



EM 1110-1-2909
30 September 2005

US Army Corps
of Engineers®

ENGINEERING AND DESIGN

Geospatial Data and Systems

ENGINEER MANUAL

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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

EM 1110-1-2909

CECW-EE

Manual
No. 1110-1-2909

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Engineering and Design
GEOSPATIAL DATA AND SYSTEMS

1. Purpose. The purpose of this manual is to provide detailed technical guidance and procedures for compliance with Engineer Regulation (ER) 1110-1-8156. The regulation establishes general criteria and presents policy and guidance for the acquisition, processing, storage, distribution, and utilization of nontactical geospatial data throughout the U.S. Army Corps of Engineers (USACE). Detailed technical guidance and requirements are stated, and standards for Geospatial Data and Systems are identified. This manual is in compliance with Executive Order 12906, Coordinating Geographic Data Acquisition and Access, and with the National Spatial Data Infrastructure and Office of Management and Budget's (OMB) Circular A-16, Coordination of Geographic Information and Related Spatial Data Activities. This manual also supports OMB's Electronic Government and Government Management Reform initiatives.

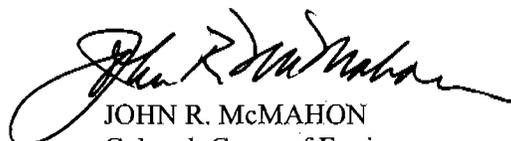
2. Applicability. This manual applies to all major subordinate commands, districts, and laboratories performing and/or contracting geospatial activities in support of planning, engineering and design, construction, operation, maintenance, and/or regulation of civil works or military construction projects. This manual is also applicable to USACE functional areas having responsibility for environmental investigations and studies, archeological investigations, historical preservation studies, hazardous and toxic waste site restoration, structural deformation monitoring investigations, regulatory enforcement activities, and support to Army installation maintenance and repair programs and installation master planning functions.

3. Distribution. This publication is approved for public release; distribution is unlimited.

4. Scope. This manual provides detailed technical guidance on implementing geospatial technologies throughout USACE as outlined in ER 1110-1-8156. The primary guidance from HQUSACE to District Commands is to initiate and fund an enterprise Geographic Information System (GIS) (eGIS) program that is consistent with HQUSACE and Division eGIS activities. This manual details some of the major issues associated with implementing eGIS such as initiating program management practices for geospatial activities; documenting geospatial technology investments; acquiring geospatial data using standards; staffing and training the workforce; managing and archiving geospatial data; and procuring software and hardware to support geospatial activities.

FOR THE COMMANDER:

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JOHN R. McMAHON
Colonel, Corps of Engineers
Chief of Staff

Chapter 1 Introduction

1-1. Purpose

a. The purpose of this manual is to provide detailed technical guidance and procedures for compliance with Engineer Regulation (ER) 1110-1-8156. The regulation establishes general criteria and presents policy and guidance for the acquisition, processing, storage, distribution, and utilization of nontactical geospatial data throughout the U.S. Army Corps of Engineers (USACE). Detailed technical guidance and requirements are stated, and standards for Geospatial Data and Systems are identified. This manual is in compliance with Executive Order (EO) 12906, Coordinating Geographic Data Acquisition and Access, and with the National Spatial Data Infrastructure and Office of Management and Budget's (OMB) Circular A-16, Coordination of Geographic Information and Related Spatial Data Activities. This manual also supports OMB's Electronic Government and Government Management Reform initiatives.

b. Guidance is provided for implementing the Corps Geospatial Strategic Focus and for full integration of geospatial technology into USACE business practices. A corporate approach to implementing geospatial technology is outlined that meets functional business process requirements in harmony with Federal, State, and local agency programs. The intent is to produce geospatial products more efficiently while serving customers.

1-2. Applicability

a. This manual applies to all USACE Commands and contractors that are responsible for civil works, military construction, and environmental restorations. Specifically, it applies to the Commands responsible for regulatory investigations, planning studies, real estate, and emergency operations. Other functions to which it pertains are automated Geospatial Data Standards (GDS) for surveying, mapping, or geospatial database development, such as modeling. This manual also pertains to Geospatial Data and Systems (GD&S) that are used to produce a variety of products including river and harbor maps, charts, and drawings; real estate tract or parcel maps; small- and medium-scale engineering drawings; survey reports; environmental studies; hazardous, toxic, and radioactive waste studies; and channel condition reports.

b. Site plans showing building structure footprints or any data set about features on the exterior of a building or structure are geospatial data, are compatible with the National Spatial Data Infrastructure (NSDI) concept, and are not excluded from this regulation. These data may use relative, assumed, or geographic coordinates, and may be stored in a Computer-Aided Design and Drafting (CADD) or Geographic Information Systems (GIS) environment.

c. USACE customers for reimbursable work, who are required to comply with the EO 12906, will determine their level of compliance. These customers, such as the Department of Defense installations, Environmental Protection Agency, and the Federal Emergency Management Agency, may opt to incorporate compliance with the EO into contracts with USACE, or they may accomplish compliance unassisted by USACE. The Army Assistant Chief of Staff for Installation Management has outlined the Army's compliance through Army Regulation (AR) 210-20 dated 16 October 2001 (see Appendix A). All military programs of geospatial-related work that USACE executes shall be in compliance with AR 210-20.

d. The NSDI outlined in EO 12906 is in cooperation with State and local governments. Everything outlined in this manual that directly supports implementation of EO 12906 and the NSDI is in compliance

with civil works-sponsored geospatial data requirements for specific projects. Sponsors are to be educated on the requirements of this manual.

1-3. References

Related publications are listed in Appendix B.

1-4. Acronyms

- a. Acronyms are listed in Appendix C.

1-5. Definitions

- a. *Geospatial data*. Nontactical data referenced, either directly or indirectly, to a location on the earth.
- b. *Geospatial Data System (GDS)*. Any automated system that employs geospatial data including GIS; Land Information Systems (LIS); Remote Sensing or Image Processing Systems; CADD systems; Automated Mapping/Facilities Management (AM/FM) systems; and other computer systems that employ or reference data using either absolute, relative, or assumed coordinates such as hydrographic surveying systems.
- c. *Geospatial Data and Systems (GD&S)*. Geospatial data and the GDS that create and process the data.
- d. *Geospatial technologies*. Technologies related to CADD, remote sensing, GIS, survey and mapping, photogrammetry, and Global Positioning System (GPS).
- e. *National Spatial Data Infrastructure (NSDI)*. EO 12906 calls for the establishment of the NSDI, which is defined as the technologies, policies, and people necessary to promote sharing of geospatial data throughout all levels of government, the private and nonprofit sectors, and the academic community. "The goal of this infrastructure is to reduce duplication of effort among agencies; to 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."
- f. *USACE Commands*. All *subordinate* entities of the U.S. Army Corps of Engineers including districts, divisions, research laboratories, and field offices.

1-6. Scope

This manual provides detailed technical guidance on implementing geospatial technologies throughout USACE as outlined in ER 1110-1-8156. The primary guidance from HQ to District Commands is to initiate and fund an enterprise Geographic Information System (GIS) (eGIS) program that is consistent with HQ and Division eGIS activities. This manual details some of the major issues associated with implementing eGIS such as initiating program management practices for geospatial activities; documenting geospatial technology investments; acquiring geospatial data using standards; staffing and training the workforce; managing and archiving geospatial data; and procuring software and hardware to support geospatial activities.

1-7. Exclusions

a. Spatial data and computer systems that do not use coordinates directly or indirectly referenced to a position on the earth are not required to adhere to this regulation. This exempts architectural, mechanical, electrical, structural, and sanitary engineering data and drawings of objects typically inside buildings, as well as the CADD systems used to develop such data and drawings.

b. This regulation also excludes business systems that focus on textual and statistical information, which is created, stored, manipulated, queried, displayed, and transferred differently from geospatial data.

c. This regulation also excludes tactical spatial data and associated computer systems such as those used for fire control, targeting, and mission planning.

d. Users of excluded systems may find this manual useful in implementing, organizing, or managing their particular type of automated system; in identifying applicable standards; or in creating and maintaining a database. This manual may enhance interoperability among GD&S and other data systems. Users of all automated systems are encouraged to coordinate, when appropriate, with users, managers, and administrators of other automated systems.

1-8. Waivers

a. A waiver can be requested for any mandatory requirement outlined in this manual. Waiver requests can be sent to HQ, CECW-E.

1-9. Trade Names

The citation in this manual of trade names of commercially available products does not constitute official endorsement or approval of the use of such products. HQUSACE does not mandate specific GIS software or systems for interoperability; however, interoperability is encouraged via data standards and processing procedures.

Chapter 2 Enterprise Geographic Information Systems (eGIS)

2-1. Introduction

a. The purpose of this chapter is to define enterprise GIS (eGIS) and its importance to the organization and to provide general guidance on implementation.

b. As defined in Chapter 1, GD&Ss include data and technologies from GIS, Remote Sensing, Survey and Mapping, GPS, CADD, and Facility Management fields. GIS is singled out in an Enterprise context because of its strong integration capabilities. Data collected and/or derived from various geospatial technologies are easily integrated through GIS. Any reference to eGIS implies geospatial information collected and/or derived from geospatial technologies.

2-2. Geographic Information Systems (GIS)

a. Traditionally, the parts of GIS have been discussed in terms of data, software, people, hardware/systems, and network communications. Initially, GIS required specialized hardware and expensive software that only highly trained experts could run. Those requirements are no longer constraints. Today, GIS runs on common network configuration with desktop hardware, and the software is reasonably priced. While workforce development will always be an issue, training on the use of the software is easily obtained (see Chapter 4).

b. As software and hardware have become more mainstream, geospatial data and technologies have become much more complex. Not only has the complexity of the internal data format increased, but data management issues have also risen, driven by the increase in the volume of the data (both size of databases and/or files and number of data sets available).

c. The data needed for GIS analysis make up the most expensive part of implementing GIS. A 1993 Office of Management and Budget estimate indicates that USACE spends \$200 million annually on collecting, processing, and archiving geospatial data. Geospatial data are an integral part of the USACE business process from project planning to operation and maintenance. A huge potential for loss exists through data mismanagement. Data become easily outdated simply because they cannot be retrieved or may not have been documented properly at the time of collection. The importance of standardizing, documenting, and providing easy access to geospatial data cannot be overstated.

2-3. Enterprise GIS (eGIS)

a. Often an individual business function or business unit within an organization determines GIS implementations. For example, hydrographic survey data are collected to monitor dredging projects, imagery is collected for a beach erosion study, and soil data are collected to evaluate the structural capacity of a site. USACE has the added complexity that GIS capabilities are not developed uniformly across the organization. For example, District A may have developed a detailed well-documented data set to support its regulatory mission, but District B may not have had a large regulatory mission and, therefore, never established a data set.

b. While support of mission requirements is the focus of any data collection activity and must not be compromised, data collection activities should also be approached as collecting information to be used by the entire organization. Mission-specific data should be collected and disseminated throughout the

organization. This is the concept of eGIS. Data collected for dredging are also available to the USACE planning studies. Soil data collected for engineering may be of use to environmental studies. Information collected for regulatory permits is available for watershed management studies. The sharing of the technology and the data associated with that technology across a multidisciplinary organization, or across loosely associated organizations, is the concept behind eGIS (Figure 2-1).

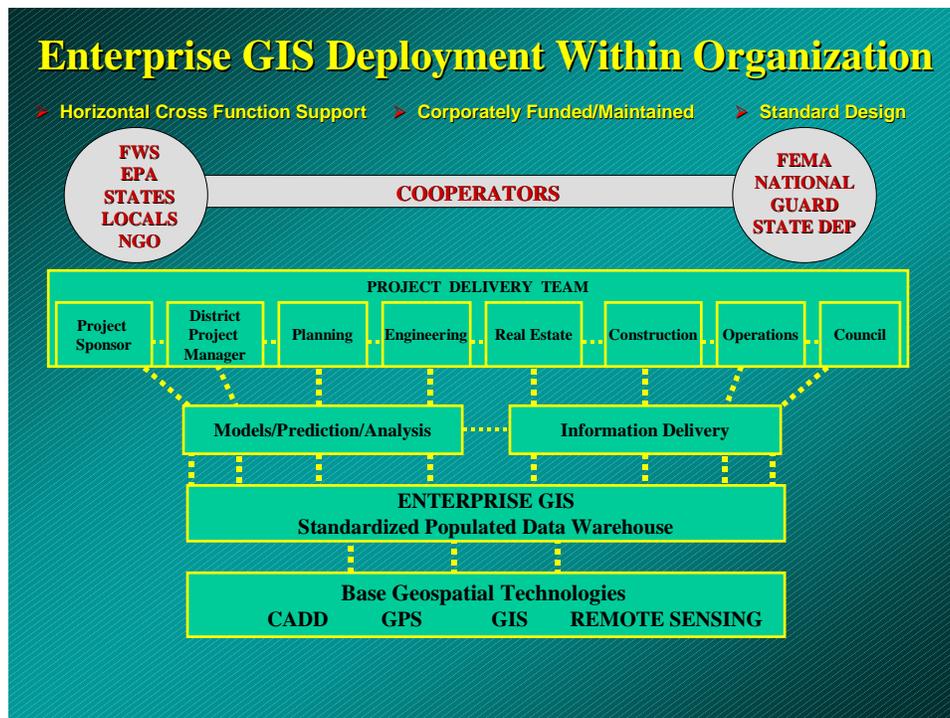


Figure 2-1. A conceptual view of eGIS

c. eGIS is the integrated geospatial technology infrastructure delivering spatial information products, services, and standard data sets to all functional elements and business processes of the organization. eGIS provides easy access to existing geospatial data sets, establishes standards for how an organization collects geospatial data, and integrates nonspatial data from existing Database Management Systems. Implementing eGIS supports the horizontal integration of USACE missions and directly supports the NSDI through collecting, storing, and documenting data to support multiple purposes and reuse. In addition to data, eGIS also includes standardizing to the extent possible the geospatial application development across the Corps.

d. Just as the USACE organization can be discussed at different levels (the entire USACE Command, a USACE District Office, a USACE Division), eGIS can be implemented at different levels with the “enterprise” reflecting the level of the Command. A definite distinction exists between a Headquarters Enterprise effort, which is focused on national coverage of USACE assets, and a District eGIS effort, which is focused on the District’s mission area and data collection efforts. While there is a distinction between the levels of implementation (Headquarters versus District Offices), the concept of eGIS needs to address linking the geospatial data. For example subsets of detailed data need to be viewed at higher levels rather than building distinct and separate geospatial data sets for different levels of the organization.

e. As eGIS is implemented at various Commands throughout USACE, Corps-wide standards, metadata, and data accessibility need to be addressed corporately. This is to ensure that the information will be available not only throughout the specific Command, but also throughout the entire USACE organization. An integrated national-level view of USACE infrastructure (horizontal integration) is needed, as well as a capability to view detailed geospatial data (vertical integration) of USACE data (Figure 2-2).

f. While there is this distinction in the user distribution, the evolution of eGIS links the various user communities together resulting in one eGIS implementation across USACE.

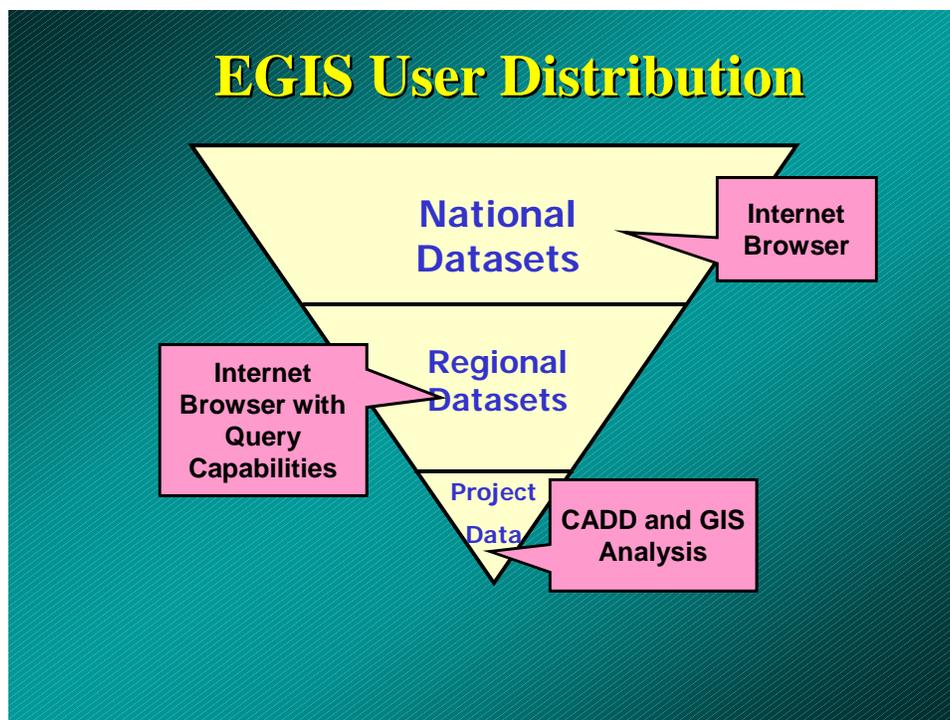


Figure 2-2. Distribution of users. Many users are interested in browsing national data sets, fewer users require accessing regional data sets, and only a few require access to project data

2-4. Benefits of eGIS

As with many information technology initiatives, it is difficult to quantify the benefits of eGIS. The tangible benefits of eGIS include the following:

- a. *Savings.*
 - *Data retention* – Increases life of data; instead of completely recollecting data, build on existing data.
 - *Data management* – Since data are more easily accessible, productivity is increased.
 - *Improve data sharing* – Groups collaborate on data collection efforts, which decreases data duplication.

- *Increased efficiency* – Decrease effort to do a task; measured in time.
- *More efficient/effective review and approval* – Everyone works with the same spatial data.
- b. *Improved product quality.*
 - *Better decisions (more defensible).*
 - *More complete picture* – Supports more complex analysis/solutions.

2-5. General eGIS Goals and Requirements

The prime goal of eGIS is to develop a shared spatial data infrastructure that will support USACE varied geospatial data needs. In order to be successful in USACE, a geographically dispersed organization, eGIS must be a distributed architecture where each Division is responsible for hosting their data. A Division may want to have Districts host or have one or two District offices host the eGIS data for the Division. It is important that eGIS is integrated with non-GIS data and applications. The Headquarters Project Delivery Team (PDT) is corporately addressing the integration of Automated Information Systems (AIS) that are for the most part non-GIS. The eGIS architecture must accommodate desktop, client-server, and Web-based applications. While desktop applications have historically accommodated more powerful analysis software, developing geospatial Web services and Web-based application should be maximized. Web services and Web-based applications provide the easiest means to integrate applications throughout a Division and across USACE. Open standards (such as those developed by the Open GIS Consortium and implemented by vendors) need to be utilized along with commercial off-the-shelf (COTS) products to the greatest extent possible in order to maximize interoperability between systems. Much of the eGIS work (developing plans, documenting, converting legacy data, etc.) can and should be accomplished using commercial providers or architect/engineer (A&E) services.

2-6. Organizational and Technical Issues

a. Each Division needs to define its specific Goals/Objectives for eGIS. Because of the various businesses that eGIS will be supporting, agreement on specific objectives throughout the Division may be difficult. One of the most important organizational issues is addressing work flow and business process changes. In many cases, eGIS will require District and Field Offices to standardize data collection and management processes. This is important because while there may be an initial goal to convert important data to a standard format it should be a one-time conversion. Changes in business processes and work flow need to be implemented in order to ensure that the eGIS data remain current and maintain their integrity. Prior to business process and work flow changes, it is important try to capture a baseline of performance. While measuring performance and calculating benefits have always proven to be difficult, they needed to measure increases in performance and support cost benefit analysis. The biggest barrier to funding eGIS has proven to be funding. USACE receives very limited corporate funds and at the time this manual was finalized, no line item funding for eGIS existed.

b. Data stewardship and integrity are the biggest technical challenges to eGIS. If data are going to be used by organizations that did not have direct input into its creation, they need to have confidence that the data are accurate and reliable. Only data sets that are accurate and reliable can be integrated into eGIS. If data sets of questionable quality are incorporated into the enterprise, users will lack confidence in the data. A quality control process and data stewards need to be identified. Other technical issues include data access and sharing, Web access speed and reliability, integrating/linking with other information data-bases, and interoperability between CADD/GIS. While much of eGIS is based on a distributed

architecture (keeping data sets close to those units that are responsible for creating/maintaining the data), it is beneficial for some data sets that are required by the entire organization be centralized. Deciding what data sets should be distributed versus centralized is also an issue that needs to be resolved.

c. While a general overview of organization and technical issues has been discussed in this section, each Division needs to resolve how these issues will be addressed within their Division and document them in their eGIS Program Management Plan. Appendix D is an example of a Division eGIS Program Management Plan.

2-7. Implementation of eGIS at Headquarters

a. The HQUSACE Enterprise GIS is developed under the guidance of the Headquarters Geospatial PDT (formerly the HQ Geospatial Committee). The HQ Geospatial PDT is committed to working together in the area of geospatial data and technology to decrease development costs for GIS functionality for USACE-wide AIS. The implementation of HQUSACE eGIS is CorpsMap.

b. CorpsMap is a spatial portal that accesses a variety of existing USACE-wide databases. It is an Internet map-based display and information dissemination system for various USACE databases that have geographically based information in digital form. CorpsMap enables USACE information to be easily accessed, creates maps easily, and integrates disparate databases.

c. As stated, the prime goal of eGIS is to develop a shared data infrastructure throughout the organization to include field, District, Division, and Headquarters. It is envisioned that this will be done using Web services and Web technology. CorpsMap will provide the National level geospatial view for USACE.

2-8. Implementation of eGIS at Division/District Commands

It is the responsibility of each Division GD&S Manager (see chapter 4) to lead and organize eGIS within the Division. It is the responsibility of HQUSACE CECW-EE to lead and organize eGIS between Divisions. It is unrealistic for a District office to make the transition from project-specific GIS applications to eGIS without working through the challenges and obstacles present with changing business processes. As with any cultural or business process change, eGIS takes time to work within an organization. While many offices are not ready to develop fully integrated eGIS capabilities, steps in the form of the following three phases are suggested to ensure eventual success.

a. *Phase I: Provide easy access to external data to everyone in the District via Internet or Intranet technology.*

(1) Establish access to National data sets through CorpsMap (<https://Corpsmap.usace.army.mil>). CorpsMap provides updated access to many National data sets as well as access to all USACE licensed data sets. All GIS development and analysis using National data sets needs to establish links to CorpsMap.

(2) While Phase I is not intended to meet the geospatial data requirements of the entire District, it is a good first step toward attaining this goal. As mentioned, much of the data from other sources is valuable for feasibility and reconnaissance studies. By establishing easy access to this data and maintaining its currency, Phase I can satisfy individual requests from State and local agencies.

b. Phase II: Data inventory.

(1) Phase II involves inventorying the types of data being collected by the District on a regular basis and how much legacy data the District owns. USACE produces a tremendous amount of geospatial data in support of its mission. USACE also has a large amount of historic or legacy data that may not be in digital form. During this phase, the District office must compile a listing of legacy data and document where it is and in what format. It is cost-prohibitive to convert all legacy data into a format to support the Enterprise. Not all legacy data are needed, and this inventory will be used to support decisions on what legacy data should be incorporated into the eGIS. In addition to legacy data, the District office must determine the type and quantity of data being collected on a regular basis.

(2) Some but not all of the geospatial data should be accessible to the entire District. This will vary from District to District. For example, a District office with a large navigation mission may establish a requirement that navigation data be accessible to the entire organization, while an office with a small navigation mission may not have the same requirement. Often large projects or studies require that data be accessed by many individuals in the District.

(3) While the data inventory is probably the most important step a District office can take toward eGIS, maintaining that inventory and actively managing data sets is critical to the entire organization. Maintaining an up-to-date inventory of all geospatial data, especially elevation and imagery holdings, is an important step to reusing data.

c. Phase III: Enterprise geospatial data. Phase III involves integrating data collection and dissemination into USACE business practices throughout the organization. Organizing the geospatial community within the Division/District and developing a Program Management Plan are key to implementing this phase. Appendix D is an example of a Division-level Program Management Plan that includes a funding strategy, charter, and architectural diagram.

2-9. Aspects of Successful eGIS at Division/District Commands

a. eGIS implementation is likely to be most effective when eGIS infrastructure/data development resources are segregated from the GIS production/analysis resources. Generally, a focused deployment is more efficient than blending tasking between infrastructure and production.

b. The movement toward an Enterprise-based deployment of geospatial technologies within the Command will involve technical and organizational components. The PDT must address technical and organizational issues during the development and during the execution of the Project Management Plan.

c. For a successful eGIS implementation, each Command must address the following four major areas:

- Workforce development (see Chapter 4).
- Data standards and documentation (see Chapter 7).
- Data stewardship and integrity (see Chapter 8).
- Business process/work flow (must be discussed in detail at each Command).

d. Other elements that support the PDT and aid in implementing eGIS successfully are the following:

- eGIS corporate vision.
- Active PDTs (technical and oversight committees).
- Division-level coordination.
- Research Management Board and Board of Directors approval.
- Strategic and tactical components.
- Performance monitoring.
- Geospatial Project Management Plan (implementation plans).
- Cost estimates.
- Funding guidance.

2-10. USACE eGIS Architecture

USACE eGIS architecture is described in the Corps Enterprise Architecture Technical Reference Manual (Version 1.0) (Figure 2-3). The architecture is based on implementation of Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) on a mainstream multi-user commercial off-the-shelf (COTS) relational database management. In following this architecture, standardization of access to a heterogeneous database environment is provided through standardization on the ESRI ArcSDE middle-ware application. Geographic information systems (GIS) Web mapping applications and third-party mapping applications (including CADD) access geospatial databases through ArcSDE or, alternatively, through an “ESRI SQL API” based on ESRI’s ArcObjects development tools. It is significant that third-party applications are directed to the geospatial database through the ESRI SDE API. Other essential components at the basis of the eGIS architecture are not addressed by SDSFIE, and client applications access them through other means. These components include data catalogs, raster data sets, and public and private data services used by USACE.

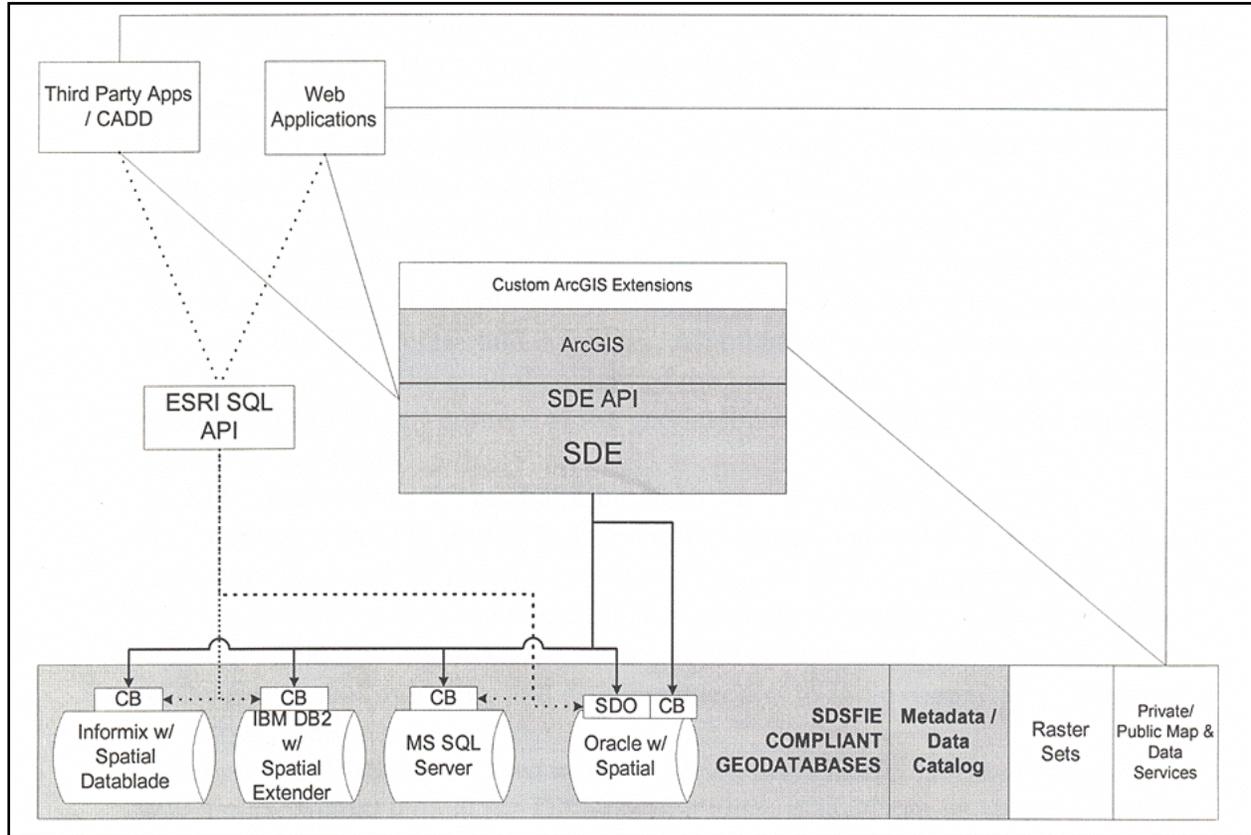


Figure 2-3. Corps Enterprise Architecture for GIS

Chapter 3 Geospatial Technologies and USACE Project Management Business Process

3-1. Purpose

The purpose of this chapter is to give specific guidance on how geospatial technologies integrate in the Project Management Business Process (PMBP) and how the PMBP can be applied to eGIS. General guidance covering the PMBP is available in ER 5-1-11.

3-2. Definitions

a. PMPB – The way USACE conducts the business required to deliver quality projects and services including internal support services. The PMBP applies to planning, development, and management of programs and projects at all echelons of USACE.

b. Project Delivery Team (PDT) – The group or groups assembled by USACE to make the PMBP work. USACE draws on its diverse resources to assemble strong multidisciplined PDTs that are unlimited by geographic or organizational boundaries. The PDT is responsible and accountable for delivering a quality project to the customer.

c. Project Management Plan – A guide for quality project delivery for the PDT. Purpose is to help maintain a constant focus on project delivery and customer service.

d. eGIS Program Management Team – A group of technical experts that guide the Command in the implementation of geospatial technologies and eGIS.

3-3. Applications and Analysis

a. General applications and analysis. GD&Ss are successful when they are implemented in a way consistent with a corporate approach and meet the needs of users. The role of GD&S in project execution can be minimal or significant, depending upon the project. Alternative analysis is a required part of most projects. GD&S can support the alternative analysis, as well as help illustrate existing conditions. For regional or watershed projects, GD&S are central for integrating science and engineering data. The use of spatial analysis in the planning process is important, because it allows for more scenarios to be explored inexpensively. Using GD&S throughout the cycle of a project has the following potential:

- (1) Access and integrate more data.
- (2) Support better and more defensible decisions.
- (3) Result in a stronger study.
- (4) Support environmental assessments.

b. Examples of using geospatial technologies to support USACE traditional work. USACE has a great diversity of GD&S applications including Dredge Disposal Permitting and Analysis, Environmental Restoration, Resource Management, Habitat Analyses, Environmental Change Detection, Aquatic Plant Tracking, Historical Preservation, Hydrology and Hydraulics, Channel/Inland Waterways Maintenance,

Emergency Response, Flood Plain Mapping, Real Estate/Cadastral, Master Planning, District/Construction Management, Socioeconomic Analysis, and Geologic/Geomorphic Analysis. These applications support both the USACE civil and military missions. They emphasize providing access to geospatial data and rendering the data into information through quantitative and qualitative analyses and visual products. Through spatial analysis, GD&S are powerful decision-support tools.

c. District GD&S application categories. GD&Ss at the District level are employed for geospatial data analysis in support of USACE projects. Numerous District-level data sets are geospatial in nature and are best accessed and managed by using GD&S technologies. Among the means of access are visualization, spatial query, and spatial analysis geospatial data integration. These technologies support basic analysis and can provide modeling support. The result is a focusing of resources to support both quantitative and qualitative decision-making in the District mission areas and prepare support materials for the Division and Headquarters.

d. Division and Headquarters GD&S application categories. GD&Ss at the Division and Headquarters levels are typically business information systems that can access and display information spatially, such as the geospatial functionality in CorpsMap, Digital Project Notebook, Engineers Link, and the GIS module of O&M Business Information Link (Operations, Maintenance). As Headquarters and Division participation increases on project-related PDT's, there is a growing need for more integrated geospatial application tools at all levels of the organization. Integrated application tools supporting both the science and business of USACE are required at all levels of the organization.

e. Laboratory GD&S application categories. GD&Ss at the laboratory level are complex with many unique analysis and modeling applications in a variety of advanced research areas, including project support to Districts. Advanced GD&S projects at USACE laboratories include terrain visualization, modeling and simulation of environmental phenomena, model integration, hyperspectral analysis of imagery to support change detection, data dissemination using Internet technology, and applications research. Through the Civil Works Geospatial Research and Development Program, District needs as well as strategic GD&S issues are addressed.

f. Sample GD&S. USACE has many application areas for GD&S. As mentioned, GD&S can be applied to each mission area USACE executes. A clearinghouse of USACE projects for GIS is located at <http://www.nww.usace.army.mil/apps/tscwrc>. This site documents the use of GIS for various projects throughout USACE.

3-4. The Role of Geospatial Technologies in the Project Management Business Process (PMBP) Project Delivery Team (PDT)

a. Because the business of USACE is science and engineering, the associated scientific and engineering technologies are part of the PMBP and the Project Management Plan (PMP). The use of geospatial technologies in a project should be addressed throughout the life of the project. Furthermore, geospatial technologies should play a key role in the project.

b. At the project initiation phase, the presence of geospatial expertise is important to determine how large a role geospatial technologies will play (see Figure 3-1). If this role is to be significant, a geospatial specialist is required to be on the PDT. This team member has the following responsibilities:

- (1) Educate the project managers, the PDTs on which they serve, and the District in general.

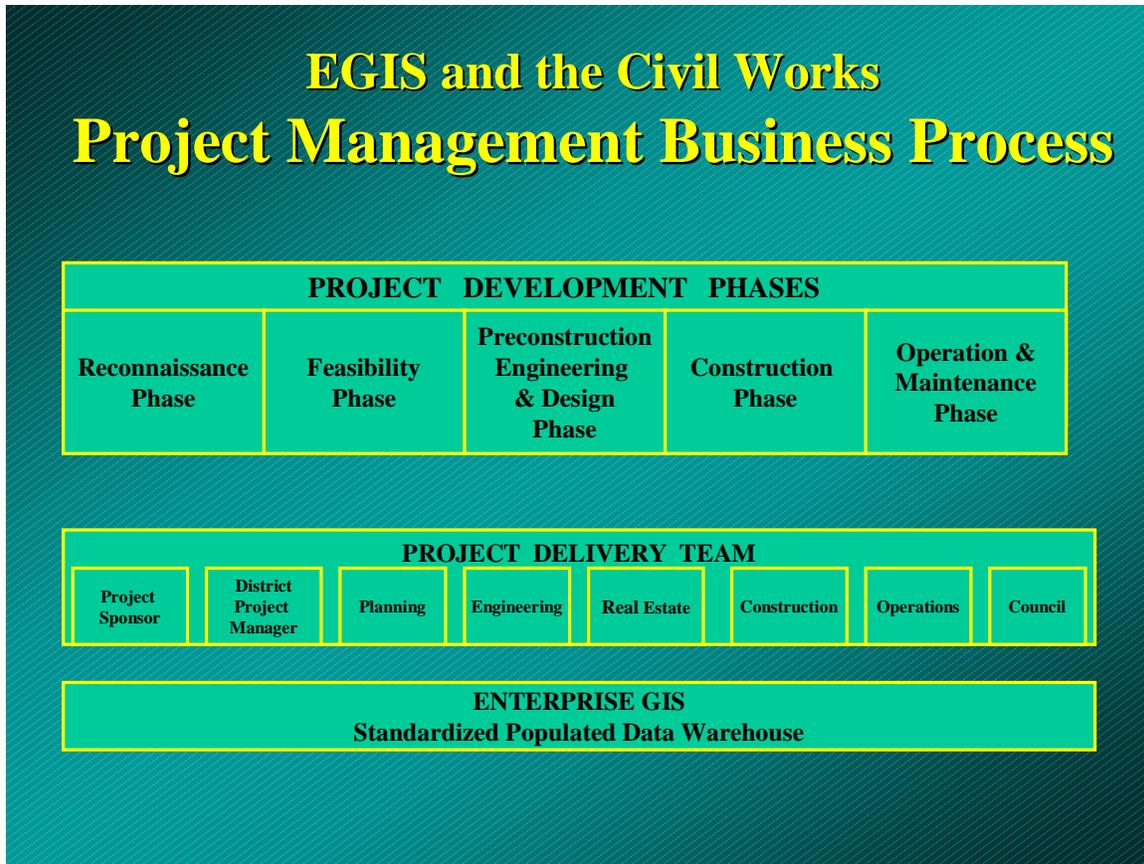


Figure 3-1. PMBP and eGIS

(2) Identify geospatial data requirements of the project and ensure that the guidelines outlined in Chapter 7 of this manual are followed for using existing data and for collecting new data (metadata, standards, etc.).

