Understanding and Evaluating Nitrate Trends in Groundwater in Wisconsin

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Failure at the faucet: Nitrate in water widespread, current rules no match for it

KATE GOLDEN Wisconsin Center for Investigative Journalism Nov 15, 2015 11 min to read

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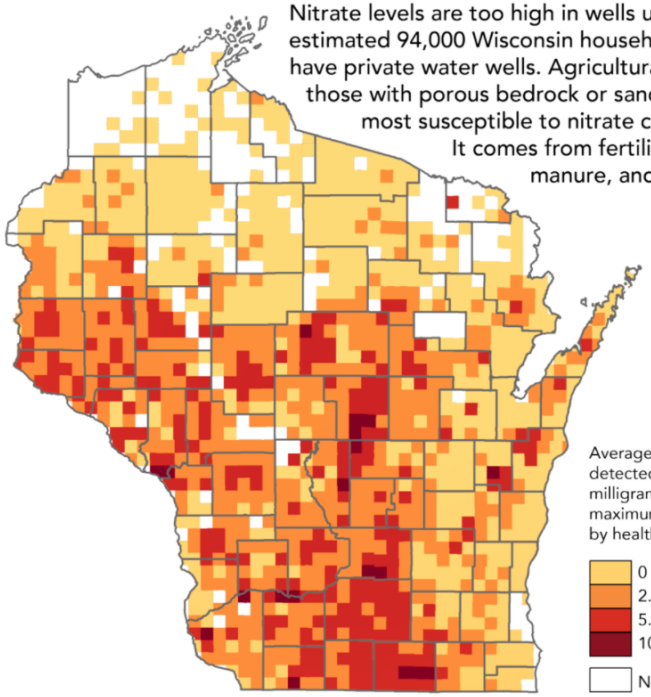
Nitrate in drinking water around Wisconsin

Nitrate levels are too high in wells used by an estimated 94,000 Wisconsin households that have private water wells. Agricultural areas and those with porous bedrock or sandy soil are most susceptible to nitrate contamination. It comes from fertilizers, including manure, and other sources.



CREDIT: Katie Kowalsky/Wisconsin Center for Investigative Journalism

SOURCE: Well Water Quality Viewer, University of Wisconsin-Stevens Point's Center for Watershed Science and Education. Private Drinking Water Quality in Rural Wisconsin, Journal of Environmental Health, 2013.

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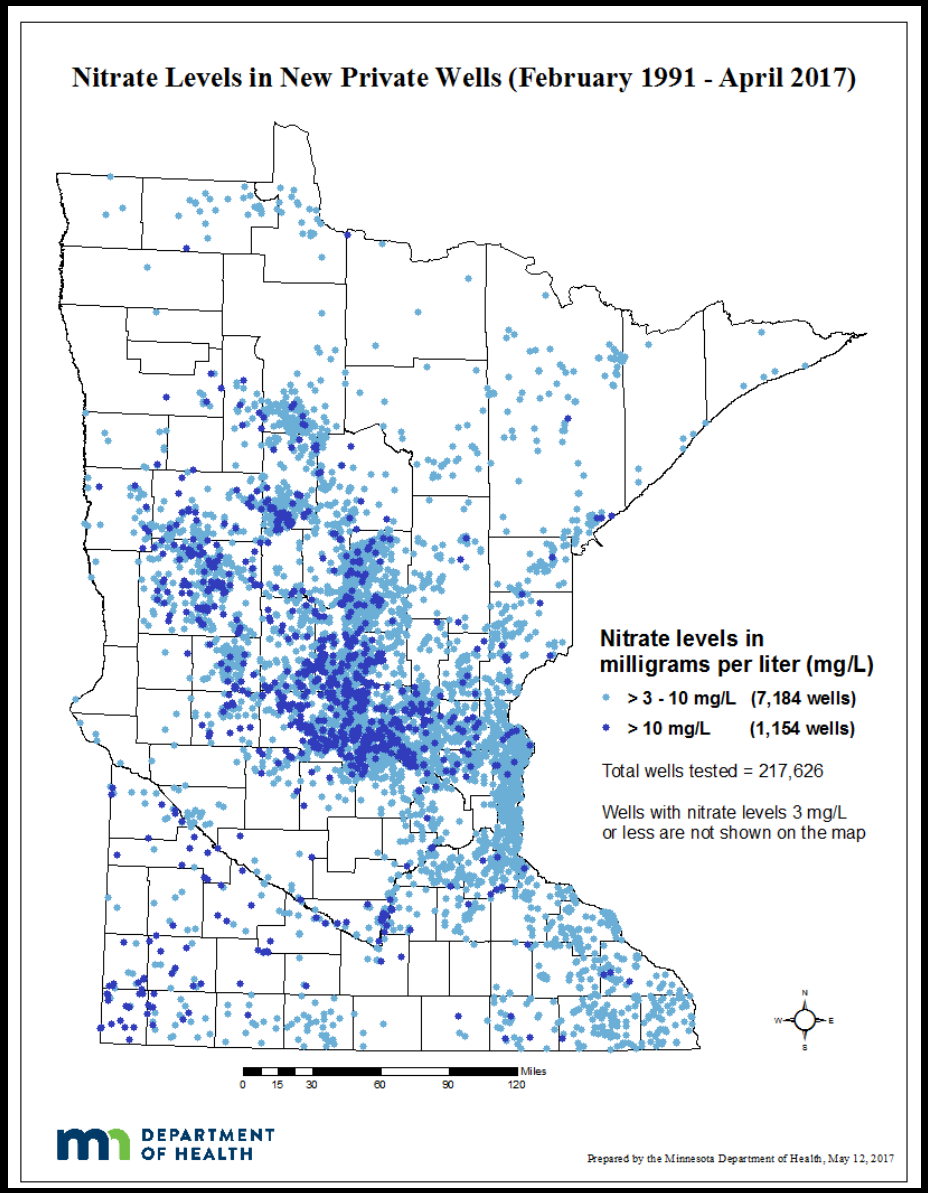

Minnesota Department of Health, 2017

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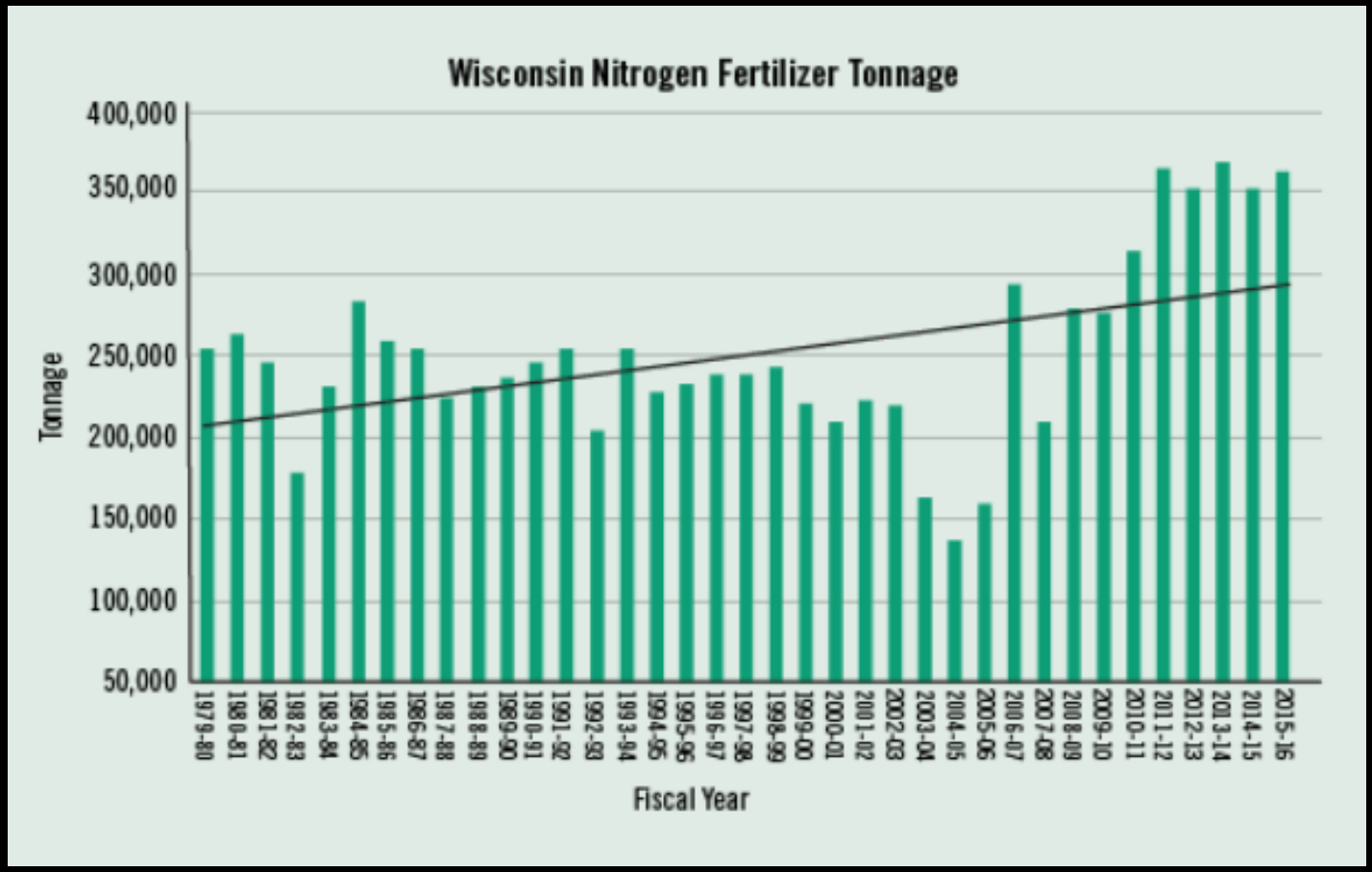

WI Land and Water Conservation Assoc., 2017

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National Water Quality Assessment

Overall objective: Describe water-quality status and trends to improve our understanding of NATURAL and ANTHRPOGENIC factors affecting water-quality conditions in our Nation's aquifers

