

The Power of the Flow Network

Cynthia Ritmiller
National Hydrographic Dataset
U.S. Geological Survey

National Hydrography Dataset (NHD)

- Partnership between by EPA and USGS
- Surface water
- User driven data
- Multi Resolution
- Comprised of
 - Watershed Boundaries Dataset(WBD)
 - Hydrography Dataset (NHD)



<http://nhd.usgs.gov/>

Watershed Boundary Dataset (WBD)



National Hydrography Dataset (NHD) Model (v2.2)

May 27, 2014

The Catalog View

Feature Detail

Attribute Tables

Processing

Processing Domains

FEATURE CLASSES

Event Feature Classes

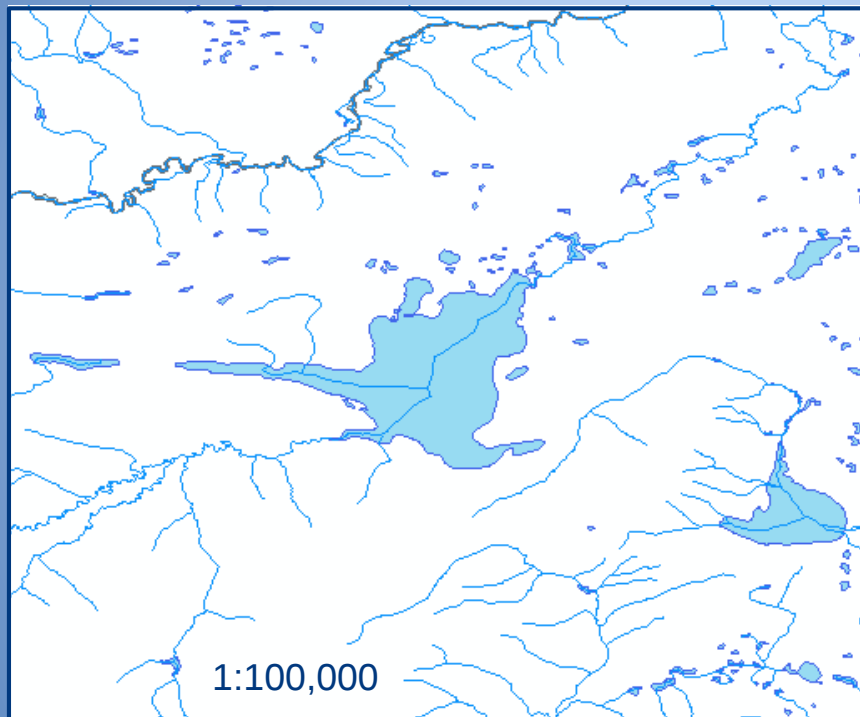
Feature Metadata

FCode (Feature) Domain

Non-FCode Domains

Water Boundary Dataset (WBD) Feature Classes

Basic NHD knowledge



- [-] NHD57368_15010014
 - [-] BackUp
 - [-] GDB
 - [-] NHD57368.mdb
 - [-] Hydrography
 - [+/-] Import_Line
 - [+/-] Import_Polygon
 - [+/-] NHDArea
 - [+/-] NHDAreaEventFC
 - [+/-] NHDFlowline
 - [+/-] NHDLine
 - [+/-] NHDLineEventFC
 - [+/-] NHDPoint
 - [+/-] NHDPointEventFC
 - [+/-] NHDWaterbody
 - [-] Hydrography_International
 - [+/-] NHDArea_Int
 - [+/-] NHDAreaEventFC_Int
 - [+/-] NHDFlowline_Int
 - [+/-] NHDLine_Int
 - [+/-] NHDLineEventFC_Int
 - [+/-] NHDPoint_Int
 - [+/-] NHDPointEventFC_Int
 - [+/-] NHDWaterbody_Int

NHD Fields and Tables

NHDFlowline

OBJECTID *	PERMANENT_IDENTIFIER *	FDATE	Resolution	GNIS_ID *	GNIS_NAME	LENGTHKM	REACHCODE *	FlowDir	WBAREA_PERMANENT_IDENTIFIER *	FType *
3016373	121575894	2/29/2012 11:22:21 AM	High	00679029	Underwood Creek	0.012	03160104001051	WithDigitized	<Null>	
3016370	121575731	2/29/2012 11:22:21 AM	High	<Null>	<Null>	3.676	03160104000331	WithDigitized	<Null>	
3016371	121575754	2/29/2012 11:22:00 AM	High	<Null>	<Null>	0.056	03160104004476	WithDigitized	121582465	
3016372	121575872	2/29/2012 11:22:21 AM	High	<Null>	<Null>	1.14	03160104004496	WithDigitized	<Null>	
3016374	121575949	2/29/2012 11:22:21 AM	High	<Null>	<Null>	0.919	03160104000245	WithDigitized	<Null>	
3016375	121576168	2/29/2012 11:22:21 AM	High	<Null>	<Null>	0.244	03160104004610	WithDigitized	<Null>	
3016377	121576346	2/29/2012 11:22:21 AM	High	00671939	Johnson Creek	1.197	03160104001214	WithDigitized	<Null>	
3016378	121576580	2/29/2012 11:22:21 AM	High	<Null>	<Null>	0.137	03160104004772	WithDigitized	<Null>	

NHDSourceCitation

OBJECTID *	SOURCE_DATASETID	TITLE	SOURCECITATION	ORIGINATOR
49131	{85B09DC5-E6A3-6AC7-E044-00144F233E68}	Geographic Names Information System	GNIS	U.S. Geological Survey
41430	{85B09DC5-E0E4-6AC7-E044-00144F233E68}	NHD basic features	NHD basic features	U.S. Geological Survey
41431	{85B09DC5-E0E5-6AC7-E044-00144F233E68}	CU boundaries	CU boundaries	U.S. Geological Survey (USGS) in coop
41432	{85B09DC5-E0E6-6AC7-E044-00144F233E68}	Geographic Names Information System	GNIS	U.S. Geological Survey
41433	{85B09DC5-E0E7-6AC7-E044-00144F233E68}	National Hydrography Dataset	NHD	U.S. Geological Survey in cooperation
42375	{85B09DC5-E2C2-6AC7-E044-00144F233E68}	NHD basic features	NHD basic features	U.S. Geological Survey
42376	{85B09DC5-E2C3-6AC7-E044-00144F233E68}	CU boundaries	CU boundaries	U.S. Geological Survey (USGS) in coop
42377	{85B09DC5-E2C4-6AC7-E044-00144F233E68}	Geographic Names Information System	GNIS	U.S. Geological Survey

NHDSReachCodeMaintenance

OBJECTID *	PERMANENT_IDENTIFIER *	REACHCODE *	REACHSMDATE	Resolution	GNIS_ID	GNIS_NAME
8657823	122040011	03160102002835	6/24/2004 11:55:30 PM	High	<Null>	<Null>
8657824	122040014	03160102002837	6/24/2004 11:55:35 PM	High	<Null>	<Null>
8657825	122040017	03160102002839	6/24/2004 11:55:39 PM	High	<Null>	<Null>
8657826	122040020	03160102002841	6/24/2004 11:55:43 PM	High	<Null>	<Null>
8657827	122040024	03160102002843	6/24/2004 11:55:48 PM	High	<Null>	<Null>
8657828	122040027	03160102002845	6/24/2004 11:55:52 PM	High	<Null>	<Null>
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8657833	122040037	03160102002852	6/24/2004 11:56:08 PM	High	<Null>	<Null>
8657834	122040041	03160102002854	6/24/2004 11:56:12 PM	High	<Null>	<Null>

