IMPLEMENTATION PLAN

NATIONAL COASTAL DATABANK

USACE Mobile District Spatial Data Branch
Mobile, Alabama

January 2006

IMPLEMENTATION PLAN FOR THE NATIONAL COASTAL DATABANK

U.S. Army Corps of Engineers

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National Coastal Databank

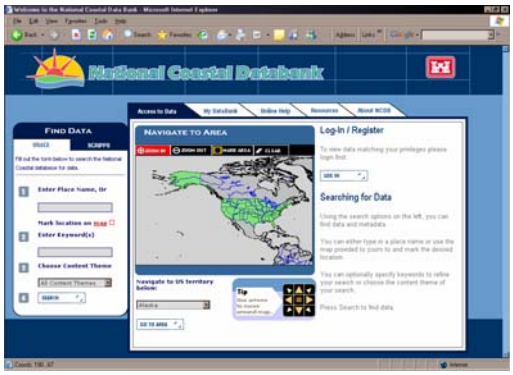
Introduction

The need for easy access to USACE coastal data has never been greater—to support the daily operation and maintenance of projects as well as to develop new tools and models for regional management. Currently, coastal data are scattered between many USACE District offices, federal and non-federal agencies, and other organizations. Because data are collected by many different sources, there is little standardization, and they can be generally difficult to access. Other common problems include occurrences of duplicated data and a lack of knowledge about the existence and location of datasets.

The National Coastal Databank (NCDB) will consolidate USACE data, allowing access through a single portal to existing coastal information and easier dissemination of new information. The NCDB's function is four-fold:

- Organize Districts to bring their coastal data online as a corporate asset
- Web portal and search engine for coastal information
- Web application service for various coastal engineering calculators and analysis tools
- Registered node on Geospatial One-Stop and IOOS interface to USACE coastal data

The NCDB will be accessed through an Internet portal (shown below) where users can efficiently search for and use all types of coastal data, information, and tools. The site will connect to a collection of servers throughout the country that maintain coastal data and information with a focus on USCAE coastal data—both spatial and temporal. Its organizational structure allows users to access data more efficiently and to easily upload new data as it is collected.



Benefits

The NCDB will benefit the districts and agencies that currently maintain and use coastal data to conduct work in support of USACE missions. It's organizational structure will allow them to access that data more efficiently and to easily upload new data as it is collected. The NCDB will also help to create the framework and architecture supporting USACE enterprise GIS guidance and policy. Although the focus is on coastal data, the infrastructure, the tools, and many applications should be applicable to non-coastal data and should be the catalyst to initiate or accelerate GIS implementation at the districts and throughout USACE.

Interaction with other complementary programs and systems will be vital to the implementation and success of the NCDB. The NCDB program will not be a duplication of effort, but will work in conjunction with other efforts and systems under development to promote the common goal of data access through a distributed network. The following are a sample of such programs: USACE eGIS, Geospatial One-Stop, Integrated Ocean Observing System's Data Management and Communication (DMAC) system, and the System-wide Water Resources Program.

Benefits to the USACE and the nation include:

- Organizes District data as a corporate asset.
- Provides a standardized "one-stop" for coastal data.
- Improves efficiency and saves time and money by reducing the wait time between requesting and receiving data.
- Increases consistency in data analysis and modeling results among coastal organizations.
- Accelerates implementation of enterprise practices throughout the Corps.

Schedule and Budget

To accomplish this effort requires interaction and coordination with numerous agencies, conversion of many existing databases, adoption of new data formats for future data, creation of nationally standardized analysis tools, and establishing visualization applications. The USACE Mobile District and ERDC Coastal and Hydraulics Lab will manage the NCDB program.

The projected cost for this effort is $16 million, to be used evenly over the four-year period of FY06-FY09. The following tasks are shown in $/year:

1. Set up NCDB in 2 USACE Div. per year **($3,000K)**
   - FY06—NAD & SWD
   - FY07—SAD & MVD
   - FY08—LRD & NWD
   - FY09—POD & SPD
2. IOOS integration **($450K)**
3. Documentation/Training/Tech. Support (**$300K)**
4. Tool Development **($150K)**
5. Application Development **($100K)**

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1. INTRODUCTION

NCDB PURPOSE

Accurate coastal information is essential for managing the country's navigation and shore protection projects. Currently, coastal data are collected, managed, and used at the many U.S. Army Corps of Engineers (USACE) district offices, as well as federal and non-federal agencies, and other organizations. Because data are collected by many different sources, there is little standardization, and data can be difficult to discover and access. Other common problems include duplicated data and a lack of knowledge about the existence and location of datasets.

The National Coastal Databank (NCDB) will create a distributed architecture for easy discovery and access to data, allowing access through a single portal to existing coastal information and easier dissemination of new information. The NCDB's function is four-fold:

- Organize districts to bring these data online as a corporate asset
- Web portal and search engine for coastal information
- Web application service for various coastal engineering calculators and analysis tools
- Registered node at Geospatial One-Stop and Integrated Ocean Observing System (IOOS) interface to USACE coastal data

The NCDB will be accessed through an Internet portal where users can efficiently search for and use all types of coastal data, information, and tools (see Figure 1). The site will connect to a collection of servers throughout the country where coastal data and information are maintained. The NCDB will be based on web services similar to ESRI's Geography Network, but with a focus on coastal data—spatial, temporal, and historic. This distributed network will not be limited to spatial data, but will also include temporal datasets, such as waves, currents, tides, and more. It will also provide for storage and retrieval of historical data and reports that aren't spatial or temporal. Its organizational structure will allow users to access data more efficiently and to easily upload new data as it is collected.

Figure 1. NCDB web portal interface

The following figure illustrates how the NCDB searches all participating servers across the country. When a user, such as a coastal engineer, enters specific search information, the NCDB performs the search and returns relevant data to the user.

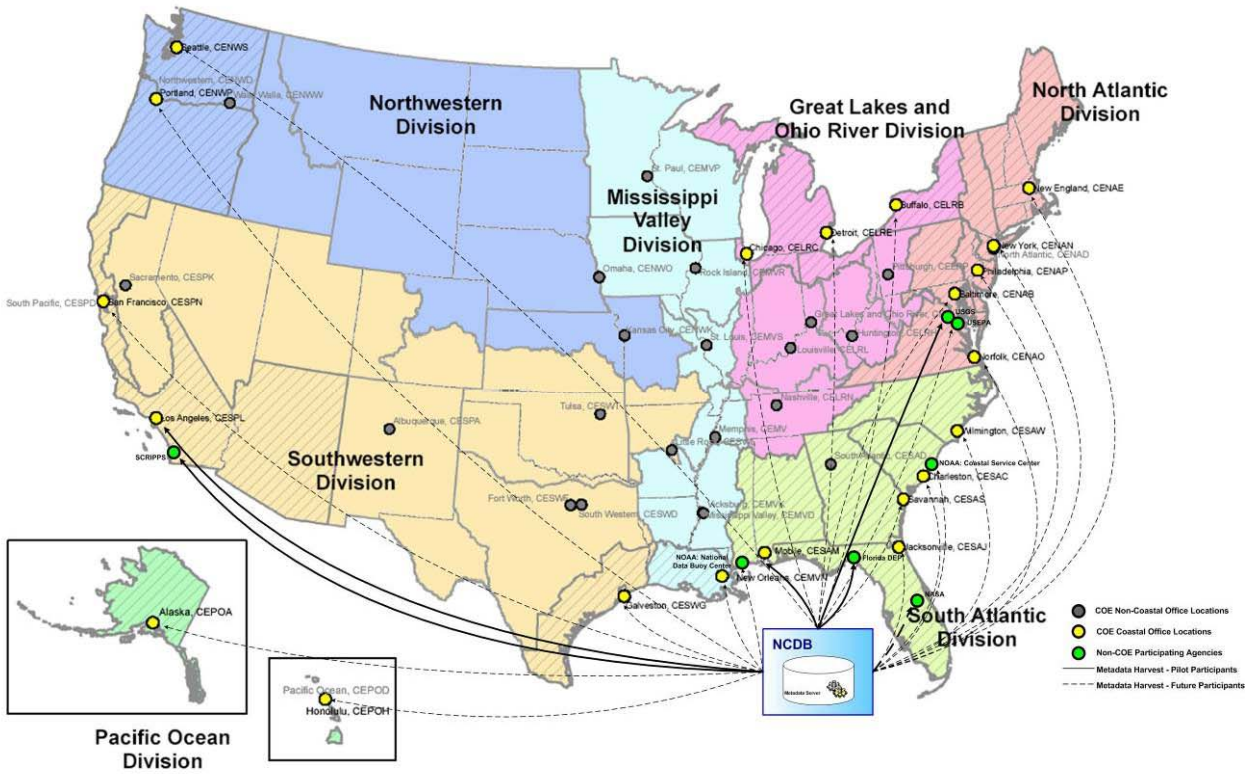


Figure 2. NCDB searches participating servers across the country

The NCDB leverages framework and architecture supporting USACE enterprise GIS guidance and policy. It also leverages the architecture being created as part of the IOOS Data Analysis, Management, and Communication (DMAC) system and the Federal Geographic Data Committee (FGDC) metadata standards. Although the focus is on coastal data, the NCDB's infrastructure, tools, and many applications should be applicable to non-coastal data and should be the catalyst to initiate or accelerate GIS implementation at the districts and throughout USACE.

Interaction with complementary programs and systems will be vital to the implementation and success of the NCDB. The NCDB program will not be a duplication of effort, but will work in conjunction with other efforts and systems under development to promote the common goal of data access through a distributed network. The following lists samples of such programs:

- **USACE eGIS (http://gis.usace.army.mil):** The NCDB will support the divisions and districts as they organize and standardize their data in compliance with enterprise GIS guidance.

- **Geospatial One-Stop (http://www.geo-one-stop.gov/):** The Geospatial One-Stop searches for and retrieves data based on metadata. The NCDB will be another node and source of

metadata for the Geospatial One-Stop to search, which will create broader dissemination of Corps data to outside users.

- **IOOS/DMAC (http://dmac.ocean.us/):** The NCDB is developing ways to standardize and link metadata for temporal data. This effort is also underway with the IOOS/DMAC program, and the Corps is working in conjunction with DMAC to accomplish this task.

- **System-Wide Water Resources Program (SWWRP):** Creating the distributed architecture and network under the NCDB will ensure USACE data are available to the new tools and discussion support systems being developed under SWWRP.

- **National Spatial Data Infrastructure (NSDI) (http://www.fgdc.gov/nsdi/nsdi.html):** The goal of this infrastructure is to reduce duplication of effort among agencies, improve quality and reduce costs related to geographic information, to make geographic data more accessible to the public, to increase the benefits of using available data, and to establish key partnerships with states, counties, cities, tribal nations, academia, and the private sector to increase data availability.

BENEFITS

The NCDB will benefit the districts and agencies that currently maintain and use coastal data to conduct work in support of USACE missions. The list below addresses just some of the many benefits of the NCDB.

- **Organize district data as a corporate asset.** The NCDB will create a distributed architecture for easy access to existing coastal information and easier dissemination of data and information.

- **Provide a standardized "one-stop" for coastal data.** Many agencies are involved in measuring and monitoring our nation's coast. The NCDB will serve as a vehicle to coordinate the agencies' data through federal standards for data sharing. This will allow coastal data users to access reliable and standardized USACE data through one information portal.

- **Improve and accelerate implementation of enterprise practices throughout the Corps.** All data in the NCDB will be standardized to meet USACE enterprise guidance and policy. The technologies developed to support the NCDB will not only be applicable to coastal data, but non-coastal data as well. This will support river system navigation, flood protection projects,

worldwide military deployment support, worldwide relief efforts, and more.

- **Improve efficiency by reducing the wait time between requesting and receiving data.** The NCDB will save time and money by enabling coastal engineers, scientists, and planners to quickly and easily access, retrieve, and use all types of coastal data and information.

- **Increase consistency in data analysis and modeling results among coastal organizations.** The computer modeling programs that study beach erosion and sediment transport are only as good as the data they use. The NCDB would reduce time and effort involved in finding and retrieving the most current and most accurate datasets for these models.

2. EXISTING CONDITIONS AND NEEDS

The USACE is responsible for hundreds of navigation and shore protection projects. Currently, approximately $300 million dollars are spent annually to collect data in support of these projects. Although policy and guidance exist for spatial data, no guidance or standards exist for temporal or historic data. For spatial data, policy and guidance implementation is not uniform across the USACE and there is great disparity among districts. There is no systematic mechanism for organizing, sharing, and archiving these valuable data. Additionally, many other federal and state agencies collect and store coastal data—leading to duplicated data and efforts.

Since January 2005, the NCDB project team has been meeting with Corps staff to discuss existing conditions for the NCDB. These include Corps organization and mission, technology and staffing considerations, and data and standards.

ORGANIZATION

USACE structure

USACE Headquarters is in Washington, D.C. Beyond Headquarters, the Corps consists of eight divisions throughout the United States with district offices and field offices around the world. Because USACE divisions and districts follow watershed boundaries instead of state boundaries, states can be divided into several divisions or districts. Figure 3 shows the divisions and districts in the United States.

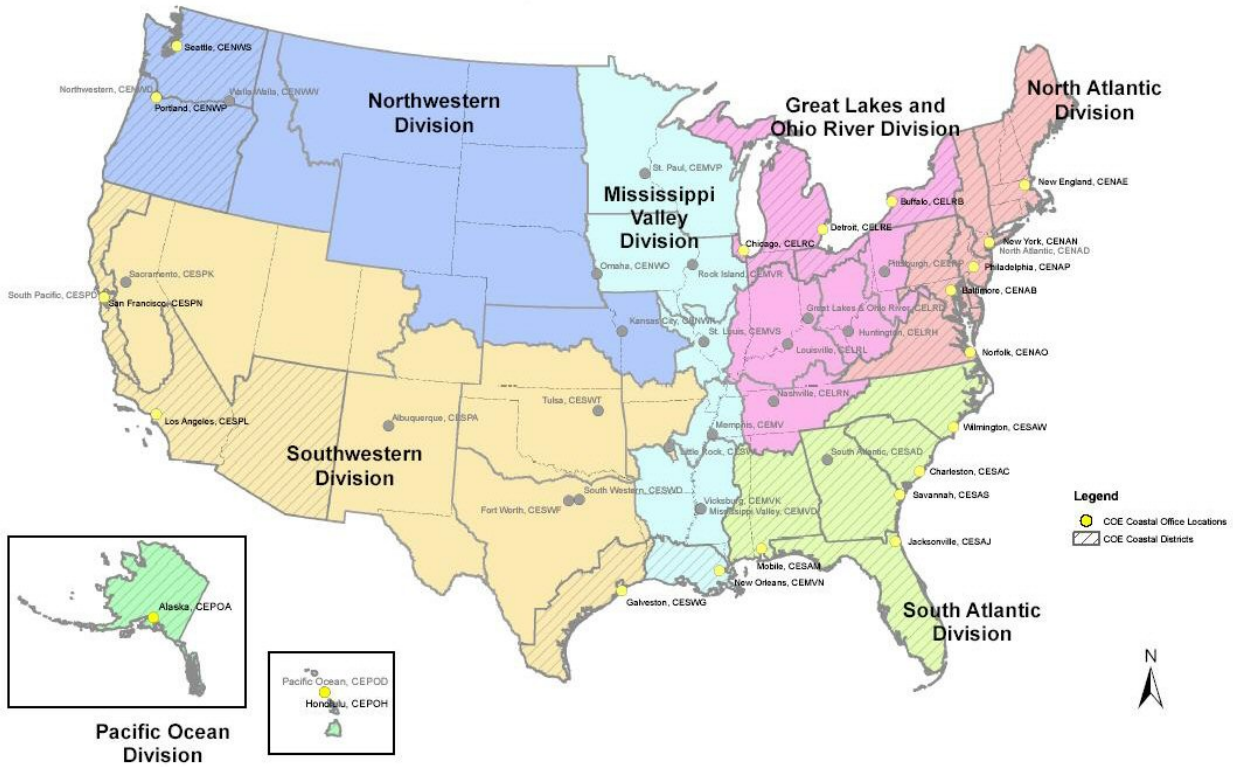


Figure 3. USACE division/district map

In addition to divisions and districts, the Corps also has multiple research and development laboratories. These laboratories fall under the direction of the Engineer Research and Development Center (ERDC). One research laboratory that could be a potential user of the NCDB is the Coastal and Hydraulics Laboratory (CHL). It performs coastal, ocean, and watershed systems analyses for the Corps and nation. Using advanced water modeling techniques, the CHL researches problems such as beach erosion, hurricane and flood damage, and shoreline protection.

Because of the distributed nature of Corps offices and labs across the world, a distributed architecture is necessary for the NCDB. This will allow the people who create and own the data and are most knowledgeable about the data to continue managing and maintaining the most current data for everyone's use.

USACE's coastal data needs

The USACE collects coastal data to manage federal navigation projects and to provide flood damage reduction in the form of shore protection projects. Regional Sediment Management is also an effort that relies on coastal data to manage sediment so that it benefits a region by potentially saving money while using natural sediment transport processes to solve engineering problems and nourish the

environment. The NCDB will allow easier access to the coastal data needed to perform the Corps' coastal initiatives.

TECHNOLOGY AND RESOURCES

Coordinated information management is crucial to keeping the Corps' information secure and accessible. Currently, data are spread across districts with no consistent way to access it. In light of regional business practices, the President's response to the Ocean Commission Report, the work of IOOS, and the direction the government is going—to increase agency coordination and cooperation—organizations need to be able to partner at the national level and share data. Having no easy way to share and access data is detrimental to the Corps' goal of working with others.

However, the Corps has instituted policy and guidance on geospatial data from Headquarters. These also include valuable resources, such as the CADD GIS Center's SDSFIE standards, ERDC's models and tools, the divisions' enterprise GIS programs, and the districts' enterprise GIS data and business practices. Additionally, the Corps has access to commercial off-the-shelf GIS software and a good network infrastructure. The amalgamation of these assets is key to USACE success, and the NCDB is critical to accomplishing this.

Despite the Corps' strengths, the current technology conditions among districts are inconsistent. For full NCDB implementation, the following inconsistencies are key concerns:

- **Available architecture.** Some offices have the capabilities to host their own data, while others are too limited to make the financial commitment to architecture, hardware, and software.

- **Staffing resources.** Some offices have people who can dedicate time to setting up and preparing data for the NCDB, while other offices are already stretched thin.

- **Corporate commitment and discipline.** The Corps has good overarching guidance and policy and good Division eGIS organization, but implementation is still in its infancy.

In planning the full NCDB implementation, these resource issues need to be addressed.

STANDARDS FOR DATA FORMAT AND ARCHITECTURE

Data standards are driven by the information that is necessary to support an organization's business functions. Standards support data collection and data maintenance efforts by doing the following:

- Organize data.
- Standardize names and terms.
- Facilitate data sharing with partners.
- Define user access and update limitations.
- Create a distributed architecture that matches USACE business practices.

Standards are important so people can perform their duties using data and procedures that are familiar, which encourages greater collaboration. When you walk into a Wal-Mart store anywhere in the world, you can expect to find the most commonly needed household products in a consistent layout and products that are of similar quality. Adopting data content and architecture standards will provide the same consistency and comfort level for all coastal dataset users, as Wal-Mart does for the people who are used to shopping there.

Data content standards

Data standards are key to the NCDB's success. USACE has highly developed data standards for spatial data and metadata but not for temporal data. For the NCDB to succeed, common data standards must be adopted and implemented—including Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) and the Federal Geographic Data Committee (FGDC) standards for metadata.

- **Spatial data.** With data in the NCDB conforming to the SDSFIE, spatial representation, attribute data types, field names, coordinate systems and all aspects of the geospatial data will be consistent. This consistency provides people in all Corps districts as well as other coastal data users more opportunities to share and manage data.

- **Temporal data.** Any other relevant standards that may be developed, such as those for temporal data, must be adopted and rigorously implemented. The NCDB program will work closely with IOOS/DMAC to develop standards for temporal data. The NCDB will encourage the coordination of efforts and help to provide guidelines for publishing such datasets through Internet web services so that temporal data can be made available for use in models, web pages, GIS applications, reporting applications, and more through the NCDB.

- **Non-spatial, non-temporal (historic) data.** Historic data include reports, pictures, etc. These data are neither spatial nor temporal, but valuable to our projects and useful in studies and decision-making processes. The NCDB includes architecture to support these types of data.

- **Metadata.** The FGDC has standards for spatial metadata, which is data about data. Currently, metadata throughout the Corps is incomplete and inconsistent. Conforming NCDB metadata to FGDC standards will result in a common set of terms and definitions. This commonality and standardization will provide NCDB users with better information for important decision making processes.

By standardizing the many available coastal datasets, the NCDB will provide easy access to a consistent, accurate, and up-to-date source of information for all coastal engineering improvement programs.

Data architecture standards

The NCDB will help to create a framework and architecture supporting USACE enterprise GIS guidance and policy and incorporating IOOS/DMAC standards for temporal data. It will support the districts in getting their data into common data formats and databases that will all be linked through the Internet. The portal will allow districts, as well as outside agencies and the public, to locate and retrieve coastal data from one virtual access point.

The distributed nature of the NCDB will allow the districts to collect and manage their own data. Districts will be able to load and publish their own data to the site, and as the data are updated by each district, the data available through the NCDB will be updated as well.

The NCDB will heavily leverage and rely on the Division eGIS programs. Under these programs, issues such as specific architecture for large versus small districts and where data will be stored will be addressed and implemented. The NCDB will leverage and link through the Division eGIS programs.

The NCDB will not be limited to the Corps' coastal data. The Corps is working to establish links with other coastal agencies, both federal and non-federal. These agencies will remain responsible for their own data. The NCDB will establish links that will be able to take users directly to the other agencies' data.

SUMMARY OF NEEDS

- Corps-wide implementation of the Enterprise GIS Guidance and Policy.
- Establish an NCDB program.
- Implement data organization at each district.
- Implement and follow common data standards.
- Link to other agencies' data.
- Integrate with IOOS.
- Link to tools at ERDC and other agencies.
- Enhance technical capabilities.

3. PILOT PROJECT

The primary goal of the pilot is to research and create a usable prototype NCDB and provide it to the pilot participants. While creating the prototype NCDB, we can test available technology to see what works and where things could be improved for the full implementation.

A second goal of the pilot is to develop this implementation plan for USACE deployment, including schedule and cost estimates, user training and support, NCDB evolution and future direction, procedures for adding new participant agencies and datasets, and updating existing datasets.

Initially, the primary participants for this pilot project included the following:

- USACE, Mobile District
- USACE, Jacksonville District
- USACE, Los Angeles District/SCRIPPS
- National Oceanic and Atmospheric Agency (NOAA)—National Data Buoy Center (NDBC)
- U.S. Geological Survey (USGS)

This section provides a high-level overview of the pilot project components and a brief summary of each. Detailed specifications for the pilot project are found in Appendix A—Software Design and Requirements Specification (SDRS). The SDRS document was created from meetings and discussions with the Corps. It defines in more detail the development efforts, design needs, and business processes involved in developing and implementing the NCDB.

OVERVIEW

The prototype NCDB pilot project involves developing the NCDB web portal, organizing data, extending the SBAS tools as the NCDB Connector Toolset, laying the groundwork for metadata publishing, and establishing the procedures for data loading.

NCDB web portal

At the end of the pilot phase, the Corps will have a prototype NCDB portal. This prototype functions by pulling in data from the Mobile District, Los Angeles District, SCRIPPS, and the National Data Buoy Center. The figure below shows the NCDB web portal as it appears in the prototype.

Figure 4. NCDB web portal

From the NCDB home page, users have the option to log in, begin a data search, view online help documentation, or link to participating agencies' websites and other NCDB-related documents, such as metadata standards and sample metadata documents. Some pages within the NCDB include the following:

- Access to Data—Initially, this page displays a form to search for data and metadata. After completing a search, this page then displays the results. Registered users can select one or more datasets to add to My Databank.

- My Databank—The registered user's personal databank functions as a shopping cart for selected datasets. This page lists all datasets that have been selected during the search. When finished selecting datasets, registered users can choose to package them for web delivery or geoprocessing.

- Online Help—Provides instructions for using the NCDB website and tools.

- Resources—Includes links to other agencies and links to related coastal information.

- About NCDB—Displays introductory information about the NCDB and its vision.

NCDB users

The NCDB website provides capabilities for searching for data, previewing results, selecting datasets, and packaging data. NCDB users fall into one of the following permission levels:

- Public level—users can search for metadata and browse results. Public users can also add data to a personal databank, download data, and geoprocess data, but they can see only public domain datasets.

- Privileged level—users can do everything that public level users can do, but also have access to in-house, non-public domain datasets.

In addition to permission levels, users also fall into one of three roles—Account Administrators, Data Loaders, and Data Users—depending on how users will use the NCDB. For detailed information, see the Administrator's Guide in Appendix D.