Decadal networks

↓

Flow system study

↓

Enhanced trends network

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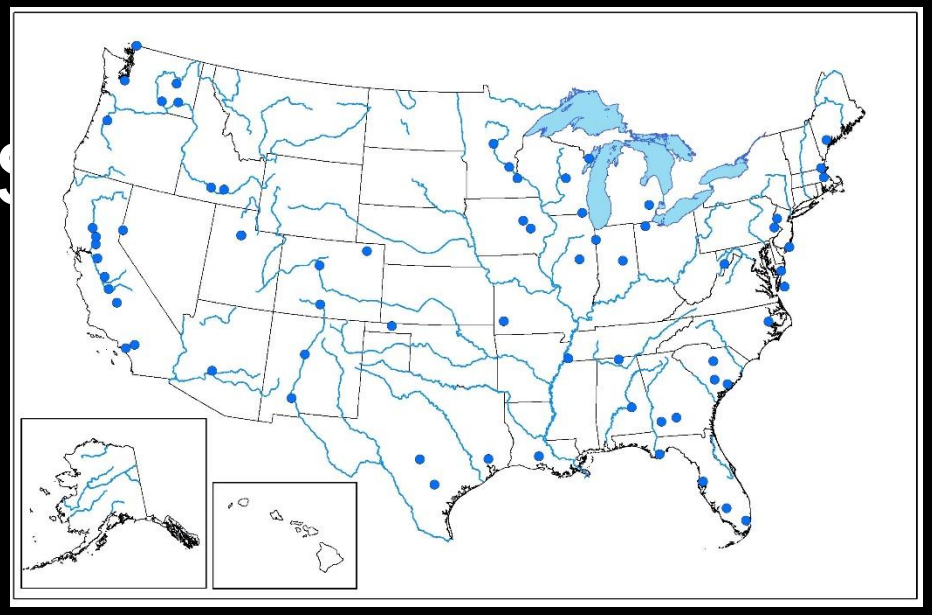
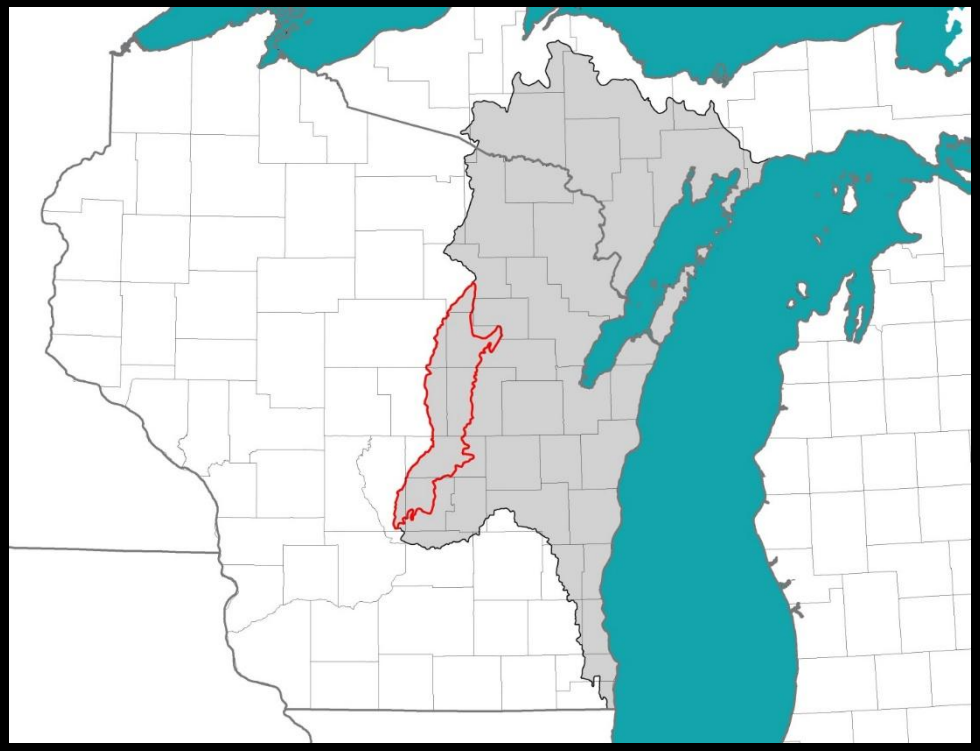
Decadal networks

Land-use effects or major aquifer study

Near decadal sampling of 30 well networks

Wide analyte list (including age-tracers)





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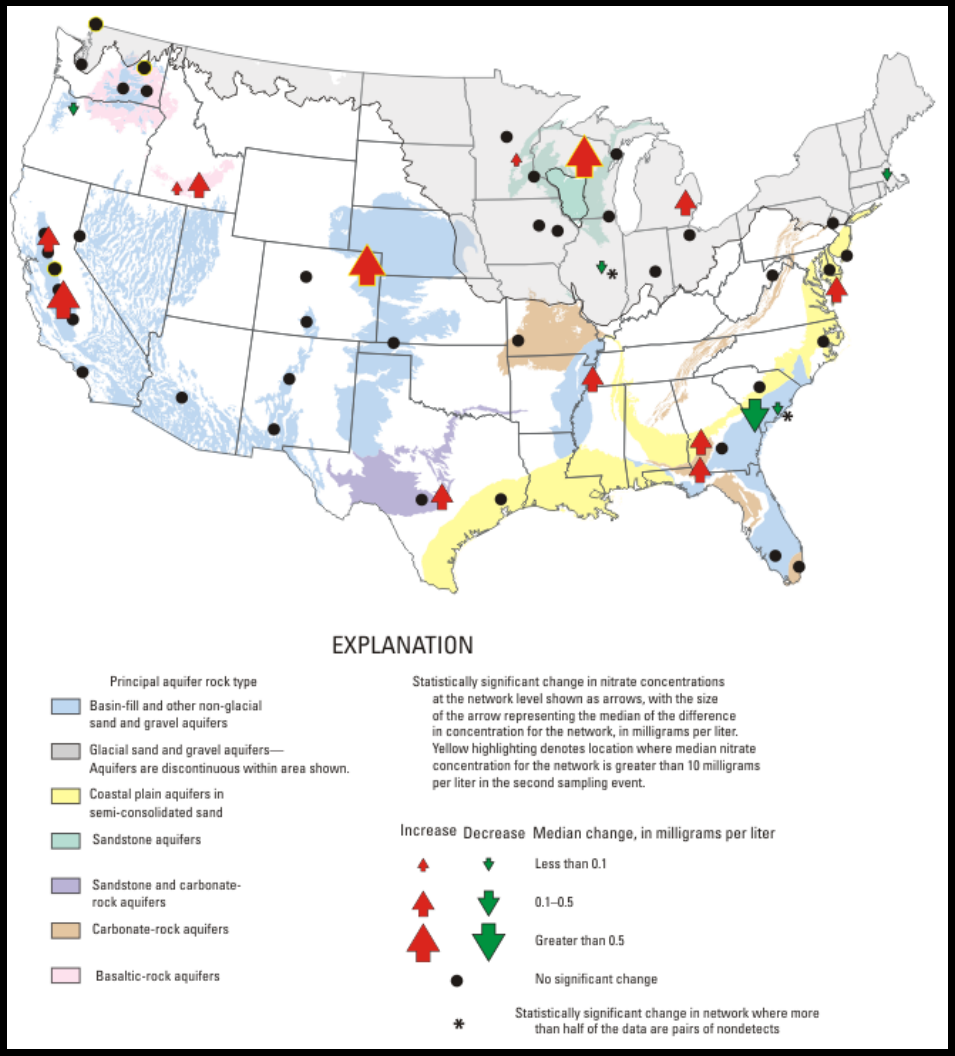

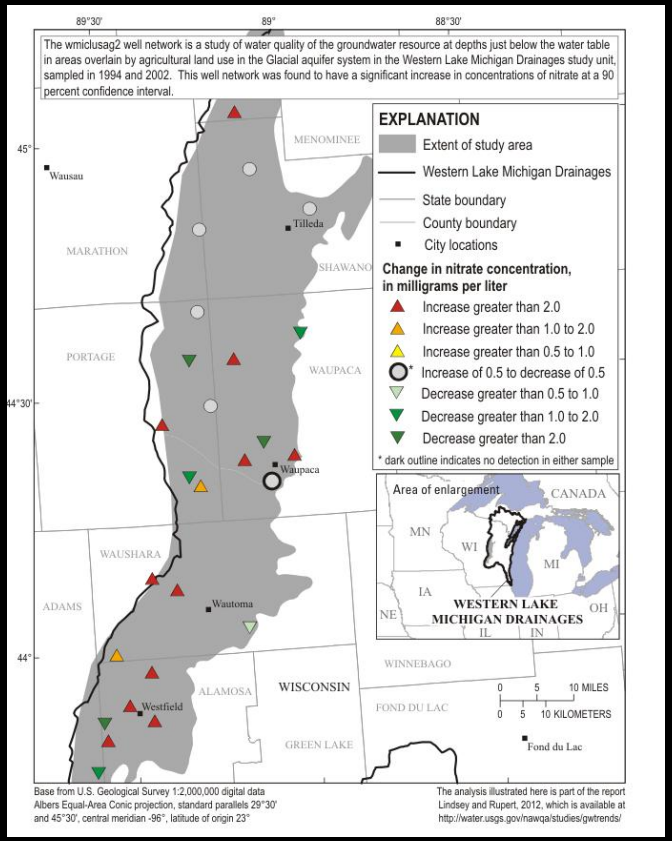

https://nawqatrends.wim.usgs.gov/Decadal/

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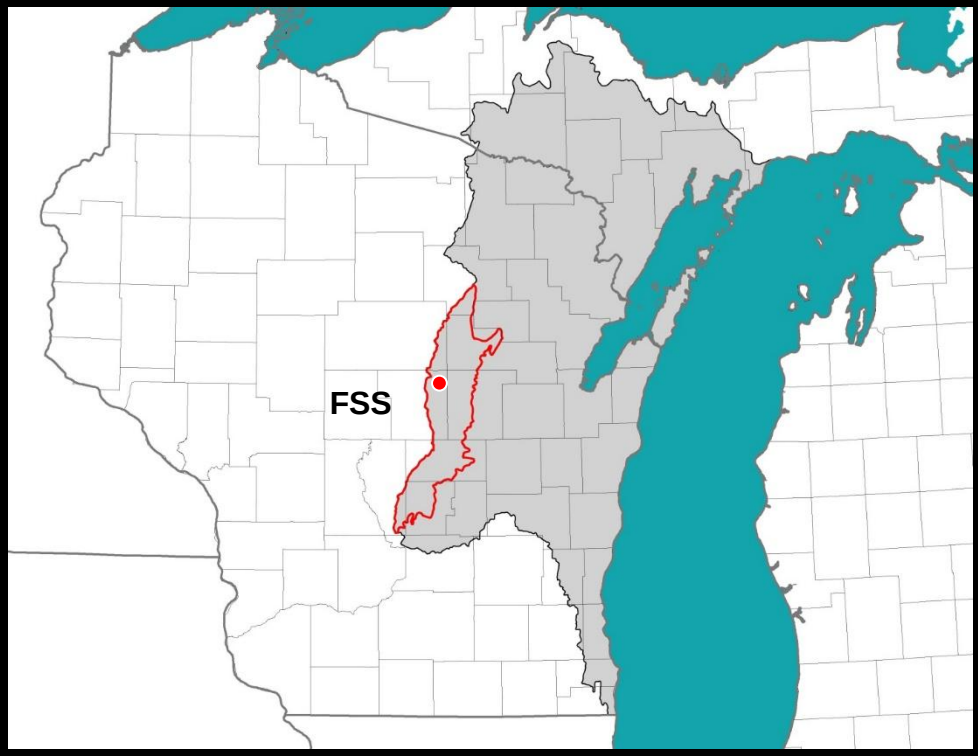
Flow system study