NHD57368_15010014
BackUp
GDB
NHD57368.mdb
Hydrography
Hydrography_International
WBD
ExternalCrosswalk
GAZ_HYDROFEATURES
GAZ_VARIANTNAMES
NHDFCode
NHDFeatureToMetadata
NHDFlow
NHDFlowlineVAA
NHDMetadata
NHDProcessingParameters
NHDSReachCodeMaintenance
NHDSReachCrossReference
NHDSsourceCitation
NHDStatus
NHDVerticalRelationship
ORG_NHDFlowlineVAA
ORG_NHDSReachCodeMaintenance
ORG_Sequence
Sequence

Metadata

Metadata Viewer

Metadata Session

NHD Metadata NHD Source Citation

Select Template Save Template

Dataset Credit

Process Description

Metadata Standard

Metadata Standard Name Content Standard for Digital Geospatial Metadata

Metadata Standard Version FGDC-STD-001-1998

Process Date September, 12, 2014

Metadata Date September, 12, 2014

Contact Information Data Quality

Contact Organization

Address

City

State or Province

Postal Code

Contact Voice Telephone

Contact Email Address

Contact Instructions

Address Type

Save Metadata Close

Metadata Viewer

Metadata Session

NHD Metadata NHD Source Citation

Select Template Save Template

Title

Source Originator

Publication Date Unknown

Data Quality Section: Lineage

Source Citation Abbreviation

Source Scale Denominator Unknown

Source Contribution

Type of Source Media

Source Currentness

Source Currentness Reference

Calendar Date September 12, 2014

Date Range

Beginning Date September 12, 2014

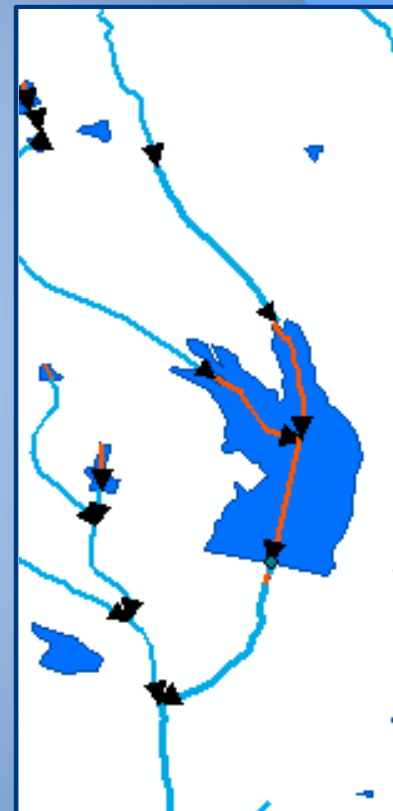
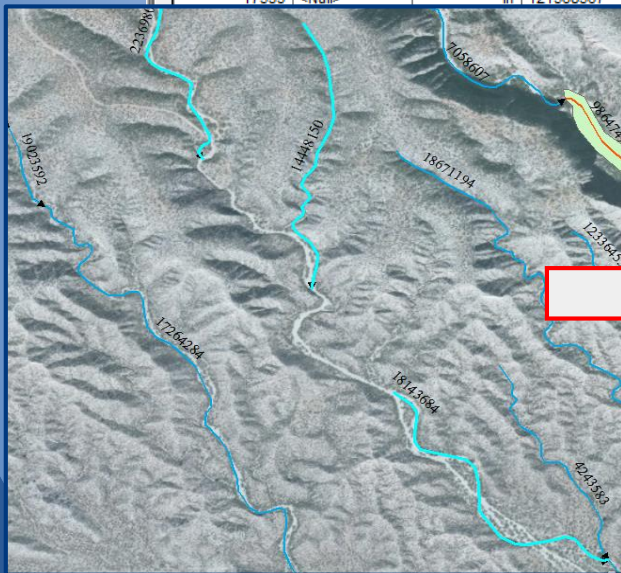
Ending Date September 13, 2014

Source (+) of 0

Save Metadata Close

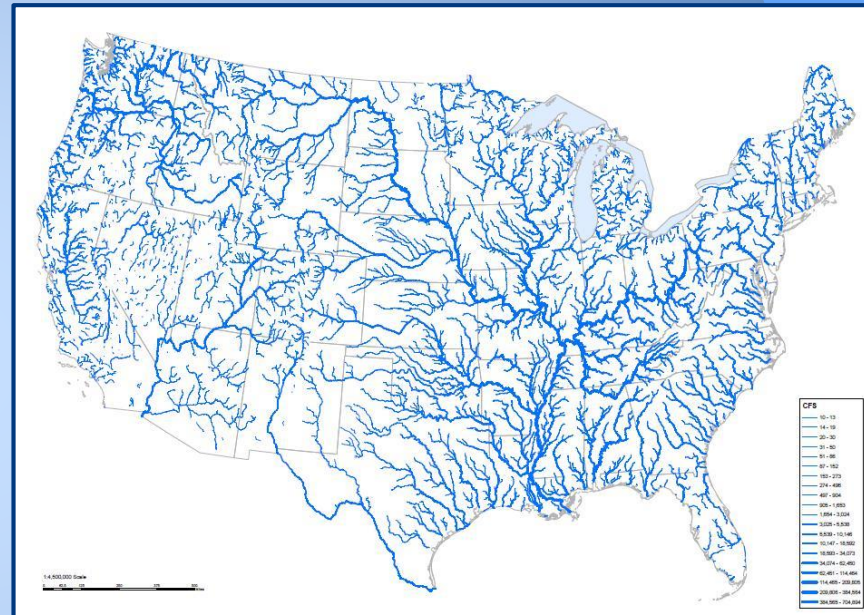
Importance of the Network

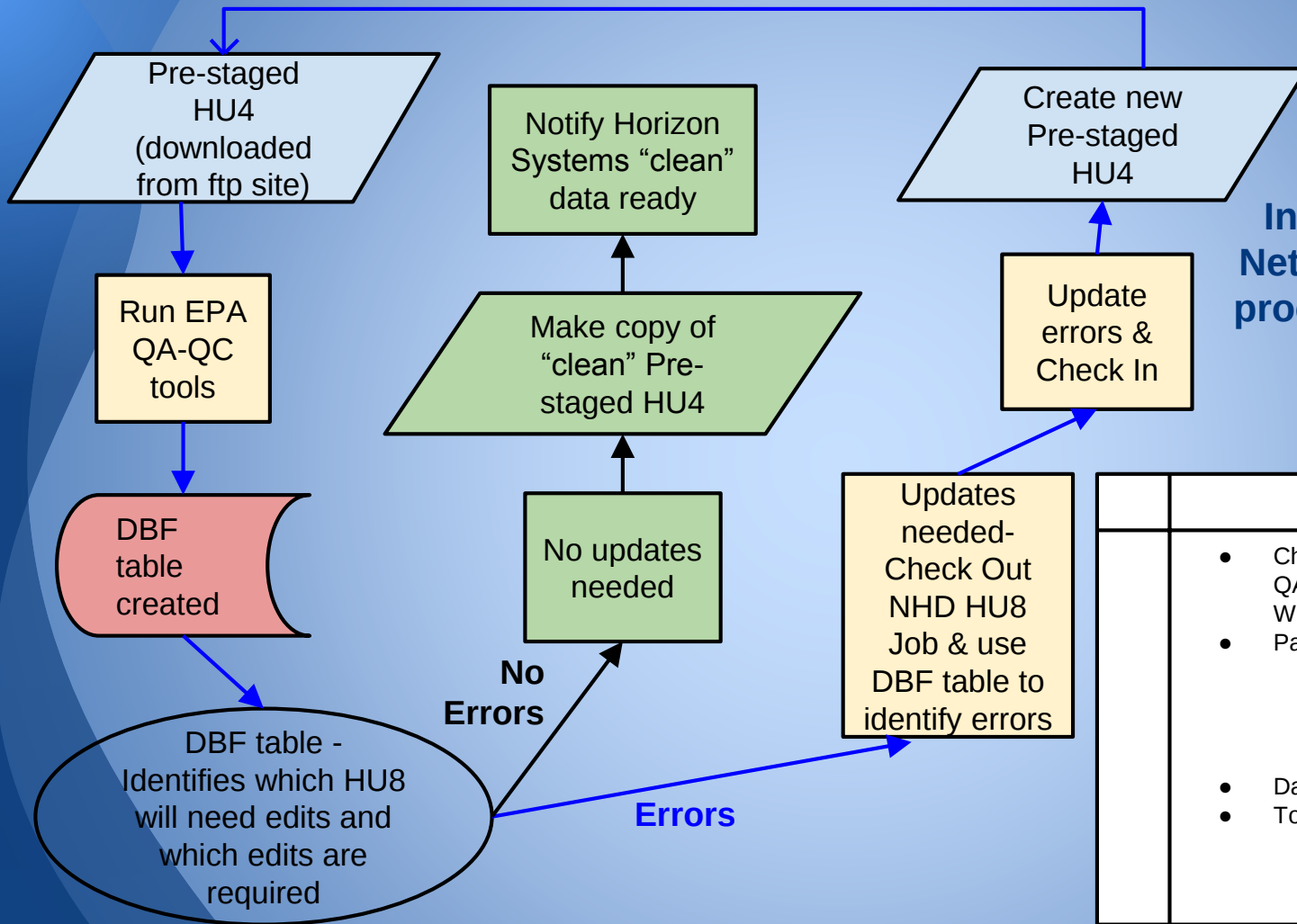
NHDFlow				
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17529	<Null>	In	121567223	121567239
17530	<Null>	In	121567317	121567355
17531	<Null>	In	121567619	121567766
17532	<Null>	In	121567886	121567878
17533	<Null>	In	121568567	121568791



