What Can Geospatial Approaches Do For Your Monitoring and Assessment Program?

Saint Mary's University of MN - GeoSpatial Services

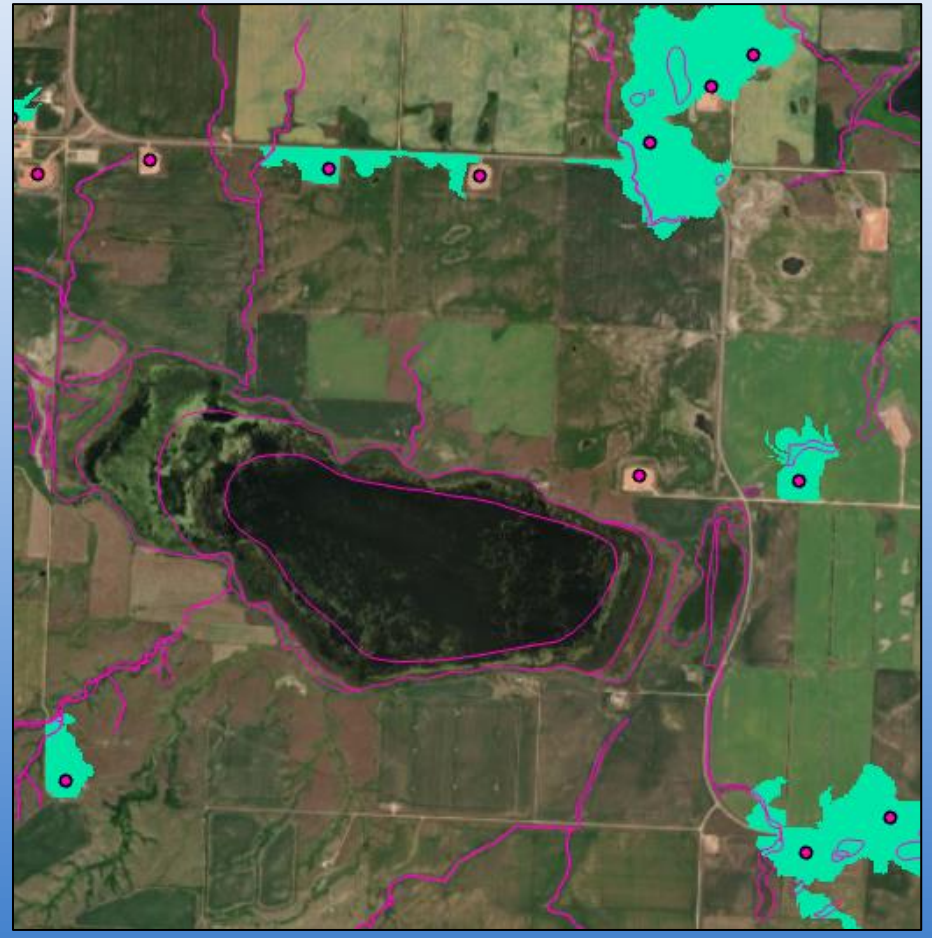
Day 3: Monitoring and Assessment (Introductory Session)

Who Are We?

- GeoSpatial Services (GSS) is a project center within Saint Mary's University of Minnesota that integrates professional services and academic apprenticeships in the areas of natural resource assessment, geographic analysis, and contemporary mapping.
- Key partner working with Federal and State Agencies, Tribal entities, and non-profits to provide comprehensive digital National Wetland Inventory (NWI) mapping, as well as:
  - Value-added wetland classifications & assessments
  - Identification of potentially restorable wetlands (PRWs)
  - Adaptation of wetland rapid assessment methods (RAMs)
  - Communicating wetland and water program development products using ArcGIS StoryMap
- Tribal partners include Three Affiliated Tribes (TAT) of Fort Berthold (ND), Shakopee Mdewakanton Sioux Community (MN), Stockbridge-Munsee Community (WI), Leech Lake Band of Ojibwe (MN), White Mountain Apache Tribe (AZ)

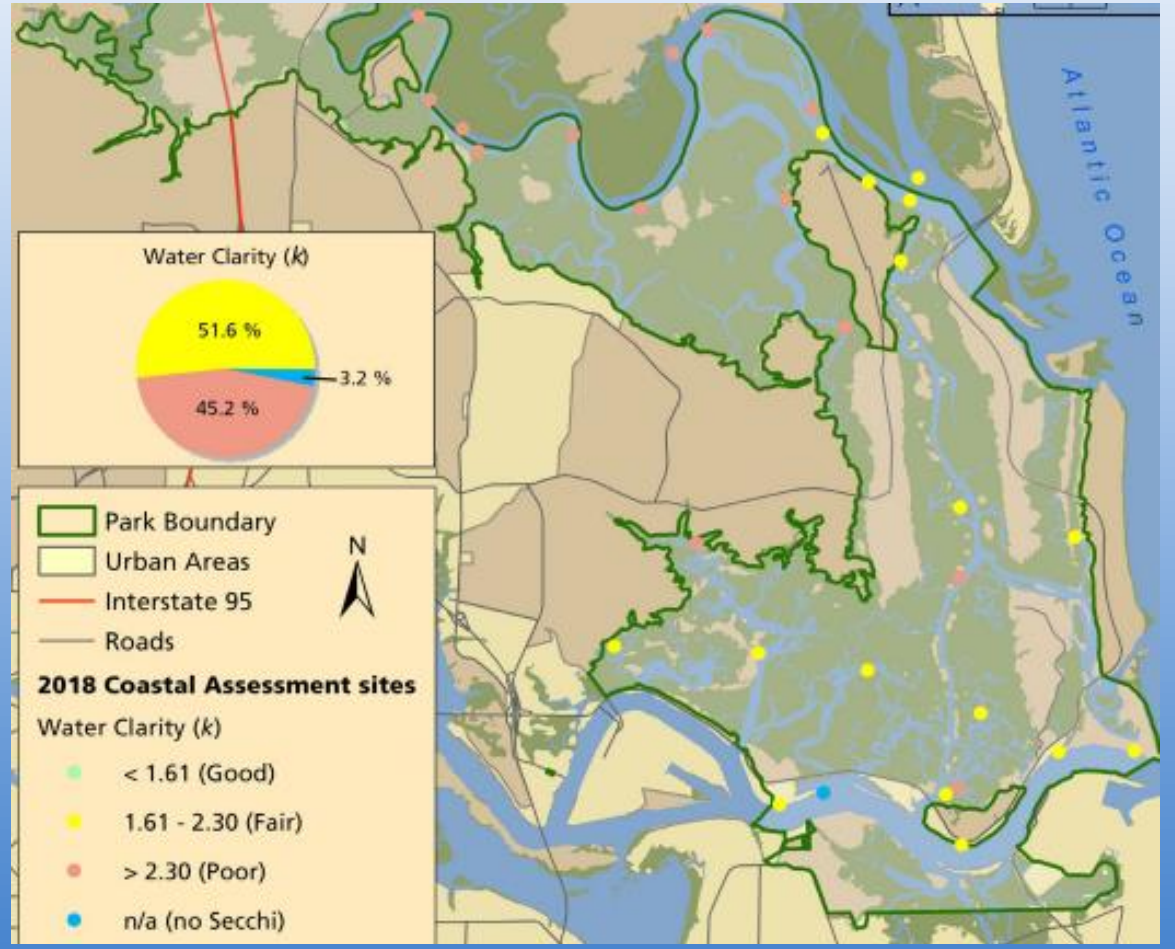
What Does “Geospatial” Mean?

- Information that describes features or events that have a location on or near the earth’s surface.
- Data can be collected in the field (with GPS units), remotely (e.g., by satellite), or created in a computer program.
- Can “overlay” data layers for analysis



How is Geospatial Data Helpful for CWA Monitoring?

