NCEM Flood Mitigation Studies and Dam Water Level Monitoring and Alerts

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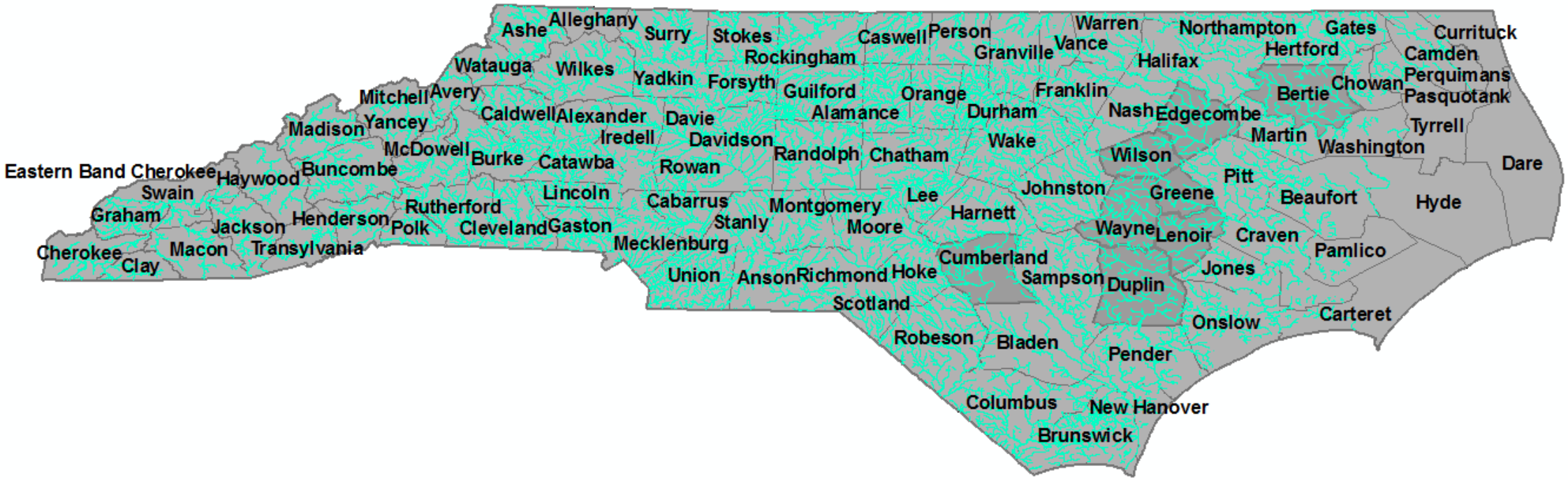
Overview

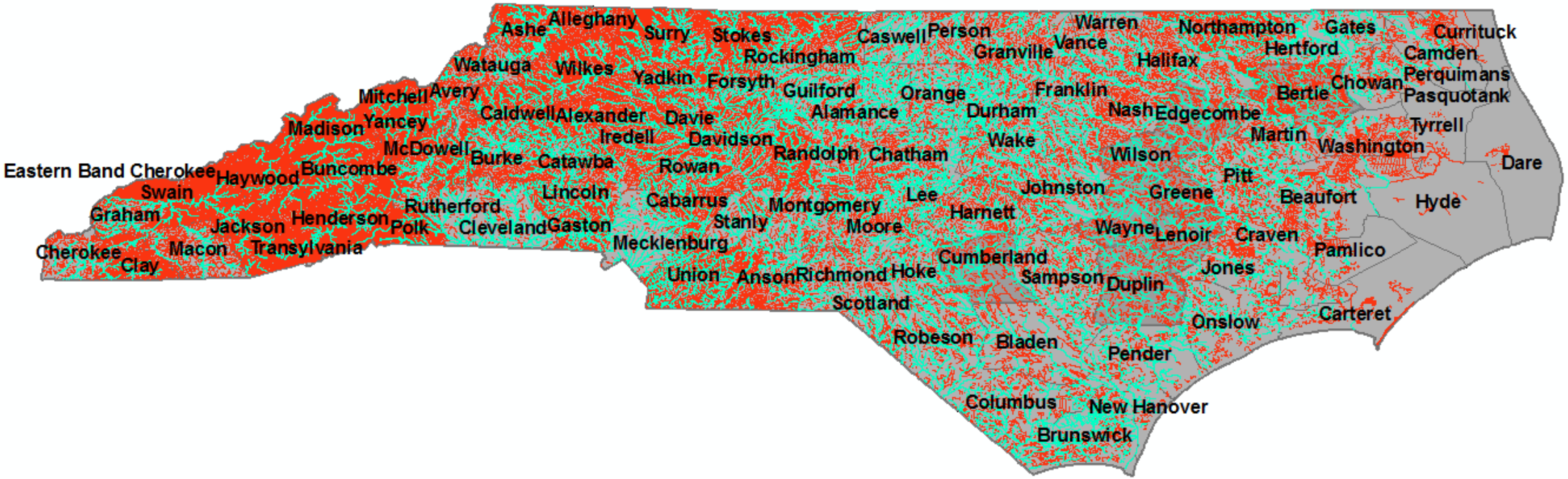
- 2-D Rain-on-Grid Flood Mitigation Studies
  - Background
  - Modeling methods and assumptions and output
  - Flood mitigation studies and online viewer
- Dam-Rainfall Runoff Modeling
  - Background
  - Modeling methods and assumptions and output
  - DamWatch

Background – 2D Flood Mitigation Studies



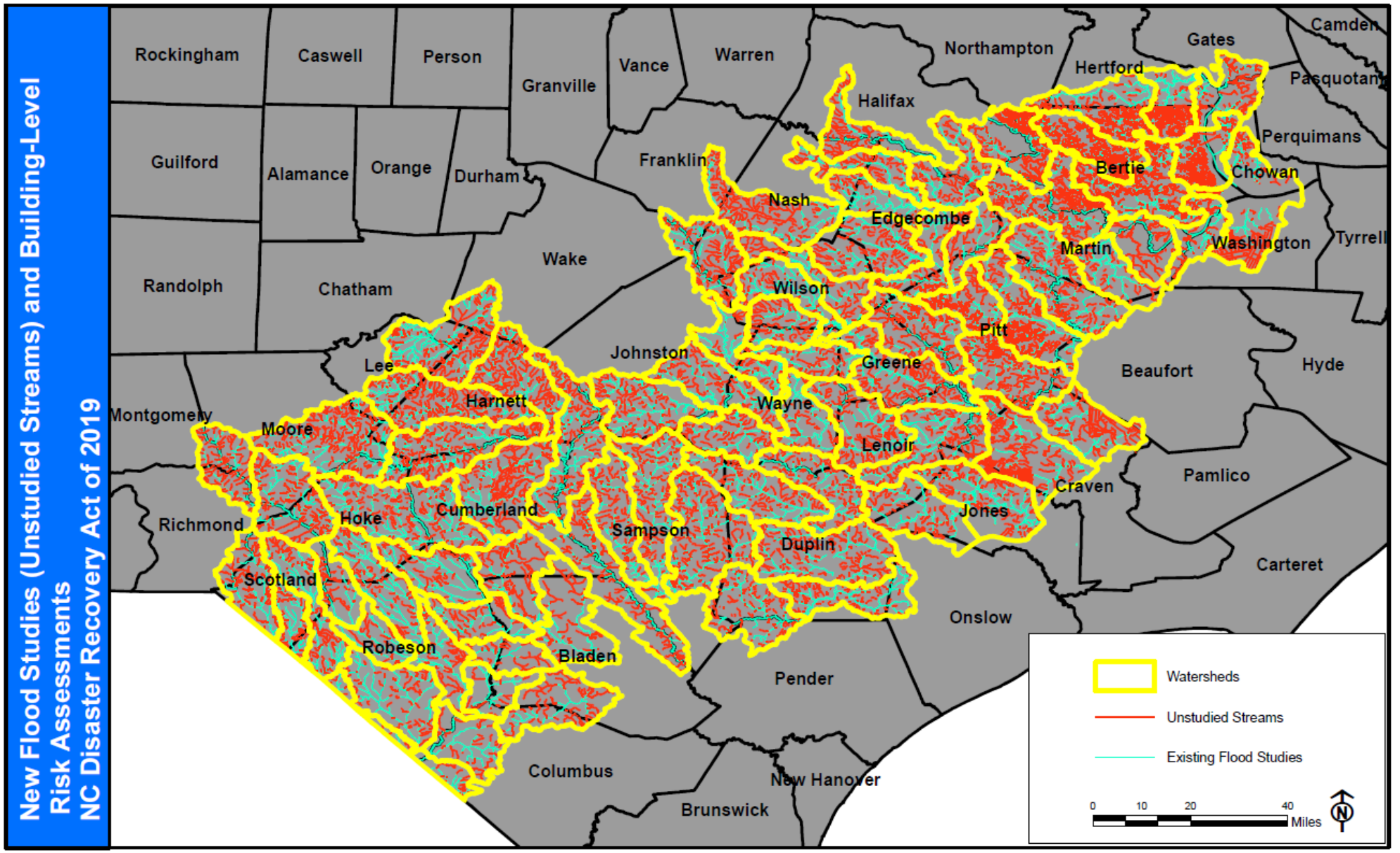
Existing Riverine Flood Studies (~28,000 miles)

Background – 2D Flood Mitigation Studies



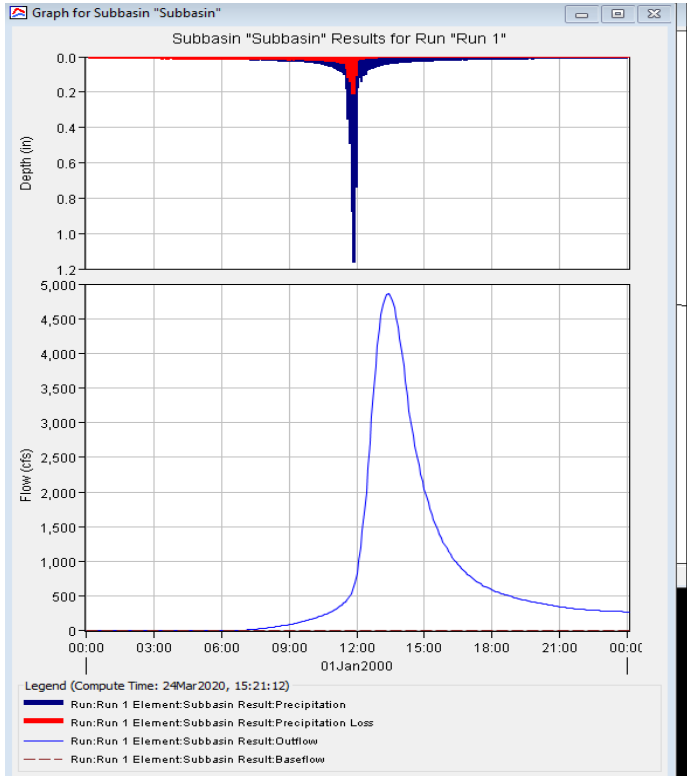
Unstudied Streams (~76,000 miles)

