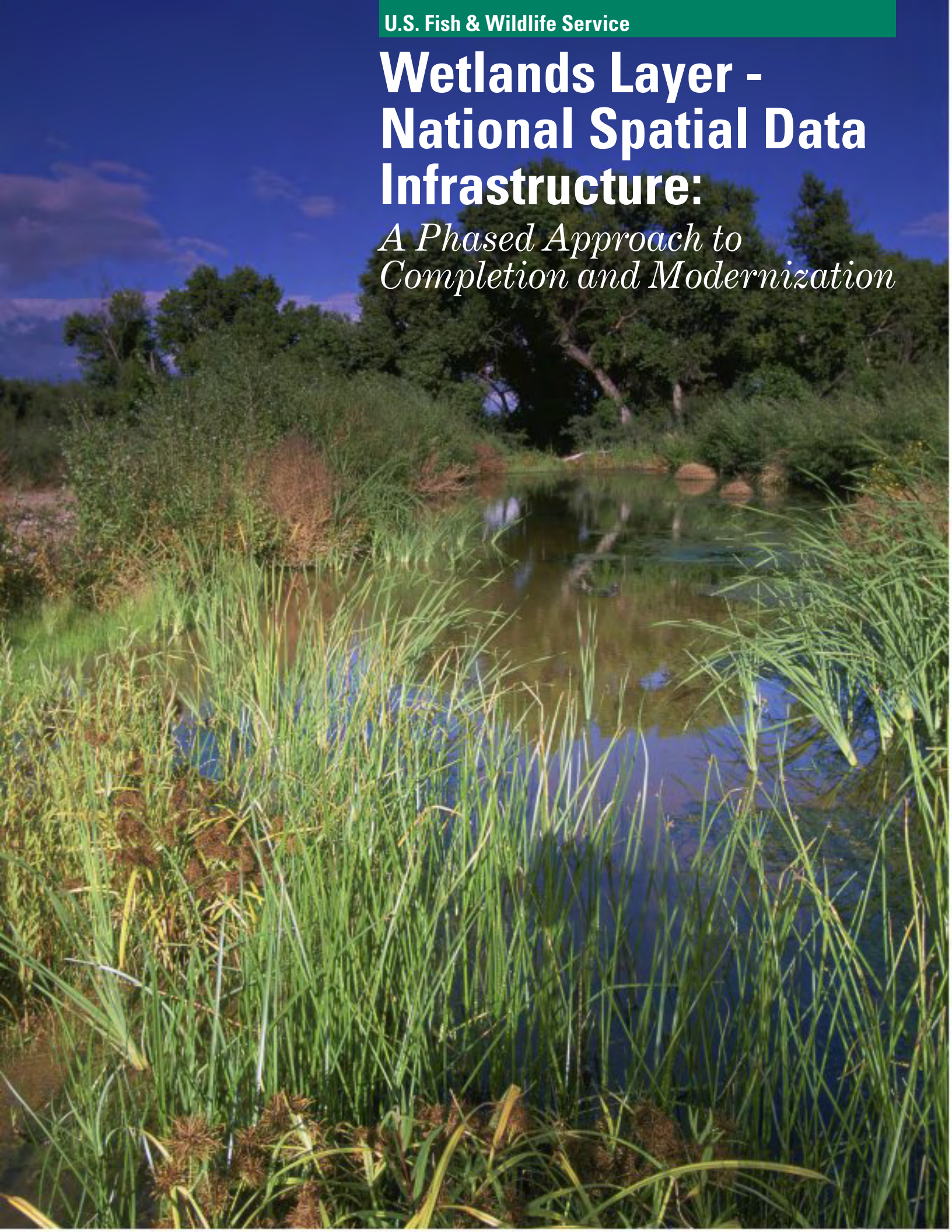
U.S. Fish & Wildlife Service

Wetlands Layer - National Spatial Data Infrastructure:

A Phased Approach to Completion and Modernization



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The Fish and Wildlife Service prepared this Nationwide Data Theme Population Plan to provide information on the development, content, availability, and phased approach for completion and modernization of the Wetlands Layer of the National Spatial Data Infrastructure (NSDI).

