



Assessment of the Groundwater Supply in Loudoun County, Virginia

David S. Ward, John Adams, Andy Stoddard

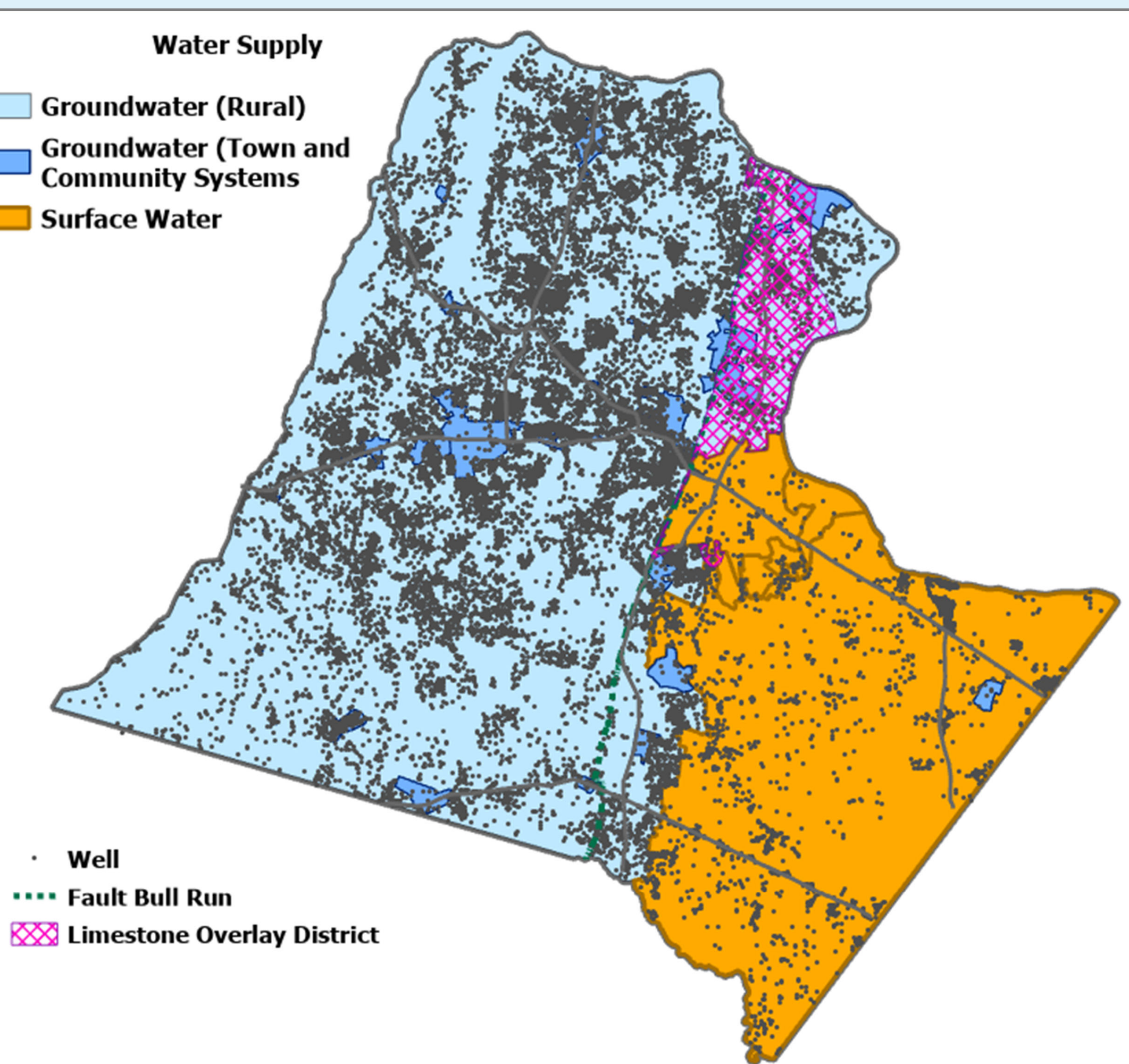
Loudoun Groundwater

Introduction

Groundwater conditions in Loudoun County have significantly worsened over the past several decades. Groundwater as a water supply is no longer sustainable as the water table has slowly declined and several droughts have caused some wells, springs and ponds to dry up. The increasing frequency and severity of drought conditions has negatively impacted the water supply and is expected to increase in the future. Changes in land use and residential development have reduced the amount of precipitation recharging the groundwater supply. This silent shift of an invisible finite resource can be devastating to our water supply and our surface waters - ponds, streams, and springs that impact aquatic life, residents, farmers and businesses. Unlike neighboring jurisdictions, Loudoun County has fallen behind over the past two decades in evaluating, understanding, and regulating groundwater.