Organizing data

For the NCDB, data remain in the districts through a distributed architecture. All spatial data are being placed into common format geodatabases and in a standardized form. Temporal and other non-spatial data are being linked to in their current location and form.

Geospatial data conforms to the SDSFIE standard. This standard is the result of many years of development by the Corps. SDSFIE enables a user to search, retrieve, and compile a complex attribute data model for numerous spatial data layers.

Temporal and non-spatial data have no overarching standard as do GIS data. SCRIPPS and NDBC provide data to consumers via the Internet through downloadable links and subscription services. As long as there is a method for registering data with the NCDB, these data will be made available for consumption through the NCDB by leading users directly to the hosting site. The ability to tightly integrate temporal data into the NCDB's analysis tools will depend on the standardization of how the temporal data are organized and what they contain. The more consistent the data formats, the simpler the task of blending temporal and non-spatial data into the NCDB.

Metadata

For this initial pilot effort, data loading capabilities were implemented for advanced district offices and non-USACE organizations. A wizard is used to verify that the data are correct and that all metadata fields are filled in.

Initially, metadata going into the NCDB pilot were inconsistent and incompatible. Most NCDB metadata fell short of the FGDC requirements. During the pilot, Woolpert adopted standards for all metadata in the NCDB.

Adhering to FGDC standards was crucial, and the FGDC provided minimum base requirements. Woolpert then extended these requirements and built upon them by adding FGDC-defined elements unique to the NCDB. This combination resulted in a comprehensive FGDC metadata standard for the NCDB. These specialized elements are customized for the Corps workflow and NCDB search tools.

For detailed information about metadata in the NCDB, refer to Appendix C—Creating and Publishing Metadata for the NCDB.

Web services

Web services are the fundamental building blocks that enable distributed computing on the Internet. They are reusable software components that can be published, discovered, and invoked over the Internet. Web services expose any function of an application to web users through standard Web protocols such as XML, Simple Object Access Protocol (SOAP), and Web Service Description Language (WSDL). One of the main advantages of using XML web services is that it provides means for software to interoperate across programming languages, platforms, and operating systems. Since web services extend client/server architecture by enabling broader accessibility to diverse applications and reusability of the Web components delivering the functionality, they have become the latest technology used for delivering data and processing services to diverse user applications.

Using web services in the NCDB provides the interoperability and flexibility required to meet the NCDB data accessibility requirements. Because web services cross platform boundaries easily and can be built to work with various data seamlessly, they are a natural fit in the NCDB portal for searching, retrieving, and processing data. The web services developed to support the NCDB Pilot are summarized in the Administrator's Guide in Appendix D.

Temporal data access

SCRIPPS provides access to its temporal data through the Internet. At the base level, a user must know identifiers for stations, data codes, and how to format request strings restricting date and time ranges for the data to be retrieved. At the time of developing the prototype NCDB, no metadata catalog methods were available; however, it is understood that this work is currently in progress by the SCRIPPS staff.

The prototype NCDB site provides a web-based graphical user interface to download the SCRIPPS buoy data. Users select a station ID and data type from dropdown lists, as shown in Figure 5. Upon entering the desired date range, the request is formulated into the proper request string and sent to the SCRIPPS server.

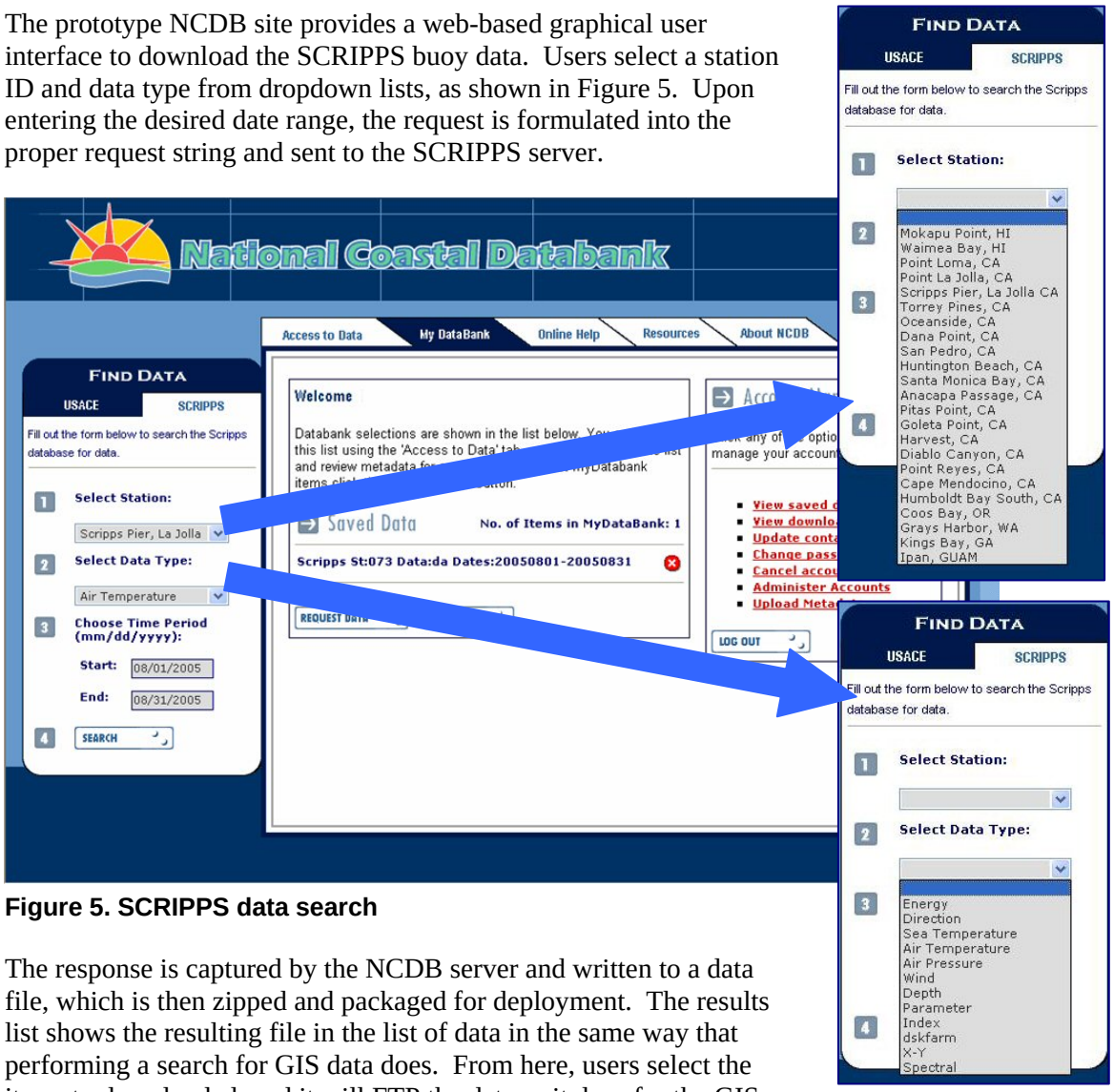


Figure 5. SCRIPPS data search

The response is captured by the NCDB server and written to a data file, which is then zipped and packaged for deployment. The results list shows the resulting file in the list of data in the same way that performing a search for GIS data does. From here, users select the items to downloaded, and it will FTP the data as it does for the GIS datasets.

NCDB Connector Toolset for ArcGIS

The NCDB Connector Toolset for ArcGIS includes two individual tools—the Area of Interest tool and the NCDB Search tool. For prototyping, these tools work in conjunction with the Spatial Data Branch's SBAS tools; they do not replace or change any existing functionality. In later development, they can be extended to work with other tools or applications as well.

- Area of Interest Tool—This tool allows users to draw a rectangular extent on the map indicating a geographic location for the NCDB to search for temporal, spatial, and non-spatial/non-temporal data.

- NCDB Search Tool—This tool retrieves datasets for the specified area. As part of this process, the search tool prompts the user for a username and password to authenticate with the NCDB site. Once the user is successfully authenticated, the returned datasets display in a form where the user can select data and request it be transferred to an FTP site for download.

For detailed information about the NCDB Connector Tools, see Appendix B—NCDB Connector Toolset User Guide.

Sharing data outside the USACE

The NCDB prototype was initially a registered node on Geospatial One-Stop, the spatial data clearinghouse of the federal government. As users of the Geospatial One-Stop search for clearinghouses, the NCDB was presented as a search option with a link taking them directly to the NCDB site. As soon as the proof of concept was complete, the NCDB prototype was removed from the Geospatial One-Stop to control expectations during its development. Once the NCDB site is hosted by USACE and has a significant amount of data loaded and published, it will be registered with Geospatial One-Stop as a clearinghouse, as shown in Figure 6.

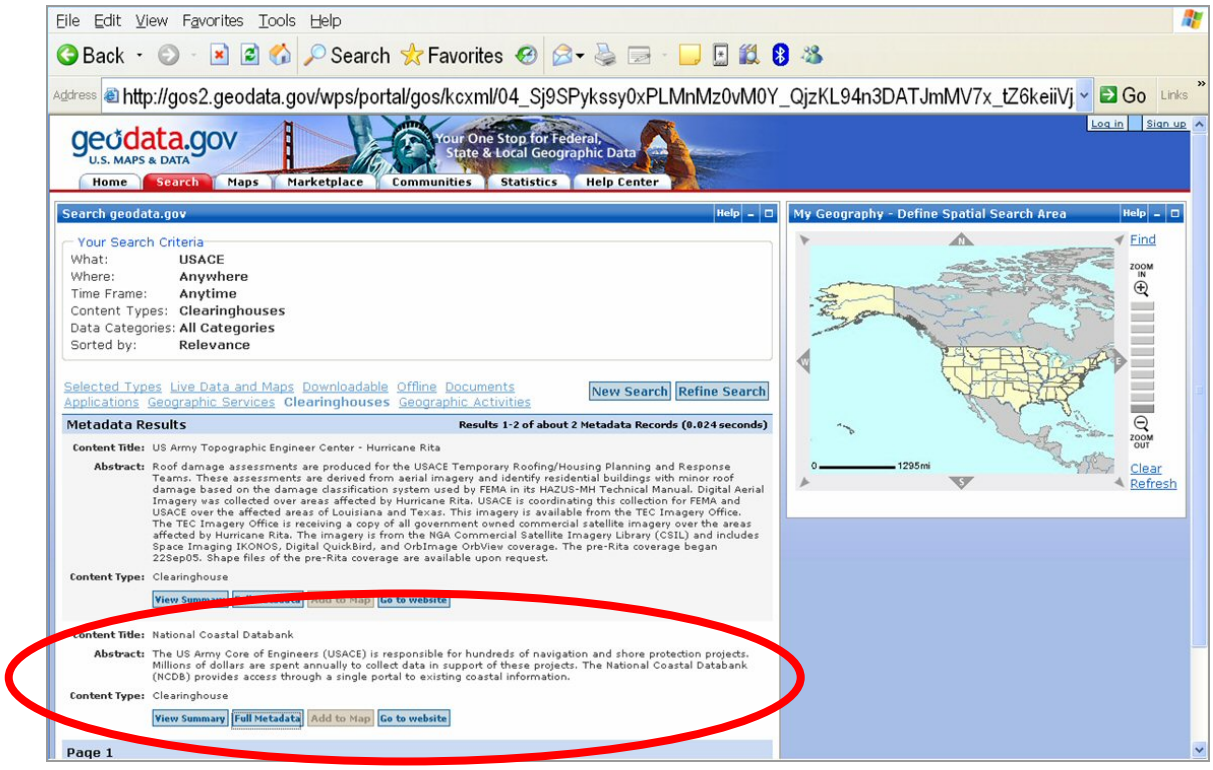


Figure 6. Geospatial One-Stop clearinghouse registration

A metadata harvesting arrangement has also been made for the Geospatial One-Stop. During prototyping, a weekly harvest of metadata from the NCDB Metadata Server to the Geospatial One-

Stop server was established and tested. This arrangement allowed users searching the Geospatial One-Stop site to find specific data within the NCDB without ever using the NCDB site directly.

As soon as the proof of concept was complete, the NCDB metadata documents were removed from Geospatial One-Stop's catalog to prevent users from seeing the data in an unusable form. Once the NCDB site is hosted by USACE, the metadata harvest relationship will be established so that people searching the Geospatial One-Stop site will find specific links to data within the NCDB.

NCDB Prototype Summary

Through the NCDB prototype, users across the country can easily access all types of coastal data using only their web browser. Coastal engineers, emergency workers, and other users can quickly create an account and then search for and access data. The ability to immediately download data minimizes the wait time of acquiring data through the mail. With various spatial and temporal data available from one search location—the NCDB website—users save precious time and money. And data processing tools provide the ability to clip, re-project, or perform calculations on data without the need for intermediate datasets, which helps users get the correct data they need the first time.

Not only does the NCDB prototype provide increased efficiency, but also standardization. By adhering to the SDSFIE standards for spatial data and the FGDC standards for metadata, coastal data accessed by users are consistent—and it supports the development and adoption of data standards for non-spatial coastal data (atmospheric, oceanic temporal data, and so on). Through this standardization, data analysis and coastal modeling among various agencies and organizations is uniform.

By simplifying the process of finding accurate and complete data, the NCDB prototype organizes data as a corporate asset. However, the mechanisms and tools within the NCDB prototype are not exclusive to coastal data. The technologies used and developed for the NCDB will easily apply to non-coastal USACE missions, such as river system navigation, flood prevention projects, worldwide relief efforts, and more.

4. IMPLEMENTATION OF THE NCDB

After implementing the NCDB Pilot project and prototype web portal, the national implementation must incorporate tests and evaluations conducted during the pilot project to ensure scalability. This section presents the plan for national implementation.

NCDB PROGRAM

To accomplish this effort requires interaction and coordination with numerous agencies, conversion of many existing databases, adoption of new data formats for future data, creation of nationally standardized analysis tools, and establishment of visualization applications. The USACE Mobile District Spatial Data Branch and the ERDC Field Research Facility at the Coastal and Hydraulics Lab will manage the NCDB program. A chartered Project Management Plan (PMP) will be established upon funding whichever group will provide specific tasks and milestones for national implementation of the NCDB. A Project Delivery Team (PDT) chartered under USACE, but consisting of team members from USACE HQ and each USACE Division and coastal District, NOAA, USGS, IOOS, FGDC, and Woolpert will execute this project. Additional technical and administrative support may be sought as the project plan evolves.

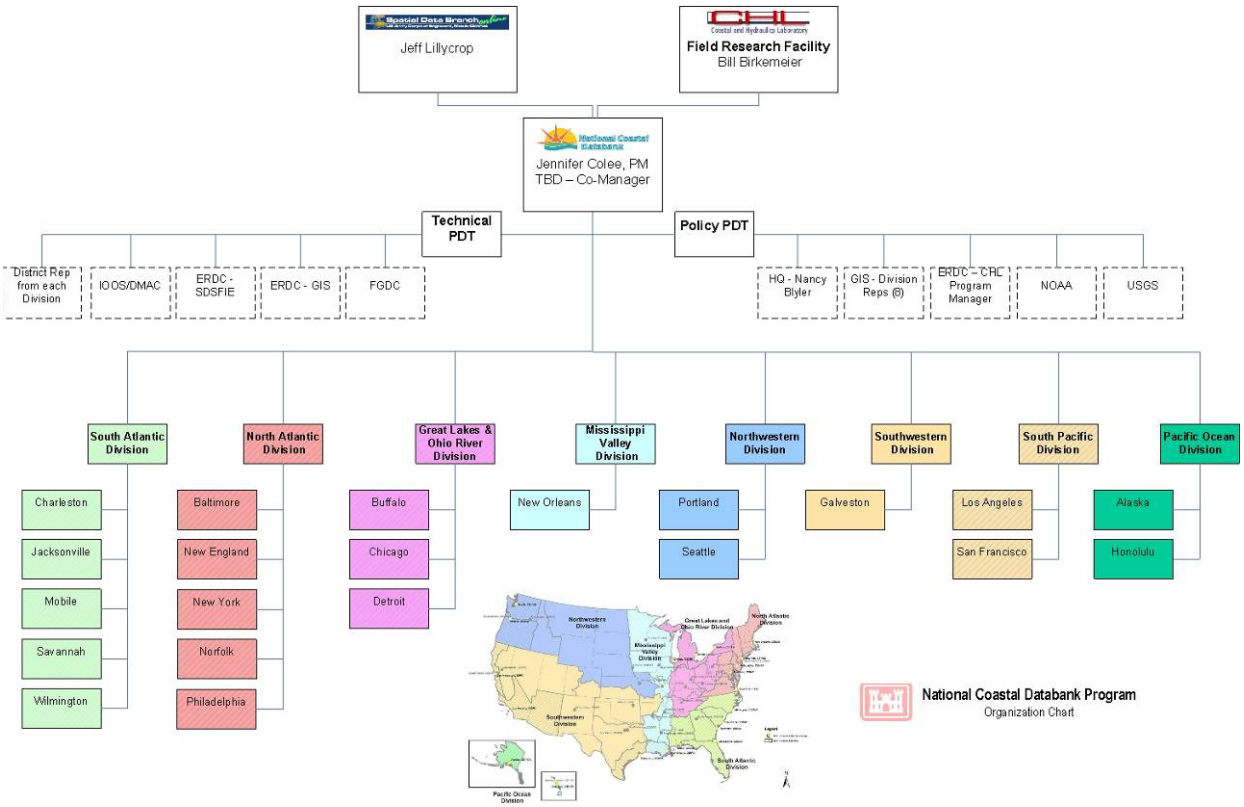


Figure 7. NCDB Program organization

NCDB ARCHITECTURE

This section discusses hardware and software needed to create the linkages and environment for the NCDB. It is scalable to handle increasing volumes of data and evolve as USACE requirements evolve. It is also scalable to handle increased volumes of users. The architecture leverages the USACE eGIS distributed infrastructure by building into it temporal and non-spatial/non-temporal data access and management components.

Goals that the architecture must support

Several key requirements must be satisfied by the architecture of the NCDB. This architecture must meet the following:

- Support the need to grow
- Maintain USACE District autonomy
- Link with other agencies

Support the need to grow

The recommended architecture must be one that supports growth on multiple levels. As the system matures, four main points are crucial to keep in mind:

- **More data will be provided.** As the NCDB gains popularity, the volume of data will increase. The capacity to grow in processing power and data storage is key so that search and retrieval times are not affected by data increases.

- **More districts and agencies will be supplying metadata.** The system must allow for adding many participants' metadata to the catalog without sacrificing performance.

- **More users will be requesting and downloading data.** With more people using the system to locate, retrieve, process, and publish data, it must accommodate an increase in network traffic as well as in the number of requests to extract and process data.

- **The size of individual data pieces will grow larger.** As technology advances, file sizes also increase. This demands more network bandwidth, more RAM, and more physical storage space.

Maintain USACE district autonomy

The architecture will be one that supports the district offices as individual work centers. There are three points to consider for district participation in the NCDB:

- **Districts create and use data locally.** The district is responsible for the data it requires for its projects. As each district brings its enterprise GIS repository online, the data for that district will be stored in the enterprise GIS database. In this database, it is accessible to everyone in the district as well as those outside the district via the NCDB Portal.

- **Districts have an eGIS implementation plan.** Through this plan, existing architecture, hardware and software, personnel, and business practices are implemented. The NCDB will leverage the business practices and workflow by adding temporal and non-spatial/non-temporal data. This provides full data control at the district that creates, manages, and uses data.

- **Districts participate in a division eGIS program.** Through this program, business practices and regional data needs and standards are established to support the Regional Business Centers. Through the Division eGIS program, the NCDB will leverage and access District data.

Link with other agencies

Hardware and software for the NCDB must be configured so that non-USACE agencies can easily access Corps data through their web portals. It must also be configured to allow everyone to find other agencies' data through the NCDB portal. Four critical concepts must be remembered when implementing the NCDB on a national scale.

- **External agency participation is voluntary.** Technical methods used for linking non-USACE agencies with the NCDB will be very similar to coastal district offices; however, the Corps has no authority to control other agencies' data storage architecture and sharing initiatives.

- **Metadata is the common thread.** As with any integrated system, there must be points of commonality. In the case of the NCDB linking to non-USACE agencies, this common point is metadata. All metadata from all participants must be, at a minimum, FGDC compliant and must be published to an Internet accessible location using one of several metadata publishing software components (such as ESRI's ArcIMS Metadata Server).

- **Advanced capabilities of the NCDB will be available.** Extended services like data packaging, email notification, data processing tools, data translators, and calculators will require more involvement by the external agency to make its metadata provide necessary information to the NCDB components.

- **Case-by-case basis.** The participation of each external agency, and subgroups within those agencies, is expected to be unique

and potentially complex. Each situation will require individual attention and requirements gathering steps. Following standard operating procedures and adhering to standards will alleviate many problems typically associated with such joint efforts.

Architecture components

The NCDB's architecture configuration is scalable to allow for growth and future expansion. Specific components of the architecture are discussed in the following sections. Figure 8 illustrates many of the possible areas where the NCDB architecture can scale up to accommodate more data or more data requests.

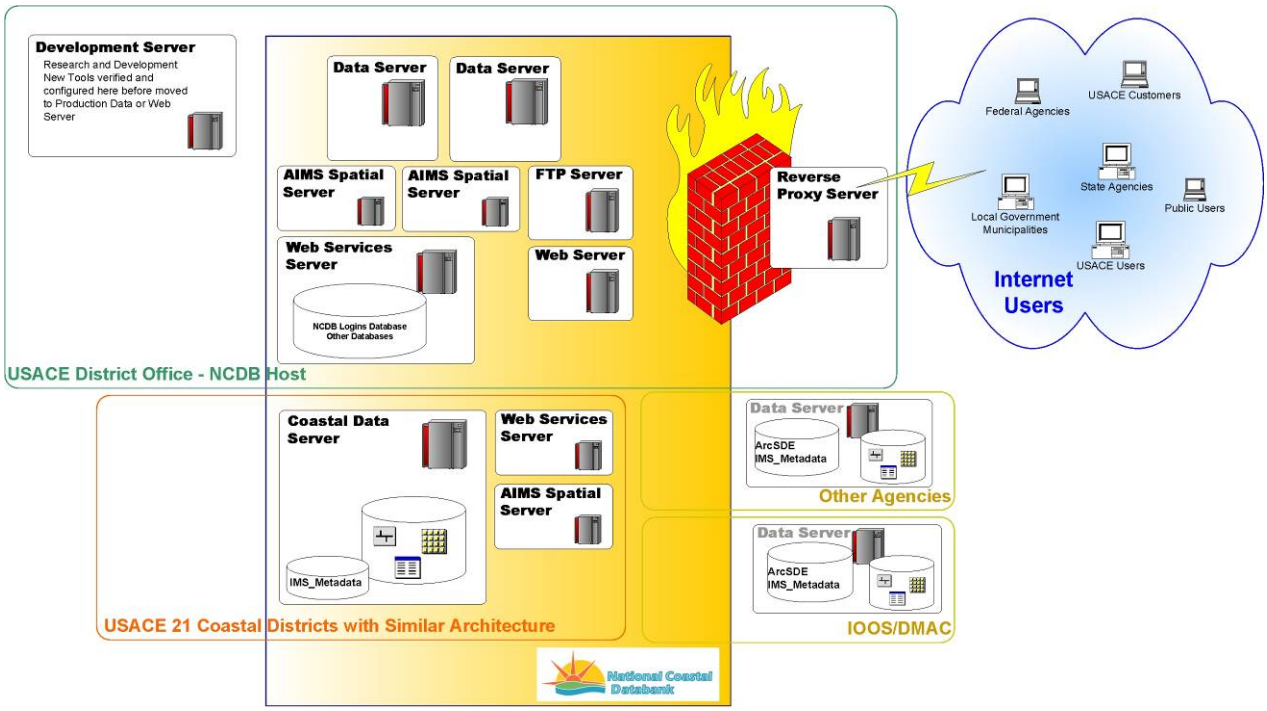


Figure 8. Scaleable hardware architecture

NCDB host district

Within the Corps district hosting the NCDB system, currently the Mobile district, there must be multiple servers. The need stems from requirements for security, development, software testing, upgrade verification, and performance. Multiple servers will be used with an optional Storage Area Network (SAN) or Network Attached Storage (NAS) device.

Data server

The data server will host two primary pieces of the NCDB system:

- The enterprise geodatabase on SQL Server with ArcSDE

- The ArcIMS services used to publish feature data, publish and search metadata, and extract feature data

Some form of high speed data access and storage mechanism is needed, such as a SAN or NAS. In the early implementations of the NCDB system, a Redundant Array of Independent Disks (RAID) array can be used to serve the data; however, as the amount of data increases and the volume of data requests increase, a more robust, scaleable storage system is necessary.