Wetlands Layer -
National Spatial Data Infrastructure:
A Phased Approach to Completion and Modernization

Fish and Wildlife Service
December 2007
Technical Revision

I. Wetlands Layer of the National Spatial Data Infrastructure

The National Spatial Data Infrastructure (NSDI) is a way of enhancing the accessibility, communication, and use of geospatial data to support a wide variety of decisions at all levels of society. Executive Order 12906 calls for the establishment of the NSDI, defined as the technologies, policies, and people necessary to promote sharing of geospatial data throughout all levels of government, the private and non-profit sectors, and the academic community. The Office of Management and Budget (OMB) Circular A-16 (Revised), August 19, 2002, affirms and describes the NSDI as the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data.

OMB Circular A-16 enumerates 34 data themes of national significance and assigns responsibility for each of the themes to one or more Federal agencies. The Federal government has the primary responsibility for the collection and coordination of data layers that may be partially collected using imagery such as wetlands, wildlife habitat, vegetation, geology, bathymetry, etc.

The OMB Circular assigns lead responsibility for coordinating the national coverage and stewardship of the wetlands data theme to the U.S. Department of Interior (DOI), Fish and Wildlife Service (FWS). The FWS provides stewardship for the wetlands data that comprise the Wetlands Layer of the NSDI. In partnership with the U.S. Geological Survey (USGS), the FWS makes these data available via the Internet. All digital wetlands data are in a seamless format for the conterminous United States and its territories. This provides resource managers and the public with digital wetland information that can be used in geographic information systems, as well as in key assessment reports, to address complex conservation issues.

The FWS has prepared this Nationwide Data Theme Population Plan to provide information on the development, content, and availability of the wetlands data layer (Sections I - VI). Additionally this plan outlines a phased approach for future actions for the completion and modernization of the wetlands data layer (Section VII).

II. U.S. Fish and Wildlife Service - Wetlands Data Standards and Stewardship

Wetlands are some of the Nation's most ecologically and economically important habitats, and provide benefits for fish, wildlife, and people. Emerging conservation issues such as global warming, sea-level rise, increasing storm severity, drought, energy development, species declines, and expansion of infrastructure are driving the need for contemporary geospatial resource information.

The FWS is the principal Federal agency providing information to the public and other agencies on the extent and status of the Nation's wetlands. These types of analyses rely on digital information to provide fast, efficient, and scientifically sound information for resolving resource management issues. The common structures, methods, and formats used in geographic information system technologies greatly facilitate this process.

Although the FWS has maintained an operational wetlands mapping effort for 30 years, in 1986, the Emergency Wetlands Resources Act mandated the FWS complete mapping and digitizing of wetlands data for the Nation, and to distribute and archive the data. During this time, the FWS developed the wetland classification system (Cowardin et al. 1979) that was subsequently adopted by the Federal Geographic Data Committee (FGDC) as a national standard for mapping, monitoring, and reporting on wetlands. Currently, FWS is also working on a FGDC Wetlands Mapping Standard. The result of these efforts form the framework for the wetlands geospatial data layer of the NSDI and capitalize on years of data collection effort by developing scientifically sound, technologically relevant tools for data analysis, display, distribution, archiving, and updating aquatic resource information.

The FWS has modernized its geospatial services to meet demands for wetlands data. The Wetlands Geodatabase and Wetlands Mapper (http://wetlandsfws.er.usgs.gov/NWI/), an Internet discovery portal, provide technological tools that allow the integration of large relational databases with spatial information and map-like displays. The Wetlands Geodatabase, which houses all FWS digital geospatial wetlands data, including digital data contributed by outside cooperators, forms the Wetlands Layer of the NSDI. This Wetlands Layer is now available to all Federal, State, tribal, and local governments, as well as the general public, and is an important component of DOI's Geospatial Blueprint, actively supporting the E-Government (E-Gov) initiative, Geospatial One-Stop (http://gos2.geodata.gov/wps/portal/gos), and The National Map (http://nationalmap.gov/index.html). These efforts also support OMB's Geospatial Line of Business initiative.

The DOI has implemented the Federal Enterprise Architecture (FEA) Data Reference Model (DRM) by organizing and categorizing its business information into Subject Areas, Information Classes, and Entities. In September 2005, the DOI assigned lead responsibility for these business Subject Areas and Information Classes to the Bureaus and requested the appointment of Principal Data Stewards to provide leadership for all areas under their purview. In FY 2006, the FWS appointed Business Data Stewards for all DOI Subject Areas and Information Classes that describe mission related activities performed by the FWS. Accordingly, the Chief, National Standards and Support Team, Division of Habitat and Resource Conservation, was appointed Business Data Steward for Water Resources Information Class which includes wetlands.