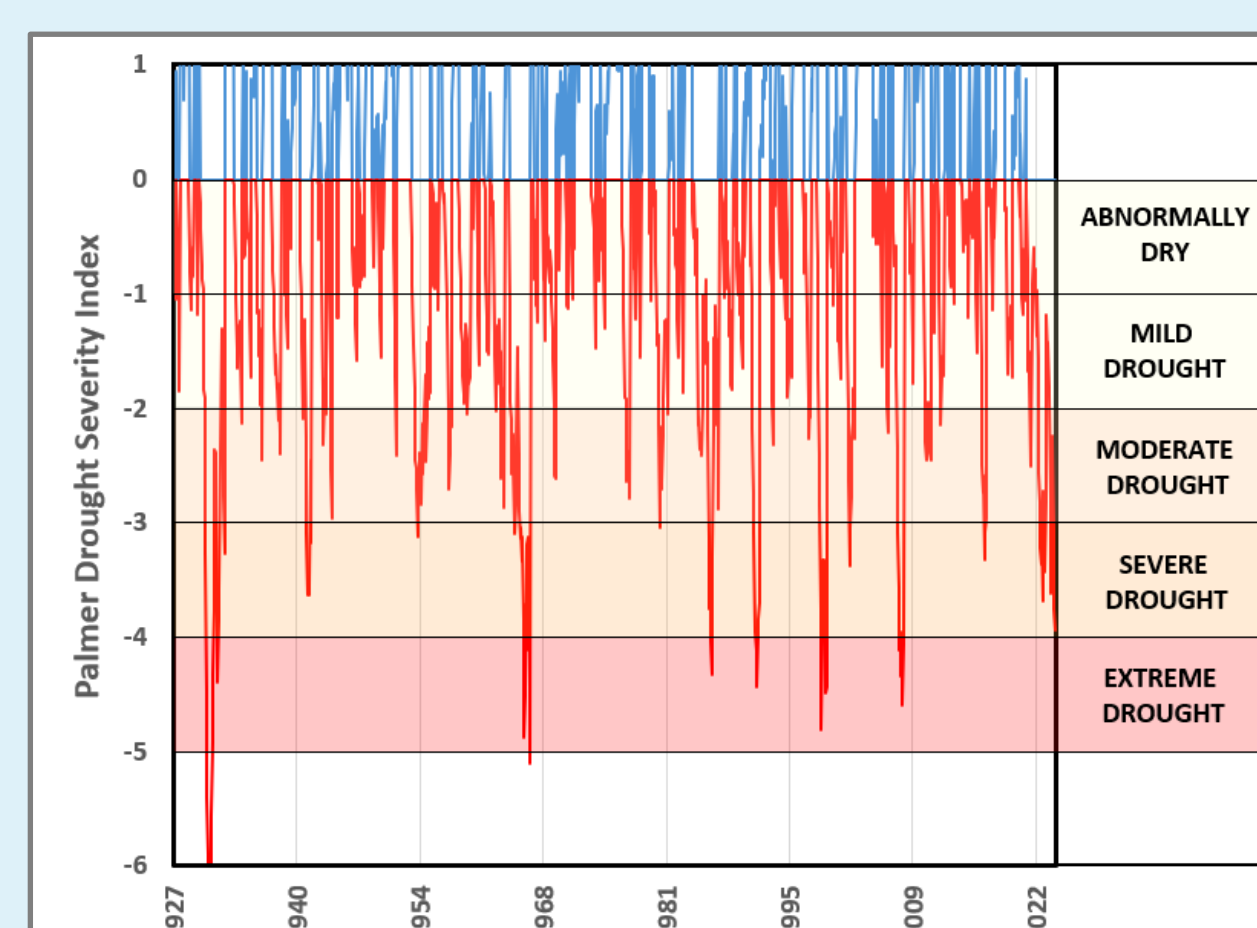
Findings

- The groundwater supply In Loudoun County, Virginia is vulnerable to disruption.
- It is increasingly stressed by both natural and human factors.
