MINNESOTA NWI UPDATE

Steve Kloiber
Wetland Monitoring Coordinator
Minnesota Department of Natural Resources

Minnesota
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Outline

- Project Background / Status
- Quality Assurance Procedures / Plan
- Quality Control – Data Validation

State Strategy

- Update the National Wetland Inventory in MN
- Status and Trends program for quantity & quality
- On-line permitting and restoration database

Why do we need an NWI update?

Some things have changed.

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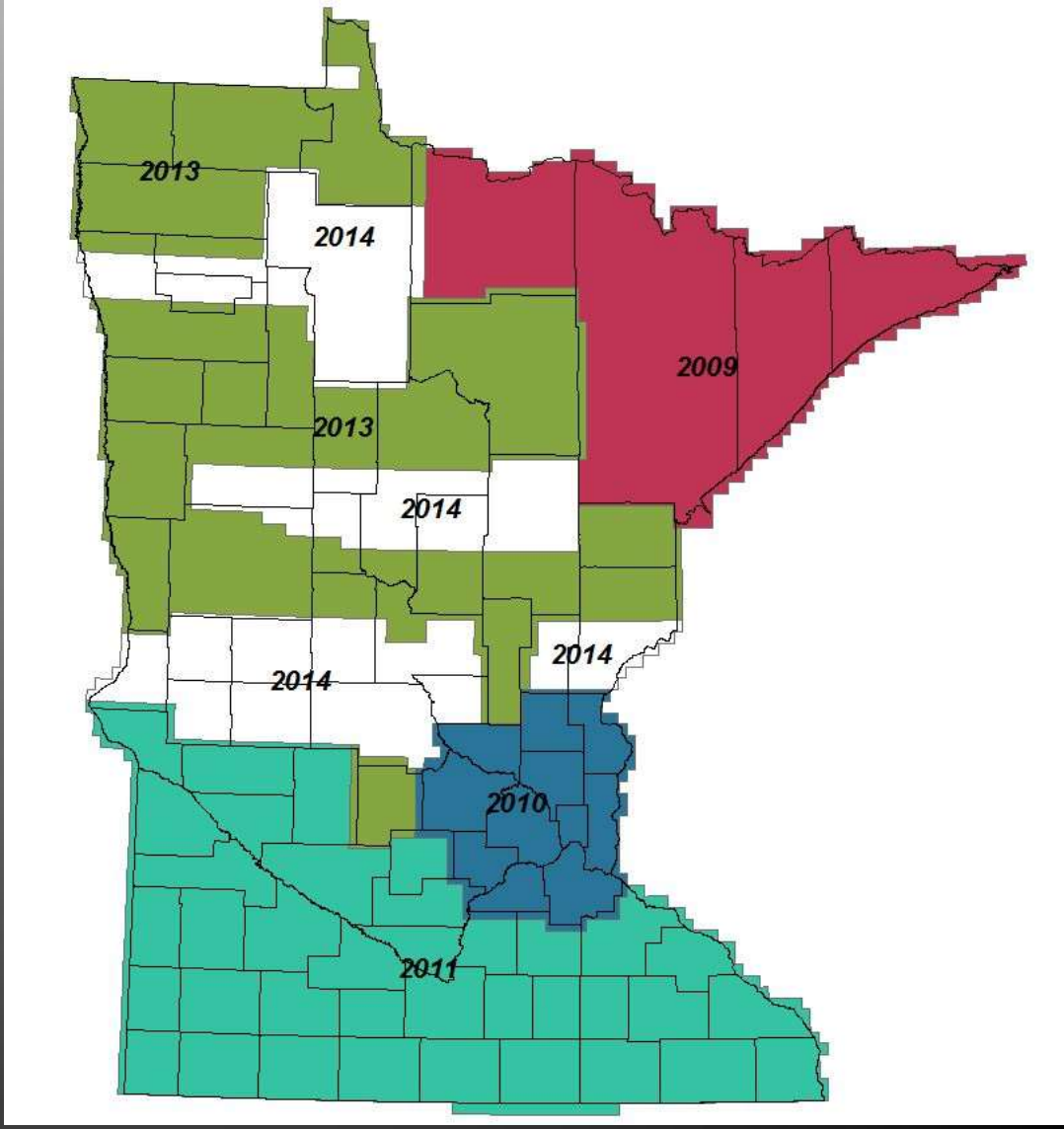
Some things have changed.

Spring Imagery Acquisition

Conducted in Geographically Defined Phases

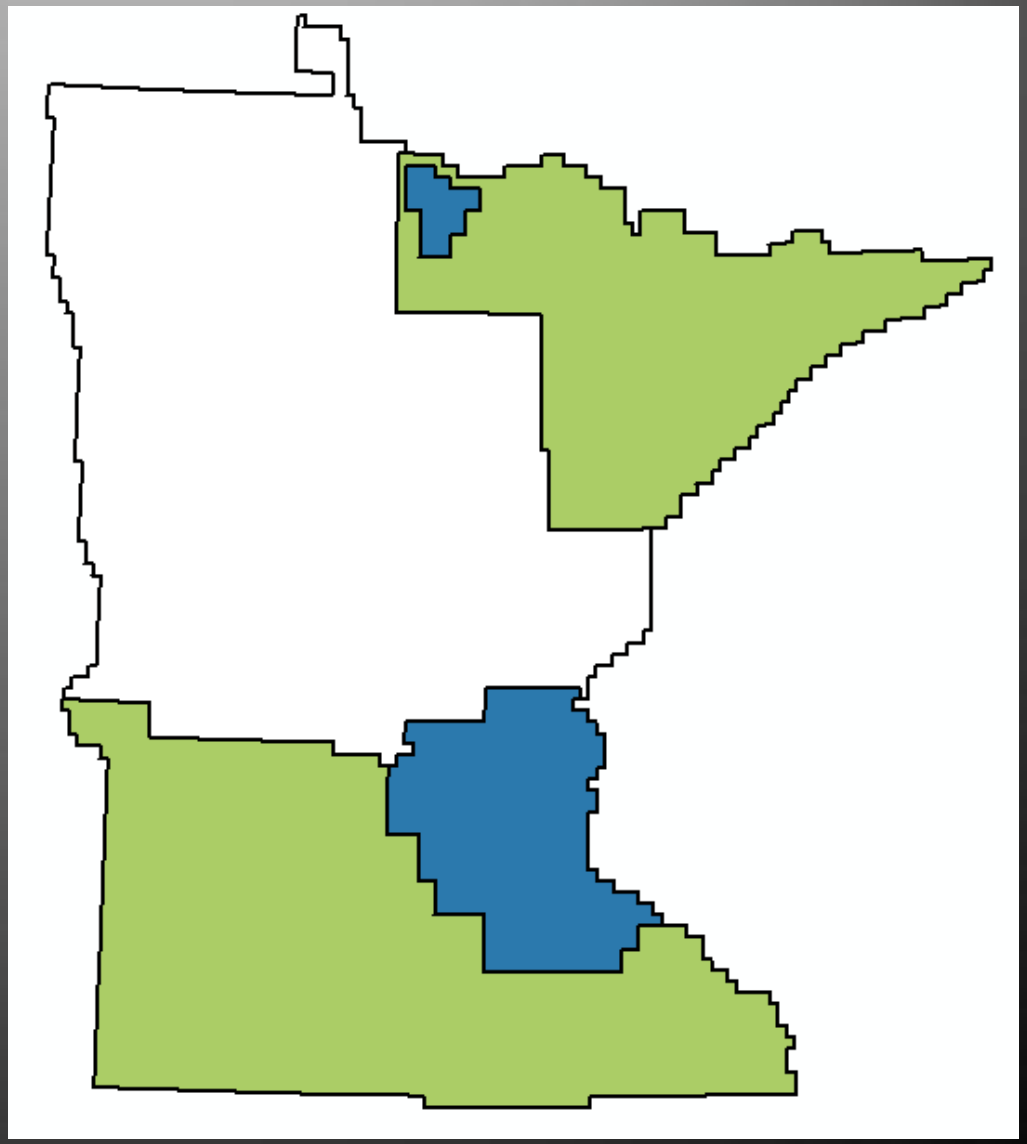
- 0.5-meter or 1-foot resolution
- Percent complete = 82%
- Percent pending = 18%