(3) Identify geospatial application and model requirements needed for the project. If a geospatial technology application needs to be developed, development should follow the guidelines outlined in Chapter 6 of this manual.

(4) Ensure that the specific PMP includes a component for managing geospatial data that includes costs and specific deliverables.

c. The extent of project resource requirements depends upon whether data and tools already exist. Environmental and planning studies typically require small-scale data; these studies can use public domain data or data USACE licenses. Construction and Engineering projects typically require large-scale data that must be collected. Regional studies require both large- and small-scale data that is integrated with nongeospatial data.

d. Civil works projects that cover large spatial areas require organized coordination specifically related to collection and mapping activities. For example, the Comprehensive Everglades Restoration Plan (CERP) is a civil works environmental restoration project that covers a spatial area of 18,000 square miles. The data collection and mapping requirements for this project involve Federal, State, and local agencies. To

coordinate, to avoid duplication of effort, to make spatial data available to diverse users, and to comply with State and Federal law, the Everglades Restoration Data Management Plan was established as part of the overall CERP. This plan was developed by members from Jacksonville District as well as representatives from Federal and State agencies. It addresses such issues as spatial data standards (GIS, surveying, mapping, and CADD) to ensure that geospatial data collected for CERP meets the needs of all its members. The CERP Data Management Plan is an example of applying the PMBP to geospatial data management in support of a civil works project. For further details on this plan, access http://www.evergladesplan.org/pm/progr_data_mgmt_plan.cfm.

e. When Data Management Plans are developed, approval is important from the Project Review Board (PRB) as well as high levels within other agencies. PRB support and involvement are critical for the success of the data management activities and the overall project.

3-5. Applying the PMBP to eGIS

a. eGIS) is a change in the way USACE has traditionally collected and accessed geospatial data for mission and project support. The concept of eGIS is not only to collect/purchase data in support of a specific project or mission, but also to collect/purchase that data for reuse in support of all of USACE (see paragraphs 2-8 and 2-9).

b. When a Command commits to implementing eGIS, a PDT is established by the Command's Geospatial Program Management Team. This eGIS PDT is then responsible for developing and executing the eGIS Project Management Business Process (see Chapter 4).

Chapter 4 Geospatial Data and Systems (GD&S) Organizational Structure

4-1. Background, Responsibilities, Location of GD&S in a Command

a. This chapter describes an organizational model for GD&S usage within USACE. It can be used as a guide in determining the level of GD&S functionality and responsibility that is appropriate for each Command. The organizational model is intended to help address some of the issues raised in the U.S. Army Corps of Engineers Geospatial Data and Systems Management Report (draft, May 2000), which can be accessed at <http://gis.usace.army.mil/>.

b. The location of GD&S within a Command is a determination to be made at the Command level. All business areas in USACE use GD&S. GD&S functionality should be made available to all USACE mission areas.

(1) *Districts.*

(a) Each District shall establish an eGIS PDT to develop a District Program Management Plan to establish an integrated infrastructure to support geospatial activities across the District. Each Division shall establish an eGIS Program Management Team (PMT) made up of District GD&S Managers. The eGIS PMT is to develop a regional plan to integrate the geospatial infrastructure across the Division.

(b) The Districts are to have fully functional geospatial data systems to meet project needs and mission requirements. This includes the GD&S necessary for data collection and database creation, geospatial analysis, and product generation. GD&S activities are distributed across the various functions in the District and integrated through eGIS (see Chapter 2).

(2) *Divisions.*

(a) The Divisions typically require less GD&S functionality than the Districts. The functionality required allows Division staffs to view, using commercially available tools such as ArcView or an Internet browser, geospatial data products created by the Districts. The Divisions can use these sources to make internal management decisions, conduct executive briefings, maintain an overview of Division activities, and coordinate GD&S activities. The Divisions must create the appropriate metadata for any in-house data sets made available to the National Geospatial Data Clearinghouse. Division geospatial viewers shall be developed in coordination with Headquarters' corporate viewing tools.

(b) The primary roles of the Division with respect to GD&S are to foster coordination and communication among the Districts and to promote eGIS within the Division. Each Division is to serve as a GD&S advocate by hosting technology exchange meetings among its respective Districts and by fostering a coordinated enterprise approach throughout the Division. Divisions may choose to conduct meetings through in-person meetings, teleconferences, video teleconferences, or Web meeting tools. An in-person meeting once a year is advisable.

(3) *Corps research facilities.*

(a) ERDC comprises seven laboratories. These laboratories require complete geospatial data systems functionality to meet their research and customer needs. ERDC does not have a central center of geospatial technology research and development. The Topographic Engineering Center (TEC) is involved in tactical

military GIS activities; imagery acquisition; and survey, mapping, and GPS technologies. The Remote Sensing/GIS Center at the Cold Regions Research and Engineering Laboratory (CRREL) develops emergency management and water control applications using remote sensing and GIS technology. The CADD/GIS Technology Center within the Information Technology Laboratory (ITL) specializes in facility management CADD and GIS applications, as well as standardization of geospatial database schemas and data dictionaries. The Construction Engineering Research Laboratory (CERL) develops GIS tools and models for environmental and facilities management on military installations. The Environmental Laboratory (EL) develops geospatial technology in support of environmental issues associated with civil works projects. The Coastal and Hydraulics Laboratory (CHL) develops watershed, groundwater, and surface sediments management and coastal process tools using geospatial technology. In addition to ERDC, the Hydrologic Engineering Center (HEC) specializes in using geospatial technologies to support flood inundation control along USACE waterways. The Civil Works Geospatial Research and Development Program is the focal point for geospatial technology research and development applied to civil works functions.

(b) To take advantage of emerging technology, Geospatial Data and Systems Research and Development (GD&S R&D) must be flexible within Corps research facilities. However, appropriate standards need to be used and metadata generated for all data sets and tools. Using standards in R&D efforts will aid in transferring the technology to the field, and metadata will increase the data life cycle. ERDC shall make the metadata for data sets available to the NSDI Clearinghouse, when appropriate. Database development that ERDC performs for military and civil works District offices shall use the applicable data standards and be documented appropriately with Federal Geographic Data Committee (FGDC) compliant metadata (see Chapter 7).

(4) *Headquarters.*

(a) Headquarters is responsible for maintaining corporate geospatial databases, such as Civil Works Project Data, District/Division Boundaries, Military Boundaries, and USACE Inventory of Dams. As corporate geospatial databases are developed, they are to be placed on the Web and metadata indexed to the NSDI Clearinghouse.

(b) Through the Headquarters Geospatial Program Delivery Team, Headquarters is responsible for developing and maintaining a corporate viewer enabling all national databases as well as Division and District data sets to be viewed using Internet GIS capabilities. This viewer, known as CorpsMap and accessed at <https://corpsmap.usace.army.mil/>, enables quick and easy access to how USACE serves the public and the military. By supporting the development of project and national databases through CorpsMap, Headquarters imposes a fundamental level of integration on the data.

4-2. GD&S Manager

a. The position of GD&S Manager (formerly GD&S Point of Contact (POC)) is a requirement of ER 1110-1-8156. USACE Division Engineers, District Engineers, and Laboratory Directors will appoint a GD&S Manager to serve as the liaison between their Command and HQUSACE (CECW-EE) on GD&S issues. The GD&S Manager is also responsible for disseminating information related to GD&S throughout their Command's geospatial data community, including field offices. Commands may opt to internally maintain separate POCs for GIS, CADD, Remote Sensing, and Surveying and Mapping. But the GD&S Manager will be cognizant of ongoing and planned efforts in these areas, and will be the focal point for information exchange between the Command and HQUSACE. The GD&S Manager, along with the Command's Geospatial Program Management Team, is responsible for providing guidance on implementing GD&S into project work flow. The GD&S Manager should also provide initial, limited guidance to Project Managers and

operations on the potential use of geospatial technologies for the project and operations. A database of GD&S Managers is maintained at <http://gis.usace.army.mil/>.

b. The GD&S Manager may also be asked to serve on committees or groups to develop GD&S policy or implement the GD&S strategic focus. When a GD&S Manager works on a specific initiative, HQUSACE will pay travel and per diem costs to the District Office. The GD&S Manager may also be asked to serve on State or local groups involved in coordinating regional GD&S activities. Participation in such groups is highly encouraged, but is ultimately at the discretion of the Command. However, funding for such participation is not provided by these groups or their members. Therefore, the Command must determine whether funding is available. The Command may authorize the use of project funding when there is a direct relationship between the coordination group's activities and the particular project.

c. The GD&S Manager has the following responsibilities:

- Serves as liaison between the Command, the Division, and HQUSACE on GD&S-related issues.
- Provides limited technical guidance on implementing GD&S technology into project work flow.
- Provides updated Digital Project Notebook information to TEC by 31 December each year.
- Coordinates submission of metadata to the Corpsgeo1 site, to be discussed in paragraph 7-3b(1)(a).
- Prepares internal guidance on metadata submission requirements.
- Coordinates and ensures compliance with all metadata requirements.
- Reviews District Web pages on the USACE Clearinghouse Node and provides changes to the Corpsgeo1 Webmaster by 31 December each year.
- Serves as ex officio member of the Command's eGIS PDT.
- Represents the District on the Division eGIS PMT.

d. To effectively represent the Command, the GD&S Manager should have a good to excellent understanding of GD&S technology and related technical issues. If necessary (because of lack of academic credits or hands-on experience with GIS-related technologies), the GD&S Manager must attend USACE's Proponent-Sponsored Engineer Corps Training (PROSPECT) courses: Introduction to GIS (Course #205) and Intermediate GIS (Course #167). These courses integrate information from a variety of GD&S sources. Since the GD&S Manager is responsible for providing technical guidance on implementing GD&S technology into project work flow, a good to excellent understanding is required of integration issues.

4-3. HQUSACE GD&S Coordination

The Engineering and Construction Division, Directorate of Civil Works, HQUSACE (CECW-E), serves as the focal point for establishing geospatial policy for USACE and integration of geospatial technologies into USACE work flow in an organized fashion. CECW-E is the Headquarters proponent for the CADD/GIS Technology Center, the Remote Sensing/GIS Center, the Survey and Mapping Center of Expertise, the Photogrammetric Center of Expertise, and the Joint Airborne Coastal Mapping and Charting Center.

a. HQUSACE Geospatial Data and Systems Manager. CECW-E will appoint a GD&S Manager for USACE to coordinate representation on the FGDC, act as technical monitor for geospatial work on the Civil Works R&D program, and serve as the Headquarters proponent for geospatial PROSPECT courses.

b. HQUSACE Geospatial Project Delivery Team (PDT). The HQUSACE GD&S PDT is chaired by CECW-E and is composed of HQUSACE personnel who play a role in GD&S, and addresses GD&S issues from a corporate perspective. Each participating HQUSACE Directorate, such as Information Management, Real Estate, Civil Works, Military Programs, and Research and Development, will nominate a member to this committee. The PDT will meet at least twice a year.

4-4. USACE District Commands

a. USACE District Commanders. ER 1110-1-8156 requires District Commanders to perform the following two actions:

- Appoint a GD&S Manager to act as a liaison between the Command and HQUSACE/CECW-E (see paragraph 4-2).
- Certify that the Command has accessed the Clearinghouse, contributed metadata to the Clearinghouse, determined any needed geospatial data that are not available from an existing source, and (4) ensured that possible data collection partnerships have been explored. This certification, included as Appendix B in ER 1110-1-8156, must be submitted to USACE annually as part of the Civil Works Budget submittal.

b. eGIS PDT. The eGIS PDT, formerly the GD&S Technical Subcommittee, is a requirement of ER 1110-1-8156. The purpose of this team is to promote interoperability among the various GD&S efforts within the USACE Command from a corporate perspective. The eGIS PDT works with the Command's PRB or Information Resource Management Steering committee, implementing geospatial technologies in the Command, to address funding. In previous guidance, the District was directed to have an Oversight Committee to guide the District's GD&S activities. Under the new model, the PRB and Information Resource Management Steering Committee are encouraged to take on this role. Representatives from H&H, Corporate Information, Survey, Emergency Management, Real Estate, Regulatory, Planning, Resource Management and Operations shall all be members of the eGIS PDT.

c. eGIS PDT responsibilities. eGIS PDT responsibilities are as follows:

- Through the GD&S Manager, work with the Command's PRB and Information Resource Management Steering Committee to ensure that geospatial technologies are consistently implemented with Command support to ensure a high level of interoperability.
- Develop, review, and update the Command's eGIS Geospatial Project Management Plan (see Chapter 5).
- Ensure that the Command documents new (post-January 1995) geospatial data using the FGDC "Content Standard for Digital Geospatial Metadata" (FGDC 1998a).
- Ensure that the Command documents existing (pre-January 1995) geospatial data to the extent practical.
- Ensure that the Command submits metadata to the Clearinghouse.

- Ensure that the Command utilizes the Clearinghouse to determine if the required data already exist before spending Federal funds on data collection or creation.
- Ensure that the Command provides public access to geospatial data within public law.
- Assist in the advancement and application of GD&S technology within the Command.

4-5. Staffing GD&S Positions

a. USACE Commands are not required to create new positions to support the requirements of ER 1110-1-8156. As GD&S technology advances within the organization and becomes an integral part of conducting the mission, GD&S skills will become part of many job descriptions. Commands may want to establish new positions to effectively use GD&S technology. Although this paragraph provides some guidance on GD&S staffing, it does not mandate establishment of specific positions.

b. Currently, GD&S positions have no formal titles in the Federal Civil Service. However, specific GD&S skills are included in some position descriptions and even used in informal titles, such as GIS Specialist, in job announcements. Attempts to develop formal GD&S titles in the past have not been successful and are unlikely to be successful in the current environment, which emphasizes general categories to promote staffing flexibility. Sample GD&S functions are listed in Table 4-1. How these functions are implemented and staffed is up to the Command. Representative paragraphs for GD&S-related positions are provided in paragraphs c(1)-(5) below. Sample GD&S job descriptions are provided in Appendix E. Neither the sample functions nor the job descriptions are intended to be a complete, exhaustive list of personnel or staffing requirements.

Function	Representative Responsibilities
GD&S Manager	GD&S Command Manager, coordinates the GD&S efforts within the USACE Command ensuring they dovetail with Division eGIS effort.
Geospatial Data Custodian	Acts as a geospatial data librarian or data steward. Implements data validation procedures and certifies data before it is posted to Intranet or eGIS.
Database Development/Collection	Spatial Data Standards for Facilities Infrastructure and the Environment and metadata collection. The responsibility of everyone collecting geospatial data throughout the Command.
Data Distribution	Responsible for distributing data and metadata via Intranet or Internet.
Visualization	Knowledge of cartography and graphics. Responsible for working with subject matter experts throughout the District in the development of maps, graphics, and visualization products.
Spatial Analyst	Knowledge of cartography and geography. Responsible for working with subject matter experts throughout the District in applying GIS tools to a project or study.

c. The GD&S Manager must understand GD&S technical issues and be a senior-level employee who understands the USACE mission. To effectively coordinate GD&S at a Corps District office, the GD&S Manager should be a GS 12/13 Physical Scientist, Geographer, Engineer, Computer Specialist, or other qualified title.

- (1) *Spatial analyst skills.*

(a) Responsible for planning and executing studies relating to physical and cultural environments for use in USACE civil works projects and military activities/operations. Duties and responsibilities require knowledge of and experience with GD&S, computers, the geographic sciences, and digital geospatial data processing. Must be able to design and build new GD&S applications using commercial software tools. Provides expert knowledge to other engineers and scientists (e.g., geologists, geographers, hydrologists, mathematicians, ecologists, and physicists) in setting up and conducting programs and projects. Formulates conclusions from spatial analyses to supplement that of the lead scientist or program manager.

(b) Plans and directs field studies to collect data to determine the quantitative relation between various environmental factors and components of structural and nonstructural alternatives for civil works and military projects. These studies include on-site data acquisition, airborne remote sensing missions, use of conventional surveying techniques, and use of automatic sensing and recording instrumentation.

(c) Participates in the directions of office studies. Negotiates with other offices (USACE Districts and Divisions, U.S. Department of Agriculture, U.S. Geological Survey, etc.) and organizations (universities, research institutions, and commercial concerns) for existing information or cooperative work. Relies on own professional skills to review, interpret, and analyze information; formulate approaches; reach conclusions; and make recommendations. Develops methods and performs studies involving the comparison of geographical regions and specific sites for the purpose of determining degrees of analogy.

(d) Performs administrative duties appropriate for the technical work described. Directs the work of professional and nonprofessional employees of lower grade, and checks performance for quality of work and rate of performance. Responsible for knowledge and observance of all regulations applicable to the work described.

(2) *Visualization skills.* Responsible for preparing animations, models, Digital Terrain Models, maps, graphics, Web pages, displays, and other visual devices for conveying information related to civil and military programs. Duties and responsibilities require knowledge of and experience with GD&S, computers, the geographic sciences, graphic and cartographic design, and digital geospatial data processing. Must be able to lay out and produce hard copy and electronic output for presentation of various physical and cultural features. Provides expert knowledge to other staff (e.g., geologists, geographers, hydrologists, mathematicians, ecologists, and physicists) in presenting information in an aesthetic and visually appropriate manner. Must have experience with using three-dimensional data for the purposes of visualization and presentation. May work with other team members on issues of Americans with Disabilities Act, Section 508, compliance.

(3) *Data distribution skills.* Responsible for providing data to internal and external users. Duties and responsibilities require *knowledge* and experience with GD&S, computers, the geographic sciences, and digital geospatial data processing. Must be able to discern user needs from basic requests, use metadata to locate data sets, and generate appropriate formats (compact disk, compressed file, etc.) for the user. Advises other staff and external customers on accessing and distributing USACE data. Often works with other team members to distribute geospatial data to external customers. May use the Internet and FTP to distribute data.

(4) *Database development/collection skills.* Responsible for developing and acquiring geospatial data using appropriate tools and sources. Duties and responsibilities require experience with GD&S, computers, geographic sciences, various source materials, and digital geospatial data processing. Must be capable of converting data from various graphic and nongraphic formats to electronic formats, and from various electronic and hard copy media. Must have firsthand experience with FGDC-compliant geospatial data documentation (metadata). Provides expert advice to other staff on the most effective and timely methods for data development, collection, and acquisition. May work with GPS, pen-based computers, and other field collection devices. Coordinates with counsel on data license and access issues related to data acquisition from

external sources. Often works with external personnel and organizations to acquire existing data. May use the Internet and FTP for acquiring external data.

(5) *Data custodian skills.* Responsible for geospatial data organization and maintenance in coordination with GD&S users. Duties and responsibilities require experience similar to Database Development/Collection. The data custodian function also requires experience with developing and maintaining database structure, database normalization, and indexing. A data custodian must have firsthand experience with the specific database management software that the Command uses. In consultation with GD&S and non-GD&S staff, develops data validation and certification routines and policies to ensure that data are ready for release to customers and the public. May work with data distribution staff to distribute geospatial data to external customers.

4-6. Professional Qualifications and Training

a. In general, each GD&S professional should have a background in a discipline that relies on spatial or locational information. Such fields include geography, cartography, remote sensing, civil engineering, biology, oceanography, urban and regional planning, agronomy, forestry, landscape architecture, and geology. Course work in GD&S topics is also crucial to GD&S positions.

b. In the present environment, the progression for a GD&S professional is similar to that of the apprentice or journeyman master sequence in the crafts. Commands should be aware that GD&S professionals require continuing education to maintain technical proficiency and currency with hardware and software.

c. A number of sources exist for GD&S training, which makes entry into the area and continuing education readily available. For a list of GIS education and training resources, see the education section accessible at <http://www.tec.army.mil/gis/index.html>.

(1) *USACE training.*

(a) The PROSPECT courses are developed to meet unique USACE training needs. These courses are taught by ERDC or HEC employees or by contractors, and some provide continuing education credits. Current geospatial PROSPECT courses include GIS Introduction, GIS Intermediate, GPS/GIS Applications, Remote Sensing Course, Flood Damage Tools – GIS, and GIS-Hydrologic Engineering. The point of contact (POC) for PROSPECT courses is

Commander
U.S. Army Engineering Support Center, Huntsville
ATTN: CEHNC-TD-RG (Registrar)
P.O. Box 1600
Huntsville, AL 35807-4301
256-895-7421/7425

(b) The Training Symposium on Geospatial Technology is sponsored by the CADD/GIS Technology Center to transfer new technology developments to USACE users. This symposium is held every 2 years and provides short courses, plenary sessions, and technical sessions. Exhibits of commercial and USACE capabilities are provided. Announcement of the symposium is made by a memorandum from HQUSACE (CECW-EE).

(2) *Other DoD training.* The *National Geospatial-Intelligence College* (NGC) at Fort Belvoir, Virginia, has several courses related to GD&S technologies including database production, remotely sensed imagery, GIS, cartography, and vendor-specific software training. The POC for NGC is:

NGC
College Administration and Policy
Office: 5855 21st Street, Suite 101
Fort Belvoir, VA 22060-5921
703-805-3266
<http://earth-info.nga.mil/nga-bin/td/db.cgi?db=td&uid=default>

(3) *Academia.* Hundreds of colleges and universities are now offering GD&S programs. These programs are often integrated with well-established academic departments such as geography, environmental science, geology, forestry, civil engineering, or agronomy. Numerous community colleges offer hands-on training in specific software, and many universities offer GD&S short courses. A listing is available in the “Directory of Academic Departments Offering GIS Courses,” which is published by The American Society for Photogrammetry and Remote Sensing and the American Congress on Surveying and Mapping.

(4) *Vendors.* Vendors provide training in the operation of software (as opposed to universities that emphasize concepts and applications to problems). This training may be acquired as part of a GD&S procurement through user groups and workshops, or through the CAD2 contract, ESRI Blanket Purchase Agreement, and other contracts.

(5) *On-line courses.* Many vendors and societies offer on-line training at affordable prices.

(6) *Professional meetings, conferences, and symposia.* Many professional organizations conduct technical meetings and offer workshops and training in GD&S technology. A few are listed below:

- The American Congress on Surveying and Mapping (ACSM)
Suite 100, 5410 Grosvenor Lane, Bethesda, MD 20814-2122
- The American Society for Photogrammetry and Remote Sensing (ASPRS)
Suite 210, 5410 Grosvenor Lane, Bethesda, MD 20814-2160
- The Geospatial Information Technology Association
(formerly Automated Mapping/Facilities Management International)
14456 East Evans Avenue, Aurora, CO 80014-1409
- The Association of American Geographers (AAG)
1710 Sixteenth Street, NW, Washington, DC 20009-3198
- The Urban and Regional Information Systems Association (URISA)
Suite 304, 900 Second Street, NE, Washington, DC 20002

Some Federal Government and State Government conferences and meetings are also dedicated to GD&S. For example, USACE is a key sponsor of the CADD/GIS Technology Symposium and Exposition. This triennial meeting brings together military and civilian GD&S technology professionals from the Federal and private sectors.

4-7. Required Elements

a. Each Command shall appoint a GD&S Manager to serve as the liaison between the Command and HQUSACE for GD&S issues.

b. Each Command shall establish an eGIS PDT.

Chapter 5

Enterprise Geographic Information Systems Project Management Plan (eGIS PMP)

5-1. Introduction

a. Developing a corporate strategy for implementing geospatial technologies is the first step to implementing an enterprise solution. All USACE Commands are required to develop and maintain an eGIS PMP. The eGIS PMP is intended to fulfill the Mission Needs Statement and Concept Studies Decision requirements of the Life Cycle Management of Information Systems. Some of the considerations used by the Commands in developing their Implementation Plans (under 1996 guidance) include resolution, format, and use of existing digital data; anticipated needs for future data and a GD&S model; compatibility of systems divisionwide; roles and responsibilities; information management support; coordination of GD&S needs and uses across disciplines (e.g., real estate, engineering, planning and construction, operations); and costs.

b. Development and execution of an eGIS PMP are necessary to guarantee the successful and effective operation and maintenance of a GD&S project. The eGIS PMP serves to supplement or update the GD&S Implementation Plan required in the August 1996 edition of this manual. Thus, the eGIS PMP is essentially a reiteration of the commitment and plan for GD&S at the Command. Furthermore, the eGIS PMP is not a new requirement but a continuation of the requirement defined in the original engineer manual. The eGIS PMP is a Command's invaluable communication tool for implementing eGIS.

5-2. eGIS PMP Development

a. The eGIS PMP is intended to be a flexible document that provides the conceptual framework and coordinating principles for development of eGIS. It is an update of the GD&S Implementation Plan that each District should have completed under the August 1996 edition of this manual. The GD&S Implementation Plan should be reevaluated as part of the development of the eGIS PMP to ensure that both documents are consistent rather than contradictory.

b. The eGIS PDT has an important responsibility in developing the eGIS PMP. It must ensure that each part of the Command has an opportunity to influence the eGIS PMP and to take ownership of both the process and the document. Because the eGIS PMP affects almost the entire organization, the senior managers may be requested to sign off on the eGIS PMP before final signature by the Commander. This raises visibility and commits managers to the plan.

c. eGIS efforts can be either enterprisewide or project-specific. Project-specific eGIS activities serve to help build the eGIS. The data of each project become part of the greater enterprise geospatial database, and thus available for supporting multiple other projects.

5-3. eGIS PMP Contents

Contents of the eGIS PMP should be kept simple. Most elements of the contents are included as part of the Implementation Plan Contents prescribed in the 1996 edition of this manual, although the specific section titles may have been different. The following list is a recommended guide for the elements of the eGIS PMP (see Table 5-1).

**Table 5-1
Comparison of eGIS PMP Elements with GD&S Implementation Plan Sections**

eGIS PMP Element	Previous Implementation Plan Paragraph ¹
Project Title	
Team Members and Stakeholders	
Scope of the eGIS	<i>b.</i> Scope; <i>e</i> (1) Scope of Existing and Proposed Systems; and <i>f.</i> Life Cycle Costs and Justification
Funding	
Schedule	<i>g</i> (4) Time Frame
Work Breakdown Structure	<i>g</i> (4) Time Frame
Quality Objectives	<i>c.</i> Design Guidance and <i>d.</i> (6) Data Quality
Acquisition Strategy	<i>g</i> (3) Acquisition Strategy
Change Management Guidelines	<i>h.</i> Evaluation Plan
Communication Strategy	
Issue Resolution Process	
Assumptions Inherent in the Plan	
GD&S Program/Project Evaluation Plan	<i>h.</i> Evaluation Plan
Approvals	

¹ Letters refer to paragraph 5-2 of the August 1996 edition of this manual.

- Project title.
- Team members and stakeholders.
- Scope of the eGIS (functions to be supported by eGIS, description of products, unique requirements, and system architecture).
- Funding (source, budget, reporting of expenditures, and establishment of Revolving Fund Account 5022 (RF5022) if applicable).
- Schedule (with appropriate entries in Project Management Information System, P2/P3E, etc).
- Work breakdown structure (who, what, when, resource estimates, milestones).
- Quality objectives (Command and customer expectations, applicable criteria and regulations).
- Acquisition strategy (identification of in-house and external resources to be used to develop the eGIS).
- Change management guidelines (how and when the eGIS PMP might change and who approves changes).
- Issue resolution process.
- Assumptions inherent in the plan.
- GD&S Program/Project Evaluation Plan.

- Approvals (signatures of eGIS PDT members and senior leadership).

5-4. Implementing the eGIS PMP

a. Once a Command has acquired the necessary approval to establish its eGIS, a number of management issues must be addressed. Critical among these issues is the need for upper management support. To meet this need, the Oversight Committee serves as an intermediary between middle and upper management.

b. USACE Command management must address the need for funding to support the PMP. Costs to be met by this funding cover the initial GD&S and geospatial data as well as operations and maintenance. Funds may be allocated to cover project costs, or the costs may be charged to Command overhead. Funding for GD&S implementation entails considering the life cycle and staffing costs.

c. The following costs must be considered for funding:

- Initial software licenses.
- Initial hardware.
- Modifications to existing hardware that may be necessary for upgrades.
- Modifications to existing software that may be necessary for new work environments.
- Applications development and software enhancement.
- Network implementation or modifications.
- Furniture and site modifications.
- Hardware installations.
- Software installations.
- Systems integration services.
- System testing.
- Staff training.
- Software tests.
- Data validation.
- Supplies, such as media for data and output.
- Data collection and conversion of old data sets to new formats.
- Data maintenance.
- Supplemental utility programs.

- Maintenance contracts on hardware and software.
- Future system upgrades.

Unique costs may be brought about by the requirement for posting geospatial data to the USACE NSDI Clearinghouse Node. Costs such as Internet connectivity and system administration should be incorporated into District-wide information technology costs. Costs associated with the NSDI Clearinghouse may include the following:

- Internet connectivity and system administration.
- Server hardware purchase and maintenance.
- Metadata creation for existing data sets.
- Maintenance of inactive data sets.
- Metadata distribution.
- Response to data requests from Clearinghouse users.

Once the implementation is underway, the management of expectations begins. The goal is to deliver some operational capability through a pilot project designed to demonstrate capabilities using an initial geospatial database. This serves to show the capabilities in a USACE environment, while delivering on a functional requirement; and achieve a first success, which should solidify management support. At the same time, this pilot project allows the beginning of staff training and provides a set of lessons learned for the larger implementations to follow.

d. Because the cost of using GD&S technology is significant, many District offices have established Revolving Fund Accounts. Revolving Fund Account 5022 (RF5022) is the primary GD&S facility account, although 5021 (CADD) and 5024 (GPS) may also support some GD&S initiatives. The RF5022 account can be funded four ways: Direct Charge, Standard Rate, Job Order, and Actual Cost. Details on establishing and funding a revolving fund account are presented in RM 37-2-10, Chapter 16.

5-5. Required Elements

Each Command shall develop an eGIS PMP (see paragraph 5-1a).

Chapter 6 Geospatial Data and Systems (GD&S) in USACE's Corporate Information Plan

6-1. Introduction

a. According to ER 25-1-2, an AIS is a combination of computer hardware and software, data, and telecommunications that performs functions such as collecting, processing, transmitting, and displaying information. Excluded are computer resources, both hardware and software, that are physically part of, dedicated to, or essential in real time to the mission performance of weapon systems. Using this definition, GD&S are considered AISs.

b. Life Cycle Management of Information Systems (LCMIS) is an analysis and control process applied throughout all phases of the life of an AIS or AIS modernization. It bases all programmatic decisions on the anticipated mission-related and economic benefits derived over the operating life of an AIS.

c. The purpose of this chapter is to address GD&S investments/activities that need to be entered into the Information Technology Investment Portfolio System (ITIPS); and put through the LCMIS process.

d. Table 6-1 summarizes GIS activity and whether ITIPS and LCMIS are required.

Table 6-1 GIS Summary		
Activity	ITIPS Data Entry	LCMIS Process
GD&S software purchase	Yes – use Support to Standard System EGIS	No – for commercial off-the-shelf
Customization and application development	Yes – if >50K	Yes – if >50K
eGIS data development	Licensed/Purchased Data – Support to Standard System EGIS	No
Surveying and mapping data collection	No	No

6-2. Information Technology Investment Portfolio System (ITIPS)

a. Background.

(1) TIPS is an automated tool for managing Information Technology (IT) for USACE, as required by the Clinger-Cohen Act. The purpose of the ITIPS is to identify USACE IT investment initiatives for planning, development, and/or operations. Information from the ITIPS is used to determine what IT initiatives should be funded, continued, or terminated.

(2) Information in the ITIPS is arrayed to make it usable vertically and horizontally at every organizational level throughout USACE. IT investments are categorized broadly to include AISs, Programs, Wide Area Networks/Local Area Networks (WANs/LANs), Office Automation, and Automated Engineering Tools. ITIPS provides the functionality to enter detailed budget information and generate an IT investment portfolio budget report for all USACE organizations. It supports the decision process for selecting, evaluating, and controlling IT investments. ITIPS serves as an integral component in developing the USACE IT budget.

(3) IT acquired and maintained by USACE activities, regardless of costs, must be entered and kept current in the ITIPS. This includes IT for all USACE functional areas, including business, scientific, technical administrative, and engineering applications. Also included is IT acquired in support of Research and Development (R&D) projects, i.e., office automation hardware and software in support of the mission and functions of the organization. Exceptions are as follows:

- Systems being developed or maintained or IT being acquired on a reimbursable basis for the sole use of customers outside of USACE.
- Any system developed as an integral part of internal R&D projects, when the system is not targeted for a production environment.

b. Categorizing GD&S in ITIPS.:

(1) The Guidance and Definitions for ITIPS FY2007 to FY2011 defines GIS as the COTS hardware and software used for mapping and analyzing things that exist and events that happen on Earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits that can be portrayed by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. All GIS initiatives will be linked in ITIPS to the Headquarters initiative eGIS, ITIPS number HCW04387, as follows:

(a) Headquarters level GIS Initiatives will use the IT Classification in ITIPS “Geographic Information System.”

(b) Field level GIS Initiatives will use the IT Classification “Support to Standard System Geographic Information Systems,” ITIPS number HCW04387.

(2) The intent of this guidance pertaining to GIS is that each District should have one entry in ITIPS documenting their consolidated approach to implementing GD&S throughout the Command, the Command eGIS financial requirements and IT plans.

6-3. Life Cycle Management of Information Systems (LCMIS)

a. LCMIS. This is a management process applied throughout the life of an AIS that bases all programmatic decisions on the anticipated mission-related and economic benefits derived over the life of the AIS. Significant investments in IT are preceded by mission analysis and an appropriate degree of work process revision to maximize anticipated benefits. In USACE, the levels of oversight for LCMIS rest upon the Chief Information Officer (CIO), the Regional CIO, and the local Chief of Information Management. The level of oversight is driven by estimated cost of the effort.

According to ER 25-1-2, LCMIS does not apply to the following:

- AIS development for non-USACE customers.
- AIS specifically designed as integral parts of USACE-owned Facility Support Systems.
- Any system developed as an integral part of internal R&D projects, when the system is not targeted for a production environment.

b. *LCMIS and GD&S.* While GD&Ss are information systems, USACE relies heavily on COTS software to perform geospatial information analysis. COTS products being used without customization or application development do not need to go through the LCMIS process. Only under the following circumstances must GD&S development go through LCMIS:

(1) Customization and/or application software development for internal USACE use, specifically commercial GIS that costs more than 50K. Since the customization or application will be based on COTS software, many of the LCMIS milestones are not necessary or can be minimized.

(2) USACE eGIS development, specifically for developing an eGIS solution.

c. *LCMIS phases applied to customization of COTS GIS software.* This subparagraph outlines a tailored LCMIS process for customizing COTS GIS software as indicated in ER 25-1-2. The intention is not to replace ER 25-1-2, but to provide guidance on what should be addressed specifically for GD&S as it applies to that manual.

(1) Information technology having developmental and deployment costs of less than 500K or total life-cycle costs estimated to be less than 1,000K are classified as IV C systems, and LCMIS oversight will be the responsibility of the local Director of Information Management/Chief of Information Management (DIM/CIM). Most of the application development that USACE is engaged in falls in the IV C category. If the customization effort is less than 50K, it should be considered an AET and does not have to be submitted to the LCMIS management process. However, it still must be entered into the ITIPS (see paragraph 6-2b(1)).

(2) GIS applications being developed by ERDC for the Civil Works R&D Program should be supervised by the appropriate Headquarters technical monitor or area manager, not by the local DIM/CIM. R&D software is developed corporately; therefore, it must have corporate oversight. The Headquarters technical monitor or area manager can delegate to local DIM/CIM as needed.

(3) For GD&S software development using COTS GIS software, the program strategy is to acquire COTS software and customize it by using either the incremental or the evolutionary process. This program strategy has a low software development risk and a relatively high return on investment (ROI). The ROI may include decrease in labor costs or increase in productivity. However, it more often includes things that are not as easily measured, such as more accurate or comprehensive decisions, a better product, or a more consistent corporate approach to solving a problem.

(4) According to ER 25-1-2, ITIPS should be used to capture and meet the requirements of LCMIS.

(a) *Mission need justification* – This phase is intended to focus primarily on functional business requirements, without specifically addressing technical solutions:

- Can the need be satisfied by a streamlined or improved manual process?
- Can the need be accommodated through an existing Information System (IS)?
- Is there an existing IS outside of the Command that has already been developed?
- Is a new/modified IS cost-effective?

As part of the mission need justification, Command is required to check the project Clearinghouse and send an email to ls-gds@usace.army.mil to see whether GIS application has already been developed. Mission needs statements can be entered into ITIPS using the description tab.

