FINAL

RE-EVALUATION OF THE RECOMMENDED PLAN:

UMR-IWW SYSTEM NAVIGATION STUDY

INTERIM REPORT

March 2008

US Army Corps of Engineers®

Congestion and capacity issues have not really been resolved, we have just been given a breather. We still have infrastructure that needs immediate attention and long term solutions…

We have a resource, sinking in disrepair, that could become a vital link in adding capacity and taking pressure off other modes in a vital corridor in the center of the country: the inland waterway system. The inland waterway system has been underutilized for many years and that portion of the industry has not seen much growth. The nation's waterway system needs to be revitalized and used more heavily to further impact congestion problems. Water transportation could become a vital resource to meet the nation's freight demands. Although it is not very prevalent now, waterways could even handle containers. Careful planning should ensure that the waterways are poised to handle more freight and that the entire support infrastructure is present to make efficient use of waterways. We should earmark funding to enhance our inland waterway system, modernize, and plan and build facilities to expand the range of products carried to include containers.

There is a growing inland waterway and Great Lakes crisis that does not receive much coverage. For too many years there has been a lack of resources aimed at maintaining and improving this segment of our transportation network. A single barge traveling the nation's waterways can move the same amount of cargo as 58 semi-trucks at one-tenth the cost, reducing highway congestion and saving money…

This is an excerpt from a presentation to the National Press Club, Washington, DC, June 6, 2007 on the "The New Face of Logistics" by Rosalyn Wilson. The presentation is based on the 18th Annual State of Logistics Report prepared by Ms. Wilson for the Council of Supply Chain Management Professionals.

REEVALUATION OF THE RECOMMENDED PLAN
UMR-IWW SYSTEM NAVIGATION STUDY

INTERIM REPORT

EXECUTIVE SUMMARY

PURPOSE

The purpose of the Interim Report is to present findings on a reevaluation of the Recommended Plan from the UMR-IWW System Navigation Feasibility Study. The Chief of Engineers had sent endorsement of the Recommended Plan to the Assistant Secretary of Army for Civil Works [ASA (CW)] in December 2004 for review and approval. In response, the ASA (CW) requested reevaluation of the navigation component of the Recommended Plan using updated forecasting and transportation models and data. This report is in response to the ASA (CW) request. It also serves as a vehicle for communication with partners, stakeholders, and public.

RECOMMENDED PLAN

The Recommended Plan is a framework plan calling for dual-purpose operation, investment in navigation efficiency improvements and investment in ecosystem restoration of the Upper Mississippi River System (UMRS) toward a vision of "long-term sustainability of the economic uses and ecological integrity of the Upper Mississippi River System." Although the focus of the reevaluation is on the economic viability of the navigation component of the Recommended Plan, reevaluation was done with appreciation of the integrated duality of the plan.

BACKGROUND

Our Nation's wealth, security, and productive capacity are directly and intimately linked to our ability to efficiently, reliably, safely, and securely transport freight in an environmentally-acceptable manner. Population growth and globalization are expected to underpin continued growth in freight both domestically and internationally through the entire planning horizon, 2010 to 2060.

The growth in freight, coupled with increasing urbanization and personal transit, are putting great pressure on the national transportation network. Congestion is materializing as one of the single largest threats to our economic prosperity and quality of life. The U.S. Department of Transportation for the first time has called for "reducing congestion" as one of the goals in its transportation strategic plan for 2006 to 2011.

Meeting the Nation's transportation challenges is going to require a multimodal approach: preserving what has been built; improving performance; adding capacity; and increasing intermodality. Stepped-up investment will be needed in ports, terminals, border crossings, and all modes, including highways, railways, airways, and waterways, in order to meet the challenge. Government policies and investments are needed that encourage intermodal linkages and better utilization of available capacity and provide leverage for private investment and innovation.

The Inland Waterway System is one of the Nation's critical transportation networks. When combined with the Intracoastal Waterways and the Great Lakes, a large geographic area and a vast majority of the population of the United States are served by commercial navigation. Commercial navigation has advantages over other modes for transporting bulk materials in a cost effective manner. It also has overlap with other modes that provides for competition, redundancy, and intermodal opportunities. Investment has not been sufficient to maintain, recapitalize, and increase efficiency and capacity of the system, resulting in a system that is less reliable and not being optimally used.

The UMR-IWW navigation system runs for 1,200 miles or 10 percent of the Inland Waterway System, and serves a five-state region. St. Louis, Chicago, and Minneapolis-St. Paul are the major metropolitan areas served directly by the system. Many smaller communities dot the river courses. The UMR-IWW has traditionally served as the primary conduit for international trade of grains produced in the five-state region. Over 50 percent of tonnage moved on the system consists of non-grain products. Since completion of the 9-Foot Channel Navigation Project in the 1940s the UMR-IWW has generated benefits far in excess of costs. It generates in excess of $1 billion of transportation cost savings annually to the Nation. These benefits compare with the annual operation and maintenance costs of approximately $115 million.

Although tonnage increased substantially on the UMR-IWW from the 1940s when the UMR-IWW 9-foot channel became operational into the 1980s, since then it has run fairly flat. The flattening of tonnage on the UMR-IWW has paralleled a number of other occurrences that may have had some influence—congestion on the system increased with usage; railways became much more efficient following deregulation in 1980 and competed aggressively for freight; agricultural export decreased for some of the period; and high ocean shipping rates in recent years made shipping by rail to the West Coast competitive with river shipping to the Gulf. In addition, corn is being used for the production of ethanol, decreasing the amount available for export.

There are indications that traffic on the UMR-IWW will resume upward growth in the future, provided investment in Inland Waterways makes it a desirable option. Increasing freight demand will impact all modes, including waterways. This will lead to additional delays on the UMR-IWW Navigation System over the 50-year planning horizon adversely impacting the national economy. Rails' easy gains in productivity following deregulation have largely played out; West (and East Coast) ports and vicinities are growing more and more congested with the increase in population and international trade; and Panama is moving ahead with expansion of the Panama Canal, which may lead to more freight moving through Gulf ports and more direct transit to Asian markets from the Gulf. In addition, roadway congestion may lead to more high-valued freight moving to rail, which may have a secondary shift of lower valued freight to waterways. The new forecasting and transportation models used in the reevaluation do not allow for a multimodal analysis of these possibilities.

FORECAST AND REEVALUATION

The reevaluation is presented in the Interim Report through four accounts – National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE) – across the full range of potential freight utilization (Figure 1). All accounts are important in reaching conclusions and recommendations, but NED received the most consideration during this reevaluation in an attempt to overcome concerns expressed regarding the economic evaluation conducted during the Feasibility Study. A two-phase economic analysis was used for reevaluation.

The Corps' traditional NED analysis looked at a high traffic scenario (HTS) and a low traffic scenario (LTS) to bracket a reasonable range of freight traffic. It was not possible to define a most likely traffic forecast. The benefit/cost ratio ranged from 1.3 for HTS to .4 for LTS conditions. As described in the following paragraph the traffic forecasts may be greater and benefit computations may under estimate what is computed through traditional NED analysis.

Traditional NED analysis is largely a single mode approach in that adequate capacity and constant cost rates are assumed for alternative modes over the planning horizon. Traditional NED analysis does not include benefits from the relative economic impacts between modes relating to such things as congestion, environmental emissions, accidents (injuries, deaths, and damage to property), noise, and wear and tear on alternative modes. Although not in traditional NED analysis, these in fact are positive NED benefits for commercial navigation on the UMR-IWW. It may also happen that traffic is underestimated for LTS and HTS conditions modeled, if multimodal relationships change and the assumptions of constant cost rates on alternative modes are not valid.

The second phase of NED economic analysis addresses these multimodal considerations qualitatively through what is termed the "multimodal transportation scenario" (MTS). The MTS is a qualitative characterization of how traffic on waterways, and the UMR in particular, might be affected by happenings in domestic and global trade and other aspects of the transportation system that are not adequately addressed through current models. The MTS includes generally accepted projections of increasing freight demand and international trade; continuing rapid growth in intermodal traffic (containers); increasing congestion at East and West coast ports and land gateways with Mexico; growing congestion on highways; expanding rail capacity becoming more difficult and costly; and expanding capacity of the Panama Canal. Although not quantified, MTS would result in more traffic and higher benefits.

There are other scenarios that would drive traffic on the UMR-IWW lower than the LTS forecast. Some of the events that would lower traffic and benefits are less agricultural export than predicted for LTS due to less land used for grain production and more land used to support domestic biofuels, locally consumed agricultural products, and urbanization; unsustainability of current farm practices leading to lower grain yields; lower forecasts for non-grain freight; and greater reliance on highway and railway traffic to move freight with the expectation that these are preferred modes. The reevaluation effort assumes that all of these scenarios are adequately covered by the MIN condition (Figure 1), which has a benefit-cost ratio of 0.2 for a flat traffic condition.

The other three accounts (RED, EQ, and OSE) are overwhelmingly positive for the integrated, dual-purpose Recommended Plan. They do not have uncertainty that would put positive expectations at risk. The integrated, dual-purpose approach has NED benefits that are not covered by the traditional quantitative and non-traditional qualitative analysis in this reevaluation.

RISKS

Risk and uncertainty, which is inherent in trying to project freight traffic and transportation needs 50 years into the future, was explored from a number of perspectives:

- Does the Recommended Plan make sense as a waterways project?
- Are there reasonable expectations that NED will be positive?
- Are there other national and regional benefits?
- Are risks and consequences associated with implementing the Recommended Plan fewer than risks and consequences associated with not implementing it?

The locks being addressed in the Recommended Plan represent some of the most congested on the inland waterway system and lack the redundancy provided by two lock sites. The Recommended Plan meets planning and project objectives of efficiency, effectiveness, completeness, acceptability, sustainability, reliability, safety, and adaptability and is a priority project of the Inland Waterway Users Board, which recommends how funds in the Inland Waterway Trust Fund are invested.

The range of NED benefits predicted through the Corps traditional analysis are inconclusive as to whether the future with project condition will result in positive economic benefits to the Nation. However, when consideration is given to nontraditional NED benefits and expectations for increasing traffic and congestion across the national transportation system, the need for continuing investment in waterway capacity and efficiency becomes more evident. There are reasonable expectations that NED will be positive.

Formulation of the dual-purpose Recommended Plan to achieve long-term sustainability of the economic uses and ecological integrity of the UMRS has largely mitigated environmental and social risks. In fact, implementation of the Recommended Plan will result in a healthier ecosystem and improved quality of life for citizens. The only outstanding risk associated with implementing the Recommended Plan relates to the level of system utilization for freight transportation, but even that risk is limited by the cost of the first increment of the Recommended Plan.

Under-investing in the national transportation system and investing in projects that have not been integrated with other aspects of the natural and human environments are likely to have serious economic, environmental, and social impacts. Under-investing in waterways will result in a lesser role for waterways in carrying freight in the future, which will put more pressure on alternative modes, modes that have more environmental and social impacts.

CONCLUSIONS

The feasibility study was restructured in 2001 from a single purpose navigation efficiency study to an integrated, dual-purpose navigation efficiency and ecosystem restoration study. The success of the restructuring is evident by continued strong support for the Recommended Plan from partners, stakeholders, and the public representing a broad spectrum of interest in the UMRS. The Recommended Plan aligns with the Congressional designation of the UMRS as a “nationally significant ecosystem and a nationally significant commercial navigation system” and with the publics expectations for sustainable balance between economic and social uses of the UMRS and healthy ecosystem.

The Recommended Plan meets planning and project objectives and aligns with national transportation goals and objectives. The multimodal qualitative assessment done as part of the reevaluation effort reveals that investment in transportation efficiency and capacity will need to increase at a greater rate in the future in order to meet anticipated increases in freight demand and personal transit, stay internationally competitive, and sustain the quality of life Americans have come to enjoy. Although it is uncertain what the role of waterways, and the UMR-IWW in particular, will be in addressing the Nation’s future transportation needs, there are future scenarios that are consistent with the broader trends in global trade and transportation and that would lead greater utilization of waterways and positive addition to substantial National Economic Development.

From a risk perspective, the Recommended Plan is a resilient plan. Of the four evaluation accounts (NED, RED, EQ, and OSE) possibility of negative consequences exists only in NED. All other accounts will, without question, produce net benefits. The greatest possible economic loss is limited by the cost of the first increment of navigation improvements.

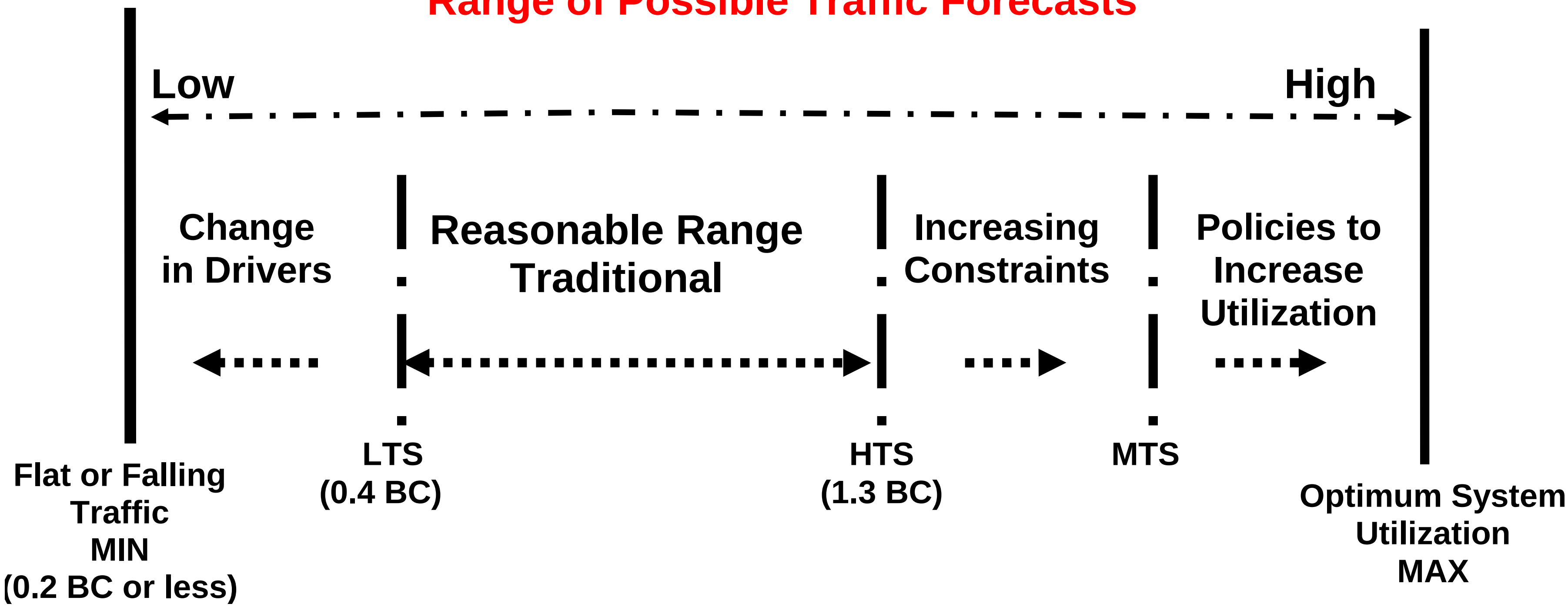
The reevaluation, although it did not reduce uncertainty in traffic forecasts over the planning horizon, did provide greater insight through improved models, additional data collection, and qualitative considerations. The results of the revaluation are consistent with results from the original feasibility study.

RECOMMENDATIONS

The Commanders of the St. Paul, Rock Island, and St. Louis USACE Districts agree with the process used to conduct the reevaluation and the content of this interim report. They reaffirm their recommendation for approval of the Recommended Plan as the appropriate plan for improving navigation efficiency of the UMR-IWW and ecosystem restoration of the UMRS, and immediate implementation of the first increment. The Commanders support continued adaptive implementation of the Recommended Plan and for Corps action in areas of collaboration and research.

- Reaffirm their recommendation for approval of the dual-purpose Recommended Plan, as presented in the Report of the Chief of Engineers, 15 December 2004, including immediate implementation of the first increment.
- Support USACE participation in interagency and public/private coordination, collaboration, and investigation to increase utilization and intermodal connectedness of the UMR-IWW Navigation System.
- Support within the context of the Corps of Engineers navigation program, investigations into improving navigation logistics, safety, security, and efficiency through advanced technologies and management practices.
- Support development of understanding and tools for the evaluation of navigation projects as part of the multimodal national transportation system through the Navigation Economics Technologies Program.

Range of Possible Traffic Forecasts



LTS – Low Traffic Scenario
HTS – High Traffic Scenario
MTS – Multimodal Transportation Scenario

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INTERIM REPORT

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INTRODUCTION

PURPOSE

The purpose of this Interim Report is to present findings from a reevaluation of the Recommended Plan proposed in the *Final Integrated Feasibility Report and Programmatic Environmental Impact Statement for the Upper Mississippi River – Illinois Waterway (UMR-IWW) System Navigation Feasibility Study*, 24 September 2004 (Feasibility Report), with emphasis on the economics of navigation efficiency improvements and export markets. Reevaluation is included as a provision of the Recommended Plan as a means to manage risk associated with an uncertain future. Project delivery for the first increment of improvements, including seven 1200-ft locks, is a lengthy process and allows for reevaluation as new data and tools come available. It was expected that reevaluation would be done 5 to 7 years after completion of the feasibility study, but instead is being done now at the request of the Assistant Secretary of Army for Civil Works [ASA (CW)]. The reevaluation uses updated data and newly developed economic forecasting models.

This report is in response to the ASA (CW) request. It also serves as a vehicle for communication with partners, stakeholders, and public. The reevaluation was conducted under the authority of Section 216 of the Flood Control Act of 1970; the same authority under which the study leading to the Recommended Plan was completed.

RECOMMENDED PLAN

The Recommended Plan is a framework plan calling for dual-purpose operation, investment in navigation efficiency improvements and investment in ecosystem restoration of the Upper Mississippi River System (UMRS) toward a vision of “long-term sustainability of the economic uses and ecological integrity of the Upper Mississippi River System.” Although the focus of the reevaluation is on the economic viability of the navigation component of the Recommended Plan, reevaluation was done with appreciation of the integrated duality of the plan.

A description of the Recommended Plan is included in Figure 2. Figure 3 presents an abbreviated assessment of the Recommended Plan against the project and planning objectives from the feasibility study.

FEASIBILITY STUDY (1993 – 2004)

In the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662), Congress designated the UMRS “a nationally significant ecosystem and a nationally significant commercial navigation system,” the only river system in the nation given this distinction. Congress stated that the UMRS “shall be administered and regulated in recognition of its several purposes.” Although the river has long been used for multiple human purposes and long appreciated for its ecological significance, Congress, through its statements in the 1986 WRDA, recognized the need for improving integrated management in order to sustain the economic value and ecosystem health of the UMRS for generations to come.

The study area is the UMR-IWW Navigation System and the UMRS ecosystem. Navigation of the UMR-IWW has been a vital component of regional and national settlement and economic development. Navigation improvements date back as early as the 1820s beginning with removal of snags, shoals, and sand bars, and the confinement of flow to the main channel. The existing 9-foot Channel Navigation Project was largely constructed in the 1930's and extends down the UMR from Minneapolis-St. Paul to its confluence with the Ohio River and up the Illinois Waterway from its confluence with the UMR to Thomas J. O'Brien Lock in Chicago. It includes 37 Locks (29 on the UMR and 8 on the IWW) and approximately 1,200 miles of navigable waterway with portions of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The UMRS ecosystem includes the river reaches described above as well as the floodplain habitats that are critically important to large river floodplain ecosystems. The total acreage of the river-floodplain system exceeds 2.5 million acres of aquatic, wetland, forest, grassland, and agriculture habitats. The Mississippi Flyway is used by more than 40 percent of the migratory waterfowl traversing the United States. These Trust Species and the threatened and endangered species in the region are the focus of considerable Federal wildlife management activities. In the middle and southern portions of the basin, the habitat provided by the mainstem rivers represent the most important and abundant habitat in the region for many species.

Use and performance of the 9-Foot Channel Navigation Project has been a phenomenally successful transportation investment, far exceeding original expectations. It generates in excess of $1 billion of transportation cost savings annually to the Nation. These benefits compare with the annual operation and maintenance costs of approximately $115 million.

Increasing freight traffic and much larger tow configurations, which require double lockage through the original 600-foot lock chambers, has led to a number of initiatives to increase capacity and efficiency of the system, including completion of 1,200-foot locks at Lock 27 in 1953; Lock 19 in 1956; Lock 26 in 1990; and a 600-foot lock at Lock 26 in 1994. However, construction of the 9-Foot Channel Navigation Project and its success as a commercial transportation system, combined with the impacts from other human activities, has adversely affected the river and floodplain ecology. The UMRS will continue to degrade unless appropriately managed through a multi-agency approach.

In 1993, a navigation study of the entire UMR-IWW system was initiated to investigate transportation capacity and efficiency issues as well as to better understand transportation and other human use impacts on the river and floodplain ecosystem. The study was restructured in 2001 as an integrated, dual-purpose study for navigation efficiency and ecosystem restoration.

The principal navigation problem addressed by the study is the potential within the 50-year planning horizon for significant traffic delays on the UMR-IWW beyond the delays that currently exist. **The principal environmental problems** addressed by the study are the changes to ecosystem structure and function that have occurred over many years from many causes, but especially since initiation of the operation and maintenance of the existing Nine-Foot Channel Navigation Project.

The future without-project condition defines what the likely and foreseeable conditions will be for the system in the absence of Federal action resulting from this study. It serves as a baseline against which alternative plans are evaluated. A scenario-based approach was used for traffic forecasting, which resulted in multiple representations of the without-project condition for navigation. It was assumed that some Federal and non-Federal actions would take place independent of actions resulting from the study, including the continued maintenance and rehabilitation of the existing system.
The ecosystem is expected to continue to deteriorate for the without-project condition. The level of authority and authorized appropriations in the Environmental Management Programs and other Federal and non-Federal programs and limited environmental management activities available under a

single-purpose navigation project have been insufficient to meet environmental needs on the UMRS. Without Federal action, degradation will continue in the future.

Formulation of navigation efficiency alternatives began by identifying measures that would contribute to a safe, reliable, efficient, and sustainable UMR-IWW Navigation System over the planning horizon of 2000 to 2050. Small-scale measures, new 1,200-foot locks, and 1,200-foot lock extensions were investigated. Longer locks, 1,200-foot versus current 600-foot, will allow the largest tow configurations to pass through a lock in a single lockage. The measures were used to form alternatives for evaluation and comparison.

Formulation of ecosystem restoration alternatives began by identifying broad ecosystem restoration goals that meet the planning objective of addressing cumulative impacts including ongoing effects of the operation and maintenance of the UMR-IWW Navigation System and developing subordinate objectives. These objectives were used to identify suitable types and numbers of ecosystem management and restoration measures. The measures were used to form five alternatives for evaluation and comparison.

The alternatives were evaluated using the system of five primary accounts established in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G): 1)* National Economic Development (NED); 2) its environmental equivalent National Ecosystem Restoration (NER); 3), Regional Economic Development (RED); 4), Environmental Quality (EQ); 5), and Other Social Effects (OSE). **The accounts relating to the navigation component are defined and updated in Chapter 3 of this reevaluation report.** The NED benefits for the navigation improvements were evaluated using a scenario-based analysis utilizing five traffic scenarios and economic model conditions. This combination of scenarios and models reflects the uncertainty associated with projecting traffic.

More information is available in the *Chief of Engineers Report to the Secretary of the Army*, 15 December 2004, and the *Final Integrated Feasibility Report and Programmatic Environmental Impact Statement for the UMR-IWW System Navigation Study*, 24 September 2004.

APPROACH

The reevaluation of the Recommended Plan is presented in this Interim Report through four traditional evaluation accounts—1) National Economic Development (NED); 2) Regional Economic Development (RED); 3) Environmental Quality (EQ); and 4) Other Social Effects (OSE)—across a range of possible futures, and in the context of the national freight transportation system. The national freight transportation system is highly complex and decentralized and shaped by a multitude of public and private decisions that are made independently over time. Decisions by one entity are influenced by government policies, decisions of others, and expectations for freight demand. Capital investments in transportation take a long time to implement. The full stream of benefits from implementation of the Recommended Plan will not begin until after 2020. Innovations and technological change continue to affect markets and freight movement. The reevaluation through a combination of quantitative and qualitative considerations attempts to bring understanding to potential benefits and risks of either implementing or not implementing the Recommended Plan.

The Interim Report is presented in four chapters. Chapter 1 addresses the breadth and nature of the national freight transportation system, including importance, national freight transportation objectives, salient characteristics, current state of acceptability, and general projections of freight demand, drawing heavily on recent reports by the U.S. Department of Transportation (USDOT) and others.

The purpose of Chapter 1 is to provide understanding of the national freight transportation system and of trends in the global economy and context for considering merits of the Recommended Plan.

Chapter 2 follows with a more detailed look at the Inland Waterway System and the UMR-IWW as a subset of it. The purpose of this chapter is to provide understanding of the role of waterways as a component of the national transportation system and to provide context for considering the merits of the Recommended Plan.

Chapter 3 updates forecasts and evaluations from the Feasibility Study, using updated economic data and models, revised scenarios, and other refinements. The reevaluation, which includes both quantitative and qualitative assessments, is presented through the four accounts:

Analysis for ***National Economic Development*** (NED) includes two complementary and additive phases. The first updates the navigation traffic forecasts and evaluation accomplished as part of the Feasibility Study using updated data and forecasting tools. This first phase meets criteria established in Corps guidance for economic evaluation of proposed navigation projects. Analysis in this phase establishes a reasonable range of traffic outcomes, bracketed by a low traffic scenario (LTS) and a high traffic scenario (HTS). In this phase of analysis the potential impacts of increasing congestion in some aspects of the transportation system; impacts of noise, safety, infrastructure wear and tear, emissions and environmental impacts relative to other modes of transportation; and impacts of system reliability and other considerations on willingness to use or invest are not considered. The second phase of the economic analysis addresses some of these issues through development of the multimodal transportation scenario (MTS).

Regional Economic Development (RED**)** consists of economic benefits that do not necessarily increase NED, but do provide economic benefits or costs to a particular region of the country. Regional impacts may have national significance by addressing social issues that are of particular concern to the Nation, and which are expected to affect the long-term welfare of the Nation. The reevaluation investigates some aspects of RED associated with implementing the Recommended Plan (such as impacts from investment in construction of the projects, from changes in transportation efficiency, and from changes in competition between modes), but not all (such as impacts from induced private and public investment in ancillary transportation infrastructure).

Environmental Quality (EQ) of the navigation component of the Recommended Plan was investigated during the Feasibility Study for both site-specific and systemic impacts on the natural environment and historic properties. A plan to avoid, minimize, and mitigate negative impacts was developed as part of the Feasibility Study and included in the Recommended Plan. Although the reevaluation is focused on the navigation component of the Recommended Plan, the plan is in fact a dual-purpose integrated plan that supports both the economic uses and ecological integrity of the Upper Mississippi River System through a sustainable management approach. This approach will produce benefits that are not captured through investigation of the navigation efficiency component of the Recommended Plan alone. Dual-purpose operation positively impacts all four accounts – NED, RED, OSE, and EQ.
Other Social Effects (OSE) is looked at through three elements, all of which have both regional and national significance: international competitiveness, national security, and quality of life. International competitiveness addresses the need for efficient, reliable, and low cost transportation in order to compete on a global basis. National security addresses the role of waterways in making the national transportation network resilient and responsive in times of national emergency. Quality of life considers impacts on the human environment and sense of wellbeing. Areas investigated include emissions, accidents, noise, traveler delays, recreation, and aesthetics.

In each account, the consequences of implementing the Recommended Plan versus not implementing it are explored. At one extreme, consequences are limited by the cost of the project under a condition where freight is flat or declining (MIN). At the other extreme, consequences are limited by optimum utilization of freight capacity that would be added through implementation of the Recommended Plan (MAX).

Three scenarios between the two extremes are explored. Two of the scenarios, the LTS and the HTS, bracket a reasonable range of outcomes under the assumption that constraints in the national freight transportation network are at equilibrium and will not change over time, i.e., alternative modes have unlimited capacity at current rate. A third scenario, the MTS, explores the potential for more freight moving to waterways due to growing constraints on roadways, railways, and East and West Coast ports. In addition, consideration is given to opportunities to facilitate greater utilization of waterways and more effective inter-modal connection with railways and roadways as recommended in the U.S. DOT's *Framework for a National Freight Policy* (April 2006 draft). A schematic of this risk-based approach is presented in Figure 1. The purpose of Chapter 3 is to provide an orderly assessment from which conclusions can be drawn on how to proceed with the Recommended Plan and or reevaluation effort.

Chapter 4 summarizes findings and results and brings the reevaluation to conclusion with an updated recommendation. As with the Feasibility Report, no attempt was made to reduce the economic forecast to a single benefit-cost comparison or to present forecasts probabilistically. Recommendations are presented in a risk-informed decision-making framework that contrasts a range of consequences possible from either implementing the Recommended Plan or not implementing the Recommended Plan. Conclusions and recommendations in this report are based on whether or not the Recommended Plan should be part of the multimodal mix of public and private transportation investments to be made over the next 10 to 15 years for the benefit of the next 50 years or more.

TRAFFIC MANAGEMENT

Although the reevaluation does not address non-structural measures beyond those called for in the Recommended Plan (moorings and switchboats), additional investigations into non-structural traffic management considerations have been accomplished since completion of the feasibility. There is considerable interest in government and business to improve traffic management for waterways. Investigations since completion of the feasibility study are consistent with results of that study. Although traffic management is not a substitute for the Recommended Plan, traffic management innovations do show promise for improving reliability, reducing transit time for select vessels (those that would have priority permits), and tracking shipments. These features would be of most value to the movement of higher valued and more time sensitive products. These measures will gain in importance as the Nation looks for ways to address the growing demand for freight transportation.

An initial investigation into appointment scheduling has been completed under the Corps' Navigation Economics Technologies (NETS) Program and augmented with some additional investigation during preconstruction engineering and design of the Recommended Plan. Results showed minor reduction in delays under some sequencing rules at forecast traffic levels, but would require imposing preferences of some vessels over others. The effort explored tow configurations and upbound/downbound sequencing, but did not consider cargo type or other attributes. Additional investigations, development, and testing are planned. To a large degree, lockmasters already utilize the concepts in mitigating congestion.

A tradeable permits concept has also been investigated under the NETS program. Under the concept, permits having different levels of locking priority would be issued. Holders of permits with different levels of priority would be free to trade with each other. The idea is to provide a mechanism for shipments that benefit from faster transit time and greater reliability to trade for higher priority. The concept warrants continued study, especially in anticipation of inland waterways being used in the future to transport higher valued, more time sensitive cargo and by specialized vessels for transporting container. There are many considerations that would have to be addressed in development of a tradeable permits concept.

The Corps is committed to investigating, testing, and deploying lock guidance systems. The primary benefit of such systems is reduction in lockage risk by giving pilots visual aids and data during lock approaches, which should result in safer operation and fewer, less serious impacts with lock facilities.

Other investigations through government and private industry are exploring systems for tracking vessels and cargo, which should improve inter-modality and supply chain management.

LIMITATIONS

The most significant limitation to reevaluation is the inherent uncertainty in forecasting 50 years into the future. Other limitations, some of which are listed here, make it difficult to explore this uncertainty.

- The models do not have full spatial-equilibrium capability. A spatial equilibrium methodology is used for grain movements, but not for non-grain commodities.

- The models are largely single mode. Models assume that intermodal relationships are in static equilibrium for the duration of the planning horizon. Multimodal considerations were accomplished through a general, qualitative approach.

- The Corps' traditional NED analytical framework does not include all categories of benefits that are proposed as a standard for transportation projects across modes.

- Scenario development and sensitivity analysis was limited. The LTS and HTS scenarios are not well-developed presentations of potential future conditions and relationships. They are largely the creation of the developers of the grain model and non-grain forecasts based on past or near term trends and expectations. The study team modified some of the more dynamic parameters to arrive at a high and low traffic scenario for grain and created a high-low range around the non-grain forecast.

- Shipper surveys may not have captured a true understanding of shipper responses relative to different conditions. Furthermore, data gathered on time and reliability was not used in analysis. Data from these surveys were assumed to remain valid over the planning horizon.

- Aggregations and assumptions were made to simplify analysis.

These limitations probably do not severely impact the quality of short-term (5 to 10 years) projections and analysis, but they limit the ability to explore a future as expansive as the 50-year planning horizon for this study where infrastructure construction is going to take 15 years to complete. The set of tools available for this evaluation did not allow for quantitative assessment of changes that are likely to affect the current equilibrium. Changes could be significant.

The qualitative multimodal analysis provides context for understanding the traditional economic analysis and provides a means for better understanding the impacts of changes occurring in markets and the transportation network. In all, the reevaluation increased understanding of the potential and resiliency of the Recommended Plan and the consequences of potential outcomes.

INDEPENDENT REVIEW

Re-evaluation products and initial draft report were subject to external peer review (EPR) by experts external to the Corps as well as an independent technical review (ITR) by Corps experts who were not involved in the planning or design of the project. Partners and stakeholders were provided an opportunity to comment on the re-evaluation products and initial and final drafts of the report. Opportunities were provided the EPR Panel, ITR Team, and partners and stakeholders to participate in three special workshops-meetings to hear about and question different aspects of the re-evaluation from those who developed the tools and who used them in analysis. Management of these reviews was through the Corps' Planning Center of Expertise for Inland Navigation (PCXIN).

The purpose of the External Peer Review (EPR) Panel was to provide external technical expertise in the review and evaluation of the forecasting models, inputs, results, and documentation used in the re-evaluation of the Recommended Plan. The EPR Panel was a five-person interdisciplinary panel with broad capabilities in economic analysis; agricultural trade and markets; waterway, rail, and truck transportation; and environmental impacts. The panel did not review engineering or design-related issues pertaining to navigational or river improvements. Although the EPR process was not structured to produce consensus, consensus viewpoints emerged in some areas, but there were also divergent views. The panel expressed both consensus and divergent views in a summary report, which it completed after review of the initial draft report. All comments received on the various panels were answered by the Re-Evaluation Team. Adjustments to the report were made between the initial and final drafts and between the final draft and final report.

The EPR Panel acknowledged that the Corps has made significant progress in developing forecasting and economic tools:

> "the Interim Report shows major accomplishments and progress in the models used for NED benefit computations - especially with respect to grain traffic forecasting and shipper demand analysis - as compared to the former TCM approach."

The EPR Panel identified the "inability to explicitly model the multimodal transportation system and the reactions of other modes to changes in the waterway system" as the greatest limitation of the reevaluation study. Although the Panel acknowledged qualitative considerations of the multimodal environment was a step in the right direction, the Panel also recognized that "there is no mechanism in the Corps' approach to adjust the forecasts for multimodal considerations."

The External Peer Review Summary Report and Corps' Response are posted on the internet at http://www2.mvr.usace.army.mil/UMRS/NESP under *Reports*.

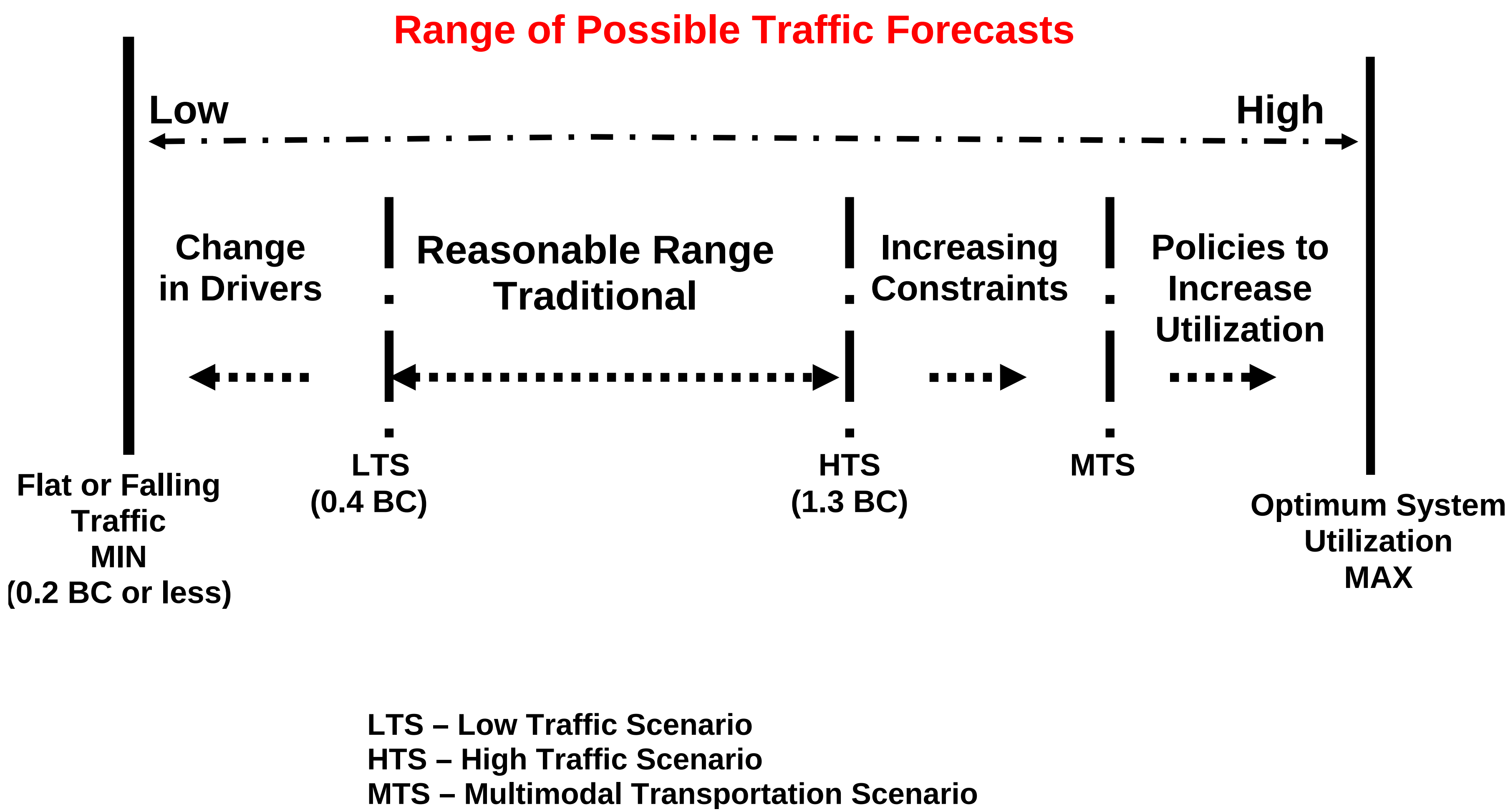

Figure 1. Schematic of Risk-Informed Decision-Making Framework for Reevaluation

THE RECOMMENDED PLAN

The Recommended Plan is a 50-year framework for modification and operational changes to the Upper Mississippi River and Illinois Waterway System to provide for navigation efficiency and environmental sustainability, and to add ecosystem restoration as an authorized project purpose. The integrated, dual-purpose plan will provide flexibility in managing operation and maintenance of the system for both navigation and the environment. The integrated, dual-purpose plan will be implemented through an adaptive approach that will include an incremental implementation strategy paired with periodic checkpoints requiring future reporting to the Administration and Congress. The Corps of Engineers will administer the plan in full collaboration with the other Federal and State agencies involved in management of the UMRS.