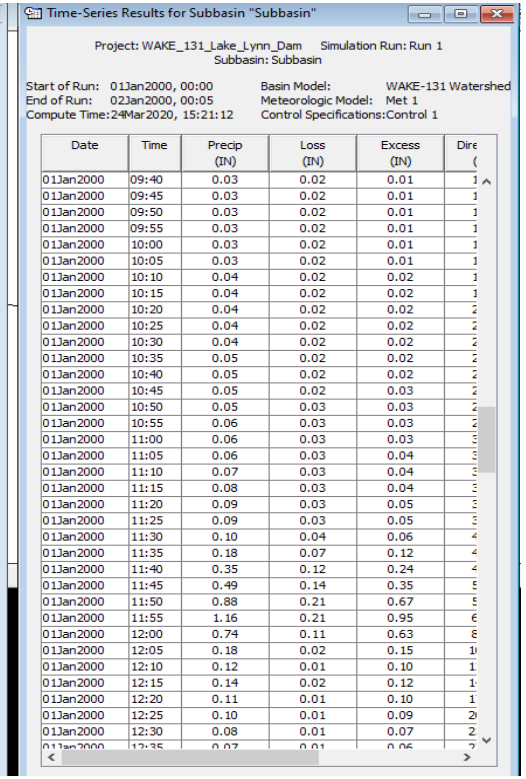
New Flood Studies and Building Level Risk Assessments for Unstudied Streams (12,723 square miles/11,135 stream miles)



2-D Modeling Rainfall Losses

- HEC-HMS or Spreadsheet
- Direct Hyetograph Development
- Losses – SCS CN Method
- Rainfall – NOAA Atlas 14, SCS Type II or III storm
  - 20, 10, 4, 2, 1, 0.5, 0.2, 0.01% events
  - 1% plus – Upper band of the 95% CI of rainfall
  - Climate Runs – assumed 10, 20, and 30% increase of 100-year rainfall depth for climate run
- Areal reduction factor – not applied. DA size was limited to smaller areas to reduce need for ARF

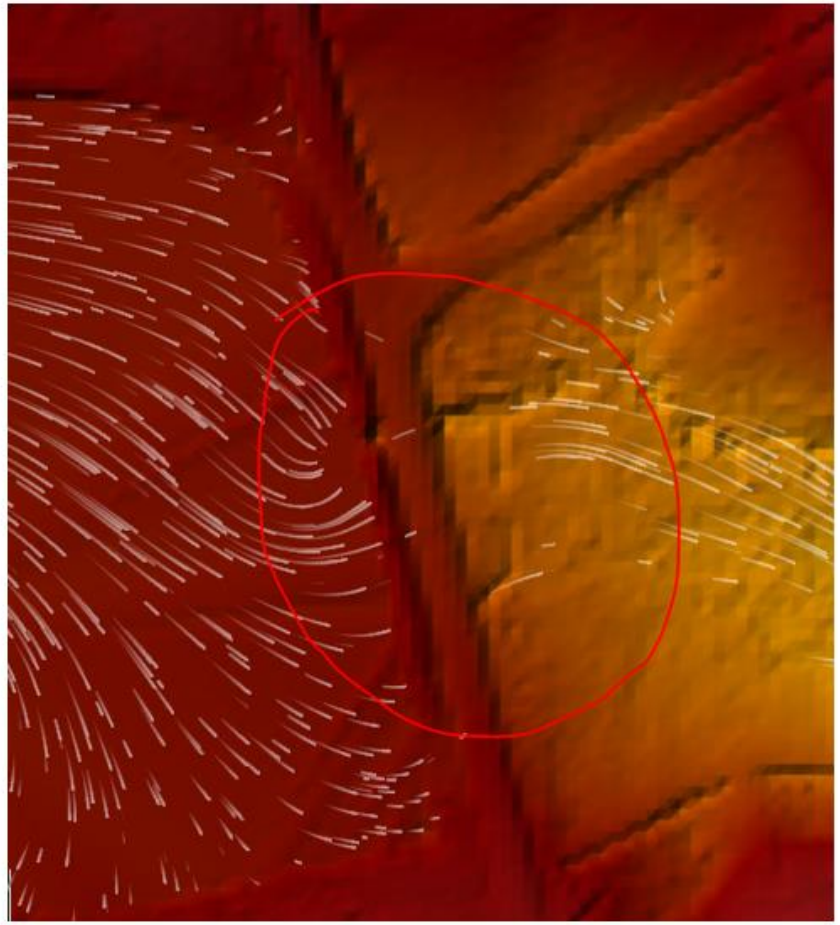


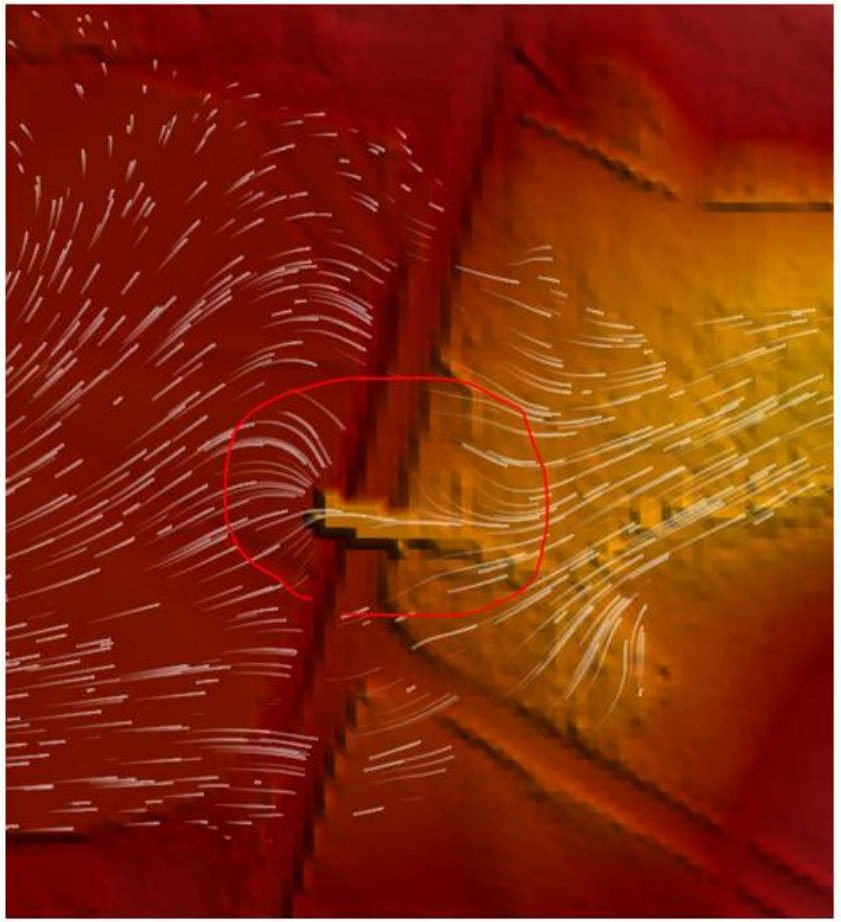


2-D Modeling Hydrology and Hydraulics

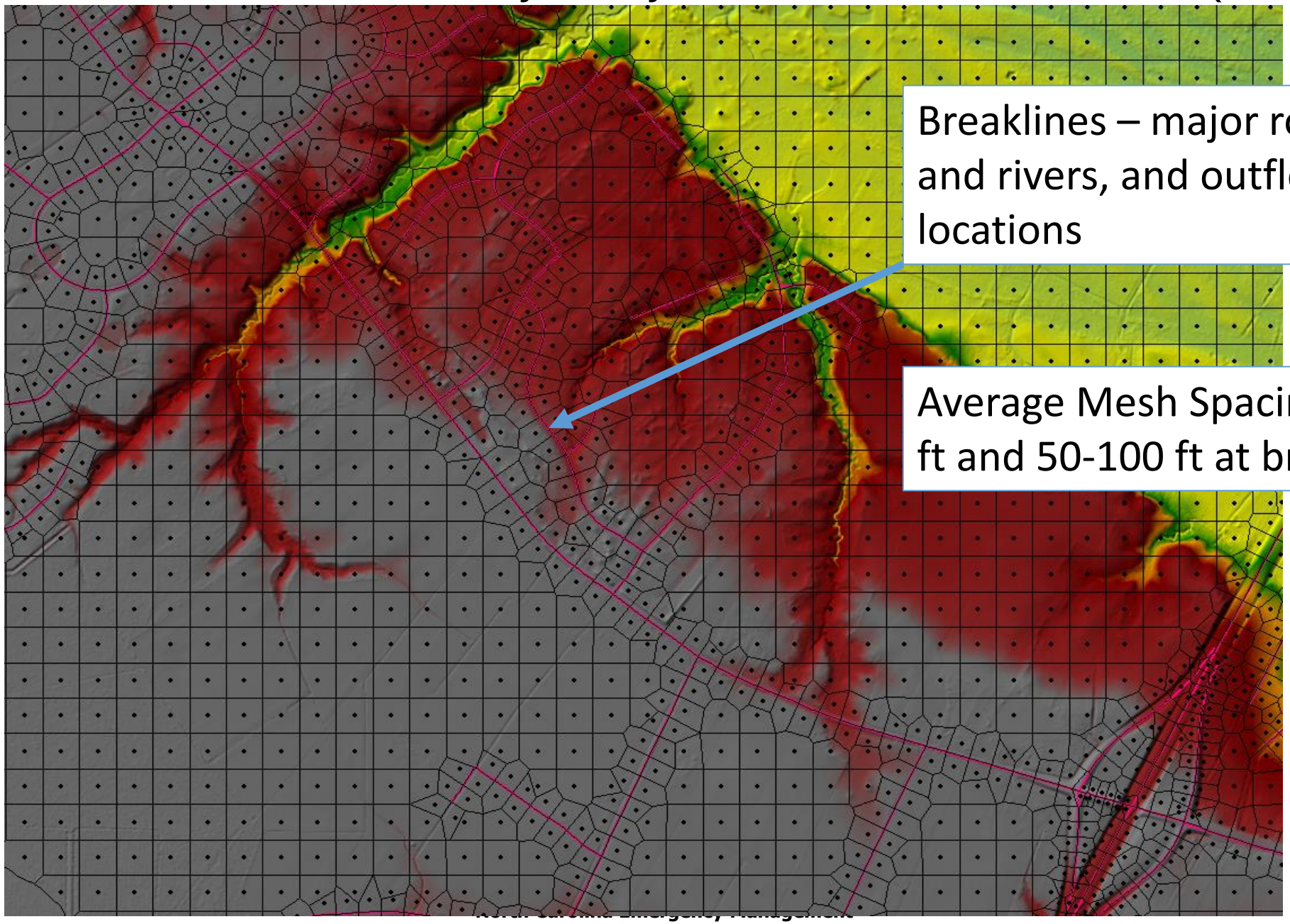
- HEC-RAS 2-D Rain-on-Grid
- Hyetographs applied directly to mesh including losses based on CN methodologies
- Terrain
  - Latest QL2 LIDAR data
  - Bridges – Embankment only – bridge deck already removed from terrain
  - Culverts - Hydro-corrected for DA > 1sq mi using NCDOT culvert inventory

Terrain Data Hydro-corrected





HEC-RAS 2-D Mesh Geometry – City of Greeneville Watershed (0302010304)