(b) *Phase 0* – Concept exploration and definition phase. The goal of Phase 0 is the development of a valid and optimized system concept that supports the required business processes and defines alternative functional and technical solutions for supporting those processes. Milestones for Phase 0 include the following:

- Brief concept to Commands' Senior Leadership. If an Integrated Product Team (IPT) is needed, the eGIS PDT can serve this purpose. If being developed through the Civil Works R&D program, briefing by the Field Review Group meets this milestone.
- Identify Project Manager, System Manager, and Functional Proponent. Since COTS is being used, minimizing development, these titles may all belong to one person.
- Develop initial Systems Decision Paper (SDP) as outlined in Section IV of Appendix C in ER 25-1-2. ITIPS can be used for capturing the necessary information that goes into a SDP. Again, since COTS is heavily used, software and architecture issues need to be addressed only as they apply to interfacing with an overarching Enterprise architecture. Probably the most important part of the SDP is to identify geospatial data requirements and to address data generation standard issues. Do geospatial data exist that the IS will be utilizing? Will the IS be generating geospatial data? If so, how do metadata get produced for the data and will the data be SDSFIE-compliant (See Appendix F)?

Developing an IS that requires geospatial data not yet collected or even existing is high risk, and should be addressed in the SDP. If the IS is generating geospatial data, these data must be documented (metadata) and SDSFIE-compliant so they can be used for multiple purposes for a longer period of time.

(c) *Phase I* – Demonstration and validation phase. The purpose of this phase is to establish the basis and rationale for migrating from documented requirements and concepts to actual development and implementation of the IS. Activities for Phase I include the following:

- Identify server requirements.
- Identify where the software and data will physically sit.
- Identify impacts of application to the network.
- Develop a test/demonstration approach.
- Develop the prototype application.
- If application is generating data, address data integrity issues.
- Further refine the SDP.

(d) *Phase II* – Development Phase. The development phase is the Life Cycle Management segment used to complete code generation and successfully conduct system tests and evaluation of the IS configuration. Since COTS software is heavily used, software testing of the COTS is not necessary. Software testing is restricted to testing the application (user-level testing) and network testing (how does running the application affect the network?). Activities for Phase II include the following:

- Perform software customization.

- Conduct application/network testing.
- Modify based on test results.
- Modify/convert legacy systems as appropriate.
- Plan operational/deployment phase.
- Plan training.

(e) *Phase III* – Production and deployment phase. The purpose of this phase is to complete deployment of the IS. This often entails establishing a Web site where the geospatial IS can be accessed or downloaded. If the deployment strategy is to load software, then a more rigorous deployment plan is needed.

(f) *Phase IV* – Operations and support phase. The purpose of this phase is to shift from development/deployment to operations/support. Again, because many geospatial applications are Web-enabled, this may only entail maintaining a Web site with documentation and current executables.

d. *eGIS and LCMIS*. Headquarters (CECW-EE) is responsible for developing an overarching LCMIS documentation for eGIS and entry in ITIPS. As of 2004, LCMIS for eGIS does not exist. Until Headquarters has developed LCMIS for eGIS, Commands should focus their efforts on development of an eGIS PMP (see Chapter 5).

6-4. Required Elements

Each Command needs to execute ITIPS and LCMIS for geospatial data and technologies as outlined in this chapter.

Chapter 7 Geospatial Data Overview and Standards

7-1. General

CADD and GIS are means to an end, rather than ends in and of themselves. That is, the technology helps users to perform a variety of tasks, but it does not satisfy any USACE mission objectives by virtue of its existence. Therefore, USACE has not mandated any particular CADD or GIS hardware or software platforms. Rather, USACE has focused on standardizing data and data life-cycle management to meet the many challenges today and tomorrow. This focus on standards and life-cycle management enables interoperability and provides an effective tool for USACE to manage the investments made in CADD and GIS technologies. The cost of developing and maintaining geospatial data is the most expensive and crucial part of implementing geospatial strategies. Standardization will enable the data collected by District or field offices to be used throughout the organization in an Enterprise implementation. In addition, strict adherence to Federal, national, and international standards will extend their usefulness to local, State, national, and international agencies. Strict compliance will also ensure that the data these other agencies collect will be compatible and interchangeable with USACE data sets.

7-2. Importance of Geospatial and Data Standards (GD&S)

The development of GD&S is adaptive and flexible in meeting the technological advances of today, the speed and accuracy of analyses, and the ongoing output of designs and displays. GD&S make possible the processing of greater volumes of shared data, and they enable a much larger audience to interpret and understand the data, whether for geospatial or other uses. To keep GD&S current and relevant requires regular refreshing in anticipation of emerging technologies. The maturation of geospatial technologies has resulted in the potential for wide use by many organizations. Standards, therefore, provide the interoperability and flexibility that allow users to adapt them to their specific environments.

a. Benefits of GD&S. The adoption of standards provides a multitude of benefits, such as the following:

- *Removal of barriers* – Standards enhance geospatial data exchange and sharing. The exchange mechanisms for the transfer of geospatial data between dissimilar systems are addressed by standards.
- *Improvement in data quality and configuration management* – Standards provide metadata to help organize and maintain the organization's internal spatial data.
- *Increased user confidence* – Standards provide confidence in the quality of the data, and they define data structure and content.
- *Greater access to geospatial data* – Standards widen the spectrum of available data that results in a broad range of choices available to the user community.
- *Integration of systems* – Standards enable the use of data across a wide spectrum of applications, thus maximizing effective use of systems.
- *Data collection* – Standards reduce duplication and overall costs of geospatial data collections.

- *Greater public access* – Standards extend the use of geospatial data in the public sector, resulting in an increase in the GD&S-user base due to data availability with an attendant diffusion of knowledge.

b. *Types of geospatial data standards.*

(1) Standards may be catalogued in several ways. Usually they are developed in either an informal or formal process, in reaction to or in anticipation of need. An informal process is developed by source of authority. An informal standard, or de facto standard, is exemplified by AutoCAD DXF. This is when the user community, through constant use, adopts a practice without any formal certification. A formal process for developing a standard requires certification by a government body or a professional organization. Types of geospatial data standards include the following:

- *Data modeling* – Either a conceptual or logical description of data organization.
- *Data content* – A definition of feature, attribute, and values.
- *Data symbology* – Specifies display and output symbol libraries.
- *Data quality reporting* – Provides a standard for data set quality reporting.
- *Metadata* – Data that describes the data set and includes information on its usage.
- *Data exchange and transfer* – Standards that define how data are exchanged or converted from one format to another.

(2) A number of organizations are involved with the formal process of developing standards. Many but not all of these organizations are given in Table 7-1 below.

**Table 7-1
Organizations with Formal Process of Developing Standards**

Level	Organization	Web Site
International	International Organization for Standardization (ISO)	www.iso.ch/iso/en/ISOOnline.frontpage
	ISO Technical Committee for Geographic Information/Geomatics (TC211)	www.isotc211.org/
	Open GIS Consortium	www.opengis.org/
	International Committee for Information Technology Standards (INCITS)	www.incits.org/geninfo.htm
	International Hydrographic Organization (IHO)	http://www.iho.shom.fr/iho.html
	Digital Geographic Information Working Group (DGIWG)	www.digest.org/About2.htm
National	American National Standards Institute (ANSI)	www.ansi.org/default.asp
	National Committee for Information Technology Standards (NCITS L1) Geographic Information Systems	www.ncits.org/tc_home/l1.htm
Federal	Federal Geographic Data Committee (FGDC)	www.fgdc.gov/index.html
	FGDC Standards Working Group	www.fgdc.gov/standards/organization/swg_organization.html
	CADD/GIS Technology Center	www.tsc.wes.army.mil/

(3) Another type of cataloged standards is based on the functionality that each addresses. This type is used in the area of Geospatial Data and Systems (GD&S) and is shown below:

- *Hardware and physical connection standards* – Pertain to the physical connection and cabling of hardware devices.
- *Application standards* – Impact the actual presentation and display of data in a GD&S, such as map design criteria.
- *Software standards* – Address the development of software and software documentation including macros.
- *Professional standards* – Establish levels of competency and training.
- *Network communication standards* – Address the protocols for the transfer of data and information from one computer system to another.
- *Data standards* – Address geospatial data transfer formats, accuracy, documentation, structure, content, and management. Note that these standards are further discussed in paragraph 7.3 below.

7-3. Geospatial Data Components and Applicable Standards

a. It is not the intent to describe in detail geospatial data. There are numerous books and published reference materials on geospatial data. It is the intent of this paragraph to describe geospatial data and identify applicable standards.

b. An entity or feature is a real-world phenomenon, such as a lake, river, house, etc. It can be modeled as a point, polygon, line, raster; but it is the thing being described. Entities, features, and geospatial data in general can be broken into three parts: the spatial component, the attribute component, and the metadata.

(1) *Spatial component.* All geospatial data has a spatial component or locational information associated with it. Locational information can take the form of latitude/longitude, State Plane coordinates, universal transverse Mercator coordinates, etc.; but in order for it to be integrated with other data sets, it must have locational information tied to a geographic system. Traditionally, survey data have been tied to local coordinates rather than a geographic reference system. CADD drawings for architectural, structural, mechanical, and electrical disciplines have not been tied to a geographic coordinate system. CADD civil/site layout drawings are traditionally tied to a State Plane Coordinate System. In order for CADD and survey data to be used in a GIS and an eGIS solution, the data need to be referenced to a geographic coordinate system. Appendix G addresses the technical aspects of georeferencing CADD data. Because today's software enables relatively easy conversion from one geographic coordinate system to another, it is not essential that eGIS efforts at the Districts all use the same geographic reference system; however, it is a good idea to identify a predominant reference system to which most data will adhere.

(a) *Datums.* To register and integrate different data sets, the data sets need to be on the same datum and coordinate system. North American Horizontal Datum 1983 (NAD83) and North American Vertical Datum 1988 (NAVD88) are the preferred datums for collecting geospatial data in USACE. The National Geodetic Survey (NGS) maintains NAD83 and NAVD88, and most State and Federal field offices have moved geospatial data collections to these datums. If other datums are being used, be aware that it will be difficult to integrate local data with regional or national efforts and NGS does not maintain older datums.

(b) *Scale and resolution issues.* The scale of digital data can be manipulated easily; however, the scale should not be made larger than the collection scale. For example, digital data generated from a 1:20,000 base should not be used for large-scale analysis. Increasing the scale/resolution of the collection scale and using it for analysis introduces spatial error into the analysis.

(c) *Spatial accuracy.* Spatial or positional accuracy refers to the accuracy of the location information. Horizontal accuracy is an estimate of the x-, y-positions of spatial objects. For example, “95 percent of the well locations are within 50 meters of their surveyed locations.” Vertical accuracy is an estimate of the z-positions of the spatial readings. For example, “95 percent of the elevation points are within ± 1 meter.” Most accuracy standards dealing with digital geospatial data have evolved from hardcopy map accuracy standards or photogrammetric standards and are being applied to digital data. The FGDC has endorsed the Geospatial Positioning Accuracy Standard, which consists of five parts. Part 3, “National Standard for Spatial Data Accuracy,” and Part 4, “Standards for A/E/C and Facility Management,” are directly related to USACE geospatial databases. Part 3 addresses accuracy of data smaller than 1:20,000, and Part 4 addresses accuracy of data larger than 1:20,000. In addition to Parts 3 and 4, Chapter 2 of the Photogrammetric Manual, EM 1110-1-1000, and Chapter 3 of the Hydrographic Surveying Manual, EM 1110-2-1003, outline USACE accuracy requirements.

(2) *Attribute component.* The attribute component, or the nongraphical component of the geospatial data, is the information about the geographic phenomena. For example, the information associated with a lake, such as the name of the lake, volume, discharge rate, etc., are all attribute information. Without the attribute information, the ability to perform spatial analysis is limited to automated mapping.

(a) Developing a database schema (database entity/attribute structure) is a continual process. The more data that are geospatially referenced and integrated into a GIS, the more data are seen as needing to be GIS-enabled. In an attempt to manage these data corporately and alleviate the expense of each District or functional area developing their own database schema, USACE has developed (through the CADD/GIS Center for Facilities Infrastructure and Environment) the SDSFIE.

(b) The SDSFIE is a set of data standards that defines the content of the database. It is endorsed by the American National Standards Institute and is an implementation of the FGDC content standards. The SDSFIE is a physical model and works with Environmental Systems Research Institute and Intergraph products. They provide a structure of the data model as well as mechanisms to transfer the data from one system to another. The SDSFIE is critical in developing the eGIS at District and project offices.

(c) The SDSFIE is most useful when used with an external database, such as Oracle, Informix, or Access. If the Command has not implemented an external database structure, the SDSFIE should be used as a data dictionary. SDSFIE compliance is described in Appendix F. The SDSFIE is updated annually with comments from users and with new information from other standards organizations. Tools are provided with each release to upgrade user databases. The SDSFIE and tools can be downloaded from <https://tsc.wes.army.mil/>.

(3) *Metadata component.* Geospatial metadata refers to the documentation of geospatial data sets. Geospatial metadata describes the content, quality, condition, and other characteristics of data.

(a) *Types of metadata.* Geospatial metadata can be divided into three categories.

- *FGDC metadata.* The Content Standard for Digital Geospatial Metadata (version 2.0) (FGDC 1998a) or FGDC Metadata is the complete documentation of a data set to enable the data to be used and reused. Documenting geospatial data with FGDC Metadata is a requirement of EO 12906, and

USACE is questioned about metadata production during OMB budget processes. See Chapter 8 for details on documenting data sets with FGDC metadata. General references to metadata in this manual imply FGDC metadata.

- *Management metadata.* Management metadata refers to a core set of elements for cataloging geospatial data. Numerous COTS software packages/modules address managing geospatial data. Management metadata are required by these COTS software to effectively and efficiently catalog and manage geospatial data within an organization. At this time, there are no mandatory or required standards for management of metadata. Some users have implemented the Dublin Core Metadata accessed at <http://dublincore.org> for management purposes.
- *Feature-level metadata.* Feature-level metadata refers to collection information about an individual feature or object. Feature-level metadata enables data sets to be merged without losing important collection information. For example, collection characteristics (such as collection date) associated with hydrographic soundings are critical information, and the association with the sounding needs to be kept intact when merging it with other data sets. No mandatory feature-level metadata standards exist at this time; however, the Inland Electronic Navigation Chart program will be establishing/identifying mandatory feature-level metadata for hydrographic surveying.

(b) *FGDC metadata resolution.* Metadata resolution refers to the amount of metadata files that are needed to describe a data set. No standard rules exist for how much metadata is needed to define data. Metadata resolution is driven by the data set. A data set of aerial photography may require only one metadata file to define it adequately. If the photography was flown over multiple geographic areas at different times, multiple metadata files are probably required to adequately describe the data set.

(c) *Benefits of metadata.* The benefits of metadata are as follows:

- Organizes and maintains an organization's internal investment in spatial data.
- Enables the reuse of data.
- Provides information about an organization's data holding to data catalogues, clearinghouses, and brokerages.
- Provides information to process and interpret data received through transfer from an external source.

7-4. Authority for Geospatial Data Standards

Standards for geospatial data in USACE are governed by the following organizations.

a. International Committee for Information Technology Standards (INCITS). The INCITS mission is to produce market-driven, voluntary-consensus standards in the area of IT. The work of INCITS L1 Committee consists of adopting or adapting IT standards and developing digital geographic data standards. INCITS L1 technical committee is the U.S. Technical Advisory Group (TAG) to /TC 211, which is the International Standards Organization (ISO) committee chartered to develop international geospatial data standards. ERDC represents USACE on this committee.

b. Open GIS Consortium (OGC). OGC is an international industry consortium of more than 220 companies, government agencies, and universities participating in a consensus process to develop

publicly available geoprocessing specifications. Open interfaces and protocols defined by OpenGIS® Specifications support interoperable solutions that “geo-enable” the Web, wireless, and location-based services, and mainstream IT. They also empower technology developers to make complex spatial information and services accessible and useful with all kinds of applications. ERDC represents USACE in OGC.

c. Federal Geographic Data Committee (FGDC).

(1) OMB Circular A-16, Coordination of Geographic Information and Related Spatial Data Activities, establishes a process to foster the development of a national spatial data framework for an information-based society. Federal, State, and local governments and the private sector provide participation to reduce duplication of effort. Federal agency responsibilities in the coordination of surveying, mapping, and related spatial data are addressed. Established in support of the process is the FGDC. The objective of the FGDC is to promote the coordinated development, use, sharing, and dissemination of surveying, mapping, and related geospatial data.

(2) Per EO 12906, Coordinating Geographic Data Acquisition and Access, the NSDI states, among other things, that Federal agencies collecting or producing geospatial data shall ensure that data will be collected in a manner that meets all relevant standards adopted through the FGDC process. It also establishes FGDC authority over the NSDI and the National Geospatial Data Clearinghouse.

d. The CADD/GIS Technology Center for Facilities, Infrastructure, and the Environment. The CADD/GIS Technology Center is a multiservice vehicle to set standards and coordinate facilities within the Department of Defense. The CADD/GIS Technology Center organization (Board of Directors, Corporate Staff, Field Working Groups, Staff) makes up the FGDC Facilities Working Group. The CADD/GIS Center develops and maintains the SDSFIE, the Architect/Engineering/Construction (AEC) CADD Standards, and the Facility Management Standards. The SDSFIE is the basis for National Committee for Information Technology Standards (NCITS) 353, and the annual release of the SDSFIE is coordinated with the NCITS 353 annual update.

7-5. Mandatory Standards

Standardizing geospatial data impacts the entire USACE organization. HQUSACE mandates only geospatial data standards that are mandated by a higher authority, are sufficiently mature, and will benefit the overall organization. ER 1110-1-8156, chapter 6, requires that persons who believe mandated standards are inappropriate for their use must apply to CECW-EE for a waiver. The waiver must explain why the standards are inappropriate and what will be used instead. Recommended standards are those where compliance is encouraged; however, the maturity of a standard is not sufficient for it to be mandatory. Below are the mandatory geospatial data standards to be used in USACE.

a. Content standards for digital geospatial metadata.

(1) These standards specify the information content of metadata for a set of digital geospatial data. The purpose of the standards is to provide a common set of terminology and definitions for concepts related to these metadata. The data documentation standard, referenced in EO 12906, mandates the documentation of all new geospatial data starting 11 January 1995 and the development of a plan to document geospatial data previously collected or produced by 11 April 1995.

(2) The metadata standard is the product of the FGDC. EO 12906 instructs Federal agencies to use the metadata standard to document new geospatial data beginning in 1995 and to provide these metadata to the public through the National Geospatial Data Clearinghouse. Numerous tools are available (commercial, in the

public domain, and associated with specific vendor products) to generate metadata. The FGDC keeps a list of those available on the Internet at <http://www.fgdc.gov/metadata/metatool.html>. CorpsMet is a metadata generation tool developed by USACE. It is available at <http://corpsgeol.usace.army.mil/>. Under no circumstances should metadata be generated using a word processing software or text package. Metadata must be generated using only a metadata-generation software tool.

b. Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE). The SDSFIE standards are applicable to all Department of Defense activities having civil works or public works, military programs, and environmental programs, or that are responsible for facilities/installation management that do not use a raster model. The SDSFIE prescribes specifications for GIS vector and object-modeled data. The intent is to satisfy the project life-cycle concept for digital data. Many subcommittees and working groups of the FGDC are working to develop content standards, and the work is at various levels of maturity. The final versions of these standards are to be incorporated into the SDSFIE for distribution and use throughout USACE. Therefore, by using the most recent version of the SDSFIE, one will also be using the most recent FGDC content standards.

7-6. Data Policies and Coordination

a. Policies. Each USACE Command may develop tailored GD&S policies to supplement and implement this guidance document. Tailored policies regarding GD&S technologies shall be drafted by the eGIS PDT and approved by the Command's senior leaders. Tailored policies shall adhere to the requirements of this document and all applicable standards, orders, and OMB circulars, and they shall support the goals of the NSDI.

b. Coordination of GD&S efforts. Coordination and prioritization of geospatial data acquisition and GD&S development efforts within a USACE Command shall be the function of the eGIS PDT.

c. Coordination with authorities. The Command's GeoPMT shall appoint a representative to coordinate USACE geospatial data acquisition and GD&S development efforts with local and State governments and national GIS coordinating committees. This representative may be the Command Geospatial Manager or another member of the eGIS PDT. If it is necessary, multiple members of this committee can liaise outside of the Command; however, information exchange then becomes critical. The purpose of the coordination is to reduce duplicative data collection efforts and identify cost-sharing opportunities.

7-7. Required Elements

a. All geospatial data shall be documented using the FGDC or ISO Metadata Content Standard (see paragraph 7-5a).

b. All nonraster geospatial data shall be structured using the SDSFIE (see paragraph 7-5b).

c. All CADD data collection shall use the AEC CADD Standards (see paragraph 7-4d).

Chapter 8 Geospatial Database Development and Management

8-1. General

The design, development, and long-term maintenance of a comprehensive geospatial database are sizable investments. To obtain maximum benefits from these investments, many issues discussed in this chapter must be considered.

8-2. Geospatial Data & Systems (GD&S) Database Development Methods

Several methods are available for developing a geospatial database, each with benefits and challenges. In deciding which method to use, the following factors and related questions should be considered:

- *Data purpose and intended use* – Why do we need these data? How will we use them? These questions will help to define the requirements for scale, features to be captured, data feature structure (line, point, polygon), and non-null attribute fields. If existing data are being acquired, what was the original purpose of those data and will they fulfill our current need?
- *Data sources* – What base maps, imagery, photography, horizontal and vertical control, etc., are available to develop new data? In the case of contract data development, do we need to include these items in the scope of work?
- *Time constraints* – How soon do we need these data?
- *Staff capability* – Does the in-house staff have the necessary knowledge, skills, and ability to develop the necessary data? Does the proposed contractor have the experience with projects of this type? Is this work within the contractual statement of work?
- *Technical capacity* – Does staff have the time to devote to developing the necessary data? Do we have the necessary equipment, hardware, and software to complete the work?
- *Standards* – For existing data, what, if any, standards have been followed in developing the data? For new data, what standards will need to be followed?

In the interest of reducing the costs of developing and maintaining geospatial data, GIS professionals generally rely on one of three methods – acquiring existing data, including ordering data from NGA, in-house development, and contract development – for establishing a GD&S database. When appropriate, all three methods (discussed below) can be combined so that acquired existing data can be supplemented with data developed in-house and through contracts.

a. Acquiring existing data.

(1) Generally, obtaining an existing database is the least costly method of database development. The major obstacle in acquisition is finding data that will meet the needs of the user. Typically, existing data have been developed to meet a specific need, and may not satisfy the requirements of USACE, particularly requirements for large-scale or detailed topographic data. Moreover, the original developers of the data may want to recover some of their costs by charging for the data or for the delivery media. Nevertheless, it may be worthwhile to investigate the availability of data from various sources such as the following:

- *FGDC Manual of Federal Geographic Data Products* – a vintage document (ca. 1992) that needs updating; available through National Technical Information Service (NTIS).
- *NSDI Clearinghouse* – A searchable Web-based clearinghouse for metadata and data. The Web site works sporadically at best: <http://www.fgdc.gov/clearinghouse/clearinghouse.html>.
- *State Geographic Information Activities Compendium* – Also dated.
- *National States Geographic Information Council* – Organization of Geographic Information Systems coordinators at the State level; <http://www.nsgic.org/>.
- *Other USACE Districts* – Because of the watershed-based organization of USACE, other Districts may have developed data in a region (e.g., county or municipality) that overlaps an area of interest.
- *Municipal governments* – County, city, township, and borough governments maintain geospatial data for a range of purposes including infrastructure maintenance, planning, engineering, and real estate assessments.
- *Tribal organizations* - Some Native American tribes have established GISs for their lands.
- *Center for Advanced Spatial Technologies* – A University of Arkansas research center that maintains an on-line “Guide to Mostly On-Line and Mostly Free U.S. Geospatial and Attribute Data;” <http://www.cast.uark.edu/local/hunt/>.

(2) See Appendix H for a Sample Memorandum of Agreement for Interagency Cooperation.

(3) Numerous private-sector firms also have existing data. These data may meet the needs of the Command better than some of the publicly available data sets. Some private-sector organizations may be willing to sell data or license data (with or without fee). However, a concern with licensing data is the license requirements of the data provider. Before licensed data are acquired or any license agreements are signed, the agreements must be reviewed by the Command’s Office of Counsel to ensure legality of the agreement. Such agreements may require negotiation and modification to bring them in line with legal requirements. If the license involves a fee, it is effectively a purchase, and is subject to procurement laws. Under these circumstances, Contracting must be consulted in addition to Counsel.

b. Ordering data from National Geospatial Intelligence Agency (NGA).

(1) Unclassified/FOUO products.

(a) General guidance for ordering geospatial products can be located under “General Ordering Information,” at: http://www.dscr.dla.mil/PC9/ORDERING_INFO.HTM. In order to obtain NGA products, the unit or Command has to have a DoDAAC number.

(b) Along with a DoDAAC number, the Geospatial Information Library utilizes the Defense Automatic Addressing System Center (DAASC) Automated Message Exchange System (DAMES). The DAMES requires a desktop personal computer, modem, and telephone line. Software and assistance are available from

The DAASC Information Center, ATTN: Help Desk
Bldg. 30207
5250 Pearson Rd.
Wright-Patterson AFB, OH 45433-5328
DSN: 986-3247
Tel: (937) 656-3247
DSN Fax: 986-3800/1
Tel. Fax: (937) 656-3800/1

The software can be downloaded at: <http://www.daas.dla.mil/developer/download.html>. Further DAMES procedures/instructions are available through <http://www.supply.nrl.navy.mil/Dames.pdf>.

(c) To determine the geospatial coverage over a specific geographic area of interest; one needs to have NGA's softcopy catalog, entitled Catalog of Maps Charts and Related Products, produced by Defense Logistics Information Services, telephone 1-888-352-9333 (NRN: CATCDLIMDIS). This can also be obtained through the DLA URL. Once this CDROM is loaded, graphics display countries and the respective maps and geospatial products available over that area of interest (AOI), by aeronautic, topographic, nautical, and digital products.

(2) Classified products.

(a) For NGA classified geospatial products, one can access NGA's Web site for Products and Services on SIPRnet at: <http://www.nga.smil.mil/products>. NGA digital maps and charts may be viewed and downloaded on-line using one of the following navigation tools: the Gateway Data Navigator (GDN) or Raster Roam.

(b) The GDN interface will display coverage, preview data, estimate the download file size, and create a compressed file for downloading for selected NGA standard products. The Raster Roam will display the requested NGA standard raster product over the area of interest, which can be selected by clicking on the base map over the AOI.

(c) *In-house development.* Developing a GD&S database in-house can be a very long, arduous process. The key factors in evaluating in-house development are the capability of in-house staff, available source materials, and time constraints.

(d) *Contract development.* Although existing databases may be available, they are usually not of sufficient scale or accuracy to meet the needs of the users. Often, the fastest method of developing accurate, useful geospatial data sets is through an A-E contract or delivery order. The private sector generally has the necessary staff resources and equipment to complete such an effort in a timely manner. The key to a contracted effort is a clear scope of work. See Appendix I for a sample scope of work for contracted GD&S data development.

8-3. Database Specification

After the methods to develop a GD&S database are selected, a specification should be established to serve two purposes: provide a firm set of rules for data collection and database construction, and describe the database in sufficient detail to permit application development. This specification will permit use of the database inside and outside of the producing organization and result in a substantial cost savings to users. At a minimum, the specification should include the following sections:

- *Scope* – A concise abstract of the coverage of the specification.
- *Applicable documents* – A bibliographic listing of the standards and references used in developing the specification.
- *Database description or collection criteria* – A summary of the information contained in and the structure/format of the database and the intended use of the data. What features/entities need to be collected. Reference appropriate data content standard (SDSFIE or AEC CADD standard).
- *Metadata* – A listing of the static metadata elements, including accuracy, datum, scale/resolution, source, and projection (if applicable). Reference FGDC Geospatial Content Standard or CorpsMet for generating the metadata.
- *Data format* – A detailed description of the data format. Specify whether data are to be delivered in Oracle, Shape file, or Microstation format.
- *Data accuracy* – Reference the appropriate accuracy standard (see paragraph 7-2b).
- *Data symbology* – Identify symbology to be used.
- *Data dictionary* – A dictionary of the feature and attribute codes used in the database. Reference appropriate data content standard.

A database should be built to meet the requirements of the database specification. Before the design of a database is finalized, it is advisable to create a prototype database and distribute it to potential users, along with a copy of the draft specification. This procedure is valuable, even if only for internal use.

8-4. Commercial Satellite Imagery Data Sources

Several commercial satellite systems are available and may provide useful data sources for a GD&S database. USACE has designated TEC as the Commercial and Civil Imagery (C2I) Acquisition Program Manager for the U.S. Army. The TEC Imagery Office (TIO) is well established, and has acquired a great deal of imagery in support of the topographic, intelligence, and space communities. The TIO acts as the acquisition agent in the Army for commercial satellite imagery, and ensures that imagery is purchased only once, thus conserving precious resources for the Army. Commands are required to coordinate with the TIO before purchasing satellite imagery. The TIO will be able to determine if commercial imagery is already available through the Commercial Satellite Imagery Library for the Command's area and time period of interest. The TIO can be contacted via the Worldwide Web at www.tec.army.mil/TIO/satlink.htm or via email at TIO@tec.army.mil. See Appendix J for detailed information about the TIO and instructions for requesting a search for C2I.

8-5. Quality Assurance

a. The primary goal of data quality assurance is to ensure a consistent and measurable accuracy throughout the database. Consistency is achieved through the use of documented, approved production procedures. Following production, an assessment of the quality of the data set should be made to ensure that the expected result is achieved.

b. The level of production control and the rigor with which the assessments must be made will vary among databases, and should be consistent with the requirements for the database. For example, a cadastral database will generally have exacting accuracy requirements and equally stringent requirements for

consistency. This type of database will need to have detailed procedural documentation, a completion signature for each production step, and a comprehensive assessment of accuracy. These requirements significantly increase the cost of production. Conversely, a small-scale database intended only as a background map for geographic orientation (e.g., Digital Chart of the World from NGA) will have only a cursory accuracy assessment and less stringent requirements for production documentation. The method used to measure accuracy can have an impact on the result. Therefore, this quality assessment should be made using standard measurement techniques, such as those described in the National Map Accuracy Standard or local techniques that are well documented.

8-6. Data Security

a. As of 2004, no guidance exists from the Department of the Army or the Department of Defense addressing the security of geospatial data. General guidance is difficult to develop because of the many factors that must be accountable. Data owners should review all data before releasing or posting the data to a public Web site. This review should account for not only the data but also the size of the population the data is to serve. As a general rule, the higher the resolution or spatial accuracy, the greater the security risk and the less of an impact in withholding the data from the public. National data sets (smaller scale/lower resolution) have little risk associated with release, and they can serve a much greater population. This review should be done in partnership with the Command's Information Assurance Manager.

b. The posting of metadata onto a public Web site, like the NSDI Clearinghouse, is not a security issue because metadata is only documentation about a data set. However, when deciding whether geospatial data should be released or posted to a public Web site, the following three categories of security concerns must be considered.

(1) *Spatial information.*

(a) Specific information concerning the position of critical sites can be a security concern. However, maps or geospatial data showing the positions of critical sites (locks, dams, military installations, etc.) are usually easily obtained from a multitude of sources. Because these locations of local or regional landmarks are well known, showing the sites on a USACE public map or Web GIS is not a security violation.

(b) Some concern does exist with using latitude-longitude or a reference grid in conjunction with a critical site. The geospatial reference information could be used for targeting missiles, bombs, etc., toward the site. The resolution of the data under review is a consideration. If the data are compiled from a small-scale source, chances are small that the latitude-longitude information would aid in targeting. If the latitude-longitude information is compiled from highly accurate sources, such as GPS, and disruption of the structure would impact a significant population, the spatial information should not be released. For example, many of USACE's CADD files are very accurate and show critical parts of a structure. Another consideration is that posting highly accurate engineering data to a public site is probably only serving a small, specialized population. As a general rule, CADD files of operational structures and facilities should not be on a public Web site.

(2) *Attribute information.* Attribute information is the basis for all spatial analysis. Because this information can be of interest to terrorists in analyzing potential targets, all attribute information must be reviewed before release. Sensitive attributes should be removed or blocked from a public site. Sensitive attributes include emergency management plans for a site, population at risk, and vulnerability information. The resolution of the data set is not a factor when reviewing attribute information.

(3) *Combining data from various sources.* The possibility of terrorists or activists accessing and combining geospatial data from unrelated U.S. sources is a serious security threat to our Nation. It is very difficult to protect against this potential because of lack of universal coordination. While USACE may be blocking from the public some sensitive information, this same information may not be determined sensitive by another agency and, therefore, released to the public. Removing the data from a USACE Web site will not ensure that the data is unavailable. At the time this manual was being published, the RAND Corporation published a study sponsored by NGA and the U.S. Geological Survey (USGS), “Mapping the Risks: Assessing the Homeland Security Implications of Publicly Available Geospatial Information.” In addition to detailing some of the complexities associated with security and releasing data publicly, the study provides an analytical process that can be used to identify and evaluate potentially sensitive geospatial information (<http://www.rand.org/publications/MG/MG142>).

8-7. Data Access

a. Data and metadata produced by USACE, including those produced by commercial firms under contract to USACE, shall be made available to the public to the extent permitted by law, current policies, and relevant OMB policies, including OMB Circular A-130, Management of Federal Information Resources. USACE has a node on the NSDI Clearinghouse, Corpsgeo1 (<http://corpsgeo1.usace.army.mil>). The metadata for USACE-funded geospatial data collections shall be posted to Corpsgeo1. HQUSACE, with the assistance of the Geospatial Data and Systems Field Advisory Group, has implemented a procedure to provide public access to USACE geospatial metadata through the NSDI Clearinghouse. See Appendix K for instructions on submitting data to the USACE Geospatial Data Clearinghouse Node.

b. Commercial off-the-shelf (COTS) software is available to establish NSDI Clearinghouse Nodes and manage metadata. Instead of posting metadata to Corpsgeo1, Commands can establish their own NSDI Clearinghouse Nodes using COTS software.

c. Each Command is responsible for establishing procedures for responding to requests from the public for geospatial data. The mechanics of ensuring public access to data holdings should be optimized for the unique missions of each USACE Command. Some Commands may choose to have all requests for geospatial data managed through a single office. Others may choose to have internal divisions respond to requests for the data they collect or produce. Some requestors may submit Freedom of Information Act petitions for data. In response to these petitions, the Command should coordinate with the Office of Counsel for help in addressing specific legal issues related to fees, timeliness of response, data under review, and data format.

d. Data acquired through a license agreement may not be subject to USACE access requirements. The Office of Counsel at the Command level must review the licenses to determine accessibility and limitation requirements. Data for which a project sponsor has received in-kind credit must be made accessible unless the negotiated, signed PMP includes a waiver for accessibility. If such a waiver is negotiated as part of the sponsorship agreement, the in-kind credit should be reduced appropriately.

e. Under some circumstances, data may be restricted from release for security reasons. Restrictions include some data that are categorized as Sensitive But Unclassified or Public But Classified in Aggregate.

8-8. Data Discovery

a. Data discovery is the complementary process to data access. While the data access process involves making data available, this process also involves finding data that are available. The data discovery process

entails performing the appropriate searches for existing data and exploring potential data-gathering partnerships.

b. Each Command shall conduct searches of the NSDI Clearinghouse for each project, program, or study for which the Command is responsible. The Command is responsible for determining if data found through such searches meet the needs of the project, program, or study. Only after the Clearinghouse has been searched should data development be initiated.

c. If data development is warranted, the Command should identify potential data partnerships. Useful data might already exist at other organizations such as State and local agencies or universities. If so, these organizations may be willing to share the existing data as well as share the effort to jointly fund further data development.

8-9. Data Archive

a. Geospatial data represent a significant national asset. USACE Commands must protect against the permanent loss of data by establishing an effective central data archive. This archive must contain a copy of all data sets produced within USACE, either in-house or on contract. It must have an effective cataloging system to ensure data sets can be retrieved in reasonable time. The data archiving process (manual, automatic, or a combination) and frequency must be appropriate for the application and sensitivity of the data.

b. The Federal Geographic Data Committee Historical Data Working Group has developed a draft brochure, “Managing Historical Geospatial Data Records: A Guide for Federal Agencies” (Appendix L), that provides guidance on the responsibilities of geospatial data developers and custodians. It lists 12 circumstances under which geospatial data sets should be archived. Any geospatial database that has current or potential future value to your Command or another government agency that cannot be easily replicated must be considered for archive. This guidance has the effect of including nearly all geospatial data.

8-10. Data Maintenance

a. Due to the nature of geospatial phenomena, once geospatial data are collected, they are often obsolete. Thus, a geospatial database represents only a snapshot in time. Therefore, ongoing maintenance is often a critical issue. This is especially true for GD&S efforts where the same data are used by multiple parts of the organization persistently. Data should be maintained as needed to support USACE applications. As a data set is updated, its metadata must also be updated and made available to the Clearinghouse.

b. The update cycle should be determined during the requirements analysis based on currency requirements and budgetary constraints. Ongoing data maintenance at GD&S expense can be costly, but it is necessary. Data maintenance is a cost multiplier that must be considered as part of the overall GD&S expense.

