

# Inland Marine Transportation Systems (IMTS) Capital Projects Business Model

## Final Report

Revision 1

April 13, 2010



**Prepared by:**  
IMTS Capital Investment Strategy Team

The views and recommendations contained within this report reflect those of the Inland Marine Transportation System Capital Investment Strategy Team and not necessarily those of the Inland Waterways Users Board, the U.S. Army Corps of Engineers, or the Administration.

Revision 1 includes minor formatting and grammatical changes, and acknowledges the Inland Waterways Users Board approval, adoption and subsequent forwarding of the report to the Assistant Secretary of the Army for Civil Works for consideration by the Administration







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This report was prepared at the request of the Inland Waterways Users Board and represents a collaborative effort between navigation industry representatives and U.S. Army Corps of Engineers inland navigation experts. The views, opinions, and findings contained in this report are those of the Inland Marine Transportation System Capital Investment Strategy Team (IMTS CIS Team, or Team). The report should not be construed as an official Agency position, policy, or decision, unless so designated by other official documentation.

On 13 April 2010, the Inland Waterways Users Board unanimously approved and adopted this report and transmitted the report to the Assistant Secretary of the Army for Civil Works (ASA(CW)), requesting that the Administration adopt and implement those recommendations of the report within the purview of the Administration. The Board further transmitted the report to the Congress, recommending that Congress implement those recommendations requiring legislative action.

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# Executive Summary – IMTS Capital Projects Business Model

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The U.S. Army Corps of Engineers (Corps) has played a major role in the nation's marine transportation system and inland water management since the country's founding and, through its navigation mission, retains a pivotal role in managing inland waterways into the future. The Corps Navigation mission is to provide a safe, reliable, efficient, effective, and environmentally sustainable waterborne transportation system for the movement of commerce, national security needs, and recreation. In fulfilling the navigation mission, the current project delivery model, that was effective in the past, is no longer appropriate for successful inland waterways management. Fundamentally, local district and regional division efforts that previously focused on addressing regional needs and improving infrastructure problems neither provide optimal solutions for managing a nationwide portfolio of assets nor the investments needed to maintain those assets. As investigated in the *Inland Navigation Construction Selected Case Studies* report and specifically recognized by the Inland Marine Transportation System (IMTS) Capital Investment Strategy Team (IMTS CIS Team or the Team), in recent years there has been an undesirable trend of lock and dam construction projects exceeding, by unacceptable amounts, their originally authorized cost and schedule expectations.

After many years of a growing balance in the Inland Waterways Trust Fund (IWTF or Trust Fund), which funds half of navigation construction and major rehabilitation projects, the Trust Fund balance began to decline in fiscal year (FY) 2003 as the Administration and Congress dedicated increased amounts of Trust Fund resources to address modernization of the inland waterway system. This trend continued through FY 2009, resulting in a decline of the Trust Fund balance to the point that expenditures must be limited to the amount of annual fuel tax revenues collected for that particular year. The increased costs and constrained IWTF have resulted in a backlog of authorized projects that have not yet begun construction. This backlog, in turn, exacerbates the declining reliability of the IMTS.