As the number of data requests increase, the data server components will be the first recommended hardware upgrade due to the process-intensive nature of serving data from databases (ArcSDE) as well as rendering maps and extracting data (ArcIMS). Figure 8 illustrates how the server tasks can be spread across two or more servers depending upon anticipated growth at the time of the upgrade.

As illustrated, one scaled architecture includes an additional data server, so the most heavily accessed data layers can be separated. Implementing ArcIMS multiple spatial servers balances the load of map rendering and data extraction requests using a typical queuing scenario in which the next available server is dedicated to the next request on a first come, first serve basis. Two items affect the need for multiple spatial servers:

- The number of requests per unit time
- The amount of time needed to process each request

ArcIMS's software structure allows it to grow virtually indefinitely by adding more spatial servers to the spatial server pool. Increasing the number of spatial servers is the most common way of scaling an ArcIMS system.

Web services servers

One of the web services servers will perform a role similar to that of a traffic cop. As requests come in from the Internet through the web server, the web services server will decide based upon the type of request which server will handle the request internally. Additionally, this server may have another role, which is to process some of the work required by way of web services such as data transfer, message queuing, email notification, NCDB User Authentication, NCDB User Administration, and more. All these web services are transportable to other hardware within the NCDB system for load balancing and performance tuning.

Another server's role will also be to host a small but essential database for NCDB login management. All users wishing to download data through the NCDB must be authenticated by the system as both a means of recording request activity and securing

certain pieces of data. The user authentication and user administration web services read/write data to the login database.

One web server will host logging mechanisms that will help identify the services that are used the most and those that take the most time. Analyzing such a log will help identify ways in which the web services can be separated to different hardware to help tune the NCDB system. Figure 8 does not represent multiple web services servers because of the vast possibilities in which they could be arranged to handle more requests and data.

Web server

The Web server's purpose is to handle all external requests for data and metadata sharing with other agencies. All traffic from Internet users is handled through the USACE's existing reverse proxy server, which communicates via a secured link through the firewall to the web server. The NCDB website is hosted on the web server, which also serves as a temporary FTP server used by NCDB components to transfer extracted data to the user requesting the data. Metadata harvested from non-USACE agencies will be funneled through the same secured communication.

As overall traffic increases, this server will see an equally large increase in traffic because all web requests are channeled through this server. To augment this traffic, a second server will be added to isolate all the file transfer operations for requested data. It is also possible to cluster web servers to handle the increased traffic; however, that is unlikely in the next three years due to the small nature of work done with each request by the web server.

Development server

The development server is to be used for testing new concepts, newly developed web services, and software upgrades. It will also be used as a temporary production server while production hardware is upgraded, consolidated, or otherwise down for maintenance.

Figure 8 does not represent additional development servers, although having multiple development servers could greatly enhance an administrator's ability to test new components and software. As new hardware is acquired for performance improvements in the production environment, it often results in a computer from the production pool being used for development purposes. This method of development server expansion and upgrade should be adequate for anticipated NCDB administration and testing over the next three years.

Fail-Over host district

The architecture must provide its products and services reliably to the users. In order to provide that reliability, a second district office will host a redundant set of hardware and software for the NCDB's search and processing capabilities. It must be configured such that one server at the fail-over host district is set to do the work of three or four clustered servers at the host district. In the event of a long-term outage at the host district, the redundant servers at the fail-over host district would be brought online to carry the load.

Establishing the fail-over system involves two primary components:

- Replicate the metadata database from the host district to the fail-over host district.
- Configure the web server, web services, reverse proxy server, and network firewalls to allow for a quick startup of the fail-over site in the event of a disaster at the host district.

NCDB participant—USACE district office

With the implementation of a single server, all data from a district office can be centralized for that district and shared with the NCDB. As illustrated in Figure 8, this server will need to host the geodatabase data using a combination of ArcSDE with either Oracle or SQL Server. The server will also need to host ArcIMS services to publish the vector data, metadata from that district, and data extraction that will be called upon when users wish to obtain data from the server. Finally, the server will need to host several NCDB specific web services for vector, raster, and LiDAR data extraction.

As the NCDB system grows and becomes more popular among the engineering community, the need for each district to handle larger volumes of data request traffic is inevitable. The NCDB architecture is intentionally designed to consolidate district data and support the enterprise GIS efforts as mandated by USACE HQ. The architecture is scalable such that different software components can be installed on their own hardware for dedicated resources, effectively balancing the workload and improving overall system performance as traffic increases.

Several steps can be taken to expand capacity—the first of which is to separate the ArcIMS server from the ArcSDE geodatabase repository. Next would be to add a server for data extraction services. After that, further analysis would be performed to find the largest bottleneck in the system. If it is an ArcIMS extraction, spatial servers may be added or image services may be separated from extraction services. If it is a data serving delay, a second ArcSDE geodatabase server may be added to spread the most commonly requested datasets across multiple servers. If the volume

of data and the number of requests are great enough, one could justify implementing a SAN, NAS, or other high performance data serving device.

NCDB participant—non-USACE agency

Agencies outside the USACE wishing to make their data available through the NCDB can do so by allowing the NCDB services to harvest their metadata. Metadata harvesting is a simple method of copying published metadata information from one organization to another without having to extract data from a server or reformat data files. It does require that the agency wishing to share their data have some things established, including the following:

- FGDC compliant metadata available for all data desired to be shared.
- Metadata are published on a metadata server, such as ESRI's ArcIMS Metadata Server or other Z3950. For more information, refer to ESRI's ArcIMS 9 Creating and Using Metadata Services guide.
- The published metadata be accessible via the Internet.

SOFTWARE

Commercial software requirements

A major prerequisite for the NCDB system is the commercial software on which the architecture and custom tools have been created. Without these specific software packages, the NCDB would not be possible. They are the foundation on which the future of the NCDB system will grow.

These plans are based on what was learned during the pilot and what software is readily available within the Corps. In many cases, substitutes may be made, but such substitutions will require significant configuration changes and component testing.

Oftentimes commercial software packages require regular maintenance and upgrade to handle new security threats or bugs found in previous versions. Vendors usually charge an annual fee for keeping your software current. The NCDB requires that all commercial software components be maintained according to the vendor license agreements.

Relational database management system (RDBMS)

Microsoft SQL Server is recognized as widely available throughout the Corps. It will be used because of its availability and the availability of people trained to administrate SQL Server databases.

SQL server is required at the host district as well as each district office.

Other database software may be used in the districts if they choose; however, the RDBMS software chosen must be supported by ESRI ArcSDE and have published connection specifications for Microsoft .NET developers. Note that such a deviation will require additional configuration and testing for it to work with other components of the NCDB system, which may lead to additional costs or implementation time for completion.

Microsoft .NET platform

The glue that keeps all the commercial software components talking to one another is the software that was written specifically to support the NCDB's objectives. The NCDB-specific software is written using Visual Studio .NET, and as such, requires that all servers hosting components of the NCDB have the .NET Runtime components installed. This installation is usually performed automatically as a part of the software deployment and requires virtually no conscious effort. It is a commercial component that will require maintenance (upgrade, security patches, and configuration) from time to time.

ArcSDE

ESRI ArcSDE software is required at the host district and each district office for two distinct purposes:

- To warehouse and maintain the geospatial data, which are themselves the corporate asset.
- To store a metadata catalog used by the ArcIMS Metadata Service when publishing and searching metadata records.

No special installation requirements exist beyond those in the documentation for building geodatabases and metadata servers.

ArcIMS

During the NCDB pilot project, Microsoft Windows and other common software for ArcIMS were chosen. It is possible to install the ArcIMS environment on Linux or Unix operating systems, but it is not recommended without further testing. This software is required at the host district as well as each district office.

Several installation and configuration specifications are given in Appendix E—Commercial Software Configuration for the NCDB.

ArcGIS Desktop

To simplify the process of creating ArcGIS Server objects, ArcGIS Desktop is required to be installed on the same machine as ArcGIS Server. No special installation requirements exist beyond those in the ESRI documentation.

ArcGIS Server

Geoprocessing tasks and certain data extraction services will require that ArcGIS Server be available at the host district. Some special installation requirements are provided for ArcGIS Server in Appendix E—Commercial Software Configuration for the NCDB.

Software development requirements

An integral part of a successful system implementation is the ability to look back on the pilot implementation notes, identify how it could be improved in the future, and then act on those potential improvements to ensure the best future implementations possible. The ability to look back and make adjustments is what allows successful pilot implementations to become successful final implementations.

During the NCDB pilot, Woolpert kept a running document of potential improvements and enhancements. This list tends to be comprised of mostly small to medium efforts affecting usability of the NCDB site or small pieces of functionality impacting user interaction. However, one noted improvement directly affects the ability of the NCDB application to scale up to use the maximum capacity of the hardware available, as well as provide for easily breaking up the individual components to run on separate machines. Each of these improvements will be outlined below. The first part outlines the improvement that directly affects scalability of the NCDB application. The second part, usability improvements, is comprised of moderate-level improvements to each NCDB subsystem.

Scalability improvements

Asynchronous handling of messages from the message queue

When extract requests are made of the NCDB, an extract message is placed into a queue. Items in the extract queue are processed on a first come, first served basis regardless of the time needed to service the request. Furthermore, if the queue is being processed on a machine with multiple processors, the queue can only be processed by a single processor at a time. During the testing stage, it was determined that a new queuing strategy could be implemented to greatly reduce the wait times for the extraction process and serve

users in a more timely manner. This could be accomplished by allowing all processors on the server to process messages in the queue, thereby increasing the number of sequential requests that are able to be handled by the NCDB. By allowing the queuing software to take advantage of multi-processor hardware, data extraction wait times can be greatly reduced, providing a more timely response to users.

Web tools to use shared process space

When websites retain information throughout a user's visit, this information is usually stored in session state variables or in a database. The process space used for these variables impacts the ability for a web application to scale up. When prototyping an application, the focus is on user functionality rather than the process space consumed by certain functions. Therefore, the current prototype web applications use "In Process" space for storing information pertinent to a user's visit to the site or application. As the system grows, this information will need to be moved "Out of Process"—meaning that a shared pool of servers use a common process space for these session related activities. So when one web server crashes, the remaining servers can pick up the load where the crashed server left off.

All prototype code developed needs to be examined and reworked slightly to change the common session related information from "In Process" to "Out of Process" storage. This code rework will allow the system to use additional servers and cluster servers.

Survivability improvements

Survivability improvements involve configuration and expansion of hardware resources so that critical components of the NCDB Search Engine are available on a redundant server in another geographic location, named the fail-over host district. It will be configured so that one server at the fail-over host district is set to do the work of three or four clustered servers at the host district. In the event of using the fail-over site, performance would be limited to the processing power of the fail-over server. In this case, it is assumed that the recovery period of the host district is not long enough to justify the additional expense associated with a completely redundant system of fail-over servers. In the unlikely event that the host district recovery time be indefinite, the time associated with acquiring new hardware and reconfiguring the fail-over host district to serve as the host district would be no more than three weeks.

Establishing the fail-over system involves two primary components:

- Replicate the metadata database from the host district to the fail-over host district.

- Configure the web server, web services, reverse proxy server, and network firewalls to allow for a quick startup of the fail-over site in the event of a disaster at the host district.

Usability improvements

Improvements in this section generally pertain to site usability by either directly limiting the type of functionality available to the user or by affecting the user's experience. They are grouped by the area of the application they affect.

User interface improvements

These improvements directly impact the way a user views the site or the functionality available to the NCBD website. The purpose of these improvements is to provide a more robust NCDB website that is easy to use and meets the needs of a majority of its users.

- Allow users access to their download history for a given period of time.
- Allow users to save their databank without requesting or downloading it and load these saved sessions in a future visit.
- For SCRIPPS data users, set up a subscription style service (for example, monthly download of wave height data).
- For USACE data users, set up a subscription style service for data updates (for example, they get a notification or automatic download when a dataset is updated).
- Include additional geoprocessing functions.
- Improve the metadata display style and content.
- Change the workflow to accommodate including metadata for hard copy documents.
- Create a user feedback system.
- Create a comprehensive online help system.
- Create standard operating procedures describing in detail the methods used by engineers and designers for acquiring data from the NCDB.

Administration improvements

These improvements enable the NCDB website administrators and those who load metadata to more easily perform required functions.

- Ability to automatically add a feature class or view to the appropriate image service.
- Ability to select multiple metadata documents or folders containing metadata and run metadata validation on all of them in a single operation.
- Ability to select multiple metadata documents and update common fields on all of them in a single operation.

- Add an ArcCatalog tool for identifying the spatial extent of non-spatial data.
- Modify the web services to allow additional metadata servers/extraction services to be added to the NCDB without the need to recompile the code.
- Create standard operating procedures describing how to bring new Corps district offices online with the NCDB.
- Create standard operating procedures describing how to bring non-Corps agencies data online with the NCDB.
- Create standard operating procedures describing how each district office is to load and maintain data and metadata for the NCDB.

Security improvements

These improvements are targeted at making the NCDB application as secure as possible. There is currently a reasonable level of security in the NCDB that is meant to protect sensitive data from users who do not have permission to view it. The levels listed below will add additional security to individual NCDB components to tie up any potential loose ends that may exist.

- Encrypt all usernames and passwords in all web configuration files.
- Implement web services security standards to provide high-level web services security from other applications.
- Add an activity logger to track data extraction requests for review and reporting purposes.
- Implement an authentication model that uses existing Corps login credentials, similar to Windows Authentication.

Back-end improvements

These are improvements that add additional, core-level, functionality to the NCDB system. This functionality then bubbles its way up to the user interface in the form of additional functions the user can perform on the NCDB website.

- Include additional geoprocessing functions in the geoprocessing web service.
- Ability to search local metadata server instead of NCDB server to limit returned data.
- Ability to specify the FTP location to upload data on which to place extracted data.
- For future tuning efforts, add an activity logger to track geoprocessing function use and dataset requests to identify those processes and data that are most commonly used.

HARDWARE AND SOFTWARE CONFIGURATION TASKS

The NCDB program will work with each district and division to implement and configure the necessary hardware and software for the NCDB. Each district will require certain components, and the NCDB program will provide onsite services to install, configure, and troubleshoot the following:

- Web services for file-based data, raster data, and LiDAR data extraction.
- Web service to FTP the extracted data.
- ArcIMS Image services to enable extraction of SDE feature class data.
- ArcIMS Metadata server to enable metadata harvesting.

District teams will provide details of the system architecture in their respective offices so the NCDB program can set up district machines in a similar way. The components listed above will then be configured on a test server to match the settings specified by the district and expected by the NCDB application. Once all the components are tested completely with the NCDB website, they will be installed and configured on the district or division's production server.

In addition to installing and configuring hardware/software, the NCDB program will also assist with data loading and metadata formatting, provide training and user documentation, and provide long-term technical support.

DATA

Temporal data

SCRIPPS data are currently being served two ways through the NCDB website—through a direct extraction method and through a metadata search. The direct extraction method is unique to SCRIPPS data since all other data are served through a metadata search. The NCDB will require that all temporal data be cataloged using FGDC standards. Each station will require one metadata document identifying the date ranges and available data download codes required for extraction.

NOAA's National Coastal Data Development Center has an established data serving plan, which follows the current minimum guidelines for time series data that have been set by the IOOS/DMAC-ST. The NCDB program will arrange a metadata harvesting agreement between the Corps and the NCDDC. The result of this agreement will be the ability to use the NCDB web

tools to search for and retrieve atmospheric and oceanic data served on NCDDC's site, including the NDBC's data and data from other NOAA offices.

Non-digital data

Participating agencies and districts may have data that are not currently available in digital form, such as hard copy paper maps. The FGDC metadata standards accommodate the requirements of describing non-digital metadata. Procedures and guidelines for creating digital metadata for non-digital documents will be developed for dissemination.

Metadata for non-digital data can be published, served, and searched through the website in the same way that metadata for digital data can. However, any data that cannot be extracted through the NCDB website should not be enabled for adding to a personal databank for extraction. Accommodations to the user interface and workflow will be made so that users can easily determine whether data can be directly extracted, accessed digitally on another site, or if it does not exist in digital form. For data that cannot be retrieved through the website, alternative instructions for obtaining copies of the data that are included in the metadata will be made easily accessible to the user.

USACE'S geospatial data

The NCDB has been designed to serve data in many formats, taking into account the Corps' current data management practices. For the project to succeed, it will be essential for all Corps districts to follow SDSFIE standards when creating and maintaining their data. Using these standards will be critical for developing future geoprocessing, data development, and analysis tools.

ArcSDE feature data

Vector data stored in ArcSDE can be served following the Corps' current workflow of using layer files with definition queries to filter data by project ID, survey ID, or any other combination of attribute queries. To make these data available through the system, an NCDB-compliant metadata document will need to be created and published for each layer file. Each metadata document must have the proper spatial extent defined, relating to the features in the definition query rather than the whole dataset.

ArcSDE raster data

Raster data stored in ArcSDE can be served through the NCDB. Because image sizes can be large, metadata files must be created to allow for extraction of reasonably sized extents. The resulting

smaller files sizes will present less of a burden on network resources and shorten wait times for users extracting raster data.

LiDAR

LiDAR datasets can pose a challenge because of the vast number of points involved with each set. The search mechanism and tools developed for the prototype were designed to work with USACE's planned database schema for LiDAR data. In this scenario, many metadata documents are created from each LiDAR dataset; each metadata document designates only a part of the full LiDAR dataset.

ESRI plans to address the needs of LiDAR data users in ArcGIS 9.2 through its terrain data model. Development of this model should be closely monitored to research its potential to provide a better way of managing LiDAR datasets. If so, it may be possible to improve how the NCDB serves LiDAR data in the future.

File-based data

The NCDB can serve standalone files, such as ESRI shapefiles, raster images that are not stored in SDE, text documents, spreadsheets, and so on. Those wishing to publish their files will create metadata with a proper spatial extent and will make the files accessible to the file extraction service. The metadata editing tool will assist in meeting these requirements.

Metadata

The FGDC has published a widely accepted metadata standard for spatial information. Temporal data unfortunately do not have such a widely accepted metadata standard; however, it is recognized that the Data Management and Communications Steering Team (DMAC-ST) is organizing such an effort at this time (refer to the document at http://dmac.ocean.us/dacsc/docs/SOW_for_Metadata_071405_NC.doc). The NCDB program will support DMAC's efforts in establishing a metadata standard for temporal data and will adhere to the standards set forth by those efforts.

Serving metadata for searching

A central metadata service has been established on a server at the host district. Database administrators at the host district will be able to publish metadata directly to this service. District offices with data to offer the NCDB will use the metadata harvesting model to publish their metadata. The NCDB user community will be required to submit valid metadata documents at the time they submit data to be served by the NCDB. A series of web forms and web services will gather the data and associated metadata, validate them, and publish them.

In the harvesting model, each district office will create and maintain a metadata service on its local data servers. Each district is encouraged to publish its metadata to a local metadata service within the district. The central metadata service at the host district will automatically harvest metadata from each district, so that all the metadata will be available to the public through the host district. While the central metadata service will serve all metadata documents, the temporal and geographic data will remain in and be served from the district servers. Because of this, the configuration files at the host district will need to be kept current with the names of participating district servers. The metadata editing requirements will be the same for all metadata documents, whether they are created in the host district or in any other office. A metadata editing tool will assist in meeting these requirements.

Serving data from other organizations

Organizations outside the Corps can participate in the NCDB in many ways. An important distinction is whether those organizations will also make their data available through the NCDB website or if their metadata will simply provide a link to their own website.

For most organizations, making NCDB's data available to their search catalogs is as easy as harvesting metadata from USACE's metadata server. The USACE's metadata server will provide a certain level of external exposure to allow such harvesting activities to take place.

Some organizations will have coastal data that they wish to be found by NCDB users. In the simplest of these cases, the NCDB will harvest data from those organizations. To accomplish this, the sharing organization must expose a metadata server through secure channels to the Internet to allow metadata harvesting. Alternatively some form of export mechanism may be employed; however, it will not be as simple as harvesting metadata directly.

In more advanced cases, an organization wishing to share its data will install a package of NCDB-specific web services, which provide specific functionality to extract data, bundle them, process them (if desired), and deliver them. This would allow an NCDB user to gain access to an external agency's data in exactly the same request/transfer mechanism as data from within the Corps. Additionally, it will allow an NCDB user to perform the desired processing functions on the data prior to delivery, such as re-projection, clip, merge, or other calculations.

All of these options for integrating the NCDB with other existing enterprise data warehouses and clearinghouses require FGDC compliant metadata. For most processing tools, the SDSFIE must be used for data structure and formatting.

The harvesting model previously discussed allows organizations outside of the Corps to participate if they have a metadata server and establish harvesting with the central metadata service. The prototype metadata editing tool will be improved to ease its use both internally and by external organizations.

Validating harvested metadata

The NCDB administrator can take several approaches to verifying the validity of metadata and the underlying data source. One possible workflow would be for the host district to harvest data, check all new or updated documents for NCDB metadata compliance, make compliant metadata public, and notify the agency of any compliance or connection issues. Maintenance tools can be built for ArcCatalog that would expand upon the capabilities of the metadata editor tool. These tools are described in more detail in the *Commercial software requirements* section of this document.

LONG-TERM NCDB ADMINISTRATION

Hardware, software, and data only make up part of a successful information systems program. One key component for a successful information system is the human resources that will be responsible for maintaining, tuning, enhancing, and helping to promote the NCDB system within the Corps.

Tasks for long-term administration

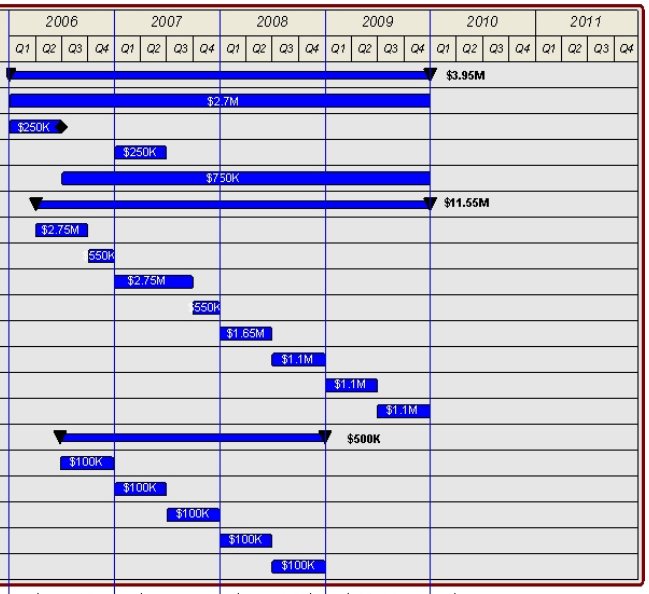
Many technical and organizational tasks will need to be performed on a routine basis to preserve the integrity of the NCDB as well as to plan for its future expansion. Some sample tasks may include the following:

- Upgrading commercial software components (ESRI, Microsoft, and possibly Oracle products)
- Upgrading NCDB software components
- Sizing and purchasing new hardware
- Installing components on new hardware
- Adding users to the NCDB login database
- Gathering feedback from NCDB users and organizing it into requirements for the next round of application development
- Providing telephone and email technical support service for Corps users
- Providing email technical support service for outside users
- Authoring documents and white papers (user support papers)
- Administering SQL Server or Oracle
- Administering ArcSDE
- Administering ArcIMS
- Administering the NCDB website

5. Budget and Schedule

The timeframe presented for NCDB nationwide implementation is four years beginning in Fiscal Year 2006. Categorical and Fiscal Year Spending are summarized in the figure below.

ID	Task Name	Start	Finish	Duration
1	**Development, Support, & Research**	**1/2/2006**	**12/31/2009**	**208w 4d**
2	Application Development & Technical Maintenance	1/2/2006	12/29/2009	208w 2d
3	Develop Tech Support System/Team	1/2/2006	6/30/2006	26w
4	Establish Redundant Fail-Over Host	1/2/2007	6/29/2007	25w 4d
5	Provide Technical Support	7/3/2006	12/31/2009	182w 4d
6	**USACE Division Deployments**	**4/3/2006**	**12/31/2009**	**195w 4d**
7	NAD	4/3/2006	9/29/2006	26w
8	SWD	10/2/2006	12/29/2006	13w
9	SAD	1/1/2007	9/28/2007	39w
10	MVD	10/1/2007	12/31/2007	13w 1d
11	LRD	1/1/2008	6/30/2008	26w
12	NWD	7/1/2008	12/31/2008	26w 2d
13	POD	1/1/2009	6/30/2009	25w 4d
14	SPD	7/1/2009	12/31/2009	26w 2d
15	**Other Agency Integration**	**6/26/2006**	**12/31/2008**	**131w 3d**
16	NOAA – IOOS/DMAC	6/26/2006	12/26/2006	26w 2d
17	FEMA	1/2/2007	6/29/2007	25w 4d
18	USGS National Map	7/2/2007	12/31/2007	26w 1d
19	US EPA	1/1/2008	6/30/2008	26w
20	NASA	7/1/2008	12/31/2008	26w 2d



	2006	2007	2008	2009	2010
Development, Support & Research	$1.11M	$1.11M	$0..86M$	$0.86M	*$3.95M*
USACE Division Deployement	$3.3M	$3.3M	2.75M	$2.2M	*$11.55M*
Other Agency Integration	$0.1M	$0.2M	$0.2M	$0.0M	*$0.5M*
Total	**$4.51M**	**$4.61M**	**$3.81M**	**$3.06M**	***$16M***

Development, Support, and Research

As discussed in the software development tasks section, this portion of the budget extends throughout the life of the project. It not only covers the cost of web application development, but it also provides a modest amount of funding for continuing research of new technologies, developing a technical support program, and establishing a fail-over host district.