- Visualize monitoring locations and data in geographic context - identify patterns/trends
- Hone in on threats/stressors
- Map/model connections by surface flow
- Useful for communication with stakeholders

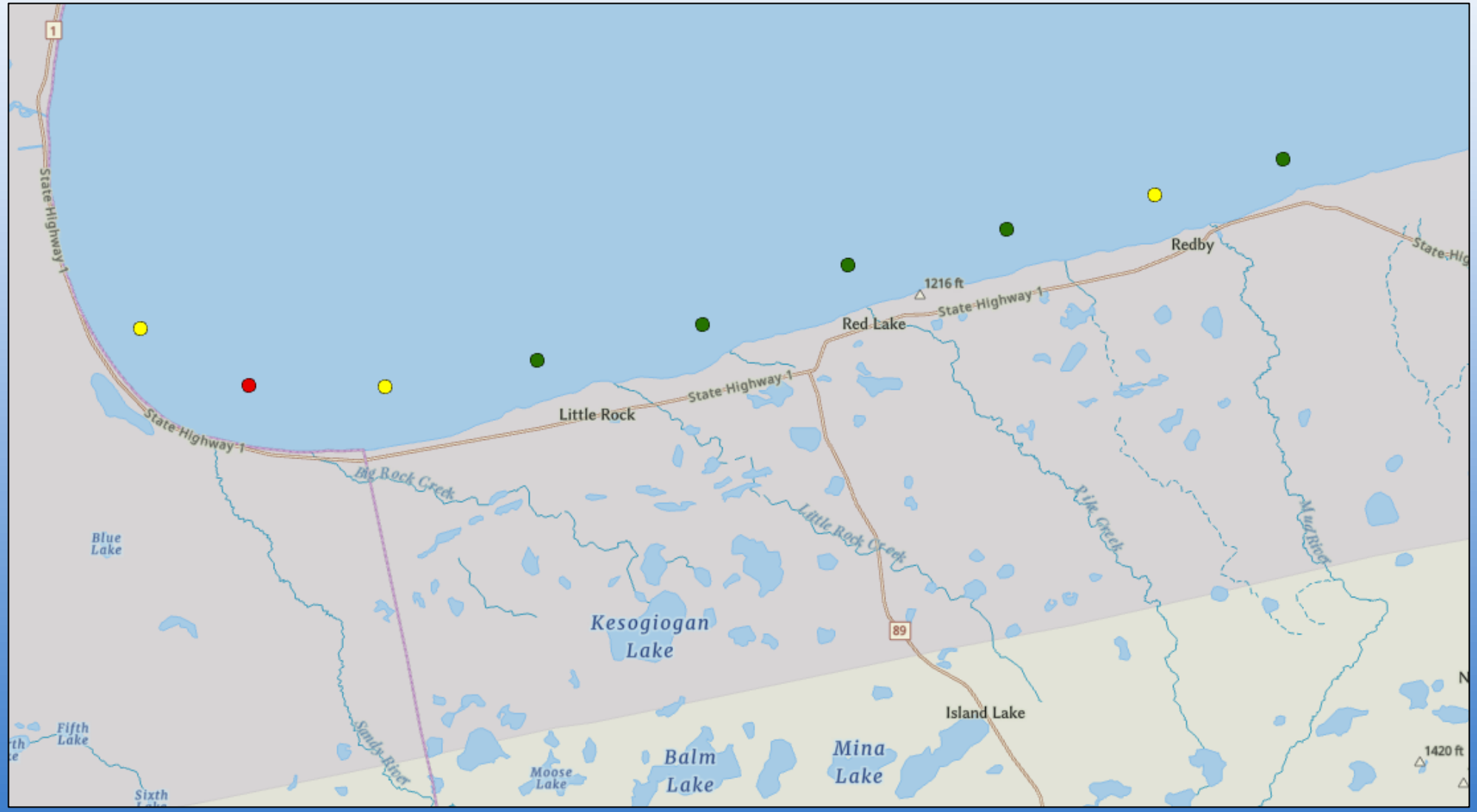


National Park Service Image

Saint Mary's University GEOSPATIAL SERVICES

NATIONAL ASSOCIATION OF WETLAND MANAGERS

Identifying Problem Areas – Examples

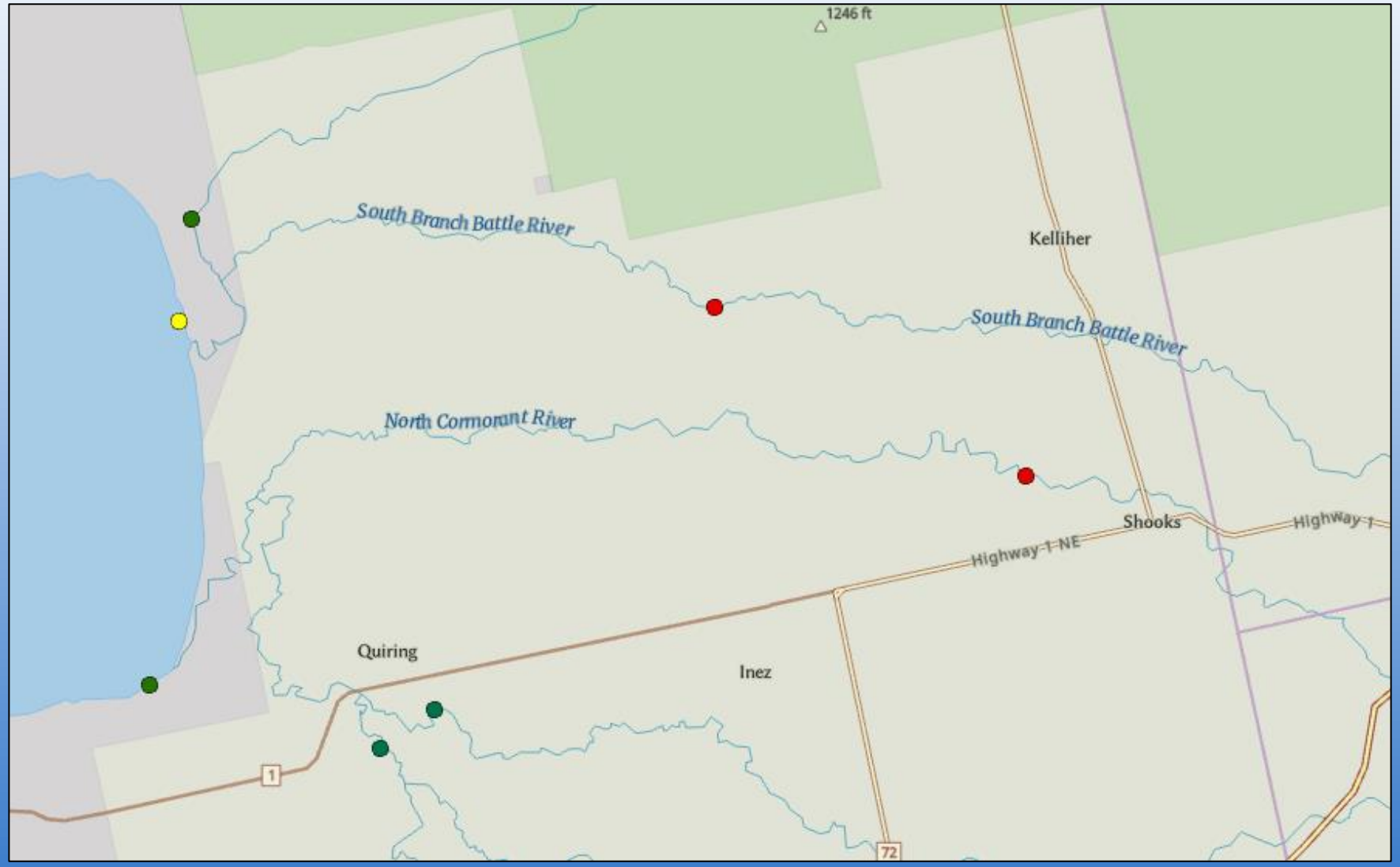


Not based on actual data

Saint Mary's University
GEOSPATIAL SERVICES

NATIONAL ASSOCIATION OF WETLAND MANAGERS

Identifying Problem Areas - Examples



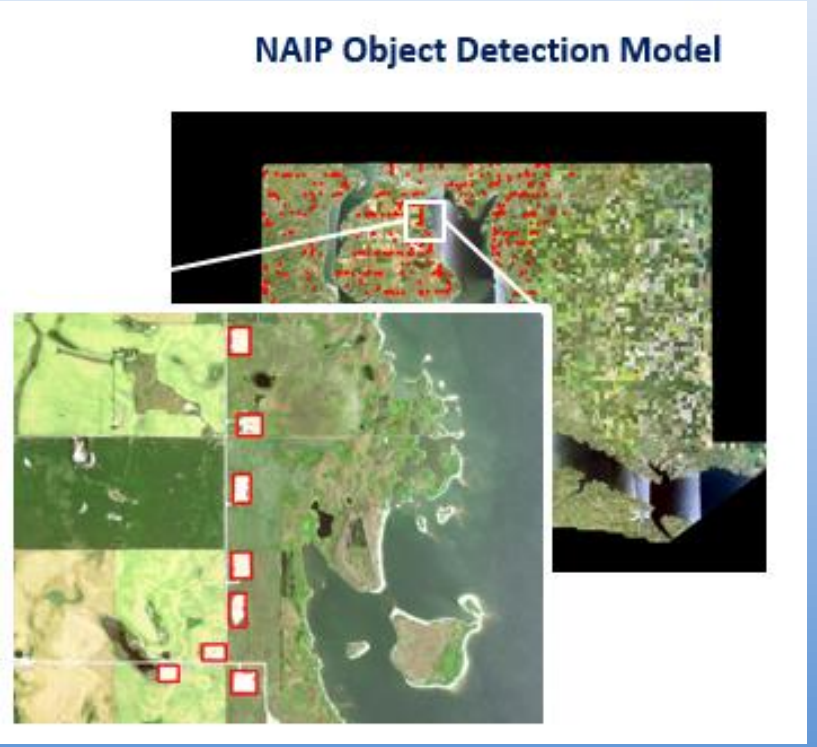
Not based on actual data

Saint Mary's University
