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# United States Coast Guard Feasibility Study For Development of a Waterways Management Decision Support Toolkit


FINAL REPORT
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Marc B. Mandler, Ph.D.
Technical Director
United States Coast Guard
Research & Development Center
1082 Shennecossett Road
Groton, CT 06340-6096

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The R&D Center's technical point of contact is W. Heerlein, 860-441-2625, e-mail: wheerlein@rdc.uscg.mil.

16. Abstract (MAXIMUM 200 WORDS)

This report discusses the feasibility of implementing the Waterway Managment Decision Support Toolkit with respect to technical issues, cost, and benefit to the **organization**. The concept is explored through the development of a Waterways Analysis Database Repository (WWADR) that supports the gathering, standardization and validation of waterways related data to support analyses; a revision to the Waterways Evaluation Tool (WET), and integration of data to support the Waterways Analysis and Management System (WAMS) and Port and Waterways Safety Analysis (PAWSA). A web-based system is recommended with centralized administrative support for data gathering from available Coast Guard and other federal agencies data sources to allow direct access to field users. Significant efficiencies may be expected through the availability of waterway data, the implementation of WET as the standard waterway assessment process, and the ability to compare similar waterways to performance standards developed from the Coast Guard strategic goals.

Appendices to the report list the development of the revision to WET, including the development of anchors and national weights, data sources that should be included in the WWADR to support WET, WAMS and PAWSA, and the framework of a Computer System Development Document (CSDD).

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## Table of Contents

## List of Figures



## List of Tables

## ACRONYMS AND TERMS

| Term | Definition |
|---|---|
| **ACOE** | Army Corps of Engineers |
| **AHP** | Analytic Hierarchy Process |
| **AIS** | Automated Identification System |
| **ARRF** | Automated Relative Risk Factor |
| **AtoN** | Aids to Navigation |
| **ATONIS** | Aids To Navigation Information System |
| **BARD** | Boating Accident Reporting Database |
| **CGDN+** | Coast Guard Data Network Plus |
| **COTP** | Captain of the Port |
| **CSDD** | Consolidated Software Development Document |
| **DGPS** | Differential Global Positioning System |
| **DOT** | Department of Transportation |
| **EAIS** | Enhanced Automated Identification System |
| **ECDIS** | Electronic Chart Display Information System |
| **FTE** | Full-Time Equivalent |
| **G-M** | Office of Marine Safety and Environmental Protection |
| **G-M RBDMG** | Office of Marine Safety and Environment Protections Risk Based Decision Making Guidelines |
| **G-MWV** | Office of Vessel Traffic Services |
| **GPS** | Global Positioning System |
| **HTTP** | Hypertext Transfer Protocol |
| **IRA** | Integrated Risk Assessment |
| **JAD** | Joint Application Development |
| **MARAD** | Maritime Administration |
| **MINMOD** | Marine Investigation Module |
| **MISLE** | Marine Information for Safety and Law Enforcement |
| **MSIS** | Marine Safety Information System |
| **MSN** | Marine Safety Network |

| Term | Definition |
|---|---|
| **MSO** | Marine Safety Office |
| **MTS** | Marine Transportation System |
| **ODBC** | Open Database Connectivity |
| **OSC** | Operations Systems Center, Martinsburg, WV |
| **PAWSA** | Ports and Waterways Safety Assessment |
| **R2TAR** | Rank Risk, Target Risk |
| **SARMIS** | Search and Rescue Management Information System |
| **SRA** | Short Range Aids to Navigation |
| **STRM** | Ship Transit Risk Model |
| **SWS III** | Standard Work Station III. The Coast Guard standard desktop computer system, including software. |
| **USCG R&DC** | United States Coast Guard Research and Development Center |
| **VNTSC** | Volpe National Transportation Systems Center |
| **VTIS** | Vessel Traffic Information Service |
| **VTM** | Vessel Traffic Management |
| **VTS** | Vessel Traffic Service |
| **WAMS** | Waterways Analysis Management System |
| **Waterway** | Any body of water wide enough and deep enough to accommodate the passage of water craft, particularly commercial vessels.<br>Also, specific waterway segments identified by either the ACOE or Coast Guard as supporting commercial or recreational vessel traffic. Waterway segments are identified by a waterway net code by the ACOE and by a WAMS waterway name and code by the Coast Guard. These two numbering systems are not synchronized. |
| **WET 1.1** | The Waterways Evaluation Tool developed by the Coast Guard R&DC. |
| **WET 2.0** | The modified Waterways Evaluation Tool presented in this report |

| Term | Definition |
|---|---|
| **WET CONCEPT** | The vision of a developed and maintained collection of data, providing the basis for a decision support and analysis computer system to assist the Coast Guard with periodic reviews, strategic planning, budget preparation, project validation, resource allocation, and other waterways management issues. The Wet Concept includes standardized data collection and analysis techniques and hence should assist with the creation of a systematic management process that is contemporary, inclusive, and repeatable. |
| **WWADR** | Waterways Analysis Data Repository. A proposed database of available information for waterways managers including available data, expert judgement, and records of analyses. The database portion of the WWM DST. |
| **WWM** | Waterways Management / Manager. Includes program activities from the Coast Guard Headquarters, District, field office and operational unit levels. |
| **WWM DST** | Waterways Management Decision Support Toolkit. A system that includes data entry and validation, storage, analysis tools, and linked data and assessments to support waterways management. |

## EXECUTIVE SUMMARY

Management of federally controlled waterways in the United States is not executed in the traditional sense of a single individual or entity controlling critical aspects of a system. Instead, it is a cooperative enterprise carried out by several federal agencies, state and local governments, and private sector interests that use, operate on, or profit from the waterway. Actual levels of operations vary from port to port and are driven primarily by commercial market forces or by physical aspects of the waterway or environment. In some ports the requirements of national defense or the recreational boating component must be considered. To ensure that appropriate levels of safety are maintained and natural resources are preserved and protected, the level of management needed in any one port may vary considerably from another.

While this diffused approach to waterway management has generally been successful, it raises some inherent issues. One of these issues is the fact that no single organization has ownership of the entire system. Without a central keeper, general descriptive information and port performance data are often generated and maintained by the providing agency. External access to these data to perform systems analysis has proven difficult and problematic. Without complementary data from other management partners, agencies like the U.S. Coast Guard are challenged to measure their impacts on the waterway at large. Without these measures, it has become increasingly difficult to justify budgets and resource allocations.

Recent initiatives, like the Department of Transportation ONE DOT's marketing of the Marine Transportation System (MTS) as a core component of the National Transportation System, are forcing those invested in waterways to take broader systems perspectives. The reason for this new level of awareness is to ensure that our ports and harbors are up to the challenge of forecasted increases in global trade. One manifestation of this increased trade will be more ships that are larger and faster and market forces that demand efficient operations measured by minimal, if any, delays. The Coast Guard must be prepared to manage these changes.

The Coast Guard is proposing development of the Waterways Management Decision Support Toolkit (WWM DST), an information infrastructure that will help support decision-making, specifically risk-based analysis. This asset will enable the Coast Guard to fulfill its current need for waterway system information and potentially partner with other waterway stakeholders to form an information brokerage.

As part of the initial effort, a Waterways Evaluation Tool (WET) will be implemented as the first of what is envisioned as a suite of tools. WET will measure waterway performance with respect to the Coast Guard strategic goals of Mobility, Safety, and the Protection of Natural Resources. WET employs a mix of data from the WWM DST's supporting database with the assessor's expert judgment to assess over 50 attributes that make up the waterway's risk-based performance model. Each attribute's rating is factored with its relative importance, or weighting, to generate a score. The relative importance, or "national weight," of each attribute is determined by a team of experts using the Analytic Hierarchy Process (AHP). These fixed "corporate values" will allow similar waterways to be compared because the assessments will be completed over an equal playing field. This capability will help the Coast Guard in many ways, but most important in its

ability to make resource-allocation decisions based more on analytic processes than on anecdotal commentary.

This report provides details of why it is feasible for the Coast Guard to implement the WWM DST concept in a development system. The development system will allow for extensive testing of the products and will support the ultimate decision to implement the tools. Feasibility is addressed with respect to technical issues, cost, and benefit to the organization.

The development of the WWM DST with WET and data outputs to WAMS and PAWSA is expected to cost between $1.7M and $2.3M over a 16-month development period. The recommended system will be Web-based for access by all levels of Coast Guard waterway managers from Headquarters, Districts, and field commands. System maintenance costs are estimated from $80,000 to $127,000 per year for personnel support and approximately $45,000 for equipment support. The expected benefits include reduced effort in gathering waterway data and improvements from the standardized waterway assessment. These benefits should accrue as available staff time for other priority management efforts in the order of $800,000 per year. The major benefit from the implementation of the WWM DST and WET will be the systematic approach to waterway assessments that will focus managers on meeting the strategic goals of the Coast Guard and the Department of Transportation.

# 1.0 INTRODUCTION

## 1.1 Purpose of Project and Study

Waterway management can be defined as the integrated efforts of public and private resources to ensure that the infrastructure, systems, and services of our ports and waterways meet the demand for a safe, secure, efficient, accessible, economically viable, and environmentally sound maritime component of the national transportation system. Due to the growing number of waterway users and the increasing awareness of waterway importance to the national economy, the associated management issues are becoming more complex. Larger vessels, such as container ships and tankers, desire faster access to port facilities to maintain their economic advantage. High-speed ferries transport commuters in major urban seaports; recreational vessels share waterway use for personal enjoyment. Federal, state, and local agencies monitor safety and environmental impacts of waterway use and incidents and develop regulations to control risks. The sometimes competing interests of mobility, safety, and environmental protection are represented by the waterway management responsibilities of the Coast Guard and are managed by separate programs and field units. The complexities of these competing interests present an opportunity to improve waterway management through a more systematic approach using consistent and shared information.

This study reports on the development of the Waterways Management Decision Support Toolkit (WWM DST) concept. ~~one~~The WWM DST concept is to create a modular framework that will collect and maintain the necessary information for waterway analyses, provide an initial assessment tool based on the Coast Guard's strategic focus areas, integrate other more focused analyses tools, and store the results of evaluations and analyses for shared access and historical performance reviews. The systems concept of an integrated WWM DST was briefed to the Director, Waterways Management (G-MW), the Chief, Office of Vessel Traffic Services (G-MWV) and Chief, Office of Aids to Navigation (G-OPN) in June 1999 and subsequently approved.

## 1.2 Feasibility Study Objectives

The purpose of this study is to report on the feasibility of developing the WWM DST concept into an operational system. This study documents the findings ~~of the study~~by identifying:

- The necessary functionality and architecture for the WWM DST
- The data sources and elements needed to populate a database for preliminary support of the Waterways Evaluation Tool (WET), Waterways Analysis and Management System (WAMS) reports, and the Ports and Waterways Safety Assessment (PAWSA) analysis tools
- The process to modify the WET analysis tool
- WWM DST System alternatives, with relative comparisons of characteristics
- Recommendations for developing the WWM DST

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### 1.3 Technical and Management Approach

WWM DST concept development began with a review of Coast Guard responsibilities and issues associated with waterway management. Current waterways management practices and major existing decision support tools were reviewed to identify opportunities for improvement through a systems approach. The Project Team focused on refining the WET 1.1 prototype as a preliminary waterway performance evaluation tool to indicate where more complex and resource intensive analyses, such as WAMS or PAWSA, should be conducted. The WET 1.1 process was closely examined and refined to reduce data gathering efforts and to improve the reporting of results. Several workshops were conducted with representatives from Coast Guard Headquarters; Program Managers representing G-MWV, G-OPN, G-OPB; and field representatives from Captains of the Port for Tampa, New York, and Baltimore.

Managing the data gathering, validation, and storage for revised WET (WET 2.0), WAMS, and PAWSA information generated the concept for the Waterway Analysis Data Repository (WWADR) as a significant feature of the WWM DST.

The technical approach followed the Coast Guard's Stage Gate Process. Senior management briefings were conducted at the Preliminary Investigation (Stage 1) and Build CG Business Case (Stage 2) levels to obtain approval and concurrence to proceed with development of the WWM DST.

Once the WWM DST concept was developed, details of implementing the system were examined for feasibility. This included the following activities:

- Identification of potential uses and users of the WWM DST, including integration of WAMS and PAWSA information into the dataset
- Identification of data quality, availability, and correlation issues
- Definition of the fundamental areas, related to a waterway, that should be assessed in the WET 2.0 Module
- Evaluation of the WET 2.0 Module practicality to present realistic and valid waterway performance evaluations
- Identification of the WWM DST's feasibility with respect to technical risk factors ~~cost,~~ and organizational benefits
- Estimati~~on~~ on ~~e~~ of ~~total~~ development and ownership costs

## 2.0 CURRENT DECISION-MAKING PRACTICES AND IDENTIFICATION OF AREAS FOR IMPROVEMENT IN COAST GUARD WATERWAY MANAGEMENT DECISION SUPPORT

### 2.1 Overview

The Marine Transportation System (MTS) initiative sponsored by the Department of Transportation has a vision: to make the marine transportation infrastructure of the United States the world's most technologically advanced, safe, secure, efficient, effective, accessible, globally competitive, dynamic, and environmentally responsible system for moving goods and people. The Coast Guard will play a major role in making the MTS vision a reality. The Coast Guard complements the MTS with national performance goals of Safety, Mobility, Protection of Natural Resources, Maritime Security, and National Defense. Waterway managers at all organizational levels within the Coast Guard consider these goals as they manage and balance the services provided in their waterways, as depicted below in Figure 1.

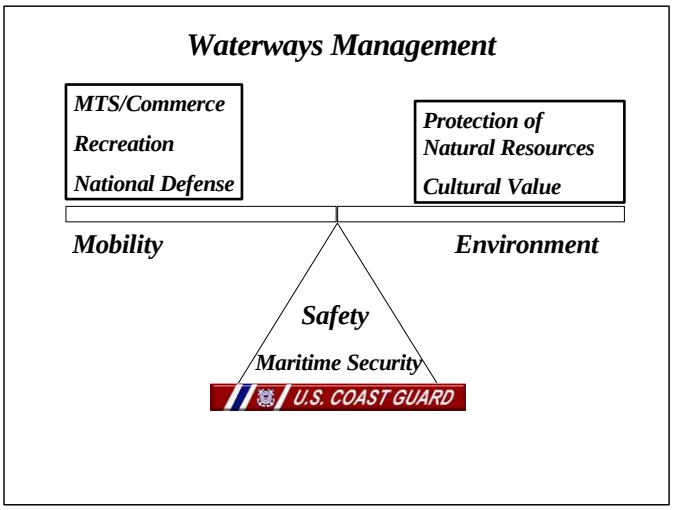


**Figure 1: Waterways management, a balancing of needs.**

The assessment of waterway performance has evolved as the Coast Guard managed its statutory requirements for waterway management, as defined in Title 14 of the United States Code. Responsibility for managing waterway services is now distributed among program managers at Headquarters, District Offices, Groups or Activities, and Captains of the Port. Responsibility for providing waterway services is distributed among the Captains of the Port, Vessel Traffic Systems, where available, and Aids to Navigation (AtoN) units. Each of these organizational levels participates in the Coast Guard's waterways management processes as data gatherers and as providers, analysts, and decision makers. Waterway management responsibilities range from the control of anchorage and movement of any vessel in U.S. navigable waters to ensure safety,

security, and enforcement of the regulations and provisions in the Ports and Waterways Safety Act to the establishment and maintenance of visual and radio aids to navigation.

## 2.2 Existing Tools

The safe and efficient operation of U.S. waterways is a highly complex process that involves numerous stakeholders. The Coast Guard provides information and guidance and applies control in some cases to ensure that the "performance" of U.S. waterways is at an acceptable level with respect to particular goals. Various approaches have been used to analyze different parts and operations in U.S. waterways and have led to the adoption of different alternatives to facilitate waterway operation. In some cases, the method of analysis has been questioned and complaints have been made that the Coast Guard does not have a systematic method of conducting such analyses.

A number of decision support tools and approaches have been developed to provide information to assist waterway managers. Many of these tools have been developed through ongoing research and development efforts, while others have been developed directly by program managers, at both the headquarters and the field levels. Specific decision support tools include the following models and procedures:

- **Waterways Analysis and Management System (WAMS).** The primary objective of WAMS is to assist the Coast Guard in managing aids to navigation services managed by the District, Aids to Navigation Branches and conducted by the district, groups, or major aids to navigation units. WAMS reports are maintained at District offices as documents. There is no database of WAMS results and recommendations.

  WAMS is intended to be a comprehensive review of all aspects of a given waterway and is a labor-intensive manual process that is repeated at five-year intervals. Information is collected on all aids to navigation services (major, minor, electronic, and privately maintained), the aid discrepancy history, changes in marks, recommendations for changes in the aid system, and an evaluation of the waterway criticality and the servicing unit's capabilities. The WAMS report summarizes the characteristics of the waterway, including geographic features, facilities, bridges, anchorages, and environmental characteristics such as tides, currents, and visibility. User profiles are also developed including summaries of vessels using the waterway, traffic patterns, frequencies of transit, cargo carried, and authorities and associations present in the waterway.

  WAMS also includes the solicitation of public comments regarding the aids to navigation services provided. Through this process, the Coast Guard receives input from the commercial, military, and recreational users who operate in the waterways.

