NSGIC – EDH for 3DNHD Webinar

Exploring the Development and Maintenance of Indiana's Local-Resolution National Hydrography and Watershed Boundary Data

Presented By:

Megan Compton, Indiana GIO – NHD Steward

David Knipe, Indiana DNR – Acting Assistant Director, Engineering Section Manager

Susan Phelps, AECOM – Indiana Local-Res NHD & WBD Contractor

July 21, 2021

3:00 – 4:00 pm

Exploring the Development and Maintenance of Indiana's Local-Resolution National Hydrography Data - TOPICS

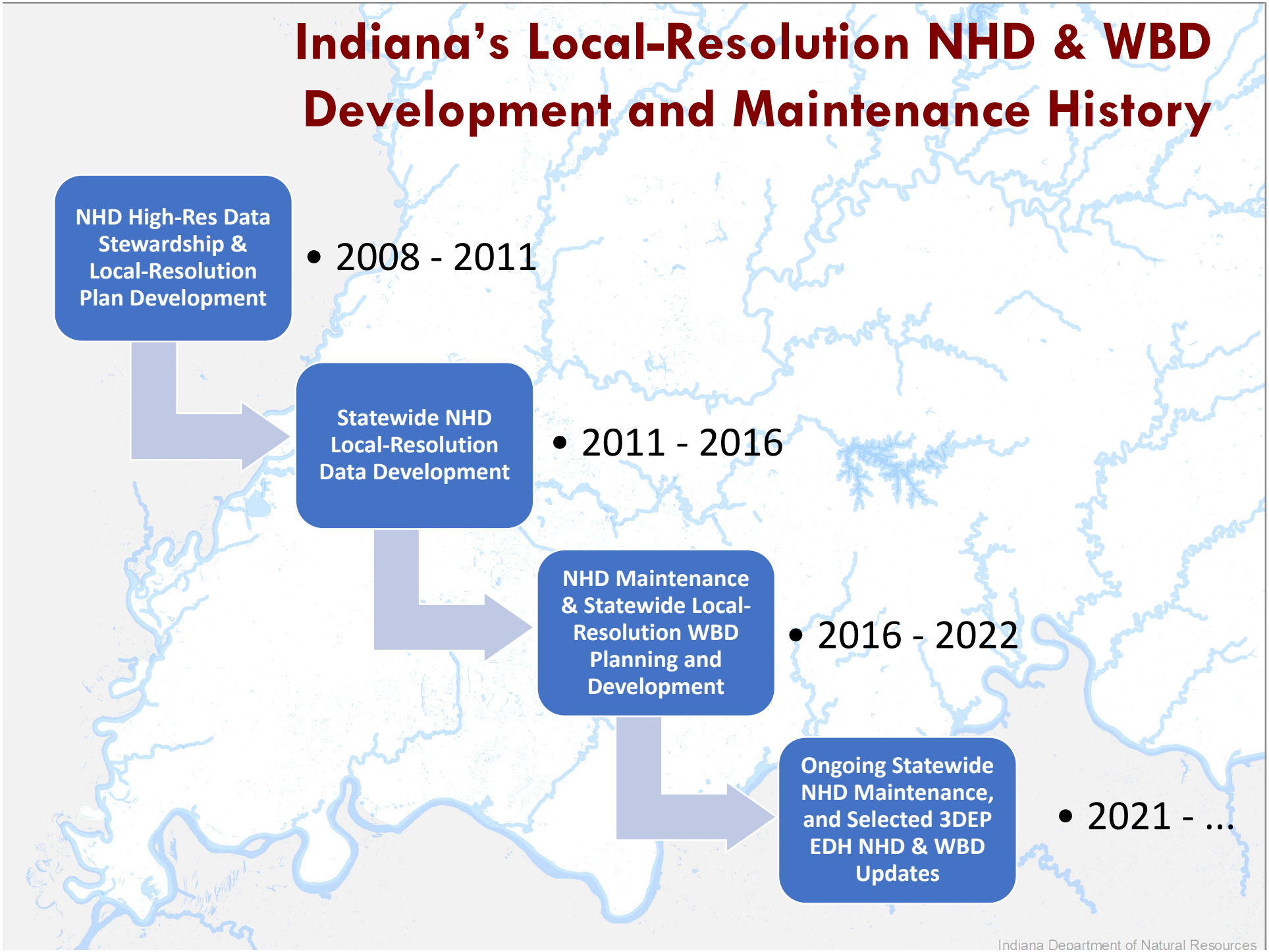
1. Introduction (Megan)
2. Background on Indiana's Local-Resolution NHD & WBD (Dave)
3. Indiana's local-resolution NHD (& WBD) project details (Susan)
4. Indiana's Local-Resolution NHD/WBD Projects - Challenges & Lessons Learned (Dave)
5. Maintenance efforts and next steps (Megan)

Introduction

Megan Compton

Indiana GIO – NHD Steward

Indiana's Local-Resolution NHD & WBD Development and Maintenance History



Indiana's Local-Resolution NHD & WBD Development and Maintenance History

2011-2016 Local-Resolution NHD Data Development (Timeline Production Details Example)

Vermilion (05120109) - 137 sq mi	**93 days**	**3/20/2013**	**7/30/2013**
Base Data Collection and Processing	15 days	3/20/2013	4/9/2013
Terrain Processing	6 days	4/10/2013	4/17/2013
NHD Conversion (AECOM)	8 days	4/18/2013	4/29/2013
NHD Conversion QC (AECOM)	3 days	4/30/2013	5/2/2013
Basin QC by Waters Workgroup	7 days	5/3/2013	5/13/2013
Address Linework QC Comments	2 days	5/14/2013	5/15/2013
NHD Conflation	40 days	5/16/2013	7/12/2013
NHD Conflation QC	2 days	7/15/2013	7/16/2013
Basin QC by Workgroup and USGS	7 days	7/17/2013	7/25/2013
Address Conflation QC Comments	2 days	7/26/2013	7/29/2013
Submit Final Deliverables	1 day	7/30/2013	7/30/2013

Indiana's Local-Resolution NHD Development Costs (38* HUC-8 Subbasins)

GIO - Contract Administration and Project Management	$ 23,598.00
IGIC - Project R&D, Planning, Source Data Prep & Final Product QA/QC	$ 236,397.00
AECOM & Local Subs - Local-Resolution Data Pilot & Production Phases 1- 3	$2,363,527.00
Total:	**$2,623,522.00**

** Indiana HUC-8 Subbasin Local-Resolution updates do not extend beyond Indiana State Line, but ties back (snaps) to existing High-Resolution NHD & WBD*

Indiana's Local-Resolution NHD & WBD Funding Sources and Partners

Indiana Office of Community and Rural Affairs (OCRA) **$2,493,738**

- FEMA Disaster Relief Emergency Fund (DREF) Grant

Indiana Geographic Information Council (FGDC, USGS and NOAA Grants) **$208,500**

- 2008 – USGS National Hydrography Dataset Stewardship Grant ($25,000)
- 2009 – USGS Geographic Names Information System (GNIS) Hydrography Updates ($25,000)
- 2009 – USGS Upper Eel Subbasin Hydrography Data Improvements Grant ($29,000)
- 2010 – USGS Iroquois Subbasin Hydrography Data Improvements Grant ($29,500)
- 2010 – FGDC CAP #2 Grant Indiana NHD Local-Resolution NHD Maintenance for Geo-Synchronization Service Development ($50,000)
- 2019 – NOAA - IDNR Lake Michigan Coastal Program WBD Development Grant ($50,000)

Indiana Department of Environmental Management (IDEM) **$12,304**

- Agency Funding ($12,304)

Background on Indiana's Local-Resolution NHD & WBD Projects

Dave Knipe

IN Department of Natural Resources

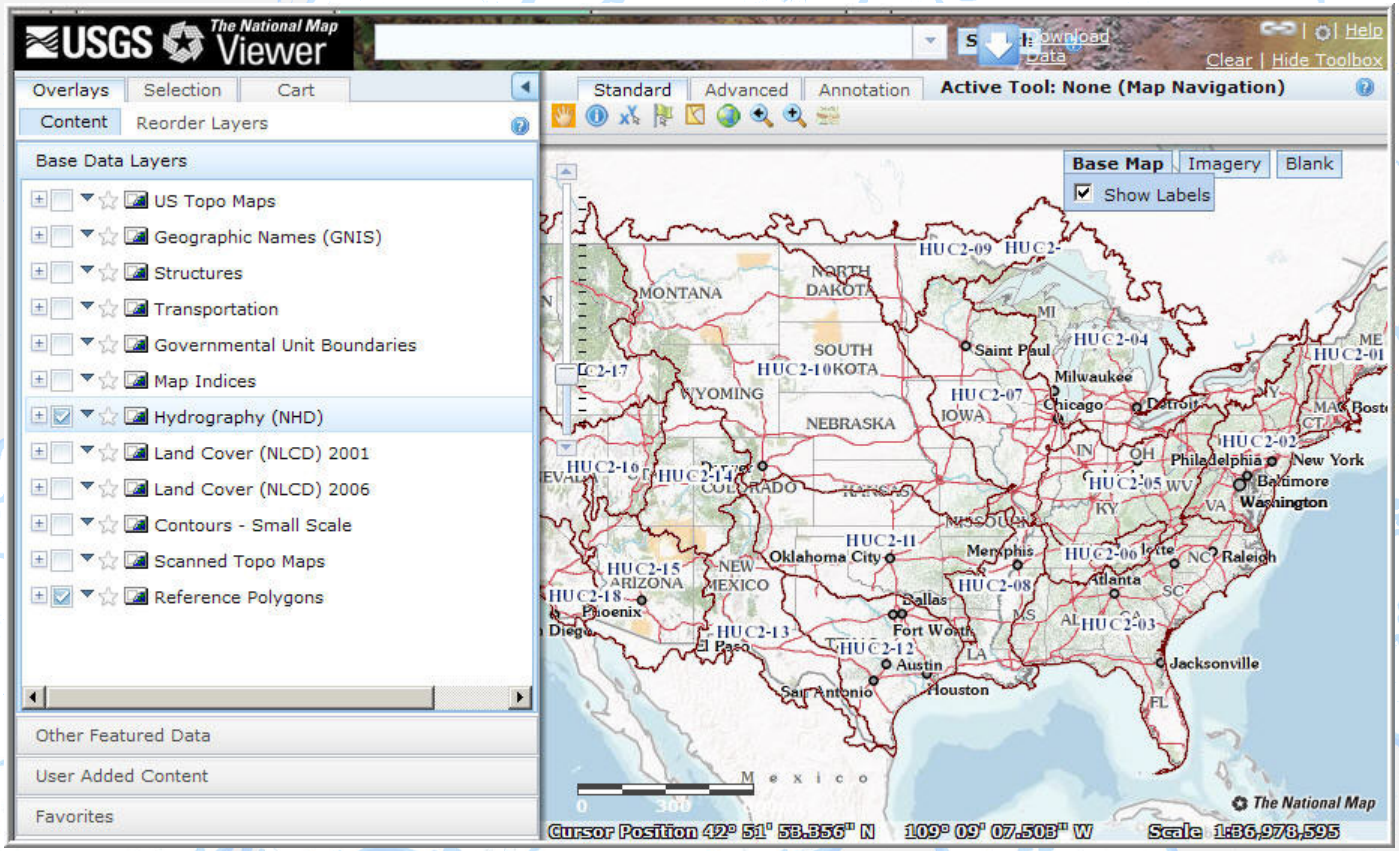
Improving the NHD for Indiana

Updating Indiana's NHD from High-Resolution to "Local-Resolution"

- Based upon best available digital orthophotography and elevation data (>=2005, most 2011-13) instead of old 24K Quad topographic maps
- Updates of physical features (existence, location)
- Data at scale of 1:2,400 or better vs. 1:24,000
- Flowlines added to 6-acre drainage basin area catchments
- Inconsistencies between quads removed
- Naming of features improved—still much to be done
- Network topology improved

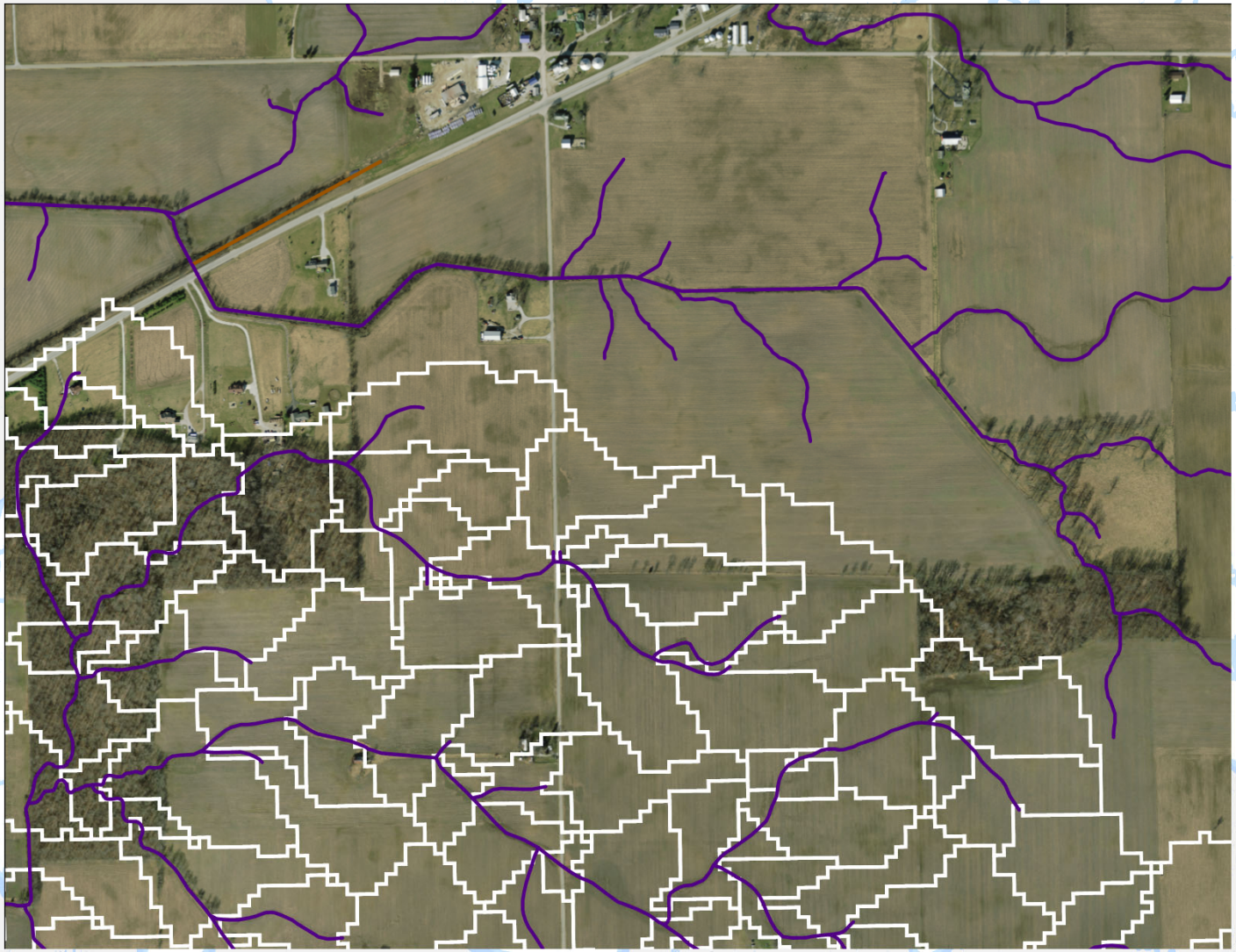
National Hydrography Dataset

Feature-based database of nation's surface water drainage system, part of the National Map