8-11. Data Liability

Data liability is an issue that requires expert legal attention. USACE liability for data covers three legal areas discussed below.

a. Liability for incorrect data. The Federal Government is protected from being sued for providing “misinformation” under the Federal Tort Claims Act. However, the Government is not protected from “malpractice.” Although a few legal precedents exist in this area, the best solution for USACE Commands is to develop sound procedures for data collection, handling, and processing and to adhere to those procedures. No USACE Command shall knowingly provide data that do not meet its stated accuracy or data that contain

undocumented or incorrect lineage. Every effort must be made to ensure that users understand the capabilities and limits of the data sets made available to them.

b. Liability for misuse. “Geographic Information Systems: A Management Perspective” (Aronoff, 1989) provides examples of how advanced Geospatial Data and Systems (GD&S) can be employed to misuse public data in a manner that would not be possible via hardcopy. Because no standing legal precedents exist in this area, a USACE-wide policy on restricting access to certain types of data has not yet been developed. To compensate for this, important protective measures are essential. All data provided through the Clearinghouse should be properly documented as to its intended use, as required by the metadata standard. Metadata files should include a statement similar to the following quote taken from Aronoff (1989):

“The data described by this metadata file was generated for a specific purpose and use. Any use beyond that intended by the data owner is strictly at the risk of the user. USACE assumes no responsibility for misapplication or misuse of the data.”

c. Liability for inaccessibility. USACE has a responsibility for collecting certain data, specifically hydrographic survey data. These data are critical to traffic on the Nation’s waterways, and must be made available and accessible to the public. Again, the proper documentation is essential, especially with the potential for loss of life and property that any misinformation can incur.

8-12. Required Elements

- a.* For imagery purchases, the Command must coordinate with the TIO (see paragraph 8-4).
- b.* When licensing geospatial data, the Command must coordinate with the Command’s Office of Counsel (see paragraph 8-2a).
- c.* USACE-funded geospatial data collections must be posted to Corpsgeo1 or a NSDI Clearinghouse Node (see paragraph 8-7).
- d.* Before USACE funds are expended for geospatial data collections, a search of the NSDI Clearinghouse must be executed for existing data that will meet mission requirements (see paragraph 8-8).

Chapter 9 Software and System Procurement

9-1. General

a. Information Technology (IT) is defined in Public Law (PL) 104-106, Section 5002 Definitions (3b). IT includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources.

b. The passage of the Clinger-Cohen Act of 1996 shifts the responsibility for management and oversight of IT from the General Services Administration to OMB. OMB is required to issue guidance in conducting IT acquisitions. Each Command's Director or Chief of Information Management provides guidance and direction in defining and developing the appropriate documentation to justify initiating the acquisition process. Requirements should be identified in the Information Mission Area Modernization Plan, and the IT assets should be stated in the Requirement Statements Management System. If solicitation or contract is deemed not to require IT, then the following brief statement must accompany the request: "The specification for this contract does not contain any requirement for IT."

c. Documentation is required to justify initiating the acquisition process. This documentation must state the specific mission for which IT resources are needed, and it must indicate measurable benefits to be derived from the investment.

(1) The planning for IT resource requirements starts with establishing the mission need. The needs identified at program initiation must be periodically reexamined to assure that they reflect the most current program conditions and IT. The following are major elements in the acquisition process: mission needs, structuring an acquisition strategy, developing producible and affordable designs, making decisions, and assessing program status as it applies to LCMIS.

(2) As part of the requirement justification, the requested IT resource must be identified so that the Director or Chief of Information Management can certify that it is consistent with Army Technical Architecture. An updated written statement of justification is required, and a financial analysis under LCMIS may be required.

9-2. Contracts

a. USACE Commands have several contracts designed for procurements of GD&S hardware, software, and technical services. These contracts are also applicable for GDS procurements, although GDS is not limited to these contracts. Using an existing contract eliminates or shortens some of the procurement steps. However, all hardware procurements must have approved LCMIS documentation, a Requirements Analysis, and Analysis of Alternatives.

b. The CADD/GIS Technology Center has established several Blanket Purchase Agreements (BPAs) with vendors and A-E firms for a variety of products and services. The USACE point of contact for these BPAs is as follows:

EM 1110-1-2909
30 Sep 05

Vicksburg Consolidated Contracting Office
Contract Specialist
Mr. Jack Little, CEMVK-CT-T
USACE, Vicksburg District
4155 Clay Street
Vicksburg, MS 39183-3435
Telephone: 601-631-7264
Fax: 601-631-7261
Email: jack.a.little@myk02.usace.army.mil

Details on the BPAs are available at <http://tsc.wes.army.mil/>. (Note: you must register to access the BPA information.)

Appendix A
Memorandum for Distribution and Interim Policy
and Guidance for Geographic Information
Systems (GIS) Technologies



DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600



REPLY TO
ATTENTION OF

DAIM-MD (AR 210-20)

16 OCT 2001

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Data Standards for Computer Aided Drafting and Design (CADD), Geographic Information Systems (GIS) and Related Technologies

1. Interim policy and guidance for Geographic Information Systems (GIS) technologies is enclosed for immediate compliance and implementation.
2. HQDA is developing a strategy to increase data compatibility, eliminate redundant GIS efforts, and integrate installation GIS databases and applications across the Army into an enterprise system. This interim policy and guidance is the first step in that process. HQDA has established the Army Range Sustainment Integration Council (ARSIC), GIS subcommittee, to coordinate this policy.
3. This guidance identifies the goals and standards necessary to establish an enterprise GIS system within the Army. The standards for creation, collection, maintenance, storage, and distribution of installation geospatial data are provided. Implementation of these standards is essential to support Army installation management decisions and to maximize mission effectiveness. Execution of these standards at all Army levels supports compliance with Executive Order 12906 and other national and DoD guidance. This guidance will reduce duplication of installation GIS data creation, collection and applications, and enable the delivery of standardized products. Accordingly, it is the vehicle to promote the life-cycle management of geospatial data and serves as a technical guideline for GIS at all Army installations.
4. Your cooperation is essential to successfully implement and develop an Army Enterprise GIS. The Point of Contact for this effort is Linda Smith, 703-692-9222, DSN 222-9222, linda.smith@hqda.army.mil. Thank you for your support.


R. L. VAN ANTWERP
Major General, U.S. Army
Assistant Chief of Staff
for Installation Management


WILLIAM G. WEBSTER, JR
Brigadier General, GS
Deputy Chief of Staff for Operations
Director of Training

DAIM-MD (AR 210-20)

SUBJECT: Data Standards for Computer Aided Drafting and Design (CADD), Geographic Information Systems (GIS) and Related Technologies

DISTRIBUTION:

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US ARMY EUROPE, ATN: AEAGX, APO AE 09014

US ARMY TRAINING AND DOCTRINE COMMAND, ATTN: ATCS, FORT
MONROE, VA 23651-5000

US ARMY FORCES COMMAND, ATTN: FCCS, FORT MCPHERSON,
GA 30330-6000

US ARMY MATERIEL COMMAND, ATTN: AMCCS, 5001 EISENHOWER AVE.,
ALEXANDRIA, VA 22333-0001

US ARMY TEST AND EVALUATION COMMAND, ATTN: CSTE-ILE-EH, PARK
CENTER IV, 4501 FORD AVE., ALEXANDRIA, VA 22302-1458

US ARMY PACIFIC, ATTN: APCS, FORT SHAFTER, HI 96858-5100

MILITARY TRAFFIC MANAGEMENT COMMAND, ATTN: MTCS,
5611 COLUMBIA PIKE, FALLS CHURCH, VA 22041-5050

EIGHTH US ARMY, ATTN: EACS, APO AP 96205-0009

MEDICAL COMMAND, ATTN: HSCS, FORT SAM HOUSTON,
TX 78234-6000

SPACE AND STRATEGIC DEFENSE COMMAND, ATTN: CSC,
HUNTSVILLE, AL 35807-3801

US ARMY SOUTH, ATTN: SOEN, FORT BUCHANAN, PR 00934-3400

US ARMY MILITARY DISTRICT OF WASHINGTON, ATTN: ANCS, FORT
MCNAIR, DC 20319-5050

US ARMY CORPS OF ENGINEERS, DIRECTORATE OF MILITARY
PROGRAMS, ATTN: CECS, 20 MASSACHUSETTS AVE., NW,
WASHINGTON, DC 20314-1000

US ARMY RESERVE COMMAND, ATTN: AFRC-ENP, FORT MCPHERSON,
GA 30330-2000

SUPERINTENDENT, UNITED STATES MILITARY ACADEMY, ATTN: MACS,
WEST POINT, NY 10996-1592

DIRECTOR, ARMY NATIONAL GUARD, ATTN: NGB-CS, 111
SOUTH GEORGE MASON DRIVE, ARLINGTON, VA 22204

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**INTERIM POLICY AND GUIDANCE
FOR
GEOGRAPHIC INFORMATION SYSTEMS (GIS)
TECHNOLOGIES**

1. **Purpose.** This document provides policy guidance on standards affecting the collection and creation of spatial data within the Department of Army.
2. **Scope.** This policy statement applies to all HQDA-funded (in-house or contracted) geospatial data creation, collection, acquisition, modification and editing.
3. **Background.** Standardization of GIS data documentation, formats, accuracy, and definition increases the Army's ability to compile data across functional areas, promotes data sharing, and reduces duplication of effort. Using current Federal and DoD standards will assist in these efforts.
4. **Enterprise GIS.** Assistant Chief of Staff for Installation Management (ACSIM), Plans and Operations Division is the lead for establishing Army guidance for enterprise GIS, and will coordinate actions at HQDA to foster enterprise GIS development. Army GIS programs and offices must take steps to establish integrated GIS data and systems on installations to allow for sharing across functional areas (engineers, resource management, range management, environment, housing, etc.) and at all Army levels. The enterprise approach will eliminate stand-alone GIS databases and applications.
5. **Data Documentation.** All GIS data will be documented in accordance with the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata. Both '*Mandatory*' and '*Mandatory as Applicable*' fields, as defined by the FGDC Standards, shall be completed for each GIS data layer. Existing GIS data shall be documented, to the extent possible, no later than 1 March 2002. Numerous compliant metadata software programs are readily available on the Internet, <http://www.fgdc.usgs.gov>, to assist in this effort.
6. **Data Sharing.** The National Spatial Data Infrastructure (NSDI) and Executive Order 12906 (April 13, 1994) state that all GIS data will be shared to avoid wasteful duplication and promote effective and economical management of resources. All federal agencies are required to participate in the NSDI as per EO12906. Army GIS personnel shall share data across functional and organizational lines, with other federal, state and local governments, and non-governmental organizations (NGO's) in accordance with applicable state and federal laws. Army Installations shall work with Reserve Component Training Sites to pursue mutually beneficial partnerships
7. **Data Standards.** The Spatial Data Standard for Facilities, Infrastructure and Environment (SDSFIE) shall be followed for geospatial database table structure, nomenclature, attributes, and symbology to allow for data integration. Installations are encouraged to utilize a Structured Query Language (SQL) compliant relational database for SDSFIE implementation. The SDSFIE and related documentation can be downloaded from the CADD and GIS Technology Center homepage at <http://tsc.wes.army.mil>.

8. **Projections and Datums.** All GIS data shall use North American Datum (NAD) of 1983, or World Geodetic System (WGS) of 1984 coordinate system datums, and the North American Vertical Datum of 1988 (NAVD88) to ensure data alignment and accuracy. Data should be displayed using an appropriate projection for installation use. The projection and datum must be documented in the metadata and provided whenever the data is distributed. A resource for explanation of projections and datums can be found in the following Corps of Engineers manual on geospatial mapping (EM 1110-1-2909), <http://www.usace.army.mil/inet/usace-docs/eng-manuals/em1110-1-2909/c-11.pdf>. This manual addresses issues related to geospatial mapping including datums, scales, and the resulting accuracy.
9. **Data quality.** All GIS data shall be created and maintained at a quality and resolution that ensures accuracy and usefulness for installation management and mission support. All GIS data created shall meet the Federal Geographic Data Committee Standard Geospatial Positioning Accuracy Standards, Part 3: National Standard for Spatial Data Accuracy, FGDC-STD-007.3-1999. Army geospatial data requirements are further defined in Engineering and Design, Geospatial Data and Systems, EM Manual No. 1110-1-2909, 1 Aug 1996. General info on GIS quality standards are at: http://front.gis.state.mn.us/committe/stand/New_dataqual.htm. The National Standard for Spatial Data Accuracy can be downloaded from: <http://www.fgdc.gov/standards/documents/standards/accuracy/chapter3.pdf>.
10. Further implementation guidance is pending.

Appendix B References

B-1. Publications

Public Law (PL) 104-106, Section 5002

Information Technology Act

EO 12906

Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure

Clinger-Cohen Act of 1996

(formerly known as the Federal Acquisition Reform Act of 1996 and the Information Technology Management Reform Act of 1996)

AR 210-20

The Army's Compliance: Master Planning for Army Installations.

ER 5-1-11

Project Management Business Process (PMBP)

ER 25-1-2

Life Cycle Management of Automated Information Systems (LCMIS)

ER 37-2-10

Financial Administration – Accounting and Reporting – Civil Works Activities

ER 1110-1-8156

Policies, Guidance, and Requirements for Geospatial Data and Systems

EM 1110-1-1000

Photogrammetric Mapping

EM 1110-2-1003

Hydrographic Surveying

OMB Circular A-16 (revised)

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<http://gis.usace.army.mil/>.

GIS Internet Resources, "Your Guide to Navigating the 'Net,'" <http://www.tec.army.mil/gis/index.html>.

National Spatial Data Infrastructure (NSDI) Clearinghouse,
<http://www.fgdc.gov/clearinghouse/clearinghouse.html>.

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http://www.evergladesplan.org/pm/progr_data_mgmt_plan.cfm.

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<http://www.nima.mil/td/curriculum/belvoir/>.

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<http://tsc.wes.army.mil/products/TSSDS/tssds/html>.

U.S. Army Corps of Engineers Geospatial Data and Systems Management Report (draft, May 2000),
<http://gis.usace.army.mil/GDM.PDF>.

USACE FGDC Clearinghouse Node Corpsgeo1, CorpsMet,
<http://corpsgeo1.usace.army.mil/>.

USACE, Geographic Information Systems (GIS) projects,
<http://www.nww.usace.army.mil/apps/tscwrc>.

Appendix C List of Acronyms

A-E.....	Architect-Engineering
AEC	Architect/Engineering/Construction
AET.....	Automated Engineering Tool
AIS	Automated Information System
AM/FM	Automated Mapping/Facilities Management
AOI	Area of interest
AR.....	Army Regulation
BOD	Board of Directors
BPA.....	Blanket Purchase Agreement
C2I	Commercial and Civil Imagery
CAD2	Computer-Aided Design 2
CADD	Computer-Aided Design and Drafting
CADD/GIS.....	Computer-Aided Design and Drafting/Geographic Information Systems
CEFMS	Corps of Engineers Financial Management System
CERL	Construction Engineering Research Laboratory
CERP	Comprehensive Everglades Restoration Plan
CHL	Coastal Hydraulics Laboratory
CIO.....	Chief Information Officer
COTS	Commercial off-the-shelf
CRREL.....	Cold Regions Research and Engineering Laboratory
CSIL.....	Commercial Satellite Imagery Library
DAASC.....	Defense Automated Addressing System Center
DAMES	DAASC Automated Message Exchange System
DEM.....	Digital Elevation Model
DIM/CIM	Director of Information Management/Chief of Information Management
DoD.....	Department of Defense
DOQQ.....	Digital Orthophoto Quarter Quads
DPN	Digital Project Notebook
DTMs	Digital Terrain Model
eGIS	Enterprise Geographic Information Systems (also Enterprise GIS)
EL.....	Environmental Laboratory
EO	Executive Order
ER	Engineer Regulation
ERDC.....	Engineer Research and Development Center
ESRI.....	Environmental Systems Research Institute
FAAT	Fully Analytic Aerial Triangulation
FGDC.....	Federal Geographic Data Committee
FMSFIE	Facility Management Standard for Facilities, Infrastructure, and Environment
ftp	file transfer protocol
GDAD	GD&S Advisory Group
GD&S	Geospatial Data and Systems
GDN.....	Gateway Data Navigation
GIS	Geographic Information Systems
GIS/FM	Geographic Information Systems/Facility Management
GPS	Global Positioning System
HEC	Hydrologic Engineering Center
HQ.....	Headquarters

HQUSACE.....	Headquarters, U.S. Army Corps of Engineers
INCITS.....	International Committee for Information Technology Standards
IP.....	Implementation Plan
IPT.....	Integrated Product Team
IS.....	Information System
ISO.....	International Standards Organization
IT.....	Information Technology
ITIPS.....	Information Technology Investment Portfolio System
ITL.....	Information Technology Laboratory
LCMIS.....	Life Cycle Management of Information Systems
LIS.....	Land Information Systems
MP.....	Metadata Parser
NARA.....	National Archives and Records Administration
NGA.....	National Geospatial-Intelligence Agency
NGC.....	National Geospatial-Intelligence College
NGS.....	National Geodetic Survey
NSDI.....	National Spatial Data Infrastructure
NTIS.....	National Technical Information Service
OGC.....	Open GIS Consortium
OMB.....	Office of Management and Budget
PDT.....	Project Delivery Team
PMBP.....	Project Management Business Process
PMP.....	Project Management Plan
POC.....	Point of contact
PL.....	Public Law
PRB.....	Project Review Board
PROMIS.....	Project Management Information System
PROSPECT.....	Proponent-Sponsored Engineer Corps Training
R&D.....	Research and Development
RDBMS.....	Relational database management system
RMB.....	Resource Management Board
ROI.....	Return on investment
RS.....	Remote Sensing
SDP.....	Systems Decision Paper
SDSFIE.....	Spatial Data Standard for Facilities, Infrastructure, and Environment
TEC.....	Topographic Engineering Center
TIO.....	TEC Imagery Office
URL.....	Uniform Resources Locator
USACE.....	U.S. Army Corps of Engineers
UTM.....	Universal Transverse Mercator
WANs/LANs.....	Wide Area Networks/Local Area Networks

Appendix D
Example USACE Division Level EGIS
Program Management Plans

TEAM CHARTER

South Atlantic Division

Enterprise Geospatial Information System (eGIS)

Program Management Team

eGIS Program Vision

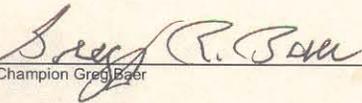
Re-engineer existing location-based district work-flows through the implementation of an enterprise GIS program and recognize the following quotas:

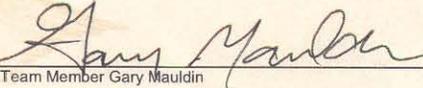
1. Increase productivity.
2. More efficient use of resources.
3. Provision for expanded and/or additional services.
4. Propagate effective, more accurate and informed decision-making.
5. Increase access and dissemination of digital information.

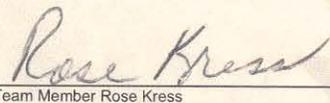
We, the members of the South Atlantic Division enterprise Geospatial Information System Program Management Team, commit to work together in a spirit of mutual respect and cooperation. We are committed to complete and implement a quality program to fulfill the intra-divisional eGIS vision. We will strive to develop a program that achieves an equitable balance between function and cost that will result in division-wide adoption and while adding value to the Army and the general public. We will create an enjoyable program in the spirit of teamwork and financial success to ensure the expeditious development of this program. We agree to the following common goals and objectives:

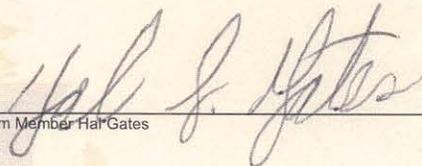
1. Communicate openly and seek wide input for our plan.
2. Establish policy, standards, and procedures.
3. Resolve problems and make decisions at the lowest possible level in a timely manner.
4. Maintain the professional atmosphere of mutual respect.
5. Conduct periodic evaluations of the Team's effectiveness.
6. Produce a quality product.
7. Develop successful inter-intra agency cooperation.
8. Demonstrate the technical capabilities of the partners.

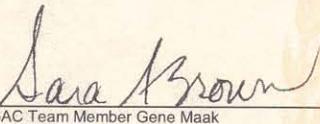
Supported By

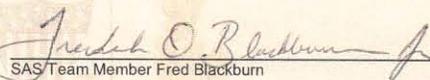

SAD Champion Greg Baer

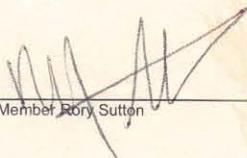

SAD Team Member Gary Mauldin

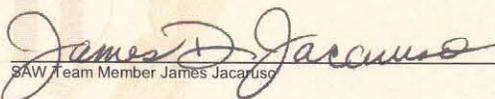

ERDC Team Member Rose Kress


SAM Team Member Hal Gates


SAC Team Member Gene Maak


SAS Team Member Fred Blackburn


SAJ Team Member Rory Sutton


SAW Team Member James Jacaruso


COMMANDER SAD Brigadier General Peter T. Madsen BG, USA

Accounting Policy for eGIS Costs and Distribution of RF5022 Facility

1. The following procedures apply to enterprise geographic information systems (eGIS) costs and distributions from the RF5022 Facility Account for GIS Operations (ER 37-2-10).

A. Costs

(1) Operational expenses such as hardware/software ownership expenses, hardware/software maintenance, hardware repair, software site licenses, expendable equipment, software and supplies, labor, training, and travel should be recorded in RF5022. These are the additional incremental costs of having a general purpose GIS capability at the district level, independent of a specific project. It allows the district's investment in spatial data to be preserved for use by other teams and future projects.

(2) Costs associated with developing tools and collecting and processing historical data that benefit a single project should be charged directly to that project or study.

(3) Costs associated with developing tools, collecting and processing historical data where the benefit cannot be attributed to a single organization, project or study should be recorded in RF5022.

B. Distribution

Distributions should be made directly to projects "if the costs contribute exclusively to the accomplishment of a single project," EC 37-1-261. Distributions should be made monthly.

(1) When the costs in A(1) and (3) above can be attributed to a single department, the costs should be distributed to the departmental technical overhead accounts. If a license holder works exclusively on one project, or a piece of hardware is dedicated to a project, the project should be charged directly.

(2) The remaining costs in RF5022 from A(1) and (3) above cannot be attributed to a specific project, study or department. They comprise the programmatic cost of preserving the much larger district investment in spatial data and tools for reuse by future projects, partners and sponsors and other USACE components. The benefits accrue to the district as a whole and should be fairly and consistently distributed to the departmental accounts of the users.

2. These procedures will be reevaluated each year and revised and resubmitted for approval when appropriate, in response to changes in eGIS technology or organization.

Approved:


LESTER S. DIXON
Co-Chair, Regional Management Board


PAUL D. ROBINSON
Co-Chair, Regional Management Board

PROGRAM MANAGEMENT PLAN

for the

**ENTERPRISE
GEOGRAPHIC INFORMATION SYSTEM
PROGRAM
(eGIS)**



US Army Corps of Engineers

South Atlantic Division

**PROGRAM MANAGEMENT PLAN
For the
ENTERPRISE GEOGRAPHIC INFORMATION SYSTEM
PROGRAM**

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- 1.4 Objectives

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- 2.2 Project Level
- 2.3 Regulation Requirements

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FOR OFFICIAL USE ONLY

PROGRAM MANAGEMENT PLAN
for the
ENTERPRISE GEOGRAPHIC INFORMATION SYSTEM PROGRAM

Preface

The Commander, U.S. Army Corps of Engineers, South Atlantic Division (SAD), along with our five districts (Charleston, Jacksonville, Mobile, Savannah and Wilmington), are committed to achieve successful execution of an Enterprise Geographic Information System (eGIS) philosophy throughout the Division encompassing all areas of our business processes.

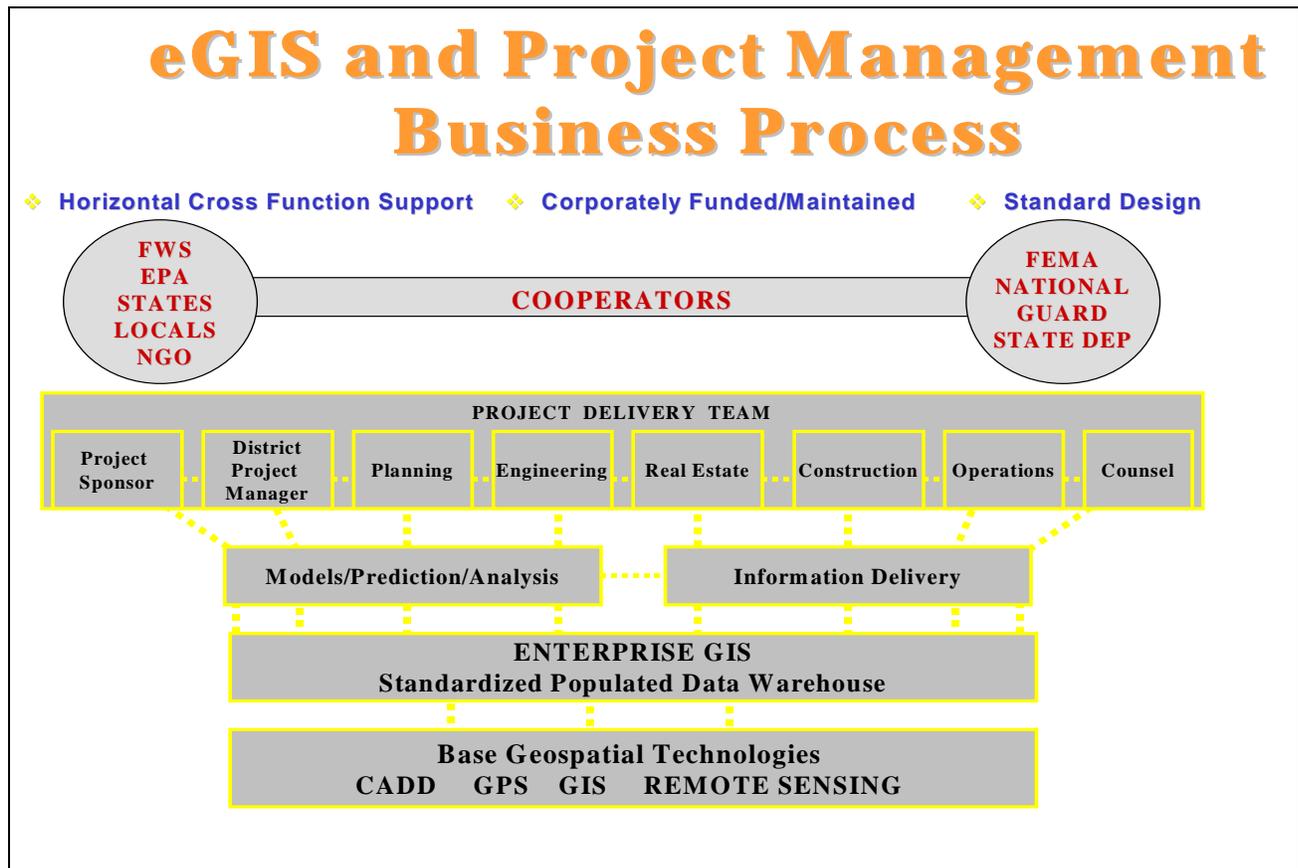
Successful execution of a truly “enterprise” GIS philosophy within SAD will require a significant commitment of time, resources and regional partnering on everyone’s part. This Program Management Plan (PgMP) provides the strategy that defines the path of execution and the cooperative efforts expected from all team members throughout the regional business center to achieve the established execution goals.

In accordance with ER 5-1-11, USACE Business Processes, this PgMP is a living, working-level document that will be approved by the Regional Management Board and revised to reflect changes in strategy, funding, or management goals, as required.

I.0 INTRODUCTION

1.1 Definition:

Enterprise Geographic Information System (eGIS) is the integration of the geospatial technology infrastructure to deliver spatial informational products, services and standard datasets to all functional elements and business processes of the organization. In essence, it is the sharing of technology and the data associated with that technology across a multi-disciplinary organization saving time, dollars, and resources. The figure below provides a conceptual view of eGIS:



1.2 Vision:

Integrate geospatial technology *infrastructure* delivering spatial information products, services and standard datasets to all functional elements and *business processes* of the organization.

1.3 Goals:

1. Support Project Delivery Teams in efficient execution of civil and military projects.
2. Protect investment in geospatial data, applications and institutional knowledge.
3. Facilitate effective evolution of GIS and CADD technologies in the South Atlantic Division as well as coordinate consistent implementation and deployment of related geospatial technologies.
4. Improve communications with other agencies, stakeholders and the private sector.
5. Support regional work sharing efforts by enabling access to geoinformation needed across the organization.
6. Facilitate civil-military crossover of geospatial technology applications, data and knowledge.
7. Contribute to COE vision of being a competitive world-class engineering organization.

1.4 Objectives:

1. Coordinate Division-wide eGIS architecture of hardware, software, data and organizational infrastructure to increase the level of interoperability between districts and facilitate workload sharing.
2. Create an eGIS stewardship plan that will protect data quality, insure data integrity and assign accountability to each District's geospatial datasets.
3. Establish protocols and procedures for developing and sharing applications, products and services within the Division.
4. Produce workforce development plan that outlines (a.) training for the general GIS users and (b.) career development and suggested strategies for the recruitment/retention of the more advanced technical GIS user and application developers.
5. Act as Division resource for eGIS technical guidance, coordination and leadership by maintaining state of the art technology, capability, and applications through high level training and participation in research and development programs.
6. Adopt relevant and useful standards for data content, structure and collection protocols.
7. Develop a funding model that facilitates an efficient workflow and an effective means of resource accountability.
8. Publish workflow documentation of business process solutions (lessons learned) to maximize Division efforts and increase division efficiency.

2.0 ROLES AND RESPONSIBILITIES OF THE eGIS TEAM

The SAD eGIS program will be a two-tiered structure consisting of a program level effort and a project level effort. The roles and responsibilities for each level are described below.

2.1 Program Level:

At the program level, the SAD Geospatial Program Management Team (PgMT) will provide oversight of the eGIS initiative. This team is a cross-functional matrix team composed of representatives from the Division office, the District offices, and ERDC. The PgMT will develop and maintain the Program Management Plan (PgMP); establish the Division-wide architecture, protocols and procedures necessary to incorporate eGIS; develop the workforce by providing regional training opportunities; facilitate regional interagency communication; serve as an ad-hoc "Field Review Group" for identifying and prioritizing R&D needs; and oversee /support the District level Project Delivery Teams in the implementation of eGIS.

The PgMT is comprised of the following members:

SAD GIS Coordinator (Team Leader)	Gary Mauldin
SAC GIS Coordinator	Sara Brown
SAJ GIS Coordinator	Rory Sutton *
SAM GIS Coordinator	Hal Gates
SAS GIS Coordinator	Fred Blackburn
SAW GIS Coordinator	Jim Jacaruso
ERDC Technical Advisor	Rose Kress

Ad Hoc Members from SAD-IM, RM, CM, etc. will be utilized as needed

* Mr. Sutton also serves as the SAD Regional Geospatial Technical Specialist

2.2 Project Level:

At the project level, the District eGIS Project Delivery Team (PDT) will direct the activities of implementing an eGIS philosophy within the district. Each District will determine the membership of their PDT with emphasis on maintaining a cross-functional team familiar with all aspects of the District's GIS activities. The PDT will incorporate their existing GIS Implementation Plan into an eGIS Project Management Plan. eGIS application specific sub teams will be created as necessary to incorporate eGIS into

specific Business Process Area applications, i.e. Regional Sediment Management, Real Estate, Permitting, etc. A comprehensive list of existing GIS tools will be developed by the PgMT for use by the districts.

2.3 Regulation Requirements:

ER 1110-1-8156, Policies, Guidance, and Requirements for Geospatial Data and Systems, dated 1 Aug 1996, requires an Oversight Committee and a Technical Committee at both the Division and District level. At the Division level, the Regional Management Board will serve as the Oversight Committee and the PgMT will serve as the Technical Committee. At the District level, the District Corporate Board or other appropriate level team will serve as the Oversight Committee and the PDT will serve as the Technical Committee.

EM 1110-1-2909, Engineering and Design, Geospatial Data and Systems, dated 1 November 2002 (draft), discusses implementation of eGIS throughout the Corps, defines eGIS and describes its importance to the organization, and provides general guidance on eGIS implementation. This PgMP reflects the requirements/recommendations described in the Engineering Manual.

3.0 WORK BREAKDOWN STRUCTURE

The following Work Breakdown Structure (WBS) disseminates the SAD eGIS initiative into three elements in order to provide visibility and organization for a complex integrated approach to implementing eGIS throughout the Division. Many tasks are carried out in parallel and are shown for the near term, approximately the CY and next FY.

Element 1 contains work items necessary to establish the Program Management Plan and provide continued information and status reports to the Regional Management Board. It also includes the Division proponent activities to ensure a coordinated, consistent effort. With exception of the first task, these efforts are continuous over time.

- Develop Program Management Plan for RMB review and approval
- Develop cost estimate for eGIS activities for FY03, FY04
- Conduct quarterly Geospatial PgMT meetings
- Monitor progress with respect to PgMP Metrics (Section 7)
- Provide periodic status report to the RMB

Element 2 contains work items necessary for the members of the Program Management Team to initiate a Division approach to eGIS. These activities require District and Division partnering to reach Division goals.

- Develop comprehensive list of existing GIS tools
- Adopt and coordinate SAD GIS format standards
- Develop eGIS funding approach for RMB approval
- Evaluate existing SAD – available/owned tools
- Develop Division-wide eGIS implementation plan for RMB approval
- Update PgMP annually

Element 3 contains work items necessary for members of the Regional Management Board and the Geospatial Program Management Team to carry out at the District level.

- Establish District Project Management Team to implement eGIS at the District
- Develop District PMP or implementation plan
- Initiate implementation of SAD eGIS Pilot Project (RSM eGIS) in SAJ (implementation schedule will vary by district)

4.0 MILESTONES AND RESOURCE REQUIREMENTS

The SAD eGIS Program Management Team has established the milestones and identified the resource requirements for the next 15 months, supporting the WBS discussed in Section 3.0.

4.1 Milestones:

1. Submit Program Management Plan to RMB	4Q03
2. Conduct quarterly Geospatial PgMT meetings	4Q03, 1Q04, 2Q04, 3Q04, 1Q04
3. Submit eGIS funding guidance to RMB	4Q03
4. Develop comprehensive list of existing GIS tools	4Q03
5. Develop cost estimate for PgMT eGIS FY04 activities	4Q03
6. Adopt SAD GIS format standards	1Q04
7. Develop district PMP or implementation plans	3Q04
8. Update PgMP	4Q04
9. Initiate eGIS pilot project (RSM)	1Q04
10. Evaluate existing SAD – available/owned tools	4Q03
11. Develop Division-wide eGIS implementation plan & cost estimate for RMB approval	4Q04

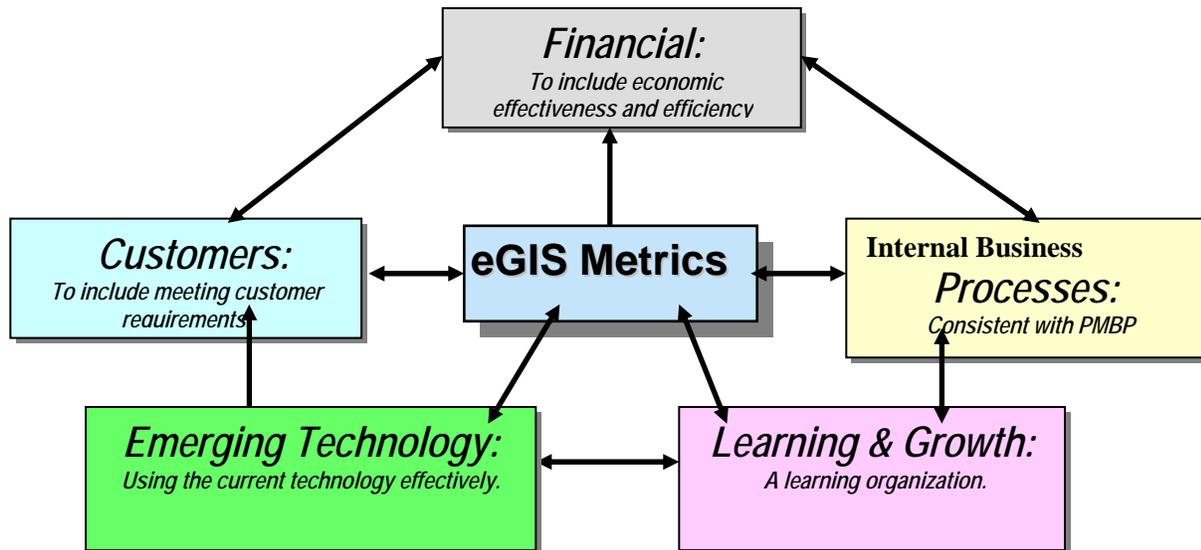
4.2 Resource Requirements:

The five Districts within the South Atlantic Division invest over \$67 million annually on geospatial data collection and use. Their combined GIS activities account for an estimated \$10M per year of that total. Each District has estimated the resources required for FY'04 to accomplish the work items identified in Section 3.0 as follows; SAC-\$200k, SAJ-\$175k, SAM-\$240k, SAS-\$270k, SAW-\$250k; totaling \$1.135M. Implementation of an eGIS philosophy will help to optimize our investment in geospatial data and reduce data collection duplication.

