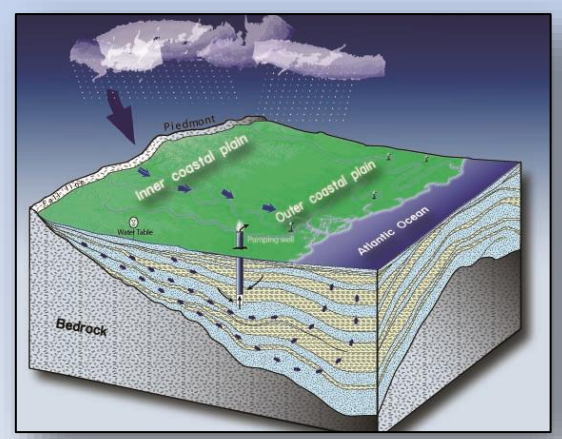
Simulation of Groundwater Flow in the Edisto River Basin, South Carolina

Greg Cherry and Matt Petkewich

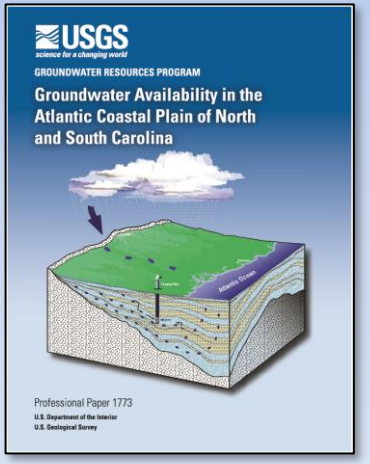
US Geological Survey – South Atlantic Water Science Center



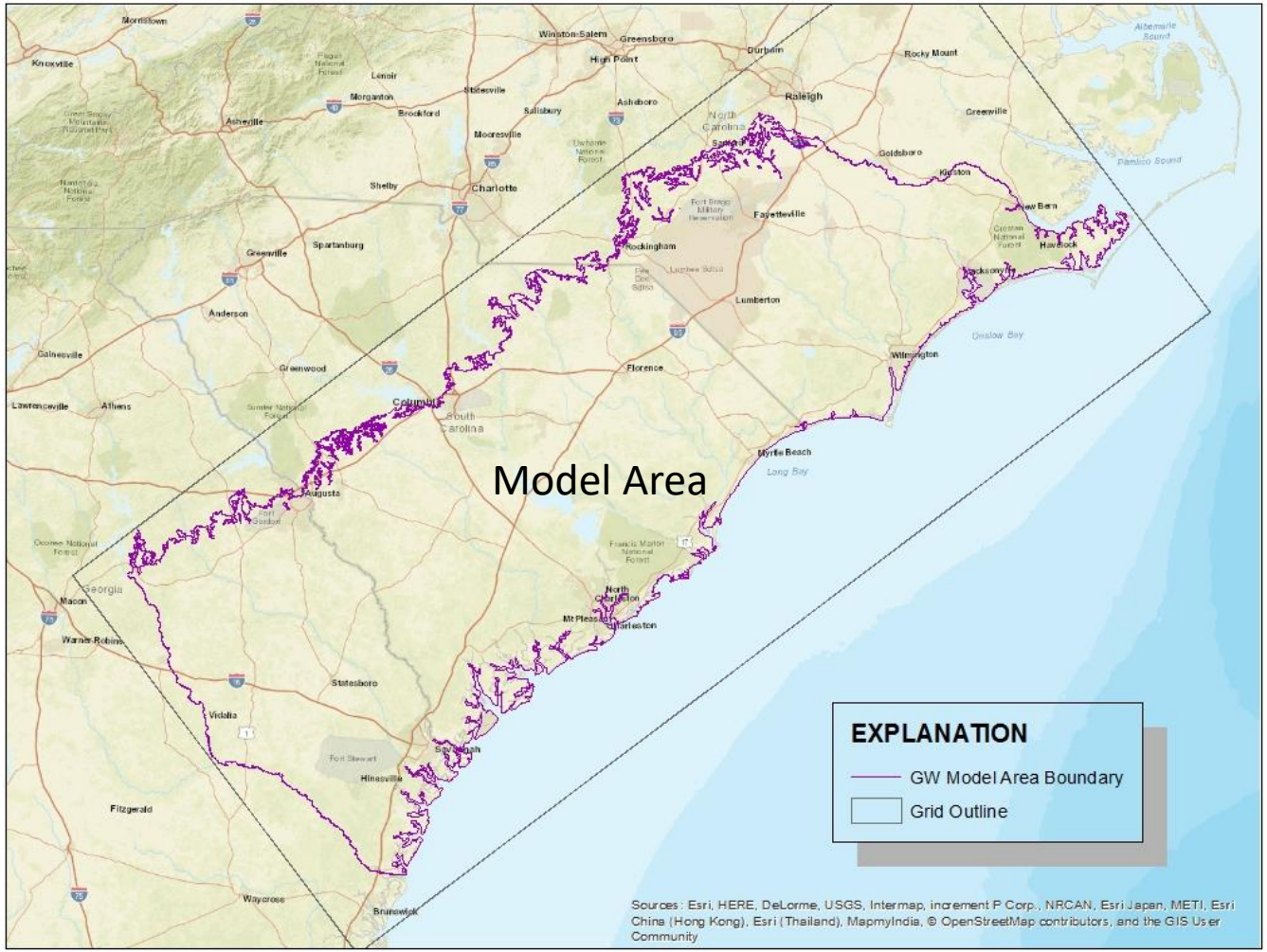
U.S. Department of the Interior
U.S. Geological Survey

USGS
science for a changing world

Groundwater Model Area



U.S. Department of the Interior
U.S. Geological Survey

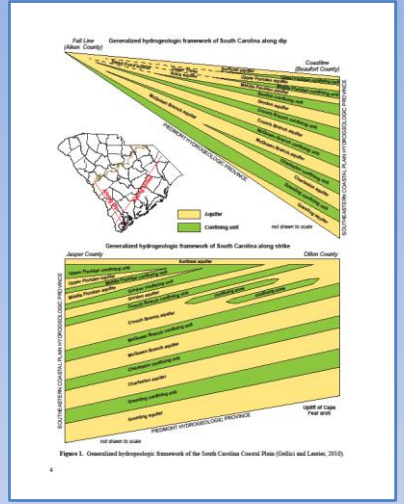


USGS
science for a changing world

Objectives

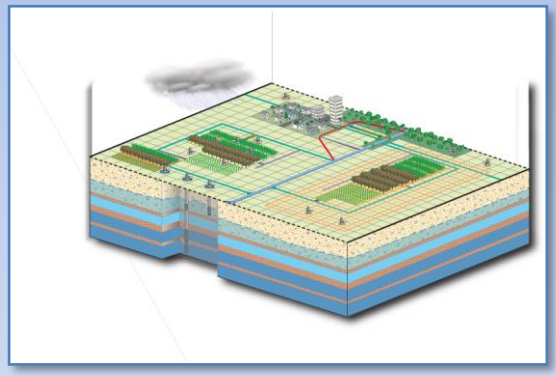
- Overall update the 2015 groundwater flow model
- Add recent groundwater use data (2016-2020)
- Include recharge from SWB Model (2016-2020)
- Apply the updated model to a series of scenarios