GEOSPATIAL SERVICES

NATIONAL ASSOCIATION OF WETLAND MANAGERS

Assessing Risks/Vulnerabilities - Example

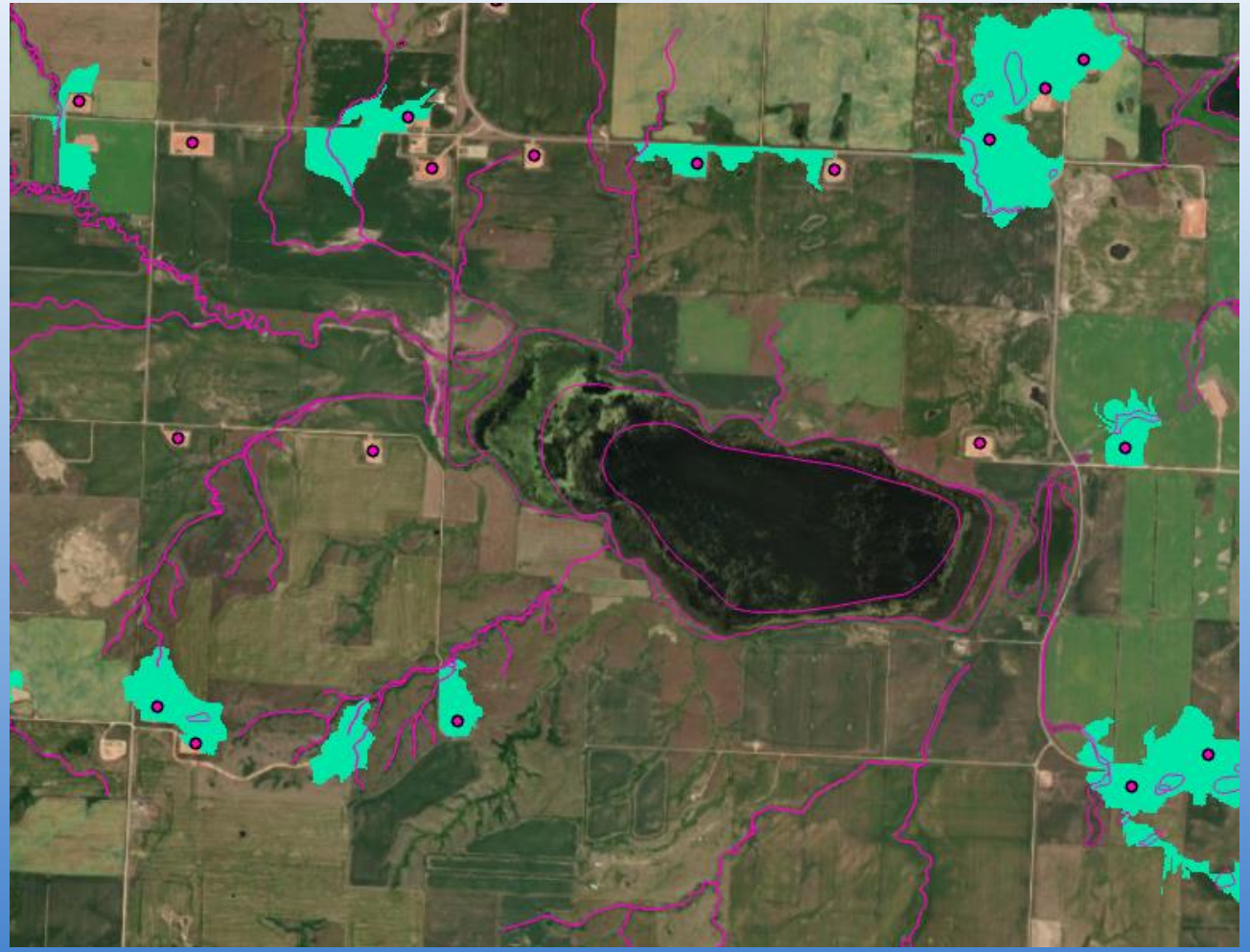
- The Three Affiliated Tribes (TAT) of North Dakota were concerned about the potential impacts of oil/gas drilling on reservation wetlands
- GSS created a deep learning object detection model for aerial imagery to identify and create a data layer for well pads
- We used a Digital Elevation Model (DEM), hydrologically modified, to derive a surface flow network.
- “Pour points” were placed around well pads to identify potentially vulnerable catchments

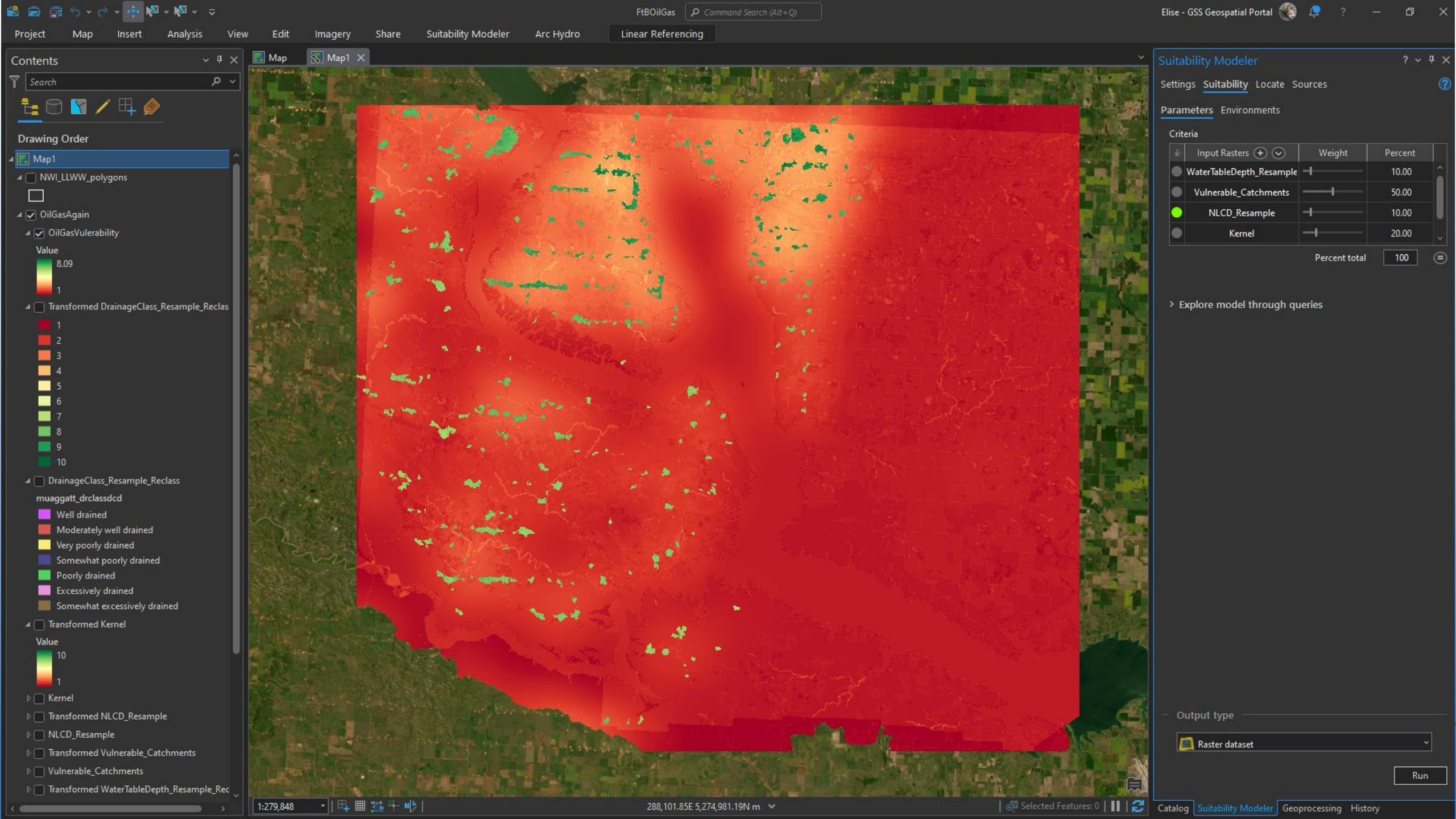


What other landscape criteria are important to consider?

