

Cunningham Creek Benthic Stressor Analysis

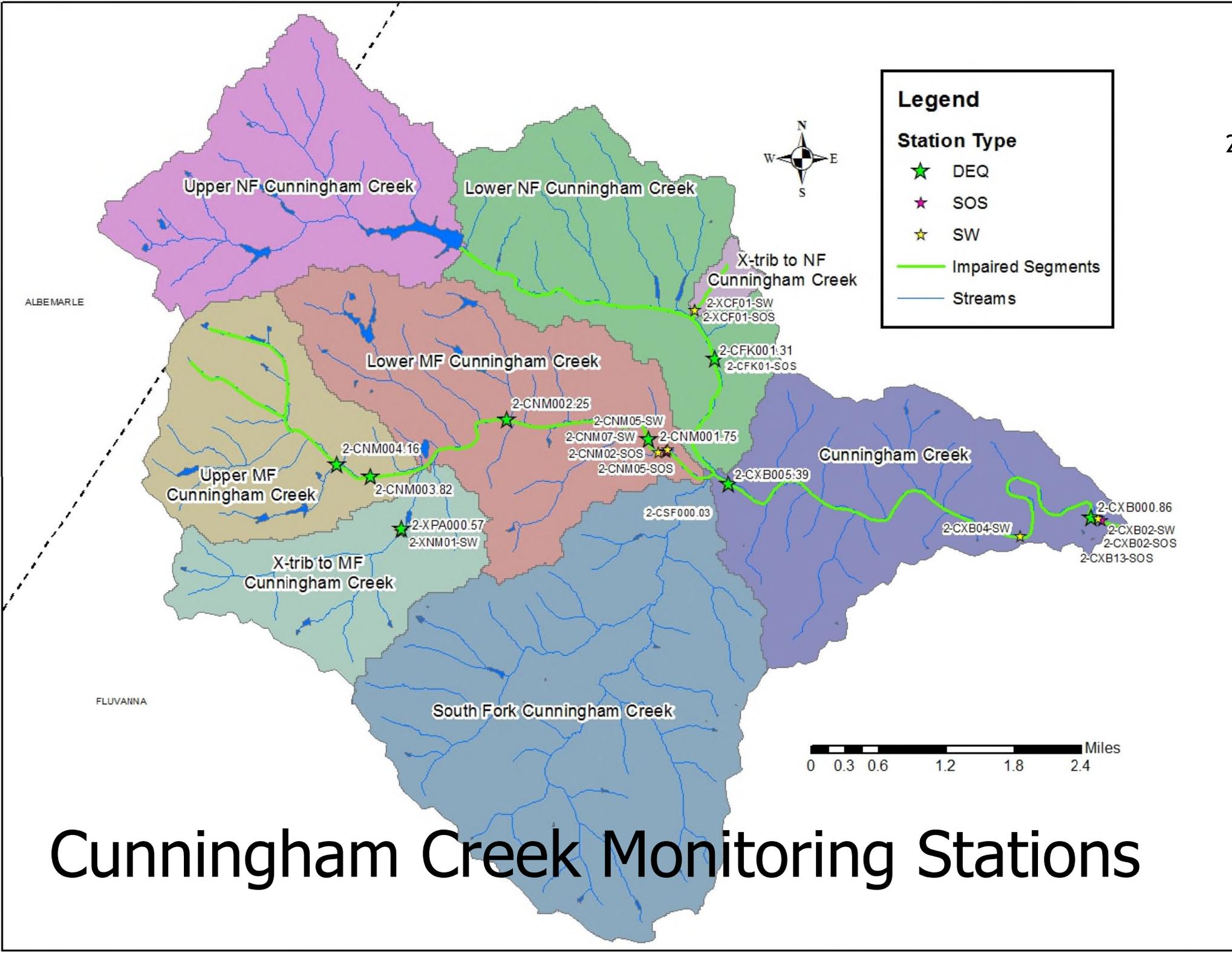


Technical Advisory Committee Meeting

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March 22, 2016



Cunningham Creek Monitoring Stations

Stressor Analysis

- Benthic impairment does not specify pollutant(s)
- Review existing data
- Weight-of-evidence approach
- Identify “most probable” source(s)

Potential Pollutants

- ammonia,
- pH,
- temperature,
- metals,
- toxic organic compounds,
- nutrients (dissolved oxygen),
- organic matter,
- streambed sedimentation,
- ionic strength (sulfates, conductivity, total dissolved solids), and
- flow/hydrologic modification.

Potential Pollutant Sources

- Agricultural runoff
- Livestock in the creek
- Residential construction
- Malfunctioning septic systems
- Forest harvesting
- Stormwater runoff
- Permitted discharges
- Spills and illegal discharges

Diagnostic Data Sources

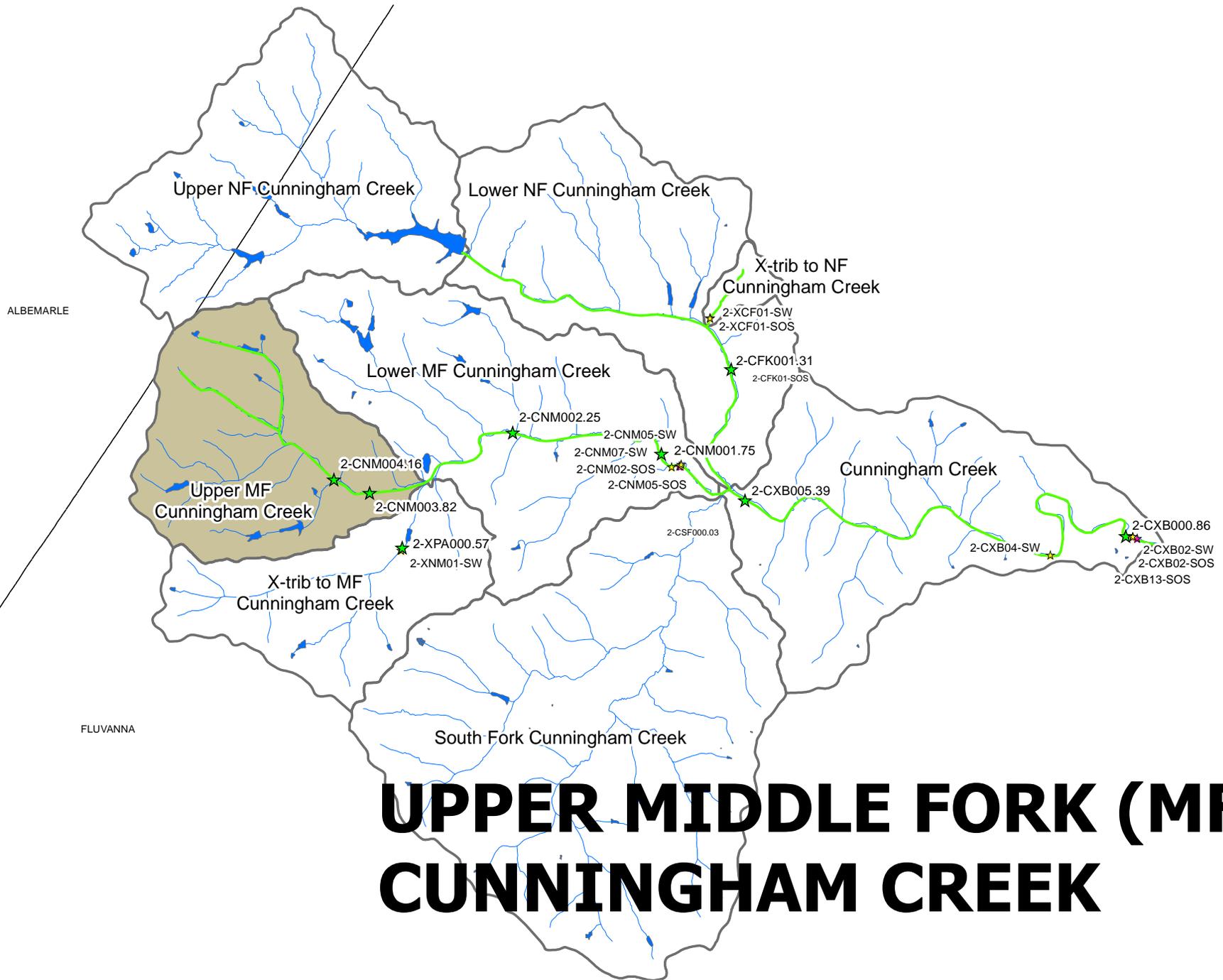
- DEQ ambient and biological monitoring data, permits, PReP incidents, and physical habitat sampling
- StreamWatch and SOS monitoring data
- DGIF dam inspection reports
- DCR cost-shared BMP installation data
- VDOF timber harvest history
- InSTAR habitat metrics and fish counts
- Google Earth current and historical imagery
- Household drinking water analyses (2009 & 2010)
- March 3, 2016 watershed tour

