A Landscape Level Approach to Wetland Functional Assessment

Wetland Mapping & Functional Assessment

Canadian River Watershed

New Mexico

GeoSpatialServices

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Association of State Wetland Managers

November, 2012

Application of
Elements of a State Water Monitoring and Assessment Program For Wetlands

April 2006

Wetlands Division
Office of Wetlands, Oceans and Watersheds
U.S. Environmental Protection Agency

Available on the web

http://www.epa.gov/owow/wetlands/monitor/

Approach for this project based on: EPA 2006 Document: Application of Elements of a State Water Monitoring and Assessment Program For Wetlands

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Elements of a State Water Monitoring and Assessment Program For Wetlands

Goals of this document:

- provide guidelines for the implementation of a state wetland monitoring and assessment program
- align monitoring programs with the requirements of the Clean Water Act
- generate information necessary to report on condition of state wetland resources
- prioritize wetland protection, restoration and mitigation
- promote interstate consistency for wetland reporting

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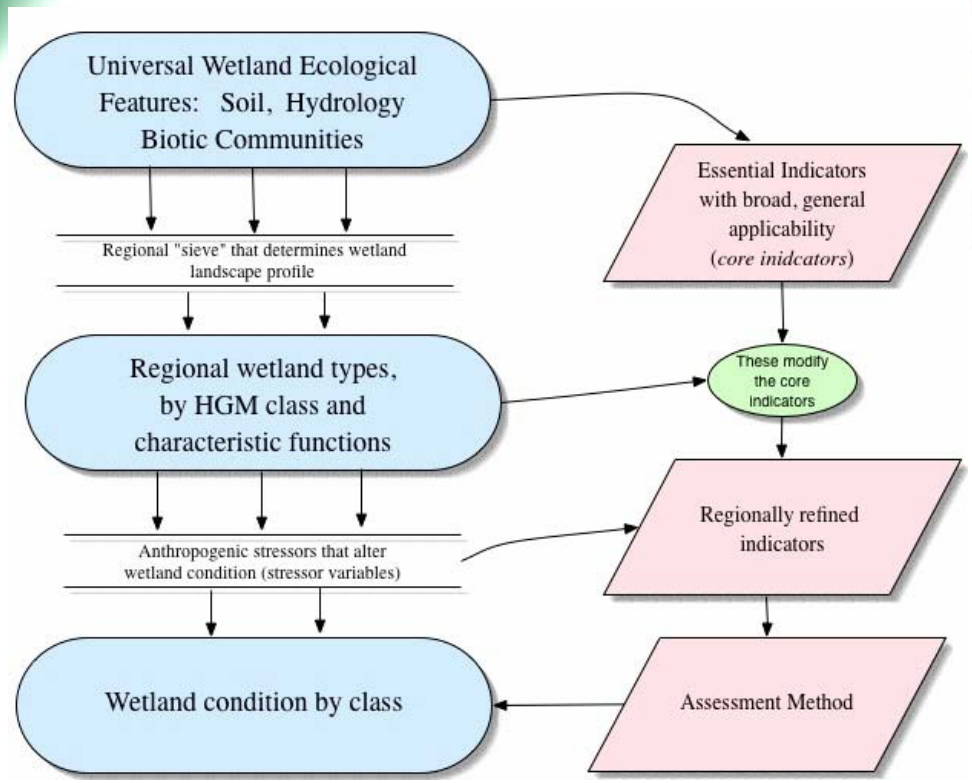
Core Indicators And Metrics



Conceptual model of state wetland assessment showing:

- ecological attributes of wetlands
- response to human disturbance

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EPA 3 Level Technical Approach

	Products/Applications
Level 1 - Landscape Assessment: Use GIS and remote sensing to gain a landscape view of watershed and wetland condition. Typical assessment indicators include wetland coverage (NWI), land use and land cover	•Targeting restoration and monitoring •Landscape condition assessment •Status and trends •Integrated reporting CWA 305(b)/303(d)
Level 2 – Rapid Wetland Assessment: Evaluate the general condition of individual wetlands using relatively simple field indicators. Assessment is often based on the characterization of stressors know to limit wetland functions e.g., road crossings, tile drainage, ditching.	•401/404 permit decisions •Integrated reporting •Watershed planning •Implementation monitoring of restoration projects, including nonpoint source BMPs, and Farm Bill programs
Level 3 – Intensive Site Assessment Produce quantitative data with known certainty of wetland condition within an assessment area, used to refine rapid wetland assessment methods and diagnose the causes of wetland degradation. Assessment is typically accomplished using indices of biological integrity or hydrogeomorphic function.	•WQS development, including use designation • Integrated reporting •Compensatory mitigation performance standards •Verify levels 1 and 2 methods

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Level 1 - Landscape Level Wetland Mapping & Assessment

Project Objectives:

Use remote sensing, image interpretation techniques, collateral GIS data, and best professional judgment to:

- Map or update the wetland landscape profile of a project study area (soil, hydrology, vegetation)

- Extend traditional wetland mapping to include “interpretable” hydrogeomorphic and other metrics

- Correlate wetland types and characteristics to wetland function on the landscape

- map and document additional wetland characteristics to provide continuity between Level 1, 2 and 3.

