

Development of Boundary and Land Ownership GIS
Files for U.S. Fish and Wildlife Service
Region 3 National Wildlife Refuges¹

by

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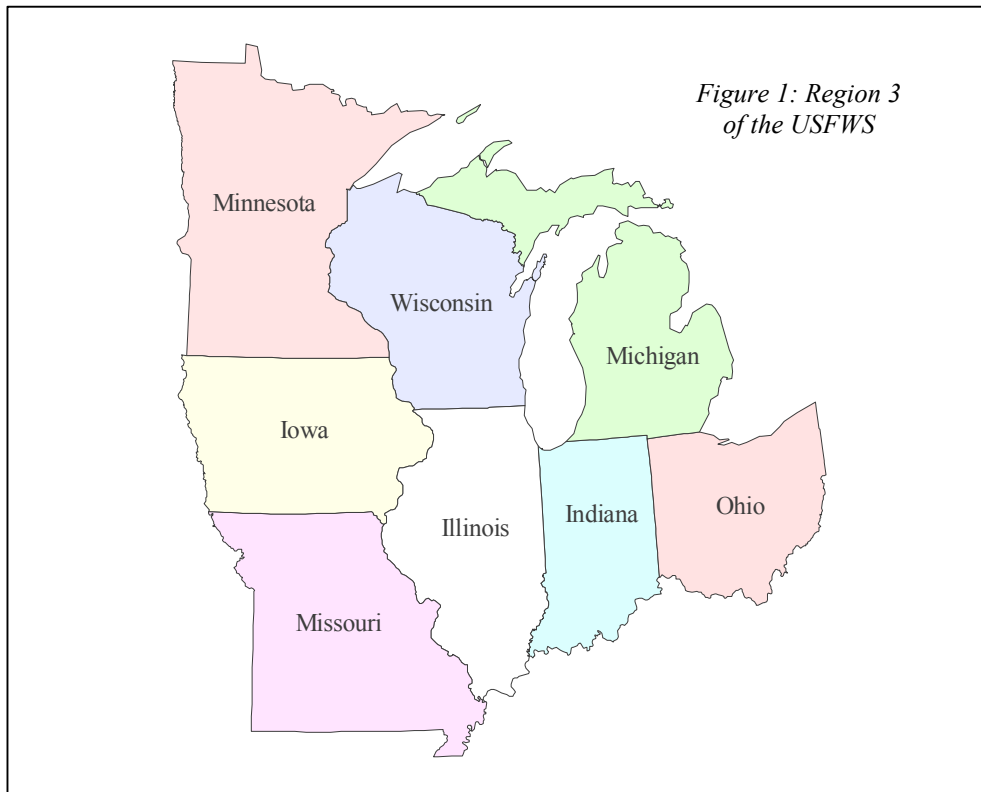
² The authors are Graduate Research Assistant, Professor and Associate Professor, respectively, Department of Forest Resources, College of Natural Resources, University of Minnesota and Refuge Planner, U.S. Fish and Wildlife Service, Region 3.

Introduction

As part of an ongoing, cooperative effort between the University of Minnesota's Department of Forest Resources and Region 3 of the United States Fish and Wildlife Service (USFWS), Graduate Research Assistants have created Geographic Information System (GIS) coverages representing national wildlife refuge legislative boundaries and federal land ownership. The boundary work began in 1998 as Regional USFWS administrators anticipated a nationwide project.

The U.S. Fish and Wildlife Service initiated a 'Service Land Digital Boundary Project' in 1999. The purpose of the project was to create a digital cartographic representation of the approved boundaries on the national wildlife refuges. Prior to 1999 the boundaries of many refuges did not appear anywhere, except on maps in selected offices of the Fish and Wildlife Service. Where digital data did exist, the coverage and quality of the representation of refuge boundaries varied greatly across the country between administrative regions. The 'Service Land Digital Boundary Project' addressed this variability and inconsistency.