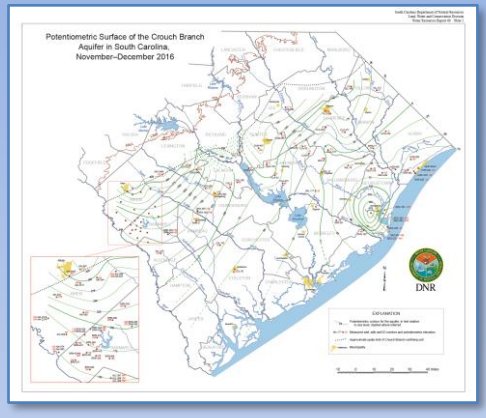
New GW Water-Use Data



Framework

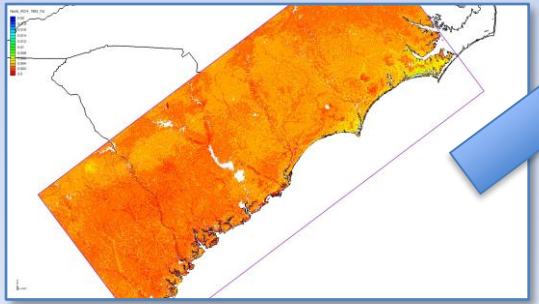
Groundwater Model





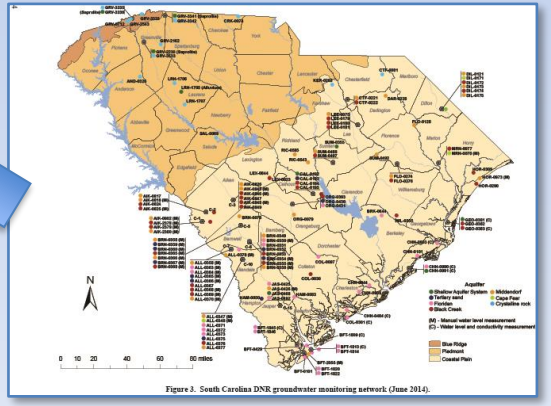
Potentiometric Maps

Recharge Model



U.S. Department of the Interior
U.S. Geological Survey

Groundwater Levels



Modifications to Original Model

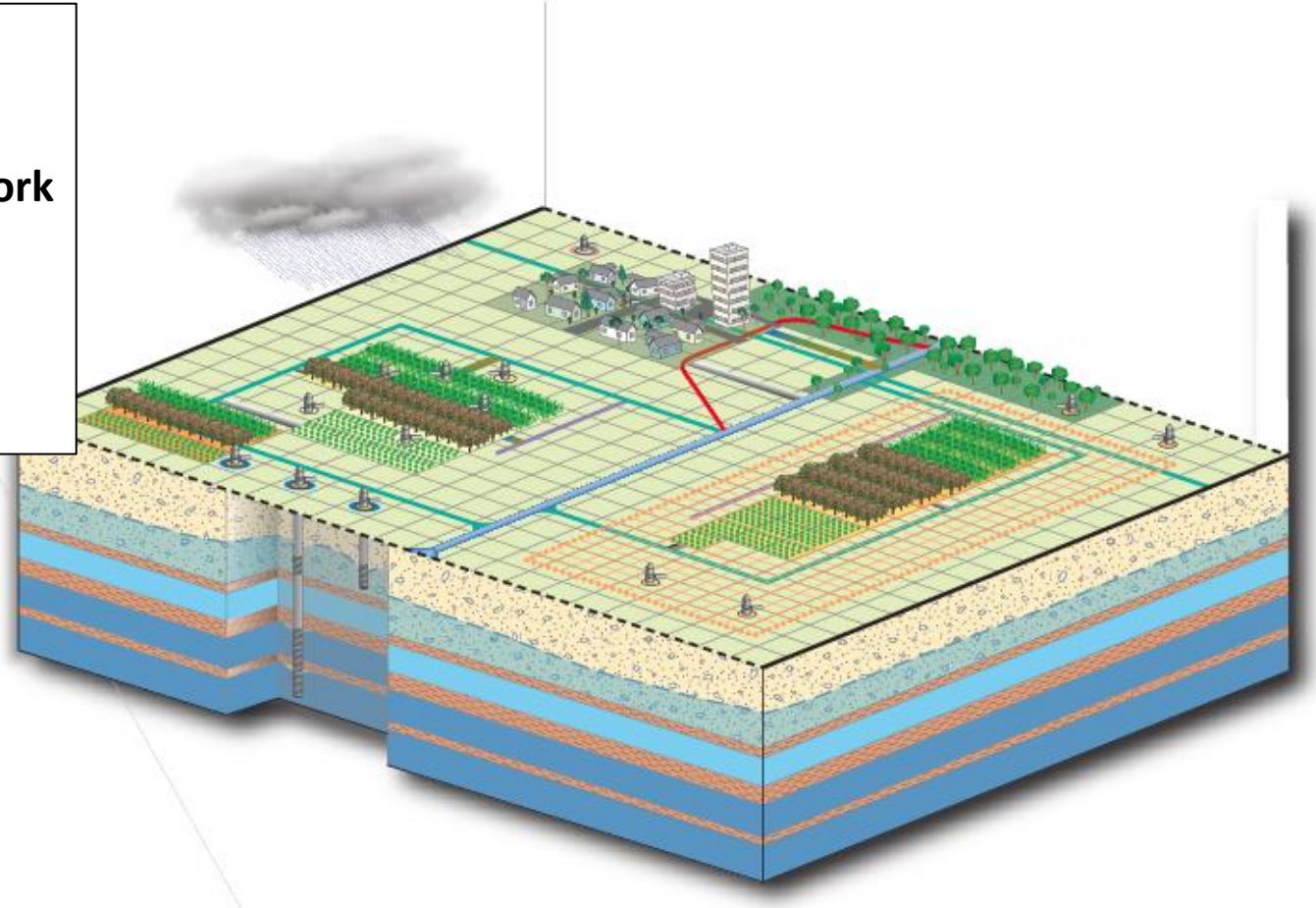
- Well and water-use data from SCDHEC database
  - 1900 – 2015 (original model)
  - 2016-2020 (updated well and water use)
- Recharge rates from Soil Water Balance model (2016 – 2020)

Primary inputs:

- Model Grid
- Hydrogeologic Framework
- Aquifer Properties
- Observation Data
- Boundaries
- Wells – Water Use Data

Primary Outputs:

- Groundwater Levels
- Budgets



Representative GW Flow Model

U.S. Department of the Interior
U.S. Geological Survey

USGS
science for a changing world

Groundwater Simulations

Predevelopment Conditions

Remove withdrawals and simulate levels prior to GW development

- Recharge rates from SWB model
- Focused on Edisto Basin

Current Groundwater Conditions

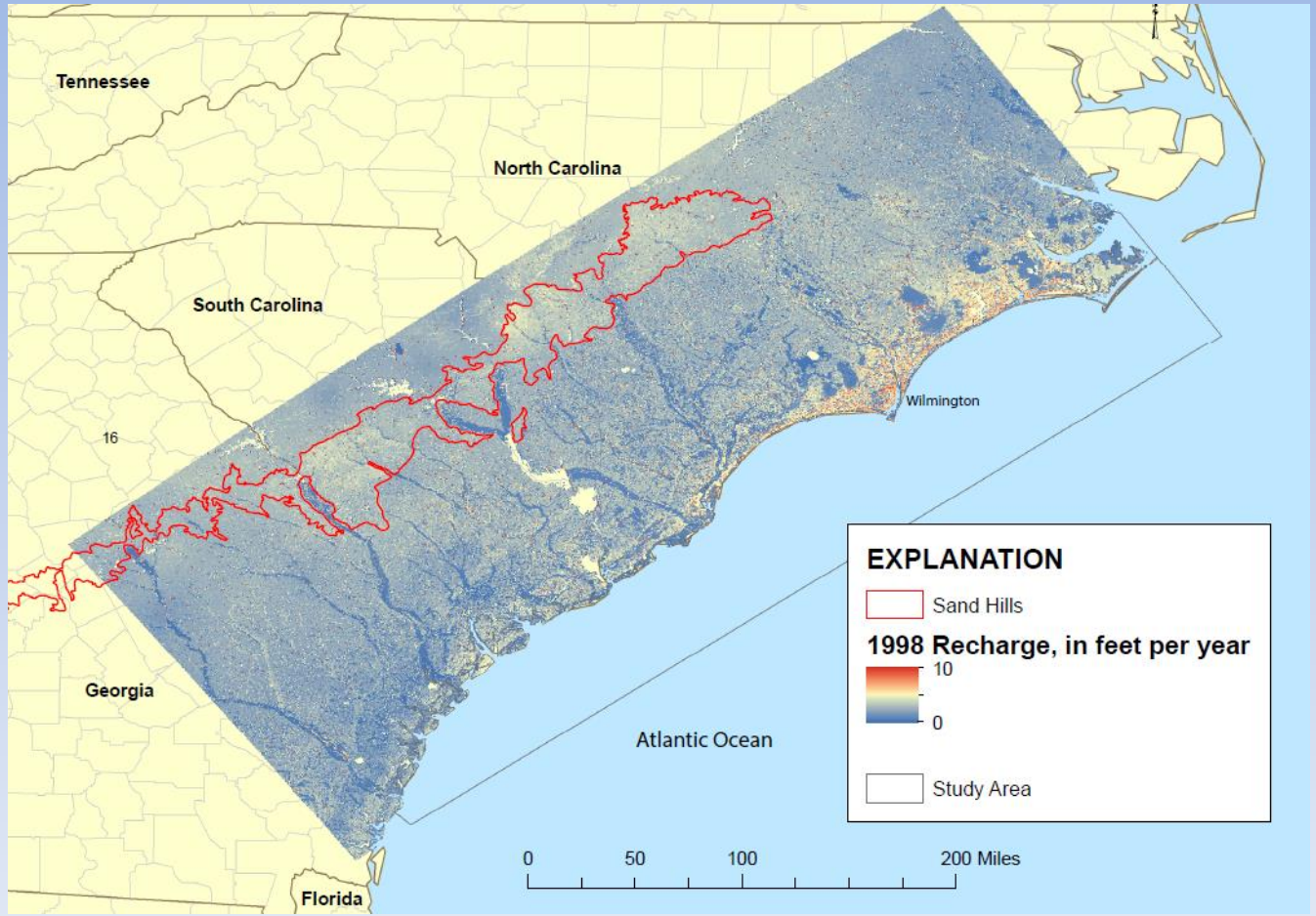
- Simulated current groundwater conditions from 1900-2020

USGS
science for a changing world

Groundwater Flow Model Limitations

- Based on limited data
- Simplification of the actual groundwater flow system
- Can limit the ability of the model to predict actual hydraulic conditions over time
- Accuracy and prediction capabilities of this model are affected by the finite-difference discretization, boundary conditions, hydraulic properties, and observations used in the model calibration
- Groundwater withdrawals simulated in the model underrepresent actual historical water use because pumping rates less than 3 million gallons per month are not required to be reported to the State agencies and, therefore, are unknown.