  WAMS data requirements are summarized in Appendix B

- **Automated Relative Risk Factor (ARRF).** ARRF is a computer program designed to estimate the relative risk associated with the transit of a design vessel through a given waterway with a specified design and aid configuration. It is used to evaluate alternative designs and aid configurations. The ARRF is based on over 15 years of man-in-the-loop simulation research examining vessel and operator performance (Armacost, 1998). ARRF is typically used with WAMS but may also be used

independently to evaluate particular situations. ARRF results are documented separately or included in WAMS reports and are maintained at District offices.

- **Waterway Evaluation Tool Prototype Mark 1.1 (WET 1.1).** WET 1.1 uses a value-tree approach to determine overall scores for a given waterway with respect to three Coast Guard goals—Safety, Mobility, and Protection of Natural Resources—and to determine the importance of a waterway with respect to various user groups and stakeholders. The primary objective of WET 1.1 is to assist the Coast Guard in assessing overall waterway performance and determining the best allocation of resources to enhance waterway management. WET 1.1 is characterized as a standard, comprehensive methodology for assessing waterway performance against the Coast Guard's strategic goals of Safety, Mobility, and Protection of Natural Resources. The prototype WET 1.1 has been tested in Jacksonville, Florida, but has not been implemented. Records of WET 1.1 evaluations are maintained in written reports.

- **Ports and Waterways Safety Assessment (PAWSA).** PAWSA is a risk-based decision support tool that provides a structured approach to identifying risk drivers within a port and then evaluating potential measures for mitigating that risk through expert input from waterway users. The process requires participation by professional mariners with local expertise in navigation, mobility, safety, and the environment. PAWSA is managed by the Captain of the Port and focuses on local customer needs by answering two critical questions:

  1) Which ports need a vessel traffic management (VTM) investment based on risk?

  2) What VTM intervention is appropriate in mitigating that risk?

  PAWSA uses a port risk assessment model, shown below in Table 1, to determine the relative importance of several criteria and subcriteria to determine an overall risk score and then uses these results to evaluate various vessel traffic management interventions to reduce risk. The port risk assessment model uses AHP as a means for determining the relative importance of individual criteria and subcriteria and synthesizing the results during a workshop that includes port stakeholders. This workshop not only establishes a baseline of ports for consideration for VTS but also provides the local port community with an effective tool to reevaluate risk. PAWSA results are maintained in written reports.

**Table 1: PAWSA port risk assessment model.**

| Ship / Traffic Conditions | Traffic Volume | Navigational Conditions | Waterway Conditions | Short-Term Consequences | Long-Term Consequences |
|---|---|---|---|---|---|
| Quality of Ships | Deep Draft | Wind Conditions | Visibility Obstructions | Injuries to People | Health and Safety |
| Crew Competency | Shallow Draft | River & Tidal Currents | Channel Width | Petroleum Discharge | Wetlands and Endangered Species |
| Mix of Shipping | Commercial Fishing Vessels | Visibility Restrictions | Bottom Type | Hazardous Material Release | Fisheries |
| Density and Congestion | Recreational Boats | Ice Conditions | Waterway Complexity | Property Damage | Economic Impacts |

- **The PAWSA Waterway Selection Booklet (PAWSA WSB).** The PAWSA WSB is a collection of data (15 categories) covering 61 geographic areas and characterized by 145 primary ports and 658 secondary ports. The data can easily be used to rank order the different ports and regions based on any of the data categories. However, there is no basis for combining the different categories or for determining the relative importance of any of the data categories. The PAWSA WSB is maintained as a report at G-MWV.
- **Ship Transit Risk Model (STRM).** The STRM uses a Bayesian model to compute the probability of a grounding or collision as a function of selected risk factors such as vessel type and size, wind speed, and visibility. The model requires a significant amount of data and subsequent analysis. STRM results are maintained at the District offices.
- **Rank Risk, Target Risk (R2TAR).** The R2TAR approach is based on the risk ranking methodology that uses a questionnaire approach to elicit relative importance from various users on a number of criteria for different waterways. The approach then uses a scoring methodology to estimate the risk associated with the waterway. The resulting risk scores were used to rank the waterways in Southeast Alaska. The 17th District then used the ranked list to target the waterways with the highest risk for improvement measures. The data collection for this project took over two years to complete. The R2TAR results are maintained at the 17th District.
- **Integrated Risk Assessment (IRA).** The IRA methodology provides guidance for conducting a detailed risk analysis using many of the traditional risk analysis tools. IRA provides a good structure that has been applied to various Coast Guard operational activities. Recently, IRA was used to guide a risk assessment for the Port of Baltimore. Although the results are not yet available, the IRA methodology represents a sound approach for conducting a detailed risk assessment of specific aspects of a given port or waterway. The results of the IRA are maintained in an R&DC report.
- **Office of Marine Safety and Environmental Protection Risk Based Decision Making Guidelines (G-M RBDMG).** The RBDMG contain theories and principles for risk-based decision-making, various tools and procedures for conducting risk analyses, and supporting material useful to managers using a risk-based approach. The guidelines provide an overall structure for a risk-based approach to decision-making.

Currently used tools focus their attention on the mobility and safety of the waterway with respect to vessel traffic management and aids to navigation services. Figure 2 below lays out the strata of tools, support, and services available to waterway managers. WAMS and supporting analyses assist at the basic level of waterway services. The RBDMG, PAWSA, WET, and IRA assist in determining the appropriate level of enhanced support services for a port.

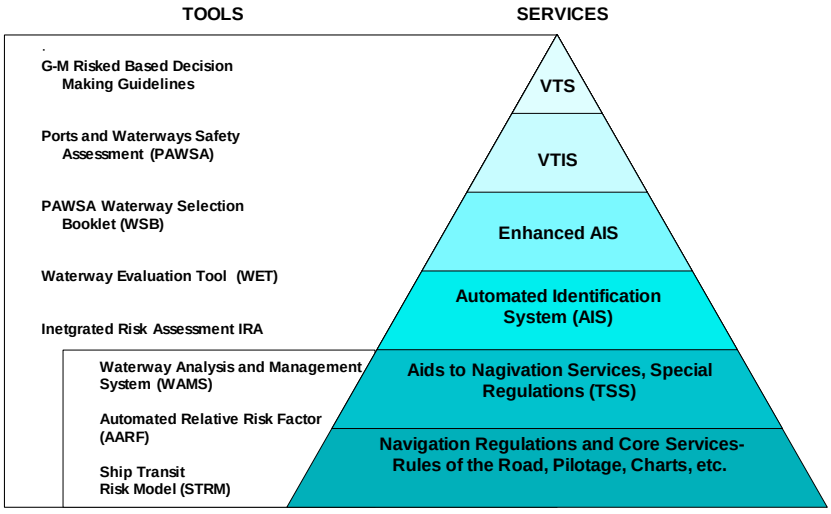


**Figure 2: Vessel Traffic Management services and supporting tools.**

## 2.3 Areas of Improvement in Waterway Management

The Coast Guard has often sought ways to help waterway managers assess the performance of waterways. The responsible programs, either the Short Range Aids to Navigation (SRA) or Vessel Traffic Services (VTS), have developed the processes and tools described above. All the decision tools described above are risk-based analytic approaches that can assist waterway managers in executing their responsibilities. These processes may be characterized as locally generated, paper-oriented, and labor-intensive, particularly in the area of data gathering and analysis.

Even with innovations in information technology, and particularly with the deployment of the Standard Work Station III (SWS III), which provided access to information through the Internet, waterway managers still have redundant responsibilities for acquiring and analyzing data for various aspects of waterway evaluations. Most of these analytical tools have different purposes, and they require varying, and often significant, efforts to complete. Nonetheless, they are complementary tools. Waterway managers at the local level representing different programs participate in the focused analyses, but currently there are no direct information links to share data and results among the various tools.

Today most of the waterway information is uniquely obtained and summarized by local Coast Guard managers and analysts through discussions with local stakeholders and users and from their own experience. This duplicates the level of effort, particularly in data gathering and management, and identifies a gap in overall management of waterways. The independent nature of these processes is depicted below in Figure 3.

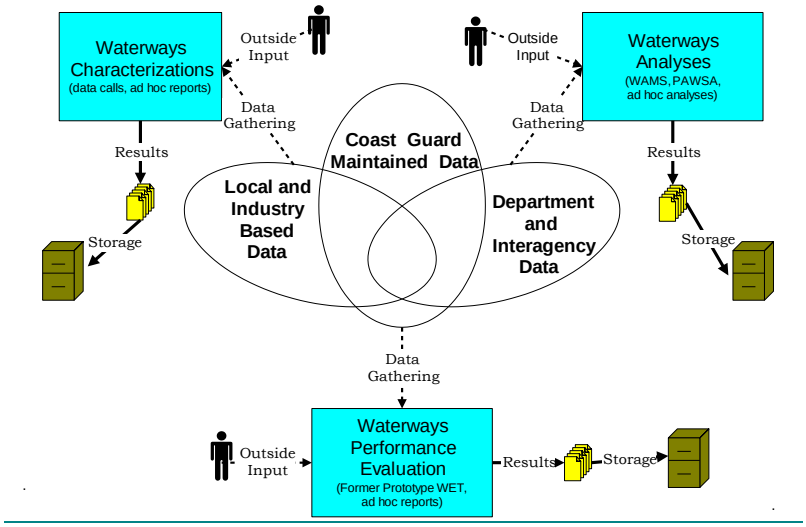


**Figure 3: WWM business processes, today.**

A comprehensive approach was attempted with the proof of concept for WET 1.1. The demonstration critique pointed out that the WET 1.1 "all-in-one," broad-based tool was difficult to develop and maintain and had limited benefit for waterway managers. During the WET 1.1 evaluation, waterway managers reported limited access to the large volume of data required to run the assessment, as well as workforce and resource constraints. WET 1.1 also presented performance measures that were less than well described and were neither easily understood nor effective in comparing waterways.

With processes and supporting tools in place, efficiencies and benefits will be realized across multiple areas of waterway management. The individual areas for improvement are discussed in more detail below.

### *2.3.1 Provide Capability for Standardized Waterway Assessments*

Waterway assessments should be routinely performed to identify and evaluate changes in the external environment and to monitor waterway performance. At the local level, regular monitoring of key indicators will allow managers to take appropriate action before the waterway's performance falls below acceptable levels. If waterway performance is declining, the waterway manager needs to identify what factors are influencing the decline in performance, and what actions could be taken to either restore performance, or to minimize the reduction in performance. At the District and Headquarter program manager level, the Coast Guard's waterway program services could be reviewed to determine current, and future needs for changes in resources. Finally, any actions or initiatives undertaken by local waterway managers to

improve waterway performance would be made available to other waterway managers for possible application within other waterways.

If a waterway meets or exceeds performance standards, routinely scheduled analyses could be deferred, relieving managers and operational units from the effort to complete more-detailed analyses, such as a WAMS or PAWSA report.

Further, proposed changes in the waterway (e.g., development and operation of high-speed ferries, improved container handling facilities, increased recreational use) need to be assessed for possible impact on Coast Guard-related management actions.

To implement this capability, the program standards in the Coast Guard's ~~the~~ strategic focus areas must be developed with supporting measures and indicators of waterway performance. These measures and indicators need to be developed from available data, which may also include expert opinion from waterway users and managers. The data required for performance monitoring must be accessible and available to the waterway managers when the assessment is initiated. A standard process for data acquisition, maintenance, and storage also needs to be developed.

To meet this requirement, the WET 1.1 system was reviewed and modified to provide the capabilities to monitor waterway performance. The results of the WET 2.0 development are provided in a separately bound volume as Appendix A to this report.

### *2.3.2 Provide Capability for Improved Data Management*

The MTS and the G-M Business Plan include goals to improve waterways management, including:

- Widespread use of information-based safety management systems in design and operations
- Information management systems that are tailored to user needs and feature rapid and accurate data entry, analysis, and retrieval
- Improvement of mission performance through improved data quality and reduction of redundant data collection

These business objectives correlate with the project goals to provide waterway management analysts with a reduction in repetitive paper-based processes, a ready source of validated data, standardized analytical tools, and an accessible repository of analyses for reference and comparison. Common threads of information are needed for the various waterway analyses. Having available information accessible to the waterway manager will reduce the effort in collecting, validating, and processing data. Data that are not available, but are gathered from expert judgment and opinion, need to be consolidated so that other analyses and tools use the common baseline for waterway performance reports.

To implement this capability, a common database that draws needed information from available Coast Guard and other agency databases is required. A significant savings in effort would be realized if available data from Coast Guard and other agency and organization information sources were collected at a central location and then made available to field personnel. Collection could be from direct connections to established databases, such as through open

database connectivity (ODBC) or other connection. Once centralized, data need to be consolidated in a consistent and useful system that allows the waterway manager to access the appropriate information for the area of study.

One of the difficulties in gathering waterway data is the inconsistency in data collected by the agencies and organizations responsible for managing waterways. The identification of waterways, for example, is inconsistent through the Army Corps of Engineers (ACOE) and the Coast Guard. The ACOE developed the waterway network to track shipments of goods throughout the United States. Each waterway is identified by a code and referenced to a geographical information system. Commodity flow and vessel movements are correlated to these waterways for data analysis. The Coast Guard maintains two separate systems for identification of waterways. The Light List, published by the Coast Guard, lists waterways by common name. Within the Coast Guard's Aids to Navigation Information System (ATONIS) there are other discrete names for waterways to support the WAMS process. Reconciliation of the differences among the various waterway naming and coding systems is necessary during the development of the WWM DST. For the purposes of this feasibility study, the ACOE net waterways were selected, as the majority of shipping data was extracted from the ACOE Navigation Center Database. Coast Guard data are referenced by position (latitude and longitude) and thereby correlated to the ACOE waterways.

As reported in the DOT Report Maritime Trade and Transportation 1999, the standardization of U.S. waterway data is being discussed among the Maritime Administration (MARAD), the ACOE, and the Coast Guard to improve the quality, consistency, and utility of waterway data.

### *2.2.3 Provide Capability for Cross-Waterway Comparisons*

Higher level managers allocate resources depending on factors that include prioritization of need to meet program objectives, return on investment in terms of risk avoidance, and availability of funds. The comparison, or ranking, of waterways with respect to program goals would assist the waterway managers in the resource allocation process. The presentation of a waterway's performance in the strategic focus areas should be an input to the final resource allocation decision. The limited funding available for waterway improvements and services mandates that the allocation of financial resources be assigned to waterways where the return on investment is justified.

To implement this capability, the proposed system needs to have the capability to assess similar waterway performance to identify the waterway performance gaps and the impact of improved services. Through this capability, the waterway manager can assess the proposed improvements and resultant performance and thus better compete for the limited resources. This capability is proposed to reside within the WET 2.0 analysis module.

### *2.2.4 Provide Capability for Changing Organizational Priorities*

Waterway management has been, and will continue to be, an evolutionary process. Coupled with performance monitoring and improved data availability, managers and reviewers seek incremental improvements in the performance of waterways. Performance standards are identified in the Coast Guard Performance Plan, as well as each program's business plan. As program initiatives improve the performance standards, they will be adjusted to reflect these improvements. For example, the Protection Through People initiative may improve operator training and qualifications, resulting in the reduction of collisions, allisions, and groundings or product spills. The realization of improved performance through this initiative will force the negative outcomes of collisions, allisions, groundings, and spills to lesser thresholds.

The capability to easily change waterway assessment criteria needs to be included within the proposed system. This will require an annual review of the program business plans and the Coast Guard's strategic objectives to ensure that waterway evaluations reflect the changing strategic plans.

### *2.2.5 Provide Decision Support Information*

Waterway characterizations, assessments, and analyses results should support waterway managers' interwaterway and intrawaterway decision-making processes, including policy-making, resource allocations, infrastructure recommendations, data call responses, funding justifications, and measures of effectiveness toward attaining Coast Guard strategic goals.

Support for assisting decision makers will exist, even with the foundation of waterway characterizations and evaluations alone. With current data in the WWADR, waterway managers can gain a broader perspective on their particular waterway's performance and can focus their attention on areas that require attention.

Policy-making can be designed to address those focus areas that have been identified by the evaluations as needing attention. Priorities may be better addressed using the waterway performance evaluation results from both interwaterway and intrawaterway perspectives. Resource decisions can be based on the outcomes of the manual or programmed analyses performed and resources allocated to waterways most in need, making these efforts more effective in improving the entire waterway system.

## 3.0 PRELIMINARY REQUIREMENTS FOR A WWM DST

### 3.1 Functional Description

A preliminary list of the required functions of an integrated Waterways Management Decision Support Toolkit were developed from the areas of improvements to waterway management processes. The primary concept evolved through discussions with Senior Waterway Managers at Coast Guard Headquarters and the R&DC staff that have supported the waterway management programs. The initial WWM DST requirements were developed through interactive sessions with program managers and through the development of the WET 2.0 module. The WWM DST requirements can be described as a centralized system that provides three separate functions:

- **Database and Archive.** The consolidation of waterways information into a central database suggested the Waterways Analysis Data Repository (WWADR). The WWADR is proposed to be a database of available information required for WET, WAMS, PAWSA, and other analytical tools, as well as an archive of completed analyses for historical review and trend analyses. Data should be centrally managed and acquired from available Coast Guard and agency databases and should be related to specific waterways.
- **WET.** The critical function of WET 2.0 is to provide a structured process for initial waterway analyses. The development of WET 2.0 is fully described in Appendix A. Once the initial assesment is completed, the results should indicate whether other, more-detailed analyses should be conducted.
- **Focused Waterway Analysis Tools.** The detailed and focused analytical tools developed by the waterway managers should be included in the system, with results stored and accessible through the WWADR. These tools could include WAMS, PAWSA, ARRF, STRM, and other tools that require significant waterway data that will be provided in the WWADR.

