inland Waterways

Inland waterways in the U.S. are some of the most advanced and extensive in the world, greatly aiding in the economic development of vast expanses of interior North America. These waterways provide benefits to U.S. consumers and producers of electricity, agricultural products, construction materials, petroleum products, steel, and other commodities. The inland waterways complement a network of highways and rail lines to form a national multi-modal freight transportation system – an engineering and logistical marvel built, redesigned, improved, and expanded throughout the nation's history. As part of the national freight network, the waterways efficiently serve the largest and the smallest communities in the U.S. from coast to coast and allows goods produced far from ocean ports to reach and compete in global markets.

The inland waterways complement a network of highways and rail lines to form a national multi-modal freight transportation system.

The inland waterways play a critical role in the U.S. freight network. In 2014, cargo transport on inland waterways reached a 5-year high, accounting for approximately 600 million tons moved from producers to consumers. Barge transportation on the waterways eases congestion on the country's highways and rail lines. In 2014, 87 million tons of grain moved on the inland waterways. Had this tonnage been shipped by rail, it would have required 870,000 additional railcars, equivalent to approximately 9,700 miles of trains.

The inland waterways play significant roles beyond relieving freight system congestion. Water transportation provides a less-costly means of transporting goods compared to rail or truck for nearly all commodities, but especially bulk materials such as aggregates, steel, and grain. The safety record of waterways workers is an order-of-magnitude better than railway workers and two orders-of-magnitude

[1] Brookings Institution. "A Bridge to Somewhere: Rethinking American Transportation for the 21st Century." 2008. http://www.brookings.edu/reports/2008/06_transportation_puentes.aspx.

better than trucking[3]. Waterway transportation contributes to national security by providing supply and troop transport, fleet access, and power generation. Navigation projects produce environmental benefits through activities, including beneficial use of dredged material for ecosystem restoration and reduced greenhouse gas emissions through reduced fuel consumption.

The inland waterways and coastal channels comprise 25,000 miles of navigable waters throughout the U.S. and referred as the Marine Transportation System (MTS). The MTS includes 13,000 miles of coastal harbors and channels, and hundreds of jetties, breakwaters, bridges, and other navigation structures. Additionally, there are approximately 12,000 miles of inland waterways and 241 lock chambers constituting the commercially-active network developed and maintained by the Corps. Today, the Corps operates, maintains, and manages nearly $264 billion of water resources infrastructure assets, of which a large portion is related to its navigation mission[4].

The network of channels maintained by the Corps includes nearly 11,000 miles of the "fuel-taxed waterways" (FTW) (Figure 1). Commercial waterway operators on the FTW pay a per-gallon fuel tax deposited into the Inland Waterways Trust Fund (IWTF), which is used to help fund capital investments vital to sustaining and improving inland navigation infrastructure. The IWTF is described in detail in Section 1.3.

[3] U.S. Department of Transportation Maritime Administration and National Waterways Foundation. 2007. A Modal Comparison of Domestic Freight Transportation Effects on the General Public. Available at: http://www.marad.dot.gov/documents/Phase_II_Report_Final_121907.pdf. Accessed on: March 30, 2015.

[4] As reported in the FY14 USACE Federal Real Property Profile annual submission.

Note: Source for base map - ESRI ArcGIS 'Major Rivers'

Figure 1. The Fuel-Taxed Inland and Intracoastal Waterways

1.2 Current State of the Waterways Infrastructure

Much of the waterway infrastructure was constructed in the first half of the 20th century, or earlier, and over 60 percent of the lock chambers are over 50 years old. While the infrastructure is operating at an overall satisfactory level, few USACE locks and dams remain in an optimal condition, with many exceeding their economic design life, and may require a major rehabilitation and possibly modernization. Aggressive management of critical maintenance and periodic rehabilitations are utilized to extend the effective life of these facilities.

Locks and dams in poor condition are more susceptible to mechanical failures that result in increases in both scheduled and unscheduled outages needed to perform maintenance and repairs, which increase congestion and costs of transporting commodities. Scheduled lock outages to proactively address maintenance issues are increasing on the FTW (Figure 2), and the occurrence of unscheduled mechanical closures have generally decreased since FY2011 (Figure 3).

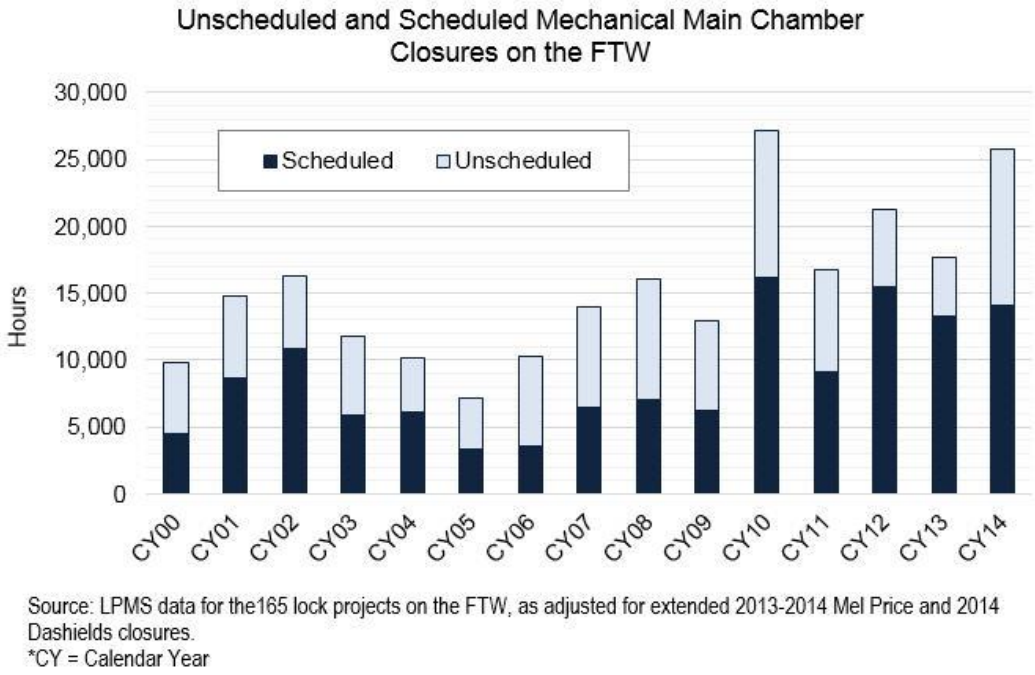

Figure 2. Unscheduled and Scheduled Mechanical Main Chamber Closures on the FTW

Unscheduled outages are especially costly to both vessel operators and the Corps. Vessel operators are unable to anticipate and minimize the costs of these incidents, and Corps project staff must choose what not to repair and what to defer, which can increase future costs of repair. Figure 3 depicts unscheduled mechanical closures on the FTW since 2000. As a part of its Civil Works Strategic Plan, the Corps is striving to reduce the instances where mechanically-driven failures at locks result in delays of more than 1 day and delays of more than 7 days[5]. It should be noted that this metric is related only to the main chamber and that for instances, such as the extended unavailabilities noted for Mel Price and Dashields, where a redundant auxiliary chamber exists it does normally require longer processing time and often may cause delays however, the waterway traffic is not completely shut down.

[5]For more information on the Civil Works Strategic Plan, see http://www.usace.army.mil/Portals/2/docs/civilworks/news/2014-18_cw_stratplan.pdf.

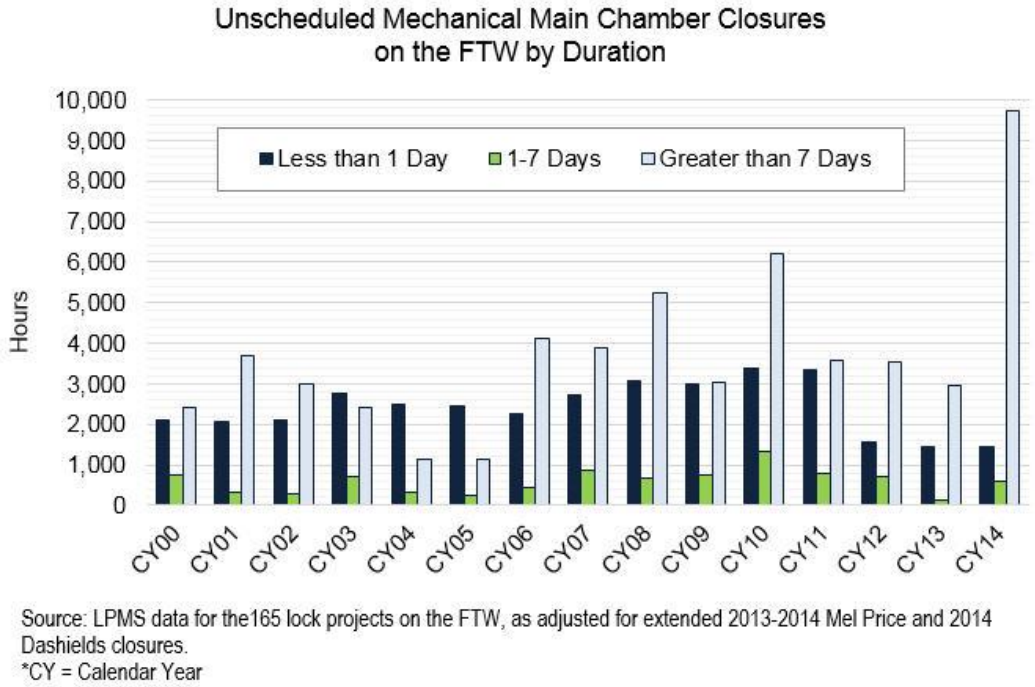

Figure 3. Unscheduled Mechanical Main Chamber Closures on the FTW by Duration

The Corps management of the Columbia-Snake Rivers highlights an example of success in system-wide risk reduction and scheduled outages. This waterway, like many others, is especially vulnerable to unscheduled lock outages because there are no auxiliary locks to provide redundancy. Therefore lock closures result in completely shutting down traffic at that location on the waterway. The eight locks on the rivers are all routinely serviced during the same 2-week outage period each spring when routine maintenance and complete inspections are done. The annual closure is announced well in advance, and shippers and other stakeholders expect and plan for the outage during March of each year. Major maintenance work requiring extended outages is occasionally necessary. The work is planned, budgeted, and regionally-coordinated for years preceding the work. In 2010, the system outage was 14 weeks to replace three large gate sets. Outreach to shippers, domestic and international customers, and other stakeholders started two years in advance and helped minimize the economic impact of the outage and prevent unscheduled closures of a longer duration in the future.

The Corps faces a challenge in the 21st century, managing the nation's aging Civil Works infrastructure and fulfilling navigation mission requirements within the federal budget. This involves operating and maintaining the portfolio of projects, and planning for the strategic recapitalization of this infrastructure. Historically Corps districts and divisions have driven the efforts to address navigation advancements locally and regionally. However, an overall national CIS that prioritizes project investment selection across the entire portfolio would help to determine on a portfolio-wide level the best sequence of different investments, and minimize unnecessary construction delay impacts and cost increases. The Corps will apply objective risk-informed, life-cycle asset management approaches in the development of the priorities for inclusion in this capital investment strategy.

1.3 Inland Waterways Trust Fund

The Inland Waterways Trust Fund (IWTF) was authorized by two separate acts of Congress. The original authorization was contained in the Inland Waterways Revenue Act of 1978 (Public Law 95-502, October 21, 1978, Sec. 1801 et seq; hereinafter, the "1978 Revenue Act"). Under the 1978 Revenue Act, Congress created the IWTF within the U.S. Treasury for the purpose of "*making construction and rehabilitation expenditures for navigation on the inland and intracoastal waterways of the United States as provided in appropriations acts*." Congress funded the IWTF with a "*tax on fuel used in commercial transportation on inland waterways*" and statutorily defined 26 specific segments of the inland and intracoastal waterways subject to the tax and eligible for construction and rehabilitation expenditures from the IWTF.

Table 1. Inland Waterways Fuel Tax Rates, 1980–Present

If Fuel Use Occurs:	The Tax per Gallon is:	In 2015 Dollars
After September 30, 1980	$0.04	$0.09
After September 30, 1981	$0.06	$0.13
After September 30, 1983	$0.08	$0.16
After September 30, 1985	$0.10	$0.19
During 1990	$0.11	$0.18
During 1991	$0.13	$0.21
During 1992	$0.15	$0.23
During 1993	$0.17	$0.26
During 1994	$0.19	$0.28
After 1994	$0.20	$0.25 (avg)
After March 31, 2015	$0.29	$0.29

As shown in Table 1, the diesel fuel tax began October 1, 1980, at $0.04 per gallon and incrementally increased to $0.10 per gallon beginning October 1, 1985. The 1978 Revenue Act did not authorize any new program, project, or activity and further provided that no expenditures from the IWTF could be made "*unless the law authorizing the expenditure for which the amount is appropriated explicitly provides that the appropriation is to be made out of the Trust Fund.*"

Because neither the 1978 Revenue Act nor other legislation initially explicitly authorized expenditures from the IWTF, the balance in the IWTF increased, reaching $260 million by the time the Water Resources Development Act of 1986 (WRDA 1986) was enacted in November 1986, and reauthorized the IWTF. No construction or rehabilitation projects on the inland and intracoastal waterways received funding from the IWTF between enactment of the 1978 Revenue Act's passage and enactment of WRDA 1986.

