U.S. Fish & Wildlife Service

Design of the Wetlands Geodatabase: Questions and Answers

Wetlands Master Geodatabase - Technical Document 03-04

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Design of the Wetlands Geodatabase: Questions and Answers (6-23-03)

The design of the Wetlands Master Geodatabase was dependent on the resolution of several important questions, some technical and some administrative. These questions fall into five broad categories:

- $ What are physical parameters, extent and boundaries of the Wetlands Master Geodatabase?
- $ What is the recommended hardware and software configuration?
- $ What type of data are stored in the database (i.e. what data must be stored to describe wetlands?)
- $ How are the data stored and validated?
- $ What are the administrative and policy considerations?

I. Physical Parameters, Extent and Boundaries of the Wetlands Master Geodatabase:

Question: What types of geographic features or objects will be stored in the Geodatabase?

Answer: Geographic data will be stored as polygons and lines. There are three geographic data layers or feature classes: wetlands, riparian and uplands. The name of the wetlands and deepwater habitats feature class is 'wetlands,' the riparian feature class is named 'riparian,' and the uplands feature data class is named 'uplands'.

In earlier wetlands maps small, compact areal features were represented as points and narrow features were represented by lines. These point and line representations were an artifact of the scale limitations of the cartographic technology. The use of modern digital technology and on-screen mapping of wetlands allows interpretation to be done at a much larger scale. Features previously represented as points can and should be delineated as polygons. Existing features previously digitized as linears will be maintained in the geodatabase. The addition of linear features is discouraged and support cannot be guaranteed in future versions of the geodatabase or the Attribution and Verification Tools.

Question: What is the geographic area covered by features stored in the Geodatabase?

Answer: Five discrete geographic areas were designated as wetland mapping areas. These were named CONUS (conterminous United States), Alaska, Hawaii, PR-VI (Puerto Rico and the U.S. Virgin Islands), and Pac Trust (Pacific Trust Territories). Alaska contains the state of Alaska including the Aleutians. Hawaii contains the principle islands of Hawaii; including Hawaii, Maui, Kahoolawe, Lanai, Molokai, Oahu, Kauai and Niihau. CONUS contains the 48 conterminous states. PR - VI contains the islands of Puerto Rico and the U. S. Virgin Islands. Pac Trust contains the U.S. island possessions and trust territories of the south Pacific (Table 1).

Table 1. Wetland mapping areas (WMA) were created to include the following geographic extent. Units are degrees, minutes, and seconds.

WMA NAME	North	South	West	East
Alaska	75 00 00 N	50 00 00 N	170 00 00 E	125 00 00 W
Hawaii	25 00 00 N	15 00 00 N	165 00 00 W	150 00 00 W
CONUS	50 00 00 N	20 00 00 N	125 00 00 W	65 00 00 W
PRVI	20 00 00 N	15 00 00 N	70 00 00 W	60 00 00 W
PAC Trust	30 00 00 N	15 00 00 S	145 00 00 E	155 00 00 W

Question: Why does the MGD contain five wetland mapping areas?

Answer: A single map area with all the data contained in one large extent from the Aleutian Islands to Puerto Rico creates a very large data set with poor precision. Using five wetland mapping areas reduces the size of the data, improves MGD performance, and increases data precision.

Question: Will each of the five wetland mapping units in the MGD have metadata?

Answer: Yes. Each of the five wetland mapping units will have project level metadata linked to them. There will also be supplemental wetlands information stored at the feature level, which will serve as feature level metadata

Question: What are the map projection parameters and planar units of the wetlands data?

Answer: The map projection is Albers Equal-Area Conic Projection. The horizontal planar units are meters. The horizontal planar datum is the North American Datum of 1983, also called NAD83. Standards for the U. S. Geological Survey published digital spatial data were used to

define the standard parallels, central meridians, and latitudes of origin for each wetland mapping area (Table 2).

Table 2. Standard parallels, central meridians, and latitude of origin for the wetland mapping areas (WMA). Units are degrees, minutes, and seconds.

WMA NAME	1st Standard Parallel	2nd Standard Parallel	Central Meridian	Latitude of Origin
Alaska	55 00 00	65 00 00	-154 00 00	50 00 00
Hawaii	08 00 00	18 00 00	-157 00 00	03 00 00
CONUS	29 30 00	45 30 00	-96 00 00	23 00 00
PRVI	08 00 00	18 00 00	-66 00 00	03 00 00
PAC Trust	08 00 00	18 00 00	145 00 00	03 00 00

The use of a map projection that preserves area is critical to wetlands areal calculations. The Albers Equal-Area Conic projection is frequently used for a wide variety of digital spatial data sets published by both the Service and the USGS.