- Ag effects on gw quality throughout aquifer at a local scale
- 4 sets of nested wells over small area
- multiple depths
- single sample
- age dating included



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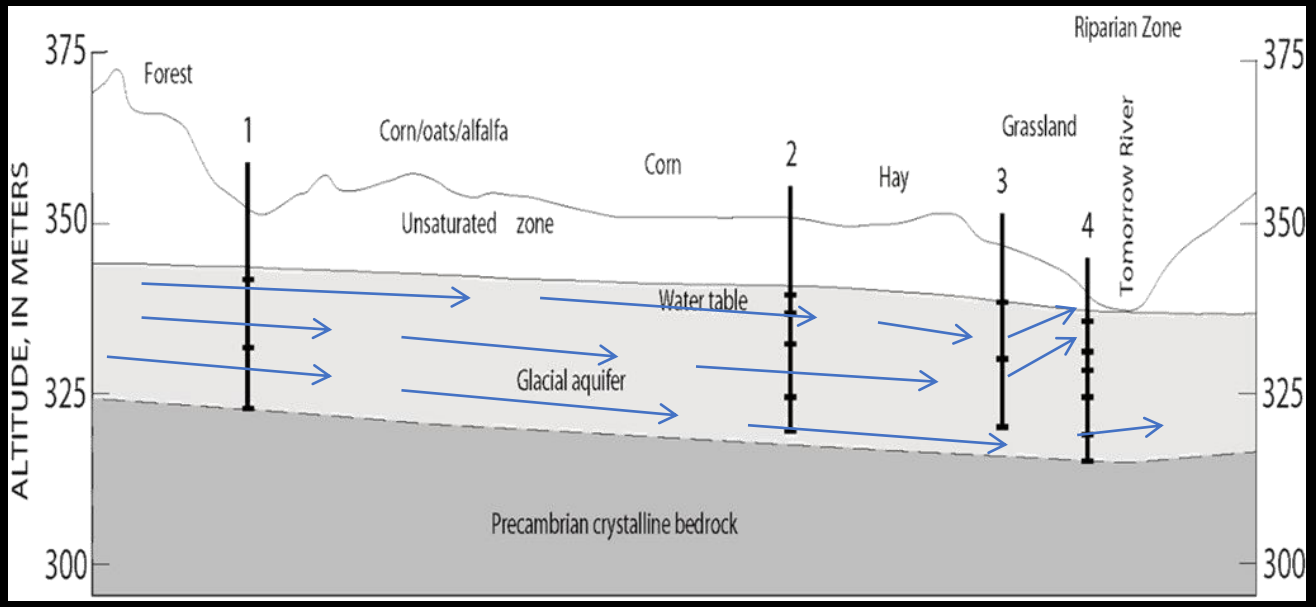

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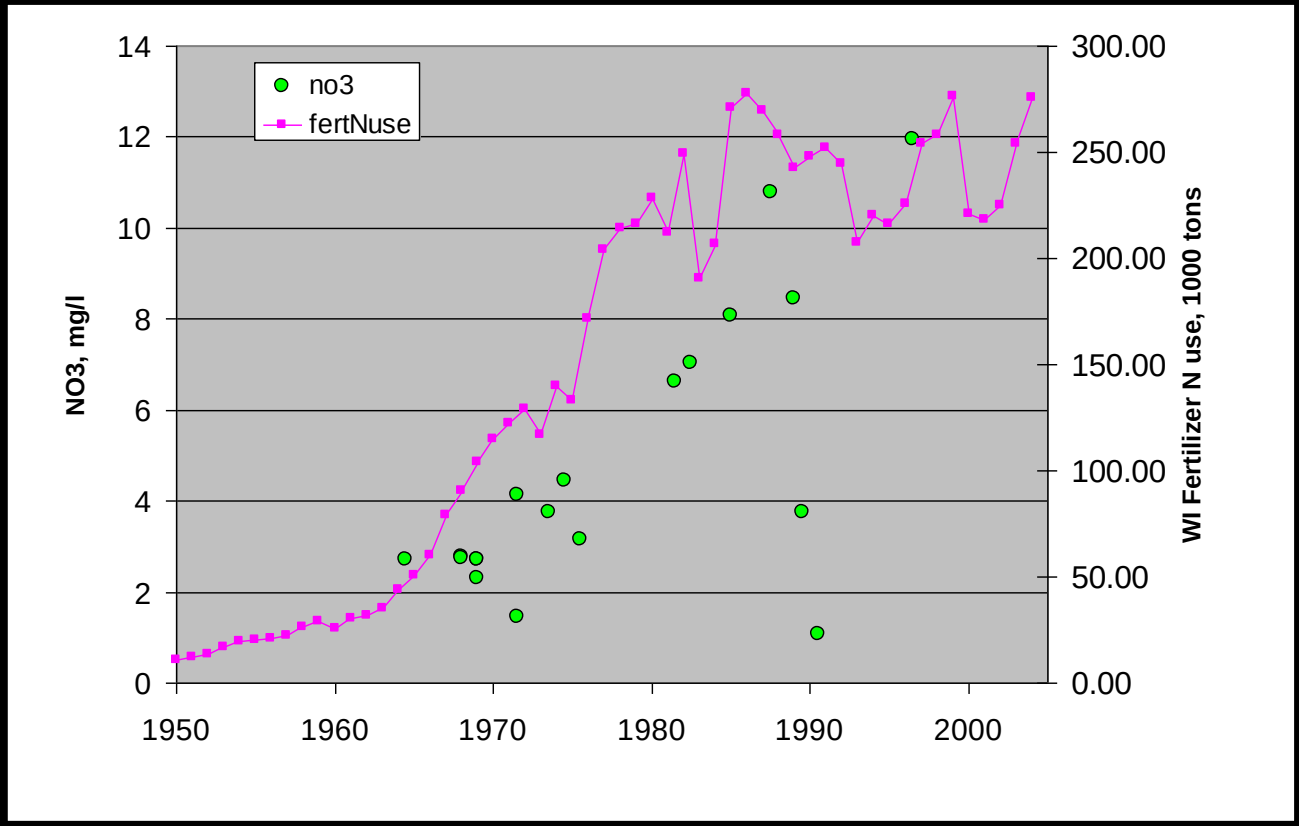

Saad, 2008

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Conclusions of the Flow systems study

- Better understanding of source water and the quality of water
- Chemical inputs to the land surface do not uniformly affect concentrations throughout the aquifer
- Age-tracers help us to establish correlations with historical chemical use and climate data
- Likely increase in NO3 with depth as it penetrates deeper into the aquifer

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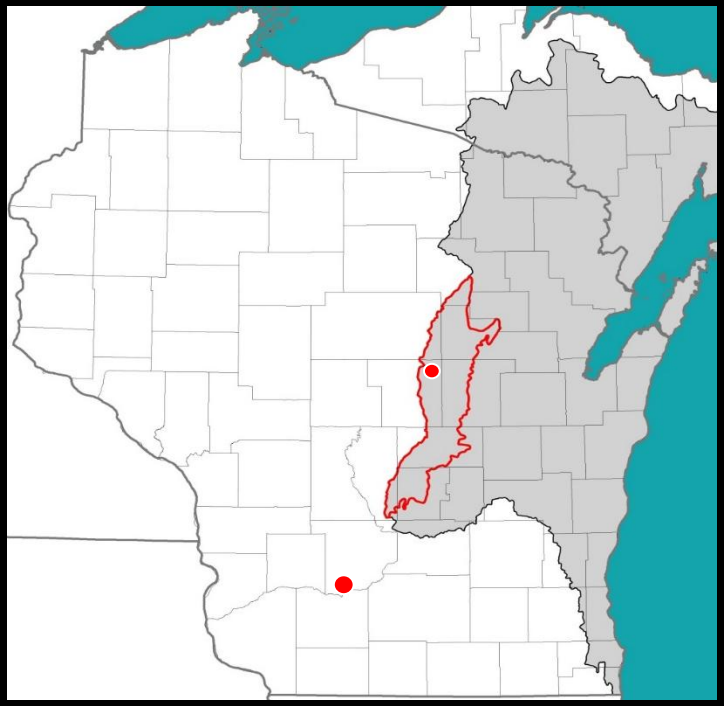
Enhanced Trends Network



What is the temporal variability of NO3 immediately downgradient from ag?

What is the timeframe for response?

What gw quality trends result from changes in current land-use practices?

What other factors cause short-term trends or variability?

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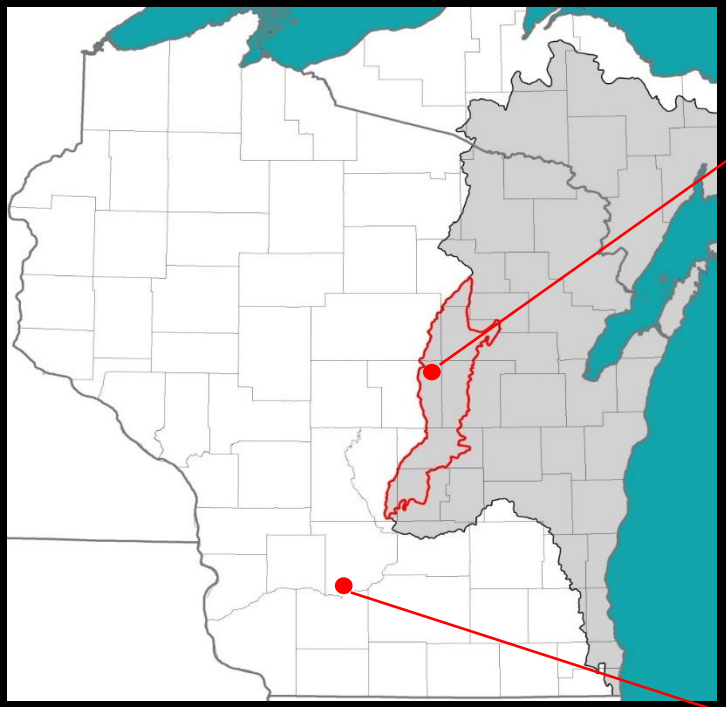
Enhanced Trends Network



Tomorrow River
2 monitoring wells (35 and 83 ft)

Monitoring equipment
- Aquatroll (WL, temp)
- YSI EXO (SC, pH, DO)
- SUNA (NO3)(TMRW R only)

Discrete WQ samples
- Annual samples from 2014-2017
- Bimonthly samples 2018-2022

Spring Green
1 public supply well (125ft)
1 monitoring well (50ft)