WRDA 1986 reauthorized the IWTF and made clear that "*the Inland Waterways Trust Fund established by (WRDA 1986) shall be treated for all purposes of law as a continuation of the Inland Waterways Trust Fund established by…the Inland Waterways Revenue Act of 1978*." WRDA 1986 increased the inland waterways diesel fuel tax rates, as shown in Table 1, to $0.20 per gallon, which started in January 1995. WRDA 1986 also added the Tennessee–Tombigbee Waterway to the list of fuel-taxed inland and intracoastal waterways and specifically authorized the construction of eight inland waterways modernization projects. Inland and intracoastal waterways projects that were already authorized, but not completed, were allowed to proceed at 100 percent General Treasury funding without drawing from the IWTF. The Achieving a Better Life Experience (ABLE) Act of 2014 increased the fuel tax rate by $0.09 to $0.29 per gallon effective April 1, 2015.

WRDA 1986 generally set fixed future project cost-sharing formulae for the various Corps project mission categories (e.g., coastal harbors, flood control, hydropower, recreation). Instead of establishing a fixed cost-sharing formula applicable to all inland waterways construction projects, WRDA 1986 established fixed construction financing requirements only for the eight inland waterways modernization projects specifically authorized in WRDA 1986, providing for those specific projects that "*one-half of (construction) costs shall be paid only from amounts appropriated from the IWTF.*" The term "construction" was defined as including "*planning, designing, engineering, surveying, the acquisition of all lands, easements, and rights-of-way necessary for the project, including lands for disposal of dredged material, and relocations necessary for the project*."

In every subsequent post-1986 water resources development act authorizing additional new construction projects on the inland and intracoastal waterways, Congress followed the 50/50 financing precedent established in WRDA 1986 for those newly-authorized projects. Although authorized with 50/50 financing, the Water Resources Reform and Development Act of 2014 (WRRDA 2014) changed the funding for the Olmsted Locks and Dam Project to 85 percent General Treasury/15 percent IWTF.

As legislated, the 27 waterways or waterway segments with the applicable fuel tax have their limits defined by river-mile points, in most cases (see Appendix A). WRDA 1986 specifically authorized use of the IWTF for a new Bonneville Lock below the downstream limit of fuel taxed waterway on the Columbia River.

The IWTF was physically established in February 1981, with the transfer of $10 million in estimated fuel tax revenues. The two basic sources for the IWTF data are the President's Budget and Treasury Department reports. The balance of the IWTF at the end of fiscal year (FY) 2015 was approximately $54 million, according to the Treasury Department statement for September 30, 2015. Table 2 shows a historical summary of the IWTF from the Treasury statements.

Table 2. Inland Waterways Trust Fund Cash Flow, 1987-2015, in $Millions (nominal)[1]

FY	Outlays	Tax Revenues	Interest Earnings	Total Revenues + Interest	Year-End Balances[1]
1987	($24.50)	$48.30	$16.50	$64.80	$300.60
1988	($62.10)	$48.10	$24.30	$72.40	$310.80
1989	($62.80)	$47.00	$26.00	$73.00	$321.10
1990	($117.30)	$62.80	$26.20	$89.00	$292.80
1991	($148.60)	$60.50	$21.20	$81.70	$225.90
1992	($122.70)	$69.90	$13.70	$83.60	$186.70
1993	($74.50)	$78.60	$7.50	$86.10	$198.30
1994	($75.70)	$88.40	$9.30	$97.70	$220.20
1995	($94.80)	$103.40	$13.30	$116.70	$242.10
1996	($85.50)	$108.40	$15.60	$124.00	$280.60
1997	($89.50)	$96.40	$17.00	$113.40	$304.60
1998	($76.90)	$91.10	$18.30	$109.40	$337.09
1999	($88.24)	$104.37	$17.41	$121.78	$370.63
2000	($102.38)	$99.58	$19.96	$119.54	$387.79
2001	($110.22)	$112.68	$20.90	$133.58	$411.15
2002	($104.49)	$95.28	$12.40	$107.68	$412.64
2003	($101.55)	$89.52	$9.52	$99.04	$399.02
2004	($117.26)	$90.85	$6.91	$97.76	$382.03
2005	($136.32)	$91.29	$7.66	$98.95	$352.60
2006	($183.87)	$80.81	$9.37	$90.18	$267.67
2007	($204.87)	$91.10	$10.38	$101.48	$137.66
2008	($202.16)	$87.60	$4.78	$92.38	$27.48
2009	($90.00)	$75.95	$0.82	$76.77	$14.25
2010	($50.13)	$73.95	$0.15	$74.10	$38.21
2011	($90.32)	$83.95	$0.05	$84.00	$31.90
2012	($88.70)	$89.20	$0.04	$89.24	$45.90
2013	($87.27)	$75.11	$0.04	$75.15	$33.82
2014	($97.87)	$81.73	$0.02	$81.75	$24.66
2015	($68.34)	$97.89	$0.01	$97.90	$54.22

[1]Year-end balances are from the U.S. Treasury and include U.S. Treasury adjustments not reflected in the table.

The Treasury's monthly statements consolidate waterways fuel tax receipts and IWTF transactions and are the only publicly available source for consecutive monthly data.

Figure 4 shows the outlays, revenues, and year-end balances of the IWTF since the initial Trust Fund expenditure in 1987. The balance in the IWTF peaked in FY 2002 at $412.6 million, and began declining as construction began on newly authorized inland waterways projects and increased amounts of IWTF resources were dedicated to those projects.

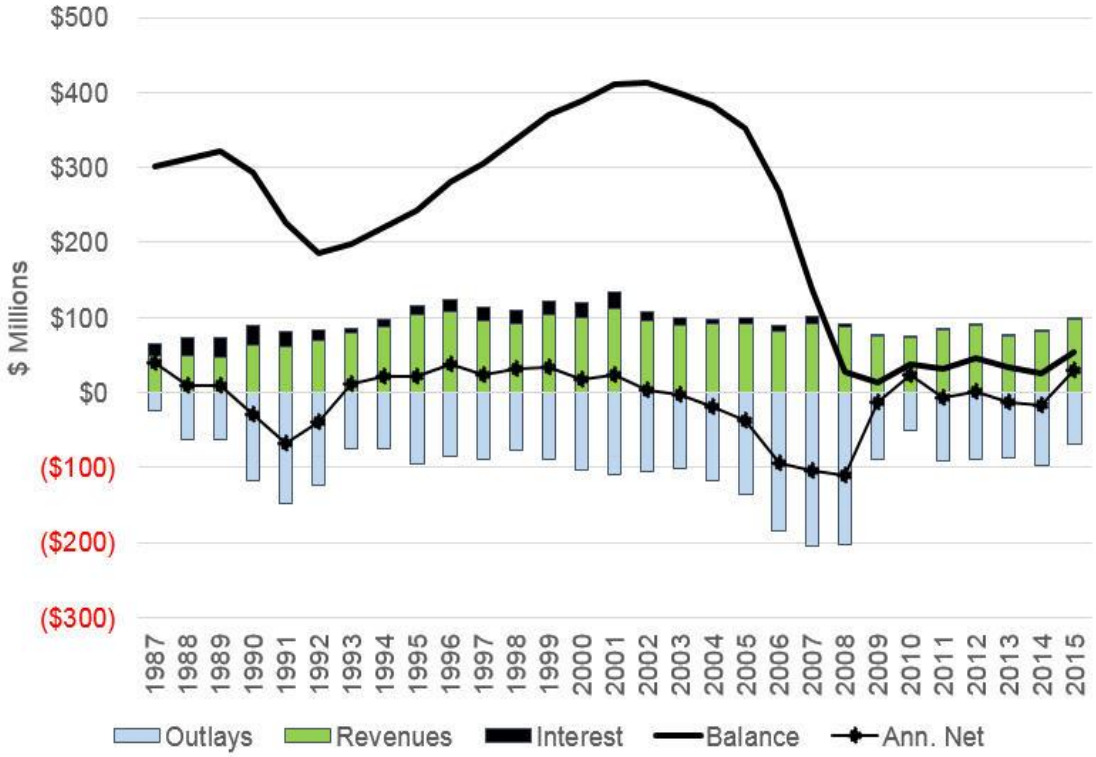

Figure 4. Inland Waterways Trust Fund Financial History

Fuel tax revenue changed from year-to-year based on fuel consumed transporting waterborne cargo on the inland and intracoastal waterways, as well as the fuel tax rate changes. Average tax revenues into the IWTF over the past 5 years have been approximately $86 million per year, with a low of $74 million in the recession year of FY 2010. Spending since FY 2002 has significantly drawn down the IWTF balance, resulting in a situation where annual IWTF expenditures since FY 2009 have been limited to the amount of annual fuel tax revenues collected for that particular year. As a result, most inland waterway construction projects are inefficiently funded or suspended, and the start of new construction and major rehabilitation projects are delayed. In FY 2009, Congress provided some relief to the constraints. In an effort to minimize the effect of the constrained IWTF funds, the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009 and the Omnibus Appropriations Act, 2009, exempted lock and dam major rehabilitation projects from being financed from the IWTF in FY 2009, albeit with the expectation that the Trust Fund share would be reimbursed in future fiscal years. The American Recovery and Reinvestment Act of 2009 (ARRA) also provided additional relief by permanently

exempting only that work performed with ARRA funds on inland waterways construction and major rehabilitation projects from drawing on the IWTF.

Since the beginning of withdrawals from the IWTF following enactment of WRDA 1986, over 25 IWTF projects have been completed. During this time approximately $3 billion has been expended from the IWTF. When combined with General Treasury appropriations this funded approximately $6 billion in inland waterways capital investments. While this investment is significant and helped keep the inland waterways as reliable as possible, there is still an investment shortfall. To overcome this shortfall, in the FY 2017 Budget the Administration has proposed a user fee. Specifically, the budget funds capital investments in the inland waterways within the limits of estimated revenues to the IWTF under current law, and proposes a new user fee to increase revenue to this trust fund to enable a significant increase in funding for investments, while also proposing that the IWTF pay 25 percent of the maintenance costs of inland navigation projects.

1.4 Inland Waterways Users Board

Section 302 of WRDA 1986 created the Inland Waterways Users Board (Users Board), which consists of 11 members appointed by the Secretary of the Army, to provide a regionally-balanced representation of the primary commercial users and shippers that use the inland and intracoastal waterways. In addition, representatives of the Secretaries of Army, Agriculture, Commerce, and Transportation currently serve as non-voting official federal observers of the Users Board.

The Users Board is a federal advisory committee intended to give commercial users a strong independent voice in investment decision-making processes for projects funded by the fuel taxes used for financing inland waterways capital improvements. The principal responsibility of the Users Board is to annually recommend to Congress, the Secretary of the Army, and the Corps the prioritization of new and replacement inland navigation construction and major rehabilitation projects. The Users Board historically meets three times a year. The Users Board has no appointed staff and receives staff support from the Corps. The Corps Deputy Commanding General for Civil and Emergency Operations serves as the User Boards' Executive Director.

Since its creation, the Users Board has submitted 27 reports providing recommendations on construction and rehabilitation priorities and spending levels for the federal commercial navigation features and components on the fuel taxed inland waterways and inland harbors. Its most recent report was submitted in January 2016.

1.5 Report Purpose

This 20-year Capital Investment Strategy (CIS) is developed per the WRRDA 2014. Specifically, Title II, Subtitle A, Section 2002, (d):

(d) CAPITAL INVESTMENT PROGRAM.—

"(1) IN GENERAL.—Not later than 1 year after the date of enactment of this subsection, the Secretary, in coordination with the Users Board, shall develop and submit to Congress a

report describing a 20-year program for making capital investments on the inland and intracoastal waterways based on the application of objective, national project selection prioritization criteria.

"(2) CONSIDERATION.—In developing the program under paragraph (1), the Secretary shall take into consideration the 20-year capital investment strategy contained in the Inland Marine Transportation System (IMTS) Capital Projects Business Model, Final Report published on April 13, 2010, as approved by the Users Board.

"(3) CRITERIA.—In developing the plan and prioritization criteria under paragraph (1), the Secretary shall ensure, to the maximum extent practicable, that investments made under the 20-year program described in paragraph (1)—

> *"(A) are made in all geographical areas of the inland waterways system; and*
>
> *"(B) ensure efficient funding of inland waterways projects.*

"(4) STRATEGIC REVIEW AND UPDATE.—Not later than 5 years after the date of enactment of this subsection, and not less frequently than once every 5 years thereafter, the Secretary, in coordination with the Users Board, shall—

> *"(A) submit to Congress and make publicly available a strategic review of the 20-year program in effect under this subsection, which shall identify and explain any changes to the project-specific recommendations contained in the previous 20-year program (including any changes to the prioritization criteria used to develop the updated recommendations); and*
>
> *"(B) make revisions to the program, as appropriate*.

This CIS report incorporates estimated IWTF revenues. While it is anticipated that additional IWTF revenues will be required in the future to provide reliable and sustainable inland waterways transportation, this report does not address additional sources of IWTF revenues. The requirement of Section 2003, Efficiency of Revenue Collection and Section 2004, Inland Waterways Revenue Studies of WRRDA 2014 will be addressed separately.