The digital data that were developed at the University of Minnesota represent the legislative boundary and federal land ownership of the approximately 50 refuges (Appendix A) in the eight states that comprise Region 3 of the USFWS (Figure 1). The legislative boundary



includes the actual and potential federal ownership delineated in a 'Final Environmental Assessment' document. The land ownership data included actual federal ownership at the time the data were developed.

There is an important disclaimer that accompanies the data. The data serves as a spatial reference for refuge personnel. The data are not intended for land survey or tax purposes.

Common Processing Procedures

Project personnel used a wide array of GIS and imaging software from ESRI (ArcInfo versions 7.2.1 and 8.0.1, ArcView 3.2), and ERDAS (Imagine versions 8.4 and 8.5) to develop the boundary and land ownership files. A combination of both Windows and UNIX workstations were employed during this process.

Initially, a digital raster graphic (DRG) mosaic was created for each refuge. The relevant 1:24000 scale United States Geological Survey (USGS) DRG's were combined into a single image, using either ERDAS Imagine or ESRI ArcInfo software, with the resulting image being saved in a .tif format. This image was then reprojected into the appropriate datum, using an ArcInfo AML entitled 'drgnad2783.aml'³. The North American Datum (NAD) of 1983, which uses the GRS 1980 spheroid, was used throughout the project. This digital mosaic served as a spatial reference for the individual refuge boundaries, and GIS coverages were registered to this image.

Boundary and land ownership files for each refuge were created using one, or a combination of, three methods (cf. Appendix A). The first method involved the use of a large format CalComp Model 813 digitizing table. Several refuge boundary files were created by table digitizing both boundary and land ownership lines from existing paper maps. These boundary files were digitally corrected on screen to match ground features on the DRG mosaic at a scale of no smaller than 1:5000.

The second method involved importing boundary and land ownership files already in a digital format. These files were supplied by the U.S. Fish and Wildlife Service as either ArcInfo export files (.e00), ArcView shapefiles (.shp), or as AutoCAD drawings (.drg). Once imported into the GIS, these boundary files were digitally corrected on screen to match ground features on the DRG mosaic at a scale of no smaller than 1:5000.

The third method involved the use of the COGO (Coordinate Geometry) module within ArcInfo. COGO is a highly accurate way of inputting legal survey descriptions based upon a Point of Beginning and detailed survey bearings. COGO was used to define the shape of specific refuge tracts or easements when survey data were available. Once these boundaries were created

³ http://gis.umn.edu/fws/useful_stuff/amls_web.htm

within ArcInfo, they were digitally corrected on screen to match ground features on the DRG mosaic at a scale of no smaller than 1:5000.

Review Process

After the refuge legal boundary and ownership coverages had been matched to the digital mosaic, a paper map, typically measuring 31 by 41 inches, was printed on a large format Hewlett Packard DesignJet 2500CP printer. The paper map was sent to the refuge for review and corrections were marked on the map. The map was then sent to Region 3 headquarters where Fish and Wildlife Service Realty personnel checked the corrections made by the refuge staff. The map was then returned to the Department of Forest Resources at the University of Minnesota where the corrections were made to the digital boundary and ownership GIS coverages. This process was repeated until the refuge staff and Realty personnel identified no further corrections.

In the next step project personnel developed a draft CD for the refuge. The CD contained all the relevant digital data created for the refuge, including metadata describing the data files (Appendix B), a text file detailing what was to be found on the CD (Appendix C), and an ArcView project file (.apr), which stored all the views of the data, as well as the layout used in the printing of the paper map. University of Minnesota personnel then checked the draft CD for completeness and accuracy, with particular attention being paid to metadata content. ArcView project files were also checked to make sure that they were fully transportable, meaning that they could be loaded without error from the CD itself. Text files were checked for grammar, and conformed to established project guidelines. Metadata files were reviewed to make sure they complied with Federal Geographic Data Committee (FGDC) data standards. Once the draft CD passed University of Minnesota quality control measures, it was sent to Region 3 headquarters to be checked by the Region GIS Coordinator. If any errors were identified they were corrected and a new version of the draft CD was created. This process continued until no errors were identified. At this point, a final CD was created and submitted to the USFWS.