The recommended navigation improvement framework includes small-scale structural and non-structural measures, new 1200-foot locks and lock extensions, and appropriate measures to avoid, minimize, and compensate for environmental impacts at a first cost of $2.59 billion at October 2004 price levels plus annual switch boat operation costs of $19.4 million. **The first increment** proposed for immediate implementation at a first cost of $2.03 billion includes:

- Small-scale measures ($218 million, including site specific mitigation)
  - Mooring Facilities at 7 lock and dam sites ($11 million)
  - Switchboats at Locks & Dams 20 through 25 in phased approach ($207 million for **first increment**)

- 7 new 1200-foot locks at Locks & Dams 20, 21, 22, 24, 25 on the UMR and LaGrange and Peoria on the IWW ($1.66 billion, including $200 million for site-specific and system mitigation) with decision points for adaptive implementation.

- In accordance with Section 102 of the Water Resources Development Act of 1986, one-half of the cost of navigation improvement construction shall be paid from the amounts appropriated from the general fund of the U.S. Treasury and one-half from amounts appropriated from the Inland Waterway Trust Fund.

Other features of the Recommended Plan (extensions of Locks 14, 15, 16, 17, and 18 and switch boats at locks 11, 12, and 13), will be revisited through an update of the feasibility study, which will be done a few years prior to completing the first increment.

The recommended ecosystem restoration framework consists of an estimated 1009 individual projects with a combined first cost of about $5.72 billion at October 2004 price levels. **The first increment** proposed for immediate authorization includes:

- An estimated 225 projects with a combined first cost of $1.58 billion. The cost of projects proposed for implementation at full Federal expense is estimated at about $1.28 billion. The first cost of the cost shared floodplain restoration projects is estimated at about $299 million with a Federal cost of about $194 million and a non-Federal cost of about $ 105 million.

- Total operation, maintenance, replacement, repair, and rehabilitation (OMRR&R) costs for these projects, over a 50-year project life are estimated at $82 million. OMRR&R costs will be the responsibility of the agency with management responsibility for the land on which the project is located or with operation and maintenance responsibility for the existing structure being modified.

- Ecosystem restoration will be accomplished through an adaptive management process.

Figure 2. Description of the Recommended Plan

PROJECT & PLANNING OBJECTIVES FOR THE RECOMMENDED PLAN (NAVIGATION)

Efficiency and Effectiveness: Implementation of the Recommended Plan will result in a marked improvement in system operational efficiency by reducing bottlenecks, adding system capacity, making lockage more efficient, and by eliminating functional obsolescence at specific project sites through addition of locks that accommodate 15-barge tows. Project design is matched with anticipated growth in demand and takes advantage of existing infrastructure to the maximum extent. Level of performance (e.g. filling and emptying times), potential demand, and project costs were integrated to arrive at an optimum balance. Efficiency and effectiveness will be magnified to the extent that the Recommended Plan encourages greater utilization of UMR-IWW and other segments of the inland waterway system, which increases Return on Investment for the entire inland waterway system, reduces the amount that will need to be invested in alternative modes, and reduces environmental and social impacts that other modes have on society to a greater extent than water.

Completeness, Acceptability, and Sustainability: Five aspects assure the Recommended Plan is a complete, acceptable, sustainable project: formulation at a system level; extensive investigation of environmental impacts; consideration of regional and social impacts; formulation as a dual-purpose, integrated plan; and collaboration with stakeholders and partners.

Sustainability is viewed as "the balance of economic, ecological, and social conditions so as to meet the current, projected, and future needs of the UMRS without compromising the ability of future generations to meet their needs." An assessment of cumulative effects was conducted using an interdisciplinary team of experts and archival information concerning changes in the system since construction of the 9-Foot Channel Navigation Project. The cumulative effects assessment provided the context against which to consider both the extent and significance of any direct or secondary effects that may result from the alternatives. This effort also contributed important information on the likely future (without project) condition of the UMRS ecosystem. This objective guided the development of alternatives for ecosystem restoration including modifications to the operation and maintenance of the navigation project for environmental considerations.

Reliability: Reliability is the ability to provide consistent lockage service throughout the navigation season or construction period for new improvements with minimal disruption to river traffic. The Recommended Plan will greatly improve reliability of 12 specific lock sites, and the UMR-IWW system as a whole, by upgrading or adding locks and replacing operating systems. At the seven most-heavily used sites, existing locks will be kept operational for additional capacity, flexibility, safety, and redundancy.

Navigation Safety: Improvements in approaches and operating systems, elimination of double lockage, and increased reliability will result in safer conditions for tow boat crews and lock personnel.

Adaptability: The Recommended Plan is a framework plan for navigation efficiency improvements, ecosystem restoration, and dual-purpose operation. Adaptive management within a collaborative environment will be an integral part of implementation. There are three increments proposed with separate authorization required for each increment. For navigation:

1. 7 new locks and small scale improvements for the first increment;
2. 5 lock extensions and small scale improvements for the second increment; and
3. additional small scale improvements for the third increment.

On the ecosystem side implementation of the first increment establishes an ecosystem level of investment that would be continued through the subsequent two increments. An efficient and reliable inland waterway with sufficient capacity supports the need of shippers and carriers to adapt to changing market conditions and provides opportunities for competition and innovation.

Figure 3. Description of Planning & Project Objectives

CHAPTER 1

NATIONAL FREIGHT TRANSPORTATION SYSTEM

TABLE

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CHAPTER 1

NATIONAL FREIGHT TRANSPORTATION SYSTEM

OVERVIEW

The United States has a world-class national freight transportation system, which has provided the Nation with the means for reliable, efficient, and low cost delivery of freight. The country's extensive network of roads, railways, waterways, pipelines, airlines, ports and terminals comprise one of the most extensive and elaborate national freight transportation systems in the world. Advanced transportation logistics systems allow shippers and carriers to traverse the intermodal pathways for fast, reliable, and low cost delivery of freight from point to point. This multimodal freight transportation system includes 4 million miles of roads, 145,000 miles of rail, and 12,000 miles of inland navigation channels. A staggering 16 billion tons of goods worth over $9 trillion (U.S. DOT FHWA 2002) move on this system annually. That translates into roughly 310 pounds of freight moved daily for each U.S. resident. The importance of a properly constituted and optimally utilized national freight transportation system to national wealth and prosperity cannot be over stated. Reliable, efficient, and low cost freight transportation increases the value of goods by moving them to locations where they are worth more; and encourages competition and production by extending the spatial boundaries of commodity and labor markets (USDOT FHWA 2002b). Freight transportation also stimulates demand for goods and services and employs more than 10 million U.S. citizens.

The United States' national freight transportation system is planned, constructed, and operated through a complex network of actions by governments at all levels and private enterprise. The approach allows for competition and private entrepreneurship to drive investment and innovation; states and local governments to act in the best interest of their communities and regions; and the Federal government to guide transportation investment and utilization in the best interest of the Nation through direct investment, grants, and policy. Complicating this already complex decision-making network, are the nature of transportation investments, which take many years to plan and complete; the nature of policy decisions, which require extensive deliberation to sort out potential consequences and require compromise to reach a point of acceptability; and the complexity and unpredictability of the global economy. Transportation investments and policy actions require tradeoffs and integration with other economic, social, and environmental factors.

While still a mighty system, the nation's transportation system is coming under increasing pressure due to aging infrastructure and increasing demand for travel and freight movement. This is despite substantial ongoing investment of several hundred billion dollars per year. At the domestic level, failure to correct deficiencies and expand capacities will result in lower national economic potential and less satisfying living conditions for citizens. As identified in the *National Strategy to Reduce Congestion on America's Transportation Network* (DOT, May 2006) congestion drains the economy, hurts families, and threatens businesses. Any lessening in economic potential will also have international implications by reducing the economic influence of the U.S. in world economy and profoundly affects national security.

ECONOMIC GROWTH AND INTERNATIONAL COMPETITIVENESS

The U.S. continues to hold claim to the distinction of being the world's largest and most successful economy. However, over the next 30 years China and India will move from their current 7th and 9th positions, respectively, to second and third behind the U.S. (Table 1.1) (AASHTO, May 2007). China with a population of 1.3 billion is projected to overtake the U.S. as the largest national economy around 2050. As part of its drive to increase economic output and productivity China is making large investments in transportation infrastructure, including port modernization and a 53,000-mile national expressway system. India with a population of 1 billion is building a 10,000-mile national expressway system. Europe with 450 million people is also investing heavily in transportation modernization and expansion of its highways, bridges, tunnels, ports, waterways, and rail lines. Transportation systems and governmental policies directly influence the movement of trade within and among countries, as well as their economic prosperity. The U.S. level of investment is lagging behind and as a result its competitive advantage in transportation is eroding.

Table 1.1. Rank of Nation's Gross Domestic Product in Inflation-Adjusted Dollars

	2000	2010	2020	2030	2040	2050
1	US	US	US	US	US	China
2	Japan	Japan	China	China	China	US
3	Germany	Germany	Japan	Japan	India	India
4	U.K.	U.K.	Germany	India	Japan	Japan
5	France	China	U.K.	Russia	Russia	Brazil
6	Italy	France	India	U.K.	Brazil	Russia
7	China	Italy	France	Germany	U.K.	U.K.
8	Brazil	India	Russia	France	Germany	Germany
9	India	Russia	Italy	Brazil	France	France
10	Russia	Brazil	Brazil	Italy	Italy	Italy

The U.S. transportation infrastructure—constructed largely from 1930 through 1960—was clearly not designed for the current levels of human and freight movement. Sophisticated supply chain logistics are threatened by potential reductions in reliability, increased delivery time, and higher transportation costs that will result from higher levels of congestion. Loss of reliability and an increasing level of delay also affect worker productivity and quality of life of citizens. The U.S. population is expected to grow by 140 million between 2005 and 2055, which is roughly the same as the population growth during the preceding 50 years. Our dependency on international trade is expected to grow to 60 percent of the Gross Domestic Product by 2030 (AASHTO, May 07). By 2035, the tonnage of U.S. freight moving on our transportation system is expected to more than double from the present 16 billion tons in response to both domestic and foreign demands. The nature of freight is also changing. Although all types of freight are expected to increase, the growth in container freight is expected to grow especially fast from 8 million units in 1980 to 42 million units in 2005 to 110 million units by 2020. Improvements and policy changes on all transportation modes will need to intensify if the U.S. is to meet the future demands for freight transportation and to maintain our world economic standing.

NATIONAL FREIGHT TRANSPORTATION CHARACTERISTICS, CAPACITIES, AND DEMAND

The following sections present transportation characteristics, capacities, and demand forecasts for components of the national freight transportation network that have the most integration and interdependence with waterways. Waterways are addressed in Chapter 2.

Roadways. Over the past century, the combined efforts of Federal, state and local governments have constructed a highway system of nearly 4 million miles—the largest and best system in the world. The 162,000-mile National Highway System is comprised of a 47,000-mile Interstate System and associated 115,000 miles of additional arterials. Another 810,000 of 813,000 miles of arterials and roadways are eligible for Federal aid. Nineteen percent of U.S. highways are owned by states, 45 percent by counties, 33 percent by cities and townships and 3 percent by the Federal government.

Highways are the keystone of the U.S. freight transportation system, carrying nearly 80 percent of domestic tonnage and 94 percent of domestic value. Trucks provide direct service for both long-distance and local shipments, and provide the pickup and delivery for long-distance shipments made by rail, barges or overnight airfreight.

The current U.S. Interstate Highway System was designed in the pre-World War II period from the experience of a very different era. As interstate transportation began in the late 1950s there were 65 million vehicles creating 600 billion vehicle miles of travel. In 2006, there were over 240 million vehicles creating 3 trillion vehicle miles of travel on a highway system that had grown only 15 percent over the same time period. Forecasts show that the interstate highway travel demand measured through vehicle miles traveled (VMT) will increase from 690 billion in 2002 to 1.3 trillion by 2026. Truck-borne freight is expected to double by 2035. By 2035 the Interstate System will carry an average of 22,700 trucks per day per mile; currently, it carries less than half that. Today only 30 miles of the Interstate carry more than 50,000 trucks per day per mile; by 2035, that number may reach 2500 miles. Whatever extra capacity was created when the interstate transportation system was put in place is being used up quickly. It is estimated that by 2020, 90 percent of urban interstates will be at or exceeding capacity. This includes the major metropolitan areas of Chicago-Milwaukee, St. Louis, and Minneapolis-St. Paul, which are the anchor cities of the UMR-IWW Navigation System. Peak-hour congestion in urban areas is expected to increase from 29 percent in 2000 to 46 percent in 2020. Rural areas will also experience greater congestion.

The value of freight shipments is expected to increase at a faster pace than tonnage in the future. According to USDOT, the value of freight is expected to increase by $20.6 billion from 1998 to 2020, which represents a compound annual growth rate of 5.5 percent. More than 90 percent of this projected increase is attributable to growth in the value of highway freight (77 percent). These trends suggest that the economic consequences of highway congestion will be much greater in the future. The growing value of highway shipments underscores the importance of keeping bulk commodities on railways and waterways to reduce highway congestion that impacts high-value goods. Highway travel is projected to increase by around 2 percent per year through 2022. If this rate persists over the 50 year planning horizon, highway vehicle miles will increase from 3 trillion vehicle miles to 7 trillion vehicle miles.

The American Association of State Highway and Transportation Officials (AASHTO) recently estimated an annual investment of $155.5 billion would be required through 2030 to bring about a national highway system that produces positive net benefits in terms of condition and performance. Actual highway spending in 2005 was approximately $75 billion. The Federal assistance for highway improvements is set at 45 percent, or $33 billion for the 2005 investment. Additional investment is needed to rebuild or replace 55,000 bridges, 15,000 interchanges, and 210,000 lane miles of pavement foundations and to expand the system by adding 10,000 miles of new routes, 20,000 miles of upgraded National Highway System routes to Interstate standards, and 20,000 new lane-miles on existing interstate routes. Some of the new lanes will be dedicated to trucks and value-priced lanes. Greater use of mass transit and alternative modes for freight will be needed to augment increased investment in roadways.

Railways. United States freight railroads are the worlds busiest and longest. In fact, U.S. railroads move more than four times as much freight as do all of Western Europe's freight railroads combined. Railroad operations for freight in the U.S. cover some 145,000 miles. America's freight rail system carries 14 percent of the Nation's freight by tonnage, 29 percent of the ton-miles, and 5 percent of the value. Over the past two decades following Federal deregulation (Staggers Act) railroads have increased their productivity by merging and acquiring, cutting track mileage by more 50 percent, reducing personnel by 50 percent, installing more computer guided automation, and upgrading track and fleet.

The railroad network that accommodated freight traffic in 2005 is very different than the rail network in place a generation ago where over-regulation resulted in a system out of sync with shippers' needs. Since deregulation in 1980, railroads have divested obsolete and over-used capacity and invested billions of dollars to increase capacity and productivity aligned with markets. However, according to a report by the Congressional Budget Office (CBO), *Freight Railway Transportation: Long-Term Issues* (January 2006), the pendulum has begun to swing toward tighter capacity and there is concern that railroads are not investing enough to meet demand for their services.

The CBO report cited work by the Transportation Research Board (TRB) the American Association of state Highway and Transportation Officials (AASHTO), and the Hudson Institute that warned of significant strains on the capacity of the national freight railway system. The TRB in 2003 reported that "Rail capacity constraints and recent problems are discouraging to the hopes of state and Federal officials, environmentalists, and motorists that rail can relieve highways of part of the burden of truck traffic growth." Railroads have increased investments in recent years, although it is unclear whether the railroad industry will invest quickly enough to avoid a curtailment of service.

One interesting note is that although the number of trains per mile of track has increased steadily since deregulation, the average speed has declined and is now at speeds of the early 1980s. Railroads are increasingly encountering situations where they could have sold more services had they had more capacity. By most accounts (STB and GAO) rail rates have fallen steadily since the 1980s due to competition and productivity improvements. However, this is not expected to continue in the face of limited capacity to accommodate growing demand, and the higher cost of adding capacity and improving efficiency in comparison to the earlier years after deregulation. According to AASHTO's 2003 *Freight Rail Bottom Line Report* the rail industry is stable, productive and competitive; it is earning enough money to be profitable, but not enough to replenish infrastructure and modernize at a quick enough pace. Rail freight demand currently exceeds carrying capacity with rail intermodal freight experiencing the greatest strain. Although major freight railroads invested $8.3 billion in 2006, which nearly double the amount of 10 years earlier, it was still not enough to finance sufficient expansion. Railroads are enhancing profitability by turning aside lower-profit carload and short-haul freight in favor of longer distance intermodal and bulk traffic.

The Federal Railroad Administration expects rail ton-miles to increase from an estimated 1.46 trillion in 2000 to 2.40 trillion in 2025 and the rail freight industry to grow an average of 2 percent per year between now and 2025. This growth reflects the adoption of technological advances in communications, command, and control; more fuel-efficient locomotives; high-capacity, lightweight freight cars; and moderate traffic growth, led by intermodal traffic. Public funding may be needed to augment private rail investment to avoid transferring 450 million tons of freight from rail to truck, avoid 15 billion in additional truck VMT and save $162 billion in shippers' costs and $ 20 billion in highway costs over a 20-year period.

International Gateways (Seaports and Land Crossings). Growth in international trade is placing more demand on seaports and land gateways. Tonnage at U.S. ports increased 13.8% between 1990 and 2000 while port capacity has increased very little. In addition to portside capacity constraints, constraints in landside access also cause bottlenecks to input and output through international ports. Urban congestion at many ports makes expansion difficult and costly. Efforts are being made to increase capacity and improve productivity at the nation's ports, such as moving some freight to "inland ports" for sorting and distribution of freight. The highly successful Alameda Corridor, which is a 20-mile long rail line that transfers freight from the crowded Los Angeles and Long Beach harbors to an inland port for sorting and distribution, is one example. Virginia Inland Port takes freight from ports of Hampton Roads. Other inland ports have been developed at San Antonio and Kansas City as part of the NAFTA railway system serving Mexican Ports. Although these types of investments are impressive additions to the transportation system, much more is going to be required in order to meet the demand, which is primarily being driven by the rapid growth in multimodal container trade with Asia.

Seaports are points of vulnerability to the entire national transportation system, because of the small number of major ports and the high volume they carry. For example, it took 23-days to eliminate backlog and get back to normal flows after a 10-day lockout of dockworkers at the Los Angeles and Long Beach ports in 2002.

The great majority of NAFTA trade crosses into and out of the U.S. in trucks. Periods of heavy traffic, limited infrastructure, and custom procedures often result in long, costly border delays.

Transportation Logistics. Technological innovations have enabled drastic changes in supply-chain management that have resulted in decreases in costs as shippers were able to consolidate distribution centers and substitute more transportation for costly inventory. Innovations continue to advance; however, these ultra- sophisticated tools require a high degree of reliability across the transportation system, which can be weakened by congestion and delay on our freight system. The result of such an occurrence is lower productivity and higher supply chain costs.

NATIONAL FREIGHT TRANSPORTATION POLICY

The U.S. DOT in its strategic plan for 2006 to 2011 has established goals in five strategic areas: safety, reduced congestion, global connectivity, environmental stewardship, and security preparedness and response. This is the first strategic plan by the U.S. DOT that recognizes "reduced congestion" as an area of strategic importance.

The Congressionally created National Surface Transportation Policy and Revenue Study Commission in its first completed report in a series of six planned reports prepared by AASHTO, *Transportation: Invest In Our Future, Future Needs of the U.S. Surface Transportation System (February 2007)* identified six recommendations for the future – preserve the current system, enhance system performance, expand capacity to meet future needs, and reduce growth in highway demand by expanding the capacity of transit and rail. These recommendations are directed at the National

Highway System, but provide for broader implications and insight. Much of the factual information in this chapter came from this report.

Concern about future congestion in the national transportation system and its impact on the nation's ability to move freight efficiently and effectively, and consequently on the economy, led the U.S. DOT to establish the *Framework for a National Freight Policy (draft - April 10, 2006)*. The Framework recognizes the need for a more unified and comprehensive approach in addressing national freight transportation needs as opposed to a single mode, project-by-project approach. The Framework identifies congestion as a challenge requiring collaborative action by public and private stakeholders. It lays out a vision and objectives with strategies and tactics necessary to achieve them.

CONCLUSIONS

Our look into the future of the national freight transportation revealed overwhelming need for investment and transformation around the vision of a freight transportation system that will ensure efficient, reliable, safe, and secure movement of goods and support of the Nation's economic growth while improving environmental quality. Over the next four decades, the projected increases in freight shipments and personal travel will overwhelm our aging and under-invested infrastructure unless action is taken now to encourage innovation and investment. *The Framework for a National Freight Policy* provides focus for coordination and collaboration. A significant response is needed in all aspects of the national freight transportation system and logistics. Under-investment in the national transportation system and investing in projects that have not been integrated with other aspects of the natural and human environments are likely to have serious economic, environmental, and social impacts.

One recommendation from the National Surface Policy and Revenue Study Committee and others is for better utilization of waterways as one way of addressing landside congestion. The National Surface Policy and Review Study Committee recommends that the Federal government support state initiatives to integrate planning and investment for water transportation with surface transportation, to address landside demands generated by ports, and to utilize the unused potential on the Inland Waterway System to relieve highway congestion (ASCE, January 2007).

CHAPTER 2

THE INLAND WATERWAY SYSTEM AND THE UPPER MISSISSIPPI RIVER SYSTEM

TABLES

FIGURES

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CHAPTER 2

THE INLAND WATERWAY SYSTEM AND THE UPPER MISSISSIPPI RIVER SYSTEM

THE INLAND WATERWAY SYSTEM

The Inland Waterway System is a subsystem of the National Waterway System, which also includes the Intracoastal Waterway System, and the St. Lawrence Seaway and the Great Lakes System. Navigable waterways serve much of the geographic area of the United States and the majority of the population. Navigation through waterways is largely out of sight and out of mind to a significant proportion of the US population. Through an integrated management approach navigation on waterways can coexist with other river purposes and a healthy ecosystem.

The Inland Waterway System is comprised of rivers, waterways, canals, and the locks and dams that provide some 12,000 miles of commercially-navigable waters, including the Intracoastal Waterway. The Inland Waterway System moves approximately 15 percent of the nation's cargo at a significantly lower transportation cost/ton than rail or truck. In 2005, this system carried 624 million tons of cargo—principally raw materials and liquid and bulk primary products, like coal, petroleum, chemicals, grain, processed metals, cement, sand and gravel. Figures 2.1 and 2.2 illustrates the trend in total tonnage and commodities hauled on the primary U.S. inland waterways over the past few decades.

The U.S. Army Corps of Engineers (USACE) is responsible for all 12,000 miles of these waterways, of which roughly 11,000 miles (figure 2.3) are part of a fuel-tax program. The tax rate on commercial users is $.20/gal, and revenues collected are deposited in the Inland Waterways Trust Fund (IWWTF). New construction and major rehabilitation of the inland waterways infrastructure is paid half from the Federal general fund and half from the IWWTF. The Secretary of the Army under Congress manages the trust. An eleven-member Inland Waterways Users Board was established under Section 302 of Public Law 99-662 [(1986 Water Resources Development Act (WRDA)] to advise the Secretary of the Army and Congress on fund management and prioritization for inland navigation projects.

Aging System. Over 50 percent of the locks and dams operated by the Corps on the Inland Waterway System are over 50 years old. Many of the 600-foot locks on the system , including those on the Ohio, Upper Mississippi, Illinois, and Tennessee Rivers, were built in the 1930's. Many of today's tows consist of 12 or more barges, which require the tow to be split and passed through the lock in two operations. Aging of inland waterways infrastructure is not necessarily a concern as long as timely investments are made in maintenance and major rehabilitations, with some capacity and modernization improvements where needed. However, in constant dollar terms, operations and maintenance funding for the Corps' civil works infrastructure has been largely flat or declining for decades, while the needs for maintaining the aging infrastructure have increased. This is adversely affecting reliability of the system. Long-established programs for preventative maintenance of principal lock components have essentially given way to a fix-as-fail policy, and even then the fix may take weeks or months to complete. Depending on the nature of the lock malfunction, protracted repair time can have major consequences for barge traffic that depends on the facility, and for shippers and manufacturers depending on timely delivery of their cargo. Unscheduled outages are more costly than outages planned well in advance.

Advantages of Inland Barge Transportation. Inland barges carry approximately 15 percent of the Nation's freight at the lowest unit cost. Barge transportation offers an environmentally sound alternative to truck and rail transportation. If cargo transported on inland waterways each year were to be moved by another mode, it would take an additional 6.3 million rail cars or 25.2 million trucks to carry the load.

Barge transportation is the most fuel efficient method of moving raw materials needed by the nation. Supporting this conclusion are the statistical data reflecting the relative distance each mode of transportation can carry one ton of cargo for every gallon of fuel burned.

Truck	70 miles
Train	420 miles
Barge	530miles

These figures show that shallow draft water transportation is approximately seven and one half times more economical, thus more efficient, than trucks and one and one quarter times more efficient than rail. Key to this efficiency is the ability of barges to carry large loads of bulk materials up to five times their own weight. The cargo capacity of a barge is approximately 15 times that of one rail car and 60 times greater than one semi-trailer (Table 2.1).

Table 2.1. Cargo Capacities

	Barge	Railcar	Semi-trailer
Tons	1,500	111	25
Bushels	53,500	3,855	875
Gallons	453,600	33,566	7,560

To move the same amount of cargo transported by a standard tow (15 barges) would require a freight train 2.75 miles long or a line of 870 semi-trailers stretching almost 35 miles. On the lower Mississippi, one 10,000 horsepower towboat can push 40 barges, the equivalent of 600 railcars or more than 2,200 semi-trailers. If the cargo moved on the inland waterways systems each year had to be moved by rail it would take 6.3 million rail cars, or on the road, 25.2 million semi-trailers. Inland waterways allow tremendous savings in fuel consumption, reduced greenhouse gas emissions and air pollution, reduced traffic congestion, fewer accidents on railways and highways, and less noise and disruption in cities and towns.

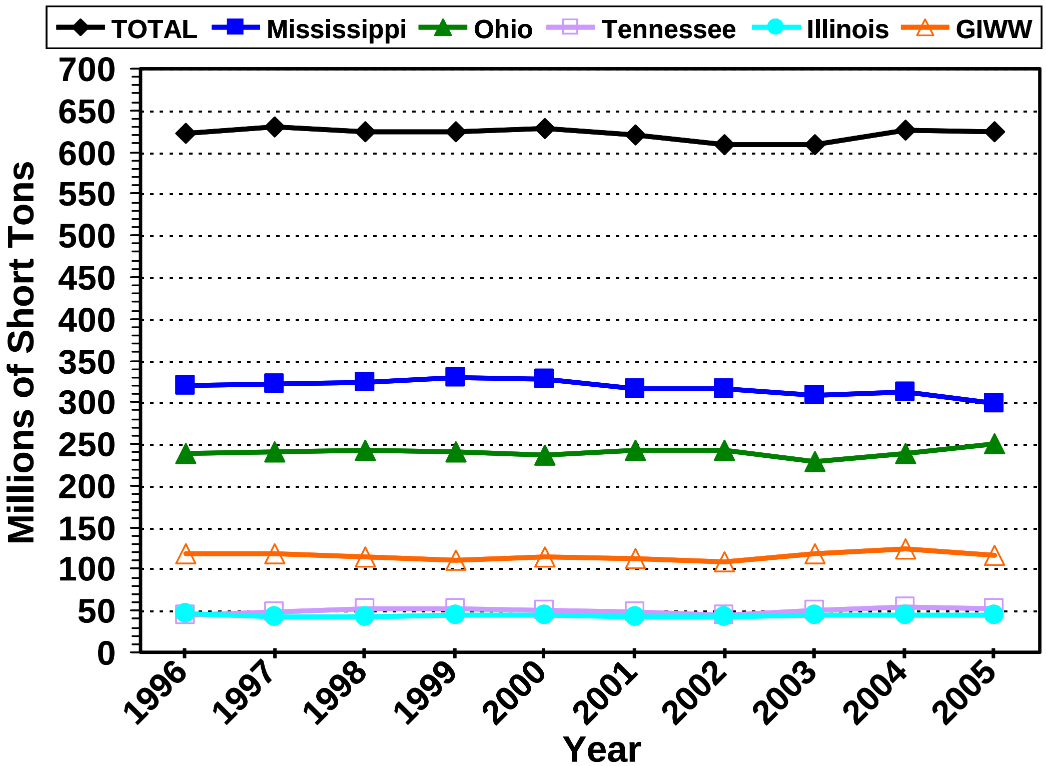

Figure 2.1. Commerce on Selected Waterways

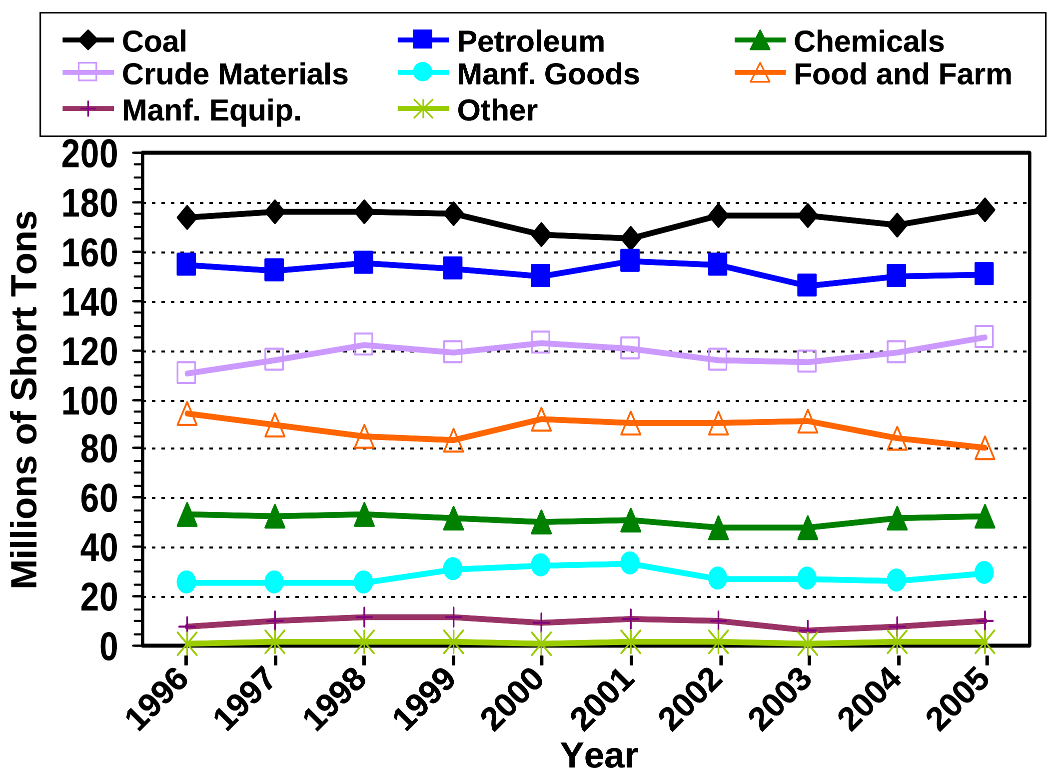

Figure 2.2. Inland Waterway Commodities

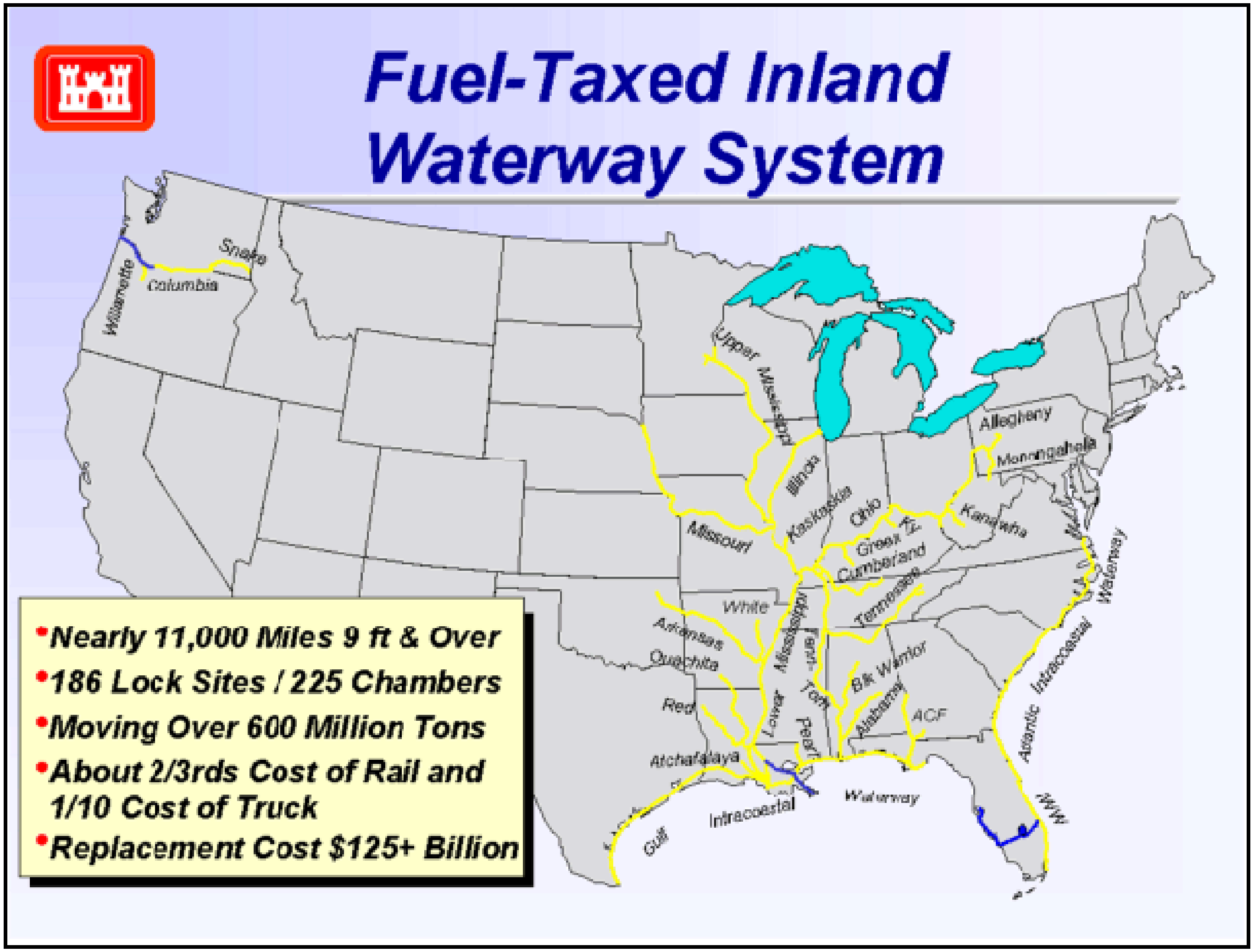

Figure 2.3. Commercially-Important Inland Waterways


Upper Mississippi River System
LAKE SUPERIOR
MINNESOTA
WISCONSIN
LAKE MICHIGAN
IOWA
ILLINOIS
MISSOURI
Upper St. Anthony Falls Lock & Dam
Lower St. Anthony Falls Lock & Dam
Minneapolis
Lock & Dam 1
Lock & Dam 2
Lock & Dam 3
Lock & Dam 4
Lock & Dam 5
Lock & Dam 5A
Lock & Dam 6
Lock & Dam 7
La Crosse
Lock & Dam 8
Lock & Dam 9
Lock & Dam 10
Lock & Dam 11
Dubuque
Lock & Dam 12
Lock & Dam 13
Lock & Dam 14
Lock & Dam 15
Lock & Dam 16
Rock Island
Lock & Dam 17
Lock & Dam 18
Keokuk
Lock 19
Lock & Dam 20
Lock & Dam 21
Lock & Dam 22
Lock & Dam 24
Lock & Dam 25
St. Louis
Lock 27
Mel Price Lock & Dam
Chicago
T.J. O'Brien Lock & Controlling Works
Lockport Lock
Brandon Road Lock & Dam
Dresden Island Lock & Dam
Marseilles Lock & Dam
Starved Rock Lock & Dam
Peoria
Peoria Lock & Dam
La Grange Lock & Dam
ILLINOIS WATERWAY
MISSISSIPPI RIVER
MISSOURI RIVER
OHIO RIVER
Cape Girardeau
Cairo, IL

THE UPPER MISSISSIPPI RIVER SYSTEM (UMRS)

Upper Mississippi River System (UMRS). The UMRS is a multi-purpose river system that provides economic and environmental benefits to the Nation. In addition to the navigation system, the Mississippi River basin's abundant and diverse resources have attracted and sustained human populations for thousands of years. There are 78 counties bordering the Upper Mississippi River and Illinois Waterway. Together, these counties contain nearly 5 percent of the Nation's population, with total estimated 2006 population of nearly 13.7 million. The estimated 2006 population for the UMR counties is 6,070,610, and 7,589,288 for the IWW counties. Fifty-four percent of the study-area counties have over half of their population living in rural areas. Little fluctuation in the population of the study-area communities is indicated, with only a 7.8 percent increase from 2000-2020.

Upper Mississippi River – Illinois Waterway Navigation System. The commercially-navigable portions of the UMR extend from the confluence with the Ohio River, River Mile (RM) 0.0, to Upper St. Anthony Falls Lock in Minneapolis-St. Paul, Minnesota, RM 854.0. The IWW extends from its confluence with the Mississippi River at Grafton, Illinois, RM 0.0 to T. J. O'Brien Lock in Chicago, Illinois, RM 327.0. The UMR-IWW Navigation System contains 1,200 miles of 9-foot deep channels, 38 lock and dam sites, and thousands of channel training structures.

Navigation Infrastructure. There are 38 active navigation lock and dam sites on the UMRS operated and maintained by USACE (see map). There are 29 active projects on the UMR; 6 of these projects feature two lock chambers. The southernmost projects, Locks and Dam 27 and Melvin Price Locks and Dam, have 110' x 1200' main chambers and 110' x 600' auxiliary chambers. Locks and Dam 15 has a 110' x 600' main chamber and a 110' x 360' auxiliary chamber. Locks and Dam 14 has a 110' x 600' main chamber and an 80' x 320' auxiliary that is over 80 years old and is used almost exclusively for locking recreational craft on a seasonal basis. The other dual-chamber project is Locks and Dam 1, which has two 56' x 400' chambers. Lock and Dam 2 has a 110' x 500' chamber. Lock and Dam 19 has a single 110' x 1200' chamber, and the remaining Mississippi River locks have single 110' x 600' lock chambers.

