Filling the Gap: Building the Upper Red River Period of Record Model
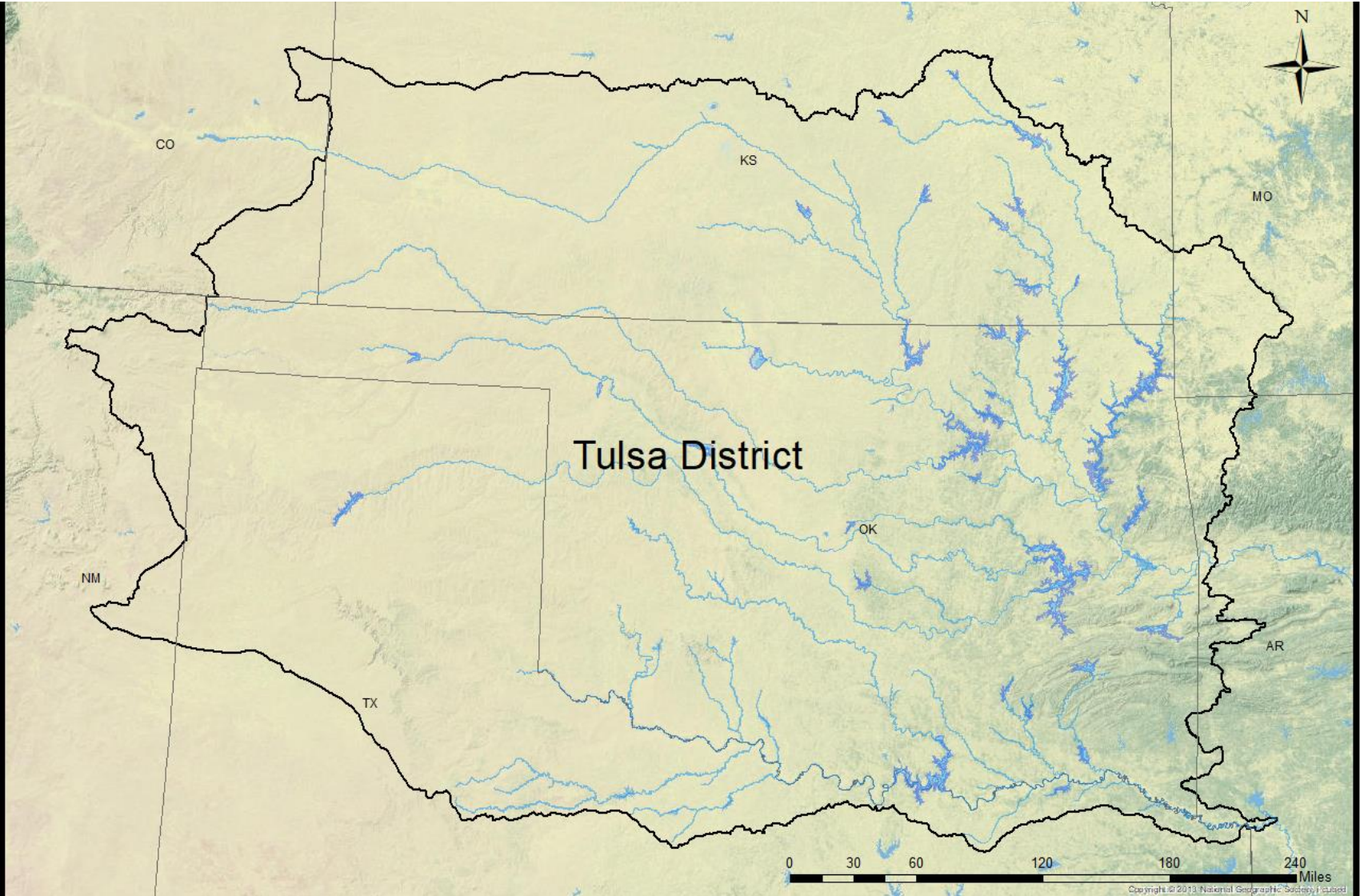