Assessing Risks/Vulnerabilities - Example

- Additional variables considered were:
  - Proximity to well pads
  - Density of well pads
  - SSURGO Soils data – water table depth and drainage class
  - Land Cover
- Analysts utilized ESRI's Suitability Modeler within ArcGIS Pro to weigh criteria variables and rate vulnerability to oil/gas impacts.




FtBOilGas
Command Search (Alt+Q)
Elise - GSS Geospatial Portal
Project
Map
Insert
Analysis
View
Edit
Imagery
Share
Suitability Modeler
Arc Hydro
Linear Referencing
Contents
Search
Drawing Order
Map1
NWI_LLWW_polygons
OilGasAgain
OilGasVulerability
Value
8.09
1
Transformed DrainageClass_Resample_Reclas
1
2
3
4
5
6
7
8
9
10
DrainageClass_Resample_Reclass
muaggatt_drclassdcd
Well drained
Moderately well drained
Very poorly drained
Somewhat poorly drained
Poorly drained
Excessively drained
Somewhat excessively drained
Transformed Kernel
Value
10
1
Kernel
Transformed NLCD_Resample
NLCD_Resample
Transformed Vulnerable_Catchments
Vulnerable_Catchments
Transformed WaterTableDepth_Resample_Rec
Map
Map1
Suitability Modeler
Settings
Suitability
Locate
Sources
Parameters
Environments
Criteria
Input Rasters
Weight
Percent
WaterTableDepth_Resample
10.00
Vulnerable_Catchments
50.00
NLCD_Resample
10.00
Kernel
20.00
Percent total
100
Explore model through queries
Output type
Raster dataset
Run
1:279,848
288,101.85E 5,274,981.19N m
Selected Features: 0
Catalog
Suitability Modeler
Geoprocessing
History

Wetlands Potentially Vulnerable to Oil/Gas

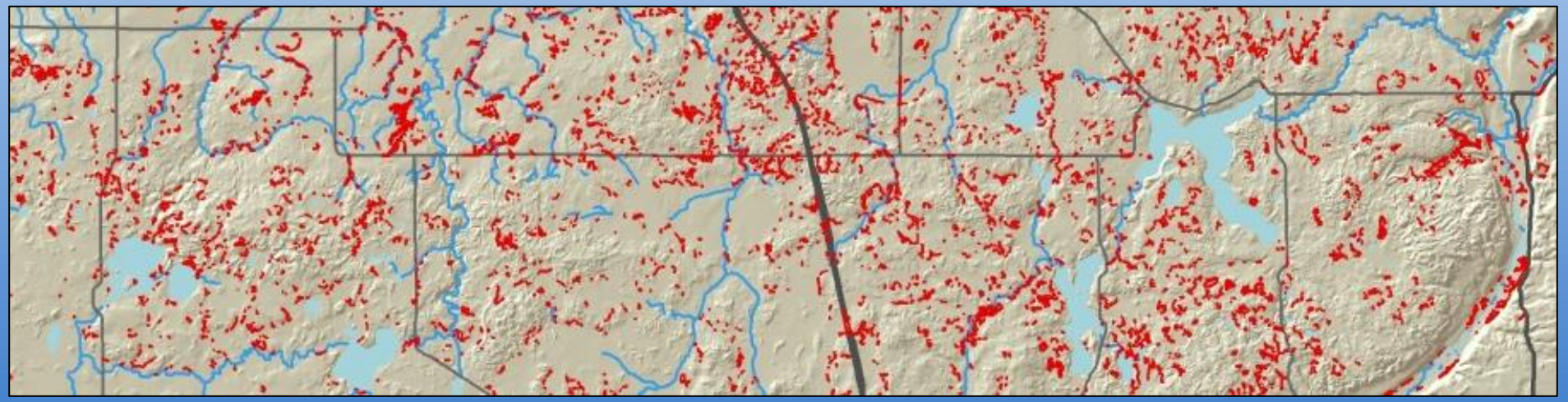
- Analysis identified 4,855 wetlands potentially vulnerable to contamination, primarily in the western half of the Reservation
- Suitability Modeler predicted that vulnerability was high for 906 of these wetlands, medium for 1,531, and low for the remaining 2,418.
- Information can help tribal managers prioritize wetlands for protection and regular monitoring.

Saint Mary's University GEOSPATIAL SERVICES

NATIONAL ASSOCIATION OF WETLAND MANAGERS

Identify/Prioritize Opportunities for Protection & Improvement

- Potentially Restorable Wetlands
  - GIS method to identify areas of focus for restoration
  - Based on landscape-level indicators derived from a digital elevation model (i.e., topography) and SSURGO soils data
  - Restoring wetlands can protect and improve water quality



Identify/Prioritize Opportunities for Protection & Improvement

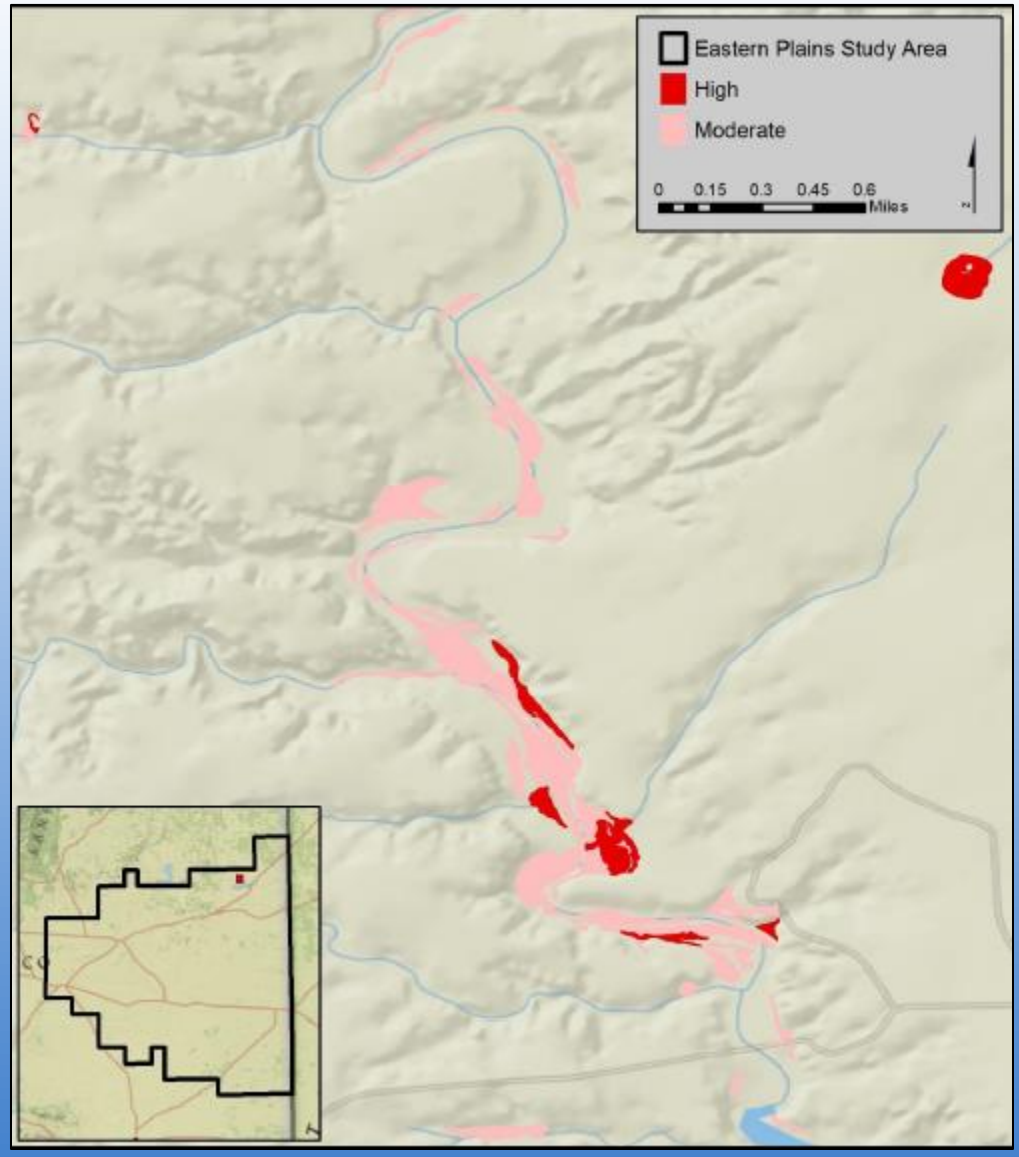
- Wetland Functional Assessments – how well is a wetland performing critical ecological functions within the landscape?
  - Includes functions related to water quality: nutrient retention/transformation, sediment retention, groundwater recharge, streamflow maintenance, and more.
  - Uses information such as surface hydrology, plant communities, water chemistry, soils, and human impact
  - Can identify wetlands or water bodies to help maintain or improve water quality