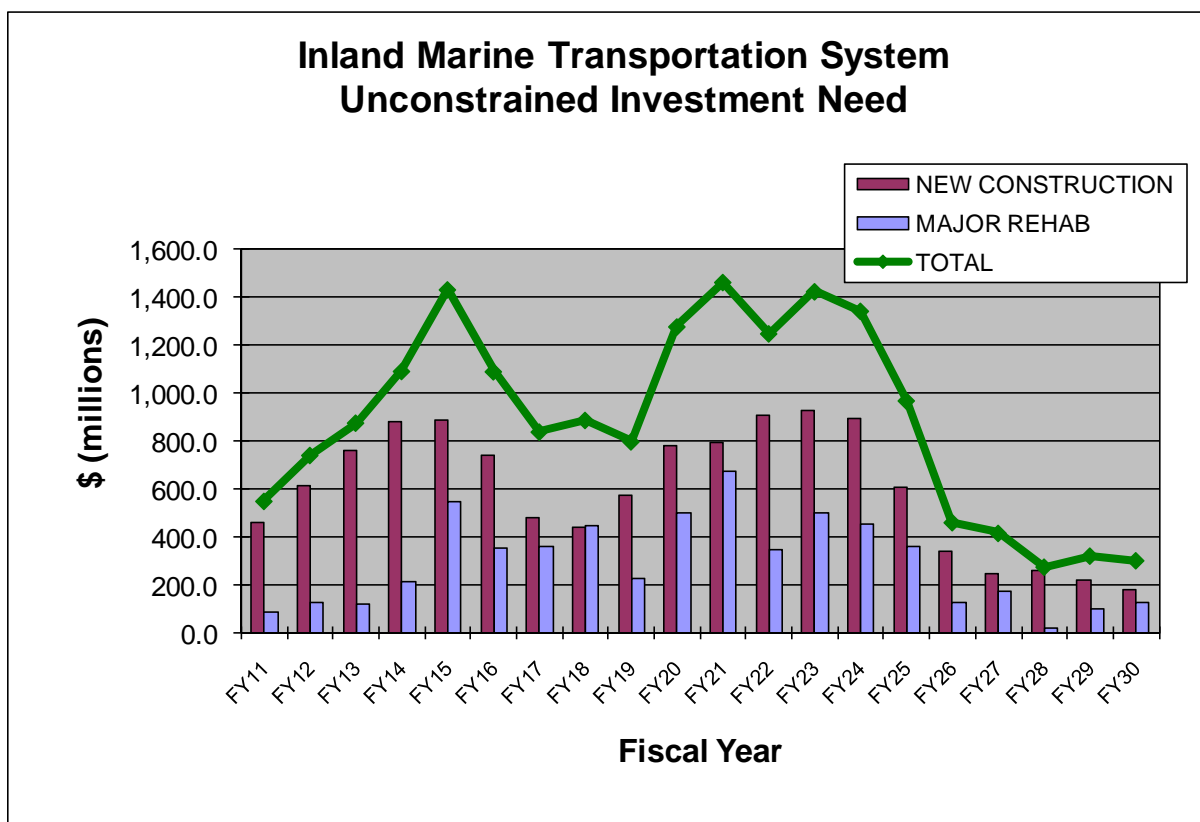
Given current average annual revenues of \$85 million, the substantial backlog of authorized projects, and the declining reliability of the IMTS, the Corps is collaborating with the Inland Waterways Users Board (IWUB or the Board) to identify ways to improve the capital projects business model in tandem with developing an investment strategy designed to improve and ensure the long-term viability of the IMTS. The goals of the IMTS CIS Team are the following:

1. Identify ways to improve the project delivery system (i.e., more reliable cost estimates and construction schedules, better contracting practices, improved project management) to ensure that future system improvements can be completed on time and within budget.
2. Develop a list of long-term capital needs for the inland navigation system, including an objective methodology for prioritizing those needs.
3. Develop a capital investment strategy that balances reliability with affordability.
4. Develop and recommend a strategy to help ensure that funding requirements can be met with reasonable certainty and efficiency.

## Unconstrained Project List

To aid the IMTS CIS Team in identifying future needs/demands on the IWTF and help in establishing a funding strategy, the Corps developed an “unconstrained” list of projects. Currently, the Corps has identified over 100 projects in the inland and intracoastal waterways system that require, or could conceivably require, capital investments in the next 20 years. For analytical purposes, this list was developed without regard to funds that would be available to perform the work. Each district identified new construction or major rehabilitation projects that were (1) under construction (Phase 1 projects) or (2) that were authorized but not yet under construction (Phase 2 projects). In addition, districts identified potential future projects over the 20-year time horizon, a few of which are already under study, assuming the availability of completely unconstrained funding (Phase 3 projects).

Over the 20-year period from fiscal year (FY) 2011 to FY 2030, the districts’ unconstrained financial requirements to address the infrastructure needs of the IMTS is reflected in Figure ES-1 and totals nearly \$18.0 billion, or an annual average of nearly \$900 million. Of the \$18.0 billion identified for expenditure, nearly \$12.1 billion (67 percent) would be for new construction and \$5.9 billion (33 percent) would address major rehabilitation projects.



Note: Fully funded estimates assume a 3 percent escalation of costs per year.