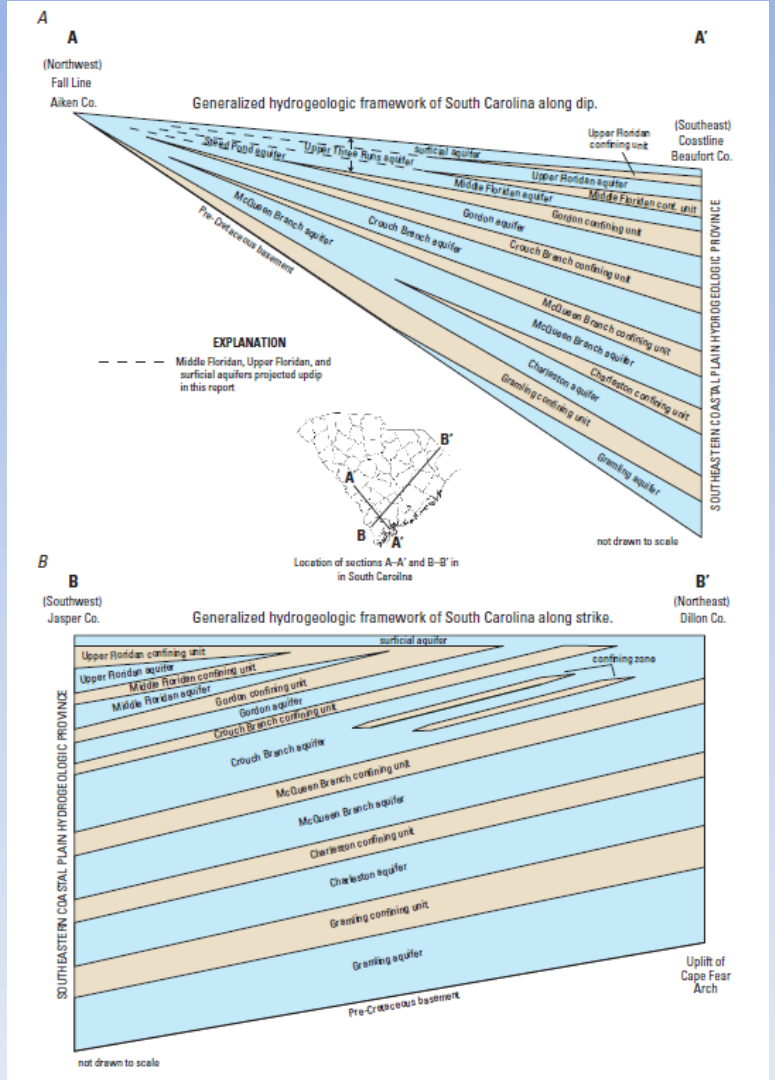
SWB Model Input



U.S. Department of the Interior
U.S. Geological Survey

USGS
science for a changing world

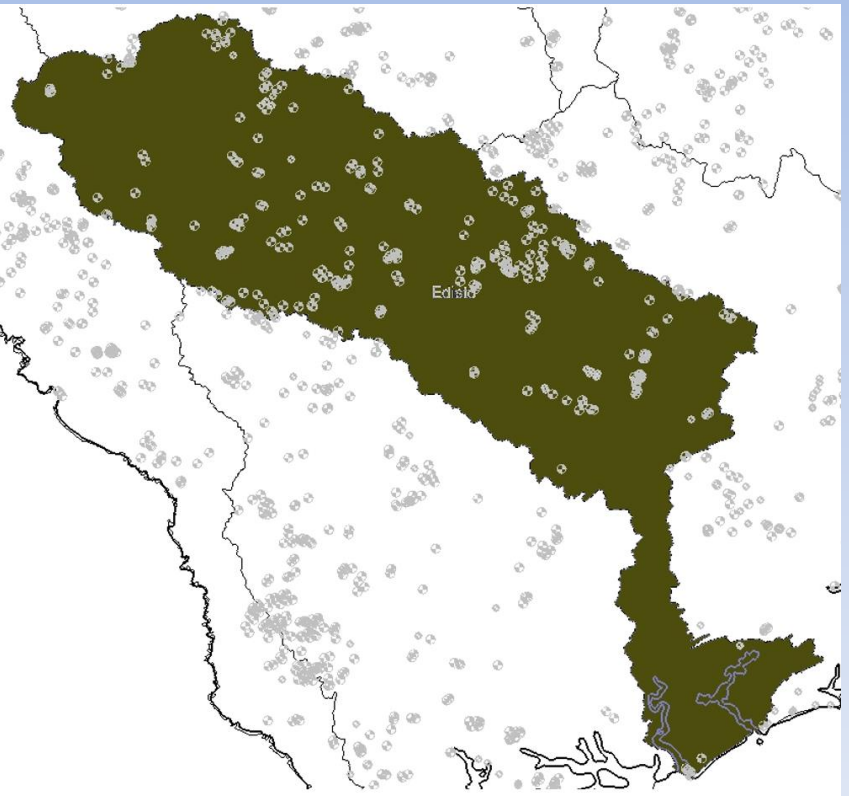
Hydrogeologic Framework



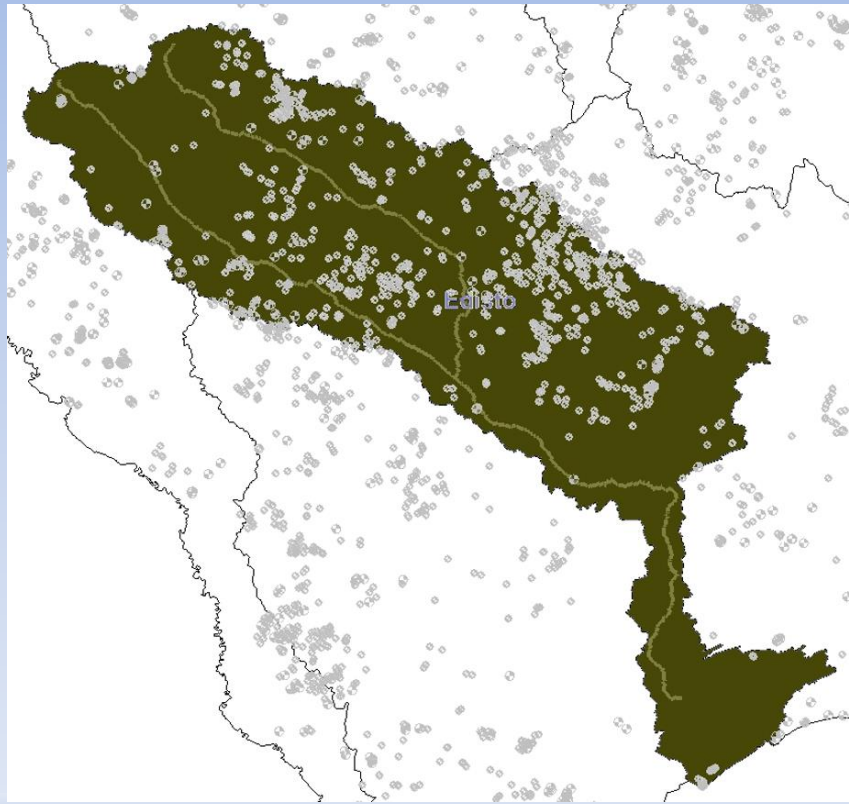
U.S. Department of the Interior
U.S. Geological Survey

Edisto Basin wells – original and updated model

Original

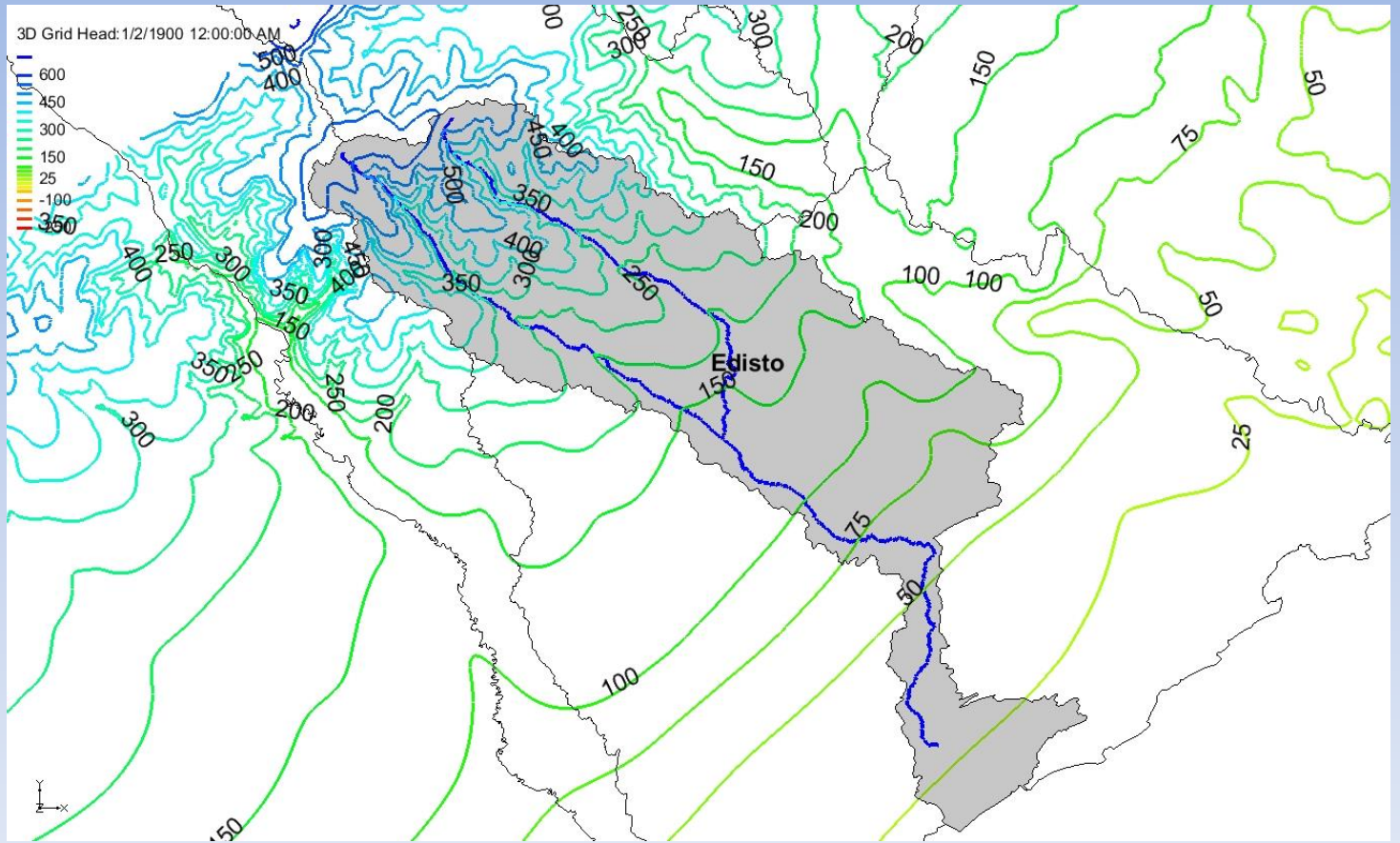


Updated



Provisional – All data is considered provisional and subject to revision.