SQL Model

```
1.) ("LLWW" LIKE('LR%') AND ( "NWI_Class" = 'AB' OR "NWI_Class" = 'EM' OR "NWI_Class" = 'FO'
OR "NWI_Class" = 'SS' OR "NWI_Class2" = 'AB' OR "NWI_Class2" = 'EM' OR "NWI_Class2" = 'FO'
OR "NWI_Class2" = 'SS') AND NOT ( ("LLWW" LIKE ('LR%IL%') OR "LLWW" LIKE ('LR%IL') ) OR
("LLWW" LIKE ('%fm') OR "LLWW" LIKE ('%fm%'))))   2.) OR ("LLWW" LIKE('LS%') AND (
"NWI_Class" = 'AB' OR "NWI_Class" = 'EM' OR "NWI_Class" = 'FO' OR "NWI_Class" = 'SS' OR
"NWI_Class2" = 'AB' OR "NWI_Class2" = 'EM' OR "NWI_Class2" = 'FO' OR "NWI_Class2" = 'SS') AND
NOT ("LLWW" LIKE ('%fm') OR "LLWW" LIKE ('%fm%')))   .3.) OR ("LLWW" LIKE('LE%') AND (
"NWI_Class" = 'AB' OR "NWI_Class" = 'EM' OR "NWI_Class" = 'FO' OR "NWI_Class" = 'SS' OR
"NWI_Class2" = 'AB' OR "NWI_Class2" = 'EM' OR "NWI_Class2" = 'FO' OR "NWI_Class2" = 'SS') AND
NOT ( ("LLWW" LIKE ('LE%IL%') OR "LLWW" LIKE ('LE%IL')) OR ("LLWW" LIKE ('%fm') OR "LLWW"
LIKE ('%fm'))))   4.) OR ( "NWI_System" = 'R' AND "NWI_Class" = 'RS' ) OR ( "NWI_System" = 'L' AND
"NWI_Subsystem" = '2' AND "NWI_Class" = 'RS' )" = 'EM' OR "NWI_Class2" = 'FO' OR "NWI_Class2"
= 'SS') AND NOT ( ("LLWW" LIKE ('LR%IL%') OR "LLWW" LIKE ('LR%IL') ) OR ("LLWW" LIKE ('%fm')
OR "LLWW" LIKE ('%fm%')))) 5.) OR ("LLWW" LIKE('LS%') AND ( "NWI_Class" = 'AB' OR
"NWI_Class" = 'EM' OR "NWI_Class" = 'FO' OR "NWI_Class" = 'SS' OR "NWI_Class2" = 'AB' OR
"NWI_Class2" = 'EM' OR "NWI_Class2" = 'FO' OR "NWI_Class2" = 'SS') AND NOT ("LLWW" LIKE
('%fm') OR "LLWW" LIKE
```

Table 16. Nutrient Transformation (NT) Conditions.

Level of Function	Wetland Types
High	unaltered PEM1A with "pl" (playa) modifier; P__(EM, SS, FO and mixes)C; P__(AB, EM)F; PABG and PABH; All concentric rings within C water regime playa basins.
Moderate	P__(EM, SS, FO)A (not associated with playas); P__(EM, SS, FO and mixes)B; PUB/ABH. NOTE: Farmed wetlands (PEM1_f) were not rated as significant for this function. Isolated J-types were not assigned a significant rating for this function.



Nutrient Transformation

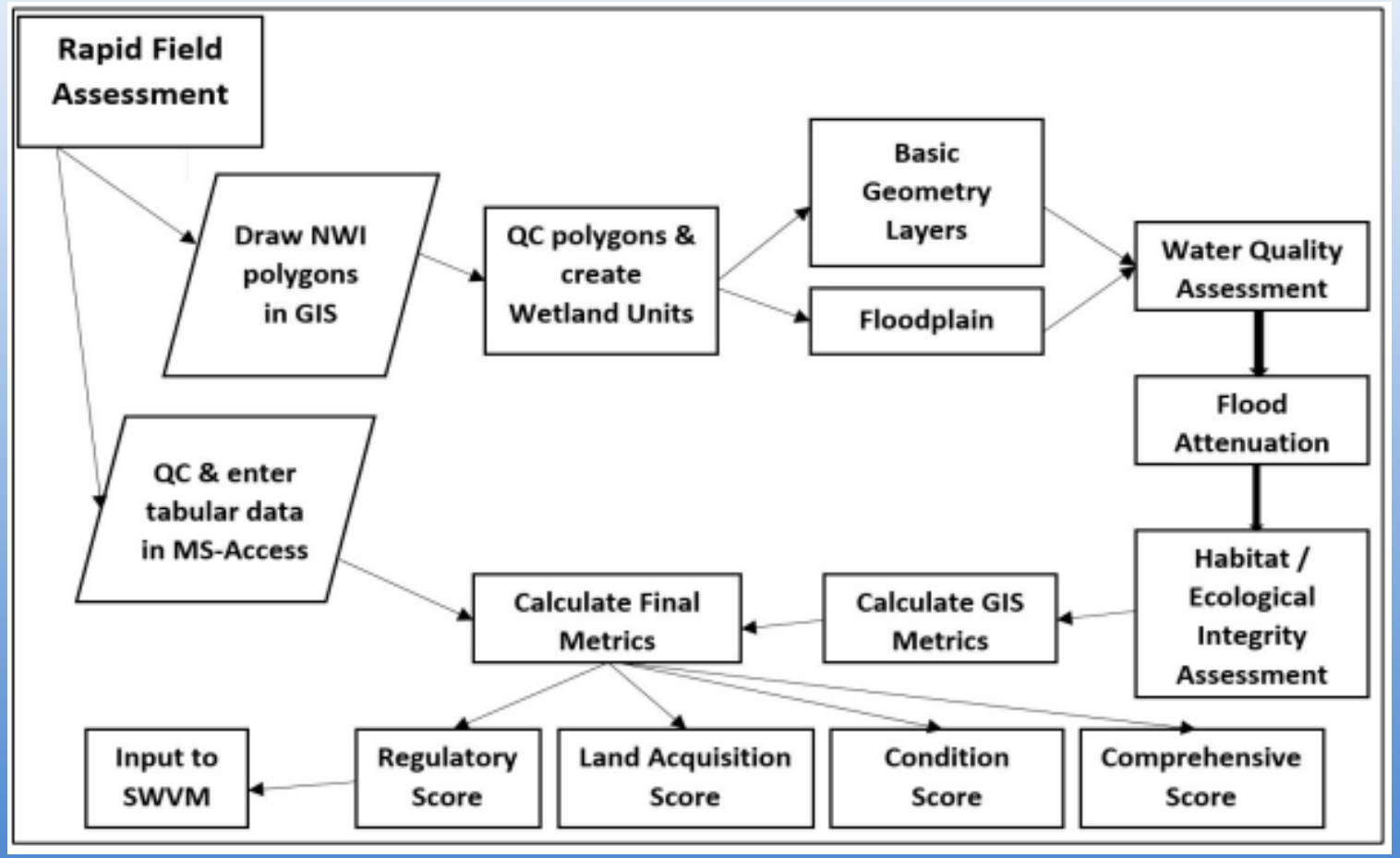
Saint Mary's University GEOSPATIAL SERVICES