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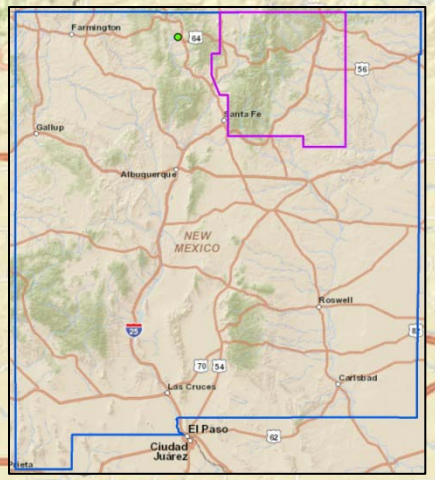
New Mexico NWI Update
Final Project Quads



Legend

- Additional Quads
- Original Project Quads
- Canadian River Watershed
- Upper Pecos Quads

Northeastern New Mexico
Study Area Description

- Watersheds (HUC 8): Upper Canadian, Upper Rio Grande, Upper Pecos Rivers
- Total Area: 9100 sq. miles or 5.7 M acres
- Counties: Colfax, Mora, San Miguel, Taos, Rio Arriba and Santa Fe
- Previous Wetland Mapping: None, limited site specific NWI
- Major Ecoregions: Montane forests, foothill shrub lands, tableland shrub and grasslands, high plains

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Major Steps of Project

- Map and classify present-day wetlands:
  - NWI Cowardin classification
  - FGDC National Wetland Mapping Std
  - Map and classify adjacent riparian areas
  - project imagery 2009 NAIP
  - numerous collateral data layers

- Add hydrogeomorphic characteristics to wetlands:
  - LLWW interpretation and classification

- Develop functional correlation table:
  - utilize local wetland professionals – “bpj”
  - establish wetland functions to be assessed
  - correlate wetland descriptors to functions

- Link to Rapid Assessment Methods
  - collect additional data, tie to HGM

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Mapping and Classification Systems

- National Wetland Inventory (NWI)

  Cowardin (1976)

- System for Mapping Western Riparian Areas

  Dick/USFWS (2009)

- Landscape Position, Landform, Waterbody Type, Water Flow Path (LLWW)

  Tiner (2011)

- Potentially Restorable Wetlands Mapping

  SMUMN (2012)

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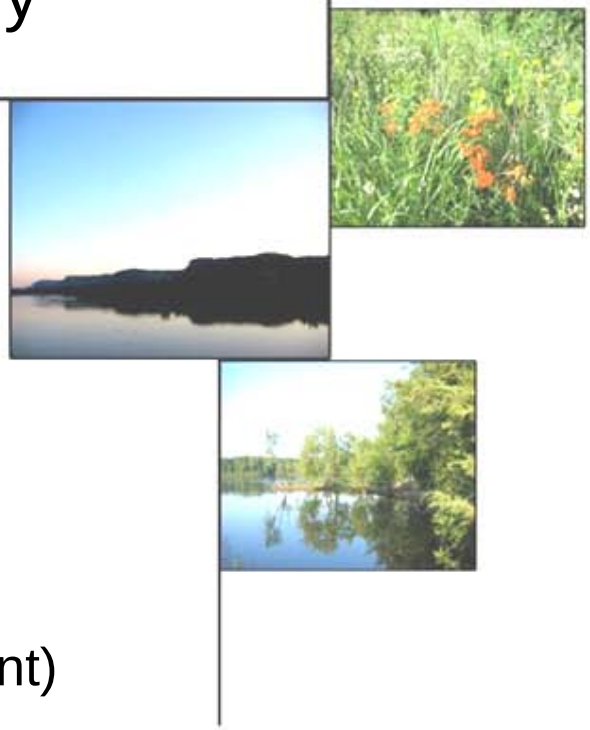
National Wetland Inventory



- Based on Cowardin (1976) and endorsed by 2009 FGDC Federal Wetland Mapping Standard
- Dominant Life Forms (e.g. forested, emergent)
- Subclasses (e.g. Persistent, Non-persistent)
- Water Regimes (generally, e.g. Wet Soil Palustrine)
- Special Modifiers (certain, e.g. farmed, beaver, excavated etc.)

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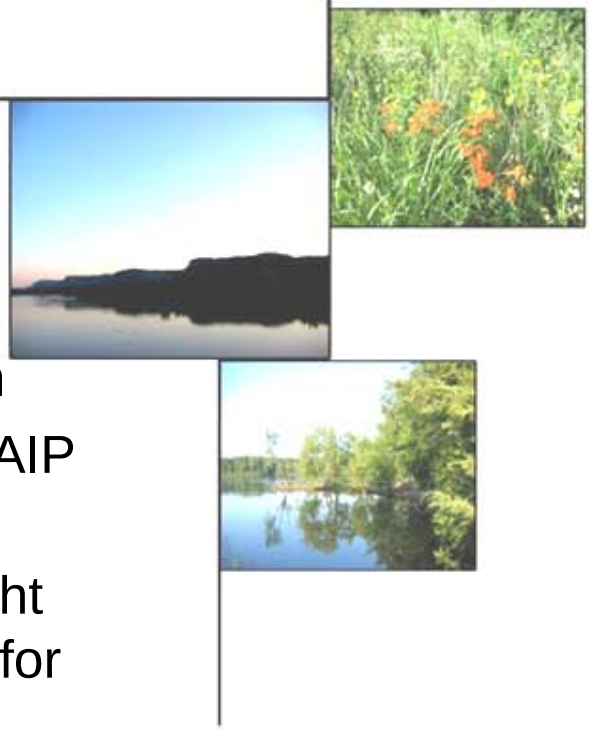
NM Project Imagery and Collateral Data



