# TCEQ Dam Safety Program Activities

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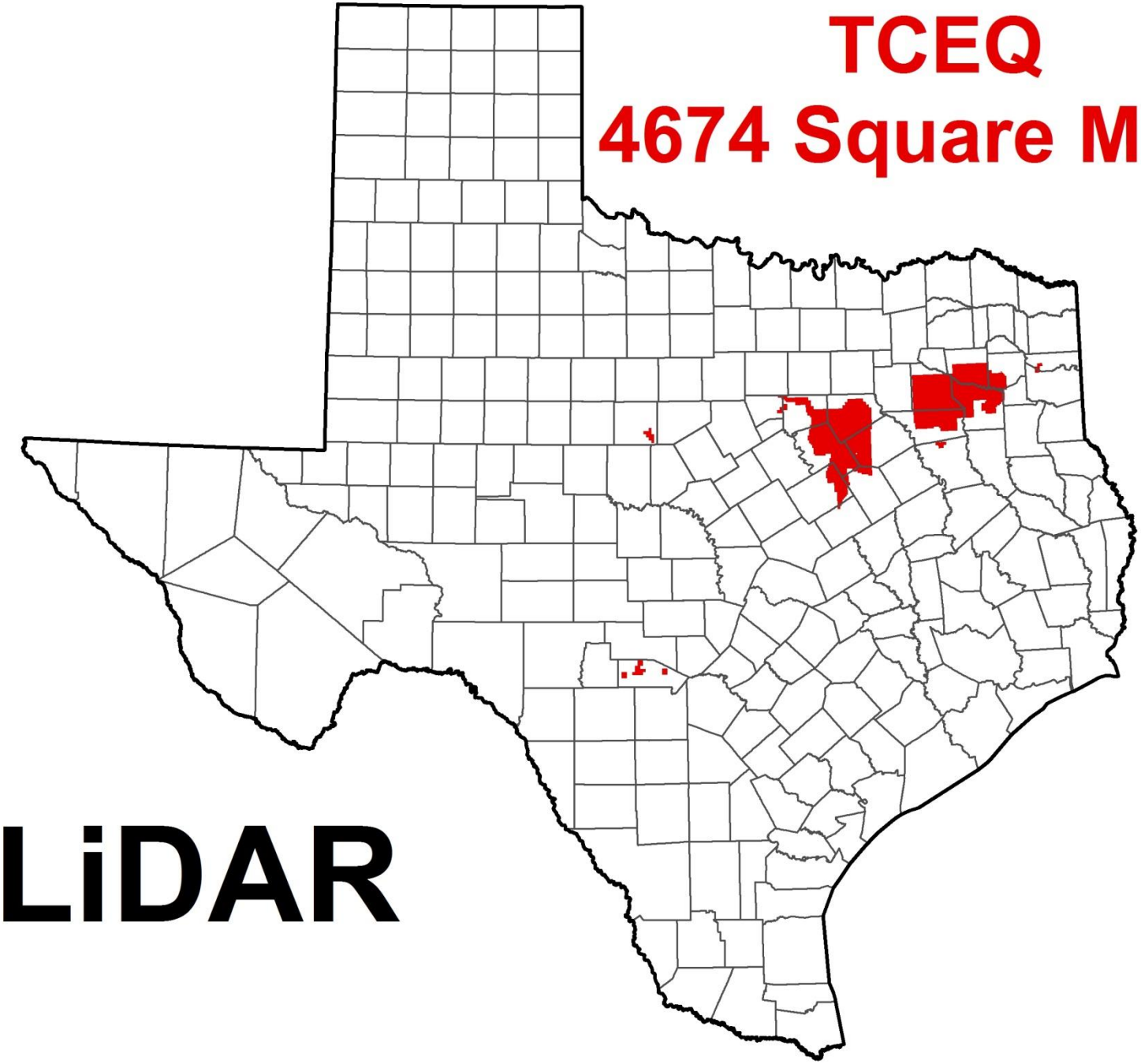
# Presentation items

- LiDAR
- Dam Owners and Engineers
- PMP Study
- Dam Failures
- Dam Safety reports