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5 February 2025
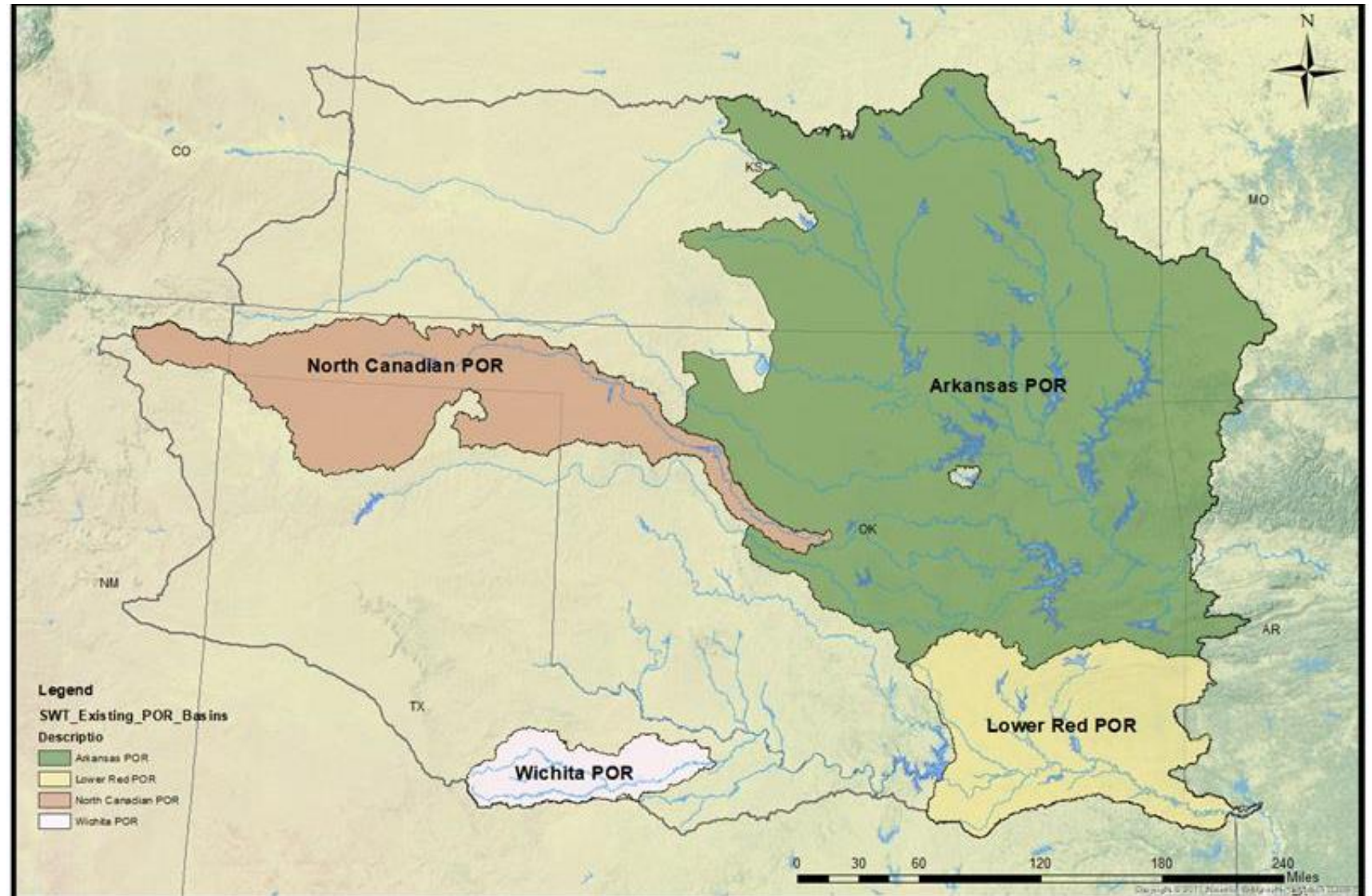
US Army Corps of Engineers ®
Tulsa District