- Loudoun's wells are increasingly competing with each other.



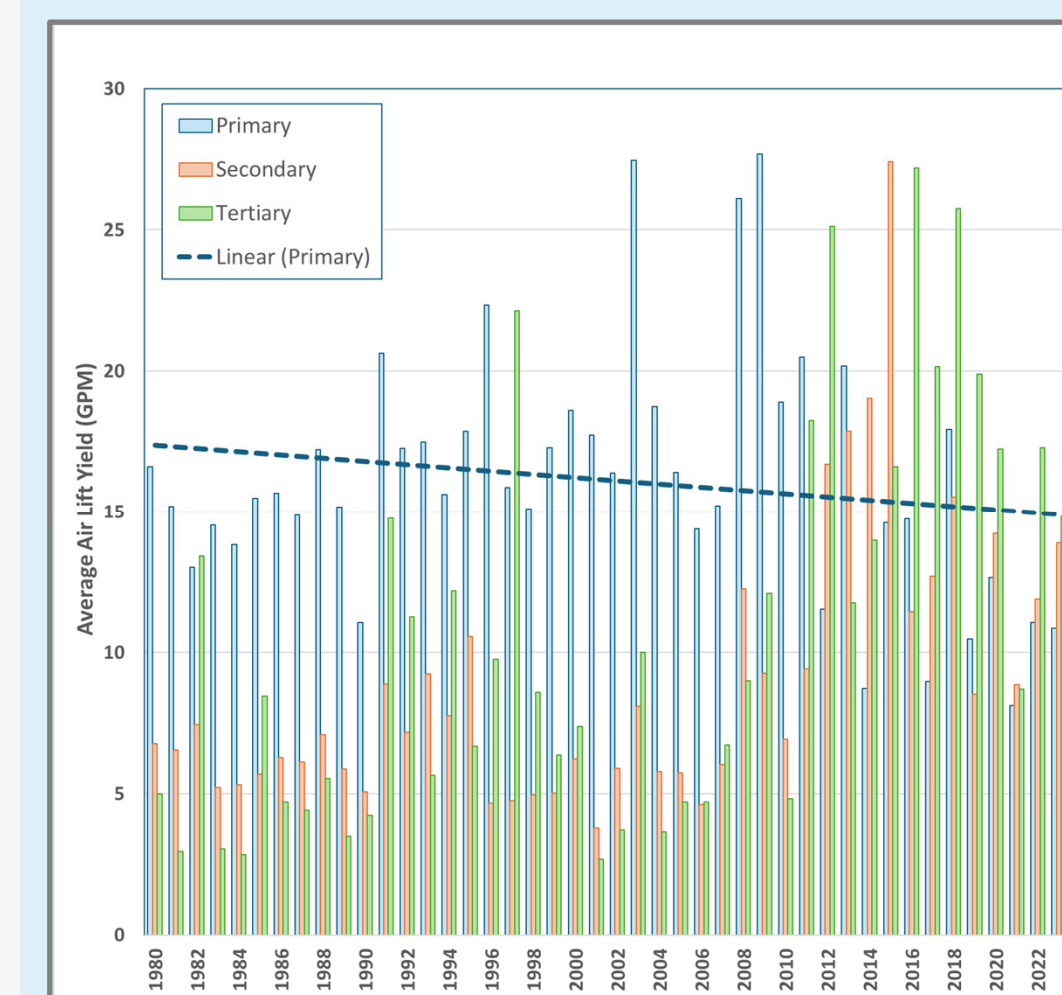
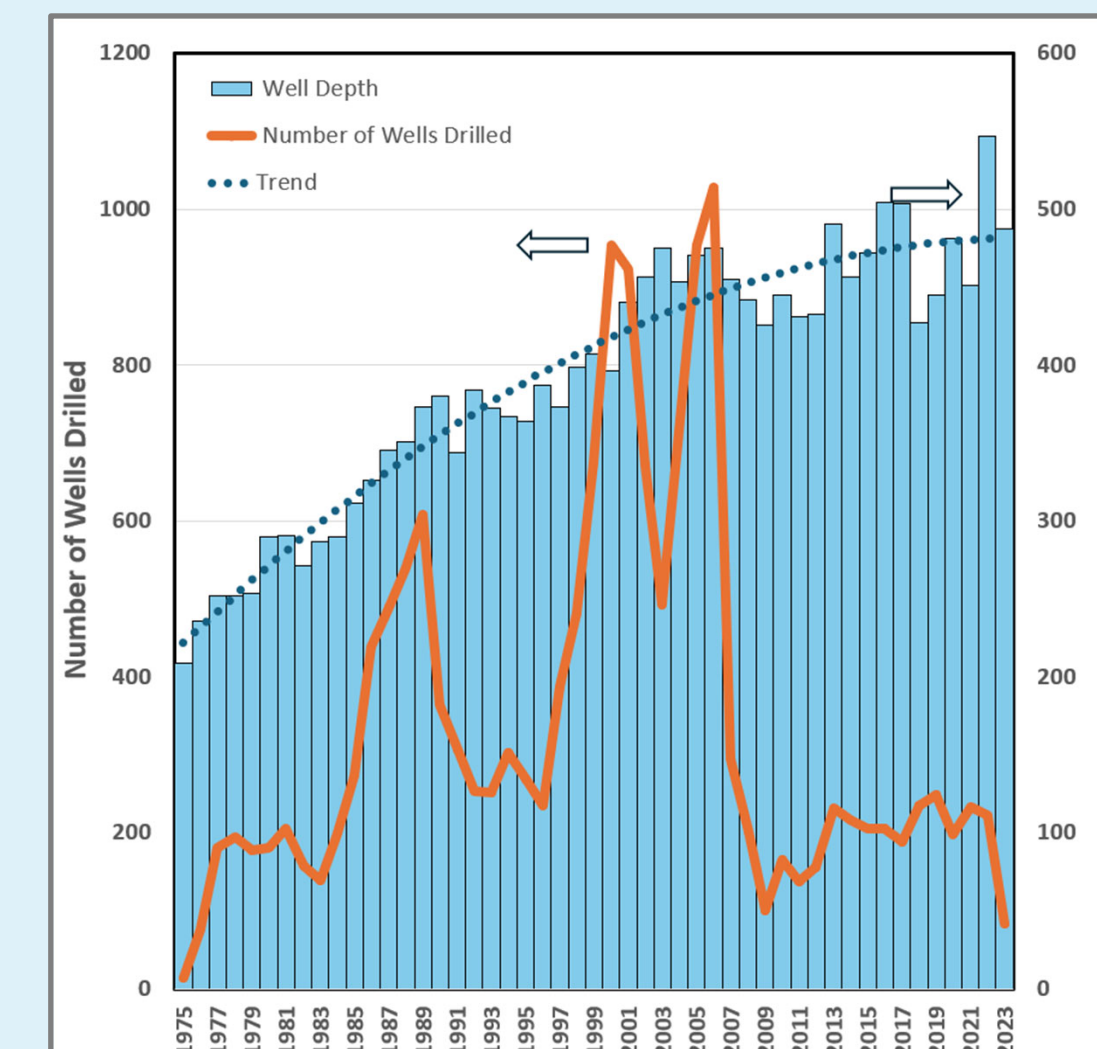
Drought