NHDPlus

- Application ready data
- Comprised of the NHD, WBD and the National Elevation Dataset(NED)
- Medium Res NHDPlus 1:100K
- High Res NHDPlus 1:24K





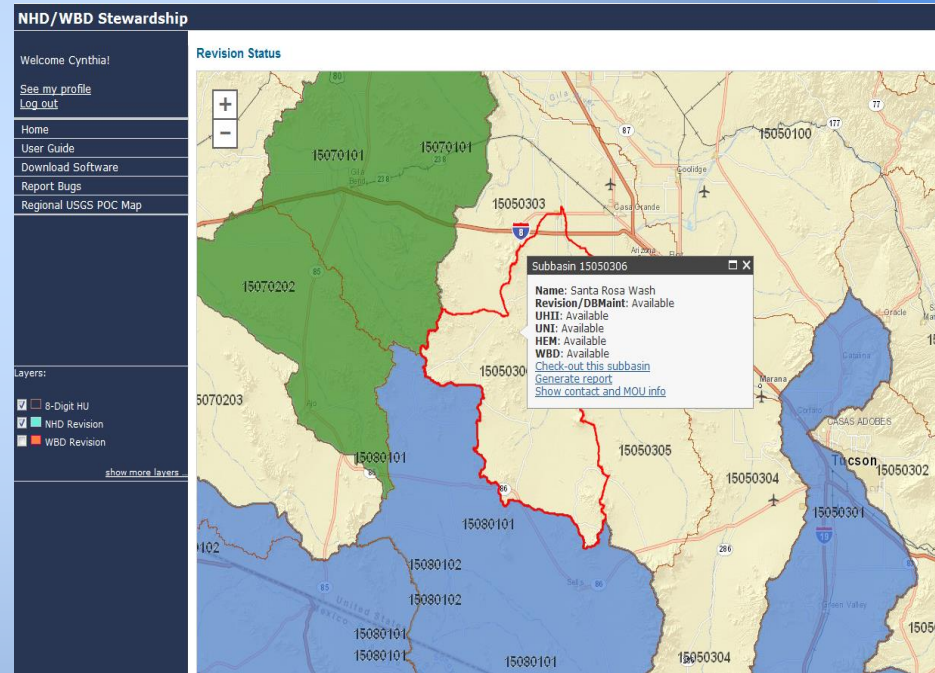
**Internal USGS NHD
Network Improvement
process in preparation
for building
HR NHDPlus**

	Influences
	• Changes with <i>ERRORLEVEL</i> for QA-QC checks: Severe (S), Warning (W), or Informational (I) • Partners: ◦ Changes within NHD data (new features and updates) ◦ Severity 3 (warning) errors not required to be fixed • Data Management • Tools ◦ Updates/changes of the tool ◦ Different versions of the tool used for edits

Editing NHD data

- Through Online Stewardship website
- Checked out by subregions (HUC 8)
- Must have a user account
- Job Tracking Workflow (JTX)

1. Open the Job in ArcMap
2. Run initial QC's
3. Complete edits
4. Run Final QC's
5. Send Job to USGS



Quality Control Checks (listed in run order)

Check 1 - Flow Table Never Navigated

Check 2 - Improper Network End

Check 3 - Invalid Flow Table Entry

Check 4 - Improper Network Start

Check 26 - Flowline with both flowing and non-flowing flow table entries

Check 5 - Potential Loop

Check 8 - Duplicate Flow Table Entry

Check 9 - Incomplete Divergence

Check 10 - Flow Table and Flowline Ftype Disagree

Check 11 - Flow Table and Flowline Flowdir Disagree

Check 12 - Isolated Network - newer than 2012

Check 13 - Coordinate Order and Flow Table Disagree

Check 14 - Flowlines Relate in Flow Table But Do Not Touch - not reviewed

Check 15 - Flowlines Touch But Do Not Relate in Flow Table (not Canal/Ditch) - not run