5.0 PERFORMANCE MEASUREMENTS

Justification of Geographic Information Systems (GIS) has proven to be difficult in past because it is difficult to determine what is important to measure and in many instances how to measure. We will measure the performance of the system as we see it initially. But experience indicates that after initial implementation of a system such as GIS many more applications and uses to improve efficiencies are identified by the users. As users become more involved with the development they will learn to rely on the system and insist on its use by the enterprise. At this point eGIS has become an integral part of the business process or simply the way we must do business. This then is the goal and the ultimate measure of success.

The figure below conceptualizes the linkages among the various elements that comprise the Enterprise Geographic Information System and the interactions that must be considered in their development. The intent of this figure is to show that eGIS is, and will become even more so, an integral part of our business processes.



The metrics developed to evaluate SAD performance with implementation of eGIS.

- reflect balanced scorecard components (i.e., financial, customer, emerging technology, internal business processes and learning/growth measurements);
- provide information to show the present performance of SAD related to eGIS at the Division and District levels
- provide information into the various processes that will guide eGIS performance improvements;
- show trends in corporate performance over time as the metrics are tracked;

Our success in implementing eGIS will be measured on how effectively it is integrated into the business process of each district. It is vital that the mission of each district be supported rather than negatively impacted for the sake of other Districts or the Division.

6.0 COMMUNICATIONS PLAN

Communication gives us connectivity energy and knowledge. It links us together as a team, creating synergy among people and processes. Communication empowers us and unites us in our public service. Communication is integral to the eGIS program and its teams.

6.1 Communication Goal:

The Geospatial Program Management Team and the Geospatial Data and Systems Technical and Oversight Committees are open, informed, and actively engaged in listening to each other, our USACE team members, and our stakeholders in the day-to-day activities of planning, design, implementation, and sustainment of eGIS. We tell our story through our actions. We welcome dialog and respect diverse perspectives in order to understand and achieve better solutions. Each eGIS PMP will reference the PgMP Communication Plan as the baseline for their actions. The eGIS teams' PMPs should stress the synergy and consistency in communications to be consistent with the direction of the eGIS Program and the PgMP.

6.2 Communication Strategy:

- Build relationships and mutual understanding.
- Increase awareness of our eGIS Program roles with USACE leaders, USACE workforce, and the public.
- Integrate strategic communications into our eGIS planning, design, implementation, and sustainment efforts.
- Communicate effectively within Geospatial Program Management Team, the Geospatial Data and Systems Technical and Oversight Committees, USACE leadership and workforce, state and local governments, and with the public.
- Practice active listening.

6.3 Communication Objectives:

- Listen to Corps members and critics regarding the application of the eGIS program to Corps projects and activities.
- Build relations with and support state and local governments, and industry groups.
- Develop central CESAD messages on eGIS and its activities.
- Communicate our messages and foster learning by USACE members through multiple forums, internet and intranet, briefings, articles, etc.

- Collect and communicate lessons learned as part of eGIS program; at the team, program, and field levels.
- Communicate the tools that will enable field members to ensure that the eGIS philosophy becomes part of all Corps planning, design, construction and operational activities.

7.0 MEASUREMENTS OF PROGRAM SUCCESS

The successful implementation of the Enterprise Geographic Information System (eGIS) will be measured against a set of metrics developed for the following general categories:

- **Financial**
 - Dollars spent on new data collection – Our investment.
- **Business Processes**
 - Number of data layers documented and listed in Data Catalog.
 - Number of field offices connected and effectively utilizing the enterprise.
 - Amount of historic data converted.
- **Emerging Technology**
 - Number and effectiveness of new applications developed
 - Number of technology upgrades implemented - Keeping up with emerging technology.
- **Customers**
 - Number of unique users – (Number of visits, Number of visitors).
 - Number of interagency extranets, interagency activities.
 - Effectiveness as it relates to customer communications.
- **Learning and Growth**
 - Number of shared applications and “COM” objects (reusable program components).
 - Number of people trained.
 - Number of guidance documents developed.

In addition to the measurements above we will look at Case Studies to determine the impact of eGIS on a specific applications or projects. Is the end product a better product because of eGIS? Is the overall efficiency improved? Was the cost of the project increased or decrease by use of eGIS? What was the benefit to the enterprise?

8.0 PROGRAM MANAGEMENT PLAN APPROVAL

The SAD Division Commander, acting through the Regional Management Board (RMB), is responsible for program oversight. The SAD PgMT will submit the eGIS PgMP to the RMB for approval. Following initial approval, the PgMP will be updated by the PgMT with major changes or deviations approved by the Regional Management Board.

Signatures of Program Management Team Members:

—
Gary Mauldin, SAD

Sara Brown, SAC

—
Rory Sutton, SAJ

Hal Gates, SAM

—
Fred Blackburn, SAS

Jim Jacaruso, SAW

Rose Kress, ERDC

Approved:

—
LESTER S. DIXON
Co-Chair, Regional Management Board

—
PAUL D. ROBINSON
Co-Chair, Regional Management Board

Appendix E
Sample Geospatial Data and Systems
Job Descriptions

POSITION DESCRIPTION *(Please Read Instructions on the Back)*

1. Agency Position No.

2. Reason for Submission: Redescription Reestablishment New Other

3. Service: Hdqtrs Field

4. Employing Office Location

5. Duty Station

6. OPM Certification No.

7. Fair Labor Standards Act: Exempt Nonexempt

8. Financial Statements Required: Executive Personnel Financial Disclosure Employment and Financial Interest

9. Subject to IA Action: Yes No

10. Position Status: Competitive Excepted *(Specify in Remarks)* SES (Gen.) SES (CR)

11. Position Is: Supervisory Managerial Neither

12. Sensitivity: 1-Non-Sensitive 2-Noncritical Sensitive 3-Critical 4-Special Sensitive

13. Competitive Level Code

14. Agency Use

15. Classified/Graded by	Official Title of Position	Pay Plan	Occupational Code	Grade	Initials	Date
a. Office of Personnel Management						
b. Department, Agency or Establishment						
c. Second Level Review	Geographic Information System Specialist	GS	301	09		9/30/02
d. First Level Review	OC: AA					
e. Recommended by Supervisor or Initiating Office						

16. Organizational Title of Position *(if different from official title)*

17. Name of Employee *(if vacant, specify)*

18. Department, Agency, or Establishment: Department of the Interior

a. First Subdivision: Bureau of Land Management

b. Second Subdivision: State Office

c. Third Subdivision

d. Fourth Subdivision

e. Fifth Subdivision

19. Employee Review-This is an accurate description of the major duties and responsibilities of my position.

20. Supervisory Certification. *I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that false or misleading statements may constitute violations of such statutes or their implementing regulations.*

a. Typed Name and Title of Immediate Supervisor

b. Typed Name and Title of Higher-Level Supervisor or Manager *(optional)*

Signature _____ Date _____

Signature _____ Date _____

21. Classification/Job Grading Certification. *I certify that this position has been classified/graded as required by Title 5, U.S. Code, in conformance with standards published by the U.S. Office of Personnel Management or, if no published standards apply directly, consistently with the most applicable published standards.*

Typed Name and Title of Official Taking Action: HR Specialist (Classification)

Signature _____ Date _____

22. Position Classification Standards Used in Classifying/Grading Position: Handbook of Occupational Groups and Families Series Definitions. Administrative Analysis Grade Evaluation Guide, Aug 90, TS-98.

Information for Employees. The standards, and information on their application, are available in the personnel office. The classification of the position may be reviewed and corrected by the agency or the U.S. Office of Personnel Management. Information on classification/job grading appeals, and complaints on exemption from FLSA, is available from the personnel office or the U.S. Office of Personnel Management.

23. Position Review	Initials	Date								
a. Employee <i>(optional)</i>										
b. Supervisor										
c. Classifier										

24. Remarks: FPL: GS-09 BUS: _____

25. Description of Major Duties and Responsibilities *(See Attached)*

DI-625

POSITION CLASSIFICATION AMENDMENT

1. OFFICIAL HEADQUARTERS	2. NAME OF INCUMBENT		
3. ORGANIZATIONAL LOCATION <input type="checkbox"/> AS SHOWN ON CURRENT DESCRIPTION <input checked="" type="checkbox"/> AS HEREBY AMENDED			
IIa. _____	d. _____		
b. _____	e. _____		
c. _____			
4. CSC TITLE AND BUREAU POSITION NO. NS0047 Geographic Information System Specialist	SCHEDULE GS	SERIES 301	GRADE 07
<input type="checkbox"/> SAME AS PRESENT: AMENDED FOR <input type="checkbox"/> CSC TITLE <input type="checkbox"/> POS. NO. <input type="checkbox"/> SCHEDULE <input type="checkbox"/> SERIES <input checked="" type="checkbox"/> GRADE			

CERTIFICATIONS

<p>5. I CERTIFY THAT THE POSITION IDENTIFIED ABOVE HAS CHANGED AS REFLECTED.</p> <p>_____ (Signature of Supervisor)</p> <p>_____ (Date)</p> <p>TITLE _____</p>	<p>5. I CERTIFY THAT THE CHANGES REFLECTED ARE PROPER AND THE POSITION AS HEREBY AMENDED IS PROPERLY CLASSIFIED</p> <p>_____ (Official Exercising Classification Authority)</p> <p>_____ (Date)</p> <p>TITLE HR Specialist (Classification)</p>
---	--

7. DESCRIBE BRIEFLY, BUT IN FULL, THE REASONS FOR CHANGES CHECKED ABOVE AND THE ADDITIONS, DELETIONS, OR REVISIONS WHICH ARE TO BE MADE IN THE DESCRIPTION PROPER.

This is an advanced developmental position. The assignments in this position are designed to prepare the incumbent to perform the duties and responsibilities in the target position of Geographic Information Specialist, GS-301-09.

The assignments are essentially the same as the target position; however, a more limited knowledge is applied, the supervisor provides continuing or individual assignments with specific instructions, specific guidelines are available, the assignments are less complex, and the effect of work product is more limited.

SUPERVISORY CERTIFICATION: I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that a false or misleading statement may constitute violations of such statutes or their implementing regulations.

Name Signature and Title of Supervisor

Date

DI-625

POSITION CLASSIFICATION AMENDMENT

1. OFFICIAL HEADQUARTERS	2. NAME OF INCUMBENT		
3. ORGANIZATIONAL LOCATION <input type="checkbox"/> AS SHOWN ON CURRENT DESCRIPTION <input checked="" type="checkbox"/> AS HEREBY AMENDED			
IIa. _____	d. _____		
b. _____	e. _____		
c. _____			
4. CSC TITLE AND BUREAU POSITION NO. NS0047 Geographic Information System Specialist	SCHEDULE GS	SERIES 301	GRADE 05
<input type="checkbox"/> SAME AS PRESENT: AMENDED FOR <input type="checkbox"/> CSC TITLE <input type="checkbox"/> POS. NO. <input type="checkbox"/> SCHEDULE <input type="checkbox"/> SERIES <input checked="" type="checkbox"/> GRADE			

CERTIFICATIONS

5. I CERTIFY THAT THE POSITION IDENTIFIED ABOVE HAS CHANGED AS REFLECTED. _____ (Signature of Supervisor)	5. I CERTIFY THAT THE CHANGES REFLECTED ARE PROPER AND THE POSITION AS HEREBY AMENDED IS PROPERLY CLASSIFIED _____ (Official Exercising Classification Authority)
_____ (Date)	_____ (Date)
TITLE _____	TITLE HR Specialist (Classification)

7. DESCRIBE BRIEFLY, BUT IN FULL, THE REASONS FOR CHANGES CHECKED ABOVE AND THE ADDITIONS, DELETIONS, OR REVISIONS WHICH ARE TO BE MADE IN THE DESCRIPTION PROPER.

This is an entry level trainee position to a full performance GS-09 level position. The incumbent of this position may be non-competitively promoted to the intermediate grade level (GS-07) after satisfactorily completing higher graded duties and upon completion of time-in-grade and qualification requirements.

The incumbent will be assigned various tasks from the attached position description on an on-the-job training basis, with the difficulty of the tasks and degree of independent performance increasing gradually, as the incumbent becomes better trained, and demonstrates the ability to assume greater responsibility.

Initially, the supervisor will make assignments by giving specific instructions on objectives, standards, methods and guidelines; and will review work closely during progress and upon completion. Review of work will be for adherence to instructions, guidelines, methods, procedures, and additional developmental needs.

SUPERVISORY CERTIFICATION: I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that a false or misleading statement may constitute violations of such statutes or their implementing regulations.

Name Signature and Title of Supervisor

Date

I. INTRODUCTION

The incumbent serves as the Geographic Information System (GIS) Specialist. Provides GIS support and advice for application of geospatial technology. This position is responsible for the acquisition and management of the wide range of spatial information required to support the management of public lands. The incumbent must have an effective mix of technical skills in the geographic and computer science disciplines as well as a working appreciation of the Bureau mission and operational procedures sufficient to support Bureau of Land Management (BLM) business activities.

This position is typically located at field/district office level.

II. MAJOR DUTIES

The incumbent performs the following duties:

1. Geospatial Analysis

- Identifies requirements and implements analytical techniques necessary to solve GIS issues.
- Develops and modifies GIS software applications and interfaces.

2. Geospatial Information Management

- Is the technical specialist for activities involving spatial data for the individual office.
- Provides technical user support for all aspects of geospatial data and software.
- Implements quality control and assurance guidelines for geospatial data projects.
- Assists in the development of statewide standards and applications.
- Works with other Federal, State and local agencies to coordinate data capture and analysis projects
- Represents the office in order to facilitate the sharing and distribution of spatial information with other Federal, state and local entities.
- Works actively to bring consistency to all geospatial data.

3. Geospatial Program Management/Coordination

- Works with a diverse group of resources specialists, planners and managers to coordinate and implement GIS activities, to include; development of project objectives, evaluation

of adequacy of existing data sources, creation/modification of GIS coverages, databases, analysis, and preparation of final output products.

- Coordinates locally with managers, resources specialist/technicians and IT staff to identify GIS hardware and processing needs and develop plans for required upgrades.

4. Geospatial Policy and Planning

- Assists in the integration of Enterprise GIS with the long- and short- term planning and management activities.

III. FES FACTORS:

FACTOR 1, KNOWLEDGE REQUIRED BY THE POSITION

Level 1-6, 950 points

- Ability to apply Geographic Information Systems and related technology in support of natural resources management.
- Practical knowledge of the techniques used in the analysis of multiple resources, combined with a knowledge of the magnitude and complexity of GIS databases. This includes comprehensive program planning and implementation techniques, data encoding and standards. Ability to coordinate a variety of simultaneous projects.
- Practical knowledge of the general land use planning process and land management programs.
- Practical knowledge of geographic/cartographic sciences, interdisciplinary resource management, and database management.
- Knowledge of appropriate database design principles to identify interrelationships among data.
- Practical knowledge of the interrelationships of various natural and cultural resources; for example, range, wildlife, soil, water, minerals and others.
- Practical knowledge of the concepts involved in predictive modeling to generate computer models of resource distribution and behavior.
- Knowledge of BLM standard GIS software/hardware.
- Ability to communicate clearly about the application of GIS with planners, resource specialists, managers, and peer professionals in Federal, State and local agencies.
- Ability to communicate effectively with a multi-disciplinary group in a knowledgeable and accurate manner.

Geographic Information System Specialist, GS-301-09

NS0047

FACTOR 2, SUPERVISORY CONTROLS

Level 2-3, 275 points

Reports to a first line supervisor who assigns specific projects in terms of objectives, priorities, and deadlines. The incumbent plans, coordinates, and performs the steps to complete the project within accepted practices in the occupation. Completed work is reviewed by the supervisor for consistency as well as contribution to the overall project. Findings and recommendations developed by the incumbent are reviewed by the supervisor.

FACTOR 3, GUIDELINES

Level 3-3, 275 points

Guidelines are Bureau manuals, written instructions, State guidance and work plan directives, implementation and work plan directives setting forth policies, regulations and procedures for management. These guidelines, however, are often very general in nature, and incomplete. There are many instances when the incumbent is required to use good judgment in interpreting and adapting existing guidelines to specific case or problems.

FACTOR 4, COMPLEXITY

Level 4-3, 150 points

The work includes various duties involving different and unrelated processes and methods. In completing an assignment, the incumbent is frequently involved in several stages of the geospatial data automation process from analysis of subject matter to final product design. The incumbent makes decisions regarding what needs to be done based on an analysis of the subject under review, including identifying the conditions and elements involved to discern interrelationships.

FACTOR 5, SCOPE AND EFFECT

Level 5-3, 150 points

The purpose of the work is to plan and carry out projects that involve identifying analyzing and making recommendations to resolve conventional problems and situations. The completed work influences decisions by managers concerning the activities studied. The BLM GIS database compiled and coordinated by the incumbent will be used to assist BLM managers in their functional responsibilities.

FACTOR 6, PERSONAL CONTACTS

Level 6-2, 25 points

Personal contacts are primarily with local staff and/or counterparts at Federal, State, or local agencies/government within a structured setting.

FACTOR 7, PURPOSE OF CONTACTS

Level 7-2, 50 points

Contacts are made to exchange professional and technical information, resolve problems, establish procedures, conduct briefings, coordinate actions, perform evaluations, provide guidance, and to explain programs, policies and procedures.

FACTOR 8, PHYSICAL DEMANDS

Level 8-1, 5 points

The work is primarily sedentary, requiring long periods of sitting in one position, intense concentration, and working for several hours at a time. Stress may be experienced on a regular basis in attempting to respond to conflicting objectives and in working against tight deadlines with limited resources.

FACTOR 9, WORK ENVIRONMENT

Level 9-1, 5 points

The work is primarily in an office/computer room environment. Occasional fieldwork may be required. Fieldwork is in support of resource mapping projects and involves extended days of travel. Poor weather conditions may prolong fieldwork beyond planning dates. Incumbent must be comfortable with less than ideal conditions in remote settings in the accomplishment of mapping projects.

Geographic Information System Specialist, GS-301-09

NS0047

EVALUATION STATEMENT

Recommended Classification: Geographic Information Specialist, GS-0301-09
Organizational Location: Bureau of Land Management
References: Administrative Analysis Grade Evaluation Guide, TS-98, August 1990.

Background: The Enterprise Geographic Information System Human Capital Group (GISHCG) developed this position description. The GISHCG was established as a subcommittee to the Enterprise GIS Implementation initiative in order to create a staffing/classification package for managers and Human Resources staff. The package consists of standard position descriptions at the GS-9, GS-11 (NS0048), and GS-12 (NS0049) levels.

Although it may be found at any organizational level, GS-09 level GIS positions are typically located at field/district office level. The GS-09 level is the first full performance level for two-grade interval GIS positions (i.e., those positions involving the exercise of analytical ability, judgment, discretion, and personal responsibility, and the application of a substantial body of knowledge of principles, concepts, and practices).

Determination of Series and Title:

To select the appropriate series, you must determine the paramount knowledge; i.e., the most important subject matter knowledge, required to perform the primary duties of the position. To determine the paramount knowledge, you must also consider the primary purpose for the position's existence, the most important qualification(s) required, recruitment sources, career progression, and the background knowledge required. Care must be taken to apply the **"paramount knowledge requirement test"** as consistently and fairly as possible.

The paramount knowledge requirement in this position is of Geographic Information Systems (GIS) including current applications, trends, data management procedures, and software/hardware uses in order to support natural resources management programs. The Miscellaneous Administration and Program series, GS-301, covers two-grade interval work which is not elsewhere classifiable. The essential criteria for classifying positions in this series are:

- that the primary work of the position is of an administrative, two-grade interval nature; and
- that the primary work of the position is not classifiable in any other series.

Positions classified in the Miscellaneous Administration and Program Series, GS-301, involve *specialized* work for which no appropriate occupational series has been established. It has been demonstrated that knowledge of such fields as geography, natural resources, physical science, or cartography obtained through completion of a full 4-year course of study leading to a bachelor's or higher degree or an appropriate combination of education and experience is suitable for successful performance of GIS work. However, placement in a series appropriate for the areas of studies listed above (i.e., 150, 401, 1301, 1370) would not be reflective of all the knowledges

required to perform GIS work, including the knowledge required to support the various and diverse amount of Bureau programs. It has also been demonstrated that knowledge related to information systems is beneficial. However, this knowledge is more characteristic to that applied by an information technology user rather than a specialist and does not meet the intent for placement in the Information Technology series. Therefore, these knowledges do not meet the "paramount knowledge requirement test."

In consideration of the paramount knowledge required, the specialized nature of the work, the mix of knowledges required (that can be obtained through varied backgrounds), providing a consistent and inclusive series for recruitment purposes, and providing a consistent career ladder progression, it is determined that this position meets the criteria for placement into the GS-301 series.

No titles are specified for positions in this series. Geographic Information Specialist has been requested. The appropriate title and series for this position is Geographic Information Specialist, GS-0301-XX.

Determination of Grade:

Individual worker positions classified in the GS-301 series are to be evaluated by reference to an appropriate multi-series guide or, if none is applicable, a standard for a specific occupational series that involves analogous knowledges and skills. The Administrative Analysis Grade Evaluation Guide (AAGEG), TS-98, August 1990, provides grade level criteria for non-supervisory staff administrative analytical, planning, and evaluative work, at grade GS-9 and above. Work covered by the guide is administrative in nature and does not require specialized subject matter knowledge and skills. While such work does not require specialized educational preparation, it does require a high degree of qualitative and/or quantitative analytical skills, the ability to research problems and issues, written and oral communication skills, and the application of mature judgment in problem solving.

This AAGEG is written in the Factor Evaluation System (FES) format. Under that system, positions are evaluated on a factor-by-factor basis using the factor level descriptions (FLDs) provided in the standard. Each factor in the position description is evaluated against the appropriate FLDs and/or illustrations in the standard. The work of the position must fully match the FLD.

Summary of Points Assigned

Evaluation Factors		Points Assigned	(Level)
1	Knowledge Required by the Position	950	6
2	Supervisory Controls	275	3
3	Guidelines	275	3
4	Complexity	150	3
5	Scope and Effect	150	3
6&7	Personal Contacts & Purpose of Contacts	75	2b

Geographic Information System Specialist, GS-301-09

NS0047

8	Physical Demands	5	1
9	Work Environment	5	1
	Total Points	1885	
	Grade Conversion (Range: 1855-2100)	GS-09	

Conclusion: This position is properly classified as Geographic Information Specialist, GS-301-09.

HR Specialist (Classification)

POSITION DESCRIPTION <i>(Please Read Instructions on the Back)</i>								1. Agency Position No.									
2. Reason for Submission <input type="checkbox"/> Redescription <input checked="" type="checkbox"/> New <input type="checkbox"/> Hdqtrs <input checked="" type="checkbox"/> Field <input type="checkbox"/> Reestablishment <input type="checkbox"/> Other Explanation <i>(Show any positions replaced)</i>		3. Service		4. Employing Office Location		5. Duty Station		6. OPM Certification No.									
7. Fair Labor Standards Act <input checked="" type="checkbox"/> Exempt <input type="checkbox"/> Nonexempt		8. Financial Statements Required <input type="checkbox"/> Executive Personnel Financial Disclosure <input type="checkbox"/> Employment and Financial Interest		9. Subject to IA Action <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		10. Position Status <input checked="" type="checkbox"/> Competitive <input type="checkbox"/> Excepted <i>(Specify in Remarks)</i> <input type="checkbox"/> SES (Gen.) <input type="checkbox"/> SES (CR)		11. Position Is <input type="checkbox"/> Supervisory <input type="checkbox"/> Managerial <input checked="" type="checkbox"/> Neither		12. Sensitivity <input checked="" type="checkbox"/> 1--Non-Sensitive <input type="checkbox"/> 3--Critical <input type="checkbox"/> 2--Noncritical Sensitive <input type="checkbox"/> 4--Special Sensitive		13. Competitive Level Code		14. Agency Use			
15. Classified/Graded by		Official Title of Position				Pay Plan		Occupational Code		Grade		Initials		Date			
a. Office of Personnel Management																	
b. Department, Agency or Establishment																	
c. Second Level Review		Geographic Information System Specialist				GS		301		11							
d. First Level Review		OC: AA															
e. Recommended by Supervisor or Initiating Office																	
16. Organizational Title of Position <i>(if different from official title)</i>						17. Name of Employee <i>(if vacant, specify)</i>											
18. Department, Agency, or Establishment Department of the Interior						c. Third Subdivision											
a. First Subdivision Bureau of Land Management						d. Fourth Subdivision											
b. Second Subdivision State Office						e. Fifth Subdivision											
19. Employee Review-This is an accurate description of the major duties and responsibilities of my position.						Signature of Employee <i>(optional)</i>											
20. Supervisory Certification. <i>I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that</i>						<i>this information is to be used for statutory purposes relating to appointment and payment of public funds, and that false or misleading statements may constitute violations of such statutes or their implementing regulations.</i>											
a. Typed Name and Title of Immediate Supervisor						b. Typed Name and Title of Higher-Level Supervisor or Manager <i>(optional)</i>											
Signature _____ Date _____						Signature _____ Date _____											
21. Classification/Job Grading Certification. <i>I certify that this position has been classified/graded as required by Title 5, U.S. Code, in conformance with standards published by the U.S. Office of Personnel Management or, if no published standards apply directly, consistently with the most applicable published standards.</i>						22. Position Classification Standards Used in Classifying/Grading Position Handbook of Occupational Groups and Families Series Definitions. Administrative Analysis Grade Evaluation Guide, Aug 90, TS-98.											
Typed Name and Title of Official Taking Action HR Specialist (Classification)						Information for Employees. The standards, and information on their application, are available in the personnel office. The classification of the position may be reviewed and corrected by the agency or the U.S. Office of Personnel Management. Information on classification/job grading appeals, and complaints on exemption from FLSA, is available from the personnel office or the U.S. Office of Personnel Management.											
Signature _____ Date _____																	
23. Position Review		Initials		Date		Initials		Date		Initials		Date		Initials		Date	
a. Employee <i>(optional)</i>																	
b. Supervisor																	
c. Classifier																	
24. Remarks FPL: GS-11 BUS: _____																	
25. Description of Major Duties and Responsibilities <i>(See Attached)</i>																	

DI-625

POSITION CLASSIFICATION AMENDMENT

1. OFFICIAL HEADQUARTERS	2. NAME OF INCUMBENT		
3. ORGANIZATIONAL LOCATION <input type="checkbox"/> AS SHOWN ON CURRENT DESCRIPTION <input checked="" type="checkbox"/> AS HEREBY AMENDED			
IIa. _____	d. _____		
b. _____	e. _____		
c. _____			
4. CSC TITLE AND BUREAU POSITION NO. NS0048 Geographic Information System Specialist	SCHEDULE GS	SERIES 301	GRADE 09
<input type="checkbox"/> SAME AS PRESENT: AMENDED FOR <input type="checkbox"/> CSC TITLE <input type="checkbox"/> POS. NO. <input type="checkbox"/> SCHEDULE <input type="checkbox"/> SERIES <input checked="" type="checkbox"/> GRADE			

CERTIFICATIONS

<p>5. I CERTIFY THAT THE POSITION IDENTIFIED ABOVE HAS CHANGED AS REFLECTED.</p> <p style="text-align: center;">_____ (Signature of Supervisor)</p> <p style="text-align: center;">_____ (Date)</p> <p>TITLE _____</p>	<p>5. I CERTIFY THAT THE CHANGES REFLECTED ARE PROPER AND THE POSITION AS HEREBY AMENDED IS PROPERLY CLASSIFIED</p> <p style="text-align: center;">_____ (Official Exercising Classification Authority)</p> <p style="text-align: center;">_____ (Date)</p> <p>TITLE HR Specialist (Classification)</p>
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7. DESCRIBE BRIEFLY, BUT IN FULL, THE REASONS FOR CHANGES CHECKED ABOVE AND THE ADDITIONS, DELETIONS, OR REVISIONS WHICH ARE TO BE MADE IN THE DESCRIPTION PROPER.

This is an advanced developmental position. The assignments in this position are designed to prepare the incumbent to perform the duties and responsibilities in the target position of Geographic Information Specialist, GS-301-11.

The work to be accomplished is essentially the same as the target position and the incumbent will perform the day-to-day assignments with considerable independence in planning/carrying out the work. However at this level, additional guidance/review will be provided for the more complex assignments (e.g., those without established precedents), in terms of discussions of policies, controversial/sensitive areas, etc., and assistance in resolving conflicts.

Work will be reviewed for interpretation of policies, guidelines, judgment used, effectiveness in completing assignments, and developmental progress towards performing the full range of duties at the level described in the position description.

SUPERVISORY CERTIFICATION: I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that a false or misleading statement may constitute violations of such statutes or their implementing regulations.

Name Signature and Title of Supervisor

Date

I. INTRODUCTION

The incumbent serves as the principle technical advisor on Geographic Information Systems to the office manager and resources staff. This position is responsible for the acquisition and management of the wide range of spatial information required to support the management of public lands. The incumbent must have a thorough and effective mix of technical skills in the geographic and computer science disciplines as well as a working appreciation of the Bureau mission and operational procedures sufficient to support Bureau of Land Management (BLM) business activities.

This position is typically located at field/district office level.

II. MAJOR DUTIES

The incumbent performs the following duties:

1. Geospatial Analysis

- Identifies requirements and implements advanced analytical techniques necessary to solve complex GIS issues.
- Develops and modifies GIS software applications and interfaces.

2. Geospatial Information Management

- Is the lead for activities involving spatial data for their individual office.
- Provides technical user support for all aspects of geo-spatial data and software.
- Develops and implements quality control and assurance guidelines for geo spatial data projects.
- Assists in the development of statewide standards and applications.
- Works actively to bring consistency to all geo spatial data.
- Works with other Federal, State and local agencies to coordinate data capture and analysis projects
- Represents the office to facilitate the sharing and distribution of spatial information with other Federal, state and local entities.

3. Geospatial Program Management/Coordination

- Works with a diverse group of resources specialists, planners and managers to coordinates and implements GIS activities, to include development of project objectives, evaluation of adequacy of existing data sources, creation/modification of GIS coverage's and databases, analysis, preparation of final output products, and data storage.
- Coordinates locally with managers, resources specialist/technicians and IT staff to identify GIS hardware and processing needs and develop plans for required upgrades.
- Promotes and implements an integrated training program to teach basic skills in the use of GIS software, data acquisition, retrieval and analysis, to meet local needs.
- Serves as a contracting officer representative (COR).

4. Geospatial Policy and Planning

- Assists in the integration of Enterprise GIS with the long and short term planning and management activities.

III. FES FACTORS

FACTOR 1, KNOWLEDGE REQUIRED BY THE POSITION

Level 1-7, 1250 points

- Ability to apply Geographic Information Systems and related technology in support of natural resources management.
- Knowledge of the techniques used in the analysis of multiple resources, combined with knowledge of the magnitude and complexity of GIS databases. This includes comprehensive program planning and implementation techniques, data encoding and standards. Ability to coordinate a variety of simultaneous projects.
- Knowledge of the general land use planning process and land management programs.
- Knowledge of geographic/cartographic sciences, interdisciplinary resource management, and data base management.
- Knowledge of appropriate database design principles to identify interrelationships among data.
- Knowledge of the interrelationships of various natural and cultural resources; for example, range, wildlife, soil, water, minerals and others.
- Knowledge of the concepts involved in predictive modeling to generate computer models of resource distribution and behavior.

- Knowledge of BLM standard GIS software/hardware.
- Ability to communicate clearly about the application of GIS with planners, resource specialists, managers, and peer professionals in Federal, State and local agencies.
- Ability to communicate effectively with a multi-disciplinary group in a knowledgeable and accurate manner.
- Knowledge of the Contract Officer Representative responsibilities.

FACTOR 2, SUPERVISORY CONTROLS

Level 2-4, 450 points

Reports to a first line supervisor who provides work assignments in terms of broad objectives and scope; the incumbent is expected to function with a large degree of independence in the coordination, scheduling, reporting and completion of assigned duties/tasks. Completed work is reviewed for effectiveness in meeting requirements or expected results. Special assignments are reviewed only to ascertain conclusions and recommendations.

FACTOR 3, GUIDELINES

Level 3-3, 275 points

Guidelines are Bureau manuals, written instructions, State guidance and work plan directives, implementation and work plan directives setting forth policies, regulations and procedures for management. These guidelines, however, are often very general in nature, and incomplete. There are many instances when the incumbent is required to use good judgment in interpreting and adapting existing guidelines to specific case or problems.

FACTOR 4, COMPLEXITY

Level 4-4, 225 points

The work assignments involve performance of and active involvement with a wide range of technical functions related to the use of spatial data. Broad and sometimes vague requirements will be received from many varied resource specialists and managers. The work involves providing guidance and assistance in organizing, analyzing, locating and evaluating a wide variety of information while coordinating with various organizational levels. The work also requires coordinating with other Federal, State, and local land managing agencies for effective direction of spatial data base compilation. In completing an assignment, the incumbent is frequently involved in several stages of the automation process from analysis of subject matter and problems, to system designs. Precise definition of user requirements and coordination with affected resources is often difficult and requires creativity in resolving problems. In some instances, these activities have no established procedures; thus the incumbent must use innovation and originality in carrying out the duties of the position.

FACTOR 5, SCOPE AND EFFECT

Level 5-3, 150 points

The purpose of the work is to plan and carry out projects that involve identifying analyzing and making recommendations to resolve conventional problems and situations. The completed work influences decisions by managers concerning the activities studied. The BLM GIS database

Geographic Information System Specialist, GS-301-11

NS0048

compiled and coordinated by the incumbent will be used to assist BLM managers in their functional responsibilities.

FACTOR 6, PERSONAL CONTACTS

Level 6-3, 60 points

Personal contacts are with individuals, or groups from within and outside the BLM in a moderately unstructured setting. These contacts are with National level, state office, and field personnel, users, computer personnel, vendor representatives, contractors and/or other Federal state and local agencies/government.

FACTOR 7, PURPOSE OF CONTACTS

Level 7-2, 50 points

Contacts are made to exchange professional and technical information, resolve problems, establish procedures, conduct briefings, coordinate actions, perform evaluations, provide guidance, and to explain programs, policies and procedures.

FACTOR 8, PHYSICAL DEMANDS

Level 8-1, 5 points

The work is primarily sedentary, requiring long periods of sitting in one position, intense concentration, and working for several hours at a time. Stress may be experienced on a regular basis in attempting to respond to conflicting objectives and in working against tight deadlines with limited resources.

FACTOR 9, WORK ENVIRONMENT

Level 9-1, 5 points

The work is primarily in an office/computer room environment. Occasional fieldwork may be required. Fieldwork is in support of resource mapping projects and involves extended days of travel. Poor weather conditions may prolong fieldwork beyond planning dates. Incumbent must be comfortable with less than ideal conditions in remote settings in the accomplishment of mapping projects.

EVALUATION STATEMENT

Recommended Classification: Geographic Information Specialist, GS-0301-11
Organizational Location: Bureau of Land Management
References: Administrative Analysis Grade Evaluation Guide, TS-98, August 1990.

Background: This position description was developed by the Enterprise Geographic Information System Human Capital Group (GISHCG). The GISHCG was established as a subcommittee to the Enterprise GIS Implementation initiative in order to create a staffing/classification package for managers and Human Resources staff. The package consists of standard position descriptions at the GS-9 (NS0047), GS-11, and GS-12 (NS0049) level.

Although it may be found at any organizational level, GS-11 level GIS positions are typically located at field/district office level. The classification factors differentiating this position from the GS-09 level are:

Factor		GS-11	GS-09
1	Knowledge Required by the Position	1-7	1-6
2	Supervisory Controls	2-4	2-3
4	Complexity	4-4	4-3
6	Personal Contacts	6-3	6-2
7	Purpose of Contracts	7-3	7-2

Determination of Series and Title:

To select the appropriate series, you must determine the paramount knowledge; i.e., the most important subject matter knowledge required to perform the primary duties of the position. To determine the paramount knowledge, you must also consider the primary purpose for the position's existence, the most important qualification(s) required, recruitment sources, career progression, and the background knowledge required. Care must be taken to apply the **"paramount knowledge requirement test"** as consistently and fairly as possible.

The paramount knowledge requirement in this position is of geographic information systems (GIS) including current applications, trends, data management procedures, and software/hardware uses in order to support natural resources management programs. The Miscellaneous Administration and Program series, GS-301, covers two-grade interval work which is not elsewhere classifiable. The essential criteria for classifying positions in this series are:

- that the primary work of the position is of an administrative, two-grade interval nature; and
- that the primary work of the position is not classifiable in any other series.