Wetland Mapping

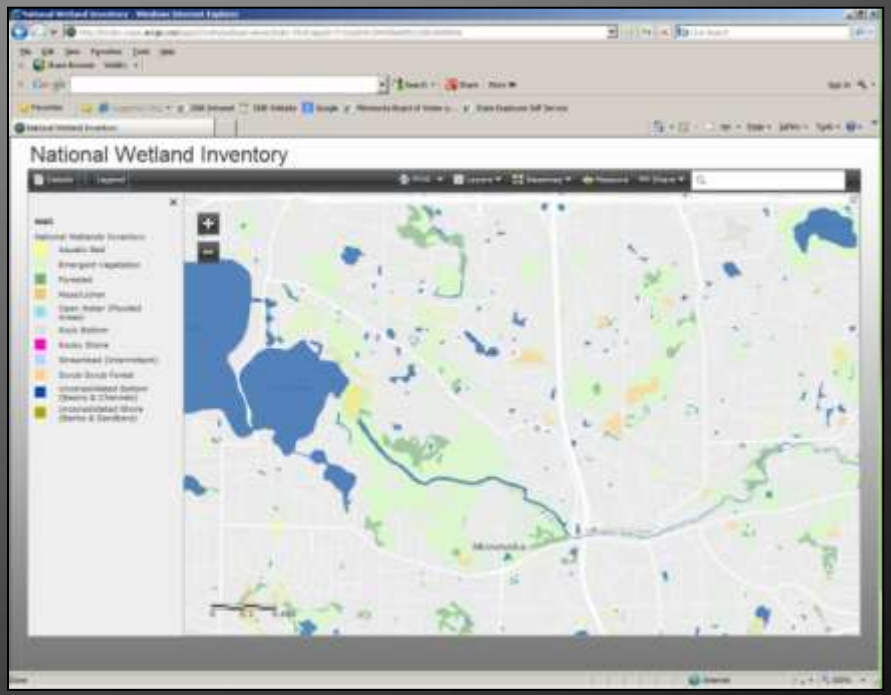
Conducted in Geographically Defined Phases

- Complete = 9%
- In-progress = 46%
- Pending = 45%



Project Schedule & Data Access

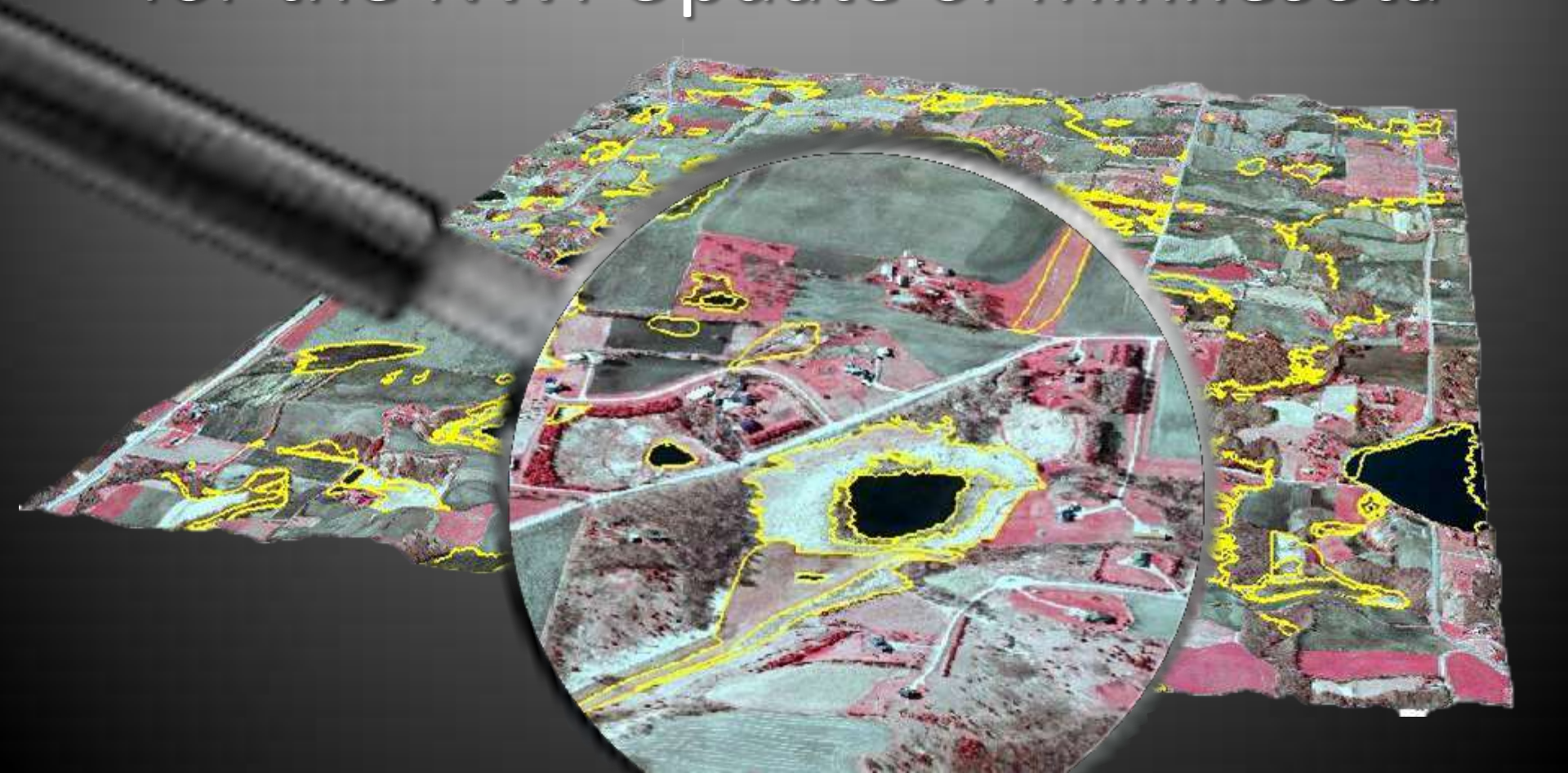
- Completion: 2019 (depending)
- Download from DNR Data Deli
- Also download through USFWS
- Online viewing at:



http://www.dnr.state.mn.us/eco/wetlands/map.html

QUALITY CONTROL

for the NWI Update of Minnesota



Definitions

- QA focuses on process improvement to prevent errors
- QC focuses on identifying errors in the finished product

QA/QC Plan

- Blueprint to ensure data are fit for purpose
- Document data quality objectives
- Describes systematic monitoring process

Define Data Quality Objectives

- Review problems with related datasets
- Review available standards and literature
- Specific objectives vary depending end user needs

Data Quality Objective Categories

- Precision/reproducibility (positional & attribute)
- Accuracy (positional & attribute)
- Resolution (scale, level of detail, MMU, etc.)
- Consistency (logical & topology)
- Completeness

Incorporating Requirements / DQOs

Requirements / Objectives

↓

Request for Proposals

↓

Contract Requirements

1.2. Project Requirements

Cowardin Classification

Wetlands will be mapped and classified according to Cowardin et al. (1979) including the system, subsystem, class, sub-class, water regime, and special modifiers.