Question: What is the minimum coordinate precision for geographic features stored in the Geodatabase?

Answer: The minimum coordinate precision is one centimeter. One centimeter accuracy is much greater precision than is necessary for the wetlands data collected, but allows for any future improvements in the positional accuracy of the data .

Question: What size geographic area (spatial index) would allow the Relational Database Management System to most efficiently retrieve geographic features from the Geodatabase?

Answer: Currently three spatial indices are used: 20,000, 60,000 and 180,000 meters.

Question: Why was more than one Spatial Index used?

Answer: A single Spatial Index set for the entire dataset would result in wetlands drawing very slowly on screen. The Wetlands Master Geodatabase will use multiple Spatial Indices that are based on typical wetlands delineation project areas. This will improve the drawing time and speed of spatial queries.

Question: Are Point and Linear data included in the Geodatabase?

Answer: Point and linear wetland data are obsolete for wetland mapping given the capabilities of the newer technologies being employed. However, the following documentation briefly explains how point data have been converted and how linear data are included as part of the database (i.e. separate feature class), and any limitations associated with doing so.

Existing features previously digitized as linears will be maintained in the geodatabase. Existing point data have been buffered to 1/10 acre (11.28 m) and will be incorporated as small polygons. Point data will not be supported in the MGD and should not be delineated by image analysts in data collections efforts. Adding linear features is discouraged and support cannot be guaranteed in future versions of the geodatabase or the Attribution and Verification Tools. At times, special projects may warrant the incorporation of some linear features. When this occurs, linears will be captured and maintained as a ***separate feature class***.

Linear features when viewed by themselves, offer few clues about cartographic inaccuracies. Dangles, overshoots, undershoots, intersects, etc. are not detectable through computerized verifications on a linear data set. It is only when linear features are combined with polygons that these errors can be identified. This situation is complicated by the fact that linear features may legitimately overshoot polygons creating linear dangles. It is also possible to have linears intersect polygons or form a portion of a polygon boundary. Developing snap tolerances or other data editing routines for a single feature class containing polygons and linears would effectively eliminate many of the linear delineations. For these reasons, if linear features are delineated they should remain as a separate feature class. The existing verification tools can be used to detect attribute errors on linears.

Question: What are the known constraints:

Answer: The system is dependent on ESRI software compatible digital data files.

II. What is the Recommended Hardware and Software Configuration of the Wetlands Master Geodatabase?

Hardware Requirements

Hardware for Arc SDE/ IMS servers: The MGD requires two servers: an ArcSDE/Oracle server and an ArcIMS server. Both systems are the same configuration/specification and are designed for two years of service. The configuration of the hardware is as follows:

> Dell PowerEdge 2500 server, Dual Pentium III processors running at 2.0 Ghz
> 4 GB of RAM, 6 SCSI hard drives with redundant power supply
> Monitor, CD burner, DVD burner.

Backup Systems: A separate tape backup system should be acquired exclusively for this dataset. Once a MGD dataset is operational, it may go for extended periods of time between updates. These interim or static datasets could be archived rather than periodically backed up.

Desktop Work Stations: The following minimum hardware requirements are necessary to effectively update and verify digital map data:

- $ CPU with a clock speed of 2 gigahertz or faster
- $ 1 gigabyte of physical RAM
- $ AGP video card with 64 megabytes of video memory
- $ 10/100-base-T network adapter
- $ SCSI or ATA100 IDE hard drive
- $ 1024 x 768 resolution monitor

> Note: RAM has more impact on speed and functionality than CPU speed. ArcMap reliability is affected by the virtual memory configuration, especially the location of the virtual memory file.

Software Requirements

Operating System: Microsoft Windows 2000 Server operating system optimized for running Oracle and ArcSDE. Microsoft Windows 2000 desktop or Windows XP for running ArcGIS. The MGD components were designed and tested using Windows 2000 and Windows XP.

GIS Software: ArcGIS 8.3 or later. The MGD uses customized tools developed using ArcGIS version 8.2 and tested using ArcGIS version 8.3 software.

Relational Database Management System (RDBMS): Oracle. Oracle is also the Departmental standard for relational database management systems software. The Service has considerable experience with Oracle. It is institutionally well supported with numerous training and technical assistance opportunities.

Cartographic Software for Hard Copy Map Output: Maplex

Programming Languages and Tools Requirements:
The custom tools used for the Wetlands Attribution and Verification were written using Microsoft Visual Basic 6.0 and ArcObjects.

III. What Types of Data are Stored in the Database?

Question: What is being mapped?