Check 16 - Flowing Connections and Elevations Disagree - not run

Check 23 - Circular Named Path - not reviewed

Check 25 - Nonlinear Named Path

Check 6 - Possible Outflowing Connection - not reviewed

Check 7 - Possible Inflowing Connection - not reviewed

Check 17 - Flowline Not in Linear Reach

Check 18 - Circular Reach - not reviewed

Check 19 - Nonlinear Reach

Check 20 - Circular Flowline - not reviewed

Check 24 - Nonlinear Flowline

Check 21 - Flowline with LengthKM = 0

Check 22 - Reachable Waterbody Not in Area Reach

Check 27 - Waterbody reach has multiple waterbodies that do not touch

Check 29 - Duplicate NHDFlowline features

Check 30 - Duplicate NHDWaterbody features - not reviewed

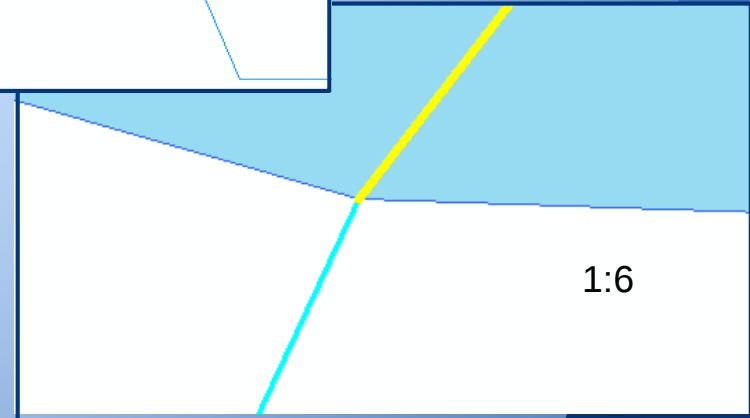
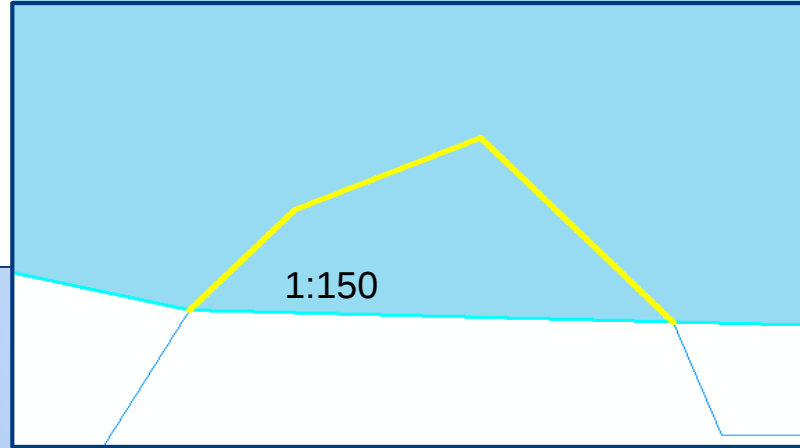
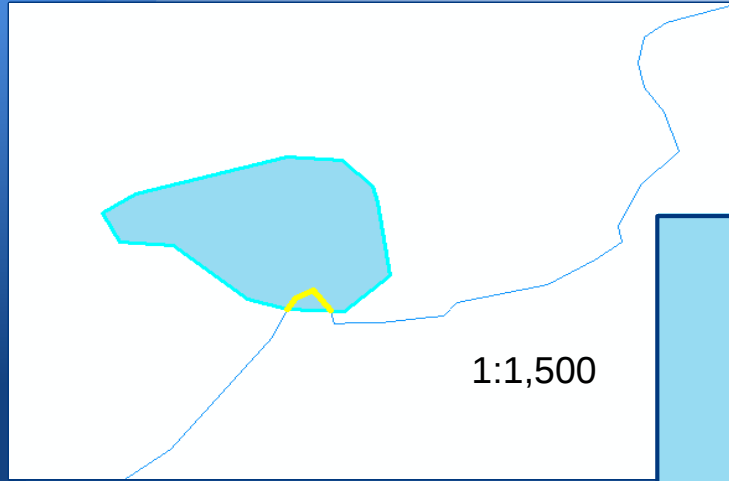
Check 31 - Duplicate NHDArea features - not reviewed

Check 32- Reach Surrounded by Different HUCs

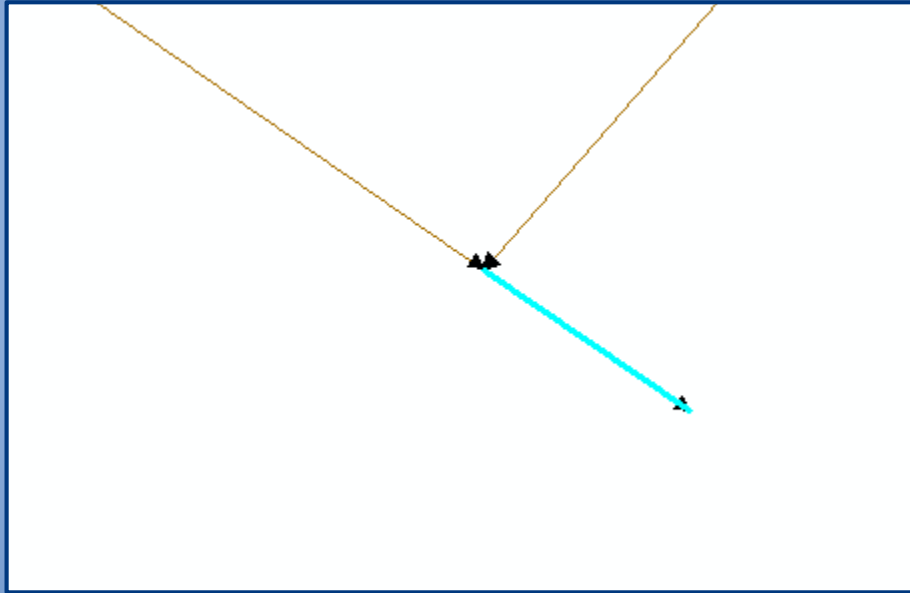
Check 33- Coastline Dangles

Check 28 - Microgaps (with cluster tolerance of 20cm)

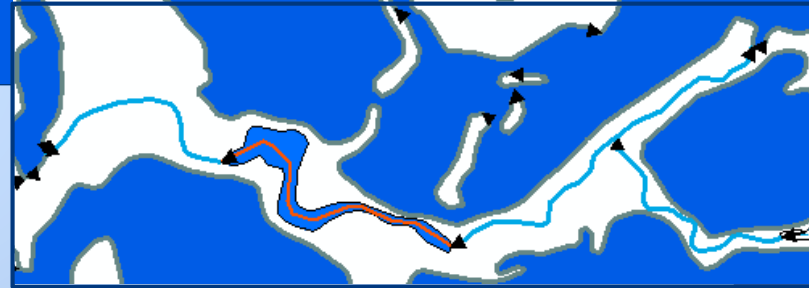
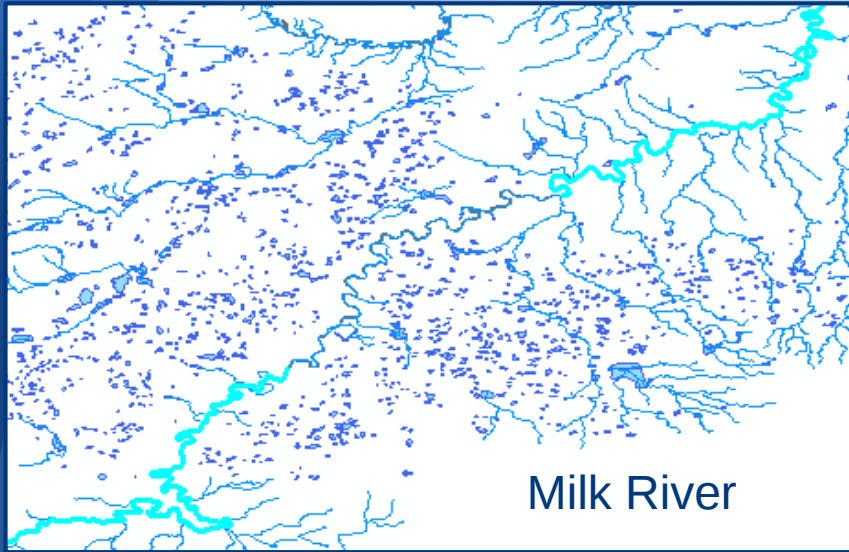
Microgap