The IWW system has eight single-chamber lock and dam projects. The seven projects on the main part of the waterway have single 110' x 600' lock chambers and are over 60 years old. There is one lock on the Kaskaskia River, located just less than a mile from the junction with the UMR and has one 84' x 600' chamber. T. J. O'Brien Lock and Dam on the Calumet River have a 110' x 1000' chamber. Most barges moving to and from Lake Michigan use the O'Brien Lock.

Most of the locks and dams within the UMR-IWW navigation system were built by the Corps in the 1930s, with an initial projected life span of about 50 years, and most were originally designed to accommodate 600-foot-long barge tows. Standard tows since then have grown from 600 feet to over 1,100 feet, nearly the length of four football fields. Twenty-three of the UMR's 29 lock locations have chambers that are 600 ft in length. The upper and lower St. Anthony Falls locks and Lock 1 are 400 ft. in length. Three locks—Lock 19, Lock 26 (renamed the Melvin Price Lock and Dam), and Lock 27—are 1,200 ft. in length. With a 1,200 ft. lock chamber, a 1,100-ft. barge tow can pass through in 45 minutes. In contrast, it generally takes between 90 and 120 minutes for a 1,100-ft. barge tow to pass through a 600-ft. lock due to the need to double-lock the barge tow. Double-locking is a procedure whereby a barge tow is broken into two sections. Each is passed through the lock chamber separately and the two sections are rejoined before continuing. Commercial users argue that not only do barge tow backups tend to occur at the 600-ft. locks where extensive double-locking causes delays, but double-locking increases the potential for work-related hazards associated with manipulating the binding and guide ropes, etc., while in the narrow lock chamber. This additional time can produce queuing delays for other barges.

Since the 1980s, the UMR-IWW has experienced increasing traffic congestion and delays related to its aging infrastructure and limited lock capacity. Unplanned closures due to aging infrastructure have increased, thus reducing the number of days annually that locks are open to traffic (Figure 2.4).

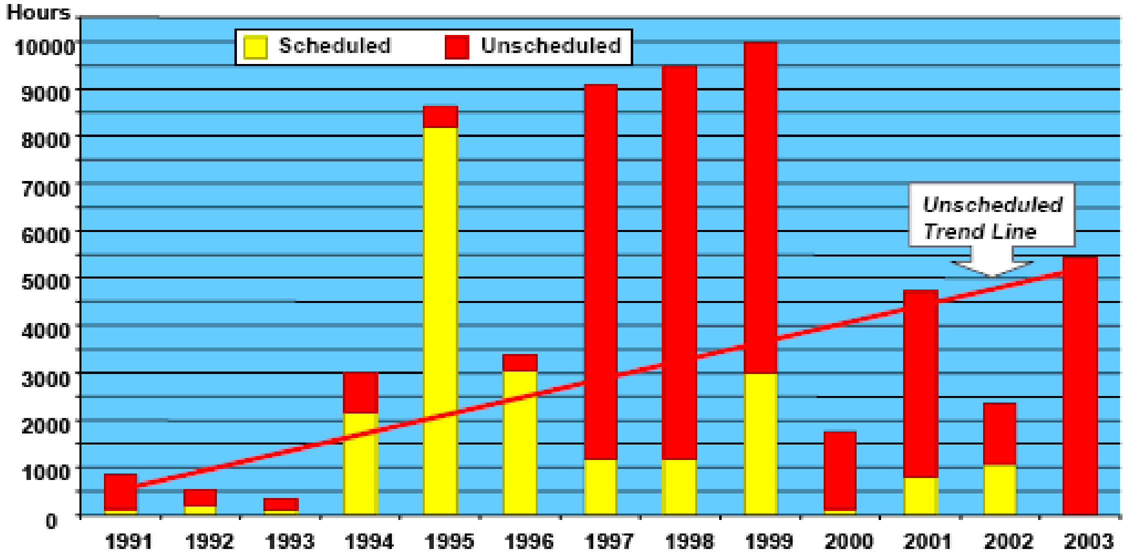

Figure 2.4. Upper Mississippi River Lock Unavailability Time Due to Scheduled or Unscheduled Maintenance or Hardware Malfunction

The Corps of Engineers reports that the UMR-IWW system has over half (19 of 36) of the most delayed lock sites in the country's system of inland waterways. Existing delays vary based on location in the system, but are generally greatest furthest downstream (Table 2.2).

Table 2.2. Average Cumulative Lock Delays, 1990 to 2001

Lock	Average Hours Per Tow
Upper Mississippi River	
Locks 1-7	3.9
Locks 8-13	5.2
Locks 14-18	10.8
Locks 19	0.9
Locks 20-25	17.0
Locks 26 and 27	10.8
Cumulative Total	48.5
Illinois Waterway	
Peoria Lock	2.5
La Grange Lock	1.3
Other 6 Locks	6.7
Cumulative Total	10.6

These delays result from traffic backups due to congestion as well as closures for operation and maintenance. From 1990 to 2001, the Corps estimated cumulative average delay per tow was 48.5 hours (more than two days) on the UMR and 10.6 hours on the IWW. For perspective, a barge trip between Minneapolis and St. Louis is estimated to take about 11.4 days, on average, including delays. In effect, the estimated average delays add about 2 days to what would otherwise be a 9-day trip. Completion of the Corp's recommended navigation improvements are not expected to completely eliminate all delays since a portion of delays are attributable to variability in demand—more than one boat arriving at the same time results in delay, and the seasonality of crop harvesting assures strong autumn demand. Corps data suggest that Locks 26 and 27 experience some of the largest delays despite having undergone fairly recent renovation and having 1,200-ft. lock capacity.

Importance of the UMR-IWW to the Region. The system is a vital part of our national economy. The commercially-navigable portions of these rivers and the locks and dams that allow waterway traffic to move from one pool to another are integral parts of a regional, national, and international freight transportation network. The system is significant for certain key exports and the Nation's balance of trade. For example, in 2000, the UMRS carried approximately 60 percent of the Nation's corn and 45 percent of the Nation's soybean exports. Corn and soybeans are shipped via the waterway at roughly 60 to 70 percent of the cost of shipping over the same distance by rail. Other commodities shipped on the system include coal, chemicals, petroleum, crude materials (sand, gravel, iron ore, steel, and scrap), and manufactured goods.

The importance of the UMR-IWW as a shipping artery is underscored by the increases in tonnage shipped on the system (Figure 2.5). Historical traffic trends reflect significantly increasing usage for the first 50 years with stabilization for the past 25 years. The average annual unconstrained growth rates forecast (2004 to 2050) reported as part of the 2007 re-evaluation effort ranged from 0.9 to 1.4 percent for the UMR and between 1.2 and 1.9 percent for the IWW. On the basis of these forecasts, total demand would grow on the UMR to approximately 170 million tons by 2050, with the IWW increasing to 108 million tons. However, the portion of this total future demand that can be accommodated on the system depends in part on what, if any, improvements are made.

The leading shipping state within the UMR is Illinois, having an average annual barge shipping of a little over 80 million tons of commodities worth over $8.8 billion. Illinois shipments included over 38 million tons of coal with the majority originating on the UMR. Over 26 million tons of grain enters the waterway at Illinois docks, with 13.2 million tons originating on the Illinois River and another 13.2 million tons loading onto barges on the UMR. Missouri was the next largest shipping state with over 15 million tons of aggregates, grains and other commodities.

There are over 582 manufacturing facilities, terminals, and docks in the Upper Mississippi River Basin that shipped and received tonnage in 2005. The Port of Metropolitan St. Louis includes 71 miles on both banks of the Mississippi River. The port shipped and received over 30 million tons of commodities in 2005, making it the largest port in the basin and the third largest inland port in the United States. Coal was the largest commodity moved in and out of the port, with more than 11 million tons loaded and unloaded.

In 2005, the UMR moved just over 109 million tons of commercial cargo. This tonnage was worth almost $19 billion. Of the almost 84.2 million tons leaving the river (tonnage shipped + tonnage through), two-thirds was destined for the Lower Mississippi River. Another 10 percent moved to the Ohio River and its tributaries. Comparatively, in 2005 the IWW moved 51.6 million tons of commercial cargo worth $9.5 billion. As illustrated in Figure 2.6, grains (corn and soybeans) dominate traffic on the system. Other commodities, mainly cement and concrete products, comprise the second largest group.

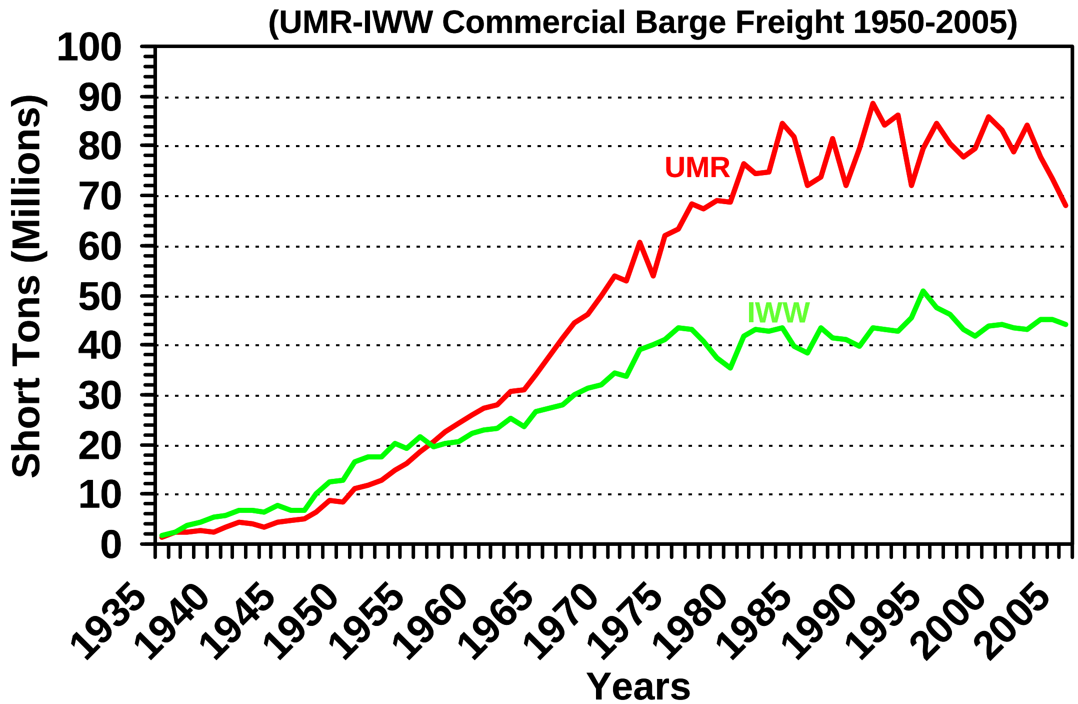

Figure 2.5. Historic Tonnage of Commercial Freight Shipped via Barge on the Upper Mississippi River (UMR) and Illinois Waterway (IWW), 1935-2005

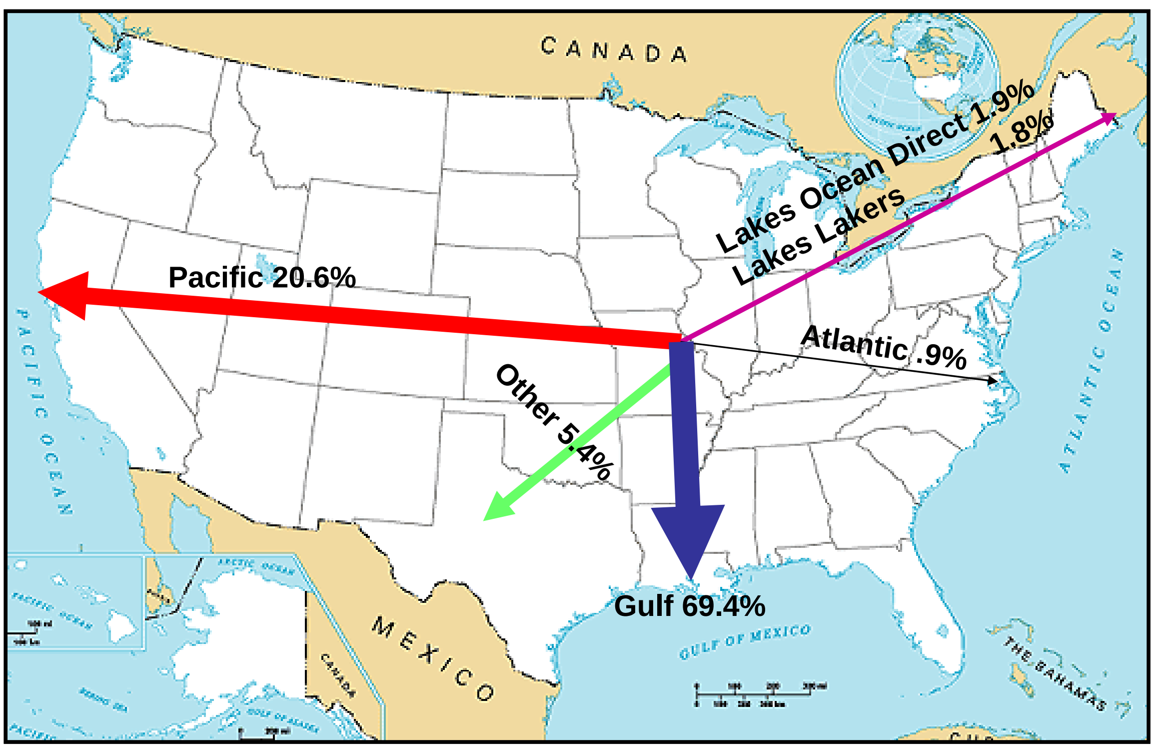

Figure 2.6. U.S. Grain Primary Export Routes

The following tables provide the most recently available data (2005) on UMR-IWW system commodity tonnages and value.

UPPER MISSISSIPPI RIVER LOCKS AND DAMS

Lock	Mile	Main Chamber Year Open	Main Chamber Size	Auxiliary Chamber Year Open	Auxiliary Chamber Size	2005 Tonnage (ktons) Up-bound	2005 Tonnage (ktons) Down-bound	2005 Tonnage (ktons) Total
St. Anthony Falls	853.3	1959	400 x 56	-	-	876	51	0
Locks & Dam 1	847.6	1930	400 x 56	1932	400 x 56	876	51	927
Locks & Dam 2	815.0	1930	500 x 110	1948	600 x 110	2,709	3,622	6,331
Lock & Dam 3	796.9	1938	600 x 110	-	-	2,709	3,622	6,331
Lock & Dam 4	752.8	1935	600 x 110	-	-	2,829	4,284	7,113
Lock & Dam 5	738.1	1935	600 x 110	-	-	3,267	4,284	7,551
Lock & Dam 5A	728.5	1936	600 x 110	-	-	3,237	4,284	7,521
Lock & Dam 6	714.0	1936	600 x 110	-	-	3,819	5,485	9,304
Lock & Dam 7	702.0	1937	600 x 110	-	-	3,819	5,485	9,304
Lock & Dam 8	679.0	1937	600 x 110	-	-	4,306	5,699	10,005
Lock & Dam 9	647.0	1938	600 x 110	-	-	6,473	5,699	12,172
Lock & Dam 10	615.0	1936	600 x 110	-	-	6,722	8,499	15,221
Lock & Dam 11	583.0	1937	600 x 110	-	-	6,804	8,375	15,179
Lock & Dam 12	556.0	1938	600 x 110	-	-	7,430	9,495	16,925
Lock & Dam 13	523.0	1938	600 x 110	-	-	7,430	9,706	17,136
Locks & Dam 14	493.0	1939	600 x 110	1922	320 x 80	8,309	11,098	19,407
Locks & Dam 15	482.9	1934	600 x 110	1934	360 x 110	8,473	10,737	19,210
Lock & Dam 16	457.2	1934	600 x 110	-	-	8,997	11,444	20,441
Lock & Dam 17	437.1	1939	600 x 110	-	-	9,817	11,979	21,796
Lock & Dam 18	410.5	1937	600 x 110	-	-	9,816	12,811	22,627
Lock & Dam 19	364.2	1957	1200 x 110	-	-	9,095	14,324	23,419
Lock & Dam 20	343.2	1936	600 x 110	-	-	9,291	15,093	24,384
Lock & Dam 21	324.9	1938	600 x 110	-	-	9,834	15,928	25,762
Lock & Dam 22	301.2	1938	600 x 110	-	-	6,768	16,324	23,092
Lock & Dam 24	273.4	1940	600 x 110	-	-	10,302	17,298	27,600
Lock & Dam 25	241.4	1939	600 x 110	-	-	10,302	17,297	27,599
Melvin Price	200.8	1990	1200 x 110	1994	600 x 110	24,931	34,809	59,740
Locks and Dam 27	185.5	1953	1200 x 110	1953	600 x 110	26,652	36,991	63,643

Locks *- highlighted represent locks proposed for 600' lock extensions of main chamber.* (Locks & Dam 14–18)

Locks *- highlighted represent locks proposed for new 1200' locks.* (Lock & Dam 20–25)

ILLINOIS WATERWAY LOCKS AND DAMS

Lock	Mile	Main Chamber Year Open	Main Chamber Size	Auxiliary Chamber Year Open	Auxiliary Chamber Size	2005 Tonnage (ktons) Up-bound	2005 Tonnage (ktons) Down-bound	2005 Tonnage (ktons) Total
Thomas J. O' Brien	326.5	1960	1000 x 110	-	-	4,577	3,081	76,580
Lockport	291.1	1933	600 x 110	-	-	10,926	4,497	15,423
Brandon Road	286.0	1933	600 x 110	-	-	11,181	4,561	15,742
Dresden Island	271.5	1933	600 x 110	-	-	11,668	5,941	17,609
Marseilles	244.6	1933	600 x 110	-	-	11,128	6,968	18,096
Starved Rock	231.0	1933	600 x 110	-	-	11,438	8,285	19,723
Peoria	157.7	1938	600 x 110	-	-	13,800	13,430	27,230
Lagrange	80.2	1939	600 x 110	-	-	13,214	17,023	30,237

Locks *- highlighted represent locks proposed for new 1200' locks.* (Peoria, Lagrange)

KASKASKIA RIVER LOCK AND DAM

Kaskaskia	0.8	1973	600 x 84	-	-	39	684	723

Upper Mississippi River* – 2005 Waterborne Commerce

(values in millions of $)

COMMODITY	TONNAGE					VALUE
	Shipped	Received	Within	Through	TOTAL	
Coal	15,339,194	2,660,712	5,290,000	1,278,713	24,568,619	$1,001
Petroleum	2,356,942	1,815,050	393,086	3,304,670	7,869,748	$1,469
Aggregates	4,854,217	323,480	4,863,322	487,402	10,528,421	$397
Grain	23,226,335	130,120	145,995	15,758,180	39,260,630	$5,670
Chemicals	506,726	3,772,410	211,041	3,920,650	8,410,827	$3,574
Ores & Minerals	204,225	1,785,759	54,280	1,590,781	3,635,045	$565
Iron & Steel	925,656	806,221	**	4,964,875	6,696,752	$4,267
Other	3,119,509	1,376,272	1,471,547	2,379,233	8,346,561	$2,096
TOTALS	50,532,804	12,670,024	12,429,271	33,684,504	109,316,603	$19,039

** Minneapolis, MN to Ohio River mouth*

*** Insufficient barge operators to release this tonnage - included in "Other"*

Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics

Illinois Waterway* – 2005 Waterborne Commerce

(values in millions of $)

COMMODITY	TONNAGE					VALUE
	Shipped	Received	Within	Through	TOTAL	
Coal	4,353,574	1,123,270	**	626,406	6,103,250	$449
Petroleum	2,790,041	1,813,510	1,997,041	103,808	6,704,400	$786
Aggregates	8,975	1,249,189	3,933,795	204,997	5,396,956	$140
Grain	13,268,904	83,535	43,787	209,202	13,605,428	$1,850
Chemicals	606,814	3,337,354	192,074	41,364	4,177,606	$1,468
Ores & Minerals	**	2,079,148	0	110,761	2,189,909	$386
Iron & Steel	1,278,058	4,021,851	74,442	707,978	6,082,329	$3,603
Other Commodities	538,008	2,928,557	3,521,881	411,348	7,399,794	$1,466
TOTALS	22,844,374	16,636,414	9,763,020	2,415,864	51,659,672	$10,148

** Illinois River, Chicago Sanitary/Ship Canal, Chicago River S. Branch, Calumet-Sag Channel, Calumet River*

*** Insufficient barge operators to release this tonnage – included in "Other Commodities"*

Source: U.S. Army Corps of Engineers Waterborne Commerce Statistics

UMR-IWW System Importance to Agriculture. The UMR basin encompasses large portions of the central and western Corn Belt and the eastern fringes of the Northern Great Plains. Five of the Nation's top agricultural production states – Iowa, Minnesota, Illinois, Missouri, and Wisconsin – have traditionally relied on the UMR-IWW navigation system as their principal conduit for export-bound agricultural products, mostly bulk corn and soybeans. Together, these states accounted for over half of the U.S. corn and soybean production and nearly half of the value of U.S. corn and soybean exports from 1998 through 2002. The region accounted for only about 10 percent of U.S. wheat production and exports.

The UMR-IWW navigation system has been the traditional export outlet for much of the agricultural production of the upper Midwest. From 1998 through 2002, the five-state region exported approximately 30 percent of its corn production, 53 percent of its soybeans, and over 91 percent of its wheat. The UMR-IWW carried nearly 66 percent of the regions corn exports and 64 percent of the region's soybean exports headed to international markets.

An average of nearly 40.7 million metric tons (mmt) of grain, oilseeds, and other agricultural products—representing 54 percent of total barge traffic—moved between Minneapolis and the mouth of the Missouri River on the UMR-IWW each year during 1998 through 2002. Corn and soybeans and products comprised the bulk of annual agricultural trade averaging a combined 35.5 mmt – representing 87 percent of all agricultural freight and 47 percent of total freight. In addition, the UMR-IWW system provides an inbound conduit for fertilizers, fuel, and other farm inputs. For example, over 3 mmt of agricultural fertilizers moved up the UMR-IWW system annually in support of U.S. agricultural production during 1998 through 2002.

While the UMR-IWW is an important transportation mode for regional corn and soybean exports, it is not the only carrier; for instance, agricultural commodities for export also reach Northwest and Gulf harbors by rail. In terms of total volume, the UMR-IWW carried about 53 percent of total U.S. bulk corn exports and 38 percent of bulk soybean exports during the 1998 to 2002 period. Only about 3 percent of U.S. bulk wheat exports moved via the UMR-IWW during the same period.

AMERICA'S MARINE HIGHWAYS

The Administration agrees that efforts should be undertaken to better utilize waterways. The Maritime Administration has begun an initiative, which has direct Presidential support, to increase utilization of waterways for the purpose of relieving pressure on other modes, truck and rail. The initiative is called "America's Marine Highways" and is authorized in Title IX, Subtitle C of the Energy Independence Act of 2007 (PL 110-140).

Rosalyn Wilson, a consultant to Council of Supply Chain Management Professionals, shared the following observations in a speech to the National Press Club on June 6, 2007:

> "…Congestion and capacity issues have not really been resolved; we have just been given a breather. We still have infrastructure that needs immediate attention and long-term solutions…We have a resource, sinking in disrepair, that could become a vital link in adding capacity and taking pressure off other modes in a vital corridor in the center of the country: the inland waterway system. The inland waterway system has been under utilized for many years and that portion of the industry has not seen much growth. The nation's waterway system needs to be revitalized and used more heavily to further impact congestion problems. Water transportation could become a vital resource to meet the nation's freight demands. Although not very prevalent now, waterways could even handle containers. Careful planning should ensure that the waterways are poised to handle more freight and that the entire support infrastructure is present to make efficient use of waterways. We should earmark funding to enhance our inland waterway system, modernize, and plan and build facilities to expand the range of products carried to include containers.
>
> There is growing inland waterway and Great Lakes crisis that does not receive much coverage. For too many years there has been a lack of resources aimed at maintaining and improving this segment of our transportation network. A single-unit barge traveling the nation's waterways can move the same amount of cargo as 58 semi-trucks at one-tenth the cost, reducing highway congestion and saving money…"

CONCLUSIONS

Waterways are being looked as one of the many ways that will be needed to address long-term congestion in the National Freight Transportation System. Waterways are under utilized relative to highways and railways, and waterways have social and environmental advantages over other modes. It will take interest on the part of Federal, state, and local government and that of shippers and carriers to better integrate waterways with other modes of transportation. Investment in waterways and landside facilities will need to increase to ensure adequate capacity and greater reliability. Waterways represent a substantial national asset that could be used to a greater extent in the future.

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CHAPTER 3

NAVIGATION TRAFFIC FORECAST AND EVALUATION

NATIONAL ECONOMIC DEVELOPMENT– PHASE 2

REGIONAL ECONOMIC DEVELOPMENT

ENVIRONMENTAL QUALITY (EQ)

OTHER SOCIAL EFFECTS (OSE)

CONCLUSIONS

TABLES

FIGURE

CHAPTER 3

NAVIGATION TRAFFIC FORECAST AND EVALUATION

OVERVIEW

In an effort to address the difficulty and inherent uncertainty of forecasting for a 50-year planning horizon, a scenario-based approach to traffic forecasting has been employed. This chapter presents navigation traffic forecasting for a number of market and transportation scenarios with and without implementation of the Recommended Plan. Impacts with and without implementation of the Recommended Plan were then evaluated through the four accounts and compared to arrive at the net impacts for each scenario.

Navigation traffic forecast and evaluation is presented through the four accounts of National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE).

NED is presented in two complementary phases. The first phase consisted of rigorous quantitative traffic forecast and economic evaluation of two scenarios in compliance with traditional Corps practice. These are the low traffic scenario (LTS) and the high traffic scenario (HTS). Traditional Corps practice is largely single mode analysis, which assumes that capacity is readily available on alternative modes at the current rate. Traditional Corps analysis does not consider traffic shifts to water due to constraints in alternative modes and does not consider externally generated NED from reductions in congestion, noise, safety, infrastructure wear and tear, emissions, and environmental impacts on alternative modes. The second phase of NED considers some of these areas through qualitative exploration of the multimodal transportation scenario (MTS).

Qualitative considerations were also given to the minimum traffic condition (MIN), which is defined as a “flat or declining” traffic projection, and maximum traffic condition (MAX), which is defined as full system utilization. Figure 1 in the Introduction shows a schematic of the relationship among all scenarios.

NATIONAL ECONOMIC DEVELOPMENT (NED) – PHASE 1 TRADITIONAL ECONOMIC ANALYSIS

SCENARIO APPROACH

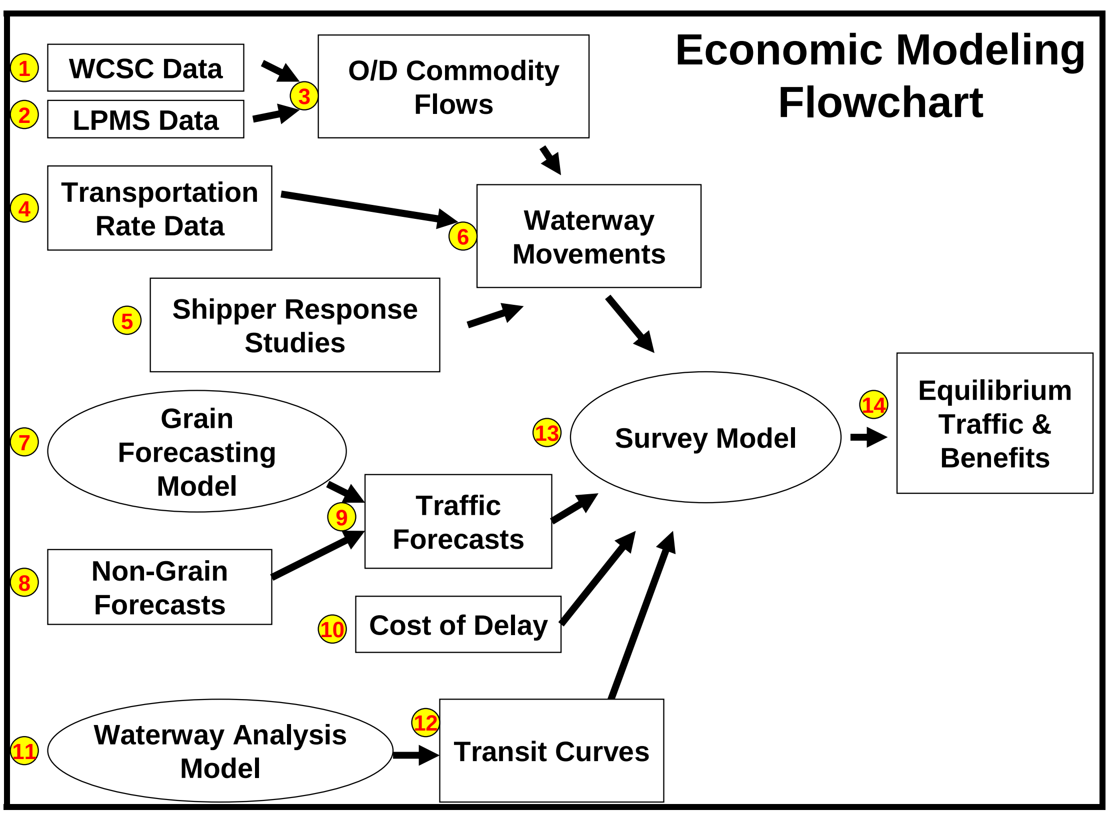
The scenarios developed represent a range of future demand for navigation on the Upper Mississippi River (UMR) – Illinois Waterway (IWW) system. As constructed, the individual scenarios were not evaluated with respect to numerical probability or likelihood of occurrence. A single most probable without project condition therefore was not identified. Alternatively, this approach was intended to define a range of reasonable alternative future scenarios that ultimately describe a reasonable range of demand for inland waterway transportation for the waterway system. While the scenarios consider a range of possible futures with respect to trends, policies, conditions, and events that could impact the economic activity and ultimately system waterway traffic, it is not presumed that the scenarios encompass the absolute extremes, but rather are limited to the more plausible.

Traffic was forecasted in two distinct efforts, one for grain (corn, soybeans, and wheat) and another for non-grain commodities. The analytical techniques for each of these efforts was significantly different, however, once the forecasts were accomplished the results were combined to produce an LTS and an HTS representing all commodity groups.

The impacts of each scenario were translated into demand for barge transportation for the waterway system broken down by the Mississippi River and the IWW. The demand forecast horizon was to 2060, and the resulting demand forecasts were unconstrained with respect to increases in future waterway congestion.

An additional consideration regarding the level of future traffic flows on the UMR-IWW system that has been investigated is the prospect of container-on-barge (COB). While not currently a significant contributor to UMR-IWW system traffic, there has been considerable speculation regarding the future prospects for COB in general and for the UMR-IWW system in particular. These prospects are discussed as a concluding consideration to specification of the LTS and HTS

For a complete description of the Global Grain Model see the December 2006 report titled *Longer-Term Forecasting of Commodity Flows on the Mississippi River: Applications to Grains and World Trade*. A detailed description of the data and methodology used to produce non-grain forecasts, as well as the evaluation of COB potential, can be found in the report titled *NESP Economic Evaluation – Waterway Traffic Forecast for Non-Grain Commodities.* The economic modeling components are depicted in the flowchart and table below.



Item	Description	Principal Investigator	Weblink
1.	**Waterborne Commerce Statistics Center Data** (origin/destination movement data, commodity tonnages..etc)	**USACE Institute for Water Resources** - Navigation Data Center, Alexandria. VA	www.iwr.usace.army.mil/ndc/
2.	**Lock Performance Monitoring System Data** (arrival times, processing times, delays..etc)		
3.	**Origin and Destination Commodity Flows**		
4.	**Transportation Rate Data**	**Chris Dager**, Tennessee Valley Authority Water and Hydro Resources Projects, Knoxville, TN	www2.mvr.usace.army.mil/UMRS/NESP/default.cfm (reports section)
5.	**Shipper Response Studies** Conducted for both Grain and Non-Grain commodities	**Wilson, Wesley W. Ph.D**. Univ. of Oregon, Dept of Economics, Eugene, OR. **Train, Kenneth E., Ph.D.** Univ. of California-Berkley, Berkley CA.	www.nets.iwr.usace.army.mil/docs/ModelPrefUpperMissGrain/07-NETS-R-02.pdf www.nets.iwr.usace.army.mil/docs/ModelPrefUpperMissGrain/07-NETS-R-01.pdf
6.	**Waterway Movements**	**USACE Institute for Water Resources** - Navigation Data Center, Alexandria. VA	www.iwr.usace.army.mil/ndc/
7.	**Grain Forecasting Model**	**Wilson, Willian W., Ph.D.** North Dakota State University, Dept. of Ag and Resource Economics, Fargo, ND. **Manguno, Richard J.** USACE New Orleans District, New Orleans, LA.	www.nets.iwr.usace.army.mil/docs/LongTermForecastCommodity/06-NETS-R-12.pdf
8.	**Non-Grain Forecasts**	**Hochstein, Anatoly B.**, Louis Berger. Group Inc, East Orange, N.J.	www2.mvr.usace.army.mil/UMRS/NESP/default.cfm (reports section)
9.	**Traffic Forecasts**	**Manguno, Richard J.** USACE New Orleans District, New Orleans, LA.	Chapter 3 of this Report
10.	**Cost of Delay**	USACE Headquarters, Economic Guidance Memorandum 05-06 "FY2004	www.usace.army.mil/cw/cecw-cp/library/egms/egms.html
11.	**Waterway Analysis Model**	**Vogt, David**, Oak Ridge National Laboratory, Knoxville, TN	www2.mvr.usace.army.mil/UMRS/NESP/default.cfm
12.	**Transit Curves**		
13.	**Survey Model**	**Hofseth, Keith D.** USACE Institute for Water Resources - Navigation Economic Technology Study, Alexandria, VA **Manguno, Richard J.** USACE New Orleans District, New Orleans, LA.	www2.mvr.usace.army.mil/UMRS/NESP/default.cfm (reports section)
14.	**Equilibrium Traffic and Benefits**	**Manguno, Richard J.** USACE New Orleans District, New Orleans, LA.	Chapter 3 of this Report

GRAIN FORECASTS

Global Grain Model. Agricultural commodities are one of the important products in world trade that are shipped on inland waterways. The international distribution of grains and oilseeds are influenced by many factors including agricultural and trade policies. Relative cost of production, interior shipping, handling, and ocean shipping costs all have an impact on trade and competitiveness of the interior logistical systems. Changes in any of these factors can potentially impact the international distribution of grains and shipments through the U.S. waterways.

A spatial framework of world grain trade was developed to evaluate this international distribution of grain flows and shipments through U.S. waterways. This framework, implemented as the Global Grain Model (GGM), is a large scale nonlinear programming model. It has the objective of minimizing costs of world grain trade, subject to meeting the demands at importing countries and regions, and available supplies and production potential in each of the exporting countries and regions. The model is solved jointly for corn, soybeans, and wheat. Relevant parameters generally fall into the categories of consumption and import demand, export supply, and costs.

Consumption functions were estimated from historical values. For the projection period, estimates of consumption were based on incomes, population, and the change in preferences as countries mature. Consumption functions were generated for each country and each grain. Import demand was defined as consumption less production. For the U.S., ethanol demand for corn was treated separately from other sources of demand in order to allow for explicit consideration of this significant market development.

For each exporting country and region, export supply was defined as the residual of production and consumption. To estimate production, each of the competing supply regions and countries were represented by yields and the area potential that could be used in production of each grain.

Costs included were production costs for each grain in each exporting country, interior shipping and handling costs by transportation mode, and ocean shipping costs. Production subsidies and import tariffs were are also included.

The model is fundamentally composed of producing and consuming regions. The U.S. is broken down into multiple consuming regions, as are Canada and Brazil. Seven other countries and seven areas (aggregations of countries) are also defined as consuming regions. Multiple producing regions are also defined for the U.S., Canada, and Brazil, as well as for seven other countries and seven areas. Consuming and producing regions are presented in Table 3.1.

Model structure is further defined by ports and reaches. Each country/area is defined by one dominant port Exceptions to this one-port designation are the United States (Pacific Northwest, Texas Gulf, Center Gulf, and East Coast), Canada (East and West), and Brazil (North and South.) Ports represent the gateways for import and export flows.

Table 3.1. Producing and Consuming Regions

Country/Area	Producing Regions	Consuming Regions
United States	24	10
Canada	5	5
Europe	1	1
Australia	1	1
China	1	1
Japan	1	1
Argentina	1	1
Brazil	2	2
Mexico	1	1
South Korea	1	1
Latin America	1	1
North Africa	1	1
Former Soviet Union- Middle East	1	1
South Africa	1	1
South Asia	1	1
Southeast Asia	1	1

In order to facilitate description of grain flows over the Inland Waterway System, six reaches were defined. These reaches included three on the Mississippi River, one on the IWW, and two on the Ohio River. The three Mississippi River reaches and one IWW reach define the flows over the Upper Mississippi River system. The reaches are defined as follows:

Reach 1 Cairo, IL to LaGrange, MO (Mississippi River)
Reach 2 LaGrange, MO to McGregor, IA (Mississippi River)
Reach 3 McGregor, IA to Minneapolis, MN (Mississippi River)
Reach 4 Illinois Waterway (Illinois Waterway)
Reach 5 Cairo, IL to Louisville, KY (Ohio River)
Reach 6 Louisville KY to Cincinnati, OH (Ohio River)

Grain Traffic Scenarios. As previously described, two traffic scenarios were developed. These scenarios are intended to represent the reasonable upper and lower limits of future traffic on the UMR-IWW navigation system.

A number of GGM inputs have been identified as significant with respect to model results, in addition to possessing a degree of uncertainty regarding their specification. These inputs have been identified as key parameters in developing the traffic scenarios. Tables 3.2 and 3.3 identify and describe key input parameters, and values, for each scenario.