**Figure ES-1. Unconstrained Investment Need of IMTS, FY 2011 to FY 2030**

## Prioritization Criteria and Prioritized List

Inland waterways system users, policy makers in the U.S. Congress and within the Administration, and others share a desire to better understand both the value of existing IMTS assets and the return on investments made to the system. Reflecting this desire, the IMTS CIS Team worked together to develop and apply logical metrics to help guide system modernization investments. After discussing numerous

approaches, the Team concluded that the most useful representation of system value and return on investment should include assessments on an asset-by-asset basis using the following:

1. The asset's current condition
2. The likelihood of diminished asset performance
3. The consequence of diminished performance in terms of repair costs, outages, and economic losses
4. How the proposed investment would improve performance or reduce the asset's likelihood of diminished performance
5. For new assets, whether the project could be expected to improve system performance.

The criteria the IMTS CIS Team selected for ranking projects fell into two broad categories: (1) structural and operational risk and reliability and (2) economic return. Structural and operational risk and reliability metrics were represented either by a Dam Safety Action Classification (DSAC) rating or a Condition Index (CI) rating.<sup>1</sup> Economic consequence metrics included Net Benefits, Benefit-Cost Ratio (BCR), and Remaining Benefit Remaining Cost Ratio (RBRCR) (for Phase 1 and Phase 2 projects only), and Economic Impact (for all projects, however this is the only category of economic criteria used for Phase 3 projects). The risk and reliability criteria were depicted as numeric grades of 1 through 5 for DSAC ratings (with 1 being the worst/failed condition), and as letter grades of A through F for CI ratings (with F being the worst/failed condition). Those risk and reliability criteria metrics were then converted to numeric scores, with a maximum weight of 40 for Phase 1 and Phase 2 projects or 60 for Phase 3 projects. The rationale for a higher weight for risk and reliability for Phase 3 projects was necessitated by the limited economic analyses data performed on Phase 3 projects and recognition that infrastructure in a failed or failing condition could require earlier attention. The economic criteria were depicted as dollars for net benefits, as ratios for BCRs and RBRCRs, and as numeric grades of 1 through 100 for economic impact. These metrics were normalized to the highest value observed for that metric in the project list, with a maximum weight of 60 or 40 depending on the project phase. Table ES-1 and Table ES-2 display the criteria used to prioritize the unconstrained project list.

**Table ES-1. IMTS Investment Strategy Criteria Weighting**

| Criteria                                      | Phases 1 and 2 | Phase 3    |
|---|----------------|------------|
| <b>Risk and Reliability</b>                   | 40             | 60         |
| Condition Index for Locks (rated A through F) |                |            |
| DSAC for Dams (rated 5 through 1)             |                |            |
| <b>Economic Return</b>                        | 60             | 40         |
| Net Benefits                                  | 15             |            |
| BCR   | 5              |            |
| RBRCR   | 25             |            |
| Economic Impact                               | 15             | 40         |
| <b>Totals</b>                                 | <b>100</b>     | <b>100</b> |

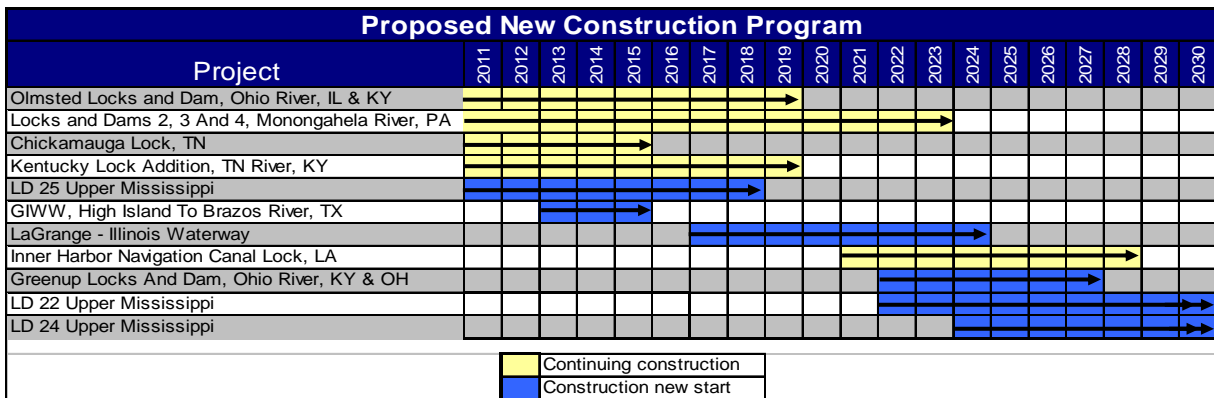
<sup>1</sup> The team is assessing the relative importance of channels on a case-by-case basis. Metrics compatible with those used for locks and dams were not available at the time this report was prepared.