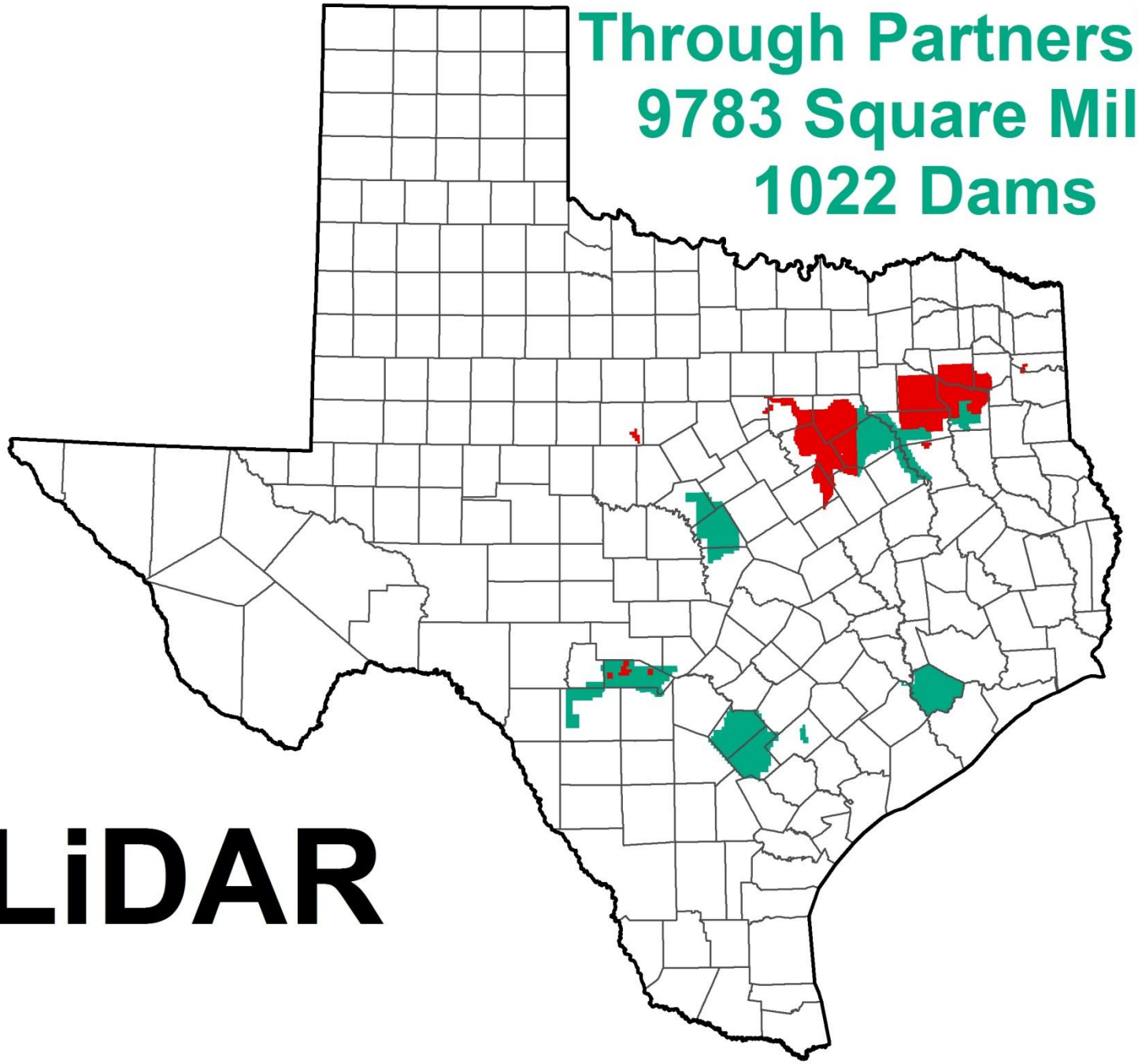

LiDAR

# TCEQ
# 4674 Square Miles



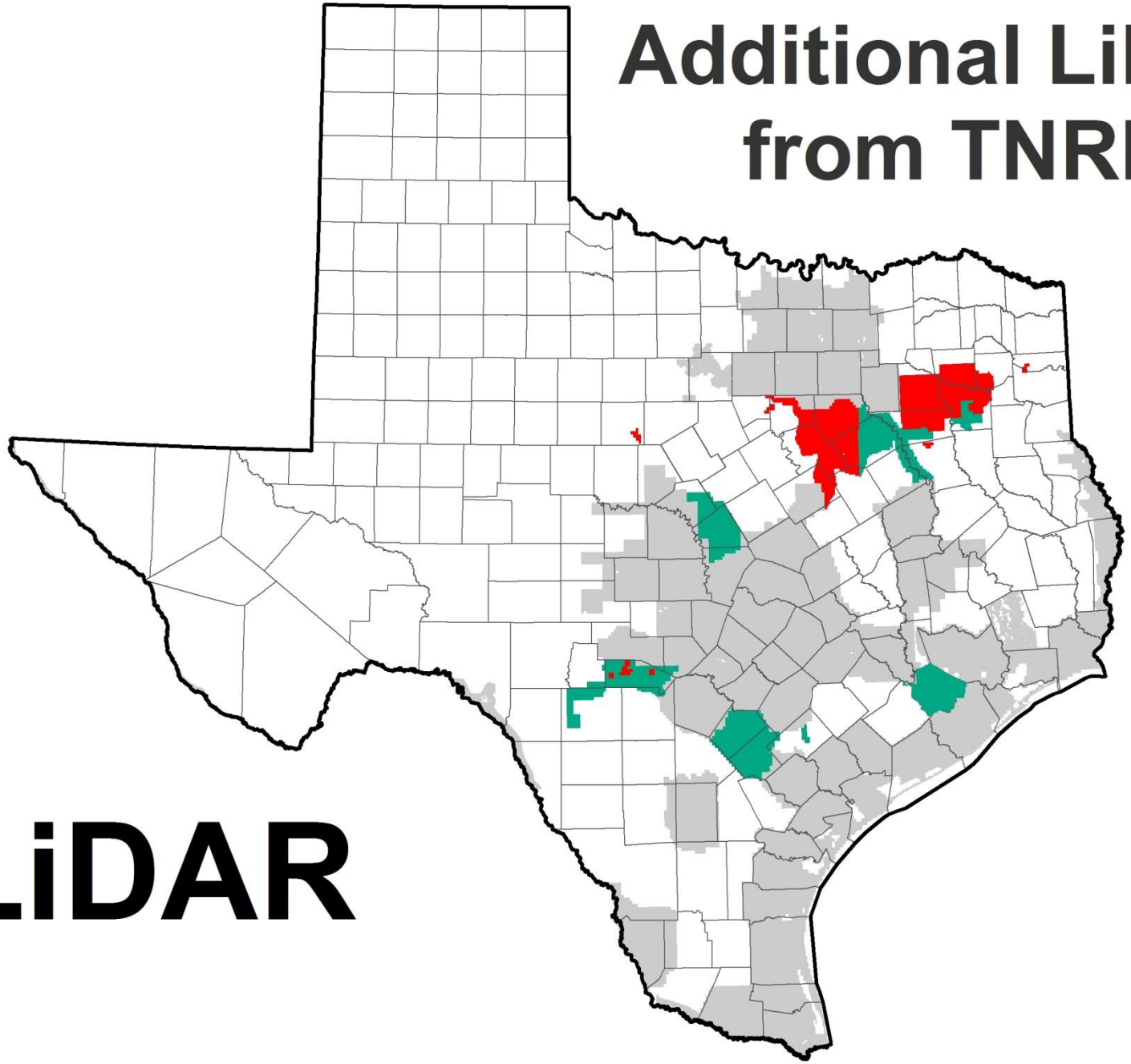
# LiDAR

# LiDAR

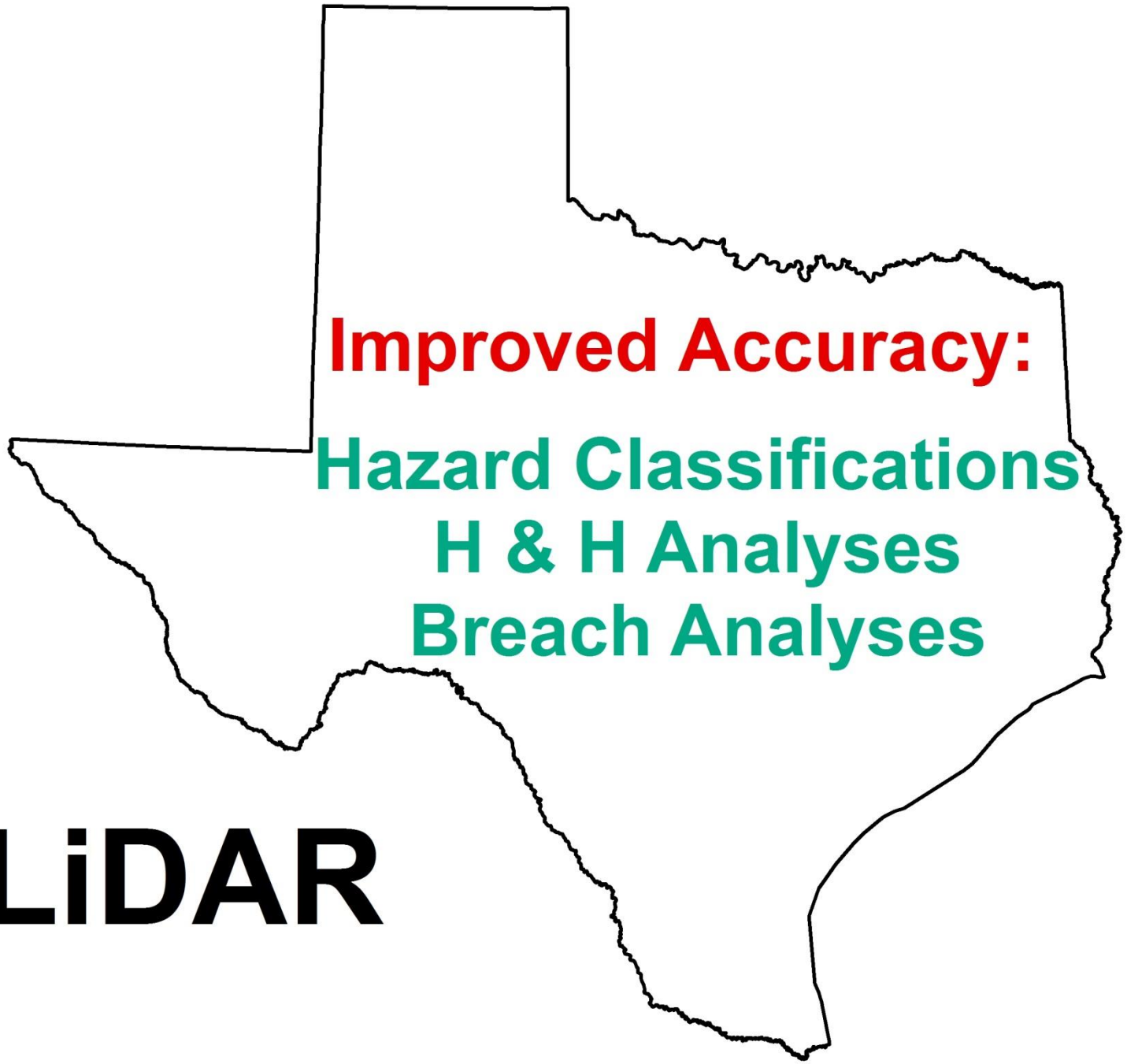


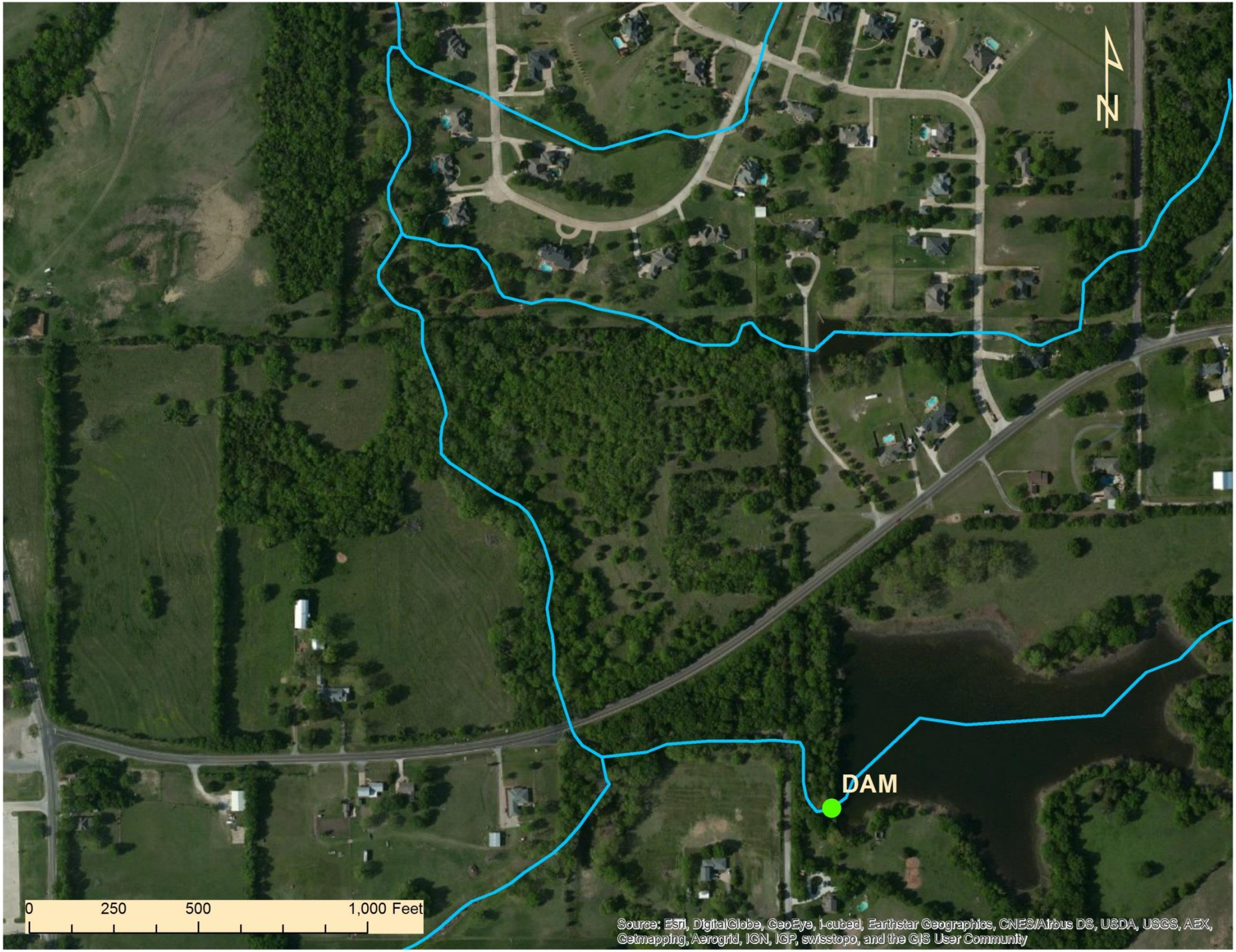
**Through Partnerships**
**9783 Square Miles**
**1022 Dams**