- Increased frequency of extreme droughts.
- Recently more prolonged drought periods.
- Historic (1930, 1941 and 1999).

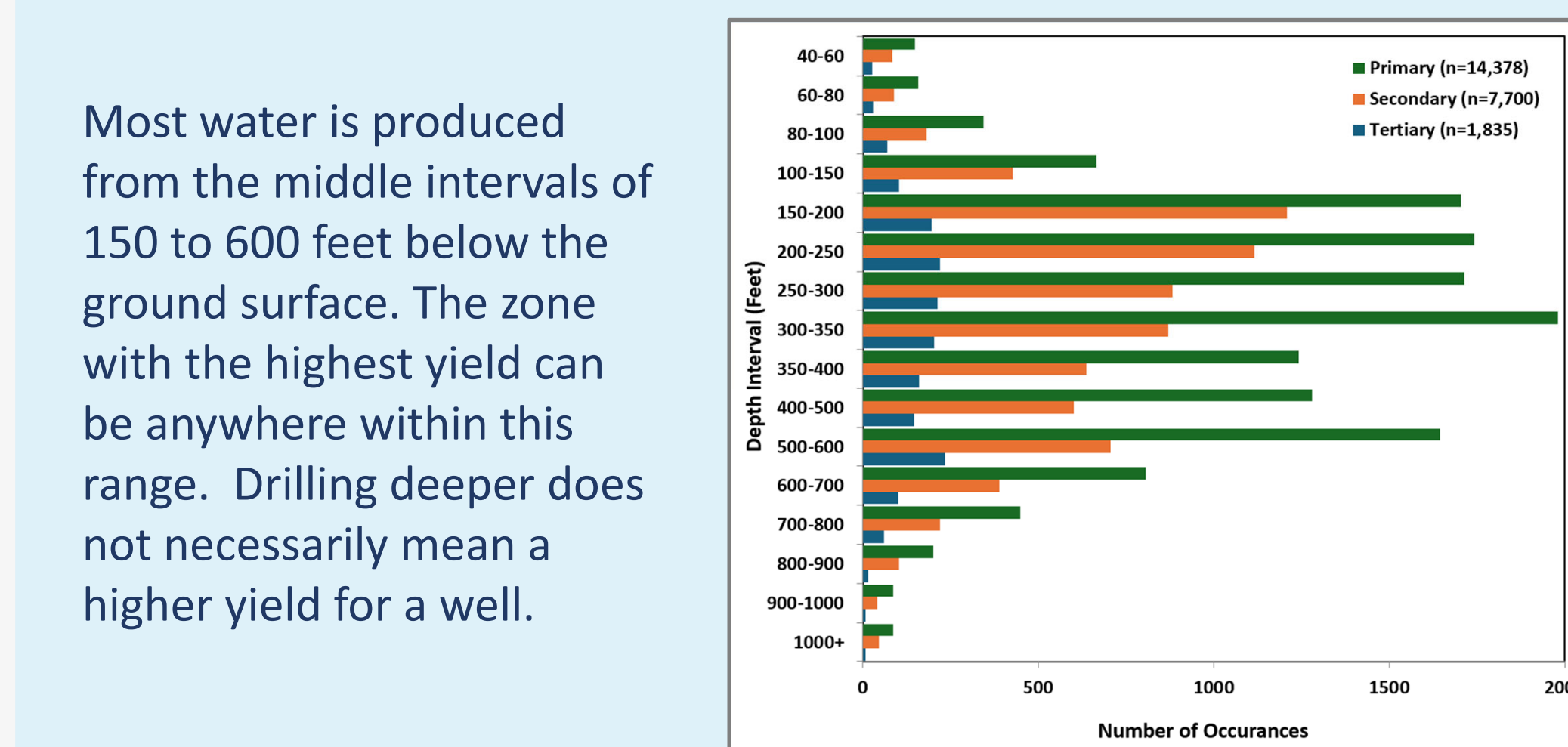


Basic Understanding of Groundwater Water Supply

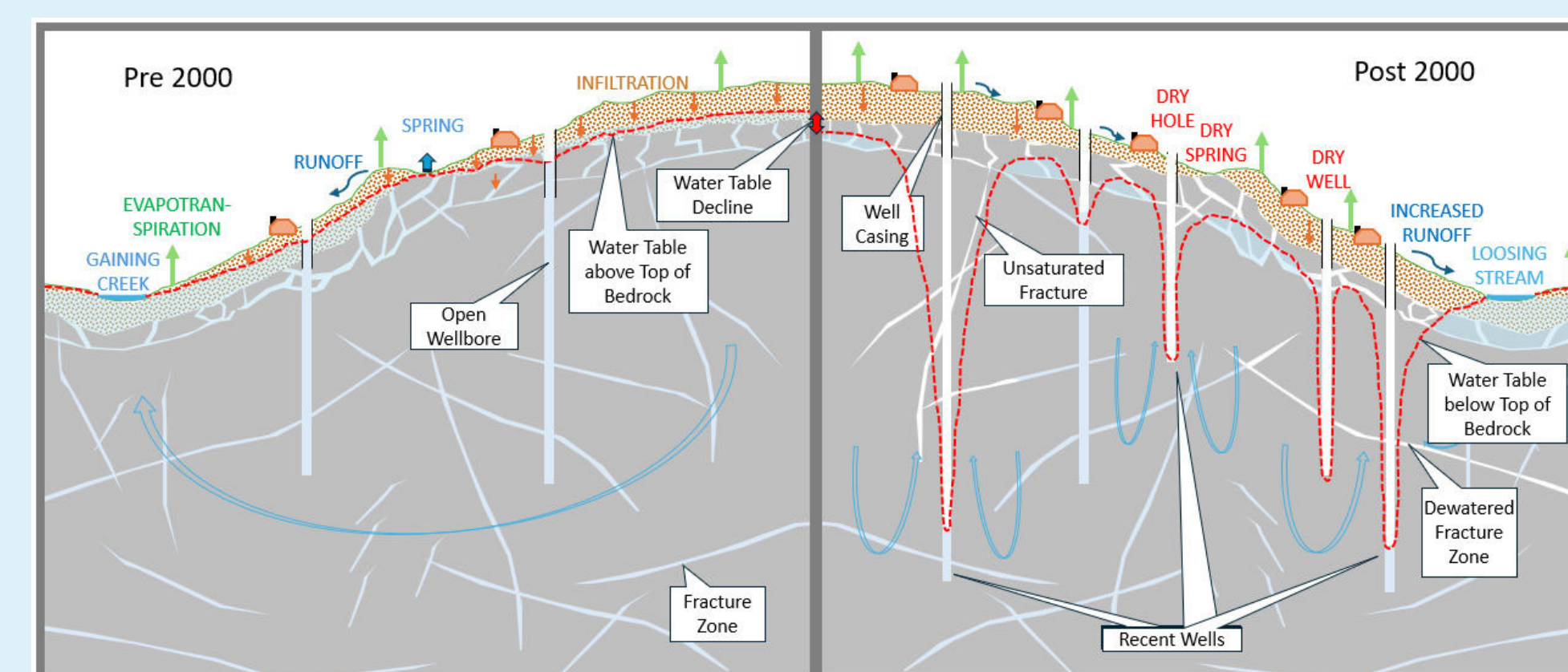
- Over time wells are drilled deeper to find more water.
- Recent average well depth was 500 feet.
- Water is not normally found below 1,200 feet as fractures are squeezed shut.
- 3,200 wells have been abandoned.



Well yields (air lift from about half of the 23,000 wells) have shown a decline of 9 percent over time.



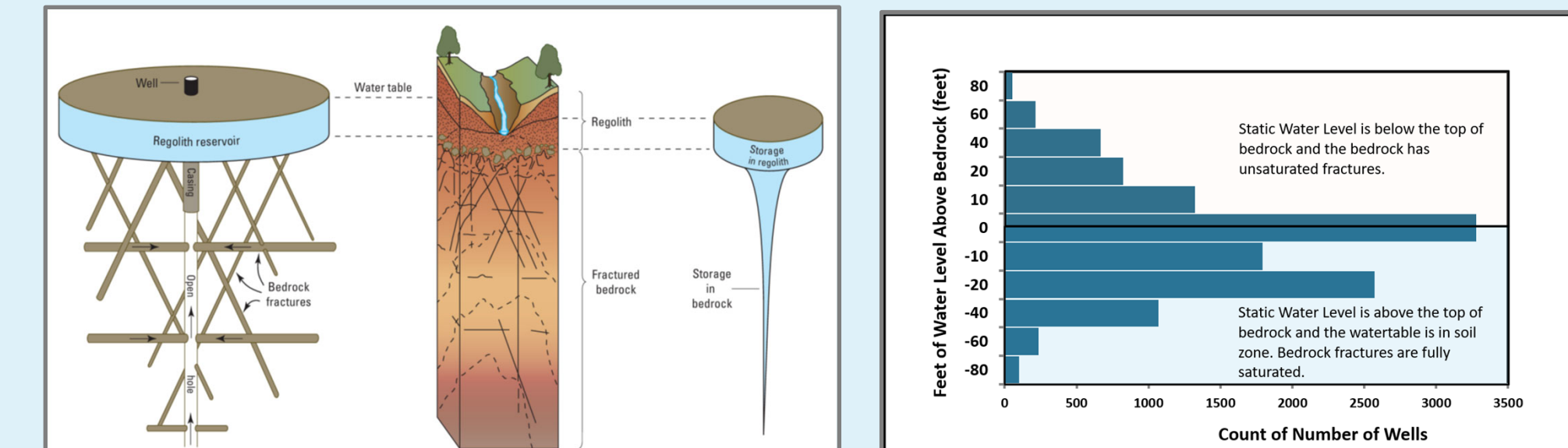
Changes Before and After 2000



- Wells are drilled deeper.
- Surface runoff has increased, Infiltration (recharge to groundwater) has decreased.
- Some wells and springs have permanently gone dry.
- The elevation of the water table has dropped from mostly above the top of bedrock elevation to below the top of bedrock.
- Groundwater storage within the weathered bedrock has diminished.