Metadata and Data Standards

A metadata file was created for each data coverage and was given the same file name as the coverage with a '.met' file extension. Several different approaches to writing metadata were used over the span of the project, including a metadata entry program named Corpsmet95 developed by the United States Corps of Engineers, and writing the metadata in a text editor. Both ESRI's ArcGIS and ArcView (through the Metadata Collection Tool extension) software packages allow for metadata to be written about a coverage from an interface within the GIS itself. Any of the methods mentioned, including combinations of methods, were used for

metadata creation during the project as long as they complied with the FGDC format (see Appendix B for an example of metadata).

University personnel checked compliance with FGDC standards by running the metadata file through the U.S. Geological Survey (USGS) program MetaParser⁴. This program checks the metadata files for format errors and deviations from FGDC standards. If any inconsistencies with FGDC standards were found, they were corrected and the new metadata file was re-run through the MetaParser program.

Final Output

The final output for each refuge included a paper map and a CD. Typically, the paper maps measured 31 by 41 inches and were printed in either a portrait or landscape orientation. These maps were displayed at a scale of no greater than 1:24000. Several of the refuges required multiple, overlapping maps in order to display the refuge extent. Maps were created as a layout in ESRI's ArcView 3.2 software and printed using the ArcPress extension. The Department of Forest Resources used a Hewlett Packard DesignJet 2500 CP large format plotter to print the maps.

Each map consisted of several standard elements. A map title bar appeared above the map frame, and contained the name of the refuge, the state, county, and the township and range of the refuge. The title was in Bookman Old Style font with typical font sizes of 96 (refuge name), 72 (state and county designation), and 48 (township and range).

A scale bar, legend, inset map, north arrow, and a .gif image of the USFWS shield appeared below the map. A brief description indicating the name of the refuge, the date of the map, and other information about the creation of the map also surrounded the USFWS shield. While these elements were required on every map produced, their location and size were dependent upon map orientation, available space on the map sheet, and personal preferences of the map creator (Figure 2).