The primary duties of this Business Data Steward are to represent the FWS in all major Departmental activities that relate to assigned business areas and coordinate the internal review of proposed DOI data standards with appropriate subject matter experts, project leaders, and database administrators in accordance with the DOI Data Standardization Procedures, April 2006. This steward is also responsible for maintaining two data standards adopted by the FWS for bureau-wide use: the Classification of Wetlands and Deepwater Habitats of the United States and the Wetlands Data Layer Standard (http://www.fws.gov/stand).

The FWS, participating with other federal agencies and other organizations, is developing an FGDC Wetlands Mapping Standard, based on the bureau standard, to facilitate the development and addition of standards-compliant contributed data to the Wetlands Layer. This new standard is expected to be approved by the FGDC in the summer of 2008.

III. Data Layer Characteristics, Status, and Continued Development

The national Wetlands Layer (geodatabase) is contained in five units (map areas) that are populated with digital vector data and raster images. These units include the lower 48 States (conterminous U.S. - Conus), Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands, and Pacific Trust Islands. The wetlands layer is a seamless digital data layer in ArcSDE geodatabase format, a single standard projection (Albers Equal-Area Conic Projection), horizontal planar units in meters, horizontal planar datum is the North American Datum of 1983 (NAD83), and minimum coordinate precision of one centimeter. Links are available to supplemental wetland information and metadata records that are compliant with the FGDC Content Standards for Digital Geospatial Metadata (CSDGM), Version 2.0, FGDC-STD-001-1998.

Currently, the wetlands data layer for the lower 48 States contains seamless information for about 33,000 7.5-minute map areas, which represents wetland map data for approximately 60 percent of the conterminous U.S. The wetlands layer also covers 27 percent of Alaska, 100 percent of the windward islands of Hawaii, 62 percent of Puerto Rico and the U.S. Virgin Islands, and 100 percent of Guam and Saipan Pacific Trust Islands. By the end of 2007, the Wetlands Geodatabase contained 61 gigabytes of data including 14.6 million polygonal features. See the status map in Figure 1 below.

The national wetlands data layer can be easily expanded and updated, and contains several levels of metadata information. A web-based data discovery site is available to the public to facilitate queries and explore the resource information available (http://wetlandsfws.er.usgs.gov)

The creation and maintenance of this data layer is an ambitious and technically involved undertaking and includes standardized map updating, creation of a wetlands relational database with temporal version capability, incorporation of non-digital data, and a true seamless data storage and retrieval system. These improved capabilities, coupled with enhanced access, help the FWS realize the objectives of providing scientifically-based applications for wetlands and water resource data. As a direct result of these efforts, the FWS has established standardized characteristics for the data layer that include:

- Metadata must be compliant with the FGDC CSDGM, Version 2.0;
- The data layer must be easily expanded and updated;
- Data must be in a consistent and standardized format;
- Data storage, management, and distribution must be contemporary both in technology and content;
- Temporal versions of data must be maintained;
- Data must be able to be integrated to related geospatial information such as riparian map data and historic wetland data; and
- Data must conform to DOI and FWS standards and policies.