The total cost of this effort will be $3.95 million. The first two years will cost slightly more than the last two to cover initial application development tasks, establish the technical support program, and establish the fail-over host district.

USACE Division Deployments

Deployment of the NCDB system requires hardware installation, software configuration, and data cleanup at each district office. Some districts will require more assistance than others, but on average, the cost to bring each district up to speed with NCDB will be $550,000. The goal for deploying the NCDB throughout the

coastal districts is to implement two divisions every year, according to the following time table.

Table 1. Deployment time table

Year	Divisions
2006	North Atlantic Southwest
2007	South Atlantic Mississippi Valley
2008	Great Lakes and Ohio Rivers Northwestern
2009	Pacific Ocean South Pacific

The total cost of district deployment for the NCDB will be $11.55 million, with more of it being spent in years one and two due to the greater number of coastal districts within those divisions.

OTHER AGENCY INTEGRATION

Sharing data with other agencies will involve investigating their system, understanding what they have, and how the NCDB will communicate with other similar data clearinghouses. This effort is estimated to take about $100,000 per organization. The key organizations to focus on during this implementation are NOAA, FEMA, USGS (National Map), USEPA, and NASA. The total cost of this effort will be $500,000.

APPENDIX A—SOFTWARE DESIGN AND REQUIREMENTS SPECIFICATION

The Software Design and Requirements Specification details the architecture of the NCDB and associated tools. It is a standalone document that has been appended to this document for reference.

IMPLEMENTATION PLAN APPENDIX A

FULL IMPLEMENTATION SOFTWARE DESIGN & REQUIREMENTS SPECIFICATION

National Coastal Databank
USACE Mobile District Spatial Data Branch

May 2005

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1. Change Control and Revision History

This specification is a living document. All changes that are agreed to by Woolpert and the client will be documented below will be and incorporated into this specification. This document will be redistributed to all project participants each time a revision is agreed upon by all parties.

As applications are developed, it is often necessary to revisit and revise the initial specifications and the initial software design so that a complete and functional application is developed and delivered to our client. Woolpert will accurately document the software requirements and design.

This document, a **software design and requirements specification (SDRS),** describes the software application to be developed for USACE Mobile District Spatial Data Branch. An SDRS defines the functionality the application will have, the environment in which the application will be developed, and any applicable constraints and assumptions.

1.1. Change Control

The software requirements documentation process provides a way of communicating changes that are necessary to the application that were either unanticipated during the planning or that were required due to changes in technology requirements, staffing or organizational requirements, or management requirements. Changes to the application development plan and design affect budgets and schedules. A change control form is provided in this document (Appendix C: Application Change Control Form). As changes arise in the development process, this form will be completed by Woolpert representatives and the client to manage expectations regarding budget and schedule. This form will be appended to this document in both electronic and hardcopy form.

1.1.1. Change Control Responsibilities

1.1.1.1. Woolpert's application developer responsibilities

1. Complete and print the Change Control Form provided in Appendix C: Application Change Control Form. This form describes the change and the resulting impact on budget and schedule. This form serves as confirmation that both the client and developer have agreed to the change.

2. Insert the completed Change Control Form in this electronic document for future reference.

3. Revise this software requirements specification to include the requested change and document the change in the revision history above.

1.1.1.2. Client responsibilities

1. Review the hard copy Application Change Control Form. A copy of this form is in Appendix C: Application Change Control Form on page 26.

1.2. REVISION HISTORY

As necessary changes to the software requirements are indicated and accepted, this SDRS will be updated accordingly. Table 1 will summarize these changes.

Table 1. Revision History

Name	Date	Reason for Change	Change Control Form

2. INTRODUCTION

This document defines the development efforts, design needs, and business processes involved in developing and implementing the National Coastal Databank (NCDB) for USACE Mobile District Spatial Data Branch.

2.1. PURPOSE

This specification serves the following purposes.

- To define the effort needed to develop and implement the National Coastal Databank.
- To define and document relevant business processes.
- To define and document necessary data structures.
- To present a prioritized list of needs and macro-level development tasks identified through an interview process to gather the information for the requirements of this project. These needs were used to determine the National Coastal Databank's functionality.

The National Coastal Databank will provide users with a web-based interface where they can search for and download spatial and nonspatial datasets for coastal areas. This document serves as a guide for application design and development and exists for these purposes:

- To document the client-approved requirements, providing an objective reference to the development team so that the resulting product reflects these requirements.
- To act as a living document. This document will be updated on an as-needed basis to reflect any changes or additions necessary to the design of the application.

2.2. RELATED MATERIALS AND DOCUMENTS

List related materials and documents here. These documents should include:

- Meeting minutes
- Scope of services

3. System Overview

This section provides an overview of the system that Woolpert will develop for USACE Mobile District Spatial Data Branch.

The NCDB is a web-based application that can be accessed through an industry standard web browser. It enables users to search for and retrieve spatial and non-spatial data pertaining to coastal areas.

When accessing the site, the user is taken to the main search page. There the user can begin to search the NCDB metadata or log in to the security system as a public user or an unrestricted user. The user's security level determines what operations of the NCDB website are available. If the user does not have an account with the NCDB, he/she can request a user account from this main page.

The user can then perform a search based on keywords and/or a spatial area. The search tools will access the NCDB metadata server, located in Mobile, where they will either find metadata for data that resides within the NCDB or metadata that points them to locations on other agencies' servers.

When the search is finished, the results will be returned to the user in a Results window. The user can then select the datasets to keep and add them to a Personal Databank. However, before adding data to the Personal Databank, the user must log in. If the user does not have an account with the NCDB, they can request a user account at this time. After logging in successfully, the user can retrieve the datasets in the Personal Databank or run one of the available geoprocessing tools on the data.

To retrieve the data, the user's options depend on the size of the dataset. For datasets smaller than 200MB, the data will be uploaded to an FTP site. The user will receive an email with a link to the FTP site when the upload is complete. These download requests will be queued to avoid overloading the server. For large datasets, the user can request a physical copy of the data.

To use the geoprocessing tools, the user must first retrieve the datasets to be geoprocessed using a second retrieval option, Retrieve for Geoprocessing. Retrieval of datasets for geoprocessing is managed by the same size restrictions as retrieval for download. The datasets are then transferred to the Mobile office, where the geoprocessing tools will allow the user to merge or clip datasets. When the geoprocessing task is complete, the user will receive an email notification with a link to the resulting data, as well as the source datasets.

In addition to the normal workflow of the NCDB, an administrative application will be created to assist the administrative staff with day-

to-day activities. The administrative site will be available, using the standard login process, to all NCDB administrators. After authenticating with the NCDB, administrative users will have an additional tab on their home page. The administrative website will provide the functionality to manage users and user permissions and to set NCDB configuration values.

4. NONFUNCTIONAL REQUIREMENTS

The nonfunctional requirements listed in this section were gathered through meetings and discussions held by pilot NCDB participants and Woolpert. These requirements are not related to the application's functionality. Rather, nonfunctional requirements define limitations, business constraints, or business rules that must be adhered to.

4.1. ASSUMPTIONS

It is assumed that all offices participating directly in the NCDB pilot project will have the following minimum software installed and running prior to installation.

- ArcSDE
- ArcIMS Metadata Server
- Windows 2003 Server with IIS 6.0

It is assumed that all offices and agencies that wish to participate in the NCDB will have well-formed metadata, on a project-by-project basis, for each dataset they want to publish.

If metadata is only available for the entire feature class, it is understood that it may be difficult to perform a spatial search on that data due to its bounding extent.

It is assumed that bandwidth is available to support the transfer of data from remote offices to Mobile.

4.2. DEVELOPMENT ENVIRONMENT

The core NCDB applications will be built using Microsoft Visual Studio .Net 2003 to run on a Microsoft Windows 2003 server using IIS 6.0. The applications will consist of an NCDB web application and multiple .Net Web Services. Web service functionality will be implemented to support the possibility of multiple client platforms in the future.

Remote web services running in the district offices that will be used to extract, filter, and package remote data will be coded as .Net Web Services Data Architecture.

4.3. DATA ENVIRONMENT

The demands of the NCDB and the previously designed geodatabase structure present a unique set of constraints regarding how data is accessed by users of the NCDB. The following sections outline, in detail, the four key components of the data architecture.

4.3.1. ArcSDE Environment

Each USACE advanced and super level district office will have its own ArcSDE server to store its data. On each server, all data has previously been organized into feature datasets containing a set of related feature classes. All data that belongs to a particular feature class is stored together in a single feature class. This means that a single feature class may contain data from multiple projects or geographic locations.

For every feature class, we will create one ArcSDE view containing public data. Therefore, if there are 101 feature classes in the geodatabase, there will be 101 ArcSDE view objects.

All feature classes, views, and tables registered with ArcSDE must have names with a length of 32 characters or less. Therefore, to develop ArcSDE views, it is necessary to abbreviate certain words in the feature class names, as shown in Table 2. These abbreviations only apply to the feature class names as they are used in views; the actual feature names in ArcSDE are not abbreviated.

Table 2. Feature class abbreviations

Word	Abbreviation
JURISDICTION	JURIS
NAVIGATION	NAV
ELEVATION	ELEV
POPULATION	POP
HISTORIC	HIST
POLLUTION	POLLUT
OBSTRUCTION	OBSTRUCT
POINT	PT
REPRESENTATION	REPRESENT
PROPERTY	PROP
ELECTRICAL	ELECTRIC
CENTERLINE	CENTERLN
ARCHEOLOGICAL	ARCHEO
PHOTOGRAPH	PHOTO
LOCATION	LOC
MUNICIPAL	MUNICIP
MANAGEMENT	MGMT
ALIGNMENT	ALIGN
SEDIMENT	SEDIMNT

The views will use the following naming convention:

<abbreviated feature class name>_pub_vu

In ArcCatalog, these views will be visible outside the feature datasets. Therefore, the strict naming convention is necessary for easy distinction between feature classes and views.

The ArcSDE views are created by the feature class data owner. Therefore, the same owner login that creates the data can also create the views and modify permissions for accessing those views.

4.3.2. ArcIMS Environment

Two types of services are necessary for the NCDB users' data needs. The first service type, ArcIMS image service, will be used to display raster data on the NCDB website, in custom tools, and in other applications. The second service type, ArcIMS extract service, will be used to provide clipping and data extraction functionality.

4.3.2.1. Image services

ArcIMS Image services will be created to serve raster data. Depending on the size and frequency of use of the raster data, multiple Image services may be created to allow for load balancing of the services themselves.

4.3.2.2. Extract services

ArcIMS Extract services will be created to provide the clipping and data extraction functionality. For the pilot, we will create extract services for raster data. Extract services are implemented through ArcIMS Image services with extract tags specified in the .axl file.

The extract services will never be accessed directly by a remote client. Instead, a small, local web service will be deployed to each district office that is hosting an ArcSDE server and participating in the pilot. This web service will be responsible for extracting the data local to the ArcSDE server's environment and packaging it in a .zip file to reduce the footprint of the transfer.

4.3.3. Metadata

The key to a successful NCDB implementation is good metadata for all data included in the NCDB. This metadata must be in FGDC format.

One metadata document will be created and managed for each layer file, raster image service, and tabular data source. It will be crucial for the data extents of the metadata document to be limited to the extent of the data being referenced.

The following is a list of fields that are required to be completed at a minimum:

- Abstract
- Purpose
- Title
- Origin
- Publication time
- Host agency URL (if applicable)
- Extent
- Theme keywords
- Place keywords
- Security classification
- Native dataset environment
- Host server
- Protocol
- Data format name
- Data source name
- Data filter (if applicable)
- Geometry type (if applicable)

4.4. CONSTRAINTS

4.4.1. Supported Browsers

The following browser versions will be required, at a minimum, to access the NCDB.

- Microsoft Internet Explorer 6.0
- Netscape Navigator 6.0

5. FUNCTIONAL REQUIREMENTS

The requirements listed in this section were gathered through meetings and discussions held with pilot NCDB participants and Woolpert. These requirements are listed as subheadings followed by brief statements about how development will proceed.

5.1. NATIONAL COASTAL DATABANK

The National Coastal Databank (NCDB) will provide users with a single point of access to metadata from every participating NCDB agency. It will handle user authentication, metadata search functionality, data transportation, geoprocessing, user management, and system configuration.

5.1.1. NCDB website

The standard NCDB website will provide the following functionality: search, results preview, dataset selection, and packaging.

Figure 1 is a sample workflow demonstrating the standard user's experience when working with the NCDB website.

Figure 1. Sample workflow with NCDB site

5.1.1.1. NCDB home page

The home page is the heart of the NCDB application. When first entering the site, the user will have the option to log in, begin a metadata search, or follow links to online help documentation, participating agencies' websites, and other NCDB-related documents, such as metadata standards and sample metadata documents.

The user may search for metadata without logging in. All data and search functionality of the website will be visible to all users. There will be no restrictions on the type of searches performed or datasets returned.

To log in to the NCDB website, the user will enter his/her username and password in the space provided and submit them to the server. Once authenticated, the user will be able to use a Personal Databank to view and download data. If the user logs in as an NCDB

administrator, the home page will contain an additional link for accessing the administrative functionality.

The NCDB will search for metadata using the following criteria:

- Extent
- Description/abstract
- Data source
- Theme
- Keyword
- Type
- Title
- Publisher

5.1.1.2. Results page

After completing a search, the user will be presented with a set of results. On the Results page, the user can select one or more datasets to add to the Personal Databank. From this window, the user can also preview the metadata for each returned dataset individually.

5.1.1.3. Personal Databank

The authenticated user's Personal Databank will function as a shopping cart for selected datasets. This page will list all datasets that have been selected during searching. Like the Results page, the user can preview the metadata for each dataset from the Personal Databank page. The user can also remove datasets from the Personal Databank. When finished selecting datasets, the user can choose to package them for web delivery or geoprocessing.

The Personal Databank will only be available to users that have authenticated with the NCDB website. Data stored in the Personal Databank will only be stored for the duration of the user's connection to the NCDB and will not be retrievable in future visits.

5.1.1.4. Data packaging page

The data packaging page will be accessible from the Personal Databank and will be restricted to authenticated users only.

After selecting datasets to download or geoprocess, the user will initiate a packaging process from the Personal Databank page.

This will begin an external process to determine how the datasets can be delivered to the user. The NCDB will determine the size of the requested data and use built-in size restrictions to choose the best method for packaging it. For all requested datasets smaller than 200 MB, the data will be transferred to an FTP site, and the user will be notified by email when the data is ready to be downloaded.

If the user specifies to retrieve the datasets for geoprocessing, the NCDB will determine the dataset sizes using the workflow described above. The data will then be transferred to Mobile, and the user will receive an email notification that the data is ready for geoprocessing. By clicking a link in the email, the user will be returned to the NCDB website and will be prompted to authenticate. The user will then be taken to the Personal Databank. There the user will specify two datasets to geoprocess and the geoprocessing operation to perform. For the pilot NCDB, the available geoprocessing options will be clip and merge. When the geoprocessing job is submitted, the user will be returned to the Personal Databank page. When the job is complete, the user will receive an email notification with links to the resulting dataset, as well as the two source datasets.

5.1.1.5. Administrative Section

A restricted section of the NCDB will be created to allow administrative users to manage users, permissions, and configuration settings as specified below.

5.1.1.5.1. User administration

Users of the NCDB will be given one of the following two designations:

- Public user—can search for metadata, browse the results, and preview a single dataset's thumbnail image. A public user cannot add data to a Personal Databank, download data, or geoprocess data. Public users can only see non-restricted datasets.

- Unrestricted user—can do everything a standard user can do, and has access to restricted datasets.

Administrator Designation

Users can also be designated as NCDB administrators. Administrative users can accept new user requests, designate a user's access level, and make changes to NCDB site default settings.

5.1.1.5.2. Configuration administration

File size restrictions and notification settings are configurable. They can be modified by the administrator.

File size restrictions

There is a file size threshold that separates data that can be sent to an FTP server during off-peak hours from data that must be manually processed and shipped using traditional methods. If the file is smaller than 200 MB, it will be transferred to an FTP site where the user can

download it. If the file is larger than 200 MB, the data must be manually processed and shipped to the user.

Notification settings

The second set of configuration values controls the email notification system of the NCDB.

By adding users to one of the following groups, they will receive notifications as described below:

- Security alerts—individuals to notify in the event of a security-related issue.
- Account managers—individuals to notify of new account requests or requests to remove existing accounts.
- Data loaders—individuals to notify, by district office, when a data load request is entered.

5.1.2. Supporting Workflows

5.1.2.1. Login workflow

The user will have two opportunities to authenticate with the NCDB. The first opportunity is on the NCDB home page, and the second is when the unauthenticated user tries to add data to the Personal Databank. After a successful login, the user will be authenticated with the NCDB and will be permitted to retrieve data from the NCDB website.

If the user authentication fails three consecutive times, the user will be prompted to request a new password or request an account. For the pilot project, password resets and approval of new accounts will be handled by an NCDB administrator. Figure 2 illustrates the NCDB login workflow.

Figure 2. Login workflow

5.1.2.2. Account request workflow

To request an account, the user will be taken to the Account Request form. On this page, the user must enter the following information:

- Name

- Organization
- Email address
- Phone number

After the user completes the information and submits the form, the information will be stored in the Account request database. The NCDB administrator will be notified of the request by email. When the request is approved or denied, the user will receive email notification. Figure 3 illustrates the NCDB account request workflow.

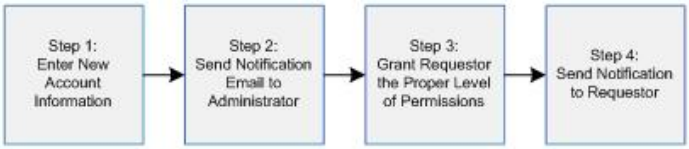


Figure 3. Account request workflow

5.1.2.3. Search workflow

When the user submits a search request, the NCDB will query its metadata service and return a brief description of all located datasets. Before displaying this list, the search engine will verify whether each source is still valid. Valid datasets will be added to the results list; for each invalid dataset, an email will be sent to the NCDB administrator. When the validation process is complete, the results will be displayed on the Results page. Figure 4 illustrates the NCDB search workflow.

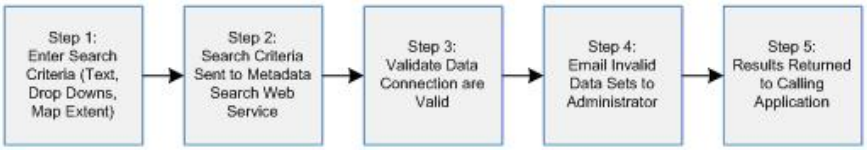


Figure 4. Search workflow

5.1.2.4. Packaging workflow

When the user chooses to package the selected data, the NCDB will perform a size check to determine the appropriate delivery method for each dataset. The user will receive an email notification with the packaging results.

Figure 5 illustrates the NCDB packaging workflow.

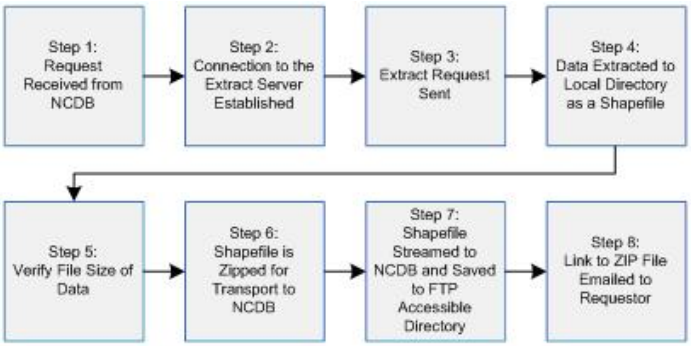


Figure 5. Packaging workflow

5.2. SBAS TOOLSET

The SBAS toolset includes two individual tools that will be added to the SBAS-A toolbar (the Area of Interest tool and the NCDB Search tool) and a template US map document that can be used to select the desired search location.

The toolset will be designed to help the user retrieve data from the NCDB for use in the SBAS tool. The SBAS toolset's built-in logic will allow the user to use the SBAS tool by simply specifying a geographic location. The toolset will automatically search for data from the five necessary dataset categories and return a list of datasets for each. The user can then choose one dataset from each of the returned dataset categories to use in the calculation.

Additionally, once the user has loaded the requested data in the map, the toolset will enable the user to save that data on a local machine. It will adjust the map document data pointers to point to the data on the local machine.

These tools will work in conjunction with the current SBAS tools; they will not replace or change any existing functionality.

5.2.1. Area of Interest Tool

The Area of Interest (AOI) tool will allow the user to draw a rectangular extent on the US map to indicate a geographic location for the NCDB search. If necessary, the extent coordinates will be converted to the coordinate system of the NCDB.

5.2.2. NCDB Search Tool

The NCDB Search tool will automatically build a query to retrieve datasets for the specified AOI. As part of this process, the search tool will prompt the user for a username and password to authenticate

with the NCDB site. If a login error occurs, the user will be notified and the search will end.

Once the user is successfully authenticated, the search tool will query the NCDB and return a list of datasets for areas within or intersected by the AOI. The returned datasets will be displayed in a form, grouped logically by dataset category. The user will select one dataset from each dataset category and request it to be transferred to an FTP site for download.

5.3. DATA LOADING WORKFLOW

The NCDB will use four basic loading strategies. The first three are relevant for organizations internal or external to the COE that wish to fully participate in the NCDB. The final strategy is relevant for organizations entirely outside of the COE that wish to publish their metadata documents in the NCDB, but do not wish to install any NCDB-related software.

5.3.1. Average District Office

The first strategy focuses on the needs of an average district office. For the purposes of this document, the average office is defined as an office which does not have an ArcSDE or ArcIMS server, but does have data to be included in the NCDB website.

Users at the average district office will use a specialized web application to post metadata and transfer related data to the NCDB. This application, the Data Loader Request Application, will be a wizard-driven web application that guides the users through the steps necessary to load data from a remote office to the NCDB ArcSDE and ArcIMS metadata servers in Mobile.

Before loading spatial data, the wizard will verify the following items at a minimum:

- The data that is requested to be loaded has been verified against the destination feature class in a field-by-field, type-by-type, and size-by-size comparison to ensure that it can be successfully loaded into ArcSDE.

- A valid metadata document, with all required fields filled in, exists and can be published to the NCDB metadata server.

If there is an associated layer file, the wizard will prompt the user for it at this time. Please note that it is not necessary to post a layer file for each set of data that is loaded; however, posting without a layer file may affect how the data can be used by NCDB users.

Once the data has been loaded and is available to be searched in the NCDB, an email notification will be sent to the user who loaded the data, as well as other identified administrative individuals.

5.3.2. Advanced District Office

The second strategy focuses on the data loading needs of a more advanced district office. For the purposes of this document, an advanced office is defined as an office that has both an ArcIMS and an ArcSDE server in their environment.

Users at the advanced district offices will use the same specialized web application, the Data Loader Request Application, to post metadata to the NCDB. However, in this situation, the users will post metadata documents to the NCDB metadata server in Mobile and load data to their local ArcSDE server.

Before loading spatial data, the wizard will verify the following items at a minimum:

- The data that is requested to be loaded has been verified against the destination feature class in a field-by-field, type-by-type, and size-by-size comparison to ensure that it can be successfully loaded into ArcSDE.

- A valid metadata document, with all required fields filled in, exists and can be published to the NCDB metadata server.

If there is an associated layer file, the wizard will prompt the user for it at this time. Please note that it is not necessary to post a layer file for each set of data that is loaded; however, posting without a layer file may affect how the data can be used by NCDB users.

Once the data has been loaded and is available to be searched in the NCDB, an email notification will be sent to the user who loaded the data, as well as other identified administrative individuals.

5.3.3. Super User District Office

The third strategy focuses on the data loading needs of the most advanced district offices, known as the super user offices. For the purposes of this document, a super user office is defined as an office which has both an ArcIMS and an ArcSDE server in their environment, as well as one or more full-time ArcSDE administrators who will be responsible for loading data in to the ArcSDE database.