The preliminary system design should follow the approach represented by the approved WWM DST concept. The goal will be to create a waterway management toolkit that supports data collection from multiple sources, standardization of data for consistent use in analysis, readily available data retrieval, and simple access to integrated and standardized assessment and analysis processes. Figure 4 ~~Figure 3~~ shows the general information flow and functionality of the proposed WWM DST~~.~~.

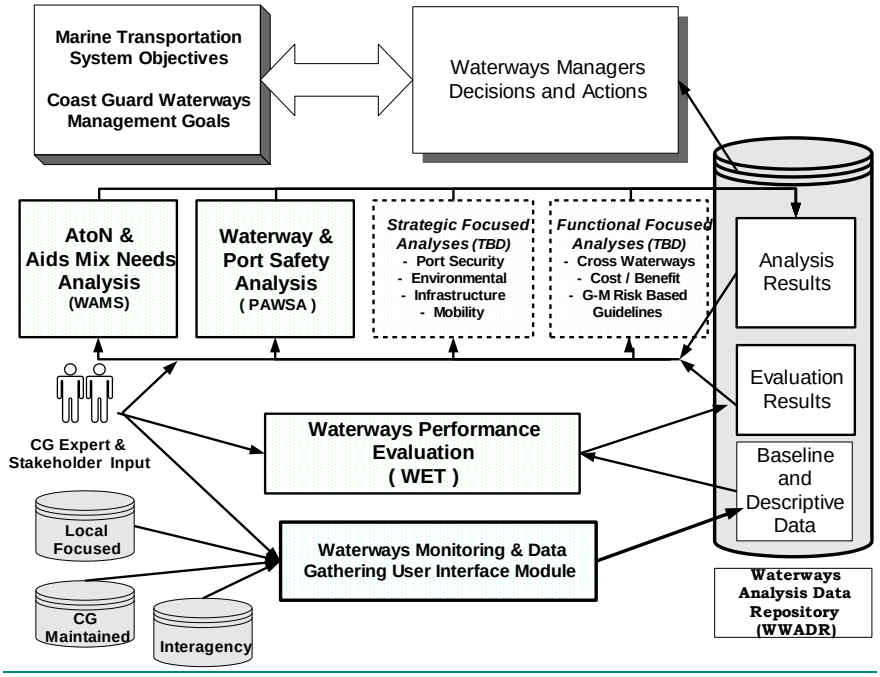


**Figure 4: Waterways Management Decision Support Toolkit, approved concept.**

## 3.2 Functional Requirements

This section describes the functional requirements of each of the components of the WWM DST.

### *3.2.1 Waterways Analysis Data Repository (WWADR)*

The WWADR is the database that supports the WWM DST. The functions of the WWADR are to collect, validate, and store waterways data and to store and maintain results of analyses. The WWADR must have a flexible design so that additional data elements could be integrated into the relational or object-based database to maintain database integrity.

The data entry and validation function of the WWADR must operate from two levels: (1) the administrative level, where information will be collected from available agencies databases, and (2) the field level, where locally available data will be entered and from which waterway assessments will be completed. Centralizing waterway information collection will provide the most benefit to field managers by reducing the need for individual information-gathering efforts.

Available information collection should be standardized through the use of ODBC utilities to established databases or through semiautomated pulling of information from CD-ROMs, Web sites, and other sources of information. Waterway characteristics and data collected from

various internal and external sources will routinely be assessed and standardized by waterway management personnel.

Frequency of data acquisition should be annual; however, there may be a defined need to select data quarterly where available to account for seasonal differences in waterway performance. Data gathering from available information systems, including the Marine Safety Network (MSN - MSIS, MISLE), the Boating Accident Reporting Database (BARD), the Aids to Navigation Information System (ATONIS), and the Search and Rescue Management Information System (SARMIS) should be the responsibility of system administrators. These administrators will ensure that a regular accession of raw data will be available for the field evaluators. This single effort to collect all available information will result in savings in effort during each analysis at each unit.

Many of these systems are maintained at OSC Martinsburg and are already supported by either staff or contract administrators who are familiar with the databases. Some of these systems are currently being modified and updated to new operating systems as the Coast Guard transitions to the Standard Workstation III. Once the modification projects are complete, the actual process of drawing information from these databases can be determined and standardized through automated or semiautomated utilities.

System administrators will be responsible for the following WWADR functions:

- System operation and maintenance.
- Annual or quarterly data collection from available databases for all analysis tools.
- Development of standardized data-gathering utilities for newly available data.
- Data standardization to maintain common units for waterway data, such as tons, pounds, or position. Current interagency efforts among MARAD, ACOE, and the Coast Guard are addressing the data standardization issue.
- Support to field managers.

Field managers will be required to enter locally available information and judgments required for the various analyses, as well as to access, view, copy, and store analyses results. Field managers should be able to discuss differences in available data from their perception of waterway activities. This feature is necessary because of possible errors in data collection, display, or accounting. Specifically, field managers will be responsible for:

- Oversight of data-gathering from expert inputs and local stakeholder plans, suggestions, and desires
- Assurance of collection, receipt, and verification of the applicability of the data
- Conversion of locally obtained data into a usable, standard form when necessary
- Assurance of sufficient data obtained for a waterway evaluation

The initial data identified for placement in the WWADR were developed from the information requirements to support WET 2.0, WAMS reports, and PAWSA. A complete description of recommended data elements and their sources is found in Appendix B.

The automated interface to the WWADR should simplify completing the required tasks of collecting and updating data for the WWADR. As a result, the candidate solution should achieve the following goals:

- Reduction in redundant data-gathering efforts
- Increased data availability and accessibility
- Consistent and quality waterways data
- Currency in waterways characterization through routine monitoring and updating of data
- Standardized data packaging and delivery format, specified for waterway data
- Reduction of ad hoc data requirements on a crisis basis
- Enhancements to internal and external communications

### *3.2.2 WET Functional Requirements*

Waterway managers require an initial assessment of waterway performance based on the strategic goals of the organization to monitor waterways programs. The goal of this initial assessment is to determine the performance of the waterway specific to the strategic goal areas: Safety, Mobility, Protection of Natural Resources, Security, and Military Readiness. With these results, waterway managers could then determine if a focused analysis were necessary to address a specific issue within the waterway, identify excesses within the waterway that provide minimal return for the resource investment, or simply determine that no further action was required.

- **Performance Assessments in each of the Strategic Areas**. A validated and systematic approach to assess waterway performance in each of the strategic areas is required. The approach used during the development of the WET 2.0 module of the WWM DST is detailed in Appendix A. This approach includes a system of attributes and national weights to calculate waterway performance. Because the prototype WET 2.0 developed is data dependent, comment fields to explain the context of the evaluation are a desired feature to support additional review of the assessment. Another desired feature is the capability to record the name and unit of the evaluator and to review comments from the various organizational levels. An included function is the development of the national weights for each attribute in the strategic area to assess the relative importance of each element in the performance assessment. The national weights are based on the Coast Guard Strategic Plan and should be updated whenever there are significant changes to the strategic focus areas.
- **Analysis of Results.** Waterway managers need to identify the causal factors that produced the waterway evaluation to determine what, if any, actions should be taken within the waterway.

  WET 2.0 results and external factors may indicate to the waterway manager that more detailed analyses are warranted. Further analyses may be conducted using one or more of the subsequent tool modules available through the WWM DST. Once the correct analysis tool(s) is identified, the appropriate data from the WWADR can be imported, and the additional data required by the analysis tool will be collected and entered. Managers only need to go through the effort of developing and accumulating additional data as warranted and necessary. Output data from the evaluation will be included in the WWADR for comparison with future analyses.

A standardized report that displays individual component factors for each strategic focus area is required. Output reports should include detailed information from each of the review levels to support waterway management decisions. The output reports should provide two levels of detail for an executive overview and for detailed analysis. WET 2.0 uses a performance map of inferred and realized risk outputs to graphically show the evaluation based on a normalized scoring derived from the worst and best cases for each of the attributes. This normalization is also needed to provide for comparisons of waterways.

- **Identification of the Practical Best Waterway Performance.** This function is needed to determine if any changes in the waterway would result in improved performance scores. The process is to evaluate the waterway considering the estimated impact of improvements or other changes in the waterway. This function could also be used by managers to determine the impact of changes in the waterway. In this case the manager would assess the impact of proposed changes to determine the difference in each of the strategic areas.
- **Cross-Waterways Comparison.** This function will compare the performance of similar waterways in each of the strategic focus areas. A normalized performance score provides a common basis for evaluation. Because resource decisions are based on the return on investment, a method of determining the best investment of scarce resources is needed. This feature would compare waterways by similar groupings to identify those waterways that would benefit most from improvements. An included feature of this function is the development of consistent waterway groupings. Suggested factors are by traffic mix (Commercial, Mixed Commercial/Recreational, Recreational, Military), traffic or cargo volume (High, Medium, Low), environmental issues (limited, severe), or port complexity (High, Medium, Low).

### 3.3 PAWSA Functional Requirements

The PAWSA process is undergoing revision to reduce its dependence on subjective data and to rely more on available waterway information. PAWSA will remain an interactive facilitated process that includes representation from port and waterway users. The process requires the participation of professional mariners with local expertise in navigation, mobility, and port safety. Stakeholders are included in the process to ensure that important environmental, public safety, and economic consequences are given appropriate attention as risk interventions are selected. Although subjective input is the basis for the process, the Port Risk Model forms the foundation for discussion and is supported by empirical data that establishes port specific weights. Port specific data concerning waterway risks and historical information are displayed and validated by the participants throughout the session. The concept of the WWADR can play a major role in meeting these data requirements, as there are similar information requirements between PAWSA and WET 2.0.

The initial function of the WWM DST with regard to PAWSA should be limited to the following:

- Include the necessary available PAWSA data within the WWADR. The PAWSA data elements are listed in Appendix B.
- Accept expert judgment and assessments from the sessions into the database.
- Store the results of the PAWSA sessions for future reference.

Future development of PAWSA as a system may result in the development of a module within the WWM DST.

### 3.4 WAMS Functional Requirements

WAMS reports, like PAWSA depend on significant data collection to characterize the waterway. Vessel transit data provides user summary information, environmental conditions support aid evaluation and design, facilities information also supports future trends and requirements. The majority of WAMS-specific data are included within the data requirements for WET 2.0. Port specific data concerning waterway risks and historical information developed for WET 2.0 can directly support the framework for a WAMS analysis. The concept of the WWADR can play a major role in meeting these data requirements as there are similar information requirements between WAMS and WET 2.0.

The initial function of the WWM DST with regard to WAMS should be limited to the following:

- Include the necessary available WAMS data within the WWADR. The WAMS data elements are listed in Appendix B.
- Accept expert judgment and assessments from the sessions into the database.
- Store the results of the analysis for future reference.

Future development of WAMS as an optimized electronic information system may result in the development of a separate WAMS module within the WWM DST.

### 3.5 Other Analysis Modules

When the WET 2.0 assessment indicates a relatively low waterway performance, the manager may need other focused analysis tools. In performing these in-depth analyses, the specific relevant characteristics of an individual waterway can be evaluated along with the impacting factors, risks, costs, and benefits. Examples of future additional waterway analysis modules that may be developed as needs and funding dictate could include:

- Port and Waterway Security Analysis
- Intramodal Mobility Analysis
- Environmental Analysis
- Waterway Activity Risk Analysis
- Infrastructure Analysis
- Competitive Analysis
- Cross Waterways Analysis
- Cost / Benefit Analysis
- Resource Allocation Analysis

The results of the assessment and all analyses that are conducted should be incorporated into the WWADR to ensure that consistent waterway information to support the repeatable processes will be in place throughout the Coast Guard.

The availability of the results of all evaluations and analyses will facilitate a better understanding of each waterway. This will support better interwaterway and intrawaterway management decisions. As new measures of effectiveness are identified, priorities emerge, and long-term needs evolve, the modular nature of the toolkit will facilitate the addition of appropriate analysis modules as they are developed.

## 3.6 Preliminary Design Description

WWM DST functionality will be implemented using a proven approach based on a common analysis data repository and a continually improving suite of tools. Tools, in the form of Web-enabled applications, will provide user review and analysis of waterways data and the ability to record local user knowledge and analysis results. A Web-based user interface was chosen because of the capability to deploy new analysis methods easily from a central server, which minimizes the effort required to update workstation programs and supports the immediate accessing of the latest version of the tools, data, and other features. Centralized administration of the system simplifies data management and synchronization.

### *3.6.1 Proposed Systems Environment~~Overview~~*

The WWM DST concept is implemented as a client-server architecture, with a central server supported by a data repository. A Web-server process that executes on the WWM DST server provides all user interfaces.

The Web-enabled tools in the toolkit reside on the WWM DST server and are accessed from this interface. Toolkit developers and database administrators have direct access to the WWM DST server and, through it, to the underlying data in the WWADR. A policy decision is required to determine whether the information will be made available to the public. If no public access is desired, the system should be maintained on the Coast Guard Intranet. Limited access for official use only would then be supported through the existing system security program. A WWM DST overview is shown in Figure 5.

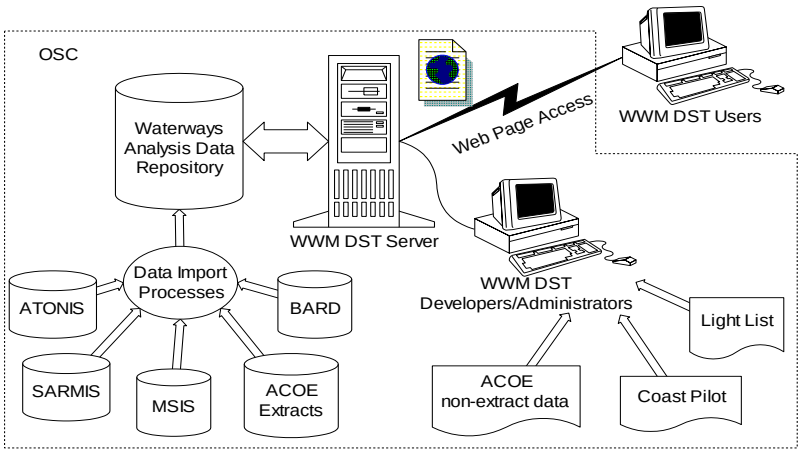


**Figure 5: WWM DST architecture overview.**

Waterway managers will use the Web-based interface to access waterway data and to perform analyses using the tools in the WWM DST. Waterway manager access will include the ability to enter local expert knowledge into the WWADR, as well as the ability to review and validate all data, regardless of source, for their respective waterways. Hardcopy input from standard sources that must be included in the WWADR will be gathered and entered by the system administrators at a central facility. Administrators, using automatic or semiautomatic data import processes, will import additional electronic input directly into the WWADR. Some of the sources considered as input are in the process of making their data available in electronically accessible files; therefore, some migration from administrator work to electronic data importing will have to be accommodated. The central server architecture also supports potential use of the system by other agencies and external (to the Coast Guard) waterway managers.

### *3.6.2 Architecture*

The interface between the WWM DST and the WWADR provides one-way acquisition and validation of source information and provides two-way information flow for analysis tasks and for recording analysis results as well as providing raw analysis data. The internal transfer between analysis results and analysis baseline data reflects the iterative nature of analysis tasks. The results of one analysis tool can then be used as input for further analysis using other tools in the WWM DST. An architecture that supports the structure of the proposed system is shown below in Figure 6.

**Figure 6: Architecture and interfaces.**

The WWM DST will comprise an evolving collection of analysis tools that will be integrated into the system or developed to meet MTS objectives and waterway management goals. As the WWM DST evolves, it must be able to accommodate and contain selected Coast Guard standard applications, custom evaluation applications, and commercial-off-the-shelf (COTS) tools. The WWADR will expand with the WWM DST by incorporating new data and adopting required data formats to support each new tool. Common referencing of waterways or geographical positions will maintain the relationship among all data elements.

### *3.6.3 ~~3.2.3 Major Components~~ Client Software and Hardware*

The WWM DST will be developed to be compatible with the Coast Guard's SWS III workstation with installed Web browser and office software suite. Currently these are Microsoft Internet Explorer and Microsoft Office 97, respectively. The Coast Guard also maintains licenses for Oracle database systems. No WWM DST system development considerations require software programs beyond those currently available for similar Coast Guard Web-based database applications. Because users already have training systems in place, the need for special purpose software training is eliminated. The use of Web-enabled technologies can support Coast Guard and external users without added distribution or training costs.

### *3.6.4 Server Software and Hardware*

Conceptually, the WWM DST server consists of one or more servers and three functional components. Specific requirements for the server(s) will be determined during development and will be dependent on the expected user load and the size of the WWADR at various stages of development and deployment. The three main functional components will be developed using a combination of commercial software products and custom utility programs and macros. Table 2 below identifies available software products with potential applicability to the WWM DST. These products will be selected during development on the basis of cost/benefit trade-offs relative to specific identified system requirements. This list may be expanded during development as specific needs are identified.

