# Llano Groundwater Development

Presented by:

James Bené, P.G.

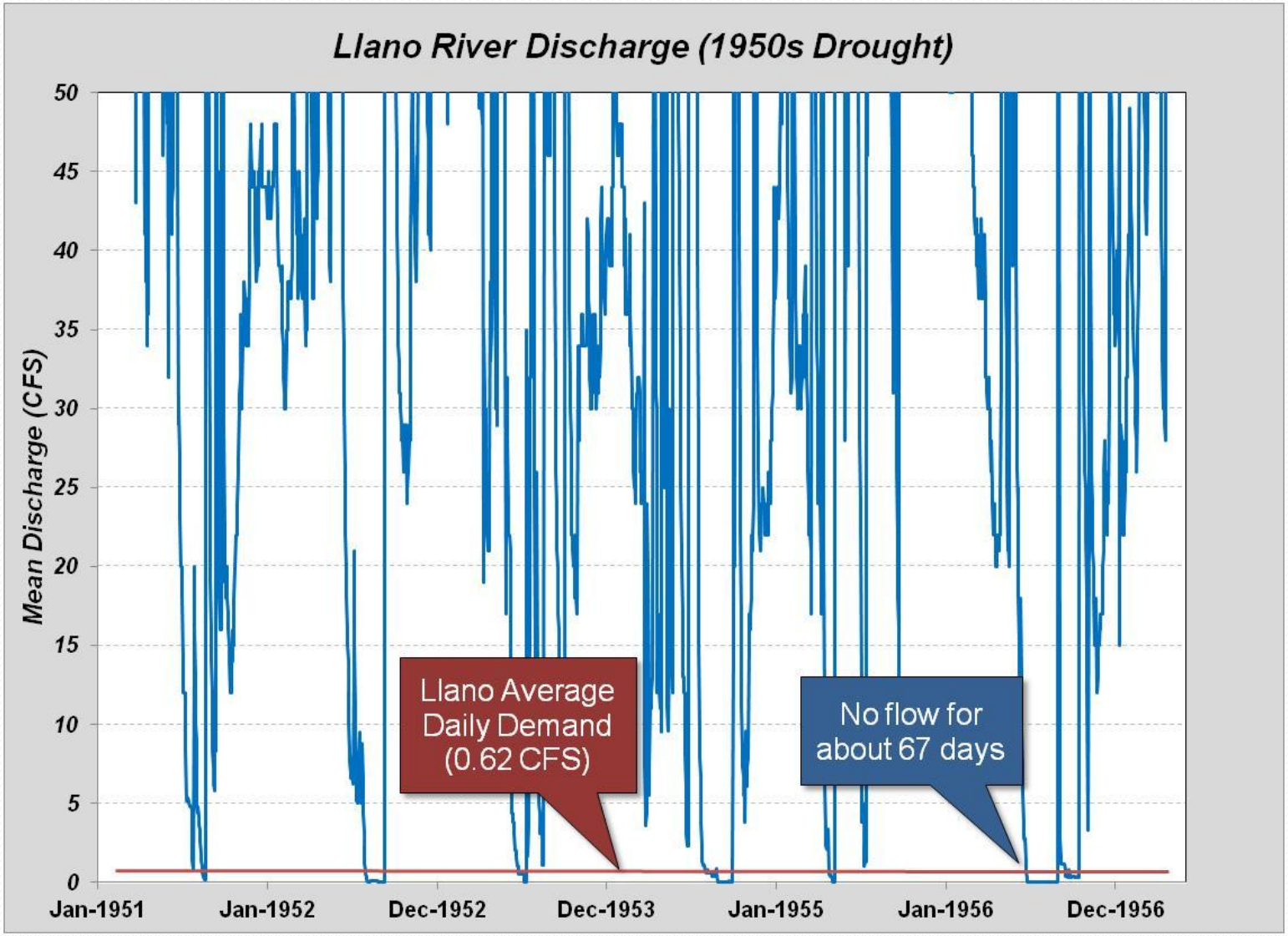
Llano City Council Meeting

July 21, 2014

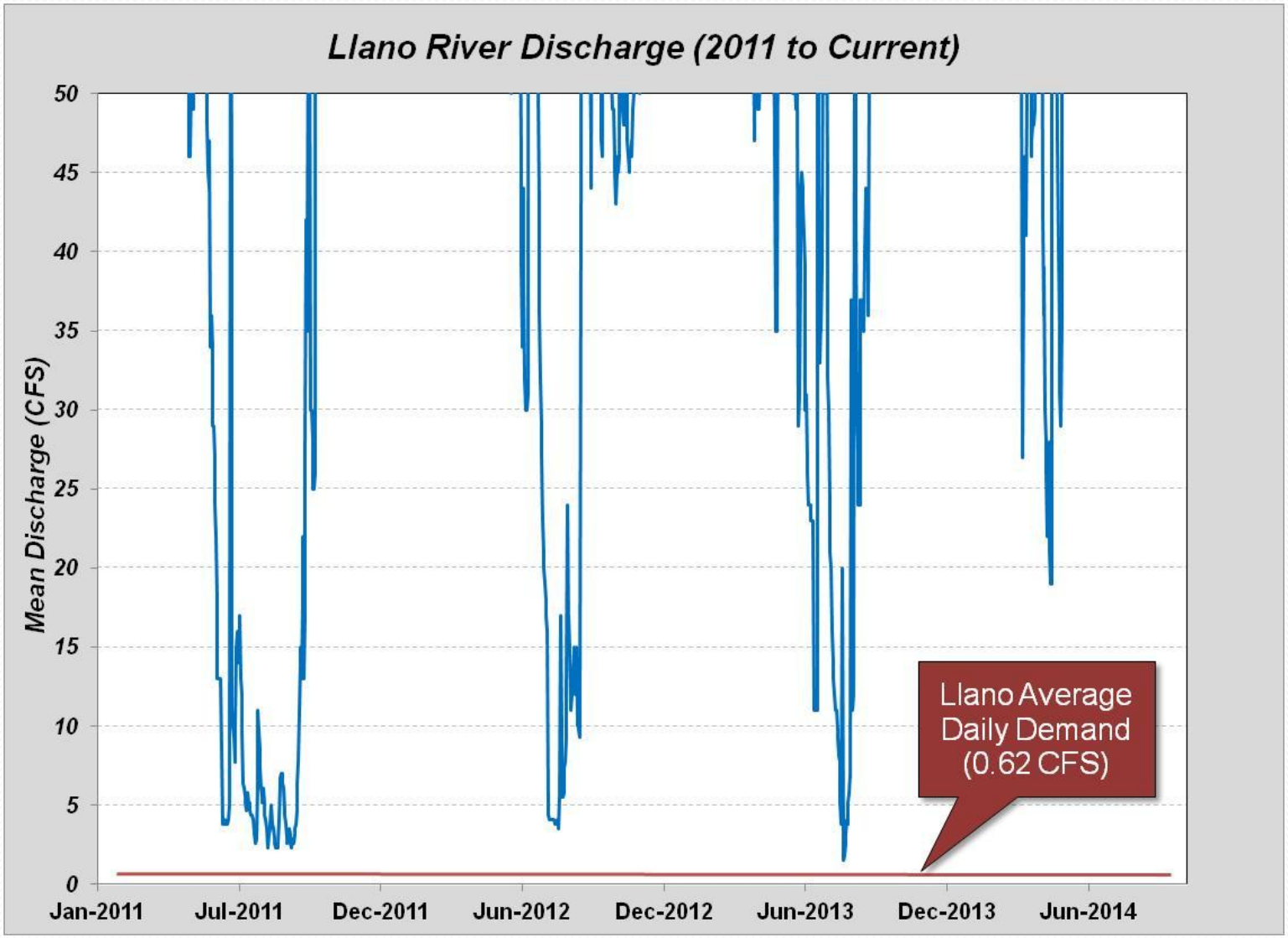
# Presentation Outline

1. River Flow – Alternate Supply Needs
2. Development of Ground/Surface Water from Lake Sediments
   - Plant Well Testing
3. Riley Mountain Groundwater Development
   - Overview
   - Steps
   - Costs