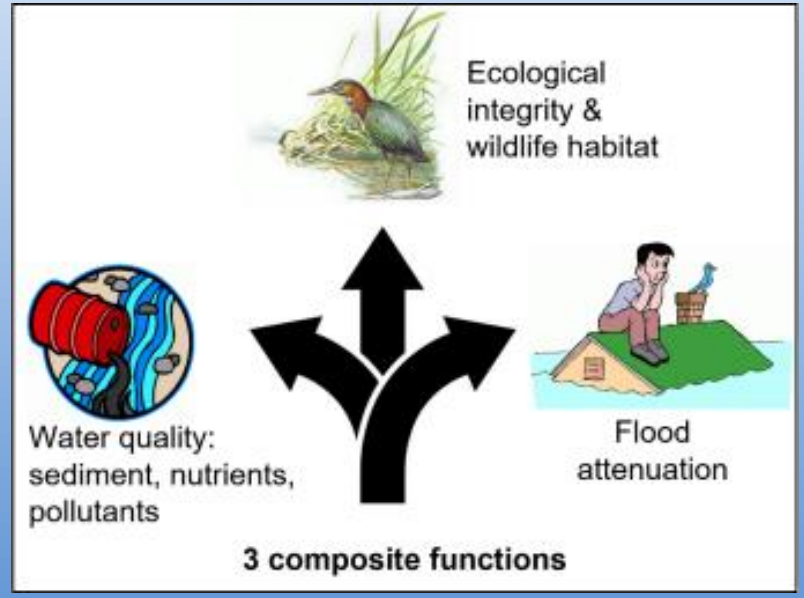
NATIONAL ASSOCIATION OF WETLAND MANAGERS

Identify/Prioritize Opportunities for Protection & Improvement

- Rapid Assessment Method (RAM) – a relatively quick, field-based wetland assessment using a consistent and repeatable process.
  - Can include field and “office” (GIS) components and be customized to incorporate cultural, educational, and recreational ratings.
  - Could be used to prioritize properties for various actions or to monitor/evaluate restoration and management activities
  - RAMs available for several states (MN, CA, OR, MT, WV), which have been adapted for tribes including the Nez Perce, Tulalip, Coeur d’Alene, and Shakopee Mdewakanton Sioux

Flow chart of field and GIS components of WVWRAM

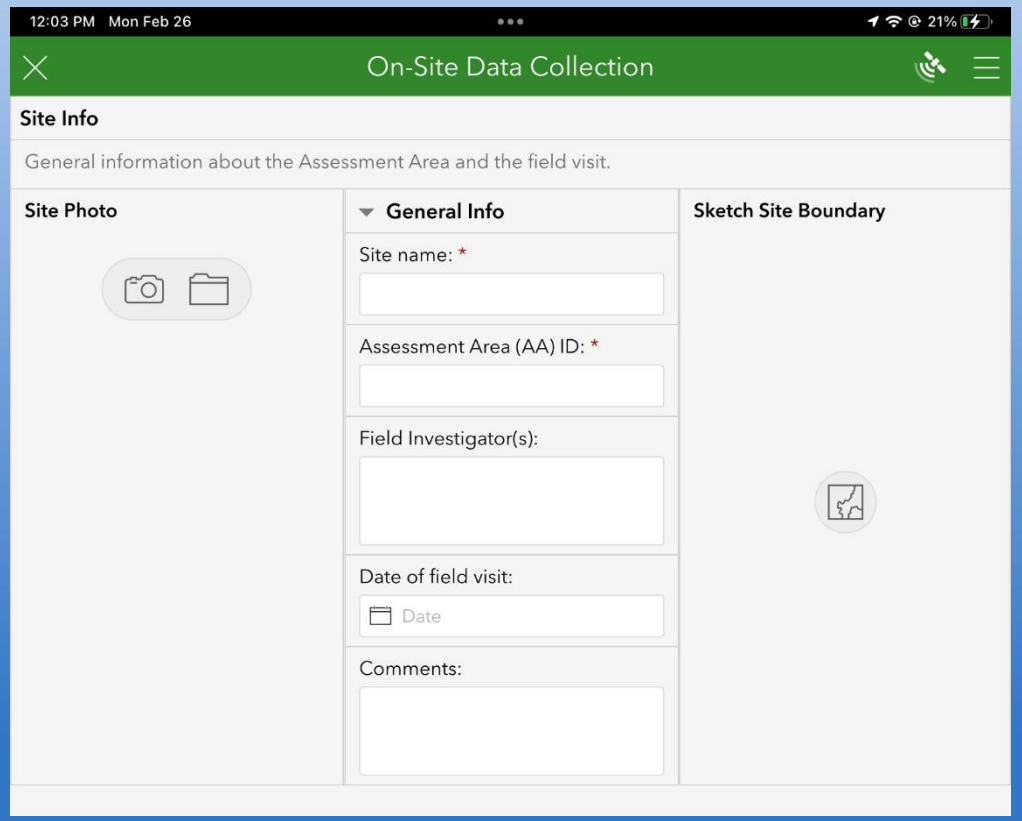


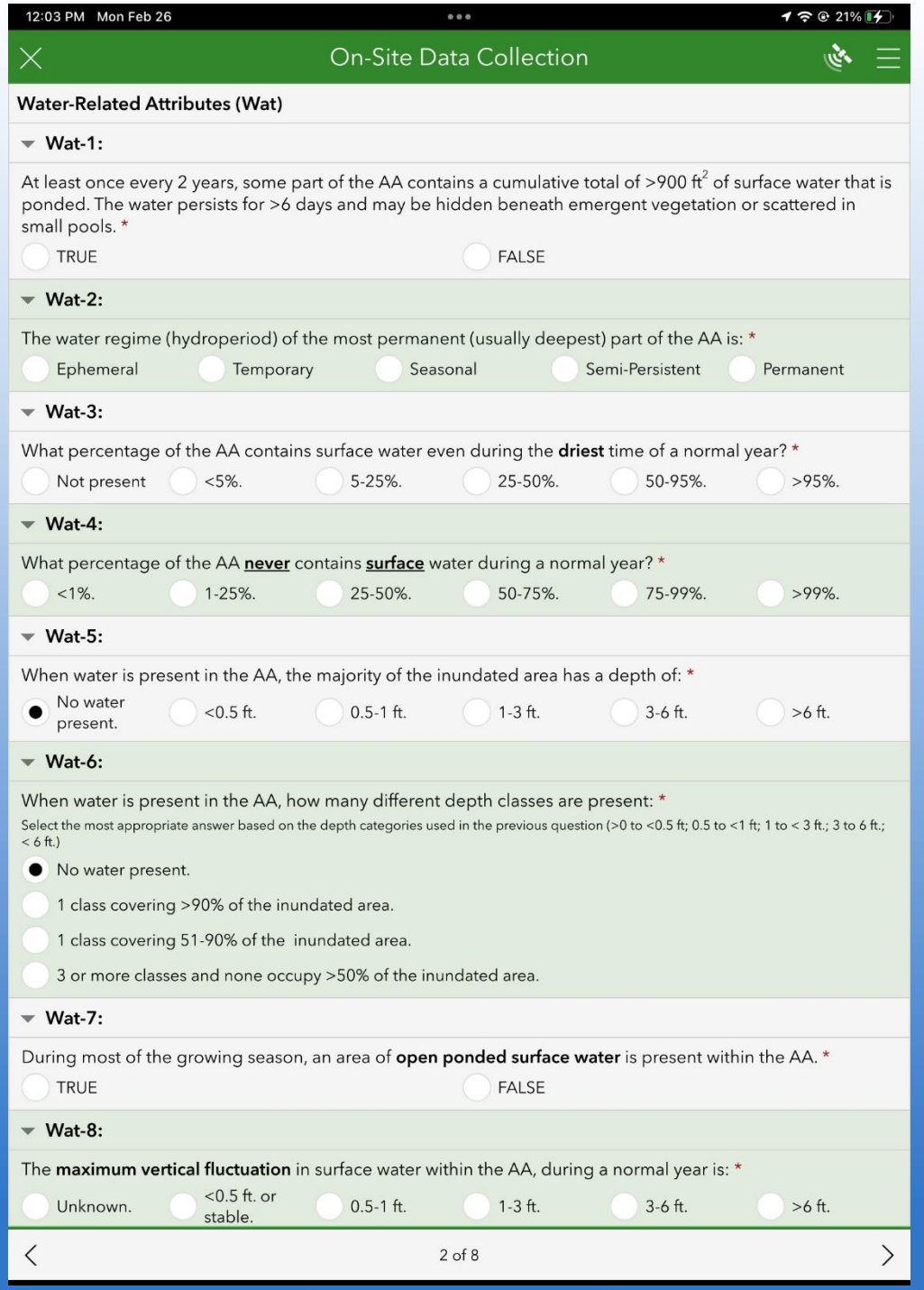


From the User Manual for the West Virginia Wetland Rapid Assessment Method (WVWRAM), 2023