# Additional LiDAR from TNRIS



# LiDAR


Improved Accuracy:
Hazard Classifications
H & H Analyses
Breach Analyses
LiDAR


N
DAM
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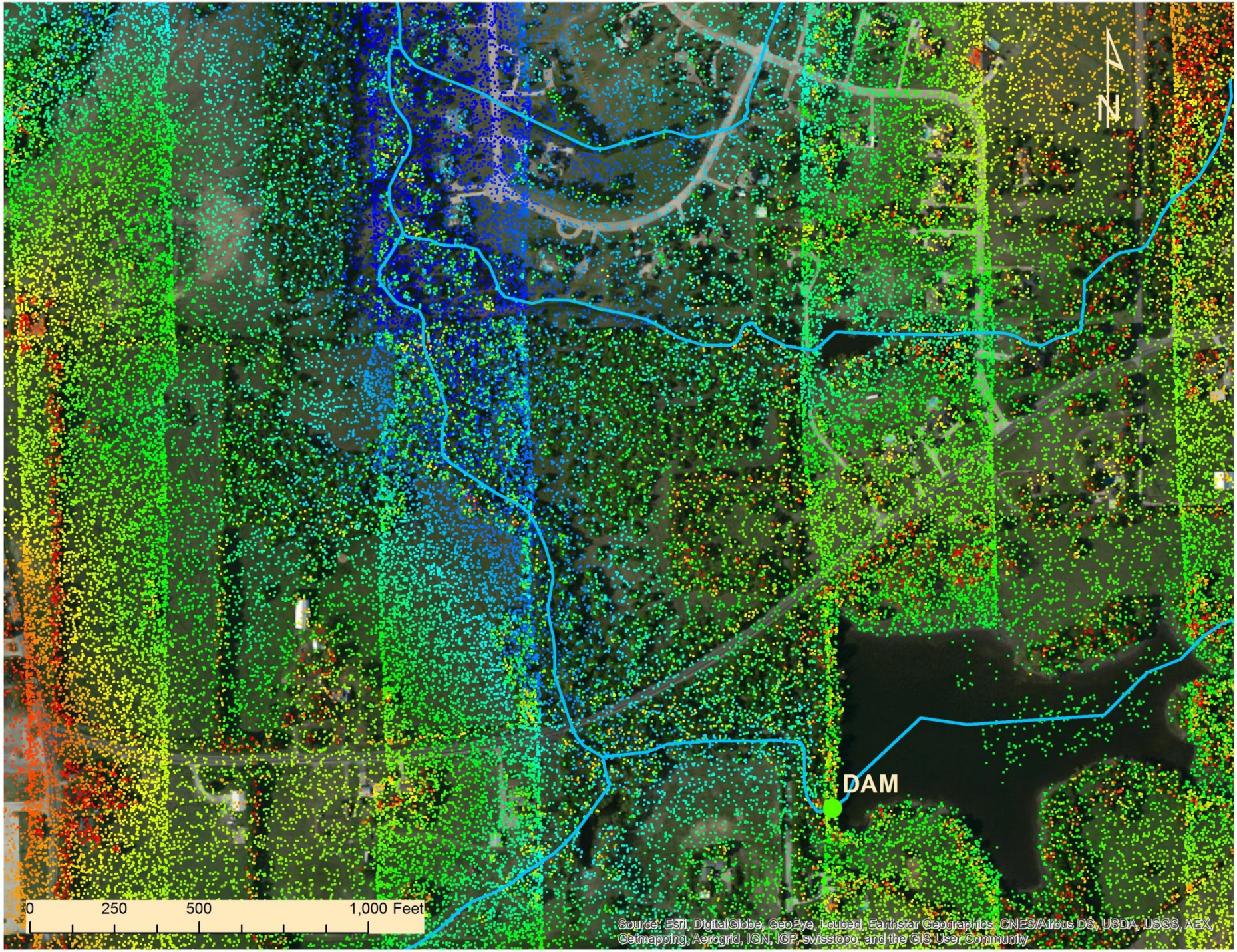
250
500
1,000 Feet
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community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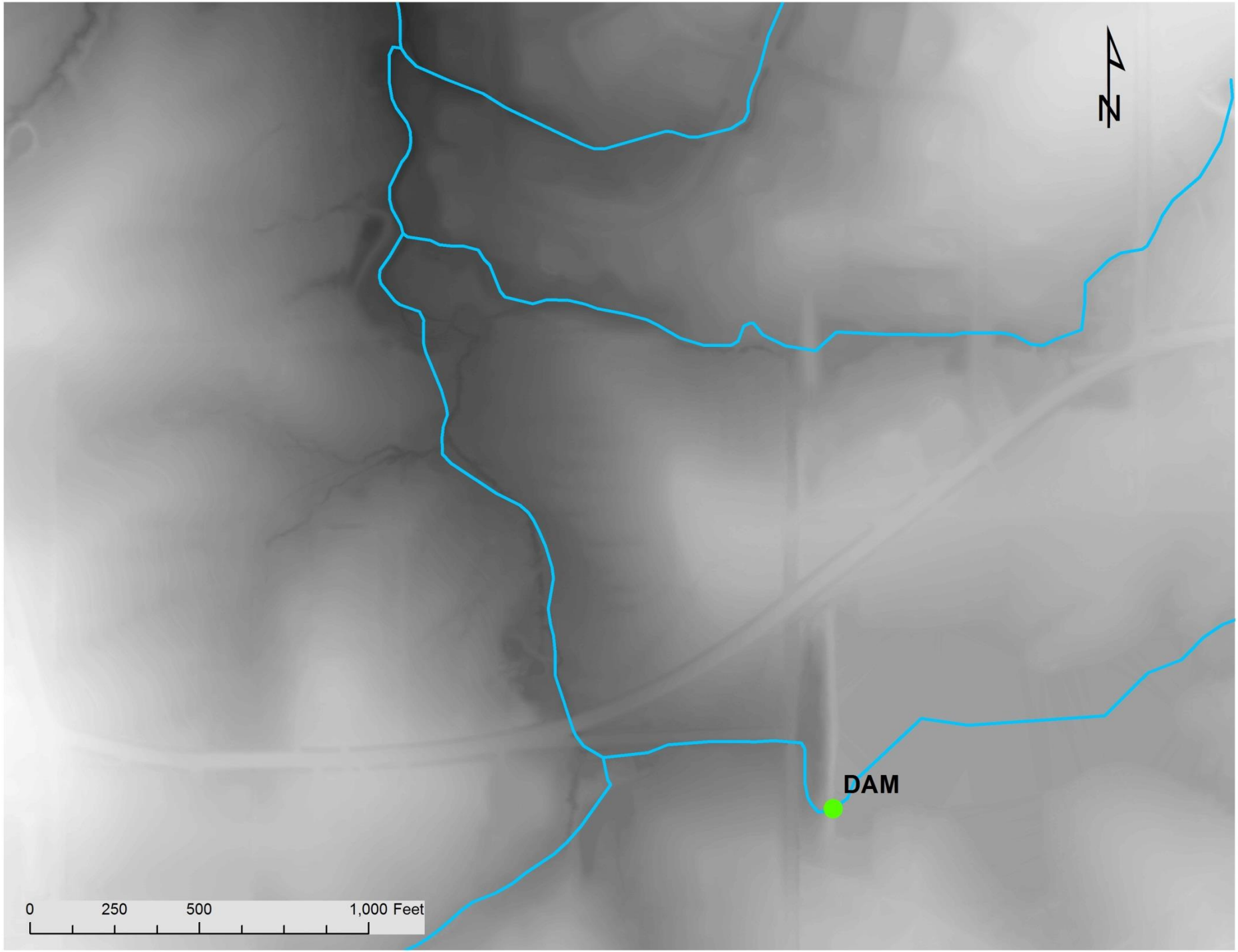
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community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DAM
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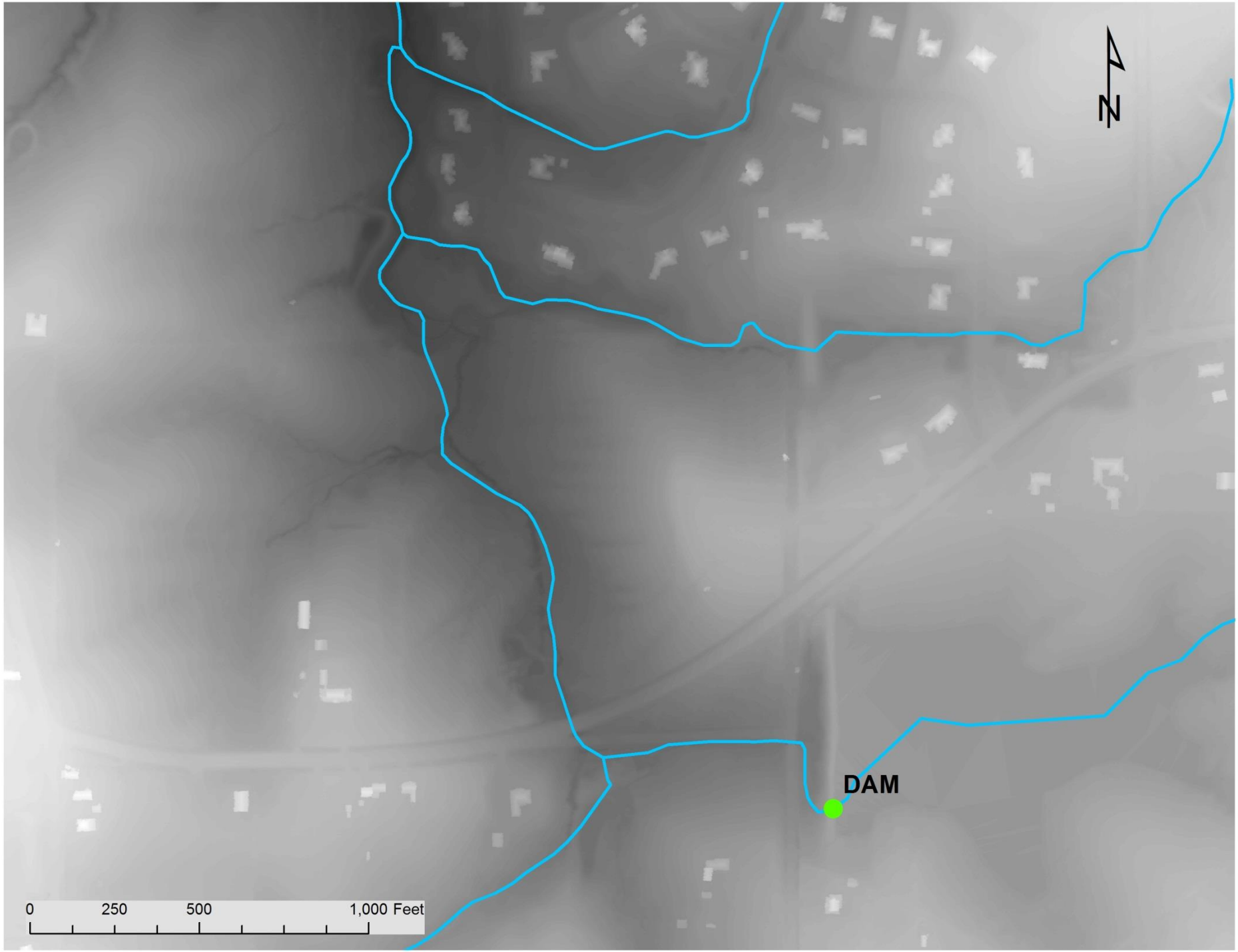
1,000 Feet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DAM
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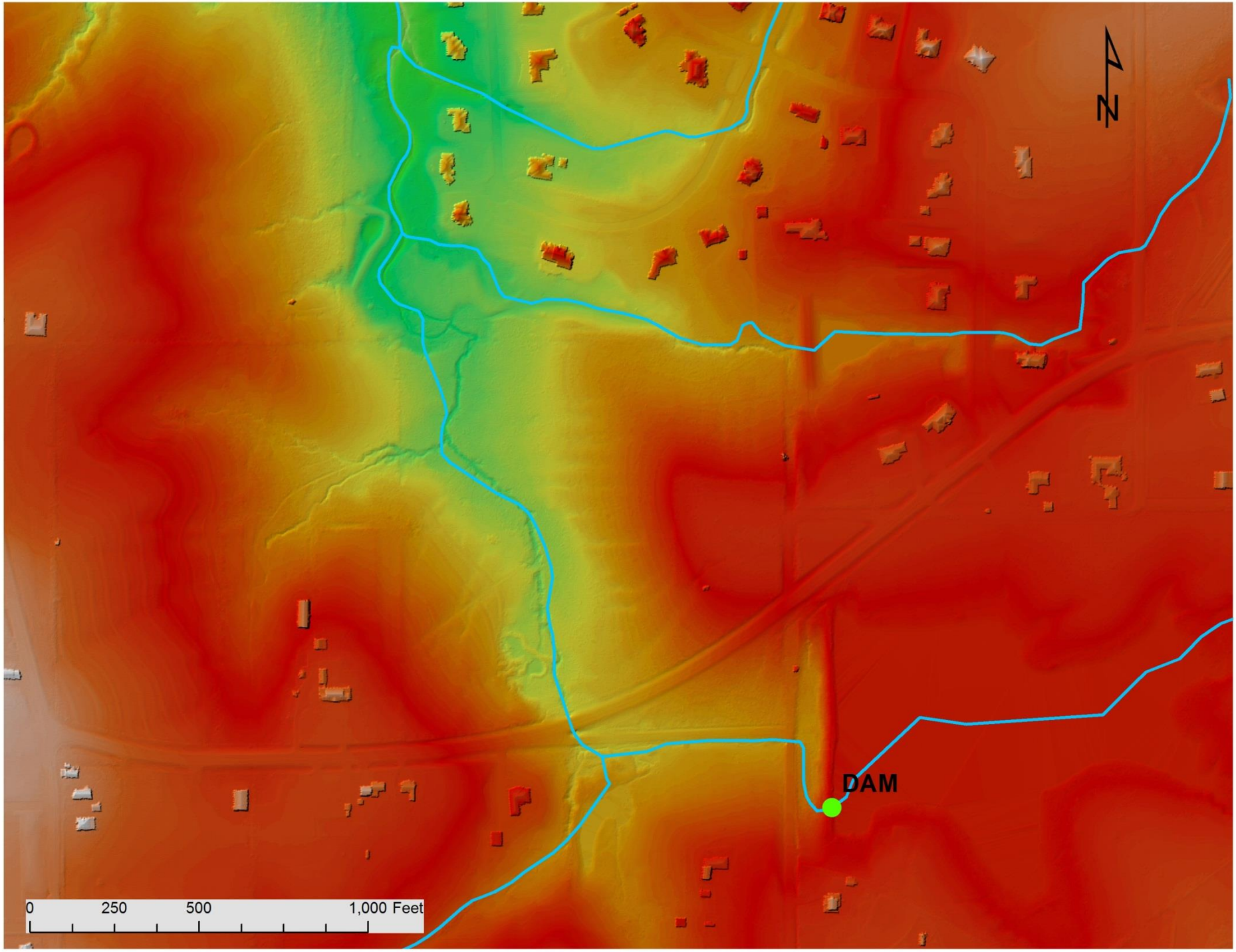
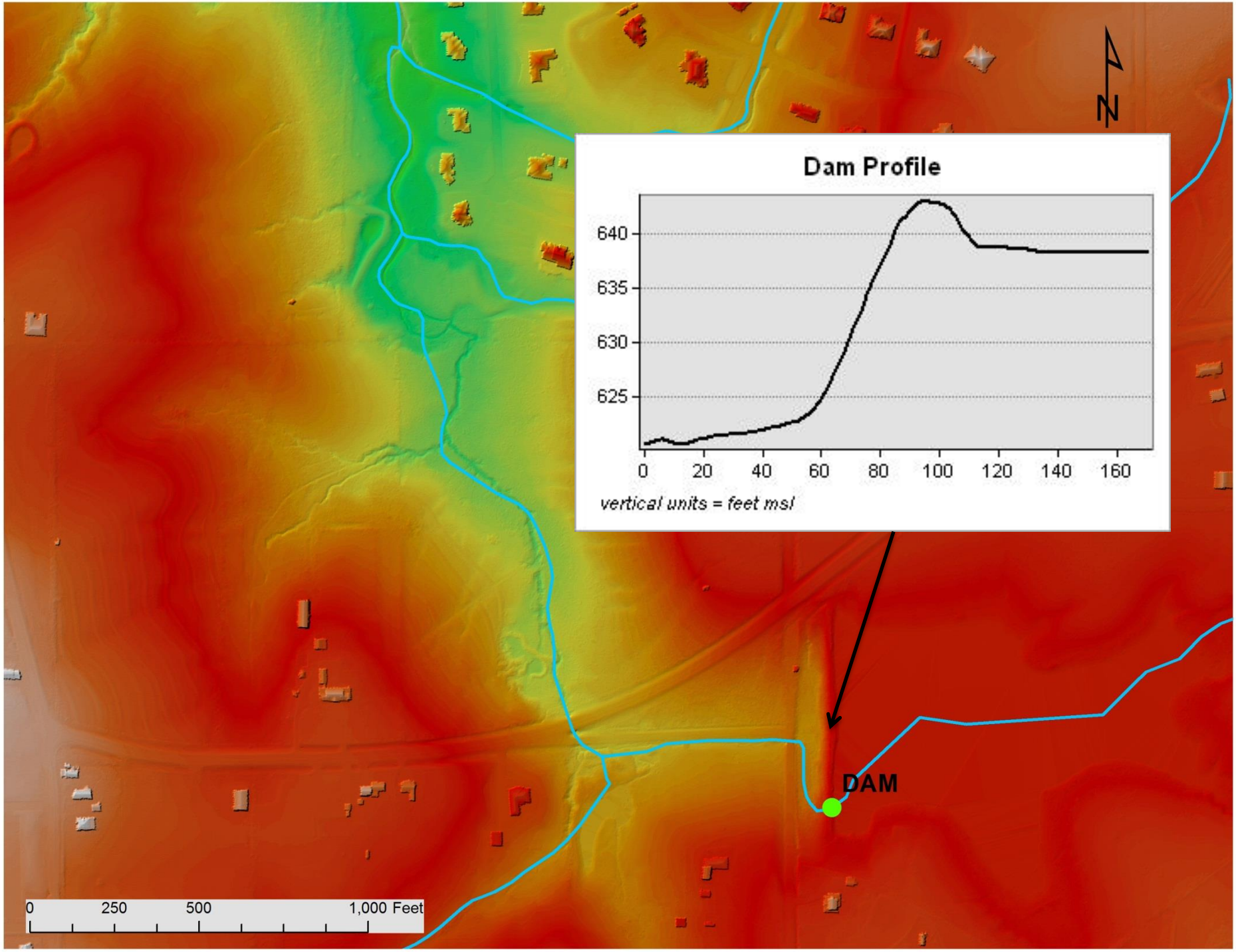

N
DAM
0
250
500
1,000 Feet


Dam Profile
640
635
630
625
0
20
40
60
80
100
120
140
160
vertical units = feet msl
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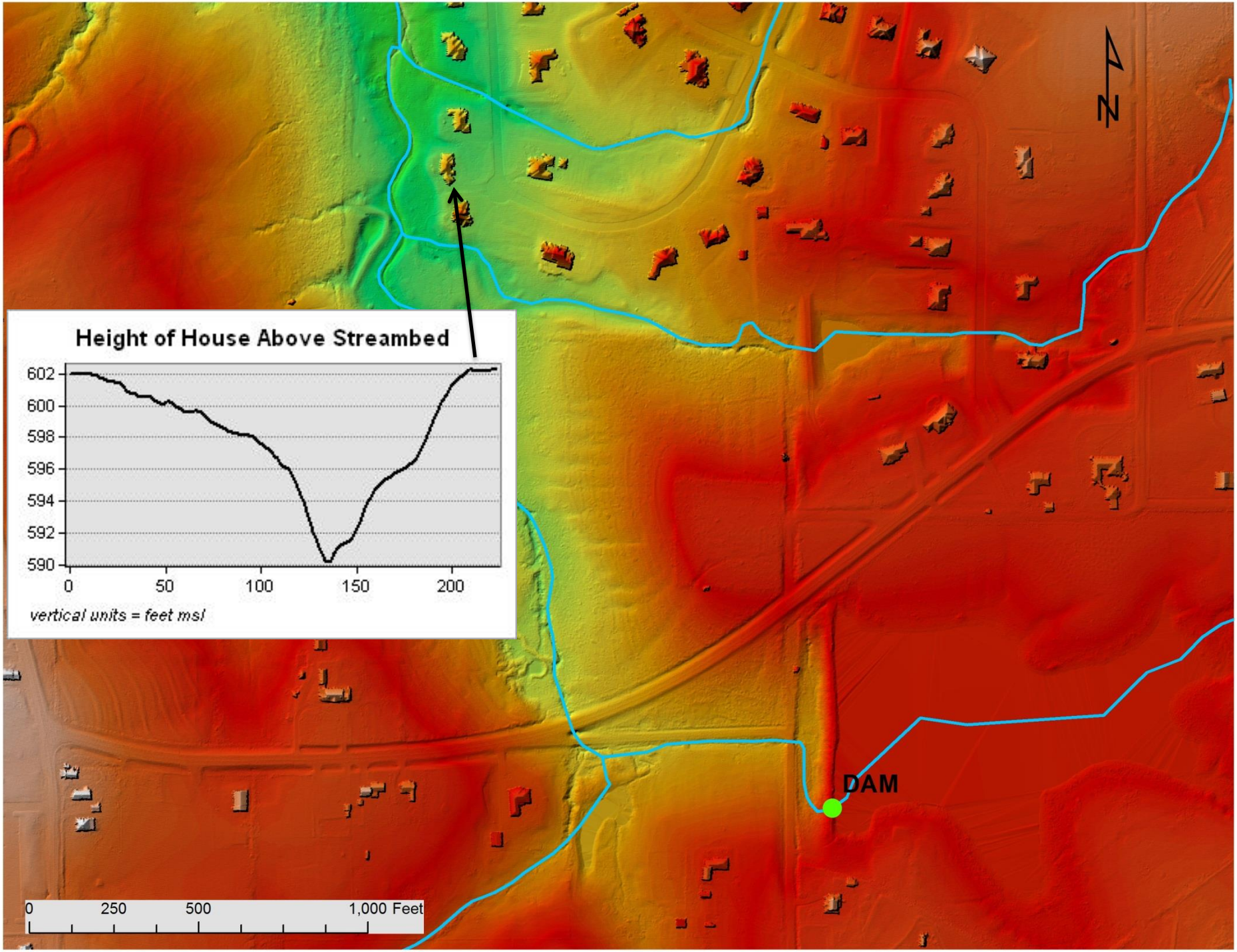
DAM
0
250
500
1,000 Feet