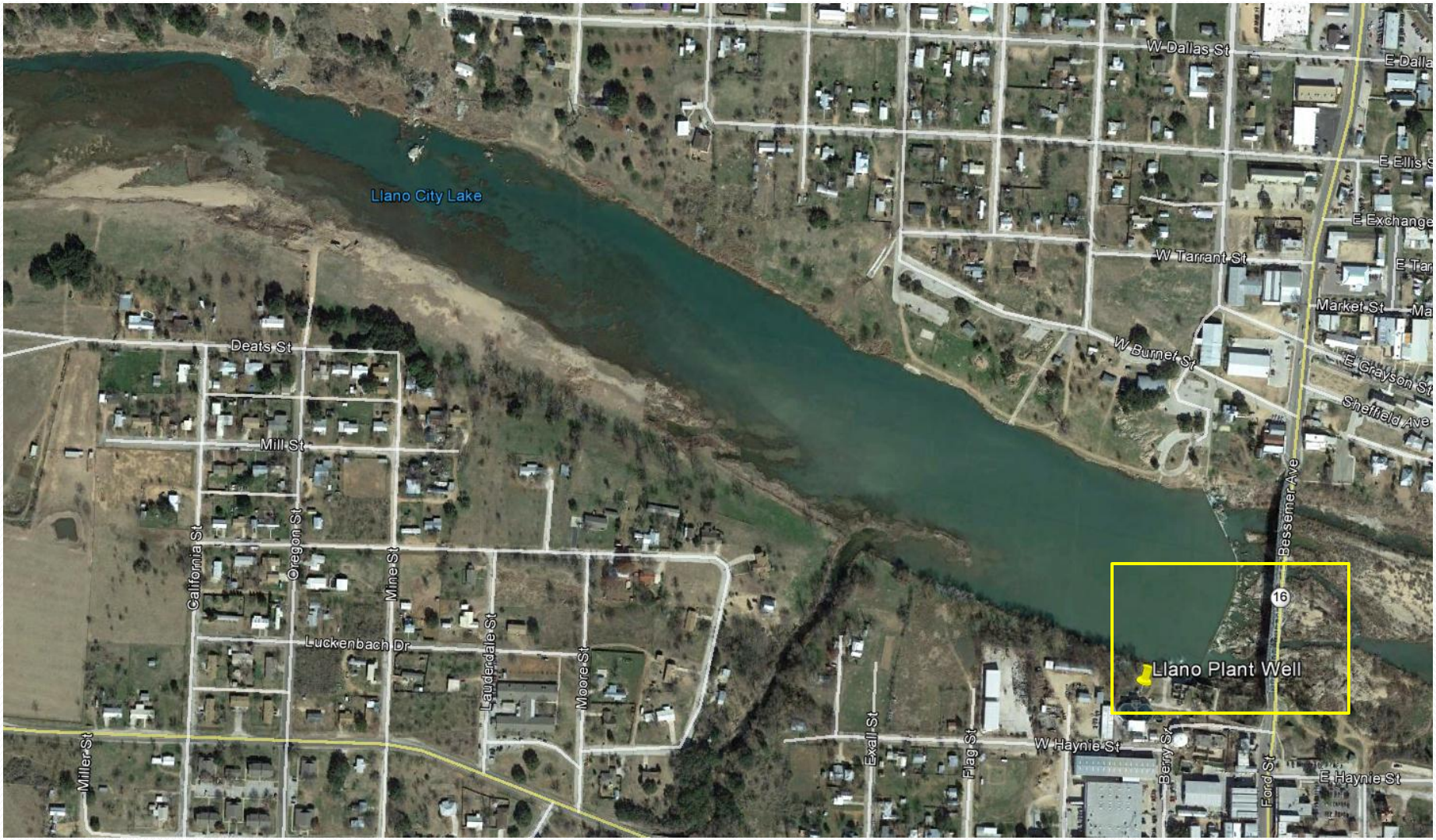
# River Flow


Llano River Discharge (1950s Drought)
Mean Discharge (CFS)
50
45
40
35
30
25
20
15
10
5
0
Jan-1951
Jan-1952
Dec-1952
Dec-1953
Jan-1955
Jan-1956
Dec-1956
Llano Average Daily Demand (0.62 CFS)
No flow for about 67 days

# River Flow


Llano River Discharge (2011 to Current)
Mean Discharge (CFS)
50
45
40
35
30
25
20
15
10
5
0
Jan-2011
Jul-2011
Dec-2011
Jun-2012
Dec-2012
Jun-2013
Dec-2013
Jun-2014
Llano Average Daily Demand (0.62 CFS)