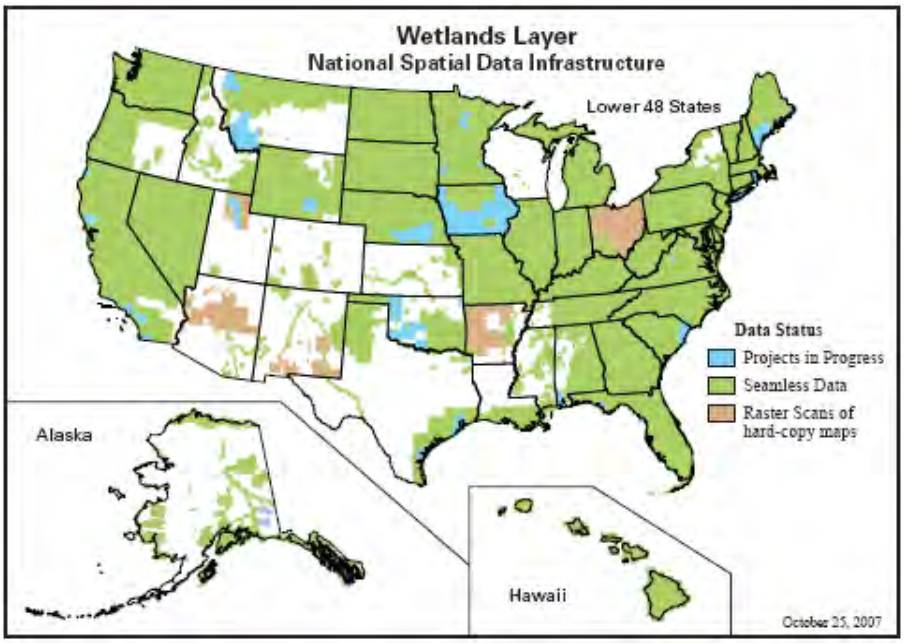

Figure 1. Status of the Wetlands Layer of the National Spatial Data Infrastructure as reported to the Federal Geographic Data Committee and Office of Management and Budget for 2007. *See image on page 6 for example of Raster Scans.*

IV. Maintaining Strong Technical Partnerships

Partnering with USGS - The FWS has developed and maintains a close working relationship with the USGS Office of Water Information's Cartographic Applications and Processing Program. Through this partnership, the USGS assists the FWS with emerging technologies, geographic information science, database management, and support. USGS continues to assist the FWS with integrating updated information into the geodatabase, providing data summaries for special projects, and technical assistance regarding data manipulation and verification. Through this collaboration, both agencies are able to share infrastructure and mutually benefit from technology developments. As a result, investments in time and costs have been reduced.

Memorandum of Understanding with the USGS - *The National Map* is a seamless, nationally-consistent set of geographic base information that serves as a foundation for integrating, sharing, and using other data. Through partnerships, USGS is incorporating important information layers. The wetlands map data have been incorporated into *The National Map* http://nationalmap.gov/ as a catalog layer (Hydrography). The FWS Division of Habitat and Resource Conservation has signed a Memorandum of Understanding with the USGS National Geospatial Program Office - *The National Map*. Although the FWS has a long-standing working relationship with USGS and The National Map, this document recognizes important ongoing work and establishes a framework for continuing cooperative efforts.

Coordination Activities to Collect, Integrate, and Maintain Spatial Wetlands Data - During FY 2007, much of the digital map data (historic or current) received by the FWS came from cooperators and other organizations, both public and private. These contributors are playing an increasingly important role in building the national wetlands data layer.

The FWS will continue to follow the NSDI model by collaborating and coordinating with data producers and actively seek data contributions. For the NSDI wetlands geospatial data theme, it is clear that contributed data from partner organizations and collaborators will be important in maintaining a viable data layer. The FWS is taking steps to facilitate the submission, verification, and acceptance of contributed digital wetland data. Information on how cooperators can contribute wetlands data is now posted on the FWS web site at http://wetlandsfws.er.usgs.gov/NWI/external_data.html.

V. Meeting Spatial Data and Metadata Needs

The existing FGDC metadata standards work well for tracking single data themes and provide consistency to metadata structure and content. For the Wetlands Layer, FGDC-compliant metadata are provided for the national data layer content.

Additional metadata are required when tracking multiple data contributors, overlapping geospatial data coverage, and different time frames. To address these metadata needs, the FWS has improved and redesigned the type of metadata available for the wetlands spatial data layer, see Figure 2, diagram of metadata hierarchy.