Height of House Above Streambed
602
600
598
596
594
592
590
0
50
100
150
200
vertical units = feet msl
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DAM
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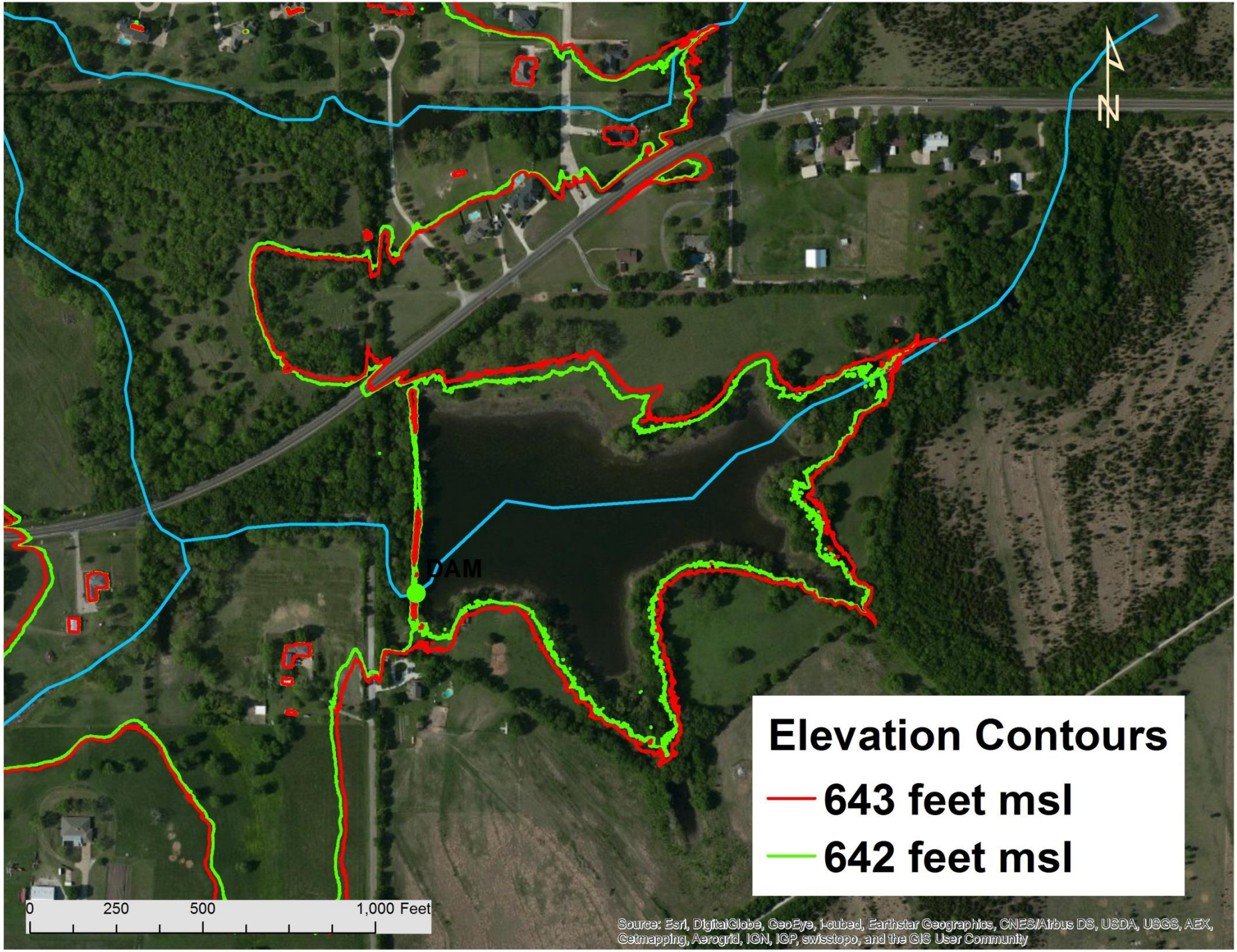
250
500
1,000 Feet


DAM
Elevation Contours
643 feet msl
642 feet msl
0
250
500
1,000 Feet
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

# Dam Owners and Engineers

# Owner Responsibilities

- Owner responsible for operating and maintaining dam in a safe manner
- Owner responsible for addressing all maintenance and safety concerns identified during an inspection
- Owner shall ensure that necessary maintenance, repairs, alterations, or modifications are initiated and completed in a timely manner

# Owner Responsibilities

- Owner has the legal duties, obligations, and liabilities incident to ownership or operation
- **Dam Owner is liable**
- 30 TAC §299.41

# Will TCEQ Enforce?

- TCEQ will not require the dam owner to breach the dam or drain the lake simply because they do not meet all of the requirements
- TCEQ will execute our enforcement powers if the dam presents an unacceptable threat to public safety and dam owner is making no attempt to alleviate the threat - Failure to act.

# What should the Owner do?

- Evaluate and prioritize
- Look at phased approach to needs of the dam
- For example:
  - Possibly making structural upgrades; and
  - Correcting serious deficiencies from maintenance neglect over the years.
  - Instead of hiring an engineer to perform a hydrologic and hydraulic analysis, which could result in an expensive study and costly modifications, especially if the dam passes more than 50% of the PMF

# What should the Owner do?

- In other cases, the hydrologic and hydraulic study may need to be first if the dam passes only a small percentage of the PMF, or if the spillways are damaged and need to be repaired
- In other words, prepare a plan of action and time line that is reasonable, financially feasible, and produces the safest dam

# What should the Owner do?

- Educate yourselves
- Ask us for assistance if you need help
- Solicit options from engineers when seeking proposals
- Seek out engineers experienced in dam design
- Seek out more than one engineer.  Research the engineering firms

# Owners and EAP Requirements

- If you cannot afford a breach analysis, develop a draft EAP that may be overly conservative
- Have analysis done later
- Ask for assistance from us if you need help

# Engineers

- Texas Board of Professional Engineers rule §137.63.(b)(1):

"endeavor to meet all of the applicable professional practice requirements of federal, state and local statutes, codes, regulations, ordinances or standards in the performance of engineering services."

- **Read and understand our rules**

# Why does an Owner need an Engineer

- Dams are deteriorating due to age and lack of maintenance in some cases
- Downstream development increasing, resulting in change of hazard classification
- Inspections, maintenance, repair, and rehabilitation needed over time
- Engineer needed to evaluate and undertake corrective action

# What can an Engineer Perform?

- Recommend course of action
- Prepare plans and specifications
- Perform hydrologic and hydraulic studies
- Perform inundation mapping
- Assist in selecting a contractor
- Provide construction inspection services

# What Engineer should I hire?

- A professional engineer licensed in Texas
- An engineering firm with an active TBPE Firm Registration number
- An engineer knowledgeable with the TCEQ Dam Safety rules and regulations
- An engineer with experience in the problem area (hydrology, hydraulics, structural, or geotechnical)

# What does an Owner need to do?

- Request references from engineer and contact references to discuss performance
- If possible, look at other projects completed under engineer's design
- Keep in touch with us to verify that the proposed work will meet the rules
- Become knowledgeable in the basics of dam safety and the rules
- Know what you are asking the engineer to do

# What does an Owner need to do?

- Carefully consider the selection of an engineer. It may save you money in the future.
- Request options for addressing the problem

# Sponsors of NRCS Watershed dams

- Water rights
- Fill out maintenance needs surveys when sent by the TSSWCB
- We recognize that SWCDs do not have funds for EAPs.  We can assist with writing EAPs.
- Contact will be made before any inspections

# Other Issues

- 401/404 permits from COE if dam is to be modified
- Aquatic resources transfer

# Probable Maximum Precipitation (PMP) Study for Texas

# PMP Study

- Started August 2014
- Completion August 2016
- Contractor – Applied Weather Associates, Bill Kappel, Project Manager
- Peer Review Committee

# PMP Study Peer Reviewers

- Dr. William Asquith, USGS and Texas Tech
- Dr. John Nielsen-Gammon, State Climatologist and Texas A&M
- George Bomar, Texas Department of Licensing and Regulation and author of *Texas Weather*

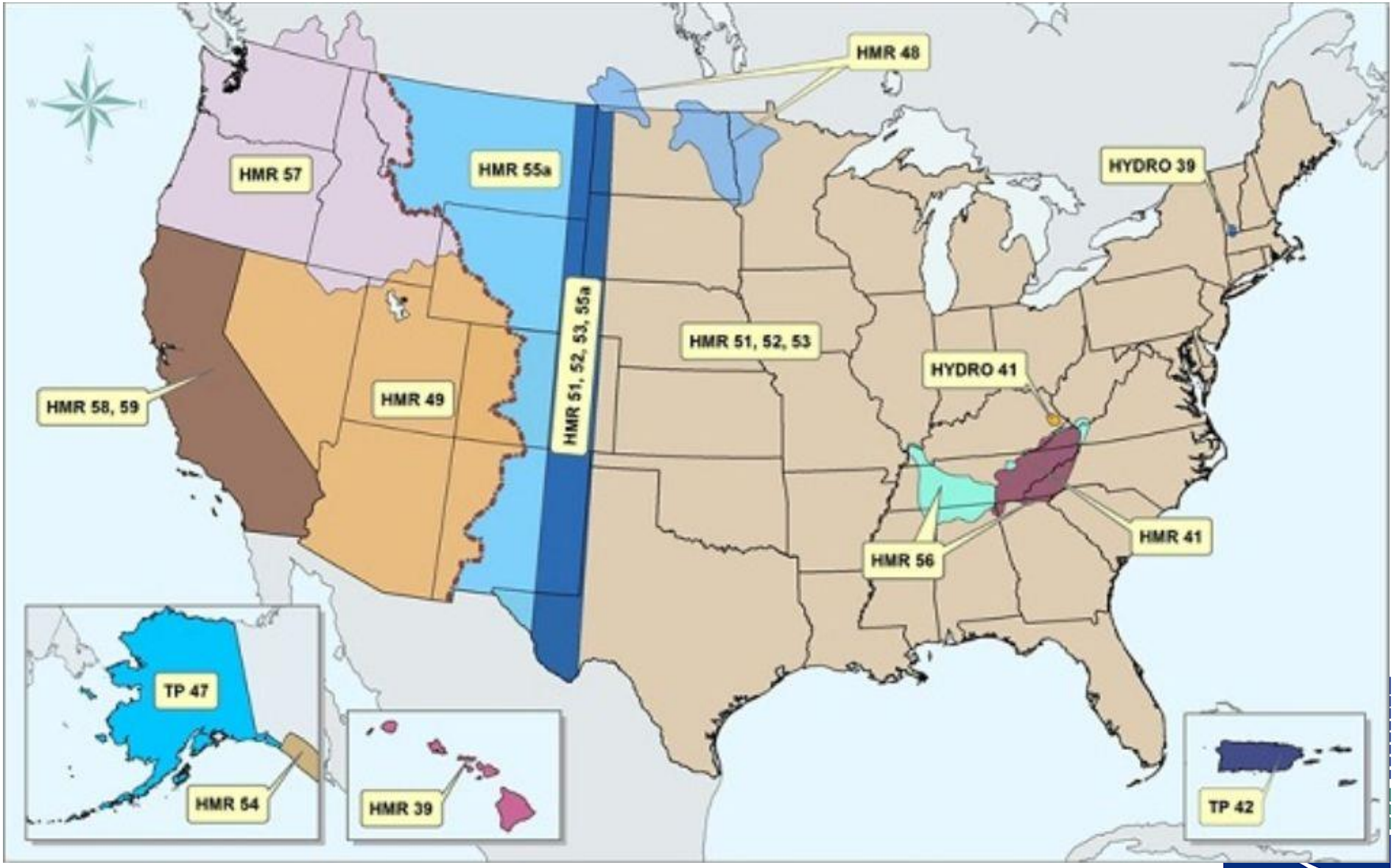
# PMP Study Peer Reviewers

- Todd Marek, P. E., NRCS, Temple
- Simeon Benson, USCOE, Fort Worth
- Charles McWilliams, USCOE, Omaha, Neb.
- Debra Rankin, P. E., TCEQ Dam Safety
- Warren Samuelson, P. E., TCEQ Dam Safety