Answer: The U. S. Fish and Wildlife Service's mission is to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service established the National Wetlands Inventory to develop and provide resource managers with information on the location, extent and types of wetland and deepwater habitats. The principal focus was to produce **topical wetland maps that were graphic representations of the type, size and location of all surface waters in the United States (wetlands and deepwater habitats)**. With implementation f the 2002 Strategic Plan, the Service is to increase the availability and application of digital map information for natural resources planning and management in support of the Service's conservation programs. **The present goal of the National Wetlands Inventory is to provide the citizens of the United States and its Trust Territories with current geospatially referenced information on the status, extent, characteristics and functions of wetlands, riparian, deepwater and related aquatic habitats in priority areas to promote the understanding and conservation of these resources.**

Question: What is a Wetland?

Answer: The Service uses the Cowardin *et al*. (1979) definition of wetland. This definition is the standard for the agency and is the national standard for wetland mapping, monitoring, and data reporting as determined by the Federal Geographic Data Committee. It is a two-part definition as indicated below:

> *Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.*
>
> *For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.*

Question: What are Deepwater Habitats?

Answer: These habitats have been defined separately because the term wetland does not include deep, permanent water bodies. Deepwater habitats were permanently flooded land lying below the deepwater of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium in which the dominant organisms live, whether or not they are attached to the substrate. As in wetlands, the dominant plants are hydrophytes; however, the substrates are considered nonsoil because the water is too deep to support emergent vegetation (U.S. Department of Agriculture 1975).

Question: What are Riparian Habitats ?

Answer: Riparian habitats are among the most important vegetative communities for western wildlife species. Because of its expertise in wetland identification and mapping, the Service is increasing its efforts to map riparian areas of he western United States. The Fish and Wildlife Act of 1956 authorizes the Service to map habitats used by fish and wildlife resources. Under this authority, the Service developed and implemented "A System for Mapping Riparian Areas in the Western United States". The Service's riparian definition is as follows:

> *Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes or drainage ways). Riparian areas have one or both of the following characteristics: 1) distinctively different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetland and upland.*

Question: What are Upland Habitats ?

Answer: Historically, all areas not mapped as wetland or deepwater were presumed to be "upland". For some projects, uplands may be grouped into five generalized categories or further subdivided as needed for specialized studies. The categories of agriculture, urban and other upland have been adapted from Anderson et al. (1976). Forested plantations and rural development categories have been adopted by the Service for use in further describing upland areas.

Agriculture
The definition of agriculture follows Anderson et al. (1976) and includes land used primarily for the production of food and fiber. Agricultural activity may be shown by distinctive geometric field and road patterns on the landscape and/or by tracks produced by livestock or mechanized equipment. Examples of agricultural land uses include horticultural crops, row and close grown crops, hayland, pastureland, native pastures and range land and farm infrastructures. Examples of what this study determined to be agricultural land uses are:

Forested Plantations
Forested plantations include areas of planted and managed forest stands. Planted pines, Christmas tree farms, clear cuts and other managed forest stands such as hardwood forestry, are included in this category.

Forested plantations can be identified by observing the following remote sensing indicators: 1) trees planted in rows or blocks; 2) forested blocks growing with uniform crown heights; and 3) logging activity and use patterns.

Rural Development
Rural developments occur in sparse rural and suburban settings outside distinct urban cities and towns. They are characterized by non intensive land use and sparse building density. Typically, a rural development is a crossroads community that has a corner gas station and a convenience store that are surrounded by sparse residential housing and agriculture. Scattered suburban communities located outside of a major urban center can also be included in this category and some industrial and commercial complexes; isolated transportation, power, and communication facilities; strip mines; quarries; and recreational areas such as golf courses. Major highways through rural development areas are included in the rural development category.

Urban Development
Urban land consists of areas of intensive use in which much of the land is covered by structures (high building density). Urbanized areas are cities and towns that provide the goods and services needed to survive by modern day standards through a central business district. Services such as banking, medical and legal office buildings, supermarkets and department stores make up the business center of a city. Commercial strip developments along main transportation routes, shopping centers, contiguous dense residential areas, industrial and commercial complexes, transportation, power and communication facilities, city parks, ball fields and golf courses are included in the urban category.

Other Uplands
Other Uplands are composed of uplands not characterized by the previous categories. Typically these lands include native prairie, un-managed or non patterned upland forests and scrub lands, and barren land. Lands in transition may also fit into this category.

Transitional lands are lands in transition from one land use to another. They generally occur in large acreage blocks of 40 acres (16 ha) or more. They are characterized by the lack reliable information that would enable identification of one of the other upland or wetland categories. The transitional phase can occur when wetlands are drained, ditched, filled, leveled or the vegetation has been removed, the area drained, and remains temporarily bare.

Question: Why are wetlands being mapped?

