

Using Quantitative Dye Trace and Discharge Measurements To Locate Groundwater Storage

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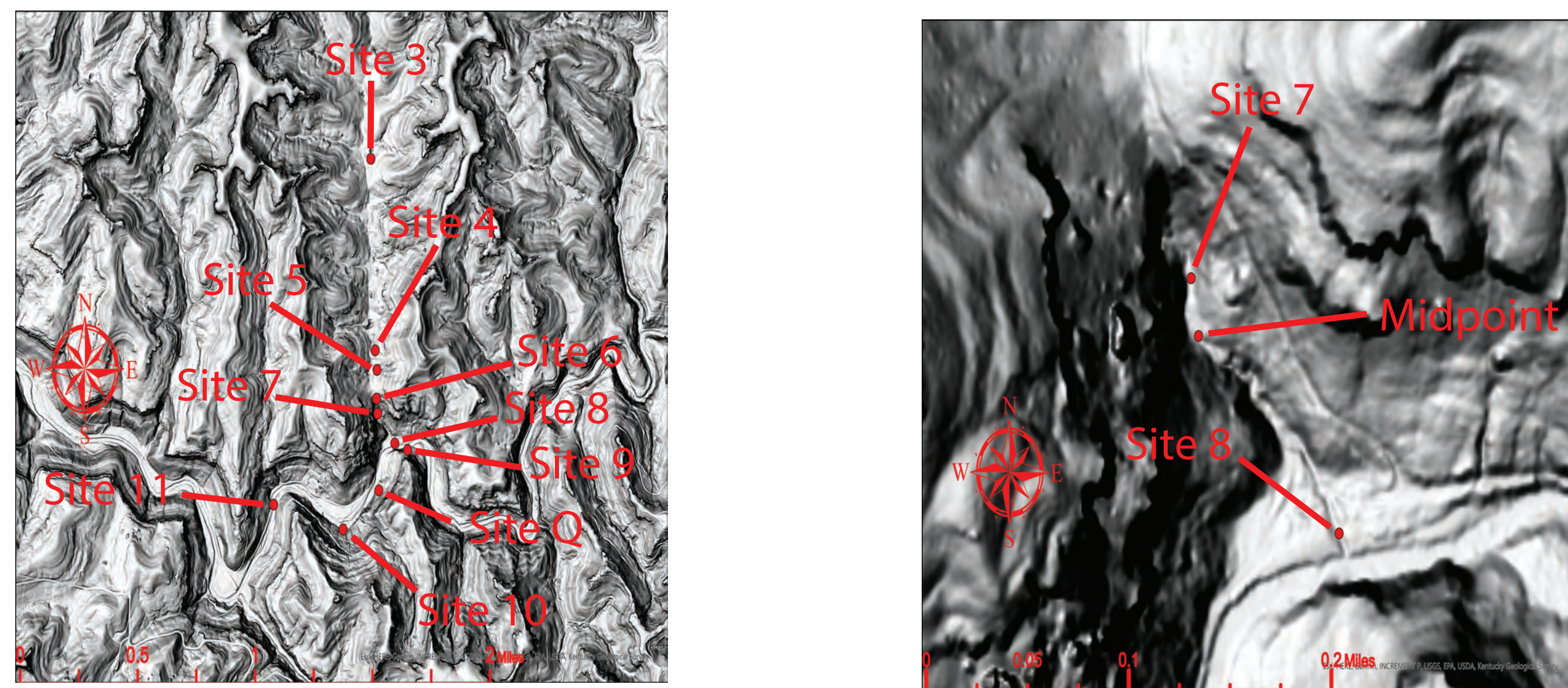
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Introduction

Knowledge of water storage throughout eastern Kentucky is important to find possible sources of fresh groundwater for drinking. Using quantitative dye tracing and discharge measurements throughout the Big Sinking Creek, two locations stored the most water: the midpoint and the point bar of the stream.