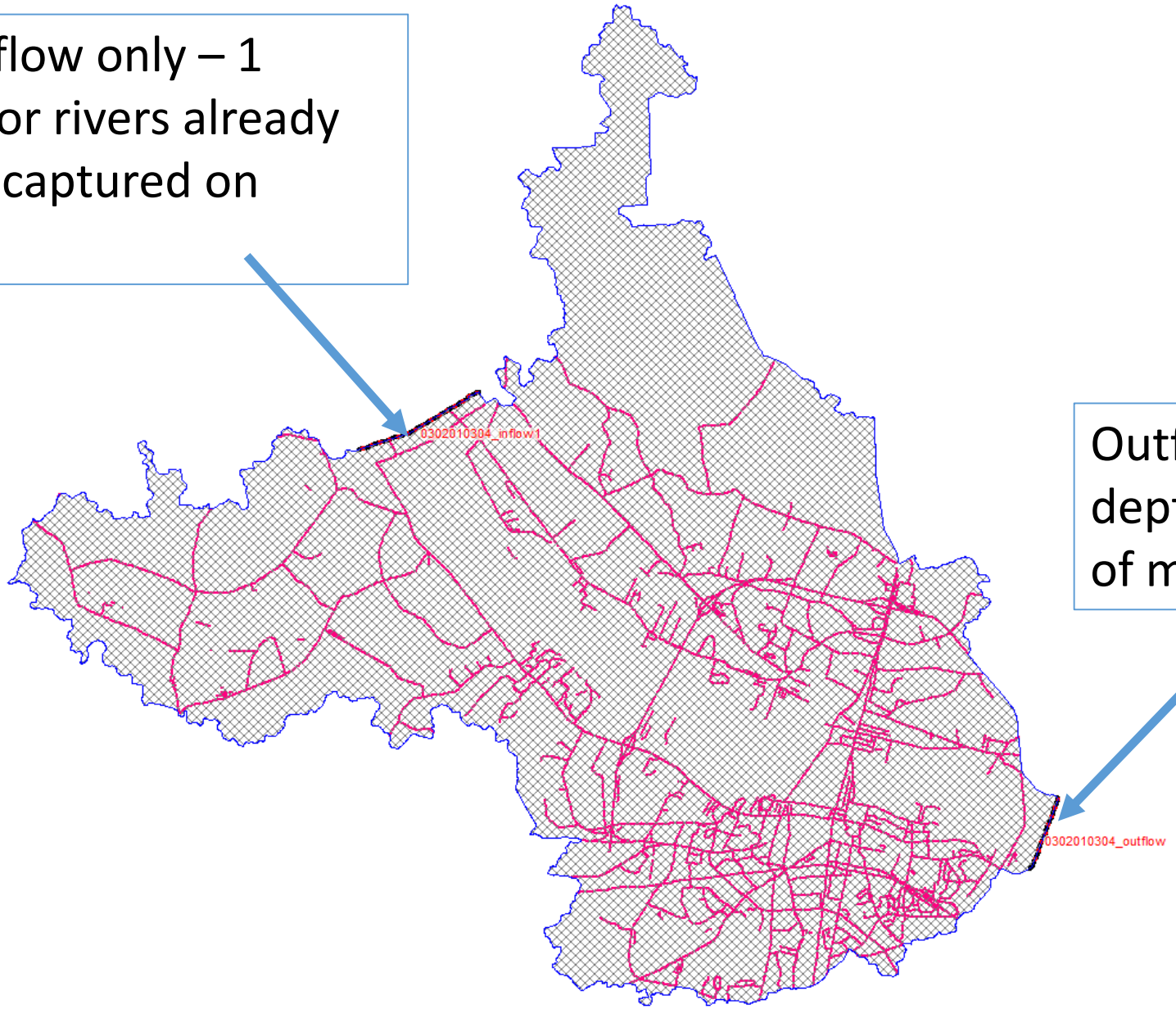


Breaklines – major roads, levees and rivers, and outflow locations

Average Mesh Spacing 100-300 ft and 50-100 ft at breaklines

HEC-RAS 2-D Mesh Geometry – City of Greeneville Watershed (0302010304)

Inflow – Baseflow only – 1 cfs/sqmi (major rivers already modeled and captured on DFIRMs)



Outflow – Normal depth based on slope of main river

Manning's Roughness (n)

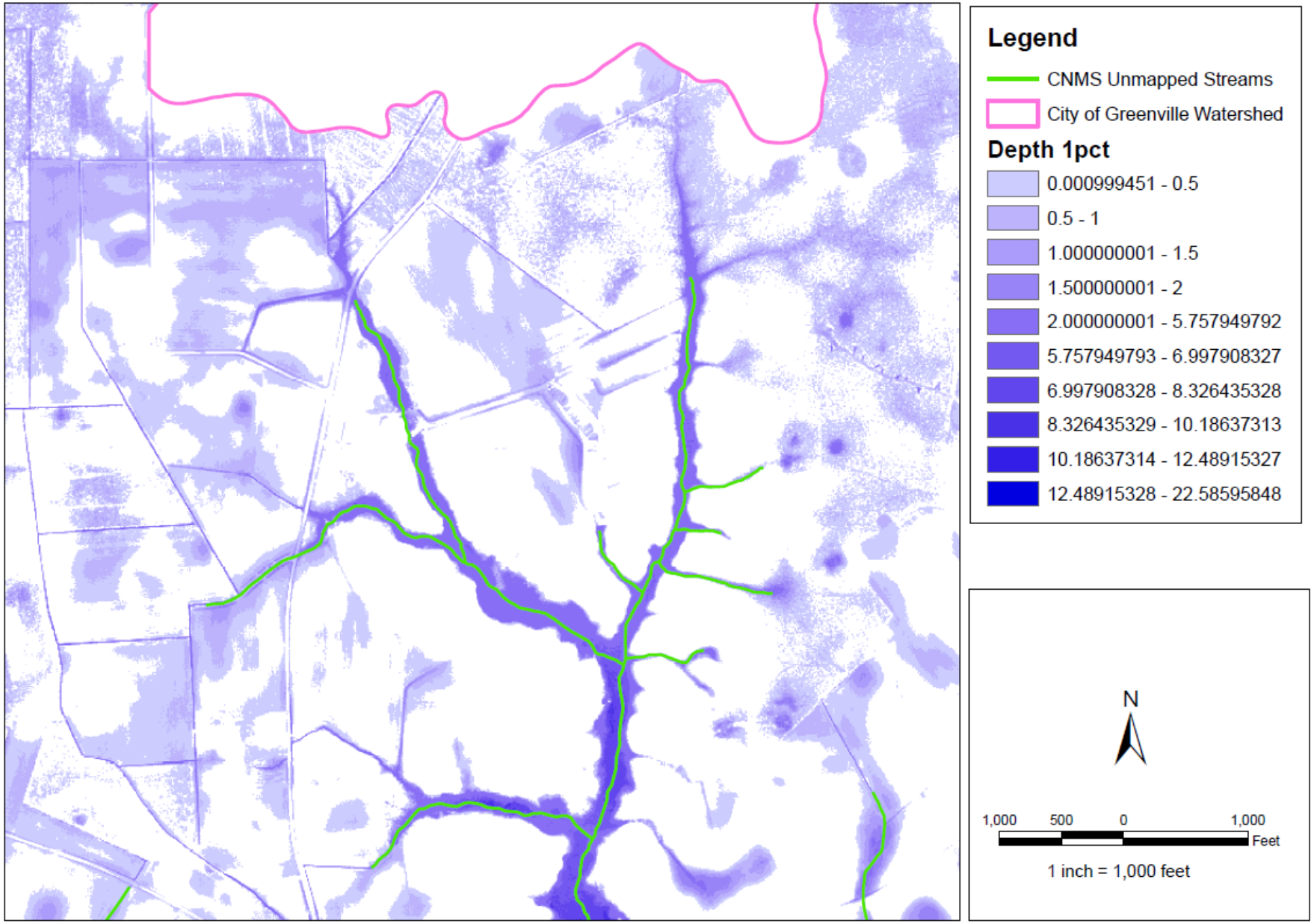
- National Land Cover Dataset (NLCD) 2016

NLCD	Normal N Value	Range of n Values	Land Cover
11	0.03	0.025-0.05	Open Water
21	0.04	0.03-0.05	Developed, Open Space
22	0.1	0.08-0.12	Developed, Low Intensity
23	0.12	0.06-0.14	Developed Medium Intensity
24	0.15	0.12-0.20	Developed, High Intensity
31	0.03	0.023-0.03	Barren Land (Rock/Sand/Clay)
41	0.13	0.10-0.16	Deciduous Forest
42	0.13	0.10-0.16	Evergreen Forest
43	0.13	0.10-0.16	Mixed Forest
52	0.1	0.07-0.16	Shrub/Scrub
71	0.045	0.025-0.05	Grassland/Herbaceous
81	0.06	0.025-0.06	Pasture/Hay
82	0.06	0.025-0.06	Cultivated Crops
90	0.12	0.045-0.15	Woody Wetlands
95	0.08	0.05-0.085	Emergent Herbaceous Wetlands

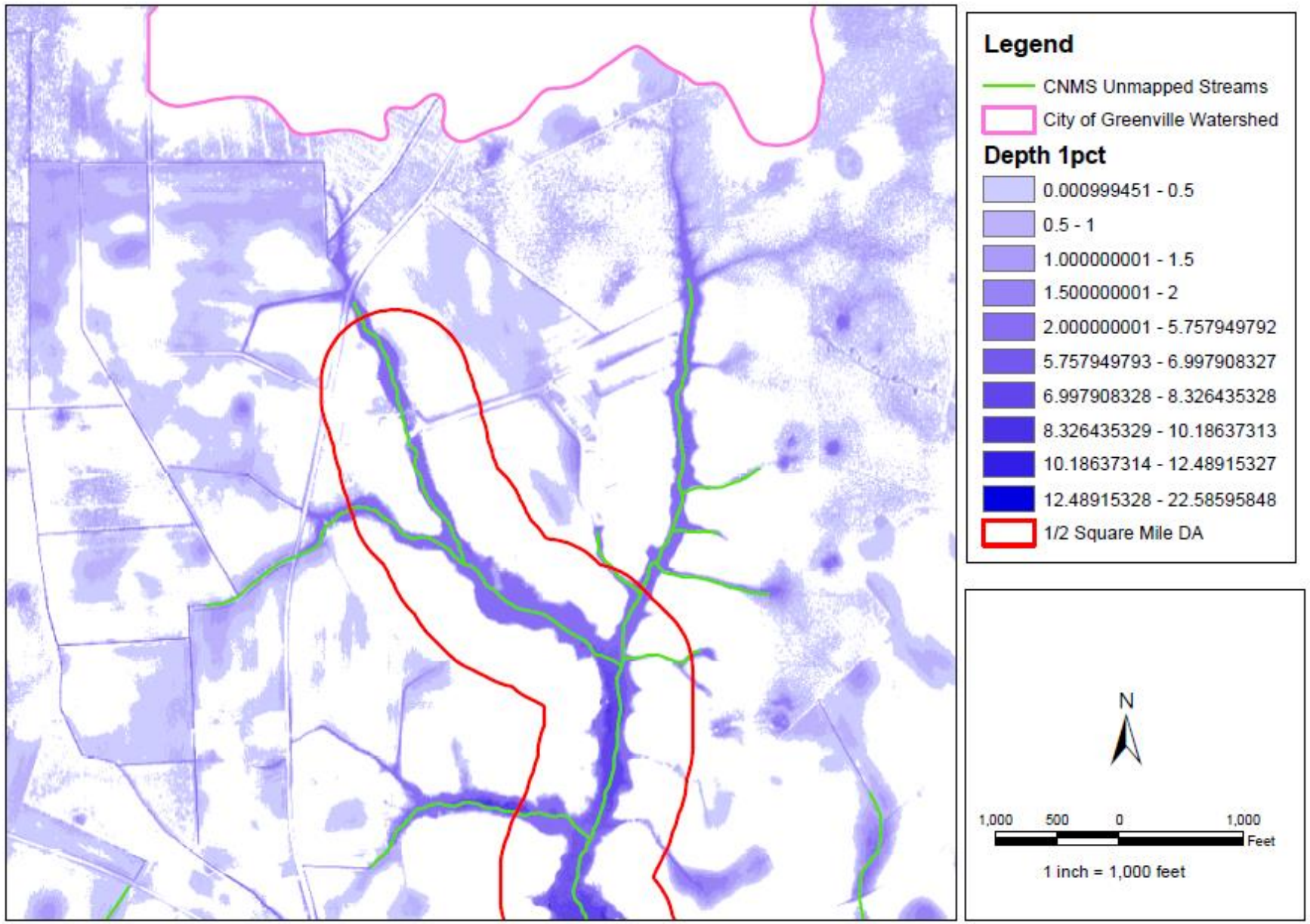
Model Validation

- Run model simulation based on Hurricane Matthew rainfall to validate the 2D rain-on-grid model
  - Modeled Hurricane Matthew water surface elevations (WSEL) are examined at High Water Mark (HWM) and gage locations with a target of being within 1 foot of the modeled versus observed WSEL
  - NFIP Claims, Public Assistance and Individual Assistance - structural impact data points were analyzed. The impact data points that had attributes indicating potential flood damage were assessed with a goal of greater than 50% of these structures falling within the modeled Hurricane Matthew inundation area.