Interpretation Challenges

- Limited resources for image acquisition
- Chose to move forward with existing NAIP imagery
- True color, mid summer, leaf on, drought conditions. Not an ideal image source for wetland interpretation
- Ideally would have been spring, leaf off, normal precipitation color infra-red
- Forced reliance on collateral data

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Maxwell Wildlife Refuge
2009 NAIP

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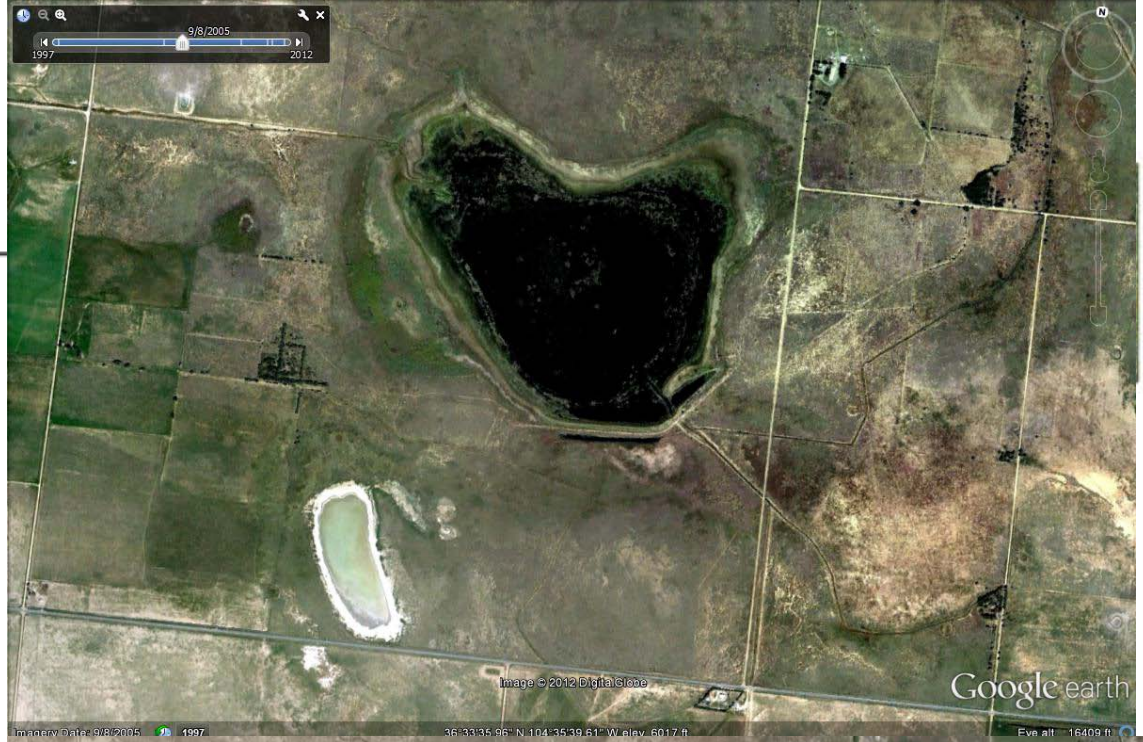
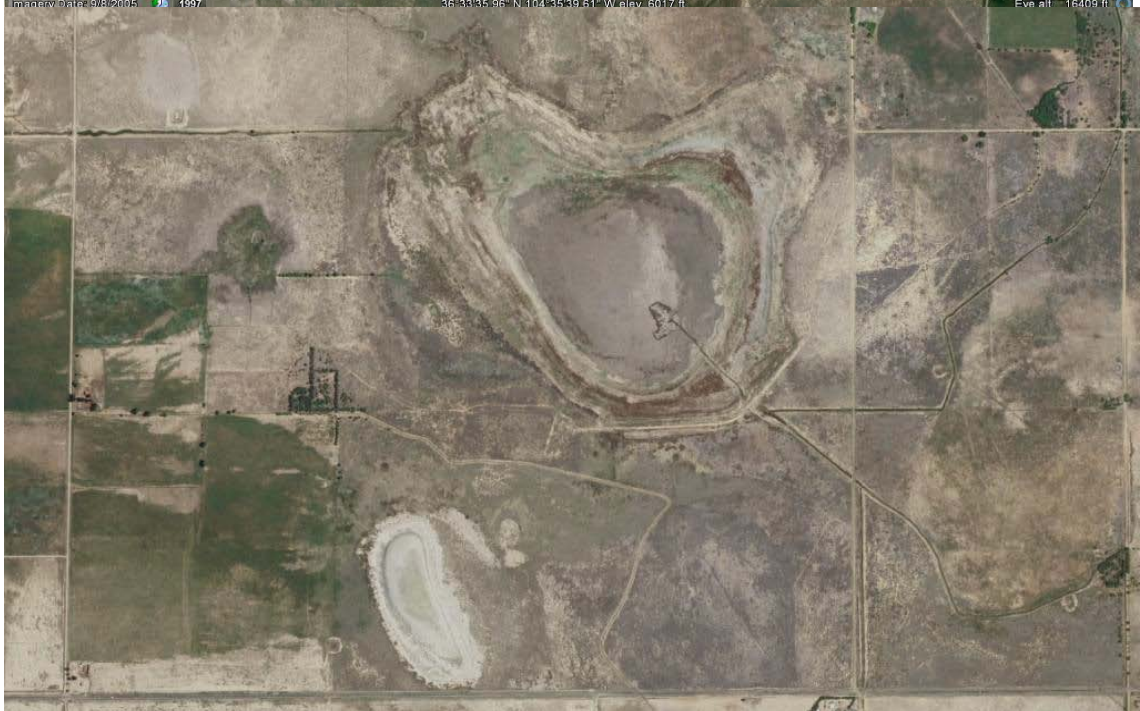
Maxwell Wildlife Refuge
2005 NAIP