Summary of Proposed Most Probable Stressors

- Upper Middle Fork:
 - In 2004: drought and nutrients
 - Currently (if impaired): **sediment**, also possibly **nutrients**
- Lower Middle Fork:
 - In 2010: pasture runoff and livestock access contributing sediment, nutrients, and possibly decomposing organic matter
 - Currently: **sediment** due to lack of riparian vegetation
- Lower North Fork:
 - In 2012 and currently: **sediment** from gully erosion near lake outlet and residential development
- X-trib to North Fork:
 - In 2010: sediment from construction
 - Currently: **sediment** from construction near outlet and possibly from unbuffered riparian livestock activity, also possibly **nutrients** from lawn fertilization
- Cunningham Creek:
 - in 2012: TP and sediment
 - Currently: **sediment**

Eliminated Stressors

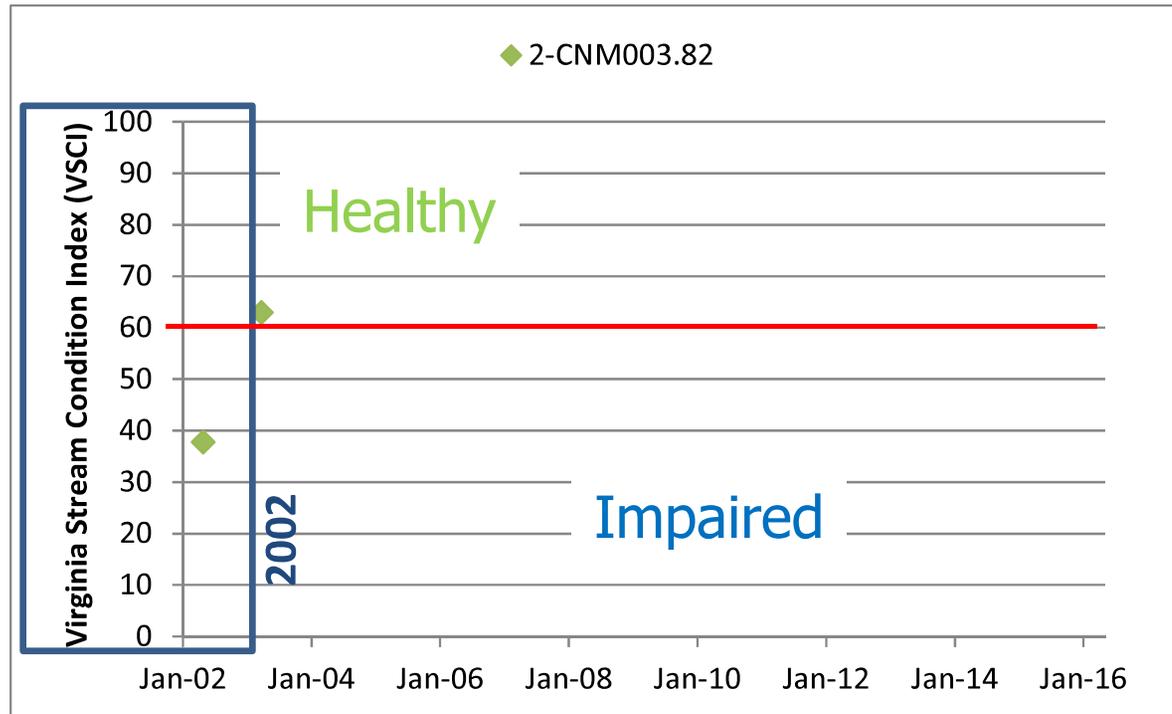
- The following stressors were eliminated because:
 - There was little or no data, and no suspected sources: **Ionic Strength, Metals, and Toxics**
 - Available data were near or below its minimum analytical detection limit: **Ammonia**
 - Available data showed no WQS exceedences: **pH and Temperature**