Geospatial Tools for Data Collection

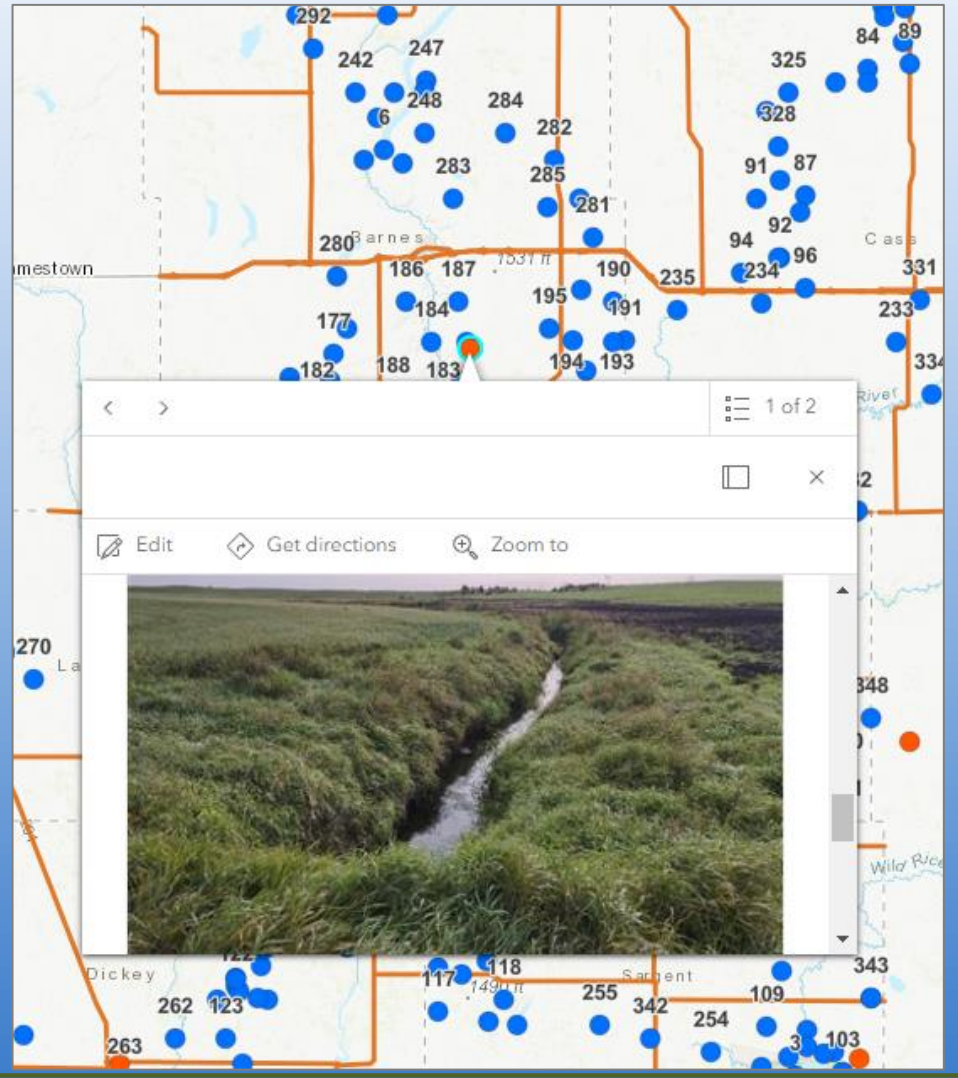
- Esri's Survey123 – "a simple and intuitive form-centric field data gathering solution" for creating, sharing, and analyzing surveys
- Customizable; can be used on tablets and phones, works online or offline