# Lake Sediment Groundwater



# Lake Sediment Groundwater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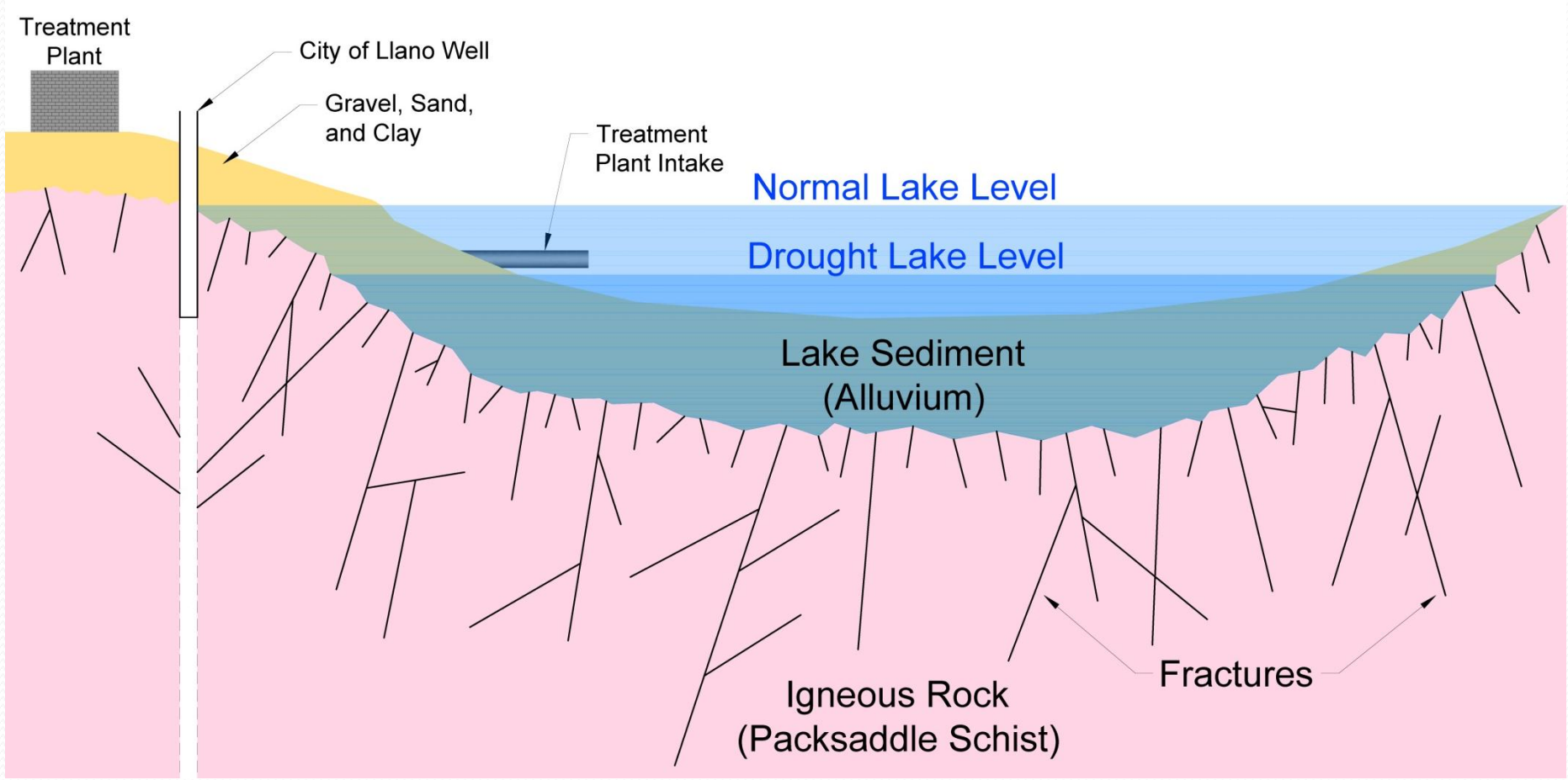
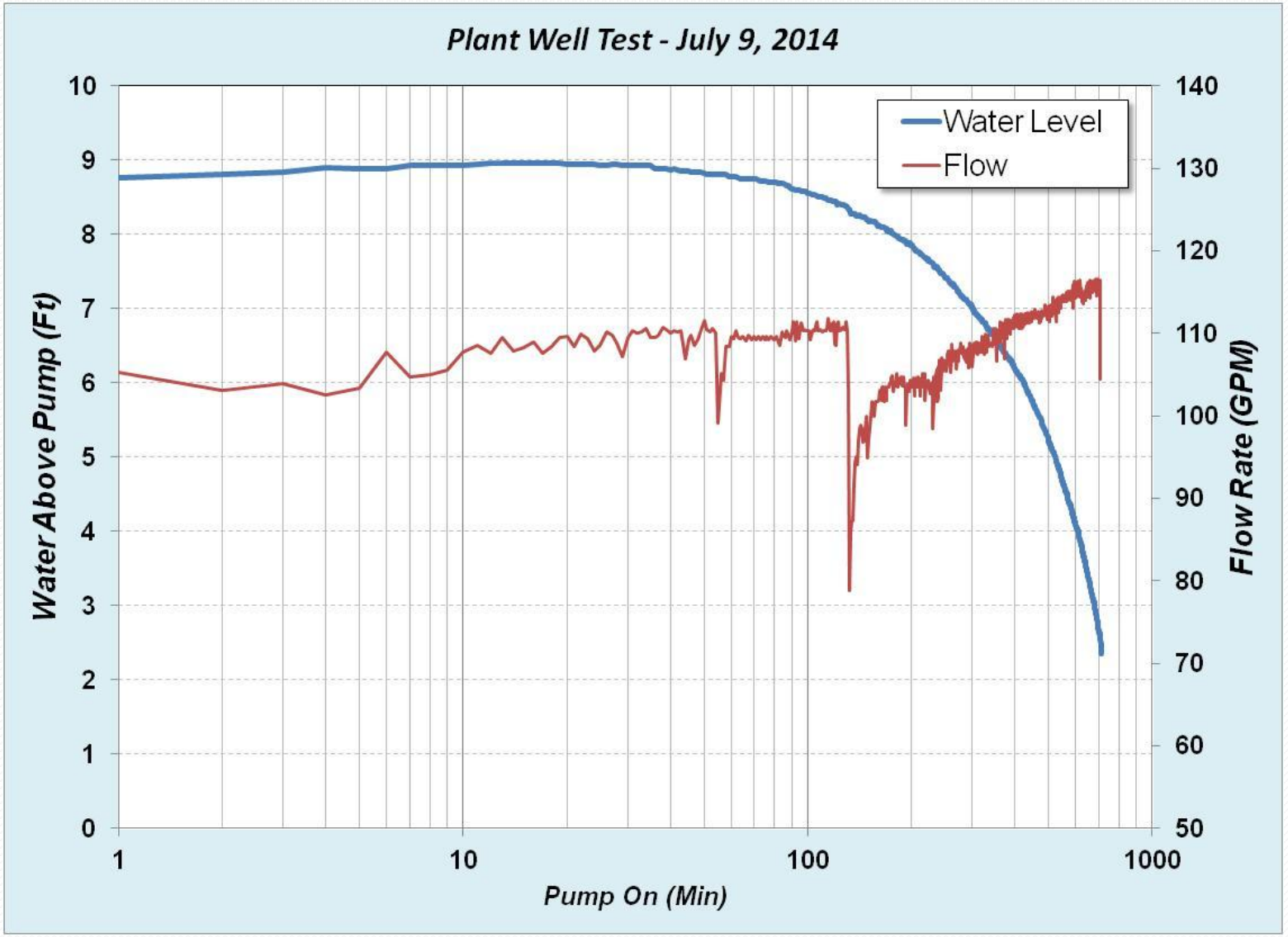
# Lake Sediment Groundwater