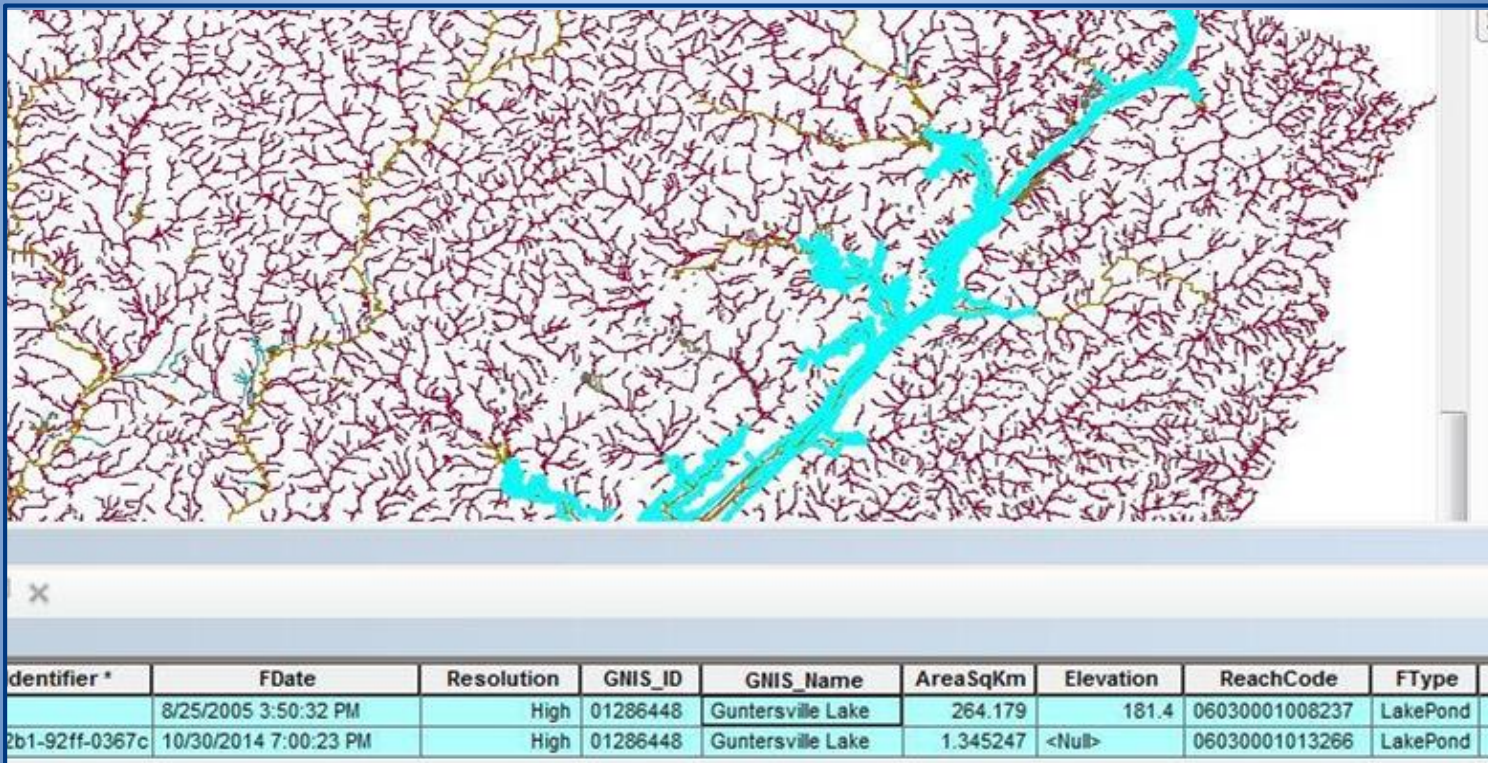
Flowline with Length less than 2 KM



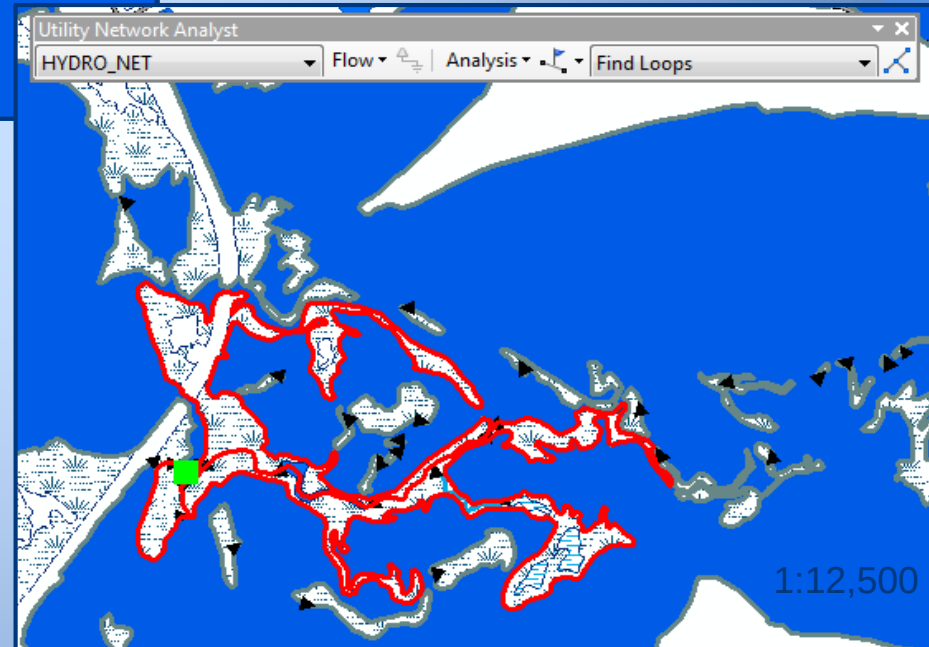
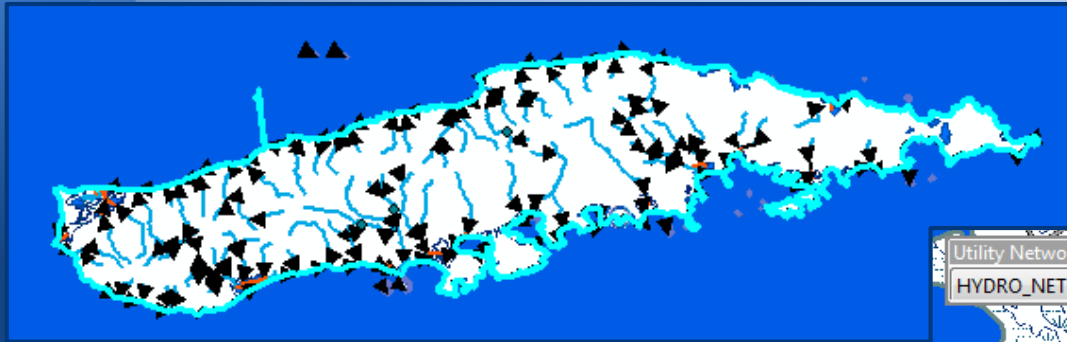
Nonlinear Named Path or Nonlinear Reach



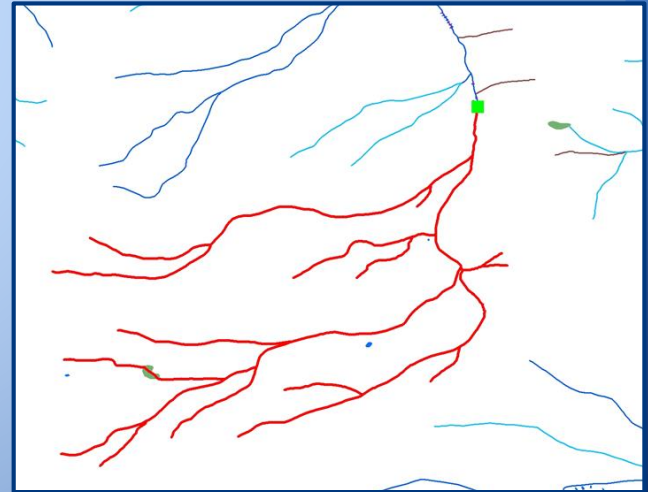
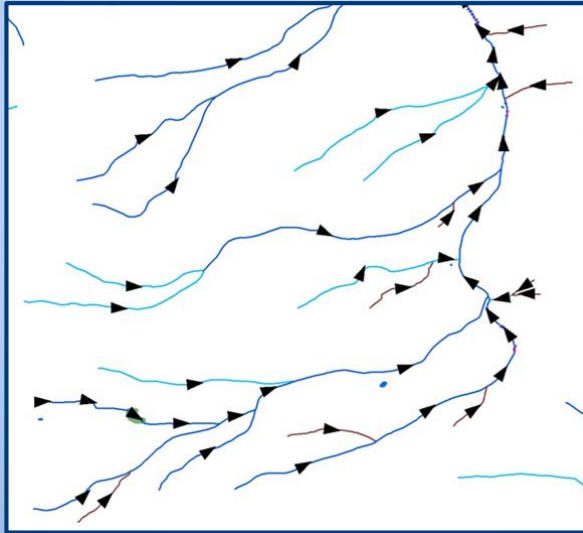
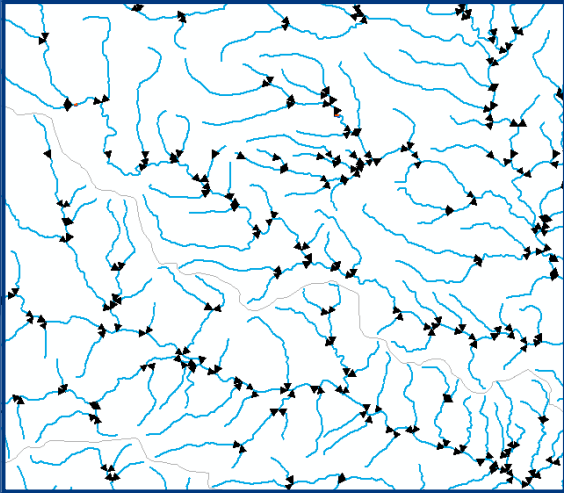
Duplicate Features