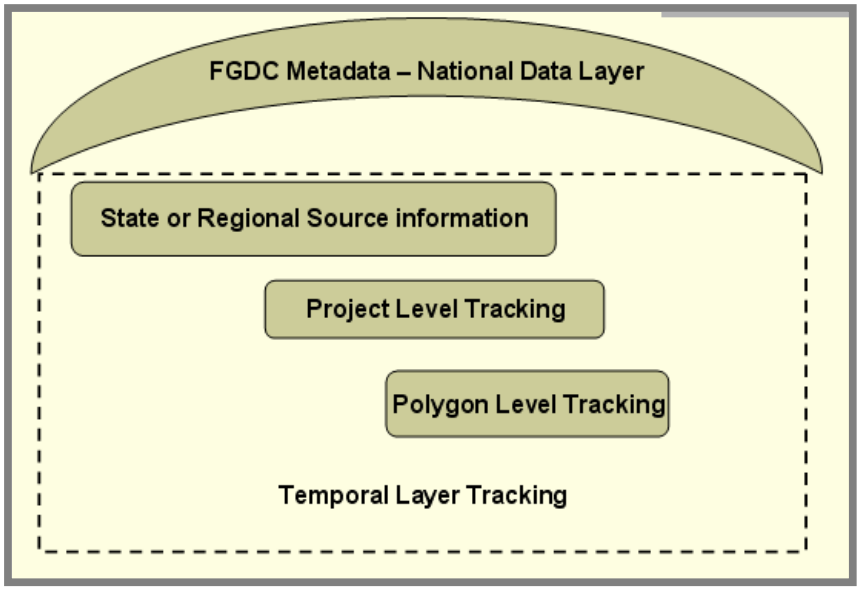

Figure 2. Metadata hierarchy.

Users can access the FGDC-compliant metadata, as well as project-level metadata (for specific updated project areas) and "historic" metadata collected when the original mapping was completed.

Supplemental metadata linked to individual polygon features in the database allow the incorporation of contributed data to the wetlands layer. This will be especially important as data are contributed to the database by other State, Federal, and partner organizations.

Other geodatabase developments are providing access to more wetland information and offering expanded data delivery options for users. In FY 2006, the FWS added: (1) the capability to download wetland map data at 1:24,000 and 1:100,000 scale, (2) raster image scans and metadata, and (3) historic map report information for 389 study areas in the lower 48 States. The FWS also finalized the geodatabase model to track the history of wetland features as they are updated through time.

Other FWS developments to assist users include work on parsing wetland attribute codes and implementation of increased image serving capabilities for raster scanned images of map data not yet available in vector form.

VI. Online Publication of Maps and Data

For the FWS, an important goal is to improve the Internet delivery of updated digital data to keep pace with growing demand for wetland resource information and support the Presidential E-Gov Initiatives to achieve operational efficiencies and enhance customer service. The Wetlands Geodatabase fuels an important Internet data delivery tool used by the FWS to reach a larger user audience. The outcome of this effort provides mission critical habitat information in state-of-the-art digital formats to help guide the conservation and stewardship of the Nation's wetlands and aquatic resources. The Wetlands Mapper (http://wetlandsfws.er.usgs.gov/NWI/) is the Internet data discovery mechanism designed to promote greater awareness of wetlands map data applications and deliver easy to use, map-like views of the Nation's wetland resources. The Wetlands Mapper is both Section 508 and OGC (Open GIS Consortium) compliant, which allows outside site administrators the ability to include wetlands in their own ArcIMS viewers as background layers.

The FWS continues to point large data users to the Web Map Service (WMS) capability. This option provides Federal and State agencies as well as large institutional users an opportunity to establish OGC linkages to ensure they are getting the latest and most complete digital data set.

Raster images of wetland map data are also being served on the Wetlands Mapper, see the example in Figure 3 below. These images are scans of the original 1:24,000 wetlands maps produced in hard copy by the FWS with the topographic map as a backdrop. These scanned PDF files are served as raster images and can be accessed from the Wetlands Mapper site as an interim product until data can be captured in vector format. In FY 2006, the number of raster scan images available to the public more than tripled and that number will double in FY 2008 as a result of cooperative funding provided by the USGS and the Environmental Protection Agency. See the current availability of raster scans on the status map on page 3.