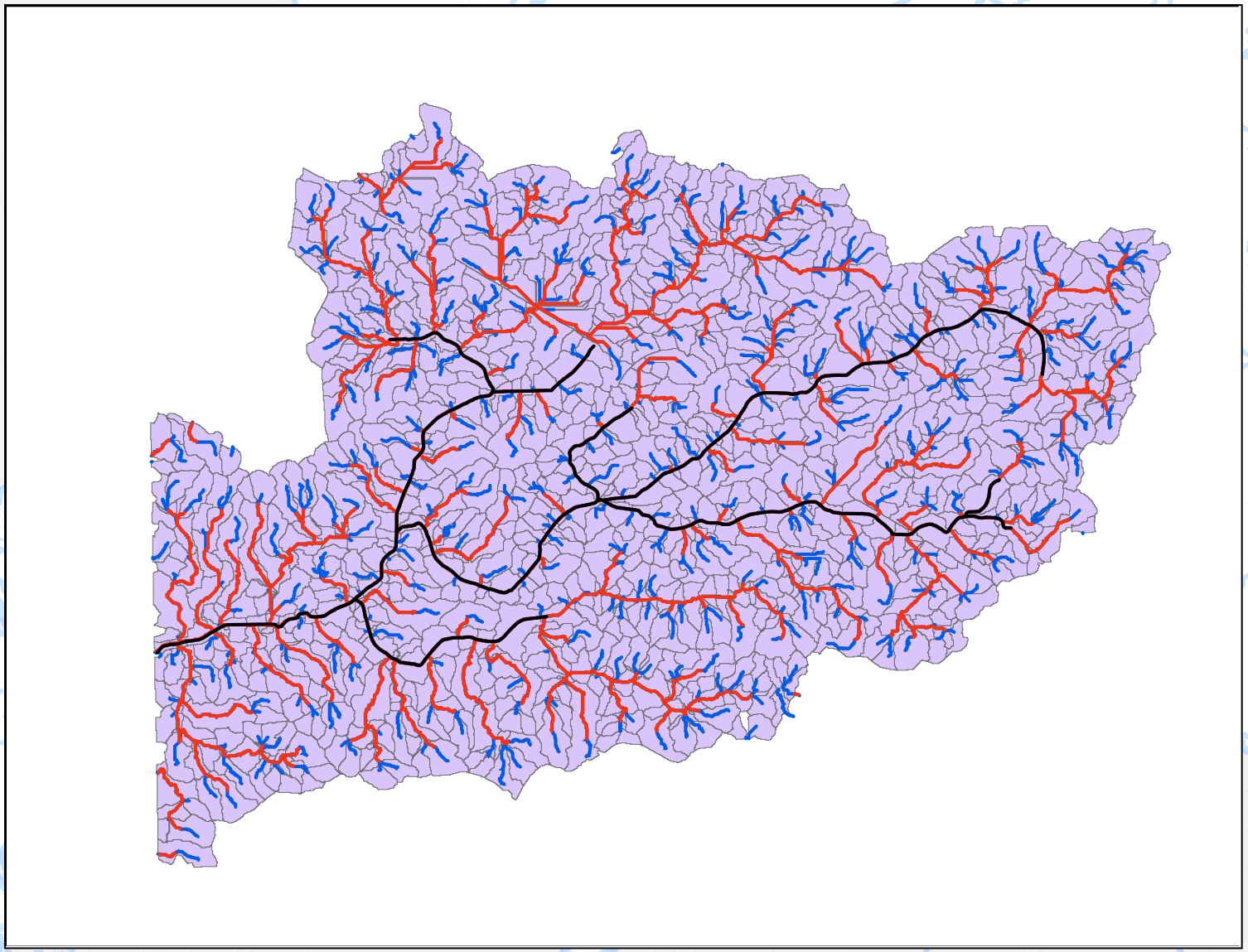


Adopted as Indiana Framework Dataset for Waters

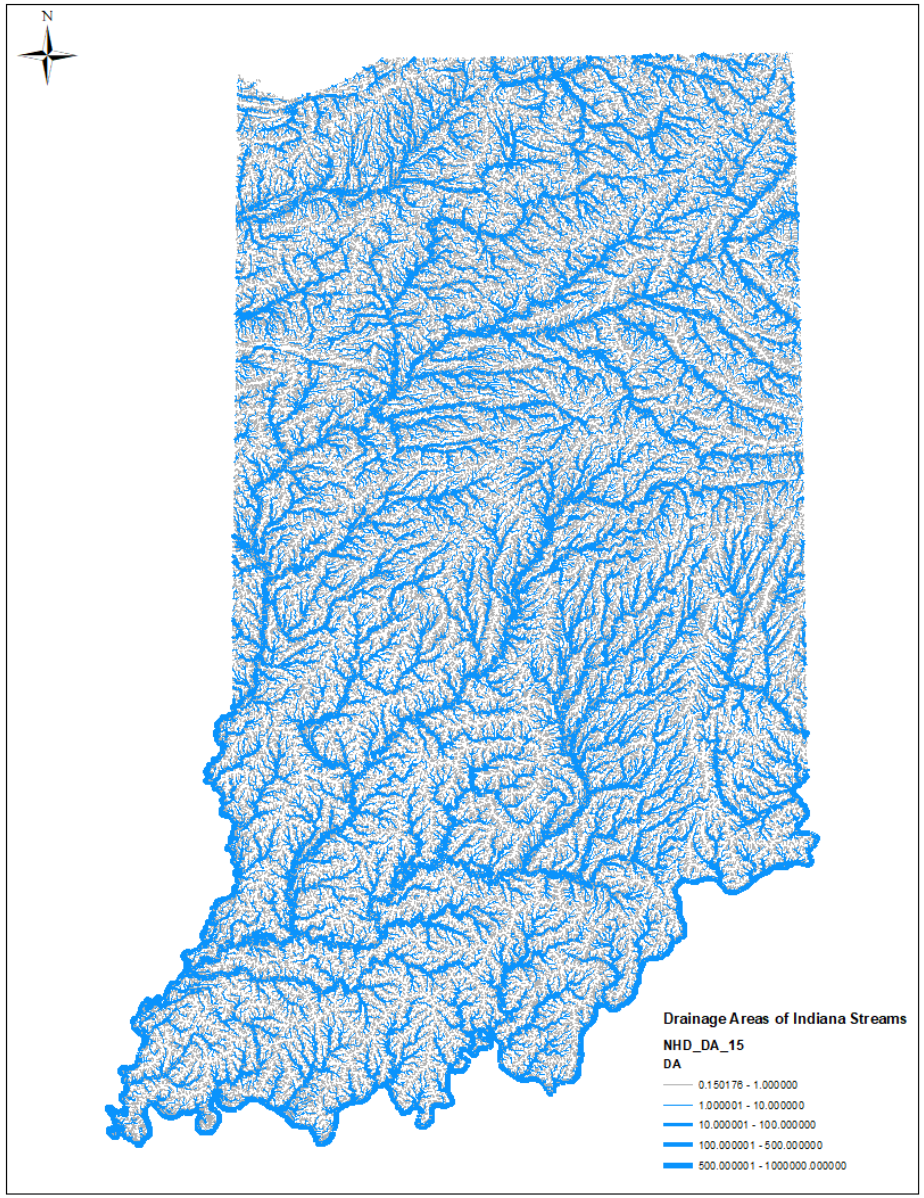
6 Acre Catchments



6 acre vs. 20 acre (and 24K NHD)

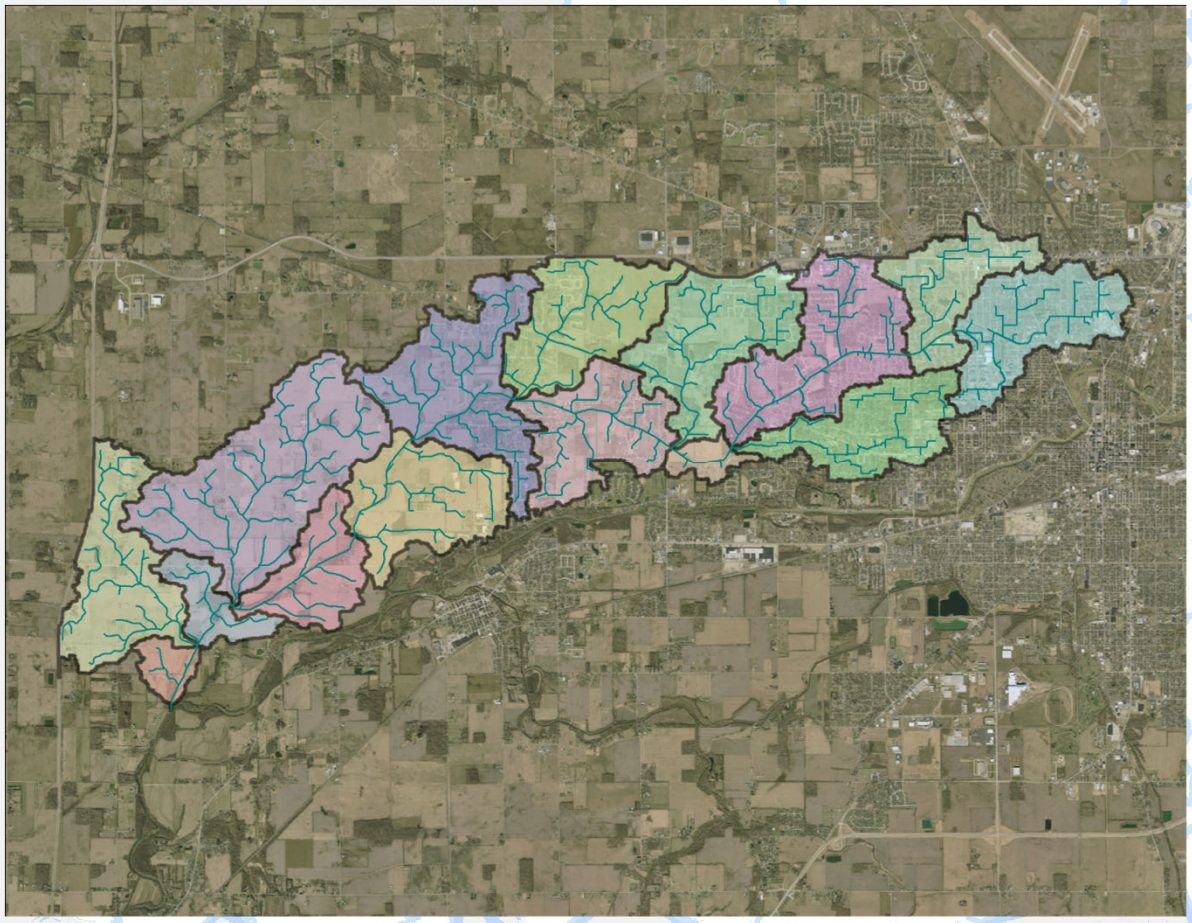


Drainage Areas of Indiana Streams



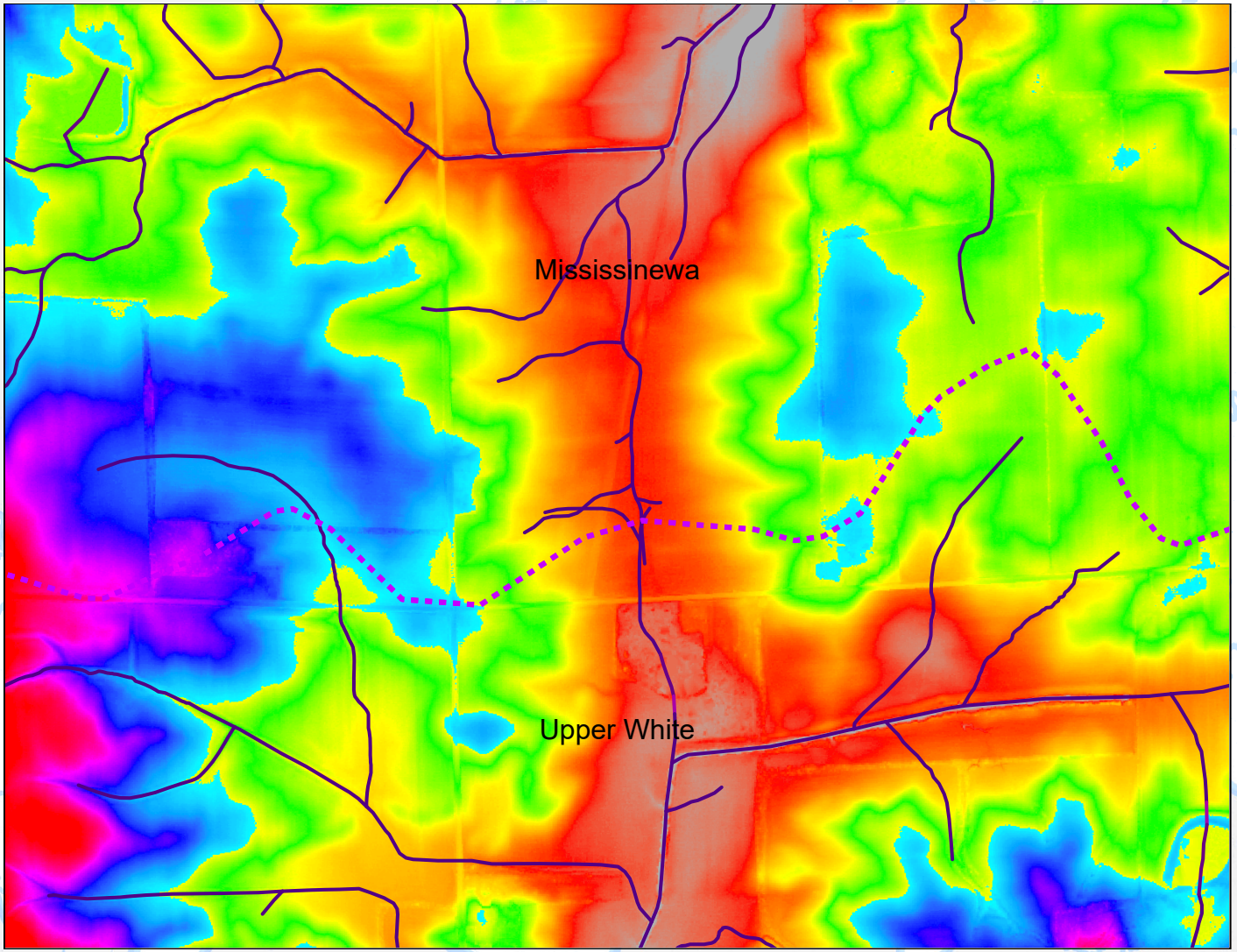
- Uses the new NHD linework with ArcHydro to derive the Drainage Area associated with every stream segment (over .15 sq mi) in NHD.
- Used by Indiana DNR for determining jurisdiction for state regulatory programs
- Used for Indiana DNR for management and data sources for the FEMA Risk MAP program, as Indiana DNR is part of the FEMA Cooperating Technical Partner program

Hydrology Studies



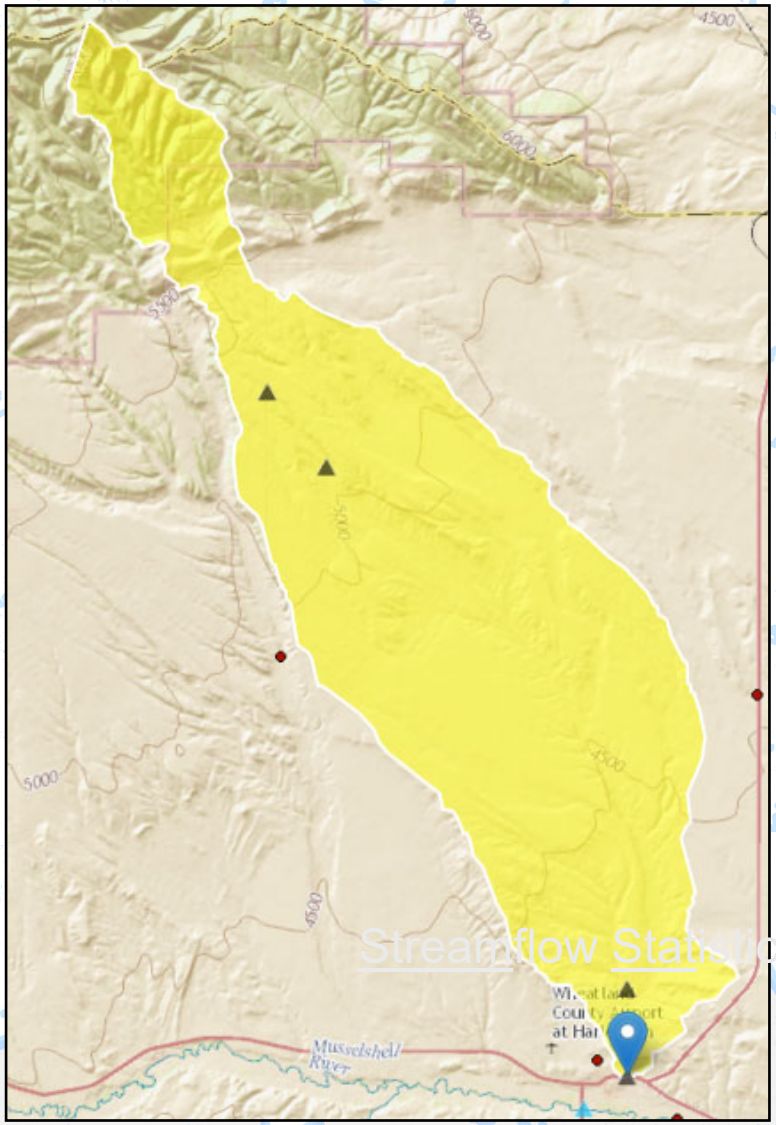
- HEC-HMS studies for support to Flood Insurance Studies
- Higher density stream network makes subbasin delineation and watershed characteristics more accurate