Maxwell Wildlife Refuge 2005 – 2009 Imagery





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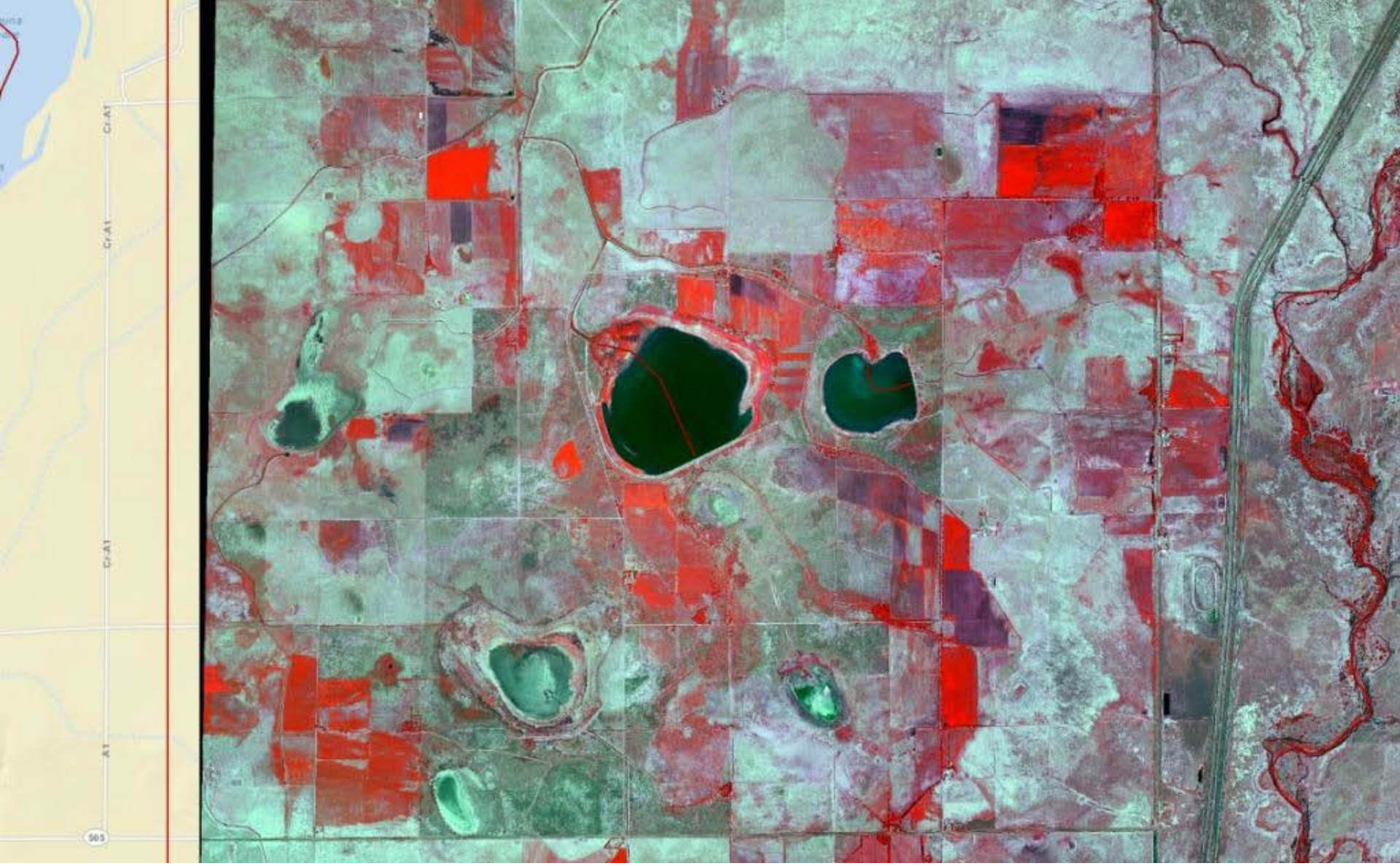