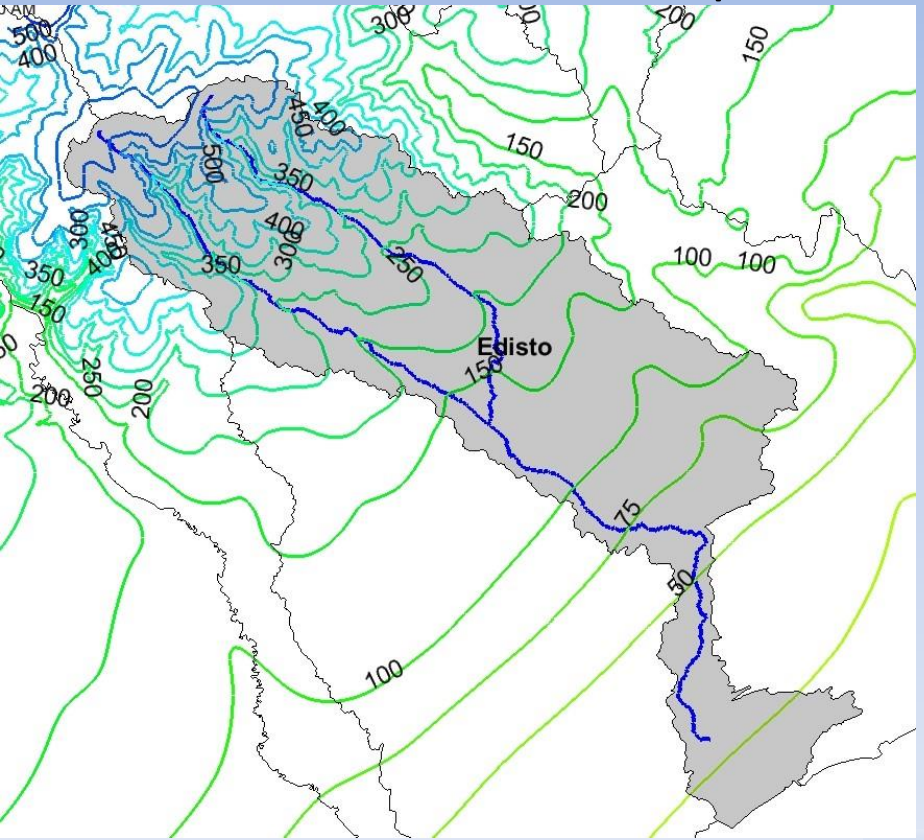
Gordon aquifer – pre-development simulation



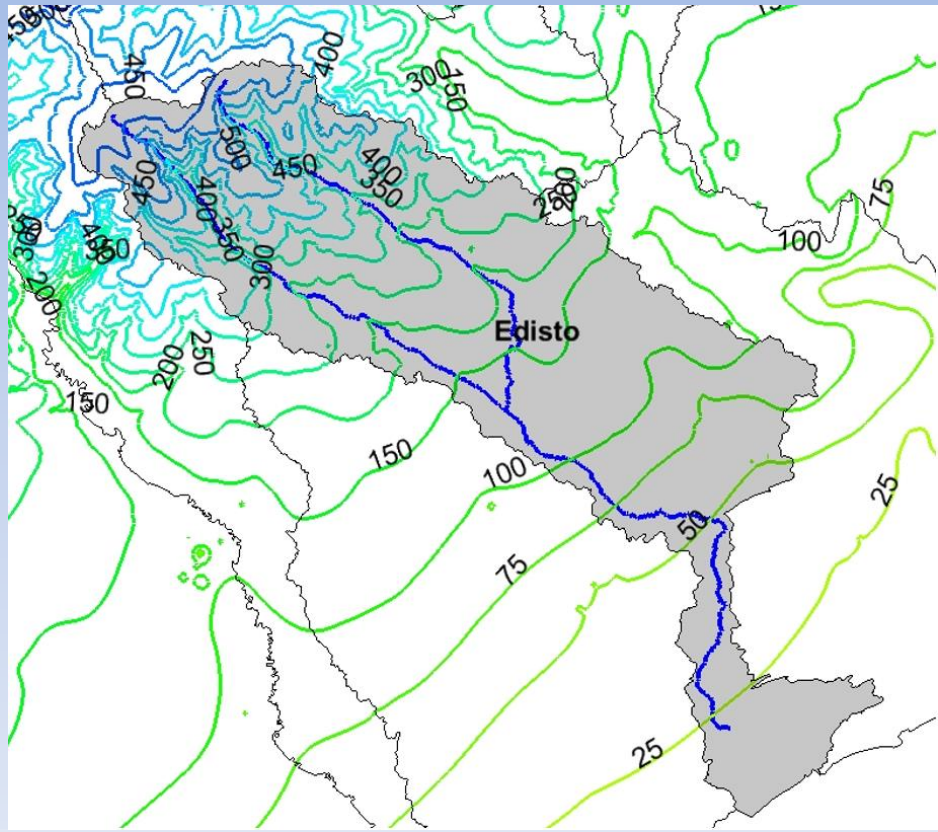
U.S. Department of the Interior
U.S. Geological Survey

Gordon aquifer

Pre-development



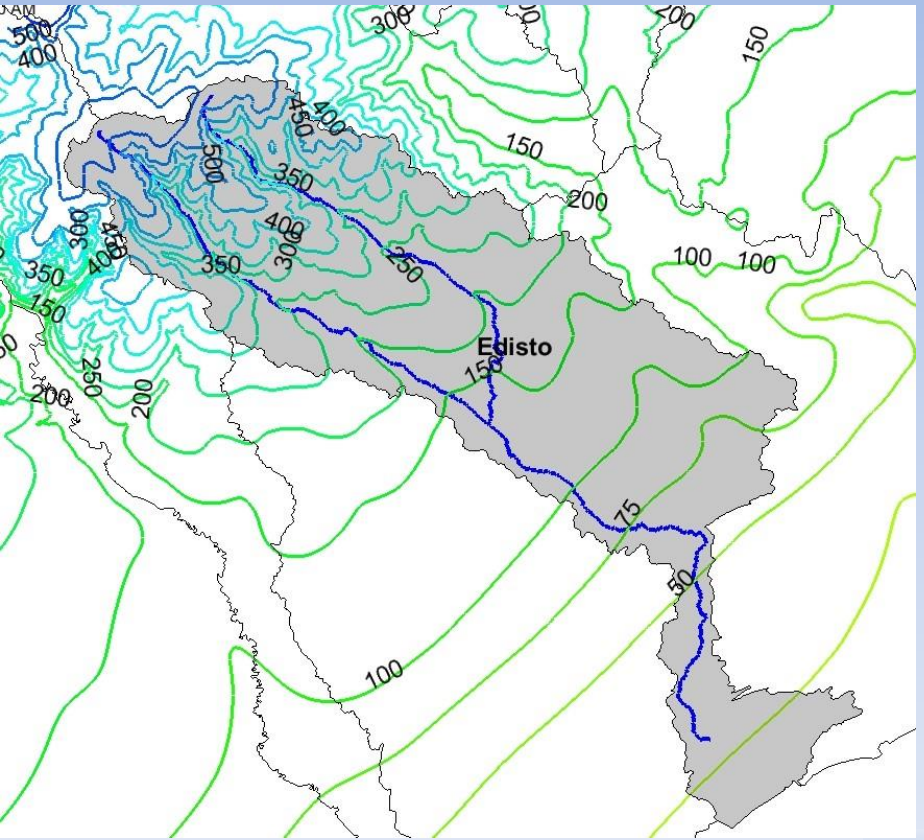
2015



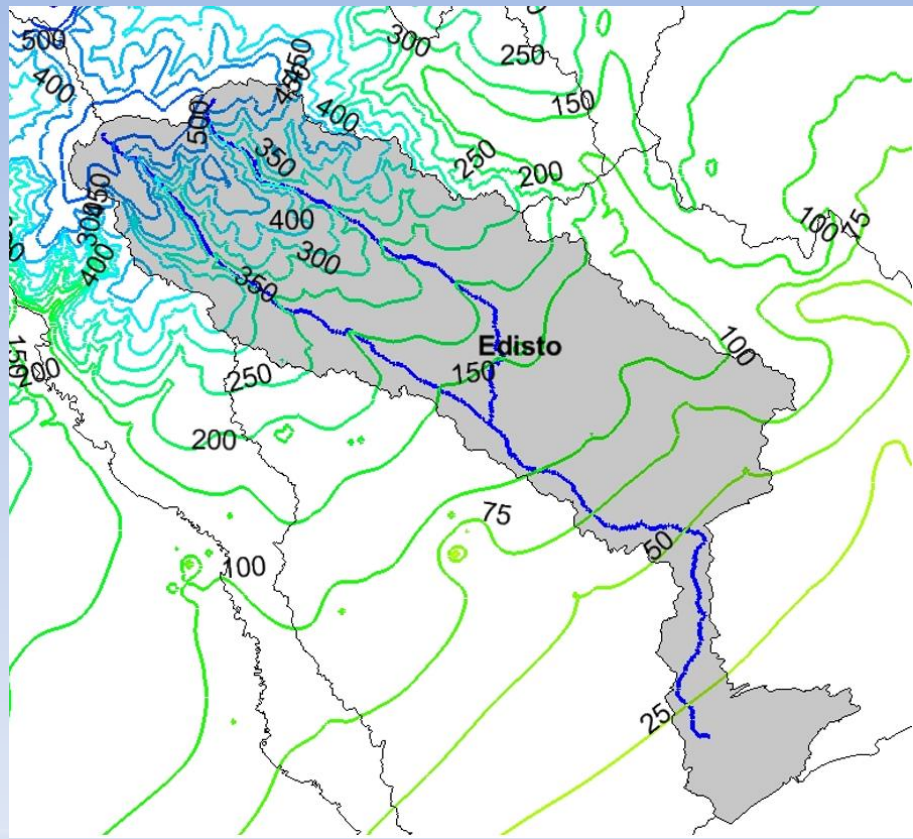
Provisional – All data is considered provisional and subject to revision.