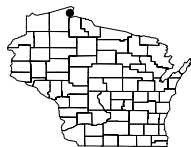
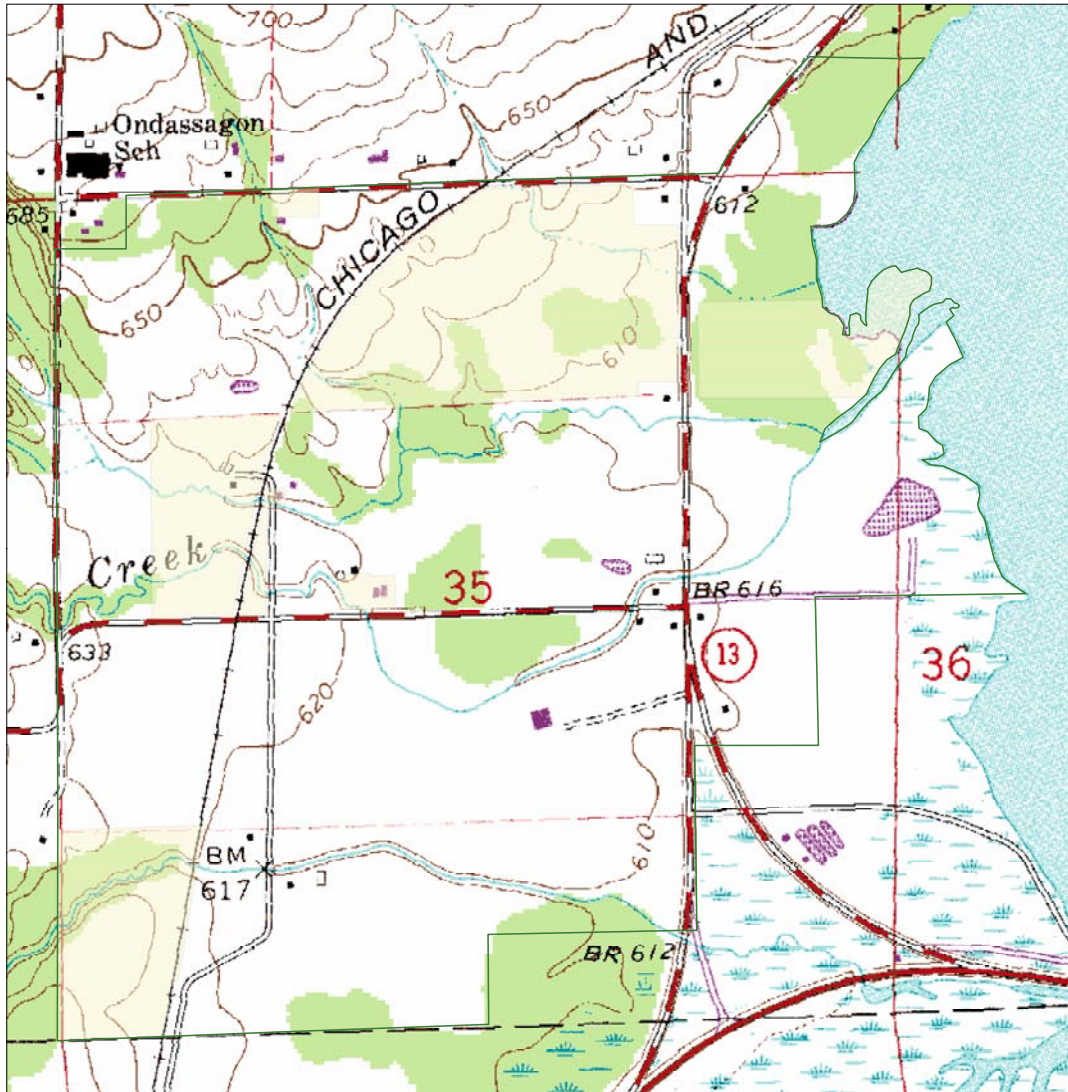
The final CD was organized into logical divisions, with two folders named data and graphics being placed within the root CD directory, along with the ArcView project file, and a text file named readme containing general information about the CD (Appendix C). The directory named data contained the boundary and land ownership files, the drg mosaic, and associated metadata files. The graphics directory contained ArcView shapefiles and a .tif image used in map creation. Four copies of this final CD were created, three of which were submitted to the USFWS. The fourth CD is kept on file at the University of Minnesota.

⁴ <http://geology.usgs.gov/tools/metadata/tools/doc/mp.html>

Whittlesey Creek National Wildlife Refuge

Bayfield County, Wisconsin

Township 48 N., Range 5 W.



Whittlesey Creek National Wildlife Refuge

May 10, 2002

Prepared by the Department of Forest Resources, College of Natural Resources,
University of Minnesota,
In cooperation with Region 3 U.S. Fish and Wildlife Service.

Legend



-  Refuge Boundary
-  USFWS Ownership



Figure 2: An example of a final refuge boundary map

Data Availability

The data created for this project are available to the public. For more information contact Mary Mitchell at U.S. Fish and Wildlife Region 3 Headquarters.⁵

The University of Minnesota is also developing a web-based application for downloading the GIS boundary data. Once the data are made available the application will be at the following web address: <http://gis.umn.edu/fws/>.

⁵ Mary Mitchell's e-mail address is: mary_s_mitchell@fws.gov. She can also be reached by phone at (612)-713-5443, or at the following mailing address:

BHW Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

Appendix A: List of USFWS Wildlife Refuges located in Region 3

State(s)	Refuge	Code	Completed on:	Sources
IA	DeSoto	DST	9/15/1999	ArcInfo .e00 files
IA	Driftless Area	DFT	3/25/2002	ArcView Shapefiles
IA	Neal Smith	WNT	5/10/2002	ArcInfo .e00 files
IA	Union Slough	UNS	1/14/2002	ArcView Shapefiles
	Upper Mississippi River			
IL	Savanna District	UMR	5/10/2002	ArcView Shapefiles
IA	McGregor District	UMR	5/10/2002	ArcView Shapefiles
MN	Winona District	UMR	5/10/2002	ArcView Shapefiles
WI	LaCrosse District	UMR	5/10/2002	ArcView Shapefiles
IL	Crab Orchard	CRO	11/8/1999	Paper maps
IL	Cypress Creek	CYC	4/10/2002	ArcView Shapefiles, Survey descriptions
IL	Illinois River			
	Chautauqua	CTQ	1/14/2002	ArcView Shapefiles
	Emiquon	EMQ	2/4/2002	ArcView Shapefiles, Survey descriptions
	Meredosia	MDA	2/4/2002	ArcView Shapefile
IA, IL	Middle Mississippi River			
	Harlow Island	MKT	4/26/2002	ArcInfo .e00 files
	Wilkinson Island	MKT	4/26/2002	ArcInfo .e00 files
	Meissner Island	MKT	4/26/2002	ArcInfo .e00 files
IL, MO	Two Rivers			
	Apple Creek WMA	TRW	9/16/2002	ArcInfo .e00, ArcView Shapefiles, Paper maps
	Batchtown	TRW	9/16/2002	ArcInfo .e00, ArcView Shapefiles, Paper maps
	Calhoun	TRW	9/16/2002	ArcInfo .e00, ArcView Shapefiles, Paper maps
	Gilbert Lake	TRW	9/16/2002	ArcInfo .e00, ArcView Shapefiles, Paper maps
	Portage Island	TRW	9/16/2002	ArcInfo .e00, ArcView Shapefiles, Paper maps
IL, MO	Great River			
	Clarence Cannon	CAN	9/17/2002	ArcInfo .e00 files
	Delair	MKT	9/17/2002	ArcInfo .e00 files
	Fox Island	MKT	2/11/2002	ArcInfo .e00 files
IN	Muscatatuck	MSC	1/14/2002	ArcView Shapefiles, Survey descriptions
IN	Patoka River	PTR	2/15/2002	Arcview Shapefiles
MI	Harbor Island	HBR	11/12/2001	Paper maps
MI	Huron	HRN	6/1/2001	Paper maps
MI	Kirtland's Warbler	KLW	5/10/2002	Survey descriptions
MI	Michigan Islands	MCH	11/12/2001	ArcInfo .e00 files, Paper maps
MI	Seney	SNY	12/15/1999	ArcInfo .e00 files
MI	Shiawassee			
	Detroit River	SHW	11/12/2001	Digital Raster Graphic (DRG)
	Grassy Island	SHW	11/12/2001	Digital Raster Graphic (DRG)

State(s)	Refuge	Code	Completed on:	Method(s)
MI	Wyandotte	WYN	1/25/2002	ArcView Shapefiles
MN	Agassiz	AGC	10/28/1999	ArcInfo .e00 files
MN	Big Stone	BGS	1/25/2002	ArcInfo .e00 files
MN	Crane Meadows	CRM	11/12/2001	ArcInfo .e00 files
MN	Hamden Slough	HAM	1/25/2002	ArcInfo .e00 files, Survey descriptions
MN	Mille Lacs	MLC	11/18/1999	Digital Raster Graphic (DRG)
MN	Minnesota Valley	MNV	3/8/2002	AutoCAD, Digital Raster Graphic (DRG)
MN	Rice Lake	RCL	11/12/2001	ArcInfo .e00 files
MN	Rydell	RDL	11/12/2001	Digital Raster Graphic (DRG)
MN	Sherburne	SHB	1/25/2002	Paper maps
MN	Tamarac	TMC	11/12/2001	ArcInfo .e00 files
MO	Big Muddy	BMD	4/5/2002	ArcInfo .e00 files
MO	Mingo	MNG	12/14/2001	AutoCAD
MO	Ozark Cavefish	OZA	11/8/1999	Digital Raster Graphic (DRG)
MO	Pilot Knob	PKB	11/3/1999	Paper maps
MO	Squaw Creek	SQC	12/15/1999	Paper maps
MO	Swan Lake	SWL	4/5/2002	ArcView Shapefiles
OH	Cedar Point	CDP	2/17/2002	Paper maps
OH	Ottawa	OTW	3/25/2002	ArcView Shapefiles, Digital Raster Graphic (DRG)
OH	West Sister Island	WTS	3/25/2002	Paper maps
WI	Fox River	FXR	11/5/1999	Paper maps
WI	Green Bay	GRB	8/14/2000	Digital Raster Graphic (DRG)
WI	Horicon	HRC	11/12/2001	Paper maps
WI	Necedah	NCD	2/17/2002	Paper maps
WI	Trempealeau	TPL	2/8/2002	ArcView Shapefiles
WI	Whittlesey Creek	WHI	3/25/2002	ArcView Shapefiles

