TEMPERATURE VARIATIONS IN INTERMITTENTLY-PUMPED WELLS WITHIN UNCONFINED ALLUVIAL AQUIFERS

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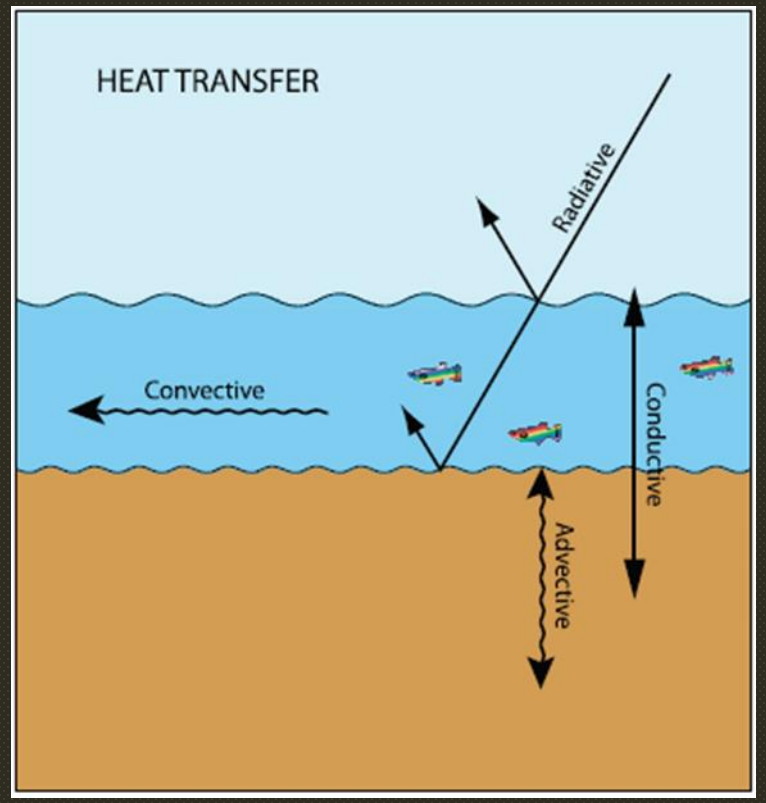
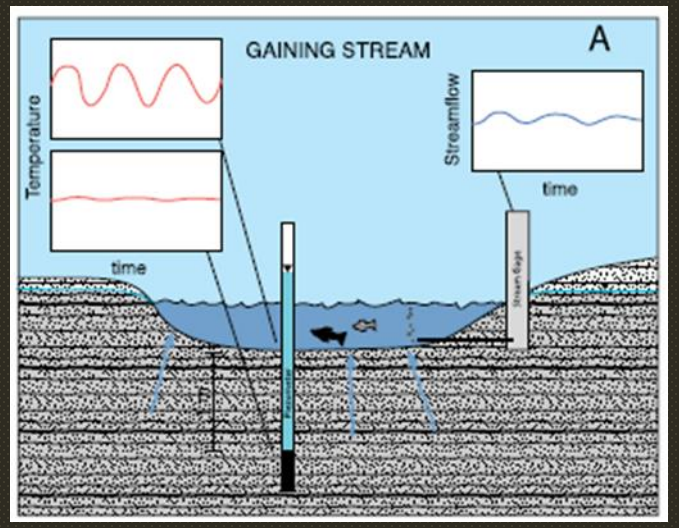
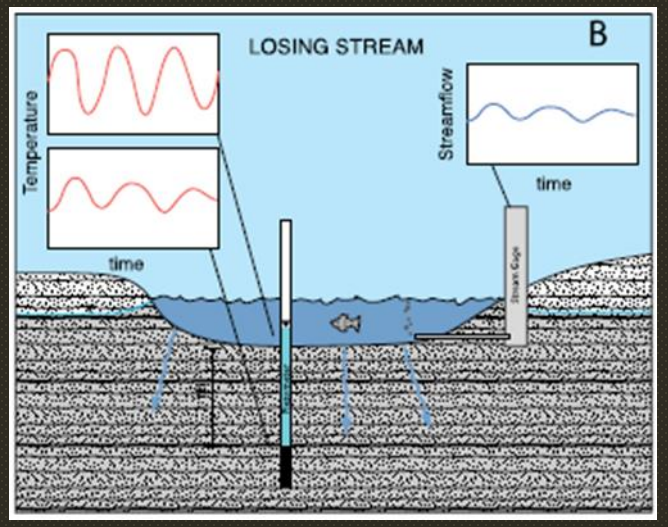
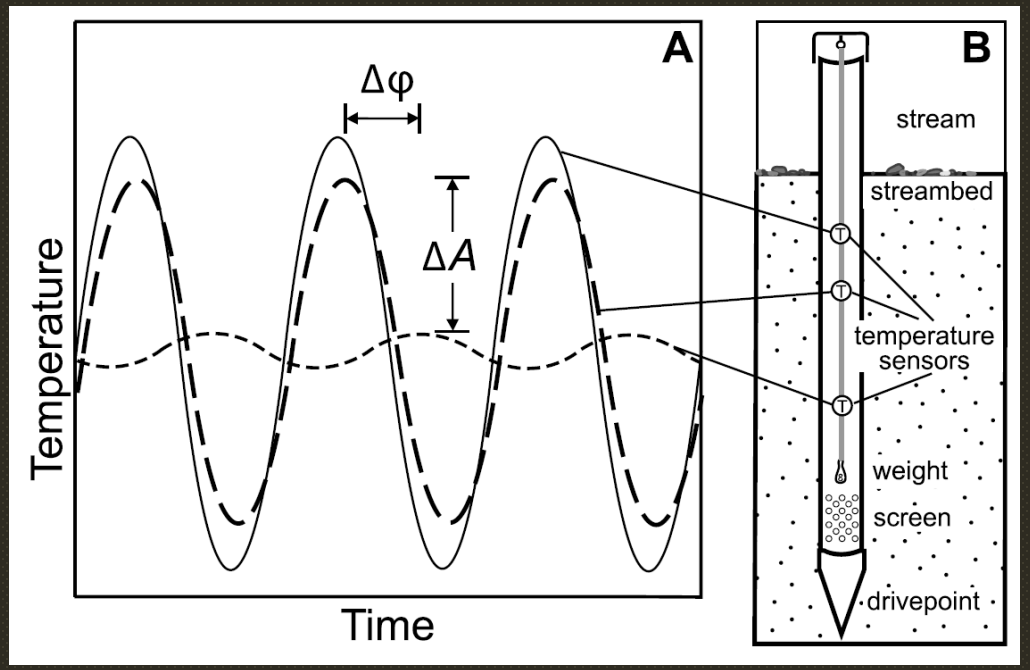
BACKGROUND