# Probable Maximum Precipitation (PMP)

- **Definition:** The ***theoretically*** greatest depth of precipitation for a given duration that is ***physically possible*** over a given storm area at a particular ***geographic location*** at a certain time of year (HMR 59, 1999)
  - **T**ypes of PMP studies:
    - **G**eneralized (Hydrometeorological Reports)
      - Provides PMP values for a region
      - HMR 51 - East of the 105th Meridian from Canada to Mexico
    - Regional/Statewide
      - Provide PMP values over regions with varying topography
      - Individual basins are included in the regional/statewide results
    - Site-Specific
      - Provides PMP values for individual drainage basins
      - Considers unique meteorology and topography

# Coverage of HMRs



# How Do Site-Specific, Statewide, Regional PMP Studies Provide Improved PMP Values?

- More storms considered
- New technologies used
- Problems/Unknowns in the HMRs corrected
- Topographic features addressed
- Updated climatologies used

# Method for Computing PMP Values

- Observed extreme rainfall events are used
- Storm based approach
- Identify extreme storms in Texas and regions that are considered transpositionable
- Identify recent extreme storms since publication of the appropriate HMRs
- Review older rainfall data records
- Identify extreme storm types
- Local storms (thunderstorms/Mesoscale Convective Systems (MCS))
- General storms (frontal systems)
- Hurricanes/Tropical Systems

# Method for Computing PMP Values

- Identify unique topography
- Precipitation enhancement/decrease
  - Orographics
- Effects on rainfall center location
  - Physically possible storm centering / orientation
- Review previous procedures
  - Identify inconsistent assumptions
  - Apply new technologies and data
  - Apply new/updated methods

# PMP Study for Texas

## Project Overview

- Comprehensive evaluations of extreme rainfall storm events
  - Extreme rainfall storm identification
  - Storm analyses
  - Storm maximization
  - Storm transpositioning
- Synoptic extreme rainfall (General Storms/ Tropical Storms)
- Thunderstorms and MCS

# PMP Study for Texas

## Background

- PMP values as provided in HMRs are overdue for updating
  - Storm data base grossly out of date (1970s)
  - Procedures used to analyze storms outdated
  - PMP values usually compound conservatism unrealistically
- Provide greater confidence, credibility, and more accurate/reliable values
- Apply updated meteorological understanding and techniques

# PMP Study for Texas

Procedure

- Update the storm database
  - Produce Depth-Area-Duration (DAD) analyses for all major storm events
- Use updated dew point analyses to maximize storms
  - Storm representative & maximum dew points
- Use of state-of-the-science procedures and tools
  - GIS & Orographic Transposition Factor
- Provide PMP values for all locations within Texas
  - All locations considered in this study
  - All durations and area sizes as required
- Utilize PMP Evaluation Tool to produce PMP on a gridded basis (~2.5sqmi grid)

# PMP Study for Texas

Procedure

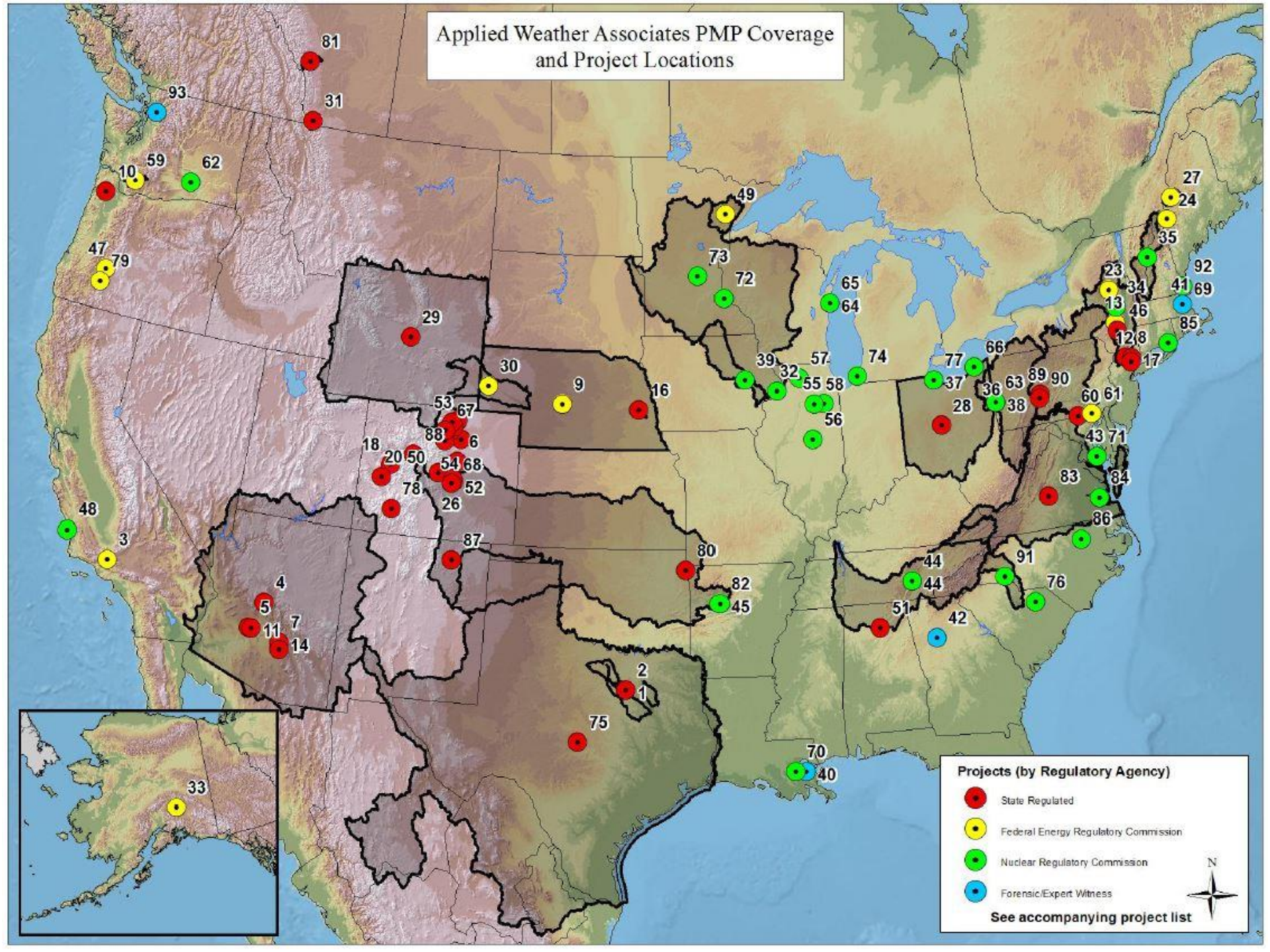
- Follow the basic procedures used in previous AWA studies
  - Nebraska, Arizona, Ohio, Wyoming statewide PMP studies
  - Numerous individual basin PMP studies (Tarrant Regional Water District)
  - Michigan and Wisconsin, Texas regional PMP
- Incorporated storms through 2015
- Used GIS to provide efficient and effective distributions of PMP values across the Texas
- PMP to provide continuity of PMP values across the region in space and time while taking into considerations differences in topography and climate

# PMP Study for Texas

## Task 1

Review of previous studies for applicability

1. AWA PMP studies (e.g Nebraska, Ohio, Arizona, Wyoming, Tarrant, Arkansas Nuclear One, Quad Cities, etc)
2. HMRs 33, 51, 52, 53, etc
3. USACE and USGS storm and flood analyses


Applied Weather Associates PMP Coverage and Project Locations
Projects (by Regulatory Agency)
State Regulated
Federal Energy Regulatory Commission
Nuclear Regulatory Commission
Forensic/Expert Witness
See accompanying project list
N

