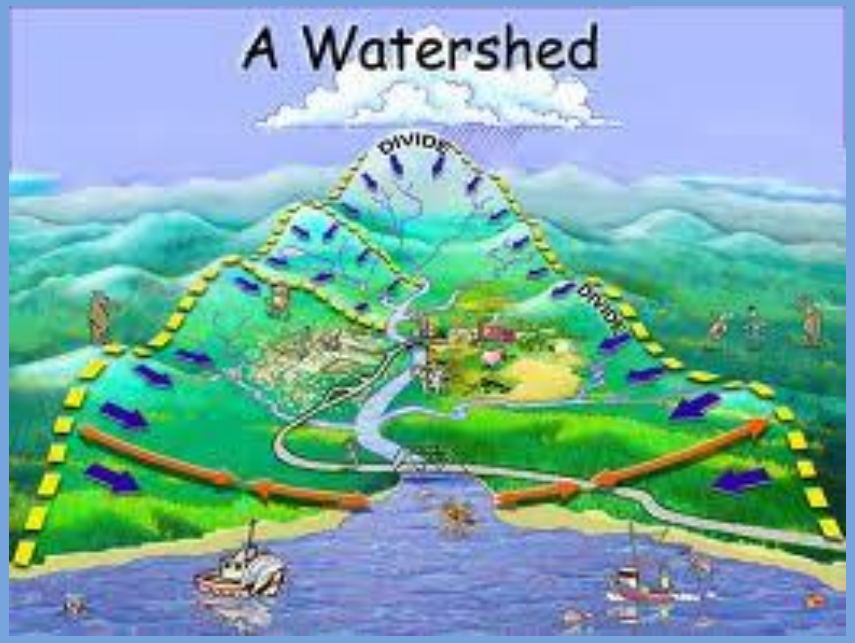
# The North Dakota Watershed Boundary Dataset: A GIS Framework Layer

Ann Fritz
Environmental Scientist
North Dakota Department of Health
Division of Water Quality

- What is the WBD?
  - Acronyms and terminology
- How was it created?
  - what is the data structure?
- What can I do with the data?
- Examples
- Conclusions



# *What is it?*

# WBD = Watershed Boundary Dataset

- A series of nested hierarchical drainage units encompassing all surface area in the nation.
- Each drainage unit is subdivided into uniform areas based on topography and hydrologic principles using Federal Standards.
- Baseline drainage area framework at 1:24,000 scale for the nation *in digital form*.
- Integral part of the NHD: National Hydrography Dataset
- Part of the U.S. Geological Survey *National Map*

# Hydrologic Unit Hierarchy

| NAME | ALIAS | HYDROLOGIC UNIT CODE | CODE | AVERAGE SIZE | EXAMPLE |
|---|---|---|---|---|---|
| Region | 1st level | 2-digit | 09 | 177,560 $mi^2$ | Souris-Red-Rainy |
| Subregion | 2nd level | 4-digit | 0901 | 16,800 $mi^2$ | Souris River |
| Basin | 3rd level | 6-digit | 090100 | 10, 596 $mi^2$ | Souris River |
| Subbasin | 4th level | 8-digit | 09010008 | 703 $mi^2$ | Moose Mountain Creek-Souris River |
| Watershed | 5th level | 10-digit | 0901000811 | 63 to 391 $mi^2$ (40,000 to 250,000 acres) | Oak Creek-Souris River |
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| | 7th and 8th | 14 and 16 digit | | < 16 $mi^2$ | |

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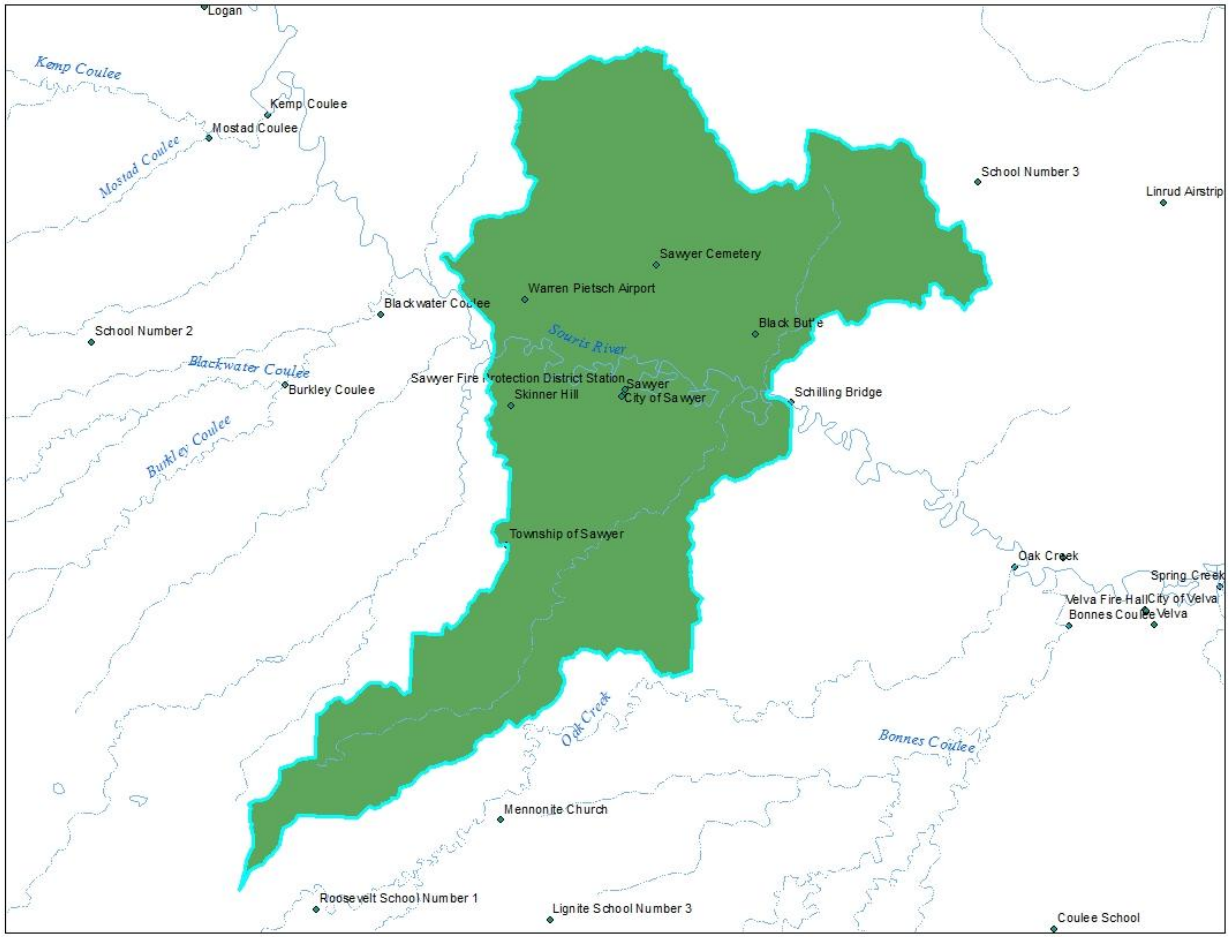

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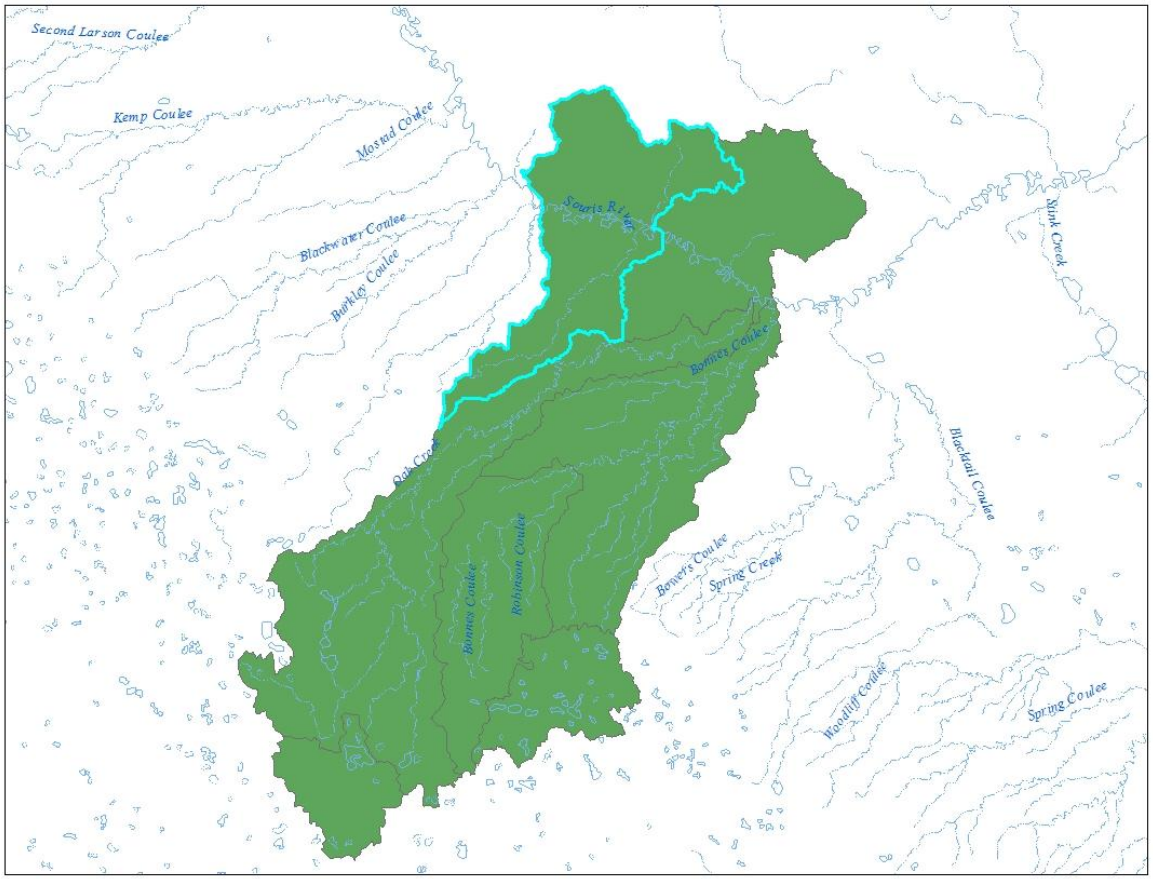