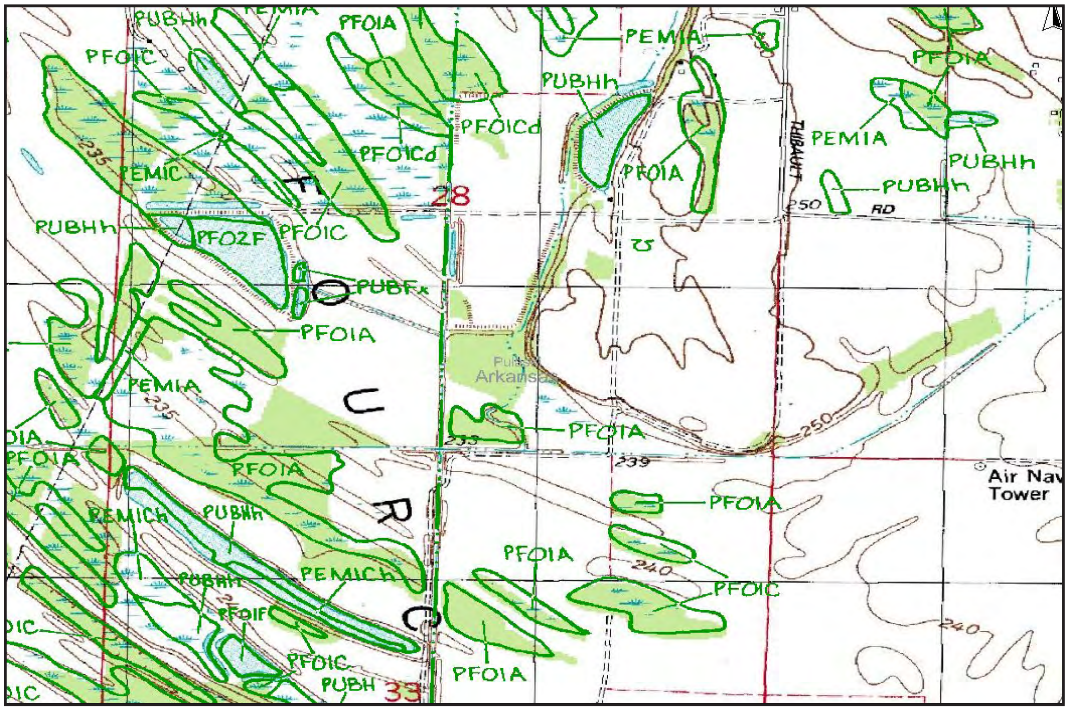

Figure 3. Hard copy wetland map information is scanned and georeferenced to the corresponding Digital Raster Graphic (DRG). These data are served on-line as interim-product raster images.

VII. Future Spatial Data Needs, Priorities, and Completion of the Wetlands Data Layer

In FY 2002, the FWS developed a forward looking strategy to guide the bureau's digital wetland mapping and assessment efforts. This strategic re-direction recognized a need to analyze and assess wetlands and other aquatic habitat data at the watershed, ecosystem and national levels. 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 FWS strategic plan for digital wetland data is focused on the development, revision, and dissemination of wetlands data and information to resource managers and the public. The present goal 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, and deepwater habitats in priority areas to promote the understanding and conservation of these resources (http://wetlandsfws.er.usgs.gov/status_trends/index.html)

In December 2007, the FWS provided additional direction based on priorities, existing budgets and personnel. The overall direction in FY 2008 is to (1) address habitat changes resulting from climatic shifts including sea-level rise, and energy development, and (2) support Strategic Habitat Conservation activities of the Bureau. Specific implementation priorities were ranked in the following order:

1) Complete the Wetlands Status and Trends Study for the Conterminous U.S. by 2010 as mandated by the Emergency Wetlands Resources Act.

2) Provide Data Stewardship for the Wetlands Layer and continue to be responsive to cooperators and data contributors.

3) Produce strategic reports on wetlands and related habitats.

4) Conduct strategic mapping and map updating.

5) Complete the wetlands data layer for the Nation.

OMB Circular A-16 Section 8.d. (2) requires NSDI data theme lead Federal agencies to facilitate the development and implementation of a plan for nationwide population of each data theme. As citied above, completion of the wetlands data layer is currently ranked as the fifth priority for FWS given competing demands for funding.

A consistent means to share geographic data among all users could produce significant savings for data collection and use and enhance decision making. Much has been accomplished in recent years to further the implementation of the wetlands geospatial data layer into the NSDI, but there is still much to be done to achieve the vision of current data being readily available for the entire country, see Figure 4, Era of Imagery, below.