Constantz, (2008)

PURPOSE

- To understand connectivity of groundwater and surface water near a leaky stream due to intermittent pumping

- To study feasibility of using heat as a tracer in bank storage zones

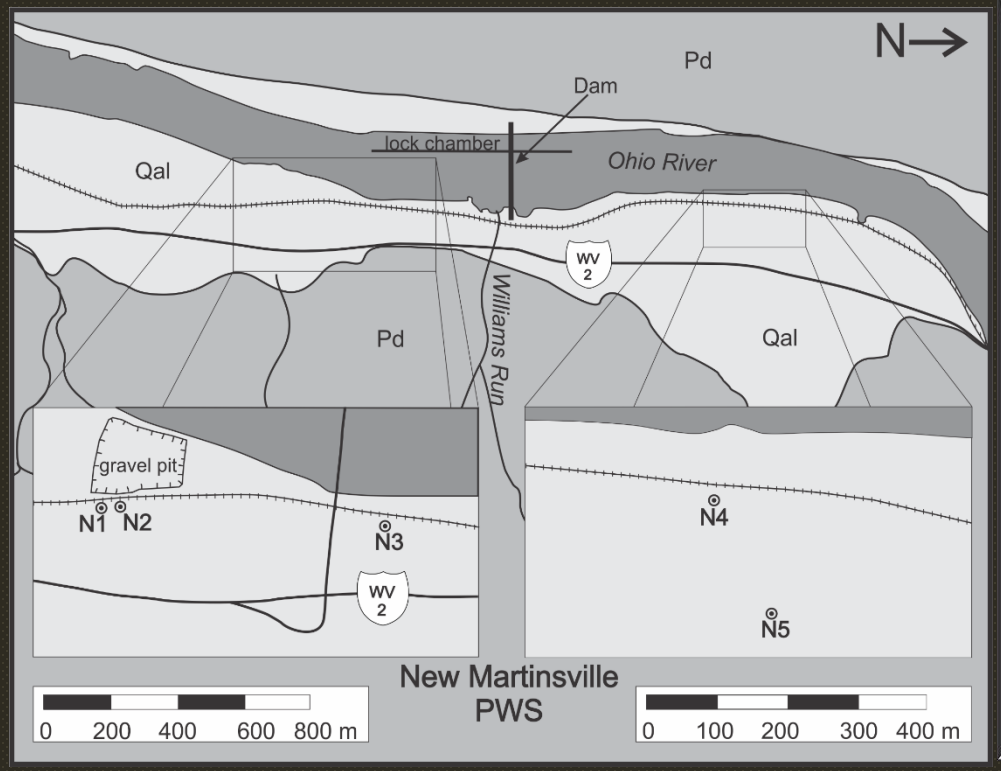
HYPOTHESIS

- If pumping induces surface water, then the temperature of produced water differs from that of groundwater