Gordon aquifer

Pre-development

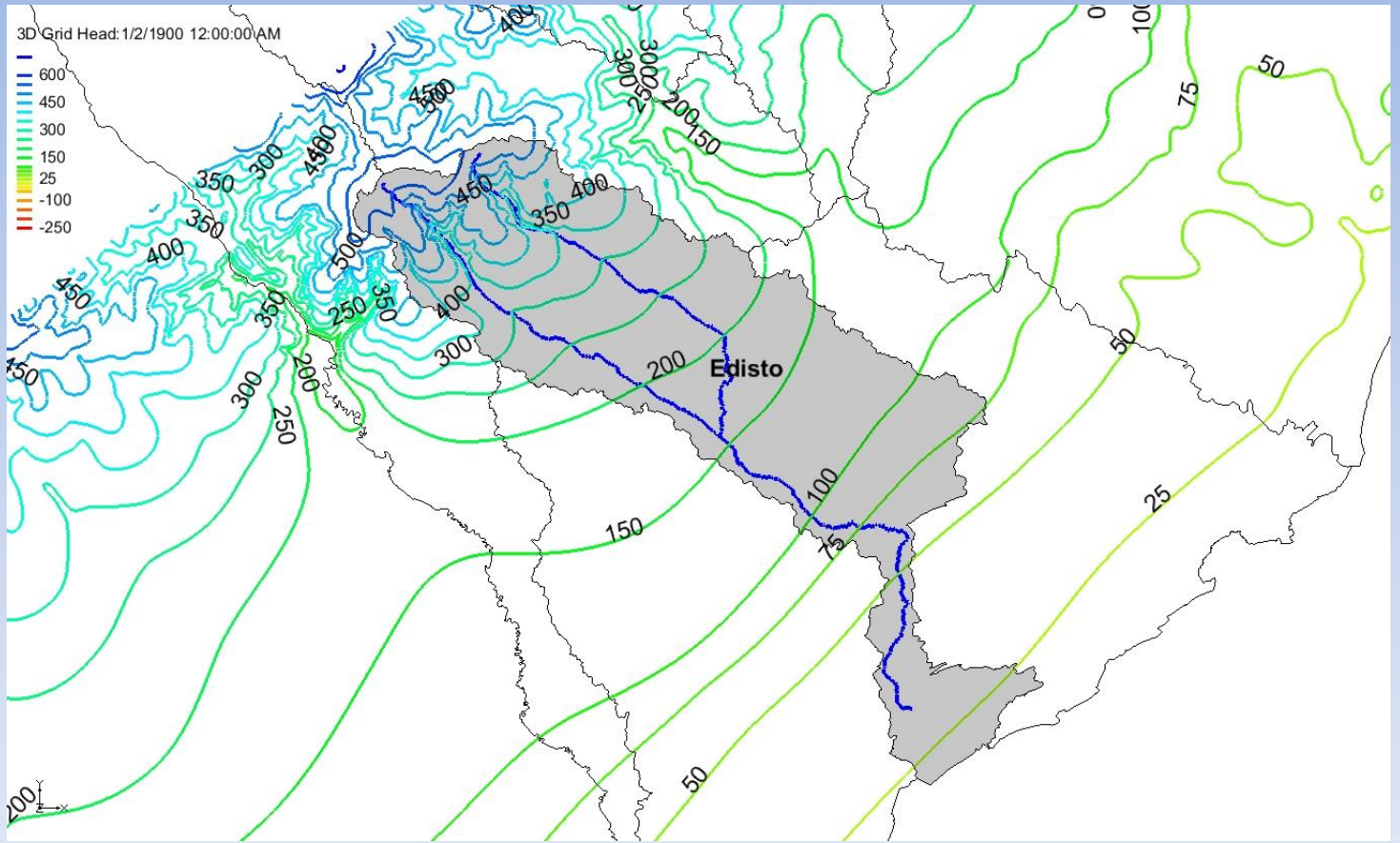


2020



Provisional – All data is considered provisional and subject to revision.

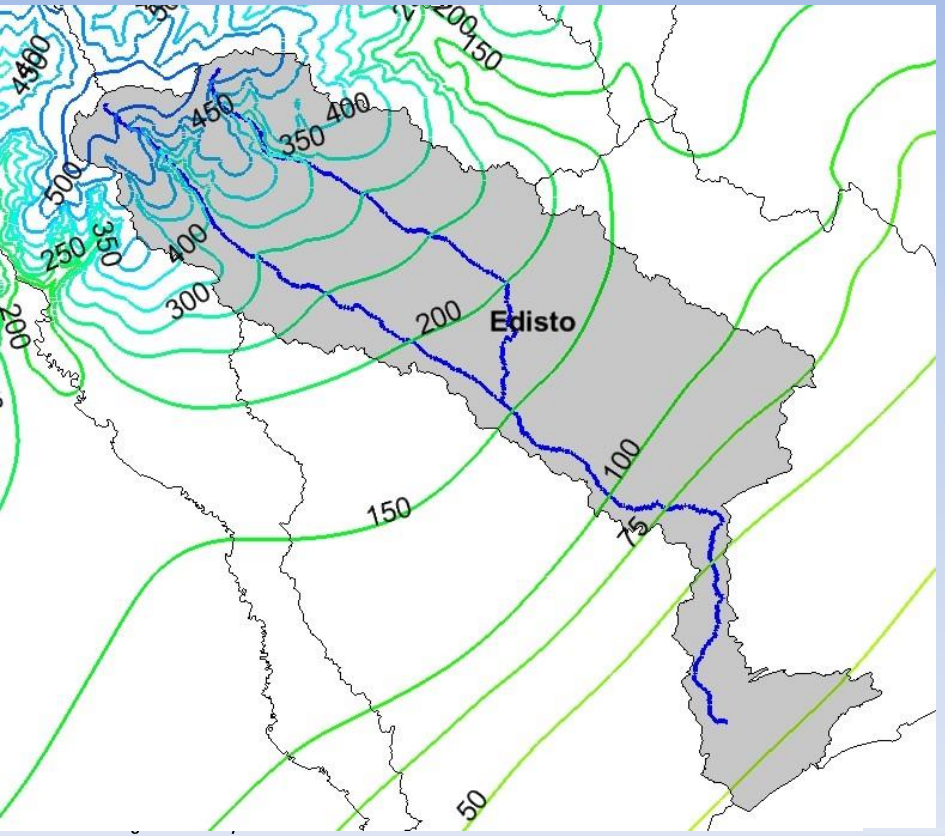
Crouch Branch aquifer – pre-development simulation



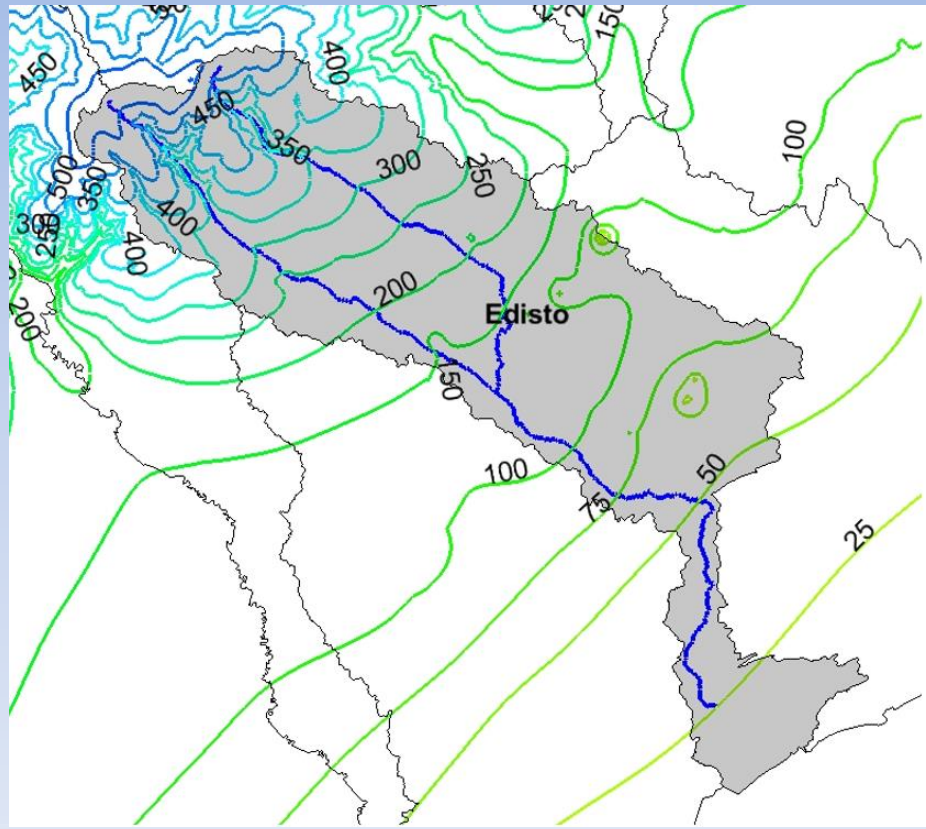
U.S. Department of the Interior
U.S. Geological Survey