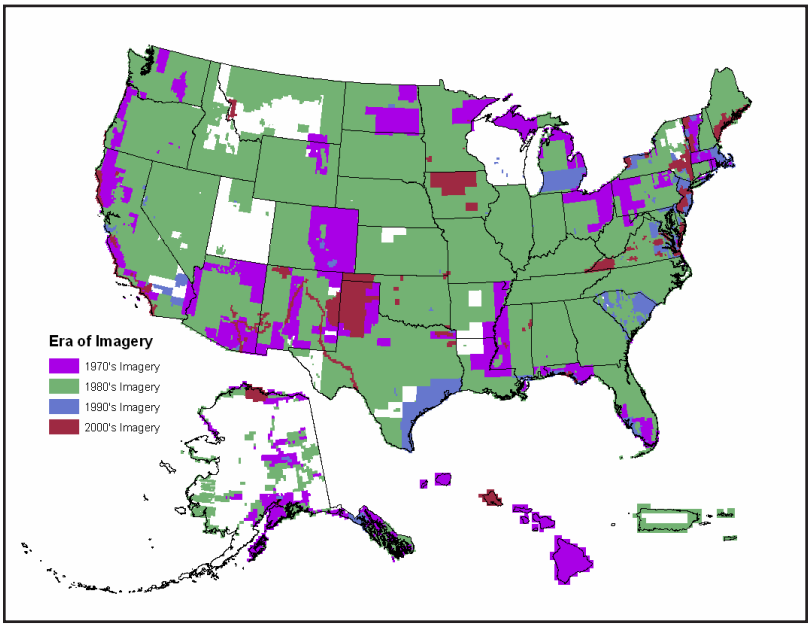

Figure 4. Status of wetlands data (both digital and non-digital) based on era of source imagery for the U.S. and Territories. Not all older data should be considered "out of date" as many areas may be refurbished to provide a contemporary data layer.

There are two areas of focus needed to meet FGDC requirements for the wetlands layer: 1) complete the wetlands mapping for the country and disseminate the information to users and; 2) explore ways to keep the national wetlands database populated with current data. These objectives must be accomplished within the realities of human and financial resources and any constraints thereon.

Currently, under ten percent of the wetlands data layer is created from source materials less than 10 years old. The FWS updates between one and two percent of the data layer with more recent wetland map information every year.

At the present time there are more areas of the country that have experienced rapid land-use changes than there are funds to produce updated wetland maps. These areas are often the target of the FWS strategic map updating projects. However, not all older maps should be considered outdated, as many existing wetland maps encompass areas where wetlands have experienced little change and might be refurbished (updated) to represent a more contemporary segment of the data layer. In the near future, the FWS will investigate techniques to identify these areas.

The wetlands data layer is increasing in size each year primarily due to existing analog data being converted to vector or raster images. Contributed data from other Federal, State and local organizations is also increasing. More and newer data will need to come from other sources in the future to achieve the goals of producing a complete data layer for the Nation and keeping it current.

A number of factors contribute to the development of a strategy to complete a national geospatial data layer as large and complex as for wetlands. The FWS has limited budgetary resources and faces many challenges in balancing increasing demands for wetlands map information for high priority resource conservation applications. For example, the emergence of climate change as a potential cause for changes in habitat(s) has become a high priority issue for FWS to address. As a consequence, under current budget scenarios completion of the national geospatial data layer will be a long-term goal. Through its strategic mapping projects, the FWS will continue to provide updated information as well as add map data to provide a complete National data layer. Additionally, the FWS will work with partner organizations to facilitate the incorporation of wetlands map data and provide this information to the public.

However, given an update cycle of one to two percent annually, it will take decades to realize the desired national objectives. The FWS would be able to complete the data layer for the Nation and provide more contemporary data if sufficient funding becomes available. The FWS has developed a phased approach to complete the data layer and implement a plan to keep it updated. Timing for the completion of any phase of this plan is subject to technological developments, personnel obligations, changing priorities, and available funding.

Key steps in implementing this approach include:

1. **Complete scanning of all available hard copy maps and make this information web accessible to users as raster images,**

2. **Complete scanning of all annotated interim wetland map data and make them web accessible to users as raster images,**

3. **Work with States and other organizations to ensure the best available data will be included in the wetlands layer of the NSDI,**

4. **Provide scalable wetland map products to complete the lower 48 States,**

5. **Convert all raster data to vector,**

6. **Provide scalable wetland map products to complete all 50 States and Territories,**

7. **Provide vector wetland data to complete the initial wetlands data layer,**

8. **Provide updated or refurbished data at the rate of 5 percent per year (2,650 quadrangles) starting in 2010 with the goal to refresh the entire data set at 20 year intervals.**

An important element of this approach is the production of scalable map products for certain areas of the nation. Scalable maps are considered interim products and may include map information at different scales, classification level(s), or resolution, capable of being easily expanded or upgraded on demand as funding becomes available. For example, the areas could be mapped at 1:24,000 scale; omit Subclass, Water Regime, or Special Modifiers; or use available 5-meter or courser resolution imagery. See the map with preliminary candidate areas for scalable maps, Figure 5, on page 9. These products still must meet the FWS geospatial data requirements for wetlands mapping although they may differ in the source materials used to create the data. In some instances, these products can be extremely useful for filling data gaps particularly in portions of the nation where there may be little demand for more detailed wetland mapping (i.e., interior Alaska). Candidate areas for the nation have been identified pending further review of resource priority needs, interagency interest, and available funding.