Answer: The Emergency Wetlands Resources Act of 1986 and its subsequent amendments gave the Service specific goals and deadlines for producing hard copy and digital wetland maps for the conterminous United States, Alaska, Hawaii, and its Trust Territories. The Act also required the Service to report to Congress on the status and trends of the Nation's wetlands through a series of scientific reports.

Wetlands provide a variety of environmental and economic benefits to the Nation. Contemporary and sound scientific information on wetlands is essential for good policy formulation. The Service plays an important role in aquatic habitat policy development and has important national fish and wildlife management responsibilities.

Question: Who are the users of this dataset and how will the wetlands data be used?

Answer: The Service's wetland maps and other report information have been widely distributed to other federal and state agencies, universities, conservation groups, consultants, local governments and international organizations. Although not designed to define the jurisdiction of any federal, state or local government regulatory program, wetland maps do provide information to guide sound and timely decisions by industry, agriculture, other private concerns and the conservation community. There are a multitude of documented uses for these products including the following:

$ environmental assessment
$ land-sue planning
$ watershed and river basin planning
$ resource evaluation
$ legislative and litigation
$ wildlife habitat management
$ land acquisition
$ zoning
$ flood hazard evaluation
$ mitigation/ impact trade-off
$ waste treatment
$ contaminant spill plans
$ highway and utility corridor design
$ energy resources
$ teaching and reference

Question: What is the current status of wetlands mapping?

Answer: The Service has mapped about 90 percent of the conterminous United States, all of Hawaii and Puerto Rico, 34 percent of Alaska and some of the islands in the Trust Territories. About 42 percent of the conterminous United States and 13 percent of Alaska are available in digital format. A current status map can be viewed on line at www.wetlands.fws.gov/Maps.

Question: Are additional ancillary datasets available?

Answer: Yes. These datasets take two forms: 1) products used in direct support of the wetlands mapping efforts such topographic maps or Digital Raster Graphics, soil surveys, navigation maps, wetland plant lists or plant community types, and 2) collections of water resource information and related land use data that can aid in the further assessment of the wetland map data. These data layers may exist in various formats and for various time frames (i.e. environmental quality, physiographic and socio-political datasets). To make many of these datasets useful will require some specialized knowledge of water resource issues as well as format, spatial and temporal applicability. Ultimately, the goal is that these data will contribute to resource monitoring and assessment capabilities using the geodatabase technology.

Question: What is a hydrogeomorphic (HGM) attribute?

Answer: In recent years, there has been strong interest in adding classification information that describes the hydrologic characteristics (e.g., water flow paths) and landscape position of wetlands. Brinson (1993) proposed a national system for classifying wetlands according to their hydrogeomorphic (HGM) features. These features include water, topography, and geological setting. Such factors are crucial for maintaining many wetland functions and can serve as the basis for grouping similarly functioning wetlands into distinct categories/classes. Wetland functional assessment models for HGM classes and subclasses have been developed in many states in recent years. In conjunction with the development of the models, many local, state and federal wetland managers have desired to see the HGM classification applied to wetland maps. These managers needed to see the extent and distribution of groups of wetlands that had similar functions.

HGM type descriptors have been selectively added to the standard wetland mapping codes as an additional field of information in the attribution tables for the digitized maps. Wetland managers use this information to identify the distribution of wetlands important for maintaining anadromous fish populations. These wetlands include (1) **riverine** wetlands on active flood plains used as juvenile rearing habitat, and (2) **slope/flat** wetland complexes contiguous with streams and rivers that provide stream flow maintenance and exportation of organic material.

Question: Does the MGD accommodate HGM attributes?

Answer: Yes. HGM codes are tied specifically to wetlands. In practice, they may be viewed as another special modifying term appended to the Cowardin wetland description. The HGM coding system proposed for incorporation to the master geodatabase is a hierarchical system that includes: (1) HGM classes, (2) basic landscape position descriptions, and (3) wetland hydrology or water flow modifiers. Following this basic classification , the system allows for additional attachment of other modifiers that may be customized for specific areas. For example, it may be desirable to distinguish commercial cranberry production areas with a special modifier if the standard Cowardin *et al*. and HGM codes do not completely differentiate these areas from all other wetlands.

This HGM coding system uses concepts and definitions from several sources including Adamus (2001), Tiner (2001), Brinson (1993), Smith (1995) and published HGM guidebooks for specific wetland classes and subclasses. Currently, there is no nationally recognized or accepted set of HGM terms or system. Some Regions may prefer one version over another. The objective of including the HGM modifiers within the master geodatabase planning is to 1) accommodate the HGM concept and 2) set a working standard for HGM modifiers.

Question: What is a Riparian attribute? Are Riparian features independent of wetlands?

Answer: Riparian attributes describe vegetative types closely associated with water and topographic relief in the western United States. They are mapped independent of wetland or upland.