Identifying inter-basin transfer points



StreamStats

- Web-based map application for retrieving basin and streamflow characteristics
  - Delineates basins
  - Compute's basin characteristics
  - Retrieves streamflow statistics
  - Solves regression equations for estimating streamflow statistics
- Plus other functionality and applications in an Ecosystem of Services



StreamStats

- StreamStats application developed by USGS StreamStats development team
- Data, analyses, and equations prepared locally (USGS Water Science Centers) in cooperation with federal, state, and local cooperators
- The StreamStats Team charge is to support the WSCs to implement data, methods, and functionality

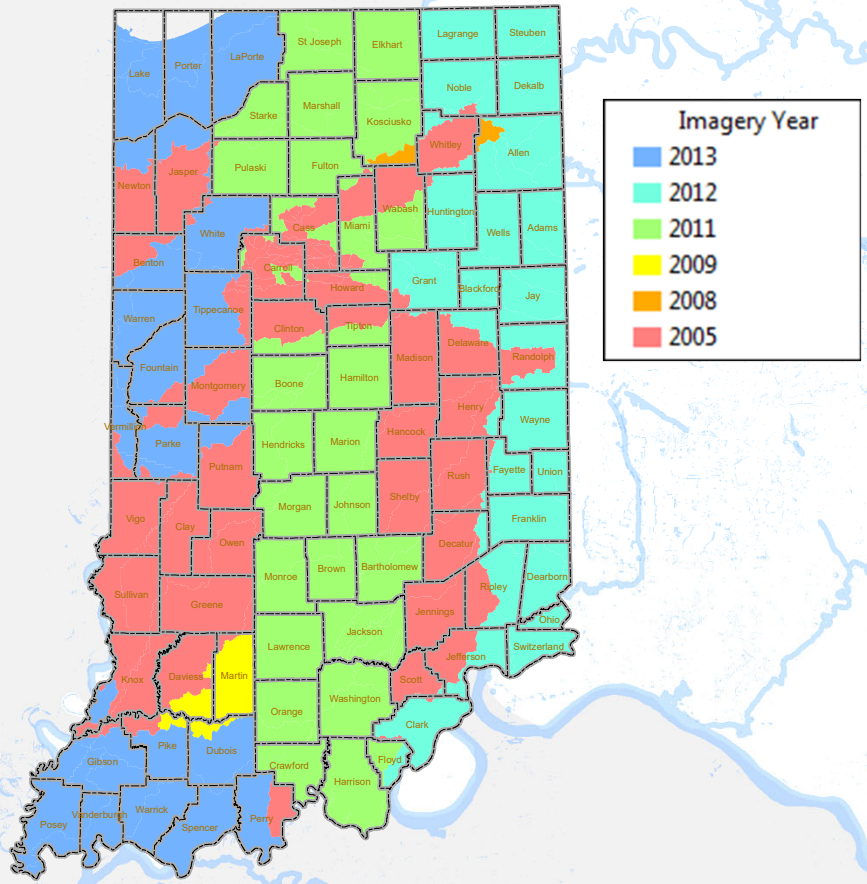
Indiana's Local-Resolution NHD Project Details

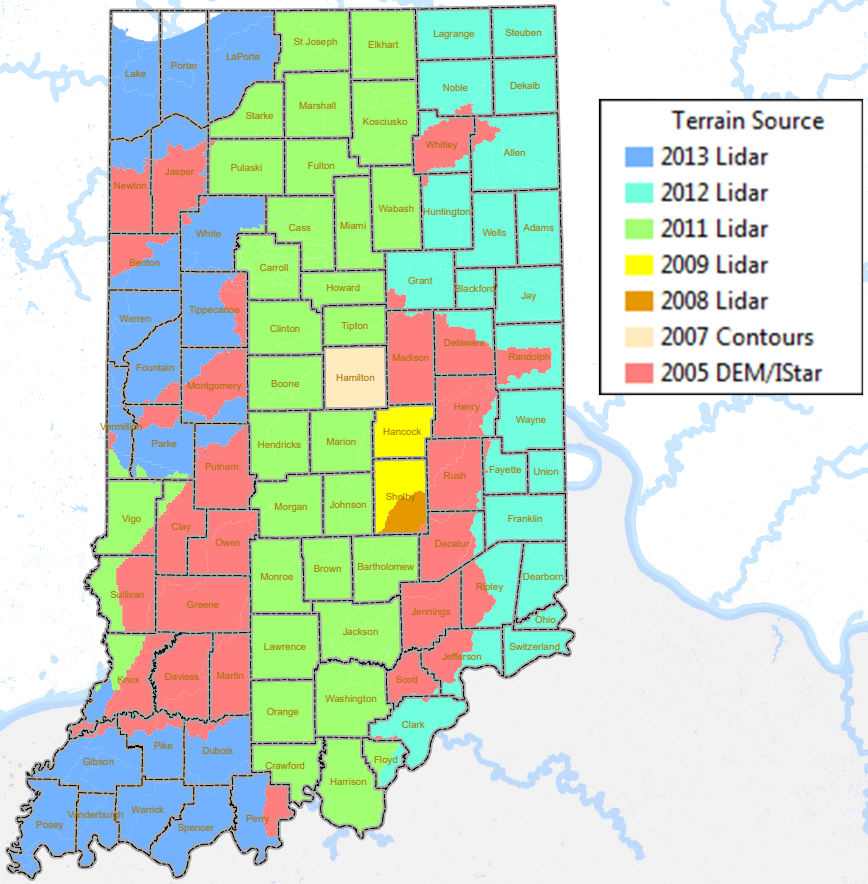
Susan Phelps
AECOM

Improving the NHD for Indiana

SOURCE DATA:

Best available digital orthophotography and elevation data (>=2005, most 2011-2013)





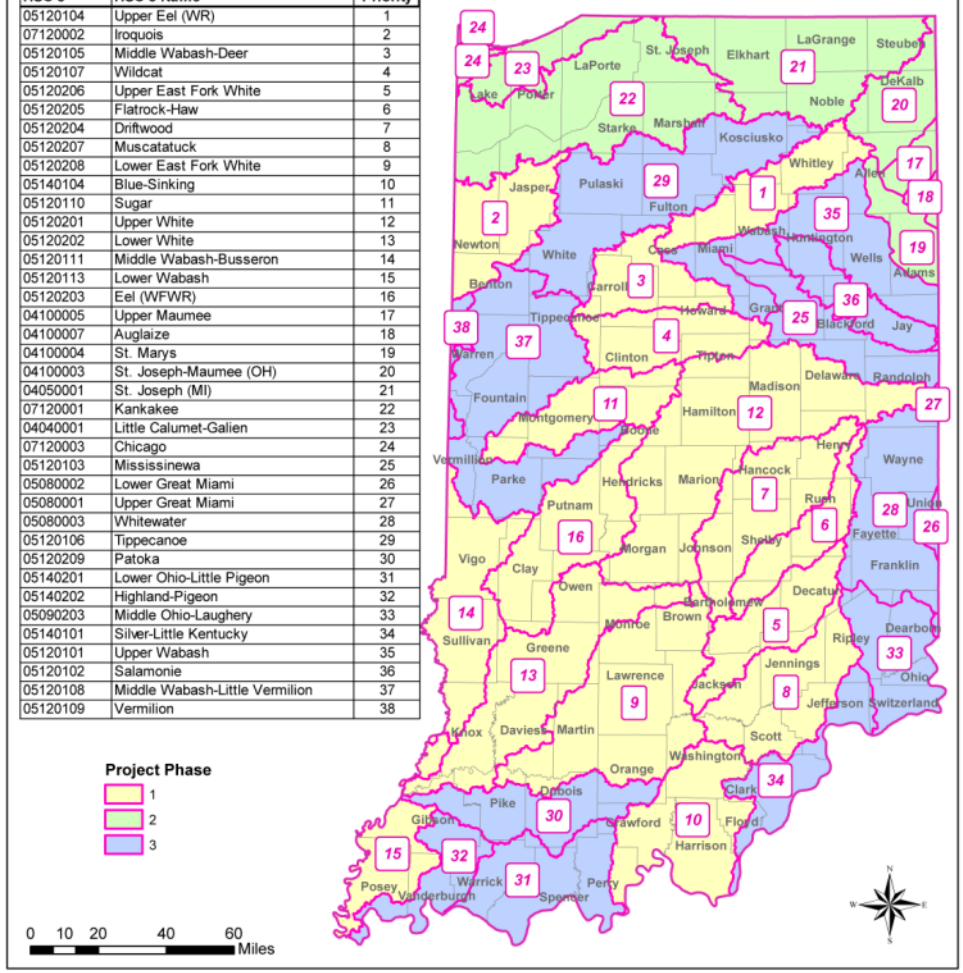
Data Creation – Project Planning

- Began Fall 2011, completion in Spring 2016
- Work completed by HUC 8 sub-basins
- Priorities based on:
  - ✦ New LiDAR, imagery
  - ✦ Stakeholder needs
  - ✦ Special circumstances like karst, urban, coastline
  - ✦ Conflation, edge-matching

Proposed Sub-Basin Priorities for Indiana NHD Upgrade - All Phases

IGIC Waters Workgroup / AECOM
NHD Local Resolution Upgrade Project
May 2014

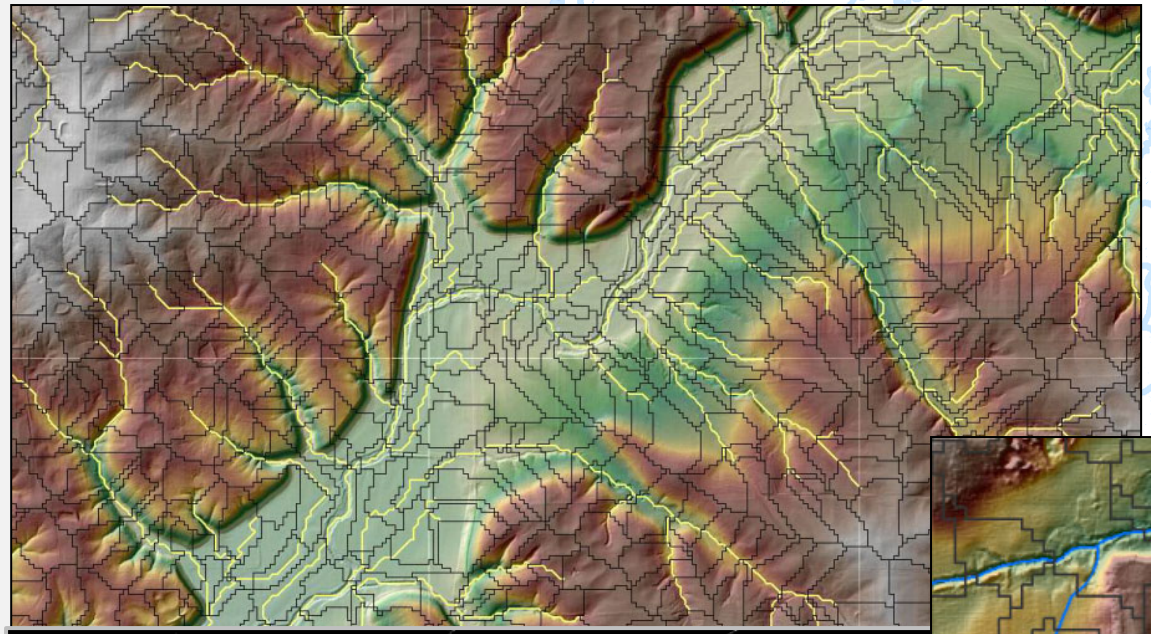
HUC 8	HUC 8 Name	Priority
05120104	Upper Eel (WR)	1
07120002	Iroquois	2
05120105	Middle Wabash-Deer	3
05120107	Wildcat	4
05120206	Upper East Fork White	5
05120205	Flatrock-Haw	6
05120204	Driftwood	7
05120207	Muscatatuck	8
05120208	Lower East Fork White	9
05140104	Blue-Sinking	10
05120110	Sugar	11
05120201	Upper White	12
05120202	Lower White	13
05120111	Middle Wabash-Busseron	14
05120113	Lower Wabash	15
05120203	Eel (WFWR)	16
04100005	Upper Maumee	17
04100007	Auglaize	18
04100004	St. Marys	19
04100003	St. Joseph-Maumee (OH)	20
04050001	St. Joseph (MI)	21
07120001	Kankakee	22
04040001	Little Calumet-Galien	23
07120003	Chicago	24
05120103	Mississinewa	25
05080002	Lower Great Miami	26
05080001	Upper Great Miami	27
05080003	Whitewater	28
05120106	Tippecanoe	29
05120209	Patoka	30
05140201	Lower Ohio-Little Pigeon	31
05140202	Highland-Pigeon	32
05090203	Middle Ohio-Laughery	33
05140101	Silver-Little Kentucky	34
05120101	Upper Wabash	35
05120102	Salamonie	36
05120108	Middle Wabash-Little Vermilion	37
05120109	Vermilion	38