Loops



Maintaining the Network



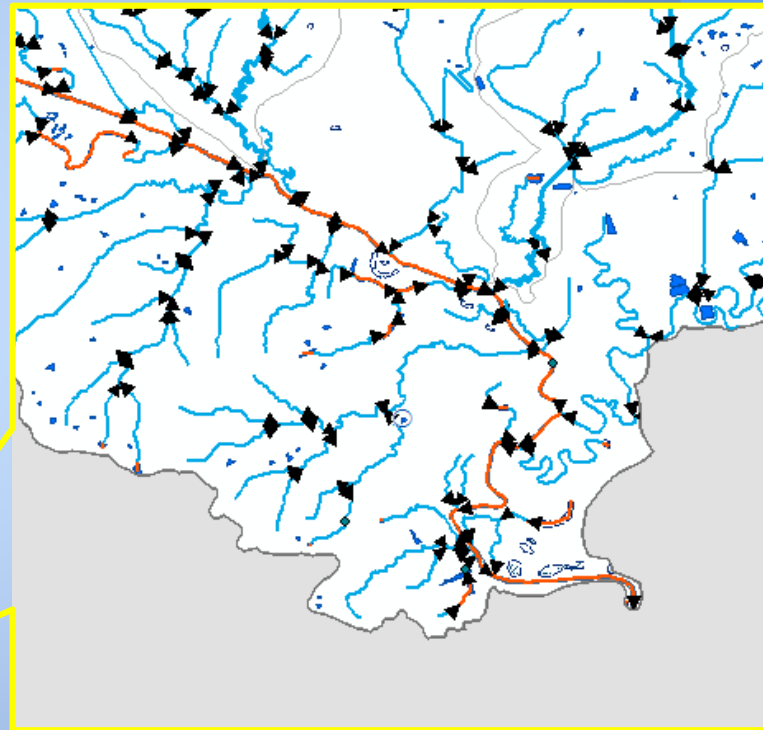
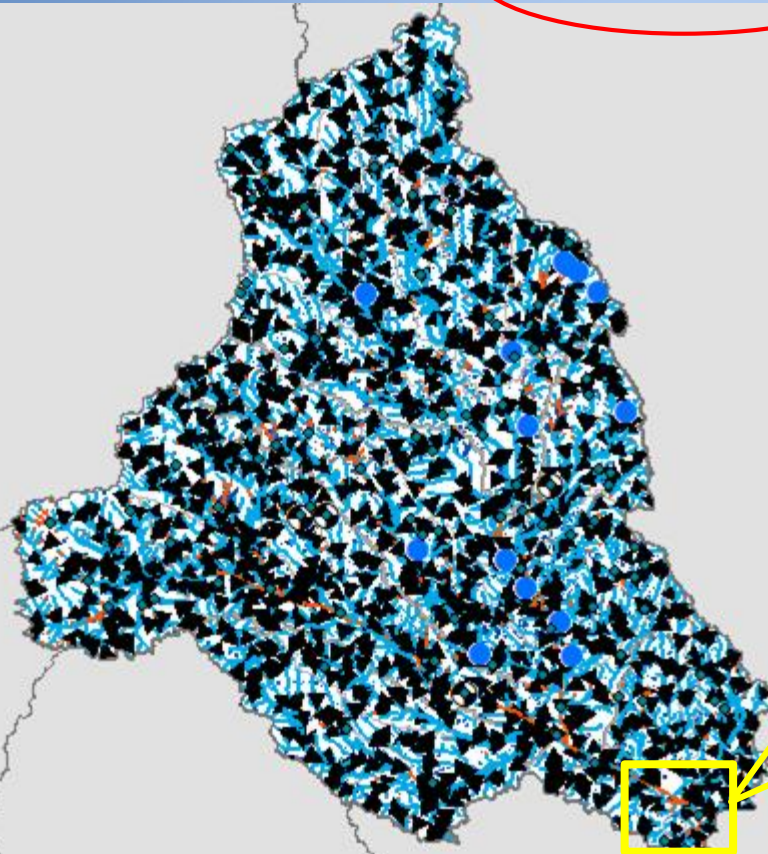
Utility Network Analyst