Table 3.2. Grain Model Input Specifications

Input Parameter	Scenario	
	Low Traffic	**High Traffic**
U.S. Corn-Based Ethanol Demand	EIA 2007 (11.2 billion gal by 2012; 13.4 billion gal by 2025)	Current Production Level Held Constant (5 billion gal)
U.S. Corn Yields	1.6 bu/yr Increase (national avg)[1]	2.0 bu/yr Increase (national avg)[2]
Rest of World Corn Yields	GGM base case	25 % increase in GGM base case[3]
U.S. Area	107% of 2002-2004 avg	107% of 2002-2004 avg
U.S. Rail Capacity	169 mmt (20 % increase in 2000-2004 max car loadings)	155 mmt (10 % increase in 2000-2004 max car loadings)
China Corn	Exports = 8 mmt	Unconstrained Model Solution
Panama Canal	No expansion	Expanded by 2020 ($1/mt net reduction in ocean costs$)[4]
UMR-IWW Navigation Infrastructure	Expanded	Expanded

All other model inputs are assumed to be equal to the base case described in the December 2006 Global Grain Model report.

[1] The base case in the December 2006 Global Grain Model report incorporates production region specific yields and yield growth. In aggregate for the U.S., the base case reflects yield growth of 1.6 bushels per year. The base case yields of the report are used to represent the yields for this scenario.

[2] U.S. average yield growth of 2.0 bushels per year represents at 25 percent increases over the base case of the December 2006 Global Grain Model. In order to retain production region specific yields, base case yields are increase by 25 percent to represent this scenario.

[3] Rest of World yields are increased over the December 2006 Global Grain Model report base case yields to reflect the same percentage increase assumed for the U.S. with this scenario. Future genetic modification technology is the basis for assumed increases in the U.S. yields, and this same technology is assumed to be exported to the Rest of World as has been the case with past genetic modification technology.

[4] Ocean shipping cost reduction of $1/mt is composed of $4/mt reduction in costs associated with being able to more fully load deep-draft vessels, and a $3/mt increase in canal tolls. Toll increase is assumed to remain in place indefinitely. (Tolls for use of existing canal are $2/mt; therefore, total tolls with canal expansion would be $5/mt.)

Table 3.3. Description of Global Grain Model (GGF) Input Parameters

U.S. Corn-Based Ethanol	The LTS assumes the 2007 Energy Information Administration (EIA), U.S. Department of Energy ethanol production forecasts. Corn-based ethanol production is assumed in this scenario. The HTS assumes that corn-based ethanol production will not exceed current levels. However, the HTS does not assume that total ethanol production is limited to corn-based production. In addition to corn-based production, total ethanol production is assumed to include rapid implementation of non-corn sources. It is further assumed that these alternative sources do not impact available production area for corn, soybeans, or wheat.
U.S. Corn Yields	The long-term national average for growth in corn yields has been approximately 1.6 bushels per acre per year. Over a more recent historical period, corn yield growth has been higher, approximately 2.0 bushels per acre per year. The longer term historical national average is assumed to represent the LTS while the High Traffic case is assumed to be 2.0 bushels per acre per year. Note that these yield increases are national averages. As actually represented in the model, production region specific growth is used. To capture the effect of accelerated growth in the HTS, growth in each region was increased by 25%, the increase in the national average values moving from 1.6 to 2.0 bushels per acre per year.
Rest-of-World Corn Yields	The LTS assumes the base case values contained in the December 2006 GGM report for each non-U.S. production region. These values are based on trend analysis. For the HTS, GGM base case yields were increased by 25%, the same increase over the base case used to define the HTS for U.S. corn. The need to adjust rest-of-world yields arises from the need to be consistent, in that, acceleration in recent U.S. yield growth is driven primarily by bio-technology and the availability of this technology is not restricted to the U.S.
U.S. Area	The assumptions of the December 2006 GGM report for the base case have been retained for both LTS and HTS. This assumes that the maximum increase in total available area devoted to corn, soybean, and wheat is 7 % of the 2002-2004 average devoted to this predication.
U.S. Rail Capacity	The base case contained in the December 2006 GGM report restricts total U.S. rail capacity to the single-year maximum rail car loadings observed during the period 2000-2004. To account for the fact that this value is not strictly a capacity, but rather an observed flow, and to allow for the fact that rail capacity is not likely to be permanently restricted to existing levels, some increase in the GGM base case assumption was assumed. These increases are 20% and 10% respectively, for LTS and HTS. Note that potential increases in capacity are with respect to capacity available for the transport of grain.
China Corn	The LTS includes a model constraint that requires China to export corn in the amount of 8 million metric tons. This would be a continuation of recent China trade policy. Alternatively, the HTS does not force an outcome by means of a model constraint. Rather, China trade with this scenario is determined by the model based on China's relative competitiveness with the rest of the world.
Panama Canal	In 2006 a Panamanian referendum was passed that endorsed expansion of the canal. Once begun, construction is expected to take 10 years. The effect of an expanded canal would be to lower ocean shipping costs, primarily by allowing vessels that currently must light-load to increase their loads. A net savings of approximately $1 per metric ton is assumed with canal construction. Ocean shipping cost reduction of $1/metric ton is composed of $4/metric ton reduction in costs associated with being able to more fully load deep-draft vessels, and a $3/metric ton increase in canal tolls. Toll increase is assumed to remain in place indefinitely. (Tolls for use of existing canal are $2/mt; therefore, total tolls with canal expansion would be $5/mt.) The HTS assumes that canal expansion will be accomplished by 2020. The LTS assumes that expansion will not occur.
UMR-IWW Navigation Infrastructure	The intended use of the GGM for purposes of this analysis is to develop a set of unconstrained traffic flows. Unconstrained in this context means unconstrained by increases in future water congestion associated with increased levels of waterway traffic. Consequently, both LTS and HTS assume expansion (1200' locks at 12 locations) of the UMR-IWW navigation system.

Grain Forecast Results Summary. Tables 3.4a and 3.4b summarizes the unconstrained traffic forecasts by traffic scenario and waterway. The associated annual compound growth rates are shown in tables 3.5a and 3.5 b. A number of clarifications and observations regarding the summary results are provided below.

Mississippi River is defined here as the Mississippi River from Minneapolis, MN to the mouth of the Ohio River at Cairo, IL, as described in the Overview section of the traffic forecasts. The tonnages reported for each river (Mississippi and Illinois) reflect origins and/or terminations only. Through traffic, i.e. traffic moving over the river segment but not originating or terminating on the segment, is not represented.

Note that the growth rates for individual grains are the same for both river segments for a given scenario. While the GGM is structured in a manner that would allow waterway forecasts for the Mississippi River and IWW to be separately produced, the growth rates presented here represent the aggregate flows for both waterways. The decision to aggregate the results for the two waterways and to use the combined rates of change in tonnage to forecast traffic for the system is a consequence of the degree of model precision at the individual waterway reach level (model reaches 1-3 represent the Mississippi River and model reach 4 represents the IWW). It was felt that a more representative forecast of future traffic could be accomplished if the aggregated results rather than individual river results were used. Consequently, commodity-specific growth rates representing the aggregate result for both rivers were applied to the 2004 base tonnages for each river to generate the forecasts. Computationally this was achieved by computing a factor of change (forecast year tonnage/base year tonnage) from the grain model results and multiplying this factor by the base year tonnages of the individual movements that make up the traffic base. As suggested above, factors of change were computed individually for corn, soybeans and wheat. Note that this process of applying a factor of change was also used with the non-grain forecasts.

Corn forecasts with the LTS warrant explanation. Corn flows decline immediately from the 2004 base, reaching a near zero level by 2030. After 2030, flows rapidly rebound, exceeding the 2004 base by 2040 and then approaching the level of the HTS by the end of the forecast period in 2060. This result is produced primarily by the effects of projected domestic corn-based ethanol demand and projected yields. Through 2030, expanding domestic ethanol demand increases total domestic demand to the point where export potential is significantly impacted. However, the forecast for ethanol demand levels off in 2030 and is held constant for the remainder of the projection period. (In fact, the 2007 EIA forecast for ethanol extended only to 2030. By assumption, the 2030 level of demand was held constant through 2060 for purposes of this scenario.) Beyond 2030, the positive effect on export potential of continuously increasing yields overcome the negative effect of ethanol demand on export potential, resulting is significant exports beyond 2030.

Wheat declines to zero by 2030 in both forecasts. This is primarily due to declining cost competitiveness.

Table 3.4a. Unconstrained Grain Traffic Forecasts - Low Traffic

(Million Short Tons)

Waterway/Commodity	2004	2010	2020	2030	2040	2050	2060
UPPER MISSISSIPPI RIVER (UMR)							
Corn	17.5	14.1	2.2	0.5	18	27.1	36.2
Wheat	2.5	2.6	2.2	0	0	0	0
Soybeans	5	7.3	6.8	7.1	5.5	4.4	3.2
Subtotal UMR Grain	**24.9**	**24**	**11.1**	**7.5**	**23.5**	**31.5**	**39.4**
ILLINOIS WATERWAY (IWW)							
Corn	11.5	9.3	1.4	0.3	11.8	17.8	23.9
Wheat	0.5	0.5	0.4	0	0	0	0
Soybeans	2.7	4	3.7	3.9	3	2.4	1.8
Subtotal IWW Grain	**14.7**	**13.8**	**5.6**	**4.2**	**14.9**	**20.3**	**25.6**
UPPER MISSISSIPPI RIVER SYSTEM (UMRS)							
Total UMR & IWW Grain	**39.6**	**37.8**	**16.7**	**11.7**	**38.3**	**51.7**	**65.1**

Table 3.4b. Unconstrained Grain Traffic Forecasts - High Traffic

(Million Short Tons)

Waterway/Commodity	2004	2010	2020	2030	2040	2050	2060
UPPER MISSISSIPPI RIVER (UMR)							
Corn	17.5	23.4	26.3	31.8	31.9	35.5	39.1
Wheat	2.5	1.8	0.4	0	0	0	0
Soybeans	5	6.3	6.9	5.6	5.2	4.2	3.3
Subtotal UMR Grain	**24.9**	**31.5**	**33.5**	**37.4**	**37.1**	**39.7**	**42.4**
ILLINOIS WATERWAY (IWW)							
Corn	11.5	15.4	17.3	20.9	21	23.4	25.8
Wheat	0.5	0.3	0.1	0	0	0	0
Soybeans	2.7	3.5	3.8	3.1	2.9	2.3	1.8
Subtotal IWW Grain	**14.7**	**19.2**	**21.2**	**24**	**23.9**	**25.7**	**27.6**
UPPER MISSISSIPPI RIVER SYSTEM (UMRS)							
Total UMR & IWW Grain	**39.6**	**50.7**	**54.7**	**61.4**	**61**	**65.5**	**70**

Table 3.5a. Compound Annual Growth Unconstrained Grain Traffic Forecasts Low Traffic

Waterway/Commodity	2004-2010	2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2004-2060
MISSISSIPPI RIVER							
Corn	-3.5	-17.1	-14.5	44.5	4.2	2.9	1.3
Wheat	0.8	-1.9	-100.0	-	-	-	-100.0
Soybeans	6.6	-0.7	0.5	-2.5	-2.3	-3.0	-0.8
Total Grain	-0.6	-7.4	-3.8	12.0	3.0	2.3	0.8
IWW							
Corn	-3.5	-17.1	-14.5	44.5	4.2	2.9	1.3
Wheat	0.8	-1.9	-100.0	-	-	-	-100.0
Soybeans	6.6	-0.7	0.5	-2.5	-2.3	-3.0	-0.7
Total Grain	-1.1	-8.7	-2.7	13.5	3.1	2.4	1.0
MISSISSIPPI RIVER + IWW Total	-0.8	-7.85	-3.4	12.6	3.0	2.3	0.9

Table 3.5b. Compound Annual Growth Unconstrained Grain Traffic Forecasts High Traffic

Waterway/Commodity	2004-2010	2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2004-2060
MISSISSIPPI RIVER							
Corn	5.0	1.2	1.9	0.0	1.1	1.0	1.4
Wheat	-5.0	-14.7	-100.0	-	-	-	-100.0
Soybeans	4.1	0.9	-2.0	-0.8	-2.1	-2.6	-0.7
Total Grain	4.0	0.6	1.1	-0.1	0.7	0.6	1.0
IWW							
Corn	5.0	1.2	1.9	0.0	1.1	1.0	1.5
Wheat	-5.0	-14.7	-100.0	-	-	-	-100.0
Soybeans	4.1	0.9	-2.0	-0.8	-2.1	-2.6	-0.7
Total Grain	4.5	1.0	1.3	-0.1	0.8	0.7	1.1
MISSISSIPPI RIVER + IWW Total	4.2	0.8	1.2	-0.1	0.7	0.7	1.0

NON-GRAIN FORECASTS

General. The following commodity groups were used to categorize non-grain traffic and to accomplish the traffic forecasts:

- Prepared Animal Feed
- Petroleum and Petroleum Products
- Industrial Chemicals
- Fertilizer
- Iron & Steel, Metallic Ores, Products, Scrap
- Coal
- Construction Materials
- Other

Each one of these commodity groups can be further disaggregated into a number of specific commodities. However, in general with respect to forecasting, the focus was on the commodity group level. Within each commodity group, attention was given to recent trends in some specific sub-commodities, and the commodity group forecasts were reflective of such trends. There are cases, such as ethanol, a specific commodity within the Industrial Chemicals commodity group, where the commodity was analyzed separately from the commodity group. Also of note with respect to ethanol is the interaction with the grain traffic forecasts. As previously noted, ethanol is an important GGM parameter used in estimating grain flows. Consequently, the level of corn-based ethanol production assumed in the grain traffic forecasts has been carried over to the forecasts of ethanol waterway forecasts.

Unlike grain, where the LTS and HTS were developed directly without first developing a base case forecast, the non-grain forecasts proceeded with development of a base forecast. The parameter values upon which the forecasts were constructed were then modified to produce the non-grain contributions to the LTS and HTS.

Data Sources. Data on demographic, economic and industry variables affecting traffic flows for each commodity group were compiled from industry interviews and different public and private sources. Some of these sources also provided long-term forecasts that were used for forecasting the base case of the future traffic flows. Variables affecting traffic and main data sources by commodity are detailed in Table 3.6.

Table3.6. Summary of Main Data Sources for Variables Affecting Traffic Flows

Commodity Category	Variable	Data Source – Historic Data	Data Source – Forecasts
Petroleum and Petroleum Products	IL/US Refinery Capacity	Energy Information Administration	Energy Information Administration, International Outlook 2006.
	IL Population	U.S. Census Bureau, Population Division, Table CO-EST2001-12-00 - Time Series of Inter-censal State Population Estimates: April 1, 1990 to	U.S. Census Bureau, Population Division, Interim State Population Projections, 2005, Projections from 2004 to 2030.
Industrial Chemicals	U.S. Industrial Production	U.S. Federal Reserve, Federal Reserve Statistical Release, Industrial Production and Capacity Utilization.	Derived by LBG from Bureau of Labor Statistics forecasted data.
	IL Industrial Production	IL Department of Commerce and Economic Activity.	Derived by LBG from IL Department of Commerce and Economic Activity with Global Insight forecasted data.
	U.S. Ethanol Production	Renewable Fuels Association, Ethanol Industry Outlook, 2006.	Energy Information Administration, Annual Energy Outlook 2007 with Projections to 2030.
Agricultural Chemicals	U.S. Total/Nitrogen Fertilizer Use	United States Department of Agriculture, Economic Research Service (ERS) Dataset, U.S. fertilizer Use & price, September 2006.	Derived by LBG from United States Department of Agriculture historic data
	5 State Population	U.S. Census Bureau, Population Division, Table CO-EST2001-12-00 - Time Series of Intercensal State Population Estimates: April 1, 1990 to	U.S. Census Bureau, Population Division, Interim State Population Projections, 2005, Projections from 2004 to 2030.
Iron & Steel, Metallic Ores, Products, Scrap	U.S. Steel Production	American Iron and Steel Institute, US Crude Steel Production 1997-2004.	International Iron and Steel Institute (IISI) "NAFTA Steel Production Projections 2005-2015".
	Share of Electric Furnaces in U.S. Steel Industry	American Iron and Steel Institute, Electric Furnace Share of United States Steel Production 1996-2005.	Derived by LBG from American Iron and Steel Institute and Expert Interviews.
Construction Materials	State/U.S. GDP	US Congressional Budget Office.	Derived by LBG from U.S. Congressional Budget Office forecasts
Coal & Coke	Coal Production, U.S. Western Region	Energy Information Administration, Coal Industry Annual reports 1997-2004.	Energy Information Administration, Report #DOE/EIA-0383(2007)
	Coal Production, U.S. Interior Western Region	Energy Information Administration, Coal Industry Annual reports 1997-2004.	Energy Information Administration, Report #DOE/EIA-0383(2007)
	State/U.S. Populations	U.S. Census Bureau, Population Division, Table CO-EST2001-12-00 - Time Series of Intercensal State Population Estimates: April 1, 1990 to	U.S. Census Bureau, Population Division, Interim State Population Projections, 2005, Projections from 2004 to 2030.
	U.S. Coal Imports	Energy Information Administration, Coal Industry Annual reports 1997-2004.	Energy Information Administration, Report #DOE/EIA-0383(2007)
	U.S. Coal Consumption	Energy Information Administration, Coal Industry Annual reports 1997-2004.	Energy Information Administration, Report #DOE/EIA-0383(2007)
	Illinois Coal+Coke Consumption	Energy Information Administration, Coal Industry Annual reports 1997-2004.	Derived by LBG from the U.S. coal consumption forecasted by the Energy Information Administration in Report #DOE/EIA-0383(2007)

LBG= Louis Berger Group

Methodology. The main methodological approach was to develop 1) baseline conditions for the integration of waterway activities into national and regional economies, 2) future economic outlooks, and 3) existing origin-destinations, and then to forecast growth using qualitative and quantitative assessments.

As is indicated above, the data for the variables defining waterway traffic are primarily obtained from secondary sources inclusive of global, national and regional forecasts published by government agencies, consultations with research organizations and interviews with industries involved in each commodity.

Each commodity is differently influenced by macro and micro variables. For example, in the case of steel, the study area includes most of the United States' national production capacity, which, however, is also influenced by expansion in the use of electric furnaces. In the case of petroleum and industrial chemicals, the focus on light products in Southern refineries shifted heavy petroleum and petroleum-related products to local plants because of the expense of the long haul from the Lower Mississippi. The construction materials are mostly locally generated.

Once the variables for each commodity are identified, their relative influence on waterway traffic is assessed using regression analysis. The input for forecasts is based on a combination of regression/trend analysis modified by information obtained from the above sources. The prediction of the various regression models is for commodity group traffic. As previously mentioned, a separate regression model was developed, and a forecast produced for ethanol. Coal on the Mississippi River was another commodity group that was further disaggregated for forecasting purposes.

It was important to separately consider coal movements north of St Louis and south of St Louis. This is due to the significance of eastbound movements of coal from Wyoming that comes by rail to the transshipment terminals below St. Louis and then primarily south on the Mississippi River. To capture the differences in these flows and those northbound coal flows on the UMR-IWW system, a coal north and coal south distinction was created.

Non-Grain Traffic Scenarios. The LTS and HTS were developed, with some exceptions, by taking the forecasted values for the independent variables in the regression models and decreasing them by 10 percent to obtain the low forecast and increasing them by 10 percent to obtain the high forecast. The following variables were treated differently:

Population: The population of one or many states does not change rapidly over a period of time. It was not expected that the population forecasts would vary substantially over the 50-year period. It was thus found reasonable not to use a decrease/increase in the forecasted values for population by 10 percent. Instead the forecasted population growth rates were decreased/increased by 10 percent to obtain the LTS and HTS.

Refinery Capacity: Refinery capacity in Illinois and other states is highly dependent on the total number of refineries in the state. The number of refineries and their installed capacities do not change rapidly (or unexpectedly). It was thus found appropriate to decrease/increase refinery capacity by 5 percent to obtain the LTS and HTS.

Industrial Production: United States and Illinois industrial production index values are used to forecast the industrial chemicals (without Ethanol) waterway traffic. The LTS and HTS obtained by decreasing/increasing industrial production by 10 to 20 percent resulted in very narrow bands. Therefore, it was decided to decrease/increase the industrial production values by 30 percent to obtain the LTS and HTS.

Ethanol Considerations. Ethanol forecasts were treated differently from the stated process of decreasing/increasing variables by a given percentage. In order to be consistent with the ethanol production assumptions of the grain forecast scenarios. The LTS and HTS with respect to ethanol were assumed to be identical with the assumptions of the grain scenarios. For the LTS, future ethanol production in the U.S. was assumed to be in accordance with the values forecasted in EIA 2007. The HTS assumed that the ethanol production from corn would reach a maximum of 5 billion gallons and would then remain constant. Therefore, the ethanol waterway tonnage was capped at the level associated with ethanol production of 5 billion gallons. (Note that the scenario designations of low and high traffic are with respect to the overall system including all commodities. The forecasted level of ethanol waterway traffic is actually greater in the LTS than in the HTS. However, because lower levels of ethanol waterway traffic are consistent with lower levels of domestic ethanol production and greater levels of grain exports, the traffic scenario that contains more waterway ethanol traffic is actually the HTS.)

Other Group Considerations. The commodity group, Other, as forecasted in NESP *Economic Evaluation – Waterway Traffic Forecast for Non-Grain Commodities*, was not incorporated into the traffic scenarios as described in the subject document. The referenced analysis computed the historical percentage of total non-grain traffic represented by the Other group. This percentage was then used in conjunction with the forecast total for the remaining non-grain commodity groups to compute the forecast values for the Other group. Other group traffic as a percent of non-grain total traffic was held constant over the forecast period.

After consideration of the stated methodology, and review of the historical traffic volumes of the Other group, an alternative forecasting approach was identified as more appropriate. Over the period 1997-2004, tonnage on the Mississippi River (Minneapolis, MN to mouth of Ohio River) averaged 6,176 tons; the comparable average for the IWW was 1,608 tons. This period was the same timeframe used to initially forecast the Other group, as well as the other non-grain commodity groups. Traffic for both segments lacked a statistically significant trend over this period. In addition, the traffic flows of the Other group are not connected from a business or production perspective to the flows of the remaining non-grain groups.

Consequently, an alternative approach was employed to accomplish the forecasts. This alternative approach used the last data point in the series (2004) minus and plus one standard deviation, held constant over the period of analysis, was used to represent the LTS and HTS. The standard deviations for the Mississippi River and IWW are 791 tons and 266 tons, respectively. (Note that the historical traffic flows described here and used in developing the forecasts represent traffic originating and terminating on the segment in question. Through traffic, i.e. traffic that passes over the segment but does not originate or terminate on the segment, is not included.)

Prepared Animal Feed Group Considerations. The commodity group Prepared Animal Feed was not addressed in the grain scenarios with the GGM, nor was it addressed in NESP *Economic Evaluation – Waterway Traffic Forecast for Non-Grain Commodities*, the general investigation of non-grain forecasts. In order to evaluate the Prepared Animal Feed group, an 8-year period was considered. The period, 1997-2004, was the same timeframe used to forecast the non-grain commodity groups. Over this period, tonnage on the Mississippi River (Minneapolis, MN to mouth of Ohio River) averaged 2,307 tons; the comparable average for the IWW was 1,235 tons. Traffic for both segments lacked a statistically significant trend. Given the modest volumes and absence of a trend, the last data point in the series (2004) minus or plus one standard deviation, held constant over the period of analysis, to represent the LTS and HTS. The standard deviations for the Mississippi River and The IWW are 377 tons and 76 tons, respectively. (Note that the historical traffic flows described here and used in developing the forecasts represent traffic originating and terminating on the segment in question. Through traffic, i.e. traffic that passes over the segment but does not originate or terminate on the segment, is not included.

Container-On-Barge (COB) Considerations. COB is not included in the traditional analysis. There is currently no use of the UMR and only minor use of the IWW for COB. COB may become viable and major component of non-grain in the future, but it will require overcoming significant obstacles. Containers and COB are discussed in more detail in Phase 2 as part of nontraditional and multimodal considerations.

Non-Grain Forecast Results Summary. Tables 3.7a and 3.7b summarize the traffic forecast estimates for the non-grain commodity groups by waterway for the LTS and HTS, respectively . Tables 3.8a and 3.8b display the corresponding annual compound growth rates.

As with the grain traffic forecasts, Mississippi River is defined here as Minneapolis, MN – mouth of Ohio River as described in the Overview to traffic forecasts. The tonnages reported for each river (Mississippi and Illinois) reflect origins and/or terminations only. Through traffic, i.e. traffic moving over the river segment but not originating or terminating on the segment, is not represented.

Table 3.7a. Unconstrained Non-Grain Traffic Forecasts - Low Traffic
(Million Short Tons)

Waterway/Commodity	2004	2010	2020	2030	2040	2050	2060
UPPER MISSISSIPPI RIVER (UMR)							
Prepared Animal Feed	2	1.6	1.6	1.6	1.6	1.6	1.6
Coal (north)	5.5	6.7	10.1	13.9	14.5	15	15.3
Coal (south)	16.6	17.3	17.3	21.5	22.3	23	23.4
Petroleum	4.6	3.4	4.3	2.6	1.7	1.2	1
Fertilizer	3.5	2.9	3.3	3.5	3.7	3.9	4
Construction Materials	23.5	26.3	33.4	38.4	42.9	47	49.1
Industrial Chemicals (w/o Ethanol)	1.1	1	1.1	1.3	1.5	1.7	1.8
Ethanol	0.2	0.4	0.5	0.5	0.5	0.6	0.6
Iron & Steel	2.7	2.1	3.3	4.1	4.9	5.7	6.1
Other	4.6	3.8	3.8	3.8	3.8	3.8	3.8
Subtotal UMR Non-Grain	**64.3**	**65.5**	**78.6**	**91.2**	**97.6**	**103.4**	**106.6**
ILLINOIS WATERWAY (IWW)							
Prepared Animal Feed	1.3	1.2	1.2	1.2	1.2	1.2	1.2
Coal	4.2	3.3	5.2	7.1	8.3	9.8	10.6
Petroleum	6.2	3.4	5.2	2.1	1	0.6	0.4
Fertilizer	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Construction Materials	5.2	7.7	12.5	16.1	19.7	23.1	25
Industrial Chemicals (w/o Ethanol)	2.6	2.4	2.7	3.1	3.6	4	4.2
Ethanol	0.7	0.8	0.8	0.8	0.8	0.8	0.8
Iron & Steel	6.5	5.2	8	9.9	11.7	13.5	14.4
Other	2.2	1.8	1.8	1.8	1.8	1.8	1.8
Subtotal IWW Non-Grain	**29.9**	**26.9**	**38.5**	**43.3**	**49.3**	**55.8**	**59.5**
UPPER MISSISSIPPI RIVER SYSTEM (UMRS)							
Total UMR & IWW Non-Grain	**94.1**	**92.3**	**117.1**	**134.5**	**146.8**	**159.2**	**166.2**

Table3.7b. Unconstrained Non-Grain Traffic Forecasts - High Traffic

(Million Short Tons)

Waterway/Commodity	2004	2010	2020	2030	2040	2050	2060
UPPER MISSISSIPPI RIVER (UMR)							
Prepared Animal Feed	2	2.3	2.3	2.3	2.3	2.3	2.3
Coal (north)	5.5	9.7	13.3	16.8	17.6	18.2	18.5
Coal (south)	16.6	17.3	17.3	21.5	22.3	23	23.4
Petroleum	4.6	7	8.5	7.3	6.5	5.9	5.6
Fertilizer	3.5	5.2	5.6	5.9	6.2	6.3	6.4
Construction Materials	23.5	32.6	41.2	47.4	52.9	57.8	60.4
Industrial Chemicals (w/o Ethanol)	1.1	1.2	1.3	1.6	1.9	2.2	2.3
Ethanol	0.2	0.3	0.3	0.3	0.3	0.3	0.3
Iron & Steel	2.7	4.6	6.1	7.1	8.1	8.9	9.4
Other	4.6	5.3	5.3	5.3	5.3	5.3	5.3
Subtotal UMR Non-Grain	**64.3**	**85.4**	**101.2**	**115.5**	**123.3**	**130.3**	**134**
ILLINOIS WATERWAY (IWW)							
Prepared Animal Feed	1.3	1.4	1.4	1.4	1.4	1.4	1.4
Coal	4.2	7.5	8.7	9.8	11.5	13.5	14.6
Petroleum	6.2	9.6	12.3	10.2	8.8	7.8	7.4
Fertilizer	1.1	1.2	1.2	1.2	1.2	1.2	1.2
Construction Materials	5.2	11.5	17.5	21.8	26.1	30.1	32.3
Industrial Chemicals (w/o Ethanol)	2.6	2.7	3.1	3.8	4.5	5.1	5.5
Ethanol	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Iron & Steel	6.5	10.2	13.6	16	18.1	20	21.1
Other	2.2	2.5	2.5	2.5	2.5	2.5	2.5
Subtotal IWW Non-Grain	**29.9**	**47.4**	**61.1**	**67.5**	**74.8**	**82.3**	**86.6**
UPPER MISSISSIPPI RIVER SYSTEM (UMRS)							
Total UMR & IWW Non-Grain	**94.1**	**132.8**	**162.2**	**183**	**198.2**	**212.6**	**220.6**

Table3.8a. Compound Annual Growth, Unconstrained Non-Grain Traffic Forecasts - Low Traffic

Waterway/Commodity	2004-2010	2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2004-2060
MISSISSIPPI RIVER							
Prepared Animal Feed	-3.5	0.0	0.0	0.0	0.0	0.0	-0.4
Coal (north)	3.3	4.2	3.3	0.4	0.3	0.2	1.9
Coal (south)	0.7	0.0	2.2	0.4	0.3	0.2	0.6
Petroleum	-5.1	2.5	-5.0	-4.0	-3.2	-1.6	-2.6
Fertilizer	-3.1	1.2	0.7	0.5	0.4	0.2	0.2
Aggregates	1.9	2.4	1.4	1.1	0.9	0.4	1.3
Industrial Chemicals (w/o Ethanol)	-1.5	1.1	1.8	1.4	1.1	0.6	0.9
Ethanol	11.7	0.4	0.8	0.6	0.5	0.1	1.6
Iron & Steel	-4.4	4.7	2.3	1.8	1.4	0.7	1.4
Other	-2.9	0.0	0.0	0.0	0.0	0.0	-0.3
Total Non-Grain	0.3	1.8	1.5	0.7	0.6	0.3	0.9
IWW							
Prepared Animal Feed	-1.0	0.0	0.0	0.0	0.0	0.0	-0.1
Coal	-4.1	4.7	3.2	1.6	1.6	0.8	1.7
Petroleum	-9.4	4.2	-8.8	-7.0	-5.6	-2.8	-4.7
Fertilizer	0.6	0.1	-0.1	-0.1	-0.1	0.0	0.0
Aggregates	6.8	5.0	2.5	2.0	1.6	0.8	2.9
Industrial Chemicals (w/o Ethanol)	-1.2	1.0	1.6	1.3	1.1	0.5	0.9
Ethanol	1.2	0.3	0.2	0.0	-0.2	-0.2	0.2
Iron & Steel	-3.7	4.4	2.2	1.7	1.4	0.7	1.4
Other	-2.8	0.0	0.0	0.0	0.0	0.0	-0.3
Total Non-Grain	-1.8	3.7	1.2	1.3	1.3	0.7	1.2
MISSISSIPPI RIVER + IWW Total	-0.3	2.4	1.4	0.9	0.8	0.4	1.0

Table3.8b. Compound Annual Growth, Unconstrained Non-Grain Traffic Forecasts - High Traffic

Waterway/Commodity	2004-2010	2010-2020	2020-2030	2030-2040	2040-2050	2050-2060	2004-2060
MISSISSIPPI RIVER							
Prepared Animal Feed	2.9	0.0	0.0	0.0	0.0	0.0	0.3
Coal (north)	10.1	3.2	2.4	0.4	0.3	0.2	2.2
Coal (south)	0.7	0.0	2.2	0.4	0.3	0.2	0.6
Petroleum	7.1	2.0	-1.5	-1.2	-0.9	-0.5	0.4
Fertilizer	6.6	0.8	0.5	0.4	0.3	0.2	1.1
Aggregates	5.6	2.4	1.4	1.1	0.9	0.4	1.7
Industrial Chemicals (w/o Ethanol)	0.9	1.3	2.1	1.7	1.3	0.6	1.4
Ethanol	2.8	0.0	0.0	0.0	0.0	0.0	0.3
Iron & Steel	9.2	2.8	1.6	1.3	1.0	0.5	2.2
Other	2.6	0.0	0.0	0.0	0.0	0.0	0.3
Total Non-Grain	4.9	1.7	1.3	0.7	0.6	0.3	1.3
IWW							
Prepared Animal Feed	1.0	0.0	0.0	0.0	0.0	0.0	0.1
Coal	10.1	1.5	1.3	1.6	1.6	0.8	2.2
Petroleum	7.7	2.5	-1.8	-1.5	-1.2	-0.6	0.3
Fertilizer	2.3	0.1	-0.1	-0.1	-0.1	0.0	0.2
Aggregates	14.2	4.3	2.2	1.8	1.4	0.7	3.3
Industrial Chemicals (w/o Ethanol)	0.7	1.4	2.1	1.7	1.3	0.6	1.3
Ethanol	0.8	0.0	0.0	0.0	0.0	0.0	0.1
Iron & Steel	7.9	2.9	1.6	1.3	1.0	0.5	2.1
Other	2.4	0.0	0.0	0.0	0.0	0.0	0.3
Total Non-Grain	8.0	2.6	1.0	1.0	1.0	0.5	1.9
MISSISSIPPI RIVER + IWW Total	5.9	2.0	1.2	0.8	0.7	0.4	1.5

ALL COMMODITIES FORECAST SUMMARY

Tables 3.9a and 3.9b summarize the unconstrained traffic forecast estimates by waterway and commodity class (grain and non-grain) for the LTS and HTS, respectively.

Table 3.9a. Unconstrained Traffic Forecasts - Low Traffic

(Million Short Tons)

Waterway/Commodity	2004	2010	2020	2030	2040	2050	2060
UPPER MISSISSIPPI RIVER (UMR)							
Total Grain	24.9	24.0	11.1	7.5	23.5	31.5	39.4
Total Non-Grain	64.3	65.5	78.6	91.2	97.6	103.4	106.6
All Commodities	89.2	89.5	89.7	98.7	121.0	134.9	146.1
ILLINOIS WATERWAY (IWW)							
Total Grain	14.7	13.8	5.6	4.2	14.9	20.3	25.6
Total Non-Grain	29.9	26.9	38.5	43.3	49.3	55.8	59.5
All Commodities	44.6	40.6	44.1	47.5	64.1	76.0	85.2
UPPER MISSISSIPPI RIVER SYSTEM (UMRS)							
Total Grain	39.6	37.8	16.7	11.7	38.3	51.7	65.1
Total Non-Grain	94.1	92.3	117.1	134.5	146.8	159.2	166.2
All Commodities	133.8	130.1	133.8	146.2	185.2	210.9	231.3

Table 3.9b. Unconstrained Traffic Forecasts – High Traffic

(Million Short Tons)

Waterway/Commodity	2004	2010	2020	2030	2040	2050	2060
UPPER MISSISSIPPI RIVER (UMR)							
Total Grain	24.9	31.5	33.5	37.4	37.1	39.7	42.4
Total Non-Grain	64.3	85.4	101.2	115.5	123.3	130.3	134.0
All Commodities	89.2	116.9	134.7	152.9	160.4	170.0	176.4
ILLINOIS WATERWAY (IWW)							
Total Grain	14.7	19.2	21.2	24.0	23.9	25.7	27.6
Total Non-Grain	29.9	47.4	61.1	67.5	74.8	82.3	86.6
All Commodities	44.6	66.6	82.2	91.5	98.7	108.1	114.2
UPPER MISSISSIPPI RIVER SYSTEM (UMRS)							
Total Grain	39.6	50.7	54.7	61.4	61.0	65.5	70.0
Total Non-Grain	94.1	132.8	162.2	183.0	198.2	212.6	220.6
All Commodities	133.8	183.5	216.9	244.4	259.1	278.1	290.6

TRANSPORTATION COST ANALYSIS

Overview. The purpose of this section is to describe the process undertaken to estimate existing transportation costs and alternative transportation costs for commodity movements currently utilizing the UMR-IWW Navigation System. The transportation cost estimates encompass the total costs incurred for existing system use including access and transfer costs as well as the total transportation costs that would be incurred if existing system movements were forced to use some alternative mode of transportation.
In this study, a stratified sample consisting of 1,353 unique UMR-IWW movements was selected from the 2004 Waterborne Commerce Statistical Center (WCSC) detailed barge data file. Results from the sample data, expressed in 2006 price levels, were then extrapolated to the 2004 population of individual barge movements.

Details of the sampling, costing assumptions and methods, and application of the estimated costs to the study population of movements is described in the remaining paragraphs of this section.

Sample Movements. A sample of 1,353 movements was identified for inclusion in this analysis and comprised 74 percent of the total tons shipped on the waterway segments described below. The sample was drawn from the 2004 WCSC movements that originated or terminated on the Upper Mississippi River above Lock and Dam 27, excluding the Missouri River, unless there was an origin or destination in the study area. Further, the sample included movements that originated or terminated on the IWW below Lockport, IL or originated or terminated in the Greater Chicago or Great Lakes area and passed through Lockport, IL. The sample was structured to include movements over the full length of the waterway system, as well as the inclusion of movements from each commodity group. Reported rates for both the water movement and the all-land alternative are based on the actual or true location of shipment origins and destinations (i.e. not the water origins and destinations.)

Water Routings. Because many of the sample movements have off-river origins and/or destinations, a full accounting of all transportation costs for waterborne movements requires the calculation of railroad and/or motor carrier rates for movement to or from the nearest appropriate port facility. Additionally, all calculations reflect the loading and unloading costs at origin and destination, all transfer costs to or from barge, and any fees or charges associated with the transportation requirements.

Land Routes. With the exception of over-sized shipments and intra-pool sand dredging, rail or truck rates are calculated for all movements. For over- dimension truck and intra-pool dredged materials, the land rate was estimated as compared to a specific modeled rate using standardized, identifiable, data inputs. As in the case of the barge-inclusive routings, many all-land routes require the use of more than one transport mode. Therefore, when appropriate, calculations include all requisite transfer charges.

Assumptions. Based on information collected from shippers, receivers, carriers, river terminal operators, stevedores, other Federal agencies, and private trade associations, the probable origins and destinations for the majority of those movements that originated or terminated at off-river locations were identified. In the absence of specific shipper/receiver information, it is assumed that the river origin and destination are the respective originating and terminating points for both river and alternative modes of transportation. In every case, an attempt was made to gather information from all shipping ports.

Specific commodity groups are discussed in more detail later in this section. However, for those movements that originate or terminate at a river port location, it is assumed that rail service could also be utilized by the shipper or receiver if that terminal is rail served. When the shipper or receiver is served by truck only, a railroad team track or transfer facility at the station nearest the off-river shipper or receiver is used for the land alternative. Only those shippers who ship more than 200,000 tons annually and who are adjacent to rail tracks would be assumed to undertake the significant capital expenditures necessary to acquire direct rail service. No consideration is given to private car leasing costs and mileage allowances made by carriers to shippers for the use of private equipment are also ignored.