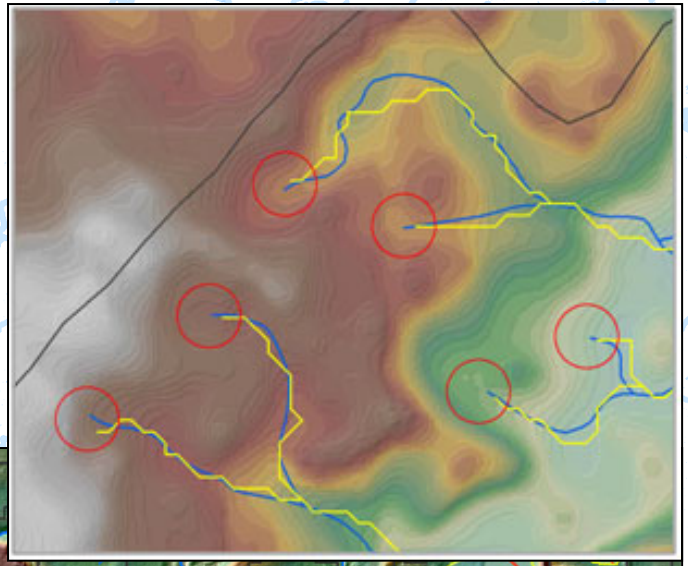


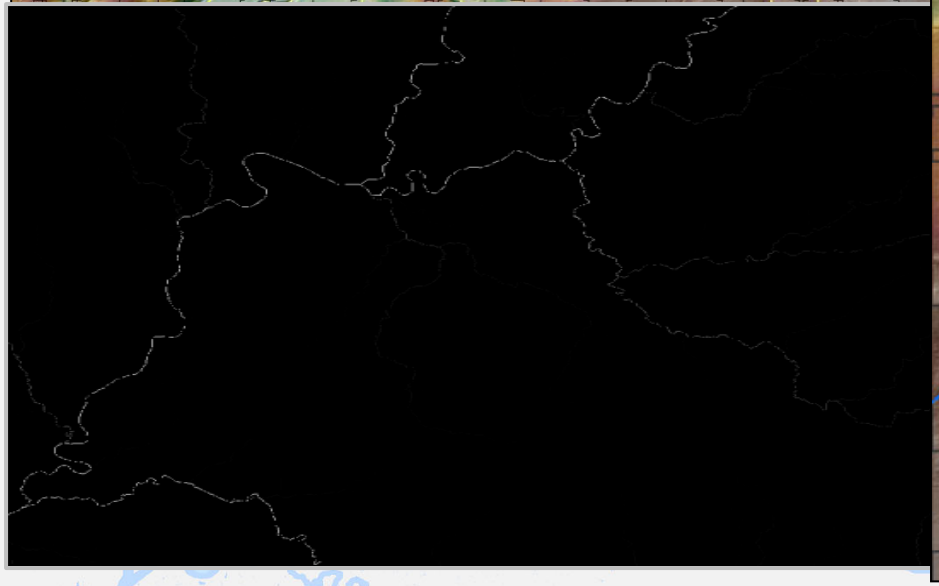
Data Creation – Project Approach

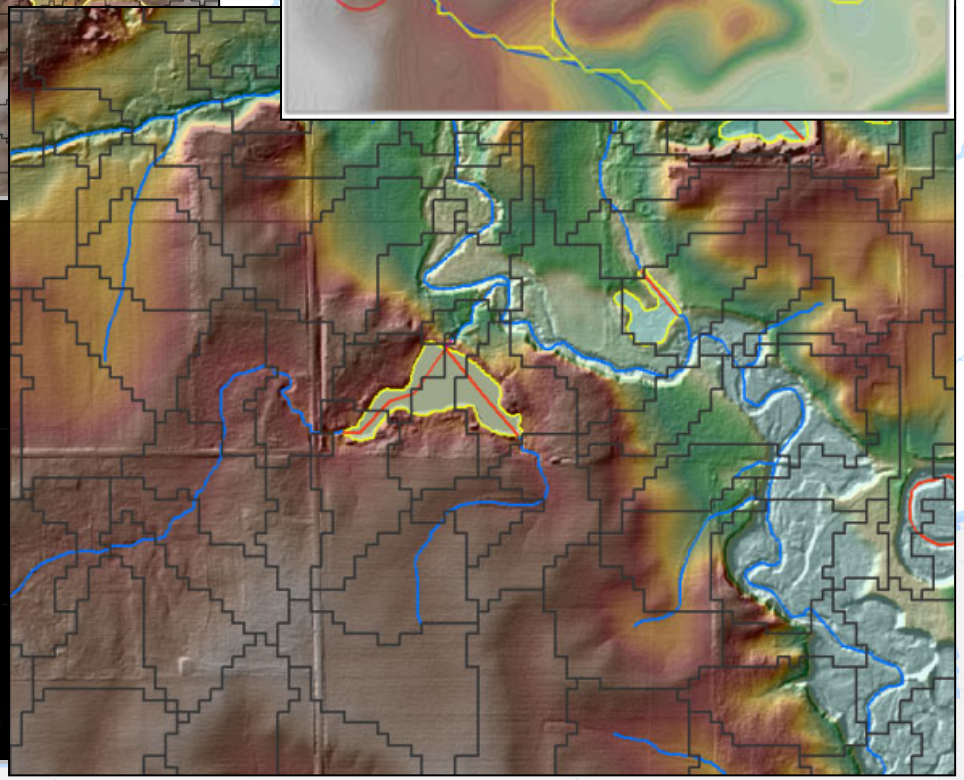
1. Pilot Study to establish project scope, specs
2. Base Data Collection and Prep
   - ✦ Imagery, terrain, 24K NHD, local hydro, stormwater
   - ✦ Initially 2005 ISTAR, then 2011-2013 LiDAR as soon as available
3. Elevation Data Hydro-Enforced
   - ✦ Elevation data imported into AECOM's proprietary WISE Terrain Analyst™ software
   - ✦ TINs built, elevation data hydro-enforced using breaklines
4. Terrain-Based Reference Files Generated
   - ✦ Hydro-enforced DEMs, hillshades for reference
   - ✦ Six acre basins, six acre "guide" streams
   - ✦ Flow accumulation grids, flow vectors

Data Creation – Project Approach



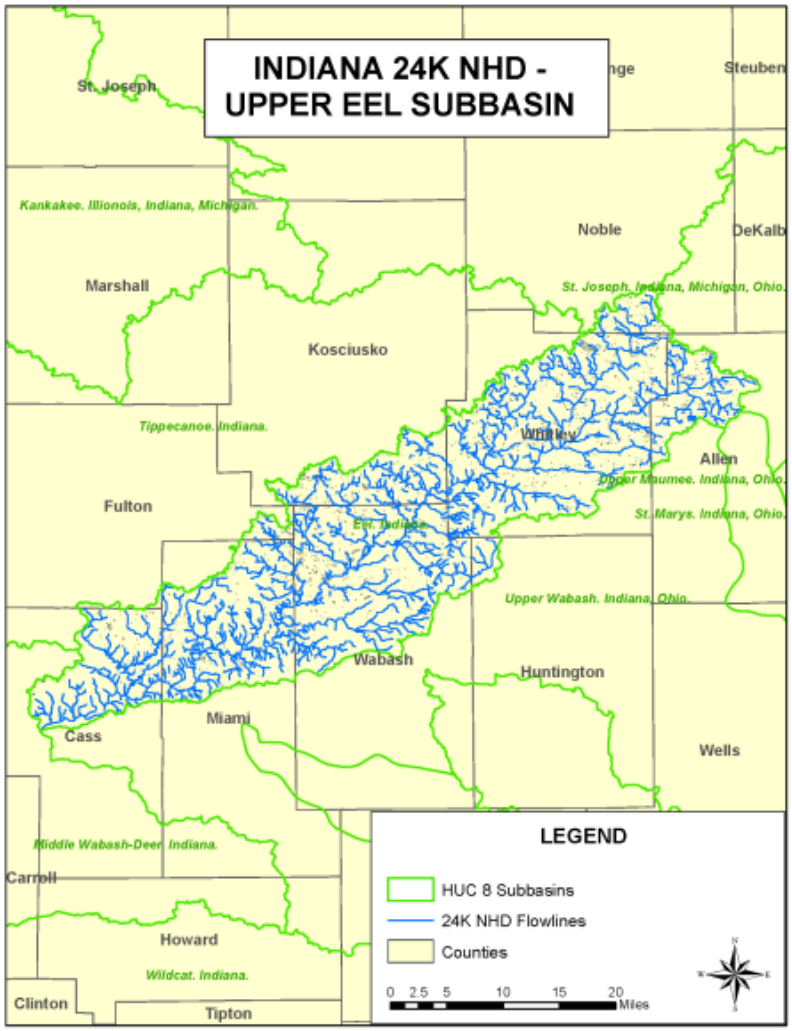




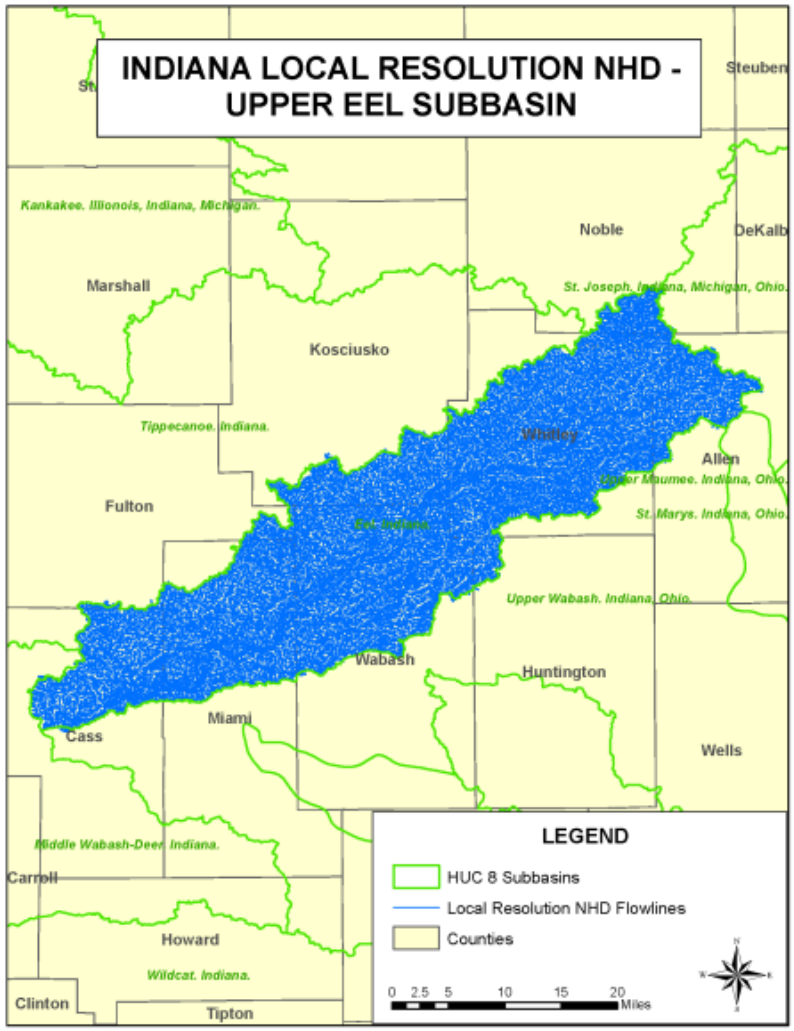


Data Creation – Pilot Study Results

- 24K NHD Features:
  - Flowline: 2,177
  - Waterbody: 2,571



- Local Resolution NHD Features:
  - Flowline: 47,821
  - Waterbody: 3,350

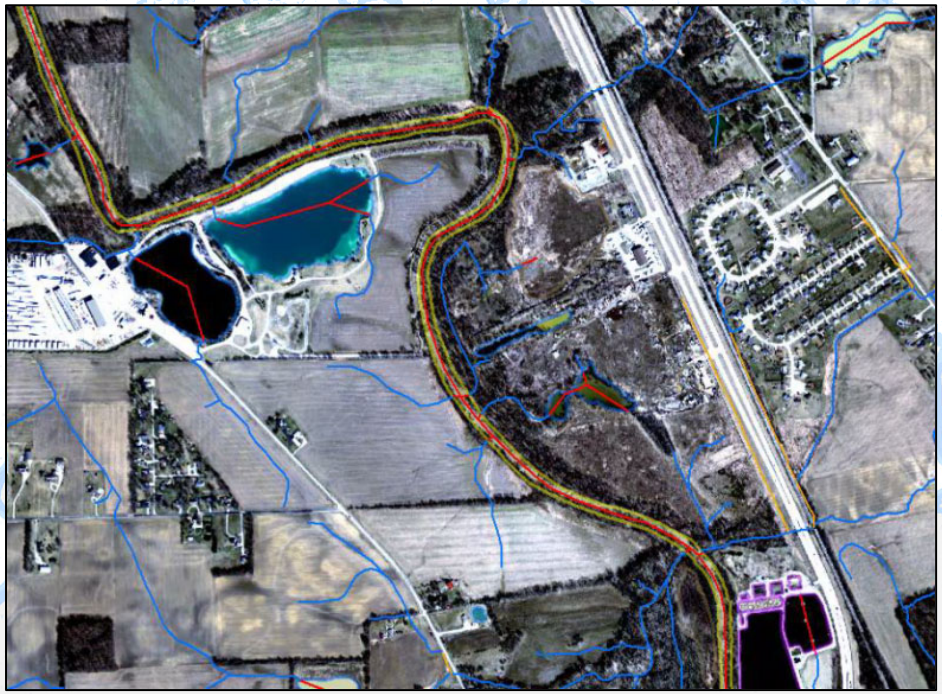


Data Creation – Project Approach

5. Linework Digitized
   - ✦ Primary base data sources - imagery, DEMs, hillshades
   - ✦ Addt'l. Reference sources - 6 acre “guide” streams, local data, 24K NHD
   - ✦ Specs for water bodies, double-line vs. single-line streams
     - Streams digitized to 6-acre drainage area upstream limit
     - Streams 40 ft wide or greater collected as Area features
     - Water bodies ¼ acre or larger included
   - ✦ Features digitized using USGS NHD schema, FTypes

Data Creation – Project Approach

5. Linework Digitized (cont'd)
   - ✦ All 24K NHD Area, Lines and Points collected
   - ✦ 24K features preserved if visible in imagery, terrain sources
   - ✦ Hydrography edge-matched to existing NHD along state borders, sub-basin boundaries
     - Coordinate with adjacent states