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Maxwell Wildlife Refuge
2009 NAIP CIR

NM Collateral Data Sources

- USGS 1:24,000 DRG
- USGS NHD streams and waterbodies
- NRCS SURRGO Soils Data
- NAIP Imagery 2001, 2005, 2009 CIR
- Google Earth imagery time slider tool
- SWQB Stream Data (cold water, warm water, fish species)
- USGS 30m and 10m National Elevation Dataset
- USFS Springs and Seeps database

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NM Pre and Post Mapping
Field Validation

Validation of image signatures

Confirmation of landscape position and other hydrogeomorphic metrics

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Final NWI Delineation

Riparian Mapping System

- **System** is a single unit category - riparian vegetation (Rp).
- **Subsystem** defines two categories reflecting the water source for the riparian area - lotic (1) and lentic (2).
- **Class** describes the dominant life form of riparian vegetation. Classes are: forested (FO), scrub/shrub (SS), and emergent (EM)
- **Subclass** further describes the Class as either dead (5), deciduous (6), evergreen (7), or mixed deciduous/evergreen (8).
- **Dominance Type** refers to vegetative species within the mapping unit, e.g. cottonwood (CW).
- **Rp1FO6CW** is interpreted as:

System:	**Rp** - Riparian
Subsystem:	**1** - Lotic
Class:	**FO -** Forested
Subclass:	**6 -** Deciduous
Dominance:	**CW -** Cottonwood

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LLWW

Based on Tiner (2011)*

Landscape Position - relationship between a wetland and an adjacent waterbody or not

Landform - shape or physical form (island, basin, floodplain, etc.)

Water Flow Path - directional flow of water (outflow, inflow, isolated, etc.)

Water Body Type – lake, pond, river, stream

*derived from HGM hydrogeomorphic classification (Brinson 1993)

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Landscape Position

(LLWW continued)

Lotic – in or along rivers and streams and in floodplains

Lentic – in or along lakes

Terrene – completely surrounded by upland or nearly so; not flooded by river or streams

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Lentic

(LLWW continued)

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Lotic

(LLWW continued)

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Terrene

(LLWW continued)

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Landforms
(LLWW continued)

- Slope
- Island
- Fringe
- Floodplain (basin, flat)
- Interfluve (basin, flat)
- Basin
- Flat

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Basin (BA)Landform

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Flats (FL) Landform

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Slope (SL) Landform

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Floodplain (FL) Landform

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Water Flow Paths

- Bidirectional (BI)
- Inflow (IN)
- Isolated (IS)
- Throughflow (TH)
- Outflow (OU)

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Bidirectional (BI) Waterflow Path

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Inflow (IN)
Waterflow Path

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Isolated (IS)
Waterflow Path

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Outflow (OU)
Waterflow Path

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Throughflow (TH)
Waterflow Path

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Waterbody Types

River (RV)

- low, middle, high gradient
- dammed

Stream (ST)

- low, middle, high gradient
- artificial

Lake (RV)

- natural
- dammed

Pond (PD)

- natural, dammed, excavated, beaver, other artificial

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LLWW Interpretation and Coding

During NWI mapping also consider and add LLWW codes:

Example (next slides, highlighted polygon):

NWI: **PSS5C**

Paulustrine, scrub shrub - dead, seasonally flooded)