**Table 2: Potential WWADR software applications.**

| System | Characterization |
|---|---|
| **Oracle 8I** | • Licenses may be available through OSC for some servers<br>• More robust database, more costly development |
| **Microsoft Access and / or SQL Server** | • Licenses available through the SWS III<br>• More user friendly, more user familiarity |
| **Microsoft Word** | • Licenses available through the SWS III<br>• Report input/output format |
| **Microsoft Excel** | • Licenses available through the SWS III<br>• More user friendly, more user familiarity |

| | |
|---|---|
| **ASCII** | • No licensing issue<br>• Standard data format for data importing/exporting |

### *3.6.5 Overall Software Environment*

The combination of software will be organized into the following functional areas:

- ~~Conceptually, the WWM DST consists of three components:~~

- **Waterways Monitoring and Data Gathering User Interface Module** is used by primarily for administrators and users to input waterways monitoring data. It will employ semiautomated interfaces through ~~Other~~ ODBC to available databases and manual data conversion from other formats (including direct expert judgment), which will load data to the central repository. The module also processes current analyses and stores them as data elements in the repository for later availability and comparison. Data management can be facilitated through the development of relational linked tables that will identify and convert imported data units to the standards required by the analysis tools. The converted data will reside in the WWADR as a consistent repeatable source of information for analysis.

- **Waterways Management Decision Support Tools** include the basic diagnostic evaluation tool and any of the analytical programs designated to be included in the WWM DST framework. The fully implemented toolkit will include models, applications, and tools to support the full spectrum of waterway evaluation and decision-support requirements. These will be integrated within the overall architecture to ensure interoperability among all tools. The decision to include an existing or developed tool into the WWM DST will be based on the data already available in the WWADR and the need to integrate the tool with other waterway analyses or assessment tools. Formats for data exchange for new tools must be standardized through developed interfaces and definitions to maintain compatibility with WWADR definitions. Initial tools to be developed into the WWM DST are WET 2.0 and data outputs for WAMS and PAWSA.

- ~~These will be integrated within a standard architecture compatible with Coast Guard information systems based on their standard interfaces and definitions.~~

- **WWADR –** The WWADR provides the means for maintaining, accessing, and documenting information that supports waterways management and its business processes and needs. This includes information about waterway usage, waterway boundaries, historical Coast Guard activity, waterway performance standards and measures, and waterway assessment results, which are used by waterway managers to support their decisions and actions. The available Coast Guard databases can support the data requirements and management for the WWADR. Potential candidates for additional software resources are shown above in Table 2.

### *3.6.6 Network and Communications*

The WWM DST will be developed to employ Coast Guard network capabilities on the Coast Guard Data Network Plus (CGDN+). All communications between servers and/or clients will utilize those identified network capacities and capabilities. All client server communication will be accomplished using the current Hypertext Transfer Protocol (HTTP) that is supported by the Web browser within current SWS III release. Interfaces among WWM DST server components will be determined during development but will be based primarily on standard Application Program Interfaces (API) supported by and distributed with the software selected for use within the WWM DST. This is considered to be an industry standard practice and is feasible at a low level of risk.

Other interfaces for importing and extracting existing data from legacy data sources will be determined during development. Interface requirements will be dependent on specific-source database data characteristics and will incorporate industry standards, such as ODBC, to the greatest extent practical. The Operations Systems Center (OSC) in Martinsburg, West Virginia, manages the currently targeted Coast Guard maintained database sources, so information hand-offs are feasible at a low level of risk.

### *3.7 Anticipated User Community*

There are numerous potential users, as identified in Table 3 below. It is expected that there will be no more than 20 concurrent users. The COTPs are the organizational level that will use the system most often—for assessment, planning, and furthering relationships with the local user groups and committees. The supervisory levels at Districts and Headquarters will use the system to assist with policy decisions and resource allocations; their utilization of the system will be on an occasional basis. Additional users would be expected when other analysis modules or tools are developed.

**Table 3: WWM DST estimate of users.**

| Level | Potential Users / Rationale | User Identification |
|---|---|---|
| **CG Headquarters** | 15 / (3 each office x 5 offices) | G-MW, G-MWV, G-MRP, G-ORP, G-OPN |
| **Districts** | 36 / (2 each x 2 branches x 9 districts) | m, oan |
| **COTPs** | 120 / (3 each x 40 COTPs) | Operations, Planning Officers |
| **Groups / Activities** | 126 / (3 each x 42 Groups) | Operations, Aids to Navigation |
| **Major SRA Units** | 60 / (2 each x 30 Units) | Operations, Command Review, WLB / WLM |
| **Total Users** | 357 | |

As other applications and analysis modules are developed, the number of users will grow to include other Coast Guard program managers and district and field managers and other agencies that manage waterway responsibilities. Further potential users may include port managers, shipping agents, and maritime insurance underwriters.

~~2~~

### 3.8 System Administration

Depending on the final systems configuration and the amount of data readily available for electronic loading into the WWADR, it will require support from a database administrator, a systems programmer, and a systems administrator. Additional assistance from a data entry person may be required if a significant amount of data transfer must be accomplished manually. The life cycle services associated with these efforts could range from one to three full-time equivalents, depending on the workload requirements and the mix of work associated with the final production system. Efficiencies in management of multiple systems should result in minimal support of the WWM DST.

The critical source of data for the WWADR is the ACOE, which publishes data annually. Because the consolidated review of waterways relies on historical data, annual updates are probably sufficient. The ACOE can also provide quarterly summaries that may be beneficial to

determine seasonal differences in waterway usage. Standardization of the data conversion process should limit the level of effort, whether a quarterly or annual update of information.

System administrators may also be required to manage the change of national weights should the Coast Guard Strategic Areas and Business Plan undergo a major revision. Major changes are not expected in this area.

### 3.9 Required Systems Documentation

Prior to beginning prototype development, a Consolidated Software Development Document (CSDD) will be prepared to identify specific WWM DST requirements for both a prototype and later for full-scale development and deployment. In addition to specific functional requirements, a CSDD includes a project development plan and a software test plan. The framework of the CSDD is included in Appendix C. The final CSDD should be developed through the Joint Application Development (JAD) process at OSC Martinsburg.

### 3.10 Estimated System Growth

This first phase of full development will include the WWADR, the user interfaces, the electronic interfaces, the final WET development, and the "feeds" to the current WAMS and PAWSA analyses. Subsequent tool development should be approached on a case-by-case basis, with priority for integration of a tool into the toolkit being based on urgency of the need and availability of funding.

The entire system will be an evolutionary process as program managers realize the benefit of the WWM DST capabilities. The assimilation of data for waterways management creates the opportunity for interagency and port managers to develop individual assessment and analysis tools that would benefit from the standardized database. The open architecture of the proposed system could be available to external organizations, consistent with current Coast Guard information dissemination policies.

### 3.11 Estimated Cost and Funding Strategy

The anticipated costs for development and operational maintenance are being developed for the program sponsor by a development contractor. Initial estimates for the initial system development are in the range of $1.7M to $2.3M over a 16-month period. Incremental funding alternatives are possible, including the initiation of the JAD process as well as demonstrations of the WET module at various ports.

Support costs include the maintenance of equipment, software, and upgrades. The possible sharing of equipment, software licenses, and associated upgrade costs by other web-based systems operated at the OSC limit the individual costs to the WWM DST sponsor. Personnel support requirements likewise could be shared as the data gathering effort will be limited to annual, or quarterly updates, therefore not requiring full time support.

Table 4 below identifies the range of support costs from the low estimate of approximately $88K to the high of $127K. Personnel costs were obtained from the Coast Guard Standard Personnel Costs for FY99, with an inflation factor applied of 3 percent extended to FY02.

**Table 4: Range of support costs.**

| | | Data Manager | | | Administrator | |
|---|---|---|---|---|---|---|
| | hrs/task | Annual | Low Est | High Est (+20%) | 20% | 33% |
| Update ACOE | 80 | 4 | 320 | 384 | 64 | 107 |
| Update MSN | 80 | 4 | 320 | 384 | 64 | 107 |
| Update ATONIS | 40 | 1 | 40 | 48 | 8 | 14 |
| Update SARMIS | 40 | 4 | 160 | 192 | 32 | 54 |
| Update BARD | 80 | 4 | 320 | 384 | 64 | 107 |
| Update NWS | 40 | 1 | 40 | 48 | 8 | 14 |
| System Maintenance | 8 | 52 | 416 | 500 | 84 | 139 |
| System Upgrades | 80 | 4 | 320 | 384 | 64 | 107 |
| Support Users | 8 | 52 | 416 | 500 | 84 | 139 |
| | | Total | 2352 | 2824 | 472 | 788 |

| | Data Manager | |
|---|---|---|
| | low | high |
| | GS -7 | GS-9 |
| Hourly Rates | $30 | $32 |
| Hours | 2352 | 2824 |
| Annual Cost | $69,393 | $89,490 |
| | Administrator | |
| | GS-11 | GS-12 |
| Hourly Rates | $40 | $48 |
| Hours | 472 | 788 |
| Annual Cost | $19,083 | $37,887 |
| Total | $88,476 | $127,377 |

# 4.0 FEASIBILITY OF DEVELOPING A WWM DST SYSTEM

## 4.1 Technical Considerations

There are no technical limitations to the feasibility of the proposed WWM DST. To maintain a low-risk position, the proposed architecture has chosen industry standards for all technical capabilities. Data management issues are an area of concern, but recent interagency initiatives are working to resolve data standardization problems. The effectiveness of the WET module in the assessment of waterway performance requires field evaluation. Growth of the WWM DST to include multiple interdisciplinary assessment tools is also feasible, as each module interfaces independently with the database and shared outputs provide the links among the assessment tools. ~~Scalability risk measures the resources that are required to achieve an acceptable performance level as seen by the WWM DST users.~~

Building the proposed WWM DST will require using a development environment that integrates Web-based application "system builds" with relational database management capability. Most major vendors of application development environment software offer database interface capability with their products. Technical risk associated with using these products can be rated as low to moderate. The greatest difficulty is often linked to finding experienced programmers who can avoid beginners' errors and use the sophisticated features often found in the tools.

The WWM DST concept presumes the ability to add future functionality in the form of analysis or display tools whose capabilities may be unknown at this time. The Web-based interface is inherently an "open architecture," where information sharing and linking are standardized in the industry. The ready availability of COTS tools and applications that function reliably within the Web-based environment effectively bounds future development effort costs. Data extracts from available databases will be automated where available and will be consistent with information administration management. This approach is feasible and represents a low level of risk.

### *4.1.2 Data Manipulation Considerations*

The following approaches to data manipulation have been considered:

- **Data Standardization.** To facilitate data standardization, a table of required data elements and units of measure will be developed. Data input administrators will review available data units to determine if conversion is necessary. Data requiring conversions should be stored in a temporary file until converted and archived in a prevalidation file in the WWADR. Upon successful conversion, the temporary data could be deleted.

  Imported data with the correct and consistent units of measure will be processed automatically to populate the prevalidation database. For local knowledge inputs, the system will prompt the user to use the unit of measure required by the system. Manipulation of data units is considered a low technical risk.

- **Geographical Referencing of Data.** Data that are not directly linked to waterways (either ACOE or Coast Guard) are often referenced to latitude and longitude. Some systems, such as SARMIS, currently record position accuracy to one-tenth of a minute. The distribution of search and rescue cases is therefore distributed on a grid-like presentation and results in multiple records per location. In some cases judgment may be necessary to assign cases to the defined waterways. A manual process was performed during the WWM DST proof of concept development; however, a systematic approach needs to be developed for the WWM DST system. An initial sort of records by proximity to established waterways is suggested, with manual intervention for cases outside established bounds. These bounds may be in the order of 50 to 100 yards for inland and harbor waterways and 1 to 3 miles for coastal routes. This issue represents a moderate technical risk, as an approved process has not been developed.
- **User Data Validation.** Before initiating the diagnostic evaluation model, the field user will process the prevalidation database, verifying the data's reasonableness and (when required) the data standardization as prompted by the on-line guidance provided by the system. The analysis data are then transferred to populate the validated portion of the WWADR. This "groomed" data will be available in the analysis data repository for use by WET 2.0 and other pertinent applications. In supporting the alignment of the AHP-required data to the appropriate waterways, a series of tables will be created. These tables will link the geographical keys (e.g., waterway name/number, longitude and latitude) associated with individual data elements to standardized, predetermined WWADR waterways.

### *4.1.3 WET 2.0*

The feasibility of the WWM DST and the WET 2.0 concept is dependent on satisfying the data-availability constraints. The approach undertaken significantly pared down the WET 1.1 value trees and data requirements. WET 2.0 considered data availability and the capability of the waterway manager to attain and input certain local knowledge and expert judgments. The evaluation criteria are supported through the AHP, which is discussed in detail in Appendix A. The technical risk of developing WET 2.0 is low.

WET 2.0 also relies on the development of national weights that define the Coast Guard's ranking of the importance of the various waterway management issues. A workshop with junior waterway managers representing Headquarters and field offices exercised the process to develop these national weights. Analysis of the evaluator's consistency, and even bias of evaluators toward their particular program, are needed to validate results. The makeup of the final national weight development team should include senior managers from all waterway management programs. The technical risk to develop the national weights is low.

Scalability risk is regarded as the ability of a system to grow over time with respect to accepting additional users or additional functionality, while still achieving an acceptable performance level as seen by the WWM DST users. All proposed technology has extended scalability.

Processing power and communications speed are major factors that affect scalability. Processing power affects user response time by limiting the computational operations that can be completed

within a reasonable time frame. Communications speed affects response time by limiting the data volume that can be sent to the user once any required computations have been performed.

Web-based database applications routinely run on single servers that support several simultaneous users. OSC Martinsburg, the host site for Coast Guard Web applications, has recently proposed a management scheme to host 25 to 50 small Web-based database applications on a single platform for support of up to 10 concurrent users per application. This proposal is consistent with industry norms, where traffic of several hundred thousand hits per day is not uncommon. WWM DST use is not expected to require the simultaneous use by the approximately 300 potential users and may fit well within the small Web-based database structure at OSC.

Coast Guard units have ready access to CGDN+, so communications limitations are not significant for internal users. Expansion of the WWM DST beyond Coast Guard users will require additional security management for authorization and log-in access or for transition of the Web-site to a publicly accessible server. Communications limitations on the WWM DST may be more significant for external users, who would use dial-up modems to access the data and programs.

### ~~*4.2.1 WET 1.1 The original WET*~~

The implementation of a WWM DST will affect the available resources currently assigned to support waterways management.

WWM responsibility is currently divided among the several programs in the Operations and Marine Safety and Environmental Protection Directorates, respective District branches for these programs, and Operational Units. Support and operation concepts need to be identified to transition the project to an operational system. Sponsorship of the system needs to be identified among the various waterway managers, as do maintenance and operating responsibilities. These issues will be addressed in the report of the proof of concept field test.

While it is expected that the initial effort will not be extensive, a policy change assigning direct responsibility for initial assessments is required to mitigate field concerns or duplicative efforts. We suggest that the assigned Captain of the Port should coordinate responsibility for initial assessments, with representation from other programs and field units.

Results from the indicators may create a backlog of further analyses for those waterways below performance expectations. A simplified waterway performance evaluation may either increase the backlog of additional analyses for waterways below a certain performance standard or allow the deferral of scheduled analyses. This potential for increased analysis should be limited because waterways management has been an evolutionary process. Understanding waterways performance allows managers to prioritize activities to those waterways most in need of further review and analysis.

### *4.2.2 Policy Considerations*

The approved concept for the WWM DST will provide the framework for standard evaluation and analysis methods as well as data management. It offers the opportunity to improve overall waterways management processes. Most of these issues are easily incorporated into current policy and represent the integration of improved information management into waterways management policies. These issues relate to the implementation, operation, maintenance, and deployment of the system:

- **Approval of the program standards for waterways evaluation.** Formal review and approval of the prototype waterways performance standards is necessary. The measures and indicators are being developed to comply with current business plans for G-M, G-MWV, and G-OPN and are also derived from the WET 1.1 developed decision trees. The development of national weights must also be completed prior to system implementation.
- **WAMS scheduling.** Current policy requires a review of WAMS for critical waterways every five years. A possible policy change, the level of effort will be to defer WAMS until the waterways performance indicators approach a "satisfactory" level. The standard to achieve or maintain this level will be reviewed during the prototype development.
- **Accessibility.** The WWMDST is being developed primarily for Coast Guard waterways managers. The functionality and standardized processes should help support other organizations (e.g., federal, state, and local agencies) in their management of a marine transportation system. Access levels to the WWM DST may range from full access, including use of all tools and data entry, to a "read only" access. In all cases, data entry access should be limited to people who have been trained and authorized for use of the system. Tracking information on individuals inputting data may also be desired as part of the validation and review process. It is envisioned that there will be numerous levels and elements at Headquarters, Districts, MSOs, COTPs, and AtoN units, with some type of data entry and assessment responsibilities.
- **Standard waterway definitions.** Definitions differ between Captain of the Port Zones and the Army Corps of Engineers. The WWM DST will associate defined waterway segments to match the ATONIS waterway definitions. COTP managers may combine waterways to develop total/partial zone analyses for unique areas (e.g., Ports/Harbors). ACOE data will be correlated to specific ATONIS waterway segments. Still, the overwhelming need is for the establishment of standard waterway definitions to be adopted by all groups involved with waterways.
- **Interpretation of composite indicators.** Clearly defined guidelines need to be developed to assist managers in interpreting composite indicators, and determining the level of acceptable performance, before more detailed analyses is pursued. Field evaluation of the WET process should be done in order to baseline waterway performance results.
- **Standard data definitions and units.** A comprehensive and concise policy regarding data format and units must be provided to the data gatherer(s) and managers. Port events are recorded in events/year, events/month, total number of events for the last five years, etc. This policy may be presented within a WWM DST data collection guide, which includes required data elements, probable data sources, and required data definitions, format, and units. A data publisher should be designated with the responsibility to provide data standardization and validation guidance.