Crouch Branch aquifer

Pre-development



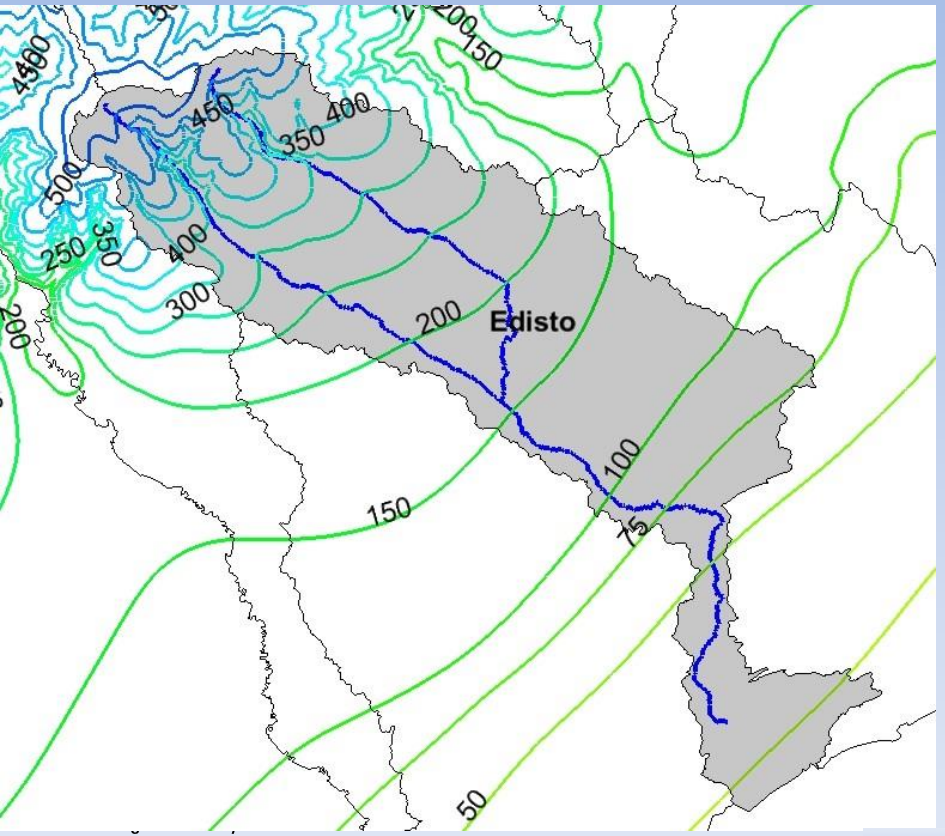
2015



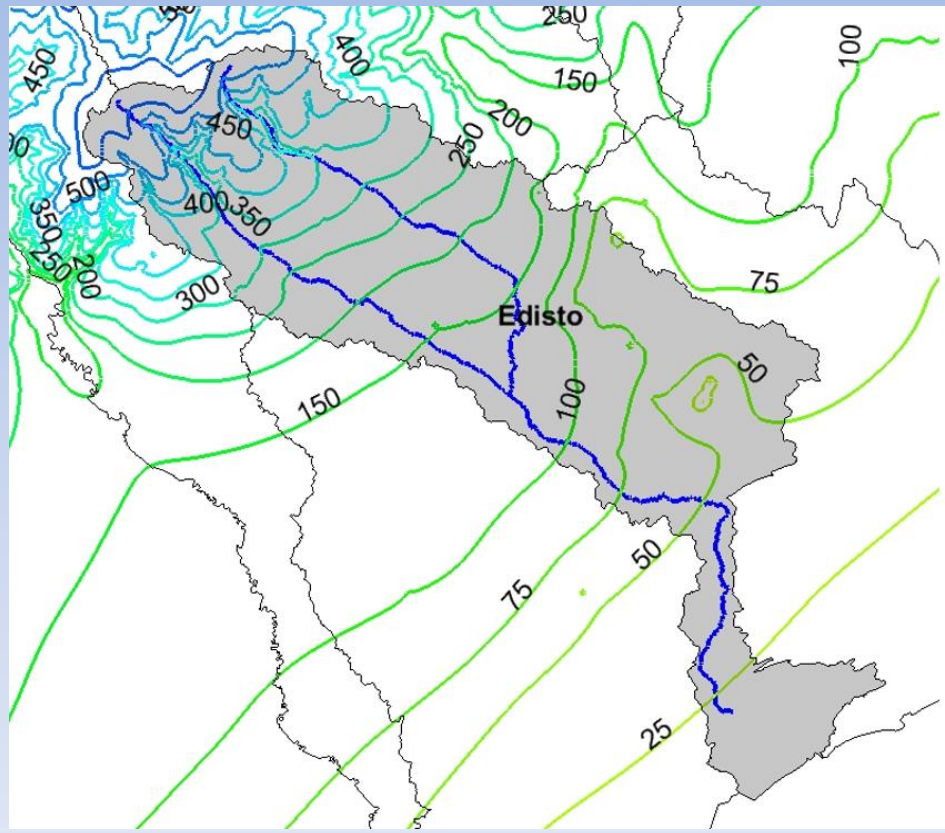
Provisional – All data is considered provisional and subject to revision.

Crouch Branch aquifer

Pre-development

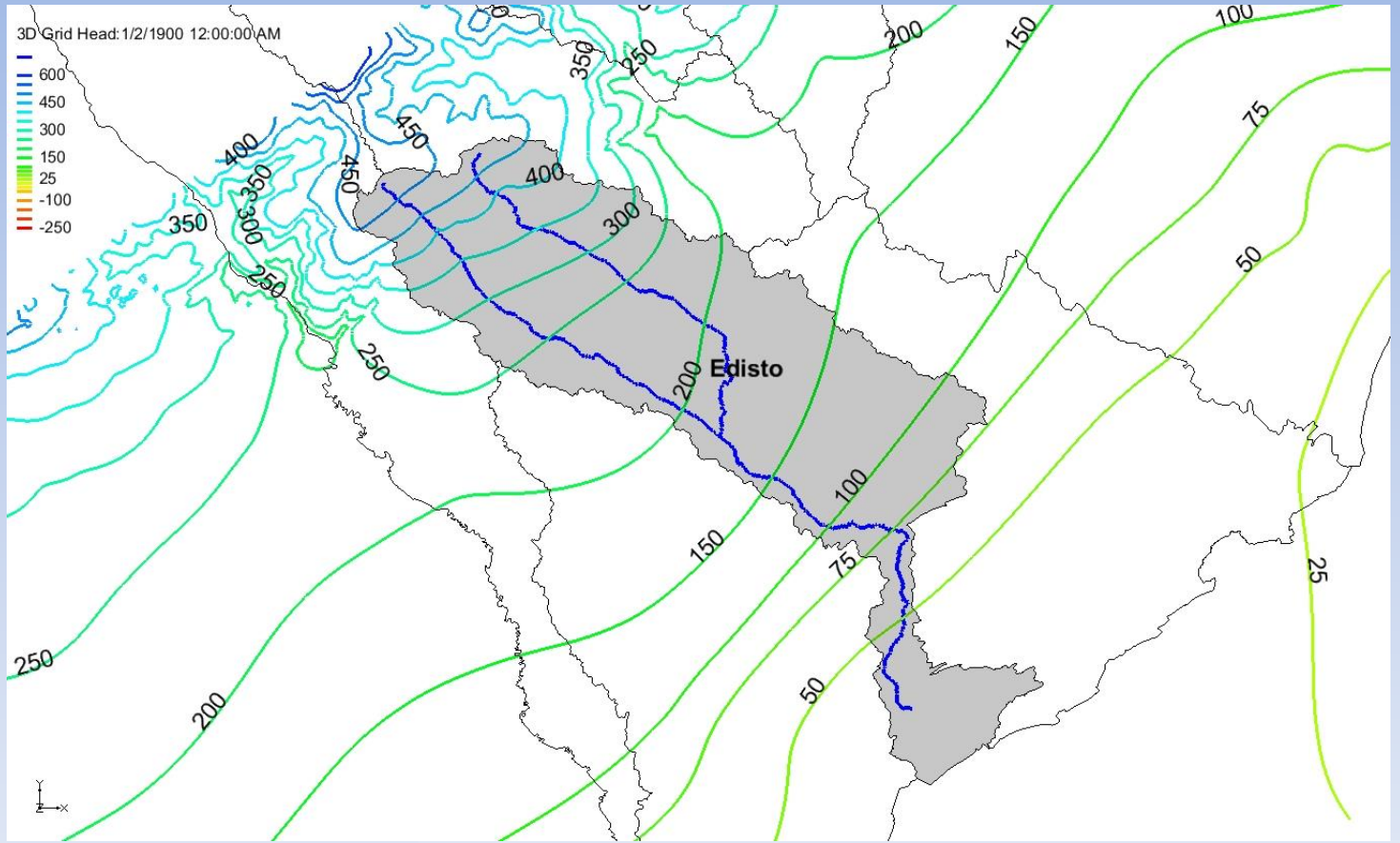


2020



Provisional – All data is considered provisional and subject to revision.

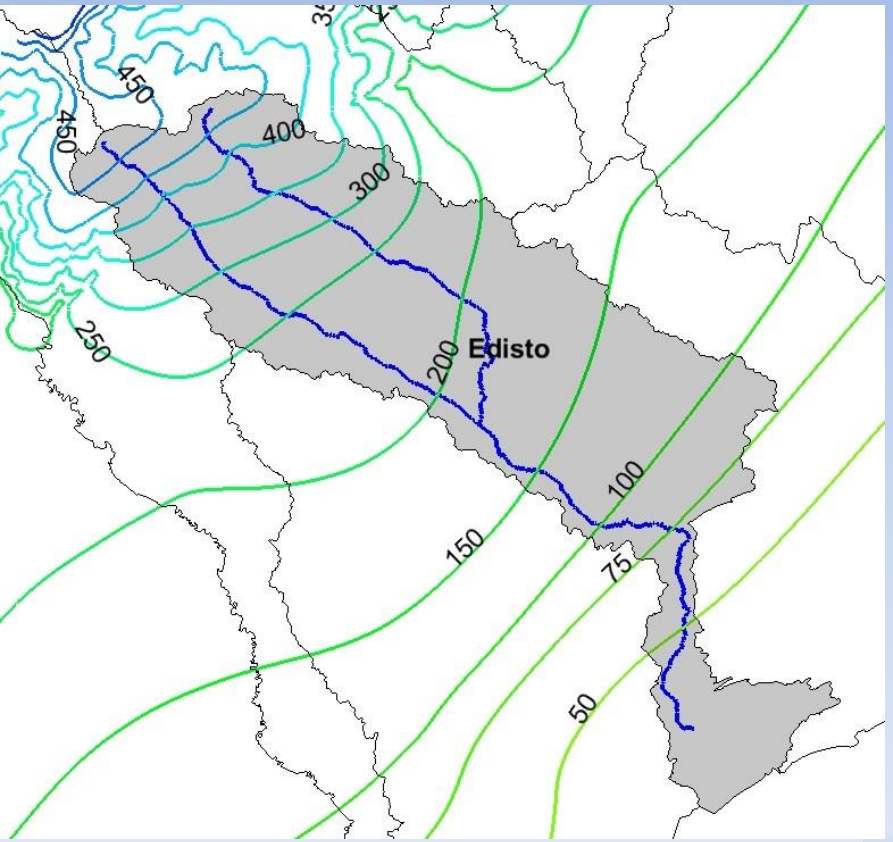
McQueen Branch aquifer – pre-development simulation