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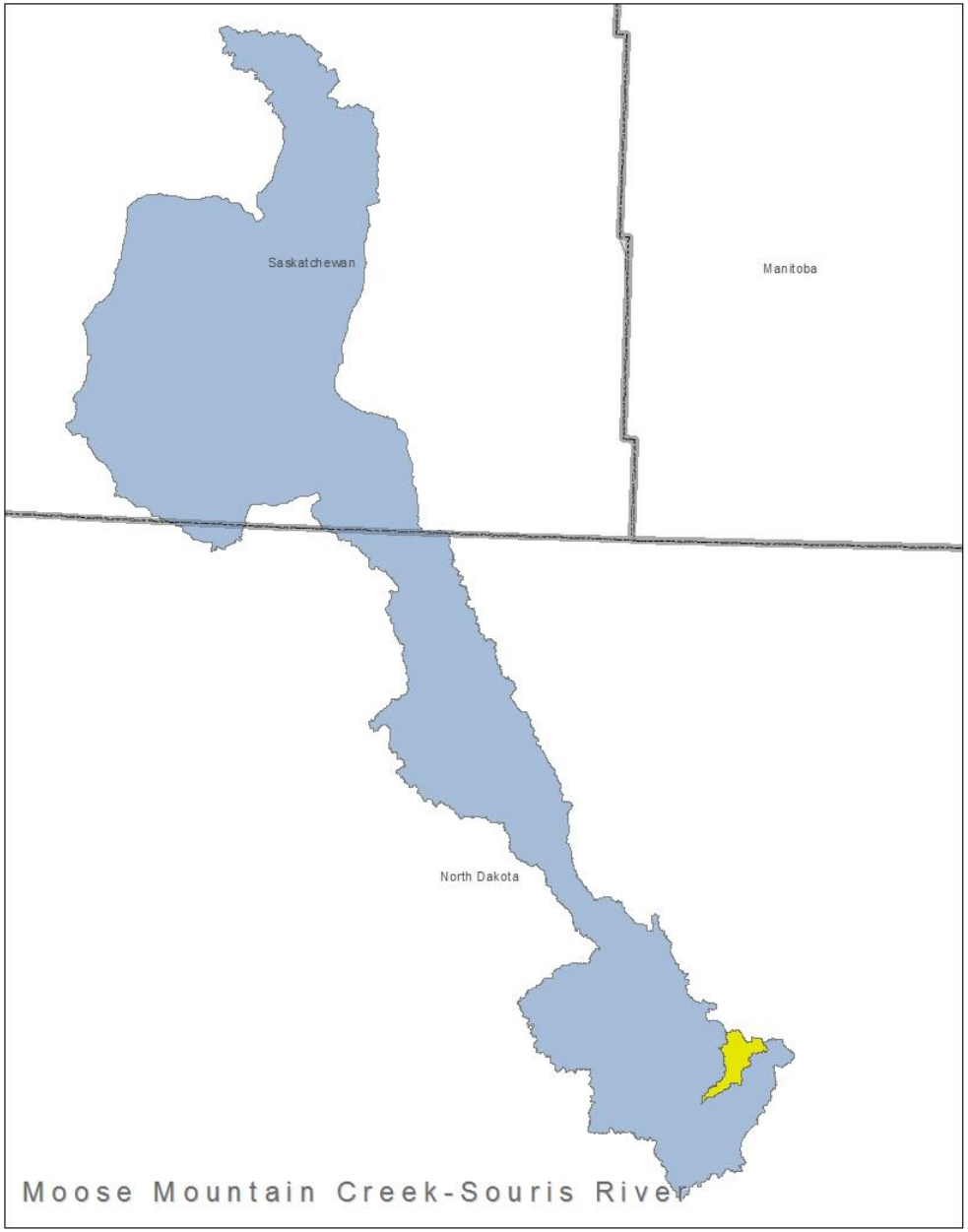
# Hydrolo

| NAME | AL | | EXAMPLE |
|---|---|---|---|
| Region | 1st | | Souris-Red-Rainy |
| Subregion | 2nd | | Souris River |
| Basin | 3rd | | Souris River |
| Subbasin | 4th | | Moose Mountain Creek-Souris River |
| Watershed | 5th | | Oak Creek-Souris River |
| Subwatershed | 6th | | City of Sawyer-Souris River |
| | 7th 8 | | |



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|---|---|---|
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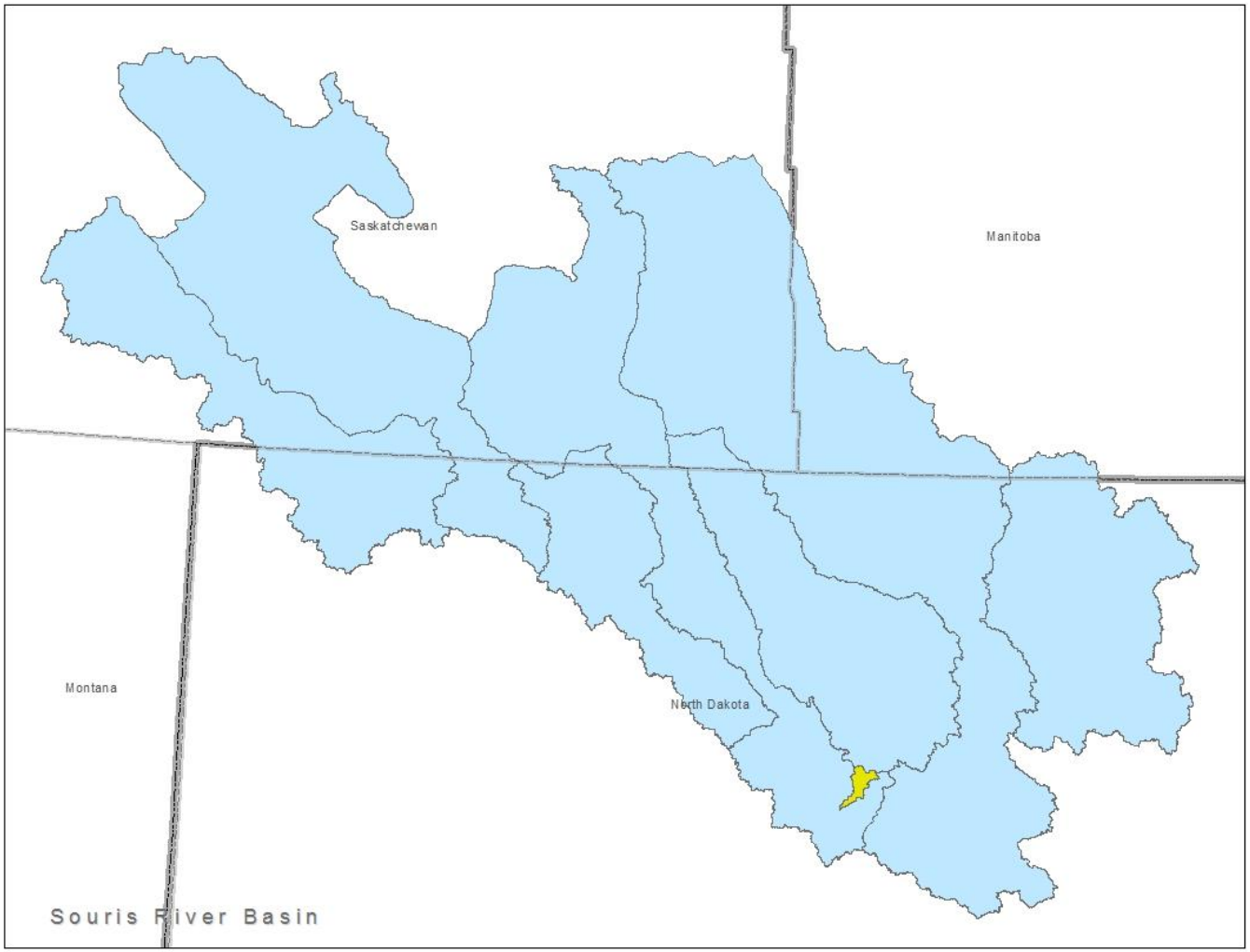
| Subregio | | is River |
| Basin | | is River |
| Subbasi | | oose<br>ain Creek-<br>is River |
| Watersh | | eek-Souris<br>iver |
| Subwaters | | Sawyer-<br>is River |
| | | |



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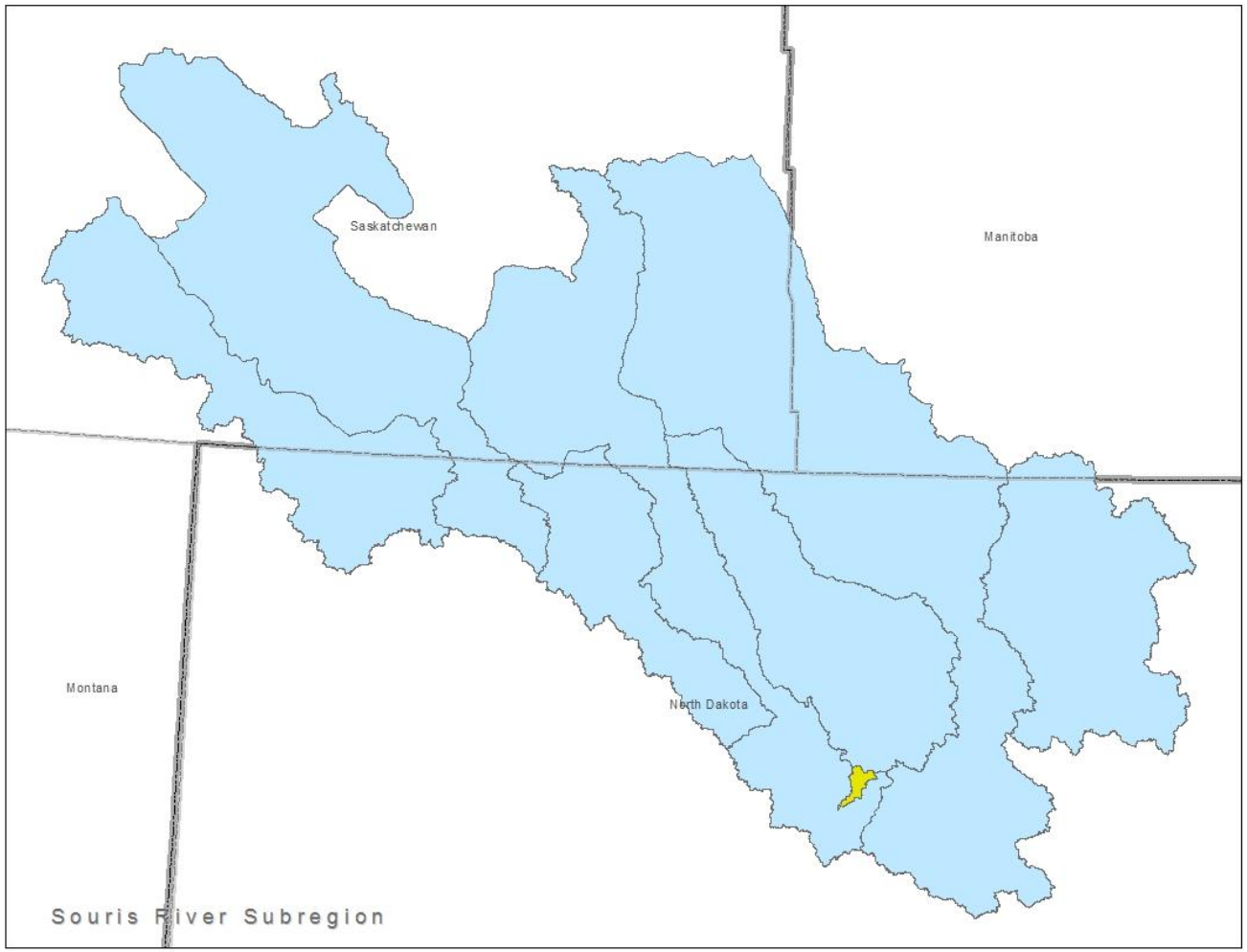