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ETN site-Tomorrow River

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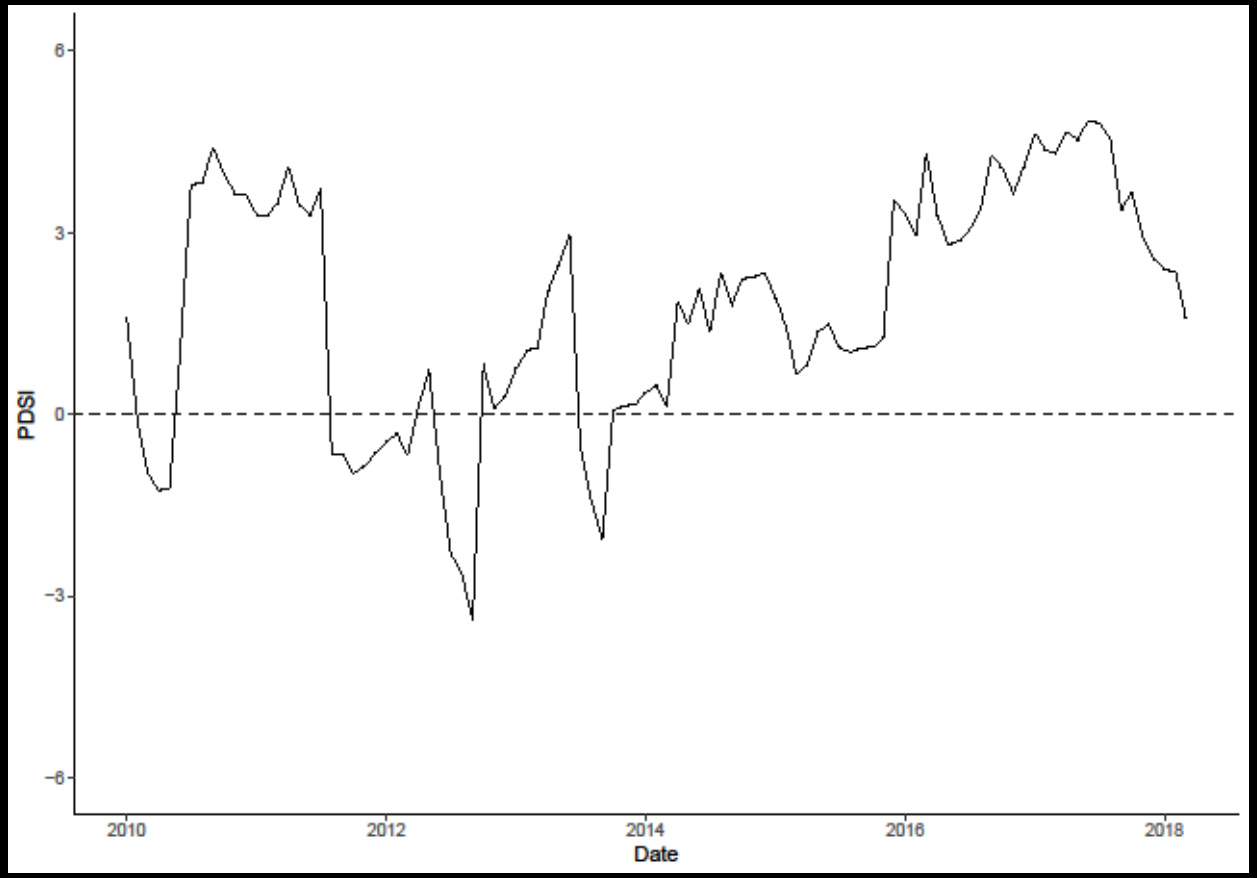
Climate variability-Palmer Drought Severity Index

Tomorrow River, Central WI



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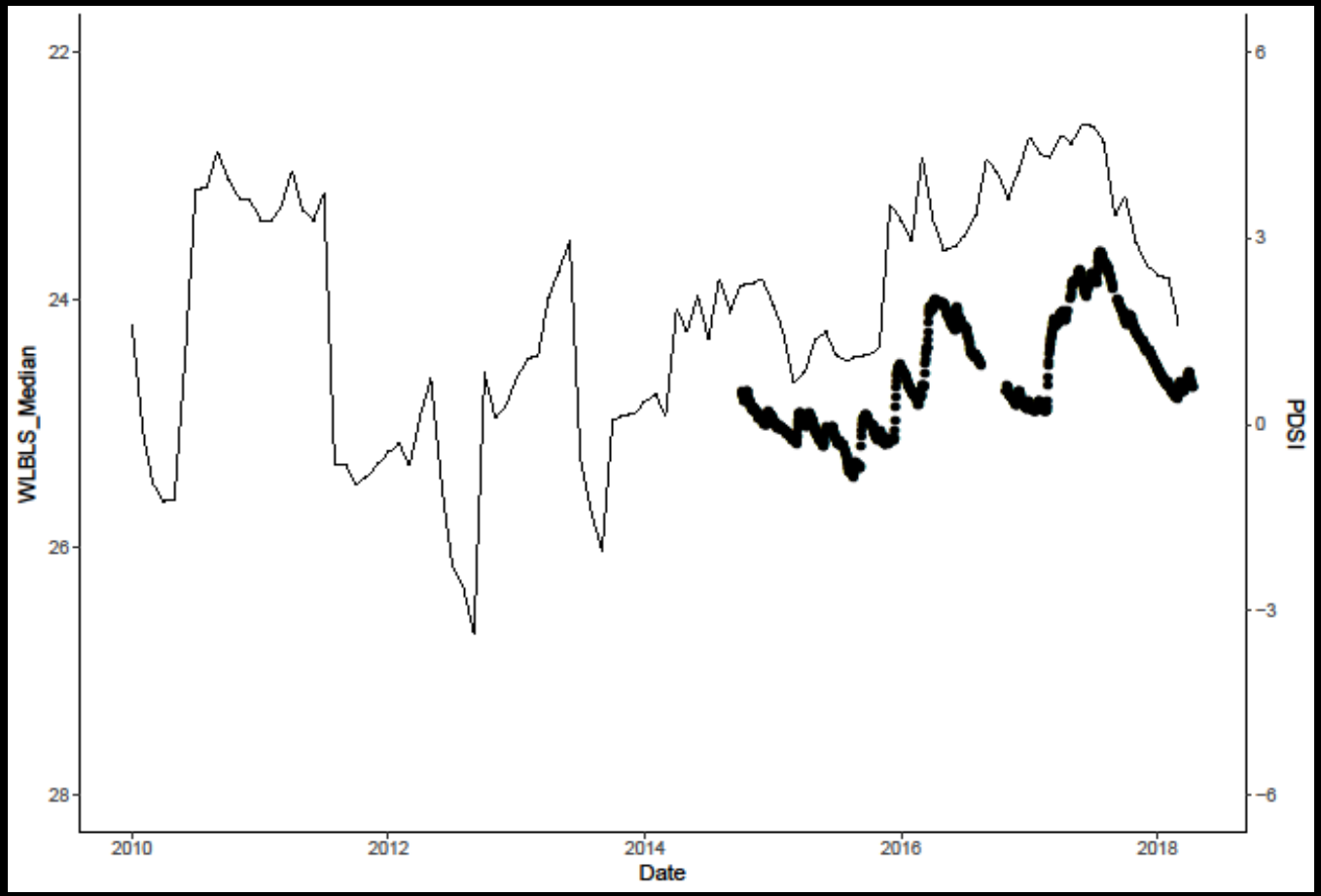
Tomorrow R shallow well

Climate variability



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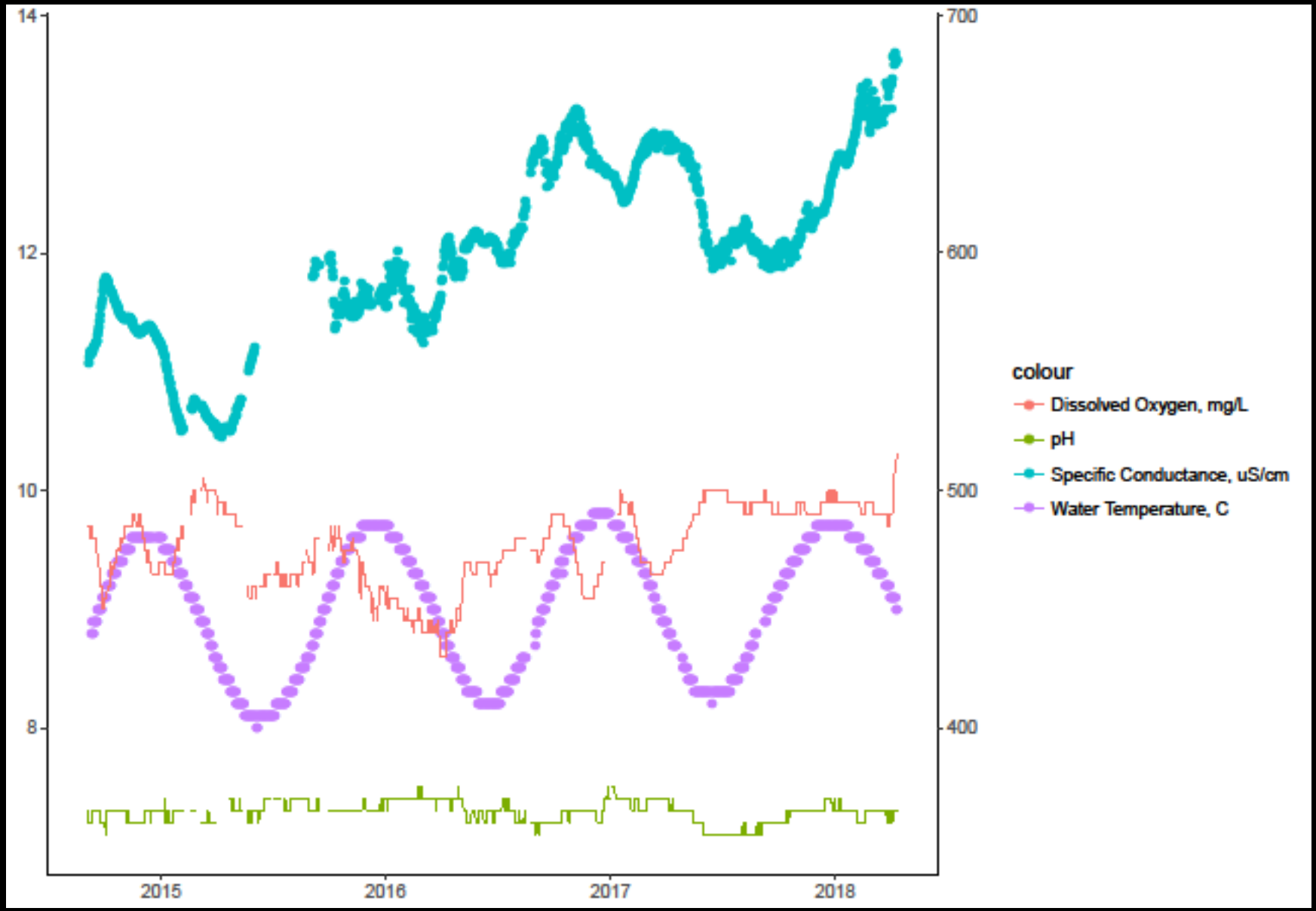
Tomorrow R shallow well