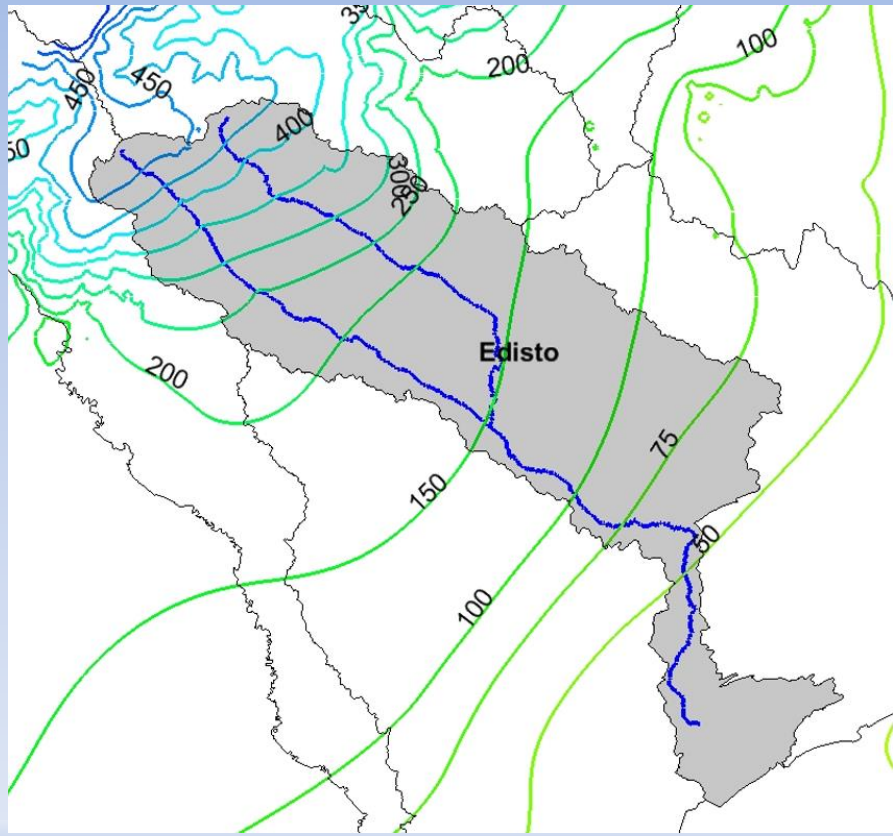
U.S. Department of the Interior
U.S. Geological Survey

McQueen Branch aquifer

Pre-development



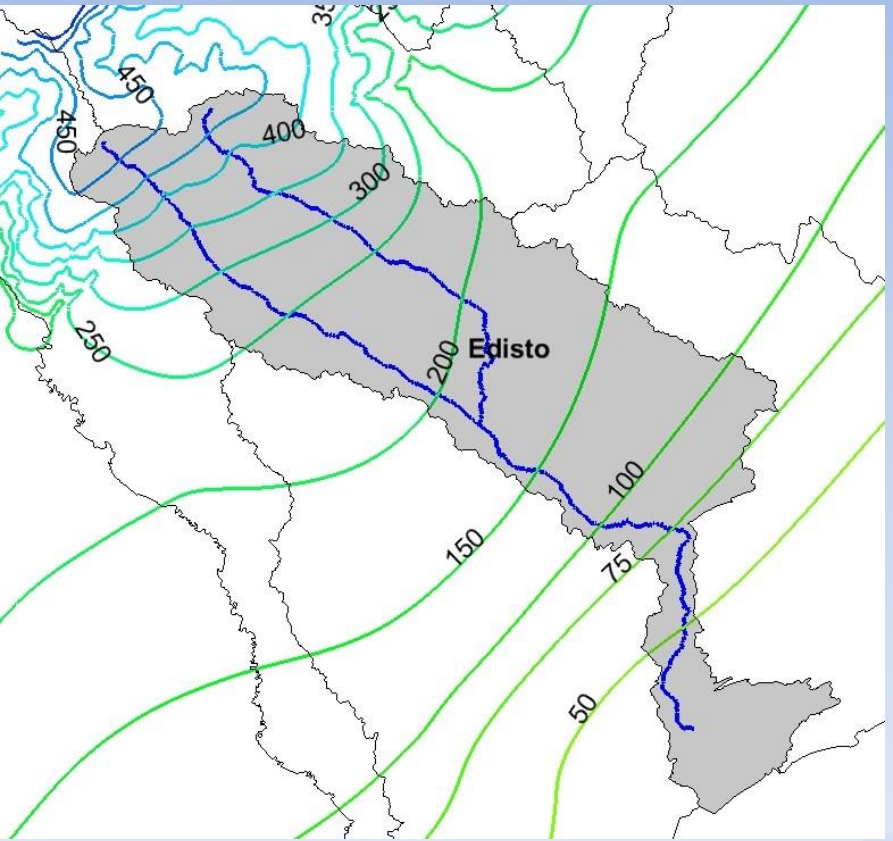
2015



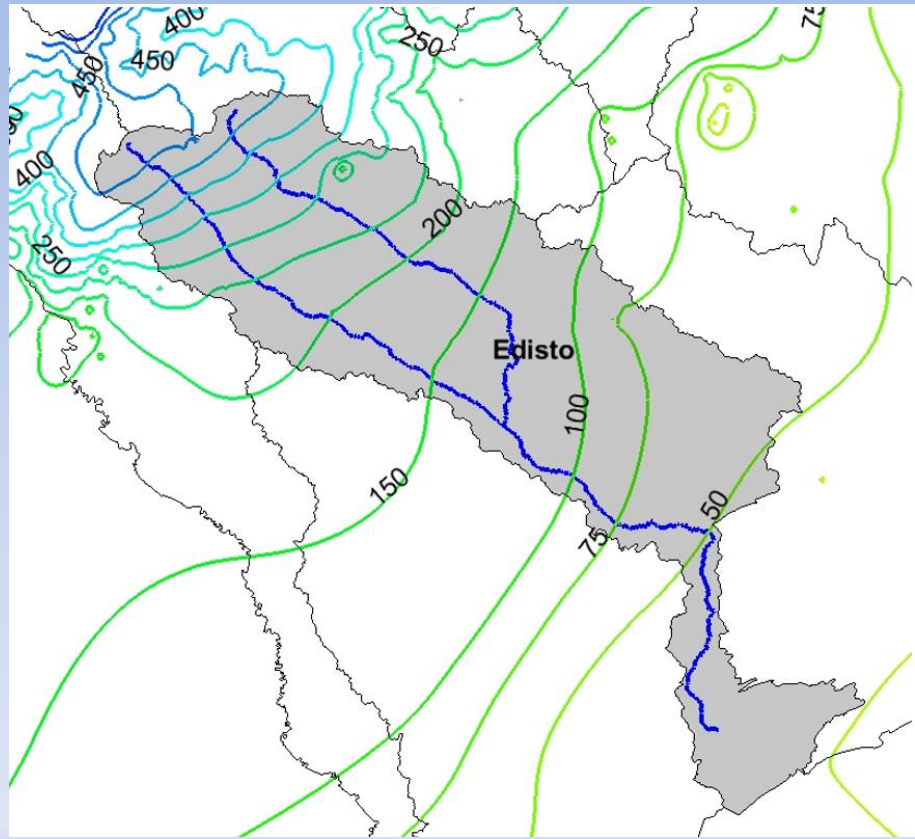
Provisional – All data is considered provisional and subject to revision.