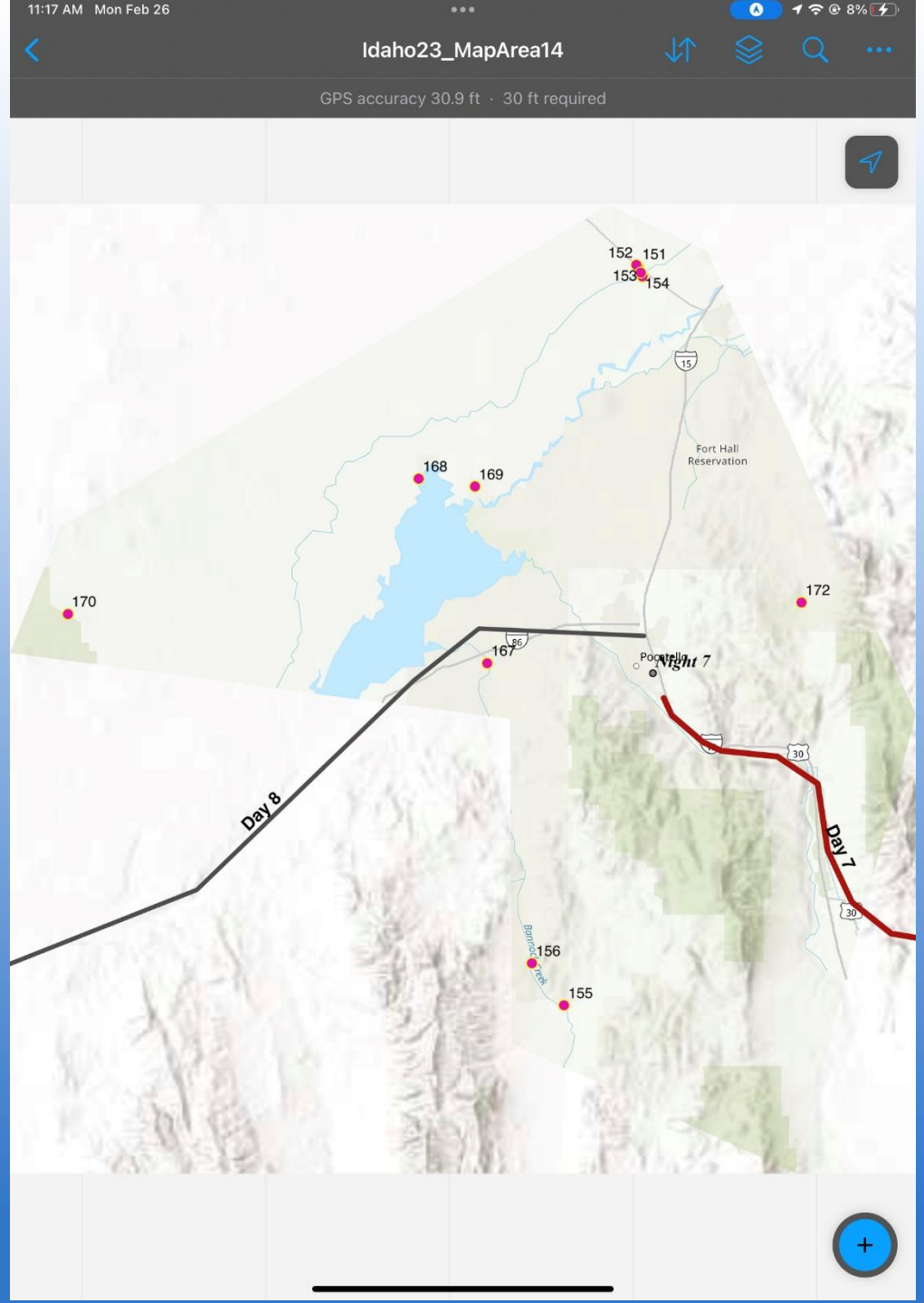
Geospatial Tools for Data Collection

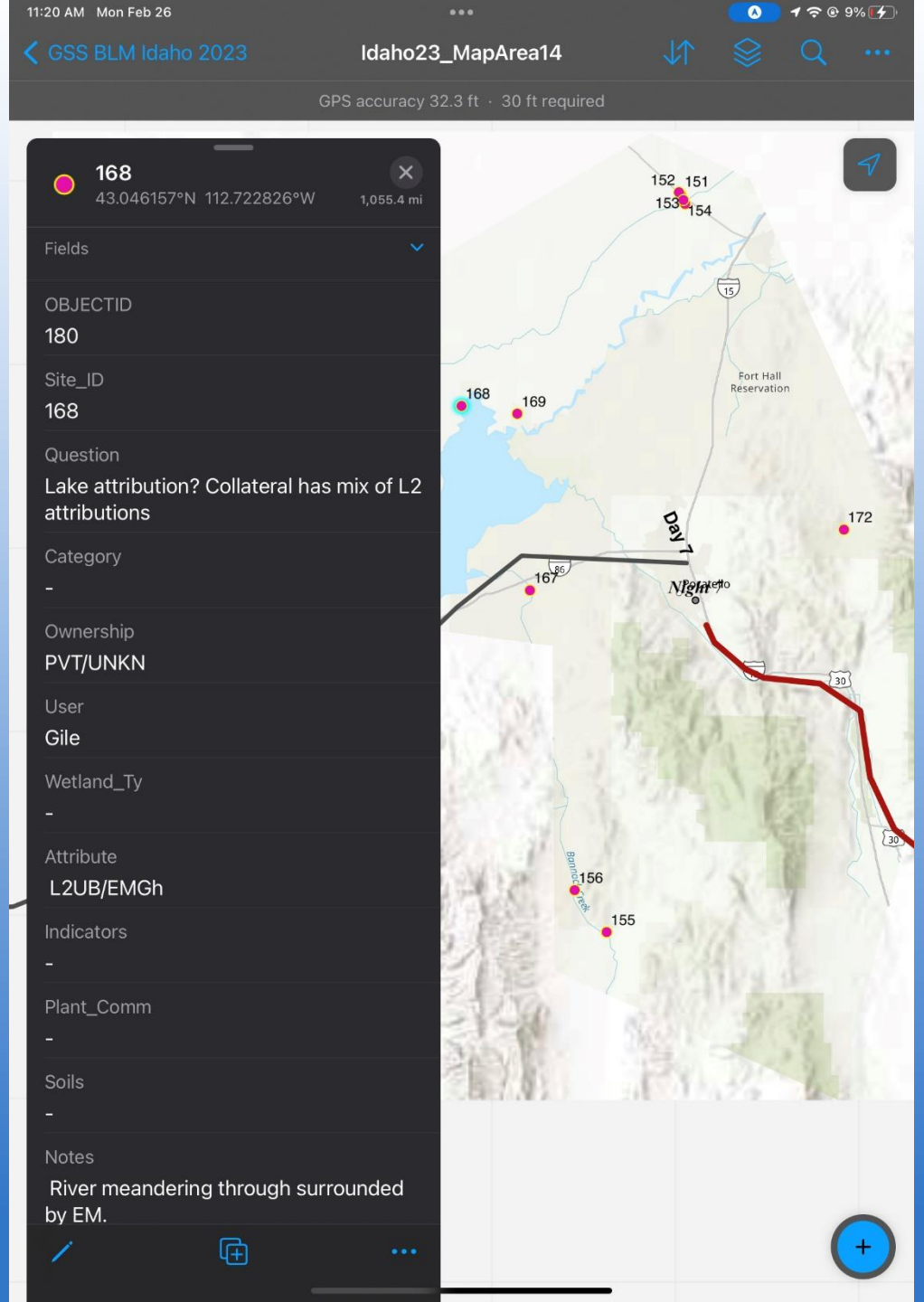
- Esri's ArcGIS Field Maps – "an all-in-one app that uses data-driven maps and mobile forms to help workers perform data capture and editing"
- Also customizable and works offline, on tablets and smartphones
- Links photos and data to geographical points in ArcGIS – no need for follow-up data entry



Saint Mary's University GEOSPATIAL SERVICES

National Association of Wetland Managers





iPad screenshots

11:19 AM Mon Feb 26

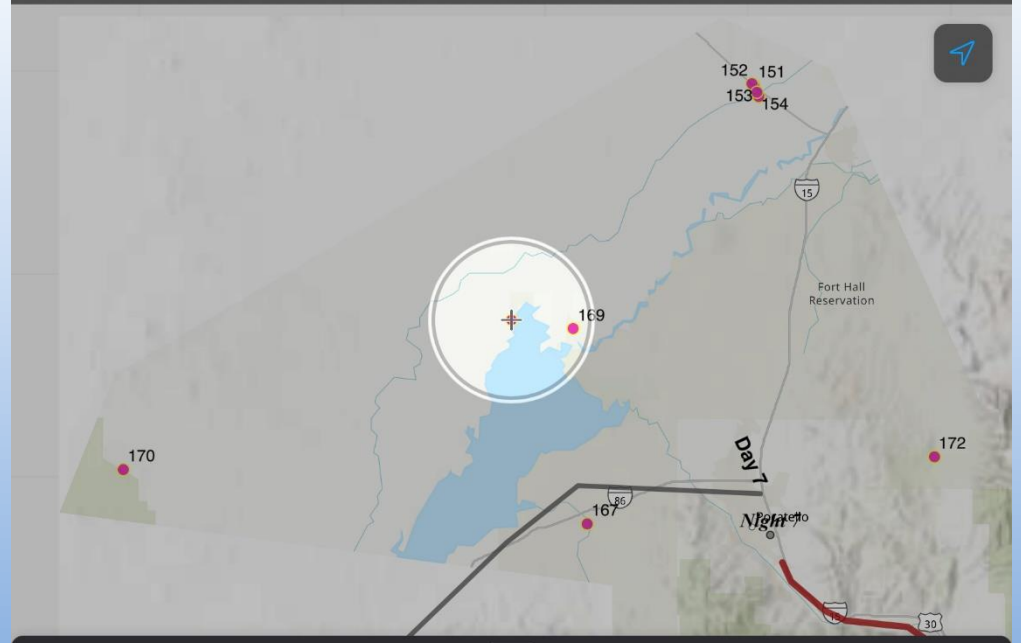
9%

Cancel

Collect

Submit

GPS accuracy 31.8 ft · 30 ft required



168

43.046157°N 112.722826°W

Update Point

Take Photo

Attach

Site_ID *

168

Question *

Lake attribution? Collateral has mix of L2 attributions

Category *

Geospatial Tools for Data Collection - Drones

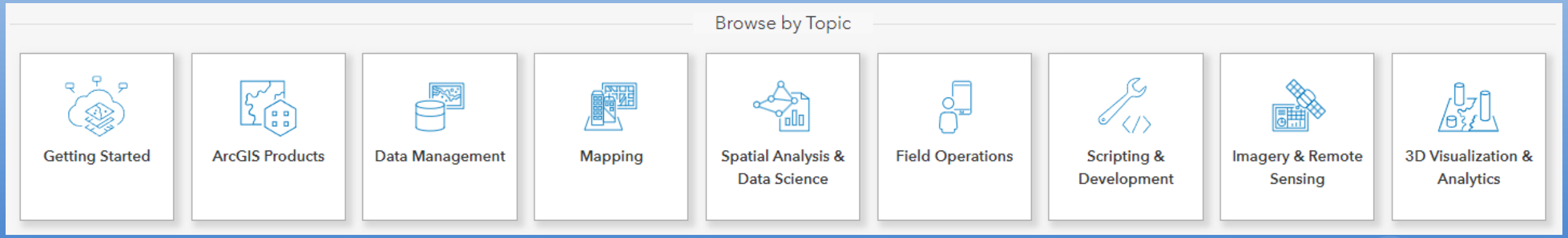
- Drones can:
  - Collect high-resolution images or video, particularly in remote or inaccessible areas
  - Collect additional data such as elevation/topography (e.g., LiDAR)
  - Document and assess impacts from stressors, both sudden events or slow changes over time
- Operation requires a Remote Pilot Certificate from the FAA, with an initial test ($175) and online recertification training every 24 months (free)
- Do they have limitations?
  - Cost
  - Battery life
  - No-fly zones or state/local legal restrictions

Sharing your Data and Telling a Story

- Esri StoryMaps - a customizable, interactive web-based application for sharing maps and spatial data alongside narrative text and multimedia content. Requires an Esri ArcGIS account.
- Tribes have used StoryMaps to share a broad range of topics, including natural resources stewardship. The Pueblo of Sandia, the Snoqualmie Tribe, and the Nez Perce Tribe have created StoryMaps to share river management/restoration projects. The Pyramid Lake Paiute Tribe has a StoryMap presenting their wetlands conservation work.

Getting Access to (and Help With) GIS Software

- All federally recognized tribes are now eligible to receive Esri licenses and training at no cost through a partnership between Esri and the BIA's Branch of Geospatial Support (BOGS). Learn more here.
- Esri offers numerous training videos and online courses.



esri

Saint Mary's University GEOSPATIAL SERVICES

National Association of Wetland Managers

Additional Resources

- BIA Branch of Geospatial Support - provides geospatial software, training and technical assistance to tribes
- National Tribal Geographic Information Support Center (or Tribal GIS) - Online videos, hosts an annual conference (April 29-May 4, 2024 in Albuquerque).
- Geospatial Resources at the EPA - includes links to available data, data viewing applications, and additional federal geospatial resources.
- NAWM webinar recording - "Geospatial Tools and Techniques for Tribal Wetland Programs"
- NAWM Fact Sheets - FAQs: Drones for Wetland Applications and FAQs: Esri's ArcGIS StoryMaps

Kathy Allen
Natural Resource Analyst
GeoSpatial Services
Saint Mary's University of MN
kallen@smumn.edu

Andy Robertson
Executive Director
GeoSpatial Services
Saint Mary's University of MN
aroberts@smumn.edu

Saint Mary's University GEOSPATIAL SERVICES

www.geospatialservices.org

National Association of Wetland Managers