LLWW: **LS1BATHhw**

Lotic Stream low gradient, Basin, Through-flow, headwaters

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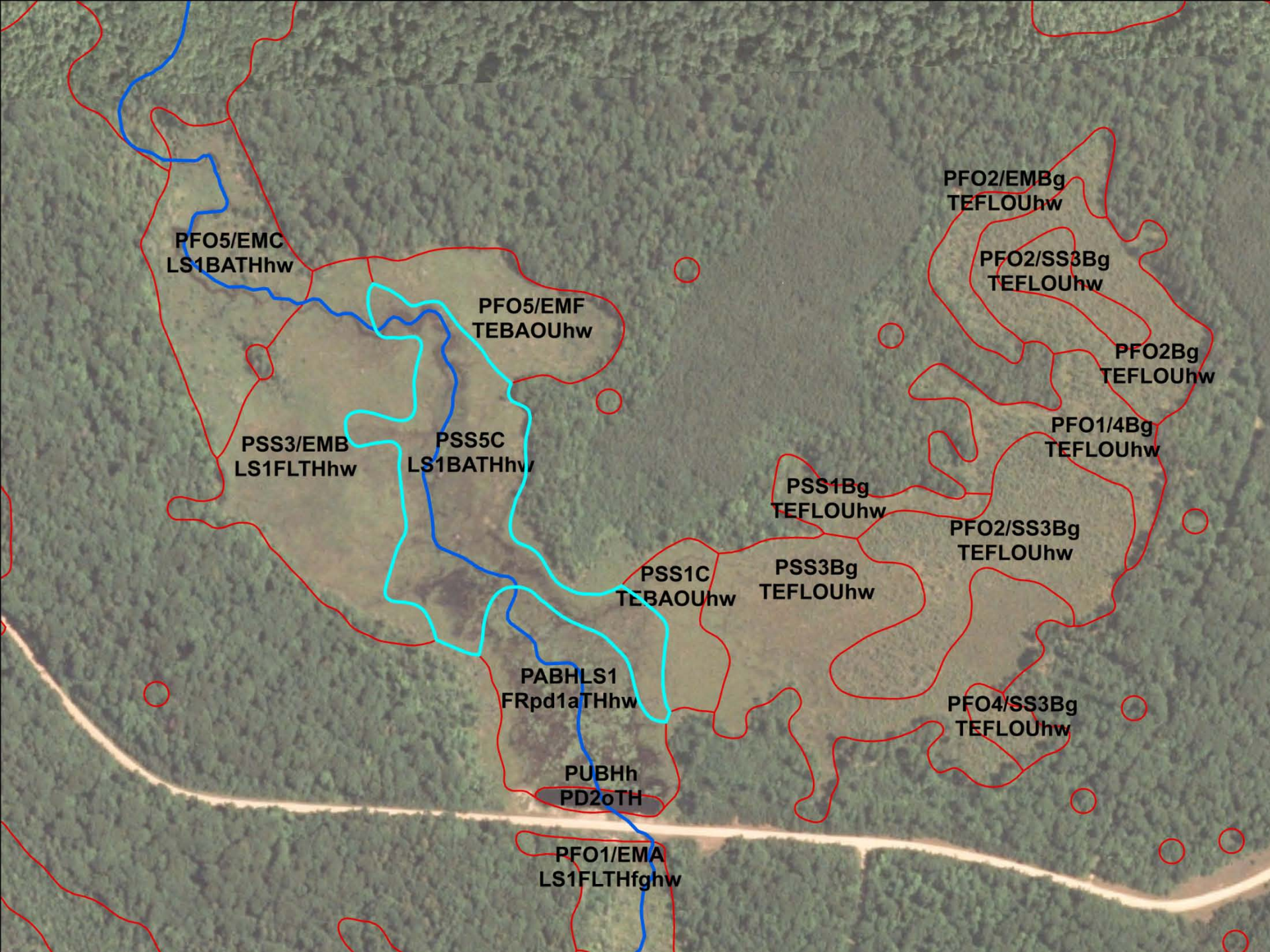
PFO2/EMBg
TEFLOUhw
PFO5/EMC
LS1BATHhw
PFO2/SS3Bg
TEFLOUhw
PFO5/EMF
TEBAOUhw
PFO2Bg
TEFLOUhw
PFO1/4Bg
TEFLOUhw
PSS3/EMB
LS1FLTHhw
PSS5C
LS1BATHhw
PSS1Bg
TEFLOUhw
PFO2/SS3Bg
TEFLOUhw
PSS1C
TEBAOUhw
PSS3Bg
TEFLOUhw
PABHLS1
FRpd1aTHhw
PFO4/SS3Bg
TEFLOUhw
PUBHh
PD2oTH
PFO1/EMA
LS1FLTHfghw

Functional Correlation Exercise

Project steering committee (NMED, NM HP, Corps, FWS, stakeholders) identified wetland functions for assessment :

- Surface Water Detention
- Streamflow Maintenance
- Shoreline Stabilization
- Nutrient Transformation
- Carbon Sequestration
- Sediment Retention
- Groundwater Recharge
- Wildlife Habitat
- Fish Habitat
- Water bird and Waterfowl Habitat

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Functional Correlation

What function does each wetland perform and how well?

- Each wetland polygon ranked high or moderate based on NWI type and LLWW characteristics
- Correlation tables from a variety of other projects used as a starting point

  Tiner (2003), Fizzell (2011), Miller et al. (2012), Richtman (2012)

- Steering committee assessed and modified these tables using Best Professional Judgment and local knowledge

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Functional Correlation

- Wetland polygons are assigned to functional categories using a series of SQL queries
- Spatial queries are used to make assignments based on adjacency and proximity
- Collateral data layers (e.g. cold water streams, bedrock geology) also support function assignments
- Separate geodatabases are produced for each function
- Functional assignments and map products are reviewed with Steering Committee and in the field

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Streamflow Maintenance

Highly Functional

- All headwater wetlands
- Vegetated wetlands along streams, rivers, lakes
- Terrene pond wetlands with through or outflow
- All wetlands with organic soil adjacent to 3rd order or higher streams

Moderately Functional

- Terrene basin isolated or outflow vegetated wetlands
- All wetlands with mineral soil adjacent to 3rd order or higher streams
- Other wetlands adjacent to lakes not already included in High

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Surface Water Maintenance (SWM)