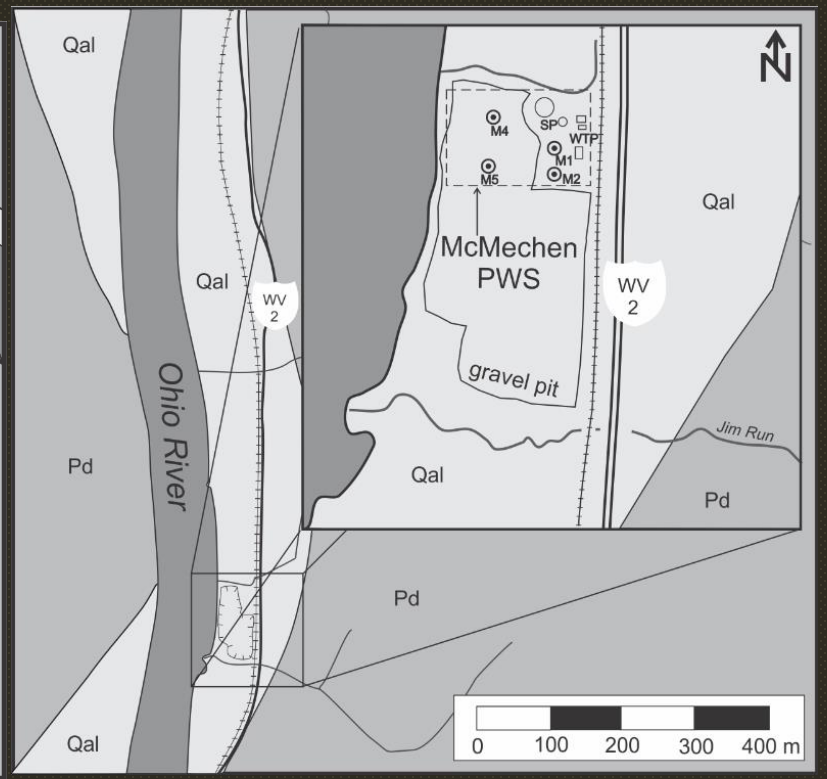
Approach

- Recorded high-frequency temperature and water level from a stream and intermittently-pumped wells tapped into shallow unconfined aquifers near a leaky stream
- Lag time (τ) between groundwater and stream temperature was estimated by visual peak matching, with estimated uncertainty of ± 5 days