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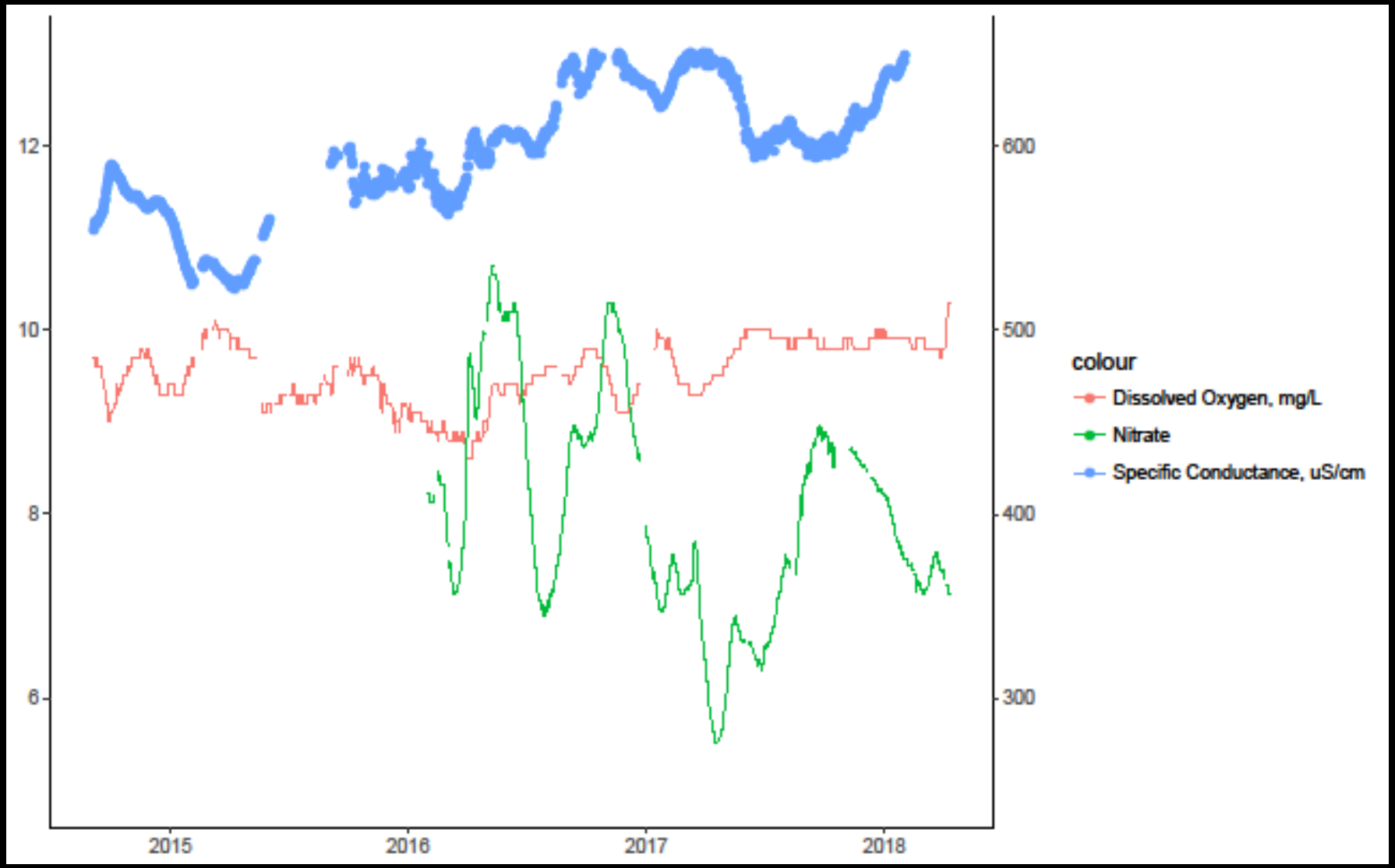
Tomorrow R shallow well



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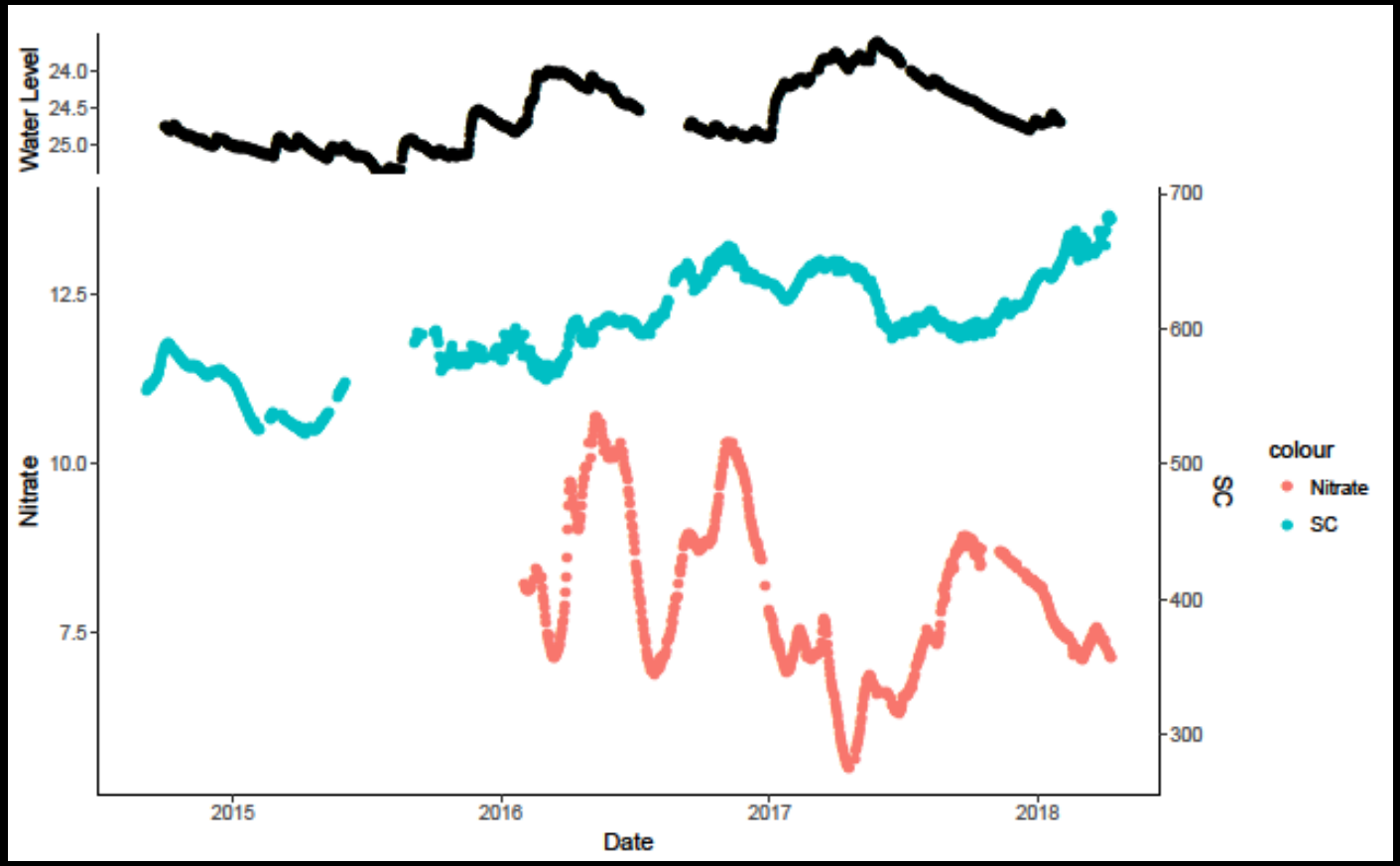
Tomorrow R shallow well



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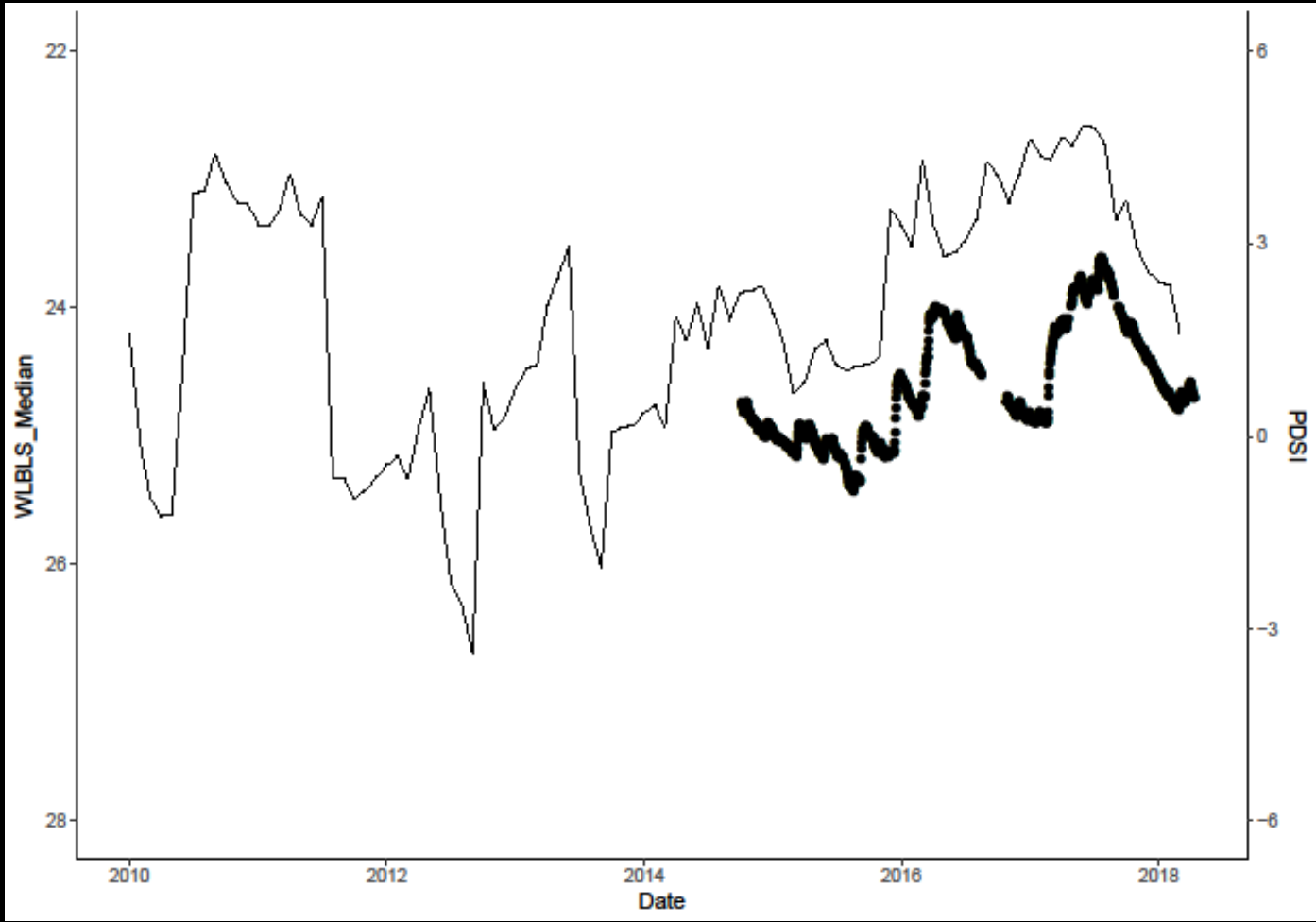
Tomorrow R deep well
Climate variability