In addition to the WRRDA 2014 revenue generation requirements, the Administration has proposed a user fee, as discussed above in Section 1.3 and in Section 6.

This report is intended as a planning framework and does not take the place of the normal budget processes or commit the government to future actions.

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2. Development of a National Capital Investment Strategy

Historically Corps districts and divisions have driven the efforts to address navigation advancements locally and regionally. However, an overall national CIS that prioritizes project investment selection across the entire portfolio is needed, to determine best investment sequencing and minimize unnecessary construction delay impacts and cost increases, while considering the impact on the federal budget. A national project delivery model – which is what the CIS is intended to be - should help the Corps to better fulfill its navigation mission, by improving its ability to better manage inland waterways investment.

2.1 Investment Program Action Team

In order to develop this national project delivery model, Corps senior leaders began formally discussing the concept for an Investment Program Action Team (IPAT) with industry in May 2014 and that the IPAT would be the group that would develop the model. The IPAT was officially formed in June 2014 by the Corps Chief of Operations and Regulatory under the umbrella of the existing IMTS Working Group. IPAT represents a diverse, well-rounded group of navigation experts from the following USACE organizations. IPAT members are listed in Appendix C.

- Great Lakes and Ohio Rivers Division (LRD)
- South Atlantic Division (SAD)
- North Atlantic Division (NAD)
- Northwestern Division (NWD)
- Mississippi Valley Division (MVD)
- Southwestern Division (SWD)
- Institute for Water Resources (IWR)
- Risk Management Center (RMC)
- Engineer Research and Development Center (ERDC)
- Civil Works Cost Engineering and Agency Technical Review Mandatory Center of Expertise (MCX)
- Inland Navigation Design Center (NDC)
- Planning Center of Expertise for Inland Navigation (PCXIN)
- Headquarters, U.S. Army Corps of Engineers (HQUSACE)

In compliance with the requirements of the Federal Advisory Committee Act (FACA), the IPAT is comprised of only Corps staff who work in coordination with navigation stakeholders.

2.2 Consideration of the 2010 Inland Marine Transportation System Capital Projects Business Model

In accordance with WRRDA 2014, Title II, Subtitle A, Section 2002, the IPAT “considered the 2010 IMTS Capital Projects Business Model (CPBM).” The intent of the 2010 IMTS CPBM – which reflects the views

of the Users Board but not the Administration - was to "identify ways to improve the Corps business model, together with developing an investment strategy designed to improve and ensure the long-term viability of the IMTS." That effort produced 17 recommendations, of which 8 were implemented, 6 are in various stages of progress, and 3 have made no progress or have been deemed un-implementable. Many of the recommendations made in the 2010 IMTS CPBM report were codified in WRRDA 2014, Section 2002. A summary, and status, of the 17 recommendations is provided in Table 3.

Table 3. Status of 2010 CPBM Recommendations

Recommendation	Status
☑ Project Management Certification	Olmsted team and Lower Mon team certified; Kentucky and Chickamauga Lock Project Managers are in process of obtaining certification.
☑ Risk-based cost estimates	Updated for Olmsted; Lower Mon 2-3-4 updated in 2014; Chickamauga Lock updated in 2015; Kentucky Lock will be updated in 2016.
☑ Conduct Independent External Peer Reviews of IMTS project	Conducted on Olmsted Post Authorization Change Report and certified cost estimate, Upper Ohio Study, and will be completed for all future feasibility studies, major rehabilitation reports, and PACRs.
☑ Appoint a board member to each IMTS Project	Representatives appointed to teams for Olmsted, Lower Mon 2-3-4, Kentucky, and Chickamauga Locks.
☑ Project status updates to Users Board	Updates provided at each meeting.
✖ Include Board Chairman signature on PMPs	Unable to accommodate, the PMP is an internal Corps document, but participation on Project Development Team is required for all navigation construction projects.
☐ Evaluate use of early contractor involvement	To be considered when new projects begin.
☐ Apply Military Construction Principles	This is contrary to long-standing budget policy and statutory guidance regarding funding of water resource infrastructure, Some efficiencies and continuity from year to year is gained by fully funding contracts for major separable elements.
☐ Establish new start recommendation procedures	Applicability initially limited due to IWTF constraints. The CIS provides a process for prioritizing projects that can be used in recommending new starts.
☐ Obtain approval for CPBM regulation	Regulation not required, many recommendations have been implemented and additional guidance will be provided to the field as necessary.
☑ Create Design Centers of Expertise	Inland Navigation Design Center established.
☑ Develop standardized designs	Inland Navigation Design Center is developing lessons learned to be used when design work proceeds. Used on small scale by designing similar components for Kentucky and Chickamauga Locks.
✖ Revisit use of continuing contracts – increase threshold to $50 million from $20 million	Previously prohibited by Congress in appropriations acts from using continuing contracts on IWTF projects; these are generally inconsistent with federal budget policy as they restrict discretion in annual budget and appropriations processes.
☐ Increase Capital Investment Program Funding to $380M per year	The ability to do this is limited by outside factors, including IWTF revenues and appropriations from the General Fund of the Treasury, and the limiting effect that each has on the other due to cost-share matching requirements.
☐ Decrease IWTF cost share for major rehab on all dam projects and major rehab lock projects below $100 million	Requires legislation.
☐Establish cost-sharing cap	Requires legislation; opposed by Administration and not supported by Congress.
☑ Increase waterways fuel tax	Legislation passed in December 2014, increased rate by $0.09 effective April 2015.
Notes:	
☑ Completed	☐ In Progress ✖ Not Implementable without authorization

In addition to the legislative requirements in Section 2002, there was one other provision in Section 2006 that has considerable influence on this CIS, specifically a reduction in the IWTF share for the Olmsted project from 50 percent to 15 percent.

While many requirements in WRRDA 2014 influence the Corps navigation construction program, it did not increase revenues to the IWTF. The ABLE Act in Dec 2014 increased the diesel fuel tax by $0.09/gallon, from $0.20 to $0.29 effective April 1, 2015. Enactment of the ABLE Act and resulting increase in the fuel tax is a vital first step in ensuring the IWTF balance remains a viable revenue source to fund inland waterways capital investment needs in the short-term. The increase in IWTF revenues has changed the dynamic between appropriations from the IWTF and those from the General Treasury; in the past, the matching share from the IWTF was the limiting factor; due to recent changes in the external budget climate, appropriations from the General Treasury are likely to be the limiting factor, at least in the short term. However, it is anticipated that additional revenues will be needed to keep the inland waterways reliable and this is the basis of the Administration's user fee proposal.

2.3 Stakeholder Coordination

WRRDA 2014 required "*coordination with the Users Board*" in development of the CIS. The Corps continues to emphasize the importance of collaborating to the maximum possible extent with industry stakeholders within the provisions of FACA requirements. Stakeholder engagement and inputs were sought frequently during the development of the initial draft report, beginning in January 2014 and continuing through May 2015.

Ultimately, the criteria, processes, procedures, and results in this CIS reflect the judgment of the Army and the Corps.

The Corps and IPAT members coordinated with industry in the following venues:

- **Corps Senior Leader Interaction** – Meeting with select industry members on a "one-on-one" basis. This was used as a briefing opportunity to inform the stakeholders of future plans within the Corps.
- **Users Board Briefings** – Industry was briefed on multiple occasions at the regularly scheduled public Users Board meetings. These were formal briefings updating industry on the progress made by IPAT.
- **Bi-weekly Feedback Webinars/Teleconferences** – These interactions were scheduled as 1-hour meetings in order to brief the stakeholders on specific topics worked on by IPAT. They also provided an opportunity for industry to provide feedback.
- **Formal Face-to-Face Meetings** – These meetings were scheduled on multiple occasions at varying locations in order to present in-depth briefings and provide the opportunity for coordination, collaboration, and feedback. These meetings proved extremely useful in assisting the IPAT members in developing the prioritization methodology, project planning, and sequencing.

2.4 Enterprise Approach

This CIS provides nationally-consistent, enterprise-level visibility on project sites where a risk-informed investment approach would focus on critical assets that:

- are in the worst shape/condition,
- have the highest likelihood of failing, and,
- would cause the highest economic impact on shippers and carriers.

Focusing constrained funds in this manner increases availability, reliability, and service life of the key assets, such as a lock or dam, and critical systems like gates and gate operating machinery.

Once this set of the riskiest projects/assets is identified, the Corps can determine how best to allocate resources to address the highest risks using different approaches, such as through maintenance, a rehabilitation or a modernization investment. The requisite analysis and justification for a major rehabilitation or new project would be accomplished through an appropriate Major Rehabilitation Report or a Feasibility Study, respectively. Once these detailed studies are complete, the project(s) are ready to be prioritized in the capital program.

3. Enterprise Methodology

This report sets the groundwork for determining the future capital investment priorities when considering projects under construction, design, or study and those that are in the anticipated pipeline based on risk. **This is a planning framework and does not take the place of the normal budget processes or commit the Government to future actions**.

3.1 Background

This 20-year CIS incorporates emerging USACE Asset Management data and principles that have been developed or implemented since 2010. These principles provide a significant leap in the Corps' ability to apply risk-informed strategy, taking into account the complete inventory of components, their conditions, their probabilities of failure, and the expected economic impacts on shippers and carriers in the event of a failure. Integral to determining the economic impacts on shippers and carriers is the Shipper Carrier Cost (SCC) model. The SCC is a national model built and maintained by the PCXIN that calculates increased transportation costs to shippers due to unscheduled lock closures.

The Capital Investment Strategy methodology uses objective, national project selection prioritization criteria and processes to focus investments on the "riskiest" and highest benefit projects.

The overall result is a robust, defendable methodology that supports a national program, removing much of the subjectivity of the methods used prior to Asset Management. By having the tools in place to determine and compare exposure to risk across all project sites in a consistent fashion nationally, enables the Corps to 'filter' the entire inland and intracoastal waterways infrastructure portfolio down to the "riskiest" and highest benefit projects to be considered for capital investments. This risk-informed focus provides a balance between long-term affordability and performance of the waterways and their infrastructure.

3.2 Filter 1 – Determine the Highest Risk Projects

Risk-informed asset management principles and processes now enable the Corps to gain considerable insights into management and investment opportunities and strategies for the navigation portfolio. Determining those projects that have the highest risk requires identifying those mission-critical components that are in the worst shape/condition, have the highest likelihood of failing, and would cause the highest economic impact on shippers and carriers. Each lock and dam project site has hundreds of critical mechanical, electrical, and structural components, and the failure of any one of them could cause an unscheduled unavailability (outage) of one day or longer. In order to understand the overall project "exposure" to the risk potential of each of these critical components, one must understand the concept of the Risk Exposure.

Each component is graded with an Operational Condition Assessment (OCA) rating of "A" through "F" and are summarized in Table 4. OCAs were performed for over 166,000 navigation lock and dam components by the end of 2010. OCAs continue to be performed on a periodic basis and when

components are repaired, replaced, or experience a significant change in condition. When considering the OCA conditions, the Corps needs to distinguish between those mission critical components that are already impacting operational performance (to some degree or another), specifically those in condition rating “C” through “F,” from those that are functioning as expected with no performance impacts (those components in condition rating “A” and “B”) is required. These two pieces of the total site risk exposure, reflecting the potential economic impact on shippers and carriers from unscheduled outages, are defined as follows:

Operational Risk Exposure (ORE) – the total risk exposure at a project site resulting from those mission critical components that are already impacting performance (Conditions “C” through “F”).

Residual Risk Exposure (RRE) – the remaining, or residual risk (per the International Organization for Standardization definition), after a “risk treatment,” which generally means that a repair or replacement has been done. Further, since a repair is currently equated to returning a component to a “B” condition and a replacement is equated to providing a component in an “A” condition, all components currently in those conditions are also considered as contributing to residual risk.

Table 4. Lock and Dam Operational Condition Assessment Rating

CONDITION RATING		DEFINITION
A	EXCELLENT	1) Has not failed AND 2) does not have critical design flaw AND 3) no documented or observed deficiencies based on available data or studies AND 4) does not show signs of normal wear.
B	GOOD	1) Has not failed AND 2) does not have critical design flaw AND 3) no documented or observed significant deficiencies based on available data or studies AND 4) deficiencies do not impact performance or safety. Best condition rating allowed if component shows signs of normal wear.
C	POOR	1) Has not failed AND 2) does not have critical design flaw AND 3) no documented or observed significant deficiencies based on available data, studies, or observed project performance issue AND 4) deficiencies do impact performance or safety.
D	INADEQUATE	1) Has not failed AND 2) does not have critical design flaw AND 3) has documented or observed significant deficiencies based on available data, studies, or has an observed project performance issue AND 4) does not violate law, failure is not imminent before next OCA, has not experienced closure/loss of service due to current condition in recent history, and no critical life safety concern exists.
F	FAILING OR FAILED	1) Has failed OR 2) has critical design flaw OR 3) has documented or observed significant deficiencies based on available data, studies, or has an observed project performance issue AND one or more of the following is true; violates law, failure is imminent before next OCA, has experienced closure/loss of service due to current condition in recent history, or critical life safety concern exists.