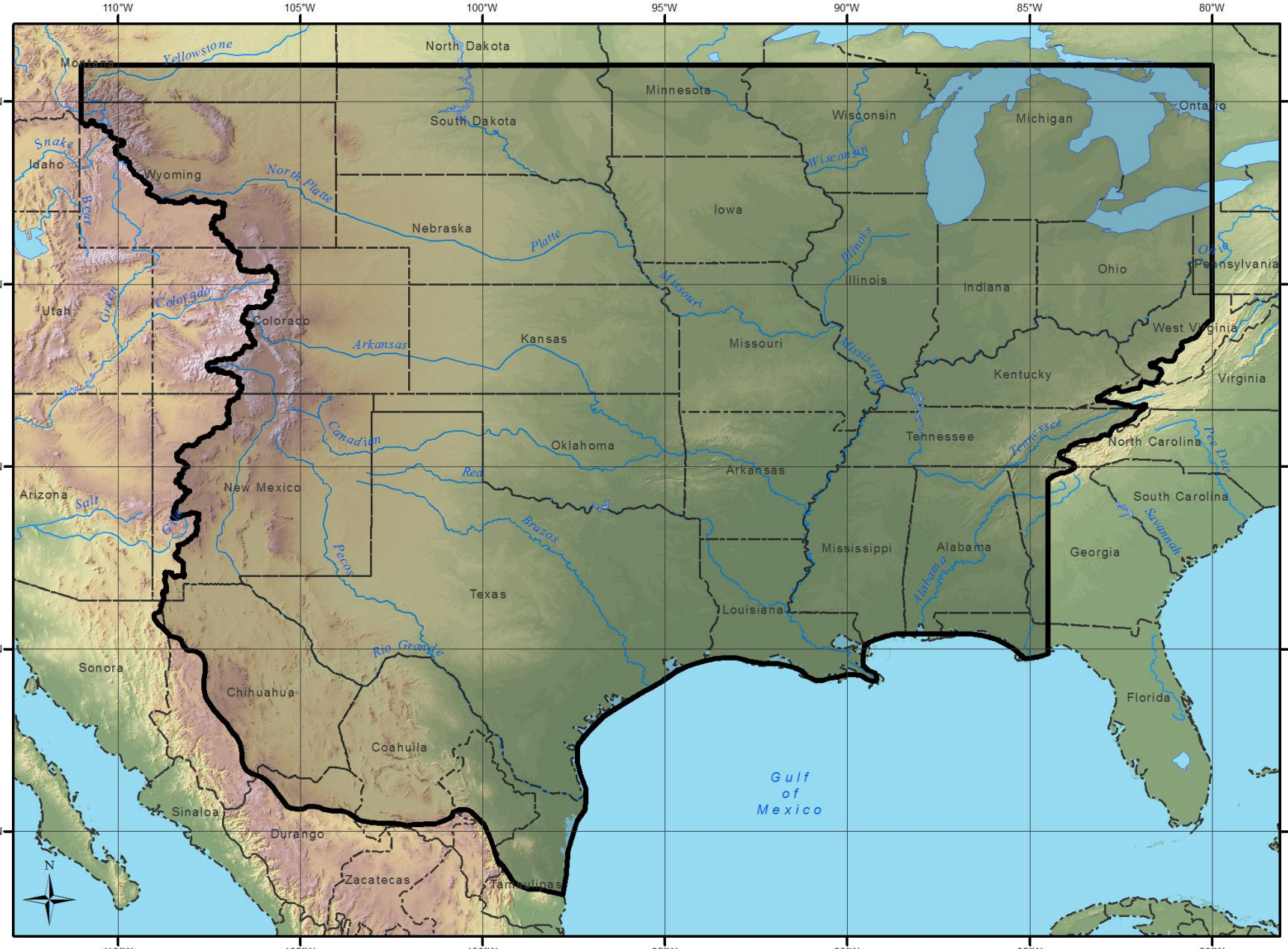
# PMP Study for Texas

Task 2

Storm Search and Short List Development

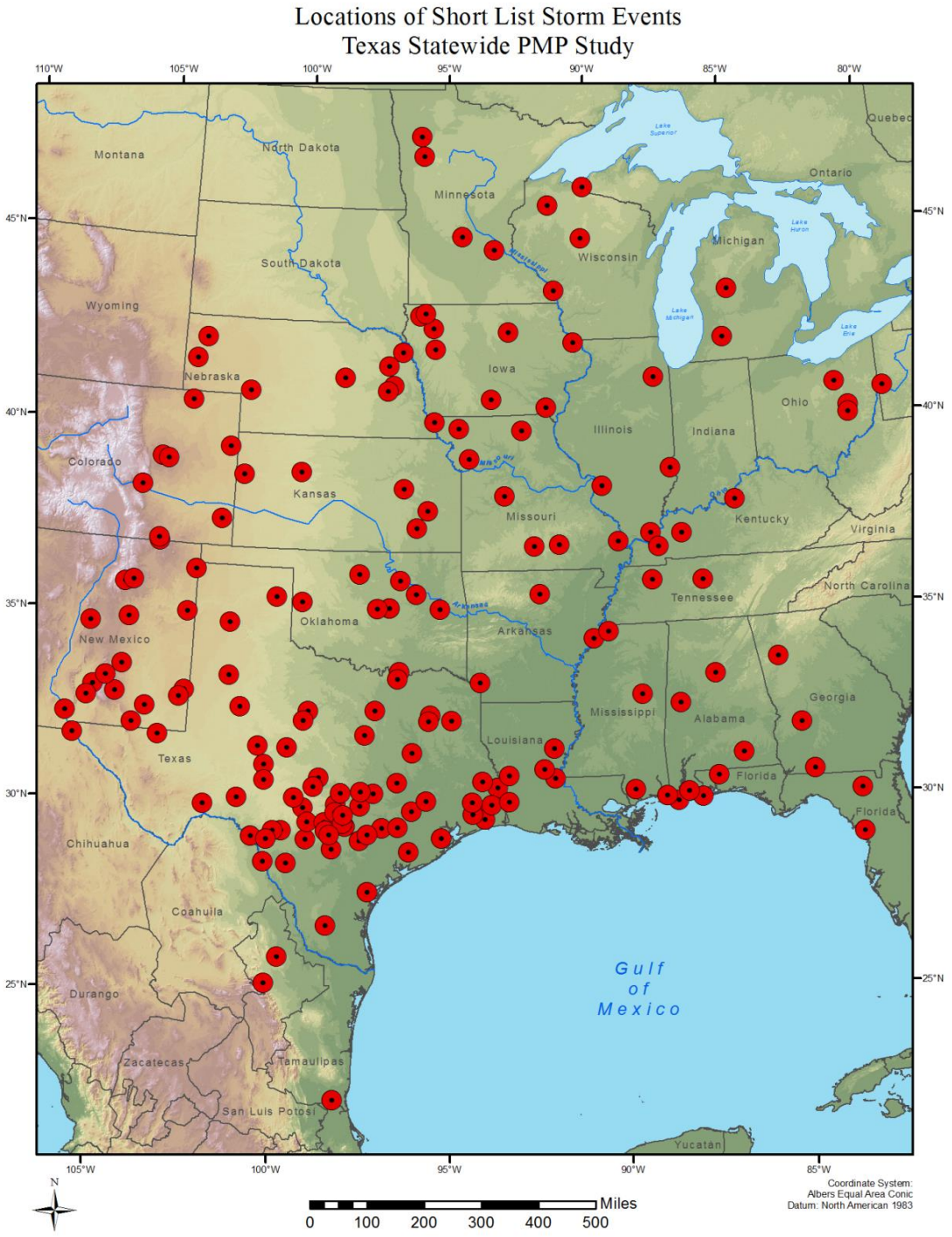
- Complete a storm search to identify the most significant storms that could have occurred over the region where storms are transpositionable to Texas
- Identify storms used in HMRs and other PMP studies
- Identify the most significant flood events that have occurred in region
- Identify extreme rainfall-producing storm types and seasons associated with those storms
- Use the Storm Precipitation Analyses System (SPAS) to analyze extreme rainfall events that have not previously been analyzed
- Use SPAS to reanalyze extreme rainfall events

# Storm Search Domain
# Texas PMP Study




Coordinate System: GCS WGS 1984
Datum: WGS 1984

# Intermediate Storm List- All Storms

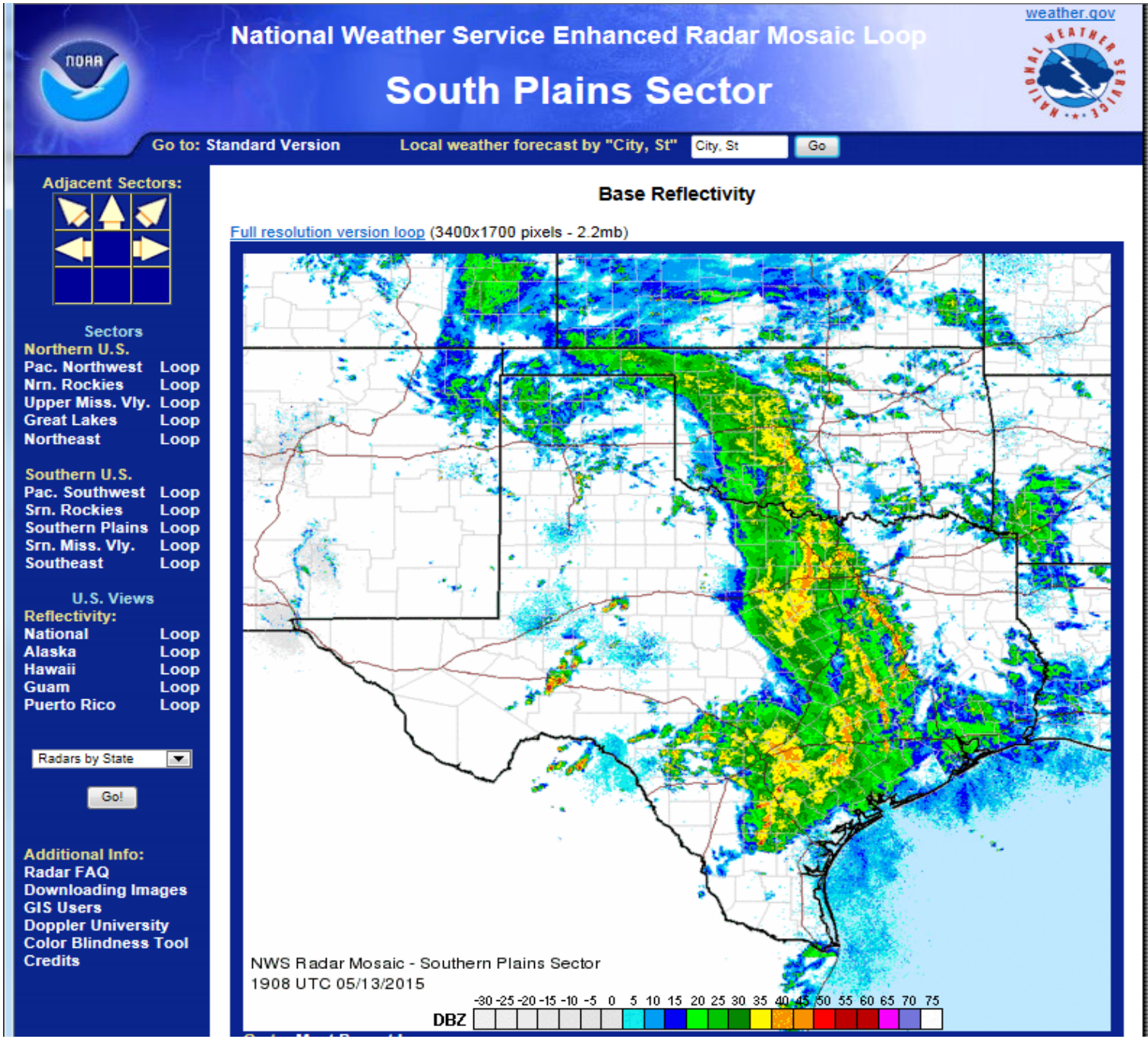


# Example Results

- Alvin storm has been reported to be 43 inches in 24 hours.  From handwritten notes, the storm appears to have been more like 45 inches in 24 hours
- Frontal system in Holt, Missouri resulted in a 12 inch rainfall in 42 minutes

# Recent Examples
# Week of May 4, 2015

- Tahoka coop station – 9.1 inches in 24 hours. The 2nd highest 24 hour rainfall total recorded in this area of the state.
- Weather observer near Coupland – 7.93 inches overnight
- Weather observer near Thrall – 7.90 inches overnight

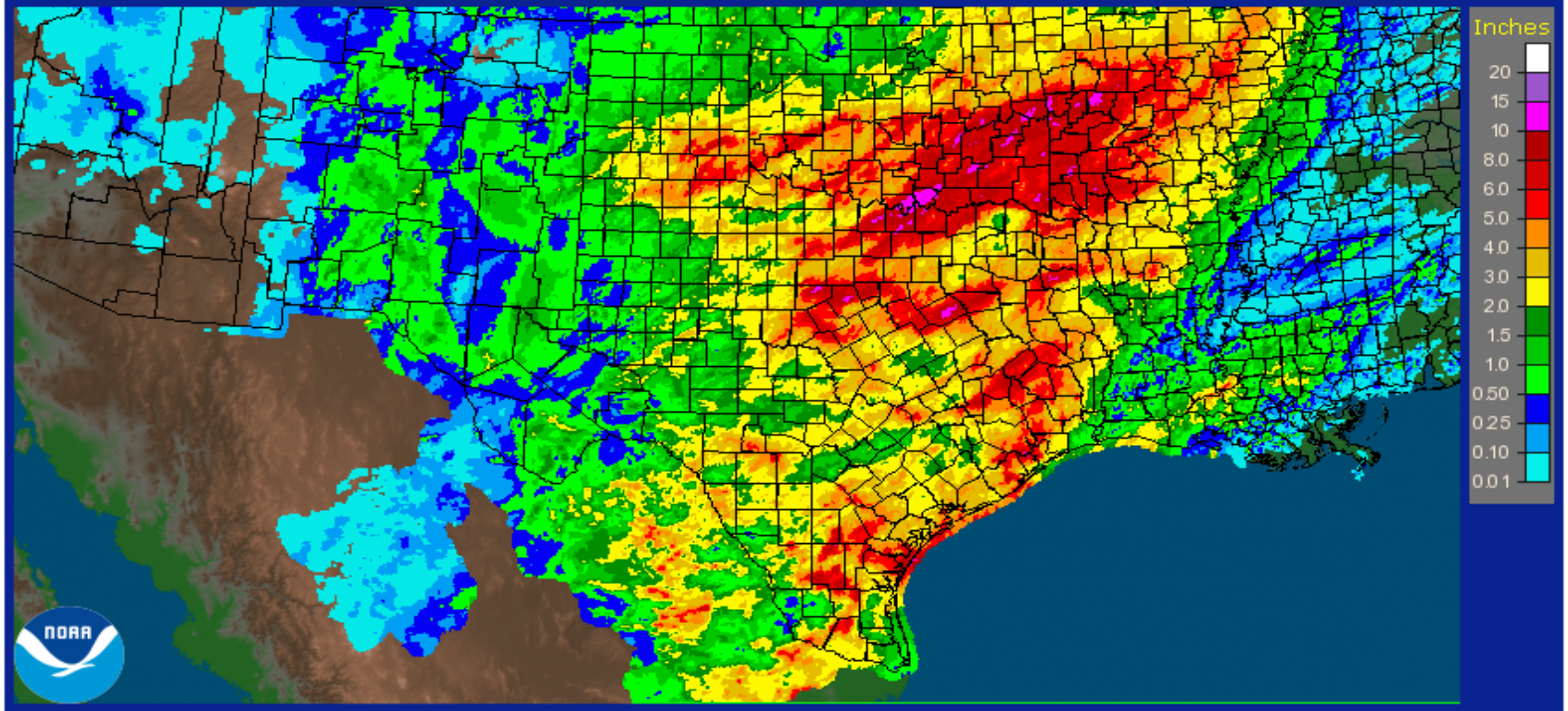

National Weather Service Enhanced Radar Mosaic Loop
South Plains Sector
weather.gov
Go to: Standard Version
Local weather forecast by "City, St"
City, St
Go
Adjacent Sectors:
Sectors
Northern U.S.
Pac. Northwest Loop
Nrn. Rockies Loop
Upper Miss. Vly. Loop
Great Lakes Loop
Northeast Loop
Southern U.S.
Pac. Southwest Loop
Srn. Rockies Loop
Southern Plains Loop
Srn. Miss. Vly. Loop
Southeast Loop
U.S. Views
Reflectivity:
National Loop
Alaska Loop
Hawaii Loop
Guam Loop
Puerto Rico Loop
Radars by State
Go!
Additional Info:
Radar FAQ
Downloading Images
GIS Users
Doppler University
Color Blindness Tool
Credits
Base Reflectivity
Full resolution version loop (3400x1700 pixels - 2.2mb)
NWS Radar Mosaic - Southern Plains Sector
1908 UTC 05/13/2015
DBZ
-30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
National Weather Service • Since 1870

Warnings & Forecasts | Graphical Forecasts | National Maps | Radar | Water | Air Quality | Satellite | Climate

River Observations | River Forecasts | Experimental Long-Range River Flood Risk | Precipitation | River Download | Other Information

Images | Download | About NWS Precip Analysis | Other Useful Information | Survey & Feedback | Regional / RFC Precip Data