**Table ES-2. IMTS Investment Strategy Condition Weights**

| Risk and Reliability<br>DSAC   Condition Index Rating | Phase 1 and 2 | Phase 3 |
|---|---------------|---------|
| 1   F   | 40            | 60      |
| 2   D   | 25            | 45      |
| 3   C   | 10            | 30      |
| 4   B   | 5             | 10      |
| 5   A   | 0             | 0       |

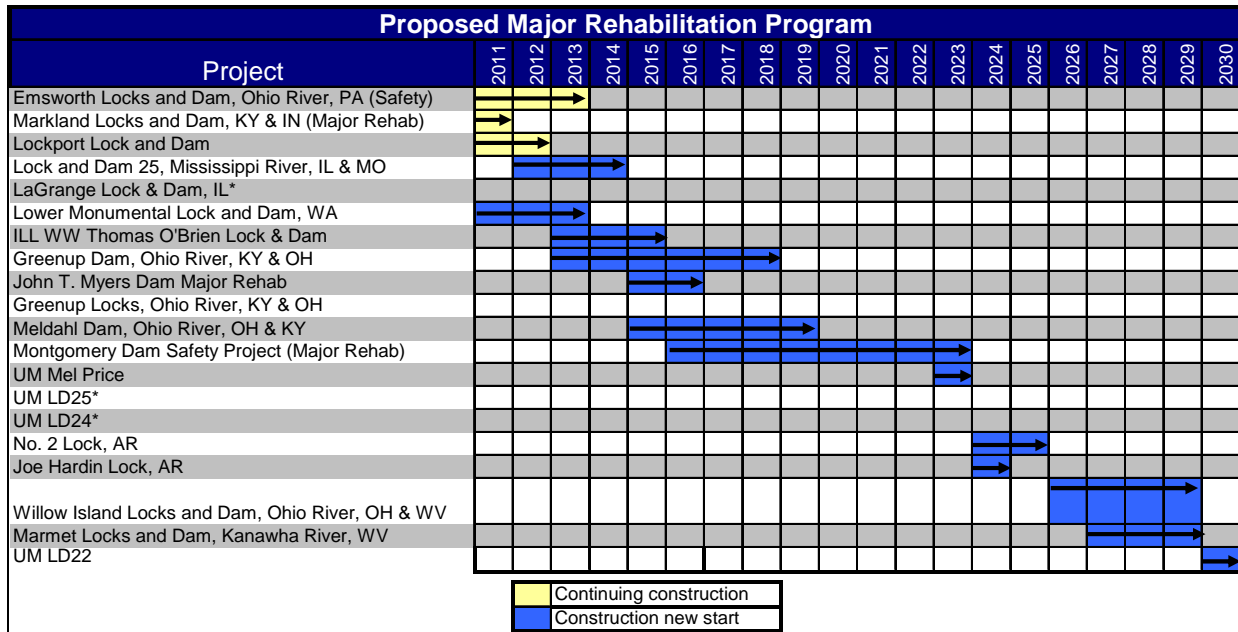
### IMTS Capital Investment Program

The IMTS CIS Team evaluated what should be reasonably addressed and completed in the next 20 years to maintain a reliable IMTS. It became apparent from this examination that two separate program component levels were required to ensure that both new construction as well as major rehabilitation projects are being prioritized and funded effectively. It was recognized that worthwhile projects already under construction should be completed as efficiently as possible. The Team recommended that new construction projects should be allocated an annual funding level of about \$320 million. Figure ES-2 shows the proposed timing associated with those new construction projects that are recommended in the plan.



**Figure ES-2. Proposed New Construction Projects Timeline**

To ensure that existing infrastructure is being continually maintained and rehabilitated in a timely and appropriate manner, the IMTS CIS Team also looked at separately funding major rehabilitation projects. The Team recommends using the average amount spent on major rehabilitation projects in the last three years, which amounts to approximately \$60 million per year. Figure ES-3 shows the proposed timing associated with major rehabilitation projects. Because there is a large bottleneck of new construction early in the capital investment strategy, the funding allocations between new construction and major rehabilitation would be skewed to new construction in the immediate near term. The target total for the 20-year capital investment strategy for new construction and major rehabilitation on average is \$380 million per year.