Study Area



Methods

- The dye was poured on 06/11/24 at 12:41 pm at Still-house Cave (site 3)
- Data loggers were placed at three different locations to track the amount of dye
- Discharge measurements were taken at ten locations throughout the stream
- The dye packets were also placed in nine locations to confirm that the dye went throughout the stream



Photo of Midpoint



Site 3 before dye



Site 9



Site 3 after dye

Discharge Results

- The discharge increases at site 9 to 4.504 cubic feet per second (cfs) on 06/04 and to 2.804 cfs on 06/25
- The discharge increases again at site Q to 5.831 cfs on 06/04 and 3.541 cfs on 06/25
- The discharge decreases to 4.816 cfs on 06/04 and 3.114 cfs on 06/25 at site 10
- The discharge increases again to 6.735 cfs on 06/04 and to 3.423 cfs on 06/25 at site 11
- The spring has the highest concentration of dye at 7387.21 $\mu\text{g/L}$ while the midpoint's concentration was 6580.76 $\mu\text{g/L}$ and the downstream's was 7351.32 $\mu\text{g/L}$
- The spring had the greatest peak of dye at 114.7583 $\mu\text{g/L}$ on 06/12 at 10:15 AM, while the midpoint peaked at 97.8559 $\mu\text{g/L}$ on 6/12 at 10:15 AM. These were the first locations to peak.
- The downstream peaked the latest at 97.5758 $\mu\text{g/L}$ on 6/12 at 12:00 PM