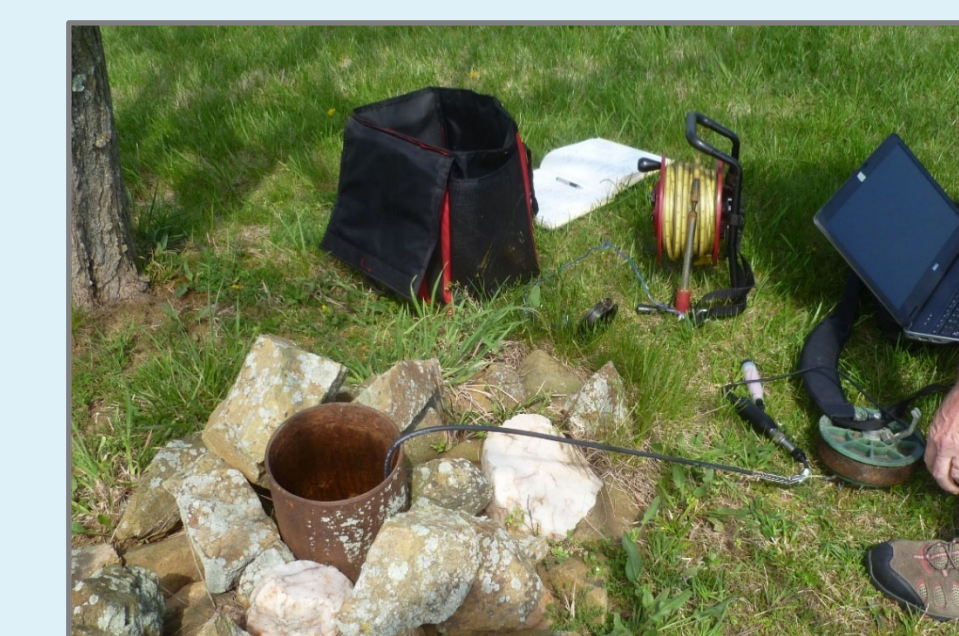
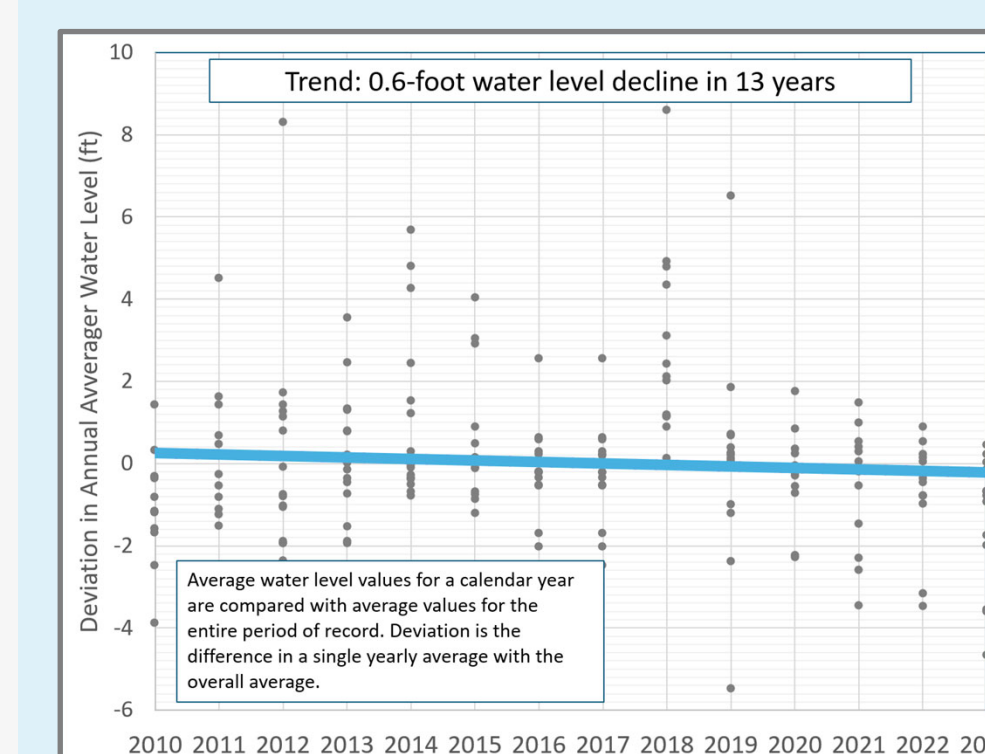
Groundwater Storage

- Two-component groundwater system.
- Overburden/saprolite is the dominant water storage reservoir.
- When the recharge rate is low, the water table falls below the top of bedrock resulting in much less stored water.