- **Data refresh requirements.** Although some data, like that from the ACOE, are updated quarterly, other updates are provided annually. Coast Guard managed data may be available upon event reporting, such as for fatalities and casualties. A policy decision is necessary to determine the frequency of data updates.

## 4.43 Economic Considerations, Benefit and Cost Factors

The Waterways Manger Decision Toolkit, as defined in this feasibility report, offers the following economic and resource impacts.

### *4.3.1 Beneficial Personnel Impacts*

A summary of expected level of effort savings is presented in Table 4 below. The primary benefits from the WWADR are the reduced data collection by local waterways managers and the resultant support from either headquarters data managers, or other field data managers who would process ATONIS, SARMIS, MSN data for WAMS or PAWSA analyses. These benefits do not account for external agency data support costs, as these are not recoverable Coast Guard costs. The assumptions for each cost factor are also listed in Table 5.

- **Reduced data gathering by waterways managers** due to input of only selected data and well-defined data requirements to support the evaluation decision trees. This assumes that units are currently completing the analyses as required. Though no direct personnel reductions are expected, the WWM DST will allow managers reprogram effort on improved and additional data analyses rather than data gathering.
- **Reduced effort to complete WAMS and PAWSA analyses.** The preformatted data drawn from the Waterway Data Repository reduces the effort required to collect, format, and analyze WAMS data. The result may be the completion of scheduled analyses on time with more complete analyses, as more time will be available for scheduled or necessary analyses. These savings should ultimately result in a reduced backlog or facilitate more frequent updates. Additionally, the satisfactory results of a WET analysis may allow the deferral of a WAMS or PAWSA analyses, resulting in the savings of effort in these areas.

**Table 5: WWM DST expected benefits.**

Current Processes Estimate of the level of effort

| | #/yr | LT @ $47/hr Data Collection | LCDR @ $53/hr Review | Total Hours | Cost |
|---|---|---|---|---|---|
| WAMS | 120 | 80 | 24 | 12,480 | $603,840 |
| PAWSA | 18 | 80 | 24 | 1,872 | $90,576 |
| Other Analyses | 18 | 80 | 24 | 1,872 | $90,576 |
| Internal Data Support | 156 | 24 | | 3,744 | $175,968 |
| | | | | 19,968 | $960,960 |

Current Processes Estimate of the level of effort, with WWM DST and WET

| | #/yr | LT @ $47/hr Data Collection | LCDR @ $53/hr Review | | Total Hours | Cost |
|---|---|---|---|---|---|---|
| WET Analyses | 120 | 8 | | 4 | 1,440 | $70,560 |
| WAMS | 60 | 16 | | 4 | 1,200 | $57,840 |
| PAWSA | 9 | 16 | | 4 | 180 | $8,676 |
| Other Analyses | 18 | 16 | | 4 | 360 | $17,352 |
| Internal Data Support | 4 | 24 | | | 96 | $4,512 |
| | | | | | 3,276 | $158,940 |
| | | | Net Savings | | 16,692 | $802,020 |

Assumptions:

| | |
|---|---|
| WAMS | 2 per Aton unit (60) per year @ 80 hrs for data collection |
| PAWSA | 2 per district per year @ 80 hrs for data collection |
| Other Analyses | 2 per district per year @80 hrs for data collection |
| Internal Data Support | 8 hrs each for ATONIS, MSN, SARMIS data calls per analysis |

50% of WAMS/PAWSA deferred with a satisfactory WET evaluation

### *4.3.2 Beneficial Program Management Impacts*

The WWM DST concept will produce the following beneficial impacts to the Coast Guard's management of waterways:

- **Level of effort savings** through automation and elimination of redundant data gathering.
- **A repeatable, defensible, and comprehensive assessment methodology** for waterway management.
- **A structured process for stakeholder input,** including harbor safety committees and other local interest groups.
- **Systematic identification of risk factors** that lead to negative outcomes on the waterway.
- **Standardized outputs measures** of waterway performance derived from Coast Guard strategic goals.
- **An analytical process** for justifying and prioritizing resource allocations.
- **Reduction of contrary recommendations.** A single-source Waterways Analysis Data Repository will contain standardized data as well as the results of individual assessments and evaluations from the COTP and AtoN waterways managers. Fewer analysis contradictions should exist, as information used with subsequent analyses will be consistent. This should greatly enhance the prioritization process by providing an objective assessment basis for decisions versus one that is subjective or political in nature.

- **More effective direction of efforts and allocation of resources.** With the initial performance evaluation highlighting those waterway areas requiring attention, a management-by-exception style can be implemented and efforts can be directed at the problem areas. Program managers can make the most of their limited resources, including financial and physical assets and personnel.
- **Meaningful metrics** for facilitating progress toward strategic business and performance goals. With meaningful, documented progress toward performance goals, better support for waterways management can be garnered in both the private and public sectors. As the Coast Guard takes the lead in meeting the strategic objectives, others will begin to appreciate the efforts being made to improve the nation's waterways.

The value of the benefits associated with the implementation of the WWM DST is ~~estimated~~ approximately $800,000 per year, as shown in Table 5.

### *4.~~4~~3.3 Support Costs*

The estimated support costs associated with the implementation of the WWM DST range from $135K to $375K per year. These estimates are ~~*tenative*~~preliminary and will be refined during the prototype proof of concept development in order to provide the government with a reasonable basis for project estimating.

Prototype development will facilitate some additional specification in these areas in order to lead to better cost estimates. Development costs should not be expected to exceed the costs for similar Web- or Central Server-based applications.

Software and system maintenance costs will be better defined during development of the prototype and the scope of the initial systems development effort. The concept presented in the prototype fits within the Coast Guard's centralized database management structure. The modular structure of the system supports changing requirements and reduced life-cycle costs, as the system needs to be updated to respond to the changing environment. In the long run, systems operation and maintenance fit within the mission and responsibilities of the Operations System Center. Actual system site and maintenance should be decided on the basis of cost factors during the final development phase. Part-time support is anticipated (e.g., no full-time staff is expected for system maintenance).

Support staff requirements included in the above estimate range three to six full-time equivalent (FTE) positions. Staffing depends on the additional tool development efforts as well as the administration, support, and maintenance strategy developed during the system requirements development and the staff assigned to manage and implement system improvements.

# 5.0 RECOMMENDATIONS

## 5.1 Overview of Recommendations

The proposed WWM DST is technically feasible. A phased approach is recommended to build the WWM DST to include the Waterways Analysis Data Repository with data to support WET, WAMS, and PAWSA and to develop the WET 2.0 Analysis module. The cost of development is reasonable, in the range of $1.7M to $2.3M, which should result in savings in the level of effort for waterways assessment in the order of $800K per year. A Web-based system is suggested, with centrally managed data gathering by system administrators.

The initial WWM DST development should commence to create a fully operational product with the scope to include:

- WWADR Development.
- Relational database serving as a Waterways Analysis Data Repository (WWADR) supporting storage as required by the imported file structures and the individual analysis tools, including data formats for Oracle, Access, Excel, Word, and ASCII.
- Electronic interfaces to appropriate systems, including ATONIS, SARMIS, and MSIS, with data management modules to be used by system administrators for nonelectronic data.
- User interface modules to support validation, standardization, and data utilization.
- Expert and stakeholder input modules to be used by local waterway managers.
- Develop data export modules for the existing waterways analysis tools, WAMS and PAWSA.
- WET 2.0 Development
- Upgrading WET into a less complex, diagnostic, performance evaluation tool. WET 2.0 should use AHP and the associated hierarchical structuring to include both objective and subjective factors. User interface modules will facilitate iterative processes and assist in ascertaining the need for further analysis.
- Access to the WWM DST through a Web-based approach, with the initial implementation housed on a server at the systems development site.

### ~~5.1.1 System Functional and Technical Scope~~

It is recommended that further development of the system include the following major steps:

- Develop the prototype to prove the concept.
- Use feedback on the prototype demonstrations from multiple potential systems users to identify additional functional requirements.
- Follow the systems development project plan as set forth in Section 3.5.
- Initiate the process of ~~S~~selecting a systems development team/vendor.

### 5.3 System Development Process Recommendation

Following acceptance of this feasibility report and the successful field testing of the proof of concept demonstration, the Coast Guard should pursue work on the project over the next 12 to 15 months to ensure that a gap is not left in the systems development effort. This can be broken out into two portions: (1) the technical portion and (2) the functional portion, on which progress can be made in-house as time and resources permit.

These steps could include technical progress with OSC by:

- Establishing a requirements refinement partnership
- Negotiating a Memorandum of Agreement/Memorandum of Understanding (MOA/MOU) and developing a joint project plan
- Conducting joint application development sessions
- Doing an Alpha test of the development system

Functional progress with program managers could be achieved by:

- Developing WET 2.0 trees for National Defense and Maritime Security
- Finalizing all WET 2.0 tree structures
- Developing national standard weights using appropriate experts
- Completing the data warehouse relationships of the WWM DST for the final WET 2.0
- Identifying other existing analysis tools for inclusion in the WWM DST structure
- Grouping waterways by common characteristics for consistent comparison
- Developing triggers from analysis results to point to the available analytical tools
- Aligning Coast Guard and ACOE waterways for improved data linkage

Once the implementation team has been identified, the systems development plan should include:

- Developing the formal WWM DST System Functional Requirements Definitions
- Developing the Systems Design and Specifications
- Acquiring the necessary hardware and software for systems development
- Programming the system code
- Populating the initial system databases
- Validating and testing system functionality
- Establishing systems administration
- Creating training materials
- Testing beta version of the system at pilot project sites.
- Refining system as required.
- Implementing Version 1.0 of the WWM DST for managers of critical waterways

~~The systems development team should then:~~

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## APPENDIX A: DEVELOPMENT AND DOCUMENTATION OF VERSION 2.0 OF THE WATERWAY EVALUATION TOOL (WET 2.0)

Revision 2.0 of the Waterway Evaluation Tool (WET 2.0) is a new risk-based decision-support tool designed to assist waterway managers at all levels. WET 2.0 provides a means to assess the "health" of a given waterway with respect to the Coast Guard goals of Maritime Mobility, Maritime Safety, and Protection of Natural Resources. The WET 2.0 Model is built on the strong foundation provided by WET 1.1 and the related analyses.

The underlying structure of the WET 2.0 Model uses the concepts of value trees to assess different waterway elements. A waterway is rated on these elements and a score is computed to provide an overall measure of waterway performance. These performance scores are used to create Performance Maps for the different Coast Guard goals and to compare "comparable" waterways or waterway segments of a given waterway. The underlying value trees provide a mechanism to "drill down" to lower levels to identify areas for remedial action or further analysis.

WET 2.0 uses the concepts of "realized risk outcomes" and "inferred risks" to create performance indicators and scores that can be used to characterize waterway performance and provide a basis for interwaterway comparisons (among *comparable* waterways). The WET 2.0 Model not only provides a composite score used to assess the overall health of the waterway, but the structure of WET 2.0 permits further analysis to examine various risk drivers and determine what areas require further examination or improvement. This "drill-down" feature permits the detailed examination of low-level factors to identify critical risk drivers for the given waterway.

The WET 2.0 Model is a high-level model that can provide a continuing analytic basis for assessing waterway performance. The results of such regular periodic assessments will help to identify areas for remedial action or further analysis using more detailed risk-based decision analysis tools. Implementation of WET 2.0 requires easy access to data, both for inputs to the WET 2.0 Model and for comparative purposes when evaluating a given waterway assessment. The development of a Waterway Analysis Data Repository is viewed as an important element in the long-term WET 2.0 implementation. Implementation requires careful attention to data collection and aggregation issues. Modification of the existing WET 2.0 AHP value trees must pay close attention to the structural requirements for those trees.

[The complete text of this appendix has been provided under separate cover.]

# APPENDIX B: WWM DST DATA REQUIREMENTS

**B.**

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Data requirements identified for the WWADR were developed from the initial requirements for WET and the existing requirements for WAMS and PAWSA. This appendix includes:

- Individual data requirements for each of the waterway analysis tools
- Data elements from the information sources
- Sample data extraction, validation, and conversion rules

## B.2 Waterway Analysis Tool Data Requirements

### *B.2.1 WET Data Requirements*

Appendix A summarizes the revision to WET. Local assessments and expert judgments required to support the WET module are fully described in Appendix A. This appendix provides additional detail for those elements supported by data, both internal and external to the Coast Guard. Specific data elements for each attribute are listed in the data source description following this section. Data Requirements for WET are shown below in Table B-1.

**Table B-1: WET data requirements.**

| Data Source | WET Attribute | Data Element Required |
|---|---|---|
| **MSN / MISLE/ MINMOD** | IS-2.4: | PSCP = Number of Port State Control Priority 1 vessels per month |
| | RR-1: | SPP = Quantity (gallons) of crude oil and persistent petroleum products spilled during the year |
| | RR-2: | SNP = Quantity (gallons) of non-persistent petroleum products spilled during the year |
| | RR-3: | SHM = Quantity (pounds) of hazardous materials released during the year |
| | RS-1.1: | CD = $ damages due to collisions, allisions, and groundings of commercial vessels |
| | | NC = Number of casualties involving commercial vessels per year |
| | RS-1.2: | CF = Fatalities due to collisions, allisions, and groundings of commercial vessels |
| | | NC = Number of casualties involving commercial vessels per year |
| | RS-1.3: | CI = Injuries due to collisions, allisions, and groundings of commercial vessels |
| | | NC = Number of casualties involving commercial vessels per year |
| **NOAA** | IM-3.3: | Average and maximum current speeds |
| | | Minimum and maximum water levels |
| | | Range of tides |
| **NWS** | IM-3.1: | Fog days or visibility < ¼ mile |
| | | Rainfall days with rain > ½ inch |
| | IM-3.2: | Prevailing wind direction |
| | | Prevailing wind speed, maximum wind speed |
| **SARMIS / BARD** | RS-2.1: | NR = Number of casualties involving recreational vessels per year |
| | | RD = $ damages due to collisions, allisions, and groundings of recreational vessels |
| | RS-2.2: | NR = Number of casualties involving recreational vessels per year |
| | | RF = Fatalities due to collisions, allisions, and groundings of recreational vessels |
| | RS-2.3: | NR = Number of casualties involving recreational vessels per year |
| | | RI = Injuries due to collisions, allisions, and groundings of recreational vessels |
| **ACOE** | IM-1.1: | M = Miles of channel (miles) |
| | | TD = Annual transits of deep draft vessels (number of vessels) |
| | IM-1.2: | M = Miles of channel (miles) |
| | | TS = Annual transits of shallow draft vessels (number of vessels) |
| | IR-4.1: | QPT= Tons of crude oil and persistent petroleum products shipped per year |
| | | VMPP = Number of vessels movements of crude oil and persistent petroleum products per year |
| | IR-4.2: | Number of movements of non-petroleum products |
| | | QNT = Number of tons of persistent petroleum products shipped per year |
| | | Tons of non-persistent petroleum products shipped |
| | | VMNP = Number of vessel movements of non-persistent petroleum products shipped per year |
| | IR-4.3: | QHT = Number of tons of hazardous materials shipped per year |
| | | VMHM = Number of hazardous materials movements per year |
| | IS-2.1: | P = Number of passengers per year |
| | IS-2.2: | QHT = Tons of hazardous materials shipped per year |
| | RR-1: | QPP = Quantity (thousands of tons) of crude oil and persistent petroleum products shipped during the year |
| | RR-2: | QNP = Quantity (thousands of tons) of non-persistent petroleum products shipped during the year |
| | RR-3: | QHM = Quantity (thousands of tons) of hazardous materials shipped during the year |
| | RS-1.1: | M = Miles of channel |
| | | TC = Annual transits of commercial vessels (thousands of trips) |
| | RS-1.2: | M = Miles of channel |
| | | TC = Annual transits of commercial vessels (thousands of trips) |
| | RS-1.3: | M = Miles of channel |

| | | |
|---|---|---|
| | | TC = Annual transits of commercial vessels (thousands of trips) |

## 1 Introduction

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| Data Source | WET Attribute | Data Element Required |
|---|---|---|
| **MSN / MISLE/ MINMOD** | IS-2.4: | PSCP = Number of Port State Control Priority 1 vessels per month |
| | RR-1: | SPP = Quantity (gallons) of crude oil and persistent petroleum products spilled during the year |
| | RR-2: | SNP = Quantity (gallons) of non-persistent petroleum products spilled during the year |
| | RR-3: | SHM = Quantity (pounds) of hazardous materials released during the year |
| | RS-1.1: | CD = $ damages due to collisions, allisions, and groundings of commercial vessels |
| | | NC = Number of casualties involving commercial vessels per year |
| | RS-1.2: | CF = Fatalities due to collisions, allisions, and groundings of commercial vessels |
| | | NC = Number of casualties involving commercial vessels per year |
| | RS-1.3: | CI = Injuries due to collisions, allisions, and groundings of commercial vessels |
| | | NC = Number of casualties involving commercial vessels per year |
| **NOAA** | IM-3.3: | Average and maximum current speeds |
| | | Minimum and maximum water levels |
| | | Range of tides |
| **NWS** | IM-3.1: | Fog days or visibility < ¼ mile |
| | | Rainfall days with rain > ½ inch |
| | IM-3.2: | Prevailing wind direction |
| | | Prevailing wind speed, maximum wind speed |
| **SARMIS / BARD** | RS-2.1: | NR = Number of casualties involving recreational vessels per year |
| | | RD = $ damages due to collisions, allisions, and groundings of recreational vessels |
| | RS-2.2: | NR = Number of casualties involving recreational vessels per year |
| | | RF = Fatalities due to collisions, allisions, and groundings of recreational vessels |
| | RS-2.3: | NR = Number of casualties involving recreational vessels per year |
| | | RI = Injuries due to collisions, allisions, and groundings of recreational vessels |
| **ACOE** | IM-1.1: | M = Miles of channel (miles) |
| | | TD = Annual transits of deep draft vessels (number of vessels) |
| | IM-1.2: | M = Miles of channel (miles) |
| | | TS = Annual transits of shallow draft vessels (number of vessels) |
| | IR-4.1: | QPT= Tons of crude oil and persistent petroleum products shipped per year |
| | | VMPP = Number of vessels movements of crude oil and persistent petroleum products per year |
| | IR-4.2: | Number of movements of non-petroleum products |
| | | QNT = Number of tons of persistent petroleum products shipped per year |
| | | Tons of non-persistent petroleum products shipped |
| | | VMNP = Number of vessel movements of non-persistent petroleum products shipped per year |
| | IR-4.3: | QHT = Number of tons of hazardous materials shipped per year |
| | | VMHM = Number of hazardous materials movements per year |
| | IS-2.1: | P = Number of passengers per year |
| | IS-2.2: | QHT = Tons of hazardous materials shipped per year |
| | RR-1: | QPP = Quantity (thousands of tons) of crude oil and persistent petroleum products shipped during the year |
| | RR-2: | QNP = Quantity (thousands of tons) of non-persistent petroleum products shipped during the year |
| | RR-3: | QHM = Quantity (thousands of tons) of hazardous materials shipped during the year |
| | RS-1.1: | M = Miles of channel |
| | | TC = Annual transits of commercial vessels (thousands of trips) |
| | RS-1.2: | M = Miles of channel |
| | | TC = Annual transits of commercial vessels (thousands of trips) |
| | RS-1.3: | M = Miles of channel |

| | | |
|---|---|---|
| | | TC = Annual transits of commercial vessels (thousands of trips) |

### *B.2.2 WAMS Data Requirements*

Table B-2 illustrates data requirements and sources for WAMS.