# Plant Well Test

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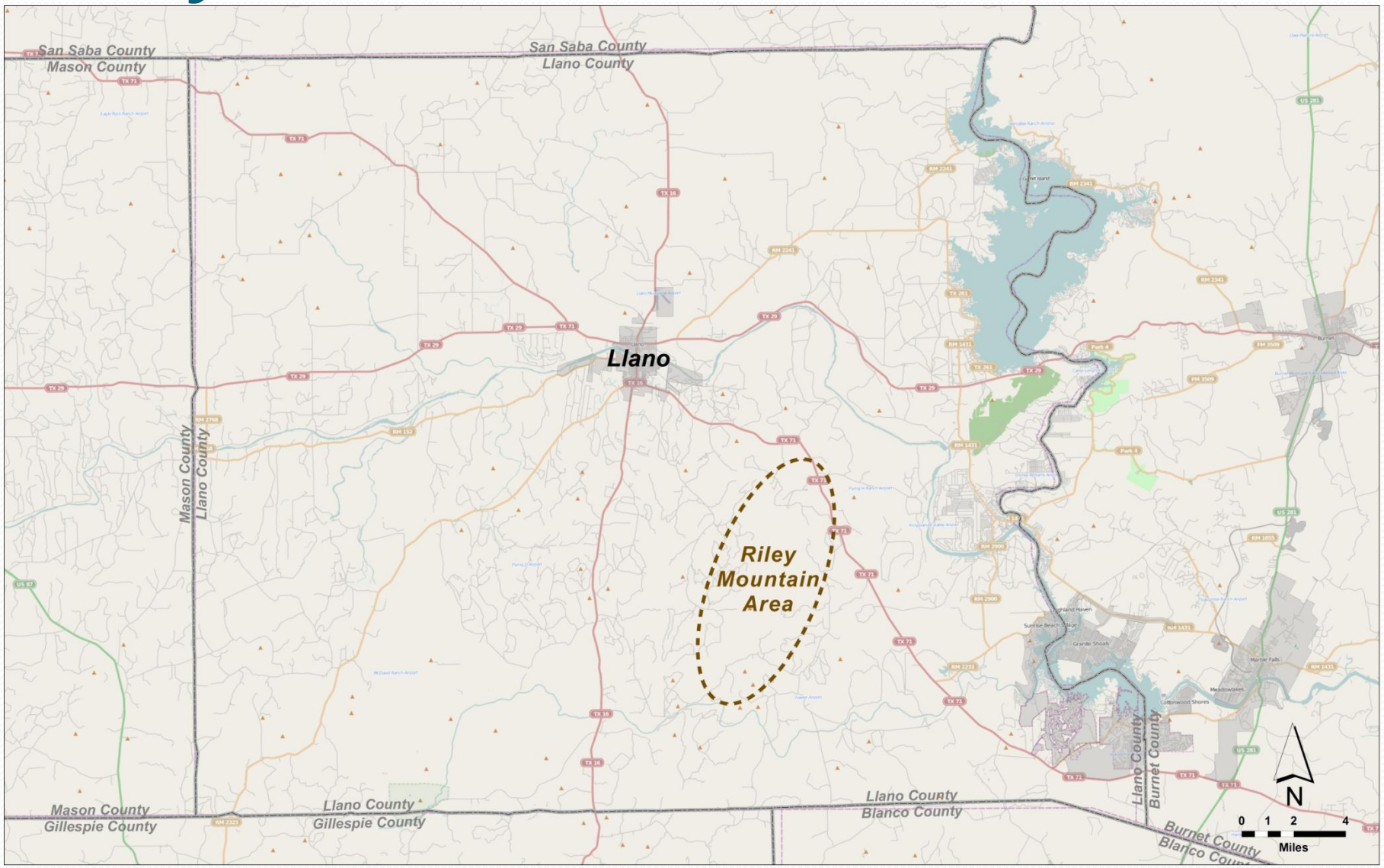
# Riley Mountain