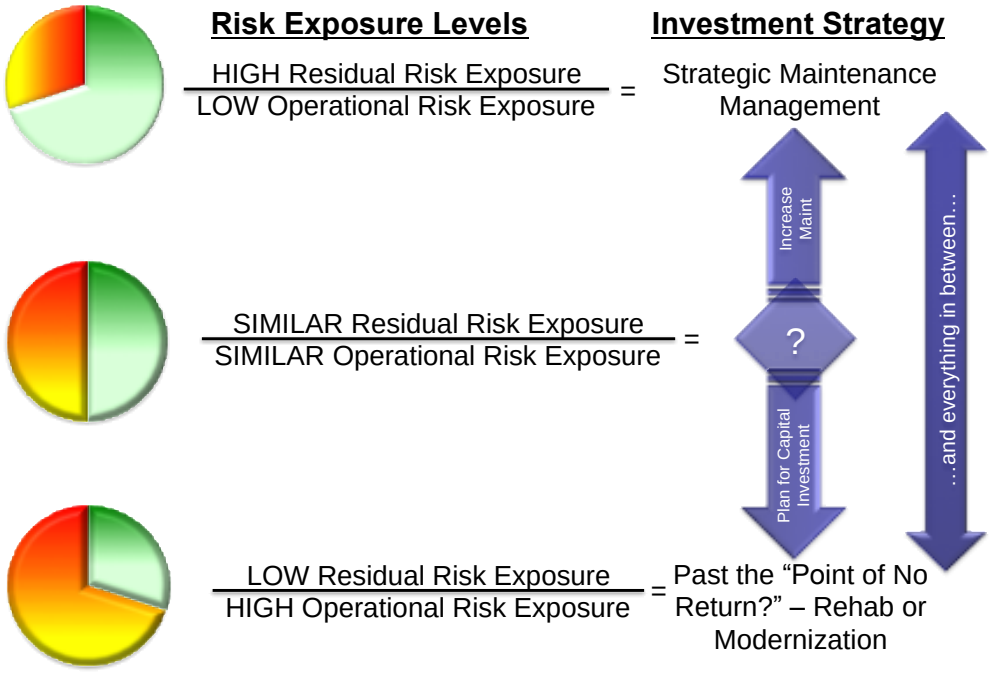

Figure 5. Risk Exposure and Investment Strategy

The relationship between a project's ORE and RRE and how it notionally informs an investment strategy is illustrated in Figure 5. At one end of the spectrum, if a project has the majority of its mission critical components in good, or like-new condition (i.e., "A" and "B" conditions and that are performing as expected) relative to those in poor or worse condition ("C" through "F" where performance is being impacted), the most likely investment strategy would be to focus on strategic maintenance management in the annual operation and maintenance (O&M) program. The goal would be to perform preventive, recurring, etc., maintenance and ensure that none of these critical components currently in "good condition" slide down the condition scale and begin impacting performance.

For instances where the operational risk and residual risk, relative to each other, are fairly equivalent, it may suggest that the organization may have to decide to plan for a major construction action and/or to adjust annual O&M to modify the risk profile accordingly. At the other end of the spectrum, if a project currently has considerably more operational risk relative to residual risk, it is a leading indicator that any "risk treatment or corrective action(s)" are likely to be beyond the means of the annual O&M funding, and a major rehabilitation or construction action may be the best or only option to mitigate that risk.

It is the last relationship of high ORE that is the initial filter for identifying projects most likely to require a construction action.

Using ORE provides the Corps with nationally-consistent, enterprise-level visibility and focus on project sites where a risk-informed investment approach would lead to repair or replace the most critical assets and/or components. The ORE identifies components that:

- are in the worst shape/condition,
- have the highest likelihood of failing, and,
- cause the highest impact on shippers and carriers.

This focus of buying down the greatest risk increases availability, reliability, and service life of the key asset, such as a lock or dam, and critical systems like gates and gate operating machinery. It should also be noted that having risk evaluated at the component level provides visibility and justification for strategic investments at the component level in the annual O&M program. This risk-informed "top-down" approach provides a more stringent and consistent evaluation of project level priorities across the portfolio than in the past, and is the initial filter for focusing the CIS.

3.3 Filter 2 – Verification of Projects

Verification of projects or component risk profiles is the second CIS filter. To ensure nationally-consistent risk profiles are used annually, the necessary OCA and ORA data will be extracted for use in the analysis at the same time every year at a time when it is useful for informing annual budget development. This provides a common and consistent annual snapshot to review a site's "risk profile." The projects identified as having high relative ORE are then verified to confirm that their risk profiles reflect current conditions. Sometimes the identified risk associated with specific components has already been mitigated or is funded and scheduled for repairs or replacement during the current or next fiscal year. Specific steps that were taken to filter out projects where risk has, or will be, bought down were to review:

- Previous year's executed work plan and determine if work was completed, *but* the condition rating had not yet been officially updated in the OCA database.
- The current FY Work Plan and determine if any ongoing work will be performed on the identified high risk components.
- The upcoming year's President's Budget amount (if known) to see if any likely future work will be performed on identified high risk components.

If a project's risk has not been bought down, then it would move to the next filter.

3.4 Filter 3 – Confirm Construction or Maintenance

The third CIS filter for projects with high relative ORE is to confirm if it meets the requirements for a capital investment or annual maintenance. To make this determination, the team applied the definition for Major Rehabilitation of inland waterway projects found in Section 205 of the WRDA 1992. "*For the purposes of laws relating to navigation on inland and intracoastal waterways of the United States, the term "rehabilitation" means --*

(1) Major project feature restoration –

(A) which consists of structural work on an inland navigation facility operated and maintained by the Corps of Engineers;

(B) which will significantly extend the physical life of the feature;

(C) which is economically justified by a benefit-cost analysis;

(D) which will take at least 2 years to complete; and

(E) *(ii) which will require at least $20 million (as amended by WRRDA 2014) or current threshold (for FY 2017, the threshold will be $21 million after inflation adjustments of the annual President's Budget) in capital outlays"*

The WRDA 1992 definition also includes *structural modification of a major project component* (*not exhibiting reliability problems*), but currently, the CIS only focuses on the larger reliability projects. Further, the definition states that Major Rehabilitation *does not include routine, deferred, or minor maintenance* and that the dollar threshold referred to above *shall be adjusted annually according to the economic assumption published each year as guidance in the Annual Program and Budget Request for Civil Works Activities of the Corps of Engineers*.

Using the three filters ensures that only key capital investment projects receive consideration in the next filter. Over a dozen projects with higher relative OREs were filtered-out and removed from further consideration at this time. The reasons that projects dropped out during the filtering process included:

- ARRA-funded actions bought down risk
- O&M-funded actions bought down risk
- Dam safety funded actions bought down risk
- Current or scheduled O&M funding bought down risk
- Needed repairs did not meet criteria for Major Rehabilitation per WRDA 1992, as amended

A list of projects passing through to this point, based on the risk exposure, is a list of the best opportunities for risk reduction at this time.

3.5 Filter 4 – Major Rehabilitation or New Construction

The methodology adds a new aspect to the process for considering "modernization" (e.g., increasing lock capacity or new redundant lock chamber or channel and safety improvements). This is done specifically by a Plan Formulation Team that determines if there is sufficient evidence for the project to proceed to the feasibility study for modernization. Considerations for modernization screening must be at a low enough level sufficient to screen projects while still maintaining the policy and requirements of the Corps planning process. The plan formulation should consider the condition and risk as described with the methodology that screens for a Major Rehabilitation but also includes additional data, information, and analysis associated with waterway traffic projections, transportation rates, waterway demand elasticities, vessel operating costs, and lock capacities, at a minimum. Based on previous success with industry collaboration and per WRRDA 2014, the team recommends an industry representative participate at this point in the process, appointing a representative of the Users Board to each navigation project.

3.6 Formal Decision Studies

This CIS sets a new direction for the Corps and expands on the past project initiation paradigm, which focused on local or regional project importance, by using a programmatic nationally-consistent focus on the inland and intracoastal waterways. Consequently, not all future projects filtering into the CIS will have a decision document or study that provides that initial detailed objective economic analysis. In rare cases, a project may undergo a reevaluation due to changed conditions that may warrant modification of the

original project. Note, the CIS includes projects that have not proceeded through this process but do have authorizing documents.

The economic return data results and outputs from these formal decision studies are critically important for use as the final filters in the CIS. These "bang for the buck" metrics are derived from even more detailed objective engineering and economic analysis than those used to determine initial screening based on the project risk exposure. In effect, every filter in the CIS involves more rigorous analysis to ensure that capital investments target projects with the highest economic benefits and greatest risk mitigation opportunities. Economic return criteria are benefit to cost ratio (BCR), and net benefits for initial project study and remaining benefit to remaining cost ratio (RBRCR) for planning purposes after construction commences.

These three metrics are all derived from engineering and economic analyses contained in approved decision reports, whether a new feasibility study, a Limited Re-evaluation Report (LRR) (also known as a Level 3 Economic Update), a General Re-evaluation Report (GRR) (also known as a Level 4 Economic Update), or a Major Rehabilitation Evaluation Report (RER)[6]. This CIS utilized calculations of project BCR, net benefits, and RBRCR from the last approved report (decision document) for a given project.

3.6.1 Benefit to Cost Ratio

BCRs are used to make investment decisions for capital improvement projects in many areas of the federal government, not just for Corps or other water resource agencies. The intent is to have a BCR greater than one indicating that the benefits exceed the Federal government's investment. In recent years, the Budget has primarily funded construction of Corps projects that are evaluated on the basis of their economic return to the nation with a BCR of 2.5 to 1.0 or higher at a 7 percent discount rate, have a BCR of 1.0 or higher at a 7 percent discount rate that can be funded to completion in that fiscal year, have significant risk to life, or have environmental benefits. Because prioritizing projects from highest to lowest BCR rank orders expected project investment returns, a project with a higher BCR generally is favored over one with a lower BCR unless other noneconomic factors (e.g., safety or cost considerations) have a higher priority or importance.

3.6.2 Net Benefits

Net benefits are the net National Economic Development (NED) benefits that will be achieved as a result of making the project investment. This category captures the benefit of expanded capacity that alleviates chronic waterways traffic congestion and delays and reduces unexpected outages associated with degradation of structural components. The official statement of net benefits for a given project change only when a more current economic analysis is performed as part of an Economic Update, LRR, or GRR.

3.6.3 Remaining Benefit to Remaining Cost Ratio

Like the BCR for projects being considered for authorization or investment, the RBRCR informs the process but focuses on the decision process going forward once construction has started, taking into account sunk costs invested in the project. Typically, construction of various features and components of

[6] For details on an LRR and GRR, see ER 1130-2-500. For details on an Major Rehabilitation Report, see ER 1105-2-100.

the project are completed (sunk costs), but until the entire project is finished, it may produce very little or no economic benefits. This results in the RBRCR increasing during the period of construction as the remaining costs continue toward zero as the project nears completion. When considering rank or priority by RBRCR, projects with significant construction completion and few benefits realized will rank higher than new construction.

3.7 Capital Investment Strategy Project Sequencing

Once high risk projects filter through the project initiation process and the appropriate decision document (feasibility or major rehabilitation) has been completed, the risk-informed focus of the initiation filters moves to a more robust return on that investment, or benefit to cost metrics.

Project sequencing is based on the project's objective, detailed engineering, and economic study, specifically the benefit to cost ratio of the identified work or other metric such as life safety. Over time, it is likely that asset conditions will change depending on annual O&M investment and normal wear and tear as well as changes in commercial traffic patterns. Therefore, it is imperative that the project conditions and engineering and economic analyses are updated per Civil Works Policy Memorandum (CWPM) 12-001[7] to ensure continued focus on the highest return capital investments.

In recent years, projects must have a BCR of 2.5 to 1.0 or higher at a 7 percent discount rate in order to receive construction funding in the budget on the basis of their economic return. The CIS does not change that criteria.

3.8 Scheduling Considerations

Scheduling of all CIS projects is executed by priority, which is primarily based on the BCR for those that have formal authorizing study documentation and operational risk exposure for those that do not. However, since the CIS is a transitional strategy, where not all projects have a common consistent updated BCR yet, some slight adjustments must be made until all projects are in compliance with the CIS methodology and Civil Works policy.

There are three major considerations for scheduling projects in the CIS:

- The first is to meet the requirements of WRRDA 2014 for an efficient funding stream based on a current risk-based cost estimate. An efficient funding stream allows work to proceed without incurring delay or contract inefficiency costs.
- The second consideration is to identify separable phases of construction that would allow flexibility in managing the IWTF balances, Corps funding, and the overall CIS schedule for an efficient program that effectively balances competing management considerations. Scheduling separable phases considers activities that use the same resources so they occur simultaneously. An example would be to schedule all of the construction of a new lock guide or guard walls requiring mass concrete placement where it is costly to mobilize and demobilize for that activity.

[7] This memorandum can be accessed from http://planning.usace.army.mil/toolbox/library/MemosandLetters/CWPM12-001.pdf

- The third key consideration when scheduling projects is the need to maintain a minimum balance in the IWTF. **The schedule represents alternatives that could be used by decision makers but does not take the place of normal budget processes or commit the government to future actions**. The budget and appropriation process will determine actual funding received by any project. The updates of the CIS will take into account the funding received and actual execution from the previous year. The process provides flexibility for addressing unforeseen circumstances and realities that a standard methodology could not be expected to capture and may supersede current planning priorities.