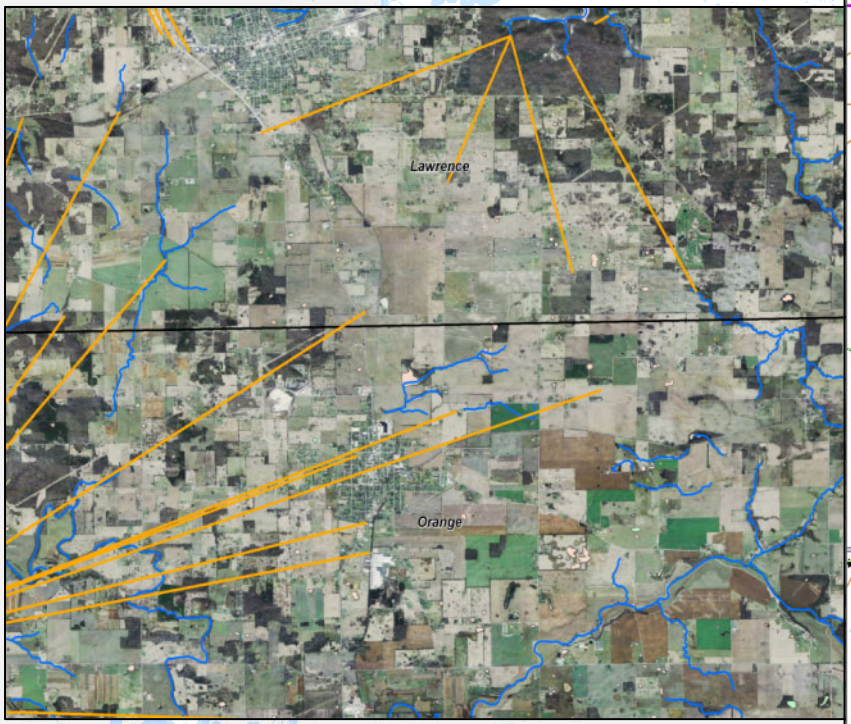


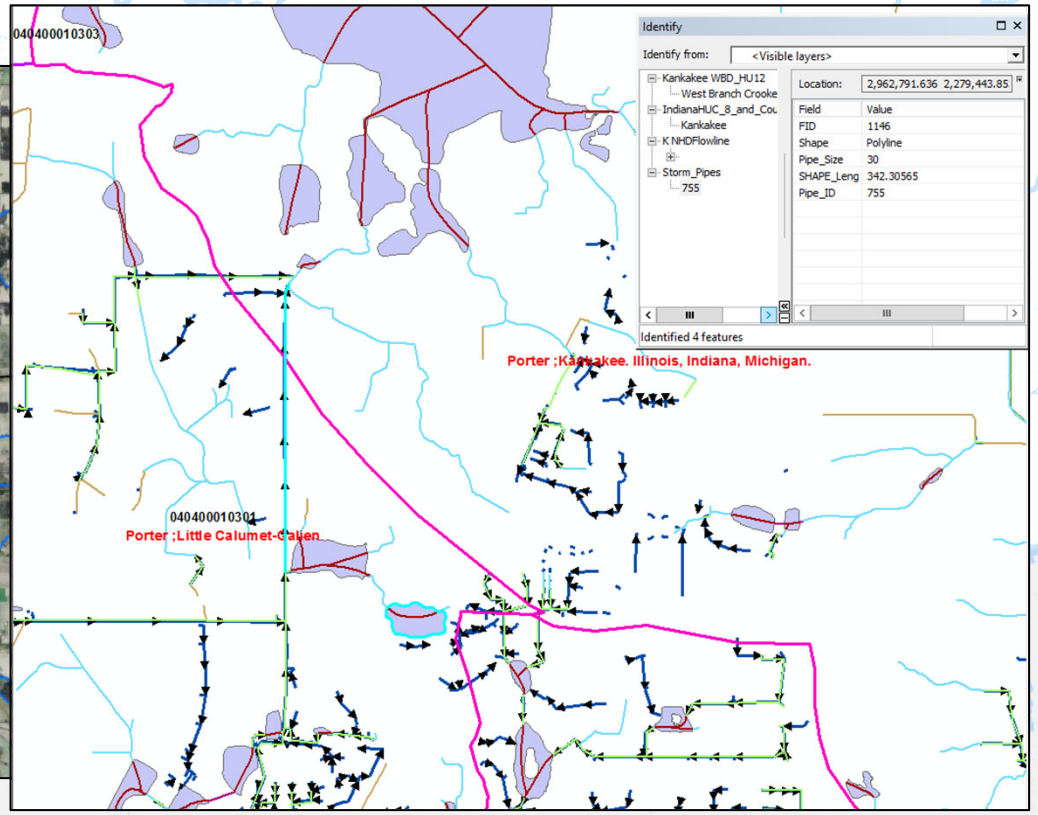
Data Creation – Project Approach

5. Linework Digitized (cont'd)

✦ County, municipal base data utilized

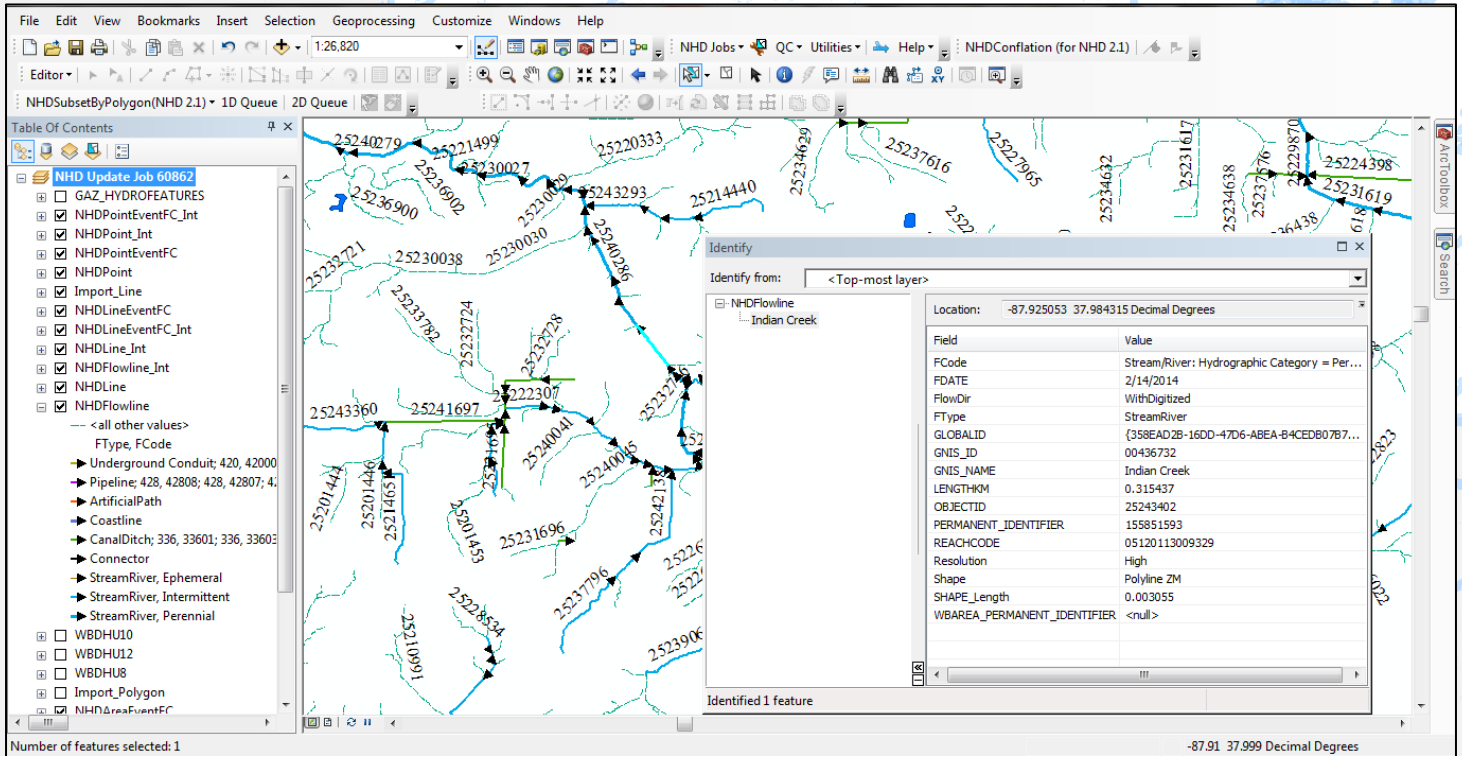
- Karst dyelines
- Streams, canals
- Stormwater
- Legal drains, tiles





Data Creation – Project Approach

6. Conflation / Attribution
   - ✦ Topo checks, flow checks, edge-matching prep work
   - ✦ 24K NHD attributes conflated to new hydro using USGS tools
     - Reach codes, GNIS info, 24K perennial/intermittent designations
7. Final product loaded into USGS The National Map

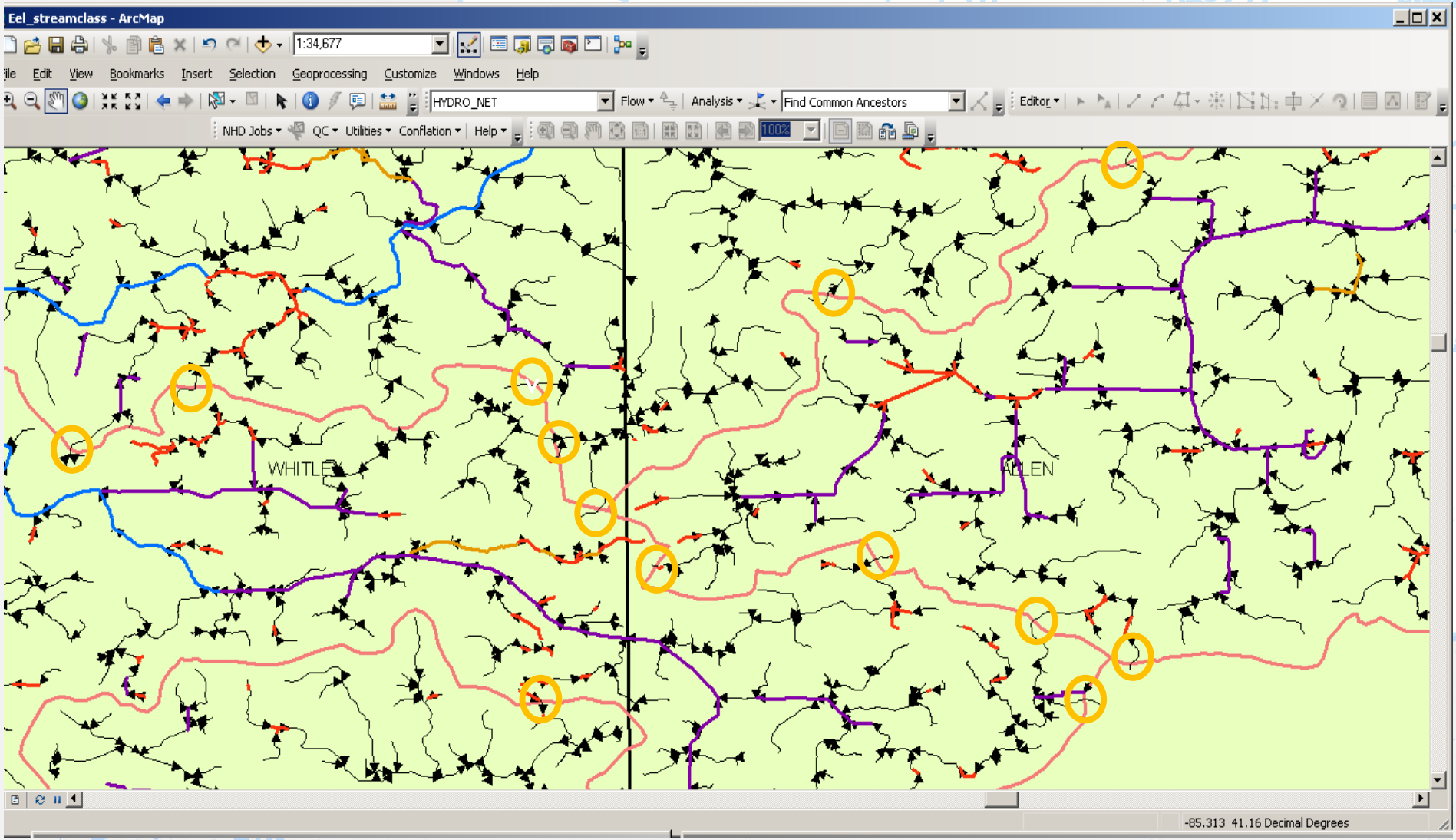


Indiana's Local-Resolution WBD Project Details

Susan Phelps
AECOM

Improving the WBD for Indiana

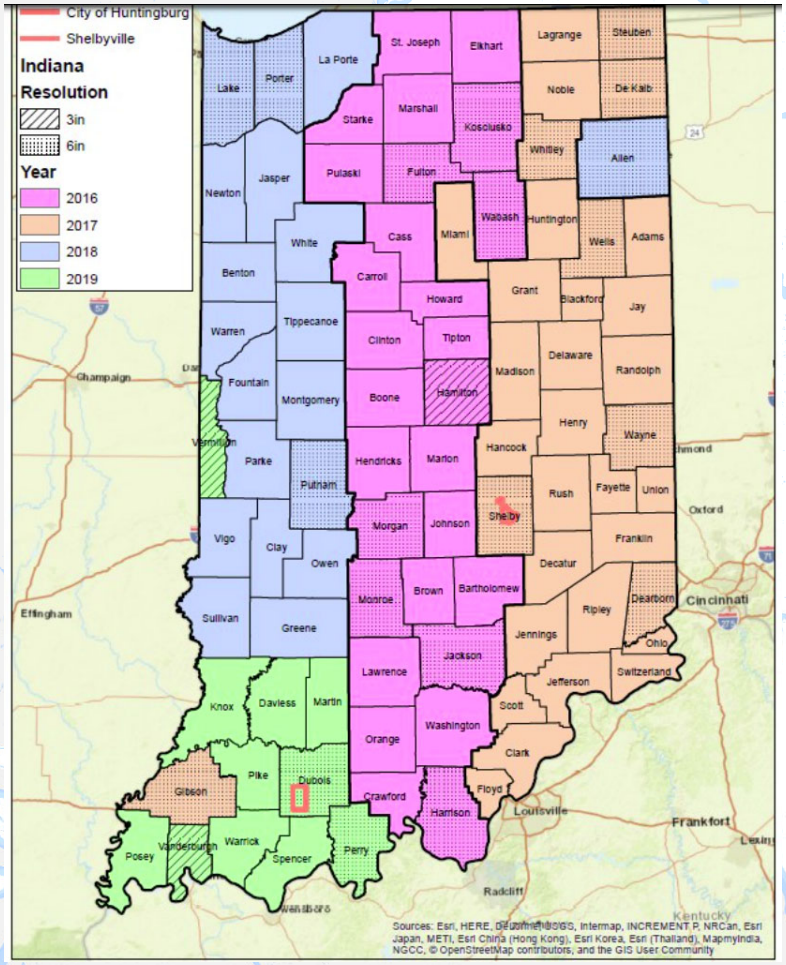
- HUC 12 watershed boundary errors due to new Local-Resolution NHD



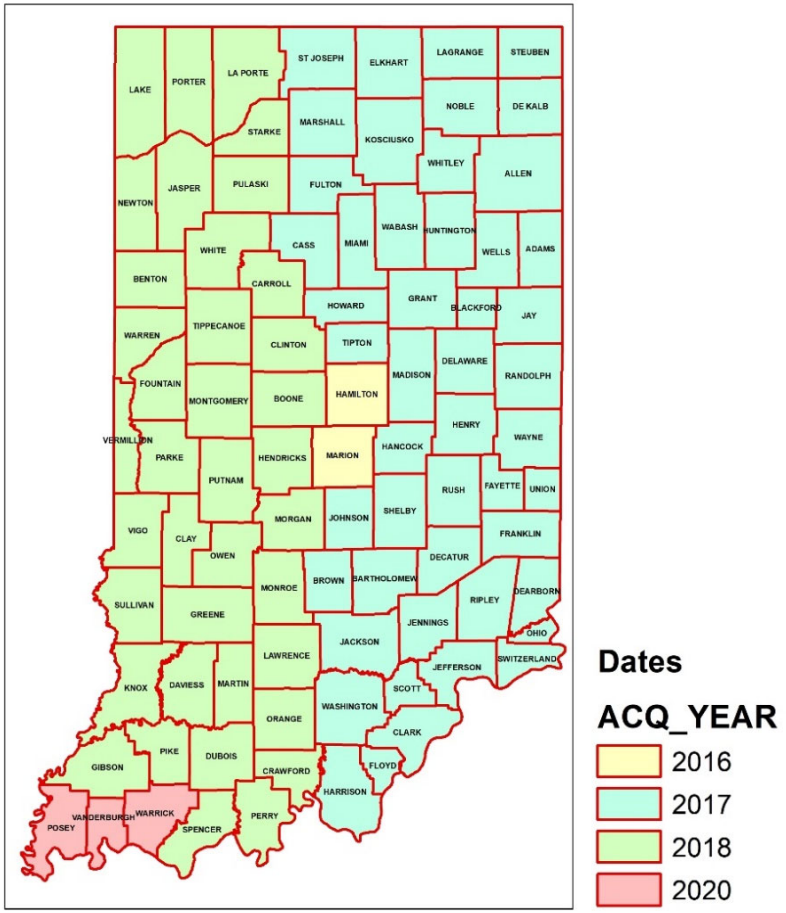
Improving the WBD for Indiana

SOURCE DATA:

Based upon best available digital orthophotography and QL2 3DEP data (2016-2020)



Indiana 2016-2020 3DEP Lidar Collection Years



LMCP WBD Project Background & Objectives

- Jan 2019 - IGIC awarded Lake Michigan Coastal Program (LMCP) grant to update WBD boundaries in northern (coastal) Indiana
  - Goal – ID NHD conflicts, correct WBD for Lake Michigan area (approx. 600 sq mi)
- Project area included 3 USGS Hydrologic Units (HUs) 8 sub-basins:
  - 04040001 – Little Calumet-Galien (536 sq mi)
  - 04060200 – Lake Michigan (Coastline)
  - 07120003 – Chicago (66 sq mi)
- Stakeholders: Indiana DNR, AECOM (Contractor), IGIC, Lake Michigan Coastal Program (LMCP), USGS, NRCS, LMCP Area Local Stakeholders