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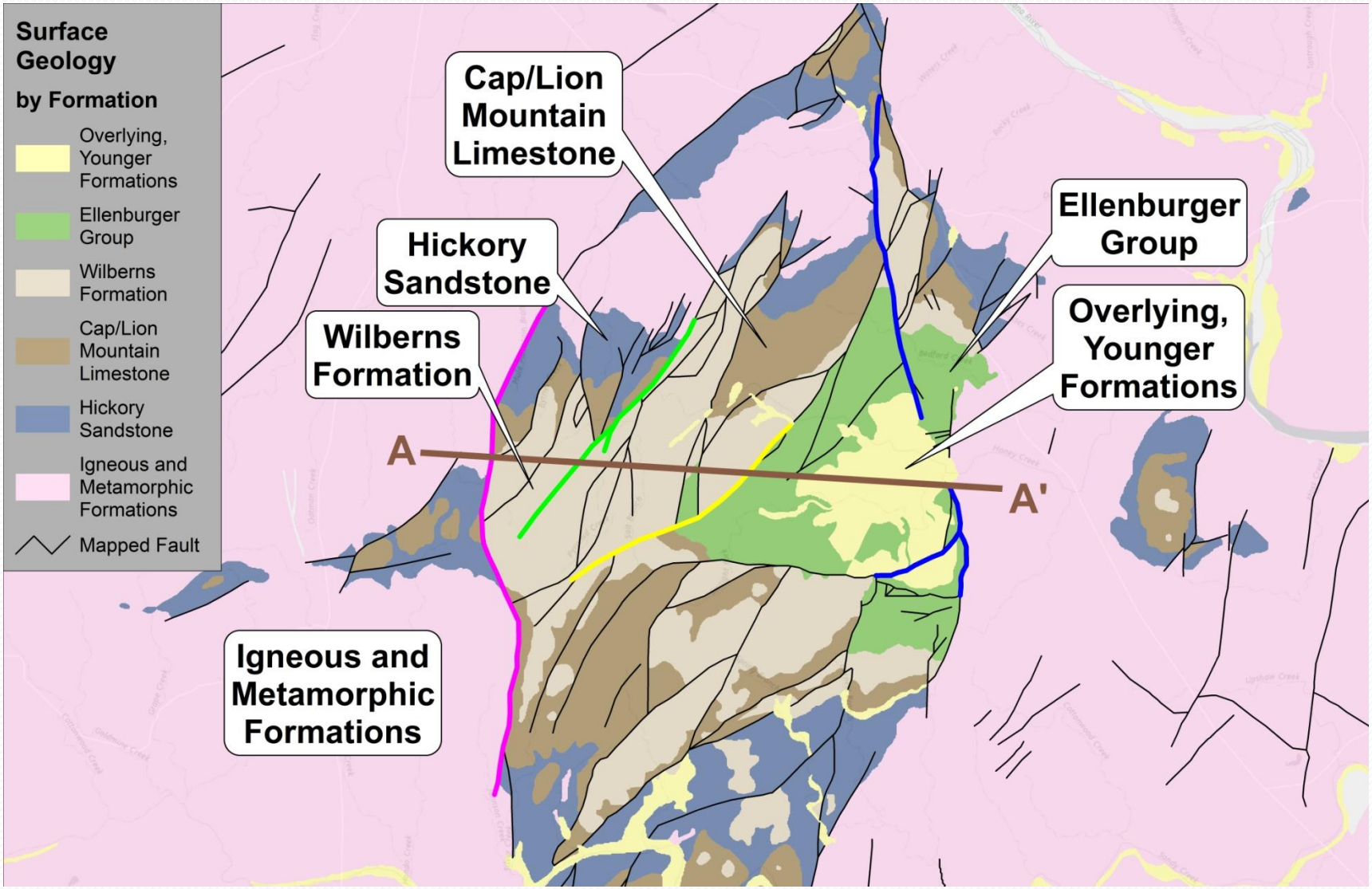
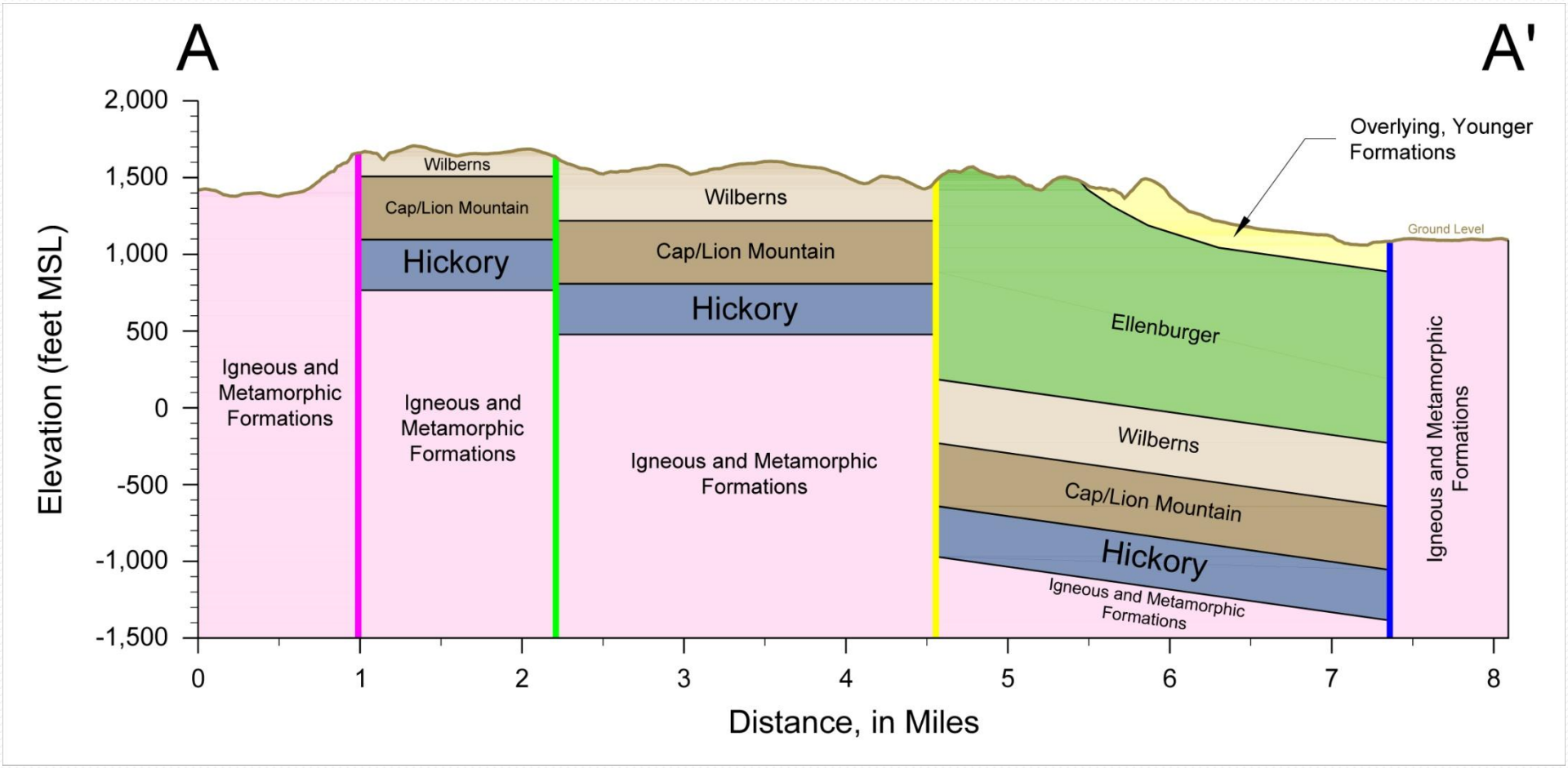
# Riley Mountain