Users at the super user district offices will use the same specialized web application, the Data Loader Request Application, to post metadata to the NCDB. However, in this situation, the users will generate a request to have data posted to their local ArcSDE

database. The users will use the same wizard-driven web application to specify their metadata document, data, and any other related files that are necessary to access the data (such as layer files). This request will be sent to a geodatabase keeper who will be responsible for loading the data into the production geodatabase and notifying the users that the load has occurred. Once the data has been loaded and the notification sent, the application will post the metadata and other related files to the NCDB website in Mobile.

Before loading spatial data, the wizard will verify the following items at a minimum:

- The data that is requested to be loaded has been verified against the destination feature class in a field-by-field, type-by-type, and size-by-size comparison to ensure that it can be successfully loaded into ArcSDE.

- A valid metadata document, with all required fields filled in, exists and can be published to the NCDB metadata server.

If there is an associated layer file, the wizard will prompt the user for it at this time. Please note that it is not necessary to post a layer file for each set of data that is loaded; however, posting without a layer file may affect how the data can be used by NCDB users.

Once the data has been loaded in the local ArcSDE database and the metadata has been published to the NCDB in Mobile, an email notification will be sent to the user who requested the data load, as well as other identified administrative individuals. If the geodatabase keeper has trouble loading the data or decides that the data should not be loaded, he/she will respond to the request by denying the load. The geodatabase keeper will provide an explanation, and an email response will be sent automatically to the requesting user.

5.3.4. Non-USACE Organizations

The final strategy meets the needs of all organizations that want to have their metadata hosted on the NCDB but do not want to install any of the NCDB web services on local machines.

In this situation, a metadata harvesting process will be established between USACE and the outside agency. Through this process, the metadata documents of the agency will be placed in a common and accessible location. On a scheduled basis, the NCDB will run an MDImport command, along with any other necessary batch processes, to connect to the remote metadata files and import them directly into the NCDB ArcSDE database.

5.3.5. Data Loading Support Components

The data loading workflows described above will rely on the following three components to perform the necessary work for loading metadata and data and enforcing proper workflow and notifications.

5.3.5.1. Data Loader Request Application

The Data Loader Request Application (DLRA) is the heart of the data loading process. Built as a wizard-driven web application, its primary purpose will be to guide users through the process of posting data and metadata to the NCDB. Its secondary purpose will be to serve as a notification system that emails appropriate personnel when certain events happen.

Figure 6 represents the standard workflow for the DLRA.

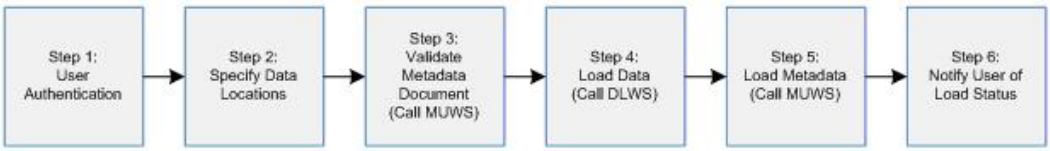


Figure 6. DLRA workflow

5.3.5.2. Data Loader Web Service

The Data Loader Web Service (DLWS) is a common set of functions hosted in the Mobile office that focuses on loading data into ArcSDE. The primary function of the DLWS will be to verify that the data to be loaded into ArcSDE matches the feature class that it is being loaded into. If the data is valid, it will be loaded into the specified feature class, and an appropriate response will be sent to the requesting application.

The DLWS will be implemented as a web service to ensure that it is entirely disconnected from the DLRA. Loosely coupling these components will ensure that updates to either will not affect the other, therefore building stability into the NCDB.

Figure 7 illustrates the workflow carried out in the DLWS.

Figure 7. DLWS workflow

5.3.5.3. Metadata Updater Web Service

The Metadata Updater Web Service (MUWS) will be responsible for adding new metadata and updating existing metadata.

When the MUWS receives a request to add new metadata, it will perform the following actions:

1. Verify that all required fields of the metadata document are populated.

2. Verify that the theme fields contain values that are valid to the NCDB website.

3. Verify that the data is accessible at the location specified in the metadata document.

4. Load the metadata document into the NCDB metadata server.

Once the metadata has been successfully or unsuccessfully loaded, the MUWS will return an appropriate response to the calling application.

Figure 8 represents the workflow of the MUWS.

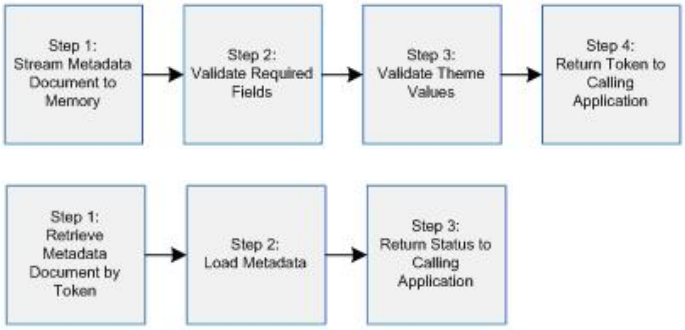


Figure 8. MUWS workflow

6. TESTING

Woolpert will work with USACE to develop testing procedures that simulate how the National Coastal Databank will be used. These procedures will be incorporated into a testing matrix that developers will use as a "script" to perform testing. Woolpert will be responsible for testing the resulting application.

An objective of Woolpert testing will be to provide the client with the completed test matrix that documents the results of all testing procedures.

Woolpert developers are expected to perform the testing procedures and provide feedback to development staff when necessary. This will occur multiple times throughout development as one of many means to make sure the National Coastal Databank is meeting its goal. Such feedback notes will be made available to the USACE Mobile District Spatial Data Branch staff upon request.

A testing matrix is created and used to track the results of the testing procedures. The purpose of this test matrix is to trap conditions that would otherwise cause the application to "crash" or seriously malfunction. This technique is commonly referred to as "error trapping." As such, the goal is to minimize the occurrences of critical failures within the application throughout its use.

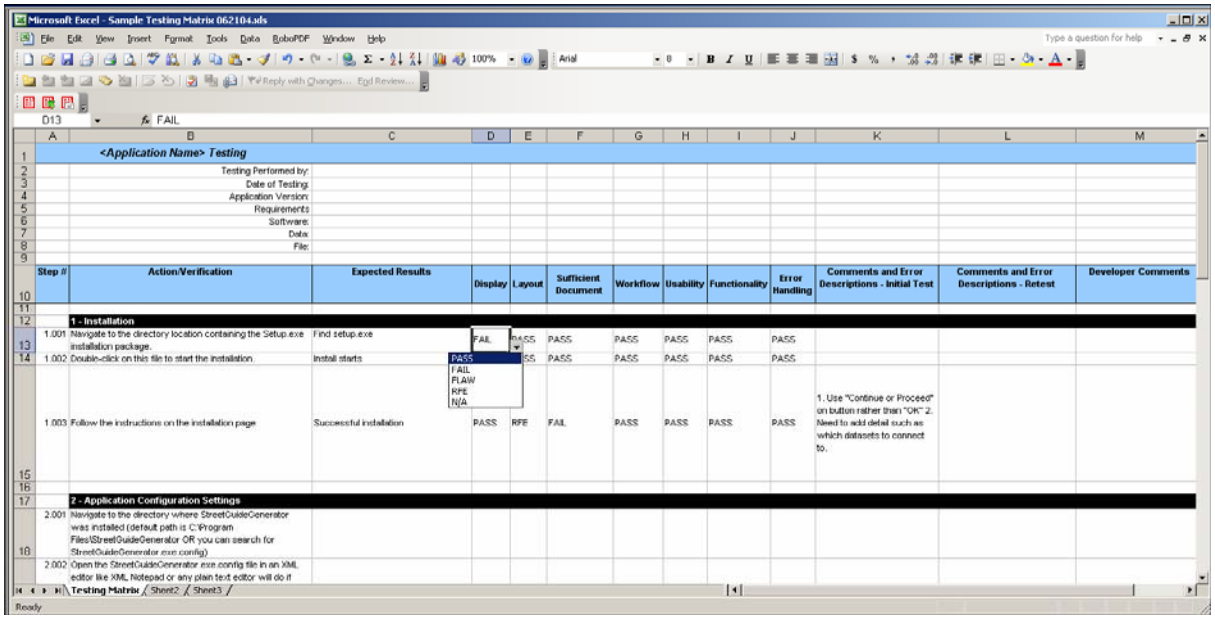
During testing, the user will record in each cell the results of that test. Table 3 lists the codes that will be used and their descriptions.

Table 3. Matrix Test Result Codes

Code	Description
Pass	The function and condition meet the requirements of the system. In some cases, an appropriate error message explaining the nature of the problem and what corrective action needs to be taken to avoid the error in the future constitute a passing grade.
Fail	This is a critical failure and is the type of result that renders the application or website useless. Results of these types of failures include lost or damaged data or application lockup. The application may require a restart, or the PC may need to be rebooted.
Flaw	A functional flaw is not a work stoppage problem; however, this type of result is what happens when a tool does not do as described in the SDRS. Certain conditions are not met or handled correctly.
RFE	An error was not encountered—the application or tool worked as intended. However, a tester noted an area of improvement (for example, a spelling error on a screen). These improvements enhance the interface or the workflow.
N/A	Not applicable.

Upon completion of the test execution, the test matrices from all testers are combined, condensed, and summarized by the system engineer. The results of the test are then provided to the development team for remediation.

Figure 9 illustrates a sample test matrix.



Microsoft Excel - Sample Testing Matrix 062104.xls

<*Application Name*> Testing

Testing Performed by:
Date of Testing:
Application Version:
Requirements:
Software:
Data:
File:

Step #	Action/Verification	Expected Results	Display	Layout	Sufficient Document	Workflow	Usability	Functionality	Error Handling	Comments and Error Descriptions - Initial Test	Comments and Error Descriptions - Retest	Developer Comments
	1 - Installation											
1.001	Navigate to the directory location containing the Setup.exe installation package.	Find setup.exe	FAIL	PASS	PASS	PASS	PASS	PASS	PASS			
1.002	Double-click on this file to start the installation.	Install starts	PASS	PASS	PASS	PASS	PASS	PASS	PASS			
1.003	Follow the instructions on the installation page	Successful installation	PASS	RFE	FAIL	PASS	PASS	PASS	PASS	1. Use "Continue or Proceed" on button rather than "OK" 2. Need to add detail such as which datasets to connect to.		
	2 - Application Configuration Settings											
2.001	Navigate to the directory where StreetGuideGenerator was installed (default path is C:\Program Files\StreetGuideGenerator OR you can search for StreetGuideGenerator.exe.config)											
2.002	Open the StreetGuideGenerator.exe.config file in an XML editor like XML Notepad or any plain text editor will do if											

Figure 9. Testing Matrix

7. EXPECTED DELIVERABLES

Deliverables that Woolpert intends to provide USACE Mobile District Spatial Data Branch include the following:

- The final Full Implementation Software Design and Requirements Specification document
- Workflow diagrams

GLOSSARY

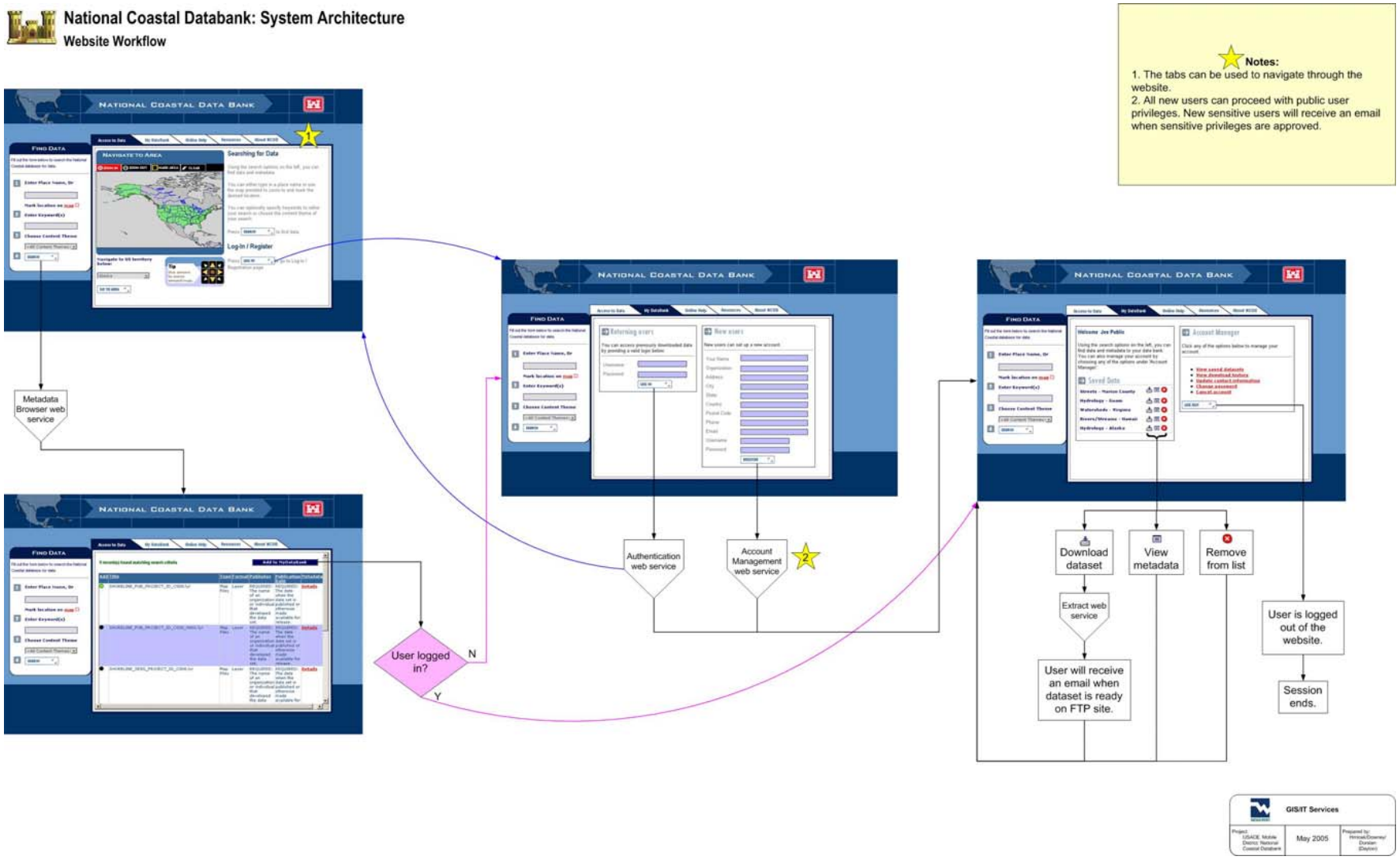
Table 4. Glossary

Term	Definition
Architecture	The internal design of an application or software package; the way its components are organized and integrated.
ArcIMS	ESRI's GIS solution to centrally build and deliver maps, data, and tools over the Internet or an intranet.
ArcInfo	ESRI's full-feature GIS software.
ArcMap	ArcMap is ESRI's desktop application for all map-based tasks including cartography, map analysis, and editing.
ArcView	ESRI's desktop GIS software.
ArcXML	Acronym. Stands for Arc Extensible Markup Language. This is a file format that provides a structured method of communication between all ArcIMS components. ArcXML defines content for services. It is used for requests and responses between clients, the business logic tier, and servers.
ASP	Acronym. Active Server Pages. Microsoft's technology for server-side scripting of web sites.
AXL	Acronym. Stands for ArcXML or an ArcXML file.
DHTML	Acronym. Stands for Dynamic HTML
DLL	Acronym. Stands for Dynamic Link Library. This is a file that is required by Windows programs to extend an application's functionality and to perform tasks.
ESRI	Acronym. Environmental Systems Research Institute, Inc.
GIS	Acronym. Geographic Information Systems
Host	A computer connected to a TCP/IP network, including the Internet. Each host has a unique IP address.
Hostname	The unique name given to a computer on a network.
HTML	Acronym. HyperText Markup Language. HTML is used to describe how web pages should be displayed by a web browser. Each browser implements the display of pages in its own fashion.
HTTP	Acronym. Stands for Hyper Text Transfer Protocol. This is a set of standards used by computers to transfer hypertext files or web pages over the Internet.
IIS	Acronym. Stands for Internet Information Server. This is a web server program that comes on Windows computers and is distributed by Microsoft.
IMS	Acronym. Internet Mapping System.
IP Address	A group of four numbers that is separated by periods. This number is used to identify a computer connected to a TCP/IP network or the Internet. An example of an IP address is 192.168.255.255.
Javascript	A scripting language used in Web pages.
Oracle	The name of a relationship database management system.
RDBMS	Acronym. Relational Database Management System
SDE	Acronym. Spatial Database Engine. ESRI's engine for storing and retrieving geographic data in an RDBMS.
TCP/IP	Acronym. Stands for Transmission Control Protocol/Internet Protocol. This governs how computers communicate on the Internet.
UML	Acronym. Unified Modeling Language.
Use Case	UML constructs representing distinct interaction between the application and external actors such as users of the system.
VB	Acronym. Stands for Visual Basic. Visual Basic is a programming

Table 4. Glossary

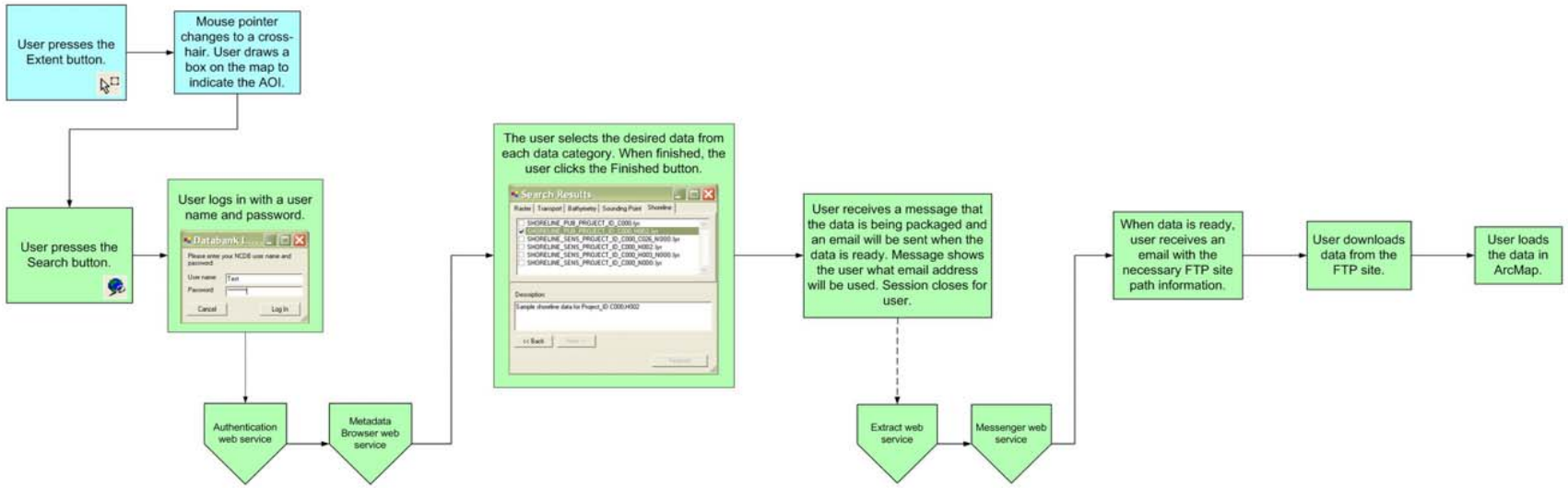
Term	Definition
	language and environment that is published by Microsoft.
VBA	Acronym. Stands for Visual Basic for Applications. This is a component of Visual Basic that is embedded in many applications so that commercial-off-the-shelf applications can be customized.
Web server	Software providing HTML pages on the World Wide Web or the hardware on which such software runs.
XML	Acronym. Extended Markup Language

WORKFLOW DIAGRAMS



National Coastal Databank: System Architecture

SBAS User Workflow

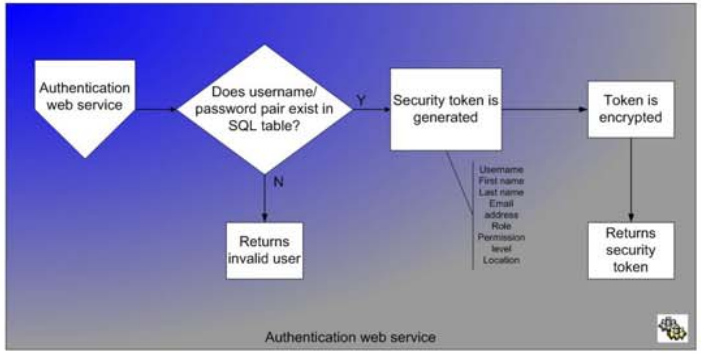


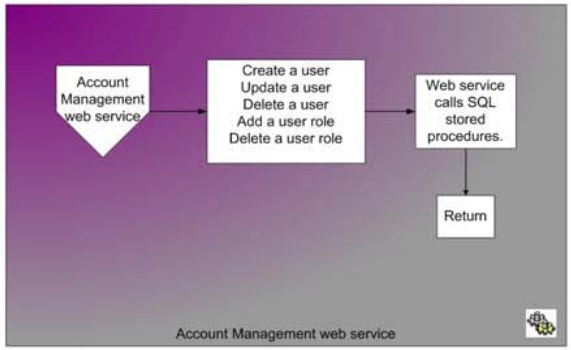
GIS/IT Services

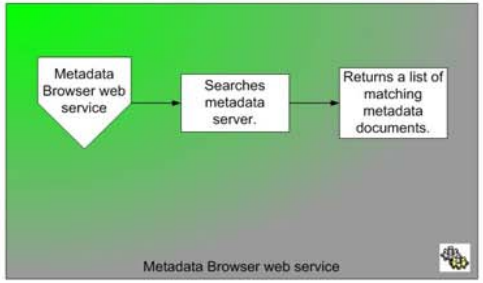
Project: USACE, Mobile District: National Coastal Databank	May 2005	Prepared by: Hencale/Downey/ Duncan (Dayton)

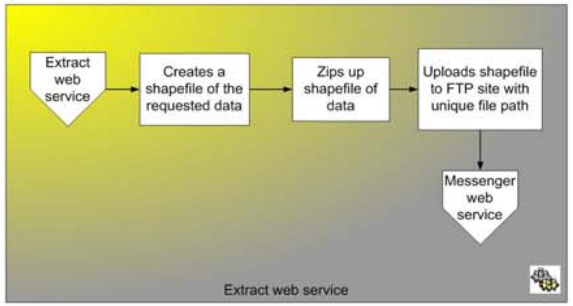
National Coastal Databank: System Architecture

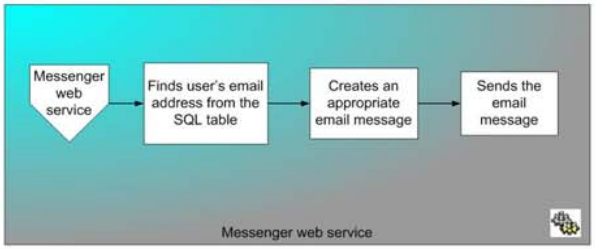
Web Service Workflows









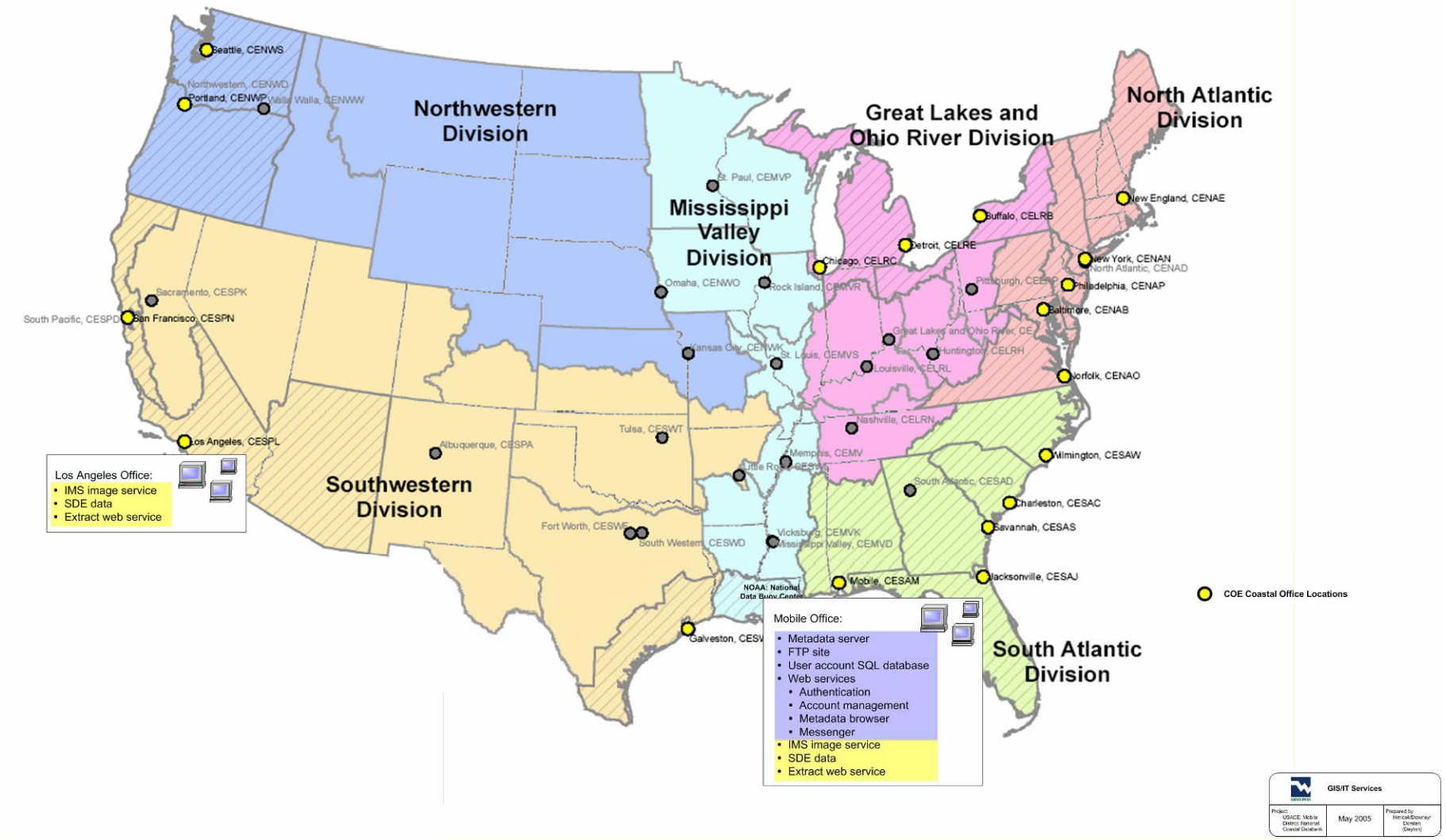


GIS/IT Services

Project: USACE Mobile District National Coastal Databank	May 2005	Prepared by: Hrncarik/Downey/ Dunlap (Dayton)

National Coastal Databank: System Architecture

Component Summary



APPLICATION CHANGE CONTROL FORM

Application Change Control Form			
Work Order No.		Change No.	
Project Name			
Revision:			
Impact on Budget:			
Impact on Schedule:			

APPENDIX B—NCDB CONNECTOR TOOLSET USER GUIDE

The National Coastal Databank (NCDB) Connector Toolset is an extension in ArcMap that allows you to search for NCDB data. It has two buttons, shown below. Follow these instructions to search for NCDB data.