LEVEL	WETLAND CODES											NOTES
	LLWW							NWI				
	Land-scape Posi-tion	CON	Water body	Land form	Water-flow Path	Sp. Mod.	CON	System	Class	Water Regime	Sp. Mod.	
High	#			#	#	hw						all headwater wetlands
			PD		TH							
			LK		OU							
	LE				TH							
					OU							
	#	*adj.*	RV									all wetlands and wetland complexes adjacent to lakes, rivers, and streams
			ST									
	LS		#	#	#		*adj.**	#	#	*not* B	g	*all wetlands adjacent to third order streams (LS)or higher (downstream in the watershed) with organic soils (g)
	TE				TH	pd						
					OU	pd						
Moderate	LE	*adj.**	LK	#	TH							*lentic wetlands adjacent to lakes
	LR1			FP	#							
	LS			BA	#							
	TE			#	TH							natural and partially drained terrene wetlands
	TE				IS	pd						
					IN	pd						
	TE	*adj.**		FL	OU		*AND*	P	#	B	#	*all saturated wetlands adjacent to third order streams (LS)or higher (downstream in the watershed)
			PD		IS							
			LK		IN							
	LE				BI							

St. Croix Headwaters Watershed
Surface Water Detention (SWD)

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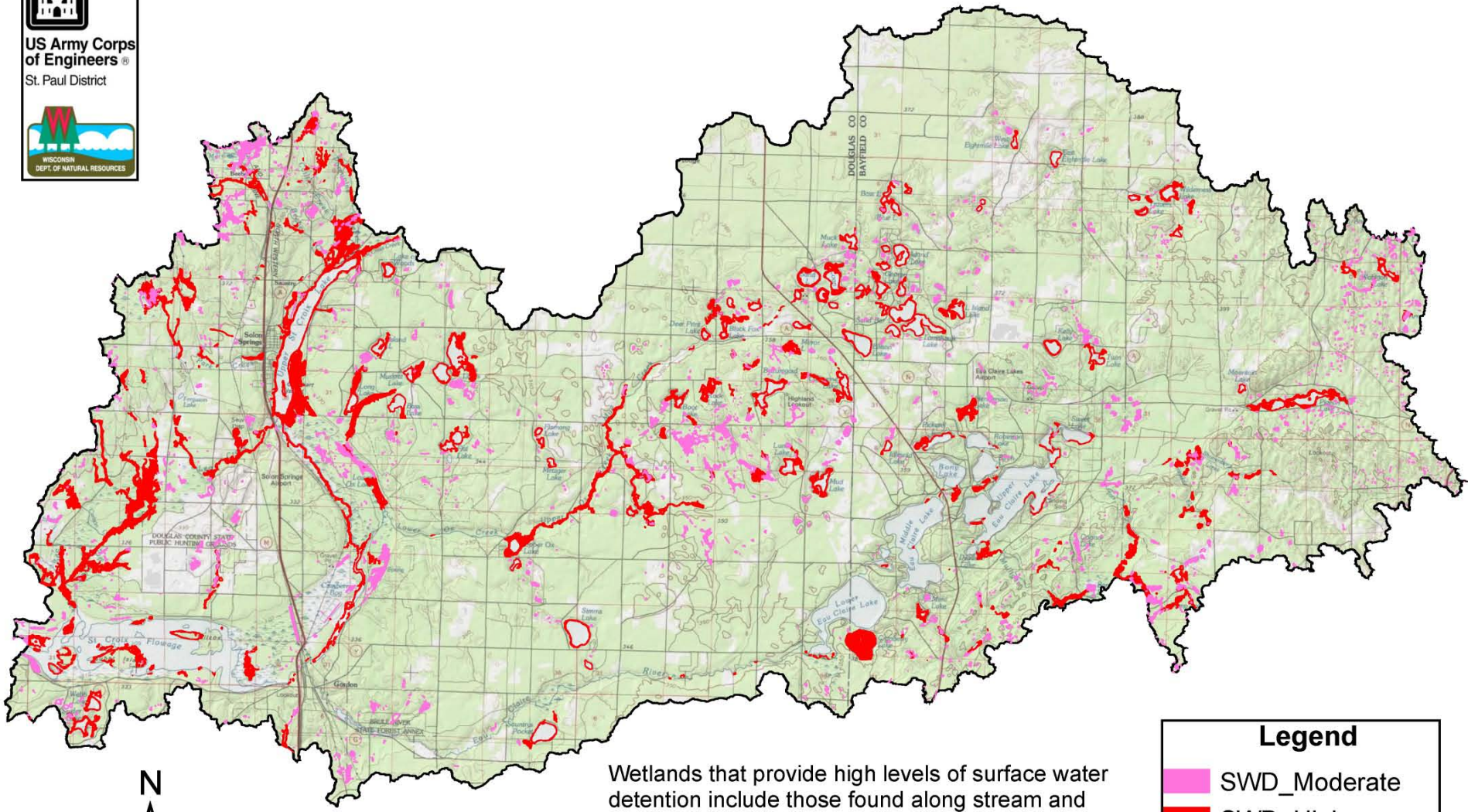
US Army Corps of Engineers ®
St. Paul District

Wisconsin Dept. of Natural Resources



N

0 1.25 2.5 5 7.5 10 Miles

Wetlands that provide high levels of surface water detention include those found along stream and river floodplains, in lakebasins and fringes and islands. Terrene wetlands with throughflow are also included. Moderate SWD is found in vegetated wetlands and ponds with isolated or outflow water path.