**Texas: Current 7-Day Observed Precipitation**
**Valid at 5/14/2015 1200 UTC - Created 5/15/15 0:29 UTC**




☑ Topo ☑ Pcpn Amount ☑ Counties ☐ Rivers ☑ States ☐ Highway/City ☐ RFC Boundary

**1. Timeframe** » **2. Product** » **3. Location** » **4. Units**

- Current Data
- Archive: Month/Year
- Archive: Daily

May 14, 2015 - Today
May 14, 2015 - Last 7 Days
May 14, 2015 - Last 14 Days

- Observed
- Normal
- Departure from Normal

- States
- NWS RFC/Regions
- NWS WFOs

South Carolina
South Dakota
Tennessee

- English
- Metric

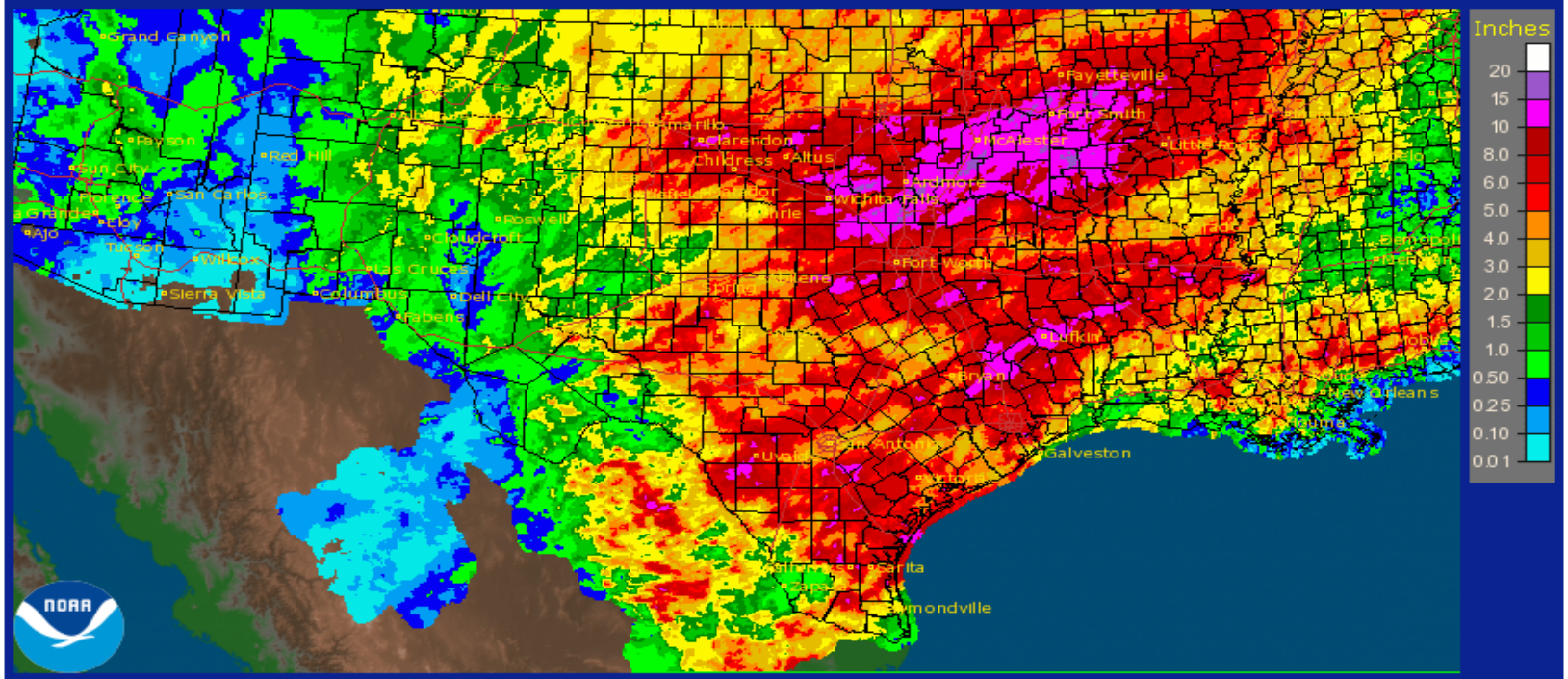
Missing Data

River Observations | River Forecasts | Experimental Long-Range River Flood Risk | Precipitation | River Download | Other Information

Images | Download | About NWS Precip Analysis | Other Useful Information | Survey & Feedback | Regional / RFC Precip Data

**The Precipitation Generation Process is currently running and began at 2015/05/21 15:30.**

**Texas: Current 14-Day Observed Precipitation**
**Valid at 5/21/2015 1200 UTC - Created 5/21/15 14:30 UTC**




Topo | Pcpn Amount | Counties | Rivers | States | Highway/City | RFC Boundary

**1. Timeframe**
- Current Data
- Archive: Month/Year
- Archive: Daily

May 21, 2015 - Today
May 21, 2015 - Last 7 Days
May 21, 2015 - Last 14 Days
May 21, 2015 - Last 30 Days
May 21, 2015 - Last 60 Days

**2. Product**

Observed
Normal
Departure from Normal
Percent of Normal

**3. Location**
- States
- NWS RFC/Regions
- NWS WFOs

Texas
Utah
Vermont
Virginia
Washington

**4. Units**
- English
- Metric

Missing Data

Update URL for Bookmarking | View Yesterday's Analysis | Zoom Out to CONUS

Print/Save Map

# PMP Study for Texas

Task 3

SPAS Storm Analysis

- All storms used for PMP develop analyzed with SPAS
- SPAS produces gridded rainfall analysis and required data sets
- USACE storms will need to be re-analyzed

# PMP Study for Texas

## Task 4

## Storm Maximizations/Transpositioning/Orographics

- Utilize the updated maximum dew point climatology for use in storm maximization and transpositioning
- Maximum average dew point values
  - 6-hour
  - 12-hour
  - 24-hour
- Sea Surface Temperatures (SST) climatology for some events

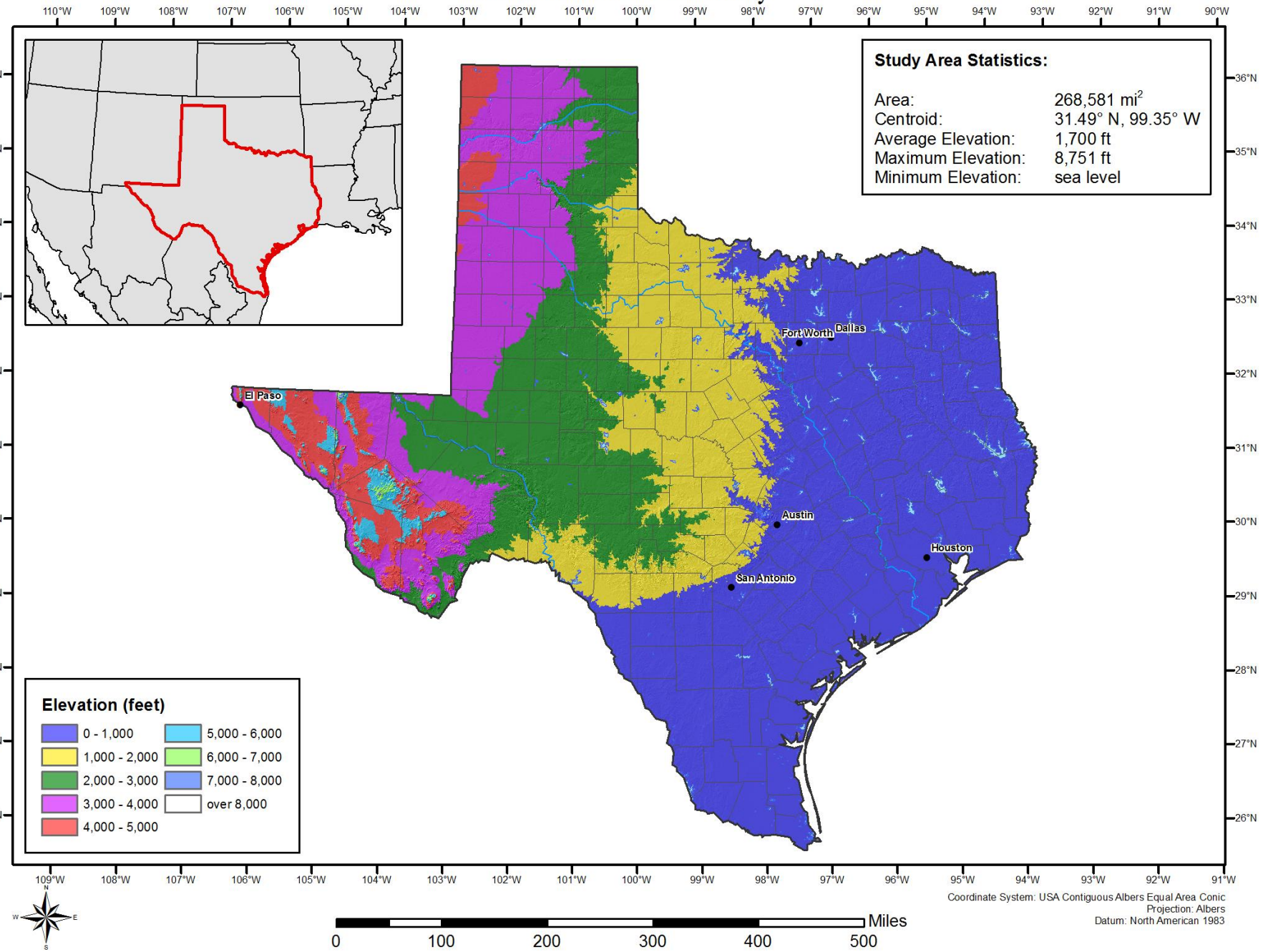
# PMP Study for Texas

## Task 5

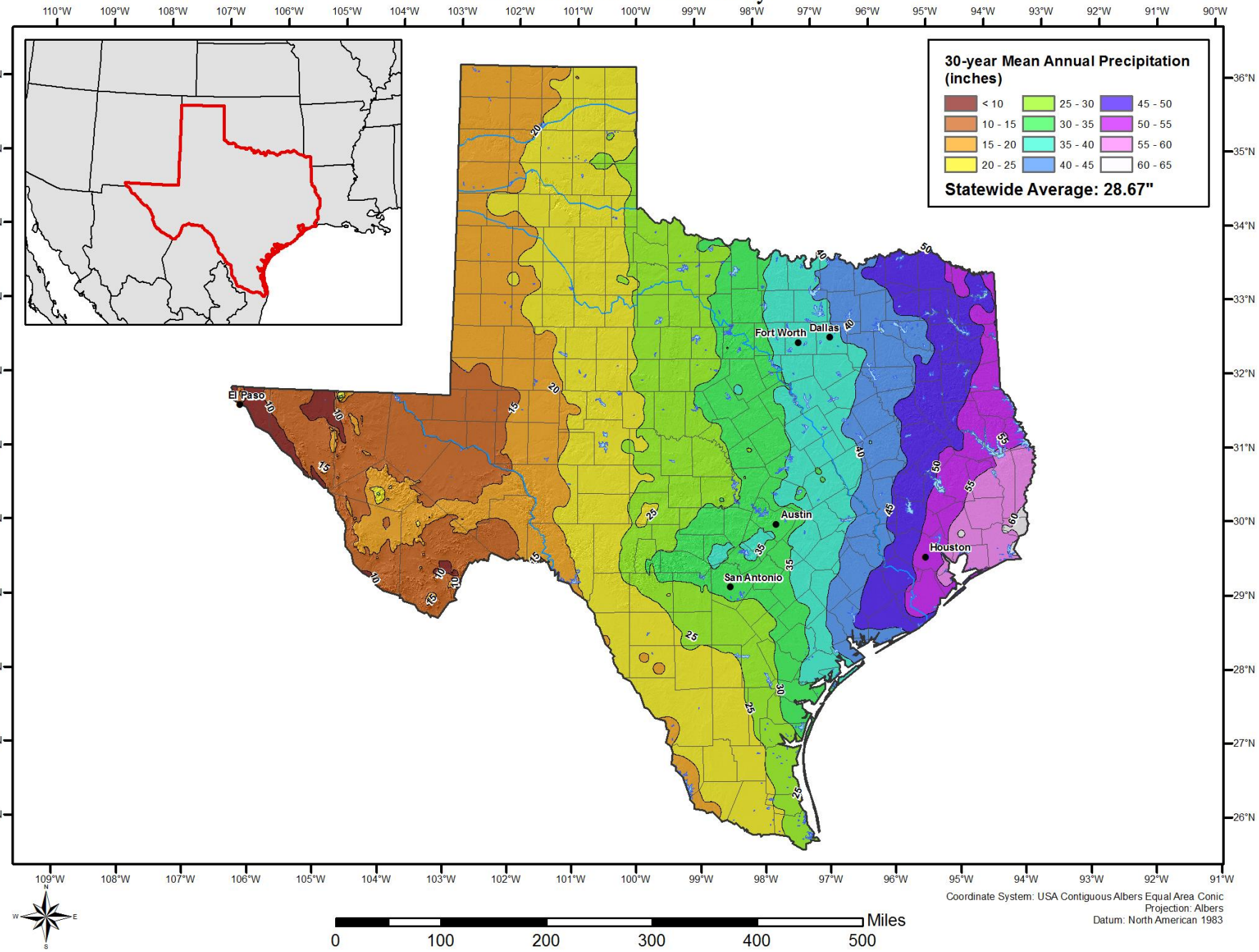
## Orographics and Grid Domain Analysis

- Develop total adjustment factors on a gridded basis
  - 2.5-square miles
  - Utilize storm Depth-Area-Duration data
  - Each storm explicitly transpositioned to each grid as appropriate
  - Allows for differences across state to be quantified
  - Each adjustment known and reproducible