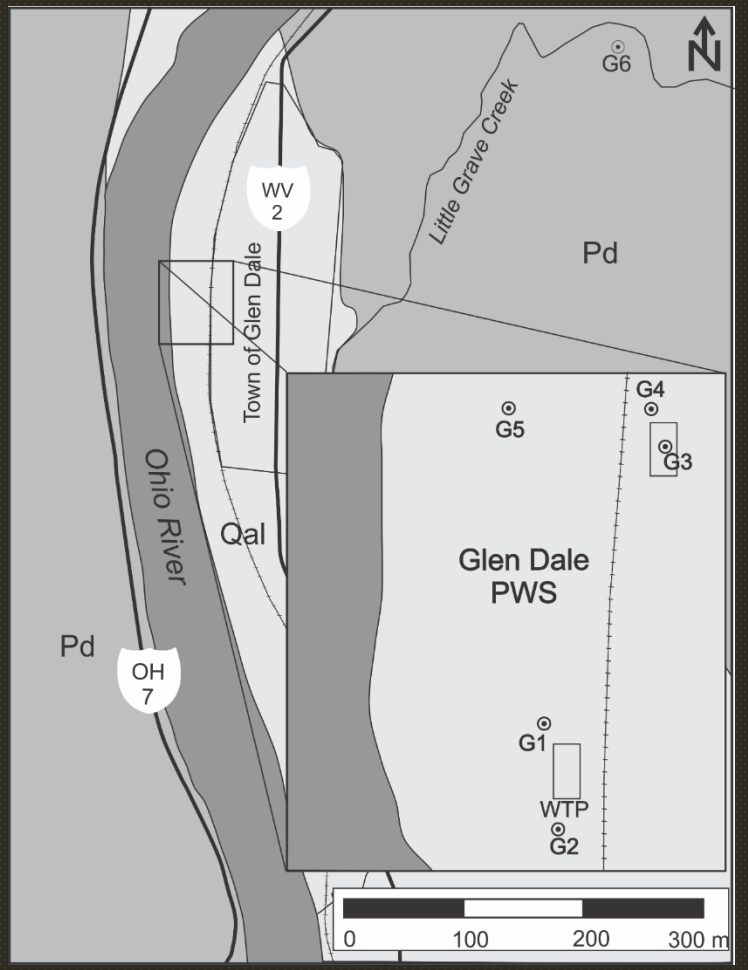
STUDY AREAS



New Martinsville



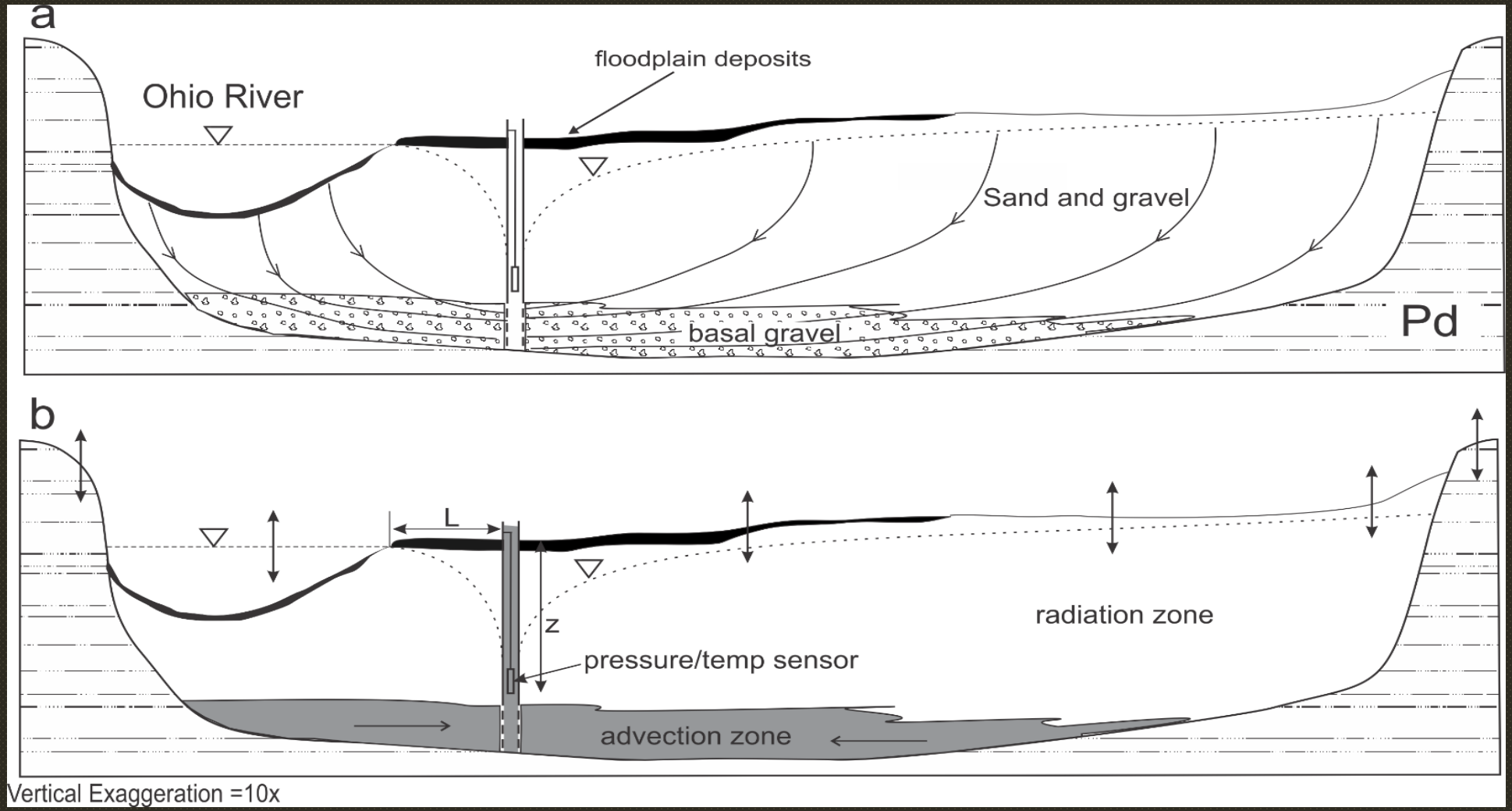
McMechen



Glen Dale

CONCEPTUAL MODEL

A conceptual geological cross-section of the Ohio River valley (top) with a pumping well and associated flow lines and (bottom) inferred heat transport mechanisms