**Table B-2: WAMS data requirements.**

| WAMS Para. | Subject / Description | Data Source | Table | Comment |
|---|---|---|---|---|
| **1** | Primary Charts | Locally Prepared | | |
| **2** | Action Summary | Local Assessment | | |
| **3** | Information Collection | | | |
| **3.1** | Narrative Description | | | |
| | Geographic features (channel lengths, widths, depths, bottom types, topography ashore) | ACOE | waternet | Align with Coast Guard waterways |
| | Facilities (docks, refineries, fisheries, marinas) | ACOE | portsall | |
| | Bridges (owners, clearances) | National Bridge Database | | |
| | Anchorages | Local Knowledge | | |
| | Environmental factors (tide, current, wind, fog, storm frequencies, 80% and 90% transmissivity values, sensitive areas) | NWS, NOAA, Local Knowledge | | |
| **3.2** | Users | | | |
| | Vessel types and their dimensions (largest vessel, tug/barges, military, fishing, recreational) | ACOE | trips, MAN*.dbf | |
| | Transit frequencies by type of vessel | ACOE | trips, MAN*.dbf | |
| | Commodities carried | ACOE | trips, MAN*.dbf | |
| | Pilot groups/port authorities, boating organizations, etc. | Local Knowledge | | |
| **3.3** | Public Comments | Local Knowledge | | |
| **3.4** | Casualty History | | | |
| | Incidents | MINMOD / SARMIS / BARD | | |
| | Injuries | MINMOD / SARMIS / BARD | | |
| | Deaths | MINMOD / SARMIS / BARD | | |
| **3.5** | Traffic Patterns | | | |
| | Traffic Routes | ACOE | trips, MAN*.dbf | |
| | Peak Transit Times | ACOE | trips, MAN*.dbf | |
| | Traffic Separation Schemes | Local Knowledge | | |
| **3.6** | Charts/Surveys | Local Knowledge | | |
| **3.7** | Aid Assignment List | | | |
| | All Aids | ATONIS | | |
| **4** | Public Comment Summary | | | |

| WAMS Para. | Subject / Description | Data Source | Table | Comment |
|---|---|---|---|---|
| **4.1** | User Rider Comments | Local Assessment | | |
| **4.2** | Written Comments Received | Local Assessment | | |
| **4.3** | Verbal Comments Received | Local Assessment | | |
| | | | | |
| **5** | Criticality Determination | Local Assessment | | |
| | | | | |
| **6** | Analysis (Evaluation/Recommendations) | | | |
| **6.1** | Minor Aids | Local Assessment | | |
| **6.2** | Major Aids | Local Assessment | | |
| **6.3** | Electronic Aids | Local Assessment | | |
| **6.4** | Servicing Units | Local Assessment | | |
| **6.5** | Horizontal Control | Local Assessment | | |
| **6.6** | Chart and Publication Alterations/ Corrections | | | |
| | | | | |
| **7** | General Comments | Local Assessment | | |

### *B.2.3 PAWSA Data Requirements*

Table B-3 represents the quantitative and qualitative data elements required to initiate and support the PAWSA process. PAWSA provides a structure for identifying risk drivers and then evaluating potential mitigation measures through expert input from waterway users. The process requires the participation of professional mariners with local expertise in navigation, mobility, and port safety. Stakeholders are included in the process to ensure that important environmental, public safety, and economic consequences are given appropriate attention as risk interventions are selected. Although subjective input is the basis for the process, the Port Risk Model forms the foundation for discussion and is supported by empirical data that establishes port specific weights. Port specific data concerning waterway risks and historical information are displayed and validated by the participants throughout the session. WET 2.0 can play a major role in meeting these data requirements.

Table B-3 presents the subfactors that make up the PAWSA Port Risk Model and data that are required to adequately support the Model's functionality, the source of data, and relevant WET Data Elements.

**Table B-3: PAWSA data requirements.**

| PAWSA Factors | Anchor | Source or WET Attribute |
|---|---|---|
| **Ship / Traffic Conditions** | | |
| Quality of Ships | # Detentions | MSN Commercial Vessel Inspection Tables |
| | # PSC Priority 1 Vessels | WET - IS-2.4 - Commercial Vessel Operation Risk Potential |
| Crew Competency | # ISM Deficiencies/Detentions | MSN Commercial Vessel Inspection Tables |
| Mix of Shipping | Average peak vessel density per hour per mile | WET - IM-1.4 – Traffic Mix / Density in the waterway (Combination of all types of vessels) |
| Density and Congestion | Speed Reduction | WET - RM-5 - Vessel Delays due to Traffic |
| | Average peak vessel density per hour per mile | WET - IM-1.4 – Traffic Mix / Density in the waterway |
| | | |
| **Traffic Volume** | | |
| | | |
| Deep Draft (Draft >20') | # Vessel Transits | ACOE Data |
| Shallow Draft (Draft < 20') | # Vessel Transits | ACOE Data |
| Commercial Fishing | # Vessel Transits | Local Data |
| Recreational | Level of Activity | Local Data |
| | | |
| **Navigational Conditions** | | |
| Wind Conditions | # Days wind > 20kts | National Weather Service |
| | Vessel Speed Reduction | WET IM-3.2 - Wind Conditions |
| River and Tidal Currents | Average Tide & Current | Tides & Currents Tables |
| | Effect on Vessel Movements | WET IM-3.3 - Currents, Tides & Water Levels |
| Visibility Restrictions | # Days of reduced visibility due to weather | National Weather Service |
| | Vessel Speed Reduction | WET IM-3.1 - Reduced Visibility |
| Ice Conditions | Vessel Movements Restrictions | WET IM-3.4 - Ice Conditions |
| | # Ice breaking days required on waterway | MSN Table |
| | | |
| **Waterway Conditions** | | |
| Visibility Obstructions | Vessel Speed Reductions | Local Input - Background lighting/ranges, blind turns |
| Channel Width | Dimensions | MSN - Proposed waterway table |
| Bottom Type | Contents/Make-up | MSN - Proposed waterway table |
| Waterway Complexity | Number of turns, converging waterways | MSN - Proposed waterway table |
| | | |
| **Immediate Consequences** | | |
| Injuries to People | # Injuries/Fatalities | WET RS-1.2/1.3 - Fatalities/Injuries associated with Commercial Vessel Casualties |
| | | WET RS-2.2/2.3 - Fatalities/Injuries associated with Recreational Vessel Casualties |

| PAWSA Factors | Anchor | Source or WET Attribute |
|---|---|---|
| Petroleum Discharge | Amount of Petroleum Products Transported (Gallons/Year) | MSN - Proposed Pollution Table / ACOE Data |
| Hazardous Materials Release | Amount of HAZMAT Transported (Tons/Year) | MSN - Proposed Pollution Table / ACOE Data |
| Property Damage | Casualties per 1,000 transits per mile of waterway or $ Value | WET RS-1.1/2.1 - Damages associated with Commercial and Recreational Vessel Casualties |
| | | |
| **Subsequent Consequences** | | |
| Health and Safety | # of people in geographic area | WET IS-2.3 - Shoreside Population at Risk (Info from Census bureau or Local Emergency Planning Council (LEPC)) |
| Wetlands And Endangered Species | % Geographic area wetlands and # of variations of endangered species | IR-2.2 - Aquatic birds, mammals, and marine life and their habitats (ACOE Data and the Department of Commerce) |
| Fisheries | # of Fisheries in Geographic area | IR-2.1 - Fisheries and their habitats (Department of Commerce) |
| Economic Impact | Impact to local Economy in dollars | Local Input |

## B.3 WWADR Data Sources

The following data sources can provide the necessary information for the WET, WAMS and PAWSA analyses. Each data source is described below with the element name, description, and specific comments that relate to WET, WAMS or PAWSA analyses.

### *B.3.1 Coast Guard Data Sources*

The Coast Guard maintains separate databases for Marine Safety, Aids to Navigation, Search and Rescue that contain relevant information for WET, WAMS and PAWSA analyses. Each program is maintained at the Operations System Center (OSC), Martinsburg, West Virginia, under support agreements with the program managers. Tables B-4 through B-7 identify the database and specific elements required that should be included in the WWADR to support WET, WAMS, and PAWSA.

**Table B-4: MINMOD / MSIS outputs.**

| Column Name | Type | Size | Description | Comments |
|---|---|---|---|---|
| accident_type | char | 20 | Type of accident | Filter for non-personal cause injuries (e.g., related to collision, allision, grounding) |
| activity | char | 64 | Activity at time of the accident | Support for determination whether a personnel caused incident or waterway related event |
| body_part | char | 20 | Body part injured | |
| category | char | 20 | Type of facility | Sample: BRIDGE |
| chris_code | char | 3 | CG specific code | Selection of persistent, non-persistent or hazardous material by CHRIS Code. |
| city | char | 25 | Closest City | Support for positioning if lat/lon or waterway are misleading |
| deaths | char | 3 | count of deaths2 | Count of deaths by waterway |
| fac_ind | char | 1 | X | |
| filler | char | 1 | Miscellaneous Entries | |
| fin | char | 8 | Facility id # | May cross reference to ACOE Facility numbers for assigning to waterways |
| flag | char | 2 | Vsl registry | |
| fname | char | 33 | Facility name | May cross reference to ACOE Facility numbers for assigning to waterways |
| impact_location | char | 30 | | |
| in_water_qty_spilled | char | 12 | | Sum of amount spilled in a waterway |
| incident_dt | char | 12 | Date of incident | File by year |
| incident_time | char | 4 | 24-hour clock | Possible sorting of incidents by day/night to drill down accident data for analysis |
| injured | char | 3 | Count of injured | Count of missing by waterway |

| | | | | |
|---|---|---|---|---|
| injury | char | 1 | X | |
| latitude | char | 6 | | Assign position to ACOE Waterways |
| location | char | 30 | Locale description e.g., JONES' LANDING | Support for positioning if lat/lon or waterway are misleading |
| longitude | char | 7 | W 76.75 | Assign position to ACOE Waterways |
| mccase | char | 10 | Case number | Key Field for recordMC93000001 |
| num_fac | char | 2 | # of facs involved | |
| num_vsl | char | 2 | # of vsls involved | |
| out_of_water_spilled | char | 12 | | Sum of persistent, non-persistent spills |
| pers_ind | char | 1 | X | |
| plocation | char | 64 | Persons location ON DECK | |
| pol_ind | char | 1 | X | |
| potential_qty | char | 12 | 1200 | Not used |
| pri_nature | char | 11 | Nature of case | Filter for collisions, allisions and groundings. |
| resulting_injury | char | 20 | Type of injury | Develop table for severity of injury from standard entries |
| river_mile | char | 4 | Mile marker | Assign position in Western Rivers with River Name |
| service | char | 19 | Vessel service | Sort for commercial, recreational activities |
| speed | char | 3 | Units = knots | Not used |
| state | char | 2 | Post Office code | Support for positioning |
| status | char | 15 | Position onboard | |
| subject | char | 30 | Incident Title | Support for incident filtering (collision, pollution, injury, etc.) if data are misleading |
| substance_name | char | 55 | Name of substance released | Filter for persistent, non-persistent or hazardous material, link to CHRIS Code table |
| total_damage | char | 9 | Total $ damage | Sum of damage by waterway |
| type | char | 1 | L liquid<br>S solid | |
| unit | char | 5 | Coast Guard invest unit | Lists COTP/MIO/MSO responsible for record. May be used in allocating incidents to ACOE areas |
| units_measure | char | 7 | | Standardize to gallons (oil) or pounds (HAZMAT) |
| vin | char | 8 | Vsl id # | Not used |
| vname | char | 33 | Vsl name | Count of indicants, track to Port State Control Category 1 vessel incidents, other analyses |
| vsl_ind | char | 1 | X | |
| waterbody | char | 29 | Nav waters | Common name, may be linked to ACOE Waterway number. |

## Aids to Navigation Information System (ATONIS)

The ATONIS database is an Oracle application maintained at OSC. Various related tables describe aid equipment, discrepancy information, and unit responsibilities. Sufficient data is required to support primarily WAMS analysis. The changing nature of aids to navigation services may require the archiving of the types and quantities of aids provided by waterway at the time of the WAMS analyses. Future changes to ATONIS may provide an archiving capability to track information on decommissioned aids. In the interim, the WWADR should maintain history of AtoN services at the time of the analyses.

ATONIS data are required primarily to support the WAMS analysis, as WET and PAWSA rely on expert judgment for the quality of aids to navigation services. The elements shown below in Table B-5 are potential information sources to provide detail on the number of aids in the waterway, by category, servicing unit, and discrepancy information.

**Table B-5: Potential ATONIS information sources.**

| Table and Column Name | Comments |
|---|---|
| **Table: Aids** | |
| AID_TYPE | Federal or Private |
| ATU | District |
| AID_NAME | Aid Name |
| AID_UID | Unique Aid Number (ATONIS Number) |
| ASSIGNED_LATITUDE | Position |
| ASSIGNED_LONGITUDE | Position |
| DESCRIPTION_TYPE | Type of Aid (LT, DBN, ULB, LBB, etc) |
| RACON_MORSE_CHARACTER | RACON Code - if not null indicates RACON present |
| SEASON_FROM_DATE | Date format for seasonal aids on station date |
| SEASON_TO_DATE | Date format for seasonal aids off station date |
| SOUND_EMITTER_MODEL_TYPE | Equipment codes |
| SOUND_EMITTER_TYPE | Equipment information |
| STATE | State |
| STRUCTURE_HEIGHT | Height of structure |
| STRUCTURE_TYPE | Type of structure - |
| **Table: Federal_aids** | |
| BACKUP_BATTERY_QUANTITY | Equipment information |
| BACKUP_BATTERY_TYPE | Equipment information |
| BACKUP_POWER_TYPE | Equipment information |
| FOG_DETECTOR_LOGICAL | Equipment information |
| MAIN_BATTERY_QUANTITY | Equipment information |
| MAIN_BATTERY_TYPE | Equipment information |
| MAIN_POWER_TYPE | Equipment information |
| RADIOBEACON | Equipment information |
| SEASONAL_BATTERY_QUANTITY | Equipment information |
| SEASONAL_BATTERY_TYPE | Equipment information |
| SEASONAL_POWER_TYPE | Equipment information |
| SOUND_POWER_SUPPLY_MODEL | Equipment information |
| **Table: Federal_floating_aids** | |
| UID | Key Field |
| AID_TYPE | Federal or Private |
| ATU | District |
| AUTHORIZED_HULL_TYPE | Coded hull type, authorized |
| RELIEF_INTERVAL_MEASURE | Length of time (yrs) hull is on station |
| SEASONAL_HULL_TYPE | Coded hull type, seasonal aid |
| **Table: Federal_fixed_aids** | |
| UID | Key Field |
| AID_TYPE | Federal or Private |

| Table and Column Name | Comments |
|---|---|
| CONSTRUCTION_DATE | Date of Construction |
| HISTORICAL_LANDMARK_CATEGORY | Registered on the National Register of Historic Places |

## Search and Rescue Information System (SARMIS)

SARMIS data are accessible through OSC. Data represent boating accidents information submitted by Coast Guard units. There may be overlapping information between SARMIS and BARD. As part of the data validation process, concurrent reports from SARMIS, MSIS, and BARD need to be reviewed. This may happen if a Coast Guard resource responds to an incident (SARMIS report) that is investigated by a local harbormaster and also investigated by the Marine Inspection Office/COTP. Table B.6 lists potential information sources for recreational vessel incidents, including date, time, deaths, injuries, damages, and cause.