1. Click the **Define NCDB search extent** tool.

2. On the map, click and drag a box around the area in which you want to search. A red box appears on the map.

   Note: *To clear the box, click anywhere on the map.*

3. Click the **Search for NCDB data** tool. The Databank Login window appears.

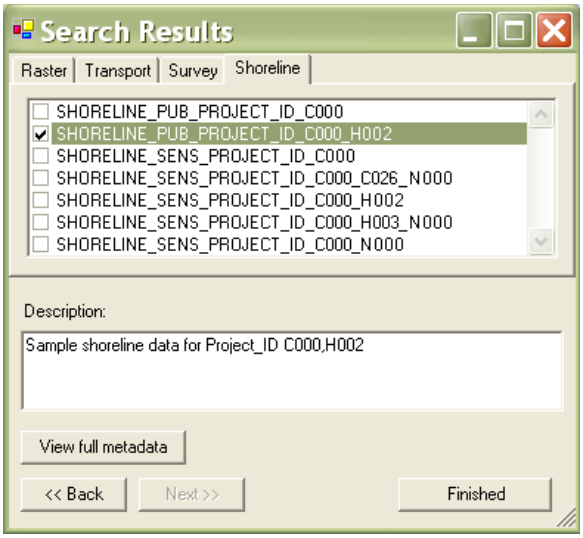
4. Enter your NCDB user name and password. Click **Log In.**

   The Search Results window, shown to the right, appears. It displays all metadata documents in four categories (Raster, Transport, Survey, and Shoreline) within the defined geographic extent.

   - To see a brief description of a file, click its file name. The descriptions displays in the Description box.

   - To view a file's metadata, click **View full metadata.**

     Note: *The metadata opens as an XML file in the application associated with XML on your computer (for example, Internet Explorer or Notepad).*



5. Check the box next to a file to select it. Click **Next** and **Back** to move among the tabs.

   Note: *You can select only one file per tab. However, you do not need to select a file on every tab.*

6. When you are done selecting files, click **Finished.** A message appears notifying you that the data has been requested. The logged in user will receive an email with a link to an FTP site where the data can be download.

APPENDIX C—CREATING AND PUBLISHING METADATA FOR THE NCDB

The search and retrieval functions of the National Coastal Databank (NCDB) rely on metadata published in an ArcIMS metadata service. Any data intended to be served through the NCDB must be accompanied by a metadata document that follows the requirements set forth in this document. Following these requirements, in addition to the standards detailed in the Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM), will result in FGDC-compliant metadata that can be used by the NCDB applications and tools. FGDC standards outline FGDC elements and also allow for additional elements—in this case elements from ESRI and custom elements created for the NCDB.

The metadata elements listed in the following NCDB Metadata Requirements table represent the elements that will be specifically used by the NCDB application and tools. Additional FGDC elements required for FGDC compliance are detailed in the FGDC CSDGM.

NCDB METADATA REQUIREMENTS

Extended Element Name	Definition	Rationale/NCDB requirements	Source	Type	Domain	Short Name	Node path
Abstract	A brief narrative summary of the data set.	Abstract information is used by NCDB for display purposes.	FGDC 1.2.1	Text	Free text	abstract	metadata/idinfo/descript/ abstract
Purpose	A summary of the intentions with which the data set was developed.	Purpose information is used by NCDB for display purposes.	FGDC 1.2.2	Text	Free text	purpose	metadata/idinfo/descript/ purpose
West Bounding Coordinate	Western-most coordinate of the limit of coverage expressed in longitude.	Bounding coordinates are used by NCDB to allow the user to search a defined geographic area for relevant metadata.	FGDC 1.5.1.1	Real	-180.0 <= West Bounding Coordinate <= 180.0	westbc	metadata/idinfo/spdom/ bounding/westbc
East Bounding Coordinate	Eastern-most coordinate of the limit of coverage expressed in longitude.	Bounding coordinates are used by NCDB to allow the user to search a defined geographic area for relevant metadata.	FGDC 1.5.1.2	Real	-180.0 <= East Bounding Coordinate <= 180.0	eastbc	metadata/idinfo/spdom/ bounding/eastbc
North Bounding Coordinate	Northern-most coordinate of the limit of coverage expressed in latitude.	Bounding coordinates are used by NCDB to allow the user to search a defined geographic area for relevant metadata.	FGDC 1.5.1.3	Real	-90.0 <= North Bounding Coordinate <= 90.0; North Bounding Coordinate >= South Bounding Coordinate	northbc	metadata/idinfo/spdom/ bounding/northbc
South Bounding Coordinate	Southern-most coordinate of the limit of coverage expressed in latitude.	Bounding coordinates are used by NCDB to allow the user to search a defined geographic area for relevant metadata.	FGDC 1.5.1.4	Real	-90.0 <= South Bounding Coordinate <= 90.0; South Bounding Coordinate <= North Bounding Coordinate	southbc	metadata/idinfo/spdom/ bounding/southbc
Theme Keyword	Common-use word or phrase used to describe the subject of the data set.	Theme keywords are used by the NCDB website to allow users to search by content type. They are also used by the NCDB Connector toolset for ArcMap to allow users to search by content type.	FGDC 1.6.1.2	Text	Free text	themekey	metadata/idinfo/keywords/ theme/themekey
Place Keyword	The geographic name of a location covered by a data set.	Place keywords are used by the NCDB website to allow users to search by place keyword.	FGDC 1.6.2.2	Text	Free text	placekey	metadata/idinfo/keywords/ place/placekey

Originator	The name of an organization or individual that developed the data set. If the name of editors or compilers are provided, the name must be followed by "(ed.)" or "(comp.)" respectively.	Originator information is used by NCDB for display purposes.	FGDC 8.1	Text	"Unknown" free text	origin	metadata/idinfo/citation/ citeinfo/origin
Publication Date	The date when the data set is published or otherwise made available for release.	Publication date information is used by NCDB for display purposes.	FGDC 8.3	Date	"Unknown" "Unpublished material" free date	pubtime	metadata/idinfo/citation/ citeinfo/pubdate
Title	The name by which the data set is known.	Title information is used by NCDB for display purposes.	FGDC 8.4	Text	Free text	title	metadata/idinfo/citation/ citeinfo/title
File or Table Name	The name of the item. For example, the name of a shapefile or a feature class in a geodatabase.	The name of the file or the geodatabase item is different from its formal, descriptive title.	ESRI	Text	Free text	ftname	metadata/idinfo/citation/ citeinfo/ftname
Online Linkage	The name of an online computer resource that contains the data set. Entries should follow the Uniform Resource Locator convention of the Internet. For items stored in an ArcSDE geodatabase, connection information shall be recorded in the form "Server=ServerName; Service=ServiceName; Database=DatabaseName; User=UserName; Version=VersionName". For Lidar data, database connection information shall be recorded in the form "Server=ServerName\Instance; Database=DatabaseName".	Per the CSDGM, the online linkage will be used to indicate the URL of the host agency for data that are not available for download from the NCDB website. The user would then be able to go to the host agency's website to search for the data. Per the ESRI Profile of the CSDGM, the online linkage will contain ArcSDE connection information for data that are stored in an ArcSDE geodatabase; NCDB tools will use this in the case of raster images which are stored in ArcSDE. Per the NCDB standard, in the case of Lidar data, the online linkage will contain SQL (not SDE) connection information to the SQL table holding Lidar information.	FGDC 8.10, ESRI and USACE	Text	Free text	onlink	metadata/idinfo/citation/ citeinfo/onlink
NCDB Security Classification	NCDB Security classification.	Public data will be available to the general public. Users with sensitive-level user accounts will be able to search for and retrieve Sensitive data as well as Public data.	USACE	Text	"Public" "Sensitive"	NcdbSec	metadata/Ncdb/NcdbSec
NCDB Server	The name of the server on which the data resides.	The name of the server is necessary for data retrieval.	USACE	Text	Free text	NcdbServ	metadata/Ncdb/NcdbServ
NCDB Data Format	Format of the data according to NCDB format categories.	Format category information will be used to determine the necessary data extract and transfer method. File data includes all data which is not being stored within SDE, such as text documents, shapefiles, or imagery.	USACE	Text	"SDE feature class" "SDE raster" "File" "Lidar"	NcdbForm	metadata/Ncdb/NcdbForm

NCDB File Name	Name of the data file with file type extension.	The name and extension of the file will be used for transferring file-based data. This element is required if NCDB Data Format is "File".	**USACE**	Text	Free text	NcdbFile	metadata/Ncdb/NcdbFile
NCDB Image Service Layer Name	The fully qualified view name, in the case of data sets in the form of views or of layer files that have been created from views, or the fully qualified feature class name.	The feature class or view name is used during feature extraction.	**USACE**	Text	"Not applicable" Free text	NcdbImgSvLyr	metadata/Ncdb/NcdbImgSvLyr
NCDB Data Filter	The definition query that was used on a table, feature class or view to produce the data set.	The definition query is used during feature and Lidar extraction.	**USACE**	Text	"Not applicable" Free text	NcdbFilt	metadata/Ncdb/NcdbFilt
NCDB Geometry type	For feature data, the geometry type.	Geometry information will be used to determine geoprocessing options.	**USACE**	Text	"Point" "Line" "Polygon" "Not applicable"	NcdbGeom	metadata/Ncdb/NcdbGeom

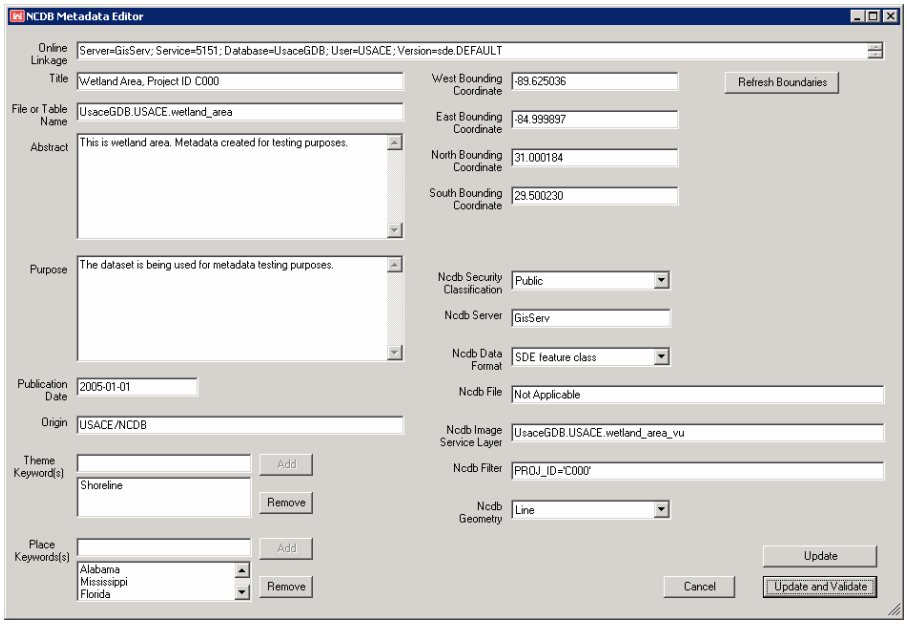
CREATING AND EDITING METADATA

Required elements

ArcCatalog can be used to create metadata for any data, whether it be an ArcSDE feature class, a layer file created in ArcMap, a text document, etc. To determine if metadata exists for a specific object, first click on that object in the ArcCatalog table of contents. Then click the Metadata tab. If metadata has been created, you will see it displayed. Otherwise, you will see a message telling you that metadata has not been created for the selected object. To create metadata, click the Create/Update Metadata button on the metadata toolbar.

Note: If you cannot view the file type you need in ArcCatalog, see the ArcCatalog help topic “Working with file types” for instructions on how to configure ArcCatalog to meet your needs.

Once you have established metadata, the FGDC elements can be edited using the ArcCatalog metadata editor. However, the NCDB elements are not created by ArcCatalog and are not recognized by the metadata editor. These elements must be created and edited using software capable of editing XML documents, or using the prototype NCDB Metadata Editor tool developed for ArcCatalog.



Once the metadata has been edited to match the standards outlined in the NCDB Metadata Requirements table, it is ready to be published. A sample XML document containing only the elements listed in this table is shown below.

```
<?xml version="1.0"?>
<metadata xml:lang="en">
  <Ncdb>
    <NcdbSec>Required: Security classification. Domain: "Public" "Sensitive"</NcdbSec>
    <NcdbServ>Required: Name of the server on which the data resides.</NcdbServ>
    <NcdbForm>Required: Information describing data format. Domain: "SDE feature class" "SDE
raster" "File" "Lidar"</NcdbForm>
    <NcdbFile>Required if NcdbForm is "File": File path and extension for file data.</NcdbFile>
    <NcdbImgSvLyr>Required if NcdbForm is "SDE feature class"</NcdbImgSvLyr>
    <NcdbFilt>Required if applicable: Definition query used in layer files or views. </NcdbFilt>
```

```
    <NcdbGeom>Required if NcdbForm is "SDE feature class". Domain: "Point" "Line" "Polygon" "Not
applicable"</NcdbGeom>
  </Ncdb>
  <idinfo>
    <descript>
      <abstract>Required: A brief narrative summary of the data set.</abstract>
      <purpose>Required: A summary of the intentions with which the data set was
developed.</purpose>
    </descript>
    <citation>
      <citeinfo>
        <origin>Required: Name of the organization or individual that developed the
dataset.</origin>
        <pubdate>Required: The date when the data set is published or otherwise made available
for release.</pubdate>
        <title>Required: The name by which the data set is known.</title>
        <ftname>Required: The name of the item. For example, the name of a shapefile or a feature
class in a geodatabase.</ftname>
        <onlink>Required: The name of an online computer resource that contains the data set, in
the case of data not available through NCDB; or ArcSDE connection information, in the case of SDE
raster data available through NCDB; or SQL connection information, in the case of Lidar
data.</onlink>
      </citeinfo>
    </citation>
    <spdom>
      <bounding>
        <westbc>Required: Western-most coordinate of the limit of coverage.</westbc>
        <eastbc>Required: Eastern-most coordinate of the limit of coverage.</eastbc>
        <northbc>Required: Northern-most coordinate of the limit of coverage.</northbc>
        <southbc>Required: Southern-most coordinate of the limit of coverage.</southbc>
      </bounding>
    </spdom>
    <keywords>
      <theme>
        <themekey>Word or phrase used to describe the subject of the data set.</themekey>
      </theme>
      <place>
        <placekey>Geographic name of a location covered by the data set.</placekey>
      </place>
    </keywords>
  </idinfo>
</metadata>
```


Spatial extent and layer files

It is anticipated that much of the USACE's data will be made available through ArcSDE. When creating metadata for ArcSDE datasets, it is important *not* to publish metadata documents for the feature classes directly, otherwise the data extent will contain the entire extent of the ArcSDE Feature class. Rather, it is recommended that the Corps continues to use ArcGIS layer files for project-specific filtering of datasets. The layer file will point to an ArcSDE layer as its data source and it will contain a definition query, which will limit the data that is accessible to that of a specific project ID, survey ID, or other attributes. With the layer file established, the metadata document should be created for that specific layer file. In this way, the collection information, owner, extent, and other metadata elements for the project or survey can match the specific records returned by the definition query. This is very important for the spatial search capabilities of the NCDB system.

ArcCatalog does not use the bounding extent from the definition query result set when it creates metadata, which can lead to bogus results from spatial data searches. The bounding coordinate elements must be manually manipulated to match the extent of the data prescribed by the definition query. This can be done through ArcMap, though the process can be tedious. The NCDB Metadata Editor tool allows users to update the spatial extent to match the definition query without leaving ArcCatalog.

NCDB DATA FORMATS

How each metadata document should be completed will depend largely on the NCDB data format. A brief description of each format explains its specific metadata needs.

SDE feature class

Metadata for data stored in an SDE feature class can be created using various approaches—directly from the feature class, from a layer created from the feature class, or from a layer created from a view of the feature class.

To create metadata directly from a feature class, fill in the required elements as described in the requirements table, keeping in mind the following:

- The ftname element must contain the name of the feature class as it appears in SDE.
- The NcdbImgSvLyr element must contain the name of the featureclass as it appears in the configuration file for the ArcIMS extract image service that is serving the data.
- The NcdbFile and NcdbFilt elements can simply be populated with “Not applicable.”

To create metadata from a layer that points to a feature class, fill in the required elements as described in the requirements table, keeping in mind the following:

- The ftname element must contain the name of the layer file (with its extension, .lyr).
- The NcdbImgSvLyr element must contain the name of the feature class on which the layer is based, as it appears in the configuration file for the ArcIMS extract image service that is serving the data.
- The NcdbFilt element must contain the definition query of the layer.
- The bounding coordinates must be populated with coordinates that reflect the smaller extent of the data referenced in the layer, if it differs from that of the whole feature class.
- The NcdbFile element can simply be populated with “Not applicable.”

To create metadata from a layer from a view based on a feature class, fill in the required elements as described in the requirements table, keeping in mind the following:

- The ftname element must contain the name of the layer file (with its extension, .lyr).
- The NcdbImgSvLyr element must contain the name of the view on which the layer is based, as it appears in the configuration file for the ArcIMS extract image service that is serving the data.
- The NcdbFilt element must contain the definition query of the layer.
- The spatial extent must be populated with coordinates that reflect the smaller extent of the data referenced in the layer, if it differs from that of the whole feature class.
- The NcdbFile element can be populated with “Not applicable.”

When SDE feature data are published through ArcCatalog, is it critical to update the ArcIMS extract image service that serves those data. For more details, read the section below entitled “Adding SDE Feature Data to Extraction Image Service.”

SDE raster

ArcSDE raster data can be extracted in its entirety, if the final size is not too large for the FTP service, or in smaller extents. To extract a portion of an ArcSDE raster image, create metadata with the bounding coordinates reflecting the smaller extent.

To create metadata for raster images stored in ArcSDE, fill in the required elements as described in the requirements table, keeping in mind the following:

- The bounding coordinates may either be populated with the full extent of the image or with a smaller extent if the image is to be clipped.
- The ftname element must contain the name of the raster image as it appears in SDE.
- The onlink element must contain the ArcSDE connection information in the format “Server=ServerName; Service=ServiceName; Database=DatabaseName; User=UserName; Version=VersionName.”
- The NcdbFile, NcdbImgSvLyr, and NcdbFilt elements can be populated with “Not applicable.”

File

File-based data include shapefiles, image files which have not been loaded into SDE, text files, and any other file which resides on a network directory rather than in a database. All files with the same name but different extensions that are found in the same directory as the specified file will be zipped together; for example, all shapefile files will be zipped, as would a .tfw file that accompanies a .tif image.

There are two possibilities for the location of files. If they reside on the same server as the NCDB_File_ExtractWS, then they can be located in any directory. If they reside on a different computer, they must be in a shared directory which is accessible to the NCDB_File_ExtractWS server. The values of the NcdbFile element must be formatted accordingly, as detailed below.

To create metadata for file-based data, fill in the required elements as described in the requirements table, keeping in mind the following:

- The ftname element must contain the name and extension of the file.
- The NcdbServ element must contain the name of the server on which the file resides.
- The NcdbFile element must contain the path, filename, and extension of the file. If the file is on a different server than the NCDB_File_ExtractWS, then this will start from the shared directory, for example, “MyMetadataFiles\Shapefiles\MyShape.shp”. If the file and the web service are on the same server, then the format should be [drive]$\[folder]*[subfolder]*\[file].[extension], or for example “c$\Ncdb\MyMetadataFiles\Shapefiles\MyShape.shp.”
- The NcdbImgSvLyr, NcdbFilt, and NcdbGeom elements can be populated with “Not applicable.”

LiDAR

LiDAR datasets can be quite large, but can be served efficiently if stored in SQL tables with attributes that can be queried.

To create metadata for LiDAR data, fill in the required elements as described in the requirements table, keeping in mind the following:

- The onlink element must be formatted with connection information for the SQL database storing the data, in the format "Server=ServerName\Instance; Database=DatabaseName."
- The NcdbServ element must contain the name of the server on which the data reside.
- The ftname element must contain the name of the SQL table containing the data.
- The NcdbFilt element can be populated with the contents of the Where clause if the data in the table are to be filtered, for example "PROJECT_ID = 'C001'".
- The bounding coordinates must reflect the whole dataset, or a smaller extent reflecting only the filtered data if a Where clause is used.
- The NcdbFile, NcdbImgSvLyr, and NcdbGeom elements can be populated with "Not applicable."

Other data formats

The NCDB is designed to assist users in accessing data in other formats as well. SCRIPPS is one example—while SCRIPPS data are currently available through the NCDB website, SCRIPPS is not listed as an NCDB Data Format simply because there is no need to create metadata for it. Users will simply search by location and date, without the need for metadata. Another example is data which are not available directly through the NCDB website. In the future, outside organizations who want to have their metadata harvested by the NCDB but not have the data themselves directly available will simply need to create FGDC-compliant metadata with special attention paid to filling out the onlink element. That element should contain a URL that will guide the user to the data. None of the seven NCDB-specific custom elements need be present.

PUBLISHING METADATA

Metadata will be published to the ArcIMS metadata service using ArcCatalog. In ArcCatalog, be sure to create a connection to the ArcIMS server using a login that has privileges to publish data to the server. Once you have done this, you are ready to publish metadata. In ArcCatalog, click on the objects whose metadata you wish to publish. Drag the objects to the appropriate folder in the ArcIMS metadata service and drop them by releasing the mouse. You will then see a status window showing the progress of the publish operation.

ADDING SDE FEATURE DATA TO EXTRACTION IMAGE SERVICE

When SDE feature data are published through ArcCatalog, the ArcIMS extract image service that serves those data must be updated if it does not already contain a reference to the data. Each view or feature

class referenced will be added as one layer in the image service, regardless of how many layer (.lyr) files have been created from them.