# Elevation Statistics
# Texas Statewide PMP Study



# 30-year Mean Annual Precipitation (1981-2010) in Inches
## Texas Statewide PMP Study



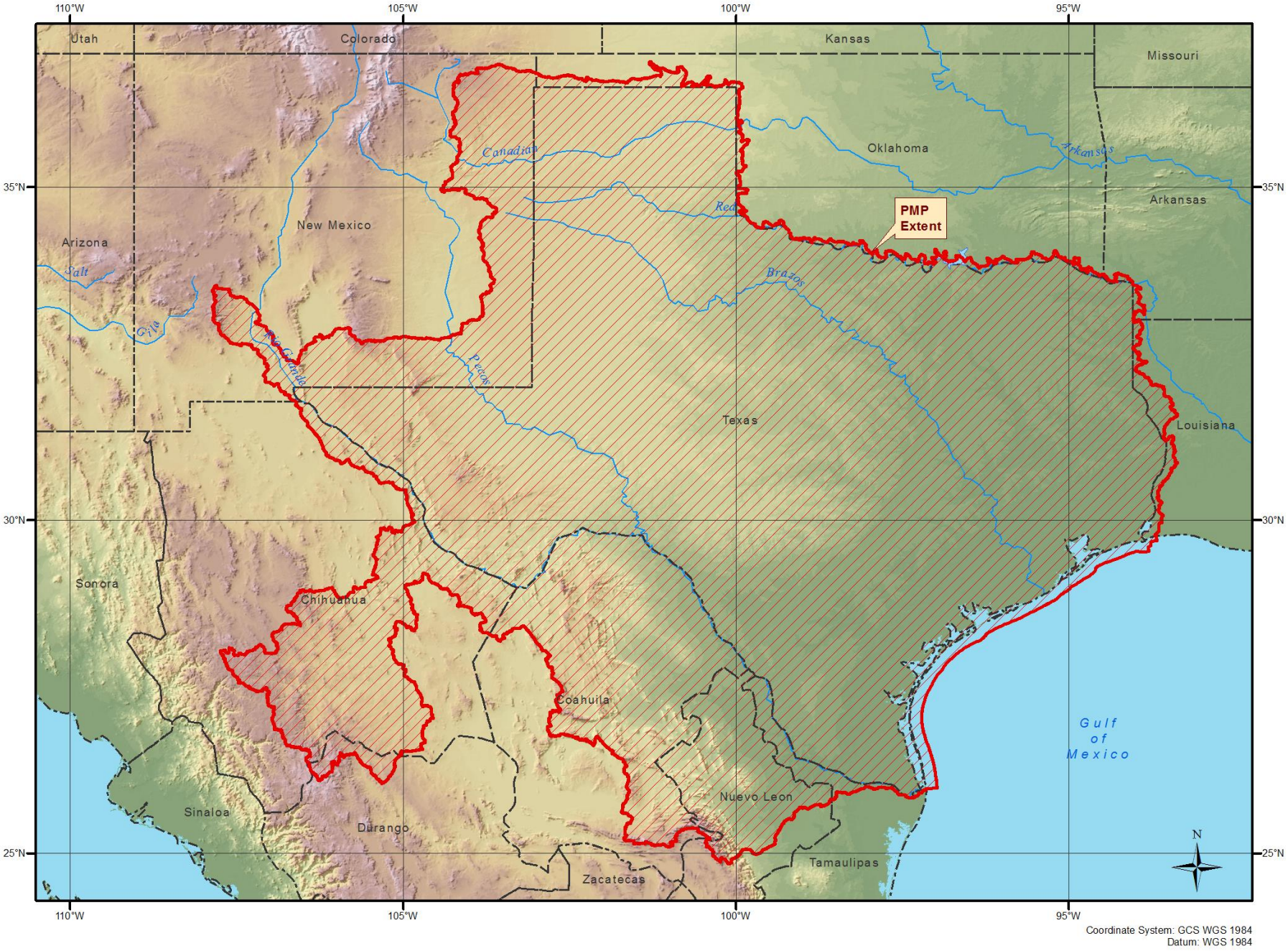
# PMP Study for Texas

## Task 6

## Develop PMP

- Values will be provided on a gridded basis or other format
- Appropriate durations, 1-hr, 6-hr….as needed
  - Not confined to 72-hrs
  - ~2.5mi$^2$
- Analyze the orographic effects of elevated terrain
- Transposition limits for each storm will be determined
  - Use the procedures developed in previous PMP studies
  - Precip frequency data to calculate the Orographic Transposition Factor
    - Corrects stippled region in HMR 51/52

# Proposed PMP Analysis Domain
## Texas PMP Study



# PMP Study for Texas

Task 7

Storm Based Hydrology Application

- Work with users to provide PMP rainfall information as needed
- Updated temporal distributions
- Other rainfall characteristics

# PMP Study for Texas

## Task 8

## Quality Control and Sensitivity

- Compare results
    - HMR PMP values
    - NOAA Atlas 14 precip frequency data
- Discuss sensitivity of various parameters and assumptions on the final PMP values

# PMP Study for Texas

## Task 9

## Final Report

- A Draft final report will be submitted for review by the Peer Review Committee
- Review comments will be incorporated into a comprehensive final report as appropriate
- An  appendix will be provided with all storm details and calculations used to determine the PMP values throughout Texas
- Maps of PMP values will be provided both in the report as well as in GIS format

# PMP Study for Texas

## Task 10

### Review Meetings

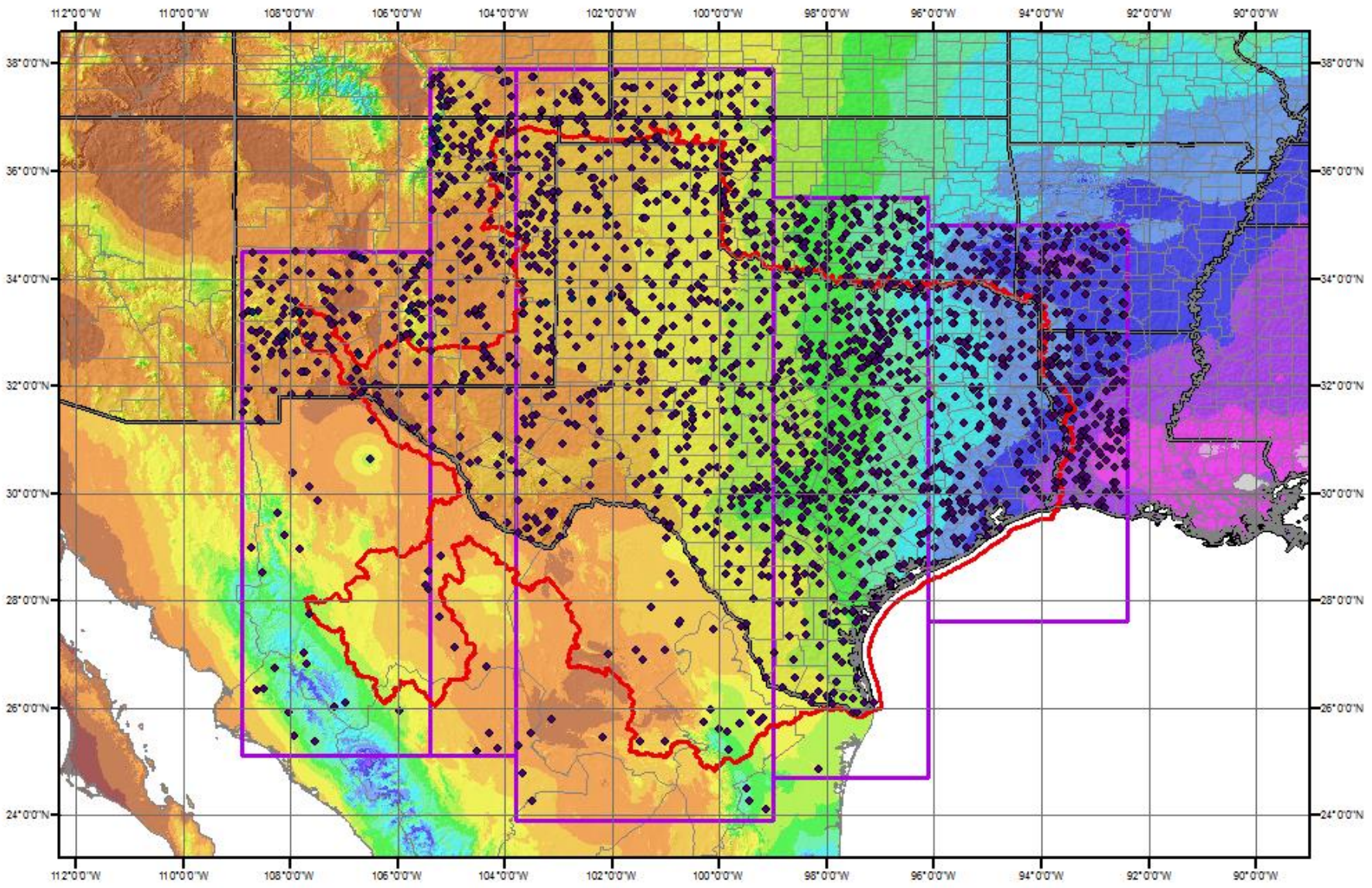
- Meetings will be held with the peer Review committee to present and review the approach and procedures to be used as well as work completed
- Two have been held to date
- Additional data has been provided by the committee members

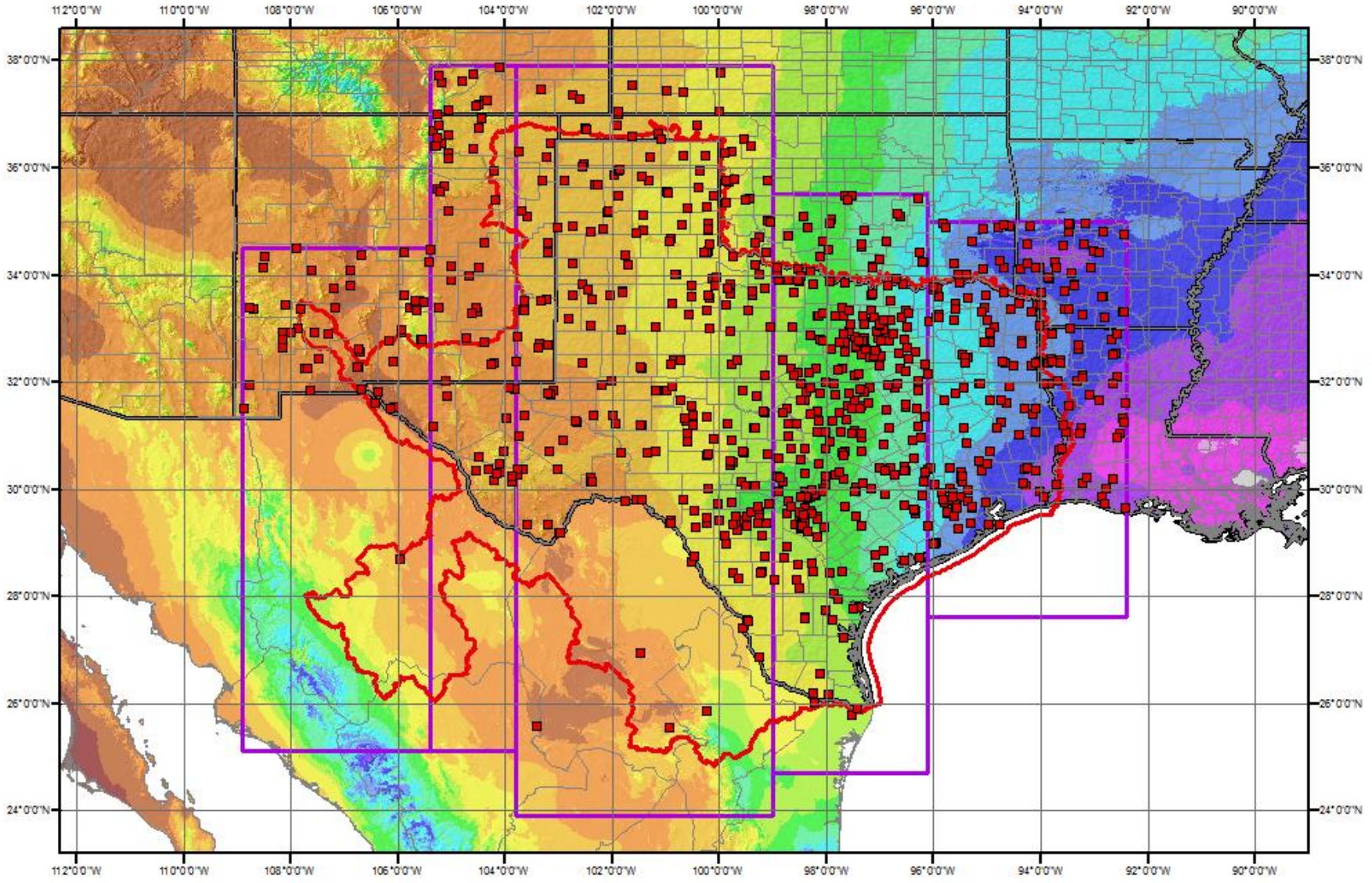
# PMP Study for Texas

Task 11

Updated Precip Frequency

- Build from extensive previous work
  - Dr. William Asquith's publications
  - Southern Regional Climate Center
- Follow same methodology as NOAA Atlas 14
- 6hr and 24hr data used for PMP calculations


112°0'0"W
110°0'0"W
108°0'0"W
106°0'0"W
104°0'0"W
102°0'0"W
100°0'0"W
98°0'0"W
96°0'0"W
94°0'0"W
92°0'0"W
90°0'0"W
38°0'0"N
36°0'0"N
34°0'0"N
32°0'0"N
30°0'0"N
28°0'0"N
26°0'0"N
24°0'0"N
Mean Annual Precipitation (inches) (source: USDA)
2 - 5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 45
46 - 50
51 - 55
56 - 60
61 - 65
66 - 70
71 - 270
Stations
Daily
AMS Extraction Zones


112°0'0"W
110°0'0"W
108°0'0"W
106°0'0"W
104°0'0"W
102°0'0"W
100°0'0"W
98°0'0"W
96°0'0"W
94°0'0"W
92°0'0"W
90°0'0"W
38°0'0"N
36°0'0"N
34°0'0"N
32°0'0"N
30°0'0"N
28°0'0"N
26°0'0"N
24°0'0"N
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46 - 50
51 - 55
56 - 60
61 - 65
66 - 70
71 - 270
Stations
Hourly
AMS Extraction Zones

# Dam Failures

# Dam Failures

- May, 2014.  Spillway failure.  Dam was not breached.
- August 2014.  Dam failed during a significant rainfall event
- May 10, 2015.  Dam overtopped and damaged.  Dam did not breach.
- May 25, 2015.  Dam overtopped and completely failed.

# Dam Safety Reports

# Reports

- If there are errors in the report, please let us know so we can correct the report and remove the incorrect report from the public file

# Reports

- There have been delays in sending the reports
- We apologize for this delay
- There are several factors causing the delays
- We are working to correct this issue

# Reports

- We are attempting to provide you with a complete and professional engineering report
- If our delays are causing you budget or other problems, let me know so I can try to address the issue

# Reports

- You are important
- Our desire is to help you protect your dam
- It may cost you dollars as a result of our inspection; however, it is for your benefit

# Questions