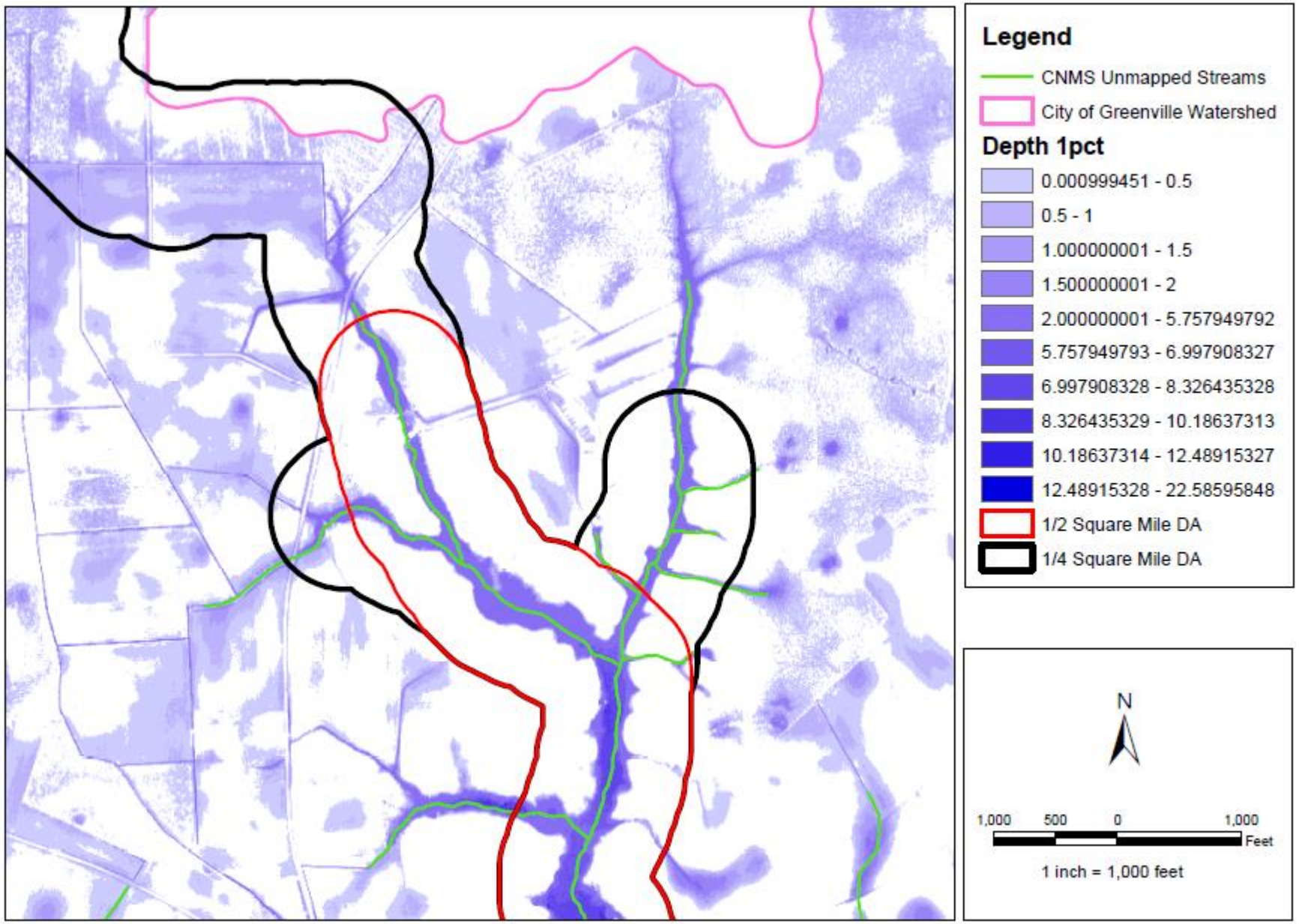
City of Greenville Watershed 2-D Modeling Flood Extents (10-ft DEM) – Raw Output



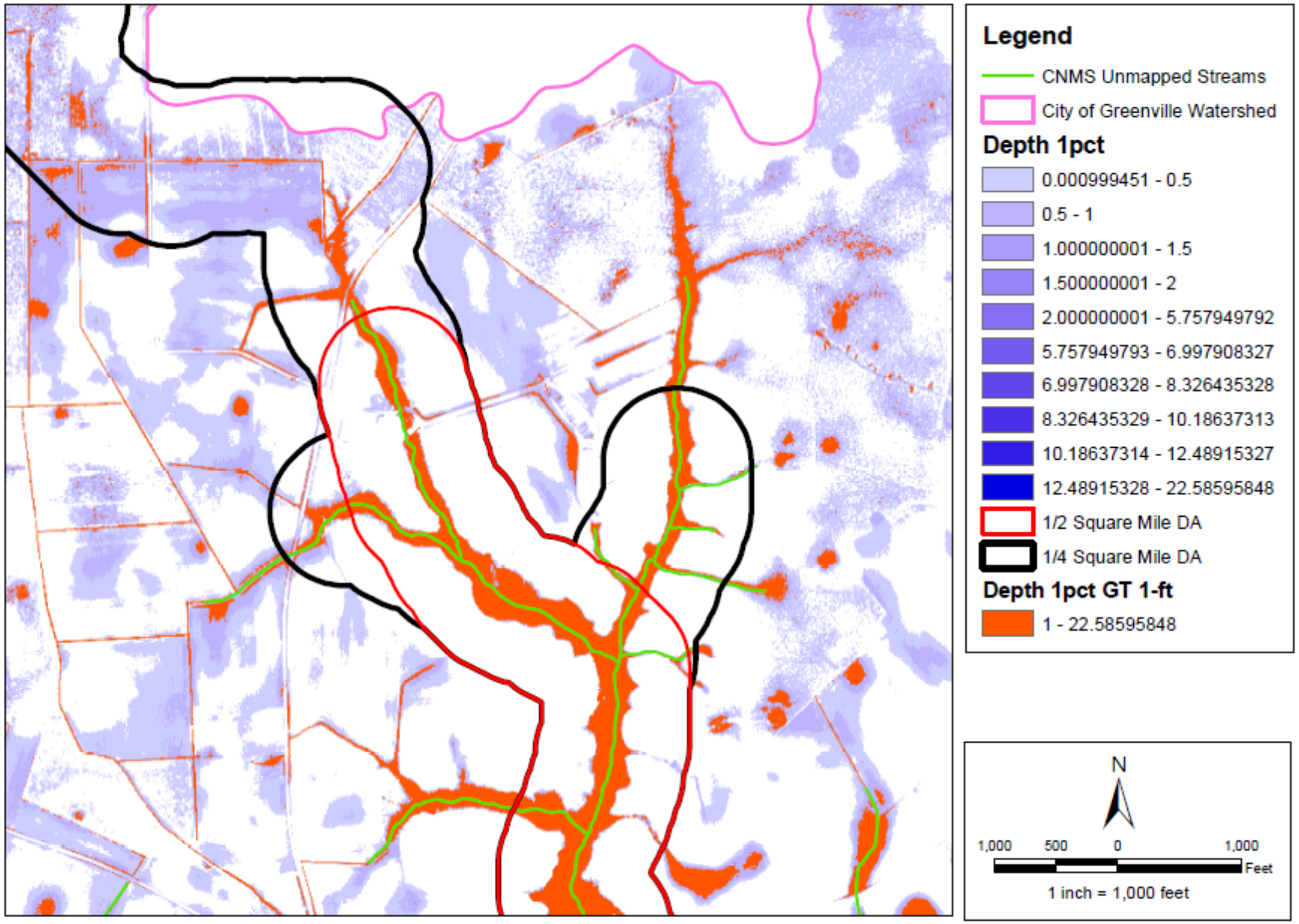
City of Greenville Watershed 2-D Modeling Flood Extents – ½ Square Mile Drainage Area



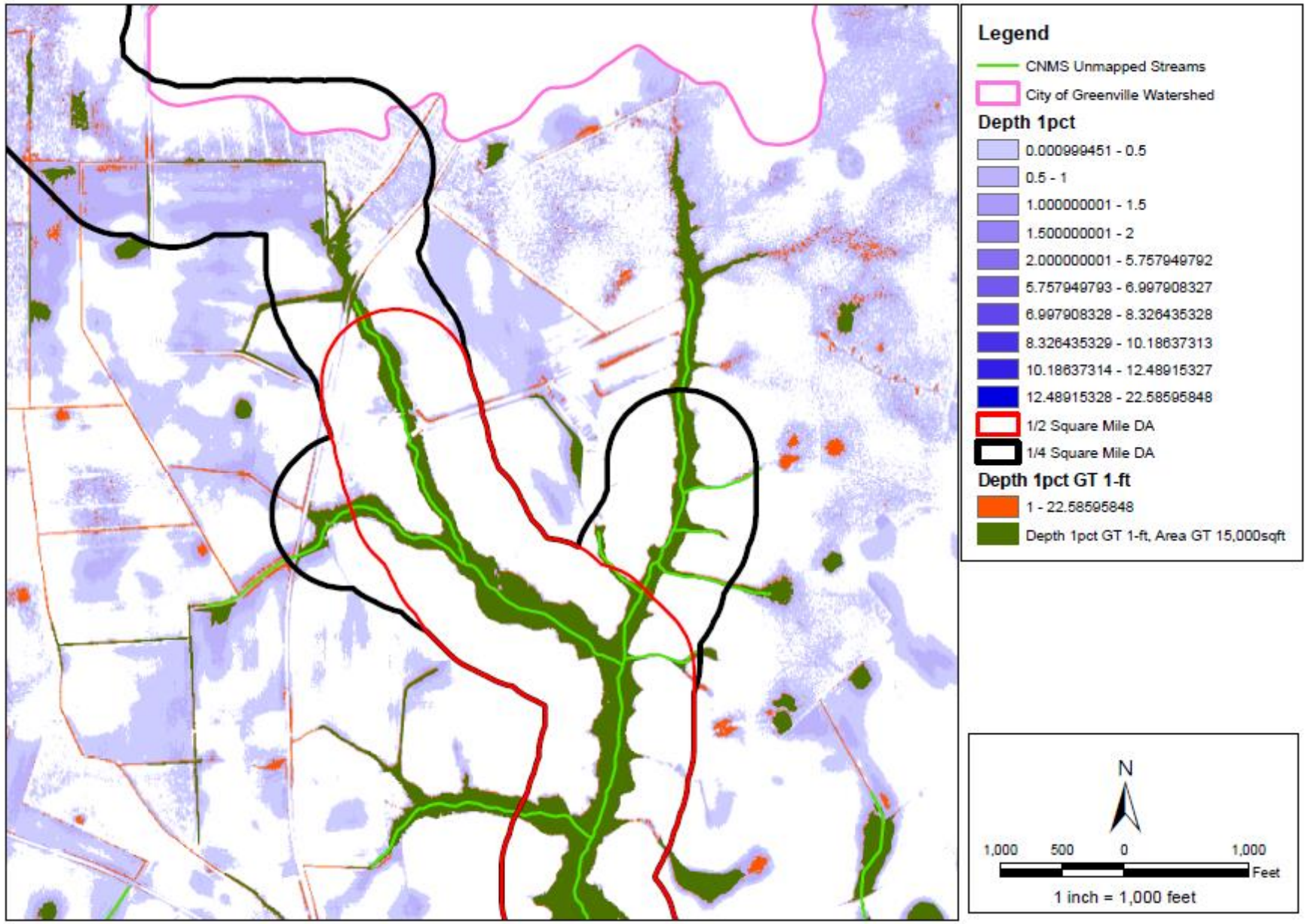
City of Greenville Watershed 2-D Modeling Flood Extents – 1/4 Square Mile Drainage Area