Together the application of the three major considerations results in an integrated approach to scheduling that enables:

- Flexibility and fine-tuning of the overall CIS schedule to accommodate annual fluctuations in revenue streams, construction execution, or other unknown factors, and,
- A minimum balance to maintain in the IWTF so that contingencies can be covered in the event of reduced revenues or unforeseen cost increases without impacting efficient funding and execution. The minimum balance used in the CIS is $20 million and is based on the fluctuations in the IWTF receipts over the last 10 years, contingencies, and delayed receipt of revenues.

The process provides flexibility for addressing unforeseen circumstances and realities that a standard methodology could not be expected to capture and may supersede current planning priorities.

The priority authorized projects are scheduled according to the ranking derived from the BCR, dam safety, or other critical metric. A project's priority ranking could change under a few scenarios:

- When projects undergo a periodic BCR update, the priority ranking may change if the BCR changes. Projects that do not have completed formal decision documents are scheduled according to the ranked priority based on operational risk exposure.
- The priority may change if the detailed study of a newly initiated project has a higher BCR or critical metric.
- Exceptions to funding projects in prioritized order may be made for economically justified channel construction projects. These projects are typically short in duration, require considerably less funding than lock and dam construction projects, and may fit into the schedule when the opportunity for funding exists and where they do not interfere with the basic principles of scheduling the high-cost, long-duration projects.

The CIS recognizes the importance of major rehabilitations to maintain system reliability, so the strategy generally provides funding specifically to address major rehabilitation projects. However, a specific funding target was not set in the CIS. Rather, they are ranked with other major rehabilitation projects by priority and then in relation to new construction projects where they fit best while maintaining overall programmatic scheduling for efficient funding.

Arriving at the recommended schedule was an iterative process, including two face-to-face meetings and several web meetings with industry. In general, the scheduling starts with those projects currently under construction in their priority order. The first project is scheduled at the earliest date in accordance with the

efficient funding schedule. The next project is then scheduled in the same manner. It is possible that a lower priority project could be completed earlier in the schedule based on the available funding. The channel projects are the best example of this situation as they are typically less expensive and do not require many years of sustained funding. Those projects can sometimes be fit into the schedule at an earlier date than ranked priority alone would suggest. For the same reason, major rehabilitation projects may also be fit into the schedule.

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4. Twenty-Year Capital Investment Strategy Plan

This 20-year CIS focuses on effectively improving the highest priority critical assets of the inland waterways infrastructure via replacement and rehabilitation and enhancing and improving the inland waterways to address critical navigation needs. It begins with an evaluation of the total risk exposure, highlighting the current risks and where ongoing investment is essential to counter unscheduled closures, longer travel times, aging, and inadequate waterways infrastructure.

4.1 Prioritization Results

As determined by the methodology in Section 3, projects are scheduled by priority. The *ongoing (in italics below)* and new construction projects that meet the criteria described in Section 3 and are included in the CIS under any of the funding scenarios are shown below 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 - Illinois Waterway System Navigation and Ecosystem Sustainability Program (NESP) (Illinois Waterway)
6. Lock & Dam 22, NESP (Mississippi River)
7. Lock & Dam 24, NESP (Mississippi River)
8. Lock & Dam 25, NESP (Mississippi River)
9. Montgomery Locks and Dam, PA (Upper Ohio Navigation Locks & Dams Improvements)

Projects other than Olmsted Locks and Dam and Locks and Dams 2, 3, and 4, Monongahela River Navigation Project need to have economics and, in some cases, cost estimates updated.

The major rehabilitation projects that meet all the criteria in the methodology described in Section 3 and included in the 20-year CIS under all funding scenarios are shown below 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 [MKARNS])
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 an RER (LaGrange and O'Brien), and the remaining six projects require completion of RER.

4.2 Funding Scenarios

Given the uncertainties of the program variables, which include receipts in the IWTF, the budget authority for the Corps, and the annual appropriations provided to the Corps, only the first five years of investment are provided in detail.

The CIS depends on the funding available to invest in the inland waterways. The program funding is variable and dependent on the receipts in the IWTF, the budget authority for the Corps, and the annual appropriations provided to the Corps. The evaluation includes development of three different funding scenarios, taking into account program variables. These scenarios include a baseline, annual allocations, and a maximized IWTF. Each represents a possible scenario that could determine the schedule for inland navigation construction throughout the next 20 years. Projects are scheduled, as detailed in Section 3, based on the available funding identified for each scenario. Projects are identified in current priority order with the annual investment through 2021. The remaining 15 years, 2021 through 2036, are shown as a summary. Potential projects are listed in alphabetical order, with a lump sum investment shown for the entire 15 years. In developing the strategy for each funding scenario, several assumptions apply:

- Amounts shown for FY 2016 include the actual funding provided through the budget including the work plan. The FY 2017 President's Budget included $225 million for Olmsted. The remaining costs were based on the current cost estimate for projects beginning in FY 2017.

- RER for projects other than LaGrange and O'Brien have not been completed. Cost estimates for those projects are rough order-of-magnitude estimates and will be updated upon completion of a RER.
- FY 2016 IWTF available includes FY 2015 balance of $54 million in IWTF.
- The Locks and Dams 2, 3, and 4, Monongahela River project does not include costs for the Port Perry Bridge or the Land Chamber. Those features have been deferred until a later date.
- IWTF minimum balance requirement is $20 million. This figure is based on the fluctuations in the IWTF receipts over the last 10 years, contingencies, and delayed receipt of revenues.
- IWTF receipts are based on Department of Treasury estimates.
- Projects listed in the first 5 years that would require an additional investment beyond FY 2021 are noted with an asterisk.
- Projects listed with a "+" have received construction funding prior to FY 2016.

4.2.1 Baseline Scenario

The Baseline Scenario assumes there is limited funding available for the inland navigation construction program, estimated based on amounts typically found in the President's Budget. The assumptions specific to the Baseline Scenario include:

- General Treasury funding is limited to $180 million per year.
- The navigation program total is limited to $250 million per year as a conservative assumption.
- Preconstruction engineering and design (PED) funding is rebalanced within 5 years of project construction start (PED is initially funded from the General Treasury in the General Investigations appropriation and then the 50 percent share is drawn from the IWTF after construction is started).
- There will be no additional programmatic funds provided by appropriations (sometimes referred to as "funding pots").

The schedule of projects for the Baseline Scenario is shown in Figure 6, and the funding profile is shown in Table 5. The Baseline Scenario generally represents a $4.9 billion capital investment program over the next 20 years; requires a maximum of $250 million in any one year, and results in a maximum IWTF balance of $240 million.

4.2.2 Annual Allocations Scenario

The Annual Allocations scenario assumes that additional appropriations continue to be provided in funding pots, similarly to the last 3 years. Assumptions specific to the Annual Allocations scenario include:

- General Treasury funding is limited to $220 million per year.
- Similar to the Baseline scenario, PED funding is rebalanced within 5 years of project construction start.
- Annual appropriations will continue to provide additional programmatic funding beyond the President's Budget for inland navigation projects.

The schedule of projects for the CIS based on the Annual Allocations scenario is shown in Figure 7, and the funding profile is shown in Table 6. The Annual Allocations Scenario generally represents a $4.9

billion capital investment program over the next 20 years; requires a maximum of $370 million in any one year; and, results in a maximum IWTF balance of $130 million.

4.2.3 Maximized IWTF Scenario

The Maximized IWTF scenario assumes there is no limit to the General Treasury funding available to match the IWTF. Assumptions specific to the Maximized IWTF scenario include:

- PED funding for NESP and the GIWW Channel projects are rebalanced when IWTF funds are available and not within a specified timeframe. The goal is not to affect the schedule for construction.
- Annual appropriations will continue to provide additional programmatic funding beyond the President's Budget for inland navigation projects.

The schedule of projects for the 20-year CIS based on the Maximized IWTF scenario is shown in Figure 8 and the funding profile is shown in Table 7. The Maximized IWTF scenario generally represents a $4.9 billion capital investment program over the next 20 years; requires a maximum of $400 million in any one year, and results in a maximum IWTF balance of $80 million.

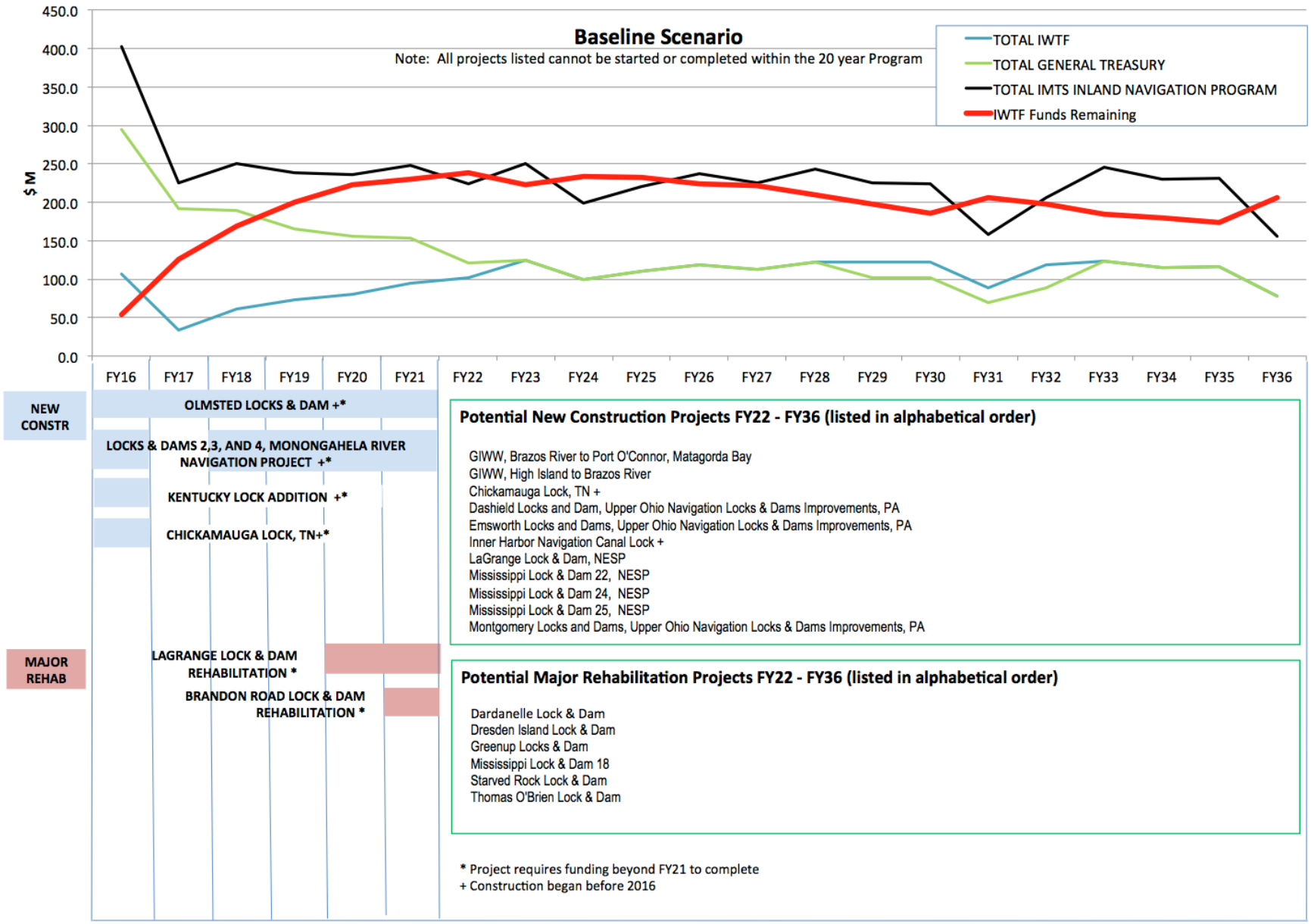

Figure 6. Schedule for Projects under Baseline Scenario

Table 5. Baseline CIS Funding Profile

Baseline Scenario ($M)

(All projects cannot be started or completed within the 20 year Program)

Division	District	Official Authorization 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	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	$2,124.0	$993.0	$1,026.9	$268	$225	$182	$133	$108	$83	$2,711
LRD	LRP	Locks & Dams 2, 3, and 4, Monongahela River Navigation Project +*	Monongahela	L	X	$1,022.0	$499.0	$535.3	$59		$68	$106	$123	$98	
LRD	LRN	Kentucky Lock Addition +*	Tennessee	L	X	$734.2	$449.0	$523.7	$45						
LRD	LRN	Chickamauga Lock, TN +*	Tennessee	L	X	$374.5	$659.0	$804.2	$30						
SWD	SWG	GIWW, Brazos River to Port O'Connor, Matagorda Bay	GIWW	C	X	$9.0	$19.5	TBD	PED FUNDING FROM GI ACCOUNT $42M						
SWD	SWG	GIWW, High Island to Brazos River	GIWW	C	X	$17.0	$0.0								
LRD	LRP	Dashields, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$800.7	$800.7								
LRD	LRP	Emsworth, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$737.1	$737.1								
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	$72.6	$72.6	$80.3					$5	$61	$566
MVD	MVR	Brandon Road Lock & Dam Rehabilitation	Illinois	D		$68.5	$68.5	$77.7						$6	
MVD	MVR	Dresden Island Lock & Dam Rehabilitation	Illinois	L		$50.0	$50.0	TBD							
SWD	SWL	Dardanelle Lock & Dam	MKARNS	D		TBD	TBD								
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								
MVD	MVR	Thomas O'Brien Lock & Dam Rehabilitation	Illinois	L	X	$46.5	$46.5								
Total Program/year FY16 through FY21. Average Total Program FY22 - FY36									$402	$225	$251	$238	$237	$242	$218