Appendix B: Sample Boundary Data Metadata File

Identification_Information:

Citation:

Citation_Information:

Originator: U.S. Fish and Wildlife Service, Region 3, Div. of Realty (Ed.)

Publication_Date: 2002

Title: Whittlesey Creek NWR Land Ownership Status Boundary

Geospatial_Data_Presentation_Form: map

Publication_Information:

Publication_Place: Fort Snelling, MN

Publisher: U. S. Fish and Wildlife Service, Region 3

Description:

Abstract:

This geo-dataset represents the land ownership status boundary of the Whittlesey Creek National Wildlife Refuge and does not necessarily indicate that all lands within this boundary are owned by the Fish and Wildlife Service.

Purpose:

The intended application of this data is to serve as a spatial reference of refuge boundaries for resource grade applications. It is specifically not intended to be used as a land survey or representation of land for conveyance or tax purposes.

Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 20020206

Ending_Date: 20020313

Currentness_Reference: Publication Date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: None planned

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -90.9711

East_Bounding_Coordinate: -90.9486

North_Bounding_Coordinate: 46.6019

South_Bounding_Coordinate: 46.5867

Keywords:

Theme:

Theme_Keyword_Thesaurus: None

Theme_Keyword: USFWS

Theme_Keyword: federal lands

Theme_Keyword: ownership status boundary

Place:

Place_Keyword_Thesaurus: None

Place_Keyword: Whittlesey Creek NWR

Place_Keyword: Bayfield

Place_Keyword: Wisconsin

Access_Constraints: None

Use_Constraints: None

Native_Data_Set_Environment: NT ArcView 3.2, ArcInfo 8.1

Data_Quality_Information:

Logical_Consistency_Report: Not applicable.

Completeness_Report:

Complete to the extent of the USGS 7.5' Quadrangle of Ashland West

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Fish and Wildlife Service, Region 3, Div. of Realty (Comp.)

Publication_Date: 2002

Title: Whittlesey Creek NWR Digital Raster Graphic (DRG)

Publication_Information:

Publication_Place: Fort Snelling, MN

Publisher: U.S. Fish and Wildlife Service, Region 3

Source_Scale_Denominator: 24000

Type_of_Source_Media: CD-ROM

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 20020206

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: FWS1

Source_Contribution: Basemap layer of mosaiced DRGs.

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Fish and Wildlife Service, Region 3, Div. of Realty

Publication_Date: 19990000

Title: Realty Status Maps and Fee Title Legal Descriptions

Type_of_Source_Media: paper

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: Unknown

Source_Currentness_Reference: Ground Condition

Source_Citation_Abbreviation: FWS2

Source_Contribution: Boundary description

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Fish and Wildlife Service, Region 3, Div. of Realty

Publication_Date: Unpublished material

Publication_Time: Unknown

Title: Whittlesey Creek NWR Boundary

Source_Scale_Denominator: 24000

Type_of_Source_Media: disc

Source_Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: 20020206

Source_Currentness_Reference: Publication Date

Source_Citation_Abbreviation: FWS3

Source_Contribution: Shapefile boundary reference

Process_Step:

Process_Description:

The ownership shapefile was received from the USFWS with a projection parameter of UTM, NAD83, Zone 15 projection. To ensure accuracy of the boundary, the View Scale was set to

no greater than 1/5000 and checked against the DRG image.

Revisions to the ownership shapefile were added using the COGO module of ArcInfo. These new tracts were then registered to the drg mosaic. Attribute items were checked and defined to comply with USFWS standards. This process was performed by the University of Minnesota in cooperation with the USFWS.