For the long run, in all cases it is assumed that the alternative modes of transportation would have the physical capacity to accommodate the additional tonnage represented by each commodity movement. Commodity specific judgments and assumptions include:

Coal. A number of assumptions are made for land haul rates for the movements of coal to utility destinations that are not rail served. Volumes to these destinations are, in many cases, substantial, so that long-haul truck transportation cannot be considered a viable option. In the absence of water transportation, receiving utilities would have to carefully evaluate those available options which might ensure their ability to continue to receive large volumes of coal. These considerations might include the replacement cost of transfer and handling facilities, the construction cost of switch or main line rail track, the cost of new or improved highway access, the economies of buying or leasing rail equipment, and the possibility of shifting origins to assure adequate coal supply. For their part, we may assume that rail carriers would be willing to construct additional track capacity if volumes are sufficient. However, these construction costs would most likely be passed on to the shipper via higher rates.

To accommodate those instances in which sample barge movements are to non-rail served utilities, we have incorporated the following judgments and assumptions. If the receiving utility is not rail served, rates are applied to the nearest railhead and trucking costs from the railhead to the destination are applied. If the shipping point is not rail served, a motor carrier charge is applied from the mine origin to the nearest railhead. It is assumed that transfer facilities would be available at both origin and destination for transfer between rail and truck.

If the receiving utility is rail served for supplies only, but not coal, the rail car unloading cost of the utility is inflated to accommodate an on-site truck shuttle to the coal stockpile. In some instances, movements involve a truck haul from multiple origins to a concentration or preparation point for loading to rail. In these instances, where shipments originate at several mines within the same general area, a representative rail origin is selected as the transfer location.

Aggregates. Land haul rates on limestone and sand and gravel reflect the modes necessary to transport the shipments from actual origins to actual destinations. If origins or destinations are not rail served, a trucking charge is applied from the nearest rail station. For those movements where both rail and truck transportation are an option, truck hauls are limited to a distance of 250 miles. This, on occasion results in slightly higher rates. However, it was deemed impractical, in the absence of water transportation, to transport large volumes of these commodities for long distances by truck. Limiting factors of truck transport include lower cargo carrying capacity, the inability to round-trip more than two times per day, and the absence of loaded back-haul opportunities.

With regard to waterway improvement materials, we assume that land movements would require a truck haul at the destination for delivery to river bank work locations. These truck movements would likely average ten miles each. It should be noted that a significant amount of channel improvement and bank stabilization work is conducted off shore or at locations without highway access, making land transportation impractical.

Grain. The computation of rates for grain is based upon the survey responses of the shippers and receivers. Specifically, if a country elevator gathers grain and then ships the grain to the river terminal, we assume a 20 mile truck haul from the farmer's field to the country elevator. In contrast, if the river terminal states that more than 60 percent of the grain comes from the farm or on farm storage, the use of country elevators is excluded from consideration. If the grain moves for export, a unit train movement is assumed, and land rates are computed from a unit train capacity elevator to the original Gulf port location. Likewise, a shuttle train approved location is given preference over other unit train load out locations. For domestic shipments, the computation of rail rates is based on the track capacity of the country elevator or domestic receiver. We assume that the grain shipper would maximize the use of his facilities and utilize gathering rates to reach the track capacity of the receiver.

Notable within the computational method is the use of both rail reported waybill rates and tariff rates depending on which value is the lowest. Since the rail tariff rates generally use the short line miles, the actual tariff miles were computed for both the waybill derived and grain tariff rates. No consideration is given to the Burlington Northern Santa Fe Certificate of Transportation program, Union Pacific Railroad Grain Car Allocation System or OT-5 authority decisions by rail carriers. Further, annual volume allowances or rebates and facilities construction allowances were not included in the rate computation.

The rail rating of feed ingredients follows assumptions similar to those used for the rating of grain - namely rates constrained by track capacity and the use of the lower of either tariff rates or rates estimated via the waybill model. Rail and barge transit programs for meals (soybean, cottonseed, oilseed and fish) were not considered.

Extrapolating the 2006 Water Cost Analysis to the Full Population of 2006 Barge Movements. Each data record in the 2004 sample data of 1,353 movements contained unique information about the movement such as port origin and destination, river origin and destination, line haul charges (river), river miles traveled, costs for river access, and similar information regarding total transportation costs for alternate routes.

Rates in the sample were matched directly with the population of 2006 baseline movements based on common origin port and dock, destination port and dock and 5-digit commodity code. This initial matching assigned costs to approximately 74 percent of the population of tonnage that used any of the locks on the waterway segments described above.

In order to assign cost to those movements not initially matched, several additional levels of matching were performed. The second matching was based on common origin port equivalent (PE), destination port equivalent, and the 11-group commodity code. A PE code is defined by ranges of WCSC port-dock codes and represents a waterway segment. (For second level matching and beyond, costs were computed on a per mile basis. For example, for a second level match, cost per mile was computed for the relevant origin PE/destination PE/commodity code triplet and used to compute the cost of the movement in question based on the movement's mileage.) After the second level of matching, 85 percent of the population tonnage was assigned costs. The third level of matching was based on common waterway segment origin and destination (the 2-digit level of the 4-digit origin and destination PE codes), and the 11-group commodity code. After this level of matching, 97 percent of the population tonnage was assigned costs. The fourth level of matching was based on common waterway segment destination (the 2-digit level of the 4-digit PE code), and 11-group commodity code. After this level of matching, 99 percent of the population tonnage was assigned costs. The fifth and last level of matching was based only on the 11-group commodity code. With this last level of matching all movements in the population were assigned costs.

SYSTEMS MODELING

Survey Model Framework. The following paragraphs provide a brief background for the Survey Model, the model used for the UMR-IWW Navigation System to measure the navigation-related NED impacts of alternative plans. The Survey Model draws on the concepts of spatial price equilibrium to establish its framework. Several important notions of a spatial price equilibrium framework are reflected in the Survey Model, and these notions represent the theoretical underpinning for the model. Most importantly these notions are reflected in the representation of the demand, or willingness to pay, for water transportation services. However, it must be acknowledged that the Survey Model as implemented, is not a fully developed spatial model. A fully developed spatial model would explicitly represent production and consumption regions, and link these regions by means of product prices and transportation costs. The Survey Model does not incorporate this level of detail. But as suggested above, by specifying the willingness to pay for water transportation in a manner that is theoretically consistent with spatial principles, the Survey Model moves in at least a partial manner in the direction of a spatial model.

As the focus of the feasibility study is congestion at the locks in the UMR-IWW Navigation System, the model is built around the performance of the system locks and the impact of the locks' performances on the supplies of inland waterway transportation by private system carriers. The carriers' supplies then interact with the derived demands of shippers to yield an estimate of the UMR-IWW Navigation System equilibrium commodity flows and prices. These estimated equilibrium market prices and commodity flows form the basis of the measure of the willingness of users to pay for incremental outputs, which, in turn, form the measure of net NED benefits created by the system. Hence, by changing the levels of demand to those levels forecast at selected times in the future and estimating the performance of system locks at those selected points in time, a sequence of system equilibria may be estimated. This sequence of equilibria yields estimates of the future NED benefits generated by the system. The change in net NED benefits created by implementing an action to improve the performance or reliability of locks at future points in time may then be estimated by comparing the without-action system equilibrium and the with-action system equilibrium at those points in time.

The model may be characterized as a comparative static, simultaneous equilibrium model, where the system equilibrium is characterized by a vector of delays at system locks and a matrix of specific origin, destination, and commodity flows. Lock delays occur when a tow arrives at a lock chamber that is already in use by another vessel. The lock delays reduce the quantity of output that system carriers can deliver per unit of time, as equipment waiting for service at a system lock is not actively producing transportation service. The reduced output of equipment increases system transportation costs per unit of output for carriers, thereby decreasing the quantity of output supplied for all transportation prices. Commodity flows are then altered as system shippers adjust their demands in response to the prices charged by carriers. The system equilibrium is the level of system delays where the quantity supplied is equal to the quantity demanded for all river origins, destinations, and commodities.

There are 38 geographic regions defined in the model. The geographic regions are defined with respect to river origins and destinations relative to the UMR-IWW System. There are 29 geographic regions defined by the lock and dam pools on the Mississippi River, 8 geographic regions defined by the lock and dam pools on the IWW, and 1 geographic region defined as the rest of the world.

The timeframe of analysis for the model is one calendar year. The model identifies an UMR-IWW Navigation System equilibrium conditional on carrier supply and shipper demand functions for a given year. To estimate the system equilibrium conditions through time, new supply and demand functions representative of the year of analysis are introduced and a new equilibrium is estimated. Consequently, the model is not dynamic in the sense of relating system equilibria through time.

The survey Model is implemented in a Microsoft Excel spreadsheet and makes extensive use of the solver tool to solve systems of equations for an equilibrium state. The system equilibrium is characterized by a set of transportation prices and traffic flows for the origin, destination, and commodity group combinations. The systems of equations relate lock performance characteristics to tow productivity; tow productivity to transportation prices and carrier supply functions; transportation prices to the shipper derived demand functions; and forecasts of changes in unconstrained demand to shipper derived demand functions.

Data Requirements and Sources. The Survey Model requires data regarding the existing and forecast performance of system components, existing and forecast commodity flows, and existing transportation costs for shippers. The sources and vintages of data used in the model are described below in Table 3.10.

Table 3.10. Survey Model Data Requirements and Sources

Data Set	Vintage	Source
Existing Lock Performance	1995-2000	LPMS/WAM
Forecast Lock Performance	1995-2000	LPMS/Engineering Work Group/WAM
Existing Commodity Flows	2004	Waterborne Commerce Statistics Center
Existing Transportation Costs	2006	Tennessee Valley Authority Rate Study
Forecast Unconstrained Commodity Flows - Grain	2007	Global Grain Model
Forecast Unconstrained Commodity Flows - Non-Grain	2007	*NESP Economic Evaluation Waterway Traffic Forecasts for Non-Grain Commodities*
Demand Function Specification - Grain	2007	*Transportation Demand for Agricultural Products in the Upper Mississippi and Illinois River Basin*
Demand Function Specification - Non-Grain	2007	*Transportation Demands for the Movement of Non-Agricultural Commodities Pertinent to the Upper Mississippi and Illinois River Basin*

Waterborne Commerce Statistical Center traffic flows for 2004 were incorporated into the Survey Model as the baseline traffic.

Existing transportation costs, reflecting a 2006 price level, are described in the section *Transportation Cost Analysis.*

The remaining data sets, existing and forecast lock performance, and demand function specification, are discussed in the following sections.

Existing and Forecast Lock Performance. Existing and forecast lock performance are ultimately incorporated into the Survey Model as transit curve input. Transit curves describe the relationship between traffic volume at a lock site and expected average delay. The transit curves employed by the Survey Model for those locks designated as critical (Locks 11-25, Peoria, and LaGrange) were generated with use of the Waterway Analysis Model (WAM), a simulation tool. The transit curves for the non-critical locks are based on the queuing theory. Critical locks are those locations where existing congestion is significant or where future levels of congestion may become significant. Also, unlike non-critical locks, relatively small changes in traffic can produce relatively large changes in expected average delay, making specification of the traffic-delay relationship more important to accurate system modeling. Detailed descriptions of WAM and transit curve development and the queuing theory applied to non-critical locks are contained in Section 4 of the Economics Appendix to the 2004 UMR-IWW System Navigation Feasibility Study. No new transit curves have been generated for this reevaluation. The transit curves used in the reevaluation have been taken directly from the 2004 feasibility study.

Demand Function Specification. Demand function specification for the waterway movements that make up a waterway's traffic base is fundamental to the estimation of benefits attributable to an existing waterway, or to proposed improvements to a waterway. Such a function defines how shippers adjust waterway quantities in response to changes in waterway operating conditions. This response fundamentally reflects the willingness-to-pay for use of the waterway, and therefore represents the basis of NED benefit estimation.

Demand function specification for this economic reanalysis relies on work produced by the Corps' Institute for Water Resources (IWR.) The work in question continues a line of research to examine the structure of transportation demands for use in planning models that is part of a larger research and development program, Navigation and Economic Technologies (NETS).

Under NETS, a series of surveys of individual shippers located in the Upper Mississippi and IWW, the Columbia-Snake Waterway, and the Ohio River have been conducted. In each case, survey methods were used to identify and target shippers that could plausibly use the waterway. To this end, survey methods focused on shippers of commodities that have a historical presence on the waterway and on shippers of varying distance from the waterway to capture the effects of space that are central to the decision to use the waterway. Using these survey data, demand models have been estimated that yield significant evidence that shippers do respond to rates, time in transit, and reliability. The responsiveness identified is two-fold. Shippers' continuous decisions (the volume of shipments) and discrete decisions (where and how to ship the product) and are both embedded in most of the studies. In all cases, the analyses reinforce the notion that shippers respond to changes in attributes that can be affected by changes in operating conditions.

Separate surveys were conducted and econometric estimations were made for agricultural products and for non-agricultural products. Individual commodities included in agricultural products were primarily corn, soybeans, and wheat. A number of other commodities, representing approximately seven percent of the survey responses, included sorghum, soy meal, and other unspecified grains. Non-agricultural products were arranged into three groups designated as "A", "B", and "C". Group A represented NAIC codes in the 200's (oil and gas extraction, mining, aggregates.) Group B represented NAIC codes 300-326 and 454 (wood, paper, petroleum, coal, chemicals, plastics, fuel.) Group C represented NAIC codes 327-332 (minerals, metals.)

The procedures, data, and results of the agricultural products and non-agricultural products investigations are detailed in Transportation Demand for Agricultural Products in the Upper

Mississippi and Illinois Basin, and Transportation Demands for the Movement of Non-Agricultural Commodities Pertinent to the Upper Mississippi and Illinois River Basin, respectively.

Agricultural Products Shipper Surveys A sample of 480 shippers located in a 10-state area was used to examine shippers' choice of mode and destination (i.e., discrete decisions of where and how to ship) and their decisions regarding the volume of shipments (i.e. the continuous decision of how much to ship.) Choices of mode and destination were examined using both revealed and stated preference data collected in the survey.

A total of 480 responses were received. Of the original 2,000, this represents a 24 percent response rate, and corrected for ineligible shippers, the response rate was 27.5 percent. Corn shipments dominate the sample and represent 295 of 480 responses. The remaining commodities include wheat, soybeans, beans, barley, grain etc.

The survey solicited stated preference responses to changes in shipment attributes. In particular, respondents provided information on the next best alternative to the shipment made to a destination by a mode. These alternatives may represent the use of a different mode, shipment to an alternative destination, with the same or a different mode, or shutdown (no alternative exists).
Stated preference questions were also framed to solicit information on the responsiveness of annual volumes to changes in shipment characteristics. In all cases, there are large numbers of shippers that state that their annual volumes would not be affected by a change in rates that applies to all shippers and only to the surveyed shipper. Similar findings hold for shipment times and reliability. Nevertheless, there are still significant numbers of shippers that state that their annual volumes would be affected.

As in previous studies, both revealed data and stated preference data are used to analyze choice and the responsiveness of choices to attributes and, in particular, to changes in rates, shipment times, and reliability. Revealed decisions reflect what the shipper actually does, while stated preference data reflect what the shipper states it would do if confronted with a hypothetical situation. Revealed data often exhibit only modest variation in the attributes causing the choice, and the range of responsiveness needed for policy analysis often runs beyond the range of data observed. This shortcoming of revealed data can be overcome by the use of stated preference data. Stated preference data, however, are commonly criticized because the respondent's stated behavior may not mirror its revealed behavior. As a result, stated preference data may not accurately reveal the parameters of interest (e.g., the parameters of the demand function). Techniques were developed which mitigated both difficulties. The key idea is that the stated preference questions can be based on the shipper's revealed decision. In this way, the criticism that stated preference question constitute hypothetical situations that are not known to respondents is overcome. Further, stated preference questions were framed over a wide range of changes in the attributes e.g., up to a 60 percent change in rates, shipment times, and reliability. This overcomes the problem of revealed data often not providing enough range in the data. Since, however, the stated preference data are constructed from the revealed decision, an econometric technique had to be developed to recognize that the stated preference data generated are endogenously determined. Finally, it is possible to gauge the consistency of revealed with stated preference data. The use of this technique provides reliable variation in the data. Estimates using revealed data can be improved upon by incorporating stated preference data.

The survey results were used as input into a theoretical shipper's modal choice model. In particular, the survey results formed the basis for estimating an econometric model based on current data of shippers' revealed best and stated next best preferences which in turn was ultimately used to estimate arc elasticities of shippers' responses to rate, time, and reliability changes of individual transportation modes. (Elasticity is a measure of the responsiveness of quantity to a characteristic such as rate, time, or reliability. Elasticity is computed as the percent change in quantity divided by the corresponding percent change in the characteristic. For example, if a 10 percent increase in the rate charged for waterway transportation resulted in a 5 percent decrease in the quantity shipped on the waterway, the associated elasticity would be negative 5/10, or -0.5. Elasticities for rate and time are negative values as rate and time are inversely related to quantity. Reliability and quantity are positively correlated; consequently, elasticity for reliability is expressed as a positive value. The term arc elasticity is used to express the fact that the change in the characteristic in question, such as rate, is specified as a discrete change from a starting value to the changed value, as opposed to a continuous change over the range that defines the change.)

Non-Agricultural Products Shipper Surveys The goal of the survey was to collect information pertaining to individual shipments and annual volumes for shippers of non-agricultural commodities. Geographically, the population was defined as shippers in Arkansas, Illinois, Indiana, Kentucky, Louisiana, Mississippi, Ohio, Tennessee, and Texas. This geographic distinction captures a sizable proportion of the tonnages that terminate on the UMR-IWW system.

The survey was stratified by commodity and by distance to the waterway. Information was collected for 232 observations. The observations were dominated by shippers that report they have but one option in shipping, and there were a number of missing values for shippers that have multiple options. This prevented the use of statistical procedures that had been developed under NETS that combine revealed and stated preference. The survey did, however, provide considerable information i.e., a much better frequency of usable responses, on stated preference responses. By limiting the data used to stated-preference data gave a larger number of responses to analyze relative to procedures that use both revealed and stated preference data.

As in the agricultural products study, the estimated models were separated into mode/destination choices and to volume decisions.

Implementation of Shipper Response Results. As summarized in the previous section, the choice models developed from the shipper response surveys indicate statistically significant annual volume and mode choice responses on the part of shippers as a result of changes in rate, time, and reliability. However, as incorporated in the Survey Model, annual volume and mode choice responses are captured for rate influences only.

Time and reliability effects on shipper decisions have not been incorporated into demand function specification within the Survey Model. The reason for exclusion of these effects is primarily due to limitations in currently available data. While it is acknowledged that the data needed to incorporate the time and reliability aspects of the shipper response investigations could be developed, the timeframe of the shipper response work and its incorporation into the survey model was a constraint. The magnitude of the elasticities for the excluded effects was not a consideration for their omission. While it is true that the mode switching elasticities with respect to time (less than -0.2) and reliability (-0.025) for agricultural products are small, the annual volume elasticities with respect to time and reliability are greater than or equal to the elasticity with respect to rate. For non-agricultural products, elasticities with respect to time and reliability are generally of the same magnitude as elasticity with respect to rate.

As estimated, elasticity with respect to time measures time as the total time to complete the shipment including all inland and waterborne logistics such as waiting for transfers and barge fleeting. The absence of a currently available source for this type of information precludes its incorporation into the Survey Model at this time. Such information could certainly be developed but would likely require implementation of a new data collection program. Of interest is consideration of the likely relative impact of the elasticities with respect to time on waterway quantities. As modeled, total shipment time is influenced only by changes in lock delay times. Lock delay times typically represent a very small portion of the water component of shipment time, and an even smaller portion of total shipment time. Consequently, given the generally modest magnitude of the elasticities with respect to time, and the typically small contribution of lock delay time to total shipment time, the impact of elasticity with respect to time would be modest in many cases. Nonetheless, the exclusion of elasticity with respect to time does allow traffic, and traffic congestion, to build to higher levels than would otherwise be the case for future evaluation years associated with system traffic growth. This effect would be most pronounced in the without-project condition for scenarios involving higher traffic growth.

The distribution of current shipment times could be developed to help capture the impact of shipment delivery time reliability on shipper decisions. The following can be surmised. 1) Delivery time mean and variance would both likely increase in a without-project condition that reflected traffic growth. 2) Infrastructure investments would likely reduce both delivery time mean and variance. 3) Changes in delivery time, and changes in delivery time variance, could be measured from one state of the navigation system to another, and the change in delivery time could be used to estimate the effect of reliability on shipper responses as specified by the elasticity with respect to reliability. However, given that reliability is defined with respect to expectations, it is not clear how changes in the distribution of shipment time would translate to a change in reliability as captured in the shipper response surveys. It is unclear how shipper perception of on-time delivery would be established and/or modified for a future condition.

Table 3.11 presents the barge annual volume elasticities with respect to rate, reliability, and time for agricultural products. The elasticities reflect rate changes that apply to the shipper and its competitors. The elasticities are also unconditional elasticities, i.e. the elasticities are computed for all shippers including those who do not make any change. Table 3.12 presents the barge mode choice elasticities with respect to rate, reliability, and time for agricultural products.

Table 3.13 presents the barge annual volume elasticities with respect to rate, reliability, and time for non-agricultural products. The elasticities reflect rate changes that apply to the shipper and its competitors. The elasticities are also unconditional elasticities, i.e. the elasticities are computed for all shippers including those who do not make any change. Table 3.15 presents the barge mode choice elasticities with respect to rate, reliability, and time for non-agricultural products.

Survey Model implementation of the choice models was accomplished in two steps. First, the annual volume response to rate was used to determine the portion of the unconstrained forecast tonnage a shipper would be willing to move at a given rate. The second step was to use the mode response to rate to determine the portion of the unconstrained potential, as adjusted in step one, a shipper would be willing to move by water at a given rate. These steps were carried out for each individual movement in the traffic base by fitting functions to the aggregate results describing annual volume and mode share response. The fitted function defines the response (of annual volume or mode choice) over a continuous range of water rates.

Separate functions reflecting annual volume response to rates were fit, and incorporated into the Survey Model, for agricultural products, non-agricultural products (Group A), comprised of North American Industrial Classification (NAIC) codes in the 200's (Oil and Gas Extraction, Mining and Aggregates), non-agricultural products (Group B), comprised of NAIC codes 300-326, 454 (Wood, Paper, Petroleum, Coal, Chemicals, and Fuel), non-agricultural products (Group C), comprised of NAIC codes 327-532 (Minerals and Metals). Separate functions reflecting mode choice response to rates were fit, and incorporated into the Survey Model, for agricultural products and collectively for all non-agricultural products. For both agricultural products and non-agricultural products, the annual volume responses used to fit the functions reflected changes (in rates) that apply to both the shipper and its competitors. The functions also reflect responses for all shippers including those who do not make any volume changes.

Unlike the annual volume case where each group of non-agricultural products was represented by a separate function, a single function was used to represent non-agricultural products for the mode choice case. The lack of meaningful variation across non-agricultural groups was the reason for use of a single function. As implement, the specific values of Group B were used to fit the function for all non-agricultural commodities. Detailed description of this implementation is described in the separate document, Survey Model Operation.

Table 3-11. Elasticity Estimates for Annual Volume with Respect to Changes in Rate/Time/Reliability - Agricultural Products

(Barge)

% Increase in:	Rate	Reliability	Time
10	-0.075	0.619	-0.31
20	-0.153	0.388	-0.321
30	-0.208	0.311	-0.335
40	-0.246	0.272	-0.344
50	-0.272	0.248	-0.348
60	-0.289	0.231	-0.349

Changes apply to shipper and its competitors.

Elasticities are Unconditional, i.e. calculated for all shippers even those who do not make any change.

Table 3.12. Switching Elasticity Estimates with Respect to Changes in Rate/Time/Reliability - Agricultural Products

(Barge)

% Increase in:	Rate	Reliability	Time
10	-0.586	0.191	-0.025
20	-0.559	0.187	-0.025
30	-0.53	0.181	-0.025
40	-0.506	0.175	-0.025
50	-0.486	0.169	-0.025
60	-0.47	0.165	-0.025
70	-0.456	0.16	-0.025
80	-0.444	0.156	-0.025
90	-0.433	0.153	-0.025
100	-0.423	0.149	-0.025

Table 3.13. Switching Elasticity Estimates with Respect to Changes in Rate/Time/reliability – Non-Agricultural Products

(Barge)

%	Rate			Reliability			Time		
Increase in:	**Grp A**	**Grp B**	**Grp C**	**Grp A**	**Grp B**	**Grp C**	**Grp A**	**Grp B**	**Grp C**
10	-0.86	-0.89	-0.95	1.56	1.03	1.15	-1.16	-1.11	-1.06
20	-0.87	-0.895	-0.945	1.28	0.88	0.97	-0.895	-0.86	-0.825
30	-0.84	-0.86	-0.907	1.103	0.78	0.857	-0.76	-0.73	-0.7
40	-0.803	-0.818	-0.858	0.975	0.708	0.773	-0.668	-0.645	-0.618
50	-0.758	-0.774	-0.808	0.876	0.652	0.706	-0.602	-0.58	-0.558
60	-0.717	-0.73	-0.76	0.797	0.603	0.652	-0.55	-0.532	-0.512
70	-0.679	-0.69	-0.716	0.733	0.564	0.606	-0.507	-0.491	-0.474
80	-0.643	-0.651	-0.674	0.679	0.529	0.568	-0.473	-0.459	-0.443
90	-0.609	-0.617	-0.637	0.631	0.499	0.533	-0.443	-0.43	-0.416
100	-0.578	-0.585	-0.603	0.591	0.472	0.503	-0.418	-0.406	-0.393

Table 3.14. Elasticity Estimates for Annual Volume with Respect to Changes in Rate/Time/Reliability - Non-Agricultural Products

(Barge)

%	Rate			Reliability			Time		
Increase in:	**Grp A**	**Grp B**	**Grp C**	**Grp A**	**Grp B**	**Grp C**	**Grp A**	**Grp B**	**Grp C**
10	-0.866	-0.637	-0.418	0.859	0.501	0.482	-0.905	-1.155	-0.404
20	-0.554	-0.417	-0.281	0.614	0.378	0.365	-0.572	-0.717	-0.269
30	-0.466	-0.358	-0.248	0.565	0.366	0.355	-0.475	-0.585	-0.234
40	-0.433	-0.341	-0.242	0.565	0.385	0.374	-0.438	-0.529	-0.227
50	-0.423	-0.34	-0.247	0.583	0.416	0.405	-0.423	-0.504	-0.23
60	-0.424	-0.347	-0.259	0.607	0.452	0.441	-0.42	-0.493	-0.239

Changes apply to shipper and its competitors.

Elasticities are Unconditional, i.e. calculated for all shippers even those who do not make any change.

WITHOUT-PROJECT CONDITION

Overview Identification of the most likely conditions expected to exist in the future in the absence of any improvements to the existing navigation system is a fundamental first step in the evaluation of potential improvements. The without-project condition serves as a baseline against which alternative plans of improvement are evaluated. The increment of change between an alternative plan and the without-project condition provides the basis for evaluating the beneficial or adverse economic, environmental, and social effects of the considered plan.

As discussed earlier in this chapter, a scenario-based approach to traffic forecasting has been employed in an effort to address the difficulty and inherent uncertainty of forecasting for a 50-year planning horizon. The scenarios developed represent a range of alternative views of the future demand for navigation on the UMR-IWW system. As a consequence of the treatment of these uncertainties, there are two representations of economic conditions that describe future conditions.

Because explicit probabilities have not been assigned to traffic levels, there is no identification of a most likely condition, and therefore, no single representation of the without-project condition. Descriptions of other considerations that are part of the two without-project conditions and, where appropriate, the rational for inclusion of a specific assumption, are presented below.

Description The without-project condition identified for this analysis includes the following analytical assumptions.

Operations and Maintenance of the System. Operation and maintenance of all system locks and dams will be continued through the period of analysis to ensure continued navigability.

Major Rehabilitation. In order to provide continued service it will be necessary to make recurring expenditures over and above those associated with operations and maintenance. These recurring expenditures, referred to as major rehabilitation, will be required at every lock site in the system during the period of the analysis. Table 3.23 includes a summary of the expected schedule of major rehabilitation expenditures by year for the without-project condition.

Lock Operating Policies. The current operating policy for the navigation system is first come, first served for commercial tows. However, the lockmasters can, and often do, depart from this procedure when warranted to obtain greater efficiency. It has been assumed that all system locks will use the most efficient locking policies that are deemed to be acceptable from both safety and operational perspectives. This includes the use of industry self help and N-up/N-down servicing.

Industry Self Help. Industry self help is a practice employed during double lockages to reduce total lockage time and to improve overall lock performance. With industry self help, the first cut of the double lockage can be moved to the guidewall or hauled to a remote site where the tow will be reassembled. This is accomplished by means of a towboat in the queue disengaging from its own barges and assisting with the extraction of the first cut of the double lockage. The efficiency gain results from the double-locking tow being able to reassemble without occupying the chamber. A variety of factors and conditions, which can be site specific, limit the times when self help can actually be implemented. With these restrictions factored in, industry self help currently results in approximately 5 to 15 minutes in savings, on average, for a double lockage.

Currently, industry self help is used on a limited basis. Inspection of historical Lock Performance Monitoring System (LPMS) data reveals that vessel assists on exit for double lockages were generally in the 1 to 2 percent range. It would be reasonable to expect that the future use of industry self help would increase with an expected increase in congestion. However, because of a number of considerations, including potential liability (for both waterway operators and the Federal Government), safety, and the potential for adverse environmental effects, the use of self help in the future was assumed to be restricted to historical usage.

N-up/N-down Servicing. The practice of N-up/ N-down servicing is another means by which additional operational efficiency can be derived. The primary benefit of N-up/N-down arises from minimizing approach times. N-up/ N-down servicing, multiple upstream lockages followed by multiple downstream lockages, results in a higher percentage of turnback lockages (next tow traveling in the same direction) that generally take significantly less time than exchange lockages (next tow traveling in the opposite direction). The time savings of replacing an exchange lockage with a turnback lockage is on average approximately 10 minutes on single lockages and 17 minutes on doubles. However, the additional time associated with turning back the chamber (averaging 11 minutes), reduces the time savings. As a result, the net savings of N-up/N-down servicing is roughly 6 minutes to double lockage tows.

Recreational Vessel Lockages. Current operating policies state that recreational vessels will not be required to wait for more than three commercial lockages before being locked. In many cases, recreational vessels are locked between every commercial lockage. While recreational vessel lockages typically take a relatively short amount of time (approximately 15 minutes at Mississippi River sites and 20 minutes at IWW sites) and can use the chamber when it is being turned back for the next tow, they do impact the overall scheduling of lockages. This feasibility analysis makes the assumption that the existing policies for recreational lockages will continue through the period of analysis.

Open River Conditions. At times on the IWW at the Peoria and La Grange sites, flow conditions permit navigation transit over the wicket dams. During these periods, referred to as open river, use of the locks is not necessary. Periods of open river are significant in that transit time is considerably shorter compared to times when transit through the locks are required. Open river has varied significantly from year to year (3 percent to 98 percent) and month to month. For the period 1939 to 1998, the percent of total time when open river was observed was approximately 38 percent and 42 percent for Peoria and La Grange, respectively.

The historical pattern of open pass at Peoria and Lagrange has been incorporated into the specification of transit curves, which describe the relationship between traffic volume and expected annual delay.

Alternative Mode Capacity. Alternative non-water transportation modes are assumed to have sufficient capability to move all traffic that would not be accommodated by water. All traffic moving by non-water modes in the future was assumed do so at current real (constant dollar) prices.

Unmodeled Waterway System. Delay and congestion costs at other potential system constraint points not explicitly modeled will not change significantly over the period of analysis. Also, all existing waterway projects across the national waterway system will be operated and maintained through the period of analysis.

SYSTEMS ANALYSIS

Overview. The Survey Model was run to estimate the total transportation cost savings (NED benefits) attributable to the with-project and without-project conditions over the period 2004 to 2068. (See xxx for discussion of the period of analysis.) Specifically, years 2004, 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2050, and 2060 were evaluated with the model. For intermediate years, the transportation cost savings were estimated by assuming a constant change in savings between the years explicitly modeled. Savings associated with years beyond 2060 were assumed to be equal to the 2060 value.

Without-Project Conditions Results. Tables 3.15a and 3.15b display tonnage for each lock site in the system by selected years, as well as tonnage for the system as a whole for the LTS and HTS, respectively. Note that system tonnage includes traffic moving over the open river (no locks and dams) segment of the Mississippi River between Lock 27 and Cairo, IL. The traffic difference between the two scenarios is significant over time. The difference reaches a maximum in 2030 when the Low Traffic forecast of grain reaches a minimum. Beyond 2030, the difference in total system traffic between the two scenarios is still significant, but the gap is reduced as growth in grain traffic rebounds in the LTS.

Tables 3.16a and 3.16b display the average delay by selected years at each lock site in the system for the Low Traffic and High scenarios, respectively. Average delays for existing conditions are the greatest on the Mississippi River at sites 20-25, and on the IWW at Lagrange and Peoria. These delays reflect the locations of greatest traffic (with the exception of Lock 26 and Lock 27 which both have significantly greater traffic processing capability compared to the rest of the system.) Changes in delay over time directly follow the pattern of traffic change. The clear relationship between traffic and average delay is reflected in the significantly greater delays associated with the HTS. As presented, average delay is the total of the average time in the queue and the average time required to be processed at the lock.

With-Project Conditions Results. Results for the recommended plan are summarized in the following tables. Note that for years prior to 2035 not all measures would be fully implemented. Therefore, those years prior to 2035 reflect only the partial degree of implementation that would be accomplished rather than full performance of the recommended plan. Table 17 summarizes the implementation timeframe for each of the features that constitute the recommended plan.

Tables 3.18a and 3.18b display lock and system tonnage for each lock site in the system by selected years, for the LTS and HTS, respectively. Tables 3.19a and 3.19b display the average delay by selected years at each lock site in the system for the Low Traffic and High scenarios, respectively.

Comparison of without-project and with project system traffic for the LTS reveals only small differences. This is a reflection of the fact that with the lesser demands placed on the system by the LTS, the system is able to accommodate the vast majority of potential traffic demands. However, this is not the case with the HTS. With the HTS the difference in without-project traffic and with project traffic becomes more significant over time. This is a reflection of the fact that the demands associated with the HTS are not fully accommodated in the without-project condition.

Table 3.20 displays the total system transportation costs savings for each traffic scenarios for both the without-project and with project conditions. For ease of comparison, these tables also display incremental transportation cost savings (with-project condition minus the without-project condition.) Inspection of the incremental transportation savings reveals that incremental savings vary greatly between the two traffic scenarios. In 2035 all features are fully implemented. At that point, incremental savings associated with the HTS are 16 times greater than with the LTS. The magnitude of this difference in incremental savings is a direct function of traffic and average delays in the respective without-project conditions. As the differences in without-project traffic and delays moderate beyond 2035, the magnitude of the incremental savings differential also moderates.

Of note are the negative values for incremental savings in 2015 for both scenarios. In 2015 moorings are the only measures scheduled to be completed, and lock construction is scheduled to be underway at seven sites. The net effect on system efficiency is negative, given that there are some unavoidable impacts on system operation due to construction activities. Also note that 2015 is not the only year that includes construction impacts to navigation operations. However, in these other years, the positive effect of implemented features exceeds the negative effect of construction impacts resulting in positive incremental savings.

Table3.15a. Without Project System Traffic -- Low Traffic Forecast by Lock and Year

Tons (1000)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	16,258	15,703	14,995	13,208	13,969	14,768	17,649	22,307	25,324	27,627
UM 12	17,749	17,116	16,270	14,290	15,122	15,996	19,142	24,150	27,394	29,871
UM 13	18,132	17,472	16,515	14,424	15,243	16,104	19,396	24,530	27,889	30,464
UM 14	20,405	19,563	18,284	15,824	16,540	17,305	20,938	26,433	30,034	32,767
UM 15	20,560	19,668	18,275	15,686	16,361	17,085	20,791	26,416	30,102	32,924
UM 16	21,096	20,089	18,495	15,830	16,512	17,243	21,091	26,778	30,555	33,478
UM 17	22,131	21,218	19,742	17,124	17,969	18,868	22,713	28,654	32,507	35,467
UM 18	22,857	21,905	20,228	17,407	18,228	19,103	23,208	29,380	33,447	36,595
UM 19	23,640	22,433	20,127	16,722	17,225	17,783	22,360	28,815	33,208	36,660
UM 20	24,756	23,501	21,054	17,486	18,004	18,576	23,391	30,126	34,737	38,364
UM 21	25,903	24,515	22,021	18,385	18,883	19,442	24,358	31,209	35,894	39,585
UM 22	26,249	24,826	22,259	18,566	19,051	19,596	24,630	31,495	36,211	39,930
UM 24	27,254	25,758	23,210	19,603	20,092	20,645	25,799	32,575	37,357	41,058
UM 25	27,256	25,760	23,211	19,603	20,092	20,645	25,800	32,577	37,360	41,061
UM 26	62,247	56,788	52,823	47,821	48,427	49,184	60,768	74,326	88,464	98,810
UM 27	68,358	61,893	57,894	52,851	52,799	52,894	64,798	78,690	93,178	104,005
LGR	33,222	29,475	28,573	27,813	27,879	28,044	33,704	39,160	47,533	53,072
PEO	28,780	25,274	25,461	25,763	25,980	26,295	30,564	34,711	41,656	45,848
Total UMRS Tons	**133,765**	**130,308**	**131,715**	**131,321**	**136,887**	**142,596**	**160,541**	**181,756**	**206,261**	**223,260**

Table 15b Without Project System Traffic -- High Traffic Forecast by Lock and Year

Tons (1000)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	16,258	22,745	24,446	26,268	27,949	29,551	29,273	29,615	30,505	31,243
UM 12	17,749	24,727	26,521	28,439	30,216	31,916	31,603	31,957	32,855	33,626
UM 13	18,132	25,224	27,038	28,978	30,777	32,495	32,147	32,495	33,397	34,182
UM 14	20,405	27,841	29,618	31,560	33,308	34,957	34,406	34,760	35,595	36,388
UM 15	20,560	28,041	29,814	31,756	33,501	35,140	34,539	34,870	35,743	36,559
UM 16	21,096	28,809	30,571	32,524	34,296	35,950	35,210	35,463	36,225	36,994
UM 17	22,131	30,386	32,330	34,469	36,405	38,220	37,479	37,765	38,570	39,360
UM 18	22,857	31,330	33,315	35,499	37,476	39,327	38,530	38,805	39,633	40,458
UM 19	23,640	31,975	33,768	35,783	37,558	39,193	38,216	38,406	39,183	40,024
UM 20	24,756	33,471	35,348	37,454	39,308	41,016	39,981	40,177	40,988	41,867
UM 21	25,903	34,901	36,788	38,930	40,770	42,474	41,357	41,565	42,376	43,267
UM 22	26,249	35,326	37,209	39,350	41,175	42,860	41,667	41,866	42,624	43,507
UM 24	27,254	36,644	38,457	40,656	42,485	44,100	42,922	43,013	43,725	44,530
UM 25	27,256	36,646	38,460	40,659	42,488	44,103	42,925	43,016	43,728	44,533
UM 26	62,247	84,322	87,203	93,439	98,572	101,672	103,752	102,777	110,272	112,972
UM 27	68,358	92,789	96,351	103,185	108,180	111,193	113,092	112,030	119,495	122,316
LGR	33,222	45,086	45,363	49,053	51,911	52,737	55,878	54,339	60,501	61,715
PEO	28,780	39,449	39,559	43,000	45,411	45,890	49,016	47,688	53,267	54,061
Total UMRS Tons	**133,765**	**181,017**	**192,702**	**207,942**	**220,644**	**231,239**	**238,301**	**242,151**	**259,621**	**268,010**

Table 3.16a. Without Project System Delays -- Low Traffic Forecast by Lock and Year

(hours)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	2.2	2.1	2.2	2.0	2.1	2.1	2.4	3.0	3.7	4.5
UM 12	2.2	2.2	2.2	2.0	2.1	2.1	2.4	3.0	4.0	4.6
UM 13	2.3	2.2	2.1	2.0	2.1	2.1	2.3	2.9	3.8	4.4
UM 14	2.5	2.4	2.3	2.1	2.2	2.2	3.0	4.0	6.3	8.3
UM 15	2.5	2.5	2.3	2.1	2.2	2.1	2.9	4.0	6.4	8.5
UM 16	2.4	2.2	2.2	2.0	2.0	2.1	2.9	3.8	5.8	7.2
UM 17	2.6	2.6	2.5	2.3	2.4	2.5	4.0	5.7	6.5	8.3
UM 18	2.4	2.4	2.4	2.1	2.2	2.3	2.9	3.8	5.2	6.5
UM 19	1.6	1.4	1.4	1.3	1.3	1.4	1.4	1.6	1.8	2.0
UM 20	2.8	2.6	2.5	2.2	2.2	2.2	3.8	5.7	6.0	7.7
UM 21	3.0	2.7	2.7	2.3	2.5	2.5	3.7	5.9	6.1	7.8
UM 22	3.8	3.6	3.3	2.7	3.3	3.4	9.2	11.0	19.2	27.9
UM 24	3.5	3.3	3.6	3.0	4.0	4.5	8.7	14.8	24.9	38.3
UM 25	3.7	3.5	3.5	3.0	3.5	3.6	7.4	12.8	25.9	37.4
UM 26	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8
UM 27	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9
LGR	2.9	2.4	5.8	2.3	3.1	3.1	3.8	16.1	9.7	14.1
PEO	2.3	2.0	4.6	2.0	2.3	2.4	3.7	15.5	8.8	13.1

Average Delay equals average time in the queue plus average processing time.