Positions classified in the Miscellaneous Administration and Program Series, GS-301, involve *specialized* work for which no appropriate occupational series has been established. It has been

Geographic Information System Specialist, GS-301-11

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demonstrated that knowledge of such fields as geography, natural resources, physical science, or cartography obtained through completion of a full 4-year course of study leading to a bachelor's or higher degree or an appropriate combination of education and experience is suitable for successful performance of GIS work. However, placement in a series appropriate for the areas of studies listed above (i.e., 150, 401, 1301, 1370) would not be reflective of all the knowledges required to perform GIS work, including the knowledge required to support the various and diverse amount of Bureau programs. It has also been demonstrated that knowledge related to information systems is beneficial. However, this knowledge is more characteristic to that applied by an information technology user rather than a specialist and does not meet the intent for placement in the Information Technology series. Therefore, these knowledges do not meet the "paramount knowledge requirement test."

In consideration of the paramount knowledge required, the specialized nature of the work, the mix of knowledges required (that can be obtained through varied backgrounds), providing a consistent and inclusive series for recruitment purposes, and providing a consistent career ladder progression, it is determined that this position meets the criteria for placement into the GS-301 series.

No titles are specified for positions in this series. Geographic Information Specialist has been requested. The appropriate title and series for this position is Geographic Information Specialist, GS-0301-XX.

Determination of Grade:

Individual worker positions classified in the GS-301 series are to be evaluated by reference to an appropriate multi-series guide or, if none is applicable, a standard for a specific occupational series that involves analogous knowledges and skills. The Administrative Analysis Grade Evaluation Guide (AAGEG), TS-98, August 1990, provides grade level criteria for nonsupervisory staff administrative analytical, planning, and evaluative work, at grade GS-9 and above. Work covered by the guide is administrative in nature and does not require specialized subject matter knowledge and skills. While such work does not require specialized educational preparation, it does require a high degree of qualitative and/or quantitative analytical skills, the ability to research problems and issues, written and oral communication skills, and the application of mature judgment in problem solving.

This AAGEG is written in the Factor Evaluation System (FES) format. Under that system, positions are evaluated on a factor-by-factor basis using the factor level descriptions (FLDs) provided in the standard. Each factor in the position description is evaluated against the appropriate FLDs and/or illustrations in the standard. The work of the position must fully match the FLD.

Summary of Points Assigned

Evaluation Factors		Points Assigned	(Level)
1	Knowledge Required by the Position	1250	7
2	Supervisory Controls	450	4

3	Guidelines	275	3
4	Complexity	225	4
5	Scope and Effect	150	3
6&7	Personal Contacts & Purpose of Contacts	110	3b
8	Physical Demands	5	1
9	Work Environment	5	1
	Total Points	2470	
	Grade Conversion (Range: 2355-2750)	GS-11	

Conclusion: This position is properly classified as Geographic Information Specialist, GS-0301-11.

HR Specialist (Classification)

POSITION DESCRIPTION <i>(Please Read Instructions on the Back)</i>							1. Agency Position No.						
2. Reason for Submission <input type="checkbox"/> Redescription <input checked="" type="checkbox"/> New <input type="checkbox"/> Reestablishment <input type="checkbox"/> Other Explanation <i>(Show any positions replaced)</i>		3. Service <input type="checkbox"/> Hdqtrs <input checked="" type="checkbox"/> Field		4. Employing Office Location		5. Duty Station		6. OPM Certification No.					
7. Fair Labor Standards Act <input checked="" type="checkbox"/> Exempt <input type="checkbox"/> Nonexempt		8. Financial Statements Required <input type="checkbox"/> Executive Personnel Financial Disclosure <input type="checkbox"/> Employment and Financial Interest		9. Subject to IA Action <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		10. Position Status <input checked="" type="checkbox"/> Competitive <input type="checkbox"/> Excepted <i>(Specify in Remarks)</i> <input type="checkbox"/> SES (Gen.) <input type="checkbox"/> SES (CR)							
						11. Position Is <input type="checkbox"/> Supervisory <input type="checkbox"/> Managerial <input checked="" type="checkbox"/> Neither		12. Sensitivity <input checked="" type="checkbox"/> 1--Non-Sensitive <input type="checkbox"/> 3--Critical <input type="checkbox"/> 2--Noncritical Sensitive <input type="checkbox"/> 4--Special Sensitive		13. Competitive Level Code		14. Agency Use	
15. Classified/Graded by		Official Title of Position		Pay Plan		Occupational Code		Grade		Initials		Date	
a. Office of Personnel Management													
b. Department, Agency or Establishment													
c. Second Level Review		Geographic Information System Specialist		GS		301		12					
d. First Level Review		OC: AA											
e. Recommended by Supervisor or Initiating Office													
16. Organizational Title of Position <i>(if different from official title)</i>						17. Name of Employee <i>(if vacant, specify)</i>							
18. Department, Agency, or Establishment Department of the Interior						c. Third Subdivision							
a. First Subdivision Bureau of Land Management						d. Fourth Subdivision							
b. Second Subdivision State Office						e. Fifth Subdivision							
19. Employee Review-This is an accurate description of the major duties and responsibilities of my position.						Signature of Employee <i>(optional)</i>							
20. Supervisory Certification. <i>I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that</i>						<i>this information is to be used for statutory purposes relating to appointment and payment of public funds, and that false or misleading statements may constitute violations of such statutes or their implementing regulations.</i>							
a. Typed Name and Title of Immediate Supervisor						b. Typed Name and Title of Higher-Level Supervisor or Manager <i>(optional)</i>							
Signature _____ Date _____						Signature _____ Date _____							
21. Classification/Job Grading Certification. <i>I certify that this position has been classified/graded as required by Title 5, U.S. Code, in conformance with standards published by the U.S. Office of Personnel Management or, if no published standards apply directly, consistently with the most applicable published standards.</i>						22. Position Classification Standards Used in Classifying/Grading Position Handbook of Occupational Groups and Families Series Definitions. Administrative Analysis Grade Evaluation Guide, Aug 90, TS-98.							
Typed Name and Title of Official Taking Action HR Specialist (Classification)						Information for Employees. The standards, and information on their application, are available in the personnel office. The classification of the position may be reviewed and corrected by the agency or the U.S. Office of Personnel Management. Information on classification/job grading appeals, and complaints on exemption from FLSA, is available from the personnel office or the U.S. Office of Personnel Management.							
Signature _____ Date _____													
23. Position Review		Initials		Date		Initials		Date		Initials		Date	
a. Employee <i>(optional)</i>													
b. Supervisor													
c. Classifier													
24. Remarks FPL: GS-12 BUS: _____													
25. Description of Major Duties and Responsibilities <i>(See Attached)</i>													

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POSITION CLASSIFICATION AMENDMENT

1. OFFICIAL HEADQUARTERS	2. NAME OF INCUMBENT		
3. ORGANIZATIONAL LOCATION <input type="checkbox"/> AS SHOWN ON CURRENT DESCRIPTION <input checked="" type="checkbox"/> AS HEREBY AMENDED			
IIa. _____	d. _____		
b. _____	e. _____		
c. _____			
4. CSC TITLE AND BUREAU POSITION NO. NS0049 Geographic Information System Specialist	SCHEDULE GS	SERIES 301	GRADE 11
<input type="checkbox"/> SAME AS PRESENT: AMENDED FOR <input type="checkbox"/> CSC TITLE <input type="checkbox"/> POS. NO. <input type="checkbox"/> SCHEDULE <input type="checkbox"/> SERIES <input checked="" type="checkbox"/> GRADE			

CERTIFICATIONS

5. I CERTIFY THAT THE POSITION IDENTIFIED ABOVE HAS CHANGED AS REFLECTED. <div style="border-top: 1px solid black; border-bottom: 1px solid black; padding: 5px 0;"> <div style="display: flex; justify-content: space-between;"> (Signature of Supervisor) (Date) </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> TITLE _____ </div> </div>	6. I CERTIFY THAT THE CHANGES REFLECTED ARE PROPER AND THE POSITION AS HEREBY AMENDED IS PROPERLY CLASSIFIED <div style="border-top: 1px solid black; border-bottom: 1px solid black; padding: 5px 0;"> <div style="display: flex; justify-content: space-between;"> (Official Exercising Classification Authority) (Date) </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> TITLE HR Specialist (Classification) </div> </div>
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7. DESCRIBE BRIEFLY, BUT IN FULL, THE REASONS FOR CHANGES CHECKED ABOVE AND THE ADDITIONS, DELETIONS, OR REVISIONS WHICH ARE TO BE MADE IN THE DESCRIPTION PROPER.

This is an advanced developmental position. The assignments in this position are designed to prepare the incumbent to perform the duties and responsibilities in the target position of Geographic Information Specialist, GS-301-12.

The work to be accomplished is essentially the same as the target position and the incumbent will perform the day-to-day assignments with considerable independence in planning/carrying out the work. However at this level, additional guidance/review will be provided for the more complex assignments (e.g., those without established precedents), in terms of discussions of policies, controversial/sensitive areas, etc., and assistance in resolving conflicts.

Work will be reviewed for interpretation of policies, guidelines, judgment used, effectiveness in completing assignments, and developmental progress towards performing the full range of duties at the level described in the position description.

SUPERVISORY CERTIFICATION: I certify that this is an accurate statement of the major duties and responsibilities of this position and its organizational relationships, and that the position is necessary to carry out Government functions for which I am responsible. This certification is made with the knowledge that this information is to be used for statutory purposes relating to appointment and payment of public funds, and that a false or misleading statement may constitute violations of such statutes or their implementing regulations.

Name Signature and Title of Supervisor _____
Date

I. INTRODUCTION

The incumbent serves as the principle technical advisor on Geographic Information Systems (GIS) to the office manager and resources staff. This position is responsible for the acquisition and management of the wide range of spatial information required to support the management of public lands. The incumbent must have a thorough and effective mix of technical skills in the geographic and computer science disciplines as well as a working appreciation of the Bureau mission and operational procedures sufficient to support Bureau of Land Management (BLM) business activities.

This position is typically located at state level.

II. MAJOR DUTIES

The incumbent performs the following duties:

1. Geospatial Analysis

- Identifies requirements and implements advanced analytical techniques necessary to solve complex GIS issues.

2. Geospatial Information Management

- Designs, develops and manages the GIS database including the conversion of thematic source maps from analog to digital form through the use of appropriate hardware and software.
- Provides technical user support for all aspects of geo-spatial data and software.
- Develops and implements quality control and assurance guidelines for geo-spatial data projects.
- Assists in the development of statewide standards and applications.
- Works actively to bring consistency to all geo-spatial data.
- Works with other Federal, State and local agencies to coordinate data capture and analysis projects.

3. Geospatial Program Management/Coordination

- Represents the office manager when working with others on GIS matters. Develops and maintains liaisons and effective working relations with related groups and individuals, agencies, and the public to encourage and facilitate cooperative management strategies.

- Works with a diverse group of resources specialists, planners and managers to coordinate and implement GIS applications. GIS applications are developed with regard to management objectives, adequacy of existing data sources, required analysis and final output products.
- Coordinates locally with managers, resources specialist/technicians and IT staff to identify GIS hardware and processing needs and develop plans for required upgrades.
- Serves as a contracting officer representative (COR).
- Attends management and professional conferences and other events for the purpose of exchanging information, presenting technical and policy information and advancing advocacy for public lands stewardship.
- Promotes and implements an integrated training program to teach basic skills in the use of GIS software, data acquisition, retrieval and analysis, to meet local needs.

4. Geospatial Policy and Planning

- Assists in the integration of Enterprise GIS with the long and short term planning and management activities.

III. FES FACTORS:

FACTOR 1, KNOWLEDGE REQUIRED BY THE POSITION

Level 1-7, 1250 points

- In depth knowledge of Geographic Information Systems and related technology using seasoned judgment to develop new insights into complex situations, apply innovative solutions to novel problems, and design new methods where established methods and procedures are inapplicable or are unavailable.
- Knowledge of the techniques used in the analysis of multiple resources, combined with a knowledge of the magnitude and complexity of GIS databases. This includes comprehensive program planning and implementation techniques, data encoding and standards.
- Ability to lead and coordinate a variety of simultaneous projects. Encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit; works with others to achieve goals. Influences, motivates, and challenges other; adapts leadership styles to a variety of situations.
- Knowledge of functions, principles, techniques of land use planning, including outdoor recreation planning and interdisciplinary resource management (e.g., environmental impact analysis, rangeland management, wildlife management etc.).

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- Knowledge of geographic/cartographic sciences, interdisciplinary resource management, and database management.
- Knowledge of appropriate database design principles to identify interrelationships among data.
- Knowledge of the interrelationships of various natural and cultural resources; for example, range, wildlife, soil, water, minerals and others.
- Knowledge of the concepts involved in predictive modeling to generate computer models of resource distribution and behavior.
- Knowledge of BLM standard GIS software/hardware.
- Ability to communicate clearly about the application of GIS with planners, resource specialists, managers, and peer professionals in Federal, State and local agencies.
- Ability to communicate effectively with a multi-disciplinary group in a knowledgeable and accurate manner. Expresses information to individuals or groups effectively, taking into account the audience and nature of the information; makes clear and convincing oral presentations; listens to others, attends to nonverbal cues, and responds appropriately.
- Knowledge of the Contract Officer Representative responsibilities.

FACTOR 2, SUPERVISORY CONTROLS

Level 2-4, 450 points

Reports to a first line supervisor who provides work assignments in terms of broad objectives and scope; the incumbent is expected to function with a large degree of independence in the coordination, scheduling, reporting and completion of assigned duties/tasks. Completed work is reviewed for effectiveness in meeting requirements or expected results. Special assignments are reviewed only to ascertain conclusions and recommendations.

FACTOR 3, GUIDELINES

Level 3-4, 450 points

Guidelines for performing the work are scarce or of limited use. Technical decisions and solutions of problems are based on the application of the incumbent's acquired knowledge experience, and judgment. The incumbent may extend methods and practices, use ingenuity and resourcefulness in the adaptation of GIS technology to the various requirements of multiple-use management.

FACTOR 4, COMPLEXITY

Level 4-4, 225 points

Work consists of a variety of duties that involve many different and unrelated processes and methods pertinent to natural resource and geo-spatial fields. Using seasoned judgment the employee decides what needs to be done by evaluating unusual circumstances; considering

different approaches; and dealing with incomplete and conflicting requirements, decisions and priorities.

In some instances, these activities have no established procedures; thus the incumbent must use innovation and originality in carrying out the duties of the position.

FACTOR 5, SCOPE AND EFFECT

Level 5-4, 225 points

The purpose of the work is to provide leadership and coordination to implement the geo-spatial program for use in planning, inventory and management of natural resources.

Work involves establishing criteria, formulating projects, assessing program effectiveness and/or investigating/analyzing a variety of unusual conditions, problems, or issues. Work affects a wide range of geo-spatial activities.

FACTOR 6, PERSONAL CONTACTS

Level 6-3, 60 points

Personal contacts are with individuals, or groups from within and outside the BLM in a moderately unstructured setting. These contacts are with National level, state office, and field personnel, users, computer personnel, vendor representatives, contractors and/or other Federal state and local agencies/government.

FACTOR 7, PURPOSE OF CONTACTS

Level 7-3, 120 points

Contacts are for coordination, collaboration, and communication with others to solve problems and reach agreement concerning differences as to appropriate practices, standards and to further the objectives of the organization's geo-spatial programs.

FACTOR 8, PHYSICAL DEMANDS

Level 8-1, 5 points

The work is primarily sedentary, requiring long periods of sitting in one position, intense concentration, and working for several hours at a time. Stress may be experienced on a regular basis in attempting to respond to conflicting objectives and in working against tight deadlines with limited resources.

FACTOR 9, WORK ENVIRONMENT

Level 9-1, 5 points

The work is primarily in an office/computer room environment. Occasional fieldwork may be required. Fieldwork is in support of resource mapping projects and involves extended days of travel. Poor weather conditions may prolong fieldwork beyond planning dates. Incumbent must be comfortable with less than ideal conditions in remote settings in the accomplishment of mapping projects.

EVALUATION STATEMENT

Recommended Classification: Geographic Information Specialist, GS-0301-12
Organizational Location: Bureau of Land Management
References: Administrative Analysis Grade Evaluation Guide, TS-98,
August 1990.

Background: This position description was developed by the Enterprise Geographic Information System Human Capital Group (GISHCG). The GISHCG was established as a subcommittee to the Enterprise GIS Implementation initiative in order to create a staffing/classification package for managers and Human Resources staff. The package consists of standard position descriptions at the GS-9 (NS0047), GS-11 (NS0048), and GS-12 level.

Although it may be found at any organizational level, GS-12 level GIS positions are typically located at state level. The classification factors differentiating this position from the GS-11 level are factor 3, Guidelines (3-4 versus 3-3), and factor 5, Scope and Effect (5-4 versus 5-3).

Determination of Series and Title:

To select the appropriate series, you must determine the paramount knowledge; i.e., the most important subject matter knowledge, required to perform the primary duties of the position. To determine the paramount knowledge, you must also consider the primary purpose for the position's existence, the most important qualification(s) required, recruitment sources, career progression, and the background knowledge required. Care must be taken to apply the **“paramount knowledge requirement test”** as consistently and fairly as possible.

The paramount knowledge requirement in this position is of geographic information systems (GIS) including current applications, trends, data management procedures, and software/hardware uses in order to support natural resources management programs. The Miscellaneous Administration and Program series, GS-301, covers two-grade interval work that is not elsewhere classifiable. The essential criteria for classifying positions in this series are:

- that the primary work of the position is of an administrative, two-grade interval nature; and
- that the primary work of the position is not classifiable in any other series.

Positions classified in the Miscellaneous Administration and Program Series, GS-301, involve *specialized* work for which no appropriate occupational series has been established. It has been demonstrated that knowledge of such fields as geography, natural resources, physical science, or cartography obtained through completion of a full 4-year course of study leading to a bachelor's or higher degree or an appropriate combination of education and experience is suitable for successful performance of GIS work. However, placement in a series appropriate for the areas of studies listed above (i.e., 150, 401, 1301, 1370) would not be reflective of all the knowledges required to perform GIS work, including the knowledge required to support the various and diverse amount of Bureau programs. It has also been demonstrated that knowledge related to information systems is beneficial. However, this knowledge is more characteristic to that

applied by an information technology user rather than a specialist and does not meet the intent for placement in the Information Technology series. Therefore, these knowledges do not meet the “paramount knowledge requirement test.”

In consideration of the paramount knowledge required, the specialized nature of the work, the mix of knowledges required (that can be obtained through varied backgrounds), providing a consistent and inclusive series for recruitment purposes, and providing a consistent career ladder progression, it is determined that this position meets the criteria for placement into the GS-301 series.

No titles are specified for positions in this series. Geographic Information Specialist has been requested. The appropriate title and series for this position is Geographic Information Specialist, GS-0301-XX.

Determination of Grade:

Individual worker positions classified in the GS-301 series are to be evaluated by reference to an appropriate multi-series guide or, if none is applicable, a standard for a specific occupational series that involves analogous knowledges and skills. The Administrative Analysis Grade Evaluation Guide (AAGEG), TS-98, August 1990, provides grade level criteria for non-supervisory staff administrative analytical, planning, and evaluative work, at grade GS-9 and above. Work covered by the guide is administrative in nature and does not require specialized subject matter knowledge and skills. While such work does not require specialized educational preparation, it does require a high degree of qualitative and/or quantitative analytical skills, the ability to research problems and issues, written and oral communication skills, and the application of mature judgment in problem solving.

This AAGEG is written in the Factor Evaluation System (FES) format. Under that system, positions are evaluated on a factor-by-factor basis using the factor level descriptions (FLDs) provided in the standard. Each factor in the position description is evaluated against the appropriate FLDs and/or illustrations in the standard. The work of the position must fully match the FLD.

Summary of Points Assigned

	Evaluation Factors	Points Assigned	(Level)
1	Knowledge Required by the Position	1250	7
2	Supervisory Controls	450	4
3	Guidelines	450	4
4	Complexity	225	4
5	Scope and Effect	225	4
6& 7	Personal Contacts & Purpose of Contacts	180	3c
8	Physical Demands	5	1
9	Work Environment	5	1

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	Total Points	2790	
	Grade Conversion (Range: 2755-3150)	GS-12	

Conclusion: This position is properly classified as Geographic Information Specialist, GS-0301-12.

HR Specialist (Classification)

Appendix F Spatial Data Standard for Facilities, Infrastructure, and Environment and Facility Management Standard for Facilities, Infrastructure, and Environment

F-1. Compliance Policy

a. Since 1993 the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) (formerly called TSSDS and SDS) and Facility Management Standard for Facilities, Infrastructure, and Environment (FMSFIE) (formerly called TFSMS and FMS) have continued to expand to meet the needs of an increasing customer community. From Release 1.600 to present, the number of “features” (entity types) has grown from just over 600 to more than 1,000 and the number of “attributes” has increased from less than 10,000 to nearly 26,000. For Release 2.000, an unpopulated database created from the entire SDSFIE/FMSFIE schema will require about 75 megabytes of hard drive space.

b. Due to its generic nature, many SDSFIE/FMSFIE tables contain a large number of attributes. Many customers have indicated they prefer to maintain only the SDSFIE/FMSFIE attributes that they need, and prefer to be able to include their “local” attributes (i.e., the attributes not currently included in the SDSFIE/FMSFIE) within the SDSFIE/FMSFIE attribute tables.

c. In 1997 the concept of a Filter was introduced to provide customers the capability to build and manage less than the full SDSFIE/FMSFIE schema (i.e., the entire SDSFIE/FMSFIE data model/data set). The Filter capability (as provided by the Filter Maker software application) permits customers to select subsets of the SDSFIE/FMSFIE schema for their specific functions and projects.

d. Up to the present time, the policy for SDSFIE/FMSFIE compliance has dictated that if an SDSFIE/FMSFIE attribute table (i.e., an attribute table included in the SDSFIE/FMSFIE schema) is present in the database, then all SDSFIE/FMSFIE attributes (i.e., attributes included in each specific SDSFIE/FMSFIE attribute table) must be present in that table. All attributes in the table must also use the formatting, ordering, and naming conventions of the SDSFIE/FMSFIE. The addition of customer-defined attributes is not allowed in a SDSFIE/FMSFIE table.

e. The SDSFIE/FMSFIE SQL Generator, Access Builder, and GeoMedia Builder tools are designed to build, test, and upgrade databases that meet the Basic level of SDSFIE/FMSFIE compliance. The “Basic” level of SDSFIE/FMSFIE compliance would be recommended for the following:

- Initial Geographic Information Systems (GIS) implementations.
- Customers who do not have experienced database administrators and GIS analysts.
- Where local policies and standards have not yet been developed for ensuring quality and integrity of data collected and delivered by multiple sources.

f. The Experienced level of SDSFIE/FMSFIE compliance would be recommended for customers who have experienced database administrators and/or GIS analysts; and where local policies and standards have been developed for ensuring quality and integrity of data collected and delivered by multiple sources.

g. The SDSFIE and FMSFIE are designed to be used with an external relational database (i.e., Oracle, Informix, Access, etc.) rather than the flat-file data structure; e.g., Environmental Systems Research Institute (ESRI) coverage and shape files and Computer-Aided Design and Drafting (CADD) objects. The use of an external relational database can provide many benefits, such as the following:

- Provide the ability to support multiple users accessing the data simultaneously using different CADD, GIS, and other software products.
- Provide an enterprise GIS solution, where data maintained in one database format (by one or multiple offices) is available to all users at an installation or within an organization.
- Provide a nonproprietary format with greater flexibility to share data with other users and applications.
- Provide a stable data format that protects an organization's data investment (vendors may discontinue products and/or support of a proprietary data structure at some time in the future).
- Avoid possible loss of data when upgrading to newer versions of CADD/GIS software, or exporting graphic and nongraphic data to other CADD/GIS software products/applications
- Maximize the return on investment by providing the capability to use data in an organization's business functions (e.g., generating reports, statistical analyses, etc.) using database, programming, and Web tools.

However, if GIS users do not yet have the experience or resources to establish and maintain an external relational database for GIS, they should use the SDSFIE and FMSFIE as data dictionaries (i.e., use SDSFIE/FMSFIE attribute and domain value naming conventions, data types, etc.). Using the SDSFIE and FMSFIE as data dictionaries for flat-file data structures can simplify and save costs on future conversion of the flat files to an SDSFIE/FMSFIE-compliant relational database.

F-2. Basic Level

Basic level is supported by SDSFIE/FMSFIE SQL Generator, Access Builder, and GeoMedia Builder tools.

a. Entity types and entities. Use SDSFIE entity type and entity naming conventions (i.e., the naming conventions included in the SDSFIE). The SDSFIE symbology (i.e., colors, line styles, or symbols) is recommended, and customers have the option of using their own symbology.

b. Attribute tables. Use SDSFIE/FMSFIE attribute table naming conventions and definitions (short names of eight characters in length). (The SQL Generator and Access Builder software applications currently construct attribute tables using the SDSFIE/FMSFIE short names.) Use of the entire SDSFIE/FMSFIE schema is not a requirement. A subset of the SDSFIE/FMSFIE schema may be used by: selecting one of the custom Filters provided with each SDSFIE/FMSFIE release; or using the SDSFIE/FMSFIE Filter Maker software application to build a custom filter based on the specific entity types required. The Filters will provide a SDSFIE/FMSFIE schema containing all of the selected graphic attribute tables (i.e., those attribute tables associated with the selected entity types) as well as all linked/joined SDSFIE/FMSFIE attribute tables. The unneeded linked/joined SDSFIE/FMSFIE attribute tables may be deleted.

c. *Attributes.*

(1) Use defined SDSFIE/FMSFIE attribute naming conventions and definitions (short names of 10 characters in length). (The SQL Generator and Access Builder software applications currently construct tables using the SDSFIE/FMSFIE short names.) All SDSFIE/FMSFIE-defined attributes, as output by the SDSFIE/FMSFIE software tools (e.g., SQL Generator and Access Builder), must be kept for the selected tables. Some options, which permit users to exclude specific predefined attributes, are being built into the software tools.

(2) If a locally configured attribute is required, determine the SDSFIE/FMSFIE table with which the attribute is associated. Determine the primary key of that table. This information is easily obtained from the SDSFIE/FMSFIE browser software application. In the database, create a new table. Name this table using the SDSFIE/FMSFIE table name, followed by a locally assigned prefix. As an example, “local_” would work quite well. Thus, if an attribute were to be added to the “bggenstr” SDSFIE/FMSFIE attribute table, a “local_bggenstr” table would be created. The very first attribute in the table would be “buildng_id,” the very same attribute that is the primary key of the bggenstr table.

(3) Figure F-1 below shows a graphical depiction of the arrangement being recommended. The two tables parallel each other inside the user’s database.

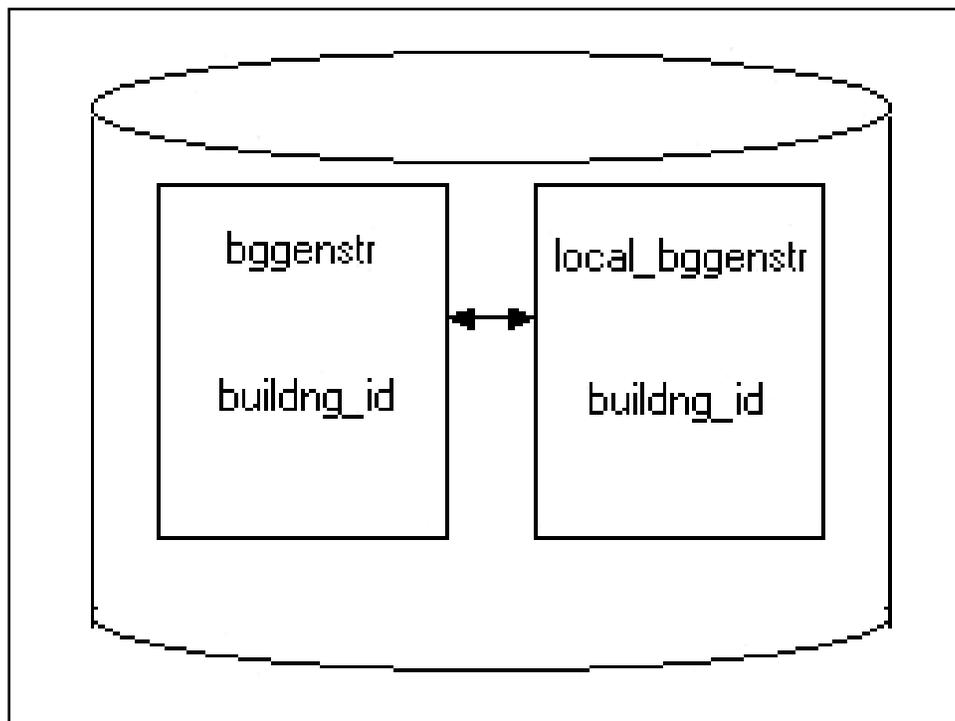


Figure F-1. Creating a local table

(4) This structure and naming convention has several advantages. First, all of the “local” tables will appear together in a tables list, and they are easily correlated to the corresponding SDSFIE/FMSFIE attribute table. This guarantees that the local attribute table will not be confused with a SDSFIE/FMSFIE attribute table, since the name exceeds the eight-character SDSFIE/FMSFIE limit and begins with the defined local identifier. By naming the first attribute as the Primary Key of the corresponding

SDSFIE/FMSFIE table, it is possible to create a join on the “building_id” in bggenstr with “building_id” in local_bggenstr, which provides the correct instance correlation.

(5) When, and if, the CADD/GIS Technology Center adds an attribute to the SDSFIE/FMSFIE that corresponds to the locally configured attribute, a single SQL query can be run that will update the values in the SDSFIE/FMSFIE table from the local table. That SQL statement would look something like:

```
UPDATE bggenstr INNER JOIN local_bggenstr ON bggenstr.buildng_id =  
local_bggenstr.buildng_id SET bggenstr.gate_num = local_bggenstr.gate_num;
```

(6) The local attribute can then be deleted from the local attribute table, or the local attribute table may be deleted if that is the only local attribute in the table (see Figure F-1).

d. Domain values. Use SDSFIE/FMSFIE domain table naming conventions and definitions (short names of eight characters in length). (The SQL Generator and Access Builder software applications currently construct domain tables using the SDSFIE/FMSFIE short names; i.e., Domain Table Name.) Use of the entire SDSFIE/FMSFIE schema is not a requirement. A subset of the SDSFIE/FMSFIE schema may be used by selecting one of the custom filters provided with each SDSFIE/FMSFIE release; or using the SDSFIE/FMSFIE Filter Maker software application to build a custom filter based on the specific entity types required. The filters will provide a SDSFIE/FMSFIE schema containing all of the selected graphic attribute tables (i.e., those attribute tables associated with the selected entity types) as well as all linked/joined SDSFIE/FMSFIE attribute tables. All of the SDSFIE/FMSFIE domain tables associated with the selected and linked/joined attribute tables are also provided. The unneeded linked/joined SDSFIE/FMSFIE attribute tables and associated domain tables may be deleted.

e. List and range domain values. Use defined SDSFIE/FMSFIE list and range domain value naming conventions and definitions (short names of 16 characters in length). (The SQL Generator and Access Builder software applications currently construct domain tables using the SDSFIE/FMSFIE domain value short names.) All SDSFIE/FMSFIE-defined list and range domain values must be kept for the selected domain tables. Local list and range domain tables may be included in the database using the same procedures as defined for local attribute tables.

F-3. Experienced Level

The Computer-Aided Design and Drafting/Geographic Information Systems (CADD/GIS) Technology Center currently does not provide tools that support customer customization of tables; i.e., deleting and adding attributes to SDSFIE/FMSFIE tables.

a. Entity types and entities. Use SDSFIE entity type and entity naming conventions (i.e., the naming conventions included in the SDSFIE). The SDSFIE symbology (i.e., colors, line styles, and symbols) is recommended; however, customers have the option of using their own symbology.

b. Attribute tables. Use SDSFIE/FMSFIE attribute table naming conventions and definitions. Short names of 8 characters in length or common names of up to 50 characters in length are acceptable. Use of the entire SDSFIE/FMSFIE schema is not a requirement. A subset of the SDSFIE/FMSFIE schema may be used by selecting one of the custom filters provided with each SDSFIE/FMSFIE release; or using the SDSFIE/FMSFIE Filter Maker software application to build a custom filter based on the specific entity types required. The filters will provide a SDSFIE/FMSFIE schema containing all of the selected graphic attribute tables (i.e., those attribute tables associated with the selected entity types) as well as all linked/joined SDSFIE/FMSFIE attribute tables. The unneeded linked/joined SDSFIE/FMSFIE attribute tables may be deleted.

c. *Attributes.*

(1) Customers have the flexibility of adding local attributes, as well as deleting SDSFIE/FMSFIE attributes not required for the customer's GIS/FM data collection, analysis, and reporting requirements. SDSFIE/FMSFIE formatting, ordering, and naming conventions must be maintained for the SDSFIE/FMSFIE attributes retained in each attribute table. The customer cannot add local attributes that duplicate the SDSFIE/FMSFIE attributes. For the SDSFIE/FMSFIE attributes, either the short name (10 characters in length) or common name (up to 50 characters in length) may be used.

(2) The following attributes must be retained in all SDSFIE and FMSFIE attribute tables:

(a) *Primary key.* The primary key attribute is required for assigning a unique identifier to the data record and for building the relationships (joins) with similar records used by the relational database software. The attribute entitled "building_id" is the primary key for the table "bggenstr" (see Figure F-2 below).

(b) *Experienced level users.* Figure F-2 provides an example of a possible experienced level SDSFIE/FMSFIE implementation. It contains a total of 62 attributes. The customers represented in the figure have determined that they only need to collect and maintain data for only 23 of these SDSFIE/FMSFIE attributes, and they have added one "local" attribute entitled "my_data." Experienced level users also have the following options:

Form Header			
Detail			
datalink	datalink	areafloor	areafloor
building_id	building_id	areausable	areausable
map_id	map_id	areas_u_d	areas_u_d
meta_id	meta_id	no_level	no_level
coord_id	coord_id	built_date	built_date
structname	structname	occup_date	occup_date
str_stat_d	str_stat_d	address_id	address_id
str_type_d	str_type_d	instln_id	instln_id
str_use_d	str_use_d	narrative	narrative
str_cnd_d	str_cnd_d	facil_id	facil_id
presntcode	presntcode		
owner_id	owner_id		
a_cost	a_cost		
my_data	my_data		

Figure F-2. Bggenstr Subset1

- The order of the attributes in a table may be changed.
- “Date/Time” data types may be used in lieu of the SDSFIE/FMSFIE integer date/time fields.
- Boolean (Yes/No) data types may be used in lieu of the SDSFIE/FMSFIE Boolean Domain Table (d_boolean).
- Shorter character fields than those specified in the SDSFIE/FMSFIE may be used.

d. Domain tables. Use defined SDSFIE/FMSFIE domain table naming conventions and definitions. Acceptable names can be either short at 10 characters or long at up to 32 characters in length. Use of the entire SDSFIE/FMSFIE data structure is not a requirement. A subset of the SDSFIE/FMSFIE schema may be used by selecting one of the custom filters provided with each SDSFIE/FMSFIE release; or using the SDSFIE/FMSFIE Filter Maker software application to build a custom filter based on the specific entity types required.

e. Domain values. Customers have the flexibility of adding local domain values and deleting SDSFIE/FMSFIE domain values not required for the customer’s GIS/FM data collection, analysis, and reporting. SDSFIE/FMSFIE formatting, ordering, and naming conventions must be maintained for the SDSFIE/FMSFIE domain values retained. The customer cannot add local domain values that are a duplicate of those defined in the SDSFIE/FMSFIE domain tables. For SDSFIE/FMSFIE list domain values, either the short name with up to 16 characters or the long name with up to 32 characters may be used.

F-3. Definitions

a. Entity set.

(1) Entity sets are the highest level of the SDSFIE data model structure and represent data organized at the project level. Entity sets are broad, generalized themes containing groupings (called entity classes) of features (i.e., graphic objects called entity types that can be depicted at their actual geographic locations on a map) and related graphic attribute data (i.e., information about the feature which is stored in a database table). The SDSFIE Release 2.00 structure contains the following 26 entity sets:

- Auditory
- Boundary
- Buildings
- Cadastre
- Climate
- Common
- Communications

- Cultural
- Demographics
- Environmental Hazards
- Ecology
- Fauna
- Flora
- Future Projects
- Geodesy
- Geology
- Hydrography
- Improvements
- Landform
- Land Status
- Military Operations
- Olfactory
- Soil
- Transportation
- Utilities
- Visual

(2) The appropriate entity set name is reflected in the first two characters of each attribute table name code.