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 budget funding is constrained to a maximum of $180M/year and total Program does not exceed $250M/yr .	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 projects 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			

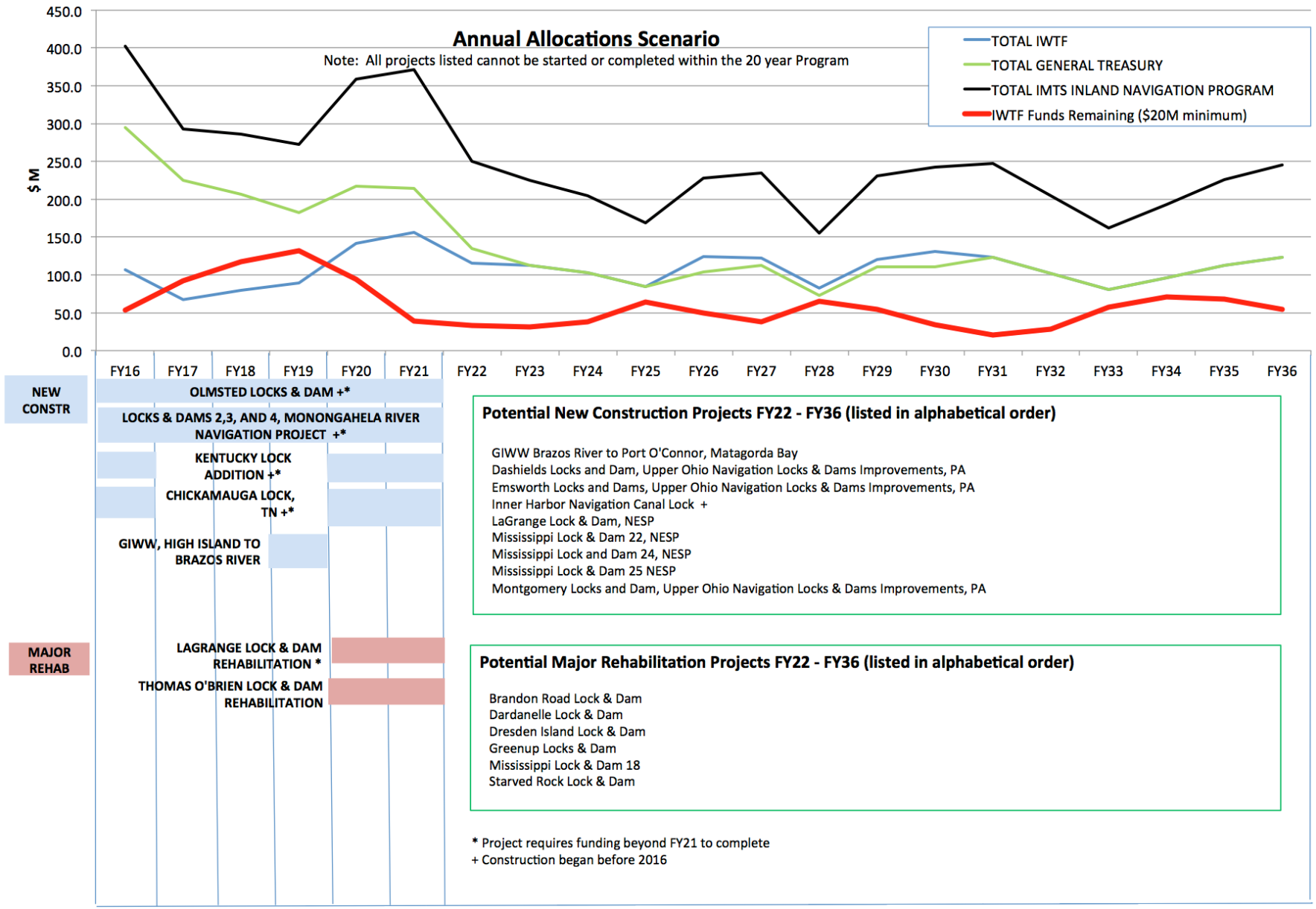

Figure 7. Schedule for Projects under Annual Allocations Scenario

Table 6. Annual Allocations CIS Funding Profile

Annual Allocations 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	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	$2,124.0	$993.0	$1,026.9	$268	$225	$182	$133	$108	$83	
LRD	LRP	Locks & Dams 2, 3, and 4, Monongahela River Navigation Project +*	Monongahela	L	X	$1,022.0	$499.0	$527.4	$59	$67	$104	$121	$96	$36	
LRD	LRN	Kentucky Lock Addition +*	Tennessee	L	X	$828.6	$449.0	$506.6	$45				$56	$56	
LRD	LRN	Chickamauga Lock, TN +*	Tennessee	L	X	$828.9	$659.0	$759.6	$30				$87	$88	
SWD	SWG	GIWW, High Island to Brazos River	GIWW	C	X	$17.0	$0.0	$18.5				$18			
SWD	SWG	GIWW, Brazos River to Port O'Connor, Matagorda Bay	GIWW	C	X	$19.5	$19.5								
LRD	LRP	Dashields, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$800.7	$800.7								$2,438
LRD	LRP	Emsworth, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$737.1	$737.1								
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	TBD	PED FUNDING FROM GI ACCOUNT $42M						
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	$72.6	$72.6	$80.3					$5	$61	
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		$68.5	$68.5								
MVD	MVR	Dresden Island Lock & Dam Rehabilitation	Illinois	L		$50.0	$50.0								
SWD	SWL	Dardanelle Lock & Dam	MKARNS	D		TBD	TBD	TBD							$518
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	$292	$286	$272	$358	$371	$197

Note:

1	Remaining cost is based on the current cost estimate beginning in FY16.	7	The total remaining cost with escalation assumes that projects are efficiently funded to completion
2	Assumes General Treasury funding is constrained to a maximum of $220M/year	8	Funding shown in FY22 - FY36 does not represent the total cost to complete all projects
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	All projects cannot be started or completed within the 20 year Program
4	IWTF receipts are based on Department of Treasury estimates	10	FY16 is actual funding provided including the work plan
5	Assumes minimum IWTF balance of $20M	11	FY17 President's Budget includes $225M for Olmsted. All other funding is efficient funding based on current cost estimates.
6	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
Green cells include balancing of prior year PED costs funded within the GI account with construction funding		*	Funding to complete project would be required beyond the 5 years shown

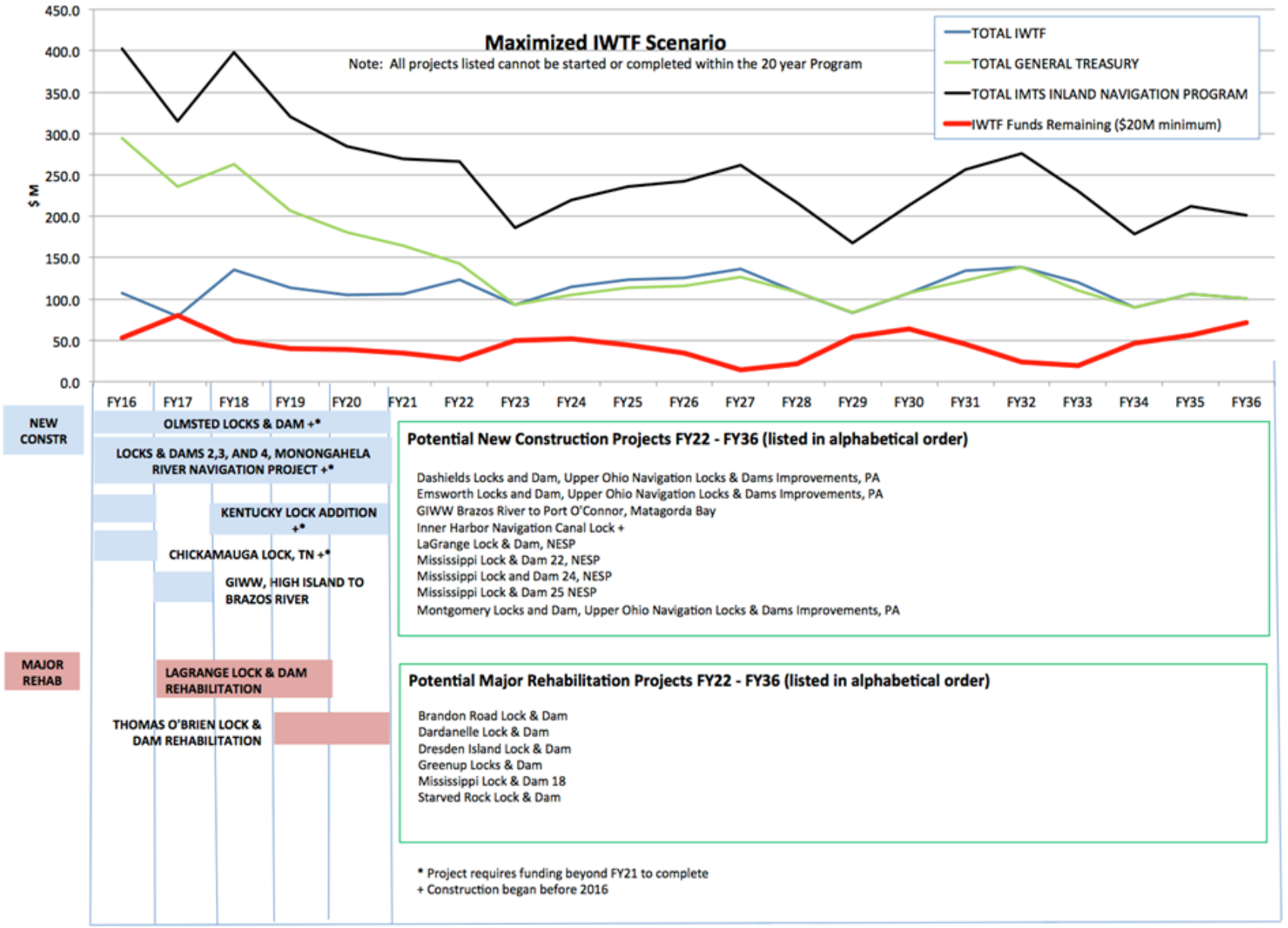

Figure 8. Schedule for Completion of Projects under Maximized IWTF Scenario

Table 7. Maximized IWTF CIS Funding Profile

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	$3,098.0	$993.0	$1,026.9	$268	$225	$182	$133	$108	$83	
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								
LRD	LRP	Emsworth, Upper Ohio Navigation Locks & Dams Improvements, PA	Ohio	L		$737.1	$737.1								$2,440
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	TBD	PED FUNDING FROM GI ACCOUNT $42M						
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			
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								
SWD	SWL	Dardanelle Lock & Dam	MKARNS	D		TBD	TBD								
MVD	MVR	Dresden Island Lock & Dam Rehabilitation	Illinois	L		$50.0	$50.0	TBD							$511
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:

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			

4.3 Key Funding Scenario Comparison

The three funding scenarios are provided to give the bounds of the most likely program. The Baseline scenario represents a $4.9 billion program over the next 20 years, requires a maximum of $250 million in any one year, and results in a maximum IWTF balance of $240 million. Due to the funding constraints in this scenario, the IWTF balance builds quickly to that $240 million while Olmsted is under construction (drawing only 15 percent from the IWTF), but begins to decline slowly at a rate of approximately $5 million per year. Generally, in the Baseline scenario, four ongoing and four new construction projects (including two channel projects) could be completed, and two would be in progress; and seven major rehabilitation projects could be completed.

The Annual Allocations scenario represents a $4.9 billion program over the next 20 years, requires a maximum of $370 million in any one year, and results in a maximum IWTF balance of $150 million. In this scenario, the IWTF balance still builds quickly while Olmsted is under construction (drawing only 15 percent from the IWTF) but with additional funding provided by funding pots, the balance decreases quickly. Generally, in the Annual Allocations scenario, four ongoing and four new construction projects (including two channel projects) could be completed, and two would be in progress; seven major rehabilitation projects could be completed.

The Maximized IWTF scenario represents a $4.9 billion program over the next 20 years; requires a maximum of $400 million in any one year; and, results in a maximum IWTF balance of $100 million. In the maximized IWTF scenario, four ongoing and five new construction projects (including two channel projects) could be completed, and one would be in progress; seven major rehabilitation projects could be completed.

A comparison of the three funding scenarios considered is shown in Table 8. It is worth noting that due to effects of inflation, project costs differ by scenario. A comparison set of projects, based on only those projects that could be completed in the Baseline scenario costing $4,740 million, costs $110 million less under the Annual Allocations scenario and $145 million less under the Maximized IWTF scenario. This represents a minimum savings and they may increase as projects in the Baseline scenario are completed later and even beyond the CIS twenty year planning window.