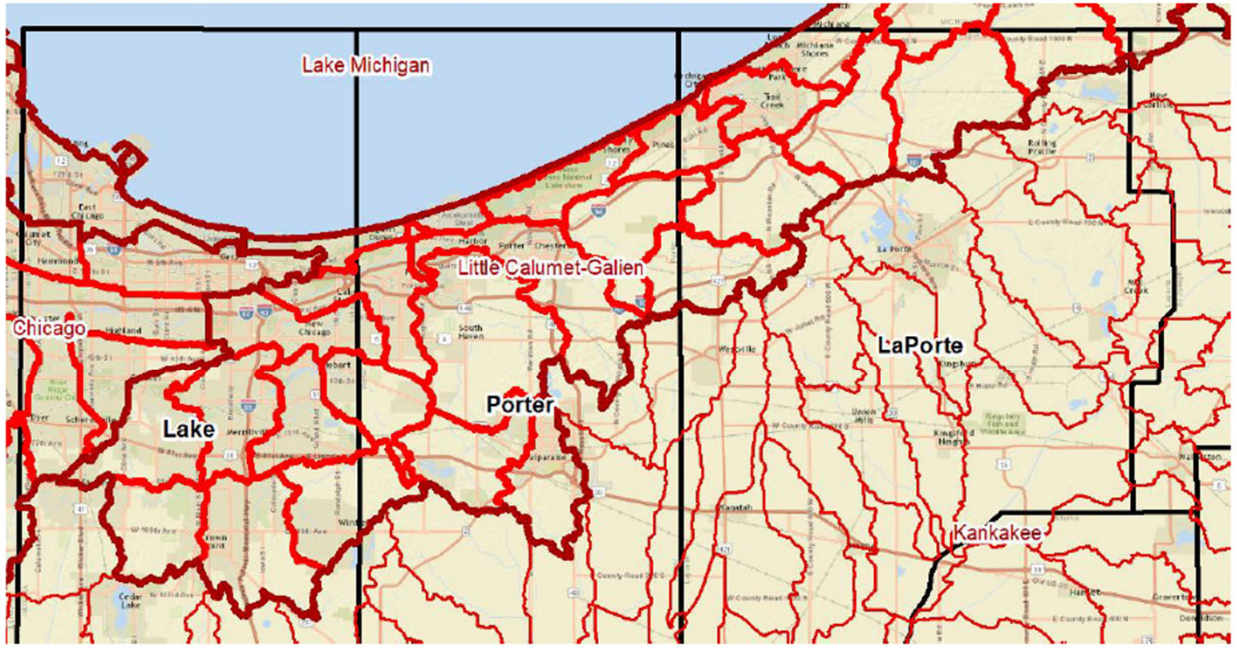


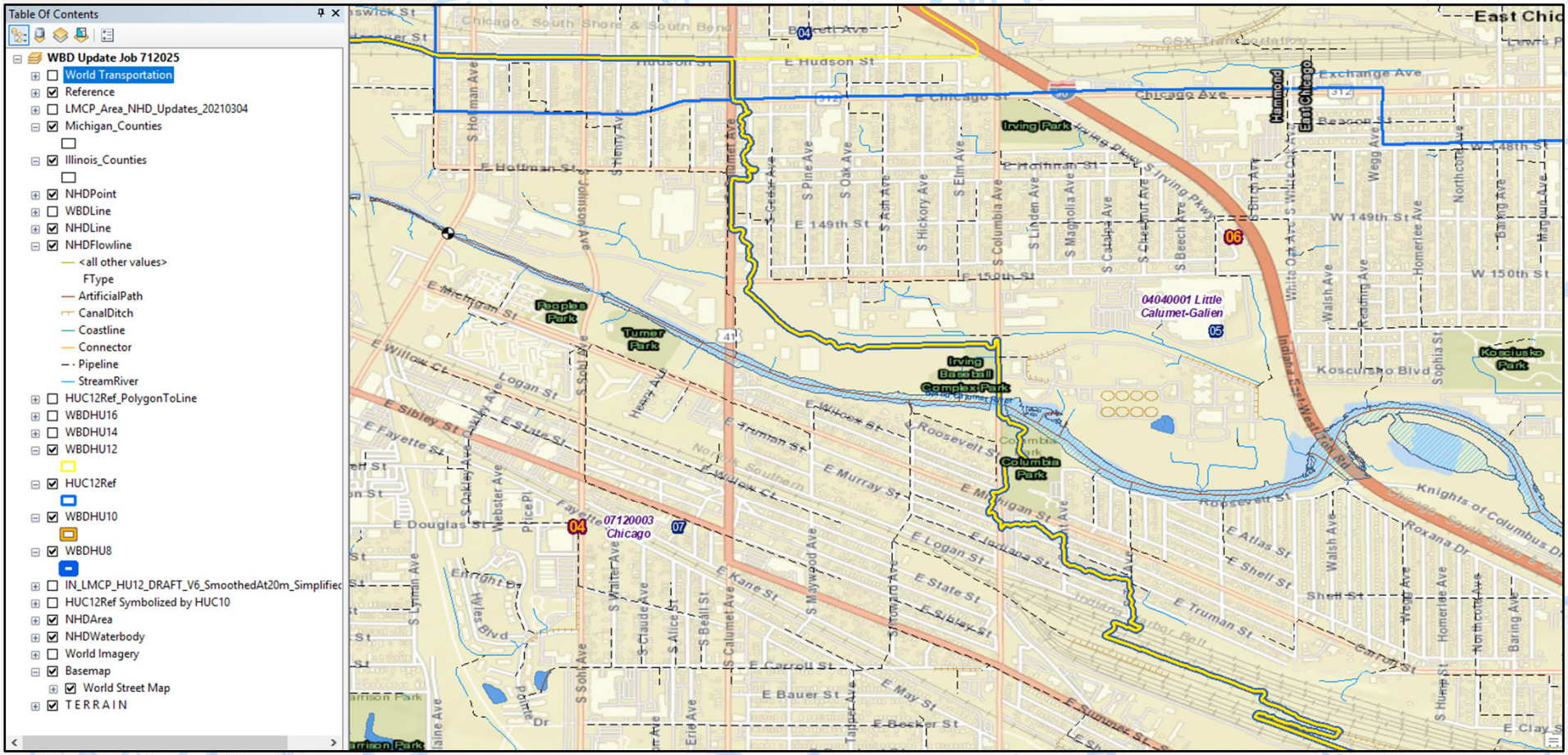
Figure 1: USGS NHD HUC 8 and HUC 12 Watershed Boundary Features Covering Indiana's LMCP Area
(Bold WBD areas above are those to be updated inside Indiana with this project)

LMCP WBD Project Tasks & Workflow

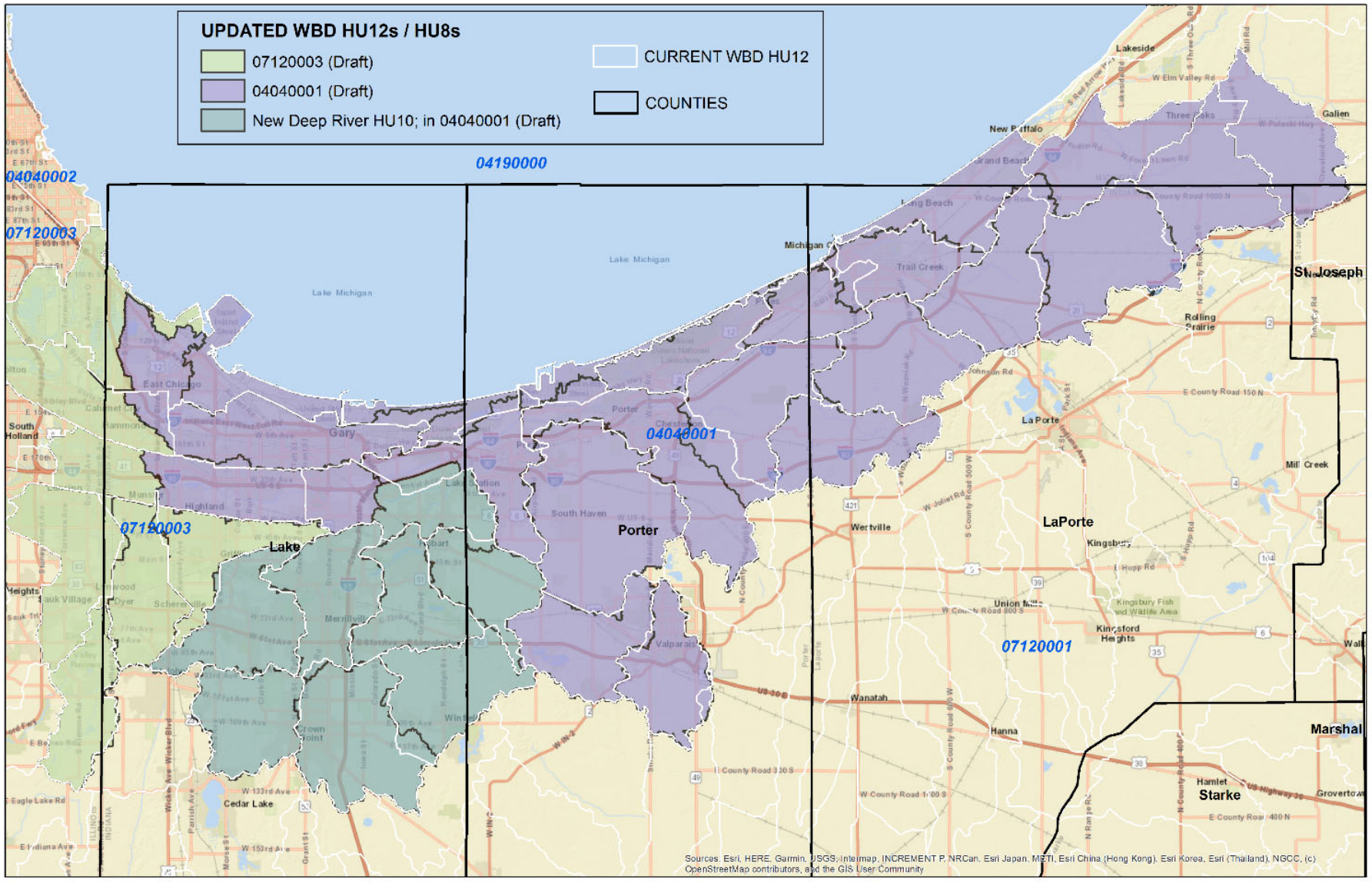
1. 2017-2018 LiDAR source data processed, DEMs hydro-enforced
2. Initial drainage basin boundaries generated at HU12 level
3. Draft WBD HU12 boundaries published to WBD data viewer for review by IDNR, USGS, local LMCP stakeholders
4. AECOM addressed 2 rounds of stakeholder QC comments, finalized HU12 boundaries
6. WBD boundaries smoothed, simplified using ArcGIS functionality
7. Existing USGS WBD boundaries for LMCP project area checked out from USGS, updates to final HU boundaries from step 6 completed with USGS' WBD Edit tool
8. Final QC checks run within WBD Edit tool, errors addressed, and updated WBD boundaries submitted to USGS, IDNR and NRCS

Resulting LMCP WBD Changes

- Grand Calumet River at Columbia Ave.

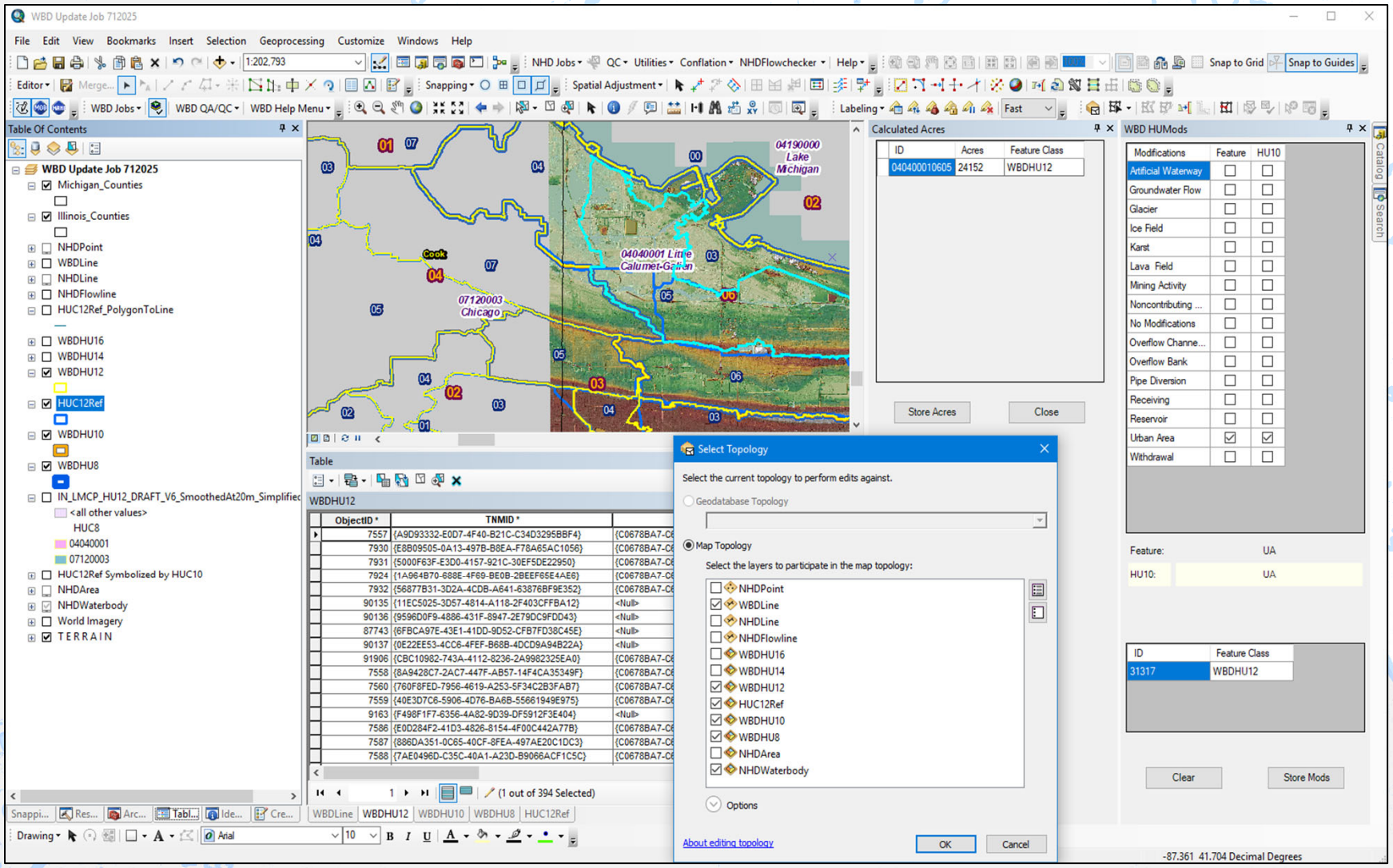


Resulting LMCP WBD Changes



Resulting LMCP WBD Changes

- Overview of USGS' WBD Edit tool



Indiana's Local-Resolution NHD/WBD Projects - Challenges & Lessons Learned

Dave Knipe

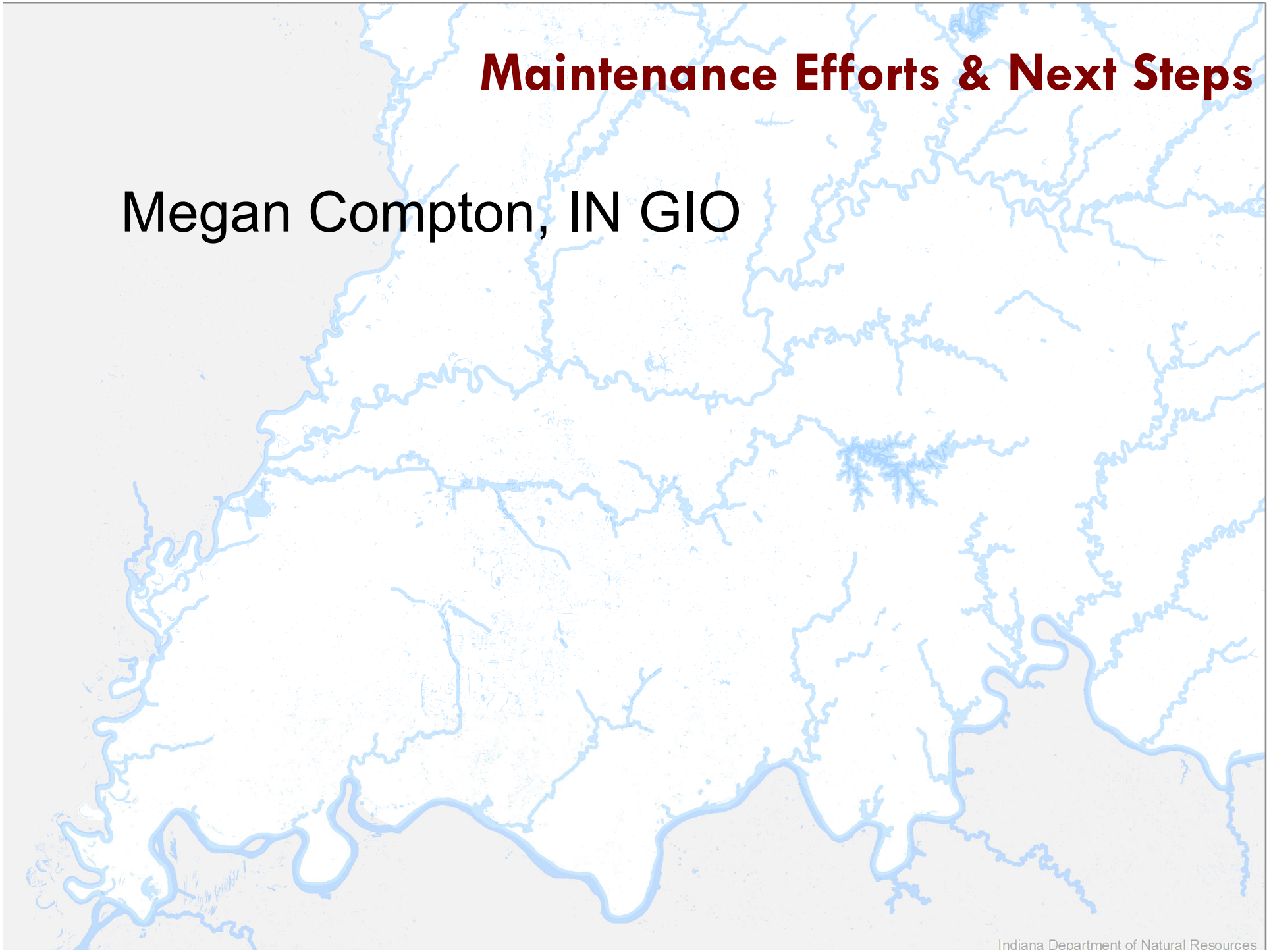
IN Department of Natural Resources

Indiana's Local-Resolution NHD/WBD Projects - Challenges & Lessons Learned

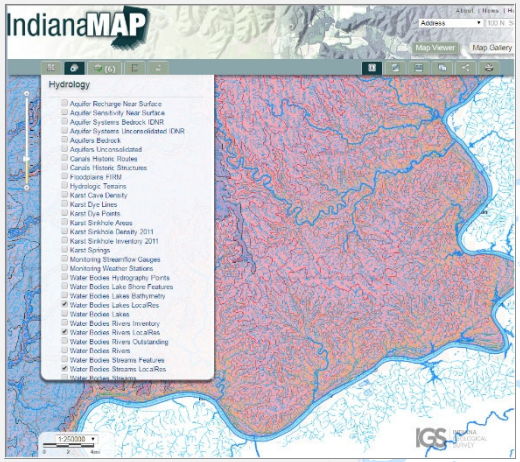
- Amount/density of hydro data
- Conflating 6 acre streams w/ USGS tools
- No drainageway FType during initial NHD project
- Karst, urban/stormwater, Lake Michigan (coastal)
- Basin overflows
- Unknown flow direction for WBD updates