Table 3.16b. Without Project System Delays -- High Traffic Forecast by Lock and Year

(hours)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	2.2	2.9	3.3	4.0	4.2	4.7	4.7	4.8	6.0	6.5
UM 12	2.2	3.0	3.5	4.0	4.9	5.3	4.7	4.8	5.8	6.3
UM 13	2.3	3.0	3.3	3.9	4.5	4.8	4.5	4.7	5.5	5.9
UM 14	2.5	3.5	4.6	5.6	6.5	7.0	7.5	7.8	12.0	13.6
UM 15	2.5	3.6	4.7	5.7	6.7	7.2	7.6	7.9	12.2	14.0
UM 16	2.4	3.4	3.8	4.3	4.7	5.4	6.6	6.8	9.3	10.1
UM 17	2.6	3.8	4.4	5.6	5.9	7.4	11.0	11.7	11.3	12.5
UM 18	2.4	3.5	4.1	4.4	5.5	6.7	6.9	7.0	8.7	9.5
UM 19	1.6	1.7	1.8	1.9	2.1	2.3	2.0	2.0	2.2	2.2
UM 20	2.8	4.1	4.9	5.3	5.9	6.9	10.3	11.6	9.8	10.7
UM 21	3.0	4.2	5.7	5.5	6.6	7.5	9.8	12.2	9.8	10.7
UM 22	3.8	6.2	9.7	9.0	13.7	17.1	38.8	31.9	39.4	45.2
UM 24	3.5	6.7	10.2	14.6	22.3	33.6	39.3	43.8	58.6	68.9
UM 25	3.7	6.6	9.0	11.7	17.5	22.2	28.7	32.9	51.9	58.4
UM 26	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
UM 27	0.8	0.9	0.9	0.9	1.0	1.0	1.0	0.9	1.0	1.0
LGR	2.9	10.8	26.3	29.1	20.6	23.9	19.9	41.4	28.9	34.2
PEO	2.3	6.1	32.7	31.7	37.9	56.7	40.7	56.9	52.0	72.5

Average Delay equals average time in the queue plus average processing time.

Table 3.17. With Project Implementation Dates

Feature	Start - Complete
Mooring Cells	2008 - 2011
New Locks at Locks 22 & 25	2008 - 2018
New Lock at Lock Lagrange	2008 - 2021
New Locks at Locks 21 & 24	2009 - 2021
New Lock at Lock 20	2012 - 2024
New Lock at Lock Peoria	2012 - 2026
Lock Extensions at Locks 17 & 18	2018 - 2029
Lock Extension at Lock 16	2020 - 2031
Lock Extension at Locks 15	2020 - 2031
Lock Extension at Locks 14	2023 - 2034
Switchboats at Locks 11 - 13	2034 - 2068

Table 3.18a. With Project System Traffic -- Low Traffic Forecast by Lock and Year

Tons (1000)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	16,258	15,711	14,995	13,285	14,189	15,083	18,532	23,259	27,050	30,402
UM 12	17,749	17,124	16,270	14,377	15,372	16,350	20,136	25,213	29,316	32,944
UM 13	18,132	17,480	16,515	14,510	15,493	16,457	20,389	25,620	29,871	33,646
UM 14	20,405	19,576	18,285	15,927	16,838	17,724	22,117	27,907	32,674	36,913
UM 15	20,560	19,679	18,275	15,790	16,665	17,515	21,997	27,879	32,719	37,053
UM 16	21,096	20,101	18,494	15,947	16,854	17,725	22,404	28,312	33,305	37,829
UM 17	22,131	21,230	19,741	17,254	18,356	19,413	24,175	30,233	35,332	39,932
UM 18	22,857	21,917	20,227	17,537	18,615	19,648	24,671	30,998	36,359	41,221
UM 19	23,640	22,445	20,125	16,853	17,618	18,325	23,799	30,565	36,368	41,696
UM 20	24,756	23,514	21,052	17,622	18,412	19,137	24,875	31,934	38,017	43,611
UM 21	25,903	24,528	22,018	18,532	19,319	20,030	25,909	33,148	39,391	45,131
UM 22	26,249	24,840	22,256	18,716	19,487	20,182	26,174	33,533	39,897	45,754
UM 24	27,254	25,773	23,206	19,757	20,539	21,237	27,341	34,810	41,321	47,295
UM 25	27,256	25,774	23,207	19,757	20,539	21,237	27,342	34,812	41,324	47,298
UM 26	62,247	56,801	52,820	47,968	49,087	50,126	62,828	78,052	93,088	106,189
UM 27	68,358	61,906	57,891	52,995	53,447	53,823	66,831	82,336	97,716	111,267
LGR	33,222	29,476	28,572	27,817	28,120	28,417	34,259	41,382	49,093	55,418
PEO	28,780	25,276	25,460	25,767	26,216	26,665	31,115	36,838	43,148	48,077
Total UMRS Tons	**133,765**	**130,324**	**131,712**	**131,477**	**137,568**	**143,577**	**162,739**	**185,914**	**211,432**	**231,356**

Table 3.18b. With Project System Traffic -- High Traffic Forecast by Lock and Year

Tons (1000)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	16,258	22,767	24,402	26,633	28,969	31,066	32,425	32,925	34,681	36,033
UM 12	17,749	24,751	26,474	28,839	31,338	33,572	35,058	35,578	37,417	38,836
UM 13	18,132	25,250	26,990	29,391	31,935	34,202	35,711	36,228	38,115	39,582
UM 14	20,405	27,875	29,560	32,086	34,750	36,966	38,950	39,529	41,696	43,394
UM 15	20,560	28,072	29,748	32,296	35,011	37,311	39,112	39,661	41,820	43,534
UM 16	21,096	28,841	30,499	33,101	35,922	38,323	40,069	40,550	42,662	44,382
UM 17	22,131	30,419	32,254	35,066	38,094	40,692	42,479	43,000	45,191	46,954
UM 18	22,857	31,364	33,236	36,118	39,239	41,911	43,693	44,210	46,486	48,336
UM 19	23,640	32,010	33,678	36,462	39,533	42,094	43,811	44,275	46,628	48,589
UM 20	24,756	33,507	35,251	38,167	41,397	44,076	45,808	46,287	48,754	50,815
UM 21	25,903	34,939	36,675	39,745	43,141	45,879	47,626	48,123	50,669	52,796
UM 22	26,249	35,366	37,087	40,227	43,692	46,465	48,218	48,723	51,321	53,496
UM 24	27,254	36,687	38,317	41,616	45,237	48,290	50,062	50,582	53,165	55,285
UM 25	27,256	36,689	38,319	41,619	45,240	48,293	50,065	50,585	53,169	55,289
UM 26	62,247	84,359	87,088	94,242	101,433	111,608	114,776	116,735	122,772	126,543
UM 27	68,358	92,825	96,239	103,964	110,965	120,875	123,863	125,669	131,727	135,621
LGR	33,222	45,089	45,356	49,065	52,541	60,048	61,536	62,860	65,508	66,384
PEO	28,780	39,452	39,549	43,005	45,845	53,024	54,529	55,875	58,019	58,408
Total UMRS Tons	**133,765**	**181,062**	**192,577**	**208,827**	**223,717**	**241,731**	**250,175**	**257,103**	**273,121**	**282,550**

Table 3.19a. With Project System Delays -- Low Traffic Forecast by Lock and Year

(hours)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	2.2	2.1	2.2	2.0	2.1	1.9	2.2	2.7	3.4	4.5
UM 12	2.2	2.1	2.1	2.0	2.1	2.0	2.3	2.9	4.0	5.2
UM 13	2.3	2.2	2.1	2.0	2.0	2.0	2.1	2.7	3.7	4.7
UM 14	2.5	2.3	2.2	2.0	2.1	2.2	1.3	1.5	1.7	2.0
UM 15	2.5	2.3	2.2	2.0	2.1	2.1	1.3	1.5	1.7	2.0
UM 16	2.4	2.2	2.2	2.0	2.3	2.4	1.2	1.3	1.6	1.8
UM 17	2.6	2.6	2.5	2.3	2.4	1.3	1.4	1.6	1.9	2.2
UM 18	2.4	2.3	2.3	2.1	2.2	1.1	1.2	1.4	1.6	1.8
UM 19	1.6	1.4	1.4	1.3	1.3	1.4	1.4	1.7	2.0	2.4
UM 20	2.8	2.6	2.5	2.3	1.0	1.0	1.1	1.2	1.3	1.5
UM 21	3.0	2.7	2.7	2.4	1.1	1.1	1.2	1.3	1.6	1.8
UM 22	3.8	3.6	3.3	1.3	1.3	1.3	1.4	1.6	1.9	2.3
UM 24	3.5	3.1	3.6	2.7	0.9	1.1	1.2	1.3	1.5	1.8
UM 25	3.7	3.5	3.7	1.0	1.0	1.0	1.1	1.2	1.4	1.5
UM 26	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8
UM 27	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1.0
LGR	2.9	2.4	5.8	2.3	0.7	0.7	0.8	1.0	1.4	1.9
PEO	2.3	2.0	4.6	2.1	2.4	0.9	1.0	1.3	1.6	2.3

Average Delay equals average time in the queue plus average processing time.

Table 3.19b. With Project System Delays -- High Traffic Forecast by Lock and Year

(hours)

Lock	2004	2010	2015	2020	2025	2030	2035	2040	2050	2060
UM 11	2.2	2.9	3.3	4.1	5.2	4.0	4.7	4.9	7.2	8.9
UM 12	2.2	2.9	3.5	4.1	4.8	5.6	5.5	5.9	8.0	9.6
UM 13	2.3	3.0	3.3	4.0	4.7	4.4	4.9	5.4	6.9	8.1
UM 14	2.5	3.3	4.3	5.4	7.9	13.5	2.1	2.2	2.5	2.8
UM 15	2.5	3.4	4.4	5.5	8.3	15.3	2.1	2.2	2.6	2.8
UM 16	2.4	3.4	3.8	4.4	8.0	11.0	1.9	1.9	2.2	2.3
UM 17	2.6	3.8	4.4	5.3	6.7	2.1	2.3	2.4	2.6	2.8
UM 18	2.4	3.4	3.9	4.6	5.8	1.8	1.9	1.9	2.2	2.3
UM 19	1.6	1.7	1.8	1.9	2.2	2.5	2.4	2.4	2.9	3.1
UM 20	2.8	4.1	4.9	6.3	1.4	1.5	1.5	1.5	1.7	1.7
UM 21	3.0	4.3	5.7	7.8	1.6	1.7	1.8	1.8	2.2	2.3
UM 22	3.8	6.3	9.6	2.0	2.0	2.1	2.2	2.2	2.7	3.0
UM 24	3.5	6.1	11.0	10.4	0.9	1.8	1.8	1.9	2.1	2.3
UM 25	3.7	6.6	11.8	1.4	1.5	1.6	1.6	1.6	1.8	1.9
UM 26	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
UM 27	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1
LGR	2.9	10.8	26.0	28.5	1.6	3.0	3.7	4.6	4.0	4.5
PEO	2.3	6.1	32.9	33.3	54.2	3.9	5.0	6.5	29.2	56.7

Average Delay equals average time in the queue plus average processing time.

Table 3.20. Total and Incremental Transportation Savings by Traffic Forecast and Year

$millions (2006 Prices)

Economic Condition	2010	2020	2030	2040	2050	2060
Low Traffic Scenario						
Without Project	$1,783.67	$1,767.15	$1,907.24	$2,298.24	$2,640.46	$2,876.29
With Project	$1,784.02	$1,769.90	$1,924.30	$2,387.18	$2,764.32	$3,082.82
Incremental Savings	$0.35	$2.75	$17.06	$88.94	$123.86	$206.52
High Traffic Scenario						
Without Project	$2,552.21	$2,827.54	$3,062.80	$3,109.51	$3,300.46	$3,368.62
With Project	$2,553.21	$2,848.29	$3,299.24	$3,457.81	$3,635.52	$3,740.64
Incremental Savings	$1.00	$20.75	$236.44	$348.30	$335.06	$372.02

PROJECT COSTS, SUMMARY OF BENEFITS, AND ECONOMIC JUSTIFICATION

Project Costs

Construction and System Environmental Costs. Project expenditures by year in 2006 prices, including site specific mitigation costs and system environmental costs, are displayed in Table 3.21. Total costs are $3.665 billion composed of $3.463 billion for construction and site specific mitigation, and $0.2 billion for system mitigation. Note that these first costs include costs for operation of switchboats. The implementation timeframe for construction is 27 years, 2008-2034 (exclusive of switchboats and system environmental costs.) This timeframe reflects an implementation process that proceeds as quickly as the measures can be designed and constructed. The timeframe is not budget constrained.

The implementation timeframe used in the analysis for construction was 27 years, 2008-2034, (exclusive of switchboats and system environmental costs), which represents a budgetary environment with reasonable expectations of occurring. This is not an optimum timeframe in terms of cost or time. Assuming no budgetary constraints, a more compact schedule and greater rate of expenditure would result in a less costly project, less impact on navigation during construction, and earlier delivery of benefits.

System environmental costs are a function of the incremental traffic generated by project features. (Incremental traffic is the difference between traffic in the without–project condition and traffic in the with–project condition.) Because of the multiple representations of economic conditions (two traffic forecasts) there are actually two estimates of incremental traffic for the recommended plan. The system environmental costs reflected here actually represent the worst case (largest increase) situation for incremental traffic identified in the December 2004 Feasibility Study. The costs shown in Table 3.21 reflect all the required expenditures to implement and maintain the required measures. As such, these costs are not strictly first costs only, since they include operations and maintenance costs, and future replacement costs. System environmental costs are treated here as first costs as an accounting convenience given the manner in which the estimates were developed.

Other NED Costs. Impacts to navigation as a result of construction activities are financial losses suffered by the industry and the Nation. While not necessarily a direct outlay of expenditures, these financial losses are NED in nature. For accounting purposes in this analysis, impacts to navigation during construction are captured in the pre base year benefit stream as negative adjustments to system savings.

Operations, Maintenance, and Replacement Costs. Among the various with-project measures there are three types of structural improvements. These are mooring cells, lock extensions and new locks. The operations, maintenance, and replacement costs for the three types of structural improvements are as follows (in 2006 prices) once the full compliment has been constructed. For mooring cells, annual operations and maintenance costs are collectively $207,000; replacement costs are collectively $429,000 every five years. For lock extensions at locks 14-18, annual operations and maintenance costs are collectively $408,000. In the case of new lock construction at locks 20-25, annual operations and maintenance costs are collectively $4,063,000. For new lock construction at Lagrange and Peoria, annual operations and maintenance costs are collectively $1,775,000.

Average Annual Costs. Table 3.22 displays total first costs, the present value of first costs, interest during construction, and average annual costs. First costs are the costs required to initially implement each project feature. The present value of first costs represents the schedule of first costs discounted/compounded to a common point in time. Average annual costs represent the amortized present value of first costs. Interest during construction represents the difference in the present value of the first cost of implementation and the undiscounted value of the first cost of implementation for those expenditures prior to the base year.

Table 3.21. Construction, Site Specific Mitigation and Systemic Environmental Mitigation Costs

(2006 Prices, $millions)

Year	Construction & Site Specific Mitigation	Systemic Env. Mitigation	Total Cost
2008-16	$1,002.750	$77.946	$1,080.696
2017-24	$1,262.115	$67.114	$1,329.229
2025-32	$709.373	$41.187	$750.560
2033-40	$116.230	$7.224	$123.454
2041-48	$106.568	$7.224	$113.792
2049-68	$266.410	$1.112	$267.522
Total	**$3,463.446**	**$201.807**	**$3,665.253**

Table 3.22. Total First Costs, the Present Value of First Costs, Interest During Construction, and Average Annual Costs

Construction and Site-Specific Mitigation	$3,463,446
System Environmental Costs	$201,810
Total Costs	**$3,665,256**
Present Value Construction & Site-Specific Mitigation	$2,964,120
Present Value System Environmental Costs	$192,522
Total Present Value Costs	**$3,156,642**
Interest During Construction	$273,222
Avg Annual Construction and Site-specific Mitigation	$159,239
Avg Annual System Environmental Costs	$10,343
Avg Annual OM&R Costs	$5,509
Total Annual Costs	**$175,091**
Base Year	**2019**

All costs in the table represent 2006 prices. Annual costs were calculated using an interest rate of 4.875 percent, a 50-year period of analysis, and a base year of 2019. The base year represents the point in time when the first large scale measures, new locks at lock 25 and lock 22, are scheduled to be operational. The base year also represents year one of the 50-year period of analysis (2019-2068), and the reference point in time for all average annual values.

Summary of Benefits. Total average annual benefits are composed of two types—transportation savings, which have been previously discussed in detail; and rehabilitation expenditure savings, which require additional explanation. Rehabilitation expenditure savings represent costs that would be avoided with project implementation. Lock extensions or new lock construction would obviate the need for certain items of work that would otherwise be required. The magnitude of this benefit category is a function of not only the magnitude of the expenditures required, but also the timing of the outlays. Specifically, the measure of this benefit is the present value difference between the projected without-project rehabilitation expenditures and the projected with-project rehabilitation expenditures. Table 3.23 summarizes the with-project and without-project total rehabilitation expenditure streams, and the present value difference in expenditure streams. The present value difference is computed using an interest rate of 4.875 percent. Note that the rehabilitation costs shown in Table 3.23 for both without-project and with-project conditions do not reflect total system rehabilitation costs. These costs only reflect the rehabilitation requirements for locks 14-18, locks 20-

25, Peoria Lock and Lagrange Lock only (the sites identified for new/extended locks in the recommended plan).

Economic Justification. Table 3.24 displays the composition of total average annual benefits, total average annual costs, net benefits (the difference between average annual benefits and average annual costs), and the benefit-to-cost ratio for each traffic scenario. The table shows that the recommended plan has positive net benefits for the HTS only, indicating that growth in current traffic volume is required for economic justification. With no growth in current traffic, net benefits would be negative and the benefit-cost ratio would be 0.2:1 (values not displayed in table.) Assuming the traffic growth associated with the LTS, net benefits remain negative with the benefit-cost ratio increasing to 0.4:1. Assuming the traffic growth associated with the HTS, net benefits become positive and the benefit-cost ratio increases further to 1.3: 1

Table 3.23 Scheduled Lock Rehabilitation Expenditures

(2006 Prices, $millions)

Year	Without Project	Recommended Plan
2015	$163.350	$84.942
2017	-	-
2018	-	-
2019	-	$19.602
2020	$190.575	$130.680
2021	-	$9.801
2023	-	-
2024	-	-
2025	$32.670	$32.670
2026	-	-
2028	-	-
2030	-	-
2035	-	-
2040	$136.125	$54.450
2045	$168.795	$163.350
2046	-	-
2049	-	$54.450
2050	$27.225	$27.225
2051	-	$27.225
2052	-	-
2055	-	-
2056	-	-
2057	-	-
2059	-	-
2060	-	-
2061	-	-
2063	-	-
2065	$163.350	$65.340
2070	$190.575	$206.910
P.V. Diff	**$170.568**	
Avg Ann Diff	**$10.259**	

Table 3.24. Average Annual Benefit Cost Summary (2006 Prices, $millions, 4.875 Percent)

	Low Traffic Forecast	High Traffic Forecast
Avg Ann Trans Savings	$56.214	$209.062
Avg Ann Rehab Savings	$20.827	$20.827
Avg Ann Total Benefits	$77.041	$229.890
First Costs	$3,665.256	$3,665.256
Present Value of First Cost	$3,156.642	$3,156.642
Interest During Construction	-$508.614	-$508.614
Avg Ann I&A	$169.582	$169.582
Avg Ann O&M	$5.509	$5.509
Avg Ann Total Costs	$175.091	$175.091
BCR	0.44	1.31
Net Benefits	-$98.050	$54.799
Base Year	2019	2019

NATIONAL ECONOMIC DEVELOPMENT – PHASE 2 MULTIMODAL ANALYSIS

NEED FOR MULTIMODAL ANALYSIS

The need to explore the relationship between inland navigation and other modes of freight transportation was driven by the premise that the growth in freight demand is likely to exceed the Nation's ability to move it effectively and efficiently at reasonable cost. Capacity and productivity of the national freight transportation system will need to increase faster through innovation and a greater rate of investment.

The second phase of NED analysis is intended to complement the traditional analysis done in the first phase. Although the traditional analysis under the first phase is a rigorous economic analysis, using state-of-the-art models and techniques, it also has limitations. Traditional analysis uses a largely single mode analysis, which is founded on the basic assumptions that capacity on alternative modes is adequate and transportation rates remain constant through the planning horizon. This does not match with current trends and projections for the national transportation system. The traditional analysis also does not include other socio-economic effects (beneficial or adverse) of a navigation project which, if monetized, could have a bearing on economic feasibility.

The research, coordination, and review conducted as part of this reevaluation have revealed more than ever the need for a multimodal analysis. Reasons include:

- proper measurement of full impact of investment in the inland waterway system
- constraints of current evaluation procedures significantly underestimate benefits of waterway investments
- comparison of transportation improvement projects at the Washington level requires use of a common set of criteria for measuring economic benefits across modes

- understanding how change (structural or non-structural) in one aspect of the national transportation system affects others and how an investment action in one aspect of the system affects investment decisions of others for other aspects of the system.

This is a significant concern at this time because the character of the country's freight traffic needs are changing dramatically and the inland waterway is likely to play a much more significant role in the next forty years than it has played in the last forty years.

The Phase 2 analysis is a qualitative exploration of the potential impacts that congestion and constraints in other modes and at ports and border crossings may have on utilization of waterways. It also gives consideration to non-traditional beneficial effects not normally evaluated in a standard Corps benefit-cost analysis for a navigation feasibility study. These will be discussed first.

NON-TRADITIONAL BENEFITS

Traditional inland navigation benefits are the cost savings of transporting freight by barge versus highway and/or rail. These are referred to as National Economic Development benefits and serve as the primary criteria for selection of a plan to recommend for implementation. However, they are not the only beneficial effect of a navigation project.

Diverting freight tonnage from the land-based transportation system to the waterway transportation system generates other benefits which include:

- reduced congestion on highways and railways;
- lower fuel use and emission of air pollutants;
- fewer injuries and fatalities;
- reduced repairs of railroad tracks and highway pavements; and
- delay of highway or railroad expansion projects.

These types of non-traditional benefits are considered external to the Corps' standard benefit-cost analysis and as such are not typically quantified in determining a project's economic feasibility. Nonetheless, when comparing the movement of freight by barge versus the alternative of truck and/or rail, these additional benefits can be significant and increase with greater utilization of the waterway. And they should be considered via a multimodal analysis to more comprehensively assess costs and benefits of a navigation project.

Of the non-traditional benefits mentioned above, congestion reduction has been given special consideration recently as a legitimate benefit to include in the NED account. Recent Corps studies have attempted to monetize them for inclusion in the benefit-cost analysis and Corps HQ has approved its use where appropriate data, tools, and methodology are applicable. This category is treated to some extent for this study as an item in the Other Social Effects (OSE) account. The impact of the incremental traffic that would remain on land if the project is not built is considered by the additional number of vehicles that are subject to delays at railroad crossings (see Other Social Effects section later in this chapter). What is not considered is the congestion reduction on railroads and highways associated with the increment of traffic that might be diverted to the waterways as a result of the recommended plan.

Congestion reduction has the potential to be a significant benefit to the waterways that currently is not monetized in the benefit-cost analysis. Waterway proponents claim that the waterway can serve as a relief valve to reduce congestion on the rail/highway network. Benefits of reducing highway congestion include the value of driver/passenger time savings and vehicle operating costs for trucks and automobiles. Reduction of highway and rail congestion also benefits business. Market area for current production facilities and access area for specialized inputs can be expanded resulting in production and delivery efficiencies. Improved logistics also allows business to take advantage of economic efficiencies such as reduced inventory associated with the just-in-time approach to production and retailing. No attempts have yet been made to assign these types benefits to the NED account. Additional research is required to determine the level of applicability to navigation improvement projects. But to the extent that a navigation improvement project can reduce highway/rail congestion, these benefits have potential significance.

Congestion

National Strategy to Reduce Congestion on America's Transportation Network
(DOT, May 2006)

- In 2003 congestion in the top 85 urban areas caused 3.7 billion hours of travel delay and 2.3 billion gallons of wasted fuel at a total cost of $63 billion (Texas Transportation Institute - TTI).

- In the 10 most congested areas, each rush hour traveler pays an annual congestion tax of between $850 and $1600 in lost time and fuel. Each rush hour traveler spends the equivalent of almost 8 workdays each year stuck in traffic.

- Congestion delays results in families spending less time together, with friends, and involved in their communities. Evidence suggests that each additional 10 minutes in daily commuting cuts involvement in community affairs by 10% (Robert Putnam, Bowling Alone, 2000).

- Congestion costs businesses – increased levels of inventory to cover for unreliability in transportation delivery, earlier shipping in anticipation of delays, higher transportation costs because of reduced efficiency. In 2005 congestion at the Otay Mesa and Tecate crossings along the California-Mexico border was estimated to cost the U.S. economy $3.7 billion in output and almost 40,000 jobs (San Diego Association of Governments).

- Between 1982 and 2003, U.S. highway congestion increased dramatically in large U.S. cities, impacting 67 percent of travel in 2003 versus 33% in 1982; lasting 7 hours per day in 2003 versus 4.5 hours per day in 1982; and increasing drive time by 37% in 2003 versus 13% in 1982. Cities of all sizes and rural areas are all experiencing congestion.

In addition to the congestion reduction benefit discussed above, other beneficial effects of the inland waterways and waterway improvement projects include reduced fuel consumption, pollution emissions, accidents (injuries and fatalities), and highway pavement repairs. These beneficial effects are commonly cited as environmental and social advantages of the barge mode of transport over rail and truck. And they are often referred to as externalities in the sense that they are external to the Corps' traditional benefit-cost evaluation of project impacts. Attempts have been made recently to quantify some these effects in monetary terms and bring them into the benefit-cost analytical framework. But they are not as yet authorized for use in the Corps' procedures for benefit-cost analysis. Instead, for documentation purposes the effects, beneficial or adverse, are often expressed in non-monetary terms and assigned to one of three other accounts: other social effects (OSE), regional economic development (RED), or environmental quality.

Like congestion reduction, these other non-traditional benefits are potentially significant as well. Compared to the rail and trucks respectively, the barge mode of transport is 25 percent and 760 percent more fuel efficient in moving freight. Trains and trucks respectively produce 5 times and 7 times more hydrocarbons; 3 times and 9 times more carbon monoxide; and 3 times and 19 times more nitrous oxide than towboats to move one ton of freight 1,000 miles. And trucks and railroads respectfully are 84 times and 115 times more likely to produce a fatality and railroads are 240 times more likely to produce an injury than barge tows. Movement of freight by barge rather than land-based modes also not only reduces the frequency of highway repairs but delays the need for costly highway and rail expansion projects as well. See the Other Social Effects section later in this chapter for further discussion of these items.

In addition to non-traditional benefits external to the Corps' benefit-cost analysis, there may also be externalized non-traditional costs, such is the social cost of public funds.

MULTIMODAL TRANSPORTATION SCENARIO

The central element of the multimodal transportation scenario (MTS) is a projection of increasing congestion on the rail/highway network and at gateway ports. The intent is to see the quantitative analysis of phase 1 (LTS and HTS) in the context of a different, more realistic, transportation environment, one growing more congested. The complexity of the transportation environment (relating to the interplay of market conditions and transportation decisions) and the lack of tools in which to make "what if" multimodal analysis precluded a rigorous quantitative evaluation of MTS, similar to what was done for LTS and HTS. Nonetheless, qualitative assessment provides some understanding of the state of the national transportation system.

One observation from performing the MTS analysis was the near certainty that the rate of transportation investment will need to increase in the future to mitigate growing congestion, allow for the efficient and reliable flow of freight comparable to what the Nation has now, and ensure a flexible and robust system under many different conditions that may happen in the future. Another observation is that in contrast to certainty in need for a greater rate of investment in transportation, there is much uncertainty in how much will be invested, what investments will be made, who will make them, and when they will be made. Qualitative assessment is valuable in evaluating a project's merits in the complex environment of the national transportation system.

Implementation of the Recommended Plan under this scenario will draw additional tonnage to the river as the new investment increases efficiency, reliability, and capacity of the UMR-IWW. Investment in waterway infrastructure provides incentives to carriers to expand and improve their operations and to shippers to take advantage of lower cost and increased reliability. In a competitive environment among carriers, rail will not willingly lose freight to water anymore than to other rail companies, truckers, etc. If carriers on waterways look like they may gain a competitive edge in the future, rail companies and truckers may willingly seek out more collaborative, inter-modal relationships in addition to direct competition. Rail may concentrate on higher valued products in competition with truckers and allow lower valued bulk freight to shift to water.

The following discussion considers several components of the multimodal transportation scenario and how they may impact on future use of the waterway as part of the intermodal transportation system.

Rail Capacity. As presented briefly in Chapter 1, the rail network in many parts of the United States is showing signs of congestion and capacity constraints. This fact is revealed through much reporting by transportation researchers and officials and through investigations into water-compelled rates and rail capacity as part of this reevaluation. Given anticipated growth in freight traffic, congestion and constraints are expected to get worse. While it is clear that privately owned railroads are making substantial capital investment to improve capacity and efficiency, it is not clear to what extent rail companies will be willing to respond to opportunities for even higher levels of investment. They will only recapitalize to the extent capital is available and will invest only if the risk of receiving an adequate return on their investment is acceptable.

To the extent that global commerce continues to expand, near-term east-west rail capacity will continue to be exhausted by the related growth in intermodal flows. Capacity constraints and congestion in the vicinity of East and West Coast ports is especially acute and will be difficult and expensive to resolve through capital investment. This may lead shippers to seek alternative ways to move goods in and out of the country.

As part of this reevaluation the Corps contracted with the Center for Transportation Research at the University of Tennessee for a qualitative assessment of rail capacity in the north – south corridor that competes with or supplements waterway capacity on the Mississippi River and Illinois Waterway.

Rail systems over most network links in the north-south have adequate capacity to handle current traffic. Although system-wide reserve capacity is minimal, networks examined in the study have been adequately responding to increasing demand without adverse impact on rail rates. The question is whether this pattern will continue under even more growth in freight demand and greater utilization of the north-south corridor and where rail is expected to move more multimodal freight in the future?

Part of the solution might be for the inland waterway system to serve as a relief valve to help lessen future highway and rail congestion. The underlying premise here is that increased rail congestion leads to increased rail costs and reduced reliability resulting in the diversion of tonnage onto water. Under traditional Corps economic analysis, it assumed that the relationship between water and rail is in static equilibrium. Increasing congestion and constraints on rail lead to higher rail rates, which in turn lead to a widening of the rate differential between rail and water, thus diverting more tonnage to water. More traffic might be expected to be carried on waterways under this scenario than is predicted through traditional analysis. As rail congestion worsens and rail rates continue to rise, the cycle repeats as the water/rail differential increases and traffic continues to be drawn to the river.

This may lead to traffic growth on the waterways in the future either in one of two ways. The barge industry may be able to compete directly for tonnage as rail /highway costs increase due to congestion. Or barge traffic may grow as an indirect consequence of railroads' decision to direct their operations towards more profitable containerized traffic and allow more bulk freight to divert to the waterway. In either case, the magnitude of traffic diversion depends on the level of rail/highway congestion and related costs.

There are vulnerable points in the north-south corridor, which do not have redundancy and would constrain trade and substantially increase congestion, if service were lost. One example is the Thebes Bridge at Thebes, IL. Were this structure removed from service, Union Pacific and BNSF north – south traffic would cause a major shift of traffic to alternative crossing, adding greatly to congestion at St. Louis and other cities with Mississippi River crossings.

Rail Investment. In response to the congestion problems and opportunities for greater profits from the rail system, railroad companies, with assistance by the government in some cases, have been upgrading their infrastructure and their operations to move freight more efficiently. As mentioned in Chapter 1, the national railway system has undergone transformation since deregulation in 1980 resulting in greatly improved productivity. More efficient rail movements have contributed to the redirection of significant volumes of export grain traffic from Gulf ports via the UMR barge system to the Pacific Northwest via railroad unit trains. The "easier" productivity gains following deregulation have largely played out. Future gains are going to be more challenging and require greater investment. Future capacity expansion will be at higher cost than in the past because it costs much more to add capacity rail to lines that are in good condition than to those which are in poor condition. There are fewer and fewer opportunities to rehabilitate lines in poor condition. Industry may not be able to deliver revenue-neutral capacity expansion. Prevailing sentiment is that every conceivable resource will be needed in order to meet projected freight transportation demands. According to the American Association of Railroads, Class I railroads spent more than $8 billion in 2006 laying new track, buying new equipment, and making infrastructure improvements. This is a 21 percent increase over capital expenditures in 2005. And system upgrades have been implemented to improve the transport of freight containers from coastal ports to interior destinations.

Examples infrastructure improvement projects include:

- Burlington Northern Santa Fe Railway Co. (BNSF) is in the process of closing the remaining gaps where double track does not currently exist on its transcontinental line
- Union Pacific Railroad Co. (UP) is adding double track on its line from the West Coast to the Midwest
- UP and BNSF are triple tracking their lines out of the Powder River Basin
- Norfolk Southern and Kansas City Southern joint venture on the Meridian Speedway between Meridian, MS and Shreveport, LA
- Chicago's CREATE program, a public-private partnership, will invest $1.5 billion to upgrade Chicago's rail infrastructure

As the railroads are more direct competitors with barges, the extent to which the barge mode can assist in addressing the congestion problem will depend largely on the magnitude of the future rail congestion problem as opposed to the highway congestion problem. That is, there will be less pressure to transfer freight to the waterways if railroad capacity is able to keep pace with demand and minimize congestion. However, if rail capacity reaches its limit and congestion on railroads worsens in the future, railroads may allow more of their bulk freight to transfer to the waterway and concentrate on more profitable container traffic. In fact this phenomenon has already been observed. This may be an opportunity for the waterways in the future as shippers increasingly look to the waterways as a more viable alternative for moving freight.

A recent survey of shippers by consultants Booz Allen Hamilton in coordination with *Traffic World* shows that shippers overwhelmingly feel that the rail system is short of capacity and getting worse. An overwhelming majority (92 percent) of respondents said that North American rail capacity problems will get worse without more investment beyond what is already planned. They also expressed concern that consolidation under deregulation has resulted in a less competitive environment (Cover Story, Traffic World, July 30, 2007).

There are more and more cases of public-private partnership in developing new and more efficient rail capacity such as CREATE program in Chicago. Class I carriers that are most highly invested in the Upper Mississippi and Illinois River basins are showing the most willingness to engage private-public partnership. If these type partnerships become necessary to ensure adequate freight transportation capacity, how will they impact on decisions relating to navigation? There might open up opportunities for more efficient and effective intermodal operation between truck-rail-water.

Coastal Port/Gateway Congestion. Congestion and constraints are also prevalent at in the vicinity of the Nation's East and West Coast sea ports and land gateways with Mexico and Canada. In response to this ports are increasing efficiency and capacity through investment and operational changes. One such change involves the development of inland ports and distribution centers. Here, containerized freight is sorted and distributed freeing up space at the primary port facility for unloading of ocean vessels.

An example is the highly successful Alameda Corridor (20-mile long rail corridor) which transfers freight from LA/Long Beach ports to rail yards away from the main port. Other inland ports have been developed at San Antonio and Kansas City as part of the NAFTA Railway system serving Mexican ports and the Virginia Inland Port serving the ports at Hampton Roads. These types of developments have their limitations, however, and as containerized freight levels increase and challenge port capacity further, the Gulf ports and the inland waterway distribution system are likely to become more competitive.

Congestion at U.S. ports has also prompted the development of new deep water ports in Mexico and Canada. These are expected to come online within the near-term future and will add port capacity for inbound freight originating from Asia. From these gateways freight will then move into the U.S. interior via rail connections similar to the existing connections with the west coast ports. However, the longer rail routings to reach interior markets are inherently more costly than water. This, again, should improve the competitive position of the Gulf ports as a gateway to interior markets, especially after expansion of the Panama Canal.