Simplified Plant Community Classification

The NWI update will also include an additional set of attributes to describe the wetland plant community type based on a modified version of the Eggers and Reed classification system developed by the Minnesota DNR.

Simplified Hydro-Geomorphic Classification

The NWI update will also include an additional set of attributes to describe the hydro-geomorphic setting of wetlands based on a modified version of Tiner's LLWW system developed by the Minnesota DNR.

Target Mapping Unit

Wetlands >½-acre in area are subject to accuracy assessment requirements defined herein; however wetlands smaller than ½-acre that are visible at 1:6000-scale will also be mapped.

Classification Accuracy

The final wetland data will meet the classification accuracy goals including a producer's accuracy ≥98% for wetland features (>½-acre) that are visible on the imagery and an overall classification accuracy ≥85% for the Cowardin class level. In addition, the final wetland maps will have a user's accuracy ≥92% for wetland features. Evaluation of this goal will be conducted by the DNR using a validation dataset developed by the DNR Division of Ecological and Water Resources.

Horizontal Accuracy

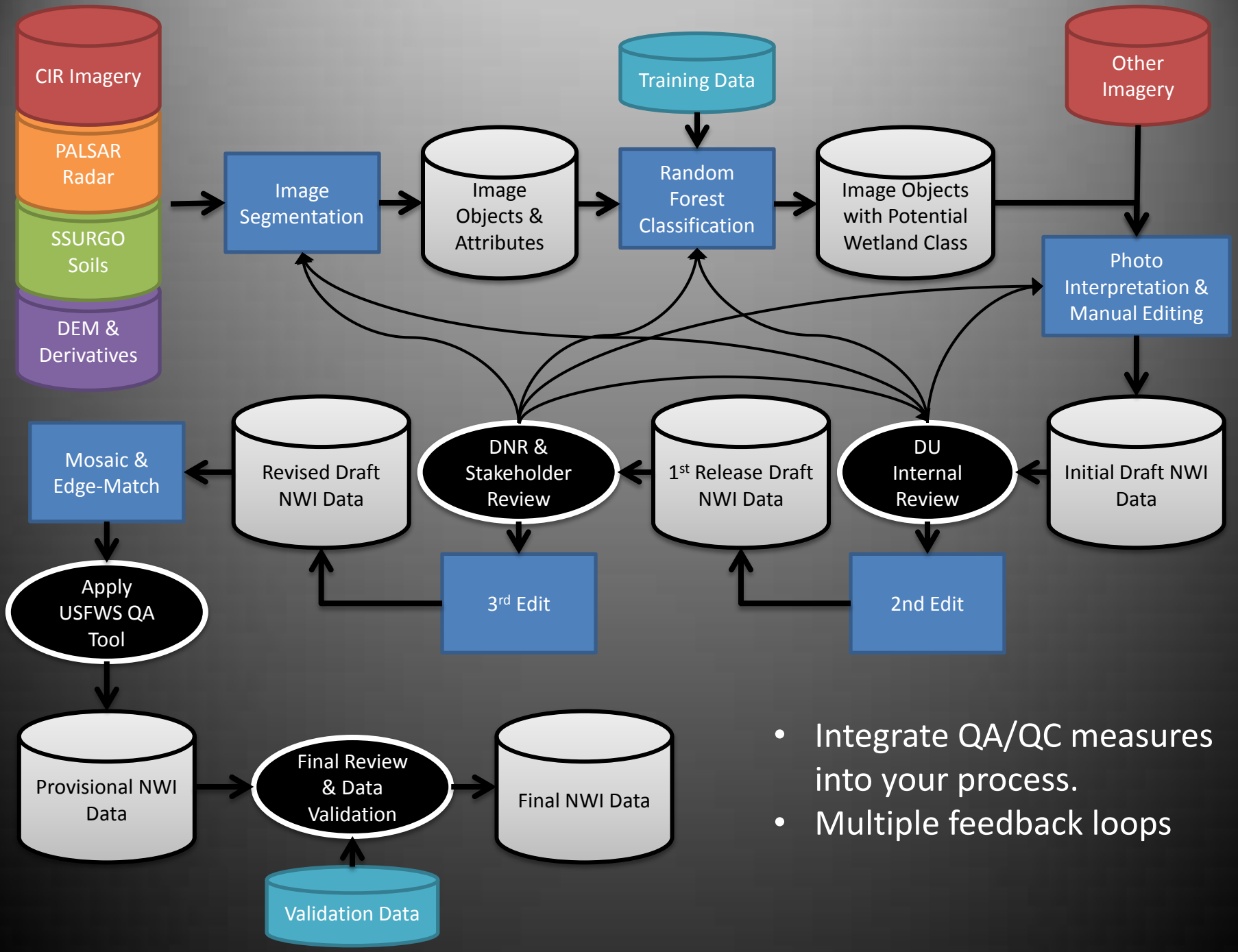
Wetland boundaries will be coincident with the base imagery. This means that 95% of well-defined boundaries (e.g. water-land boundaries) will occur within 20 feet of the boundary position on the base imagery.

Data Verification

The data must be logically consistent and topologically complete. The data must be complete polygons with no overlaps and no gaps between adjacent polygons. The final data must be edge-matched across tile boundaries into a seamless coverage. Whenever practical, boundaries should be edge-matched to data for areas adjacent to the project area. Wetland classification attributes will be checked to ensure that only valid attributes are used.

Metadata Information

Metadata for this project will meet the requirements of the Minnesota Geographic Metadata Guidelines. Metadata information will include a tested classification accuracy statement, an error matrix, a full description of the data lineage, and spatial reference information (http://www.lmic.state.mn.us/chouse/meta.html).


CIR Imagery
PALSAR Radar
SSURGO Soils
DEM & Derivatives
Image Segmentation
Image Objects & Attributes
Training Data
Random Forest Classification
Image Objects with Potential Wetland Class
Other Imagery
Photo Interpretation & Manual Editing
Initial Draft NWI Data
DU Internal Review
2nd Edit
1st Release Draft NWI Data
DNR & Stakeholder Review
3rd Edit
Revised Draft NWI Data
Mosaic & Edge-Match
Apply USFWS QA Tool
Provisional NWI Data
Final Review & Data Validation
Validation Data
Final NWI Data
Integrate QA/QC measures into your process.
Multiple feedback loops