UPPER MIDDLE FORK (MF) CUNNINGHAM CREEK

Benthic Monitoring Summary

Upper MF Cunningham Creek

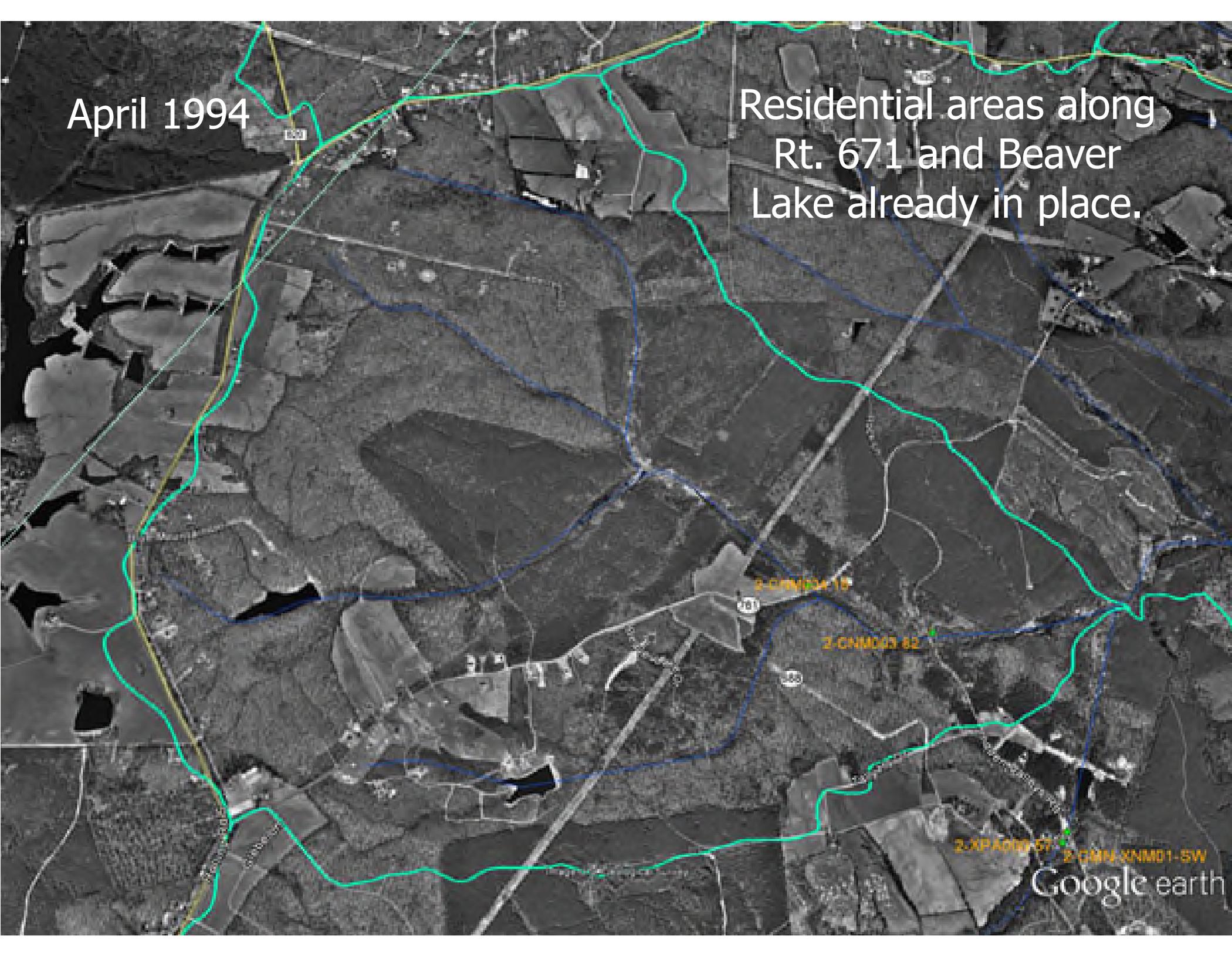


DEQ biologist notes (04/29/02 sample): "Poor score due to large number of midges during drought, but there was still a good diversity of sensitive taxa".

No additional benthic data have been collected in this assessment unit, as the road to the site has been closed.

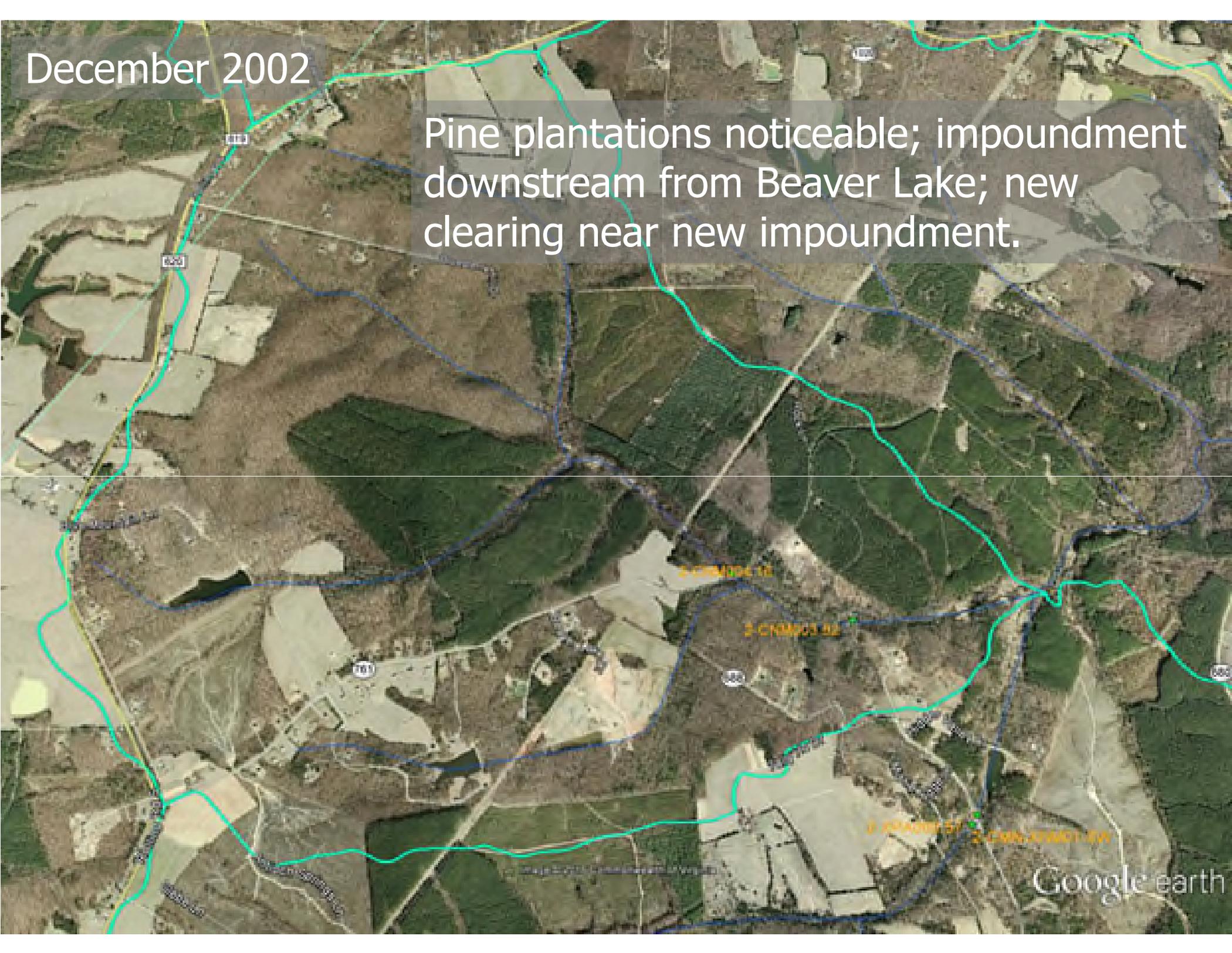
April 1994

Residential areas along
Rt. 671 and Beaver
Lake already in place.