Tulsa District

Current Areas with Period of Record Modeling
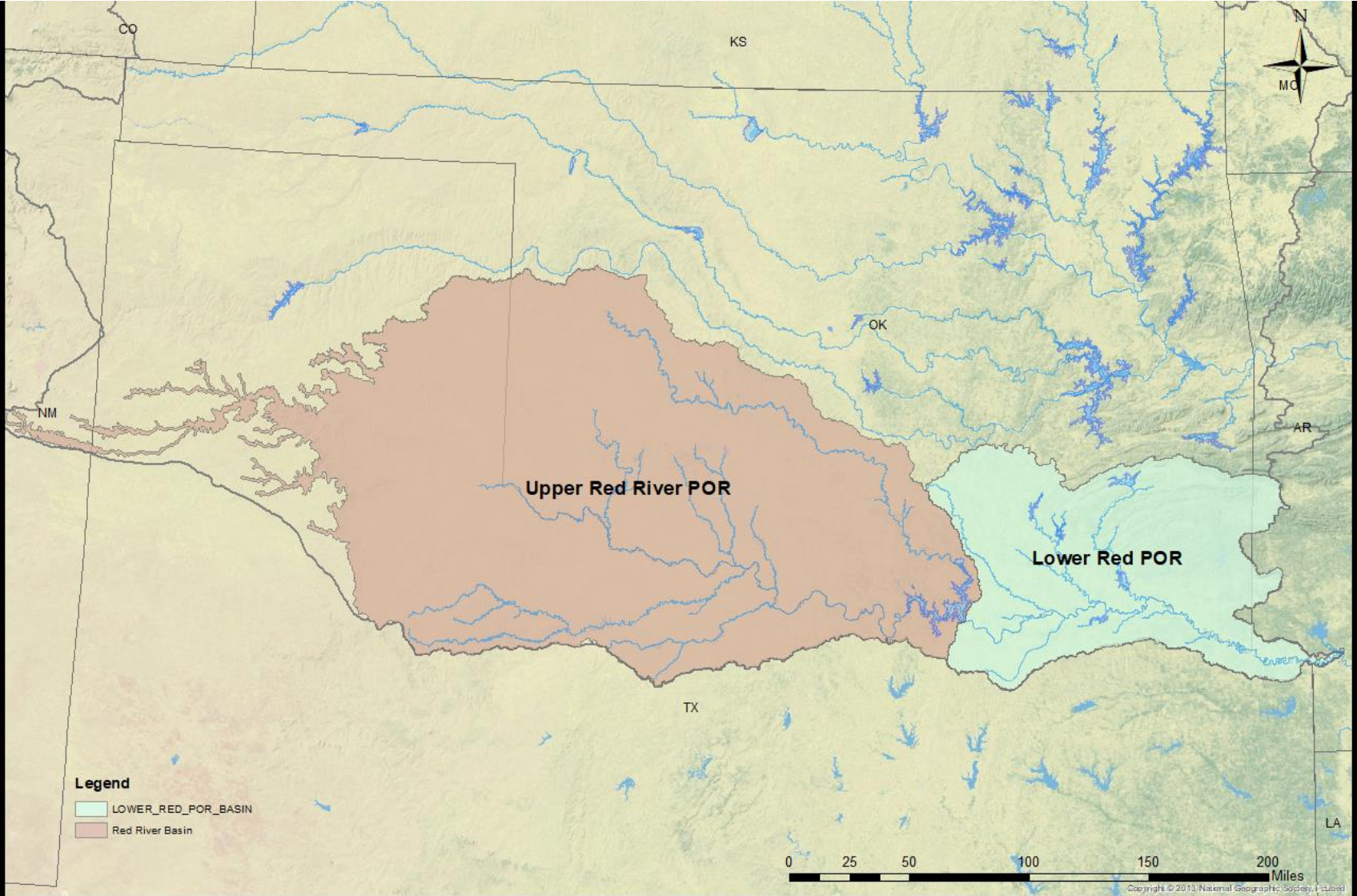