Table 8. Comparison of Baseline, Annual Allocations, and Maximized IWTF Funding Scenarios

Comparison of Baseline, Annual Allocations, and Maximized IWTF Funding Scenarios ($M)			
	Baseline	Annual Allocations	Maximized IWTF
New Construction Investment	$4,239	$4,302	$4,304
Major Rehabilitation Investment	$638	$636	$637
Total 20 Year Program	$4,877	$4,938	$4,941
Maximum Inland Navigation Program Funding ($M) (after 2016)	$250	$370	$400
Average Annual Inland Navigation Program Funding ($M)	$230	$235	$235
Maximum IWTF Balance ($M)	$240	$130	$80

Another way to compare the three scenarios is in the context of the “Scheduling Considerations” noted in Section 3.8. One of the strengths of the CIS process is that it provides great flexibility and ability to fine-tune the overall CIS schedule to accommodate annual fluctuations in revenue streams, construction execution, or other unknown factors. In Figure 9, the annual planning capital investment costs for the “Total 20 Year Program” (shown in line 3 of Table 8) for the three scenarios are illustrated over the entire 20 year CIS period. Possible “planning flexibility windows” are illustrated for each scenario. The general size of the window is a leading indicator of the magnitude of opportunity the CIS team has in accounting for variability of the annual funding fluctuations. These planning flexibility windows illustrate opportunities related both to potential available funding and duration of a planned construction activity.

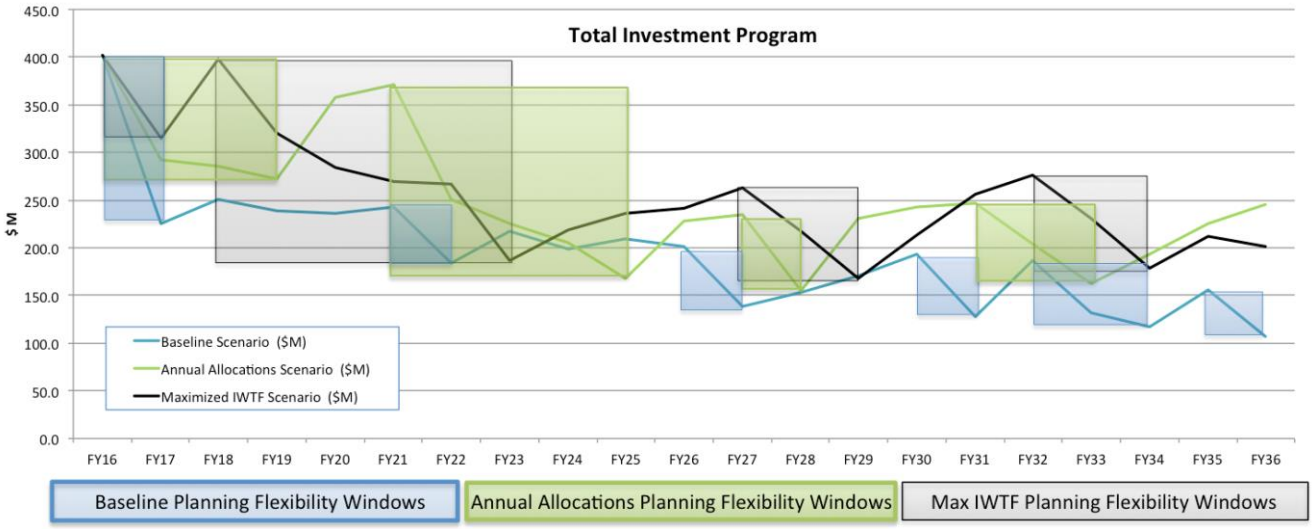

Figure 9. Planning Flexibility Windows over 20 year CIS

Depending on project specific efficient funding requirements, one can see multiple opportunities in each scenario to “move projects to the left” to deliver benefits as early as possible. While the CIS process flexibility is readily evident in all scenarios, there are clear differences in the depth and breadth of opportunities available for consideration.

Another way to compare the scenarios is by looking at the annual breakout of the estimated IWTF balance shown in total in Table 8. This can be an important long-term capital project strategy planning consideration. While a certain level of buildup in the Trust Fund is often useful to enable efficient funding of large, long duration, complex projects, it can also be a leading indicator of potential inefficiencies. Recall from Figure 4 that the IWTF peaked in 2002 at just over $412 million, and note the steep decline in the IWTF balance from that peak, due to an increased emphasis on initiating projects to get them in the pipeline where the Trust Fund expenditures exceeded the revenues until 2009, after which annual IWTF expenditures were limited to IWTF revenues. The overall result was spending down the IWTF surplus but simultaneously constructing more projects than could be efficiently funded, which delayed delivery of project benefits considerably. Some have yet to be delivered almost a generation later and are legacy projects that this CIS must consider. While a formidable challenge, the CIS process should provide considerable flexibility in which to manage almost any current or future scenario.

5. Updating Process for the Capital Investment Strategy

The CIS should be reviewed annually and updated as needed by the Corps' implementation team in coordination with feedback from industry. Considering the requirements put forth in WRRDA 2014, this report will be updated and provided to Congress no later than every 5 years. This section outlines a recommended Corps implementation strategy for annually updating portions of the CIS. Given that program funding is variable and dependent on the receipts in the IWTF, the budget authority for the Corps, and the annual appropriations provided to the Corps, it is important that data, analysis, and decision making remain current in order to arrive at the best strategy for providing reliable inland waterways in the future. In addition, the process will continue to be improved over time through development of additional data and analysis approaches, experience with execution, and further process improvements. The entire CIS may not be updated, but to ensure the most current data and information is used for decision making, specific updates may include but are not limited to:

- Reviewing and updating the project risk profiles (Filters 1-3).
- Updating project priorities as necessary.
- Updating the scenario charts and tables in Section 4.

5.1 Corps Capital Investment Strategy Updating Team

It is important that a team continue to be assigned the responsibility for review and update of the CIS. The team should have leadership at the Corps Headquarters level (initially Headquarters, Civil Works, Operations Community of Practice, Corps Civil Works – Operations and Regulatory Division) where the data, spreadsheets, and other information needed for the assessment would be centrally located. The team would also include at least one member from each division with inland waterways responsibilities (LRD, MVD, NAD, NWD, SAD, and SWD) and appropriate representation from both the PCXIN, IWR, INDC and the Cost CX. This team will continue to coordinate closely with the navigation stakeholders, including the Users Board. In addition, other advisors and subject matter experts may be consulted, as needed, as the process matures and improves.

5.2 Capital Investment Strategy Updating Process

The following presents a schedule for updating the evaluation process. Both the CIS and project performance must continually be monitored and measured to ensure the benefits of the strategy are realized or to identify instances where the results are falling short of expectations. The periodic review and update process provides an avenue where unusual circumstances or projects can be individually assessed if they do not fit into the current evaluation criteria. This is an investment strategy intended for planning purposes that may inform a more detailed budgeting process. As projects get closer to receiving construction funding, the annual funding requirements should become more precise and any options or alternatives identified. For example, in the current CIS, it was noted that the Chickamauga Lock could use approximately $50 million to reach a natural stopping point in the project before significant funding was required for concrete placement. This information was used in one of the funding options to better utilize funding and optimize the schedule.

5.2.1 Capital Investment Strategy Updating Calendar

Figure 10 illustrates the calendar for the CIS annual updating and review process. Month-to-month activities are described in the following paragraphs.

<table>
<tr><th colspan="12">CIS Implementation</th></tr>
<tr><td>Jun</td><td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td><td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td></tr>
<tr><td></td><td colspan="2">Summer Users Board Meeting</td><td></td><td></td><td colspan="2">Fall Users Board Meeting</td><td></td><td colspan="2">Winter/Spring Users Board Meeting</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">President's Budget Release</td><td></td><td></td></tr>
<tr><td colspan="3">Update Total Risk Exposure. Add and delete project as required. Include BCR data for projects that have completed studies. Update project costs, and project schedules if changed. Coordinate with the Navigation Industry, including the Users Board.</td><td colspan="5">Meet to make any adjustments to the priority list based on updated data. Coordinate with the Navigation Industry including the Users Board. Present draft changes at the Fall Users Board meeting.</td><td colspan="2">Finalize changes to the priority list. Present at the Winter/Spring Users Board meeting. Make recommendations for upcoming budget development.</td><td colspan="2">Budget prepration at the District.</td></tr>
</table>

Figure 10. Implementation Calendar for the Capital Investment Strategy

April to May

Districts will prepare budget (FY+2) submissions during the months of April and May. Districts should ensure that all OCA data are accurate. Project costs and schedules should be adjusted as required based on current knowledge, data and recent execution, and the risk exposure will be reevaluated.

June to August

HQ USACE will develop the budget using updated information provided by the Districts and MSCs. Information from economic updates, feasibility studies, and RER should be submitted to the team for review. The team will work with the industry stakeholders, including Users Board, to make any adjustments to the priority list based on updated data.

September to January

The proposed FY Budget Year +2 will be submitted to the Office of Management and Budget with recommended priorities. The team will continue to work with the industry stakeholders, including Users Board, to make any adjustments to the priority list based on update data. At the fall Users Board meeting in the November to December timeframe, any updated and new information will be presented to the Board. The team will work with the updated information to reassess the priorities and determine if any changes need to be made to the priority list. The team will coordinate with the navigation stakeholders, including Users Board, through face-to-face meetings and regularly scheduled telephone calls.

February to March

The President's Budget, which is typically submitted in February, will reflect the Administration's priorities for funding the inland waterways. A Work Plan for any additional funding for inland waterways projects

provided in an annual appropriations act will also be submitted to Congress in accordance with the requirements of the Act. The President's Budget and any Work Plan allocations for that fiscal year, as well as any changes to the priority list, will be finalized and presented at the winter/spring Users Board meeting. Recommendations will be made for upcoming budget (FY+2) development with regard to beginning studies, construction new starts, and funding levels.

5.2.2 Communications

The success of the CIS depends on communications and cooperation among the Corps, the Office of the Assistant Secretary of the Army for Civil Works, the Office of Management and Budget, and the industry stakeholders, including Users Board with support from the U.S. Congress. To facilitate the process, several meetings of the participants need to take place each year. These meetings will also aid in developing a common, consensus-based understanding of the navigation needs and priorities.

Recommended meetings include the following:

- The CIS team leader, Users Board Chairman, and others as needed would meet each March to discuss the team's priorities for the upcoming budget year. The priorities would include recommended new studies and new start construction projects necessary to continue to provide reliable waterways. Program and project performance would also be discussed.
- In addition to working virtually throughout the year on the CIS, the CIS team and the navigation stakeholders would meet at least once per year to review the program and project performance, evaluate the sufficiency of the program investment level, and IWTF revenues, and recommend process improvements.

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6. Future Improvements

The methodology for prioritizing the CIS will and should evolve from this analysis. The current CIS process relies heavily on the project-specific BCRs and RBRCRs from standard planning and budget practices. While the CIS is intended to be a planning framework, there are challenges associated with the process that might necessitate different budget decisions impacting the 5-year window in the scenarios. These may include but are not limited to:

- Updated project costs.
- Updated project benefits.
- Update to project conditions and risks.
- Challenge of old or out of date data.
- Legal or environmental challenges.

While the planning and budget processes require the economics of the recommended plan to be current (no older than 5 years for new construction and no older than 3 years for projects under construction as prescribed by Engineering Regulation 11-2-100 and Civil Works Policy Memorandum 12-001), the assumptions underlying these analyses may not match the investment timings of a CIS process. Navigation projects are analyzed in a local or regional system context, and the commonality of traffic between projects can affect their priority. The objective of a CIS is not only to prioritize investments with the greatest returns but also to maximize NED benefits for the nation.

While the use of risk exposure is a huge step, it is not the final step. Future advancements may include a next generation of condition assessment capability (OCA Version 2), failure curves directly tied to maintenance and repair completed (or not), reliability event trees, full systems analysis (supply and demand), and optimal Life Cycle Investment Strategies from preventive maintenance to recapitalization.

One additional piece of proposed future advancements will consider “modernization” (e.g., increasing efficiency and/or capacity, including channels). Specifically, establishment of a “Plan Formulation Team” who assists in determining if there is sufficient evidence for the project to proceed to the feasibility study for modernization. Considerations for this modernization screening must be at a level sufficient to “screen” projects while still maintaining the intent of the Corps planning process. The plan formulation should consider the condition and risk as described with the methodology that screens for a major rehabilitation but also includes additional data, information, and analysis associated with waterway traffic projections, transportation rates, waterway demand elasticities, vessel operating costs, and lock capacities at a minimum.

Other improvements could include:

- Identifying and quantifying other inland waterways beneficiaries to develop a fuller understanding of these waterways and their importance to the nation.
- Automating the prioritization process to more efficiently manage the program and enable analysis of different factors/constraints.