**Table B.6: Potential SARMIS information sources.**

| Unit Case Number | Unique Case Number |
|---|---|
| Case_Month | Month of incident - full date required for WWADR |
| Nature_of_Incident | Classification of incident, filter for waterway related incidents |
| Nature_of_Incident_Desc | Description of the incident |
| Latitude | Position |
| Longitude | Position |
| Victim_Vessel_Type | Type of vessel |
| Victim_Usage_Type | Use at time of incident |
| Day_of_Month_Time | Day/time |
| Lives_Lost_Before_CG | Count of Deaths by case, before CG action |
| Lives_Lost_After_CG | Count of Deaths by case, after CG action |
| Property_Lost_In_KDollars | Property Damage/Lost - filter for waterway related incidents |
| Port_Short_Name | Name of nearest port |
| Lives_Lost | Count of Deaths by case |
| Total_Injuries | Count of injuries by case |

## Boating Accident Report Database (BARD)

The Boating Accident Report Database is accessible through G-OPB. Data represents information of boating accidents submitted by local and state agencies. There may be overlapping information between SARMIS and BARD. As part of the data validation process, concurrent reports from SARMIS, MSIS and BARD need to be reviewed. This may happen if a Coast Guard resource responds to an incident (SARMIS report), that is investigated by a local harbormaster, and also investigated by the Marine Inspection Office/COTP. BARD data are not currently listed by latitude and longitude. Correlation tables of waterways and states need to be developed to assign BARD documented cases to ACOE waterways. Additionally, a large percentage of BARD incidents occur on state waterways. These items may be filtered out in the data gathering stage.

Table B.7 lists potential information sources for recreational vessel incidents, including date, time, deaths, injuries, damages, and cause.

**Table B.7: Potential BARD data sources.**

| Accident Report # | Unique Number |
|---|---|
| Number of Vessels | Number of vessels involved |
| Date | Date of Incident, file by year |
| Time | Time of Incident |
| Location | Local Name |
| Name of Body of Water | Local Name |
| Nearest City or Town | Support for positioning |
| County | Support for positioning |
| State (Accident location) | Support for positioning |
| Clear | Weather Conditions |
| Cloudy | Weather Conditions |
| Fog | Weather Conditions |
| Rain | Weather Conditions |
| Snow | Weather Conditions |
| Hazy | Weather Conditions |
| Accident Type 1 | Comment on accident type |
| Accident Type 2 | Comment on accident type |
| Accident Type 3 | Comment on accident type |
| Other (Type of Accident) | Category of accident - caused by waterway related events |
| Cause of Accident | Proximate causes determined by investigators |
| Cause 2 | Proximate causes determined by investigators |
| Cause 3 | Proximate causes determined by investigators |
| Other (Cause of Accident) | Proximate causes determined by investigators |
| Damage, Non-Boat Prop # | $ cost from estimates |
| Describe Property Damage | Description |
| Recreational Accident? | Defines Recreational, Commercial or other incidents |
| Deceased Status | Count of Deaths |
| Death Caused by | Death Cause, filter for waterway related events |
| Caused By Other | Death Cause, filter for waterway related events |
| Victim Activity | Activity at time of incident, filter for waterway related events |
| Other Activity | Activity at time of incident, filter for waterway related events |
| Victim Physical Condition | Injury results, filter for serious injuries |
| Primary Injury | Injury results, filter for serious injuries |
| Secondary Injury | Injury results, filter for serious injuries |
| Treatment > First Aid | Injury results, filter for serious injuries |
| Admitted to Hospital | Injury results, filter for serious injuries |
| Victim Status | Injury results, filter for serious injuries |
| Injury Caused By | Injury Cause, filter for waterway related events |

### *B.3.2 U.S. Army Corps of Engineers Data*

Tables B-8 through B-10 identify the ACOE Navigation Data Center-provided data by table name, with specific fields, type, size, descriptions, and comments regarding the integration of the data into the WWADR. These comments include such factors as positioning reference, data standardization, and alignment with Coast Guard uses for WET, WAMS, or PAWSA. Some data are available from the Waterway Commerce of the United States CD-ROM published annually by the ACOE. Direct liaison with the NCD staff is expected to draw information directly from the ACOE databases and to obtain elements that are not provided in the public domain. The existing Memorandum of Agreement between the Coast Guard and ACOE should be reviewed to ensure that data support requirements are provided.

**Manuscript Cargo Files**

Data are provided in Parts 1-4 and Summary Files. Manuscript Cargo Files contain data on annual tons of cargo by waterway for published commodity groups for the Atlantic (part 1), Mississippi Valley and Gulf Coast (part 2), the Great Lakes (part 3), and the Pacific (part 4). Table B-8 was consolidated from the following files: "manatl.dbf", "manmvg.dbf", "man.glk.dbf", "manpac.dbf", and "manu9950.dbf". File "manu9950.txt" is a summary of all the cargo moves for calendar years 1993 to1997.

**Table B-8: Manuscript Cargo Files.**

| Field Name | Type | Size | Description | Comments / Required Action |
|---|---|---|---|---|
| allo1 | Number | 1 | 1 = Inbound Receiving, 2 = Outbound Shipping, 3 = Local, 4 = Thru | Count of allo1 for each waterway will be the sum of trips. Filter out barges (Vessel type) to obtain total powered vessel trips. Not all data in WCUS CD. |
| allo2 | Number | 1 | 1 = Upbound or East or North, 2 = Downbound or West or South | |
| pub_group | Number | 4 | Publication Commodity Group | Select Publication Commodity Groups by Persistent, Non-Persistent, Hazardous Materials, Cargo |
| rec_type | Number | 4 | 0=nonpublished cargo, 1,3,4 = cargo, 5 = trips, 6 = unpublished trips, 7 = Passengers/Units, 8 = Totals | |
| tons | Number | 9 | Short tons in thousands (0 means less than 500 tons) | Sum of tonnage by commodity and waterway. |
| traffic | Number | 2 | 00 = Foreign Trip & Draft, 01 = Domestic T&D, 11 = Foreign Imports, 12 = Foreign Exports, 21 = Canadian Imports, 22 = Canadian Exports, 30 = Coastwise, 40 = Lakewise, 50 = Internal, 70 = Local, 80 = Intraterritory, 90 = Ferry | Provides detail on the nature of the traffic and coastal route |
| trans_type | Number | 1 | 1=cargo, 2=tonmiles, 3=trips | Count Trips, Sum Cargo by Type (PUB_GROUP) as filtered |
| wtwy | Number | 4 | WCSC Waterway Code | Link Waterway Code to Coast Guard Waterways |
| year | Number | 4 | Calendar year the movement took place based on date of unloading. | Archive data by year |

| | | | | |
|---|---|---|---|---|
| draft | | | Shipping draft | Not in WCUS CD |

**Port Series Reports**

Port Series Reports describe the physical and intermodal (infrastructure) characteristics of the coastal, Great Lakes, and inland ports of the United States. Facility data include, but are not limited to, location (latitude/longitude, mile, and bank); operations (name, owner, operator, purpose, handling equipment, rates, and details of open and covered storage facilities); type and dimension of construction (length of berth space for vessels and/or barges, depth, apron width, deck elevation, and details of rail and highway access); and utilities available (water, electricity, and fire protection).

Published reports include extensive descriptive material, such as project authorization, bridge/tunnel/railroad infrastructure data, meteorological information, and anchorage descriptions. All viable commodity handling and maritime service wharves are included, as are aerial maps and photos of individual facilities (WCUS April 1999). Table B-9 includes information from data table "Portsall.dbf".

**Table B-9: Port facility information.**

| Field Name | Type | Size | Description | Comments/Required Action |
|---|---|---|---|---|
| name | text | 200 | Name of wharf | Used for positioning information |
| location | text | 160 | Location of wharf on wharf waterway or in port | |
| address | text | 50 | Street address for wharf location | |
| county | text | 30 | County for wharf location | |
| town | text | 30 | Locality or common name of wharf location | |
| state | text | 2 | State for wharf location | |
| waterway | text | 50 | Waterway on which wharf is located | Relate to Coast Guard waterway |
| port | text | 21 | Port name | Used for positioning information |
| mile | number | 5 | Waterway mile of wharf location above or below a datum point | |
| bank | text | 5 | Bank of river for wharf location(left or right) | |
| latdec | number | 10 | Wharf location latitude: decimal | Used for positioning information |
| long dec | number | 10 | Wharf location longitude: decimal | |
| purpose | text | 255 | Purpose for which wharf is used, including commodities handled and/or services performed | |
| rwy conn | text | 250 | Railway connections serving port facility | May be used for intramodal assessments |
| commodity1 | text | 2 | Commodity code for first commodity handled at wharf | Possible use for risk assessment based on the capability to handle petroleum or hazardous material products |
| commodity2 | text | 2 | Commodity code for second commodity handled at wharf | |
| commodity3 | text | 2 | Commodity code for third commodity handled at wharf | |
| commodity4 | text | 2 | Commodity code for fourth commodity handled at wharf | |
| remarks1 | text | 240 | Remarks, including description of wharf-related storage facilities and their operators – part 1 | These remarks may include potential changes to the port facility under review by the ACOE, or from comments provided by the port operator |
| remarks2 | text | 240 | Remarks 2 | |
| remarks3 | text | 240 | Remarks 3 | |
| depth 1 | text | 2 | Depth alongside wharf's first operational element being described | These remarks may be used to characterize the port facilities for the WAMS analysis |
| depth 1a | text | 2 | Second depth alongside wharf's first operational element being described | |
| tot berth 1-3 | text | 5 | Berthing distance of wharf's first operational element being described | |
| year | text | 4 | Year of last survey | Selection filter for current information |
| first name | text | 50 | First name of contact person | These elements may be used to generate a list of stakeholders for WET, PAWSA or WAMS reviews. |
| last name | text | 50 | Last name of contact person | |
| phone | text | 43 | Telephone number of facility operator or contact person | |
| fax | text | 12 | Fax telephone number of facility operator or contact person | |

**Commodity Codes and Names**

Table B-10 lists commodity codes and names as used in the publication Waterborne Commerce of the United States with reference to commodity codes used in the Public Domain Database and by the Lock Performance Monitoring System. These elements may be filtered for persistent, non-persistent, or hazardous materials, and general cargo for WET, WAMS. and PAWSA analyses. Data included in this table are derived either from file "comm.txt" or file "comm.dbf".

**Table B-10: Commodity Code cross-reference.**

| Field Name | Type | Size | Description | Comments/Required Action |
|---|---|---|---|---|
| pddb_group | Number | 4 | Public Domain Commodity Code | Used to classify reported shipments as persistent, non-persistent, or hazardous materials. |
| pddb_name | Char | 70 | Public Domain Commodity Name | |
| pddb_group | Number | 4 | Public Domain Commodity Code | |
| pms_group | Number | 2 | LPMS Commodity Code | |
| pub_group | Number | 4 | Publication Commodity Code | |
| pub_name | Char | 70 | Publication Commodity Name | |

### *B.3.3 Other Data Sources*

Other data sources include the National Weather Service climate data to provide wind speed and direction estimates for the development of local judgments on climatological impacts and visibility data (rainfall and fog-days); National Marine Fisheries Service data on fisheries and protected species in the waterway regions; and NOAA data regarding currents, tides, and charting information. Much of this information is available through local publications.

### *B.3.4 Data Conversion*

The specific actions required to support data extraction, validation, and transformation will be developed during the design of the system as all data elements are collected. Table B-11 lists general rules that will be included in the data conversion module.

**Table B-11: WWM DST WWADR Data Conversion Rules**

| Rule Class | Rule Category | Example Description |
|---|---|---|
| Extraction | Metadata mapping | Identify the data elements and the corresponding WWM DST attribute element names. |
| Extraction | Data Normalization | Provide unique values for elements with multiple source values in databases, for example, "TOW/TUGBOAT" and "TOWBOAT" both become "TOWBOAT" in the data warehouse. Latitude and Longitude converted from Deg Min Sec Direction and Deg.decimal (+/-) for North South East and West into a standard format. |
| Validation | Physical Error Conditions | Discard records from the extract files based on criteria such as incompatible elementary data types (cannot be translated), incorrect elementary data types (e.g., character where numeric expected), and missing values where a mandatory field is defined. Research lost records for manual intervention or new standard rule development, as applicable. |
| Validation | Logical Error Conditions | Limited functional data error handling on data extract files, not to exceed five specific functional data error cases that can be handled with simple logic (e.g., 00 Latitude 00 Longitude) will be performed. Other examples include but are not limited to values out of allowable domains such as invalid state codes or out of domain ranges. |
| Transformation | Encode/Decode Translation | Interpret and translate indicators and code values to populate data warehouse dimension text and code values. Examples are commodity codes, vessel type codes, etc. |
| Transformation | Measure Transformation | Execute algorithms to calculate numeric values based on a common unit of measure. For example, converting all vessel length dimensions to meters. Standardize units of measure to gallons, pounds, etc |
| Transformation | Combination | Use multiple elements to create one attribute. For example, Latitude/Longitude - combine 10ths of degree and minutes together to make one attribute. |
| Transformation | Date/Time | Create date and time format for fields with dates and times. |

## APPENDIX C: COMPUTER SOFTWARE DESIGN DOCUMENT

This appendix presents the outline of the Consolidated System Development Document (CSDD) for the Waterways Management Decision Support Toolkit with recommended tailoring. The framework of the CSDD is presented in italic text and represents the requirements for the document.

United States Coast Guard

# Prototype
# Waterways Management
# Decision Support Toolkit
# (WWM DST)

## Consolidated Software Development Document

## Table of Contents

## 1.0 SCOPE

*This section shall be divided into the following paragraphs.*

### 1.1 Identification

*This paragraph shall contain a full identification of the system and the CSCIs to which this document applies, including, as applicable, identification number(s), title(s), abbreviation(s), version number(s), and release number(s).*

### 1.2 System Overview

*This paragraph shall briefly state the purpose of the system and the software to which this document applies. It shall describe the general nature of the system and software: summarize the history of system development, operation, and maintenance; identify the project sponsor, user, developer and support agencies; identify current and planned operating sites; and list other relevant documents.*

### 1.3 Document Overview

*This paragraph shall summarize the purpose and contents of this document.*

### 1.4 Manuals

*All manuals (e.g., Software User Manual) described in this DID shall be delivered as separately bound Appendices.*

## 2.0 REFERENCED DOCUMENTS

*This section shall list by document number and title all documents referenced in this document. This section shall also identify the source for all documents not available through normal Government stocking activities. Relevant documents from the Feasibility Study and other development efforts should be included here.*

## 3.0 PLANS

### 3.1 Software Development Plan

*This paragraph shall be divided into subparagraphs as needed to describe the contractor's plans for developing the software. Included shall be:*

*a. An overview of requirements and constraints defining/affecting the work to be done.*

*b. Plans for complying with CG-SDDS general requirements, including, as applicable, the software development process to be used; general software engineering plans (methods to be used and approach for reusable software+ safety analysis, meeting processing resource and reserve requirements, and recording rationale), and general software testing plans (approach*

*for achieving the required level of independence, testing on the target computer system or an equivalent+ and stressing the software).*

*c. Plans for complying with CG-SDDS detailed requirements, including, as applicable, the approach to be followed in each build for developing project plans; establishing and maintaining a software development environment; performing or participating in system requirements analysis; performing or participating in system design analysis; software requirements analysis; software architectural design; software detailed design; coding and unit testing; unit integration and testing; CSCI testing: CSCI integration and testing; performing or participating in system testing; preparing for software use and support; preparing for software delivery; software product evaluations; software configuration management; joint (customer/contractor) reviews; software development management; and any other software development activities.*

*d. Schedule(s) and activity network(s) for the project.*

*e. Project organization and resources, including organizational structure to be used; personnel resources (staff-loading, skill levels, locations, clearances); contractor facilities to be used; Government furnished items required and dates needed; other required resources, plans for obtaining them, and need/availability dates.*

*f. Software Quality Assurance. Subparagraphs to describe the approach to be followed for software quality assurance. The planning in each subparagraph shall cover all requirements described in paragraphs 5.21, 5.21.1, 5.21.2, and 5.21.3 of the CG-SDDS.*

### 3.2 Software Installation Plan

*This paragraph shall be divided into subparagraphs as needed to describe the contractor's plans for installing the software at user sites. These plans shall include, as applicable:*

*a. Installation overview: list of sites; installation schedule; point of contact for questions; required materials; overview of briefings and training to be given; overview of tasks to be performed and responsible organizations; description of required personnel; overview of security considerations.*

*b. Information needed by computer operations personnel at each site: schedule of activities; inventory of required software, facilities, and accommodations; composition of the installation team; each member's tasks; procedures for installation, conversion from the old system, and data updates during the installation.*

*c. Information needed by users at each site: schedule of activities; procedures for the installation, conversion from the current system, and data updates during installation.*

### 3.3 Software Support Plan

*This paragraph shall be divided into subparagraphs as needed to describe the contractor's plans for transitioning the software to the support agency. These plans shall describe, as applicable:*