Legend

SWT_Existing_POR_Basins

Descriptio

- Arkansas POR
- Lower Red POR
- North Canadian POR
- Wichita POR

North Canadian POR

Arkansas POR

Lower Red POR

Wichita POR

Red River

Current and Planned Modeling Areas

Current Period of Record Modeling in Tulsa District

Arkansas River (1940-2024)

North Canadian River (1939-2016)

Lower Red River (1938-2019)

Wichita River (1924-2002)

Period of Record (PoR) modeling in USACE Tulsa District

Model watershed for the time period including pre and post construction of projects.

Use observed data where possible and fill missing data with best approximated methods.

Be able to model entire time period based on current status of watershed. (Using current EAC, operating rules, water users, project conditions) This is the regulated state of the model.

Re-run the system with all reservoirs "turned off" to pass inflows. This is the unregulated state of the model.

Check data sets against previous modeling to confirm results.

Use output data for various studies (Dam Safety, Planning, Reallocations, Water Accounting, etc), water control manual updates, outside data requests.

Steps for model building

- Gather Data
  - Decide what gages to include and build entire time-series with observed and any calculated hydrology needed to buildout the datasets.
  - Gather all data for reservoirs post-construction for observed data and use any pre-existing gages or design data to fill in the pre-construction data.

- Create Routing
  - Once we have gages and reservoir locations decided we can then create the routing between points.
  - We are using existing routing reaches from other calibrated models to simplify the process. Mainly these are from our CWMS real-time models.
  - Need to create step response routing for reservoirs and control points for routing releases.

- Model Build Out
  - Need to build model(s) that can calculate the incremental locals for all non-headwater points and to run the regulated/unregulated PoR runs
  - Implement rules for reservoir operations based on the SWT Modeling Techniques.

- Model Verification
  - Check model output at each step to verify routing and reservoir performance is within observable constraints.

Upper Red River Model Build-Out

- Breakout the modeled area by balancing gage locations with best full period data, able to provide enough detail for all reservoirs to run according to their operating rules, and without making the model unnecessarily complicated with extra gages, confluences, etc.

- 8 Reservoirs
  - 7 Headwater (Altus, Arbuckle, Foss, Ft Cobb, Kemp, Tom Steed, and Waurika)
  - 1 Tandem (Denison)

- 17 Stream Gages
 - 6 Headwater
  - 11 Downstream

Filling Data Gaps – Calculated Hydrology.

- Reservoirs – (inflows, outflows, evaporation rates during pre-impoundment times for the reservoirs)
  - Inflows
    - Use the monthly average acre-feet design values from the Water Control Manual or design documents.
    - For daily distribution, use nearby gages with data available during desired time periods.
  - Evaporation Rates
    - Use the monthly average of existing evaporation data to fill in during pre-impoundment
  - Outflows
    - Use HEC-ResSim models, with calculated inflows and evaporation rates to estimate what outflows would have been pre-impoundment.

Filling Data Gaps – Calculated Hydrology.

- Gage Sites – (flows)
  - Drainage Area Reduction (DAR)
    - If reasonable, DARs will be used to estimate data for missing time periods
  - Routing model
    - If DAR method is not applicable, an HMS model has been built to estimate flow peak and timing.