\* Note – Lagrange, Greenup, UM LD 25 and UMLD24 do not show scheduled rehabilitation projects due to new construction projects at these facilities. Their priority remains as a placeholder until the new construction work begins and criteria is re-evaluated for these projects.

**Figure ES-3. Major Rehabilitation Projects Timeline**

The proposed 20-year capital investment strategy generally addresses the highest priority new construction and major rehabilitation projects as determined by the criteria weighting and decision principles implemented. With a \$380 million average annual investment level, this investment strategy addresses at least 27 of the candidate projects that have been identified by Corps districts and highlights how those projects would be prioritized based on the recommended investment level. Figure ES-4 compares cumulative project completions at the current investment level of about \$170 million per year (\$85 million from general appropriations and \$85 million from the IWTF) with project completions at the recommended investment level of \$380 million per year. The recommended investment plan addresses five DSAC 1 and three DSAC 2 dams, as well as one lock facility that was rated F and six that were rated D through the operational condition assessment process.

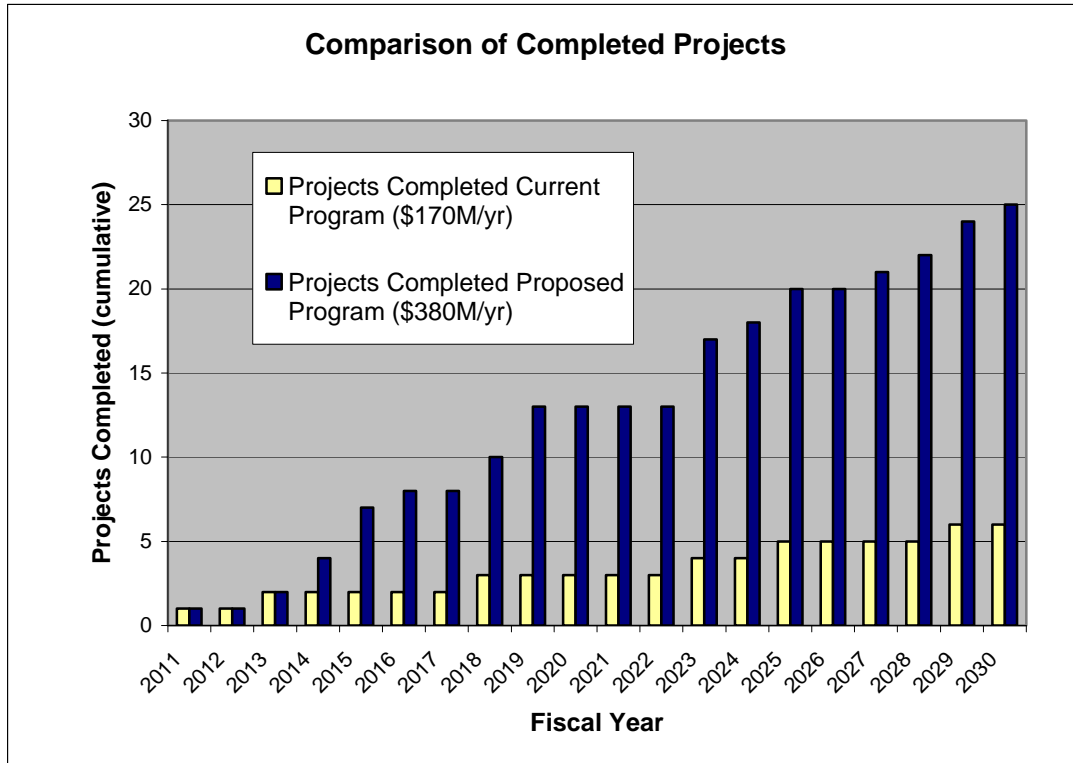


Figure ES-4. Comparison of Completed Projects

## Funding Model

### *Cost-Share Recommendations*

With the recommended \$380 million annual funding-level program, IWTF revenues are proposed to be increased beyond what is anticipated under current law to address the needs of the IMTS. The IMTS CIS Team members understand the implications of an increase in revenues and have strived to develop cost-sharing recommendations that are fair and equitable.

The IMTS CIS Team reviewed and evaluated more than a dozen options for funding the IMTS capital investment program. These options included maintaining the current cost-sharing arrangement of 50 percent federal and 50 percent IWTF for all capital investments; varying that percentage; excluding some projects/features, such as dam or major rehabilitation projects; setting different thresholds for the cost-sharing of major rehabilitation projects; and capping the IWTF share for some projects with significant cost increases, such as Olmsted Locks and Dam and Lower Monongahela Locks & Dams 2, 3, and 4 (Lower Mon).