Source_Used_Citation_Abbreviation: FWS1

Source_Used_Citation_Abbreviation: FWS2

Source_Used_Citation_Abbreviation: FWS3

Process_Date: 20021313

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: G-polygon

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator

Universal_Transverse_Mercator:

UTM_Zone_Number: 15

Transverse_Mercator:

Scale_Factor_at_Central_Meridian: .9996

Longitude_of_Central_Meridian: -093.000000

Latitude_of_Projection_Origin: +00.000000

False_Easting: 500000

False_Northing: 0

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: .01

Ordinate_Resolution: .01

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137

Denominator_of_Flattening_Ratio: 298.257222101

Entity_and_Attribute_Information:

Overview_Description:

Entity_and_Attribute_Overview:

Shape- Internal ArcView polygon designation

Area- Area of poly/region in square coverage units

Perimeter- Perimeter of poly/region in coverage units

Status- Land currently owned by USFWS (o)

Nwrname- Three letter refuge unit abbreviation

Name- USFWS Refuge name

Entity_and_Attribute_Detail_Citation: FWS1

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: U. S. Fish and Wildlife Service, Region 3

Contact_Person: Mary S. Mitchell

Contact_Position: GIS Coordinator

Contact_Address:
Address_Type: mailing and physical address
Address:
BHW Federal Building, 1 Federal
Drive
City: Fort Snelling
State_or_Province: MN
Postal_Code: 55111-4056
Contact_Voice_Telephone: 612-713-5443
Contact_Electronic_Mail_Address: mary_s_mitchell@fws.gov

Distribution_Liability:

This data set was constructed for use by Refuge staff only. The U.S. Fish and Wildlife Service (USFWS) shall not be held liable for improper or incorrect use of the data described and/or contained herein. These data are not legal documents and are not intended to be used as such. It is the responsibility of the user to use the data appropriately and consistently recognizing its limitations. The USFWS gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. It is strongly recommended that these data be acquired directly from the USFWS and not through other sources which may have changed the data. This disclaimer applies both to individual use of the data and aggregate use with other data.

Standard_Order_Process:

Digital_Form:
Digital_Transfer_Information:
Format_Name: ArcView Shapefile
File_Decompression_Technique: No compression applied
Digital_Transfer_Option:
OffLine_Option:
Offline_Media: CD-ROM
Recording_Format: ISO 9660

Fees: None

Metadata_Reference_Information:

Metadata_Date: 20020313

Metadata_Contact:

Contact_Information:

Contact_Organization_Primary:
Contact_Organization: U. S. Fish and Wildlife Service, Region 3
Contact_Person: Mary S. Mitchell
Contact_Position: GIS Coordinator
Contact_Address:
Address_Type: mailing and physical address
Address:
BHW Federal Building, 1 Federal
Drive
City: Fort Snelling
State_or_Province: MN
Postal_Code: 55111-4056
Contact_Voice_Telephone: 612-713-5443
Contact_Electronic_Mail_Address: Mary_S_Mitchell@fws.gov

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998

Appendix C: Sample *readme.txt* file found on CD distribution of boundary data

Documentation:

This CD contains GIS data for the Whittlesey Creek National Wildlife Refuge, Wisconsin.

Overall Description:

This CD contains Boundary Layers and a Basemap Layer. The various geo-referenced data exists as either shape files or Tiff image files. There are also metadata files (a detail description) of each data layer. These metadata files can be found in the Data directory as .met files, which match up with a data layer and can be opened from any text editor. All are geo-referenced to UTM Zone 15 with a DATUM of Nad83.

Data:

This directory contains ArcView Shapefiles for the Legislative boundary and Land Ownership Status boundary of the Whittlesey Creek NWR. The shapefile whileg is the Legislative boundary and the shapefile whibnd is the Land Ownership Status boundary. This directory also contains a reprojected USGS Digital Raster Graphic (DRG), metadata file and a readme file with additional information on the DRG. The TIFF image ashland_w83.tif is the DRG mosaic used for boundary verification.

Graphics:

This directory contains ArcView Shapefiles and a Tiff image used in creation of the map.