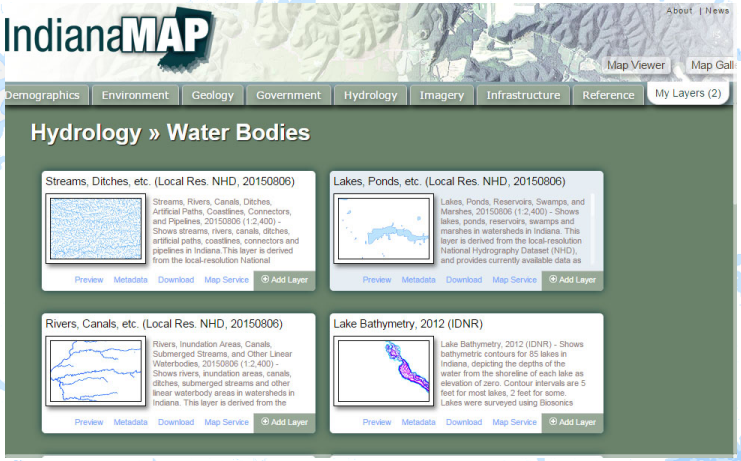
Maintenance Efforts & Next Steps

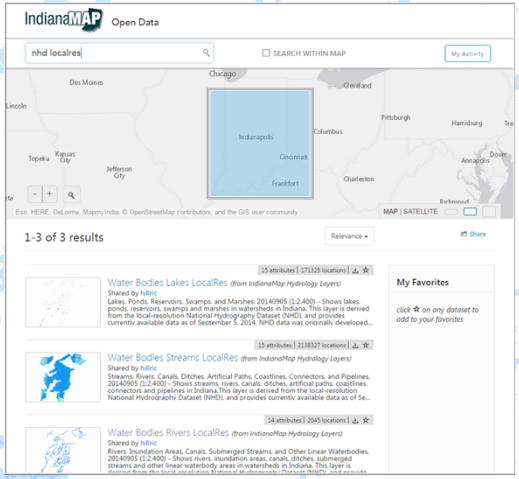
Megan Compton, IN GIO



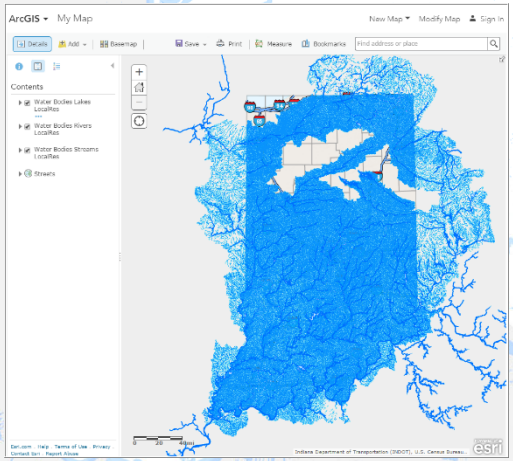
Accessing Indiana's Local-Resolution NHD Data

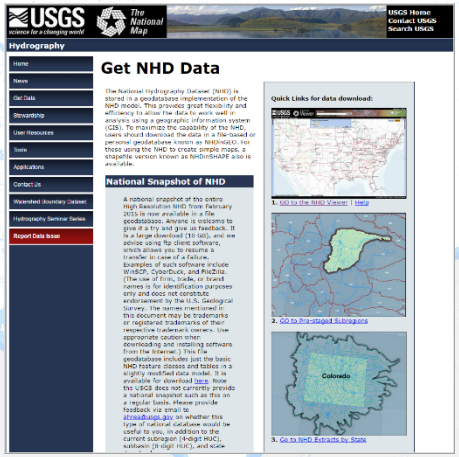


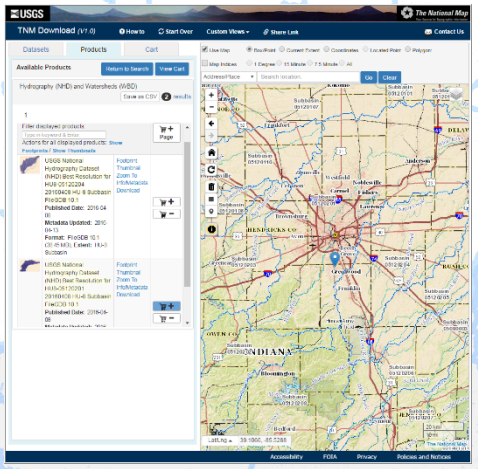




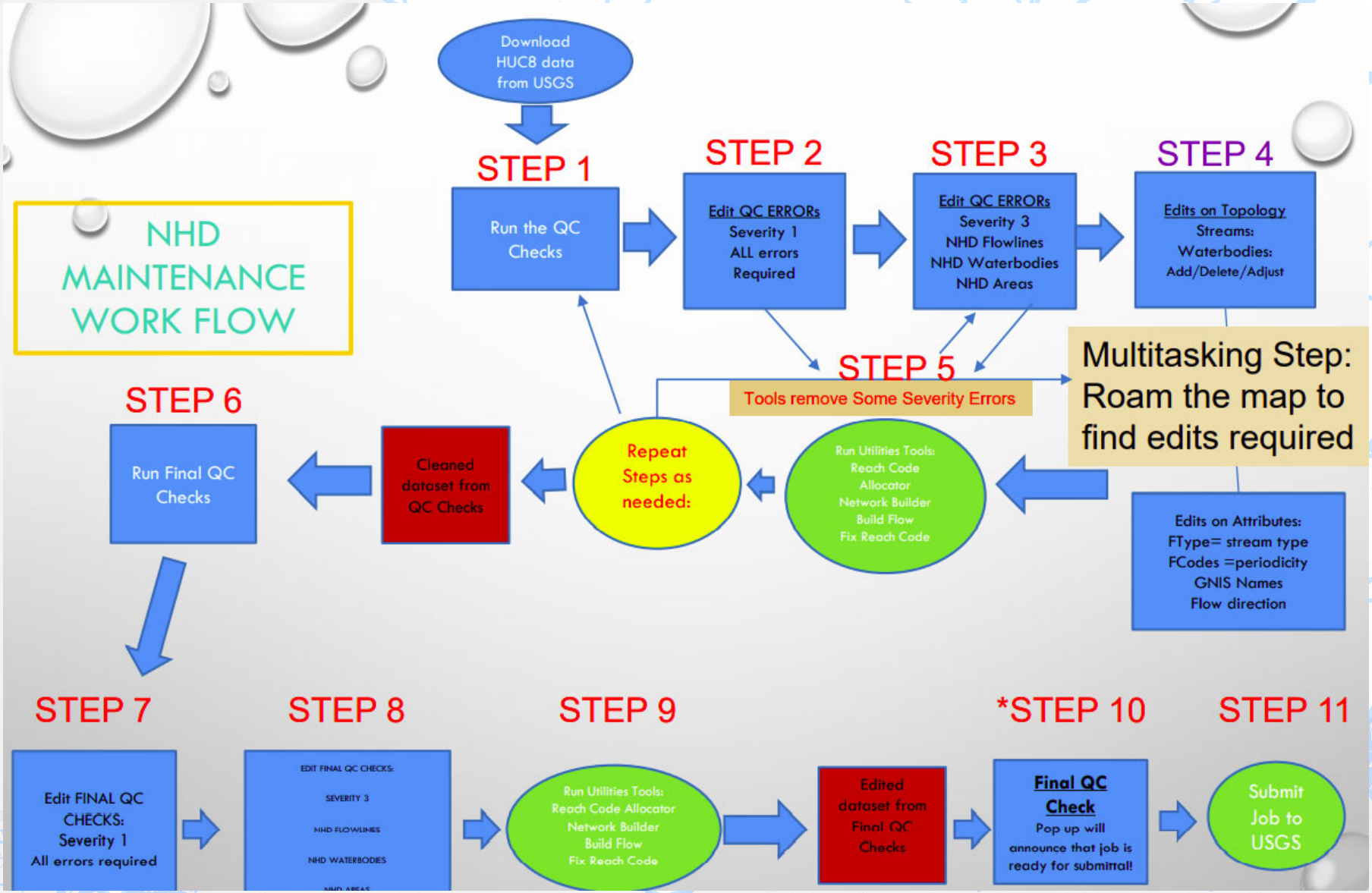
Provide multiple ways for end-users to access all new data (web viewing, downloading, and web services)







Provide Ongoing NHD/WBD Stewardship, Maintenance



Provide Ongoing NHD/WBD Stewardship / Maintenance

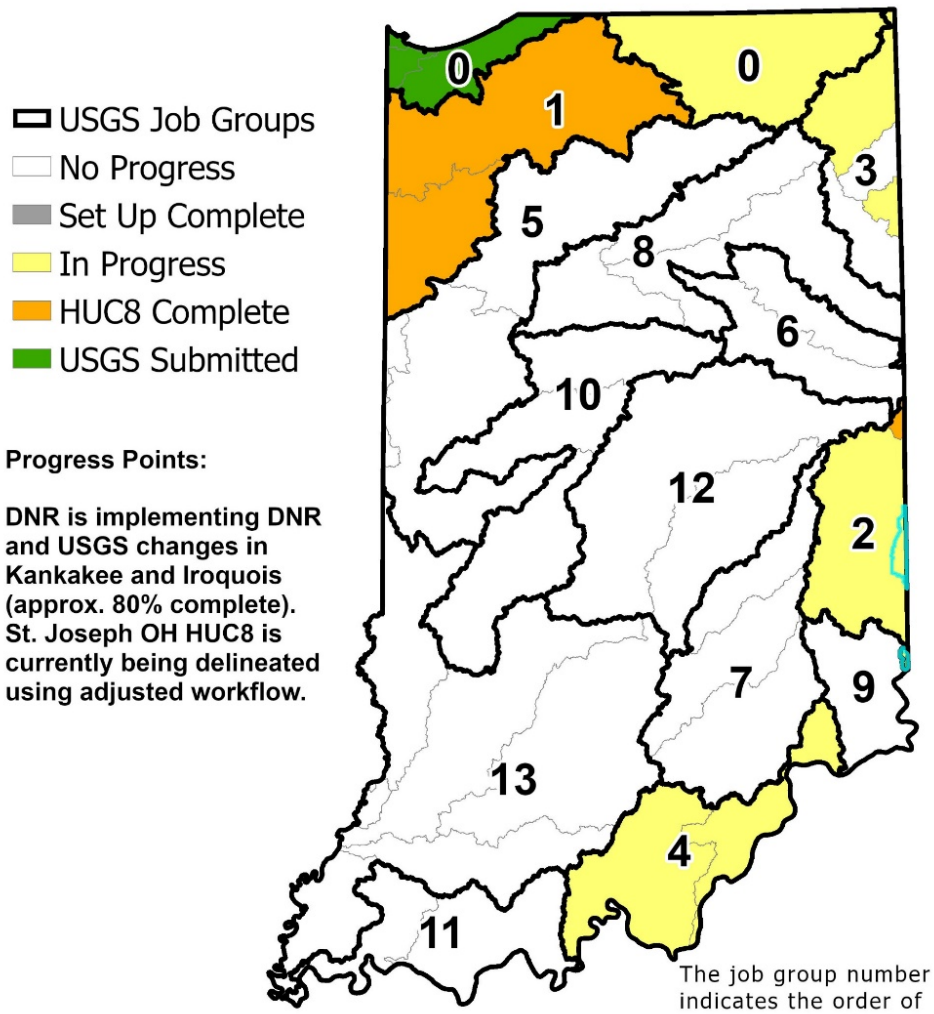
1. Indiana Stewardship Team Roles
   - Megan Compton, Indiana GIO – NHD Steward
   - Chris Morse, Indiana NRCS Office – WBD Steward
   - David Knipe, Indiana DNR – Engineering Section Manager
   - Robert Wilkinson, Indiana DNR – NHD Maintenance
   - Joanna Wood, Indiana DEM - NHD Maintenance
   - IGIC Waters Workgroup – Project Support
   - David Nail, USGS - IN State Liaison
   - Joel Skalet, USGS - NHD/WBD Support
   - Susan Phelps, AECOM – Indiana Local-Res NHD & WBD Contractor
2. Community Feedback provided through USGS Markup Tool (Both USGS & Indiana Staff address feedback)
3. Indiana Led Edits (GNIS Names, WBD updates, default FCode classification updates to Drainageway)

Local-Resolution NHD & WBD Issues & Next Steps

- Finish Statewide WBD updates
- Collecting, Proposing and Adding new [Local] GNIS Stream & Water Body Names
- Perform Review and Re-Classification of ALL new Local-Resolution StreamRiver reaches following new USGS Drainageway definition / classification
- Targeted NHD Updates using new 3DEP Statewide Lidar
- Review and Evaluate Indiana's Local-Resolution NHD mapping's impact on Waters of the United States (WOTUS) definitions and rules