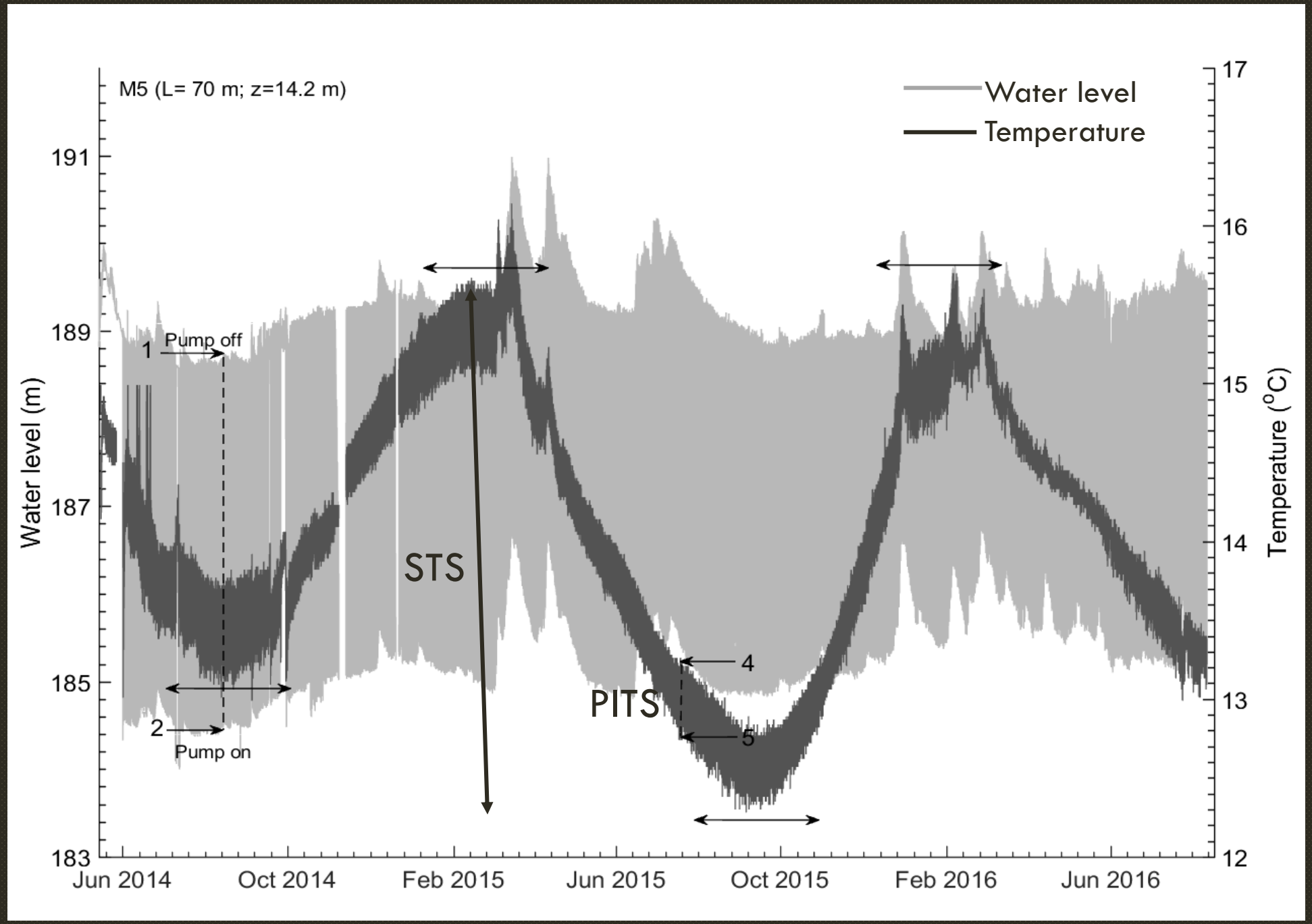


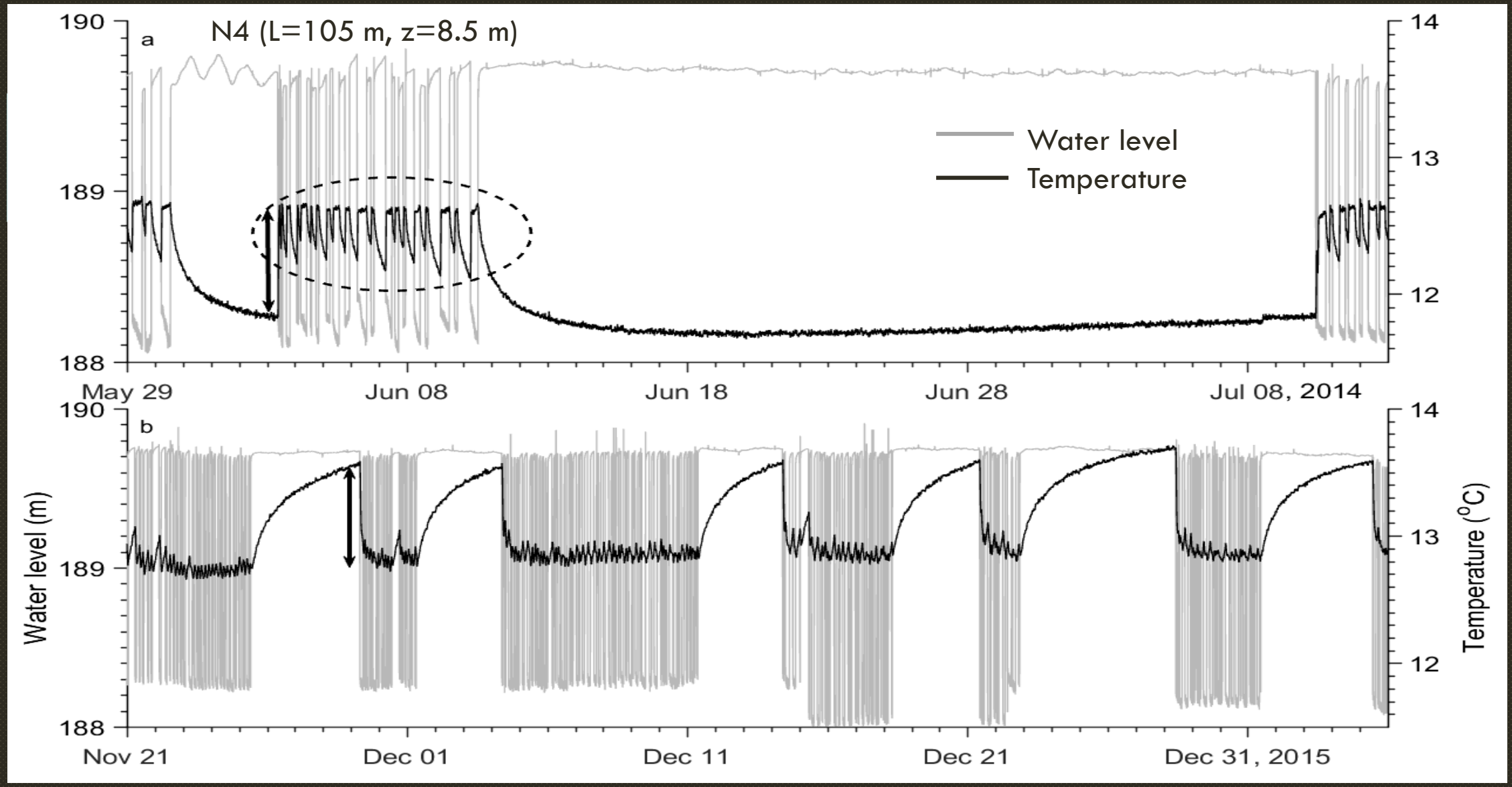
ASSUMPTIONS

- Fluid flow to the well is dominantly horizontal in the screened interval and dominantly vertical above it.
- Changes in subsurface temperature are slow and form nearly-horizontal isotherms in this radiation zone.
- In this horizontal flow zone, it is speculated that isotherms would be vertical.