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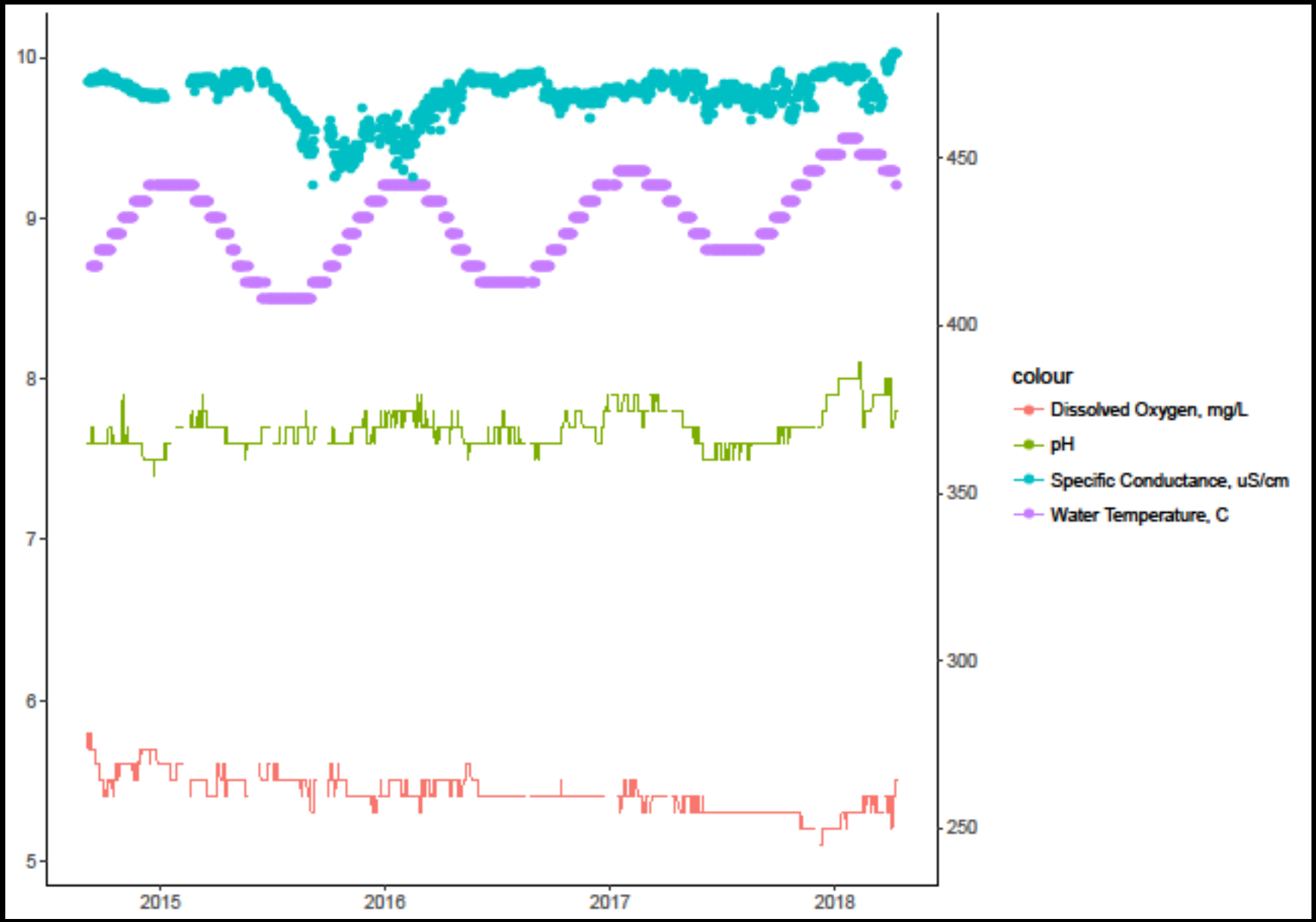
Tomorrow R deep well



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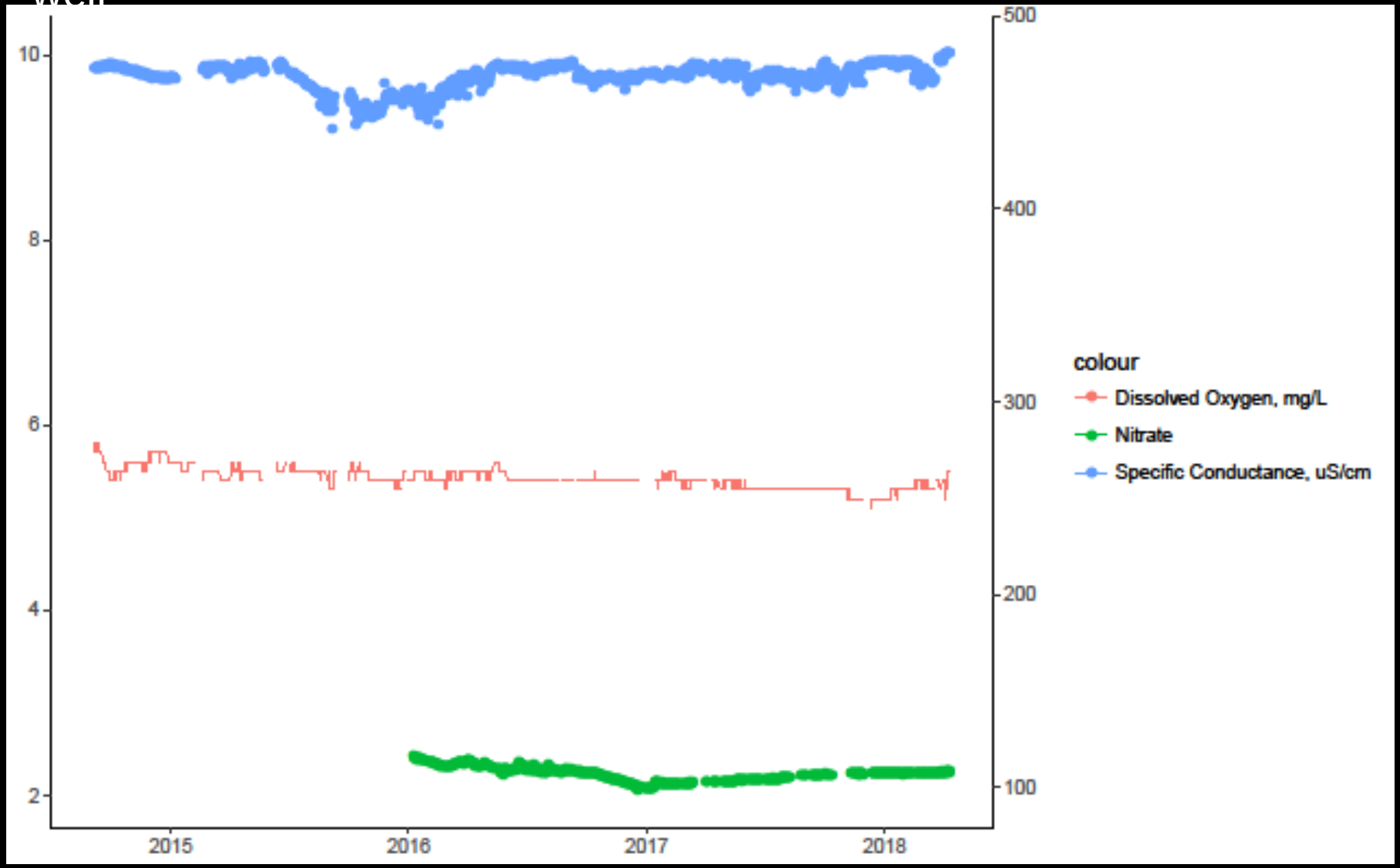
Tomorrow R deep well



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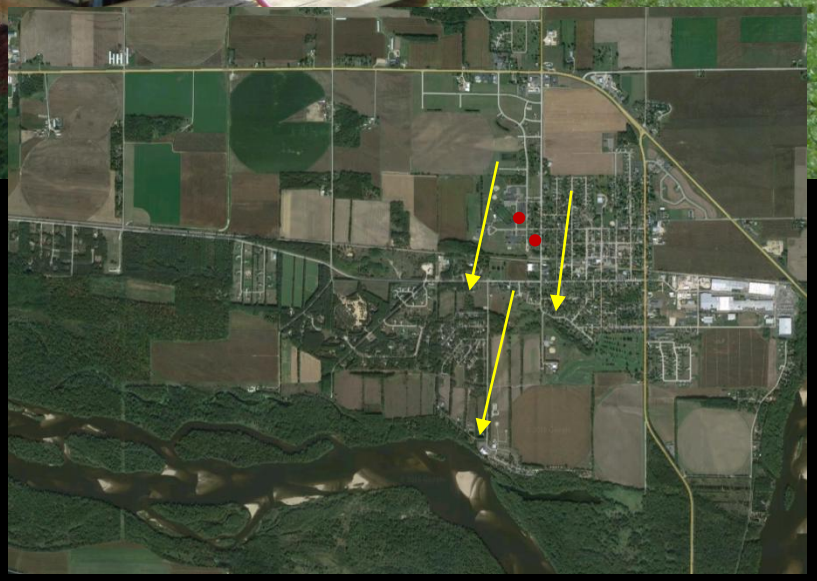
ETN site- Spring Green