Question: Are Riparian and Wetland polygons mutually exclusive (i.e. no overlap)?

Answer: No. Because all riparian mapping is to be accomplished by the Service will be done in concert with wetlands mapping (or wetlands maps), the riparian mapping codes were prepared to be synchronous with the standard wetland attributes. This does not mean all riparian areas are wetlands. Wetlands and riparian may overlap. Some wetlands may be wholly or partially designated as riparian, but other riparian areas may be wholly or partially exclusive of wetland.

Question: Can Riparian polygons have HGM codes?

Answer: No. HGM modifiers were developed exclusively for wetlands.

Question: Where is the use of split wetland classes or subclasses defined?

Answer: The use of split classes and subclasses is described in the Photo interpretation Conventions (U.S. Fish and Wildlife Service 2000). This is an operational procedures manual describing conventional photo interpretation protocols. It was last updated in 2000 and does not reflect procedural considerations when wetland mapping is done in a "heads-up" environment using tools such as ArcGIS. This document indicates the following with regard to mixed classes and mixed subclasses:

> Mixed classes should not be used unless the following conditions are met: (1) The wetland contains two or more distinct cover types each encompassing at least 30% aerial coverage, but is too small in size to allow separate delineation of each cover type. (2) The wetland contains 2 or more classes or subclasses each compromising at least 30% aerial coverage so evenly interspersed that separate delineation is not possible.

Mixed classes shall be limited to the following and their reciprocals:

FO/SS, FO/EM, FO/UB, FO/US, SS/EM, SS/UB, SS/US, EM/AB, EM/UB, EM/US, AB/UB, US/UB

The mixed classes are based on the percentage of a mapping unit falling into each class. If 70% (aerial cover) or greater of a dominant species falls into one class, the whole unit will be mapped as a pure class. In general, however, mixing should be limited because of the tremendous increase in the number of wetland cover types that can result from mixing classes and subclasses.

Mixing of Subclasses

The same rules will be used for mixed subclasses. The mixed subclasses shall be limited to the following and their reciprocals:

PFO and PSS, ½, 1/3, 1/4, 2/4, 3/4, 6/7.

A backslash (/) is used to distinguish a mixed class or mixed subclass.

Question: How does the Wetland Plant List relate to the wetlands MGD?

Answer: Approximately 7,000 species of wetland plants are believed to occur in wetlands. The Service's National List of Vascular Plant Species That Occur in Wetlands includes plant species found in wetlands and contains information such as the plant's taxonomy, geographic distribution, common names, indicator status, and habitat. Using the database information developed from the plant list formulation, it may be possible to link mapped wetlands through their classification codes to certain wetland community types. Ecoflora in Microsoft Access may provide the initial steps in making these linkages.

Question: How are the Regional variations in mapping wetlands standardized?

Answer: Standardization of the Master Geodatabase is very important for consistency and utility. The development of standardized protocols and operational conventions will be an important part of the overall development of the database. Documentation and training will also play a big role as the database becomes operational.

There will always be some Regional variations in how wetlands are mapped. For example, some Regions may choose not use any split classes. The master geodatabase has been built to accommodate the split class option, whether or not any Region chooses to exercise that option. Think of these differences in the context of how a bank operates. A single bank may maintain walk-in service, ATM machines, or drive through service. You have the option of using any or

all of these mechanisms to deposit or withdraw money. You may never use the ATM machine but that does not eliminate that option nor does it change your account balance.

Question: Can a set of rules be established for including the point and linear features contained in or as part of the wetlands polygons?

Answer: Yes. The convention is that vegetative life form classification will take precedence over substrate. For example, if a linear Riverine (coded R4SB) is internal to a PFO polygon, the vegetated feature (PFO) will take precedence over the linear. Polygonal PFOs (forested) would similarly take precedence over linear PEMs (emergents) etc. This follows the ecological hierarchy originally established in the Cowardin system. Many linear stream features can also be retained either by displaying the base topographic map or through the National Hydrography Dataset.

Question: Should image analysts delineate point and linear features?

Answer: Points should not be delineated. Small wetlands can be delineated with polygons to the extent they may be displayed at the projects nominal scale. Delineation of linear features is discouraged. However, if special projects may warrant the use of linear data, they will be stored as a ***separate feature class*** within the geodatabase.

Question: Do deepwater habitats belong in the wetlands feature class?

Answer: Yes. Essentially, the wetland maps should portray all surface waters given any limitations of the projects nominal scale.

Question: Should the hydrography dataset be used for mapping certain wetland or water features?