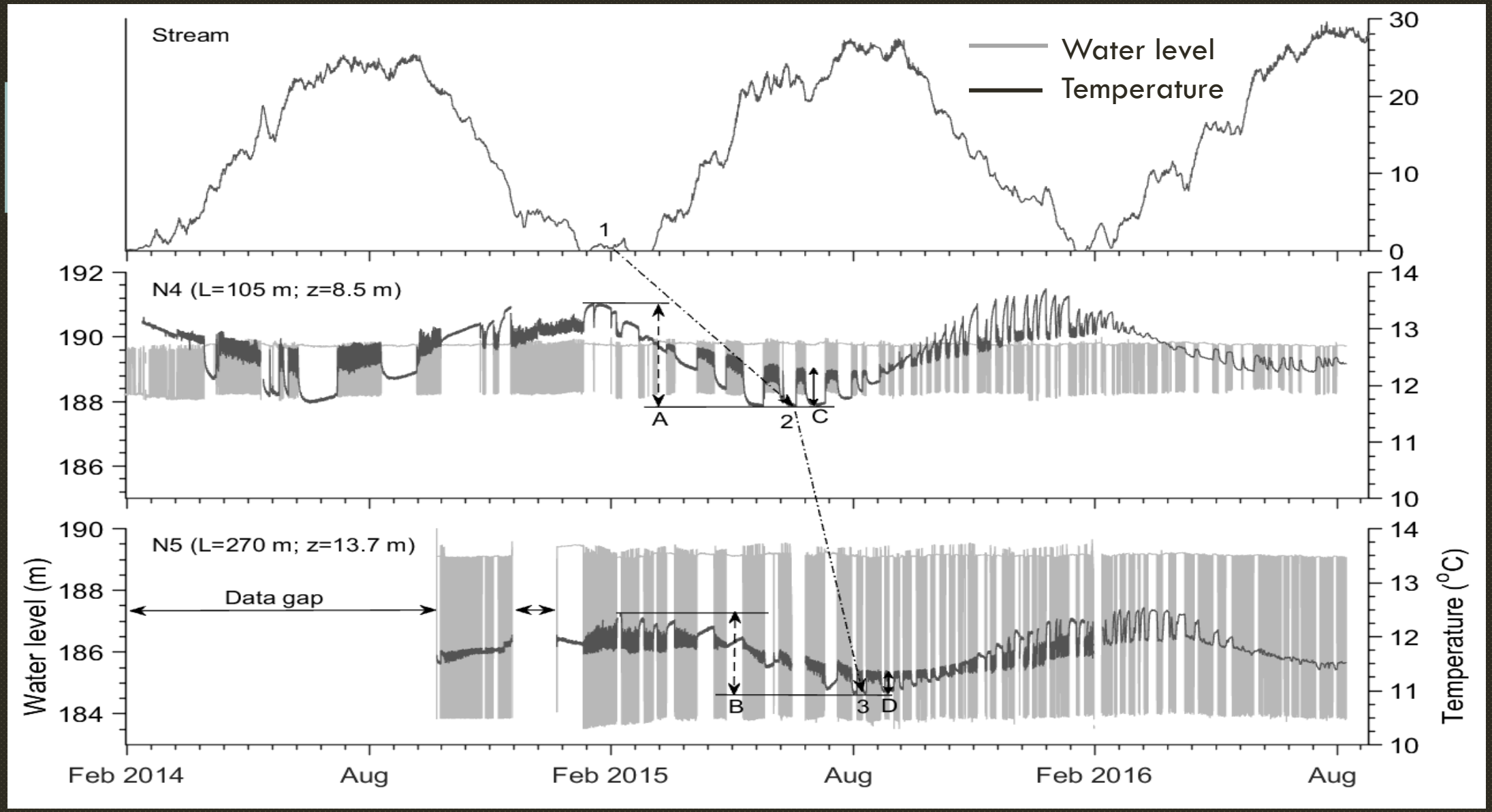
RESULTS

Temperature variations superimposed on seasonal fluctuations of water levels for well M5 between May 2014 and August 2016.