The Gulf gateway connection to the Mississippi River provides a unique arrangement whereby direct ship-to-barge and barge-to-ship transfer of containers allow for all water connection to ports on the inland waterways and even to the Great Lakes through Chicago. The Sea-Point project at Venice, LA will be such a facility. Construction is scheduled to begin early 2008.

Expansion of the Panama Canal. Another factor that can affect the level of future barge traffic on the UMR system is the expansion of the Panama Canal. The expansion, expected to be completed before 2020, will reduce ocean freight costs and as a result likely draw more freight in and out of the country through the Gulf, including a substantial increase in containerized traffic. Distribution of containerized freight will require some level of barge utilization both upbound to markets and downbound either as empties or filled with goods destined for foreign markets. In addition, the all-water routings through the Gulf ports and up the Mississippi River with their inherently lower cost should be favorably competitive with routings through the U.S./Mexican/Canadian coastal ports that require a lengthy rail segment to reach interior markets.

Some of the additional freight will likely move through Gulf ports onto barge, but most of the higher valued freight will more likely move by train and truck. This will exacerbate constraints on rail and increase the likelihood that more traffic will move to water than predicted through traditional analysis, mostly bulk commodities and lower valued products, but also more containers. As congestion grows on the railroads due to growth of container traffic, they may be willing to focus on this more profitable side of their business and allow their bulk trade to divert to waterways. Recent studies have shown that this is already occurring to an extent (Water-Compelled Rates and Available Navigation in the Upper Mississippi River-Illinois River Basins: An Update, February 2007, Tennessee Valley Authority). The waterway will be in much better position to attract this traffic, traffic for which it is more suited, if investments are made to improve the system's reliability and efficiency. As a result waterways will assist in reducing congestion levels on the Nation's railroads and highways.

Reliability of Waterway System. Regardless of future volume levels traffic on the UMR system will be subject to delays at undersized and increasingly less reliable locks. Average age of the 192 commercially active locks exceeds 50 years old. Unscheduled closures on the UMR through 2003 are trending upward at a rate of over 9 percent per year. Scheduled maintenance has generally been declining reflecting the declining availability of O&M funds and suggesting a shift in approach from lock maintenance to "fix-as-fail". A consequence of this trend would be perceived and real decreasing service levels to UMR shippers and carriers, and a trend toward decreasing system capacity to handle current (and future) volumes of traffic. More importantly, the locks in their existing (and projected) condition limits the potential for future growth in areas such as container traffic and the ability of the waterway to serve as a means to reduce landside rail/truck congestion. Unanticipated lock disruptions may appear to be isolated events under the fix-as-fail approach. But the increasing frequency and magnitude of the disruptions create the perception that the system is unreliable. And reliability is critical to shippers in today's economy. A project such as that recommended by this study can begin to reverse this trend. It will not only improve performance and reliability at the affected locks but it will add capacity to the navigation system including the ability to serve as a relief valve for projected landside congestion.

Containers and the Intermodal System, Including Container-On-Barge (COB). When considering the future traffic potential on the UMR-IWW system, container traffic is a category that requires particular attention. As freight traffic, much of which is in the form of container traffic, is expected to grow in the future and create a congestion crisis. North-south movement of containers through rail and the waterway system are viewed by some proponents as an outlet to which freight traffic may be diverted for relief. The magnitude to which this may eventually occur is uncertain at the present time.

Up until now Gulf Coast ports have overwhelmingly served regional container markets with intermodal truck, even though multiple Class I rails serve these ports. Gulf Coast ports are now planning to add hundreds of thousands of TEUs in capacity over the next few years and expand beyond regional distribution and are seeking cooperation with railroads to move these containers inland. BNSF and UP, which dominate east-west container traffic, however, are continuing to invest heavily in east-west infrastructure at this time. BNSF and UP prefer the east-west container movement because it involves longer hauls, which is more profitable to rail. BNSF and UP are not likely to make investment in north-south routes until greater demand is demonstrated. Canadian National, which moves freight east-west between Halifax and Vancouver and north-south through Chicago to New Orleans. Increasing congestion at West and East Coast ports and expansion of the Panama Canal will facilitate transportation decisions in favor of the Gulf Coast. (Getting on Track, Traffic World, August 13, 2007).

The New Orleans Port provides a unique opportunity to move containers inland by water as an alternative to truck or rail, including all water transfer from ship to barge. See section on "Coastal Port/Gateway Congestion" concerning Sea-Point project). The following discussion addresses some of the considerations when assessing the potential for container-on-barge (COB) service on the UMR-IWW system.

COB test projects have been undertaken and failed due to lack of sufficient volume to sustain their operations economically. This suggests that the infrastructure and logistical apparatus, both for the inland waterway and the intermodal system to which it is a part, in its present form, has not yet developed sufficiently to take advantage of the COB opportunity set before it. Or it could mean that business does not view COB as an attractive enough alternative (i.e., sufficient cost savings) to induce a change from their current way of doing business. In any case, conditions don't appear favorable at the present time to produce a profitable COB service on a large scale.

The navigation system, including locks in particular, is a significant obstacle to the growth of COB traffic. The advantage of container based freight movement is the speed, efficiency, and reliability that standardized containers allow in handling and transport. The navigation system by its nature affects each of these characteristics negatively. The barge mode of transport is inherently slow with movements taking weeks to complete that otherwise take days by rail/truck. Extra handling is also required to load and unload barges creating additional inefficiencies. The navigation locks inhibit container movement in two ways. First, even under normal conditions, tows can create queues as they wait to transit a lock. The related delays (hours, days), not only add costs of the trip, but adversely affect operations at the eventual destination of the freight in transit. Second, the aging lock infrastructure is becoming less reliable in recent years as indicated by more frequent unscheduled closures. O&M expenditures are not sufficient to prevent these events from occurring. And reliability, even more than speed, is the most important characteristic of today's just-in-time approach to logistical operations. If businesses can't count on receiving inventory when they need it, other costlier measures must be taken to compensate. This might include keeping additional inventory on hand as a buffer against stock outages. These are the types of costs that today's logistical systems are trying to pare out of business operations with just-in-time approach. The inland waterway system, as presently funded and configured, doesn't lend itself well to the transport of consumer goods. Under these conditions, business is unlikely to make the necessary investment to alter their operations to accommodate COB.

Given the limitations of the waterway in terms of timeliness and reliability, niche roles such as repositioning of empty containers and movement of freight that is not as time-sensitive is more suitable. There have been some recent developments in the area of COB mode of transport that have taken advantage of these niches. A limited COB service is currently in place being operated by Osprey Line LLC. Weekly service on the Mississippi River includes runs from New Orleans to Memphis (note the lack of navigation locks). Inducement based service is also available between Houston and Chicago. Another COB-related development is the expansion of a port facility at Beardstown, Illinois on the Illinois River. The project as planned will receive and unload barged containers transferred from Chicago. The containers will then be refilled with identity preserved grain from local producers and reloaded onto barge for movement to export terminals at the Gulf.

These developments indicate that niches currently do exist for COB. And opportunities will likely grow in the future as congestion worsens and shipping costs increase. To attain significant COB traffic levels, however, radical changes are required in supply chain logistics, operations, and equipment (e.g. specialized COB vessels). One such project, that may offer a glimpse into the future of COB logistics, is the Sea-Point project located at Venice, LA near the mouth of the Mississippi River at the Gulf. The project, which is privately funded, is unique as an intermodal connection at the deep water/shallow draft transfer point. As planned, it will transfer containers from ocean vessels directly to barge for movement to intermodal terminals further upriver. Efficiencies are expected in the form of reduced handling of containers, decreased congestion at the intermodal access points, and use of cheaper barge transportation in the supply chain.

Regulatory Environment. As the waterway system has developed and matured, it has fallen under the jurisdiction of many levels of government. Local, state, and Federal rules and regulations on use and expansion affect various parts of the system. As currently structured the regulatory framework is viewed as a hindrance to a cohesive and efficient marine transportation system. Removal of redundancies and overlapping boundaries will assist in the implementation of improvements necessary to meet future transportation demands.

Funding. Any discussion of the need for improvements of the intermodal freight system generally includes the recognition that government funding constraints limit the implementation of worthy projects. New funding options must be developed to meet future demands on the system. Options that have been identified include expanding eligibility for existing TEA-21 programs, creation of a National Freight Transportation Bank, issuance of a new series of Transportation Bonds, value added tax applied to cargo, creative private/public partnerships, and controversial measures such as user fees and higher gas taxes. For individual projects deemed profitable from an investor's standpoint, private funding may be sufficient. An example is the Sea-Point project at Venice, LA. This project, involving the transloading of freight containers from ocean vessels directly to barge, is privately funded and is expected to begin construction late 2007.

Government Promotion of Inland Waterways. The European experience (Table 3.15) provides an example of how Europe has used government policy and investment to encourage greater utilization of waterways. Provision of the basic infrastructure (channels and harbors of sufficient depth, lock and dam structures to maintain river elevations, maintenance to attain a minimum level of performance, technology to monitor performance, etc.) is common among both the European and U.S. systems. However, the Europeans are much more aggressive in providing government incentives to promote use of their inland waterways in an effort to take advantage of the social and environmental benefits inherent to the barge mode of freight transportation. Comparing the two systems requires caution because of some important differences that might allow for different approaches to government intervention. Europe has a higher population density; its freight movements are of shorter distances, the rail system is oriented more toward passenger traffic than freight traffic; and government intervention may be seen as more acceptable than in the U.S.

European planners recognize that waterway projects will not develop spontaneously, but need government assistance in planning and funding. In addition to the standard transportation cost savings, public aid is justified by the other positive effects of waterway projects, among which are external cost savings (accidents, pollution, noise, fuel, etc.) as well as savings of costly road and rail expansion projects.

The U.S. Department of the Transportation is providing the greater vision for improvement of the Nation's transportation system through its "Strategic Plan for 2006 to 2011" and the *Framework for a National Freight Policy*. The USDOT strategic plan presents goals and objectives in five areas: safety, reduced congestion, global connectivity, environmental stewardship, and security preparedness and response.

Table 3.25. Examples of Government Incentives Implemented in European Systems

Incentive Credits	water transportation receiving credits for environmental and social benefits resulting in diversion of traffic from land to water; doing so helps balance external costs between modes
Deregulation	eliminate rules that allow inefficiencies
Modernization	eliminates overcapacity and improves engine efficiency and env effects (lower pollution)
Users Fees - Road	reflects full costs for truck operation; results in shift to environmentally friendly modes (water)
PACT program	financial assistance for innovative intermodal projects; increases competitiveness of environmentally friendly modes (water)
Infrastructure investment	waterway terminals, equipment, intermodal connections such as road, rail segments
Inland Waterway Freight Grants (UK)	promotes waterway projects as environmentally and socially beneficial to offset capital costs for facilities development
Trans European Network	assist in development of intermodal transportation corridors
Sea Motorways	integrates short-sea shipping and inland waterways into a more complete intermodal network
Research	continuously explore and test new innovative technolgies or advancements.

Concern about future congestion of the freight transportation system and its effect on the Nation's economy prompted USDOT to establish the *Framework for a National Freight Policy*. This document has been developed with recognition of the need for a more unified and comprehensive approach in addressing national transportation needs as opposed to the traditional single mode, ad hoc, project by project approach. The Framework identifies congestion as a challenge requiring collaborative action by both public and private stakeholders. It lays out a vision and objectives with strategies and tactics necessary to achieve the objectives. Two objectives include tactics related specifically to the inland waterways. These are:

- Objective 1 – Improve the operations of the existing freight transportation system
  Tactic – Prioritize timely operations and maintenance projects for inland waterways and Great Lakes
- Objective 2 – Add physical capacity to the freight transportation system in places where investment makes economic sense
  Tactic – Ensure that inland waterways trust fund revenues are used for construction of additional lock capacity where needed.

The other Framework objectives, relevant to the inland waterways in a more general way, include using of public and private pricing tools to more fairly distribute system costs and benefits; minimizing regulatory barriers; addressing transportation needs as they emerge; maximizing safety and security; and better managing environmental and social impacts of freight transportation.

Like U.S. DOT's Framework, the Maritime Administration (MARAD), an agency within the U.S. DOT, also has developed a Strategic Plan to guide their activities. The Corps' recommendations for navigation and environmental improvements fit well within the principals of this Strategic Plan. The Plan includes the strategic objective of commercial mobility which is intended to "promote and facilitate a United States maritime transportation system that improves the safe and efficient movement of goods and people," primarily by addressing congestion reduction. Two of the outcomes

MARAD hopes to produce through attainment of the commercial mobility objective are (1) a maritime transportation system that better meets customer needs and expectations and (2) increased transportation choices. The Corps' recommended plan conforms to the objective of commercial mobility and will contribute to the successful realization of these outcomes.

The Strategic Plan includes fifteen "Means and Strategies" intended to help achieve a more efficient maritime transportation system that meets future demands. Most of these have particular relevance to the inland navigation system. Noteworthy means and strategies in MARAD's Strategic Plan, to which UMR lock expansion is congruent, include:

- Partner with public and private organizations to increase the use of waterborne transportation to relieve landside congestion, improve overall transportation safety and mitigate environmental problems.
- Partner with industry, state, and local governments, and other Federal agencies to assess the potential, social, economic, and environmental advantages of increased maritime trade, to improve the existing network for shipping operations, and to identify new business opportunities for U.S. inland, domestic, and international maritime industries.
- Foster public-private partnerships to improve land and waterside access to ports and marine terminals and transportation infrastructure, to move freight more efficiently in a safe, secure, and environmentally responsible manner.
- Partner with industry and other government organizations, both foreign and domestic, to reduce barriers to inter-modal transportation through the adoption of safe and environmentally responsible national/international containerized and non-containerized standards

The Federal government supports activities that will increase use of the waterways as a means of reducing congestion. MARAD has recently initiated a program called the Marine Highway Initiative which is intended to promote the more complete integration of the inland waterway into the overall inter-modal system. Ways of doing this include facilitation of public/private partnerships, promotion of research, and financial inducements such as low-interest loans and tax relief.

Uncertainty - Markets (e.g. corn-based ethanol) and Shifting Trade Flows; Global Warming; and Other Factors. The future becomes increasingly uncertain the further out one tries to forecast. Coupled with long lead time to implement large-scale transportation projects, decision-making becomes difficult and investments risky. Land available for grain production, growth and source of biofuels, market for locally grown and consumed agricultural products, urbanization, grain yields, non-grain markets, modal mix, and technology are some of the factors that have great variability as one looks into the future.

The growth of corn-based ethanol production is a case in point. It has the potential to significantly affect the demand for barge transportation in the coming decades. Corn-based ethanol produced domestically will consume corn locally that otherwise would be transported on the inland navigation system to reach export terminals. Based on current plans for new ethanol plants production is expected to grow from a current level of 5 billion gallons to 11 billion gallons by 2020. According to the Institute for Agricultural and Trade Policy, if only a quarter of the new Midwest ethanol plants come on line, up to half of the corn in the Midwest states currently sent for export could be diverted to domestic ethanol production. The USDA itself has stated that much of the corn for ethanol production will be diverted from exports. In fact, even if only a fraction of the plants come on line, some Midwest states (Iowa, Nebraska) would theoretically need to import corn from other states in order to meet the expanded ethanol capacity. Fifty percent of the Minnesota corn crop will be consumed by ethanol plants currently under construction and under development, up from a current level of 18 percent.

Although these forecasts have a ring of certainty to them, corn-based production of ethanol is uncertain over the planning horizon. Important variables include the price of oil, amount of corn production, ethanol production costs, water availability for the production of ethanol, the emergence of other feedstock for production of ethanol such as prairie grass, a switch to other energy sources, changes in government policies, etc. could drastically affect the domestic consumption of corn for ethanol and thus the volume of corn available for export. For example, cellulose from a variety of sources has proven to be a more efficient feedstock for ethanol production than corn. A ten-year study by the University of Minnesota demonstrated the effectiveness of prairie grasses on marginal lands as feedstock for ethanol production. Pilot plants are now in operation. If cellulose does take over as the primary feedstock for ethanol, it could lead to greater demand for water transport than would exist even in the absence of biofuels.

International market conditions for Midwest grain have changed substantially since the period of rapid growth in barge demand in the 1960s and 1970s. Changes in the patterns of global supply and demand, increases in the number of trade agreements, and increases in ocean shipping rates have resulted in the emergence of new trade routes for agricultural commodities that have drawn exportable supplies of corn and soybeans away from the UMR system. Some corn and soybeans traditionally shipped via the UMR-IWW have moved by train to Pacific Northwest ports to access growing Asian markets. NAFTA has facilitated the growth of markets in Canada and Mexico that are being served by the rail/truck intermodal system. In addition, expected competition from South American soybean producers especially may lead to a refocusing of exports away from Atlantic-rim markets toward Asian, Mexican, and Canadian markets where the U.S. may have comparative advantages. If these expectations are realized, growth in future barge demand from the agricultural sector will not materialize.

Relatively recent studies which analyze climate scenarios in the context of crop production in the United States (Mendelsohn 2001 and McCarthy et al 2001) suggest that under most climate change scenarios the Midwest United States would see an increase in crop production related predominately to the effects of increased CO2 on yields. There is considerable uncertainty in forecasting the effects of climate change on world agricultural production.

REGIONAL ECONOMIC DEVELOPMENT (RED)

REGIONAL ECONOMIC IMPACTS

Regional impacts considered in this analysis from implementation of the Recommended Plan include the direct impacts, consisting of project costs, such as for construction or other spending for labor, goods, and services; savings to shippers that would arise from the improved efficiency of the navigation system; and benefits of lower transportation costs for shippers as a result of competition between water transportation and alternative modes, which is referred to as “water compelled rates”. Other areas of consideration are addressed qualitatively.

REGIONAL ECONOMIC IMPACTS – FEASIBILITY STUDY

In the Regional Impacts Study dated August 4, 2004 completed under contract for the UMR-IWW System Navigation Feasibility Study, Tennessee Valley Authority estimated RED impacts with an economic model constructed by Regional Economic Models Inc. (REMI) of Amherst, Massachusetts. REMI models are econometric models with highly detailed input-output industry categories. The direct impacts of the project proposals consist of the project costs, such as construction impacts or other spending for labor and for goods and services, and the savings to shippers that would arise from the improved efficiency of the navigation system.

Direct construction activity results in indirect impacts in the local economy such that money spent on construction activity, labor and the purchase of materials, generates additional income and employment in a multiplier fashion. In a large construction project such as considered for the Upper Mississippi and IWW, impacts can range far from the local or regional construction area as purchases are made over long distances, construction workers often migrate to the construction site and leave their families at home where the construction earnings are partially spent, and some of the construction work is done by private companies at remote locations. In like manner, the savings to shippers that would arise from the improved efficiency of the navigation system are spent and generate additional income and employment in a multiplier fashion.

The impacts (from the 2004 study) were measured in four variables: gross regional product (GRP), real personal income (RPI), output (OUTP), and employment (EMP). Annual rates were converted to present value using the federally-mandated discount rate of 5.875 percent. Table 3.26a is a summary of the regional impacts for the total of project costs and shipper savings, and Table 3.26b is a summary of regional impacts for project costs only. Employment impact is shown as an annual average. The tables are averages of the 15 scenario-model combinations explored in the Feasibility Study. Only Alternative 6 from the Feasibility Study was analyzed for regional impact, even though the Recommended Plan is actually a blending of Alternatives 4 and 6. This does not make much difference however, since Alternative 4 features (not included in Alternative 6) contribute only a small portion to project costs and shipper savings.

Table 3.26a. 5-State Region Economic Impacts – Project Costs + Shipper Savings for Alternative 6 (Feasibility Study) – in millions of dollars

GRP	Real Personal Income	Output	Employment	Ratio GRP/Cost
$2,799.11	$2,032.95	$5,209.43	2555	3.38

Table 3.26b. 5-State Region Economic Impacts from Project Costs for Alternative 6 (Feasibility Study) – in millions of dollars

GRP	Real Personal Income	Output	Employment	Ratio GRP/Cost
$2,089.79	$1,469.25	$4,246.29	1954	2.53

REGIONAL ECONOMIC IMPACTS - PROJECT COSTS

The ratio of GRP to Cost from the 2004 study multiplied by the estimate of current project costs will give an indication of current increase in Gross Regional Product resulting from current project costs.

REGIONAL ECONOMIC IMPACTS - SHIPPER SAVINGS

Using a similar ratio method for updating RED benefits from shipper savings is probably not valid. Ten years have passed since the rate study for the Feasibility Study and the current rate study for the economic reevaluation. Too many changes (in Origin-Destination patterns and barge and rail rates) have occurred over that 10 year period.

REGIONAL ECONOMIC IMPACTS - WATER COMPELLED RATES

Water compelled rates are generally considered to be RED Benefits. In 1995, the Rock Island District of the Corps contracted with the Tennessee Valley Authority (TVA) for an evaluation of what have come to be called the “water-compelled” effects of Mississippi and Illinois River navigation. This investigation revealed more than one billion dollars in annual savings to railroad users that were attributable to the competitive impact of the two river systems. More than half of this amount ($506.8 million) was associated with savings in the movement of coal. Substantial savings were also observed in the movement of regional grain products, specifically, corn, soybeans, and wheat.

Quantitative results for the current water compelled rate study are reported in Table 3.27. There are several striking findings that are immediately apparent when these results are compared to the 1995 values. First, both corn and soybeans are completely absent from the table of current results. The primary explanation for this outcome lies in the strong growth in the regional production of ethanol and bio-diesel. This, of course, does not imply that the volume of corn or soybeans moving to export has been driven to zero; it does, however, imply that the volume of export quantities for which rail and barge once competed has diminished substantially. It is also likely that the elimination of regional short-line railroads is a contributing factor to the reduction in the competition between rail and barge for the movement of export corn and soybeans. There is credible evidence that the Class I carriers that serve the Gulf actively price in ways designed to keep grain from moving to the river. However, the short-line rail carriers were very much a navigation partner. Their re-integration into the Class I carriers, thereby, eliminated an important means for more distant producers to access commercial navigation. Next, the total value of benefits to wheat shippers is significantly below the 1995 level of nearly $190 million. Again, this is a reflection of changed commodity flows. The majority of export wheat from the region now flows over the deep-draft ports of the Pacific Northwest. It is possible or even probable that the rail rates for wheat that continue to be influenced by available navigation are for domestic movements.

Table 3.27. Water Compelled Rates

Commodity	Water Compelled Rate Impact
Wheat	$54,216,873
Coal	$24,866,749
Non-Metallic Minerals	$1,420,497
Lumber and Wood	31,431, 352
Pulp Paper and Products	$61,560,821
Coal and Petroleum products	$99,968,392
Primary Metal	$53,565,649
Fabricated Metal	$2,973,260
Scrap Materials	$13,631,449
Total	**$343,635,043**

Finally, the current value for savings to coal shippers is only roughly five percent of what it was in 1995. The reduction in water-compelled rail rates for the movement of coal also reflects the strong growth in the use of Powder River basin coal, a movement for which there is, generally, no navigation substitute. Railroad capacity (both line-haul and terminal) is at a premium. The insensitivity of rail rates to available navigation clearly suggests that rail carriers are not seeking additional low-valued capacity nor are they particularly fearful of losing, at least, a portion of existing coal traffic. While the historical sources of water-compelled rail rate benefits have dwindled in importance within the study region, the impact is partially offset by the growth in effects for other commodities, particularly petroleum coke. As refiners have de-emphasized asphalt production, they have increasingly turned to petroleum coke as a substitute output. Similarly, higher than usual coal prices have induced many industrial users to supplement the btu content of coal burns with the high btu coke. As a result rail volumes of petroleum coke have soared and the long-observed relationship between available navigation and rail rates for such movements has become increasingly important.

The nature of the interactions between rail carriers and commercial navigation has not changed. However, the extent and the magnitude of navigation's competitive impacts on railroad prices have diminished measurably over the past dozen years. This outcome is likely attributable to readily observed changes in the destinations of many grain products and the total elimination of any excess railroad capacity. Shifts in grain usage have, in part, been tied to a growth in ethanol production. At the current time, it would appear that this growth will continue, perhaps at an accelerated rate. The elimination of excess railroad capacity reflects steady growth in the movement of dry-bulk commodities and an explosion of inter-modal traffic that is largely the product of increased globalization and associated import growth. Like ethanol usage, international trade is likely to continue to grow over any foreseeable time horizon.

To those who observe transport markets on an ongoing basis, the current findings come as little surprise. Dwindling freight capacity has been a central topic at professional transportation meetings and within professional transportation publications for, at least, 5 years. Thus, it is not surprising that railroads currently (and for the foreseeable future) enjoy the luxury of sometimes ignoring a competitive mode that, in the past, played a far more prominent role in the determination of railroad rates. Nonetheless, for those who advocate for increased navigation investments, the same capacity constraints that have dampened observable water compelled rail rate effects also underscore the potential importance of inland navigation and its substantial capacity on a forward-looking basis.

REGIONAL ECONOMIC IMPACTS – OTHER

Other regional impacts are expected to come from secondary investment in improvements by carriers and shippers to upgrade fleets and fleeting, port, and intermodal facilities**.** Reminder – the values for RED benefits shown in this report are only for the navigation efficiency component. The ecosystem restoration component provides comparable RED benefits in the form of jobs, income for state economies, and non-monetary goods and services (water quality, abundance and diversity of flora and fauna, etc.)

ENVIRONMENTAL QUALITY (EQ)

ECOSYSTEM RESTORATION AS A PROJECT PURPOSE

The Recommended Plan is dual-purpose plan for navigation efficiency and ecosystem restoration. To assure ecosystem sustainability the Recommended Plan calls for dual-purpose operation and maintenance. The ecosystem restoration component is designed to off set the ongoing and cumulative effects of operating and maintaining the 9-Foot Navigation Channel Project and to restore and preserve ecosystem function. The adaptive implementation of the ecosystem restoration plan was developed in collaboration with the stakeholders and is contained in the recommendations of the Feasibility Report. The formulation and evaluation of the ecosystem restoration component of the Recommended Plan done during the Feasibility Study is still valid and there is no reason for its reevaluation except to the extent that it is an integrated part of the dual-purpose Recommended Plan.

Implementation of the Recommended Plan will result in a healthier, sustainable ecosystem.

CONSTRUCTION SITE AND SYSTEMIC ENVIRONMENTAL MITIGATION

The plan also recommends construction site and systemic mitigation to avoid, minimize and compensate for the direct effects of the proposed navigation efficiency measures including increased commercial navigation traffic forecast to result form the improvements. The mitigation plan was subjected to a sensitivity analysis to determine if any modifications were required based on the results of the reevaluation.

Environmental Quality also considers impacts that may occur on alternative transportation modes due to traffic increases on roads and railroads in the future without project condition (absence of navigation efficiency improvements on the waterway). These are addressed in the section on Other Social Effects (OSE).

Reevaluation. Several models were used to forecast navigation traffic at various stages of the study. In the Final Integrated Feasibility Report and Programmatic Environmental Impact Statement for the UMR-IWW System Navigation Feasibility Study (PEIS) the mitigation costs were calculated based upon traffic forecasts generated by the Tow Cost Model, the Essence Upper Bound model, and the Essence Lower Bound model. These models predicted annual traffic use over the 50-year project life for the without project alternative as well as the navigation improvement alternatives. These traffic

forecasts were used in several evaluation models to determine the incremental traffic effects on fisheries, submersed aquatic vegetation, bank erosion, backwater and secondary channel sedimentation, and historic properties.
During this economic reevaluation, the mitigation plan within the PEIS was revisited and tested to determine how it would change with a new traffic forecast. These tests were used to determine if the mitigation plan need to be modified due to changes in the expected traffic. There were two assumptions made for this reevaluation: modeled traffic forecasts are equally reliable, and the models used to develop fish mitigation costs directly correlate with changes in the total number of tows per day.

Incremental Traffic. The system (non site-specific) component of the mitigation strategy is based upon the concept of incremental traffic. Incremental traffic is defined as the expected increase in traffic that would occur over time as a result of the construction or implementation of a navigation efficiency measure. An increased efficiency is expected to lead to an increase in commercial traffic. The PEIS focused on assessing the effects to resources of concern of this projected incremental increase in traffic. Therefore, mitigation was based on the additive or synergistic detrimental effects of increased commercial traffic on the significant biological and cultural resources of the UMR-IWW system. The mitigation plan used the modeled Future Without Project Alternative traffic level as a baseline condition for mitigation and the highest predicted traffic level as the reasonable worst case scenario.

The incremental increases in traffic, measured in terms of increased tows per day by Pool, were used for calculating environmental effects, mitigation, and as a guide for the geographic distribution of non site-specific mitigation measures. Two new traffic forecasts were compared to the mitigation plan in the PEIS [(Alternatives 4 & 6, most favorable traffic scenario)(Table 3.28)]. Both new traffic forecasts (Low and High) predicted a smaller incremental increase in traffic than was predicted by the PEIS (Table 3.29).

Table 3.28 Comparison of Total Traffic Forecasts for the Years 2010-2050

	Low Traffic	High Traffic	PEIS
Total Traffic	549,842 tows	868,515 tows	916,804 tows
W/O Project Traffic	522,534 tows	790,690 tows	758,968 tows
Incremental Increase	27,308 tows	77,825 tows	157,826 tows

Sensitivity Analysis. A sensitivity analysis was performed to approximate the effect of using the new High Traffic forecast on mitigation cost (Table 3.29). Because the Low Traffic forecast predicted the least traffic and therefore the fewest environmental effects, it was not considered in this analysis. The difference of the increased traffic between the High Traffic and the mitigation plan was approximately 80,000 fewer tows over the 50-year project life. The, fishery mitigation costs were estimated by reducing by the difference in incremental traffic from the new forecasts from that used in the PEIS (51 percent). The effects of increased traffic were not significant for the other environmental resources (bank erosion, backwater and secondary channel, submersed aquatic vegetation, and historic properties) because these are based on the first cost therefore there was no need to implement additional measures to protect these resources beyond those identified in the mitigation plan.

Table 3.29. Comparison of Mitigation Cost Between New High Traffic Forecast Compared to the Forecast Used for the Mitigation Plan in the PEIS

Avoid, Minimize & Mitigation Measures	Mitigation Cost for Navigation Efficiency Alternative Plans High Traffic	PEIS (Alternative 4 & 6)
B1. Bank Erosion	$17,563,523	$17,563,523
B2. Backwater & Secondary Channel	$29,390,769	$29,390,769
B3. Plants	$16,530,098	$16,530,098
B4. Fish	$29,981,629*	$60,802,331
B5. Env. Monitoring	$14,292,780	$14,292,780
B6. Historic Properties	$10,590,000	$10,590,000
B7. Site Specific Mitigation	$37,297,628	$37,297,628
subtotal	$155,646,428	$186,467,129
B8. Administration	$15,564,643	$18,646,713
B9. Total Mitigation Cost	**$171,211,070**	**$205,113,842**

* Estimated (The NavLEM fishery model was not re-run for this analysis.)

MITIGATION CONCLUSIONS

CEQ guidance suggests that reasonable worst-case be assessed when there are gaps in relevant information or scientific uncertainty. There is considerable uncertainty in forecasting future navigation traffic on the system. To compensate for this uncertainty in mitigation planning, a reasonable worst-case analysis was conducted as well as a sensitivity analysis considering other traffic forecast scenarios that showed the incremental increases identified in the PEIS is conservative and an appropriate basis to formulate mitigation planning. Even though this analysis showed that the cost of mitigation could be reduced if fewer boats entering the system the uncertainty remains. Therefore the mitigation strategy identified in the PEIS will remain unchanged. The mitigation costs were adjusted for inflation from 2003 dollars in support of the economic reevaluation presented elsewhere in this document.

OTHER SOCIAL EFFECTS (OSE)

Other Social Effects (OSE) addresses the relationship between the outputs of a study recommended plan and the social and cultural setting that could be impacted. In the UMR-IWW System Navigation Feasibility Study Report OSE addressed issues of noise, accidents, life, health and safety, displacement, community impacts, employment, and income. For this Interim Report the OSE account examines three primary areas: international competitiveness, national security, and quality of life that a healthy and sustainable multiuse river system offers to the human community.

INTERNATIONAL COMPETITIVENESS

The United States has benefited from several decades of substantial public and private investment, yielding perhaps the world's most advanced transportation and logistical infrastructure network, giving U.S. shippers a significant comparative advantage in the serving of common export markets.

There is evidence, however, that the gap is closing. Competing agricultural countries such as Brazil, Argentina, and China are also aggressively investing in river transportation improvements. Argentina and Brazil are expanding their already extensive network of navigable inland waterways. Significant investment has been made in recent years to extend the reach of barge and vessel traffic inland from the deep rivers of the region's major port cities along the Atlantic Coast.

The United States needs to continue to invest in its infrastructure to maintain and enhance our competitive advantage. This is a two edged sword in that timely, low cost transportation also provides benefit to importers and consumers of imported goods where competition among domestic and import distributors pass savings on to consumers.

Shippers of bulk commodities rely on volume to make a profit. For a barge plying the inland waterways, a key determinant of the amount of freight that can be carried in a season is the time it takes to make each haul. The UMR closes for nearly four months every winter above the Quad Cities near Lock and Dam 15. This increases the time pressure to move a maximum quantity of the fall's harvest before the winter freeze occurs. The shorter the haul time the more total hauls that can be made and the more freight that can be moved. As a result, delays associated with aging locks and dams represent lost time, lost potential freight, and lost profits. Waiting delays also represent lost fuel. Towboats on the UMR-IWW burn about 80 gallons of diesel fuel per hour. The engines are kept running while each towboat waits for its turn through the lock.

Figure 3-1 portrays the seasonal traffic pattern on the Mississippi River. Displayed are the monthly average tonnages over the 2000-2006 time periods for Lock 8, Lock 15, and Lock 25. The winter closure of the river above Lock 15 is evidenced by the absence of traffic for December-January-February, with smaller amounts of localized traffic present at more downstream locations. Traffic rapidly builds during the early spring and peaks during the June-July-August period.

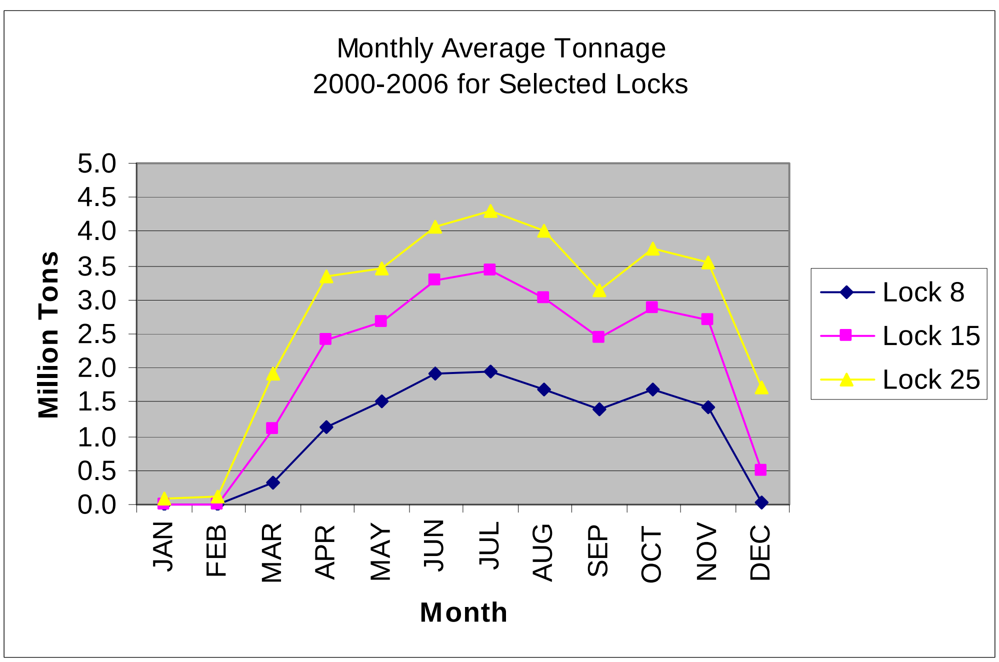


Figure 3.1. Seasonal Traffic Pattern on the Mississippi River

In competitive grain and oilseed markets, transfer costs—handling and transportation charges—are a major factor in determining market price differentials. Frequently, transportation costs are a large portion of the delivery price, particularly for raw, unprocessed commodities, like bulk corn. U.S. Department of Agriculture research shows that nearly half the cost of U.S. grain at its final destination is accounted for by the cost of transportation from the farm gate to the final consumer. The accessibility and cost of transportation affects the ability of our farmers to keep and expand foreign markets. Our competitors in South America have a geographic advantage over the U.S. Our major competitors, Argentina, Brazil and China, have made investments in their transportation systems and are dramatically reducing their costs for moving grain (Personal Communication from Lisa Kelly, NCGA). Agricultural producers are concerned about transportation costs because the price that they receive for their agricultural commodities is derived from the price established in major markets (whether a processing plant, feedlot, or export terminal) by subtracting transportation and handling costs. The more it costs to transport a commodity to a buyer, the less the producer will receive and vice versa. As a result, any process that reduces the cost of moving a commodity to a buyer likely benefits producers by raising the price that they receive, which subsequently benefits the local economy by generating greater farm income and associated economic activity. [1]

In contrast, increased domestic transportation costs widen the farm-to-market price differential. A widening differential generally compels exporters to offer the products in international markets at higher prices, that is, less competitively. Higher U.S. export prices relative to international competitors will lower demand for U.S. exports of corn and soybeans. Lower export demand reduces total demand, and consequently lowers the prices and income received by farmers for a given level of production. In the long run, permanent changes to corn and soybean prices relative to the prices for other production activities will likely alter the crop mix of farms in the affected region.

The strength of a transportation system lies in its diversity, with each mode having its own system-specific advantages: motor carriers have the ability to provide door-to-door service; water carriers can handle bulk commodities at a very low cost; and rails can transport a broad range of commodities over long distances. The efficiency and competitiveness of different transportation systems is essential to both economic growth and productivity, and ensures that the United States will be competitive in the world market.

NATIONAL SECURITY

National security encompasses a complex array of economic, social, environmental, political, diplomatic, cultural, and military dimensions to ensure the wealth of our Nation and our quality of life as a people. Terrorism and natural disasters pose major risks worldwide because of the vulnerability of transportation infrastructure to attacks and to hurricanes, typhoons and earthquakes. Therefore, planning for security and safety has assumed a major role in logistics and transportation decisions and now penetrates every level of operations. Recent events have focused considerable attention on the potential occurrence of major incidents of public terrorism and natural disaster. In the U.S., such incidents have included the terrorist attacks of the World Trade Center in New York City and the Pentagon, the bombing of the Federal Building in Oklahoma City, and Hurricane Katrina.