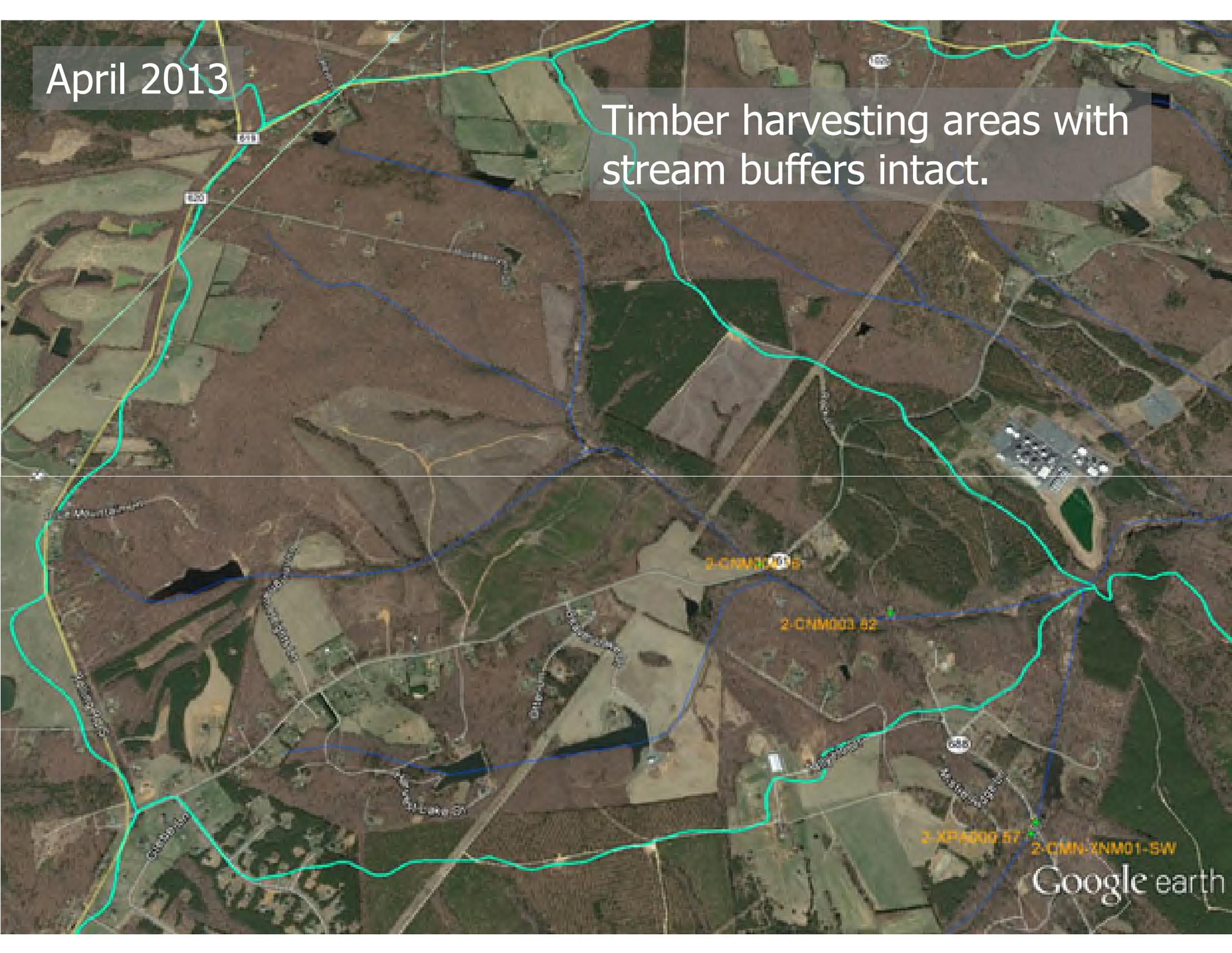
December 2002

Pine plantations noticeable; impoundment downstream from Beaver Lake; new clearing near new impoundment.



April 2013

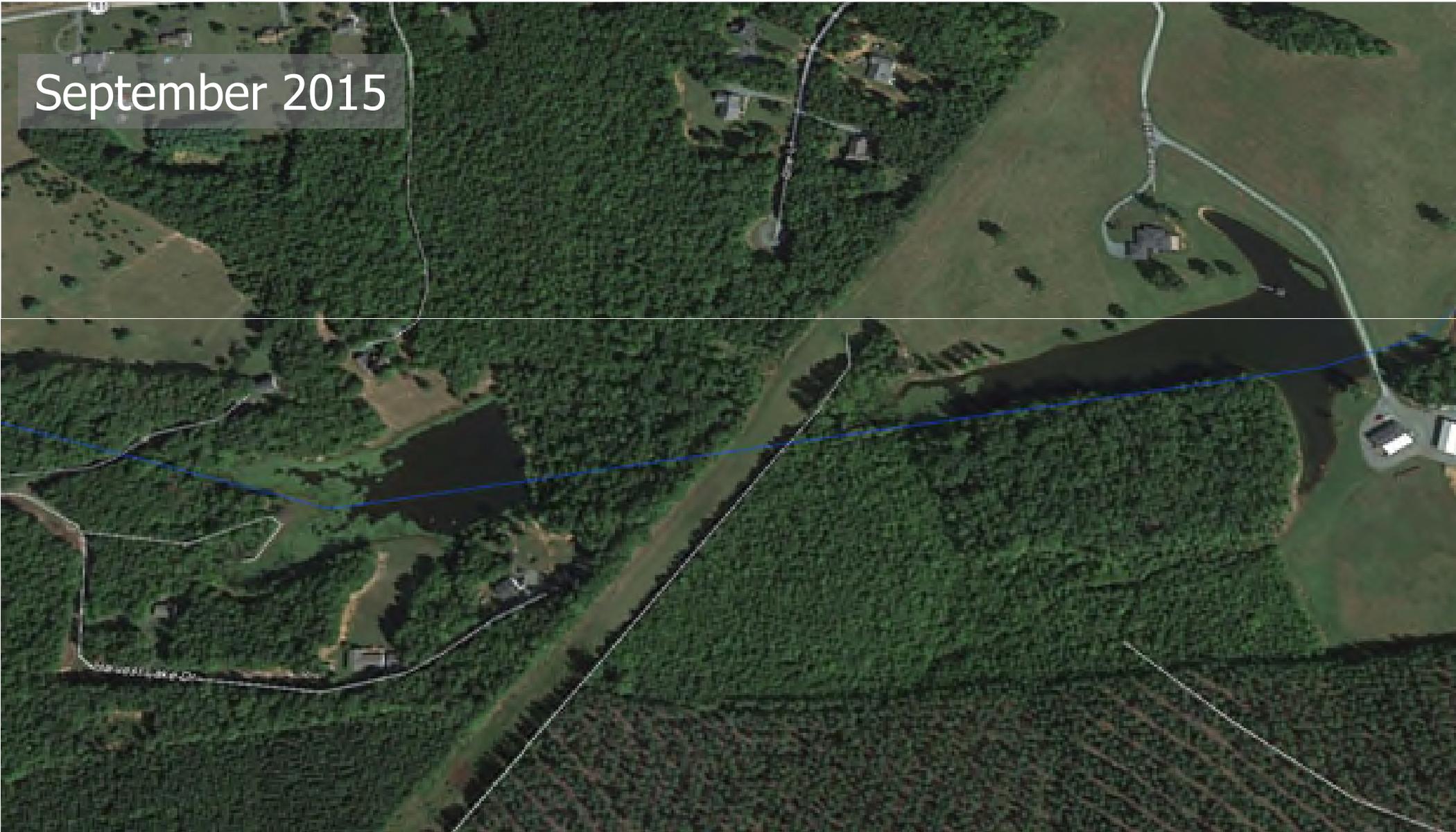
Timber harvesting areas with stream buffers intact.



Significant amounts of algae visible on Beaver Lake and downstream impoundment: 2005-2008, 2011, and 2015.