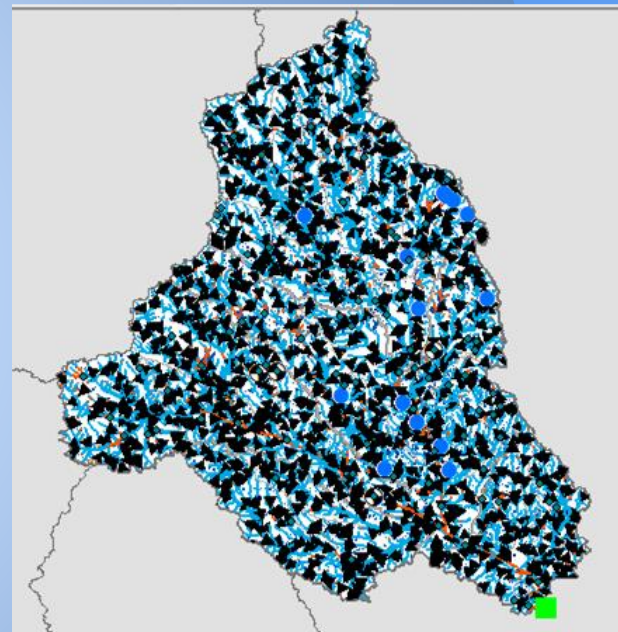
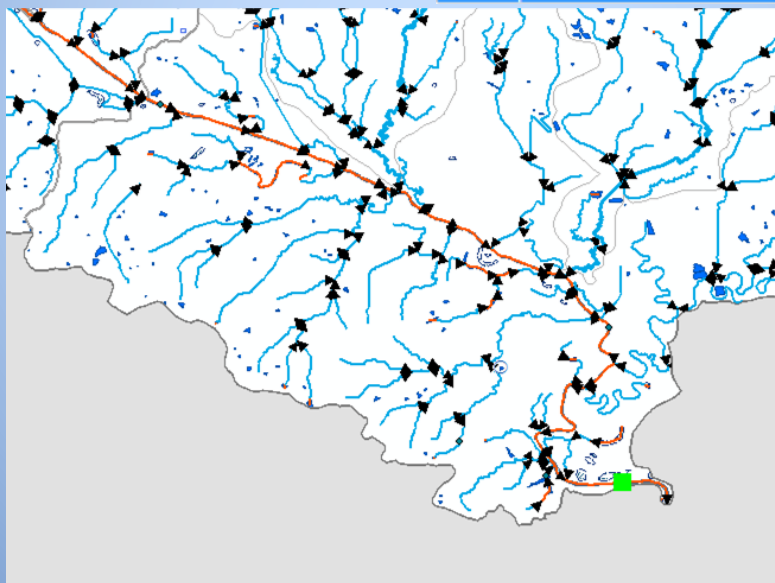
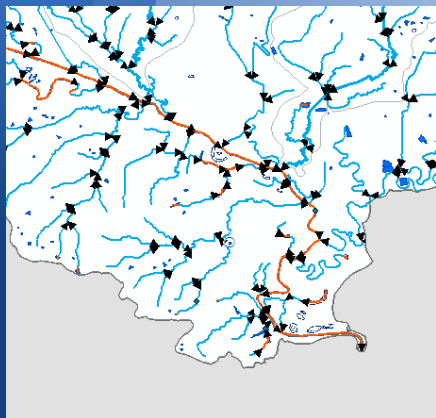
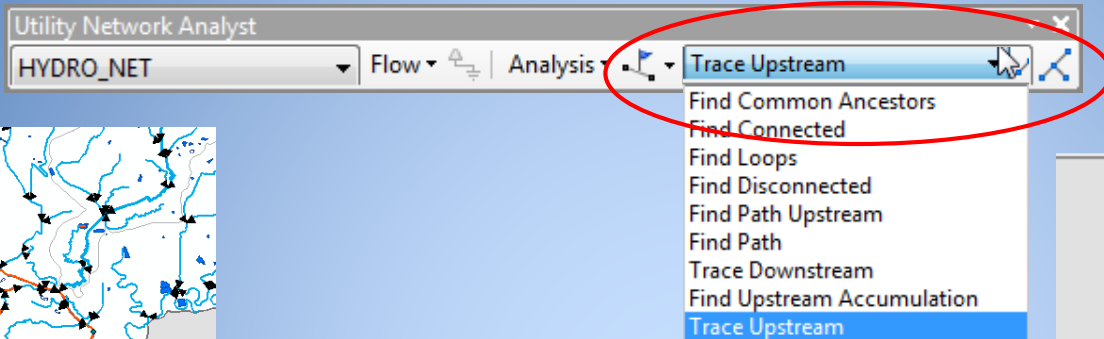
HYDRO_NET

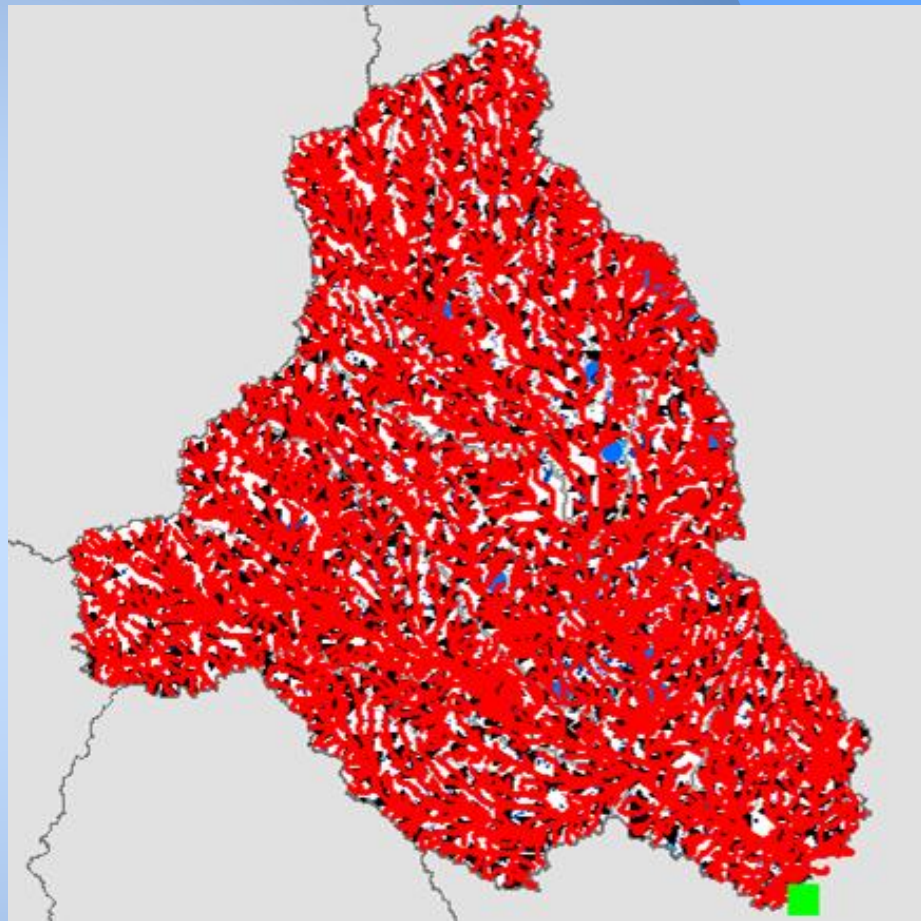
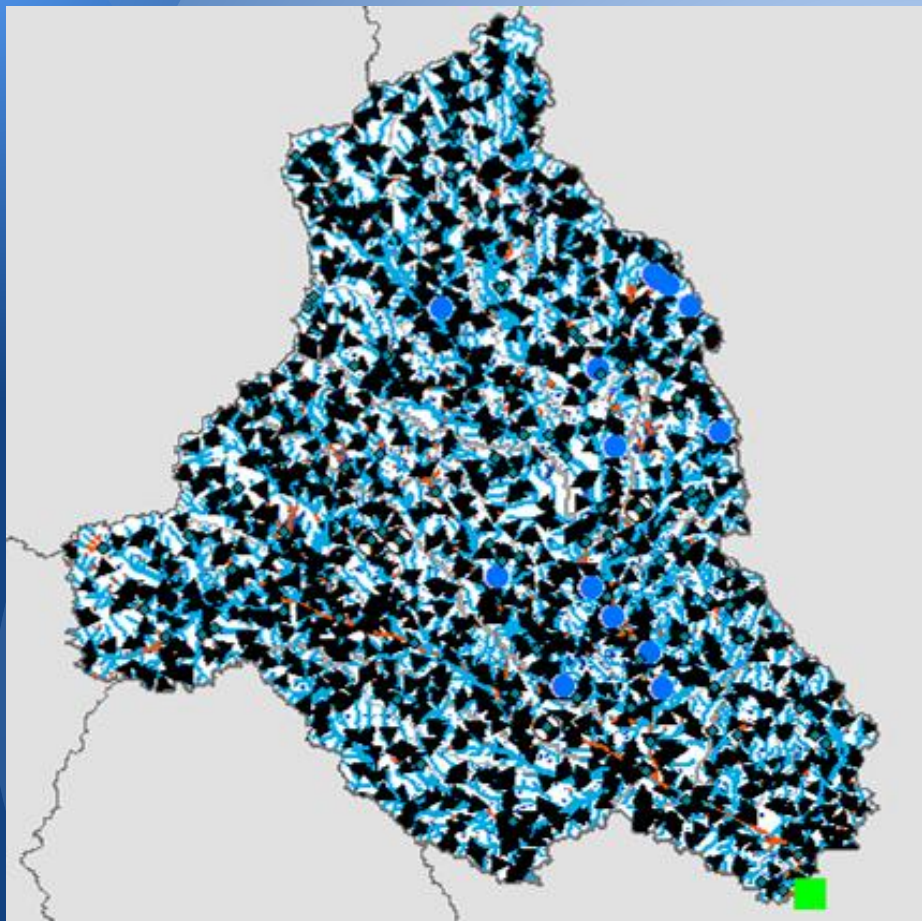
Flow