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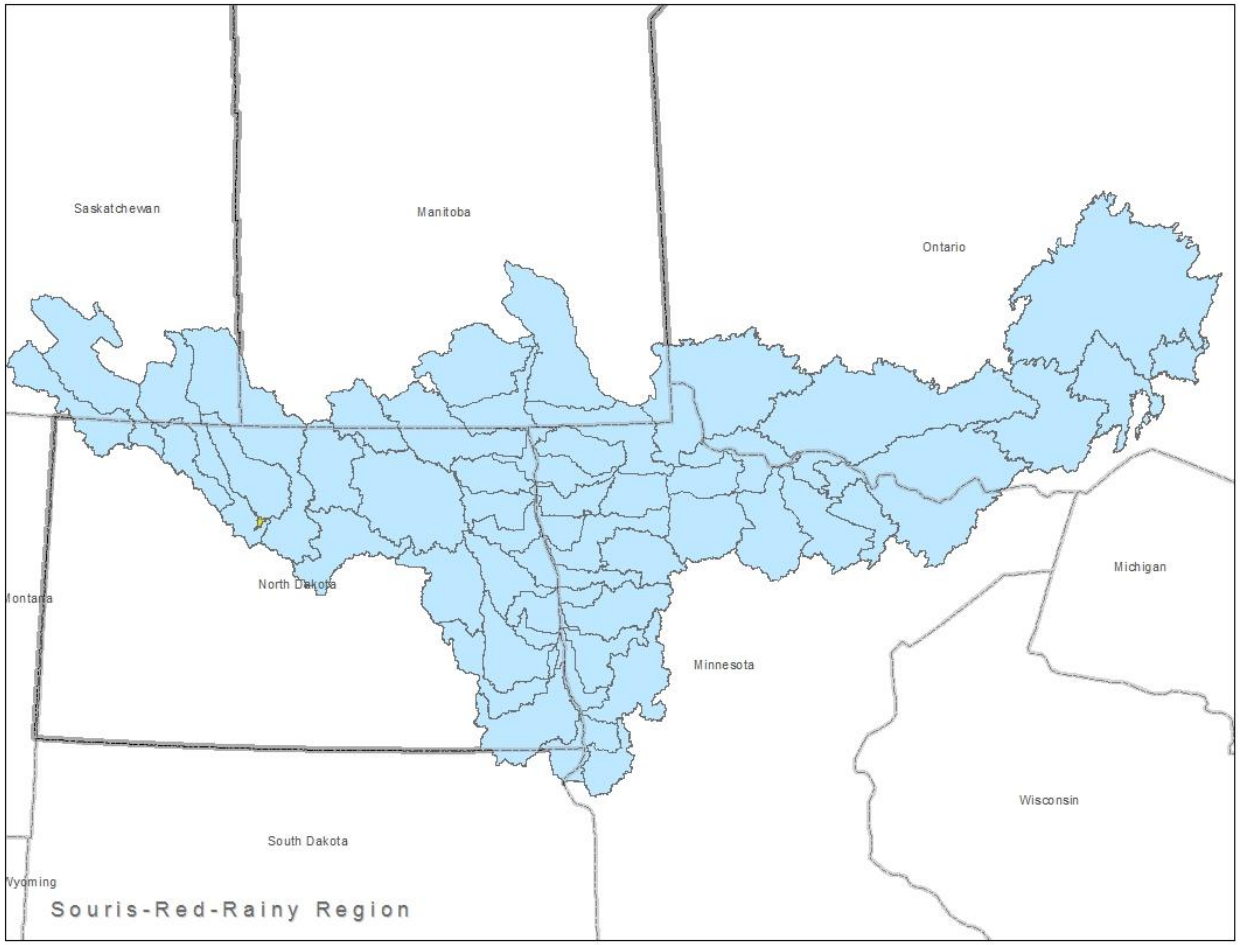


*HOW was it created?*

# Standards, Certification & Updates

Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD), By the U.S. Geological Survey and U.S. Department of Agriculture, Natural Resource Conservation Service

Chapter 3 of Section A, Federal Standards, Book 11, Collection and Delineation of Spatial Data.

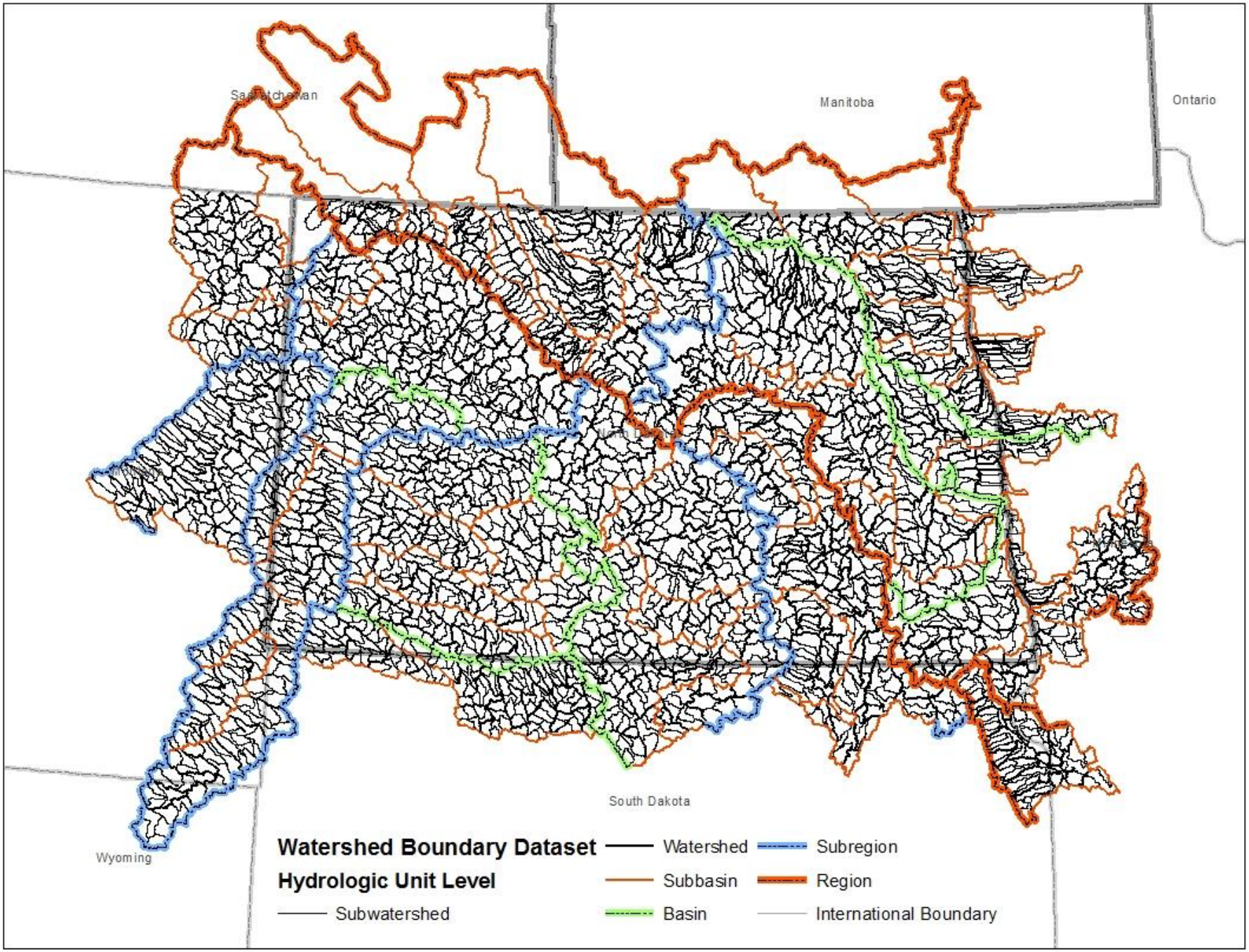
Techniques and Methods 11-A3; Third Edition, 2012