Current Routing Model
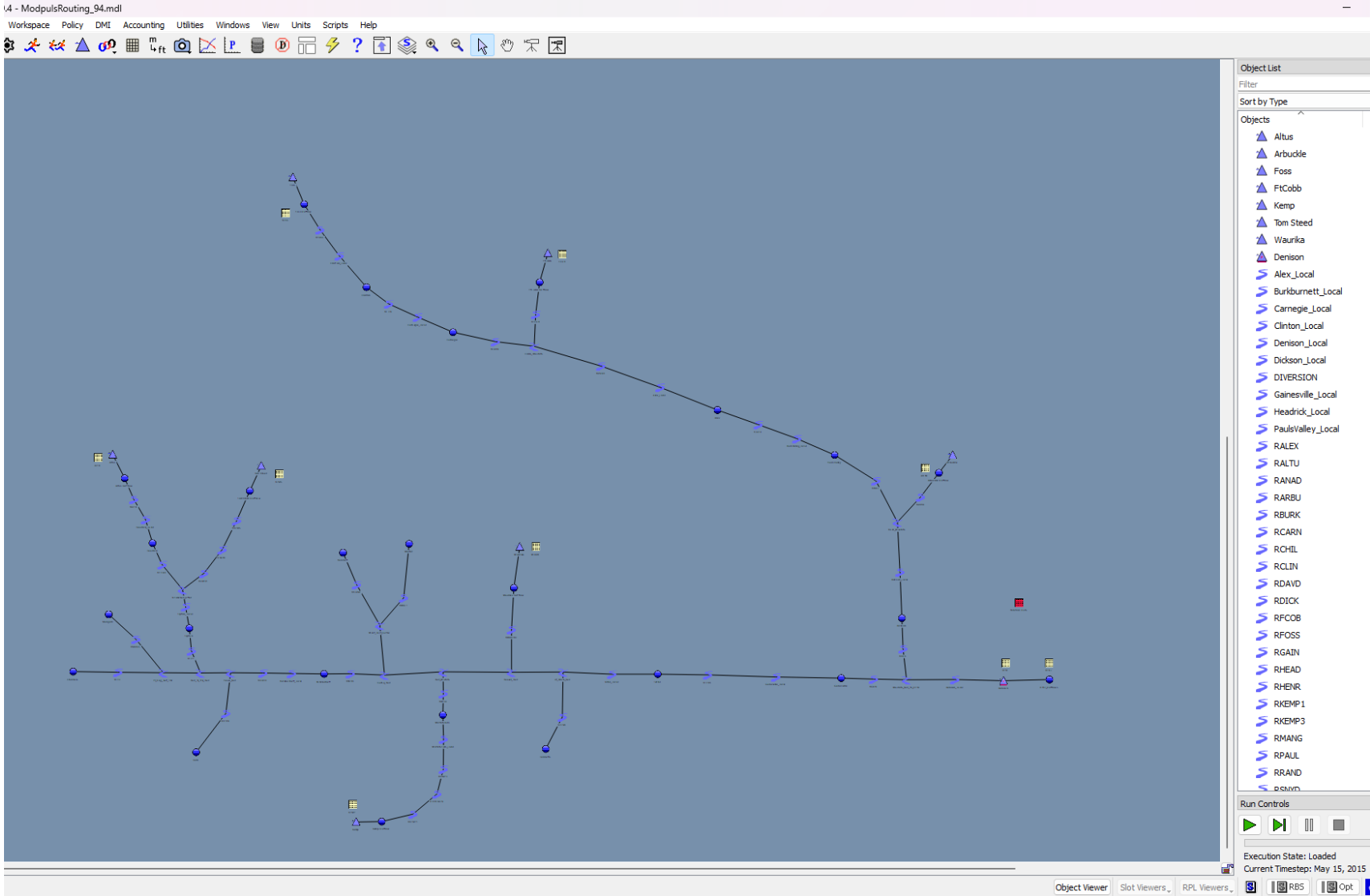
Future Project Goals

- Once we have a working Upper Red model our goal is to update routing in the Lower Red model and merge the two.

- We have funding from the State of Oklahoma to help the Water Resources Board in filling any other gaps in our PoR modeling statewide.

2015 Red River Flood at Lake Texoma with flow over emergency spillway.

Image from texomaconnect.com

Questions?