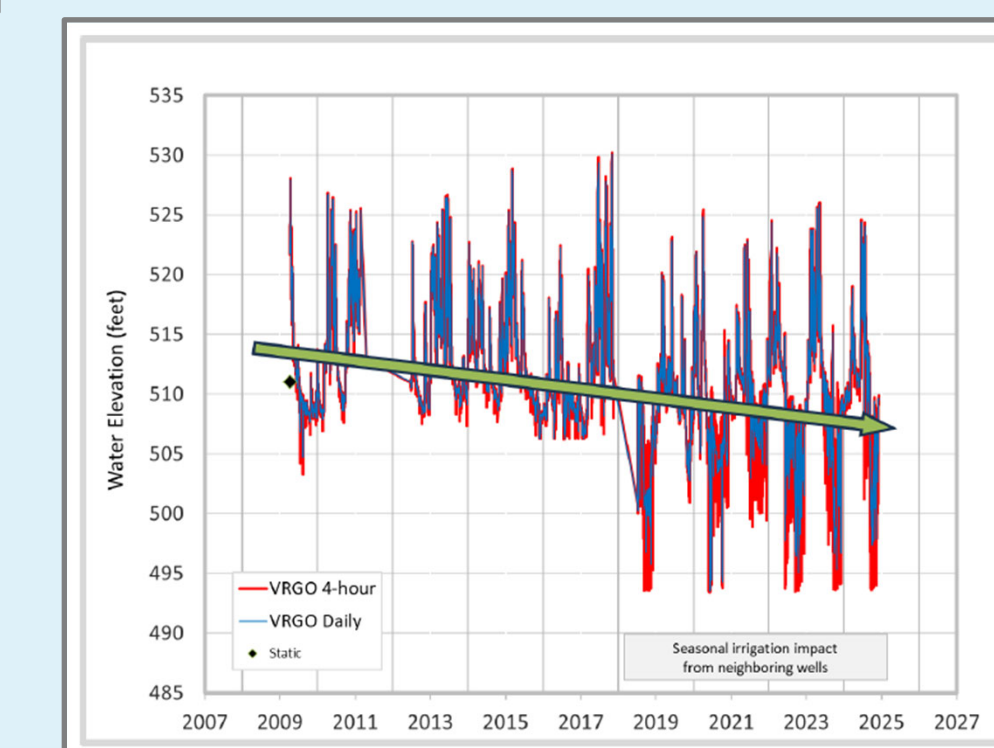
Groundwater Water Level Monitoring

Loudoun County Groundwater Monitoring Program

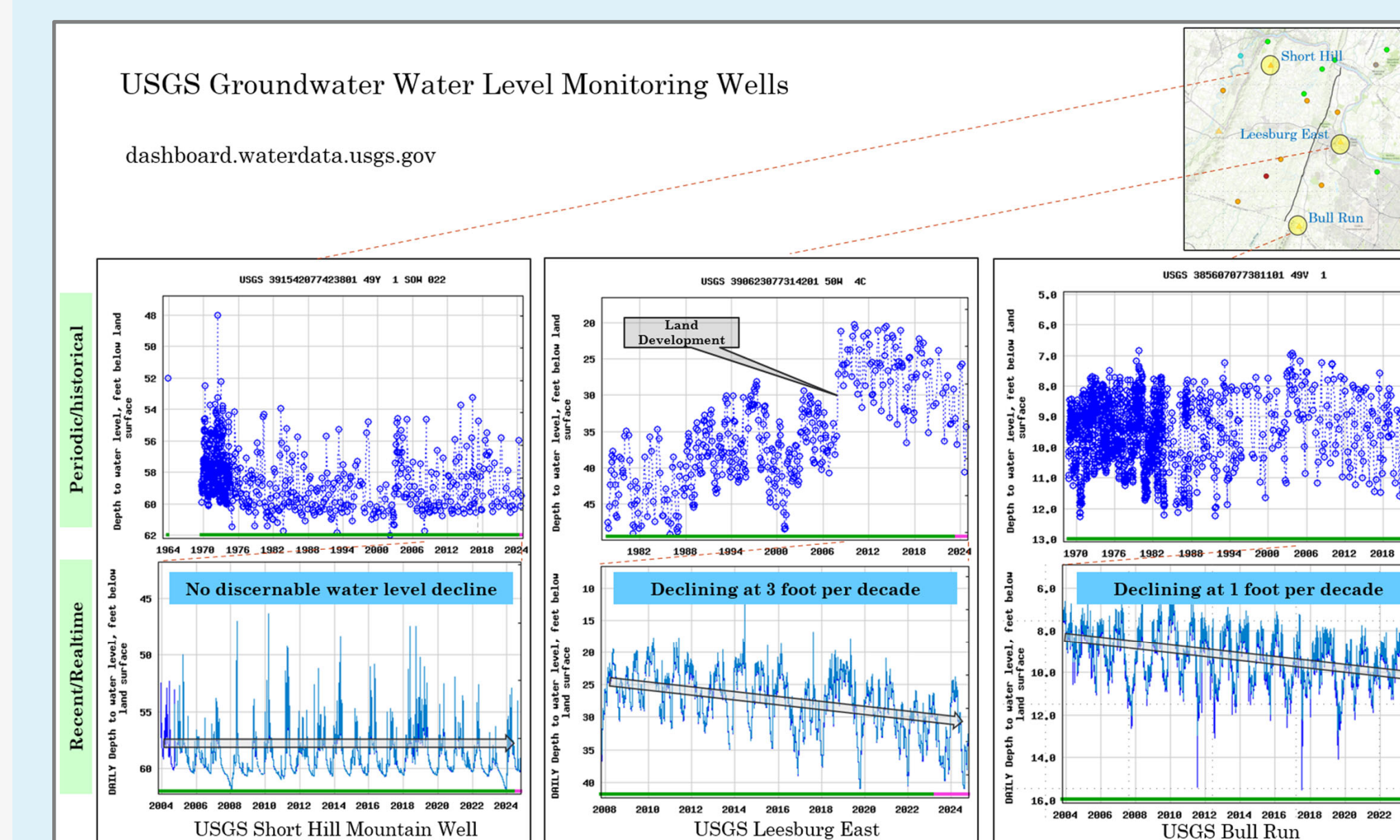


Example:

- Impacted since 2018 by nearby irrigation well.
- Declined 6 feet in 16 years.
- Data collection every 4 hours shows pumping effects.

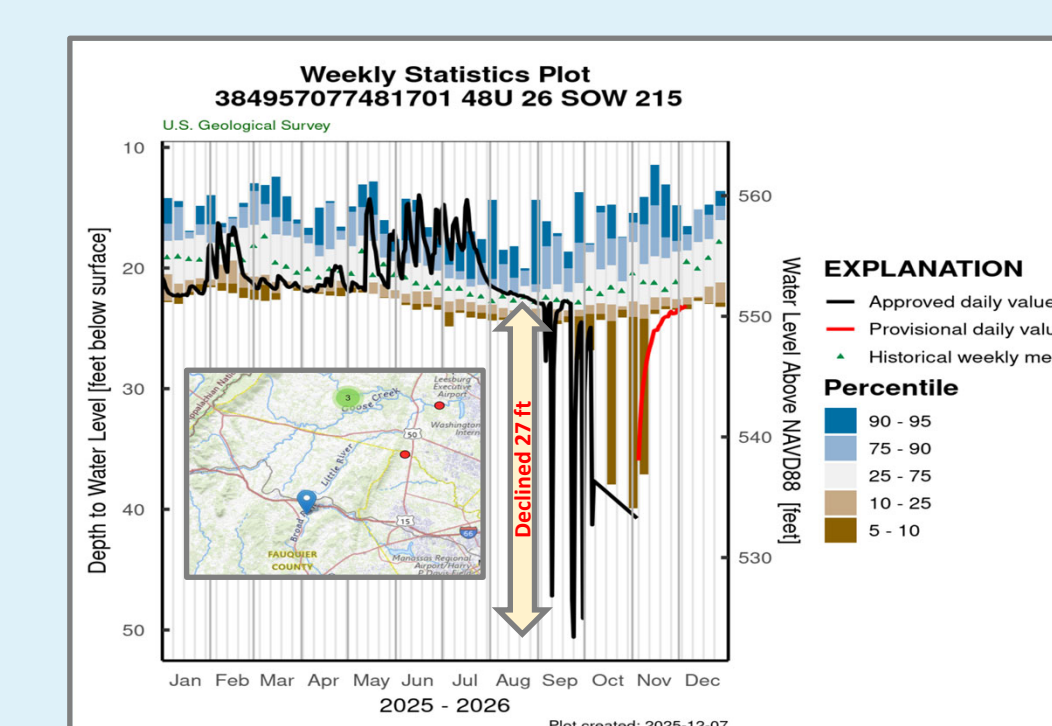


US Geological Survey Groundwater Monitoring Program

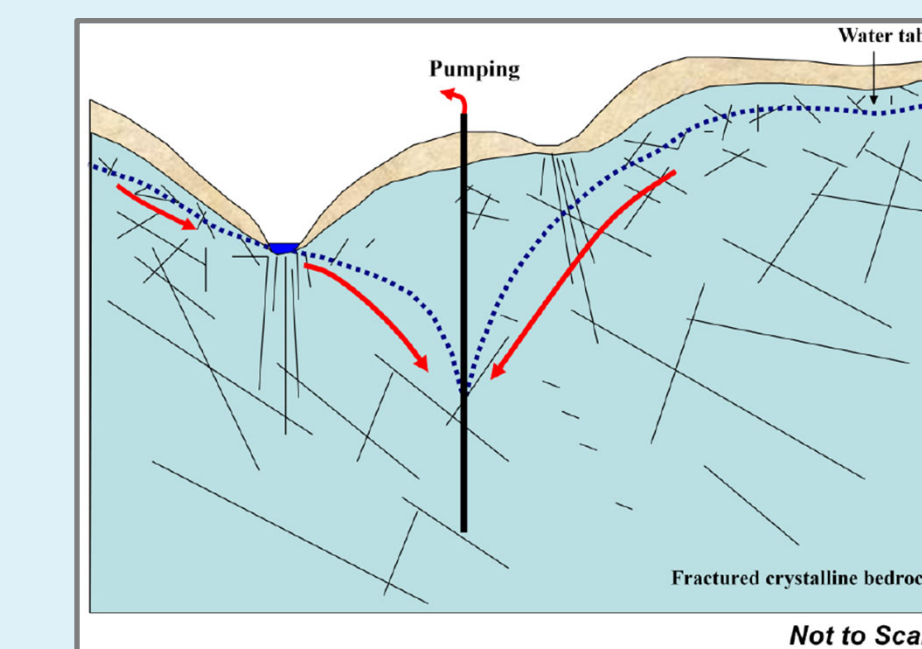


Loudoun County wells exhibiting long-term decline in water levels.