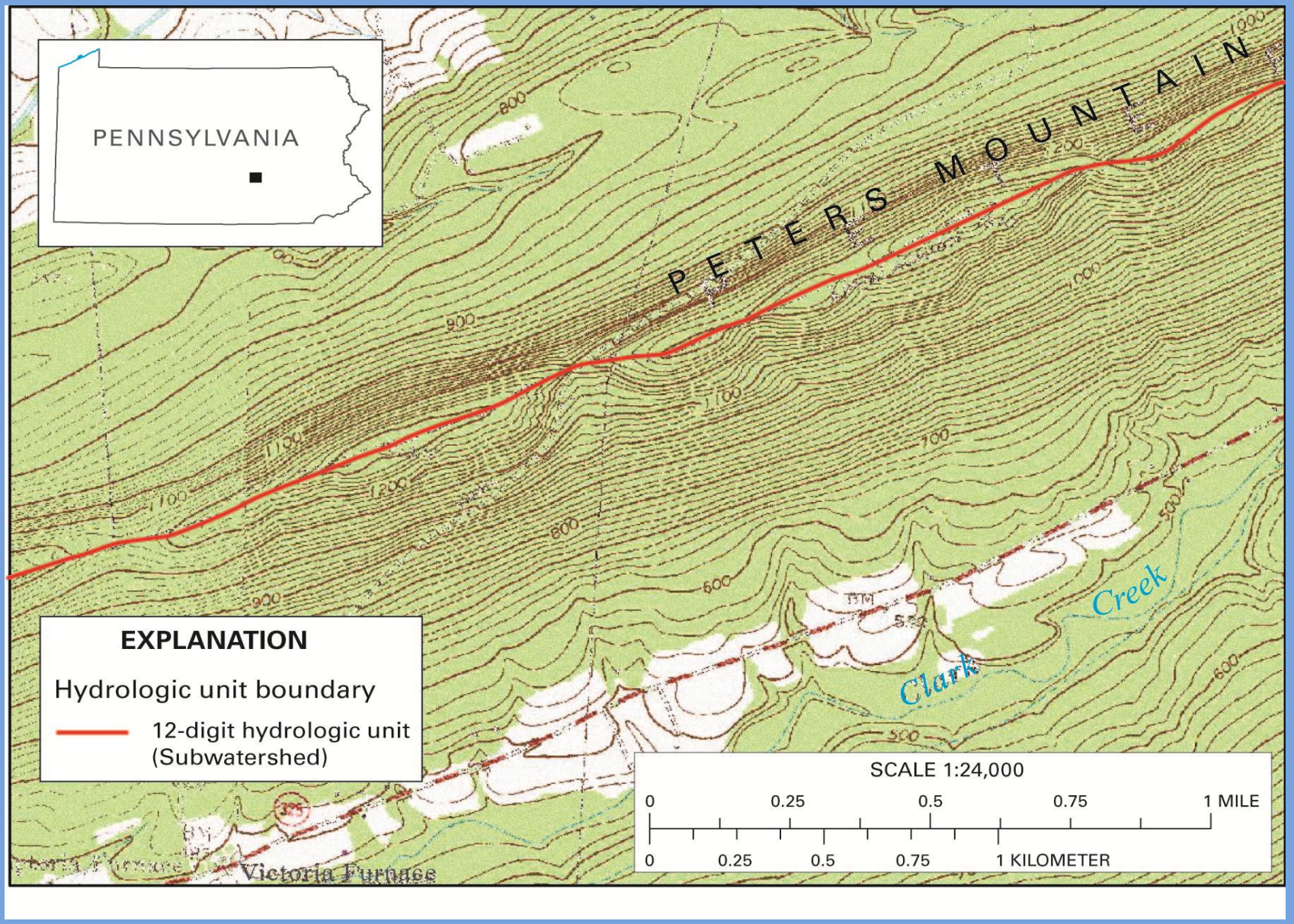
# *WHO created the WBD?*

- North Dakota Cooperators (signed MOU)
  - ND Dept. of Health
  - ND State Water Commission
  - ND Geological Survey
  - U.S. Forest Service - Dakota Prairie Grasslands
  - U.S. Geological Survey
  - U.S. Dept. of Agriculture - Natural Resource Conservation Service

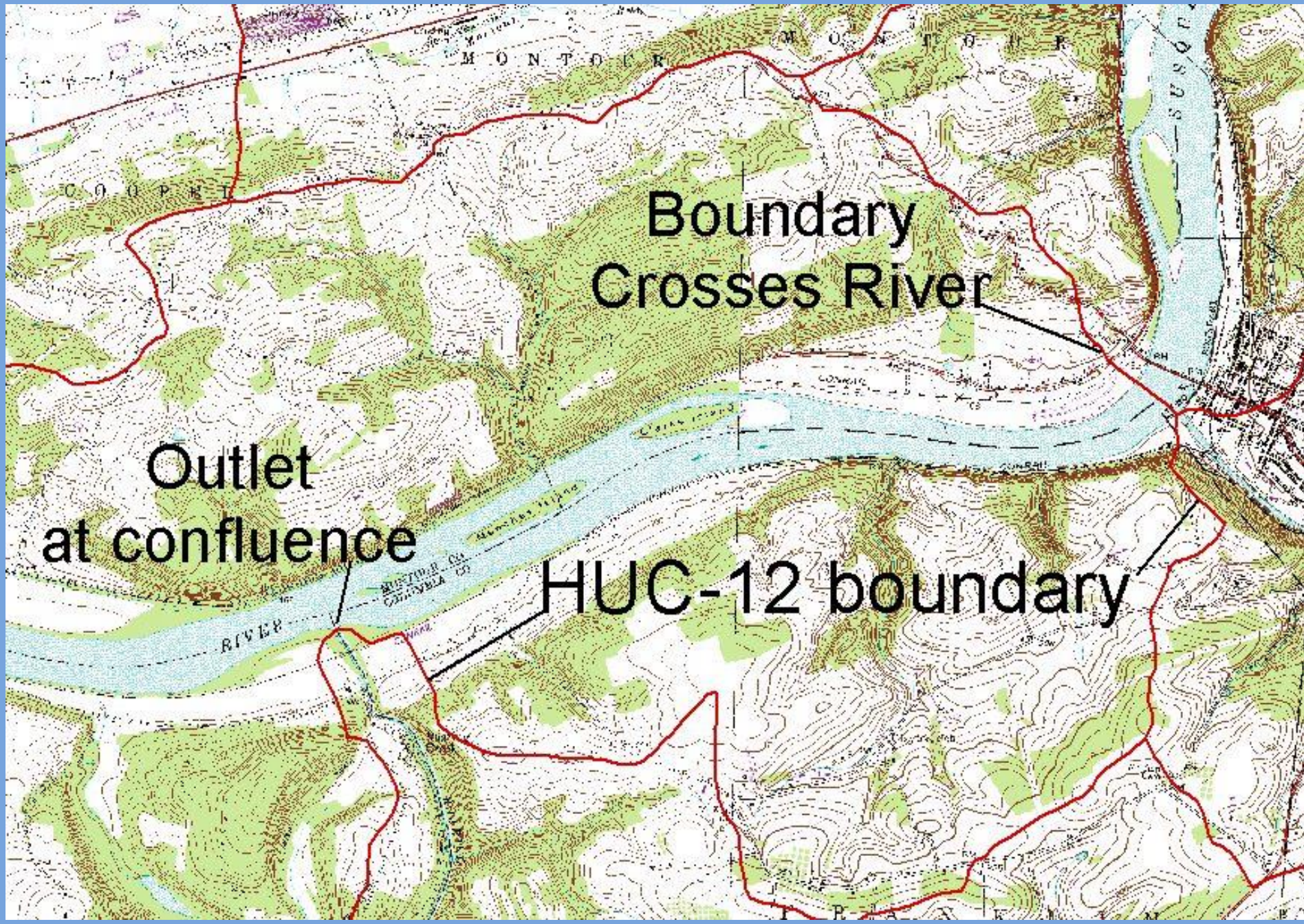
- International Cooperators
  - Manitoba Water Stewardship
  - Saskatchewan Water Stewardship
  - Canadian Agri-Environment Services Branch - PFRA
- Regional Cooperators
  - Minnesota Department of Natural Resources
  - U.S. Geological Survey – MN Water Science Center
  - U.S. Geological Survey – SD Water Science Center
  - U.S. Forest Service - Dakota Prairie Grasslands
  - U.S. Dept. of Agriculture - Natural Resource Conservation Service (MT, ND, SD state offices)

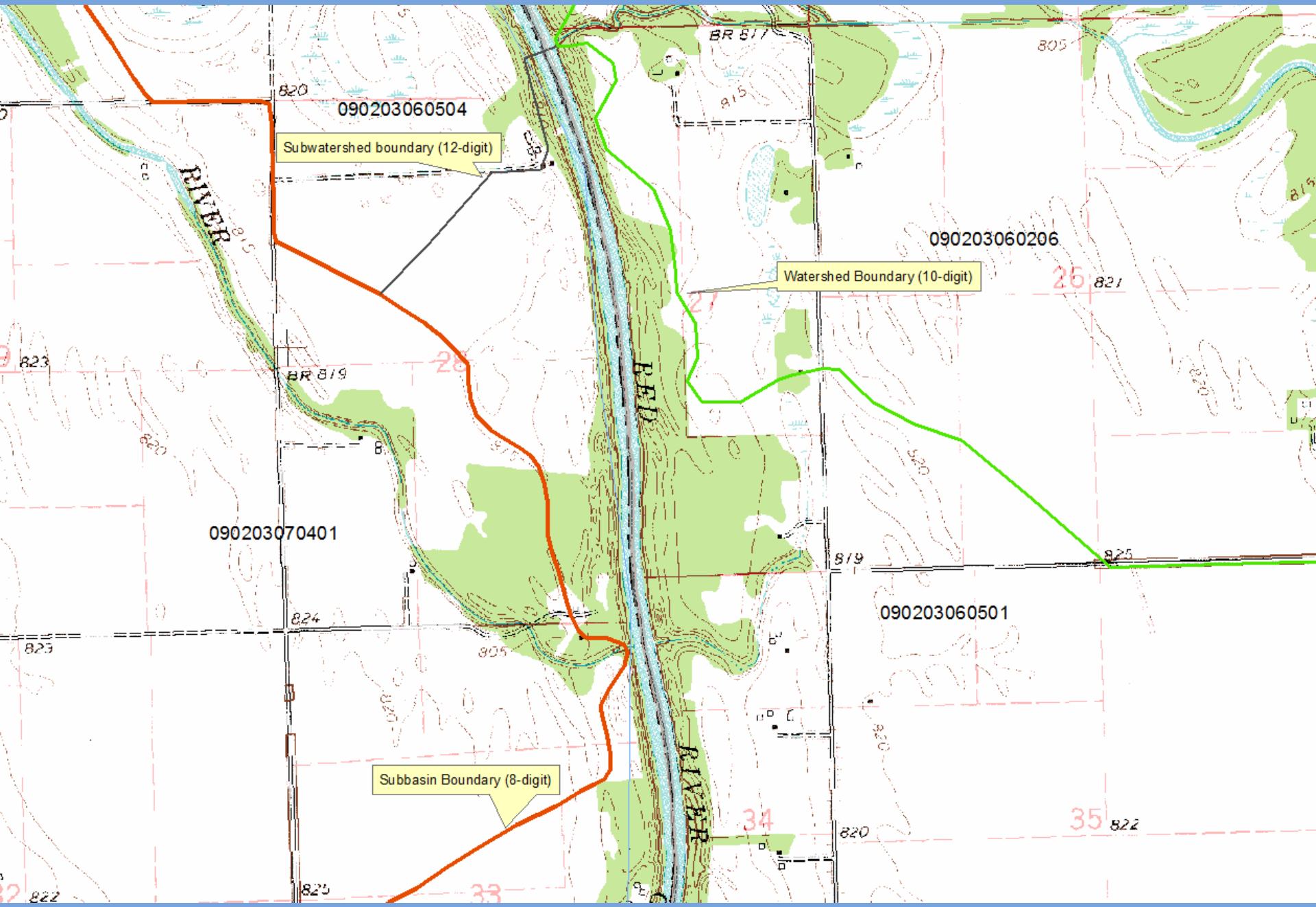
Additional technical or financial support provided by U.S. Bureau of Reclamation, ND GISTC Data Acquisition Funds, EPA Consolidated Funding Grant, and EPA National Environmental Information Exchange Network grants.