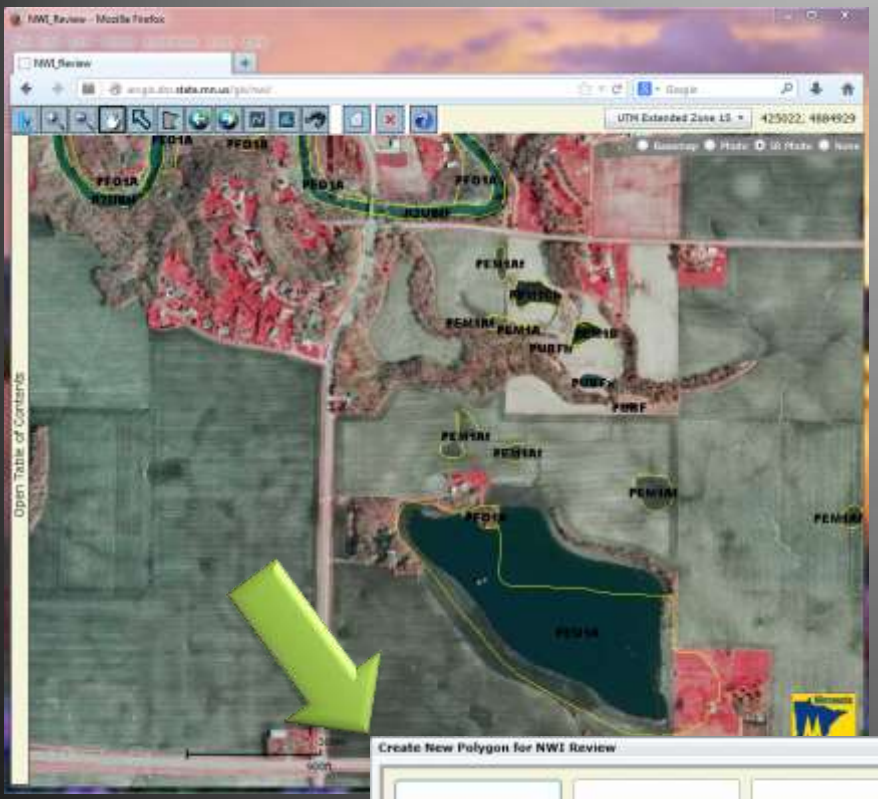
Desktop Feedback Loop

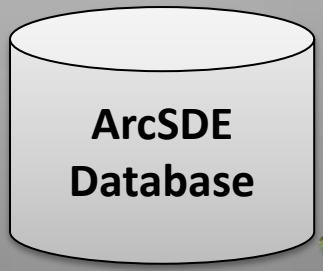
- Wetlands from DOQQ process are compared to stereo imagery
- Stereo visualization can improve interpretation
  - Sharper images
  - More precise locations

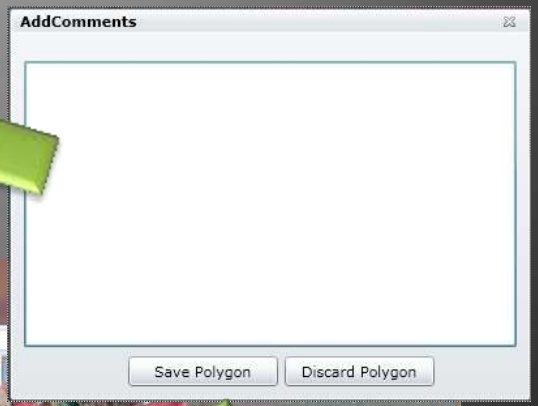
Field Feedback Loop

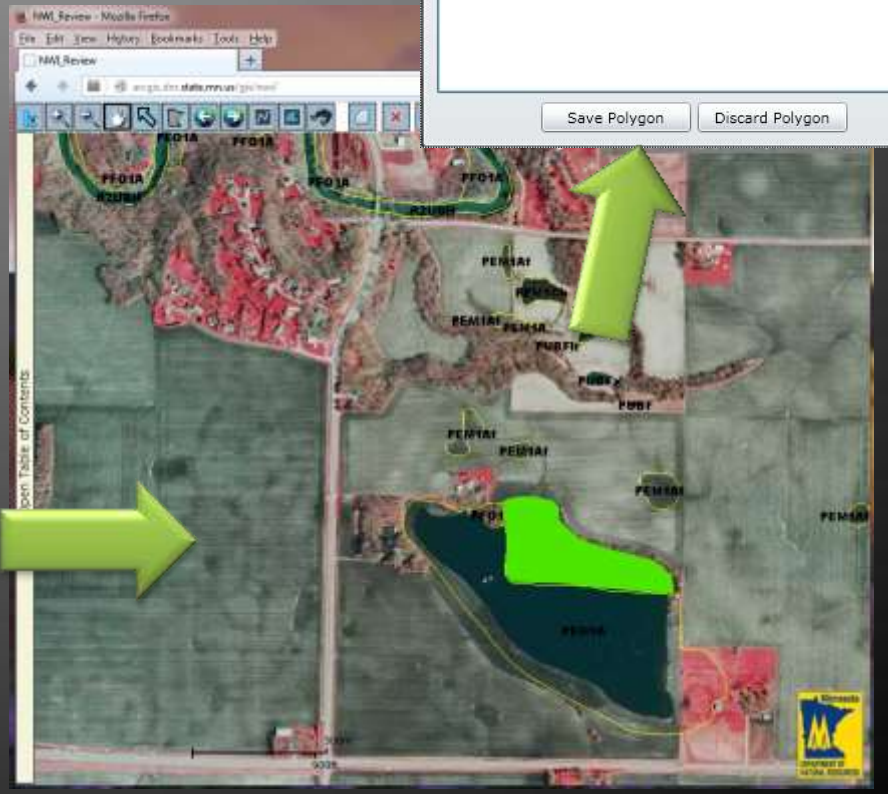
- Field checking on selected wetland polygons