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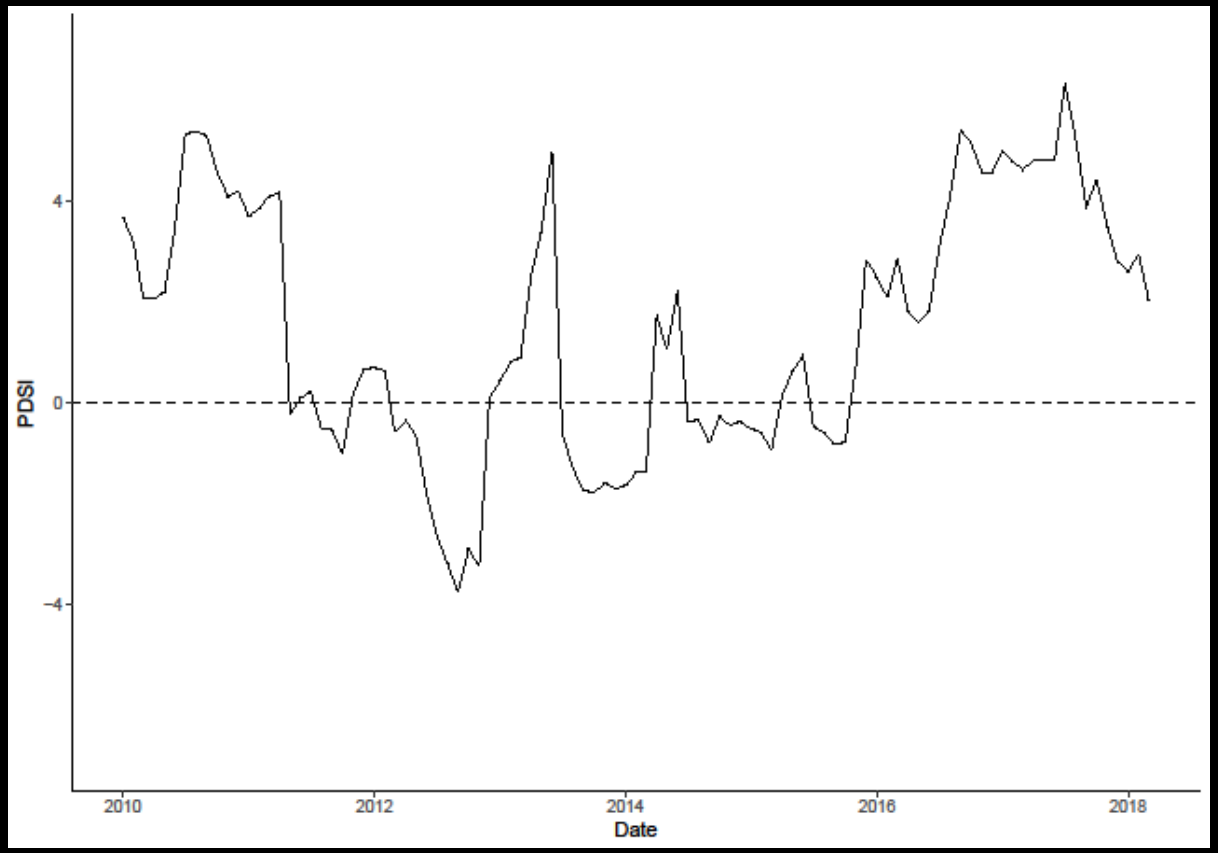
Spring Green, Southwest WI Climate Variability



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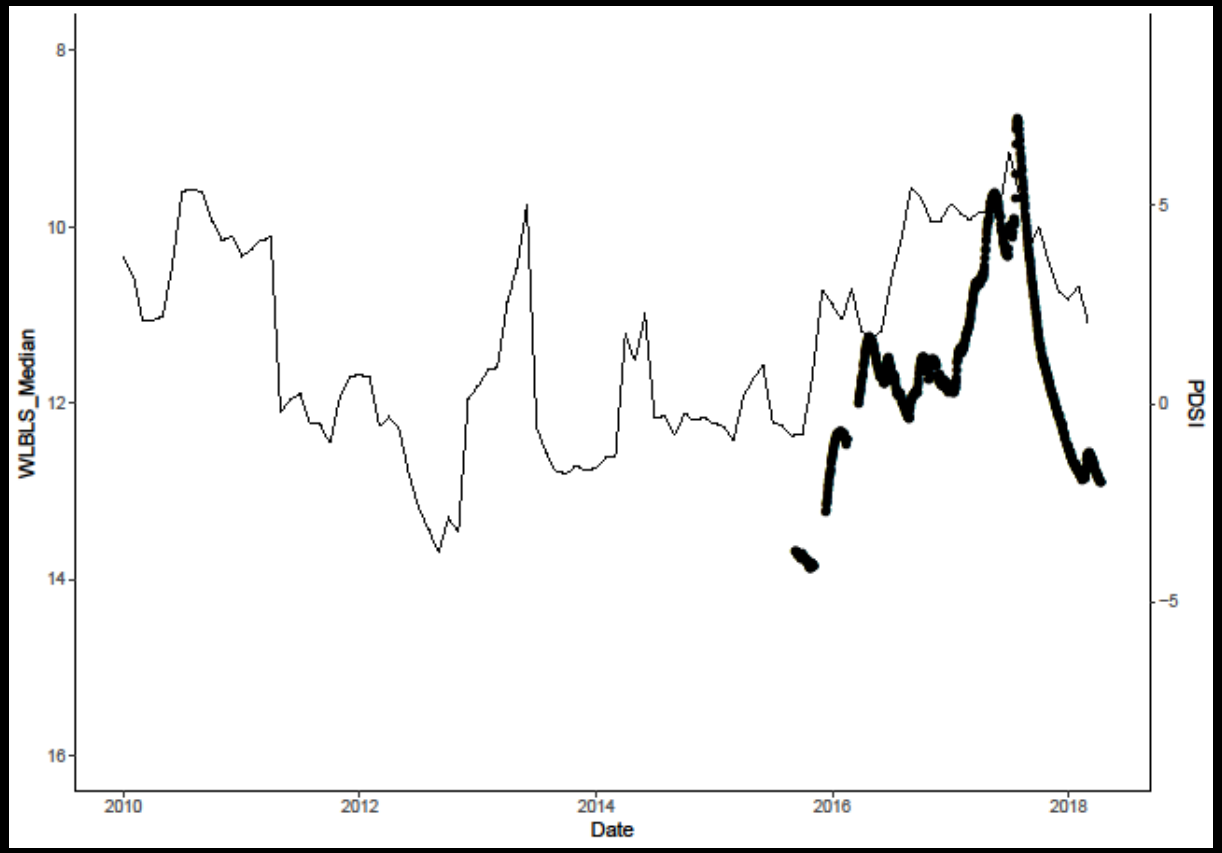
Spring Green monitoring well
Climate variability



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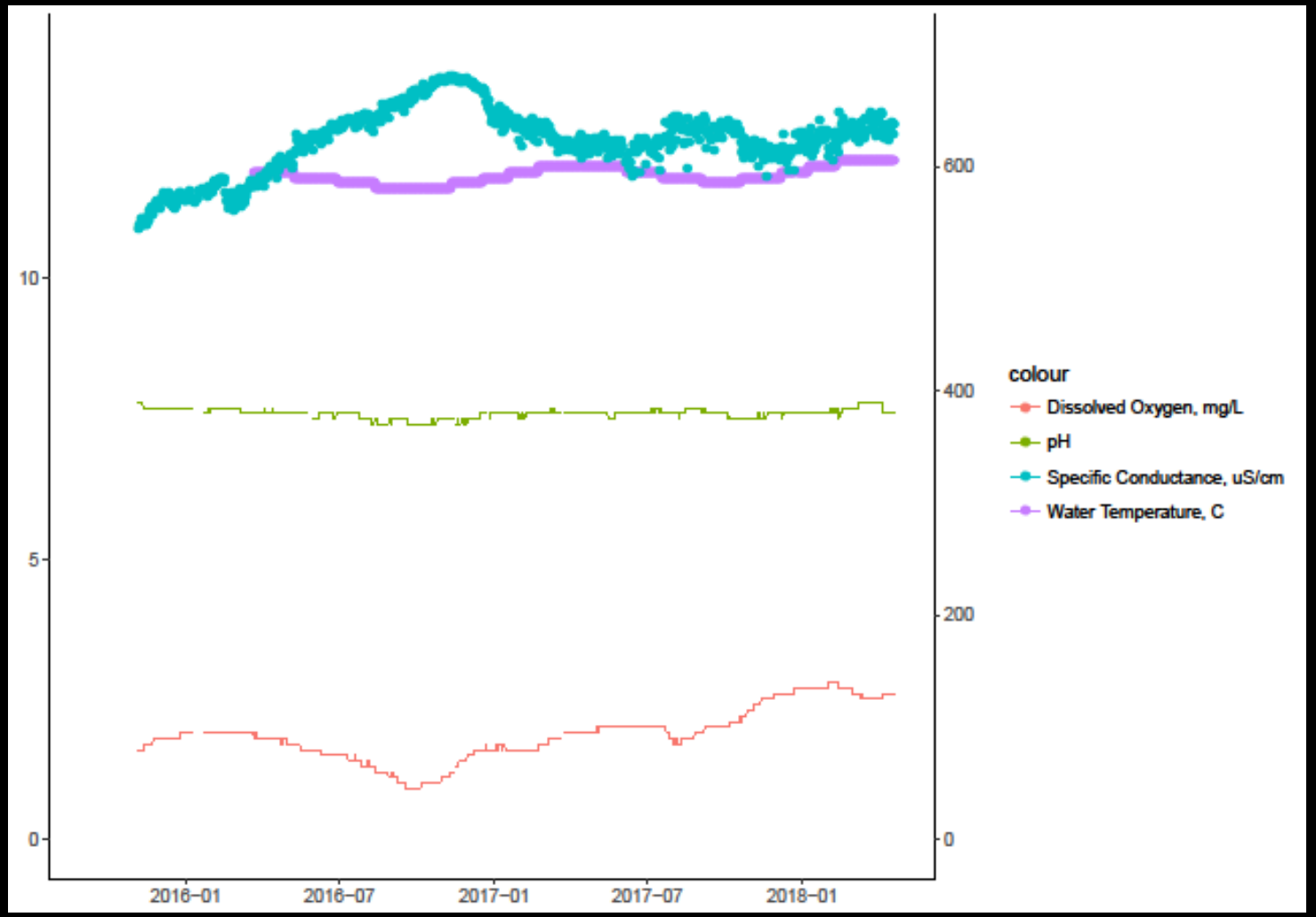
Spring Green monitoring well