Saskatchewan
Manitoba
Ontario
South Dakota
Wyoming
Watershed Boundary Dataset
Hydrologic Unit Level
Subwatershed
Watershed
Subbasin
Basin
Subregion
Region
International Boundary




Followed Federal Standards for delineation, 1:24K map accuracy standards


Boundary
Crosses River
Outlet
at confluence
HUC-12 boundary


090203060504
Subwatershed boundary (12-digit)
090203060206
Watershed Boundary (10-digit)
090203070401
090203060501
Subbasin Boundary (8-digit)
RED RIVER
BR 819

# Polygon Attribute Fields

| Field Name | Definition | example |
|---|---|---|
| HUC_X | Numeric identifier for each level (2,4,6,8,10, and 12) of hydrologic units | |
| HUC_X_NAME | Name assigned to each level (2,4,6,8,10, and 12) of hydrologic units | |
| HU_X_TYPE | Geomorphic and other considerations used to develop the hydrologic unit. | S, C, F, M, W, I |
| HU_X_MOD | Two-character, uppercase abbreviation(s) for either (1) the type of modification to natural overland flow that alters the location of the boundary or (2) the special conditions GF-ground-water flow, GL-glacier, IF-ice field, OF-overbank flow, KA-karst, NC-noncontributing area, and IT-interbasin transfer that may exist in the unit. | AW, DM, LE, MA, NM, UA, RC*, WD* |
| NContrib_Acres | Area that does not flow toward the outlet of a hydrologic unit. | |
| HU_X_DS | Downstream unit; new data model will have FROM_HUC and TO_HUC | |
| STATES | States that the unit is located. | MT,ND,CAN |
| META_ID | identification of metadata, state postal code followed by numeric designation | ND10 |

Line Attribute Fields

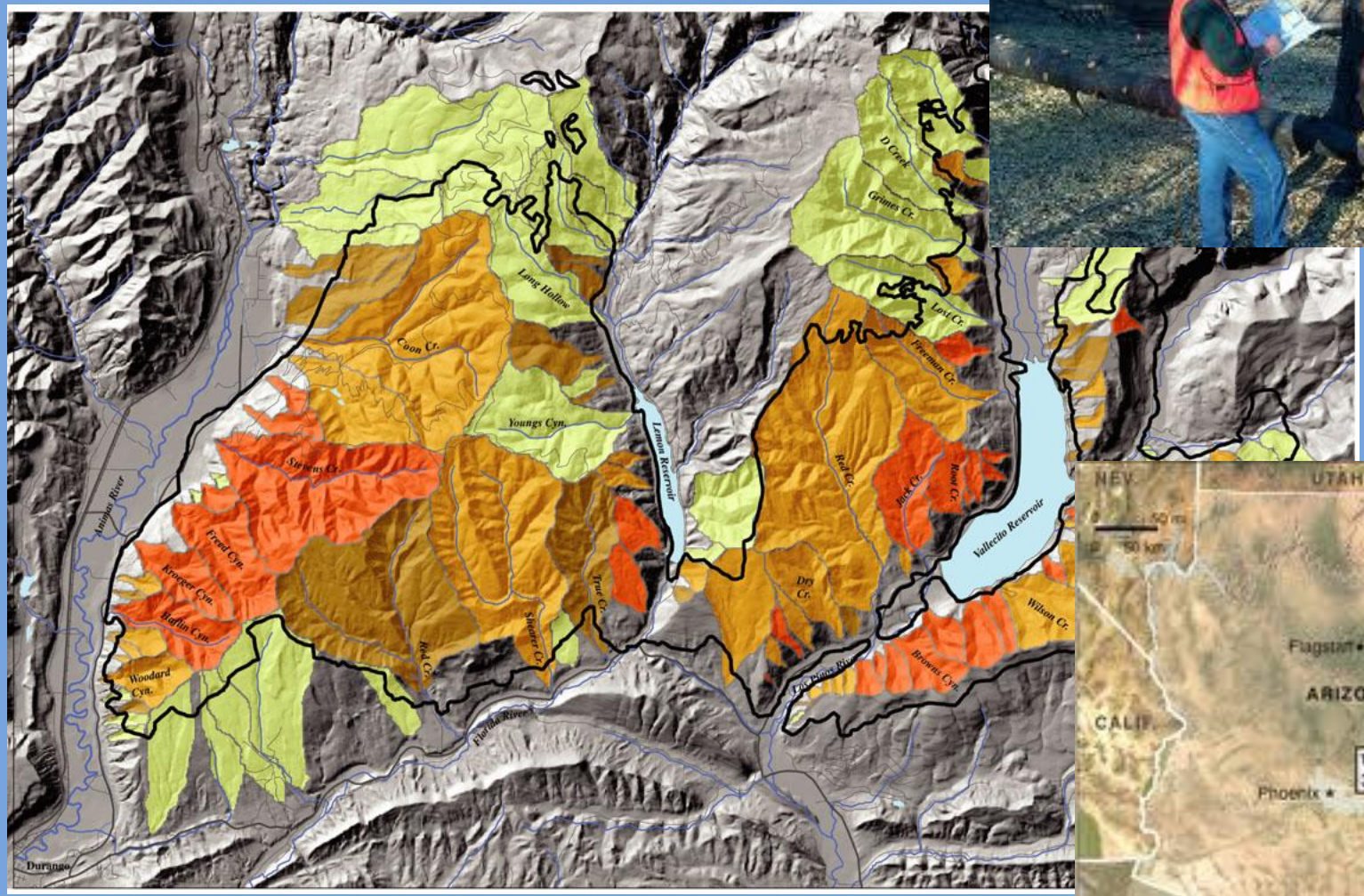
| Field Name | Definition | example |
|---|---|---|
| HU_LEVEL | Numeric identifier for each level of hydrologic units | 1,2, 3, 4, 5, 6, 7, 8 |
| LINESOURCE | Code for the base data used for delineation of hydrologic unit boundaries which indicates if the line was created using digital raster graphics, imagery, LiDAR or some other data source. | DRG24,NAIP2010 |
| HU_MOD | Two character abbreviation used to track special conditions applied to a specific boundary line segment. If more than one modification is used, they are listed in order of importance. | TF, AW, UA, DM |
| META_ID | identification of metadata, state postal code followed by numeric designation | ND10 |

# *WHAT can I do with the WBD?*

**Three Primary Functions Supported by the WBD**

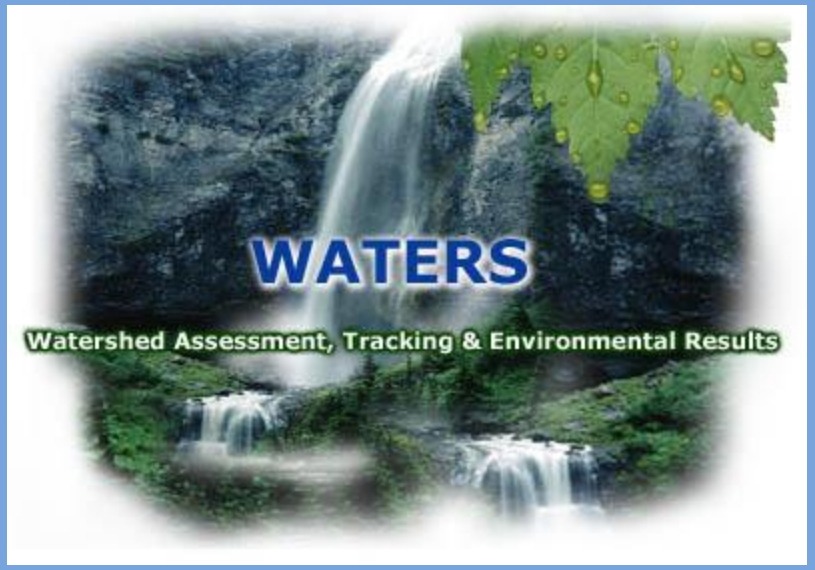
- **Water Accounting**: Assignment of a detailed, unambiguous address to any point or area in the United States small enough to be relevant to local, state and national programs and water resource initiatives
- **Depict the flow of water through the landscape**: The network connectivity of each nested level is identified within the structure of the WBD. This allows easy identification of all upstream and downstream drainage units at multiple spatial scales
- **The aggregation of Basin characteristics**: Both vertical and horizontal integration with other component datasets. The WBD will easily integrate and be interoperable with other national and local datasets