After a high-level review and evaluation of the options presented, the IMTS CIS Team recommends the following cost-sharing program:

- All *lock* construction projects should be cost-shared 50 percent from general appropriations and 50 percent from the IWTF and all major rehabilitation *lock* projects costing at least \$100 million should be cost-shared at 50 percent from general appropriations and 50 percent from the IWTF.
- Construction and major rehabilitation *dam* projects and major rehabilitation *lock* projects below \$100 million should be entirely funded from general appropriations.

- With the program recommendation of \$380 million per year and the proposed program shown in Figure ES-2 and Figure ES-3, the average IWTF requirement over the next 20 years is \$110 million per year, with the federal cost-sharing requirement averaging \$270 million per year. In the future, these average amounts may vary depending on the mix of projects in the program.

Another feature the Team recommends is establishment of a project-by-project cost-sharing cap to protect industry from unreasonable cost escalation and project delays. The IMTS CIS Team recommends that the cap be set at the Feasibility or Rehabilitation Evaluation Report base cost using risk-based cost and schedule estimates. This risk-based cost estimate will include contingencies reflected in the relevant decision document and will be escalated to the new construction start date, plus whatever additional amount, if any, that both the Corps and the Board agree is appropriate. This cap places additional emphasis on the need to produce more reliable project cost estimates in the underlying decision document and to manage projects within the identified and agreed upon project budgets and schedules, protecting both the waterways industry and the general taxpayer from preventable project cost escalation and delay.

### *Revenue Recommendations*

The IMTS CIS Team also reviewed alternative options for generating revenues for the IWTF. These options included the current revenue plan consisting of a waterways fuel tax, a user fee, bonding, and other revenue sources, such as state funding or other beneficiaries of the IMTS. The Team acknowledged that the current revenue-raising system is a workable, understood, acceptable, and auditable system for collecting the waterways industry's share of the IMTS capitalization costs and that the additional revenues required in the Teams' consensus recommendations should best be raised through an increase in the current fuel tax. The recommended program would require a 30–45 percent increase in the current fuel tax (a \$0.06–\$0.09 per gallon increase). The 30 percent increase is based on an assumption that, under current law, anticipated future revenues would equal the average \$85 million annual amount generated over the past five years, while the 45 percent increase is based on FY 2009 actual revenues of \$76 million.

### *Process Improvements*

Given the challenges with the current project delivery model, as highlighted with a few recent projects, and the need to improve the process so that the IMTS remains viable for the foreseeable future, change is essential. In addition to insufficient funding identified in *The Inland Navigation Construction, Selected Case Studies Report*, other factors identified in the report also have contributed significantly to the cost increases and schedule delays affecting recent Corps capital projects. Because many of these issues could be controlled with an improved project delivery process, the IMTS CIS Team, in combination with its development of the capital investment strategy, examined the Corps' current project delivery process and developed a number of recommended process improvements. Together with the underlying premise that the necessary project funding will be provided in an efficient manner, the team believes that these improvements will achieve the goal of an improved capital projects business model. Some of these recommendations are already in the process of being implemented and just need to be measured and monitored. Other recommendations can immediately be put into practice, while still others will take additional study or authority to implement. The following recommendations have been organized into those three categories:

#### *Already Implemented Process Improvement Recommendations*

1. **Encourage project management certification.** A project management certification program was recently developed and implemented. Senior leaders within the Corps should emphasize the benefits of and encourage certification. The Corps should ensure that only certified project managers are assigned to critical IWTF projects.

2. **Develop highly reliable risk-based cost estimates for IMTS projects meeting certain thresholds.** Risk-based cost estimates are now required for all projects over \$40M and meeting certain thresholds. Only a few of existing projects incorporate updated risk-based cost estimates. As a first step, the IMTS CIS Team will recommend a list of existing projects to be reevaluated using risk-based cost estimating techniques by the summer 2010 Board meeting. In the future, all IMTS projects being proposed for congressional authorization would have a risk-based cost estimate having at least an 80 percent confidence level performed prior to completion of the project's feasibility report.
3. **Require independent external peer reviews for IMTS projects meeting certain criteria.** Independent external peer reviews are a new requirement for large or controversial capital projects. The IMTS CIS Team will follow the new regulation, which was implemented in December 2009, for external peer reviews. No additional specific action is required at this time.