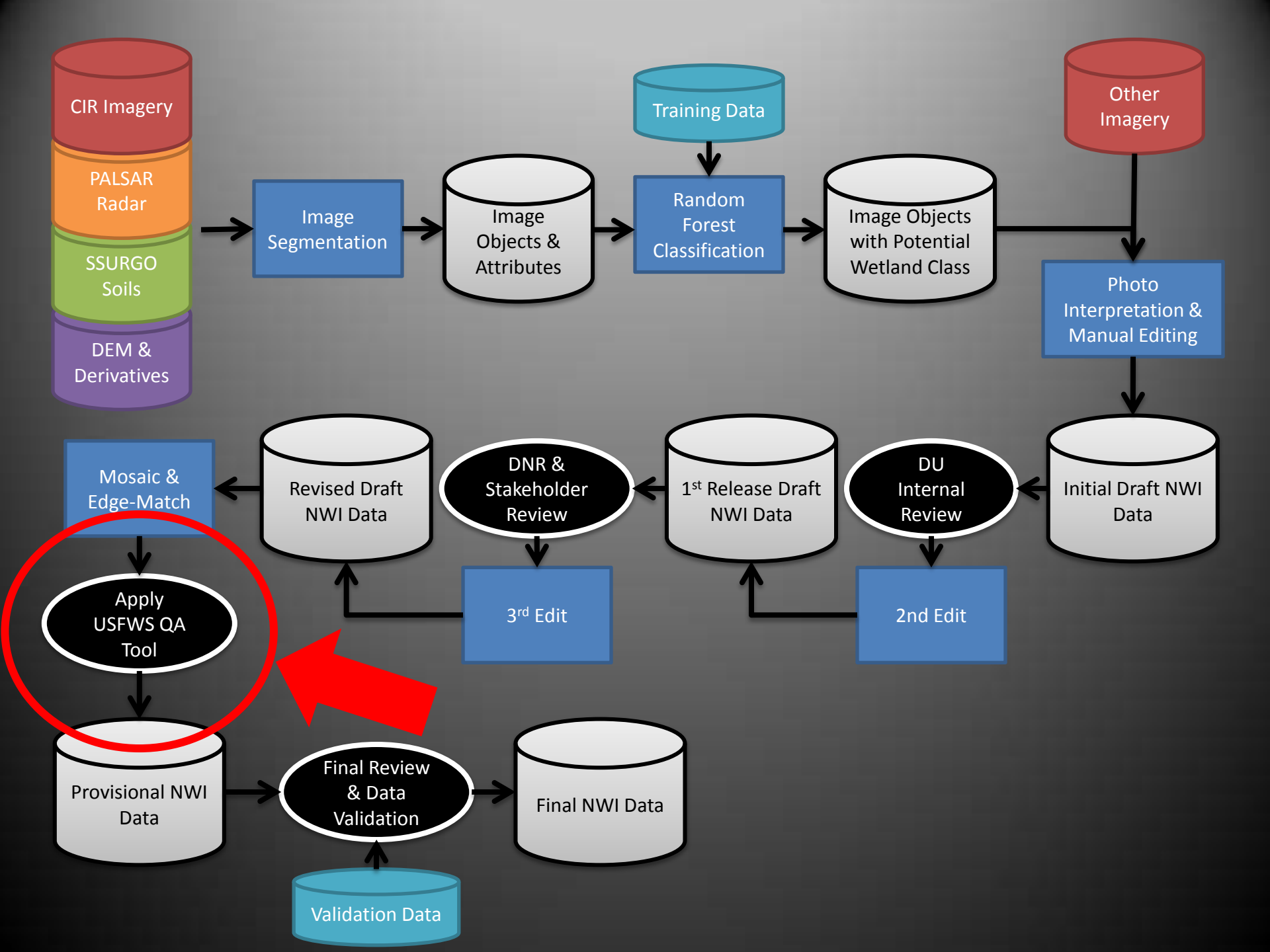
Crowdsource Feedback Loop







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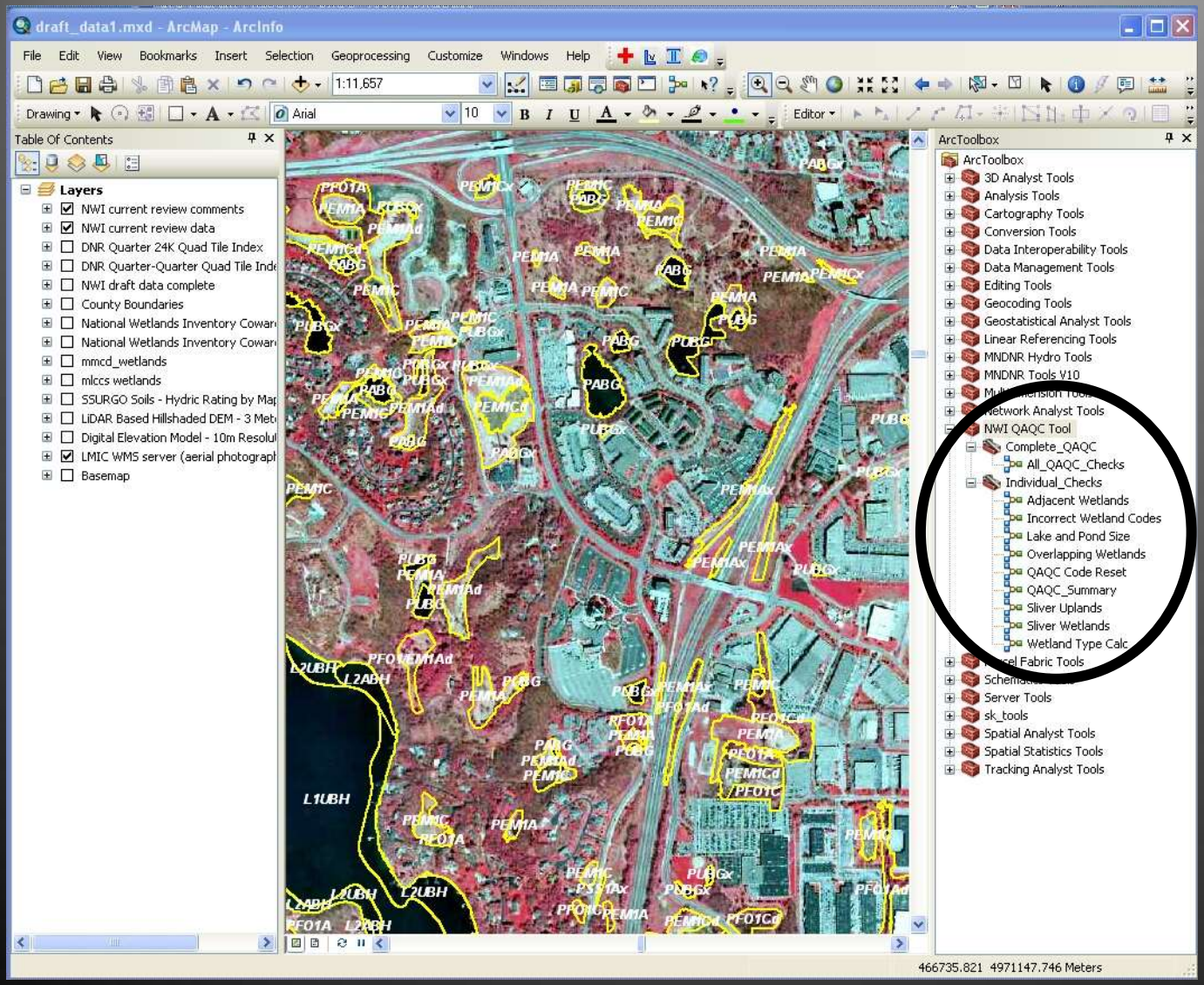
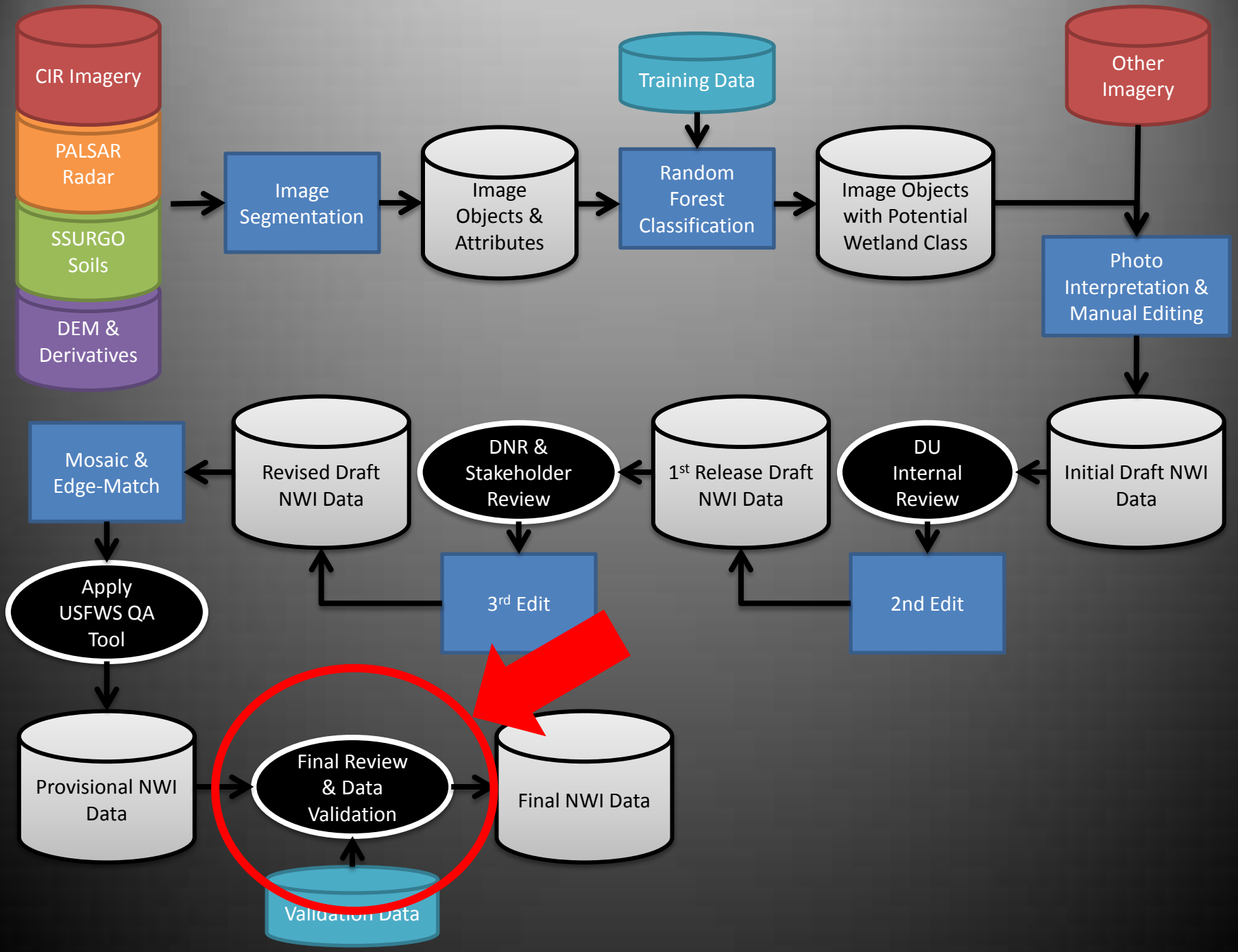
USFWS QA/QC Tool



USFWS QAQC Tool performs a variety of automated checks in ArcGIS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FGCD Wetland Mapping Accuracy Goal

- "Ninety-eight percent of all wetlands visible on an image, at the size of the TMU or larger shall be mapped regardless of the origin (natural, farmed, or artificial)."