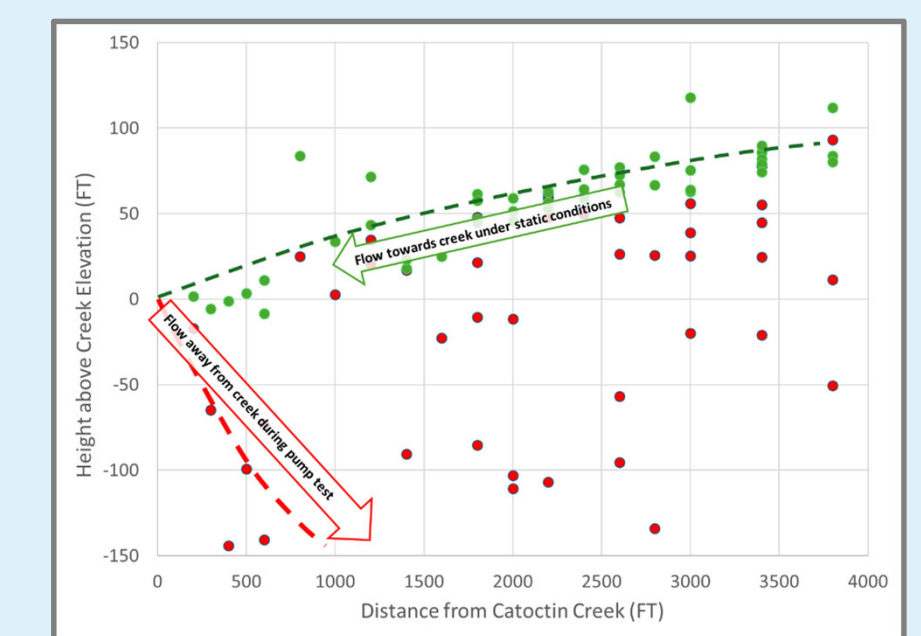
Fauquier County well recently is significantly impacted by irrigation well 300 feet away.



Pumping Changes Streams from Gaining to Losing

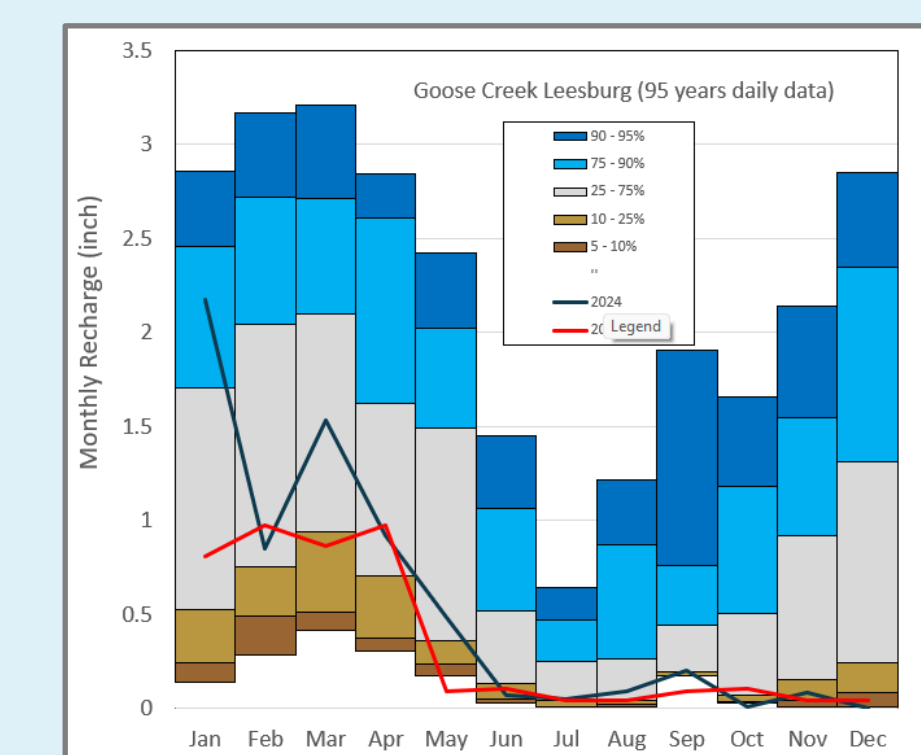
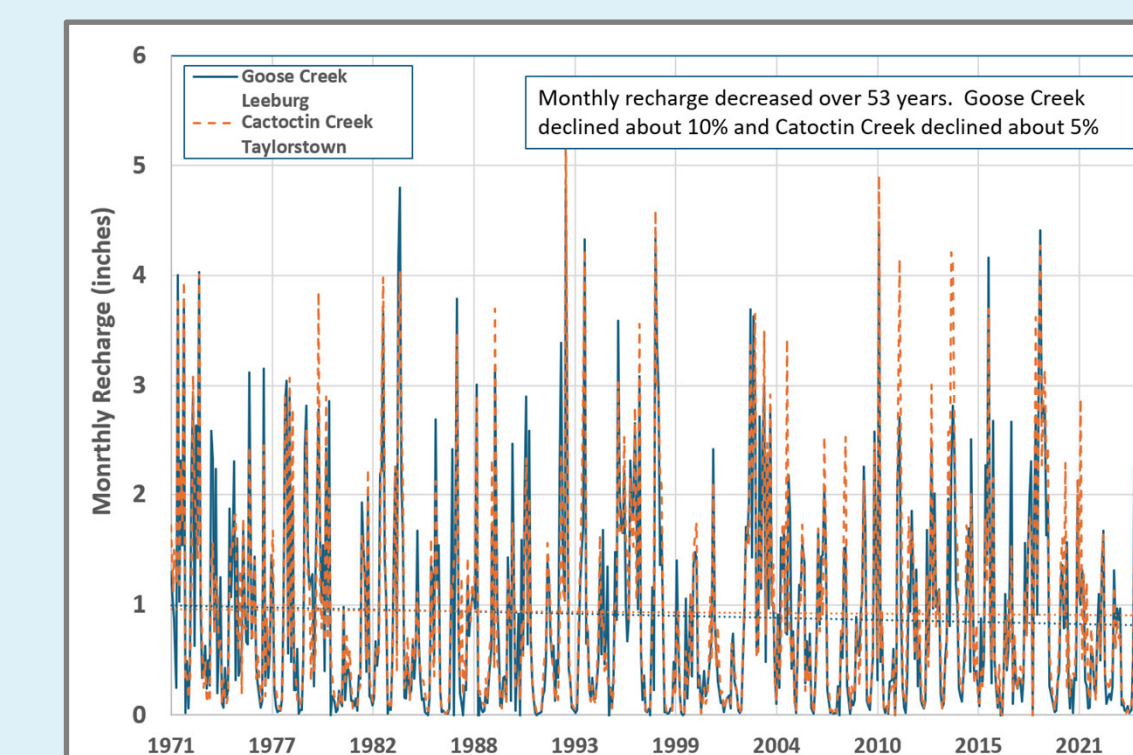


Stream depletion caused by nearby well.