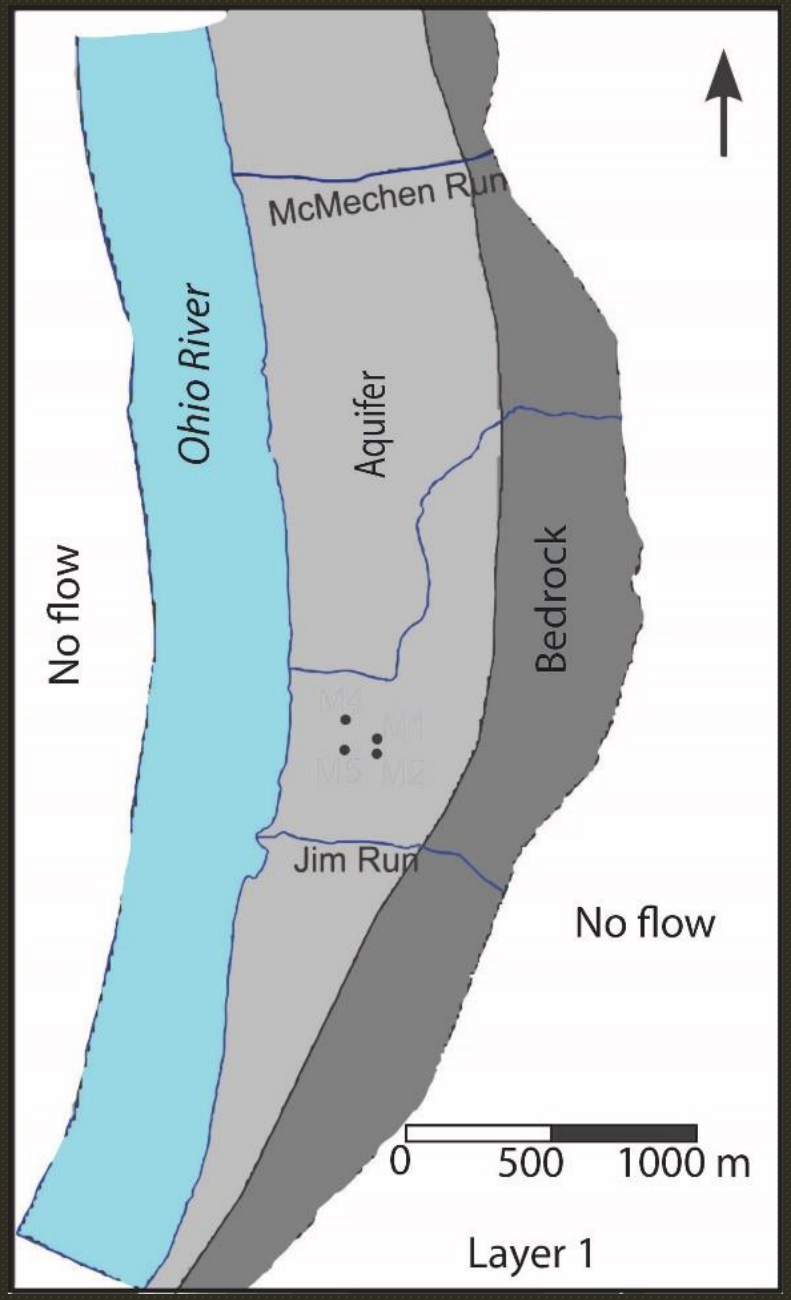




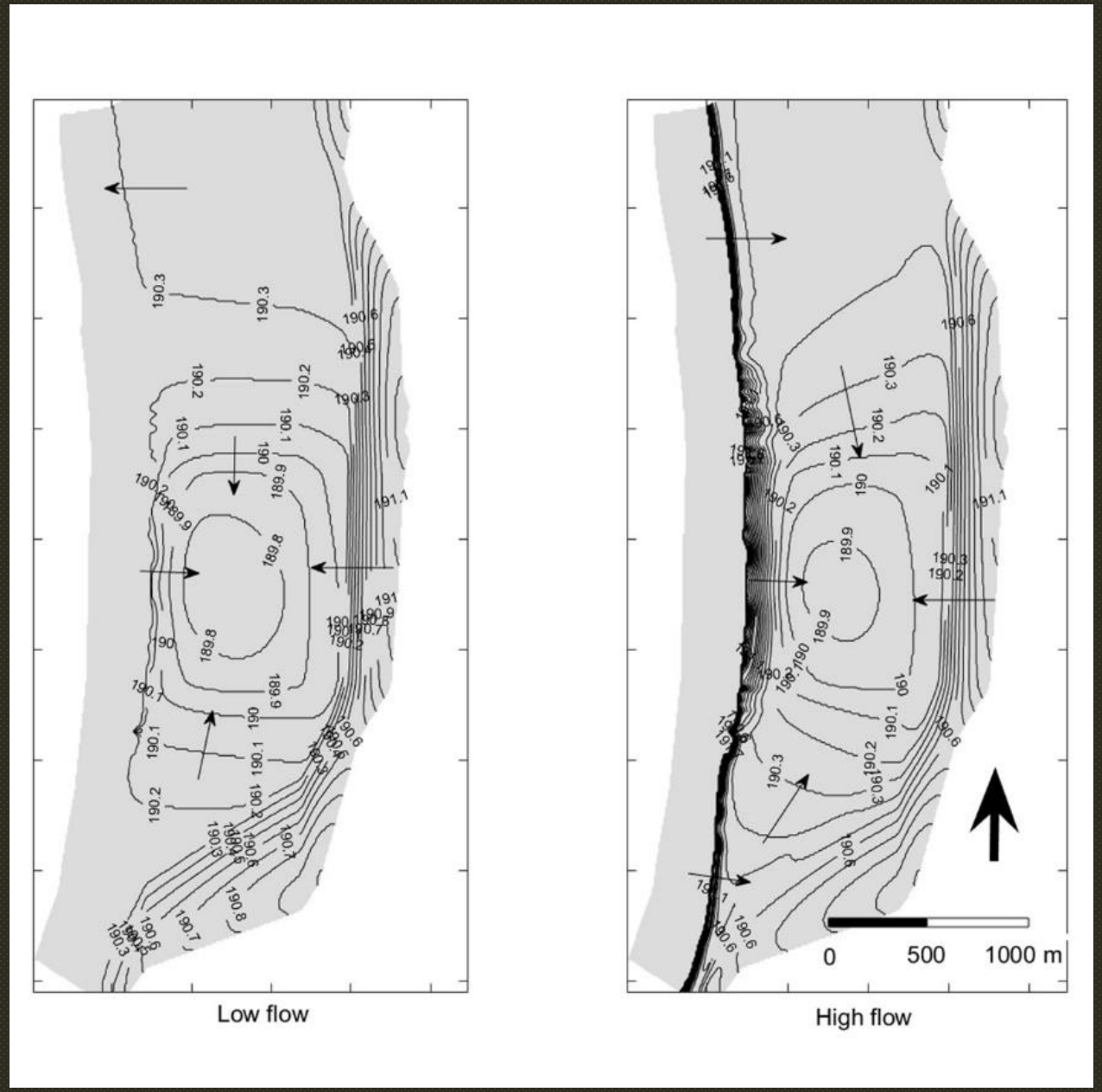
High-resolution PITS during different seasons for well N4. Each tick mark on the X-axes represents one day.



Stream temperature fluctuations (top), water-level, and temperature variations from February 2014 to August 2016 inside wells N4 and N5



Model zonation



Head Distributions

LIMITATIONS

- Results and interpretations are based on a limited number of observations
- Multiple sources of water could mix together obscuring temperature signals of the production water
- Different combinations of L, z, and pumping rate could substantially affect the magnitudes of PITS, STS, and lag time

CONCLUSION

- Both water level and temperature in pumping wells change abruptly and continually in response to pumping.
- Water level and temperature changes (STS) were largest for wells closest to the surface and nearest to the river.
- The temperature difference between groundwater outside the casing and that produced by pumping (PITS) is highest during summer and winter
- Stream exfiltration occurs year round and constitutes a significant portion of the water budget for a number of wells.
- Water level and thermal data offer a reliable field-based method for observation of groundwater-surface water exchange in a bank storage zone.

ACKNOWLEDGEMENTS

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- Sean Orlofske (Glen Dale)
- Gary William (McMechen)
- David Benson (New Martinsville)

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- Dave Hall (Glen Dale)