14

September 2015



Stressor Analysis

Upper MF Cunningham Creek

15

- Biological Monitoring at 2-CNM003.82 (04/02, 03/03)
 - The 2002 sample had a dominance of chironomids which may be indicative of elevated nutrients; algae has been visible on several ponds;
 - A high number of filterer-collector organisms (2002), which may be indicative of organic contributions. Neither sample had a high MFBI metric value, which could be indicative of organics.
 - A low % of haptobenthos organisms (2002) which may be indicative of habitat loss due to sediment; some bank stability issues noted.

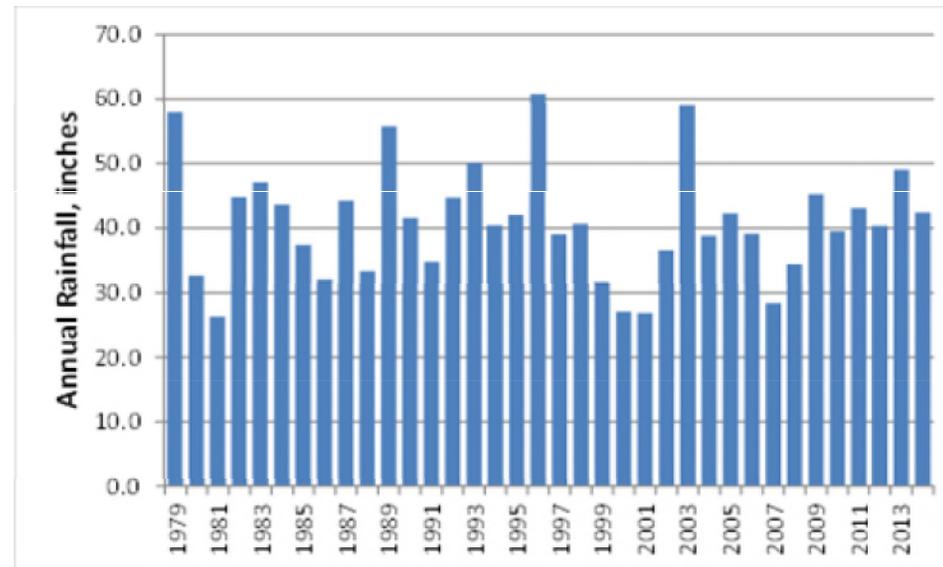
- Ambient Monitoring at 2-CNM004.18 (07/04 – 05/06)
 - 7 out of 12 samples TN > 0.30 mg/L, rated as “optimal”; TP averaged 0.034 mg/L, and was rated as “fair” by DEQ’s ProbMon Condition Classes; no TP threshold exceedences.
 - 2 out of 11 samples exceeding the *E. coli* bacteria standard.
 - No samples had elevated TSS or turbidity.

- Other
 - Older residential homes may have some septic issues; fertilization of residential lawns, in general, may contribute nutrients.
 - No biosolids applications.

Analysis (con't.)

The last benthic sample in 2003 showed a healthy biological community.

Drought conditions that existed in 2000-2002 cited as the impairment cause have not recurred since 2008.



Monitoring is needed for DEQ to re-assess and possibly de-list.

Most Probable Stressor(s)

Upper MF Cunningham Creek



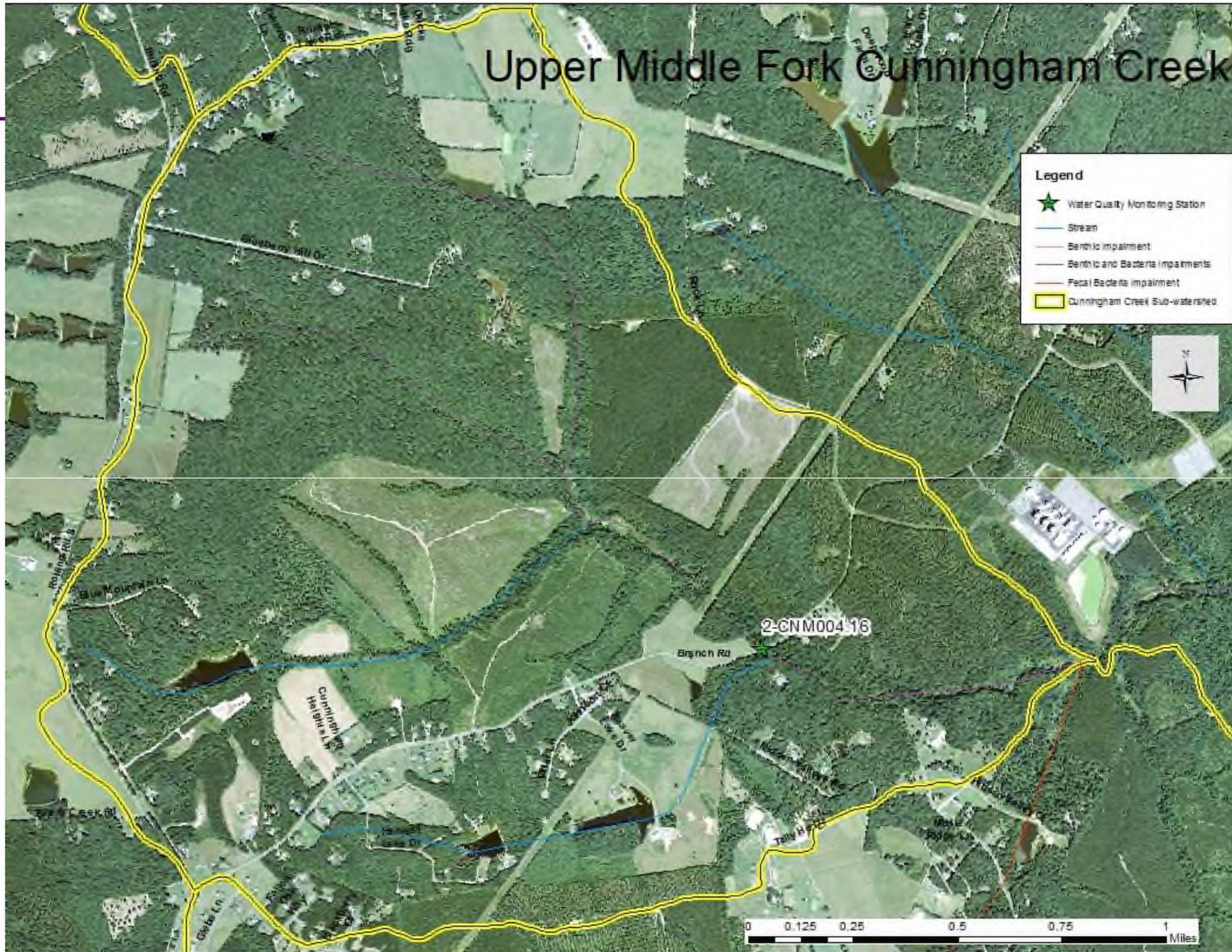
Sediment deposition,
but clear flow,
2-CNM004.16,
03/03/16



Most probable stressor in 2004: drought.

Most probable stressor currently: sediment from land disturbance, possibly also affected by nutrients from older septic systems or fertilization from residential lawns.