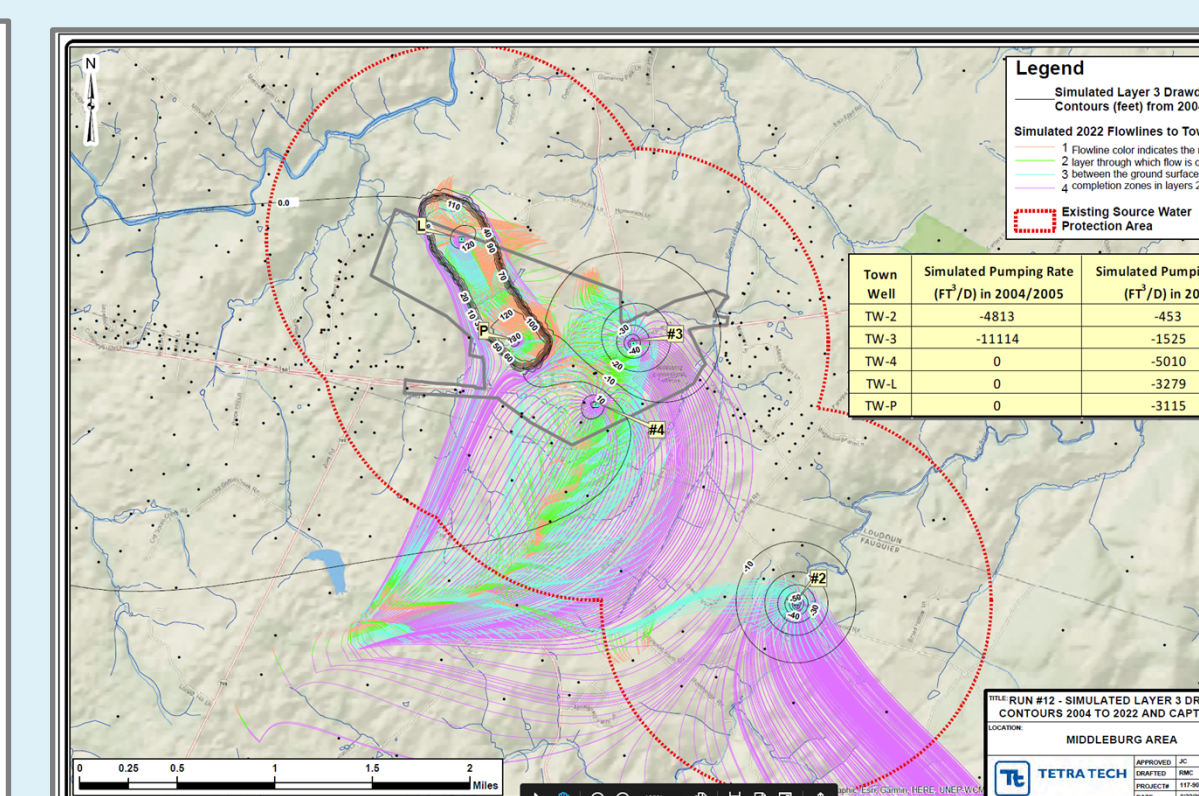
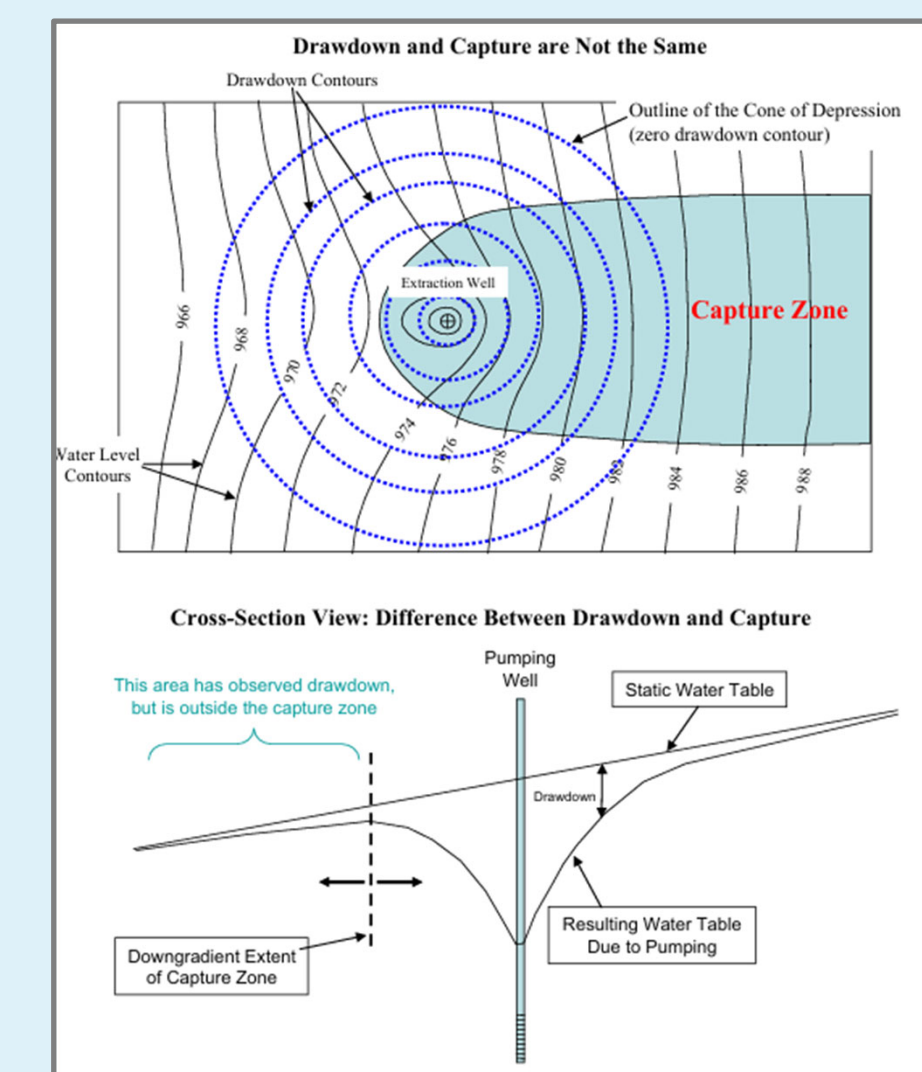
Flow reversal during pump test near Catoctin Creek.

Groundwater Recharge derived from Streamflow



Long-term decrease (5-10%) and significant monthly variations in groundwater recharge.

Drawdown versus Capture Zone



Capture zones using 3D numerical models identify areas where the groundwater originates from.

Conclusion

The "Assessment" provides compelling and scientifically defensible evidence that groundwater resources in Loudoun County are being impacted by continued growth, that there have been periods of significant drought which are anticipated to worsen in magnitude and frequency, and that groundwater as a water supply is no longer sustainable under existing practices, monitoring, management, regulation and planning. Adverse conditions for groundwater resources will only worsen with climate change.

References

Assessment of Groundwater Supply (8/24/2025), Frequently Asked Questions and Timeline are available at www.LoudounCoalition.org.

Contact and Resources

LoudounGroundwater@gmail.com
www.LoudounGroundwater.com
www.FaceBook.com/LoudounGroundwater
www.YouTube.com/@LoudounGroundwater