*a. Resources required to support the deliverable software: facilities; hardware: software: data; documentation; personnel.*

*b. Procedures that contractor may wish to recommend to the support agency for supporting the deliverable software.*

*c. Plans for training personnel to manage and implement support of the deliverable software: schedule; location; types of training.*

*d. Anticipated areas of change to the deliverable software.*

*e. Plans for transitioning the deliverable software to the support agency: activities; roles and responsibilities; resources required; source of each resource; schedules; procedures for installation and checkout in the support environment.*

## 4.0 CONCEPT AND REQUIREMENTS

### 4.1 Operational Concept

*This paragraph shall be divided into subparagraphs as needed to describe the operational concept for the system. This concept shall describe, as applicable:*

*a. The current system or situation, including background, objectives, and scope; operational policies/constraints; description of the current system/situation (operational environment; major components and the interconnections among them; interfaces to external systems or procedures; capabilities/functions; inputs, outputs, data flow, and manual and automated processes; performance characteristics; quality attributes; and provisions for safety, security, privacy, and continuity of operations); variations in different states or modes of operation; users or personnel involved; support/ maintenance concept and environment.*

*b. Justification for and nature of changes, including: new/modified factors that require a change; deficiencies in the current system or situation; new or modified capabilities/functions or other changes needed; priorities among the changes; changes considered but not included; and assumptions and constraints that apply.*

*c. The concept for a new or modified system, including all items listed in part (a).*

*d. Operational scenarios that illustrate the new or modified system.*

*e. Summary of impacts on the user, development, and support agencies.*

*f. Summary of improvements, disadvantages/limitations, alternatives and trade-offs.*

### 4.2 Prototype System Requirements

*This paragraph shall be divided into subparagraphs as needed to specify the requirements for a system (or segment). This paragraph shall include:*

*a. Identification of any states or modes in which the system is required to operate.*

*b. Itemized requirements, sufficient for acceptance, regarding each of the following, as applicable, annotated to identify variations in different states and modes:*

*1) System capabilities (or functions/subjects/objects) and associated parameters such as response times, accuracy, etc.*

*2) Databases/data banks that must be incorporated into the system*

*3) Interfaces with other systems, equipment, software, databases, and users*

*4) Physical characteristics, such as weight limits, dimensional limits, color*

*5) System quality factors, such as reliability, maintainability, availability*

*6) The environment within which the system is required to operate*

*7) Design and construction standards, including safety, security, and privacy*

*8) System documentation; logistics considerations; personnel and training*

*c. The order of precedence or importance of the requirements*

*d. Qualification methods to be used to verify compliance with each requirement*

*e. Requirements for delivery, including packaging and handling*

### 4.3 CSCI Requirements

*This paragraph shall be divided into subparagraphs as needed to specify the requirements for each CSCI. It shall include, as applicable:*

*a. Itemized requirements for the CSCI, sufficient for acceptance, regarding each of the following, as applicable, annotated to identify variations in different states and modes:*

*1) CSCI-external interfaces (4.4 may be referenced)*

*2) CSCI capabilities (or functions/subjects/objects) and associated parameters such as response times, accuracy, etc.*

*3) CSCI-internal interfaces and internal data elements*

*4) Unique-to-site data, conditions, or parameters*

*5) Sizing and timing; safety, security, and privacy*

*6) Design constraints; software quality factors allocated to the CSCI*

*7) Considerations regarding human performance/human engineering*

*b. A two-way mapping between CSCI requirements and the system requirements allocated to the CSCI (see 5.1.c).*

*c. The qualification methods to be used to verify compliance with each requirement.*

*d. Requirements for delivery of the CSCI, including packaging and handling.*

### 4.4 Interface Requirements

*This paragraph shall be divided into subparagraphs as needed to specify requirements for one or more interfaces between one or more CSCIs and other configuration items or critical items. These requirements may describe the interface characteristics of existing items or specify the required interface characteristics of new or to-be-modified items. This paragraph shall include, as applicable:*

*a. Identification and overview of each interface to which this paragraph applies.*

*b. The requirements for each interface:*

*1) Requirements pertaining to transmitted data elements, including, as applicable: identifier; description; source(s); recipient(s); units of measure; limit/range of values; accuracy: precision/resolution; timing characteristics; legality checks; data type; representation/format; sequence, priorities, or other dependencies*

*2) Identification of each message or other data assembly that must be transmitted between the interfacing items, and required assignment of data elements to each*

*3) The required priority among the interfaces, data elements, messages, or assemblies transmitted between the interfacing items*

*4) Specification of each interface/communications protocol that must be used, including as applicable: fragmentation/reassembly of messages; message formatting; legality checks, error control and recovery procedures; synchronization; flow control; data transfer rate; routing, addressing, and naming conventions; transmission services; status and other reporting features; security and privacy features*

*c. The qualification methods to be used to verify compliance with each requirement.*

# 5.0 DESIGN

## 5.1 System/Segment Design

*This paragraph be divided into subparagraphs as needed to describe the design of a system (or segment), including:*

*a. System behavioral design: decisions that transcend system internal structure, such as' allowed or expected inputs; planned behavior in response to each input; planned outputs; decisions on system databases/data banks; type of flexibility to be built into the system; levels of availability, integrity, and confidentiality to be offered.*

*b. System architecture, including:*

*1) Internal structure of the system: segments, HWCIs, CSCIs*

*2) Relationships among the segments, HWCIs, and CSCIs .*

*3) Identification, purpose, and description of each external interface of the system*

*c. Identification of system requirements allocated to each HWCI,*

*CSCI, and system-internal interface.*

*d. Description of processing resources to be used.*

*e. Traceability from system requirements to HWCIs, CSCIs, manual operations.*

**5.2 CSCI Design.**

*This paragraph shall be divided into subparagraphs, as needed, to describe the design of one or more CSCIs. The description of each CSCI shall include:*

*a. CSCI-wide behavioral design: decisions that transcend CSCI internal structure.*

*b. Rules/schemes/conventions used in designing the CSCI and expressing the design.*

*c. CSCI architectural design, indicating the role of the CSCI within the system architecture; the internal architecture of the CSCI (including name/ID and purpose of each software unit; and CSCI structure, including flow of execution/data among units); any non-developmental software to be incorporated into the CSCI; and allocation of memory and processing time to the software units.*

*d. CSCI detailed design, describing for each software unit:*

*1) Purpose*

*2) Requirements allocated to the software unit*

*3) Derived design requirements (e.g., algorithms used)*

*4) Constraints, limitations, or unusual features*

*5) Programming language and rationale, if different from the CSCI language*

*6) Reusable software to be used*

*7) Program library in which the software unit is to be placed*

*8) Inputs, outputs, and other data elements of the software unit, including, as applicable for each: identifier; description; units of measure; limit/range of values; accuracy; precision/resolution; priority; frequency of input, calculation, or output; legality checks to be performed; data type; data representation, format, or structure: sources, including other software units where the data element is set; destinations, including other software units where used; maximum size and storage needs; and access method, such as random or sequential*

*9) The logic flow to be used by the software unit, including conditions under which software unit execution is initiated; conditions under which control is passed to other software units; response and response time to each input; and dynamically controlled sequencing during the software unit's operations*

*e. Traceability from the CSCI requirements to the software units.*

**5.3 Interface Design**

*This paragraph shall be divided into subparagraphs, as needed, to describe the specific interface characteristics selected to respond to the CSCI-external interface requirements. It shall include, as applicable:*

*a. Identification and overview of each CSCI-external interface to which this paragraph applies, including interface diagrams as appropriate, and a characterization of each interface (sequential/concurrent operation, real-time, store-and-retrieve, etc.).*

*b. The following information for each interface, as applicable:*

*1) Description of each data element to be transmitted, including as applicable: identifier; description; source(s); recipient(s); units of measure; limit/range of values; accuracy; precision/resolution; timing characteristics; legality checks; data type: representation/format; sequence or other dependencies*

*2) Identification of each message or other data assemblies transmitted between the interfacing items, and assignment of data elements to each message or assembly*

*3) The relative priority of the interface and of each data element, message, or assembly transmitted between the interfacing items*

*4) Description of each interface/communications protocol to be followed, including as applicable: fragmentation/reassembly of messages; message formatting; legality checks, error control and recovery procedures; synchronization; flow control; data transfer rate; routing/addressing/naming conventions; transmission services; status and other reporting features; security and privacy features*

### 5.4 Database Design

*This paragraph shall be divided into subparagraphs, as needed, to describe the design of one or more databases. It shall include, as applicable, for each database:*

*a. An overview of the database, including:*

*1) Database environment: systems that will use the database; relationship to other databases; estimated storage requirements; overview of components and files; data communications environment*

*2) Internal labeling conventions used in the database design*

*3) Overview of conceptual and physical organization and design considerations*

*4) Instructions for personnel who will contribute to or use the database*

*5) Support software available for handling the database*

*6) Overview of security, privacy and criticality considerations*

*b. Information needed to establish and administer the database, including:*

*1) Identification of offices responsible for database administrative functions*

*2) Identification of the Database Management System (DBMS), hardware configuration, utility software, and integrity and access controls*

*3) Schema information, including: overall structure; rationale; data elements and the subschemas in which they are visible, description of each subschema; logical organization; physical structure; sizing formulas; recovery methods; cross-reference to requirements*

*4) Area/file information, including: rationale; content of each area/file; description of each area/file; information about data storage; any limiting factors regarding allocation, expansion, paging, loading, size; recovery methods for reconstructing the necessary data and structure*

*c. Information needed by applications developers to use the database, including:*

*1) Detailed technical description of the database, including for each subschema or local view: name; purpose; a list and description of records; sets or predefined relations; areas/files; access routines and query path structures; and security/privacy controls*

*2) Information about any utility software to aid in database use*

*3) Description of any error handling routines and procedures available*

*4) List of all messages output during execution of database software*

# 6.0 SOFTWARE TESTING

## 6.1 Software Test Planning

*This paragraph shall be divided into subparagraph, as needed, to describe plans for conducting CSCI, CSCI integration, and software system testing. Included, as applicable, shall be:*

*a. A description of the software test environment at each test site, including hardware and software items; issues of security/privacy and Government rights; plans for installation, testing, and control of the environment; organizations that will participate in the testing; the number and skill types of personnel required during the test period; dates and time they will be needed; plans for orientation and training; and identification of tests to be performed at the site (by reference to tests in part c.).*

*b. General information about the testing to be performed, including levels of tests of be performed (e.g. CSCI, CSCI integration, system); classes of tests (e.g., stress tests, timing tests); any test requirements that apply to all, or a group of, tests; extent of testing to be performed (e.g., specified sampling of possible inputs) and rationale for the extent selected; planned sequence or progression of tests; and data recording, reduction, and analysis procedures to be used during and after the tests.*

*c. Identification of planned tests for each item to be tested, including test name; objective; test level (using the levels defined above); test class (using the classes defined above); qualification method(s) specified in the requirements specification(s); cross reference to the software requirements addressed by this test; special test requirements; type of data to be recorded; type of data recording/reduction/analysis to be employed; assumptions and constraints; and security and privacy considerations.*

*d. Schedules for conducting the tests identified above, including pretest activities; preparation of test inputs and databases; any orientation or training associated with the testing; the testing itself; and any period for review/approval of test results.*

## 6.2 Software Test Descriptions

*This paragraph shall be divided into subparagraphs, as needed, to describe the test cases and test procedures to be used for CSCI, CSCI integration, and software system testing. For each item to be tested, this paragraph shall include:*

*a. Preparations for each test, including security/privacy considerations; test schedule; and pre-test procedures for hardware, software, and other aspects of the test.*

*b. Description of each test, including test name/identifier; security and privacy considerations; and description of each test case to be included in the test:*

*1) Cross-reference to the software requirements addressed by the test case*

*2) Means of control of test sequence (manual, semi-automatic, or automatic)*

*3) Prerequisite conditions that must be established*

*4) Test inputs: description, source, timing/sequence, means of control*

*5) Expected results, both intermediate and final, as applicable*

*6) Criteria for evaluating the results*

*7) Test procedure: numbered steps to be followed in initiating, carrying out, and analyzing the results of the test case, including, as applicable, alternative actions, expected results, and evaluation criteria for each step*

*c. Any assumptions or constraints applicable to the test case.*

### 6.3 Software Test Report

*This section shall be divided into subparagraphs, as needed, to describe the results of CSCI, CSCI integration, and software system testing. For each item tested, this paragraph shall include:*

*a. An overview of the results of each test, including reference to a test log; description of the test's completion status (for example, "all results as expected," "problems encountered," "deviations required"); and, when not "as expected," a summary of the problems or deviations that occurred.*

*b. Detailed results of each test, including the completion status of each test case associated with the test; a description of each problem encountered, including the test procedure step where the problem was encountered and reference to associated problem report(s); and a description of each deviation from the documented test cases/test procedures, including test procedure step where the deviation occurred, nature of the deviation, rationale, and an assessment of its impact on the validity of the test case.*

*c. Evaluation and recommendations, including an overall assessment of each item under test; an assessment of the manner in which the test environment may be different from the operational environment and the effect of this difference on the capabilities tested; and any recommended improvements in the design, operation, or testing of the item(s) under test.*

# 7. USER/OPERATOR MANUALS

## 7.1 Software User Manual

*This paragraph shall be divided into subparagraphs, as needed, to tell a hands-on software user how to install, initiate, use, and terminate a single CSCI, a group of related CSCIs, or an overall software system. The software user manual should combine manuals for field and computer center users. Specific instructions should be included for operator functions such as data entry and validation, and so a separate manual for system administrators is not suggested and has been tailored out of this CSDD. This section should include, as applicable:*

*a. A software summary, describing software uses; functions performed; logical parts and communication paths from a user view; interfaces; performance characteristics; supervisory control; hardware and software that must be present for the software to run; contingencies and alternate modes of operation; and points of contact and procedures for obtaining assistance and report problems.*

*b. Access information, including information for first-time users (equipment familiarization; overview of access, security, and privacy features; and procedures the user must perform to be identified or authorized to access, install, or use the software); procedures for beginning work, including options and a possible problems; and description of how to cease or interrupt use.*

*c. A processing reference guide, including:*

*1) An overview of software use*

*2) Conventions such as use of colors, audible alarms, abbreviated vocabulary, etc.*

*3) Detailed processing procedures, organized by function, menu, or other method, as appropriate, including options, examples, formats, messages, etc. as needed*

*4) Description of any batch or background processing performed by the software*

*5) Procedures for creating and retaining backup data*

*6) Procedures for restart/recovery and continuity of operations*

*7) List of error and other messages, their meaning, and action to be taken for each*

*d. A nontechnical description of the software for the system operator, including intended uses; operations of the system and how they are interrelated; inventory of the software that makes up the system; list of files and databases/data banks referenced/created/updated by the system; list of reports produced by the system; overview of system processing, communications processes, and security, privacy, and continuity of operation.*

*e. A description of the runs to be performed, including:*

*1) A list of the runs, purpose of each run, and software/jobs includes in each*

*2) Schedule of acceptable phasing of the system*

*3) Setup and execution procedures for any software diagnostics*

*4) Error messages and corresponding correction procedures*

*5) Detailed information needed to execute runs, including control statements; run management information; files/databases/data banks input to or created/updated by the run; reports produced, including security/privacy, media, size, copies, recipients; instructions for reproducing and distributing reports; and procedures for restart/recovery and continuity of operations.*

### 7.2 Software Input/Output Manual

*This paragraph was tailored out of the CSDD.*

### 7.3 Computer System Operator Manual

*This paragraph was tailored out of the CSDD.*

## 8. SUPPORT INFORMATION

### 8.1 Version Description

*This paragraph shall be divided into subparagraphs, as needed, to provide describe a software version containing one or more Computer Software Configuration Items (CSCIs). It shall include, as applicable:*

*a. An inventory of materials released, including software and documentation.*

*b. An inventory of all software that is part of the software version.*

*c. A list of all changes installed since the previous version, including change classifications, trouble reports, and change proposals, as applicable.*

*d. Identification of unique-to-site data contained in the software version.*

*e. Identification of interfacing items and the version's impact on interfaces with them.*

*f. List of documents pertinent to the version, or changes to them.*

*g. Operational effect of each change in the version.*

*h. Instructions for installing the version.*

*i. Identification of problems or known errors in the software version.*

### 8.2 Software Product Specification

*This paragraph shall be divided into subparagraphs, as needed, to provide source code listings, compilation/build procedures, and (by inclusion or reference) design information needed to understand and modify/enhance the source code as required. It shall include, as applicable:*

*a. Information, or reference to information, describing the design of the as-built software.*

*b. Source code listings and an index and comments for accessing them.*

*c. Description of the compilation/build process for creating the executable software.*

*d. The measured resource utilization of the CSCI(s) at the time of delivery.*

*e. Procedures for modifying the CSCI(s).*

## 9.0 NOTES

*This section shall contain any general information that aids in understanding this document (e.g., background information, glossary). This section shall include an alphabetical listing of all acronyms, abbreviations, and their meanings as used in this document and a list of any terms and definitions needed to understand this document.*

## APPENDICES

*Appendixes may be used to provide information published separately for convenience in document maintenance (e.g., charts, classified data). As applicable, each appendix shall be referenced in the main body of the document where the data would normally have been provided. Appendixes may be bound as separate documents for ease in handling. Appendixes shall be lettered alphabetically (e.g., A, B).*