This plan has been prepared based on current funding for FY 2008 and projections through FY 2010. Full or partial implementation of this Plan is contingent upon adequate funding to complete the priority tasks described herein.

"The present goal 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, and deepwater habitats in priority areas to promote the understanding and conservation of these resources."

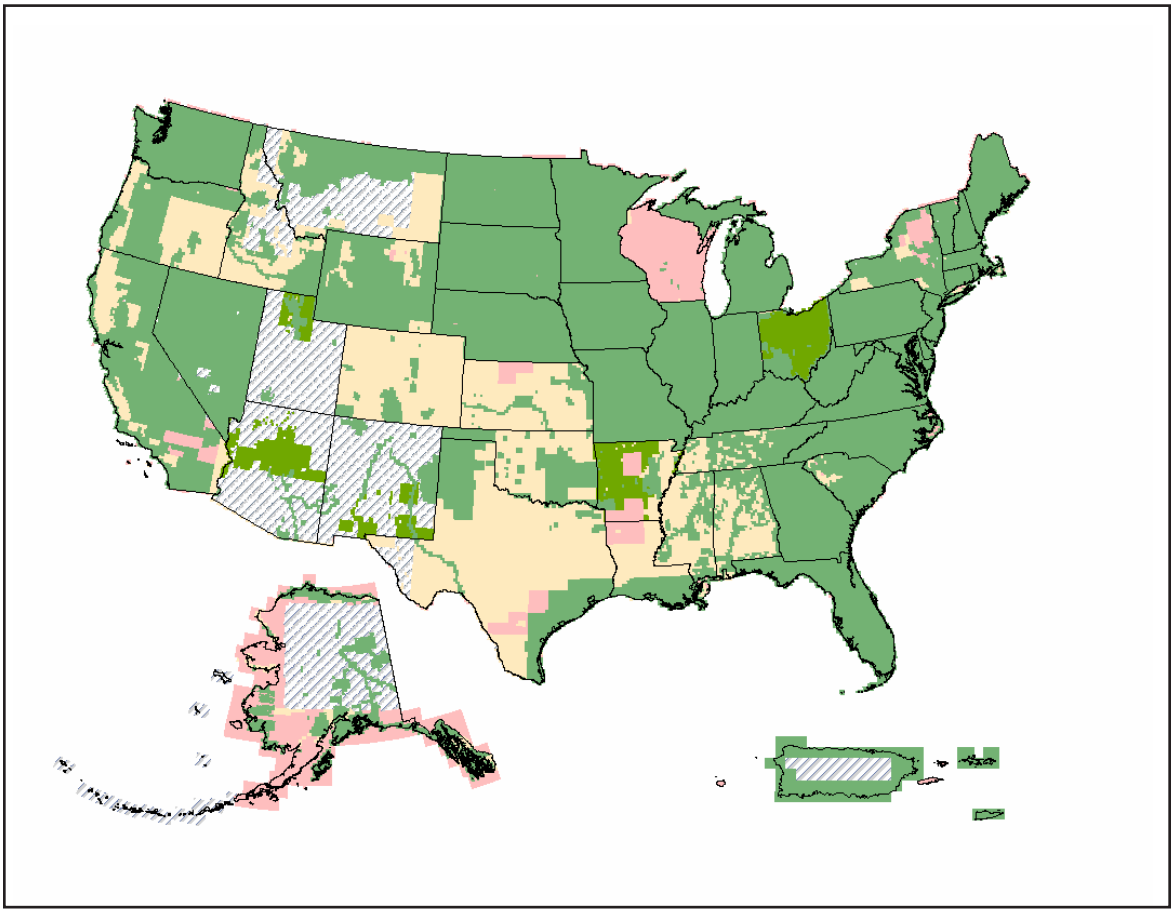

Figure 5. Preliminary candidate areas for scalable map products to assist in providing initial wetland map data for the nation have been identified by blue-lined areas on this map. The primary green area on the map identifies the areas with digital data; the smaller yellow-green areas have scanned raster images on-line, available for digitizing. Areas in tan have hard-copy maps available for scanning and digitizing. Pink areas represent unmapped areas that are not considered appropriate for scalable maps either because there are interpreted imagery available for converting into digital data or because finer scale mapping is recommended.

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