In the .axl file describing the image service, each layer added must be edited to meet specific NCDB needs. The id attribute must be set to the same value as the name attribute for each layer, and the extract tags must be added as well, as shown in the following sample.

```
<LAYER type="featureclass" name="USACEGDB.USACE.SHORELINE_VU" visible="true"
id="USACEGDB.USACE.SHORELINE_VU">
    <DATASET name="USACEGDB.USACE.SHORELINE_VU" type="line" workspace="sde_ws-0" />
    <SIMPLERENDERER>
      <SIMPLELINESYMBOL width="1" captype="round" color="27,227,27" />
    </SIMPLERENDERER>
    <EXTENSION type="Extract">
      <EXTRACTPARAMS clip="true" />
    </EXTENSION>
      </LAYER>
```

More information on ArcXML can be found in the ArcXML Programmer’s Reference Guide, available through ESRI.

APPENDIX D—NCDB ADMINISTRATOR'S GUIDE

The NCDB website requires one or more people designated as Administrators. People fulfilling this role will be responsible for maintaining and updating the software components and supporting databases that comprise the NCDB portal. This document describes some of the tasks necessary for NCDB administration and provides background information about the NCDB website and components.

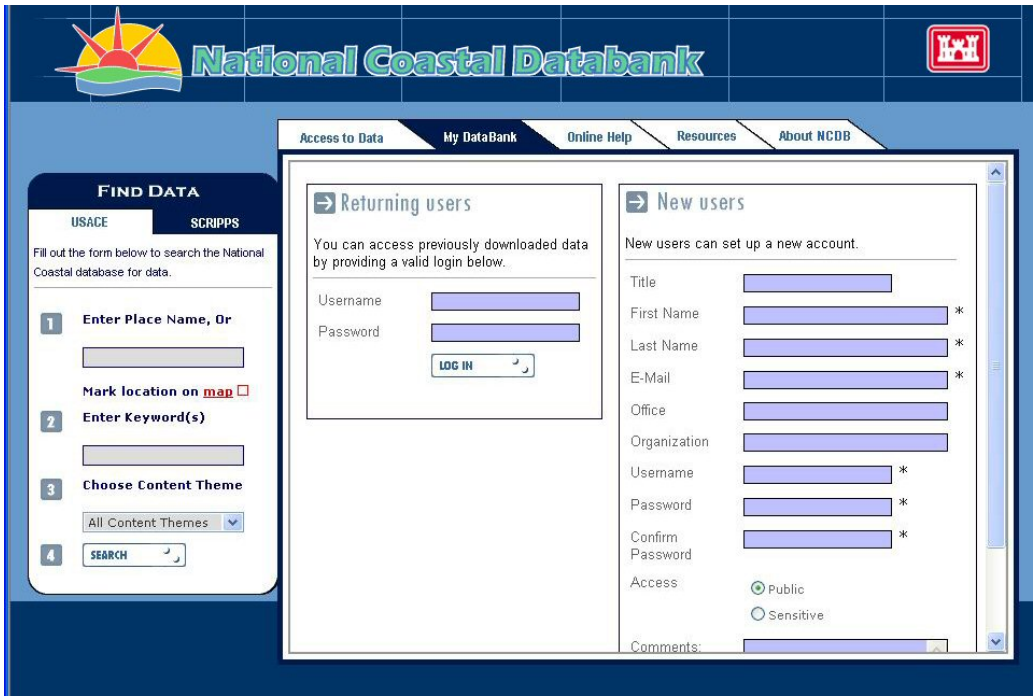
NCDB USERS DATABASE

The NCDB users database is a SQL database containing information about users—in particular, their permission levels and roles and events.

Administering NCDB users

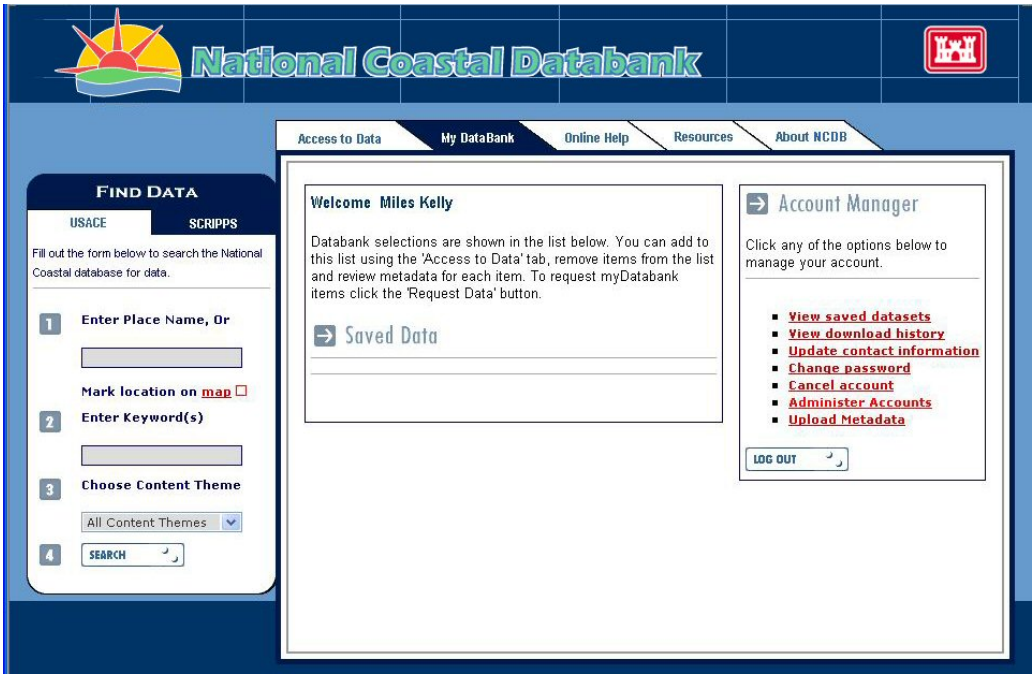
Basic user administration tasks are completed through the NCDB website interface, not directly in the database. The website uses the Account Manager web service, which in turn calls appropriate stored procedures in the database.

Any public user can use the NCDB website to browse for and view metadata without needing to log in. However, to request data, users must create an account. On the NCDB main page (shown below), new users must enter contact information to set up a new account and access the NCDB. New users are immediately given Public access, but they have the option to request Sensitive access.



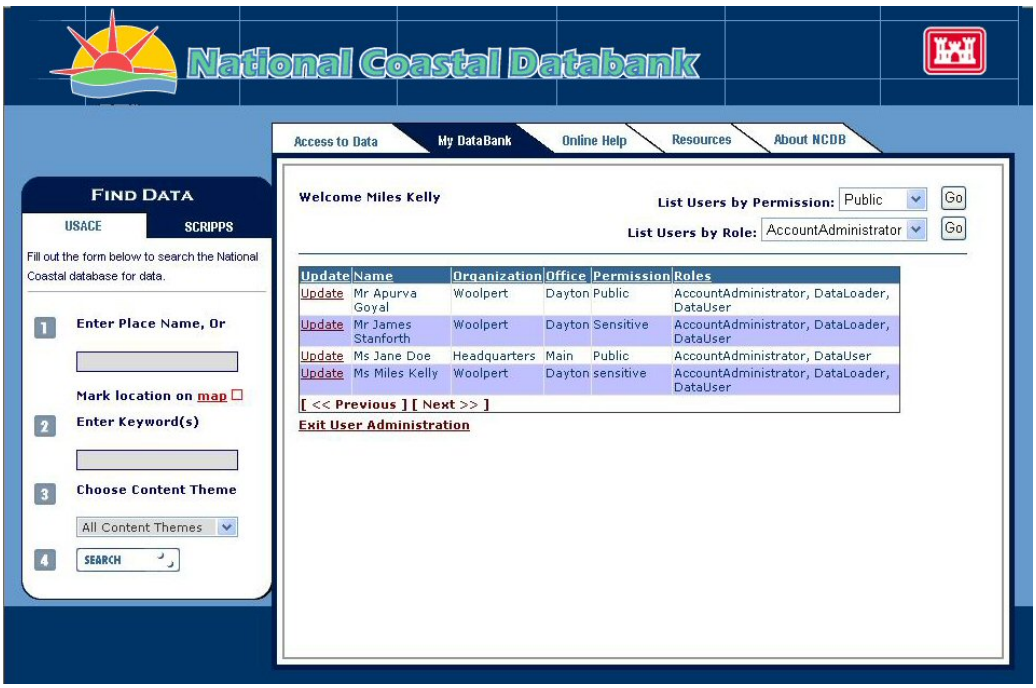
When a user requests Sensitive access, an email is sent to NCDB Administrators to review the user's information for access upgrade. The steps below describe how to upgrade users.

1. Log into the NCDB as a user that has been assigned the AccountAdministrator role. The page shown below appears.

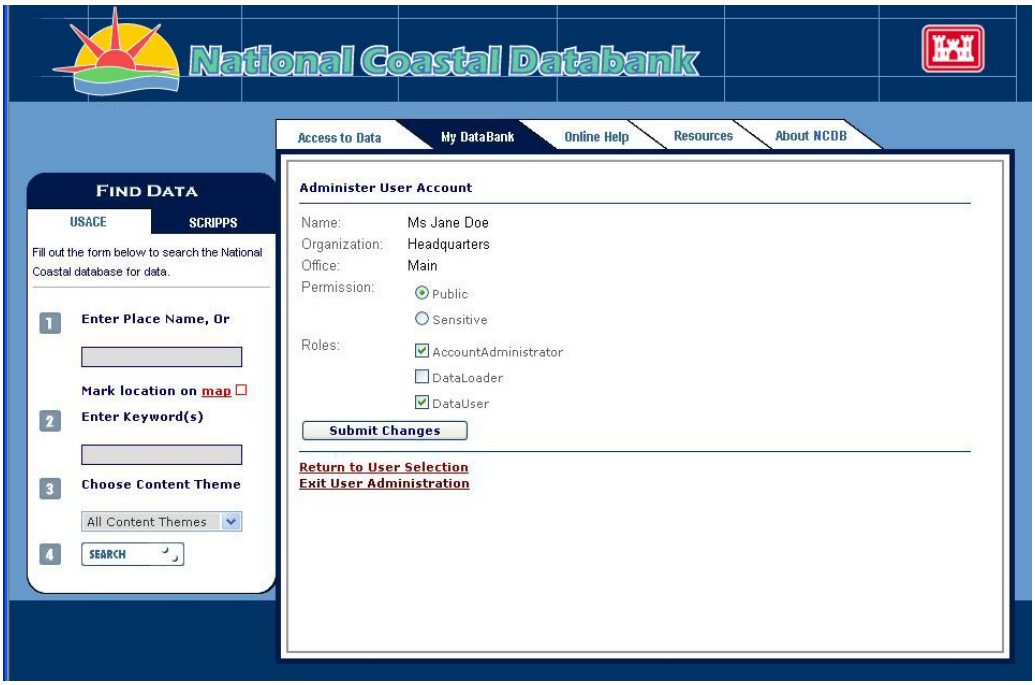


2. Under Account Manager, click **Administer Accounts.** The list users page displays.

3. From the dropdown lists, select whether to list users by permission or role. Click **Go** to search the database. A list of users displays, as shown below.



4. To update a user, click **Update** next to the username. The Administer User Account page, shown below, displays.



5. Set the user's permission level as appropriate. Check the appropriate boxes next to the user's role(s).

6. Click **Submit Changes.**

Users granted ***Public*** permission can search for metadata, browse results, add data to a personal databank, download data, and geoprocess data, but they can see only non-sensitive datasets. Those granted ***Sensitive*** permission can do everything that public access users can do, but have access to sensitive datasets.

Members of the ***DataUser*** role can browse and download data. This is the default role assigned when a new account is created.

In addition to browsing and downloading data, the ***DataLoader*** role was intended to allow a user to upload metadata for validation and publishing. As the envisioned workflow for managing metadata publication has moved away from a web interface toward the use of metadata harvesting, this role currently offers no additional functionality to the user. However, as processes for harvesting are better defined, this role may again come into play.

Members of the ***AccountAdministrator*** role are notified of website errors, can assign permissions and roles to other users, and browse, download, and publish data.

Events

The events tables are central to the Messaging components. Events are defined, such as AccountRequest, with appropriate attributes such as email subject, message body, and recipient groups. To change the subject or message body for the emails currently configured, the administrator must change the text directly in SQL.

At this time, there are a limited number of events defined. It would be possible in the future to expand the number of events and create additional user groups to leverage more power from the Messaging service and more carefully control the distribution of messages. However, without additional programming, any additional events added to the tables will not be used.

At times, the Messaging web service also sends messages to individuals. For example, when a user requests data and the data has been successfully processed, the Messaging service sends an email to the user with the appropriate FTP location, but there is no need to contact anyone else.

FTP SITE

The FTP site designated for file transfer is critical to the success of the system, and it is important to manage the FTP site correctly in order to maintain the security of sensitive data.

When files are zipped and ready to be uploaded to the ftp site, a folder with a unique, random name is created on the site. The user

receives an email with a link to this folder. Security for sensitive files that are uploaded to the FTP site must be maintained by disallowing browsing in the main folder. In this way, a user without sensitive access cannot browse for and download any sensitive datasets that a sensitive user may have requested.

While the default email message to the user suggests a time period during which files should be retrieved from the site, this limit and cleanup of the ftp site are the responsibility of the administrator. File deletion does not happen automatically. The suggested time period can be changed in the events table of the NCDB users database by the SQL administrator.

TEMPORARY FILES

Several processes require that files be temporarily written to specified directories for processing. In many cases, these files will not automatically be cleaned up. Therefore, an administrator will want to periodically check the directories specified in configuration files of certain web services, as listed below.

- **SCRIPPS web service.** Requests for SCRIPPS data will result in a text file being written to the directory specified in the NCDB.SCRIPPS.Output key of the SCRIPPS web service configuration file.

- **Raster Extract web service.** Requests for raster data, which are being stored in SDE will require that the raster be extracted as a .bsq file to the location specified in the NCDB.RasterExtract.Output key of the Raster Extract web service.

- **LiDAR Extract web service.** Requests for LiDAR data will require that a text file be created in the location specified in the NCDB.LIDAR.Output key of the LiDAR web service configuration file.

- **Geoprocessing web service.** User requests for geoprocessing data will require that each dataset be extracted to the location specified in the NCDB.Geoprocessing.OutputLocation key of the geoprocessing web service configuration file. The resulting dataset will also be written to this directory.

- **File Extract web service.** File-based data will be copied to the location specified in the NCDB.FILE.Output key of the File Extract web service configuration file before being zipped.

ERROR REPORTING

To give administrators the ability to monitor system errors, a customized and consistent method of error reporting has been incorporated into all NCDB components. When exceptions are thrown in any of the web services, the windows service, or the website code, the error message and stack trace are written to a simple text file log. The location and name of each log is specified in the configuration file of each component. This is a passive system in that administrators are not notified in any way if an entry is written to the log.

Certain errors will be actively reported to administrators via email, such as extraction errors that users experience. If a user requests feature data but the extract service had been stopped for some reason, the user would receive a simple email message stating that there had been an extract failure. The account administrators, however, would receive an email notification as well with further detail, as described in the Events section of this document.

ARCIMS SERVICES AND CONFIGURATION

Three ArcIMS services, detailed below, are critical to the NCDB functioning correctly.

Metadata service

When the metadata server component of ArcIMS is installed, it is possible to create a metadata service that holds metadata in an SDE database. Metadata roles can be configured in the ArcIMS access control list, aimsacl.xml. Note that roles established in the aimsacl.xml will affect all ArcIMS services running on that instance of ArcIMS, not just the metadata service, and therefore it is critical to ensure proper access. An example of allowing access to all other services while constraining access to metadata publishing is as follows.

```
<USER name="*" service="*" />

<USER name="publish" password="publish" services="MyMetadata"
roles="metadata_publisher" active="1" />
```

The name of the metadata service, as well as a valid user and password combination, as specified in the aimsacl.xml file, must be specified in the MetadataBrowser web service configuration file.

The aimsacl.xml file is typically kept in the servlet engine directory, along with the esrimap_prop file. The esrimap_prop file must be edited to be aware of the aimsacl.xml file. The authenticate, authMethods, and aclFileName keys must have valid values. See

ArcIMS administration documentation for further detail about managing access to services.

Extract service

The extract service allows for the extraction of feature data from a geodatabase. The extract service is an image service that points to the required feature data and includes certain extraction tags in the image service axl file. The name of the extract service must be specified in the DataExtraction web service configuration file.

Map Search Image service

An image service serving basic shapefiles is used on the NCDB website's main page to allow users to specify a geographic area in which to search for data. The name of the map search image service must be specified in the website's configuration file.

WINDOWS SERVICE AND MICROSOFT MESSAGE QUEUE

Two components that work together to form a key part of the data request and extraction service are NCDB_data_extraction, which is a Microsoft Message Queue, and NCDB_Extract_WS, which is a Microsoft Windows service.

Message queuing

Message queuing is a Windows component installed through the Add/Remove Windows Components option of the Add/Remove Programs dialog. Properties of the queue can be viewed by accessing Control Panel | Administrative Tools | Computer Management, expanding Computer Management (local), and expanding Service and Applications. The NCDB message queue will be a private queue, and its name must be referenced in the extract Windows service configuration file.

The message queue's purpose is to hold data extraction requests in order, while waiting for them to be processed. A request, in this case, refers to a selection made at one time by a user through the NCDB website, which may contain more than one specific request for data of all data types. In simpler terms, when the user selects one or more datasets and clicks the Request Data button on the website, one request listing all desired datasets is sent to the message queue.

Extract Windows service

NCDB_Extract_WS is an application installed locally as a Windows Service. The default installation directory is C:\Program

Files\Woolpert Inc\. Properties of the service can be viewed through Control Panel | Administrative Tools | Services. It is recommended that the service be set to Automatic startup, as it needs to be running for the NCDB site to function.

When started, the extract Windows Service will check the message queue every 10 seconds to see whether a data extraction request has been made. If it finds a message in the queue, it will stop its 10-second timer while processing the request. A request, in this case, refers to a selection made at one time by a user through the NCDB website, which may contain more than one specific request for data of all data types.

The extract Windows Service will then call the appropriate extraction web services, wait for a response from each stating whether the data was successfully extracted and uploaded to the FTP site, compile the results into a single email for the user, and send the information to the Messaging web service, which will formulate a notification email for the user. At that point, it will restart its timer and begin checking the message queue for additional requests.

To perform these functions, the extract Windows Service must have access to all of the individual extraction web services as well as the Messaging web service. Access is provided by including the correct URL to the service in the configuration file for the extract Windows Service.

The extract Windows Service has its own configuration file in XML format, called web.config. Sample values and descriptions of the keys in this file are listed below.

Table 1. NCDB_Extract_WS web.config file

appSettings		
Key	Sample value	Description
NCDB_Extract_WS.ExDataWS.ExtractData	http://sam-db01mob:7556/opj/ncdb/DataExtraction/ExtractData.asmx	URL of the DataExtraction Web Service on local machine.
NCDB_Extract_WS.MessagingWS.Messaging	http://sam-db01mob:7556/opj/ncdb/Messaging/Messaging.asmx	URL of the Messaging Web Service on local machine.
NCDB.ExtractService.MessageQueue	.\Private$\ncdb_data_extraction	Full name of the private message queue that handles the data download requests.
NCDB.ExtractService.FTPServer	ftp.gis.sam.usace.army.mil	URL to the FTP server where requested data will be stored.
NCDB.ExtractService.FTPFolder	/incoming/NCDB	Name of the folder in the root ftp directory where the data will be stored. If there is no subfolder under the incoming directory, the value of the key will be "/incoming".
NCDB.ExtractService.LOG	E:\Temp\ExtractServiceLog.log	Location for the error log for this service.
NCDB_Extract_WS.ExSCRIPPSDataWS.ExtractData	http://sam-db01mob:7556/opj/ncdb/NCDB_SCRIPPS_WS/ExtractData.asmx	URL of the SCRIPPS Extraction Web Service on local machine.
SAM-DB01MOB	http://sam-db01mob:7556/opj/ncdb/NCDB_File	URL of the File based data extraction Web Service on local machine. Please note that the

Table 1. NCDB_Extract_WS web.config file		
appSettings		
Key	Sample value	Description
	_ExtractWS/Extract.asmx	name of the key has to be same as the machine name where the file based data to be extracted is located.
NCDB_Extract_WS.ExRasterDataWS.Extract	http://sam-db01mob:7556/opj/ncdb/NCDB_Raster_ExtractWS/Extract.asmx	URL of the Raster Extraction Web Service on local machine.
Extract.TimeOut	1200000	Timeout for DataExtraction, SCRIPPS Extraction, File Extraction and Raster Extraction Web services in milliseconds.
LIDAR.Extract.TimeOut	1200000	Timeout for the LIDAR Extraction service in milliseconds.
Messaging.TimeOut	3600000	Timeout for the Messaging service in milliseconds.
NCDB_Extract_WS.Geoprocessing.Geoprocessing	http://sam-db01mob:7556/opj/ncdb/NCDB_Geoprocessing_WS/Geoprocessing.asmx	URL of the Geoprocessing Web Service on local machine.
SAM-APGIS\SAMEGIS	http://sam-db01mob:7556/opj/ncdb/NCDB_LIDARExtractWS/Extract.asmx"	URL of the LIDAR Extraction Web Service. Please note that the name of the key has to be same as the SQL server name and instance where the LIDAR data to be extracted is located.

.NET WEB SERVICES

Web services are used extensively in the NCDB. Each web service performs a specific function and can be administered individually. Some will be installed and maintained only on the servers in Mobile, while others must be present in other offices as well. A description of each web service used by the NCDB is summarized below.

Table 2. Web services summary	
Web Service Name	Description
AccountManager	Provides methods to the NCDB website that allow public users to create and update their user account, and allow authorized account managers to create, update, and manage user accounts. This Web service accesses the NCDB users SQL database.
DataExtraction	Extracts the SDE feature class data by sending an ArcXML request to the Extract Image service. All the extractable feature classes should be loaded in the Extract Image service. This Web service is called by the Extract Windows service.
Messaging	Can be called to send email notification to the appropriate users based on the type of event (for example, data extraction or user account change requests). Events and users are defined in the NCDB users SQL database.
NCDB_File_ExtractWS	Extracts stand-alone file data from a shared directory location. The extracted data is in a zipped file format. This Web service is called by the Extract Windows service.
NCDB_FTPWS	Transfers extracted data to the specified FTP location. This Web service is called by all the extract web services. It should be installed on both the machine where the Extract Image service is located and the machine where all extract Web services are installed.

Table 2. Web services summary	
Web Service Name	Description
NCDB_Geoprocessing_WS	Geoprocesses the datasets based on the user-specified parameters. The extracted data is in a zipped file format. This Web service is called by the Extract Windows service.
NCDB_LIDARExtractWS	Extracts the LIDAR data from the specified SQL database. The extracted data is in a zipped file format. This Web service is called by the Extract Windows service.
NCDB_MasterExtractionWS	Collects all the data extraction requests made by a single user in one session and places these requests in a message queue. Messages in the message queue are processed by the Extract Windows service.
NCDB_MetadataBrowser	The NCDB website and the NCDB Connector desktop tool call this service to search and return a set of metadata documents based on the user-specified search parameters.
NCDB_Raster_ExtractWS	Extracts the raster data from SDE. The extracted data is in a zipped file format. This Web service is called by the Extract Windows service.
NCDB_SCRIPPS_WS	Extracts SCRIPPS data based on the user-specified search parameters. The extracted data is in a zipped file format. This Web service is called by the Extract Windows service.
NCDB_SCRIPPSBrowser_WS	The NCDB website calls this service to search SCRIPPS data based on the user-specified search parameters.
UserAuthentication	Authenticates a user on the NCDB website for data extraction. An encrypted security token stores all the information about the user. The NCDB website and the NCDB Connector desktop tool call this service to access the NCDB users SQL database.

.NET CONFIGURATION SETTINGS

Each of the web services and the website used in the NCDB system has its own configuration file in XML format, called web.config. Each web.config file has many keys in it, some of which will not need to be altered, and others that are intended to give the administrator control over settings that may need to change. For those keys whose values may need to change, the keys, a sample value, and a description of their role are given in the tables below.

Note that in the case of the directory location where the FTP web service looks for files to upload, there are several web services with web.config keys which must specify the same value. The output directory specified for each of the extraction web services (file, LiDAR, data (SDE feature), raster, and SCRIPPS) must be the same directory specified in the OutputDirectory key of the FTP web service.