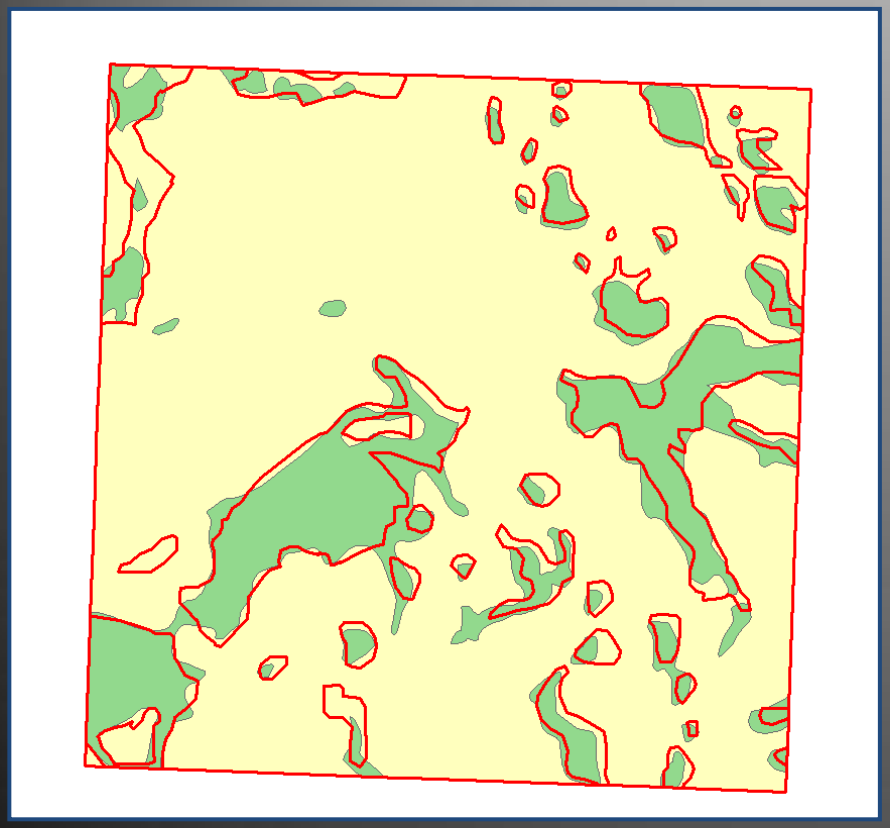
Questions About the FGDC Goal

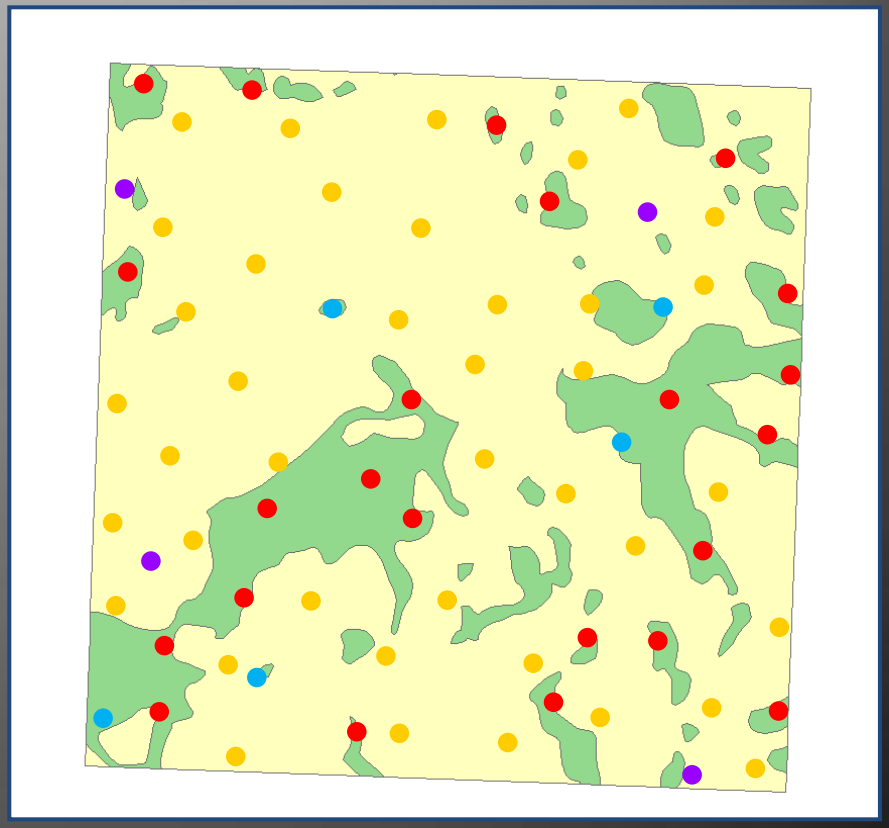
- Assessment methods
  - Field-check or photo-interpretation
  - Points or polygons
  - Handling confusion between classification error and positional error
- Is a 98% producer's accuracy feasible
- Why is there no goal for user's accuracy