Answer: The National Hydrography Dataset (NHD) is an excellent source of collateral data and a prime example of an ancillary dataset to be used to compliment the wetlands mapping. It should not be used to replace existing mapped features, nor should it be used as the sole source of information on lakes, rivers and streams. The National Wetlands Inventory dataset uses imagery as the driving source of information location, extent and classification of wetlands and deepwater habitats.

Some Regions may elect to use the NHD to supplement their mapping efforts rather than re-delineate streams and small rivers in particular.

Question: What additional ancillary datasets should be included?

Answer: Listing all possible ancillary datasets that should be included is probably not possible at this point. However, ancillary datasets will fall under four major categories: Environmental Quality (stream gauge data, etc.), Physiographic (ecoregions, watersheds, etc.), Socio-Political (states, counties, etc.), and Biological (flora and fauna). There is a tremendous amount of work to do in this area collect, correlate, catalog, test and store these ancillary data layers.

Question: Why are some wetland map attributes not listed in the current classification scheme or attribute keys?

Answer: Some older wetland maps contain attribute codes that are no longer used. The removal of invalid attribute codes would result in the loss of classification data imparted by the original "invalid" attributes. The attributes for those polygons can be corrected at the time of wetland updates for that area, or via some other data correction protocol.

III. How are Data Integrity and Data Quality Issues Handled in the MGD?

Question: What are the key elements of the Service's Information Quality Guidelines that relate to the development of the MGD?

Answer: All information disseminated by the Service must comply with basic standards of ***quality*** to ensure and maximize its ***objectivity***, ***utility*** and ***integrity***. The Service will ensure that information disseminated will be developed from reliable methods and data sources and will otherwise ensure information quality at each stage of development. Accurate documentation of process, the use of appropriate internal and external review procedures , consultation with experts and steps to verify data quality are important considerations. Information released will be developed only from reliable data sources based on accepted practices and policies, utilizing accepted methods for information collection and verification.

Question: How does the MGD incorporate the 'Best Available Science', 'Sound and Objective Scientific Practices', including peer review?

Answer: The design, development and deployment of a Wetlands Master Geodatabase is a demanding task involving elements of geography, computer technology, software development, database development, data storage, archiving, web-interface technologies, ecological and cartographic expertise. When faced with similar tasks most successful businesses depend on the integration of intelligence, capability and experience from a number of sources to do the job. Following this blueprint, the Service has leveraged the design and development of the Wetlands

MGD through partnerships and collaboration with those agencies and organizations that have experience in the practical application of state-of-the-art technology and capabilities.

The USGS maintains expertise in technical areas of cartography, computer assisted mapping and geographic information systems. Both the Service and USGS are actively engaged in the system design and implementation of the MGD. Techniques for digital file conversion, map updates, data capture, verification and data storage, and dissemination have been developed jointly by the Service and USGS.

Both the Service and USGS recognized that technical expertise and peer review at the highest level was going to be important to ensure that intricate database design criteria, hardware and software performed to meet Service expectations. The Service and USGS initiated contact with the ArcGIS development team at Environmental Systems Research Institute (ESRI), regarding the Wetlands Master Geodatabase project. Input from ESRI was requested because they represented the defacto industry standard in the development of environmental geo-spatial data configuration and systems design.

Key issues relating to data quality and integrity, have been addressed in the 14 design steps built into the MGD planning and architecture. The MGD will provide a standardized map update process; the creation of a wetlands relational database with temporal version capability; the incorporation of non-digital data and; a true seamless data storage and retrieval system. By implementing modern database technology, the MGD permits client-server database access with greatly improved interface to the Service users as well as the public. These improved capabilities coupled with enhanced access help the Service realize the objectives of providing scientifically based applications for wetlands and water resource data.

Question: What role did ESRI play in the development and peer review of the wetlands master geodatabase?

Answer: ESRI agreed to provide technical help and review of the geodatabase design and has afforded the Service use of advanced software functionality not yet released, technical feedback and interaction at the developmental level. Such interactions have yielded tremendous benefits to the Service in the development of the MGD.

ESRI also provided expert peer review of the wetlands MGD Data Model and made numerous suggestions to improve the efficiency of storing wetlands data.

Question: What documentation exists to ensure accepted practices and standards are applied?

Answer: A series of technical reports have been prepared to address automated data integrity and security concerns and ensure accepted practices and standards were applied and well documented. These include the following:

- **$** Automated Information System and Data Project Charter
- $ A Plan for the Development of the Wetlands Master Geodatabase
- $ Wetlands Master Geodatabase Security Plan
- $ National Wetlands Inventory Wetlands Mapping Standards and Protocols
- $ Addressing Information Quality Guidelines, U.S. Fish and Wildlife Service, Wetlands Master Geodatabase
- $ Wetlands Master Geodatabase Data Model, Tables and Schema (Conus and Alaska)
- $ Wetlands Master Geodatabase Project Scoping
- $ MGD Hardware and Software Plan
- $ Critical Questions for Wetlands MGD Development
- $ Organization and Plan for Ancillary Datasets (MGD**)**

Question: What Federal Geographic Data Committee Standards relate to this effort?