Legend

- SWD_Moderate
- SWD_High
- StCroix_Watershed

Wetland Functional Summary - 2009
Saint Croix Headwaters Watershed

Wetland Function	Acreage	% of Watershed Acreage	% of Total Wetland Acreage in Watershed
General			
Total Area of Watershed	215,508.3	--	--
Upland	177,718.5	82.5%	--
Wetland	37,789.8	17.5%	--
Surface Water Detention (SWD)			
High	18,284.3	8.5%	48.4%
Moderate	14,315.7	6.6%	37.9%
Function Total	32,600.0	15.1%	86.3%
Surface Water Maintenance (SWM)			
High	27,133.4	12.6%	71.8%
Moderate	4,918.2	2.3%	13.0%
Function Total	32,051.6	14.9%	84.8%
Nutrient Transformation (NT)			
High	18,137.8	8.4%	48.0%
Moderate	6,693.7	3.1%	17.7%
Function Total	24,831.5	11.5%	65.7%
Sediment Retention (SR)			
High	14,222.4	6.6%	37.6%
Moderate	4,659.5	2.2%	12.3%
Function Total	18,881.9	8.8%	50.0%
Carbon Sequestration (CAR)			
High	4,839.3	2.2%	12.8%
Moderate	32,950.5	15.3%	87.2%
Function Total	37,789.8	17.5%	100.0%
Shoreline Stabilization (SS)			
High	7,852.4	3.6%	20.8%
Moderate	3,552.2	1.6%	9.4%
Function Total	11,404.6	5.3%	30.2%

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Extending Level 1 Mapping and Characterizations

- Map or model potentially restorable wetlands
  - use terrain models (basins, flow network, TWI etc.)
  - use hydric soil components from SSURGO
  - subtract existing wetlands and non-compatible land uses
  - orthorectify and classify historic aerial imagery
- Identify/describe reference wetlands of various types
- Record adjacent upland land uses and buffers
  - coded to wetland geodatabase database by type and presence
  - infiltration, runoff, erosion, sedimentation, nutrients, pollutants
- Add vegetation species, soils etc. where interpretable
- Crosswalk LLWW to regional HGM sub-classes for RAM

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Wetland Functional Summary - 1948, 1992, 2009
Western Portion of Saint Croix Headwaters Watershed

Wetland Function	1948		1992		2009		Change 1948 to 2009		Change 1992 to 2009	
	Acreage	% of Study Area	Acreage	% of Study Area	Acreage	% of Study Area	Change in Acreage	% Change in Acreage	Change in Acreage	% Change in Acreage
Surface Water Detention (SWD)										
High	11,742.5	20.0%	13,195.1	22.5%	9,063.6	15.4%	-2,678.9	-22.8%	-4,131.5	-31.3%
Moderate	3,971.3	6.8%	4,392.8	7.5%	8,666.1	14.7%	4,694.8	118.2%	4,273.3	97.3%
Total	15,713.8	26.7%	17,588.0	29.9%	17,729.8	30.2%	2,016.0	12.8%	141.8	0.8%
Surface Water Maintenance (SWM)										
High	19,965.9	34.0%	19,975.5	34.0%	18,183.5	30.9%	-1,782.5	-8.9%	-1,792.1	-9.0%
Moderate	984.2	1.7%	897.8	1.5%	1,910.4	3.3%	926.2	94.1%	1,012.6	112.8%
Total	20,950.1	35.7%	20,873.3	35.5%	20,093.9	34.2%	-856.2	-4.1%	-779.5	-3.7%
Nutrient Transformation (NT)										
High	11,828.1	20.1%	10,139.2	17.3%	10,943.5	18.6%	-884.6	-7.5%	804.3	7.9%
Moderate	4,952.1	8.4%	4,933.0	8.4%	5,130.3	8.7%	178.2	3.6%	197.2	4.0%
Total	16,780.1	28.6%	15,072.2	25.7%	16,073.7	27.4%	-706.4	-4.2%	1,001.5	6.6%
Sediment Retention (SR)										
High	5,627.7	9.6%	5,326.3	9.1%	5,184.3	8.8%	-443.4	-7.9%	-142.0	-2.7%
Moderate	375.9	0.6%	1,707.1	2.9%	1,665.6	2.8%	1,289.8	343.1%	-41.4	-2.4%
Total	6,003.6	10.2%	7,033.4	12.0%	6,850.0	11.7%	846.4	14.1%	-183.4	-2.6%
Carbon Sequestration (CAR)										
High	2,360.4	4.0%	2,593.9	4.4%	2,831.7	4.8%	471.3	20.0%	237.8	9.2%
Moderate	19,175.3	32.6%	18,897.1	32.2%	18,747.9	31.9%	-427.4	-2.2%	-149.1	-0.8%
Total	21,535.7	36.7%	21,491.0	36.6%	21,579.6	36.7%	43.9	0.2%	88.6	0.4%

Questions?

Andy Robertson
Project Manager
GeoSpatial Services
Saint Mary's University of Minnesota

aroberts@smumn.edu
507-450-5598

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