Field vs Photo-Interpretation

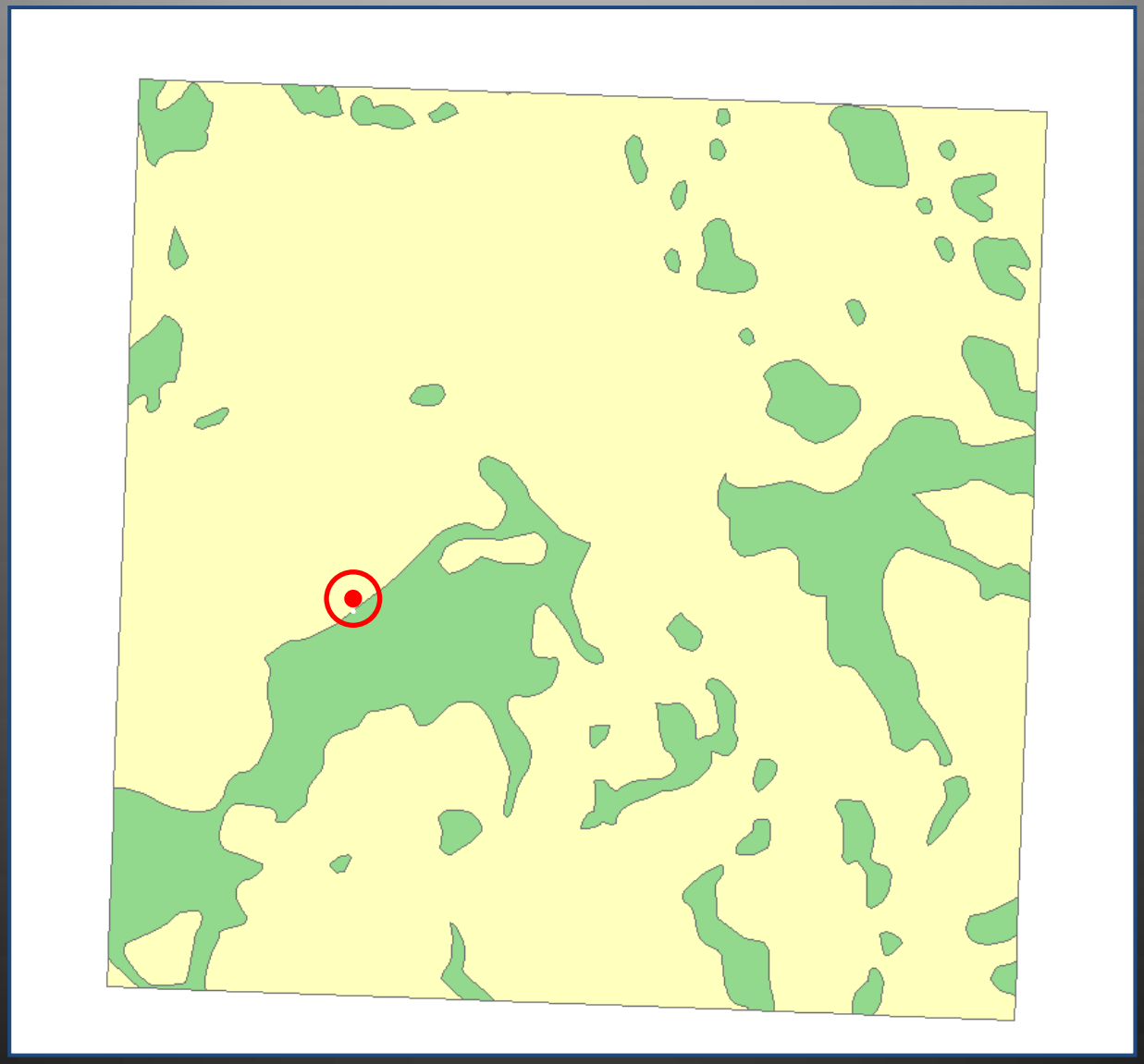
- PI method
  - "Visible" standard implies PI
  - Visible to whom?
  - PI experience = accurate?
- Field method
  - Field accuracy > PI accuracy
  - Time consuming, expensive
  - Access restrictions

Points vs. Polygons

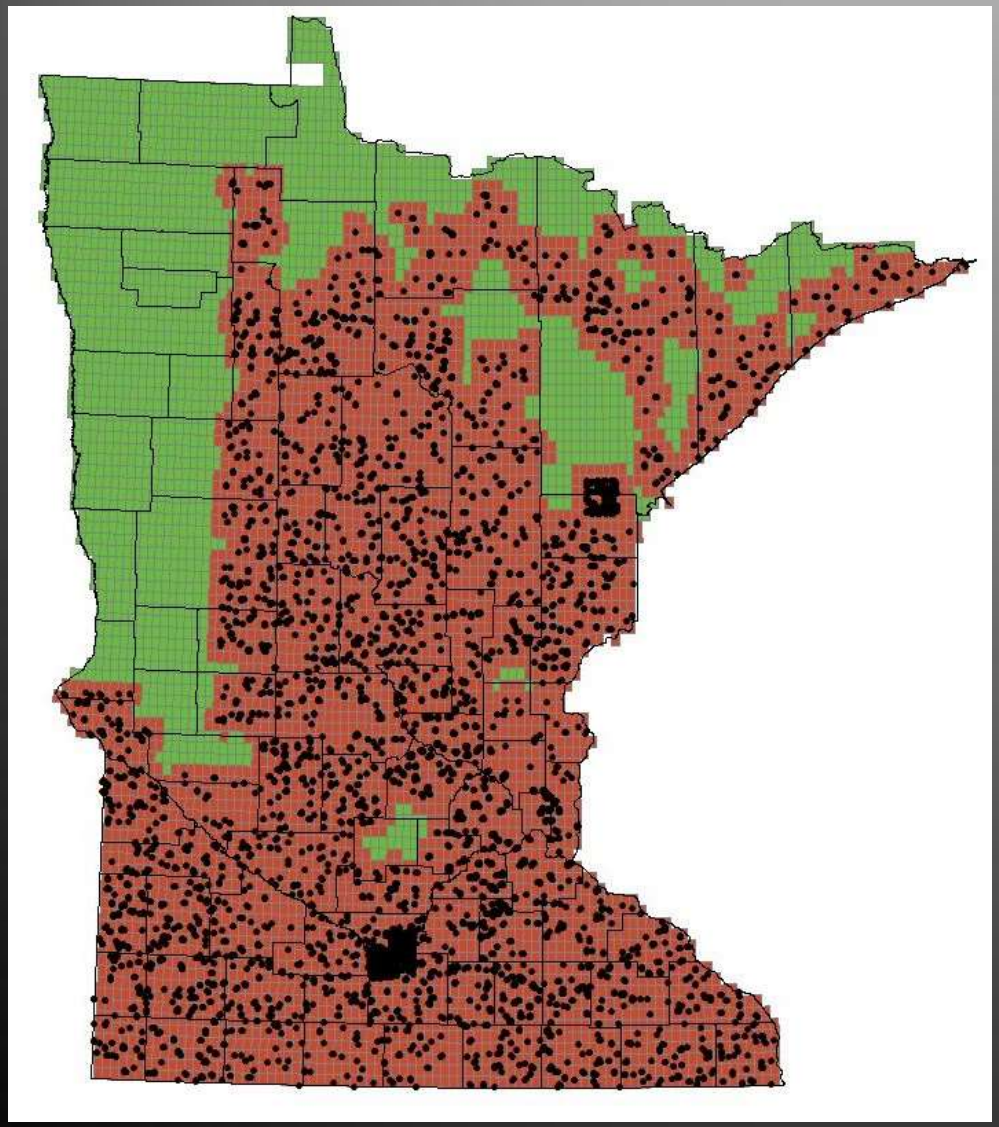




Classification Error or Positional Error



Validation Data



Field points

- Stratified-random
- 75% wetland /25% upland
- Field-checked by UMN
- ±5.64 meters (image+GPS)
- Audited

PI points

- Interpreted from high-resolution digital stereo imagery
- 75% wetland /25% upland
- ±1.53 meters (image)

Feature Assessment Using PI Points for East-Central MN

	Map Determination		
Reference Determination	Upland	Wetland/DW	Total
Upland	208	12	220
Wetland/Deepwater	47	624	671
Total	255	636	891

Overall Accuracy	93%
Wetland Producer's Accuracy	93%
Wetland User's Accuracy	98%

Feature Assessment Using Field Points for East-Central MN

	Map Determination		
Reference Determination	Upland	Wetland/DW	Total
Upland	201	18	219
Wetland/Deepwater	54	470	524
Total	255	488	743