Answer: The MGD uses the FGDC Content Standards for Digital Geospatial Metadata (CSDGM), also referred to as FGDC-STD-001-1998.

The Service also uses the FGDC Standard, Classification of Wetlands and Deepwater Habitats (Cowardin et al. 1979) approved as the Federal Standard for mapping, monitoring and reporting wetlands data on December 17, 1996.

The horizontal planar units are meters. The horizontal planar datum is the North American Datum of 1983, also called NAD83.

Question: What Department of the Interior Standards relate to this effort?

Answer: DOI adheres to FGDC Standards. The effort also adheres to United States National Map Accuracy Standards. (see “Map Accuracy Standards”, Fact Sheet FS-171-99, US Geological Survey, 1999.)

DOI has established ORACLE as a standard for relational database management systems. The MGD also relies on ORACLE.

Standards for the U. S. Geological Survey published digital spatial data were used to define the standard parallels, central meridians, and latitudes of origin for each wetland mapping area.

Hardware components comply with existing Departmental Information Technology purchase agreements.

The MGD complies with the Service's Standards for Geographic Information Systems (FWM# 406, 270 FW 8) and the Data Management Standards (FWM# 406, 270 FW 6).

Question: When downloading information from the Wetlands MGD, how can this information be cited for scientific reporting?

Answer: The citation for the wetlands data will be the same as previous citations used for the Service's wetlands data. For authored report information the citation should follow the Department of the Interior format: (Author). (Publication date). (Report title). U.S. Department of the Interior, Fish and Wildlife Service, (Originating location). (Number of pages).

To reference map information the recommended citation is: U.S. Department of the Interior, (Publication date). Fish and Wildlife Service, National Wetlands Inventory. On-line resources @www.wetlands.fws.gov.

Question: What computer/data security issues exist and how are they addressed?

Answer: Under the definitions of the Service Information Quality Guidelines, Data Integrity refers to the security of information - protection of the information from unauthorized access or revision, to ensure that the information is not compromised through corruption or falsification. The wetlands MGD resides on a server which is only accessible by Service and authorized USGS personnel involved in the development and testing of system operations. The MGD Security Plan addresses standard firewall and computer security measures taken to ensure that data integrity are not compromised. To this end, the MGD Manager plays a key role in overseeing data input, conducting final data verification, granting permission for data access, maintaining data logs and status and coordinating with the appropriate system manager(s) and IT personnel.

Dissemination of the information contained with the MGD must be tempered by the need for information sensitivity. For this reason, the Service may host or support ancillary data layers

used for assessment and analysis, without serving those data to the public. The primary concern is for information on private lands and private property rights. Every effort will be made to protect the anonymity of land owners or the location of certain sensitive property landmarks or features.

Question: How are Metadata tied to the MGD? How are sub-meta or intra-data integrated to the MGD?

Answer: Metadata are stored in the Wetlands MGD using standard ESRI tools in FGDC compliant format. This adheres to the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata (CSDGM), also referred to as FGDC-STD-001-1998. Metadata are required at the National and Project levels. Additional supplemental information which serves as feature level metadata is included in the MGD as well. Examples of metadata formats and requirements are further spelled out in the MGD technical documentation "Required Forms and Submissions For MGD Data Input".

Question: Does the Wetlands MGD support the integration of data in a way that will make it easier to share data with other users?

Answer: Yes. The geodatabase enables the Service can move away from the static archive of wetland map data and start to address the integration of multiple types of resource information to compose a true inventory. This means that map data, report information, field observations, habitat photos, plant and soils data that the NWI has collected can be linked and easily accessed as part of the master geodatabase. The common structures, methodology and exchange formats provided by the geographic information system technologies greatly facilitate data sharing with other users.

Question: What is the primary purpose of the web site being developed to support the Wetlands MGD?

Answer: The Service is the principal Federal agency that provides information to the public on the extent and status of the Nations wetlands. In that context the site must fulfill two purposes: 1) Provide a portal for wetlands information ranging from general descriptions and examples for the general public, to more technical report information such as the status and trends reports and posters. This will include building in important links to other agencies and other data sources. 2) To provide the public with easy access to wetlands map information produced by the Service. This requires supporting information such as disclaimers, links to wetland classification systems, map legend information and metadata.

Question: What are the five main reasons users would visit this web site?

Answer: The main reasons are:

1) Search for general information on wetland habitats.

2) View or download technical reports on wetlands or related habitats.