City of Greenville Watershed 2-D Modeling Flood Extents – Depth > 1-ft



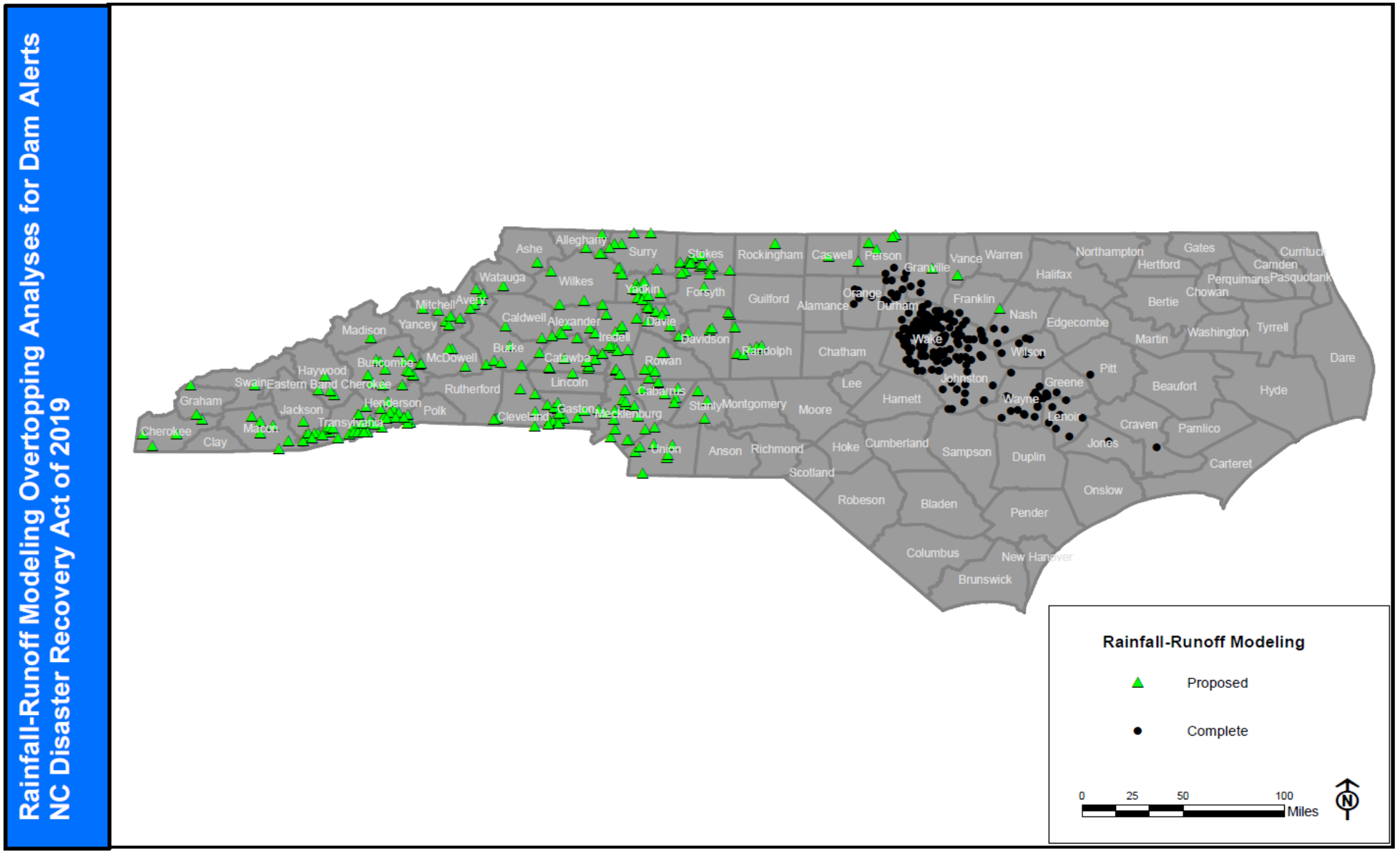
City of Greenville Watershed 2-D Modeling Flood Extents – Depth > 1-ft and Polygons > 15,000 sqft



HB200 Flood Mitigation Studies

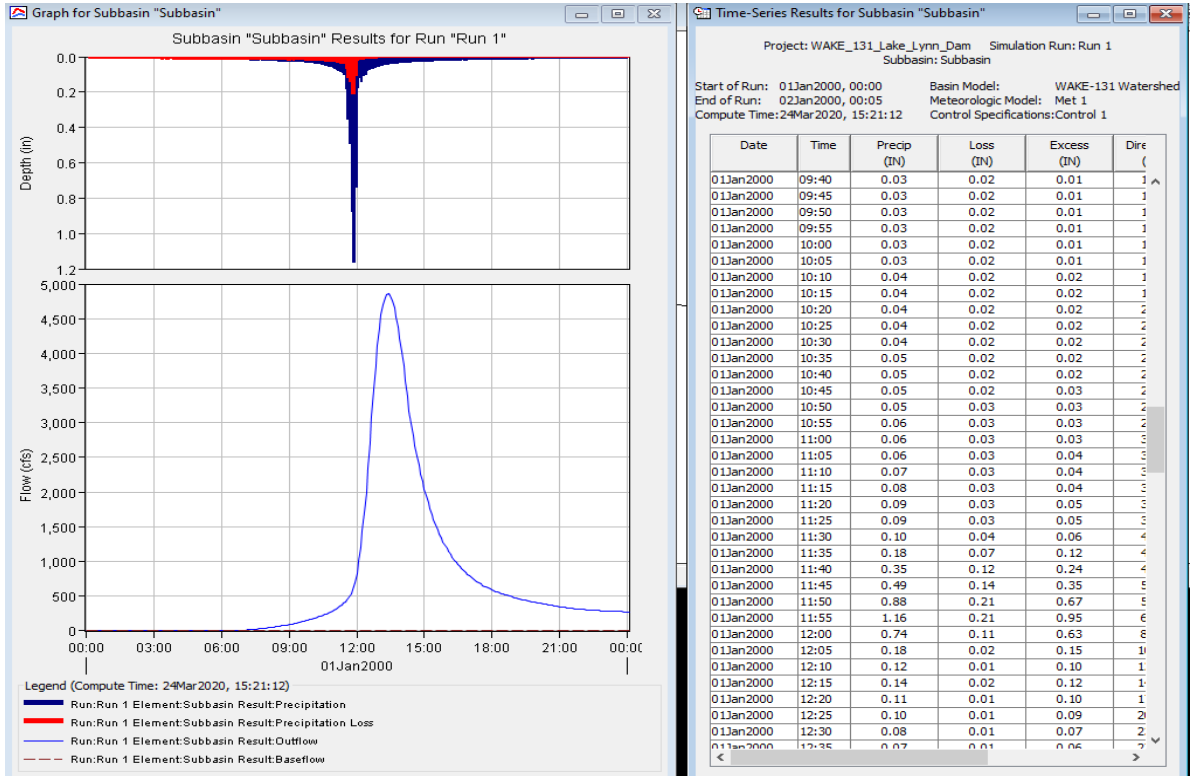
- Flood Risk Assessment – Building-level flood damage assessments for all return periods
- Non-structural building mitigation strategies – Evaluated for all structures
- Areas of mitigation interest – identified by structures with highest cost-to-benefit ratio based damages based on 30 and 50-year time period
- Data will be shared through a new GIS web application for non-regulatory products
- Mapping will not be published on regulatory DFIRMs

Rainfall-Runoff Modeling Overtopping Analysis for Dam Alerts



Background

- NCDEQ – Overtopping analysis in 2018-2019 – Approximately 268 dams in the Neuse and Lumber River Basins
- Goal is to see the amount of rainfall required to overtop a dam and cause possible dam failure
- 25, 50, 100, 200, 500 and 1000-year return periods
- Site selection
  - Structural height >25-ft
  - Maximum storage > 50 ac-ft

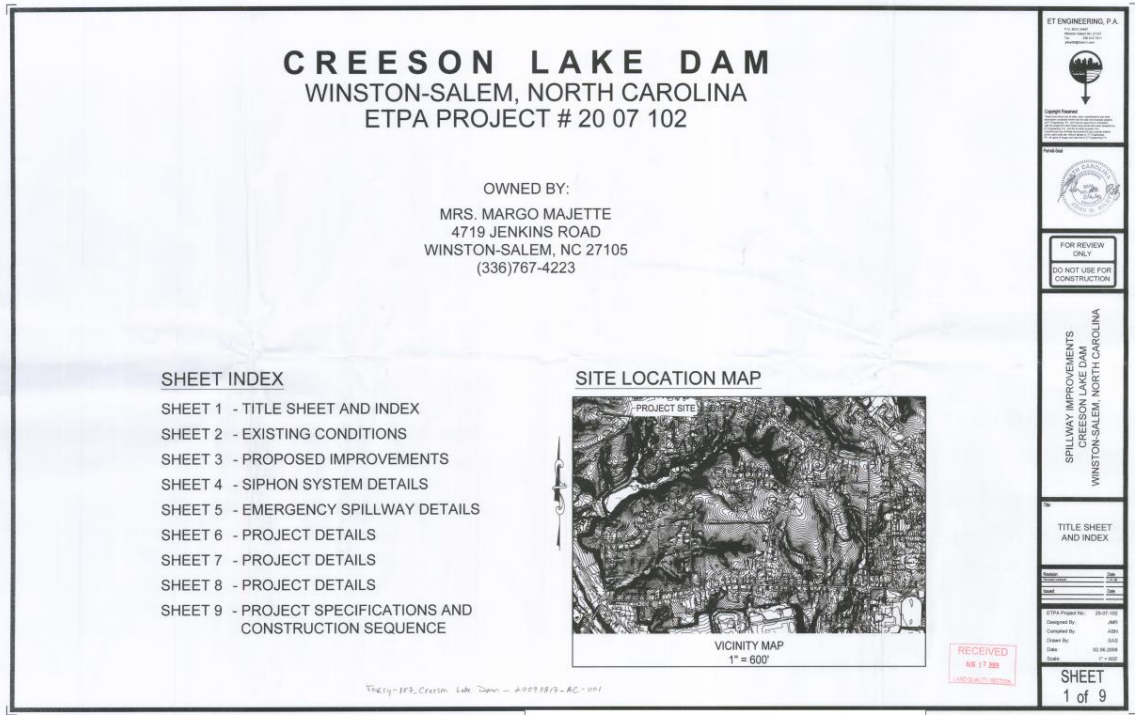


Dam Overtopping Methodology

- Data Collection
- Watershed Delineation
- Reservoir stage-storage and spillway rating curves
- Watershed Parameters and Rainfall
- Hydrologic and Hydraulic Overtopping Analysis

Data Collection

- Dam “as-builts” or dam surveys
  - Dam Safety where available
  - Field survey for dams with insufficient data to model
- Landuse – Latest 2016 National Land Cover Dataset (NLCD)
- Soils - NRCS Soil Survey Geographic Database (SSURGO)
- Terrain – NCEM QL1 or QL2 LIDAR



CREESON LAKE DAM
WINSTON-SALEM, NORTH CAROLINA
ETPA PROJECT # 20 07 102

OWNED BY:
MRS. MARGO MAJETTE
4719 JENKINS ROAD
WINSTON-SALEM, NC 27105
(336)767-4223

SHEET INDEX

SHEET 1 - TITLE SHEET AND INDEX
SHEET 2 - EXISTING CONDITIONS
SHEET 3 - PROPOSED IMPROVEMENTS
SHEET 4 - SIPHON SYSTEM DETAILS
SHEET 5 - EMERGENCY SPILLWAY DETAILS
SHEET 6 - PROJECT DETAILS
SHEET 7 - PROJECT DETAILS
SHEET 8 - PROJECT DETAILS
SHEET 9 - PROJECT SPECIFICATIONS AND CONSTRUCTION SEQUENCE

SITE LOCATION MAP

VICINITY MAP
1" = 600'

RECEIVED

ET ENGINEERING, P.A.