# *post-wildfire landslide analysis*



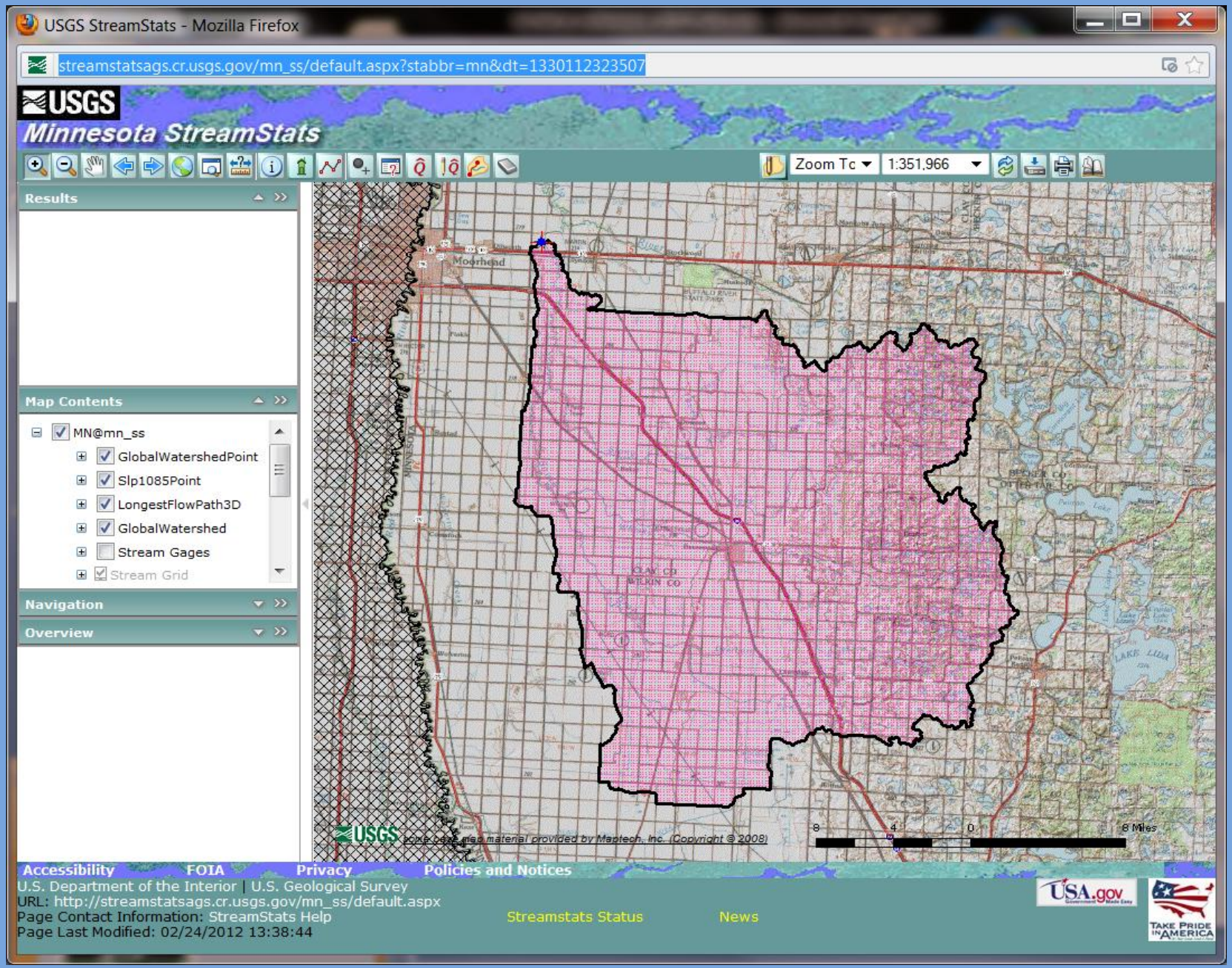
define conditions for fire-related debris flow occurrence and develop a basin-scale model for debris flow probability.

# *WBD and NHD are backbone of...*




**WATERS (Watershed Assessment, Tracking & Environmental ResultS)** unites water quality information that was previously available only from several independent and unconnected databases.

EPA gathers water quality information to address public concerns such as: How healthy is my watershed?
Can I drink the water?
Can I eat the fish?
Is it safe to swim in the water?




Interactive mapping of drainage area to a point

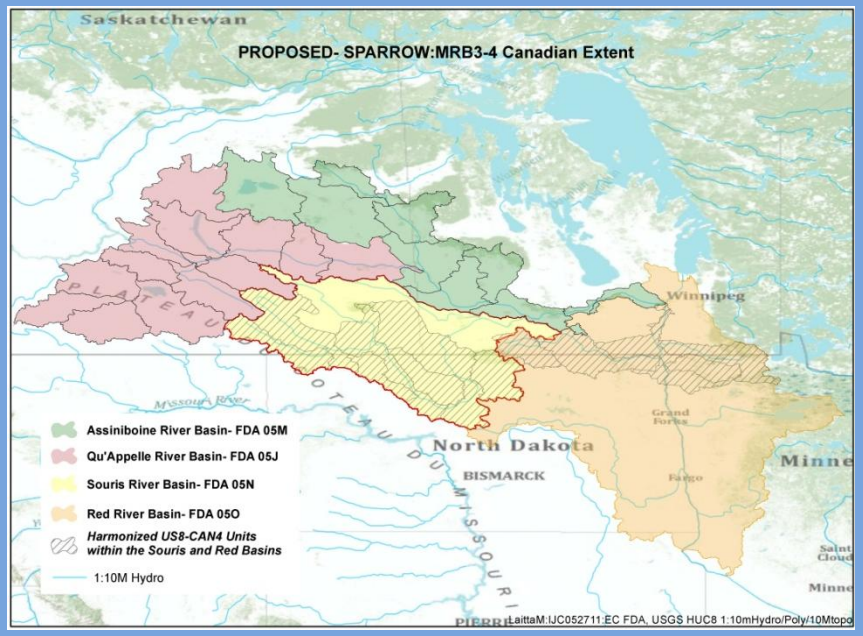
# SPARROW Modeling of the Red, Souris and Assiniboine - Summary

**The problem:**

- Water quality (nutrients) a persistent problem in the Red-Assiniboine basin and L. Winnipeg
- Questions as to nutrient loads across the borders and total loads to L. Winnipeg, mitigation strategies etc.
- IJC – relatively new movement into WQ modeling (compared to Hydraulic, etc.)

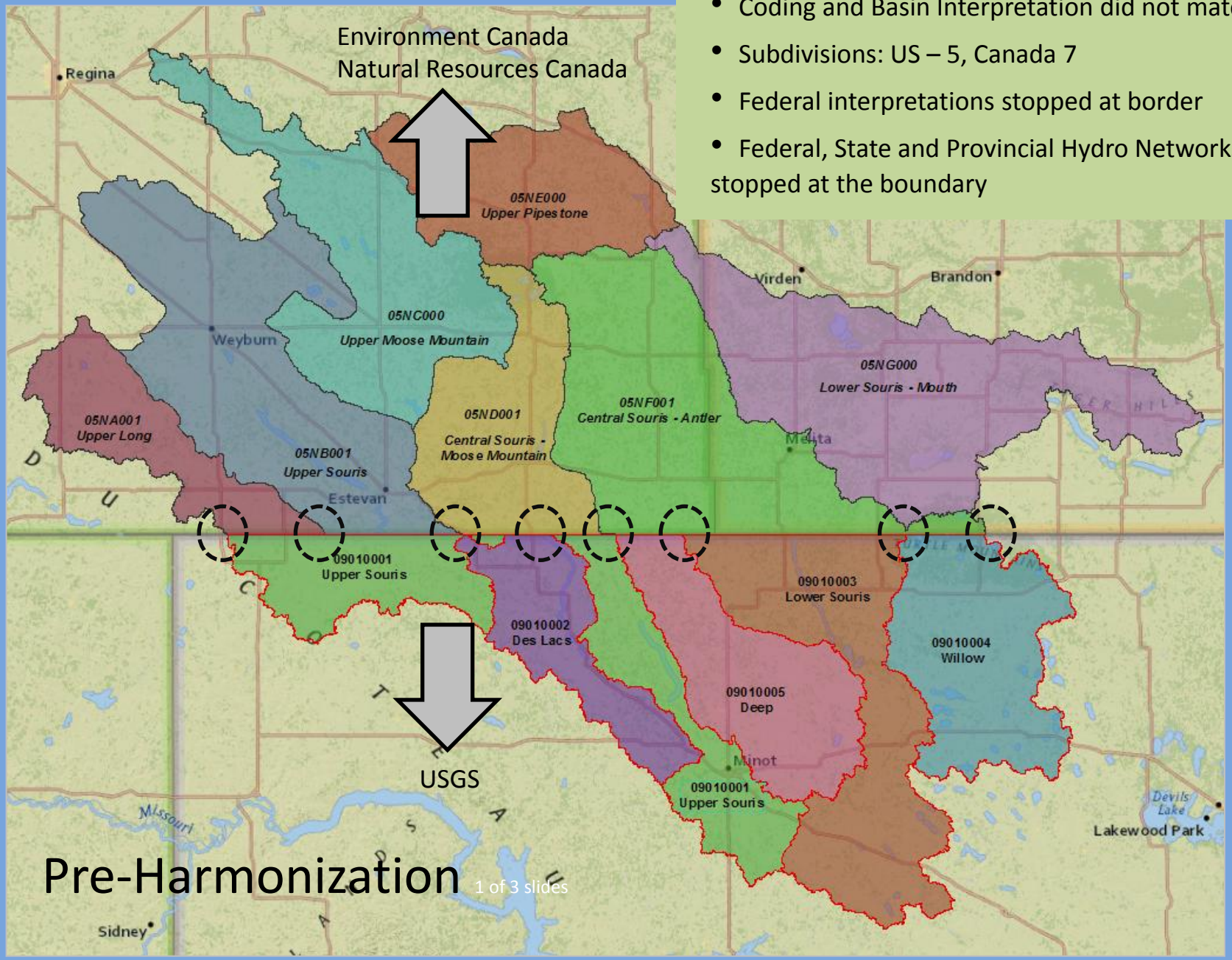
**The project:**

- International Watersheds Initiative (IWI) – bi-national integrated approach to investigating water quality issues in Red-Assiniboine basin.
- Pilot system to demonstrate utility of the USGS SPARROW Water Quality Model in bi-national and Canadian context
- Build on IWI hydrographic and geospatial harmonization project and associated expertise
- Project ongoing – overview of model and progress thus far