3) View or download wetland map information.

4) Search for wetland plant information.

5) Search for technical information on wetland related technologies such as classification, delineation, remote sensing, inventory and monitoring ecological change.

Question: What special technical or functional requirements are needed for the web site?

Answer: Technical support for web service of Government data. Reasonable download capability for larger files including technical reports, files, maps and the ability to link to other related web sites.

IV. Administration and Policy Considerations

Question: How do these geospatial data investments fit into the Agency's Enterprise Architecture and Strategic Plan?

Answer: The National Strategy for the NWI was designed to increase the availability and application of digital information for natural resource planning and management in support of Service conservation programs. This strategic plan is focused on the development, updating, and

dissemination of wetlands data and information to Service resource managers and the public. The Strategy indicates these assessments should 1) provide scientifically based applications for wetlands and water resource data already available from various resource agencies and 2) expand the capability of the Inventory to integrate digital map data with other resource information to produce timely and relevant management and decision support tools. The development of the MGD is in direct response to the need to upgrade digital information and improve data access and enhance analytical capability.

Question: How is the geospatial information and technology being used to improve efficiency or effectiveness of programs?

Answer: Both efficiency and effectiveness are improved through the production of digital wetlands data. Increasing numbers of migratory birds, fishes, and endangered species need sufficient quality habitat in an ever-changing landscape. Because of continuing habitat alteration, loss and degradation, aquatic species are especially vulnerable. Resource managers in the Service use the digital wetlands data for effective habitat management and acquisition needed to perpetuate migratory bird populations; for fisheries restoration; flood plain planning; watershed management; federal project planning; and endangered species recovery plans.

By implementing modern database technology, the MGD permits client-server database access with greatly improved interface to the Service users as well as the public. These improved capabilities coupled with enhanced access, help the Service realize the objectives of providing scientifically based applications for wetlands and water resource data.

Question: Does the Agency Intend to Use FGDC Data Standards?

Answer: Yes. The MGD complies with the Service's Standards for Geographic Information Systems (FWM# 406, 270 FW 8) and the Data Management Standards (FWM# 406, 270 FW 6).

The Service also uses the FGDC Standard, Classification of Wetlands and Deepwater Habitats (Cowardin et al. 1979) approved as a Federal Standard for mapping, monitoring and reporting wetlands data on December 17, 1996.

Question: Will these data be available to other applications and users, or will it rely on bridges and table transfers?

Answer: Yes. All of the digital data files that compose the core wetlands data layer of the MGD will be available for Geographic Information System (GIS) users. Provisions for

standardized hard copy output have also been addressed for those users with no web access.

Question: The MGD Manager is a key position. What are the functional responsibilities of this position?

Answer: The MGD Manager has responsibility for the operation the master geodatabase configuration and systems. This includes responsibility for the integrity and distribution of the digital geo-spatial data. The data manager will coordinate and oversee permissions for database editing; provide oversight of geodatabase procedural modifications; maintain database security protocols; track system status, metadata, ancillary datasets; and update system documentation. The MGD manager provides the final quality assurance review of data submitted for inclusion within the MGD.

Question: What are the advantages and disadvantages associated with the MGD?

Answer: There are numerous advantages provided by the MGD. Some of these include:

$ Streamline data distribution.
$ Streamline data update process and review
$ Creation of a Wetlands relational database.
$ Creation of a transactional database.
$ Creation of a versioned database.
$ Standardization of update process including metadata.
$ Standardization of delineation and attribution protocols.
$ Incorporates modern database technology.
$ Seamless data storage and retrieval.
$ Simplify access, use and analysis of data by the layperson.
$ Client-server database access.
$ Storage of data in a collection of RDBMS tables.
$ Allow for the incorporation of non-digital data.
$ Improve web interface to public.

Some of the disadvantages observed to date include the following:

$ Requires Service staff to be GIS literate

$	Deals with electronic media (preparation, storage, distribution and archiving is different)
$	IT security procedures differ between Service Regions.

Question: Does the National Spatial Data Infrastructure Clearinghouse Network (which includes the FGDC Clearinghouse, the Geography Network and Others) provide suitable data that would meet the needs without the cost of creating new datasets?

Answer: Yes, and the Service has adopted a limited number of the appropriate datasets as collateral or ancillary data. However, the charge to map the wetlands and deeepwater resources of the United States falls to the Service.

Question: For datasets that you plan to acquire–What geospatial datasets that already exist are affected?

Answer: The Service is not aware of any affects on existing datasets. The core data of the MGD is composed of wetlands and deepwater habitats as defined by the Service. These data were produced by the Service and will be supported through the MGD.

Question: Do any new Federal standards need to be developed as part of this process?

Answer: No new standards need to be developed.