Upper Middle Fork Cunningham Creek



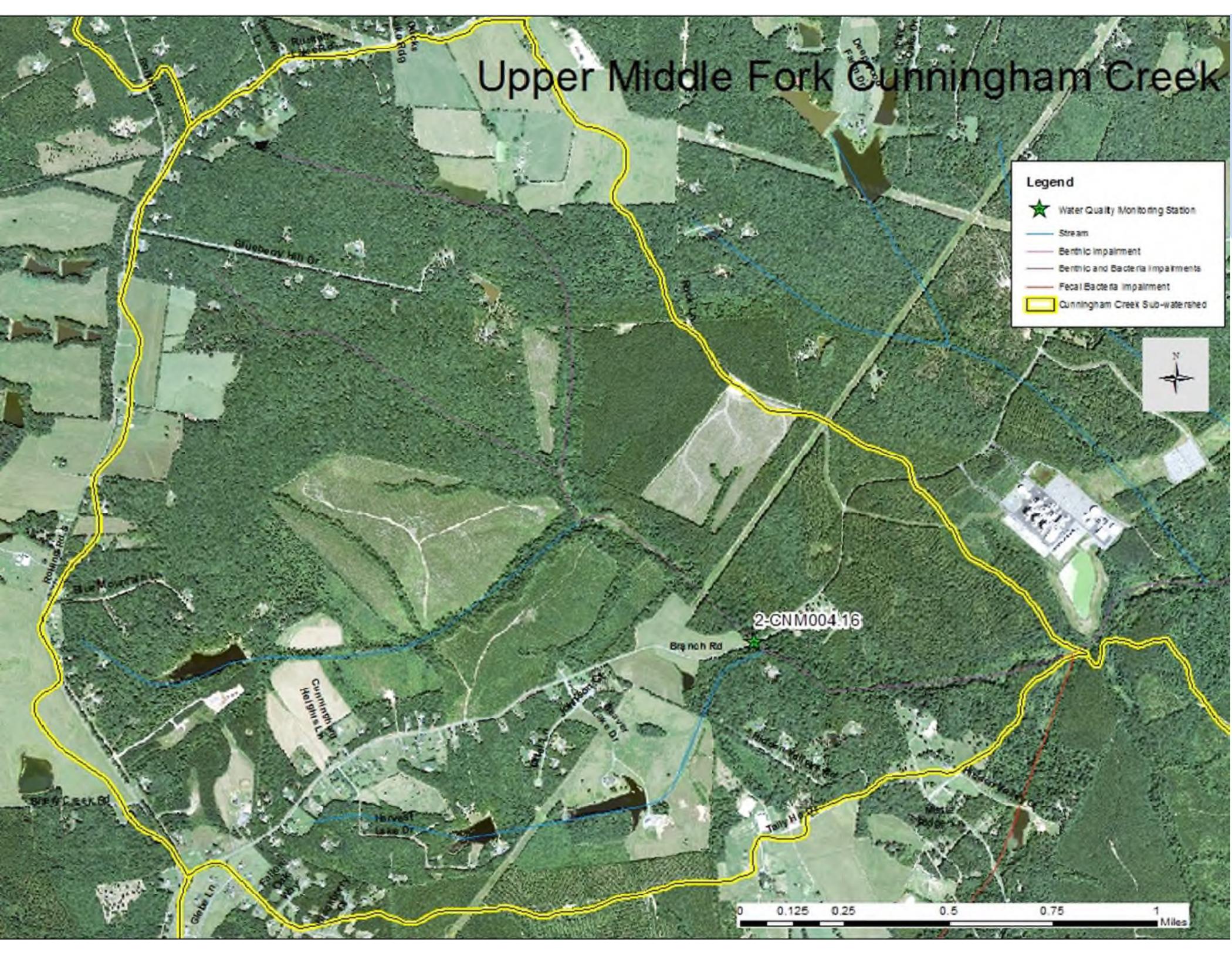
Upper Middle Fork Cunningham Creek

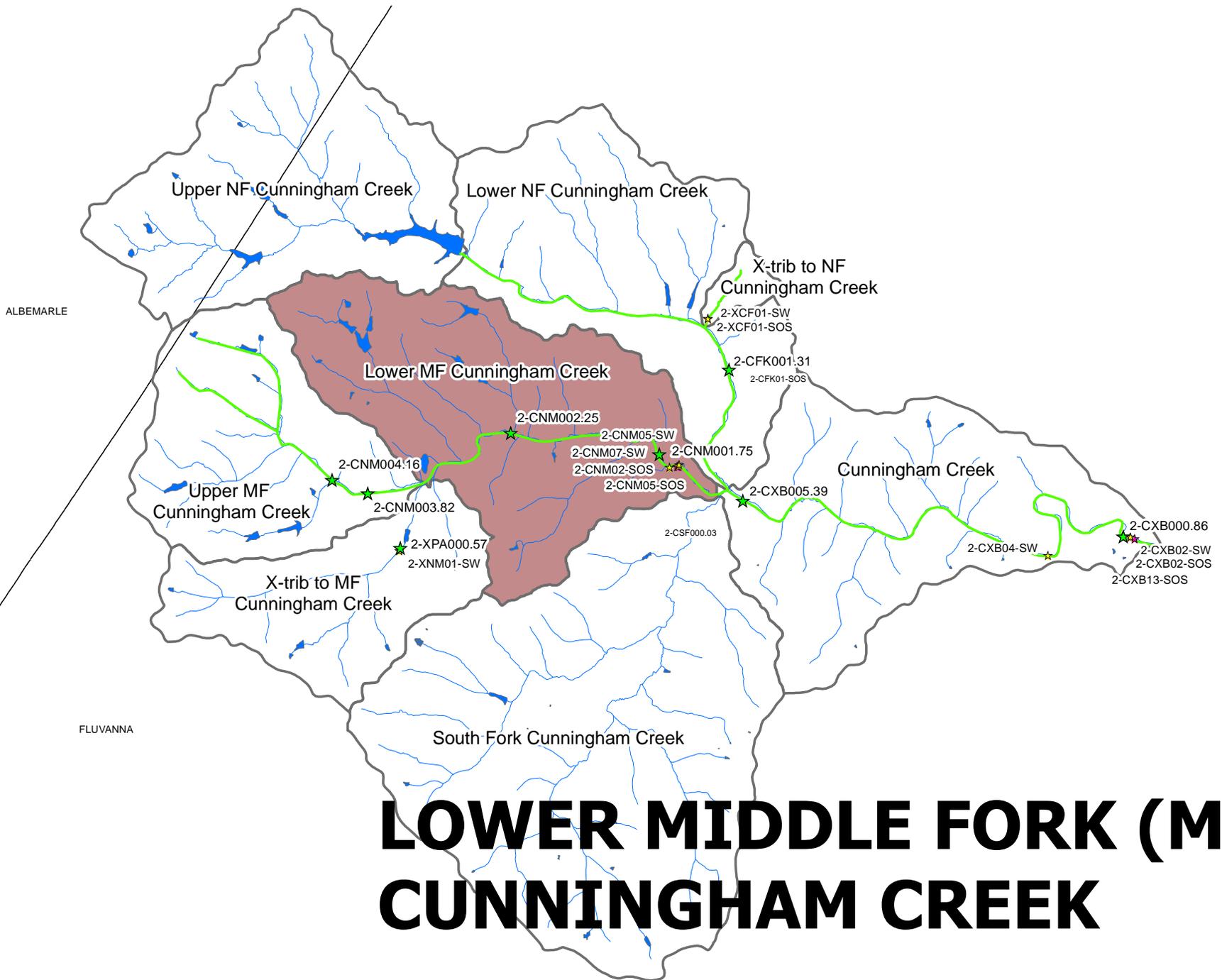
Legend

- ★ Water Quality Monitoring Station
- Stream
- Benthic Impairment
- Benthic and Bacteria Impairments
- Fecal Bacteria Impairment
- ▭ Cunningham Creek Sub-watershed