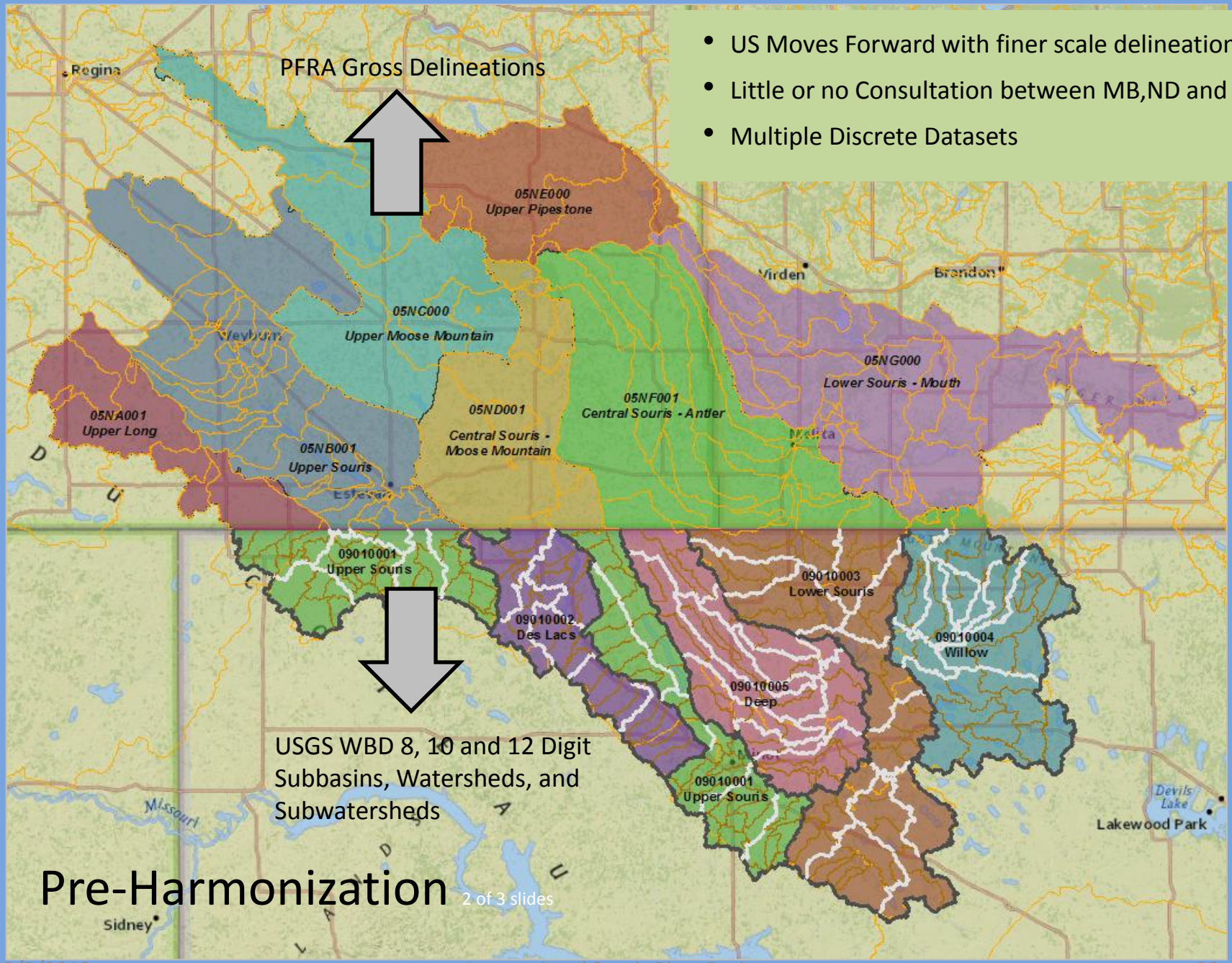

SPARROW models can be used to explain spatial patterns in monitored stream-water quality in relation to human activities and natural processes as defined by detailed geospatial information. Previous SPARROW applications have identified the sources and transport of nutrients in the Mississippi River basin, Chesapeake Bay watershed, and other major drainages of the United States.

- Coding and Basin Interpretation did not match
- Subdivisions: US – 5, Canada 7
- Federal interpretations stopped at border
- Federal, State and Provincial Hydro Networks stopped at the boundary




# Pre-Harmonization

1 of 3 slides




- US Moves Forward with finer scale delineations
- Little or no Consultation between MB,ND and SK
- Multiple Discrete Datasets

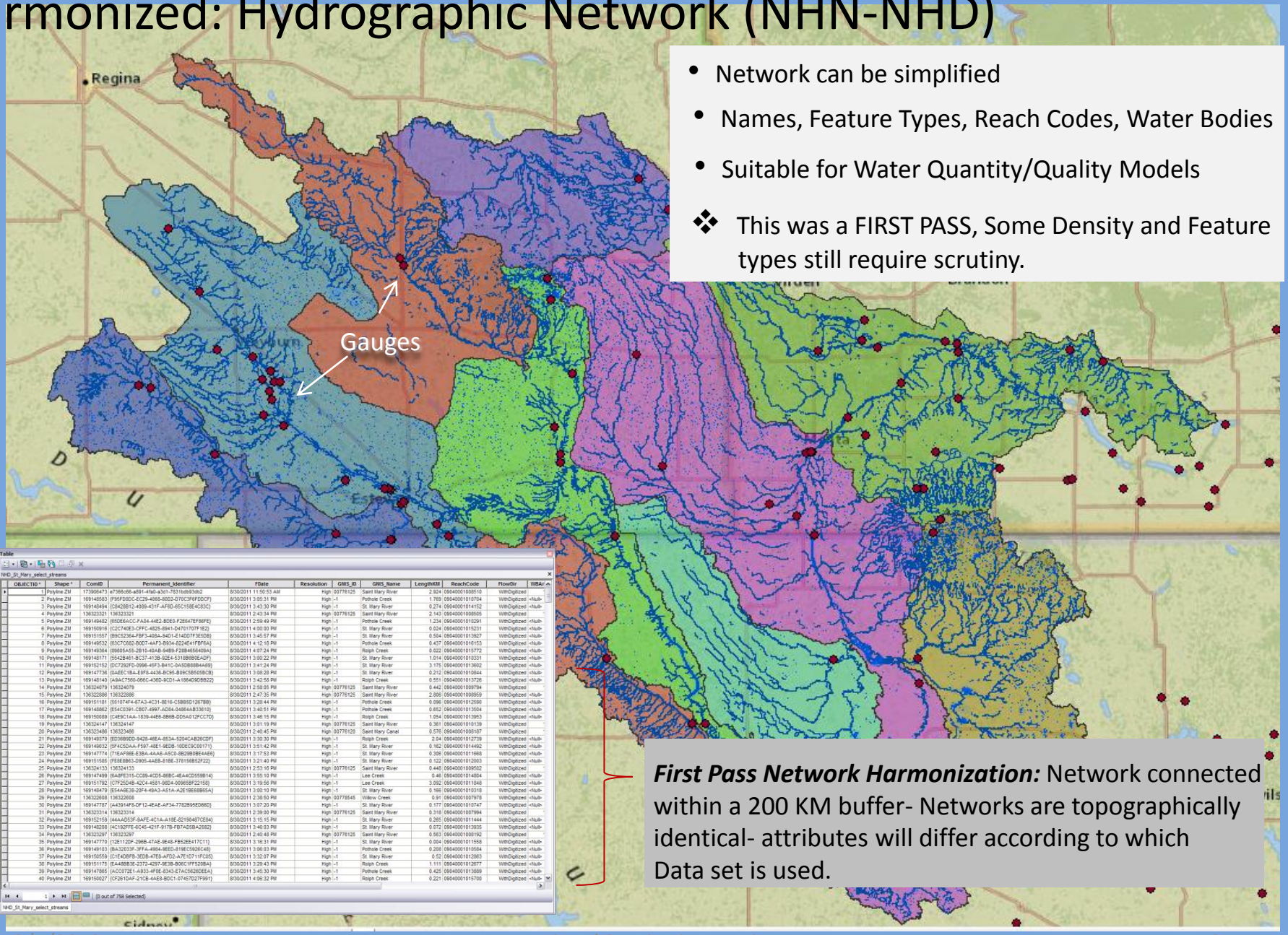
# Pre-Harmonization

2 of 3 slides

# Harmonized: Hydrographic Network (NHN-NHD)

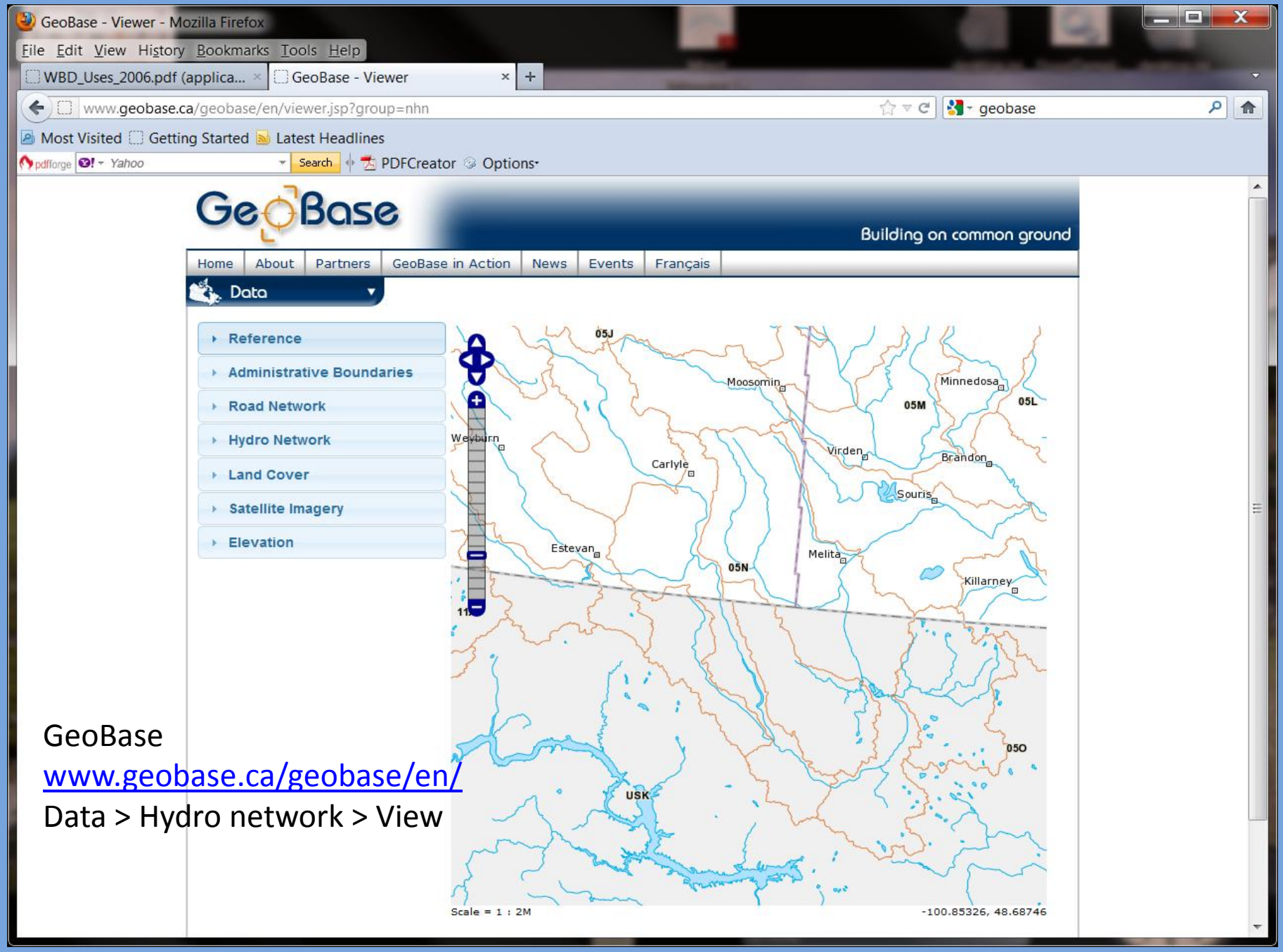
- Network can be simplified
- Names, Feature Types, Reach Codes, Water Bodies
- Suitable for Water Quantity/Quality Models

❖ This was a FIRST PASS, Some Density and Feature types still require scrutiny.