Table 3. Website web.config file		
appSettings		
Key	Sample value	Description
WebTools.WebMap.ServerName	localhost	Server name
WebTools.WebMap.ServerUrl	http://localhost	Full server URL

Table 3. Website web.config file		
appSettings		
Key	Sample value	Description
WebTools.WebMap.ServiceName	NCDB	Map service name
WebTools.WebMap.PortNumber	5300	Map service port number
WebTools.WebMap.ApplicationName	National Coastal Databank	Application name
WebTools.WebMap.ActiveTool	ZOOMIN	Initial active map tool
WebTools.WebMap.MapWidth	360	Map width
WebTools.WebMap.MapHeight	223	Map height
WebTools.WebMap.ScaleFactor	50	Scale factor for single click zooms
WebTools.WebMap.MapUnits	FEET	Map units
WebTools.WebMap.ScaleUnits	FEET	Scale units
ncdb.extract.Extraction	http://goyal/NCDB_MasterExtractionWS/Extraction.asmx	Extraction web service URL
ncdb.extract.Timeout	300000	Extraction web service timeout
ncdb.accountManager.AccountManager	http://kelly2/accountManager/accountManager.asmx	Account Manager web service URL
ncdb.accountManager.Timeout	300000	Account Manager web service timeout
ncdb.metadataBrowser.MetadataBrowser	http://goyal/ncdb_metadatabrowser/metadatabrowser.asmx	Metadata browser web service URL
ncdb.metadataBrowser.Timeout	300000	Metadata browser web service timeout
ncdb.searchScripps.SearchData	http://goyal/NCDB_SCRIPPSBrowser_WS/SearchData.asmx	Scripps search web service URL
ncdb.searchScripps.Timeout	300000	Scripps search web service timeout
ncdb.userAuthentication.Authenticate	http://goyal/userAuthentication/authenticate.asmx	User authentication web service URL
ncdb.userAuthentication.Timeout	300000	User authentication web service timeout
ErrorHandler.FilePathName	C:\Temp\NCDB.Website.Log	Error handler file path name
ContentThemes	All Content Themes,----------,Raster,Shoreline,Survey,Transport	USACE search content themes

Table 4. AccountManager web.config file		
identity		
Attribute	Sample value	Description
impersonate	True	Allows Integrated Windows Authentication; important for access to the SQL users database
userName	Domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
Database.ConnectionString	Data Source=SAM-DB01MOB\SAMEBIZ;Persist Security Info=False;Integrated Security=SSPI;Trusted_Connection=Yes;Initial Catalog=NCDB_Dev	SQL users database connection string using Integrated Windows Authentication
Database.Database	NCDB_Dev	SQL users database
FilePathName	E:\temp\NCDB.AccountManager.log	Error handler file path name
ChangePwd	dbo.upd_NCDB_Users_ChangePassword	SQL stored procedure name
DelEventsUsers	dbo.del_NCDB_EventUsers_AllEventsforUser	SQL stored procedure name
DelUserRoles	dbo.del_NCDB_UserRoles_AllUserRolesforUser	SQL stored procedure name
DelUserRole	dbo.del_NCDB_UserRoles_OneUserRole	SQL stored procedure name
DelUser	dbo.del_NCDB_Users_OneUser	SQL stored procedure name
InsUserRole	dbo.ins_NCDB_UserRoles	SQL stored procedure name
InsUser	dbo.ins_NCDB_Users	SQL stored procedure name
SelAllUsers	dbo.sel_NCDB_Users_All	SQL stored procedure name
SelPermissionsDomain	dbo.sel_NCDB_d_Permissions	SQL stored procedure name

Table 4. AccountManager web.config file		
SelRolesDomain	dbo.sel_NCDB_d_Roles	SQL stored procedure name
SelUserRoles	dbo.sel_NCDB_UserRoles_AllRolesOneUser	SQL stored procedure name
SelUserRole	dbo.sel_NCDB_UserRoles_SpecificRoleOneUser	SQL stored procedure name
SelUsersbyPermission	dbo.sel_NCDB_Users_ByPermission	SQL stored procedure name
SelUsersbyRole	dbo.sel_NCDB_Users_byRole	SQL stored procedure name
SelUserbyUsername	dbo.sel_NCDB_Users_ByUsername	SQL stored procedure name
SelUsernmPwd	dbo.sel_NCDB_Users_VerifyNamePword	SQL stored procedure name
UpdUserRole	dbo.upd_NCDB_UserRoles_ChangeUserRole	SQL stored procedure name
UpdUser	dbo.upd_NCDB_Users	SQL stored procedure name
EmailAddr	@Eml	SQL parameter name
ErrCode	@Ret	SQL parameter name
Eventname	@Evname	SQL parameter name
Firstname	@Firstnm	SQL parameter name
Lastname	@Lastnm	SQL parameter name
NewRole	@NewRl	SQL parameter name
Office	@Offc	SQL parameter name
OldRole	@OldRl	SQL parameter name
Organization	@Org	SQL parameter name
Password	@Pwd	SQL parameter name
Permission	@Perm	SQL parameter name
Role	@Rl	SQL parameter name
Rows	@Rows	SQL parameter name
Title	@Ttl	SQL parameter name
Username	@Usrnm	SQL parameter name
NCDB_Users.UserName	0	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.Permission	1	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.Title	2	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.FirstName	3	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.LastName	4	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.Email	5	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.Office	6	Index number of parameter returned by upd_NCDB_Users
NCDB_Users.Organization	7	Index number of parameter returned by upd_NCDB_Users

Table 5. DataExtraction web.config file		
identity		
Attribute	Sample value	Description
impersonate	True	Allows Integrated Windows Authentication
userName	Domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
NCDB.ExtractData.DTD	D:\Web Services\OPJ\Services\NCDB\arcxml.dtd	Location of the arcxml.DTD file
NCDB.ExtractData.FileSize	100000000	Maximum allowable size of file (in bytes) that can be FTPed.
IMSServer.SAM-APGIS	http://sam-apgis	URL to the server where metadata is stored
ImageService	EGIS_Extraction_Service	Name of the Image Service that is used

Table 5. DataExtraction web.config file		
		for extraction of SDE Feature class data
ImageService.Username	gcwgs84_viewer	Username for the image service
ImageService.Password	USACE	Password for the image service
SAM-APGIS.FTP	http://sam-apgis/NCDB_FTPWS/DataFTP.asmx	URL to the FTP web service on local machine. The key should be named in the following format:<machine name>.FTP
NCDB.ExtractData.LOG	C:\Temp\NCDB.Extraction.log	Location for the error log file.

Table 6. Messaging web.config file		
identity		
Attribute	Sample value	Description
impersonate	true	Allows Integrated Windows Authentication; important for access to the SQL users database
userName	domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
LogDirectory	E:\temp\NCDB.Messaging.log	Error handler file path name
ConnectionString	Data Source=SAM-DB01MOB\SAMEBIZ;Persist Security Info=False;Integrated Security=SSPI;Trusted_Connection=Yes;Initial Catalog=NCDB_Dev	SQL users database connection string using Integrated Windows Authentication
SMTPServer	sam-db01mob	Name of SMTP server for sending messages
SelEvent	dbo.del_NCDB_EventUsers_AllEventsforUser	SQL stored procedure name
SelEventNotify	dbo.del_NCDB_UserRoles_AllUserRolesforUser	SQL stored procedure name
SelUsersbyUsername	dbo.del_NCDB_UserRoles_OneUserRole	SQL stored procedure name
UserName	dbo.del_NCDB_Users_OneUser	SQL stored procedure name
EventName	dbo.ins_NCDB_UserRoles	SQL stored procedure name
ErrCode	dbo.ins_NCDB_Users	SQL stored procedure name
Users.UserName	0	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.Permission	1	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.Title	2	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.FirstName	3	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.LastName	4	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.Email	5	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.Office	6	Index number of parameter returned by Sel_NCDB_Users_ByUsername
Users.Organization	7	Index number of parameter returned by Sel_NCDB_Users_ByUsername

Table 7. NCDB_File_ExtractWS web.config file		
appSettings		
Key	Sample value	Description
NCDB_File_ExtractWS.DataFTPWS.DataFTP	http://sam-db01mob:7556/OPJ/NCDB/NCDB_FTPWS/DataF	URL of the FTP Web Service on local machine.

	TP.asmx	
NCDB.FTP.FileSize	100000000	Maximum allowable size of file (in bytes) that can be FTPed.
NCDB.FTP.TimeOut	1800000	Timeout for the service in miliseconds.
NCDB.FILE.Output	E:\Temp	Location of the directory where the file will be zipped and stored temporarily before being FTPed.
NCDB.FileExtract.LOG	E:\Temp\NCDB.FileExtract.log	Location for the error log for this web service.

Table 8. NCDB_FTPWS web.config file

identity		
Attribute	Sample value	Description
impersonate	True	Allows Integrated Windows Authentication; necessary if accessing remote folders
userName	Domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
NCDB.DataFTP.FTPServer	gis.sam.usace.army.mil	URL to the FTP server
NCDB.DataFTP.FTPFolder	incoming	Name of the folder in the root ftp directory where the data will be stored.
NCDB.DataFTP.RootFolder	/NCDB	Name of the folder under the FTPFolder where the data will be stored. This can be left blank if no sub-folder is required under the FTPFolder.
NCDB.DataFTP.FTPUserName	ftpdoer	Username for the ftp server
NCDB.DataFTP.FTPPassword	password	Password for the ftp server
NCDB.DataFTP.FileSize	100000000	Maximum allowable size of file (in bytes) that can be FTPed.
NCDB.DataFTP.OutputDirectory	E:\Temp	Location of the directory where the file will be zipped, renamed and stored temporarily before being FTPed.
NCDB.DataFTP.Log	E:\Temp\FTP.Log	Location for the error log for this web service.

Table 9. NCDB_Geoprocessing_WS web.config file

identity		
Attribute	Sample value	Description
impersonate	true	Allows Integrated Windows Authentication
userName	domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
NCDB_Geoprocessing_WS.FTPWS.DataFTP	http://sam-db01mob:7556/OPJ/NCDB/NCDB_FTPWS/DataFTP.asmx	URL to the FTP web service on local machine.
NCDB.Geoprocessing.OutputLocation	E:\Temp\Geoprocessing	Complete path to the directory where the datasets to be geoprocessed will be downloaded, processed and zipped back again for FTP. Separate folder will be created for each request. Name of each folder will be unique and will be same as the name on the FTP site.

Table 9. NCDB_Geoprocessing_WS web.config file		
identity		
NCDB.Geoprocessing.Host	SAM-DB01MOB	Name of the machine where ArcGIS Server is installed.
NCDB.Geoprocessing.ServerObject	GeoProcess	Name of the map server object.
NCDB.Geoprocessing.Log	E:\Temp\NCDB_Geoprocessing.Log	Location for the error log for this web service.

Table 10. NCDB_LIDARExtractWS web.config file		
identity		
Attribute	Sample value	Description
impersonate	True	Allows Integrated Windows Authentication; necessary for accessing SQL tables containing LiDAR data
userName	Domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
NCDB_LIDARExtractWS.DataFTPWS.DataFTP	http://sam-db01mob:7556/OPJ/NCDB/NCDB_FTPWS/DataFTP.asmx	URL of the FTP Web Service on local machine.
NCDB.FTP.FileSize	100000000	Maximum allowable size of file (in bytes) that can be FTPed.
NCDB.FTP.TimeOut	1800000	Timeout for the service in miliseconds.
NCDB.LIDAR.Output	E:\Temp	Location of the directory where the file will be zipped and stored temporarily before being FTPed.
LIDARExtract.ErrorLog	E:\Temp\NCDB.LIDARExtract.log	Location for the error log for this web service.
SAM-APGIS\SAMEGIS.Username	gcwgs84_viewer	Valid user for connecting to the SQL database where LIDAR data is stored. The user should also be able to query the table. Please note that the name of the key has a prefix of the SQL server name and instance (SAM-APGIS is the SQL server name and SAMEGIS is the instance) where LIDAR data is stored. If there are more than one SQL database where the data is stored, a new key with the SQL server name and instance prefix followed by a dot and suffix “Username” can be added to make that data accessible without recompiling the code.
SAM-APGIS\SAMEGIS.Password	password	Valid password for connecting to the SQL database where LIDAR data is stored. The user should also be able to query the table. Please note that the name of the key has a prefix of the SQL server name and instance (SAM-APGIS is the SQL server name and SAMEGIS is the instance) where LIDAR data is stored. If there are more than one SQL database where the data is stored, a new key with the SQL server name and instance prefix followed by a dot and suffix “Password” can be added to make that data accessible without recompiling the code.

WindowsAuthentication	True	Determines if the Web service uses Windows or SQL authentication to access SQL server where the LIDAR data is stored. A value of true indicates that Windows domain account will be used to access SQL server; false indicates that SQL server authentication will be used.

Table 11. NCDB_MasterExtractionWS web.config file

identity		
Attribute	**Sample value**	**Description**
impersonate	True	Allows Integrated Windows Authentication; necessary for allowing access to the Message Queue
userName	Domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	**Sample value**	**Description**
NCDB.ExtractData.MessageQueue	.\Private$\ncdb_data_extraction	Full name of the private message queue that handles the data download requests.
NCDB.ExtractData.LOG	E:\Temp\Master_Extract_Log.log	Location for the error log for this web service.
NCDB_MasterExtractionWS.MessagingWS.Messaging	http://sam-db01mob:7556/OPJ/NCDB/Messaging/Messaging.asmx	URL to the Messaging web service on the local machine.

Table 12. NCDB_MetadataBrowser web.config file

appSettings		
Key	**Sample value**	**Description**
NCDB.MetadataBrowser.ServiceURL	http://sam-apgis	URL of the Metadata Server
NCDB.MetadataBrowser.ServiceName	EGIS_Metadata_Service	Name of the Metadata Service
NCDB.MetadataBrowser.ServiceUserName	gcwgs84_viewer	Username for the Metadata Service. This user only needs permission to browse metadata.
NCDB.MetadataBrowser.ServicePassword	password	Password for the Metadata Service. This user only needs permission to browse metadata.
NCDB.MetadataBrowser.DTD	D:\Web Services\OPJ\Services\NCDB\arcxml.dtd	Complete path to the arcxml.DTD file.
NCDB.MetadataBrowser.StyleSheet	http://localhost/dataviewer/css/metadata.xsl	Path to the style-sheet for viewing metadata. This should be left blank.
NCDB.MetadataBrowser.ErrorLog	E:\Temp\NCDB.MetadataBrowser.log	Location for the error log for this web service.
NCDB.MetadataBrowser.PublicPermission	Public	Valid tag for public access to the data. This should match with the corresponding value in NCDB Security Classification node in the metadata.
NCDB.MetadataBrowser.SensitivePermission	Sensitive	Valid tag for sensitive access to the data. This should match with the orresponding value in NCDB Security Classification node in the metadata.
NCDB.MetadataBrowser.RasterDataFormat	SDE Raster	Valid tag for the NCDB data format name for raster data. This should match the value of node NCDB Data Format for raster data in the metadata document.
NCDB.MetadataBrowser.SDEFeatureClass	SDE Feature Class	Valid tag for the NCDB data format name

DataFormat		for SDE Feature Class data. This should match the value of node NCDB Data Format for SDE Feature Class data in the metadata document.
NCDB.MetadataBrowser.FileDataFormat	File	Valid tag for the NCDB data format name for stand alone file data. This should match the value of node NCDB Data Format for stand alone file data in the metadata document.
NCDB.MetadataBrowser.SCRIPPSDataFormat	SCRIPPS	Valid tag for the NCDB data format name for SCRIPPS data. This should match the value of node NCDB Data Format for SCRIPPS data in the metadata document.
NCDB.MetadataBrowser.LIDARDataFormat	Lidar	Valid tag for the NCDB data format name for LIDAR data. This should match the value of node NCDB Data Format for LIDAR data in the metadata document.
NCDB.MetadataBrowser.PointGeometry	Point	Name of the geometry type for point features. This should match the value of node NCDB Geometry type for point features in the metadata document.
NCDB.MetadataBrowser.LineGeometry	Line	Name of the geometry type for line features. This should match the value of node NCDB Geometry type for line features in the metadata document.
NCDB.MetadataBrowser.PolygonGeometry	Polygon	Name of the geometry type for polygon features. This should match the value of node NCDB Geometry type for polygon features in the metadata document.

Table 13. NCDB_Raster_ExtractWS web.config file

appSettings		
Key	Sample value	Description
NCDB_Raster_ExtractWS.DataFTPWS.DataFTP	http://sam-db01mob:7556/OPJ/NCDB/NCDB_FTPWS/DataFTP.asmx	URL of the FTP Web Service on local machine.
NCDB.FTP.FileSize	100000000	Maximum allowable size of file (in bytes) that can be FTPed.
NCDB.FTP.TimeOut	1800000	Timeout for the FTP service in miliseconds.
NCDB.RasterExtract.Output	E:\Temp	Location of the directory where the file will be zipped and stored temporarily before being FTPed.
NCDB.RasterExtract.LOG	E:\Temp\NCDB.RasterExtract.log	Location for the error log for this web service.
NCDB.RasterExtract.SDEUtilityPath	C:\ArcGIS\ArcSDE\sqlexe\bin\sderaster.exe	Full path (including the name of the exe) to the location where ArcSDE utility for extracting raster is installed.
NCDB.RasterExtract.TimeOut	60000	Timeout for the Raster Extract service in miliseconds.
NCDB.RasterExtract.RasterID	1	RasterID value. This should always be 1. To make sure this is always one- mosaic the rasters in SDE and do not use multiple rasters in same raster dataset.
SAM-APGIS.Username	username	Username for making connection to the SDE where raster data is stored. Please note that the name of the key has a prefix of the server name where SDE data is stored. If there are more than one SDE database where the data is stored, a new key with the server name prefix followed by a

		dot and suffix "Username" can be added to make that data accessible without recompiling the code.
SAM-APGIS.Password	password	Password for making connection to the SDE where raster data is stored. Please note that the name of the key has a prefix of the server name where SDE data is stored. If there are more than one SDE database where the data is stored, a new key with the server name prefix followed by a dot and suffix "Password" can be added to make that data accessible without recompiling the code.

Table 14. NCDB_SCRIPPS_WS web.config file

identity		
Attribute	Sample value	Description
impersonate	True	Allows Integrated Windows Authentication
userName	Domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
NCDB_SCRIPPS_WS.DataFTPWS.DataFTP	http://sam-db01mob:7556/OPJ/NCDB/NCDB_FTPWS/DataFTP.asmx	URL of the FTP Web Service on local machine.
NCDB.FTP.FileSize	100000000	Maximum allowable size of file (in bytes) that can be FTPed.
NCDB.FTP.TimeOut	1800000	Timeout for the service in miliseconds.
NCDB.SCRIPPS.Output	E:\Temp	Location of the directory where the file will be zipped and stored temporarily before being FTPed.
NCDB.SCRIPPS.LOG	E:\Temp\NCDB.SCRIPPS.log	Location for the error log for this web service.
NCDB.SCRIPPS.Proxy	http://netaccess.woolpert.com:80	Name of the proxy server. This can be left blank if no proxy server is used.

Table 15. NCDB_SCRIPPSBrowser_WS web.config file

appSettings		
Key	Sample value	Description
NCDB.SCRIPPS.BROWSE.LOG	E:\Temp\NCDB.SCRIPPS.BROWSE.log	Location for the error log for this web service.
NCDB.SCRIPPS.BROWSE.Proxy	http://netaccess.woolpert.com:80	Name of the proxy server. This can be left blank if no proxy server is used.

Table 16. UserAuthentication web.config file

identity		
Attribute	Sample value	Description
impersonate	true	Allows Integrated Windows Authentication; necessary for access to the SQL users database
userName	domain\username	The domain and user account for logging into the database
password	password	The password for the given userName
appSettings		
Key	Sample value	Description
wLib.Common.UserAuthentication.Connection	Data Source=SAM-	SQL users database connection string

Table 16. UserAuthentication web.config file		
identity		
Attribute	Sample value	Description
	DB01MOB\SAMEBIZ;Persist Security Info=False;Integrated Security=SSPI;Trusted_Connection=Yes;Initial Catalog=NCDB_Dev	using Integrated Windows Authentication
wLib.Common.UserAuthentication.IsUserValid	dbo.sel_NCDB_Users_IsUserValid	SQL stored procedure name
wLib.Common.UserAuthentication.GetUserRole	dbo.sel_NCDB_UserRoles_AllRolesOneUser	SQL stored procedure name
wLib.Common.UserAuthentication.GetUser	dbo.sel_NCDB_Users_ByUsername	SQL stored procedure name
wLib.Common.UserAuthentication.ParamUserName	@Usrnm	SQL parameter name used in sel_NCDB_Users_IsUserValid and in sel_NCDB_Users_ByUsername
wLib.Common.UserAuthentication.ParamPassword	@Pwd	SQL parameter name used in sel_NCDB_Users_IsUserValid
wLib.Common.UserAuthentication.ParamRows	@Rows	SQL parameter name used in sel_NCDB_Users_IsUserValid
wLib.Common.GetUserRole.ParamUserName	@Usrnm	SQL parameter name used in sel_NCDB_UserRoles_AllRolesOneUser
wLib.Common.UserAuthentication.ErrorLog	E:\temp\NCDB.UserAuthentication.log	Error handler file path name

APPENDIX E—COMMERCIAL SOFTWARE CONFIGURATION FOR THE NCDB

Each piece of software must be installed and configured so that it is compatible with the rest of the NCDB system. Deviations from default installation items are listed below.

RDBMS SOFTWARE

Microsoft SQL Server is recommended because of its availability and simple administration requirements. This software is required at the host district as well as each district office. When installing SQL Server, the option to enable full text searches must be selected as this is a requirement for ESRI's ArcIMS Metadata Server component. Refer to ArcSDE and ArcIMS Metadata Server documentation for requirements when installing the RDBMS software.

ARCSDE

ESRI ArcSDE software is required at the host district and each district office for two distinct purposes:

- To warehouse and maintain the geospatial data, which is itself the corporate asset.
- To store a metadata catalog used by the ArcIMS Metadata Service when publishing and searching metadata records.

No special installation requirements exist beyond those in the documentation for building geodatabases and metadata servers.

ARCIMS

During the NCDB pilot project, Microsoft Windows and other most common software for ArcIMS were chosen. It is possible to install the ArcIMS environment on Linux or Unix operating systems, but it is not recommended without further testing. This software is required at the host district as well as each district office.

The steps below must be followed while installing ArcIMS Metadata Server and ActiveX connector.

Operating System/IIS Prerequisites

Step 1: Make sure the following operating system/IIS prerequisites have been installed:

- Windows 2003 Server
- IIS 6.0 on Windows 2003
- Windows .NET Framework, Version 1.1
- Windows .NET SDK

Step 2: Create a directory called "Output" at the root of C:\.

Step 3: Create a Virtual directory in IIS for the Output directory.

Step 4: Give full permissions to the Output directory to the "Everyone" user.

ArcIMS Installation

Step 1: Make sure the following features are selected while installing ArcIMS:

- Application Server
- ActiveX Connector
- Manager
- Metadata
- Spatial Server

Step 2: Make sure the following ArcIMS prerequisites are installed in the order specified below.

- Java 2 SDK Standard Edition Version 1.4.2 (refer to the ESRI article at http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=26036)

- Servlet Exec 5.0
  - Provide read/write access to the ServletExec Data directory. Make sure that IIS guest user and administrator have read/write access.
  - Stop and start the services IIS Admin and World Wide Web Publishing Service.
  - Verify that the ServletExec installation was successful.

Step 3: Once the metadata server is installed and the metadata service is created, the aimsacl.xml file located at C:\Program Files\New Atlanta\ServletExec ISAPI\Servlets can be edited to enable authentication and assign roles for metadata browsing and publishing. If it is desired that any user can browse metadata, then the following tag should be added as the first tag in the aimsacl.xml file:

```
<USER name="*" services="*" />
```

Step 4: In the Esrimap_prop file located at C:\Program Files\New Atlanta\ServletExec ISAPI\Servlets, make sure that the authenticate tag is set to true and the authMethods tag is set to Digest.

Step 5: If the authentication has been enabled in aimsacl.xml for publishing and viewing metadata, enabling authentication, make sure to uncheck Integrated Windows Authentication and Digest Authentication for the ServletExec_ISAPI.dll in Internet Information Services Manager.

For more installation details, refer to the ArcIMS documentation available on ESRI's website.

ARCGIS SERVER

Installing ArcGIS Desktop

To simplify the process of creating ArcGIS Server objects, ArcGIS Desktop should also be installed on the same machine as ArcGIS Server. No special installation requirements exist beyond those in the ESRI documentation.

Installing ArcGIS Server

The steps below have to be followed while installing ArcGIS Server:

Step 1: While installing ArcGIS Server, make sure to install .NET support for Server Object Container and Server Object Manager.

Step 2: Install the .NET component of the Software Developer Kit.

Step 3: Add the valid users to the agsadmin and agsusers group.

- Administrator
- ArcGIS Container account
- ArcGIS Server account
- ASPNET
- Internet Guest User account
- IWAM user account
- Domain user account

Step 4: After adding users to the user groups, log off the machine and log back on again for these changes to take effect.