[1] For a discussion of the economy-wide economic costs associated with higher agricultural transportation costs (including higher consumer food prices, as well as local, state, and national tax revenue and employment losses) see Evans, Carroll & Associates, Dr. Michael Evans, *Determination of the Economic Impact of Increased Congestion on the Upper Mississippi River – Illinois River Waterway*, March 2002. For further information see also "Regional Impacts of Proposed Navigation and Ecosystem Improvements on the Upper Mississippi River and Illinois Waterway", prepared by the Tennessee Valley Authority for the Rock Island District U.S. Army Corps of Engineers, August 2004.

The transportation sector contains a virtually unlimited number or components and activities that might become targets of terrorist attacks, or could be used by terrorists to enable a broader attack on people, property, or the functioning of the U.S. economy. The first line of national security under such conditions is a flexible, reliable, redundant, and robust national transportation system that is adequate to sustain the wealth of the Nation and the quality of life of its people in normal times; to support mobilization and evacuation efforts of all sorts; and to continue to function during times of extreme duress.

The U.S. surface transportation system consists of a vast network of interconnected infrastructures including highways, transit systems, railroads, airports, waterways, pipelines and ports, and the vehicles, aircraft, and vessels that operate along these networks. Interdependencies exist between transportation and nearly every other sector of the economy. Consequently, the effective operation of this system is essential to America's continued prosperity, economic productivity, and national defense. Although much of the national transportation system is planned, owned and operated by other units of government and private transportation companies, the responsibility for ensuring that as a system it meets national security criteria lies with the Federal government. It does this through direct investment, policies, regulations, strategic frameworks and plans, and incentives with focus on critical infrastructure.

Critical infrastructure is a term used by governments to describe material assets that are essential for the functioning of a society and economy. Critical infrastructure protection is the study, design and implementation of precautionary measures aimed to reduce the risk that critical infrastructure fails as the result of war, disaster, civil unrest, vandalism, or sabotage. In applying this it becomes readily apparent that in order for critical infrastructure to withstand these special circumstances, it must also be functionally relevant, reliable, and well maintained. Critical elements that are functionally obsolete, unreliable, and deteriorating are a risk to national security.

The first national effort addressing the Nation's critical vulnerabilities resulted in the 1996 creation of the President's Commission on Critical Infrastructure Protection. In October 1997, the Commission issued "Critical Foundations: Protecting America's Infrastructures," calling for a national effort to assure the security of the United States' increasingly vulnerable and interconnected infrastructures. The report found that the Nation is so dependant on our infrastructures that we must view them through a national security lens. They are essential to the Nation's security, economic health, and social well being. In short, they are the lifelines on which we as a Nation depend.

U.S. commerce depends heavily on the export, import, and domestic movement of raw materials, manufactured goods, foodstuffs, and consumable supplies. Success in an increasingly global economy requires an efficient world network of vessel, port, air, rail, and road systems. This vast transportation network facilitates the efficient movement of goods and people and provides this Nation a distinct competitive advantage in the global economy.

Inland and intra-coastal waterways have unique capabilities for moving large volumes of commodities and containers, oversized machinery, and equipment of strategic importance, but they also overlap with other modes of transportation. During World War II, the movement of crude oil and refined petroleum products comprised the major commodity of inland waterborne traffic. Barges also handled other strategic materials such as coal, steel, sulfur, toluene, and other chemicals. In mobilizing for World War II the improved waterways of the Mississippi River system served as a highway for thousands of Army and Navy vessels built at inland shipyards along the Mississippi and Ohio Rivers. This enabled the large coastal shipyards to focus on constructing warships and large merchant vessels.

The benefit provided by the Mississippi River Navigation System directly impacts the ability of the United States to compete in the global economy/marketplace and consequently enhance its economic element of power. Our national security is dependant upon improving the economic engine of the country.

The inland waterway system has been and remains one of the critical transportation networks within Nation's complex transportation system. The Recommended Plan contributes to national security by increasing flexibility, reliability, redundancy, and robustness in the inland waterway system and the national transportation system.

QUALITY OF LIFE FACTORS

With its widespread impact on the region's economy, recreation and ecology, it's no wonder the expansive Upper Mississippi River (UMR) waterway system has long been recognized as the Midwest region's lifeblood. For many villages and towns in the valleys and on the bluffs, the UMR defines who they are as a people, and the health of the river and its tributaries is central to the quality of life in those communities.

Nature is the source of goods and services and is the space in which society develops and evolves. The concept that environmental quality and life quality are linked comes from the idea that a quality environment provides the necessary goods and services to satisfy life quality needs. The Midwest region offers natural landscapes with open spaces, outdoor recreational opportunities and productive natural resource systems that underlie a quality of life that contributes to robust economic growth by productive families, businesses and investments.

Natural resource amenities are important both economically and socially in that they generate jobs and income as well as community stability and social interaction. The term amenity-driven growth is used by researchers to describe the ability of healthy, attractive natural resources to generate jobs and incomes. Many communities throughout the Midwest region and elsewhere have found that land and water can generate more jobs and income when they provide recreational opportunities, scenic vistas, and other amenities for consumers.

Quality of life, recreation, and environmental values are important mechanisms of amenity-driven growth. Quality of life is the product of the interaction among social, health, economic and environmental conditions which affect human and social development. Quality of life values can be powerful, and the ones directly related to natural resources (open space, outdoor way of life, recreation opportunities) can significantly influence where people and business locate. Areas with abundant amenities tend to attract people and to experience faster growth in jobs and income. Environmental planning and sustainable development is essential to ensure a better quality of life.
Human well-being is highly dependent on ecosystems and the benefits they provide. One measure of a society could be the quality of life derived from ecosystems and the benefits they provide such as food and drinkable water. Human cultures are strongly influenced by ecosystems, and ecosystem change can have a significant impact on cultural identity and social stability. Human cultures, knowledge systems, religions, heritage values, social interactions, and the linked amenity services (such as aesthetic enjoyment, recreation, artistic and spiritual fulfillment, and intellectual development) have always been influenced and shaped by the nature of the ecosystem and ecosystem conditions.

The environment serves as a source of pleasure to humans in viewing the sun on the horizon, admiring the tranquil beauty of a forest-ringed lake, or driving along a scenic river road. Many people would argue that environmental and natural resources are, in fact, priceless.

The UMR System contains resource-rich environmental systems that provide a broad spectrum of services to humankind and offer many amenities potentially capable of generating amenity-driven growth. Riverine habitats provide many direct benefits, from recreational opportunities, such as hiking, boating, fishing and wildlife observation, to ecotourism, trails, state parks and areas with aesthetically pleasing topography and scenery. The forces underlying amenity-driven growth can exert a powerful influence on the economy of the cities, counties and states in the UMR region.

No one can reasonably doubt the economic importance of natural resources. Natural resources don't have to be converted into crops, electricity or other commodities to support economic growth. Instead, growth can occur when natural resources provide recreational opportunities (bird-watching, fishing, boating, etc.) and other amenities consumers find desirable. That growth will be witnessed when communities experience. The development of local businesses that support outdoor recreation such as hotels/motels, restaurants, souvenir shops, boat repair shops, public parks and swimming areas.

The environment is the very foundation of the economy, and protecting the environment and conserving natural resources is essential for a competitive economy in the 21st century. Nature provides services such as clean air, water, and soil that are rarely factored into the cost of doing business. Nature-based ecotourism is one of the fastest-growing segments of tourism worldwide. It is a particularly important economic sector in a number of countries and a potential income source for many rural communities. Ecotourism is typically small-scale, involving individuals or small groups of visitors with modest needs that can usually be met by small, community-based enterprises. Ecotourists are often also interested in learning about the natural and cultural history of the area, in addition to simply experiencing it. The growth of ecotourism worldwide is a hopeful indicator of a rising interest in, appreciation for and concern about the natural world.

Society is increasingly recognizing the myriad of functions that ecosystems provide, without which human civilizations could not thrive. Despite growing recognition of the importance of ecosystem functions and services, they are often taken for granted and overlooked. People increasingly seek both goods, such as clean water, and services, such as recreation opportunities. Ecosystem goods and services are import to people and thus have economic value. This value can materialize in market prices as sellers and buyers trade a good or service. However, the absence of a market price does not mean that a good or service has no value. There are spiritual, historic, cultural and artistic resources that produce ecosystem goods and services that have value even though it is not traded in markets.

Through the ages, rivers have played a central role in the evolution of human societies. Many early civilizations sprung up alongside rivers. As symbols of purity, renewal, timelessness and healing, rivers have shaped human spirituality like few other features of the natural world. To this day, some societies continue to immerse themselves in the waters of the rivers in rituals of cleansing that are central to their spiritual life. Rivers have also shaped landscapes by carving remarkable canyons with their erosive power and creating huge deltas through their deposition of sediment. Evoking magic, mystery and beauty, rivers have inspired painters, poets, musicians and artists of all kinds throughout history, adding immeasurably to the human experience. Rivers are sources of inspiration and deep cultural and spiritual values, and their beauty enhances the quality of human life.

Byproducts of a healthy, sustainable river system with cleaner water and more habitat include recreational, environmental and economic benefits. Indirect and non-use benefits evolve from the satisfaction derived from knowing that the environment/ecosystem has been preserved for future generations.

A healthy river system encourages sustainable economic development that creates jobs and revitalizes communities in an environmentally sound manner. A healthy river system provides an intangible benefit of diverse open space for human exploration, experiential education, spiritual renewal and aesthetic enjoyment.

The value of a healthy, sustainable ecosystem might be defined in terms of its beauty, its uniqueness, its irreplaceability, its contribution to life support functions or commercial or recreational opportunities, or its role in supporting wildlife or reducing environmental or human health risks, or providing many other services that benefit humans.

Vice President Gore's National Performance Review called for the agencies of the Federal government to adopt a proactive approach to ensuring a sustainable environment through ecosystem management. One objective of environmental management is improved human life quality which involves the use of both natural and economic goods and services.

Environmental planning and sustainable development are essential to ensure a better quality of life. Quality of life is the product of the interplay among social, health, economic and environmental conditions which affect human and social development.

From the social perspective, river resources are an important and vital fact of the Midwest economy and it is important to secure Federal involvement for an enhanced system.

Emissions. The following information on emissions and accidents was presented in the feasibility study but is still valuable information to consider in the decision process. This work evaluates and quantifies impacts of waterway traffic versus rail for the categories of emissions, accidents, and noise and other community impacts (Tolliver 2000 and 2004). While the effects described here are potentially NED in nature, the level of input detail and lack of standardized measurement techniques within the Corps preclude these impacts from being considered in the NED formulation process.

The change in rail and waterway traffic emissions impacts attributable to an alternative can be quantified by comparing the gallons of fuel consumed in waterway and rail transportation for each alternative. Emission factors per gallon of fuel consumed can be used in developing the estimates.

The weighted-average waterway trip distance for incremental grain traffic ranges from 1,300 to 1,500 miles for the five traffic scenarios in the UMR-IWW System Navigation Feasibility Study dated 24 September 2004, with a mid-range estimate of 1,400 miles. The projected length of haul by rail is 1,400 miles (i.e., 60 percent to the Gulf of Mexico at 1,000 miles and 40 percent to the Pacific Northwest at 2,000 miles). The highest Revenue Ton Mile per Gallon (RTMG) forecast for upper river movements under any traffic scenario is 368. Thus, the highest possible weighted-average RTMG for a river movement to New Orleans is 558, when both upper and lower river values are considered. In comparison, the fuel model predicts railroad revenue ton-miles per gallon of 636 and 684 for non-unit and unit-train movements, respectively. Based on these inferences, the general conclusion of the analysis is that there is no evidence to suggest that the potential waterway investments would have a significant beneficial effect on annual fuel consumption. The emission of air pollutants is directly linked to fuel consumption. Therefore, it is unlikely that the potential waterway investments would have a significant beneficial effect on the emission of air pollutants.

Accidents. Included in this data are estimates of the differential financial cost of accidents and fatalities resulting from waterway and rail transportation. The National Safety Council unit costs of $3.5 million and $44,000 are used in estimating fatality and injury costs, respectively. Annual costs are estimated for the with-project and without-project scenarios. If investments are made, the incremental traffic would move on the waterway instead of the railway. Without-project accident costs are based on railroad accident factors, while with-project costs reflect waterway accident data. A two-step analysis process was followed for both modes: 1) estimate annual accidents, fatalities, and injuries for the incremental traffic; and 2) multiply the annual events by the applicable unit cost per property damage, fatality, or injury.

Table 3.30 displays the projected reduction in accident costs for traffic Scenario 3, Alternative 6. As the table shows, the net change is very large; $39 million in year 2050 under Alternative 6, ESSENCE – Upper Bound. The Alternative that we are currently reevaluating was referred to as Alternative 6 in the Feasibility Study.

Table 3.30. Projected Change in Accident Costs for Traffic Scenario 3 and Navigation Efficiency Alt #6
Accident Costs (Injuries and Fatalities)
Alternative #6, Scenario 3 (Millions of $)

Year	Tow Cost Model (TCM)	Essence Lower Bound	Essence Upper Bound
2025	2.5	8.2	14
2035	12	21	33
2050	16	27	39

Other. The change in rail and waterway traffic noise and other community impacts attributable to each alternative have been evaluated and quantified. Incremental railroad traffic will result in changes in traveler delay at railroad/highway crossings. A comprehensive analysis of grade crossing delay is beyond the scope of this study. However, several illustrations are presented based on probable routings. In the first illustration, half of the grain traffic to the Gulf of Mexico (or 30 percent of the incremental traffic) is assigned to the Union Pacific lines that run through East St. Louis, Pine Bluff, Arkansas, and several other cities en route to New Orleans. In the second illustration, all of the grain traffic to the Gulf of Mexico (or 60 percent of the incremental grain traffic) is assigned to UP lines.

The grade crossing delay and noise analysis procedures use the same database. Changes in noise levels are analyzed at the same crossings for the selected cities using the same number of incremental trains. Noise is an important community impact that is considered by the Surface Transportation Board in rail-line analyses. Incremental railroad traffic may result in three main types of noise: 1) locomotive (propulsive); 2) train; and 3) horn noise. Table 3.31 lists the estimated crossing delay and noise impacts, assuming that 30 percent of the incremental grain traffic moves via the Gulf of Mexico route.

An example is used to illustrate the interpretation of the tables assuming 30 percent of the incremental grain traffic follows this route. Under Alternative 6 (TCM) in 2035, the projected reduction in housing units subject to railroad noise levels of 65dba or greater is 648, and 1,244,000 fewer highway vehicles would encounter grade crossing delays totaling 38,000 hours per year.

Table 3.31. Crossing Noise and Delay Impacts - Alternative #6 Using Scenario 3 Traffic Levels
Crossing Noise and Delay Impacts
Alternative #6, with 30% of Incremental Grain Traffic (YR 2035)

Impacts	Tow Cost Model	Essence Lower Bound	Essence Upper Bound
Housing Units>65dba	648	847	1,016
Delay/yr in hours	38,445	51,260	64,075
Vehicles delayed/yr.	1,243,897	1,658,529	2,073,161

CONCLUSIONS

This chapter on forecast and evaluation started with presentation of a rigorous evaluation of the Recommended Plan using the Corps traditional approach to economic analysis of a navigation project. Subsequent sections presented the evaluation of the Recommended Plan in the context of the national transportation system, regional economy, environmental quality, and other social considerations.

Much effort went into improving the quality of the traditional economic analysis through developing more refined models; updating data; projecting potential freight movement that could move on water, including an investigation into container-on-barge; revising freight rates; and understanding transportation choices of shippers under different conditions. In isolation the results of the traditional analysis suggest that the Recommended Plan may contribute positively to the NED under some plausible freight forecasts, but not all. Although the traditional analysis serves to base line economic viability, it is not enough to base a decision. More information is needed to understand the potential impact of economic pressures not accounted for in the traditional analysis and to see the value of the Recommended Plan through other lens.

If the traditional analysis is taken in the context of the national transportation system, the regional economy, the impact on environmental quality, and other social considerations that affect the wellbeing of the Nation and its people, much more information becomes available for understanding the value of the Recommended Plan. All of the other considerations expressed in this chapter increase the desirability of the Recommended Plan in terms of economic, environmental, and social benefits.

As stated in conclusions for Chapter 2, the Recommended Plan is only part of the solution. The UMR-IWW is part of a much larger Inland Waterway System. The condition of the entire system, which is the sum total of public policy, public investment, and private investment and decisions, influences the value that the Recommended Plan will have in the future. This thinking also extends to the intermodal relationship waterways have with other modes of transportation. Steady improvement in the quality of the system is likely to lead to greater use of the system, which in turn increases the return on investment. This is especially desirable in consideration of the pressures on the national transportation system and the prospects for growing congestion in the future. It is also likely that the value of the Recommended Plan will not optimize in an environment where the greater system continues to deteriorate.

A case in point is COB investigations done as part of the reevaluation. A decision was made for the traditional analysis not to include COB in either LTS or HTS, because of the traffic forecasts for waterways was small and uncertain. However, in the context of a national transportation system where rail is running at almost maximum capacity, where congestion in many places across the system is increasing, and where freight is expected to continue to grow at a substantial rate, it seems that more containers moving north and south will impact waterways, if not directly then indirectly, by moving freight that is of less value for rail and truck. For this to happen, however, waterways must be maintained as a desirable alternative.

CHAPTER 4

RISKS, CONCLUSIONS, AND RECOMMENDATIONS

TABLE

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CHAPTER 4

RISKS, CONCLUSIONS, AND RECOMMENDATIONS

RISKS

Risk-informed decision-making is a deliberate process. Risk analysis produces information about the nature and causes of risk. Deliberation is the process of understanding risks and formulating decisions based on them. The risk analysis for this Interim Report is qualitative. Deliberation consists of interaction with the External Peer Review Panel and partners and stakeholders regarding drafts of this report. Qualitative risk assessment refers to the consideration of negative consequences without the ability to assign probabilities and/or values to the negative consequences. The Corps of Engineers is fully responsible for the final assessments of risks, conclusions and recommendations resulting from this deliberation.

Several trends and aspects of the evaluation are assumed definitive and absolute over the planning horizon: 1) domestic and international freight demand will increase; 2) a greater rate of investment than currently exists will be necessary to ensure adequacy of freight transportation in the future; 3) environmental impacts from implementation of the Recommended Plan are fully understood and fully addressed in the plan for mitigation; and 4) implementation of the Recommended Plan will achieve desired navigation performance objectives at the cost specified.

The nature of freight demand and the actions by governments at all levels and by private enterprise, which will define the future of freight transportation for the time period of interest and the consequences of the Recommended Plan (2020 to 2060), are, however, uncertain. There are an indeterminable number of possible combinations, producing an indeterminable number of outcomes.

The approach taken in this reevaluation of the Recommended Plan and presented in Chapters 2 and 3 was to bring understanding of risk and uncertainty by evaluating the Recommended Plan from a number of different perspectives. The understanding of risk and uncertainty provides context in which decision-making is possible. Components of the reevaluation include:

1) Seeing the Recommended Plan as a navigation project for the Inland Waterway System through planning objectives, national transportation goals and objectives, and priorities of the Inland Waterways Users Board (IWUB).

2) Evaluating National Economic Development (NED) through the Corps' traditional approach across a range defined by a reasonable low traffic scenario (LTS) and a reasonable high traffic scenario (HTS). This was similar to what was done for the Feasibility Study, but includes refinements in projecting grain forecasts, non-grain forecasts, demand elasticity for grain and non-grain, and analytical models. Researchers assigned definitive values to parameters, which numbered in the thousands, based on past trends and near-term projections. Models were calibrated to the recent past. High and low values were then assigned to key parameters for use in the Global Grain Model and to non-grain projections.

3) Considering non-traditional NED benefits and interrelationship with other elements of the national transportation system, through the multimodal transportation scenario (MTS). The

Corps' traditional analysis is basically a single-mode analytical methodology where it is assumed that transportation rates among competing modes existing now will hold through the planning horizon and that there will be adequate capacity in alternative modes. The underlying assumptions regarding freight growth and transportation investments suggest that these relationships are not likely to hold true over the planning horizon.

4) Considering the redundancy and other benefits of new locks. The Recommended Plan recommends new 1,200 foot locks at Lock and Dams 20-25 on the Upper Mississippi River and La Grange and Peoria on the Illinois Waterway. These sites currently have single 600-foot locks which are 60-70 years old. This makes the waterways vulnerable to closures. A closure at any of these seven locks in the lower part of the system results in a shut-down of the Upper Mississippi or Illinois Waterway to thru traffic. The NED analysis quantifies the redundancy benefits by measuring the benefits of new lock in reducing the economic impacts of short term closures and closures resulting from scheduled major lock maintenance.

   However, due to the absence of long duration closures in the historic data records for these lock sites, the benefits of reducing the impacts of low probability but high impact long closures was not reflected in the NED analysis. Such closures are possible and have occurred at other locks in the system. Reduction of the risks of such long duration closures is a significant unquantified NED benefit of the Recommended Plan and increases resiliency of the national transportation system. In addition, parallel usage of dual locks increases system flexibility, which in turn provides opportunities for greater reliability, efficiency, and capacity than demonstrated in the system economic analysis. Dual locks encourage more preventative maintenance by lessening the impact of planned lock outages for maintenance purposes. Dual locks will lessen the impact from outage of a lock and speed recovery from such an event. New locks result in safer operation by eliminating the dangerous operations of breaking tows and reassembling them.

5) Considering Regional Economic Development (RED), Environmental Quality (EQ); Other Social Effects (OSE) accounts in recognition of the fact that there are important national considerations that are not captured in NED.

6) Comparing consequences of implementing or not implementing the Recommended Plan over the full range of possible traffic levels (MIN and MAX).

Table 4.1 provides a tabular summary of the consequences of implementing the Recommended Plan relative to not implementing the Recommended Plan over the full range of possible traffic levels. The Recommended Plan is highly positive across all planning objectives and aligns with the priorities of the IWUB. Consequences related to RED and OSE will be positive for all traffic levels and will increase with increasing traffic. Some of the benefits have national significance. Implementation of the dual-purpose Recommended Plan will produce substantial environmental benefits under all traffic levels, but lower traffic will put less stress on the ecosystem. The NED is the one area where there is the potential for negative results under the lower portion of the traffic range.

Risk is financial and limited to the first increment costs of the navigation component. There is little risk of negative regional, social, and environmental consequences and little risk that national economic consequences will exceed investment. Considering the anticipated stress on the national transportation network over time, however, it is reasonable to conclude that traffic on waterways—provided they are maintained as efficient and reliable—will be greater than estimated through the Corps' traditional analysis. It is reasonable to conclude that Federal investment in the first increment of the Recommended

Plan will yield positive benefits in all four accounts—NED, RED, EQ, and OSE. In addition, other mitigating national benefits that offset the financial risk include:

1) **Adding freight capacity, increasing efficiency and reliability, and increasing choice and competition in and among transportation modes,** which benefits national security, international competitiveness, and regional standard of living;
2) **Reducing the economic impact of long-duration closures by providing local redundancy**;
3) **Changing operations of the UMR-IWW System from single to dual-purpose**, which requires collaboration between navigation and ecosystem interests, advances sustainability of the UMRS ecosystem, and ensures preservation of a national treasure;
4) **Providing incentive for greater utilization of waterways**, reducing pressures on other modes. Potential paybacks are significant. Implementing the Recommended Plan now will become a consideration in alternative mode investment decisions. Implementing in anticipation of traffic growth rather than as a reaction to it will greatly reduce the compounding effects of construction on congestion.

With aggregate freight on the UMR-IWW flat for more than 10 years, why is it reasonable to conclude that freight traffic on the UMR-IWW will increase and the Recommended Plan will have positive NED benefits? As explained in more detail in Chapters 2 and 3, freight on the UMR-IWW grew rapidly after opening the 9-Foot Channel Navigation Project and continued to grow into the 1980s, but has since leveled off. The leveling-off period coincides with impressive efficiency gains in rails after deregulation (1981 Staggers Act). Rail deregulation not only led to more efficiency on Class I rails, it led to consolidation of short-line railways, which adversely affected their connectedness with waterways. Combined with higher ocean rates and efficient port operations, rail freight to the Gulf and West Coast took greater share of freight. Other reasons include years of low levels of international grain trade during the 1990s and changes in the make-up of freight and shipper expectations.

The Nation may be at a turning point with regard to freight capacity; past trends that have resulted in flat traffic on the UMR-IWW may not be applicable to long-term trends for the future. Rail in the central north-south corridor has limited capacity in many locations and limited opportunities to meet demand expected in the future. The pricing power of rail is evident in changes in water-compelled rate studies spanning the last 12 years. Although rail will continue to gain in efficiency and capacity, the easier gains from deregulation have played out. In addition, West Coast ports are reaching capacity and are located in highly congested urban areas. Expanding to meet growing freight demands may be limited by space and cost. As freight demand increases, more is expected to move through Canadian and Mexican ports. The Panama Canal will open up opportunities for more freight in and out of the country through the Gulf. Inland waterways have the potential for efficient all water transportation deep into the U.S. midland, which would allow some freight to bypass landside operations at sea ports.

Freight by truck is expected to grow faster than other modes, but highway congestion, fuel costs, and other environmental considerations may increase costs and reduce reliability, which may in turn lead shippers to move more higher-valued freight by rail or water. With rail already nearing capacity in some segments, there may be incentive to move more freight to water and to create rail-water intermodal relationships. Even relatively small shifts in better utilization of available infrastructure will help in alleviating the pending freight transportation crisis.

The current ongoing debate over corn production and use, i.e. fuel and/or food, is exemplary of the challenges and uncertainties regarding long-term market and transportation forecasting. The strategies for achieving national transportation system goals and objectives recognize the need for multimodal flexibility, redundancy, and intermodal operation, so that the Nation is prepared for a wide-range of market and transportation developments.

CONCLUSIONS

The Upper Mississippi River System is a nationally significant ecosystem and a nationally significant commercial navigation system. The Mississippi River is one of the world's great rivers. It is recognized as a "river that works" and a "working river." Environmental organizations with worldwide reputations, such as The Nature Conservancy and the Audubon Society, have established highly visible programs around the significance of this river ecosystem.

The public expects a sustainable balance among economic uses of the Upper Mississippi River System and a healthy ecosystem. Two principle messages received from the public during the course of the UMR-IWW System Navigation Study are 1) an appreciation of the UMRS for its economic, social, and ecological values and 2) a concern for the future of the river system. It was evident that the public prefers multiple-purpose studies that ensure compatibility and sustainability above single-purpose ones. The decision in 2001 to transform the UMR-IWW Navigation System Feasibility Study into a dual-purpose, integrated plan for ecosystem restoration and navigation efficiency has created a unique opportunity to bring stakeholders together around a shared vision of "long-term sustainability of the economic uses and ecological integrity of the Upper Mississippi River System."

Because it will link management of the river for navigation with management of the river ecosystem, the dual-purpose Recommended Plan will require collaboration among stakeholders with diverse special interests. The Corps, through implementation of the dual-purpose Recommended Plan and its other programs, will be positioned to serve the Federal role in facilitating maturation and realization of the shared vision for the UMRS through collaboration among partners and stakeholders.

Since completion of the Feasibility Study in December 2004, the Corps, in collaboration with its partners, has been adding definition to the framework presented in the Feasibility Study and preparing designs for implementation. Measures for both ecosystem restoration and navigation efficiency are being readied for implementation. A science panel of distinguished scientists and engineers are advising the Corps and its partners on using scientifically-based adaptive management in guiding investment in the UMRS. Over the past couple of years, partners and stakeholders have met in a number of workshops to explore how to effectively collaborate on adaptive management of the UMRS.

Investment in transportation efficiency and capacity will need to increase in order to meet anticipated increases in freight demand and personal transit and stay internationally competitive. The United States has the best multimodal freight transportation system in the world, which provides competitive advantage in the world economy and translates into a higher standard of living for citizens.

Long-term transportation forecasts, principally due to the combination of increasing population and globalization, are for increased freight demand and personal transit, domestically and internationally. The current rate of transportation investment is insufficient to keep pace with projected demand.

Without an increase in investment, the level of congestion (and other social impacts) and the cost of transportation will grow, adversely impacting the Nation's ability to compete internationally.

The Recommended Plan meets planning objectives and aligns with national transportation goals and objectives. The dual-purpose Recommended Plan positively addresses all planning objectives—efficiency, effectiveness, completeness, acceptability, safety, reliability, adaptability, and sustainability—as a navigation project for improvement of the UMR-IWW. The Feasibility Study considered these objectives in a system-wide assessment that resulted in formulation of the Recommended Plan. The navigation projects identified in the Recommended Plan align with investment priorities for the Nation's Inland Waterways as determined through the Corps' prioritization process and the recommendations of the IWUB. The Inland Waterway System constitutes a critical transportation network for the Nation.

The Recommended Plan aligns with the policy goal areas called out in the Department of Transportation Strategic Plan for 2006 to 2011: safety, reduced congestion, global connectivity, environmental stewardship, and security preparedness and response.

The DOT's *Framework for a National Freight Policy* (draft – April 10, 2006) was prepared to provide focus for coordination and collaboration among public and private parties with a stake in the Nation's freight transportation system. The Recommended Plan aligns with many areas of the National Freight Policy Framework for improving operation of the existing freight transportation system, including promoting alternative freight capacity; adding capacity to the freight transportation system; maximizing safety and security of the freight transportation system, including preservation of redundant capacity for security and reliability; and better managing the environmental, health, energy, and community impacts of freight transportation.

The Maritime Administration's (MARAD) goals and objectives as stated in their Strategic Plan for Fiscal Years 2003-2008 remain relevant under DOT's more recent Strategic Plan. The Maritime Administration sees that "one of the great challenges, and opportunities, for the marine transportation system is identifying new and better ways to team with the rail and truck industries to provide a true value-added modal shift to water to relieve congestion in surface modes, add to their overall capacity, and speed delivery of their freight loads. We see this as the essential context for the emergence of new all water, and land-water, short sea shipping services." The Recommended Plan is consistent with MARAD's "America's Marine Highway" initiative.

Implementation of the Recommended Plan provides an incentive for governments at all levels and private enterprises to collaborate on better use of the UMR-IWW and more effective intermodal operations. This may be an opportune time as utilization of railways is increasing, and providing adequate capacity in the Mississippi River corridor will require substantial investment in the future in order to keep pace with demand. In addition, congestion in urban areas is increasing; Gulf ports may become alternatives to congested East and West Coast ports; and expansion of the Panama Canal is underway. Freight demand is expected to continue to grow through the entire planning horizon.

Risk in implementation of the Recommended Plan has largely been mitigated through formulation, design, and an adaptive management approach. As explained in the *Risks* section of this chapter, outstanding risk is financial and related to uncertainty in the level of future utilization of the UMR-IWW. The consequences are limited by project costs and mitigated by other benefits.

Risk associated with under-investing in the national transportation system and investing in projects that have not been integrated with other aspects of the natural and human environments are likely to have serious consequences for the Nation in terms of security, international competitiveness, environmental degradation, and quality of life.

There will need to be stepped-up investment in critical transportation systems in all modes to ensure a national transportation system with the resiliency and robustness capable of serving many different possible futures and capable of withstanding shocks due to accidents, natural disasters, and terrorist acts. There will also need to be stepped-up investment to ensure preservation of critical ecosystems, which are under growing pressure from human activity.

For these reasons, the potential gains from implementing the Recommended Plan outweigh the risks associated with not making the investment in the Recommended Plan. Implementation of the Recommended Plan will improve the Nation's critical waterway system and restore and preserve the UMRS ecosystem.

RECOMMENDATIONS

The Commanders of the St. Paul, Rock Island, and St. Louis USACE Districts agree with the process used to conduct the reevaluation and the content of this interim report. They reaffirm their recommendation for approval of the Recommended Plan as the appropriate plan for improving navigation efficiency of the UMR-IWW and ecosystem restoration of the UMRS, and immediate implementation of the first increment. The Commanders support continued adaptive implementation of the Recommended Plan and for Corps action in areas of collaboration and research.

- Reaffirm their recommendation for approval of the dual-purpose Recommended Plan, as presented in the Report of the Chief of Engineers, 15 December 2004, including immediate implementation of the first increment.

- Support USACE participation in interagency and public/private coordination, collaboration, and investigation to increase utilization and intermodal connectedness of the UMR-IWW Navigation System.

- Within the context of the Corps of Engineers navigation program, support investigations into improving navigation logistics, safety, security, and efficiency through advanced technologies and management practices.

- Support development of understanding and tools for the evaluation of navigation projects as part of the multimodal national transportation system through the Navigation Economics Technologies Program.

Table 4.1. Risk Assessment Summary

<table>
<tr><td></td><td colspan="5">TRAFFIC SCENARIOS</td></tr>
<tr><td></td><td>MIN</td><td>LTS</td><td>HTS</td><td>MTS</td><td>MAX</td></tr>
<tr><td></td><td colspan="5">direction of increasing traffic →</td></tr>
<tr><td>Characterization of Scenarios</td><td colspan="5">LTS and HTS consist of variants of a base conditions established through data search, collection and analysis by reputable researchers. They were determined by setting “reasonable” lower and upper values to a few key parameters in the Global Grain Model and non-grain trends. Information sources include surveys, past trends, and government/industry trends and forecasts. More sophisticated models for forecasting demand and traffic on the UMR-IWW were developed by reputable modelers and calibrated to actual results of recent years. Traditional Corps assumptions used in the LTS and HTS analysis include constant shipping rate relationships between modes and adequate capacity on alternative modes. The period of interest does not start until new locks become operational and stretches many years into the future. MIN (flat or declining traffic) and MAX (optimum utilization) define upper and lower bounds.

MTS considers impacts on the UMR-IWW caused by increasing congestion and capacity constraints in alternative modes. The MTS analysis brings some understanding to uncertainty related to transportation investment in the Nation’s complex and decentralized transportation system. Analysis for MTS, although qualitative and speculative, reflects rationale possibilities for outcomes.</td></tr>
<tr><td></td><td>-</td><td>-</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td></td><td colspan="5">direction of increasing benefits →</td></tr>
<tr><td>NED
(National Economic Development)</td><td colspan="5">Under traditional analysis (LTS and HTS) the benefit-cost ratio is expected to be between 0.4 and 1.3 to 1. Traditional analysis, however, only captures traditional NED benefits; it does not capture NED benefits related to the additional cost of environmental, economic, and social impacts from using alternative modes. Furthermore, if reports about freight capacity constraints and congestion in alternative modes prove to be correct, a possible outcome is more utilization of waterways (MTS). It is expected that as demand increases and the cost to add capacity and mitigate congestion increases, more effort will be put into increasing utilization of under used capacity in all modes. In order for this to happen, reinforcing decisions throughout the decentralized system, public and private, will need to happen. Greater utilization of the UMR-IWW would increase NED benefits, an increase that could be substantial. Traditional analysis does not fully capture the risk reduction of adding second locks has on minimizing the possibility for total channel closure for extended periods of time.

NED of the ecosystem restoration component of the Recommended Plan is not quantifiable at this point in time. Efforts are underway to better understand the value of biological goods and services. Intuitively, especially considering the growing demands on our natural environment and water resources, it seems that NED derived from a dual-purpose, integrated approach to managing the UMRS could be substantial.</td></tr>
<tr><td></td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td></td><td colspan="5">direction of increasing benefits →</td></tr>
<tr><td>RED
(Regional Economic Development)</td><td colspan="5">It is highly likely that implementation of navigation component of the Recommended Plan will have positive economic benefit for the region it serves. The estimates of RED do not include secondary investments, such as private investment in ports and terminals.

RED of the full dual-purpose Recommended Plan is substantially higher than for just the navigation component. RED derived from a dual-purpose, integrated approach to managing the UMRS has not been computed.</td></tr>
</table>

<table>
<tr><td rowspan="2">EQ (Environmental Quality)</td><td>MIN
+</td><td>LTS
+</td><td>HTS
+</td><td>MTS
+</td><td>MAX
+</td></tr>
<tr><td colspan="5">direction of increasing benefits (←)

Implementation of the dual-purpose Recommended Plan will have substantial ecosystem benefit in terms of river function, physical adaptations, and biological response. There is uncertainty in what will be the constituents of biological response, so monitoring is part of the plan. The Recommended Plan is designed to achieve a sustainable balance between the economic uses of the river system and a healthy ecosystem and is supported by extensive research and study into navigation impacts and experience in both navigation management and ecosystem restoration of the UMRS. The adaptive, long-term nature of the Recommended Plan will allow adjustments in response to what is being learned.

It is likely that the rate of ecosystem gains will be impacted by the degree to which the UMRS is used for navigation and other economic purposes.</td></tr>
<tr><td rowspan="2">OSE (Other Social Effects)</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td colspan="5">direction of increasing benefits (→)

A key underlying assumption is that water transportation is more socially acceptable with fewer environmental impacts than competing modes of transportation – a greater separation of freight from people, safer, quieter, less pollution, and more fuel efficient. In addition transportation investment, such as this, that increases efficiency, capacity, reliability, and transportation choices will benefit national security and international competitiveness.</td></tr>
<tr><td rowspan="2">Planning Objectives</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td colspan="5">direction of increasing value (→)

As presented in Figure 3 of the Introduction, the Recommended Plan formulated during the Feasibility Study was determined to be the best alternative with regards to meeting planning objectives – efficiency, effectiveness, completeness, acceptability, safety, reliability, adaptability, and sustainability. The Recommended Plan has favorable priority when compared to other investments considered for the Inland Waterway System. The planning objectives are consistent with the goals and objectives for the National Transportation System established through the U.S. DOT relating to safety, congestion, global connectivity, environmental stewardship, and security preparedness and response. The Recommended Plan matches well with the Framework for a National Freight Policy. As utilization of the UMR-IWW increases the value of the Recommended Plan in satisfying planning and transportation objectives increases.</td></tr>
<tr><td>Consolidated Statement of Risk</td><td colspan="5">It is reasonable to conclude that implementation of the Recommended Plan will result in positive benefits in all four accounts. Risk in implementation of the Recommended Plan has largely been mitigated through formulation, design, and an adaptive management approach. Outstanding risk is financial and related to uncertainty in the level of future utilization of the UMR-IWW. The consequences are limited by project costs and mitigated by other benefits.

Risk associated with under investing in the national transportation system and investing in projects that have not been integrated with other aspects of the natural and human environments are likely to have serious consequences for the Nation in terms of security, international competitiveness, environmental degradation, and quality of life. There will need to be stepped up investment in critical transportation systems in all modes to ensure a national transportation system with the resiliency and robustness capable of serving many different possible futures and capable of withstanding shocks due to accidents, natural disasters, and terrorist acts. There will also need to be stepped up investment for the preservation of critical ecosystems, which are under growing pressure from human activity. Implementation of the Recommended Plan will improve the Nation's critical waterway system and restore and preserve the UMRS ecosystem.</td></tr>
</table>

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