Finish statewide WBD updates

WBD Status Update: JULY 2021



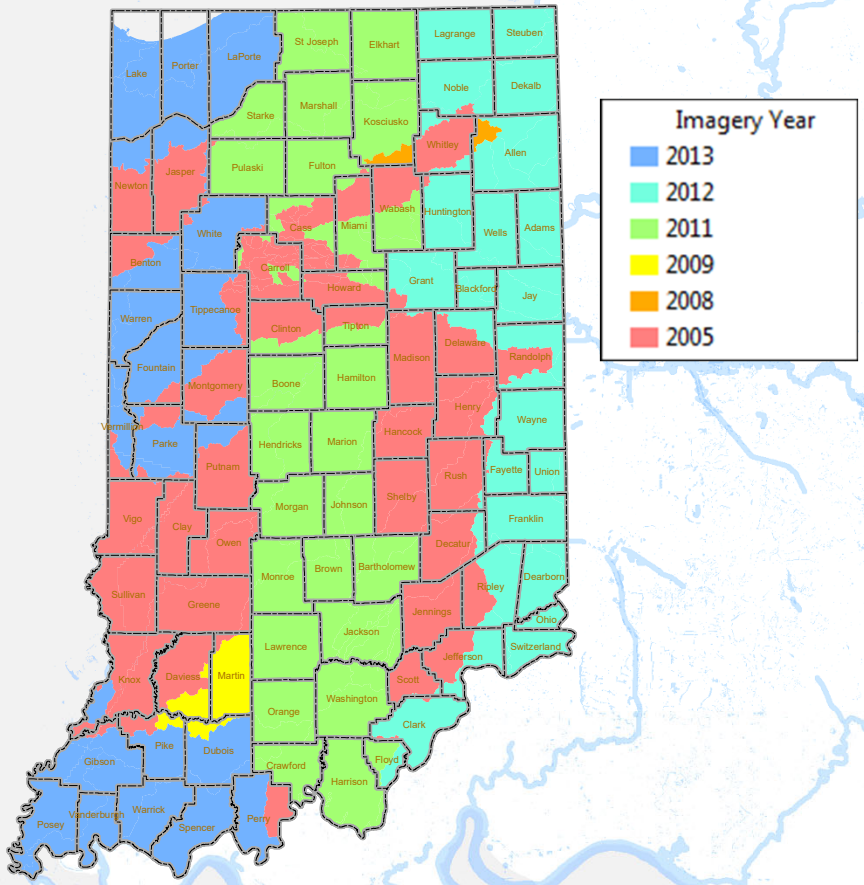
Collecting, Proposing and Adding new [Local] GNIS Stream & Water Body Names

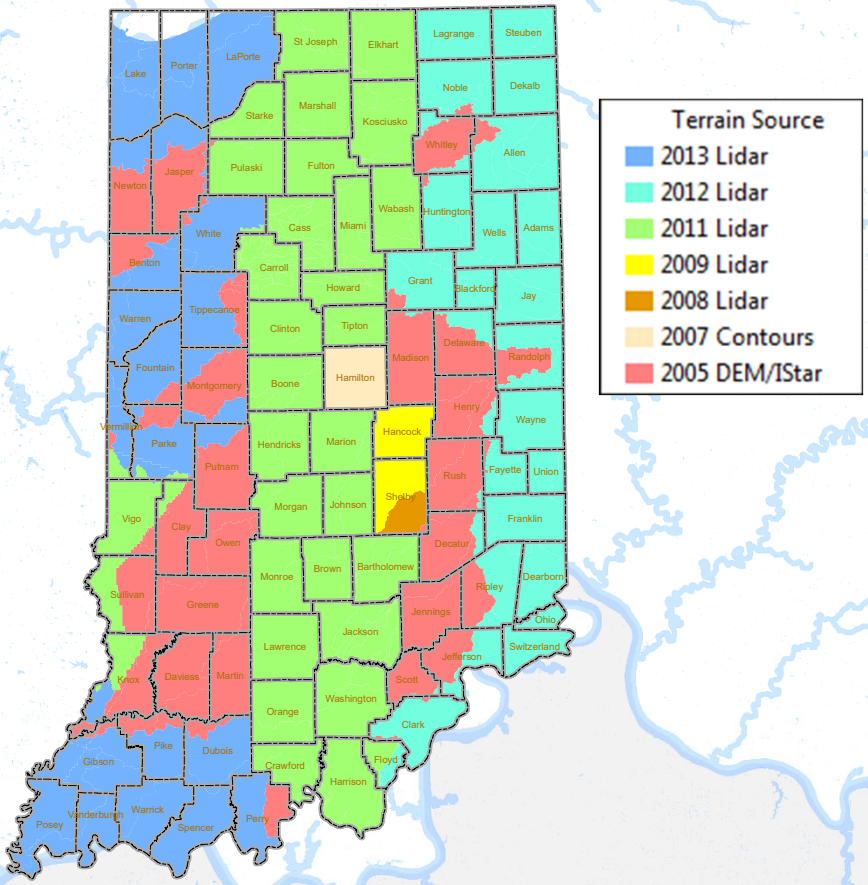
Solicit Public / Local Expert Input [Story Map]

Perform Review and Re-Classification of ALL new Local-Resolution StreamRiver reaches following new USGS Drainageway definition / classification

- Because of Indiana's 6-acre threshold requirement, there were many new flowlines captured that extend beyond physical streams to represent the "headwater / overland flow" portion of existing streams.
- Originally, all new StreamRiver segments were added with FType of 460 (StreamRiver) and FCode of 46000 (no further attributes).
- After the Indiana project was complete, USGS added a new StreamRiver FCode assignments for these new stream segments: Drainageway (46800), but this change still needs to be implemented.
- Indiana now needs to "review" and re-classify (batch updates?) FCode & FType classification for all new NHD Features.

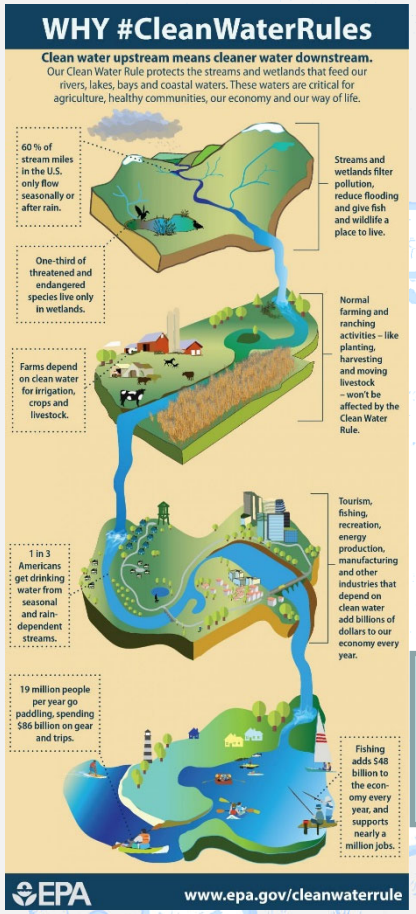
Targeted NHD Updates using new 2016-2020 3DEP statewide QL2 lidar (2005 Terrain & Imagery Areas)

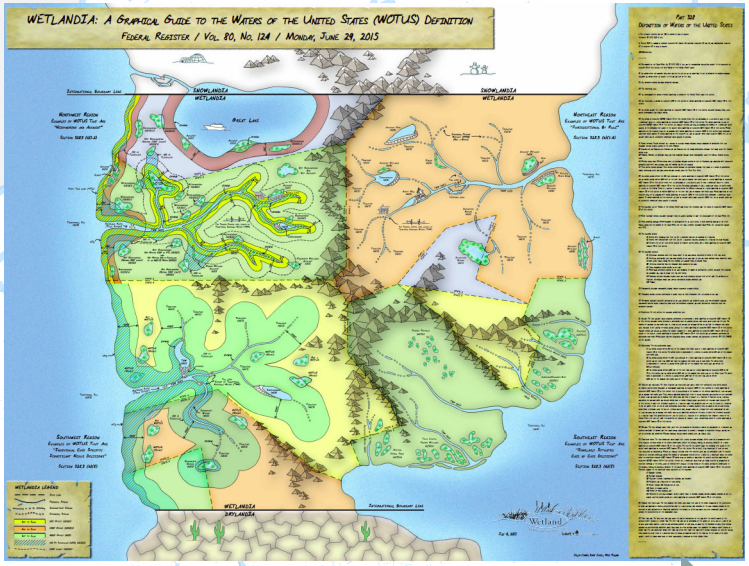




Review and Evaluate Indiana's Local-Resolution NHD mapping's impact on Waters of the United States (WOTUS) definitions and rules

WOTUS – EPA Clean Water Rules (Link)





EPA's Clean Water rules define WOTUS, but currently there is no "**real**" map of WOTUS based on these written rules. To better inform this conversation, we believe we are in a unique position to create a WOTUS map for Indiana using our statewide Local-Resolution NHD data

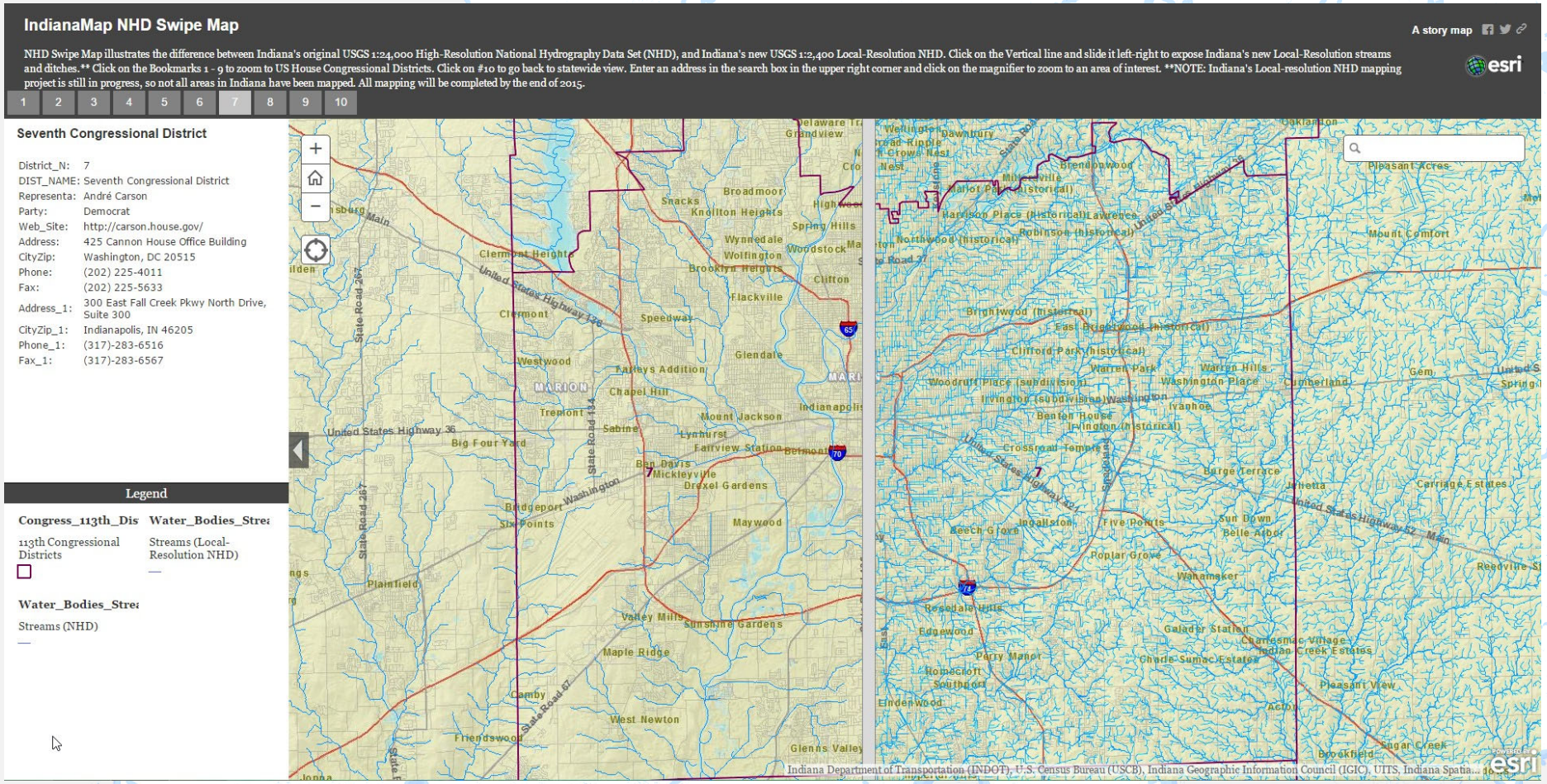
Exploring the Development and Maintenance of Indiana's Local-Resolution National Hydrography and Watershed Boundary Data

For more information, please contact:

- **Megan Compton (Indiana GIO, NHD Steward) @ MCompton@iot.IN.gov**
- **David Knipe (Indiana DNR – Acting Assistant Director, Engineering Section Manager) @ dknipe@dnr.IN.gov**
- **Susan Phelps (AECOM – Indiana Local-Res NHD & WBD Contractor) @ susan.phelps@aecom.com**

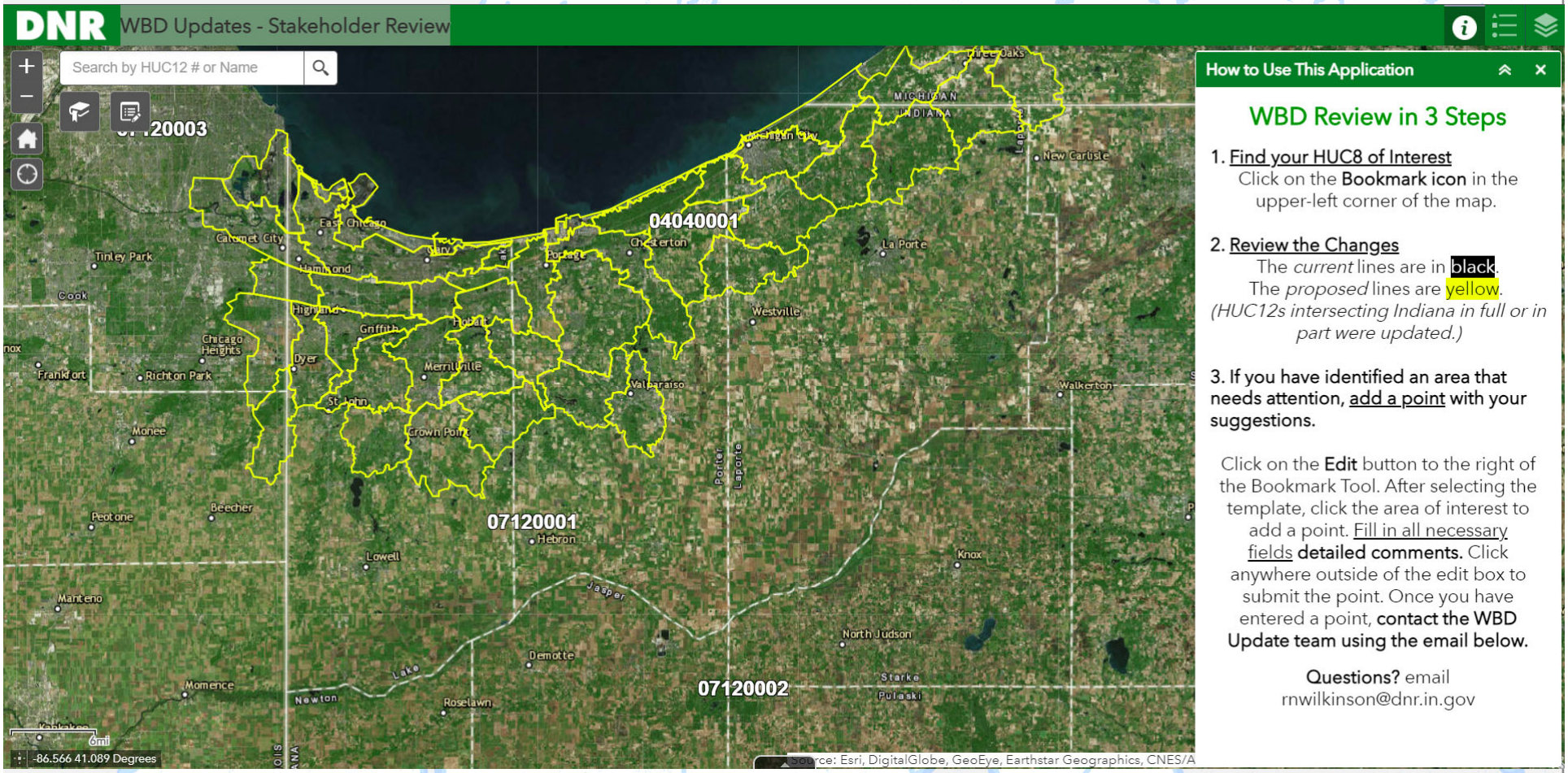
Compare High-Resolution vs. Local-Resolution NHD

1:24,000 1:2,400



http://arcg.is/1HHmzQa

IDNR WBD Updates Stakeholder Review



https://indnr.maps.arcgis.com/apps/webappviewer/index.html?id=b42a1beace5444f48f8afa1cae447d4e)