2-CN004.16





LOWER MIDDLE FORK (MF) CUNNINGHAM CREEK

April 1994

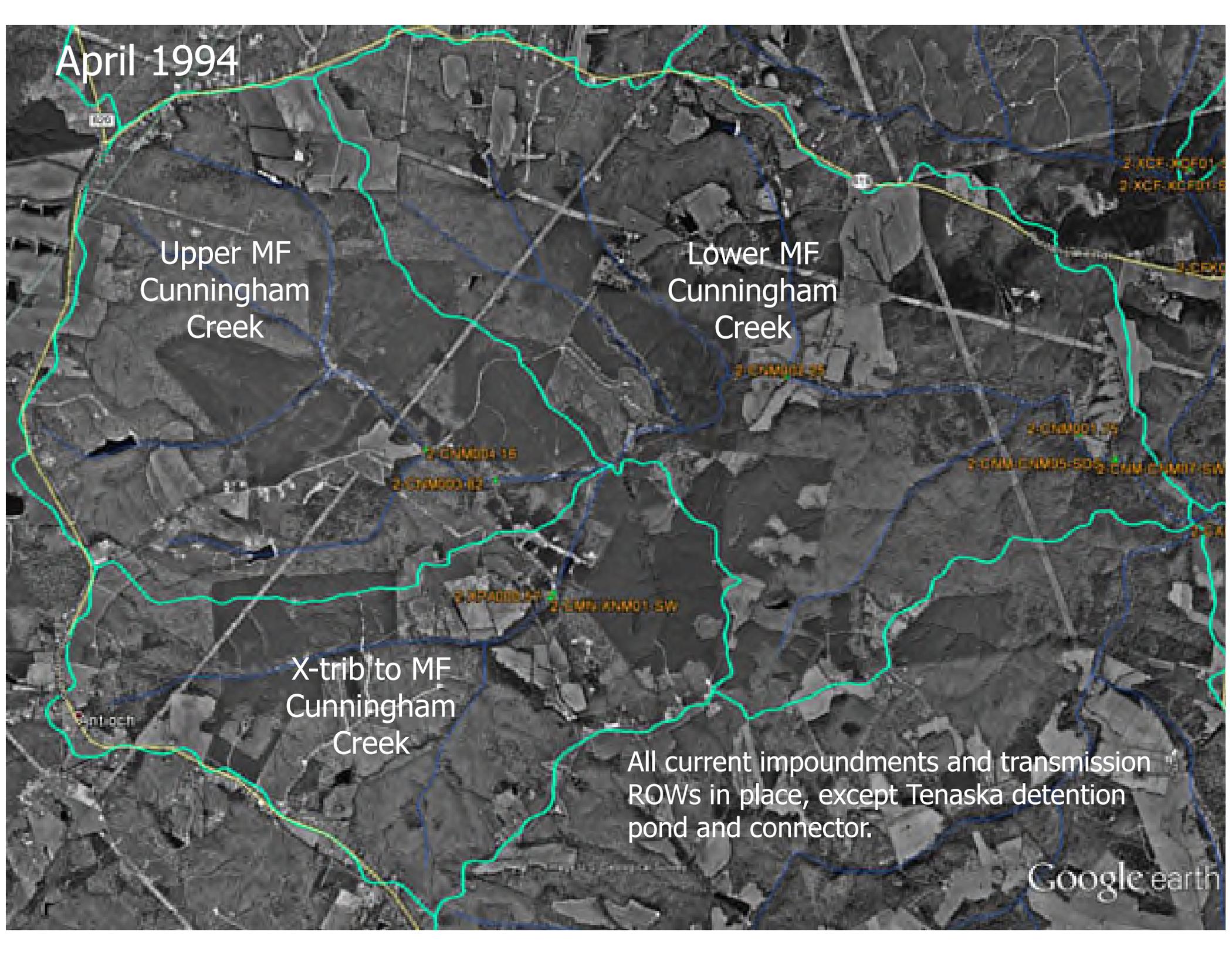
Upper MF
Cunningham
Creek

Lower MF
Cunningham
Creek

X-trib to MF
Cunningham
Creek

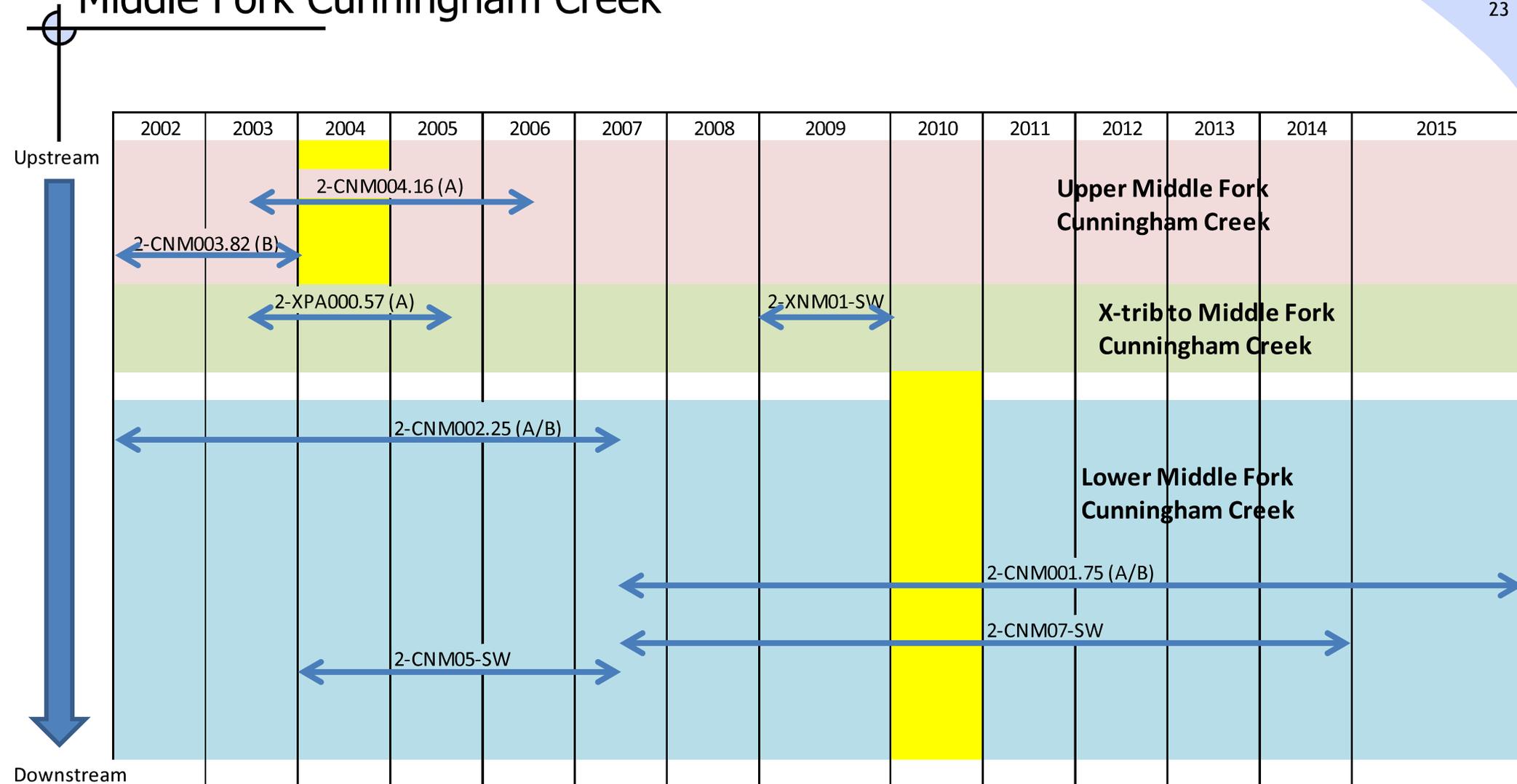
All current impoundments and transmission
ROWs in place, except Tenaska detention
pond and connector.