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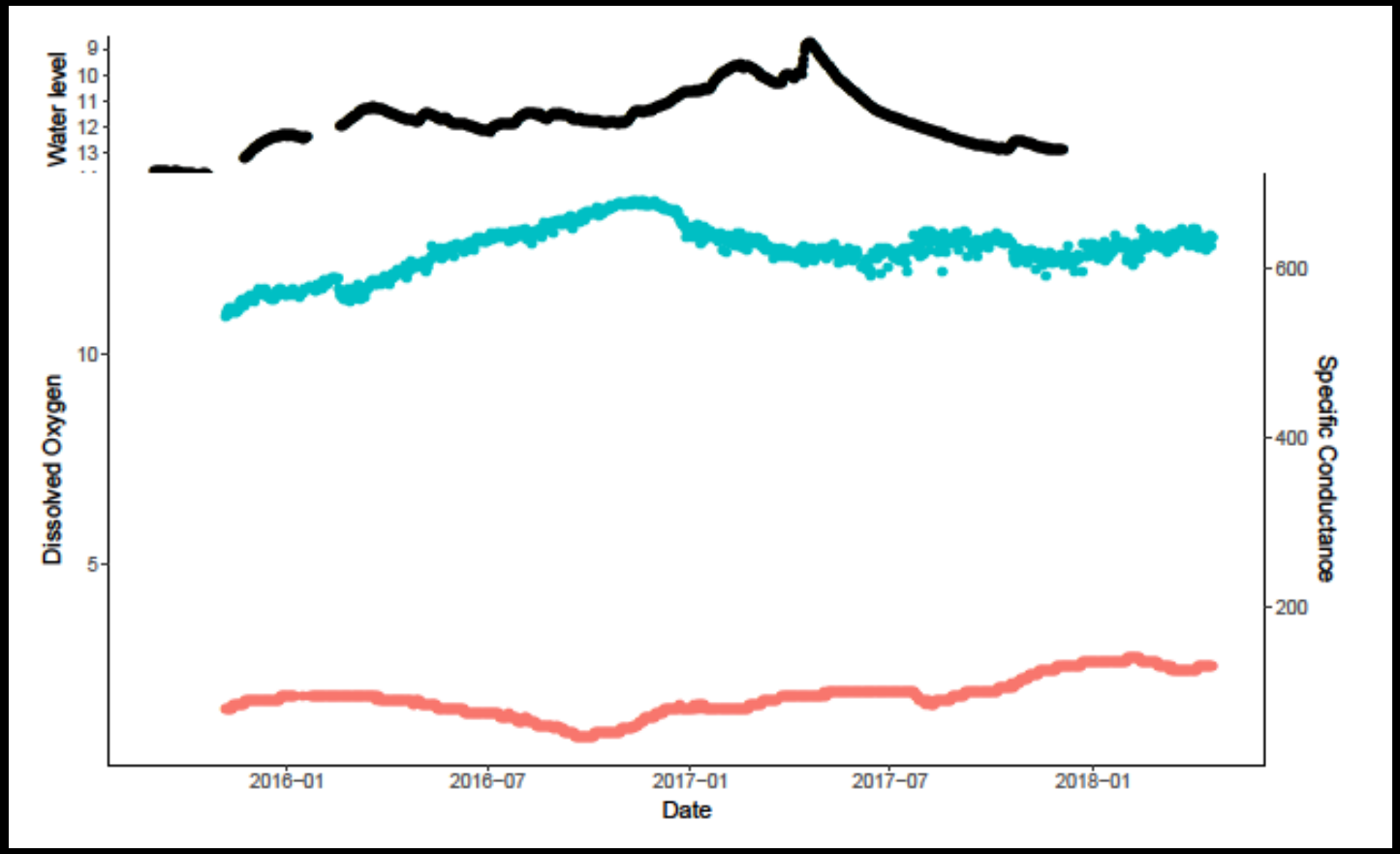
Spring Green monitoring well



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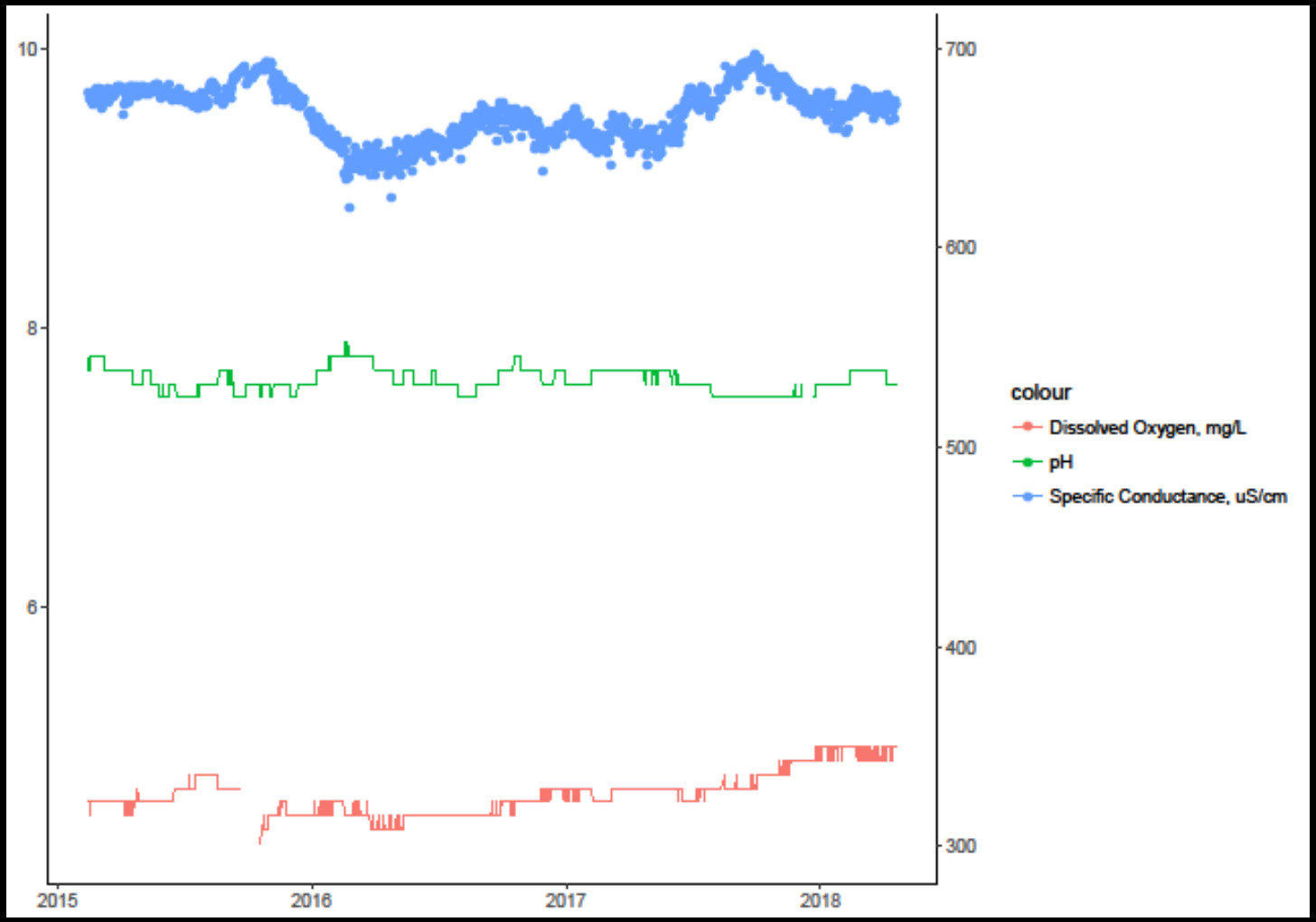
Spring Green public supply well



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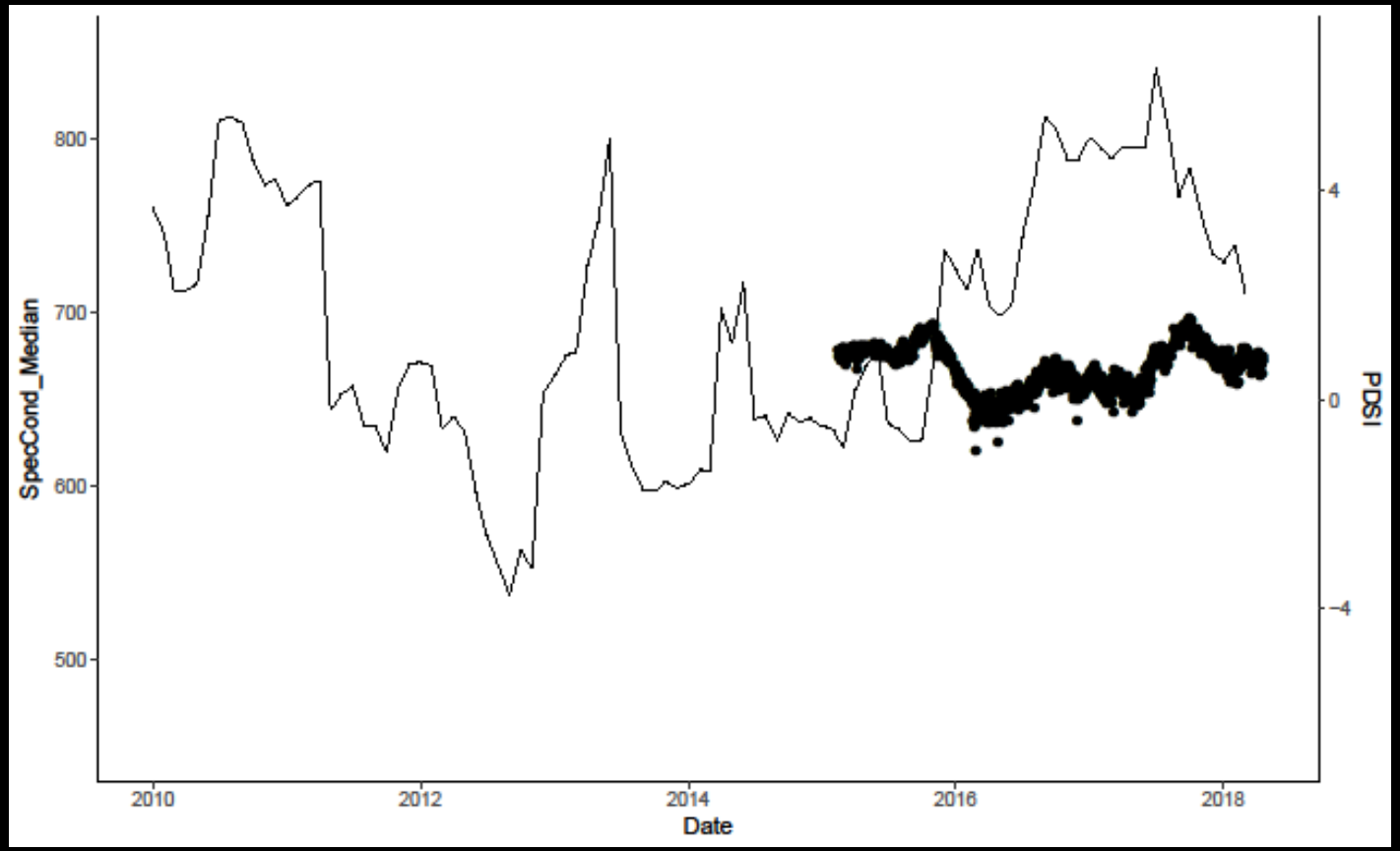
Spring Green monitoring well
Climate variability (SC)



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Future directions

- Continued high-frequency and discrete data collection (thru 2022)
- Nitrate sensor at Spring Green well(s)
- Dig deeper using stable isotope and age-tracer data

- Design better groundwater-quality studies, tailor data collection to setting, goals
- Model occurrences of drinking water exceedances
- Investigate how management practices can influence WQ in the short and long term

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QUESTIONS?