Analysis

Trace Upstream

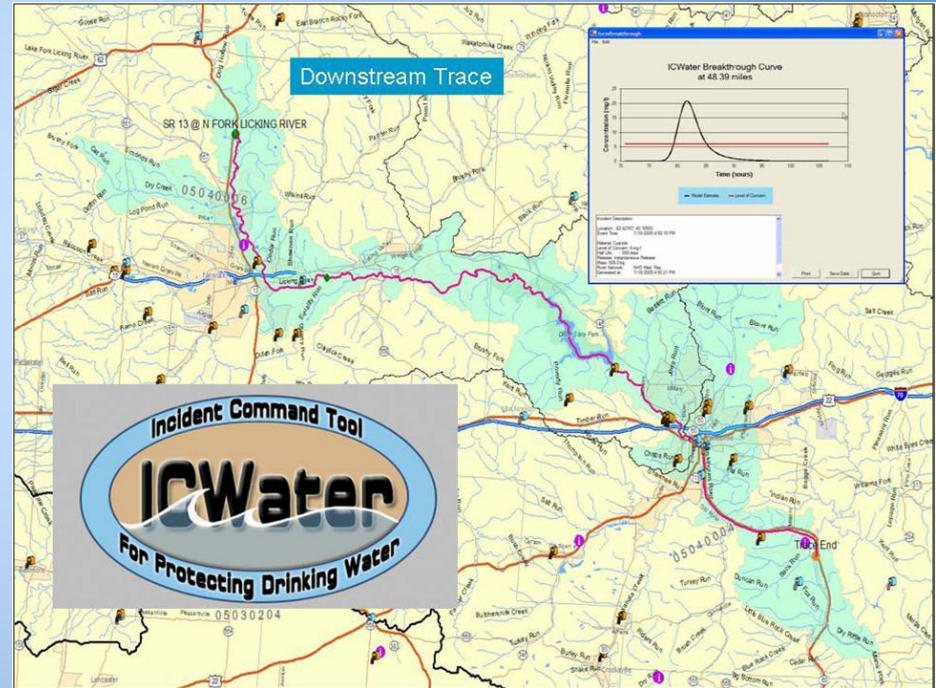






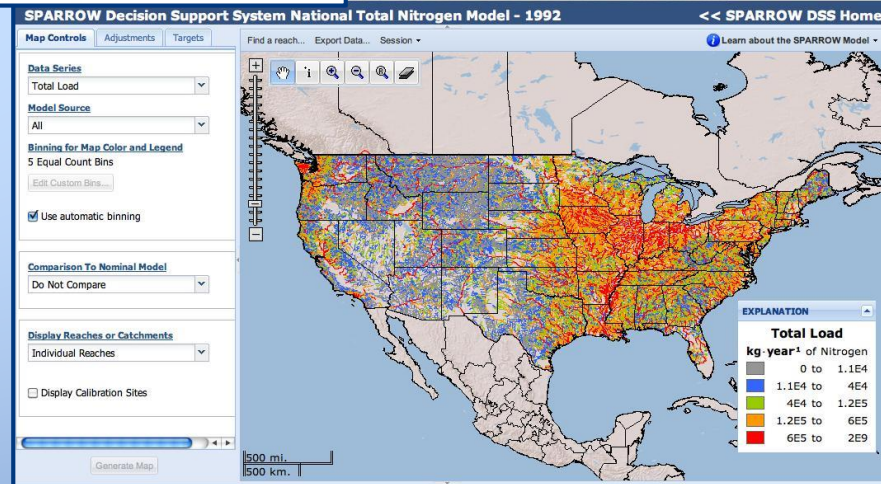
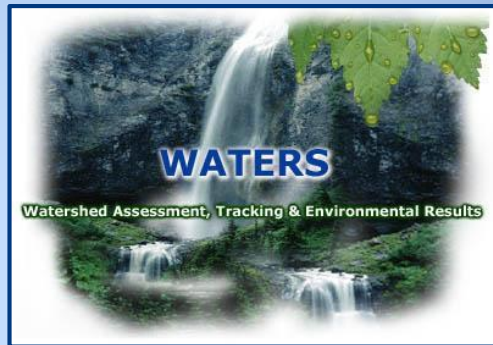
Applications of Network

- Hydrologic Modeling
 - NHD Trace tool
 - NHDPlus
 - StreamStats
- Emergency Response
 - Drinking water
- Fisheries Management
 - Barriers



Applications of the Network

- Environmental Protection
 - WATERS
 - New England SPARROW
 - Spills
- Resource Management
 - U.S. Forest Service Natural Resource Information System (NRIS)



Any Questions or Comments?

National Hydrography Dataset

Cynthia Ritmiller

critmiller@usgs.gov

Resources

- USGS website www.usgs.gov
- NGTOC website <http://ngtoc.usgs.gov/>
- NHD website <http://nhd.usgs.gov/index.html>
- NHD stewweb <http://usgs-mrs.cr.usgs.gov/stewweb/>
- NHD User Guide
http://nhd.usgs.gov/userguide.html?url=NHD_User_Guide/Feature_Catalog/NHD_Feature_Catalog.htm
- **National Map Viewer**
<http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd>
- NHDPlus

Links to the feature catalog for The Hydrography Dataset

Flowline

[Artificial Path](#)
[CanalDitch](#)
[Coastline](#)
[Connector](#)
[Pipeline](#)
[StreamRiver](#)
[Underground Conduit](#)

Line

[Bridge](#)
[DamWeir](#)
[Flume](#)
[Gate](#)
[Levee](#)
[Lock Chamber](#)
[Non Earthen Shore](#)
[Rapids](#)
[Reef](#)
[SinkRise](#)
[Sounding Datum Line](#)
[Tunnel](#)
[Wall](#)
[Waterfall](#)

Point

[DamWeir](#)
[Gaging Station](#)
[Gate](#)
[Lock Chamber](#)
[Rapids](#)
[Reservoir](#)
[Rock](#)
[SinkRise](#)
[SpringSeep](#)
[Waterfall](#)
[WaterIntake/Outflow](#)
[Well](#)

Waterbody

[Estuary](#)
[Ice Mass](#)
[LakePond](#)
[Playa](#)
[Reservoir](#)
[SwampMarsh](#)

Area

[Area of Complex](#)
[Channels](#)
[Area to be Submerged](#)
[BayInlet](#)
[Bridge](#)
[CanalDitch](#)
[DamWeir](#)
[Flume](#)
[Foreshore](#)
[Inundation Area](#)
[Levee](#)
[Lock Chamber](#)
[Rapids](#)
[Sea Ocean](#)
[Spillway](#)
[StreamRiver](#)
[Submerged Stream](#)
[Wash](#)
[Water Intake/Outflow](#)

Network Improvement Project

Process description:

Validating and updating the high resolution NHD flow network connectivity using software developed to QA/QC the flow network for medium resolution NHD Plus.

Metadata:

Validated the high resolution NHD network connectivity using checks originally developed to QC the flow network for medium resolution NHDPlus. The QC checks are grouped into the following categories: Invalid Geometry; Database Integrity; Flow; Spatial; and Feature to Feature rules. Within each of these categories there are numerous QC checks that assign each potential error a Severity Level of "Severe (1)", "Warning (3)", or "Informational (5)". Each severe error is corrected before a job is submitted to the NHD Geodatabase. For the Network Improvement project the QC software was run by HUC-2 (NHD Region) and a report of all the potential errors was created under contract by Horizon Systems, the developer of the QC software. USGS NGTOC Denver personnel reviewed each HUC-4 (NHD Sub-Region) and identified the errors that needed to be fixed. Network Improvement editing was done by the USGS NGTOC Denver personnel. See Metadata contact info for details.