Google earth



Monitoring Matrix

Middle Fork Cunningham Creek



- Impairment listing Year

All StreamWatch (SW) and Save Our Streams (SOS) stations monitor benthic inventories only.

DEQ monitoring stations may be: A= ambient water column water quality; and/or B=benthic monitoring.

December 2002

Heavy livestock use and possible stream access, possibly through 2008, prior to current owners of Middle Fork Farm.

2-CNM002.25

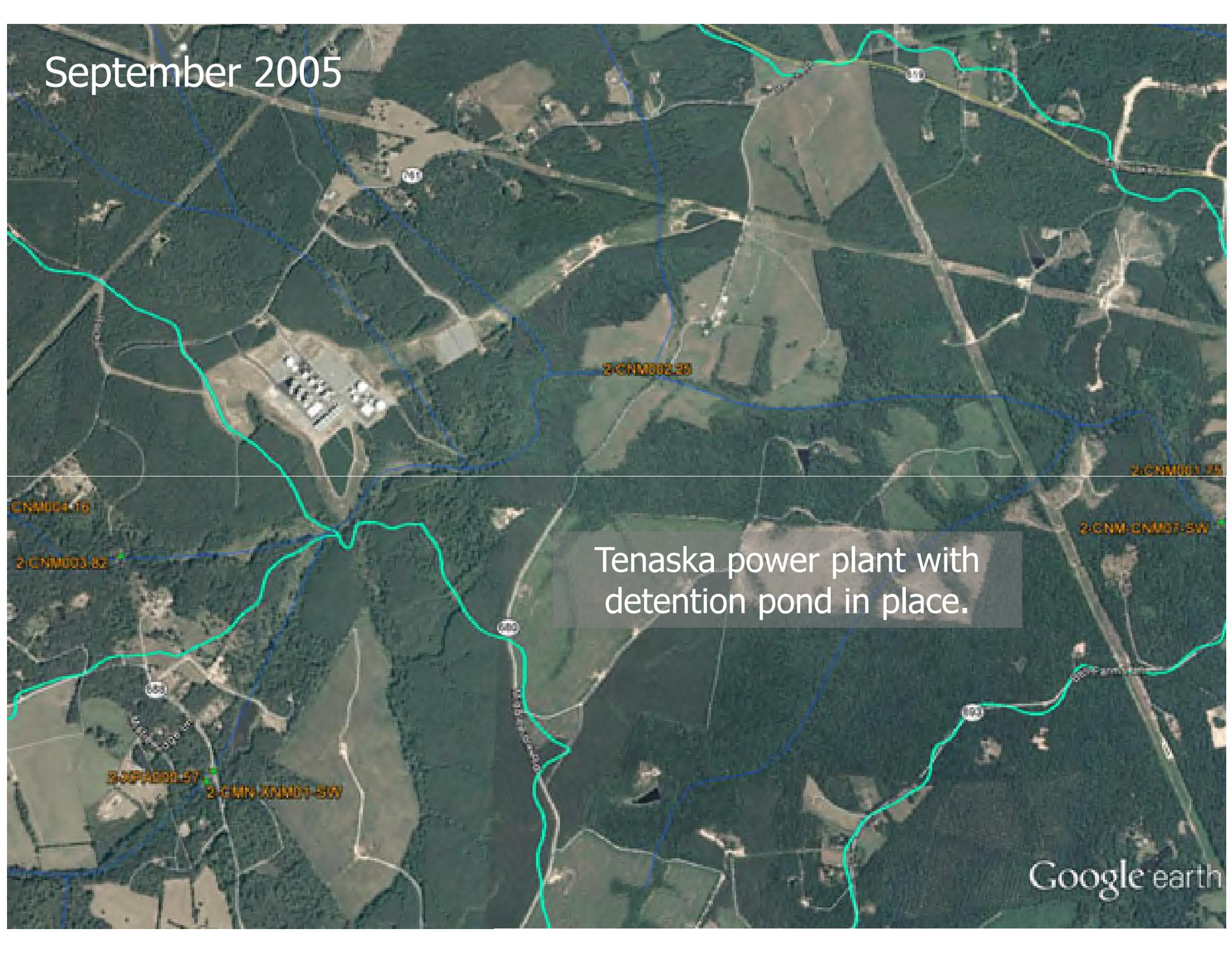
September 2003

Tenaska power plant being built, upstream of 2-CNM002.25, also a connector ROW crossing 3 tributary streams to MF.

September 2005

Tenaska power plant with
detention pond in place.

Google earth



Initial Stressors

- 07/03 – 05/06: 2-CNM002.25 ambient average concentrations (n=18): **TN = 0.418 mg/L; TP = 0.080 mg/L**; 10 *E. coli* samples exceed WQS; repeated samples with tubificid and asellid organisms (indicative of sewage or possible rotting carcass) and 16/22 samples had high numbers of filterer-collector organisms, which could be indicative of organic contributions.
- 2010: Initial listing for benthic and bacteria impairments.
- **Most probable stressor in 2010:** sediment, nutrients, and possibly decomposing organic matter from pasture runoff and livestock access near 2-CNM002.25 prior to 2008; possibly some effects of construction and discharges from Tenaska prior to 2010.

Changes and Current Stressors

- 2010-2013: 150 acres of timber harvested (VDOP)
- 2014: Pasture area becomes orchard and vineyard; remaining goats and horses excluded from 3,400 linear feet of stream.
- 2015: 2-CNM001.75; average ambient concentrations (n=9) greatly reduced: TN = 0.254 mg/L; TP = 0.025 mg/L.
- 08/13/15: 2-CNM001.75; LRBS = -0.641 – slightly impacted.
- Repeated observed lack of riparian vegetation and sediment deposition noted at all 4 benthic stations; some bank instability issues.