(3) For Computer-Aided Design and Drafting (CADD) (e.g., MicroStation and AutoCAD) and CADD-based Geographic Information Systems (GIS) (e.g., MGE, AutoDesk Map, and Bentley GeoGraphics), the entity set name is also represented in the first two characters of each design file name code.

b. Entity class. Entity classes comprise the next level of the hierarchical SDSFIE data model structure. Entity classes contain groupings of similar features (called entity types) and related “graphic” attribute data. Each entity class is equivalent to a separate map or drawing file. Equivalent names used by various CADD/GIS software vendors are provided in Table F-1 below.

CADD/GIS Software (Vendor)	Counterpart Name for Entity Class
MGE (Intergraph)	Category or Design file
ARCINFO (ESRI)	Workspace
MicroStation (Bentley)	Design file
AutoCAD (AutoDesk)	Drawing File

The name of an entity class is represented by a three-character code, which makes up a part of the attribute table name codes (and design/drawing file-name codes for CADD and CADD-based GIS).

a. Entity type.

(1) Each entity class contains one or more entity types. An entity type is the logical name assigned to a graphic feature (i.e., an object that can be graphically depicted on a map or drawing). Each entity type has a corresponding graphic attribute table containing specific information about the entity type.

(2) An entity type is equivalent to a “coverage” in ArcInfo and a “view” in ESRI ArcView. Entity types in MGE are grouped by features.

(3) For CADD (e.g., MicroStation and AutoCAD) and CADD-based GIS (e.g., AutoDesk Map and Bentley GeoGraphics) software, entity types represent a grouping of like cartographic (or CADD) elements (called entities) assigned to separate levels/layers.

b. Discriminators.

(1) Effective use of GIS relies on the ability of the user to adequately differentiate subtle differences in geographical features, or entities. This differentiation permits greater value in output products by selectively displaying entities based on some predefined criteria. While some differentiation is determined by the assignment of the graphical properties (e.g., color), it is often useful to expand the capability of this differentiation to display only selected entities (i.e., displaying a map of only the paved roads).

(2) Historically, the CADD user has accomplished this differentiation by assigning these different entities to different layers or levels within the drawing file. Virtually all CADD systems provide a simple capability to turn various layers on or off to allow for the display of only selected entities. This technique allows the user to “discriminate” these entity types on the basis of the layer or level. The user must understand that paved roads are to be placed on a different level from unpaved roads.

(3) Other GIS applications, including ArcInfo, do not store data with level/layer assignments, but rather organize graphic entities based on a specific entity type (road) with a “discriminator” included as a part of the attached attribute data (paved or unpaved). This allows the display of all roads without having to access multiple drawing files. The additional differentiation of using layer/level or tabular attribute, or both if desired, has been included in this version of the SDSFIE to allow for differentiation of these entity types.

(4) The individual features are logically grouped into entity types with the inclusion of a discriminator field in the corresponding attribute data. Because this discriminator has only discrete values, it is defined with respect to a domain table, which defines the values that discriminate the entities. Continuing with the previous example, the attribute table associated with entity type roads (trvehrd) now contains an attribute. This attribute defines the paved status of the road (paved_d), which refers to the domain table (d_pavstt) that contains the values “PAVED” and “UNPAVED.” A user or developer can now select the roads that have the paving characteristics desired, or ignore the discriminator completely and display all roads. The technique allows for maximum flexibility in displaying only the data desired to convey the maximum amount of information.

(5) Within the standard, the inclusion of the discriminator concept requires the addition of another entity category. This additional category or grouping of entities is defined as entity types that consist of a given graphic feature “road.” These entity types are normally included in the standard as nouns, while the discriminators represent adjectives that further define or describe these nouns. This modification significantly changes the format of this release of the standard.

c. Attribute table.

(1) An attribute table is a relational database table containing data, or information, about a specific SDSFIE entity. SDSFIE attribute tables are linked directly to a graphic entity (using the electronic tools provided with CADD/GIS software). They are classified as graphic (i.e., SDSFIE) attribute tables. FMSFIE attribute tables are indirectly linked to graphic entities via Foreign Key Joins to the SDSFIE attribute tables.

(2) A database can be defined as a structured collection of data items about a specific topic. A database table can be defined as a group of similar records. A database table is like a spreadsheet where the columns represent the fields, or attributes, and the rows represent the records, such that each row will be associated with a single record. A typical GIS links the graphical element, how it is displayed on the screen, with the associated record in the data table.

(3) The SDSFIE/FMSFIE has been designed for use with relational database management system (RDBMS) software. RDBMS software provides a means of managing the related data contained in one or more database tables. Examples of RDBMS software include Oracle (Oracle Corporation) and Access (Microsoft Corporation), SQLServer, and Informix. RDBMS software provides electronic tools for defining relationships (i.e., connections) between the different database tables. These relationships can be defined as one to many (most common); one to one (rare, usually merge tables to one); and many to many (needs a junction table).

(4) The name code of each attribute table is composed of eight characters, due to a design requirement to support both DOS and Windows 3.1-based GIS and database (e.g., dBase) programs. The first two characters and the next three characters in the table name reference the parent entity set and the entity class, respectively. The last three characters in the table name represent a particular attribute table.

(5) Some equivalent terms for attribute table used in GIS and relational database management system (RDBMS) software include the following:

- “feature attribute table” - in MGE.
- “attribute table” - in ArcInfo.
- “database table” - in RDBMS software.

d. Domain table.

(1) Domain tables contain standardized lists of permissible values for specific attributes. They provide a predefined finite set of allowable values, which may be enlarged by each user. Included are diverse tables of units of measure, types, styles, status, names, methods, materials, dispositions, sources, dimensions, data, classes, building numbers, etc. The user can add to these lists and range domains installation-specific values as needed.

(2) Two categories of domain tables are included in the SDSFIE: list domains, which provide a “picklist” of allowable discrete values; and range domains, which provide a range (i.e., the minimum and maximum) of allowable discrete values.

(3) Each domain table name code is restricted to eight characters with the first two characters being “d_.” All attributes whose values are constrained by a domain value have a name code which ends in “_d.” The name code for all attributes whose values are defined by the “unit of measure” domain table (d_uom) end in “_u_d.”

Appendix G Geo Referencing and Computer-Aided Design and Drafting Documents

To gain information on a large geographical area with many different buildings requires access to geospatially correct building drawing information. General Geographic Information System (GIS) data on an area does not include necessary information such as facility entrances, exits, service areas, building structure, building population distribution/circulation, or building materials that may be important to a study. (Large glass areas are vulnerable, steel is weak when exposed to fire, wooded areas can spread fire, and masonry walls can collapse when shaken.) Therefore, building drawing information that is incorporated into a GIS drawing must be geospatially correct. How and when to incorporate geospatial information to create the correct geospatial location for a project file is the challenge of this paper.

The method that this paper attempts to replace involves having the project designed initially with geospatial coordinates, and following through all engineering and facilities drawings based on the same geospatial information. This method is at best inconvenient and highly unreliable. It allows major errors to result when many people are contributing drawings to a model file based on an unfamiliar coordinate system. The possibility of all architects and engineers creating an entire set of drawings with the building rotated 43.75 degrees or 176.48 degrees or 315 degrees to match the real spatial orientation is practically impossible. To attempt to require this as a current business practice would be very expensive and inefficient, as well as unnecessary.

This paper presents a sequence that allows a drawing to have the correct geospatial location. Following this sequence, the drawing can be created by a single qualified user to make the connection between the standard architectural and engineering drawings and the GIS drawing.

An architectural drawing can (and should) be created using a common model origin point that is not geospatially located, and still be retrieved into a geospatially correct drawing using the process as outlined in the following description (see Figure G-1).

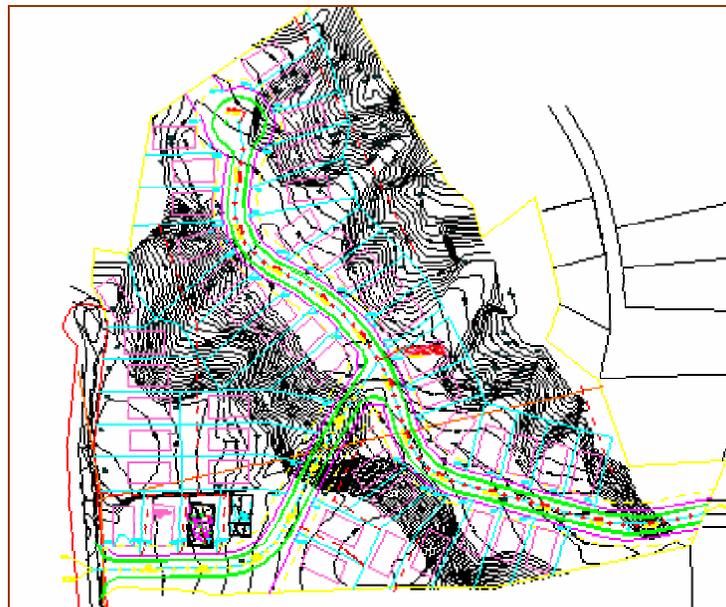


Figure G-1. Geospatially Correct Site Plan

The GIS site plan given in Figure F-1 above shows a proposed development, created in AutoCAD MAP®. House floor plans, created in AutoCAD Architectural Desktop®, have been brought in as an externally referenced file. This is the same as linking the files, in that it allows changes in the original file to be included in the file that references it. Enlargement of a section of the development with floor plans is shown below with referenced or linked floor plans attached to the drawing (see Figure G-2).

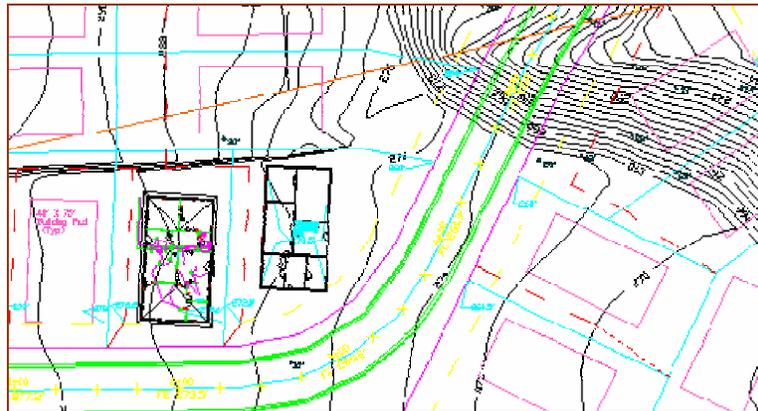


Figure G-2. Enlargement of Floor Plan

The building's architectural and engineering plans were created with a common origin reference point for the model file, but not geographically referenced (see Figures G-3 through G-6 below). This allows all project drawings to be referenced directly between each other without any translation. The architects and engineers are not required to know how to create a drawing that is geospatially correct, but are only required to keep all drawings relative to a single project origin point. There are no requirements on where this point is located.

A composite drawing file is created that contains information from the main set of drawings that are linked or referenced-in. This drawing is independent of both the main set of drawings, and it is used only for a basis for including information in the final Geographic Information System (GIS) document. To include information at this point using reference files requires no understanding of GIS or of the real geospatial location. A reference file is brought in at a common project or model origin point. For all the project drawings, this point is the same, allowing multiple floors as well as the engineering drawings to drop in over each other.

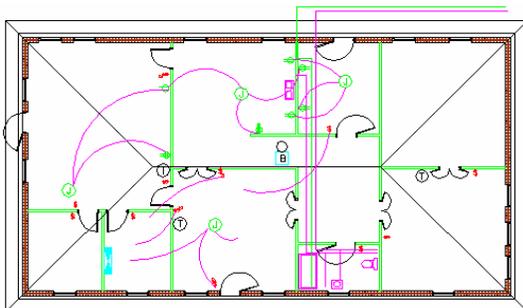


Figure G-3. Composite Plan
Floor Plan, Roof Plan, Electrical, Plumbing

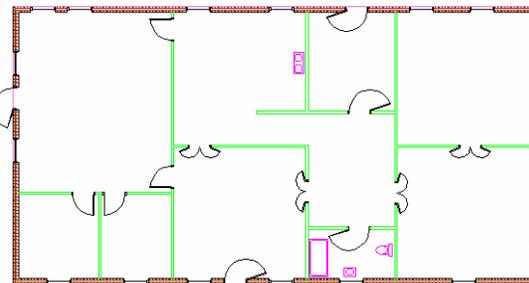


Figure G-4. Floor Plan
Walls, Windows, Doors, Plumbing Fixtures

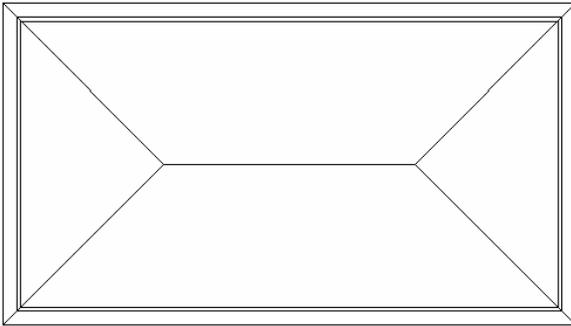


Figure G-5. Roof Plan
Roof Plan Drawing Information

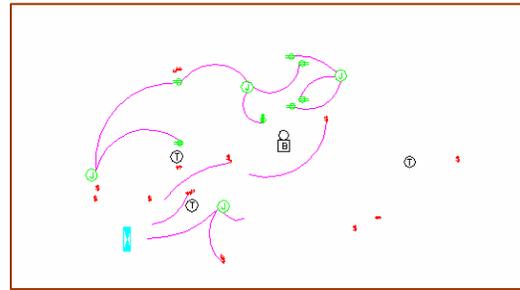


Figure G-6. Electrical Plan
Electrical Drawing Information

A new geo-referenced drawing can be created that references the existing composite drawing. The geo-referenced drawing, created with an understanding of geospatial coordinate systems, could accurately orient and position the referenced file into the real-world coordinate system. This is the prepared file that would allow direct reference into another spatially referenced file. Figure G-7 to the right shows two drawings referenced into the main development (also geo-spatially correct) at the correct geospatial location. The information contained within the smaller drawing is dependant upon the original composite drawing. Additional reference drawings can be added to the composite and will automatically become accessible to the final drawing.

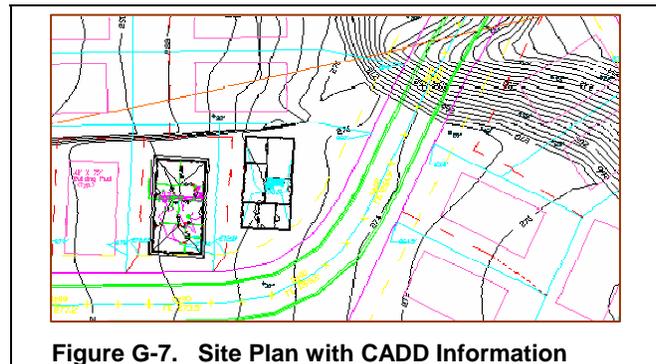


Figure G-7. Site Plan with CADD Information

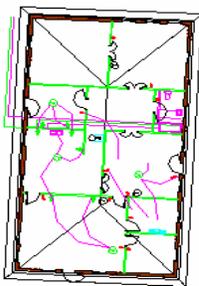


Figure G-8. Geo-Positioned Composite Drawing
Geo-positioning drawing to show real-world spatial location.

A composite drawing is externally referenced into this geo-positionally correct drawing, and given the correct real-world position and orientation. A new location point and angle needs to be set to give the drawing a correct GIS location.



Figure G-9. Site Plan
The geo-positionally correct drawing is referenced directly into the site plan without any modifications to scale, orientation, or position.

Three steps to integrating the standards drawings into the geospatially correct location are presented below.

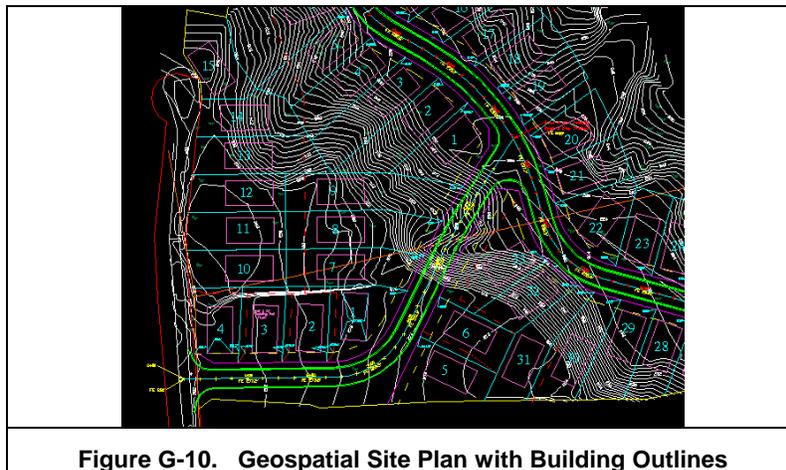
Step 1 - Create building drawings according to a common project origin point (a model file origin point). In this instance, the Architectural Desktop package was used to design the floor plan.

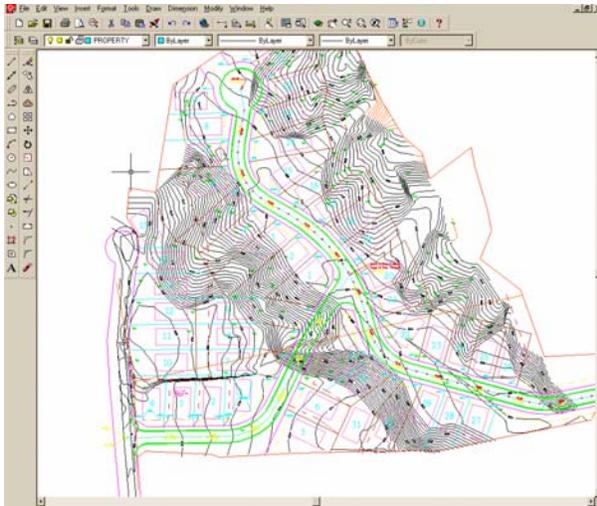
Step 2 - Create a composite drawing containing no information except referenced file information that is desired to be shown in the final geospatially correct GIS drawing. Each drawing that is referenced-in is located at the same model origin point and at the same angle and scale, avoiding potential operator errors from incorrect values. This drawing is dynamic, and it will be changed as needed with referenced drawings added or dropped from the composite. To show the architectural and plumbing plans in the development site plan, the user would remove the reference file for other drawings that may be connected. The development plan would then have referenced drawings reloaded to update the current information for only the plumbing and architectural information.

Step 3 - This step is the critical step in relating the other drawings to the correct geospatial position. Someone such as a surveyor or engineer familiar with GIS will need to use the previously composed composite file and reference that into the new drawing that will be geospatially correct. The referenced drawing will need to be correctly positioned with real GIS locations and given a real-world angle for orientation. If the units used for the composite are feet and inches and the units used for the plan are in decimal units, then a scale factor will need to be applied to the composite drawing of 1/12 for the X and Y and Z insertion value.

The newly created geospatially correct drawing can then be referenced directly into the final development site plan without any further position or orientation change (see Figure G-10).

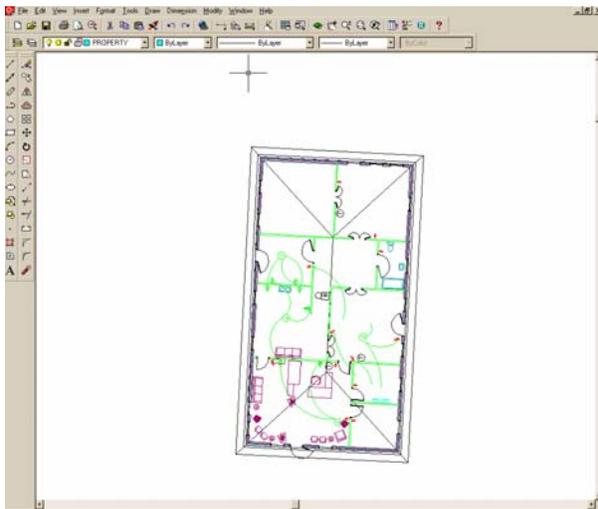
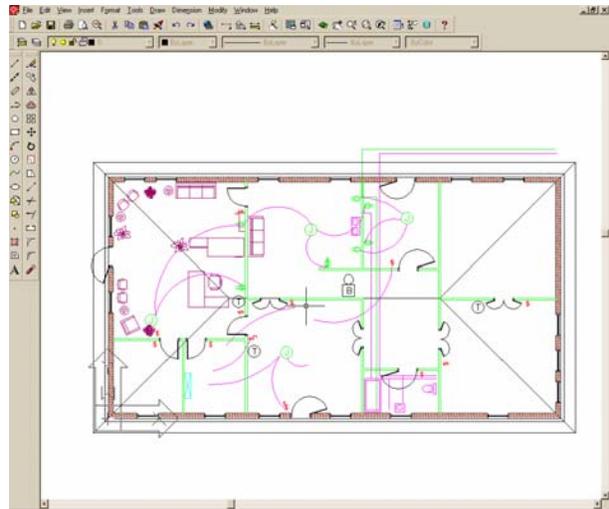
If changes are made to the original floor plan or electrical plan or plumbing plan, then these changes are brought into the final GIS plan. Since the final GIS plan is dependant upon the other drawings to provide the information, a separate, independent document is not created.





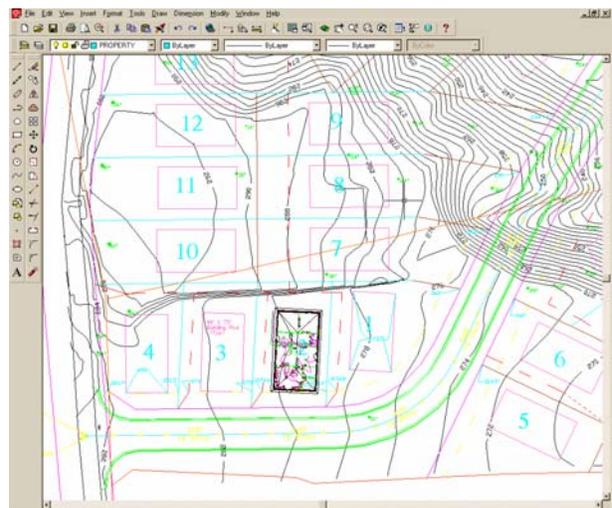
◀ The site plan created at the correct geospatial location (the coordinates are geospatially correct).

Composite Drawings ▶
The floor plans for each lot are created at a model origin point (common for each individual project or lot but not geospatially correct). All project drawings can be referenced into this single composite drawing.



◀ **Geospatial Composite**
The composite floor plan for each lot brought into a geospatial drawing that is created.

Geospatial Drawing ▶
The floor plans for each lot are created at a model origin point (common for each individual project or lot but not geospatially correct).



Appendix H
Sample Memorandum of Agreement
for Interagency Cooperation

The following sample document provides a basis for a Memorandum of Agreement with external organizations for Geospatial Data and Systems. Users are advised to revise this document to meet their needs, and to coordinate any interagency agreements with their respective Offices of Counsel.

MEMORANDUM OF AGREEMENT

BETWEEN THE
<<PARTNER>>
AND THE
U.S. ARMY CORPS OF ENGINEERS, <<DISTRICT>>

PURPOSE AND AUTHORITY

This Memorandum of Agreement (MOA) is entered into by and between the <<PARTNER>> and the U.S. Army Corps of Engineers, <<DISTRICT>> (<CExxx>>) for the purpose of establishing respective responsibilities of the parties for delivering and/or sharing Geographic Information System (GIS) data, services and other such related work as may be agreed upon in the future. Implementation of requested services will be accomplished through the <<DISTRICT>> GIS Coordinator. This MOA is entered into pursuant to the Economy in Government Act, 31 U.S.C. 1535; 10 U.S.C. 3036(d) and the Intergovernmental Cooperation Act (31 U.S.C. 6505)

INTERAGENCY COMMUNICATIONS

To provide for consistent and effective communication, the <<PARTNER>> and <<DISTRICT>> shall each appoint field representatives to discuss and consider activities that may be pursued under this MOA.

The <<PARTNER>> and <<DISTRICT>> field representatives shall coordinate all requests for assistance under this MOA and shall serve as points of contact between the <<PARTNER>> and the <<DISTRICT>> on matters relating to this MOA.

The <<PARTNER>> and <<DISTRICT>> field representatives shall prepare agreed upon individual support agreements (ISAs) pertaining to data and application development and/or data management. The ISAs shall describe in detail the scope of the services to be provided, schedules, necessary funding arrangements, individual project managers, and such other particulars as are necessary to describe clearly the obligations of the parties with respect to the requested services. The authorized representative of each party shall agree to the ISA prior to the initiation of services by the <<DISTRICT>>. The <<DISTRICT>> will have exclusive direct communication authority with its contractors.

The GIS data sharing requests shall be communicated directly between the GIS coordinators of the respective organizations. The GIS coordinators will then be responsible for monitoring work accomplishment through normal workflow channels.

PROVISION OF ASSISTANCE

Nothing in this MOA can be or should be construed to require the <<PARTNER>> to use the services of <<DISTRICT>>, or require the <<DISTRICT>> to accept assignments from the <<PARTNER>>.

FUNDING

The <<PARTNER>> will provide funding resources for all costs associated with <<DISTRICT>>'s provision of assistance excluding data sharing. Major funding transfers, of \$250,000 or more, will be accomplished by using SF 1151, Nonexpenditure Transfer Authorization. The SF 1151 will be prepared and forwarded to CDR HQUSACE (CERM-FC) Washington, D.C. 20314-1000 for allotment. For individual taskings less than \$250,000 in total or less than \$50,000 in contracts, funding will be provided by reimbursable order with monthly billings to be made by SF 1080, Voucher for Transfer Between Appropriations. The reimbursable order (ISA) will specify the funding limitations and the applicable appropriation.

Direct costs are the costs that can be directly identified with and charged to the work under the ISA. Examples of such costs are salaries, wages, technical services, materials, travel and transportation (including permanent change of station costs), communications, and any facilities and equipment expressly approved for purchase under the ISA. In addition, any extra-ordinary costs such as hiring of outside experts and consultants (including legal support) to analyze claims and/or to testify before a board or court and costs directly identified for termination of the agreement are considered direct costs under this agreement.

Indirect costs are the overhead (including general and administrative and departmental) costs that cannot be directly identified to the work under the provision of assistance and are distributed/charged based on a predetermined rate against direct labor. Examples of such costs are salaries, equipment, materials, etc., of administrative support offices.

Expenditure limits established in the ISA will not be exceeded without prior approval from the <<PARTNER>>. If the actual cost to the <<DISTRICT>> is forecast to exceed the amount of funds available, the <<DISTRICT>> shall promptly notify the <<PARTNER>> of the amount of additional funding necessary to pay for the assistance. The <<PARTNER>> shall either provide the additional funds to the <<DISTRICT>>, or require that the scope of the assistance be limited to that which can be financed by the available funds, or direct termination of the project. Upon furnishing the assistance contemplated by the ISA, the <<DISTRICT>> shall conduct a final accounting within 100 days of project completion to determine the actual costs of the assistance provided.

APPLICABLE LAWS

The <<DISTRICT>> shall furnish all assistance under this MOA in accordance with applicable U.S. laws and regulations, and any applicable U.S. executive agreements. Unless otherwise required by law, all contract work undertaken by the <<DISTRICT>> shall be performed in accordance with the <<DISTRICT>> procurement and claims policies and procedures.

RECORDS AND REPORTS

The <<DISTRICT>> shall utilize established accounting systems to establish and maintain records and receipts of the expenditure of all funds provided by the <<PARTNER>>. Records shall be maintained in sufficient detail to permit identification of the nature of expenditures made by the <<DISTRICT>> and shall be made available for inspection by the <<PARTNER>> upon request.

The <<DISTRICT>> shall provide the <<PARTNER>> with project progress, financial, and related status reports on tasks agreed upon in the ISAs, including providing financial reports on all funds received, obligated, and expended. Frequency of reports will be agreed upon in subsequent ISAs.

CLAIMS AND DISPUTES

All claims submitted by contractors arising under or relating to contracts awarded by the <<DISTRICT>> shall be resolved in accordance with United States law and the terms of the individual contract. The <<DISTRICT>> has dispute resolution authority for these claims. Any Contracting Officer's final decision pursuant to such a claim may be appealed by the contractor pursuant to the Contract Disputes Act of 1978 (41 U.S.C. 601-613). The Corps of Engineers Board of Contract Appeals (ENG BCA) is designated as the appropriate board of contract appeals. In lieu of appealing to the ENG BCA, the contractor may bring an action directly to the United States Claims Court. The <<DISTRICT>> shall be responsible for litigating all such appeals. The <<DISTRICT>> shall consult with the <<PARTNER>> regarding any settlement negotiations.

The <<DISTRICT>> shall notify the <<PARTNER>> of meritorious claims or appeals and shall submit requests to the <<PARTNER>> for funds to cover such claims or appeals. The <<PARTNER>> shall promptly provide such funds as are necessary to pay the costs of meritorious claims or appeals.

PUBLIC INFORMATION

Justification and explanation of the <<PARTNER>> programs shall be the responsibility of the <<PARTNER>>. The <<DISTRICT>> will make public announcements and respond to all inquiries relating to the ordinary procurement and contract award and administration process.

EFFECTIVE DATE AMENDMENT AND TERMINATION

The MOA is effective upon the date of the last signature by the parties. This MOA may be modified or amended only by written agreement.

Either the <<PARTNER>> or the <<DISTRICT>> may terminate this MOA by providing sixty calendar days written notice. In the event of termination, the <<PARTNER>> and the <<DISTRICT>> shall consult with each other concerning all claims for termination costs; however, the <<PARTNER>> shall continue to be responsible for all costs incurred by the United States under this MOA, or under the ISAs, and for the costs of closing out or transferring any ongoing contracts.

U.S. Army Corps of Engineers
<<DISTRICT>>

<<PARTNER>>

By: _____

By: _____

Name: _____
(PRINT)

Name: _____
(PRINT)

Title: _____

Title: _____

Date: _____

Date: _____

The GIS Coordinators as of June 16, 1998 are;

<<NAME>>
<<TITLE>>
U.S. Army Corps of Engineers
<<DISTRICT>>
<<ORG>>
<<ADDRESS>>
<<CITY>>, <<STATE>> <<ZIP>>
Phone: xxx.xxx.xxxx Fax: xxx.xxx.xxxx
Email: xxxxx.xxxxx@usace.army.mil
<http://xxx.xxx.usace.army.mil>

<<NAME>>
<<PARTNER ORGANIZATION>>
<<AGENCY>>
<<ADDRESS>>
<<CITY>>, <<STATE>> <<ZIP>>
Phone: xxx.xxx.xxxx Fax: xxx.xxx.xxxx
Email: xxx.xxxxx@domain.name

Appendix I Sample Scope of Work for Aerial Photography, Digital Orthophotography, and Digital Mapping

<<ORG CODE>>

(DATE)

<site/project name>

Architect-Engineer (A-E) Contract # << >>

I-1. Background

The U.S. Army Corps of Engineers (USACE), <<DISTRICT>>, is working with <<partner agency/customer>> on <<project>>. This project requires detailed mapping in digital and hardcopy formats. The mapping will include surface and subsurface features and digital orthophotographs. The mapping will support <<design, environmental monitoring, etc.>>.

For these applications, USACE requires large-scale, high-resolution data that are spatially accurate and correctly attributed. These data will be analyzed and manipulated using Geographic Information System/Computer-Aided Design and Drafting (GIS/CADD) software designed to handle large volumes of data. Additionally, USACE and <<partner>> will update the data as necessary to reflect current conditions at the project site.

I-2. General Requirements

a. Location of work. The project area is the entire <<site>> which comprises __ <<acres/hectares/square miles/square kilometers>>. The area is shown on the enclosed vicinity plan.

b. General statement of work. In general terms, the project shall consist of:

- Acquiring aerial photography and appropriate horizontal and vertical ground control.
- Developing digital orthophotographs.
- Producing digital geospatial data (i.e., GIS/CADD layers) as defined in this scope of work.
- Preparing geospatial metadata in compliance with Federal standards.

I-3. Detailed Requirements

Note that these requirements should be confirmed with the photogrammetry manual (EM 1110-1-1000).

The A-E shall provide all necessary services associated with obtaining and providing the aerial photography described.

a. Flight plan layout and flight line index. The A-E shall produce one flight plan and one flight line index for the photography. The flight plan requires flight lines oriented north-south. The flight plan shall reflect aerial coverage inclusive of the entire installation as described in General Requirements above.

b. Airborne Global Positioning System (GPS) survey techniques. To augment control previously established using conventional on-the-ground survey methods, while making the fly-over to obtain aerial photography, the A-E shall use airborne GPS surveying techniques to capture the ground coordinate for each frame of photographic coverage. Cross-tie flight lines shall be added as necessary to ensure an accurate aerial triangulation solution. Airborne GPS coordinate values shall reference the <<UTM Zone 18 WGS84 Geodetic Datum UTM in meters>>.

c. Fully Analytical Aerial Triangulation (FAAT) services. The A-E shall use FAAT techniques to extend and densify ground control for the aerial photography at both scales. The A-E shall develop a fully analytical block and bundle aerial triangulation solution for each scale of photography. All measurements shall be accomplished using a first-order analytical stereo plotting system. The results of the final bundle adjustment must support Digital Elevation Model development and digital orthophotography production that meets National Map Accuracy Standards. The results of the aerial triangulation adjustment must reference <<UTM Zone 18, WGS84 Geodetic Datum UTM in meters>>. The A-E shall prepare a report and coordinate listing describing the processes used and the accuracies that were achieved as well as a refined coordinate listing and plot of the control network for the photography before commencing Digital Terrain Model (DTM) development.

d. Aerial survey. The A-E shall obtain new aerial photography of the entire installation of <<Picatinny Arsenal>> during the fall after deciduous trees have dropped their foliage. Aerial photography shall be obtained with a forward overlap of 80 percent and an overlap between flight lines of 40 percent to ensure against potential difficulties with sun angles and to seam together a mosaic of the final photography. The aerial film shall be annotated at the moment of exposure using a GPS-controlled flight management and control system. Aerial photography shall be obtained in accordance with the following guidelines.

(1) *Film quality.* Only fresh, fine-grain, high-speed, dimensionally stable, and safety base aerial film emulsions shall be used. Standard safety procedures shall be followed for rolling unexposed film forward before beginning exposures. Appreciable image movement at the instant of exposure shall be prevented.

(2) *Flying conditions.* Aerial photography shall be obtained only during periods when the sun angle exceeds 30 percent; the project site is free of snow, clouds, or cloud shadows (clouds obscure no more than 5 percent of any frame); the project site is free of dust and haze; and rivers and/or streams are within their normal banks.

(3) *Aerial camera.* The A-E shall use a precision aerial camera with a single-lens of standard 6-inch focal length for obtaining all photography. The camera shall be equipped with a high-resolution, distortion-free lens and a between-the-lens shutter with variable speed. The aerial camera used shall be of equal or better quality to a Wild Model [RC-30]. The camera shall have been calibrated by the U.S. Geological Survey (USGS) within 3 years of award of this delivery order. As evidence, the A-E shall provide a current USGS calibration report that is less than 3 years old.

(4) *Aircraft flight operations and equipment.* The flight crew and camera operator shall have had a minimum of 400 hours experience in flying precise photogrammetric mapping missions. The camera shall be installed in a mounting that dampens the effects of aircraft vibration. Aircraft exhaust gases shall be vented away from camera opening.

e. Processing, handling, quality of products after survey.

(1) The A-E shall produce one set of stable base film diapositives (natural color) for the photography to be used for the analytical aerial triangulation adjustment and the DTM development process. Images seen on diapositives shall be clear and sharp in detail; of uniform density; have the proper degree of contrast for all

details to show clearly; and be free of clouds and cloud shadows, streaks, smoke, static marks, fog, and other blemishes that could render them unsuitable for intended uses.

(2) The A-E shall produce one set of contact prints for each overflight (one natural color and one false color infrared) separated into even and odd numbers. Contact prints shall be printed on semigloss paper. The even-numbered set shall be provided to the Government as confirmation of the aerial photographic coverage. The odd set shall be held by the A-E for development of the analytical aerial triangulation solution.

(3) Border information to be printed on the film and prints shall include the date of photography, flight line and exposure numbers, negative scale (as a ratio and in feet), and the project title and location. The camera panel of instruments should be clearly legible on all processed negatives. Failure of instrument illumination during a sortie shall be cause for rejection of the photography. All fiducial marks shall be clearly visible on every negative.

(4) *Film storage.* The A-E shall store all diapositives in his possession on winding spools in plastic or metal canisters, with at least 3 feet of clear film left on the end of each roll, in a temperature-controlled setting. Each canister shall be labeled for identification and possible future delivery to the Government.

f. Production of digital orthophotography.