FOR REVIEW ONLY
DO NOT USE FOR CONSTRUCTION

SPILLWAY IMPROVEMENTS
CREESON LAKE DAM
WINSTON-SALEM, NORTH CAROLINA

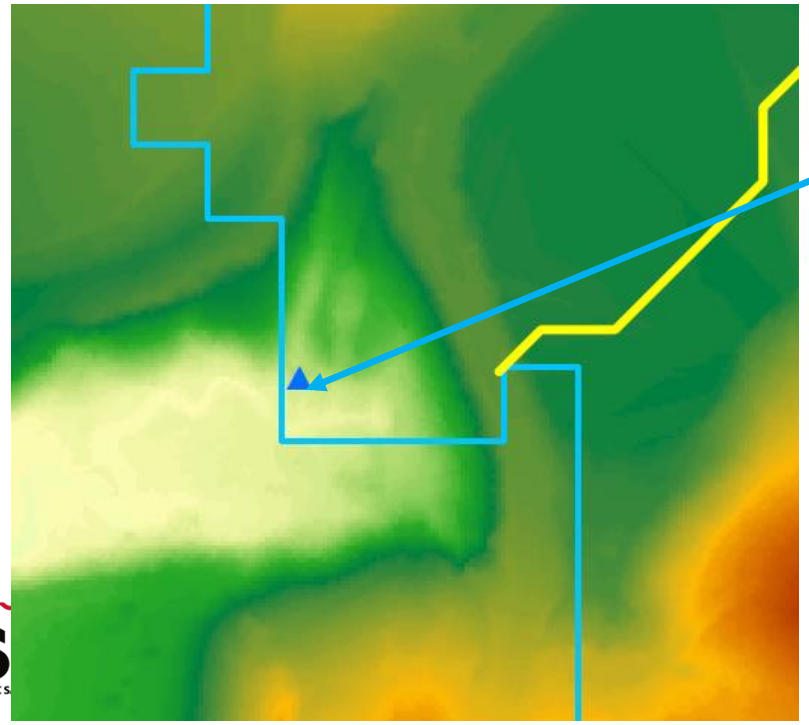
TITLE SHEET AND INDEX

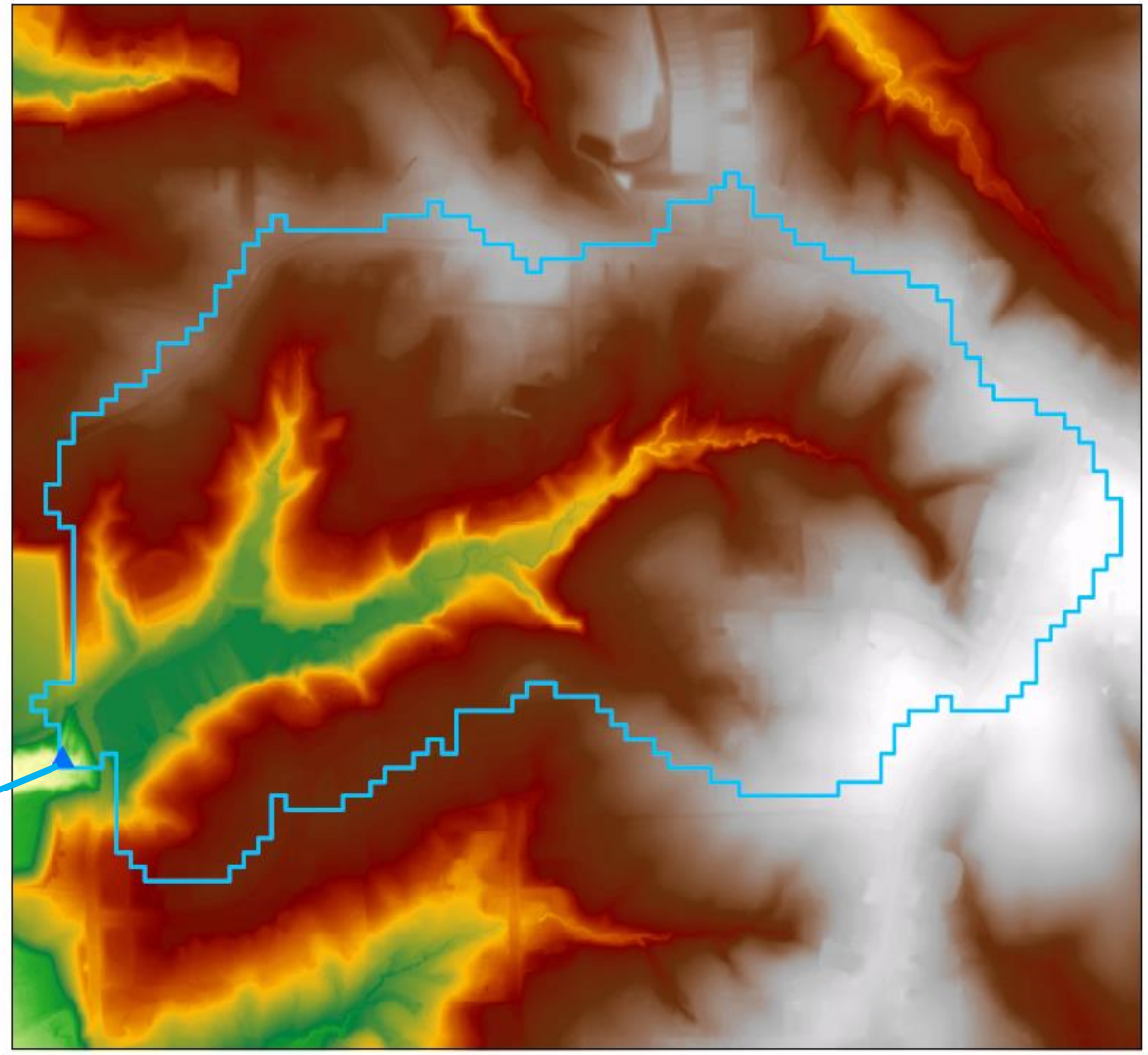
SHEET 1 of 9

Watershed Delineation

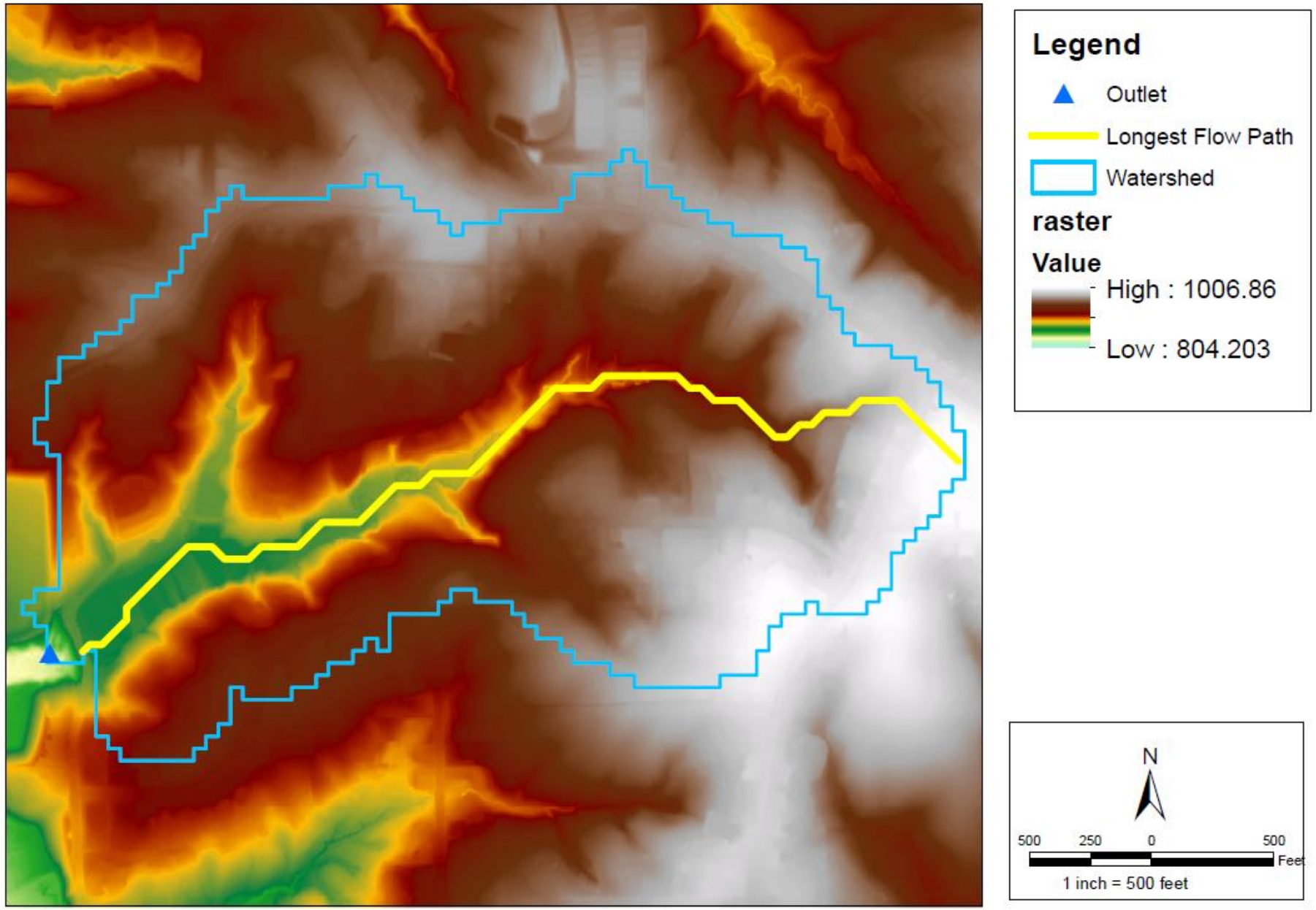
Creeson Lake Dam (FORSY-157)