Overall Accuracy	90%
Wetland Producer's Accuracy	90%
Wetland User's Accuracy	96%

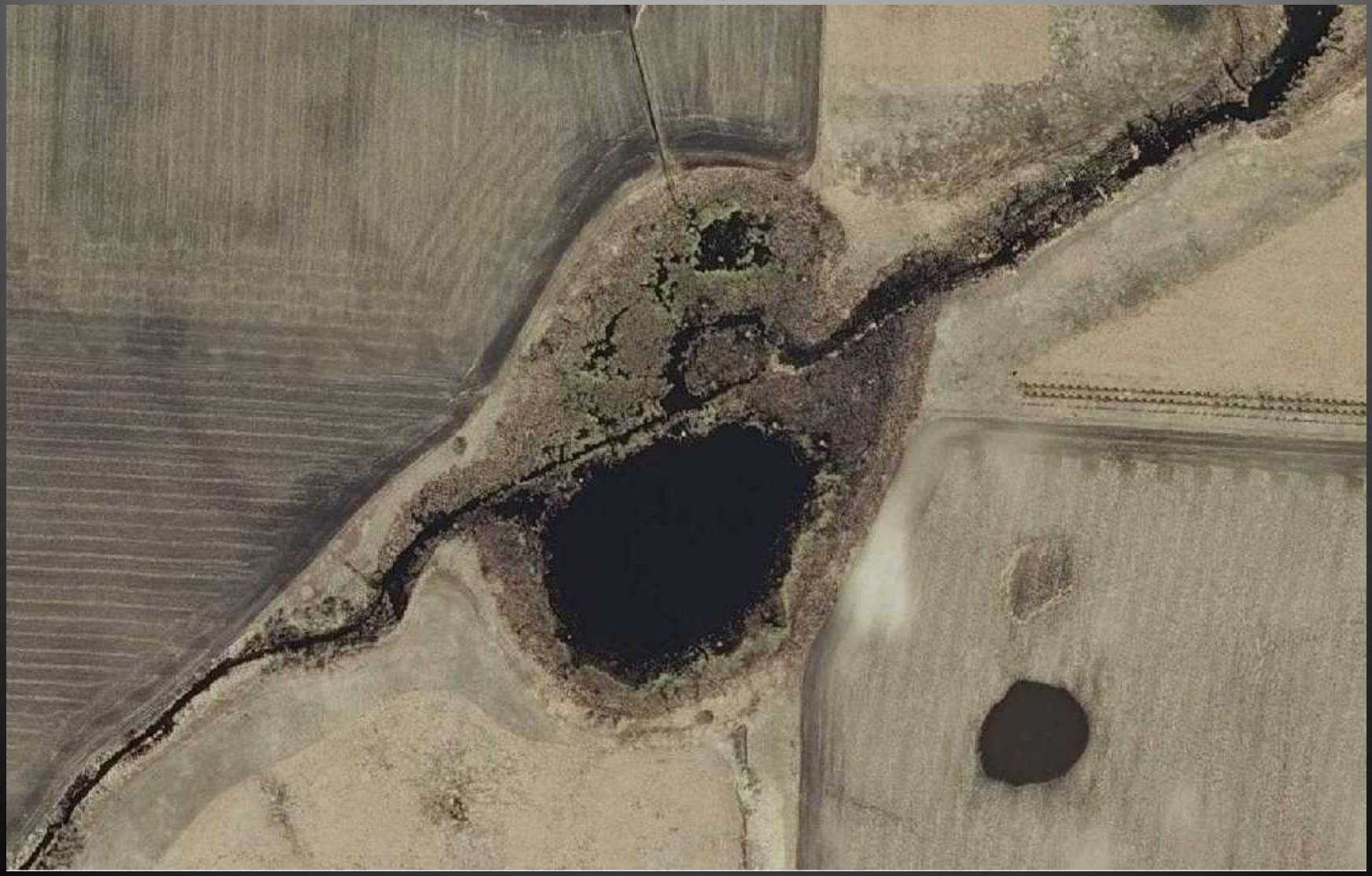
Class Assessment Using PI Points for East-Central MN

	Map Class													
Reference Class	**L1UB**	**L2AB**	**L2EM**	**L2UB**	**L2US**	**PAB**	**PEM**	**PFO**	**PSS**	**PUB**	**R2AB**	**R2UB**	**R2US**	**UPL**	**Total**
L1UB	39			5								8			52
L2AB	2	26	9	3		1	4								45
L2EM															0
L2UB	5	3	3	31								3			45
L2US					1										1
PAB						21	5			11	1	1			39
PEM						2	99	2	1	1				18	123
PFO							1	30	3					19	53
PSS							13	2	20			1		7	43
PUB		1		1		22	7	1	1	142				5	180
R2AB															0
R2UB						2	2					58			62
R2US							1	1				6	6		14
UPL							5	5				1		208	219
Total	46	30	12	40	1	48	137	41	25	154	1	78	6	257	876

Reflections on Class Error Matrix

- An “accuracy” assessment
  - Implies the reference data are 100% accurate
- Some common classes aren’t reliably separated with field observation or remote sensing
  - Temporal variability (AB – UB)
  - Spectrally indistinguishable (L1 – L2)

Temporal Variability



Temporal Variability

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Spectrally Indistinguishable

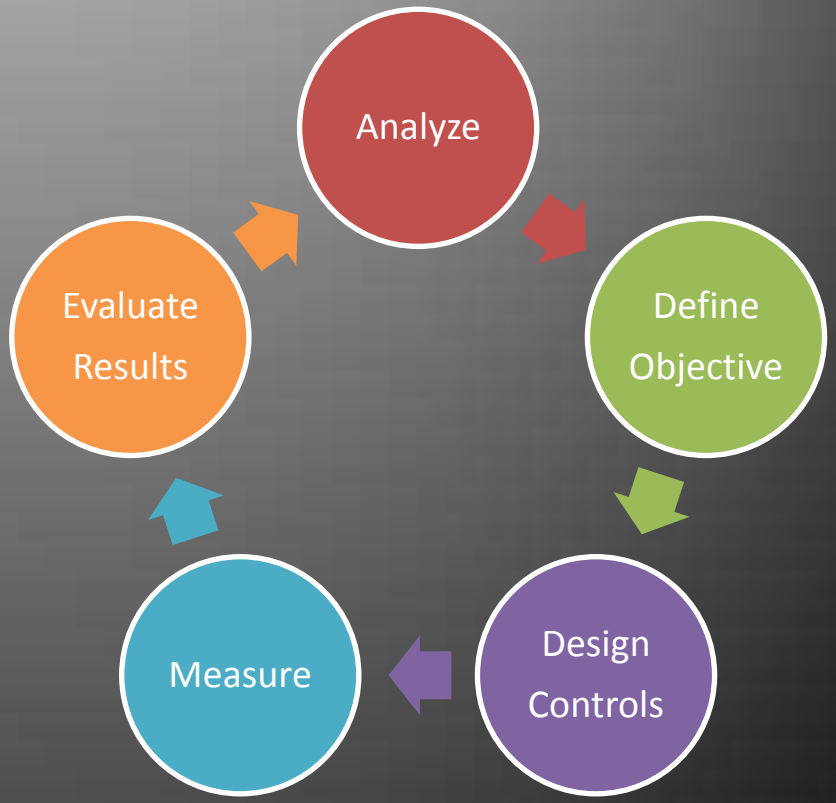
Spectrally Indistinguishable

Wetland Class Accuracy

- Photo-interpreted validation data
- Wetland & deepwater classes only
- Overall class accuracy
  - All points = 78%
  - AB/UB confusion excluded = 84%
  - L1/L2 and AB/UB excluded = 86%

Take Home Message

- QA/QC shouldn't just happen at the end
  - Have a plan
- Accuracy assessment is complex
  - Many decisions influence results
  - FGDC standard does not provide guidance



A Modest Proposal

Producer & User Accuracy Wetland/Upland	Quality Grade
Both > 95%	A
95% > Both > 90%	B
90% > Both > 80%	C
80% > Both > 70%	D
Both < 70%	F

East-Central MN

Producer Accuracy = 93%

User Accuracy = 98%

Overall Quality Grade = A-

Acknowledgments

- Funding – ENRTF
- DNR
  - Doug Norris
  - Molly Martin
- University of MN
  - Joe Knight
  - Jennifer Corcoran
  - Lian Rampi
- DU/Equinox
  - Robb Macleod
  - Aaron Smith
  - Robb Paige
- St. Mary's University
  - Andy Robertson
  - Dave Rokus
- Tech Advisory Committee
  - Brian Huberty
  - Nancy Read
  - Mark Gernes
  - Susanne Maeder
  - Rob Sip
  - Steve Eggers
  - Jeremy Maul
  - Les Lemm
  - Dale Krystosek

Questions?