(1) The A-E shall produce digital raster files of the aerial photographic frames required for digital orthophoto production. The A-E shall use a flatbed scanner with a geometric repeatability of 2 microns. The scanner must be capable of capturing 24-bit (3-color band) information in a single pass. All raw raster scans shall be produced directly from the original film. The A-E shall post-process the scans using image-dodging software to remove tone differences induced by sun angle, shadows, or other factors. The required scans shall be produced at an input resolution of 1,200 DPI (dots per inch) yielding a resolution of 1' per pixel for the natural color imagery. Prior to scanning, the A-E shall prepare a sample scan from the photography. The scan should reflect the resolution and file size of the completed digital orthophotos. The raw scans shall be provided in TIF format on a CD-ROM disk. Each CD-ROM shall contain an ASCII text file indicating identification information similar to that printed on borders of film and prints for identification. This file should include date of photography, flight line and exposure numbers (may need to be in summary form), negative scale (as a ratio and in feet), and the project title and location. Files shall be named so as to clearly distinguish the photography within this digital orthophoto from the other scale, as well as from any flown previously.

(2) The A-E shall develop DTM files for use in digital orthophoto production. DTM data shall be collected on a regular grid at a post spacing to be determined by the photogrammetrist that will accurately characterize the terrain. All data collection shall be accomplished using first-order analytical stereoplotters. The DTM data shall be collected for each stereo model and merged into a single, project-wide dataset. This merged file shall be evaluated for accuracy and to insure that the dataset contains no spikes or zero elevation points. The data for each digital orthophoto shall be clipped out of these datasets.

(3) The A-E shall produce digital orthophotography in accordance with the following criteria: 24-bit natural color at a scale of 1"=100' with a pixel resolution of 1' per pixel. Each digital orthophoto shall cover an area measuring 3000' X 2000,' yielding a completed file size of 108 MB per orthophoto. A total of xx tiles are required to cover the project area.

(4) The completed orthophotographs shall be provided to the Government in GeoTIFF format on CD-ROM. The accuracy of the differential rectification will be checked by measurement of all control points and/or pass points. The edge match of all orthophotographs shall also be checked interactively. No linear feature may be offset more than 10 pixels at either scale of orthophotography. The A-E shall produce a

mosaic of the natural-color orthophotography and re-sample the imagery to a resolution of 5 feet per pixel. The mosaic shall be processed to minimize tone and contrast differences between adjacent orthophotos. The completed mosaic shall be written to CD-ROM in GeoTIFF format.

g. Digital geospatial data.

(1) The A-E shall develop digital geospatial data for the features in Table I-1 below. The A-E shall capture these features using appropriate stereo compilation and photogrammetric procedures as defined in EM 1110-1-1000. The mapping shall meet National Map Accuracy Standards. That is, no feature shall be spatially displaced by more than 1/40th-inch of map scale. All data shall follow the Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE) version 2.x.

(2) The features listed in Table I-1 shall be developed for the project site. The data shall follow graphic and attribute standards defined in the most recent version of the SDSFIE.

(Note that Table I-1 is only a guide. When filling out a scope of work, users are required to evaluate their specific requirements and refine the specifications for each use of this sample.)

Table I-1	
Selected Features for Project Sites	
	Features
Site boundary (if applicable)	Environmental, continued
Transportation	GW feasibility studies
Paved roads	Landfills
Unpaved roads and trails	Water table contours
Bridges	UST/AST locations
Railroad	Vegetation
Runways/helipads	Tree stands
Parking lots paved & unpaved	Individual landmark trees
Road centerline	Large hedgerows
Structures	Topography
Labs	Contours
Offices	Spot elevations
Schools and libraries	Geodetic Control
Housing	USGS Benchmarks
Warehouses	Utilities
Public building (fire/police stations, government offices)	Water
Water bodies	Sewer
Lakes	Electrical
Ponds	Telephone
Rivers	Cable
Streams	Natural gas
Drainage channels	Steam
Culverts	Other
Environmental	Golf Courses
Wetlands and marshes	Recreational fields
Sensitive habitat	Cemeteries
Wells	Power stations
Remediation/removal areas	Incinerators
CERCLA locations	Sewage treatment plants

(3) The final delivery format for the digital spatial data shall be <<Microstation DGN, Arc/INFO Coverages, Arc/INFO export .e00, Shapefiles, other file type>>.

(4) The final delivery format for the associated attribute data shall be <<Microsoft Access, ORACLE version <>, etc.>>. Attribute data and spatial data shall be properly related using a relate field of datalink in both datasets.

h. Geospatial metadata. In compliance with Executive Order 12906, all geospatial data for this project shall be documented with metadata. Metadata shall conform to Content Standards for Digital Geospatial Metadata (CSDGM) as defined by the Federal Geographic Data Committee (FGDC). One metadata file is required for each feature type, the DTM, and the digital orthophotography.

I-4. General Contract Requirements

a. Contract relationship. The contract relationship shall be directly between <<DISTRICT>> and the A-E. If the A-E receives requests for services beyond the scope of work from <<sponsor/partner>>, he shall notify USACE for direction before acting on the requests. All correspondence shall be sent through USACE.

b. Payments. Partial payments will be made monthly as the work progresses, with billings made monthly. Requests for payment will be submitted by the A-E on ENG Form 93 along with a narrative that describes the progress of work for that billing period. This narrative is the same as the status report listed in 4.5. ENG Form 93, and shall be submitted to the Project Manager for approval based on the services performed to date.

c. Government ownership. All data, reports, and material related to this project are the property of the Government and shall not be released by the A-E or his subconsultants without the prior written approval of USACE (and Partner).

d. Security clearance. No security clearances are required to perform this work. The A-E may be required to coordinate site visits for data collection with the installation where items and information of a sensitive nature may be compromised, or where historic sites are located in restricted areas.

I-5. Schedule of Submittals and Deliverables

The following items are required under this delivery order.

a. Planning submittal. Shall consist of the following, with one of each submitted to USACE and <<sponsor/partner>> no later than 5 days before the date of the overflight:

(1) *Flight line index in digital and hard copy form.* The A-E shall submit a hardcopy paper plot of each scale of photography and the digital files used to make the indices as Microstation design files on CD-ROM disk of the flight-line index.

(2) *USGS camera calibration report.*

b. Aerial photography. Shall consist of the following:

(1) All aerial photography shall be flown and completed before emergence of deciduous foliage in the spring.

(2) Airborne Global Positioning System (GPS) time-tagged, photocenter file shall be completed at the time of the overflight and submitted within 20 calendar days of the date of aerial photography.

(3) *Photographic submittal*. Shall consist of the following, to be submitted within 90 calendar days of the date of photography:

- One set of working diapositives for each scale of photography shall be submitted to the Government. Working diapositives shall be submitted within 90 days of the date of photography.
- One set of diapositives for use in aerotriangulation; to be stored by A-E in temperature-controlled setting as described above.
- One set of natural-color contact prints shall be divided into odd and even sets. The odd set shall be maintained by the A-E, and the even set shall be submitted within 90 days of the date of photography.

(1) *Digital submittal*. Shall include 24-bit raster scans for all frames required for digital orthophoto production, and shall be submitted on CD-ROM within 135 calendar days of the date of photography. Each CD-ROM and file shall be identified as described in section I-3f(1). Each submittal shall contain the following:

- Analytical aerotriangulation adjustment and report shall be completed and submitted within 135 calendar days of the date of aerial photography.
- DTM data files shall be collected and submitted within 135 calendar days of the date of aerial photography.
- Digital orthophotos in 24-bit, natural-color at a scale of 1"=MMM' with a resolution of X' per pixel, tile size 3000' X 2500' in GeoTIFF format on CD-ROM shall be submitted within 135 days of the date of photography.
- Digital mosaic of the natural-color orthophotos resampled to a resolution of 1' per pixel in GeoTIFF format on CD-ROM shall be submitted within 135 days of the date of photography.

(2) *Time extension*. The Government agrees to extend the delivery order submittal dates by 1 day for each day of delay due to Government review and approval of prior submittal.

I-6. Special Criteria and Instructions

Engineer Manual (EM) 1110-1-1000, "Photogrammetric Mapping," 31 March 1993;
American Society for Photogrammetry and Remote Sensing, 1990;
SDSFIE, Version 2.x

I-7. Government-Furnished Data

Vicinity Plan
TSC Website to acquire SDSFIE (<http://tsc.wes.army.mil>).

I-8. Points of Contact

a. <<Partner>>

b. USACE Project Manager: <<NAME>>

Department of the Army,
Commander, <<District>>
ATTN: <<CExxx-xx-xx>> (NAME)
<<ADDRESS>>
Telephone: <<xxx.xxx.xxxx>>
Fax: <<xxx.xxx.xxxx>>
E-Mail: xxxxx.xxxxxx@usace.army.mil

Appendix J

Civilian and Commercial Imagery Office

J-1. Introduction

As part of the U.S. Army Corps of Engineers (USACE), the Engineer Research and Development Center's Topographic Engineering Center (TEC) is responsible for Army-wide monitoring of commercial satellite imagery acquisition. TEC's Imagery Office (TIO) conducts the research, acquisition, archiving, and distribution of current and historical imagery and related products for the Army as well as for customers. Responsibilities include researching available archives (both government and satellite vendors), placing orders, managing funding when needed, tracking acquisitions, and distributing data to the customer. TIO also ensures data are stored in the National Imagery and Mapping Agency's Commercial Satellite Imagery Library. Access to this data is cost-free for USACE and associated contractors. Provided the correct licensing has been purchased, the data is also available to the Department of Defense (DoD) and to the Title 50 Intelligence Community as listed below:

- Office of the Director of Central Intelligence.
- Central Intelligence Agency.
- National Security Agency.
- Defense Intelligence Agency.
- National Imagery and Mapping Agency.
- National Reconnaissance Office.
- Other offices within the DoD for the collection of specialized national intelligence through reconnaissance programs.
- Intelligence elements of the Services.
- Federal Bureau of Investigation.
- Department of Treasury.
- Department of Energy.
- Bureau of Intelligence and Research of the Department of State.
- Such elements of any other department or agency as may be designated by the President, or designated jointly by the Director of Central Intelligence and the head of the department or agency concerned, as an element of the intelligence community.

J-2. Development of TEC's Imagery Office (TIO)

To help Army agencies/organizations avoid duplicating commercial and civil imagery purchases, the Office of the Assistant Chief of Engineers designated TEC in 1990 to act as the U.S. Army Commercial and Civil Imagery (C2I) Acquisition Program Manager. To accomplish this task, the TIO was initiated with the added

focus on educating the soldier on the uses, types, and availability of commercial satellite imagery. As Army use of this imagery increased and as the number of satellites increased, the TIO has grown to keep up with the demand. Currently, TIO provides thousands of dollars of imagery support to its customers, and is an active participant in National Imagery and Mapping Agency's Commercial Imagery Strategy.

TIO is the designated repository of selected commercial satellite imagery data pertaining to terrain analysis and water resources operations worldwide. These data support worldwide military applications and operations. TIO executes the Commercial Imagery Program for TEC and the Army. The current revision of Army Regulation 115-11, "Geospatial Information and Services," strengthens the role of TIO as the point of contact for acquisition of commercial satellite imagery in the Army.

J-3. How to Order Commercial Satellite Imagery

USACE Commands are required to first coordinate with TIO before purchasing satellite imagery from a commercial vendor. USACE organizations with requirements for commercial satellite imagery must forward requests to TIO for research, acquisition, and distribution of the data. The requests can be submitted as follows:

TIO@tec.army.mil

Telephone: 703-428-6909

Fax: 703-428-8176

Online Request Form

www.tec.army.mil/forms/csiform1.html

Each request should include the following information:

- Geographic area of interest. Please provide Upper Left and Lower Right coordinates (e.g., 27 00 00N 087 00 00W) and path/row, if known.
- Acceptable date range for data coverage (e.g., 5 January 1999 to 3 March 2000).
- Cloud cover and quality restrictions (e.g., less than 10 percent cloud cover, no haze, 10 degrees off nadir).
- Satellite system/sensor. (For basic satellite information, access www.tec.army.mil/TIO/satlink.htm.)
- Desired end product (digital or hard copy and preferred media type; e.g., CD-ROM).
- Point of contact, mailing and electronic address, and telephone number.

J-4. Purchased Commercial Satellite Imagery Submission to the Commercial Satellite Imagery Library (CSIL)

Commercial satellite imagery that the TIO purchases for customers is disseminated upon receipt to the requestor as well as to the CSIL. This provides data access for DoD/Title 50 users.

J-5. Frequency of Imagery Collection

NIMA's goal is to obtain imagery within 24 hours of requests. However, frequency of imagery collection depends on a variety of conditions that include cloud cover, revisit time, and angle of collection (i.e., viewing angle or look angle). For example, revisit time to obtain data requires data from different collection dates (days, weeks, months, or years). The change detection product quantifies alterations in land use and land cover. For more details, access www.tec.army.mil/TIO/satlink.htm.

a. Sensor availability. Commercial satellite imagery users have access to a sizable number of data choices. The United States has Landsat 7 and other instruments associated with the Earth Observing Program with data for use/purchase. For a complete list of available sensors and their capabilities and benefits, access www.tec.army.mil/TIO/satlink.htm.

b. Possible civil applications. Commercial satellite imagery, such as Space Imaging's IKONOS, Orbimage's Orbview-3 and Orbview-4, and EarthWatch's Quickbird, requires no special permission for use. With proper licensing, commercial satellite imagery can aid in recovery efforts after natural disasters, because no restrictions or sensitivities exist affecting product distribution. The high frequency of repeat coverage is a useful tool within USACE and the Army.

Commercial imagery provides a backdrop for Geographic Information Systems vector data. It also provides a tool for facilities management, remediation, flood-plain management, and erosion and sedimentation studies. Commercial imagery can be useful to USACE in planning, managing, and inventorying natural resources. Flood-control efforts in USACE and the Army can utilize commercial satellite imagery for accurately capturing flood boundaries, tracking erosion/levee damage, documenting levee repairs, providing model validation, and providing a graphic context.

Commercial satellite imagery can also be used as a tool to aid in the determination of severe, moderate, and light damage zones; impassable roads; damage model input; debris estimation; ice and water distribution; roofing; change detection; and damage to critical facilities and infrastructure, such as bridges, power plants, and power transmission towers.

Appendix K How to Submit Metadata and Data Files to the USACE Geospatial Data Clearinghouse Node

K-1. Introduction

Note: Updates to this topic will be available at <http://corpsgeo1.usace.army.mil/howto/>.

a. About this appendix. Throughout this appendix, the U.S. Army Corps of Engineers (USACE) Geospatial Data Clearinghouse Node server is referred to as the Geospatial Server or the Server.

The Webmaster of the Geospatial Server is mentioned throughout this appendix. The Webmaster is available at [http://webmaster@corpsgeo1.usace.army.mil](mailto:webmaster@corpsgeo1.usace.army.mil).

The purpose of this appendix is to describe for USACE employees:

- How to sign up to access the Geospatial Server.
- File format and filename requirements for submitting files to the Geospatial Server.
- How to submit, delete, or replace geospatial metadata and data files on the Server.
- How to access and view metadata that is on the Server.
- How to edit your organization's *collection metadata* files, which HQUSACE puts on the Server.

b. About geospatial metadata. Geospatial metadata is information about geospatial data (any data that has geographic coordinates). U.S. Federal Executive Order No. 12906 requires that all Federal agencies create a metadata file for any geospatial dataset or series of datasets created. It also requires that these metadata files be made accessible to the public and that they be made in the accepted standard format. The standard format is designed to contain all needed information for various types of data. The rigidity of the standardized structure allows the files to be read and indexed by computers. The Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata is the first standard created in the United States (1995). The International Standards Organization (ISO) developed the ISO Metadata Standard 19115.3 in 2001. The FGDC is working with the ISO to develop one worldwide standard. As of August 2002, most metadata creation tools in the United States still output metadata in Content Standard format. For more information on metadata, metadata creation tools, or the Content Standard, see <http://www.fgdc.gov/metadata/metadata.html> or <http://corpsgeo1.usace.army.mil> and follow the link to "Download Metadata Software."

c. About the National Spatial Data Infrastructure (NSDI) Clearinghouse. The NSDI is a system of websites developed by a cooperative group of U.S. Federal, State, and local government and private agencies. It is designed to allow access to geospatial data from many sites via one central website. Agencies participating in this Clearinghouse create geospatial metadata repositories on their local computers or Clearinghouse Nodes, using formats that conform to Clearinghouse standards. The Clearinghouse central server can then index these metadata files at their remote metadata repositories. Anyone with Internet access can search the indexed metadata files based on variables such as geographic location, time period, and keywords. When a relevant metadata file is found, it will contain specifications about the data such as data

quality, points of contact, and where the data can be located. The number of U.S. and International participants in the Clearinghouse has grown to 267 (2002).

d. About the USACE Geospatial Data Clearinghouse Node. USACE participates in the National Spatial Data Infrastructure (NSDI) Clearinghouse. USACE has a Web server on which is stored geospatial metadata about data belonging to USACE agencies. This service is called the USACE Geospatial Data Clearinghouse Node. Data can also be stored there, if desired. The Uniform Resources Locator (URL) of this server is <http://corpsgeo1.usace.army.mil>. The metadata files stored here are indexed by the NSDI Clearinghouse.

e. About the Geospatial Data and Systems Point of Contact (GD&S POC). Every USACE agency should have a designated GD&S POC. The responsibilities of the GD&S POC are defined in USACE Engineering Regulation 1110-1-8156. To find out who the GD&S POC is for your organization, go to the GD&S POC Database at <http://corpsgeo1.usace.army.mil/poc.html> and type in your agency designation. The GD&S POC should be involved in the organization of the metadata creation and submission process as well as overall geographic data management in an agency. Before submitting metadata to the USACE Server, it may be beneficial to find out from the GD&S POC or another knowledgeable person if there is a plan within your agency for file naming conventions, record-keeping of submitted files, or other types of data management.

K-2. Getting Access to the Geospatial Data Server

Access is the same for submitting either metadata or data files. To register for either, three steps are required.

a. Have a UPASS User ID and UNIX password. All USACE employees are qualified to have a UPASS user ID and a UNIX password. For information on how to obtain these, contact your local computer support group.

b. Sign up to get access to the Geospatial Server. Ask your computer support group's UPASS Administrator to request access within the UPASS system to the Geospatial and Worldwide-Web (WWW) Server. Once the request is submitted to the UPASS Administrator for the Geospatial and WWW Server, access will be granted to the Server. Access is usually granted within 48 hours.

c. Send your contact information to the Server Webmaster. For the submission system to work, you must submit your name, email address, and USACE organization to the Corpsgeo1 Webmaster: webmaster@corpsgeo1.usace.army.mil.

K-3. Metadata and Data Requirements

a. File format requirements. Metadata file format has three requirements:

- Conformance to the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (until the metadata-processing program on the Server recognizes the ISO Standard).
- Each line in the metadata file must be indented according to the rules required by mp, a metadata parser software program.
- The file format must be plain ASCII text file format. The file should not be in HTML or SGML format when it is submitted.

The output of the free USACE metadata creation software tool, CORPSMET (see below), or any metadata creation software that conforms to the Content Standard will conform to these requirements.

No requirements for data formats are on the Server. The Server accepts only geographic data (i.e., data with geographic coordinates). Data producers are responsible for the quality of their geospatial metadata.

b. Metadata creation tools. The metadata generator software package, CORPSMET, developed by a contractor for USACE, creates metadata in the correct format. It outputs the metadata file in the correct hierarchically indented format. It runs on Windows and NT operating systems. It is free and menu driven. It can be downloaded by going to the Server homepage at <http://corpsgeol.usace.army.mil> and following the link to “Download Metadata Software.” “Download CORPSMET” is an option on this page. Sample metadata files and a metadata training manual are also available from this page. After downloading, the file must be unzipped before being installed. For more information on unzipping or for help installing CORPSMET, ask your computer support group.

Other metadata creation software packages are also available. Before using them, check to be sure they are outputting the metadata in the correct standard format. Some Geographic Information System softwares, such as ArcInfo, offer an option for users to create metadata as they create a dataset.

c. Filename conventions. When metadata files are put on the Server, a program runs that uses the filename extension of each file to determine how to process the file. The following naming conventions are required:

Type of File	Required Filename Extension
Original metadata	.met
File to replace current files on the Server	.rep
File to be deleted	.del
Data file	No required extension

To ftp (file transfer protocol) a file to the Server, the name can be up to 100 characters. All filenames should consist of a continuous string of characters which may include numbers, letters, underscore (_), hyphen (-), and dot (.). Other special characters should be avoided. Spaces in filenames are not allowed. Filenames are case sensitive.

The GD&S POCs and persons submitting metadata are responsible for keeping track of their organizations’ metadata filenames. The filename will be needed if the metadata has to be replaced, updated, or deleted in the future. The filenames currently in a Command’s metadata directory can be seen by using anonymous ftp to view the Command’s metadata directory. (See section J-8 for how to view the metadata files.)

K-4. Submitting Geospatial Metadata Files to the USACE Geospatial Data Clearinghouse Node

To put a metadata file on the Geospatial Data Server after it has been registered to access the Server, follow these steps:

- Plan the filename. Remember to use the .met extension for metadata file submissions. Any number of files can be submitted during one ftp session, including metadata and data files.

- Use the ftp software on your computer. Because many brands exist of ftp software, it would be impossible to describe them all. For information on how to use the ftp utility on your computer, contact your computer support group.
- Use the following parameters to initiate ftp to your home directory:

Host: geodata.usace.army.mil

Login ID: *yourUPASSid*

Password: *yourUPASSUNIXpassword*

Note that geodata is a different server name than the one the public uses to view the files. This Server is used only to post, maintain, and index metadata and data files. When you have successfully logged on, you will be in your home directory. This is the only place on the Server where you can put files. Use your ftp software to put the files on the Server in your directory.

- Once the metadata is on the Server, close the session and exit from the ftp software.
- The software that moves the files to the correct directory on the Geospatial Server processes new files about every 2 hours. Therefore, do not check the directory immediately after submission. Once a metadata or data submission, replacement, or deletion is successfully processed, an email message will confirm this within a few hours. If the file is not successfully processed, a return email message explaining why will arrive within a few hours.

K-5. Submitting Geospatial Data Files to the USACE Geospatial Data Clearinghouse Node

a. Data quality. The producers of geospatial data are responsible for the quality, integrity, and maintenance of the data that they produce.

b. Data file formats. Geospatial data in any format is accepted on the Server. This includes output generated by any Computer-Aided Design and Drafting (CADD) system or Geographic Information Systems (GIS). Geospatial data includes any data with geospatial coordinates. Please be aware of the filename conventions for placing data on the Server as described above in section J-3c Filename conventions.

c. Data and the referring metadata file. When a data file is submitted to the Server, a metadata file that refers to that data file must also be submitted to the Server at the same time. (However, a metadata file may be submitted without a data file.)

Section 6 of a metadata file is the “Distribution Information” section. It contains information about the distribution of and options for obtaining the data to which the metadata refers. It should also contain information about one or more datasets to which the metadata refers. Which of the optional data descriptors in this section to use depends on where the data is located. A part of this section (6.4.1) is for “Non-Digital Data,” and a part (6.4.2) is for “Digital Data.”

To submit a data file and the referring metadata file to the Server, the metadata file must be referenced as follows: <http://corpsgeo1.usace.army.mil/filename.ext>. Note that the name of the data file to which your metadata refers must be in the place of the filename.ext. This reference has to be in Section 6 “Distribution Information” of the metadata file in the location for “Network Resource Name.” The script that processes the files takes this text and turns it into a link to the actual data file. (The text <http://corpsgeo1.usace.army.mil> is just dummy text to alert the processing script as to what it needs to do.) This metadata on the Server will

enable requests for downloading of the corresponding data immediately, if the data is on the corpsgeo1 Server.

If data is submitted with metadata, the Section 6 “Distribution Information” must contain options that are set up like this (notice the hierarchical indentation of the options):

6: Distribution Information:

Standard Order Process:

Digital Form:

Digital Transfer Option:

Online Option:

Computer Contact Info:

Network Address:

Network Resource Name: http://corps_geo1.usace.army.mil/filename.ext

Note that the filename.ext area is to be replaced with the data filename to which the metadata file refers.

The data and referring metadata files must be submitted at the same time for correct processing.

If a data file arrives at the Server without a metadata file, the data file will be put in storage for 2 weeks, and the sender will be notified to submit a metadata. If the metadata file is submitted within 2 weeks, a resubmission of the data file will not be necessary; Metadata Parser (MP) will take the data file from the temporary storage directory and process it normally.

To submit a data file that corresponds to a metadata file already on the Server, the old metadata file must be deleted from the Server and resubmitted with the data file. This will enable you to include the required text in the “Network Resource Name” section of the metadata file and allow MP to process the two files correctly.

One metadata file may refer to multiple data files. If this is the situation, Section 6 of the metadata file, “Distribution Information,” will have more than one “Network Resource Name.” For example:

Distribution Information

Standard Order Process

Digital Form

Digital Transfer Option

Online Option

Computer Contact Info

Network Address

Network Resource Name http://corps_geo1.usace.army.mil/fname1.ext

Network Resource Name http://corps_geo1.usace.army.mil/fname2.ext

Network Resource Name http://corps_geo1.usace.army.mil/fname3.ext

Note that the fname1.ext, fname2.ext, and fname3.ext are the areas for the filenames of the data files that correspond to the metadata file.

To summarize:

- A metadata file can be submitted without a data file.
- If a data file is submitted, it must be simultaneously submitted with a referring metadata file.

- One metadata file can refer to multiple data files.
- Multiple metadata files can refer to one data file.

d. *Submitting the data file.* When submitting a data file, use the process described in section J-4 to ftp the file to the Server. At the same time the data file is submitted, also submit the corresponding metadata file.

K-6. Replacing a Metadata File on the Server

To replace or delete a metadata file on the Server requires first knowing the exact filename of the file to be replaced or deleted. To find the filename, use an anonymous ftp or use the Worldwide Web and go to the URL <ftp://corpsgeo1.usace.army.mil/> to locate the organization's metadata directory with the filename (see section J-8).

To replace or delete files originally placed on the Server by someone else, contact the Webmaster and provide proof that you are now responsible for these files. The filename of the replacement file should be in the format:

filename(.met).rep.

Note that the filename.met is the filename of the file to be replaced. The original filename will end with .met, so the replacement filename must end with .met.rep. The extension .rep will cause the Server to replace the metadata file currently in your Command's metadata directory having the name filename.met with the file you just put in your home directory.

When submitting a replacement file, use the same process described in section J-4 to ftp the file to the Server.

K-7. Deleting a Metadata File on the Server

First create a dummy file on your local computer with the same filename as the name of the file you want to delete plus the extension .del. It does not matter what is in the dummy file. The filename should be in the format:

filename(.met).del.

Note that the filename(.met) is the filename of the file to be deleted. The filename of the existing metadata file will end with .met, so the dummy file's filename will end with .met.del. The extension .del will cause the Server to delete the metadata file you have named.

When you are ready to submit the replacement file, use the same process described in section J-4 to ftp the file to the Server.

K-8. How to View Metadata on the USACE Geospatial Data Clearinghouse Node

Notice to data users: The data in the data files that are described in the metadata files produced by USACE are the results of collection and processing for specific USACE activities. These data are valid only for their intended use, content, time, and accuracy specifications. The user is responsible for the results of any application of the data for other than the intended purposes.

a. *Using the Web to view metadata files.* Go to the URL <http://corpsgeo1.usace.army.mil>. Click on the button “Locate Metadata.” Choose whether you want to view metadata on the USACE Server or on the National Clearinghouse. If you want to view USACE metadata, you can choose to go to a map to select an organizational element or to a textual list of the organizations. Select the appropriate button. Select the organization whose metadata you want to view. Click on the link “Detailed Metadata” and then the folder called “metadata.” Click on a file that has the filename extension *.html* or *.met*.

b. *Using ftp to view metadata files.* Use your Web browser to ftp to <ftp://corpsgeo1.usace.army.mil/>. Keep clicking on the organization whose metadata you want to view as you burrow down into the ftp site until you can choose the “metadata” folder. Once in the metadata folder, click on a file with the filename *.html* or *.met*.

K-9. Editing Collection Metadata on the Server

a. *Collection metadata.* The USACE geospatial data and metadata available on the Web include *collection metadata* and *detailed metadata*. A collection metadata file is a single metadata file that describes a number of related data files that are routinely collected by an agency. For example, the data may be hydrographic files that have been collected for 20 years. A detailed metadata file describes a unique data file or a collection of data files that are not routinely collected by an agency.

HQUSACE has created a series of collection metadata templates for all USACE Commands to edit or delete, as appropriate. Links to these templates are found under each Command’s data pages. The changes to these pages can be made on a paper copy or electronic copy of the file and then sent to the Webmaster of Corpsgeo1 to be published. You can make the changes to the electronic file as described below, then send the resulting file to the Webmaster as an email attachment.

b. *Electronic editing of a collection metadata file.* While browsers differ, general instructions for saving an electronic copy of a web page to your local computer are given here. To download the web page to your PC, use your browser to view the collection metadata file web page. Save the file to your PC by using the browser menu options: File/Save as. Choose to save in the format of either HTML or text. Note where in your directory structure the file is being saved and its filename. Press enter.

Once a file is saved, the collection metadata file will have all the HTML tags necessary for viewing it from your Web browser on your local PC. To view the file on your browser while you edit it, use the browser menu options File/Open File in Browser or File/Open/Browse to locate and open the electronic copy of the metadata file you just downloaded.

You can then open the file in your word processor *as a text-only file* or in any text-only editor to make needed changes in the file and view the results from your browser. Please remember to open and save file in “Text Only” format in your word processing software. Any images in these files will not appear as you edit and view them on your local computer. This is normal. When the file is placed back on the Server, the images will appear as they should.

If you are using Microsoft (MS) Word and it will not allow you to open the file in text-only format, you have two options:

- Change the filename extension to *.txt* while opening the file to edit it. Then save it with the *.htm* filename extension to view it on your browser.

- Select the MS Word menu options, Tool/Options/General, and check the option “Confirm Conversion at Open.” When you open the file, you can then choose to open it as a text file.

c. *Editing a paper copy of a collection metadata file.* Print a hardcopy of the page from your Web browser while you are viewing it. Edit it and fax the edited version to the corpsgeo1 Webmaster at 603-646-4658. Please make your edits clearly. Please contact the Webmaster at webmaster@corpsgeo1.usace.army.mil to let him know the fax is coming.

K-10. Frequently Asked Questions

- What if the data set I have been working on has security restrictions?

No geospatial data or metadata file that has any secure information should be posted on a public website, including the USACE Geospatial Data Clearinghouse Node. If you are creating a secure geospatial dataset, you should create a metadata file for that dataset and give it to the owner of the data along with the data files.

- Am I supposed to make a metadata file for every geospatial data file that I create?

You should make a metadata file for every unique data file or dataset that you create. If you are making a related set of data files, then one metadata file may suffice.

- Must I also publish the geospatial data file when I publish its metadata file on the USACE Geospatial Data Clearinghouse Node?

No. You may publish the geospatial data that is described in the metadata file that you are posting, but it is not required.

- May I publish a data file and not its corresponding metadata file on the USACE Geospatial Data Clearinghouse Node?

No. Any data on the USACE Geospatial Data Clearinghouse Node must have a corresponding metadata file.

- How can I view USACE Geospatial Metadata?

See section J-8.

- Who should I contact if the Server is not posting the metadata files or data files that I send?

Corpsgeo1 Webmaster: webmaster@corpsgeo1.usace.army.mil.

- Who can I contact for more information about the USACE metadata submission?

Contact help at one of the following four sites:

Your organization’s GD&S POC. Find out who is your POC at the GD&S POC Database web page at <http://corpsgeo1.usace.army.mil/poc.html>.

Corpsgeol Webmaster: webmaster@corpsgeol.usace.army.mil.

HQUSACE Geospatial Data and Systems Manager – Nancy.J.Blyler@hq02.usace.army.mil.

You can also keep up with USACE GIS news and information by joining the USACE GD&S POC Email List. Find out how to sign up for the email list at <http://gis.usace.army.mil/contacts.htm>.

- Where can I find more information about USACE geospatial data and geospatial data systems?

More information is available at <http://gis.usace.army.mil/>.

Appendix L
Managing Historical Geospatial Data Records –
A Guide for Federal Agencies

The Federal Geographic Data Committee

Managing Historical Geospatial Data Records – A Guide for Federal Agencies

The development of a National Spatial Data Infrastructure (NSDI) is an important step in ensuring the Nation's economic, environmental and scientific well being. The NSDI includes initiatives to establish an electronic clearinghouse to improve public access to and use of geospatial data and to implement content standards for metadata. The NSDI will play an important role in protecting and preserving geospatial data records through their life cycle from creation and use until they pass into the Nation's archives.

This fact sheet explains the responsibilities of Federal geospatial data producers for properly creating data, documenting data with appropriate metadata, making data available through the clearinghouse, and arranging for the appropriate disposition of the data. While the fact sheet is designed for Federal geospatial data producers, the guidelines and principles may be useful to anyone collecting or producing geospatial data.

What Is the Law?

The National Archives and Records Administration (NARA) is the Federal agency responsible for acquiring, preserving, and making available those records of enduring value created or received by various components of the Federal government. Federal agencies are required to manage records in accordance with the NARA regulations, as codified in 36 Code of Federal Regulations, chapter 12. They are required to seek the approval of the Archivist of the United States before any Federal Records are destroyed, stored in Federal Records Centers, or transferred to the National Archives for permanent preservation. State, local and regional governments and many corporations have similar regulations and guidance for their records.

Geospatial data producers and managers should be aware that this responsibility begins with the design and contracting for hardware and software systems used to create that data. Minimum system capabilities must ensure appropriate retention and disposition of the records required by law. When designing a new system, or considering the disposition of geospatial data in existing systems, geospatial data producers and managers should consult with the agency's departmental records officer or information resources manager to verify all legal requirements are met.

What Records Are Appropriate for Preservation?

Records in geospatial database systems that provide evidence of the organization, policies, programs, decisions, procedures, operations, or other activities of an agency of the Federal Government may be appropriate for preservation. A broader body of geospatial data may be preserved because of the value of the information it contains. Storage media for these data may include magnetic tape, floppy and hard disks, and optical cards and disks. The electronic records may include geospatial data files and databases with a national scope or those at the project or operations level.

How Do Agencies Document Historical Information About Their Datasets?

The Federal Geographic Data Committee's (FGDC) Content Standards for Digital Geospatial Metadata specify required elements for capturing information about lineage, processing history, sources, intended use, status of the data, and other types of information available through the clearinghouse. This information establishes intellectual control over both the content of the data and the context within which the originating agency created and used the data. Additional historical information may be captured in records documenting the system design and use, and outputs from the data in the form of reports, maps, and other graphic materials.

Sources of Information

Information about retaining records (records scheduling and appraisal) is available from:

- Office of Records Administration, NARA
Telephone: (301) 713-7110

Information regarding electronic records is available from:

- [Center for Electronic Records](#), NARA
Telephone: (301) 713-6630
Fax: (301) 713-6911

Additional information can be accessed through NARA's homepage:

- URL: <http://www.nara.gov/>

Information about the FGDC is available from:

- FGDC Secretariat
Telephone: (703) 648-5514
Fax: (703) 648-5755
E-mail: fgdc@fgdc.er.usgs.gov
URL: <http://www.fgdc.gov/>

The FGDC maintains an anonymous FTP site at:

<ftp://fgdc.er.usgs.gov/gdc/>

Should the Geospatial Dataset be Saved?

Before you dispose of any geospatial data you should consider the following questions:

1. Do the data involve or reflect any legal rights of the Government or individuals?
2. Will the data be needed to defend the agency or the Government against charges of data fraud or misrepresentation?

3. Could the data be useful to other Federal geospatial data users or the broader geospatial research community?
4. Will other users require access to the original “raw” (unedited, unprocessed) data?
5. Have the geospatial data been made available to other users through agency data sharing agreements, data user services, or the clearinghouse?
6. Can secondary users understand or interpret the data without technical expertise or assistance from the producer?
7. Are the data difficult or expensive to replicate?
8. Are there significant costs or consequences to the program or the Government if the data are lost?
9. Can the data be usefully integrated with newer data resulting from resurveying or improved methods of data collection and interpretation?
10. Does the estimated research value of the data exceed the costs to maintain them for secondary use by Government researchers or other?
11. Will the data be useful for analyzing geographic distributions over time?
12. Do the data support the study of geophysical changes over time?

If the answer to any of these questions is “yes,” the data may have long-term or permanent value. The agency’s records management or information resources management staff should be consulted for further guidance.

Geospatial Database System Considerations

Records Retention: Every dataset, record, or file in the system should have a designated retention period. Temporary records should be deleted or transferred to alternate storage media or facilities for temporary records only at specific times according to an approved records retention schedule.

Records Preservation: Geospatial data creators are required under 44 U.S.C., chapter 29, to preserve permanent records, both the data and appropriate documentation. When the designated permanent records are transferred to NARA at the predetermined date, the transfer will be in a format and on a media acceptable to NARA at the time of transfer.

Records Integrity: The hardware and software systems design must ensure data integrity. This can be accomplished by using passwords and audit trails, by restricting when records can be edited, and by maintaining a “history” file in a meaningful format of all changes, when appropriate.

Historical Data Working Group
FGDC, 590 National Center, Reston, VA 22092
URL: <http://www.fgdc.gov/nara/hdwgfsht.html>
Last modified: 7-27-1998