- Reevaluate the $20 million IWTF minimum balance requirement based on actual fuel tax receipts and execution. Determine if the minimum balance can be adjusted or if fluctuations can be included (e.g., minimum balance minus 10 percent, 20 percent, and so on).
- Consideration of results from WRRDA 2014, Section 2004 *INLAND WATERWAYS REVENUE STUDIES.*
- The FY 2017 President's Budget funds capital investments in the inland waterways within the limits of estimated revenues to the Inland Waterways Trust Fund under current law, and proposes a new user fee to increase revenue to this trust fund to enable a significant increase in funding for investments, while also proposing that those revenues pay a percentage of maintenance of inland navigation projects.

Figure 11 graphically illustrates the path as the CIS moves toward a more objective approach to capital investments.

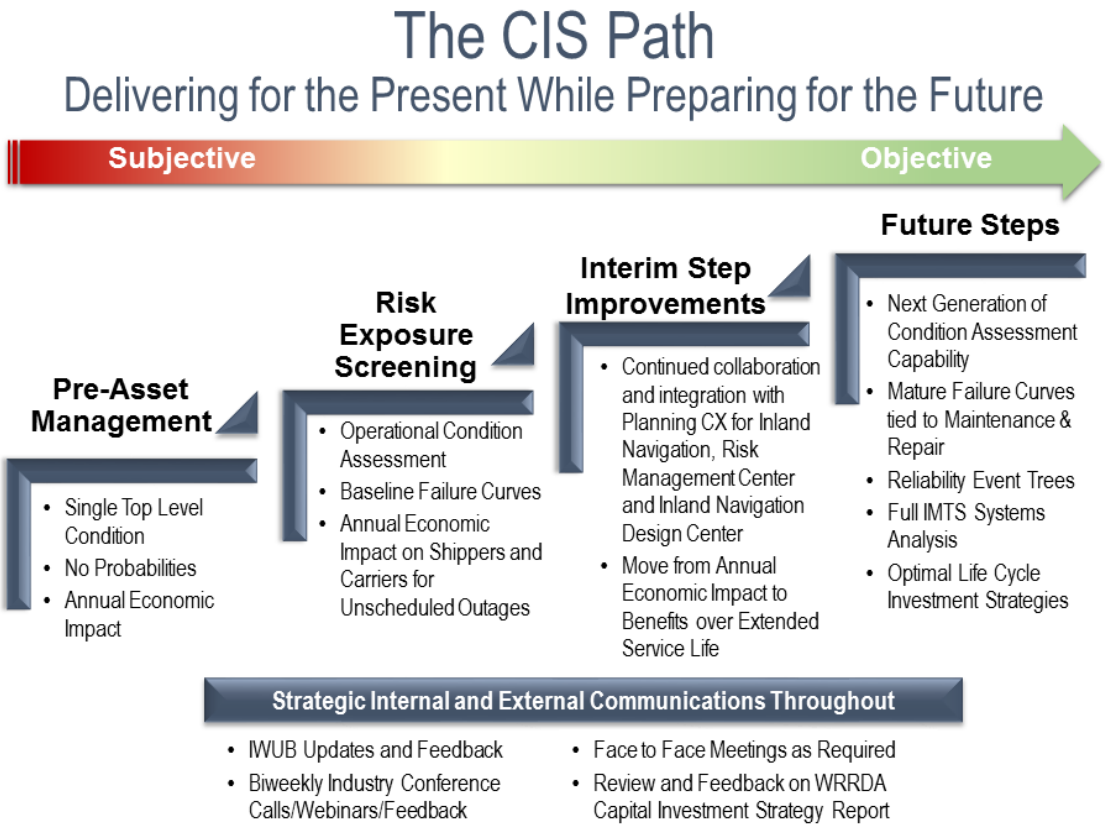

Figure 11. The CIS Process Progression

Appendix A: Inland and Intracoastal Fuel Taxed Waterways

Statutory Definitions of Inland and Intracoastal Fuel Taxed Waterways of the United States

SOURCES: Public Law 95-502, October 21, 1978.

Public Law 99-662, November 17, 1986.

1. Alabama-Coosa Rivers: From junction with the Tombigbee River at river mile (hereinafter referred to as RM) 0 to junction with Coosa River at RM 314.

2. Allegheny River: From confluence with the Monongahela River to form the Ohio River at RM 0 to the head of the existing project at East Brady, Pennsylvania, RM 72.

3. Apalachicola-Chattahoochee and Flint Rivers (ACF): Apalachicola River from mouth at Apalachicola Bay (intersection with the Gulf Intracoastal Waterway) RM 0 to junction with Chattahoochee and Flint Rivers at RM 107.8. Chattahoochee River from junction with Apalachicola and Flint Rivers at RM 0 to Columbus, Georgia at RM 155 and Flint River, from junction with Apalachicola and Chattahoochee Rivers at RM 0 to Bainbridge, Georgia, at RM 28.

4. Arkansas River (McClellan-Kerr Arkansas River Navigation System): From junction with Mississippi River at RM 0 to Port of Catoosa, Oklahoma, at RM 448.2.

5. Atchafalaya River: From RM 0 at its intersection with the Gulf Intracoastal Waterway at Morgan City, Louisiana, upstream to junction with Red River at RM 116.8.

6. Atlantic Intracoastal Waterway: Two inland waterway routes approximately paralleling the Atlantic coast between Norfolk, Virginia, and Miami, Florida, for 1,192 miles via both the Albemarle and Chesapeake Canal and Great Dismal Swamp Canal routes.

7. Black Warrior-Tombigbee-Mobile Rivers: Black Warrior River System from RM 2.9, Mobile River (at Chickasaw Creek) to confluence with Tombigbee River at RM 45. Tombigbee River (to Demopolis at RM 215.4) to port of Birmingham, RM's 374-411 and upstream to head of navigation on Mulberry Fork (RM 429.6), Locust Fork (RM 407.8), and Sipsey Fork (RM 430.4).

8. Columbia River (Columbia-Snake Rivers Inland Waterway): From The Dalles at RM 191.5 to Pasco, Washington (McNary Pool), at RM 330, Snake River from RM 0 at the mouth to RM 231.5 at Johnson Bar Landing, Idaho.

9. Cumberland River: Junction with Ohio River at RM 0 to head of navigation, upstream to Carthage, Tennessee, at RM 313.5.

10. Green and Barren Rivers: Green River from junction with the Ohio River at RM 0 to head of navigation at RM 149.1.

11. Gulf Intracoastal Waterway: From St. Mark's River, Florida, to Brownsville, Texas, 1,134.5 miles.

12. Illinois Waterway (Calumet-Sag Channel): From the junction of the Illinois River with the Mississippi River RM 0 to Chicago Harbor at Lake Michigan, approximately RM 350.

13. Kanawha River: From junction with Ohio River at RM 0 to RM 90.6 at Deepwater, West Virginia.

14. Kaskaskia River: From junction with Mississippi River at RM 0 to RM 36.2 at Fayetteville, Illinois.

15. Kentucky River: From junction with Ohio River at RM 0 to confluence of Middle and North Forks at RM 258.6.

16. Lower Mississippi River: From Baton Rouge, Louisiana, RM 233.9 to Cairo, Illinois, RM 953.8.

17. Upper Mississippi River: From Cairo, Illinois, RM 953.8 to Minneapolis, Minnesota, RM 1,811.4.

18. Missouri River: From junction with Mississippi River at RM 0 to Sioux City, Iowa, at RM 734.8.

19. Monongahela River: From junction with Allegheny River to form the Ohio River at RM 0 to junction of the Tygart and West Fork Rivers, Fairmont, West Virginia, at RM 128.7.

20. Ohio River: From junction with the Mississippi River at RM 0 to junction of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, at RM 981.

21. Ouachita-Black Rivers: From the mouth of the Black River at its junction with the Red River at RM 0 to RM 351 at Camden, Arkansas.

22. Pearl River: From junction of West Pearl River with the Rigolets at RM 0 to Bogalusa, Louisiana, RM 58.

23. Red River: From RM 0 to the mouth of Cypress Bayou at RM 236.

24. Tennessee River: From junction with Ohio River at RM 0 to confluence with Holstein and French Rivers at RM 652.

25. White River: From RM 9.8 to RM 255 at Newport, Arkansas.

26. Willamette River: From RM 21 upstream of Portland, Oregon, to Harrisburg, Oregon, at RM 194.

27. Tennessee-Tombigbee Waterway: From its confluence with the Tennessee River to the Warrior River at Demopolis, Alabama.

Appendix B: List of Acronyms

ABLE Act – Achieving a Better Life Experience Act

ARRA – American Recovery and Reinvestment Act of 2009

BCR – benefit to cost ratio

BLM – Business Line Manager

CECW-CO – U.S. Army Corps of Engineers Civil Works –Operations and Regulatory Division

CI – Condition Index

CIS – Capital Investment Strategy

COP – Community of Practice

Corps -- U.S. Army Corps of Engineers

CPBM – Capital Projects Business Model

CW – Civil Works

CWPM – Civil Works Policy Memorandum

CY – Calendar Year

DSAC – Dam Safety Action Classification

ERDC – Engineer Research and Development Center

FACA – Federal Advisory Committee Act

FTW – fuel taxed waterways

FY – fiscal year

GIWW – Gulf Intracoastal Waterway

GRR – General Re-evaluation Report

HQUSACE – U.S. Army Corps of Engineers Headquarters

IMTS – Inland Marine Transportation System

INDC – Inland Navigation Design Center

IPAT – Investment Program Action Team

IWR – Institute for Water Resources

IWTF – Inland Waterways Trust Fund

LRD – Great Lakes and Ohio River Division

LRP – Pittsburgh District

LRR – Limited Re-evaluation Report

MCX – Mandatory Center of Expertise

MKARNS – McClellan-Kerr Arkansas River Navigation System

MRR – Major Rehabilitation Report

MTS – Marine Transportation System

MVD – Mississippi Valley Division

MVR – Rock Island District

MVS – St. Louis District

NAD – North Atlantic Division

NDC – Navigation Data Center

NED – National Economic Development

NESP – Upper Mississippi River - Illinois Waterway System Navigation and Ecosystem Sustainability Program

NWD – Northwestern Division

NWW – Walla Walla District

OCA – Operational Condition Assessment

OMB – Office of Management and Budget

O&M – operation and maintenance

ORA – Operational Risk Assessment

ORE – Operational Risk Exposure

PCXIN – Planning Center of Expertise for Inland Navigation

PCXIN-RED – Planning Center of Expertise for Inland Navigation – Risk Informed Economics Division

PED – preconstruction engineering and design

RBRCR – remaining benefit to remaining cost ratio

RER – Major Rehabilitation Evaluation Report

RM – River Mile

RMC – Risk Management Center

RRE – Residual Risk Exposure

SAD – South Atlantic Division

SAM – Mobile District

SCC – Shipper Carrier Cost

SWD – Southwestern Division

USACE – U.S. Army Corps of Engineers

Users Board – Inland Waterways Users Board

WG – Working Group

WRDA 1986 – Water Resources Development Act of 1986

WRRDA – Water Resources Reform and Development Act

Appendix C: Contributors

This report was prepared in response to Section 2002 of the Water Resources Reform and Development Act of 2014 and represents a cooperative effort between the U.S. Army Corps of Engineers and inland navigation stakeholders. This is a planning framework and does not take the place of the normal budget processes or commit the government to future actions. The information and findings in this report represent those of U.S. Army Corps of Engineers and do not necessarily reflect those of the Inland Waterways Users Board.

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The following U.S. Army Corps of Engineers participants are acknowledged as official Inland Marine Transportation System (IMTS) Investment Program Action Team (IPAT) members:

James Hannon – former Chief, Operations and Regulatory Division - HQUSACE Champion
Edward Belk – Chief, Operations and Regulatory Division - HQUSACE Champion
Jeffrey McKee – Chief, Navigation Branch - HQUSACE Advocate
Stephen (Scott) Beams – Lock & Dam/Float Plant Engineer - SAM
Sheryl Carrubba – Navigation BLM - NWD
Patrick Chambers – IMTS WG Program Manager - HQUSACE
Darrell Davis – Acting Navigation BLM - LRD
Richard (Dylan) Davis – Navigation BLM - SAD
Louis (Lou) Dell'Orco – Chief, Operations, MVS
Patrick Donovan – Chief of the PCXIN - RED
Douglas Ellsworth – Co-Lead of IPAT - Senior Asset Management Specialist - HQUSACE
Kareem El-Naggar – former IMTS WG Program Manager - LRD
James Fisher – Asset Management - LRD
Mark Hammond – Senior Economist - LRD
Andy Harkness – Chief of the RMC Eastern Division- IWR
Jeanine Hoey – Co-Lead of IPAT - Chief Programs and Project Management - LRP
Michael Jacobs – Cost Center of Expertise - NWW
Frederick Joers – Inland Navigation Design Center - MVR
Michael (Steve) Jones – former Navigation BLM - MVD
Virgil (Buddy) Langdon – Economist - PCXIN
David Moser – USACE Senior Economist - IWR
Mark Pointon – Navigation Manager - IWR
Mindy Simmons – former Senior Program Manager for Navigation - HQUSACE
Jeffrey Stamper – Inland Navigation Design Center – MVS
Richard Thorsen – Navigation BLM - NAD
Poy-Har Kathleen Wu – Navigation BLM - SWD

U.S. Army Corps of Engineers

Investment Program Action Team
(IPAT)