- NCEM 3-10-ft LIDAR DEM
- ArcHydro
- Outlet – Immediately downstream of dam



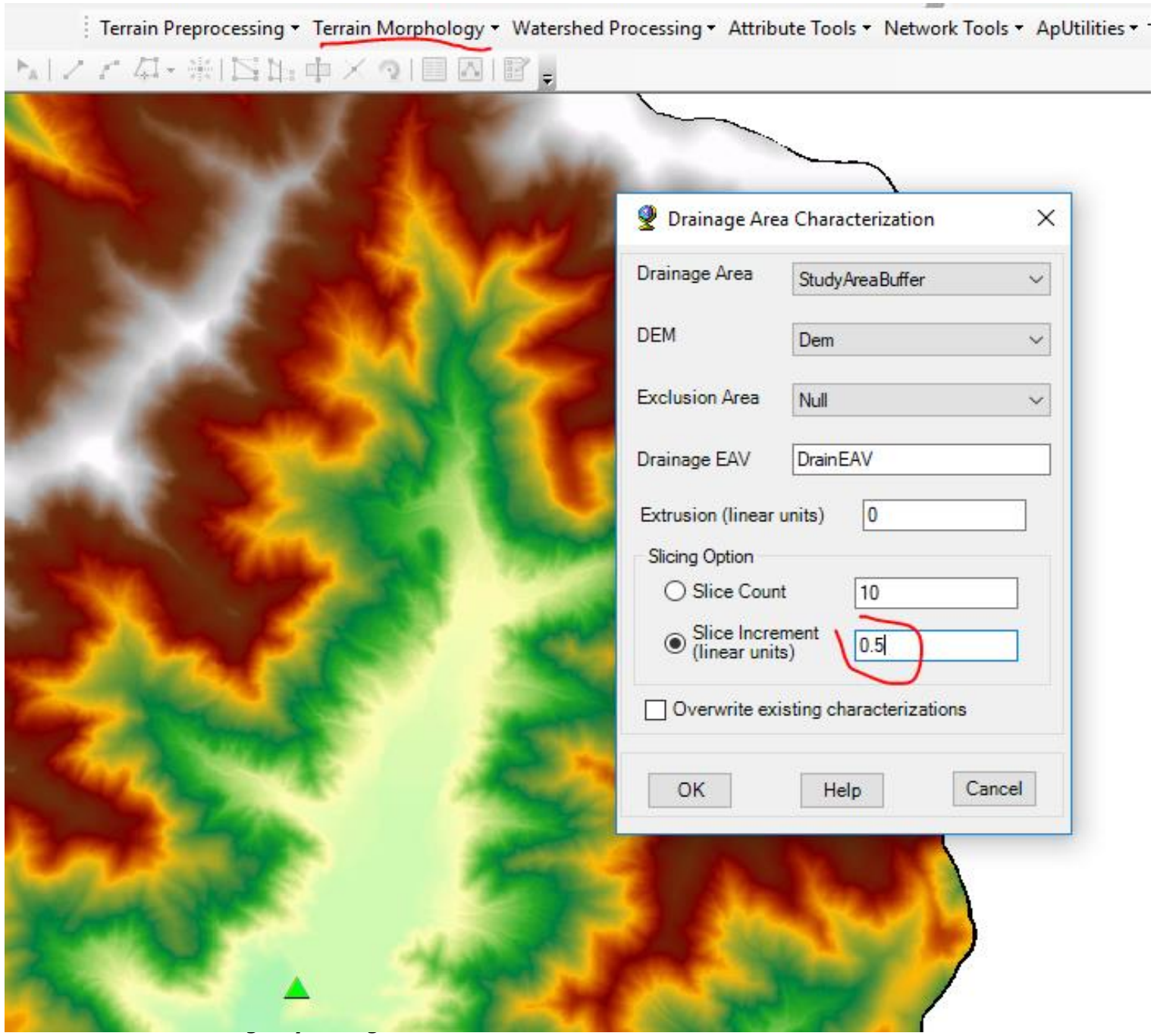


Longest Flow Path



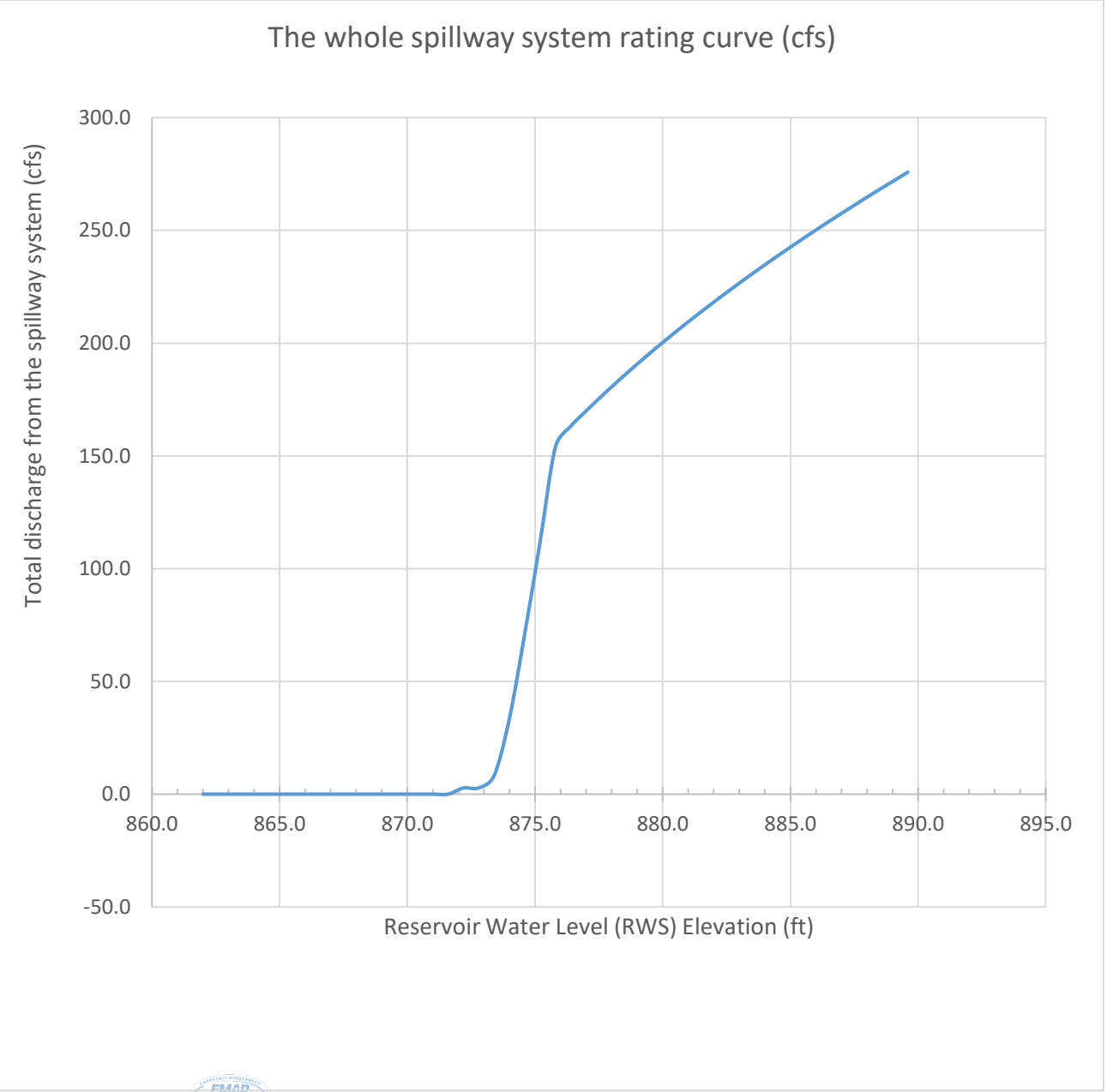
Stage-Storage Curves

- ArcHydro
  - Terrain Morphology
  - Start at Normal Pool
  - 0.5-ft elevation interval



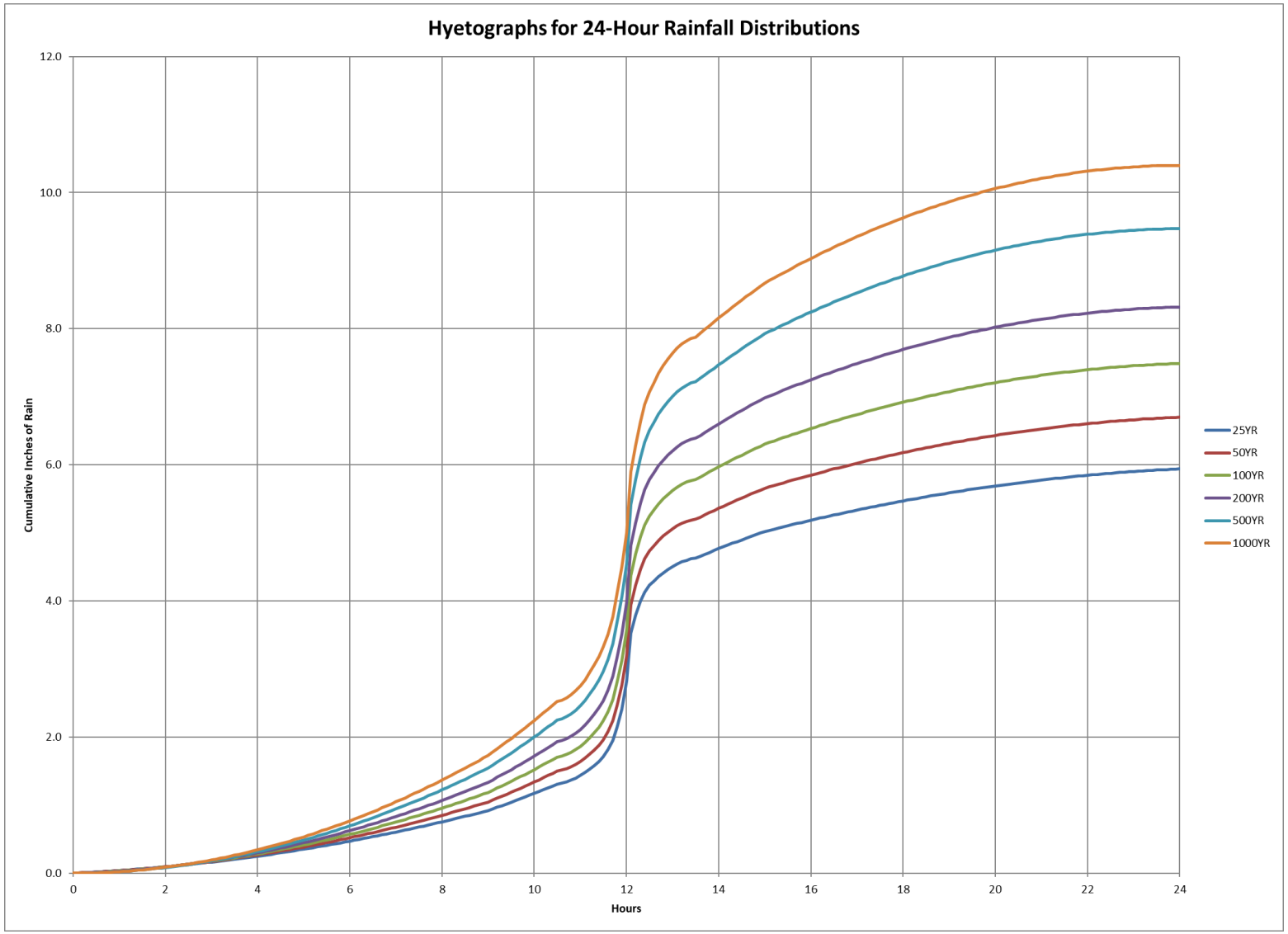
Spillway Rating Curves

- ArcHydro
  - 0.5-ft intervals
  - Normal pool to several feet above top of dam
  - Spreadsheet for primary and secondary spillway rating curves