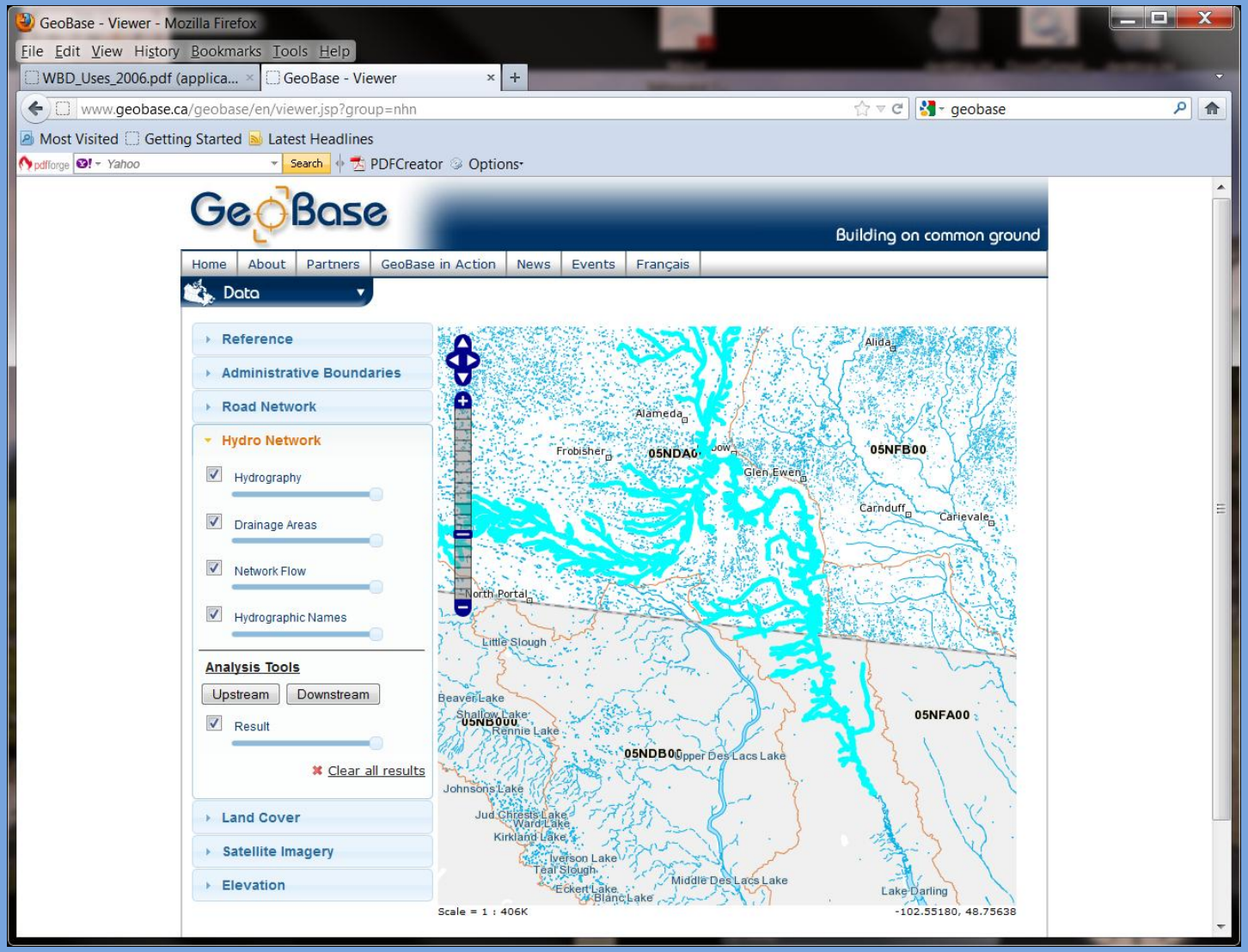

***First Pass Network Harmonization:*** Network connected within a 200 KM buffer- Networks are topographically identical- attributes will differ according to which Data set is used.

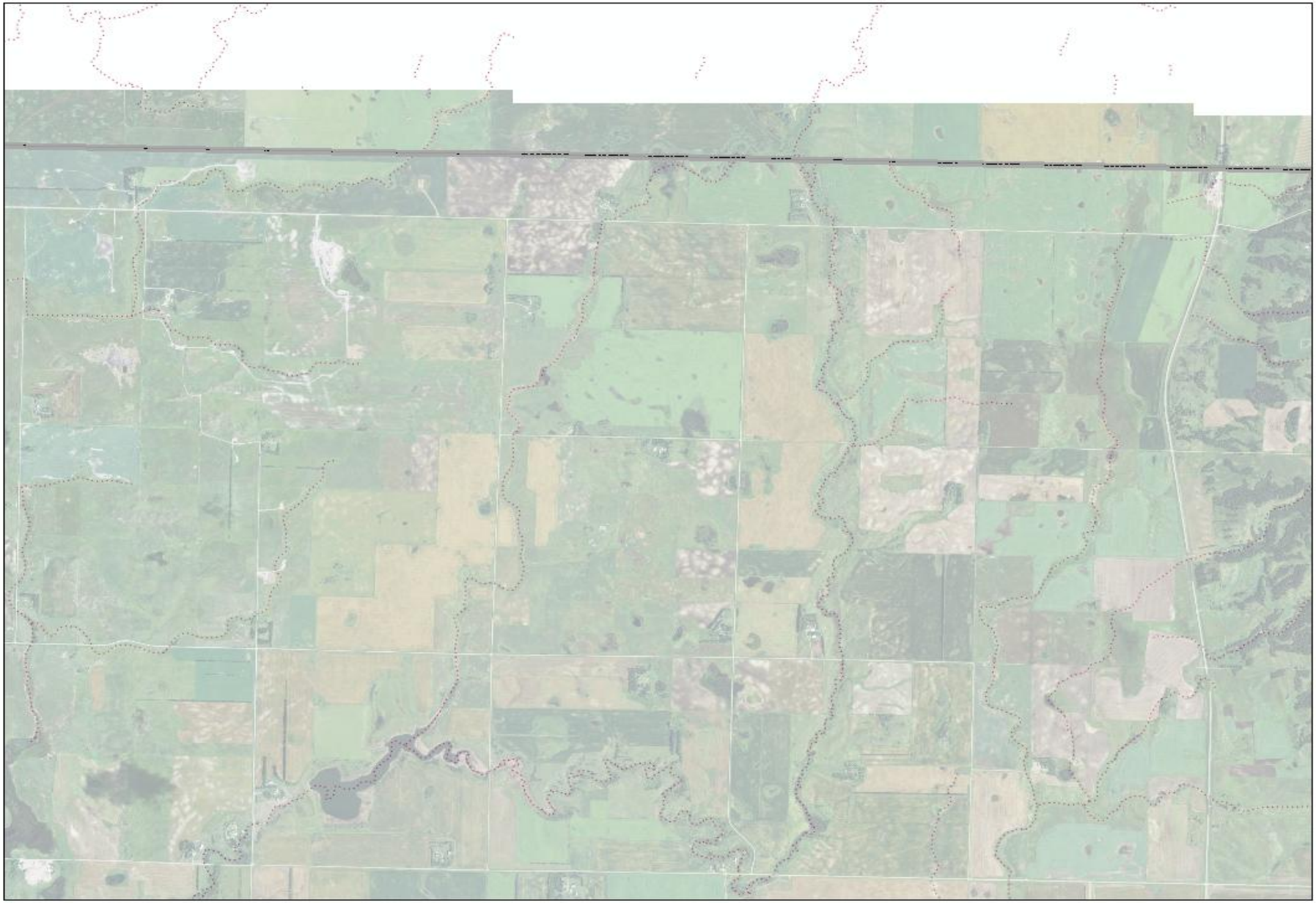



GeoBase

[www.geobase.ca/geobase/en/](www.geobase.ca/geobase/en/)

Data > Hydro network > View


GeoBase - Viewer - Mozilla Firefox
File Edit View History Bookmarks Tools Help
WBD_Uses_2006.pdf (applica...
GeoBase - Viewer
www.geobase.ca/geobase/en/viewer.jsp?group=nhn
geobase
Most Visited
Getting Started
Latest Headlines
Search
PDFCreator
Options
GeoBase
Building on common ground
Home
About
Partners
GeoBase in Action
News
Events
Français
Data
Reference
Administrative Boundaries
Road Network
Hydro Network
Hydrography
Drainage Areas
Network Flow
Hydrographic Names
Analysis Tools
Upstream
Downstream
Result
Clear all results
Land Cover
Satellite Imagery
Elevation
Alida
Alameda
Frobisher
05NDA00
05NFB00
Glen Ewen
Carnduff
Carievale
North Portal
Little Slough
Beaver Lake
Shallow Lake
05NB000
Rennie Lake
05NDB00
Upper Des Lacs Lake
05NFA00
Johnsons Lake
Jud Christs Lake
Ward Lake
Kirkland Lake
Iverson Lake
Teal Slough
Eckert Lake
Blanc Lake
Middle Des Lacs Lake
Lake Darling
Scale = 1 : 406K
-102.55180, 48.75638



add GeoBase Hydro Network to ArcGIS map document using WMS (Web Mapping Service)

- WBD is surface area drainage for the nation.
- WBD provides framework data for the federal and state agencies that deal with natural resources.
- WBD was consistently created across the nation using Federal Standards.

- *We're all on the same page*

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