- Nearest reliable, long-term source of groundwater
- Target aquifer is the Hickory Sandstone (Riley Formation)
- Deposited about 550 million years ago
- Hickory saturated thickness likely 300+ feet
- Hickory base is about 1,100 feet depth
- Recharged through infiltration of precipitation on surface (percolates through outcrop and fractures)

# Riley Mtn. Surface Geology



# Riley Mtn. Cross Section



# Development Steps (Two Wells)

1. Well Design and Technical Specifications
2. TCEQ Construction Submittals
3. Contractor Bidding
4. Test Drilling, Geophysical Logging, and Drill Stem Sampling (Small Diameter Hole)
5. Finalize Well Design, Construct and Develop Well
6. Testing and Sampling
7. TCEQ Interim Approval Submittals

# Development Risks

- Completed well needed for reliable aquifer testing and water sampling
  - Elevated radionuclides common in Hickory groundwater
  - “Drill stem” sample in test hole will give some indication of water quality but is not definitive
  - Aquifer productivity may be less than anticipated

# Radionuclide Treatment

- Beta Particles (Tritium) and Photon Radiation
  - Ion exchange (water softener)
  - Reverse osmosis
- Radium 226 & 228 (Combined) and Uranium
  - Ion exchange (water softener)
  - Reverse osmosis
  - Lime softening

# Estimated Timeline

| Technical Specifications and Contractor Selection (Months from Notice to Proceed) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Task** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Design and Assemble Specifications | | | | | | | | | | | | |
| Contractor Bidding | | | | | | | | | | | | |

| Test Drilling and Logging (Months from Notice to Proceed) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Task** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Finalize Contract and Mobilize Drilling Equipment | | | | | | | | | | | | |
| Test Drilling and Logging | | | | | | | | | | | | |

| Well Design, Construction, and Testing (Months from Notice to Proceed) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Task** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Finalize Design | | | | | | | | | | | | |
| Mobilize Equipment, Construct and Develop Well | | | | | | | | | | | | |
| Testing and Sampling | | | | | | | | | | | | |

| TCEQ Submittals And Approvals (Months from Notice to Proceed) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Task** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Assemble Well Construction Submittals | | | | | | | | | | | | |
| Well Construction Review and Approval | | | | | | | | | | | | |
| Assemble Interim Use Submittals | | | | | | | | | | | | |
| Interim Use Review and Approval | | | | | | | | | | | | |

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# Est. Drilling Costs (2 Wells)

| Engineering/Geological Capital Costs | | | | |
|---|---|---|---|---|
| *Item* | *Quantity* | *Unit* | *Unit Price* | *Cost* |
| Technical Specifications and Bidding | 1 | LS | $20,000 | $20,000 |
| TCEQ Submittals | 1 | LS | $10,000 | $10,000 |
| Test Drilling Oversight | 2 | EA | $10,000 | $20,000 |
| Drill Stem Sampling Oversight | 2 | EA | $5,000 | $10,000 |
| Well Construction Oversight | 2 | EA | $25,000 | $50,000 |
| | | | **Engineering Subtotal** | **$110,000** |
| **Well Contractor Capital Costs** | | | | |
| Mobilization/Demobilization | 1 | EA | $50,000 | $50,000 |
| Test Hole Drilling & Logging | 2 | EA | $100,000 | $200,000 |
| Test Hole Drill Stem Sampling | 2 | EA | $15,000 | $30,000 |
| Well Construction | 2 | EA | $225,000 | $450,000 |
| Permanent Pumping Equipment | 2 | EA | $60,000 | $120,000 |
| | | | **Contractor Subtotal** | **$850,000** |
| | | | **Total Capital Cost** | **$960,000** |

# Estimated Project Costs

| | |
|---|---|
| $960,000 | Drill and Complete Two Production Wells |
| $2,675,900 | Riley Mtn. to Llano Delivery System |
| $3,635,900 | Total Estimated Project Cost |

$190,000: Cost of test drilling at one site (no aquifer found – project unsuccessful)

# Discussion