*Immediately Implementable Process Improvement Recommendations*

1. **Appoint a Board representative to each IMTS project.** The Board Chairman should assign a representative from the Board to each active project by the summer 2010 IWUB meeting. Those representatives will be forwarded to the project managers for inclusion as Project Delivery Team (PDT) members.
2. **Provide project status communication to the Board.** The following template, shown in Figure ES-5, should be used for briefing project status beginning at the summer 2010 Board meeting.



**Lock and Dams 2, 3 & 4 Monongahela River Navigation Project**



Project Cost: \$1,438,700,000 (Oct 2008)  
 Remaining Balance: \$894,800,000  
 FY10 Allocation: \$6,200,000

**Status (one slide/project)**

- **Recent events since last Board Meeting**
- **Upcoming events in support of milestones**
- **At macro level.....not in the weeds!**
- **All red dates need to be addressed**
- **Example for Lower Mon; actual dates not used**

| <b>Schedule of Remaining Work</b> | Design Initiated | Contract Award | Construction Complete | Project Benefits | Capitalized Cost Closeout |
|-----------------------------------|------------------|----------------|-----------------------|------------------|---------------------------|
| Charleroi River Wall              | 1-Oct-02         | 30-Sep-05      | 1-Nov-10              | N/A              | 30-Jan-11                 |
| Upper and Lower Guard Walls       | 1-Oct-02         | 28-Aug-09      | 30-Sep-11             | N/A              | 31-Dec-11                 |
| Charleroi River Chamber           | 1-Oct-02         | 30-Sep-12      | 30-Sep-14             | 31-Jul-14        | 31-May-15                 |
| L/D 3 Removal                     | 1-Oct-12         | 30-Sep-13      | 30-Sep-14             | 31-Jul-14        | 31-Dec-15                 |
| Dredging                          | 1-Oct-01         | 30-Apr-12      | 30-Jun-14             | 1-Jul-04         | 31-Dec-15                 |
| Municipal Relocations             | 1-Oct-97         | Various dates  | 30-Jun-14             | 31-Jul-14        | 31-May-15                 |
| Port Perry Bridge Relocation      | 1-Oct-04         | 30-Sep-12      | 30-Sep-14             | 31-Jul-14        | 31-Dec-15                 |
| Charleroi Land Chamber            | 1-Oct-02         | 30-Sep-15      | 30-Sep-20             | 30-Apr-20        | 30-Apr-21                 |

| <b>Legend</b>                        |  |
|--------------------------------------|--|
| Completed                            |  |
| Scheduled prior to next IWUB Meeting |  |
| Date changed since last report       |  |

**Building Strong!**

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**Figure ES-5. Proposed Project Status Briefing Template**

3. **Include the Board chairman and representative as signatories for all project management plans (PMPs).** Project management plans for new projects should be developed during the planning

phase. Existing PMPs should be updated to include the Board representative and Chairman as signatories over the next year. All plans should be signed by the spring 2011 Board meeting.

4. **Apply lessons learned to managing new projects.** The Navigation Community of Practice (COP) should set up a system to capture lessons learned specifically for IMTS projects and ensure that they are reviewed prior to initiating new work.
5. **Evaluate use of early contractor involvement as a contract vehicle for an IMTS project.** The Corps should identify one or more pilot projects where early contractor involvement would improve the outcome.
6. **Implement applicable principles from the Military Construction (MILCON) Model.** Adopting several principles of the MILCON model would result in a culture change; these principles should be reinforced at all levels throughout the Corps Civil Works program hierarchy. Principles include that cost estimates cannot be exceeded, schedules must be met, and a multiyear funding stream must have a commitment from the U.S. Congress. Contracts should be structured with awardable options that can be eliminated if costs are exceeded, but still provide a functioning facility. Project managers and project staff members should follow guidance requiring that budgets and schedules be met and abandon the presumption that additional funding will always be available. The culture should reflect that the construction program cannot afford what would be “nice” for the projects, but can address only what is necessary.
7. **Establish procedures for recommending new construction starts.** Through the new IMTS capital projects business model, the Corps should establish the procedures for recommending new construction starts.