McQueen Branch aquifer

Pre-development

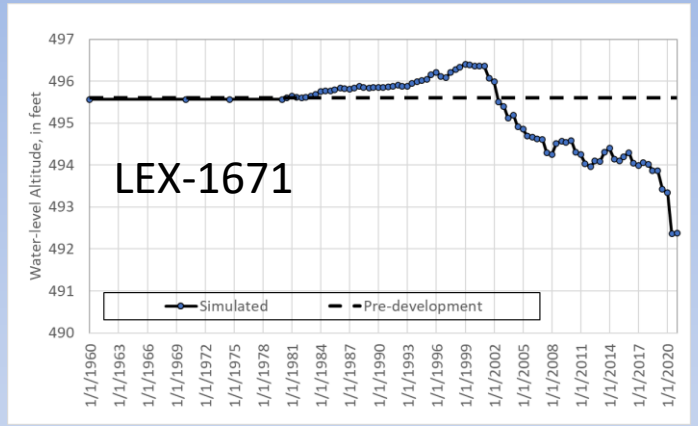


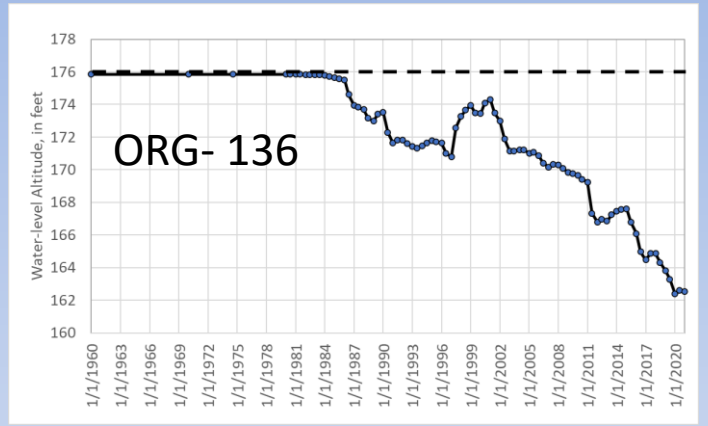
2020

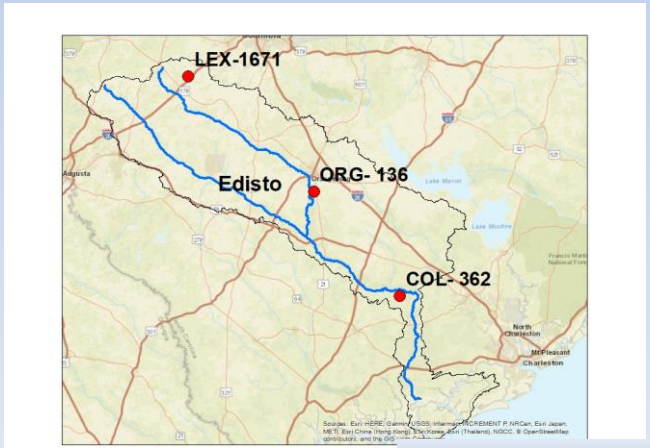


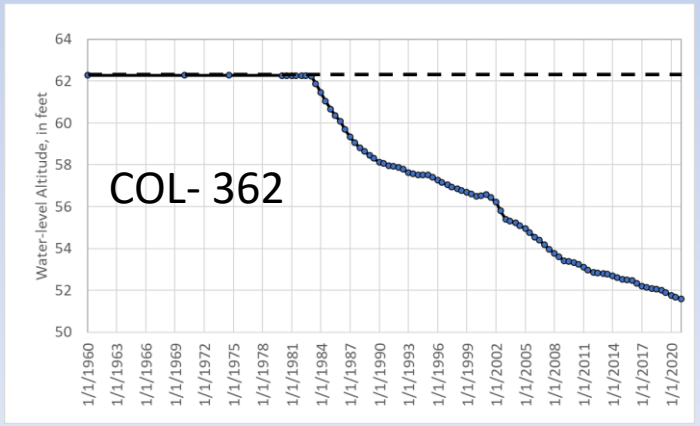
Provisional – All data is considered provisional and subject to revision.

Simulated water levels in the Gordon aquifer





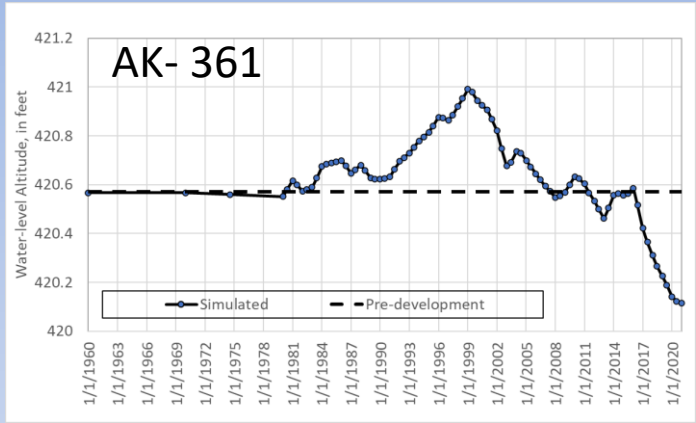


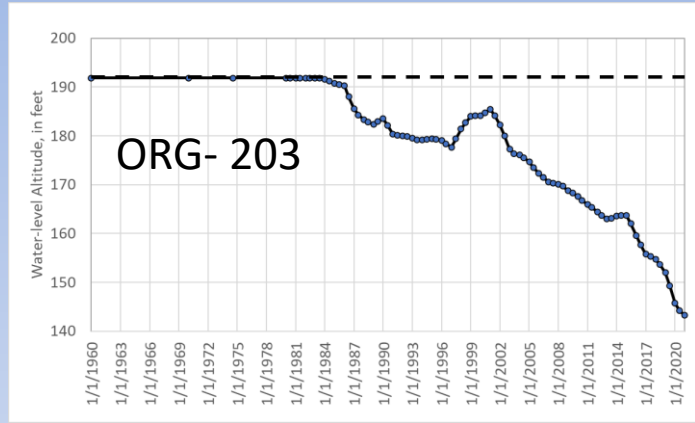


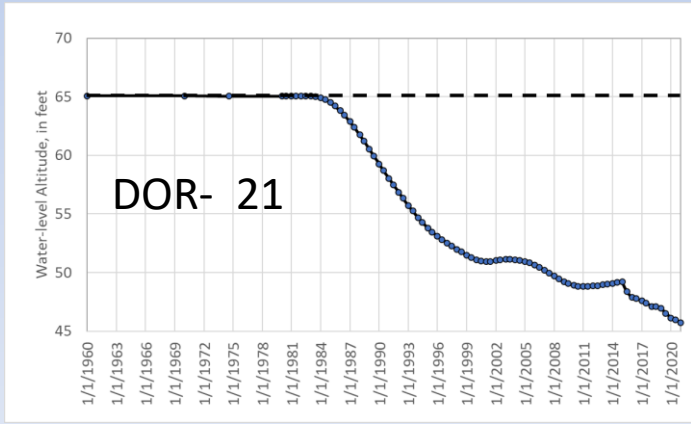
Provisional – All data is considered provisional and subject to revision.

U.S. Department of the Interior
U.S. Geological Survey

Simulated water levels in the Crouch Branch aquifer



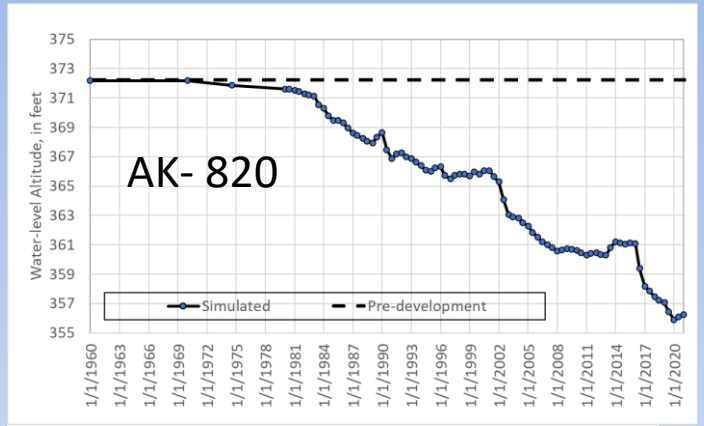


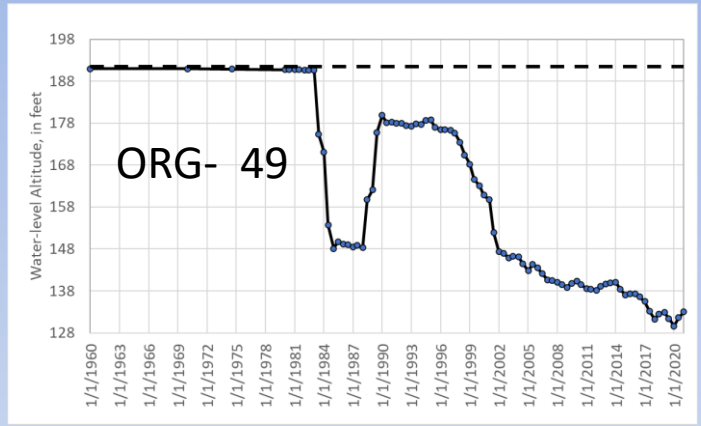


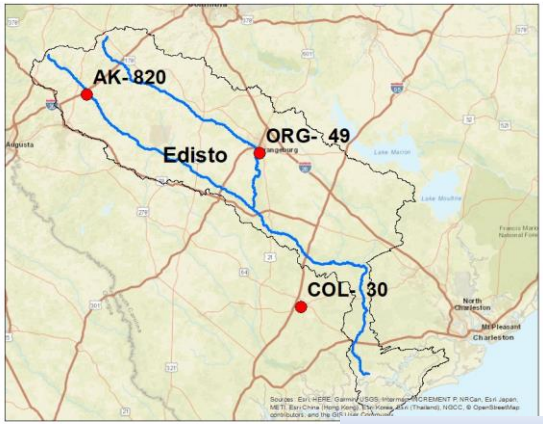
U.S. Department of the Interior
U.S. Geological Survey

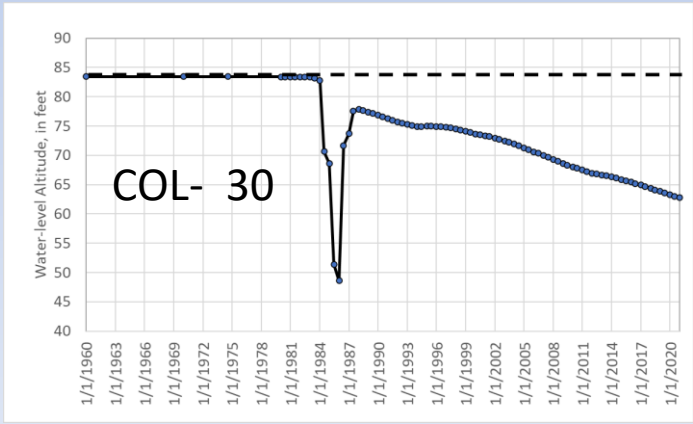
Provisional – All data is considered provisional and subject to revision.

Simulated water levels in the McQueen Branch aquifer









Provisional – All data is considered provisional and subject to revision.

U.S. Department of the Interior
U.S. Geological Survey

Groundwater Scenarios

Current groundwater use

- Constant pumping rates from 2021-2070 using average pumping rates derived from groundwater use from 2015-2019

Permitted groundwater use

- Constant pumping rates from 2021-2070 using fully permitted pumping rates

Business-as-usual water demand

- Projections from 2021-2070 based on assumption moderate population and economic growth

High water demand trend

- Projections from 2021-2070 based on assumption high population and economic growth

USGS
science for a changing world

Questions?

Greg Cherry
gccherry@usgs.gov
470-557-0868

Matt Petkewich
mdpetkew@usgs.gov
803-727-9041