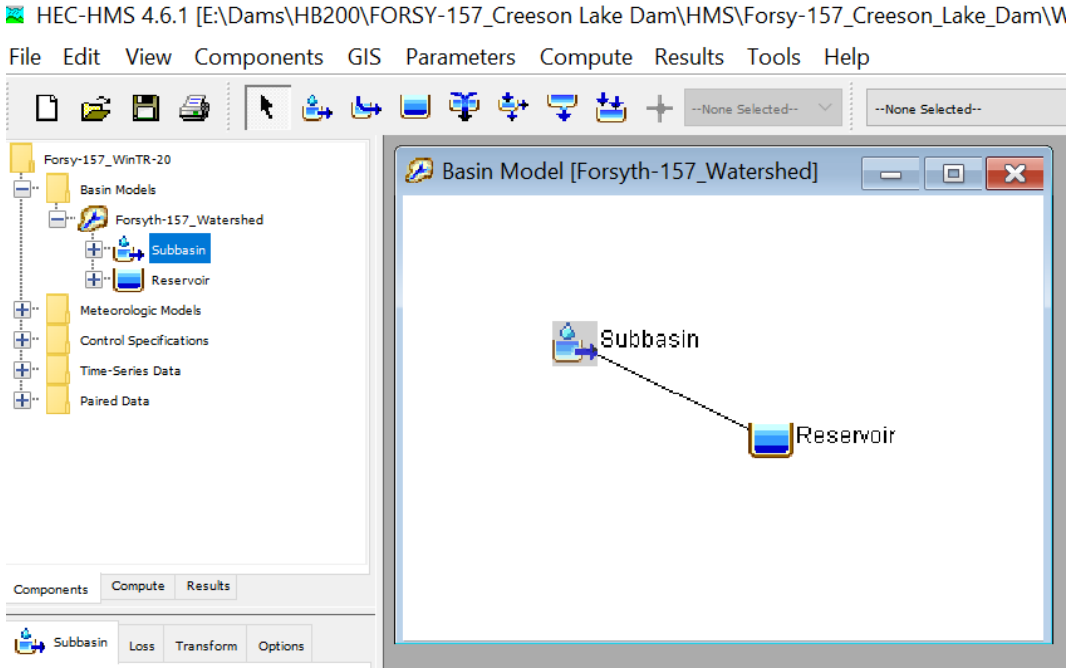
Watershed Parameters

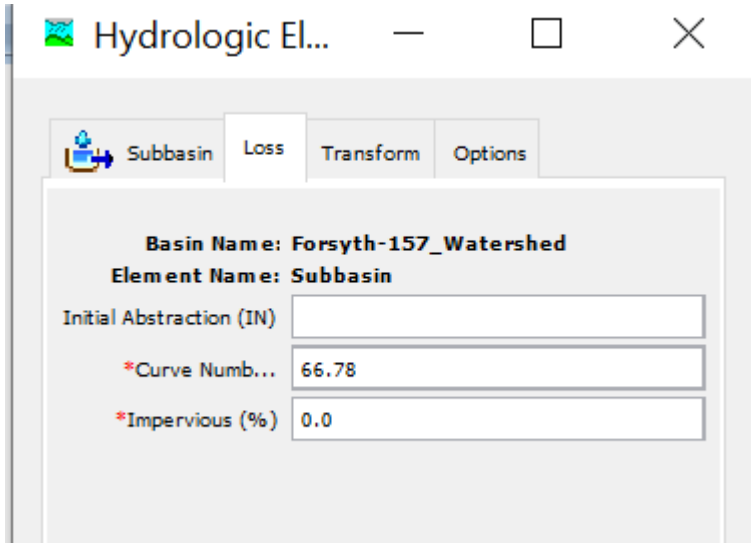
- Lag Time – SCS watershed lag method
- Infiltration losses – SCS Composite Curve Number (CN)
- Precipitation – NOAA Atlas 14

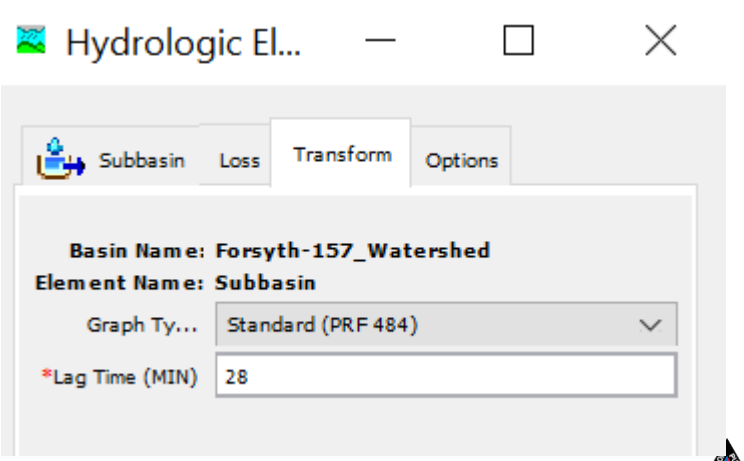


Hydrologic and Hydraulic Modeling

- HEC-HMS
  - Single watershed, single reservoir
- Loss Method – SCS CN
- Transform – SCS Unit Hydrograph and Lag Time
- Baseflow – none
- Precipitation – SCS type II or III storm
- 24-hour simulation – longer for larger watershed



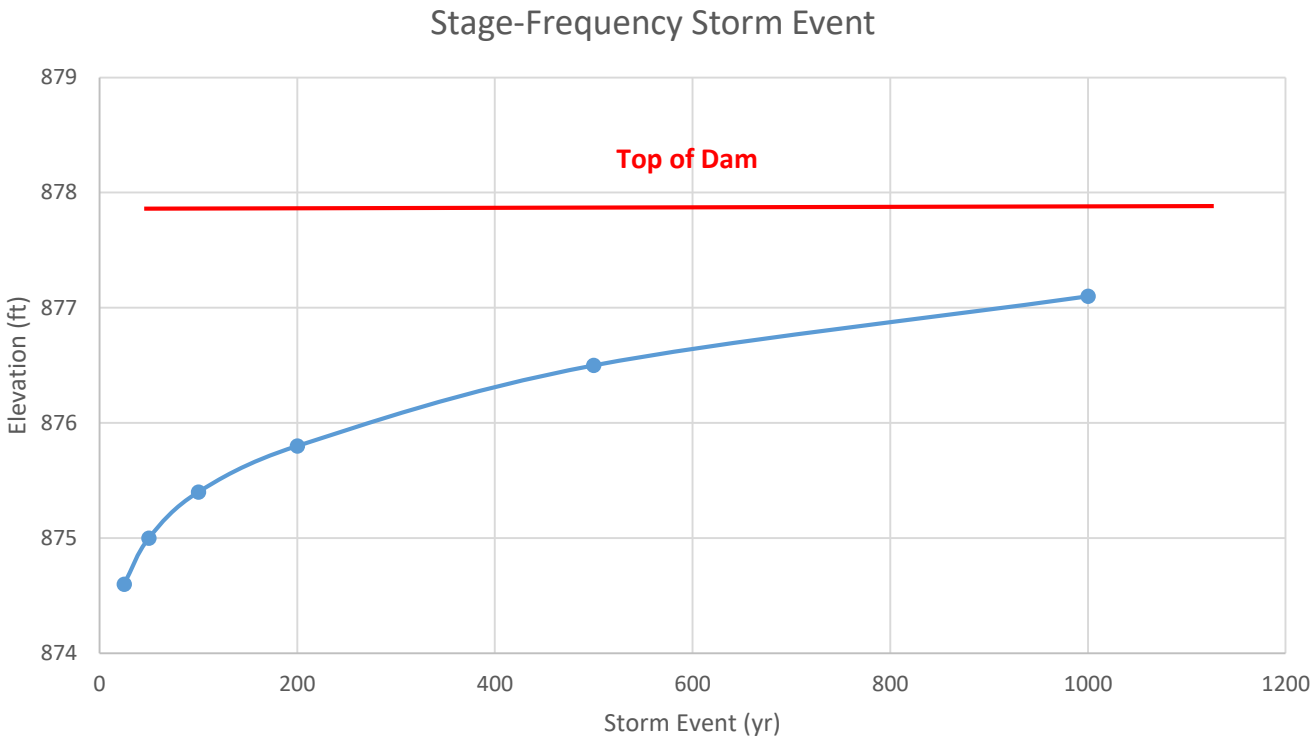




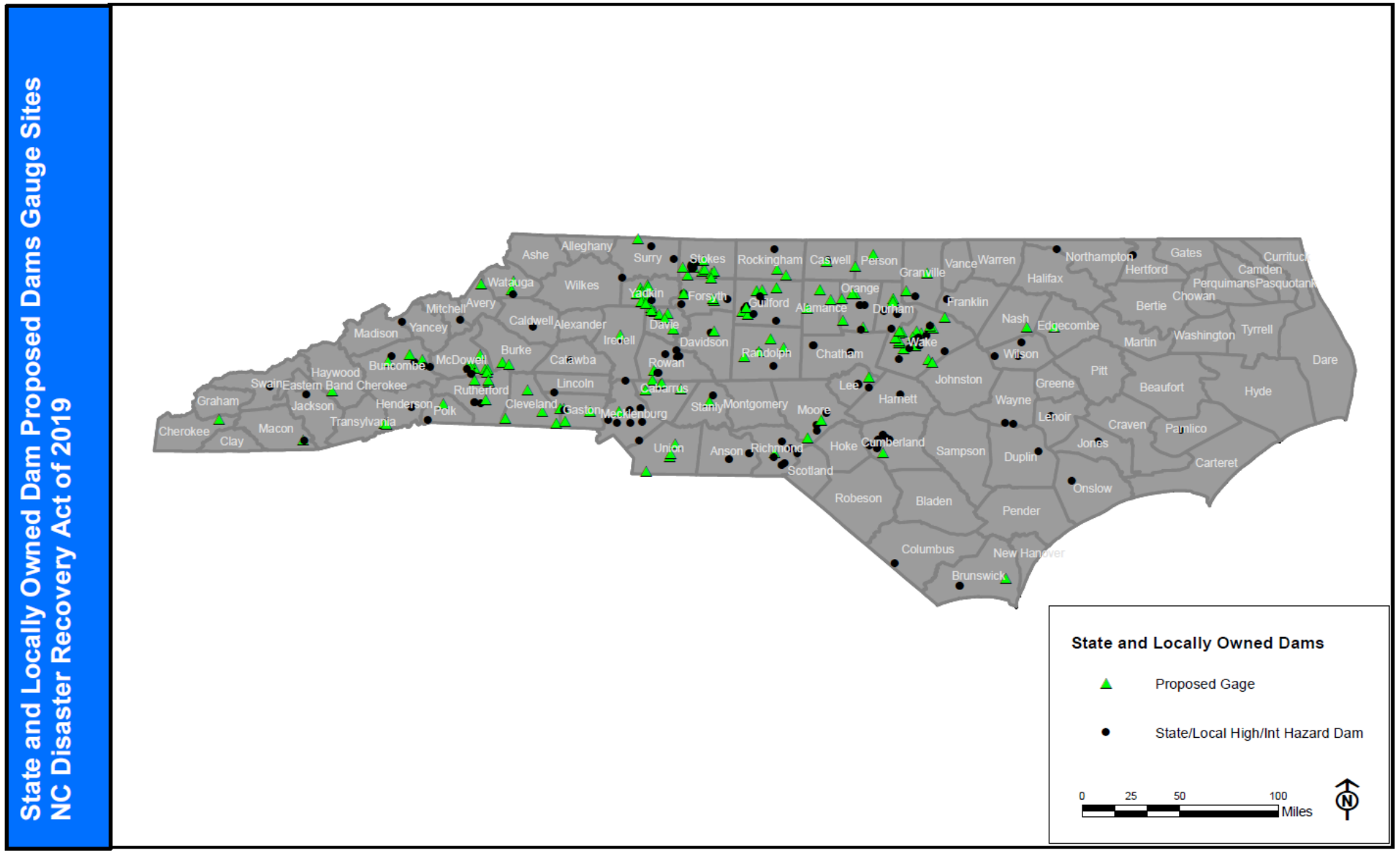
Overtopping Analysis Results

Top of DAM 878
Normal pool 872

storm event	rainfall depth	elevation	freeboard
25	5.94	874.6	3.4
50	6.7	875	3
100	7.49	875.4	2.6
200	8.32	875.8	2.2
500	9.47	876.5	1.5
1000	10.4	877.1	0.9



State and Locally Owned Dam Gauge Sites



Dam Alert Application

- Purchased DamWatch from US Engineering
- Cloud based application
- Active alerts for dams based on forecast and observed rainfall and overtopping analyses results or gauges readings at dams
- DamWatch Data
  - 555 total overtopping analyses
  - 130 water level sensors
  - Dam breach analyses boundaries
  - USGS and NCEM stream gauges