### *Process Improvement Recommendations Requiring Additional Study or Authority*

1. **Revisit use of the continuing contracts clause.** Use of an appropriately structured continuing contracts clause or fully funding contracts often is essential to move forward with the larger civil works IMTS project being proposed. The Corps must work with the U.S. Congress to develop a continuing contracts clause that adequately protects the prerogatives of both the legislative and executive branches while not causing unnecessary project delay and cost escalation. One approach for consideration is to fully fund all contracts up to \$50 million (current Corps regulations require all contracts \$20 million or less to be fully funded), while allowing contracts greater than \$50 million to have the option of using an agreed-upon continuing contracts clause.
2. **Draft and ultimately obtain approval for a capital projects business model regulation.** The process improvements and funding strategies recommended in this report should be incorporated into a regulation to direct future IMTS project prioritization and funding. A smaller subset of this Team should develop the regulation with a draft prepared by September 30, 2010.
3. **Create Design/Review Center(s) of Expertise.** Implementation of this recommendation would require organizational changes affecting a number of non-navigation-related considerations that would in turn have to be evaluated. This recommendation is offered to Corps senior leadership for study and evaluation.
4. **Develop a portfolio of standardized designs.** A team from Corps Engineering and Operations should be identified to consider a pilot project for design of a lock component that could be used throughout the IMTS. In addition, for new projects, it may be helpful to begin requiring a design concepts meeting that involves senior design and technical personnel who are not otherwise involved in the project to brainstorm ideas, solutions, and experiences on past projects.

## Benefits

The capital investment strategy and process improvements described above are expected to result in measurable benefits to the IMTS. Cost growth that has become typical with IMTS projects will be reduced. Using the *Selected Case Study Report* as a basis, cost growth on IMTS projects under the in-place business model can be as high as 60 percent of the initial cost. Of that amount, about 30 percent is attributable to inefficient funding and 70 percent to other factors, such as differing site conditions or design changes. Another benefit to the capital investment strategy is avoiding additional benefits foregone on construction projects by completing current ongoing projects efficiently and on time. Additionally, it is important to monitor and measure project performance as the capital investment strategy is implemented to document the benefits of the program with this improved process. The Team estimates the benefits of the recommended program to be the following:

- The avoided cost growth due to inefficient funding over the 20-year capital investment program is conservatively estimated to be between \$350 million and \$1,180 million.
- Benefits foregone to date at only two of the larger construction projects, Olmsted and Lower Mon, are calculated to be \$5.2 billion.
- With the 20-year capital investment program, more than \$2.8 billion in additional benefits foregone would be avoided when looking only at the projects that are currently under construction and the schedule for completing these projects under the current program.

## Future Improvements

The Team recognizes that as the process matures, changes will be needed to continue to provide the best program and a reliable IMTS. Additional studies and data are recommended to advance the current recommended process, including, but not limited to, the following:

- Developing criteria for channels that are comparable to those developed for lock and dam projects. These criteria would eliminate the need to evaluate channel projects to determine their priority without an established process for comparison.
- Changing the rating scale for the Relative Risk Matrix Rankings for Operations and Maintenance budget work packages (currently ranked 25 to 1 and 5 to 1, with 25 and 5 being the worse condition) to parallel the DSAC scale (1 through 5, with 1 being the worse condition) for consistency.
- Identifying and quantifying other IMTS beneficiaries to develop a fuller understanding of the IMTS and its importance to the nation's waterways.
- Developing and standardizing additional economic data for proposed projects to improve the information used to prioritize projects.
- Developing reliability data for all projects to use the full capability of the Impact Algorithm.
- Automating the prioritization process to more efficiently manage the program and enable analysis of different factors/constraints.

The inland waterways project delivery process has faced increased criticism over funding priorities, the timing of capital projects funding, escalating costs and construction schedules, and project delivery issues. The IMTS CIS Team's review and analysis resulted in the recommended capital investment strategy and process improvements. While unlikely that any set of recommended improvements could completely eliminate cost increases and schedule delays, these recommended improvements—in combination with the development of the capital investment strategy and with the underlying premise that the funding will be provided in an efficient manner—will achieve the goal of an improved capital projects business model.

*This report was prepared at the request of the Inland Waterways Users Board and represents a collaborative effort between industry representatives and U.S. Army Corps of Engineers inland navigation experts. The views, opinions, and findings contained in this report are those of the Inland Marine Transportation System Capital Investment Strategy Team and should not be construed as an official agency or board position, policy, or decision, unless so designated by other official documentation.*