Results

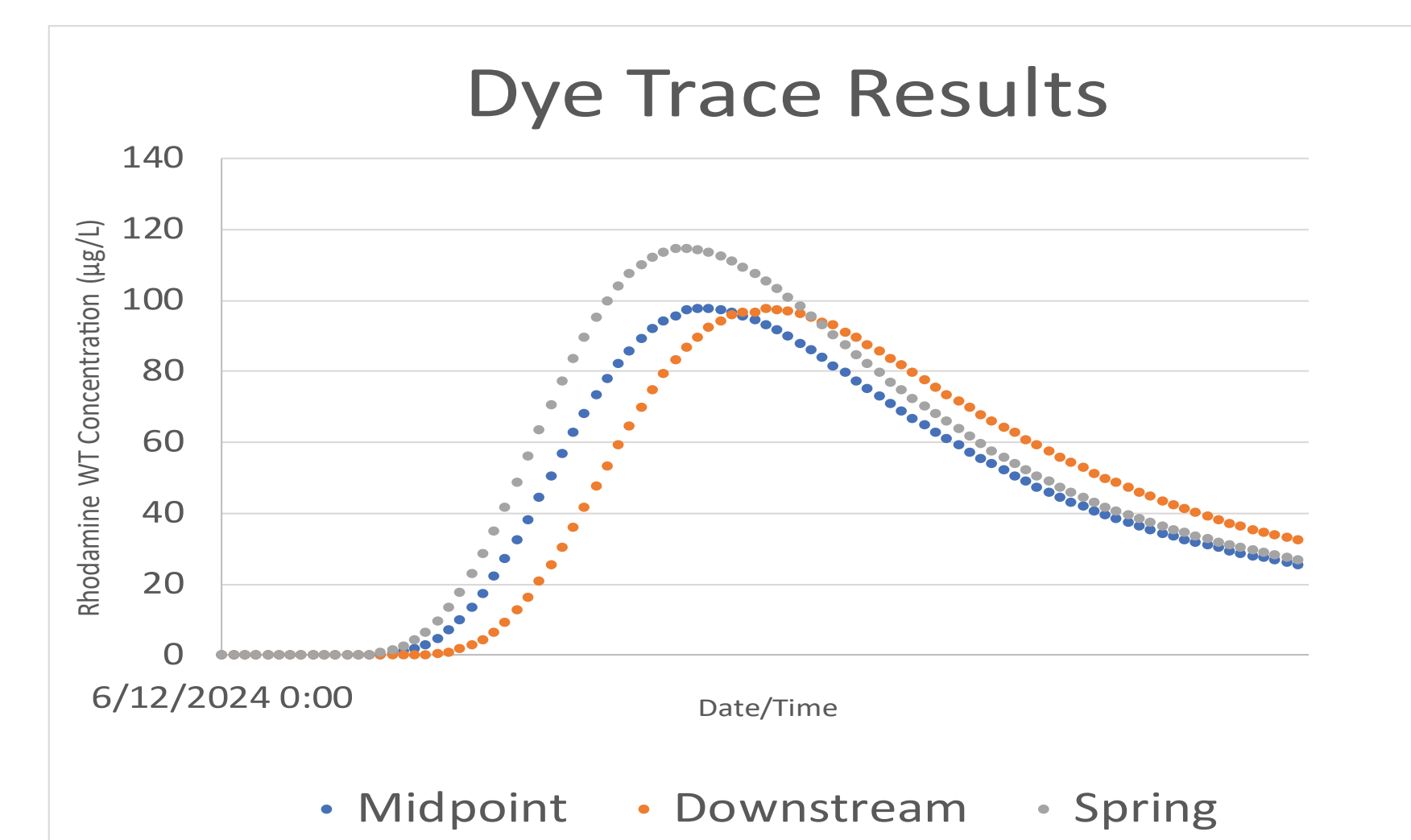
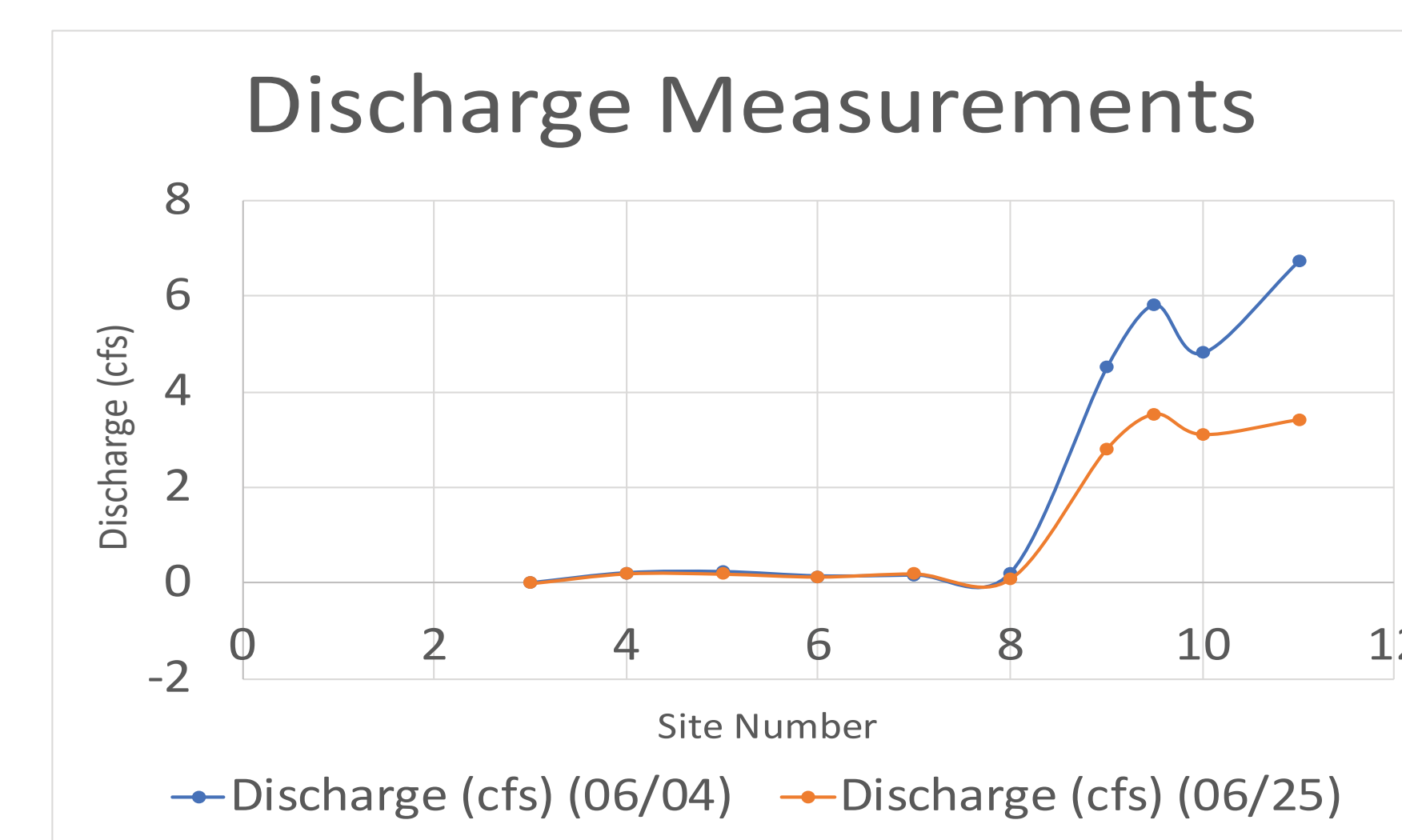


Figure 1.

Models

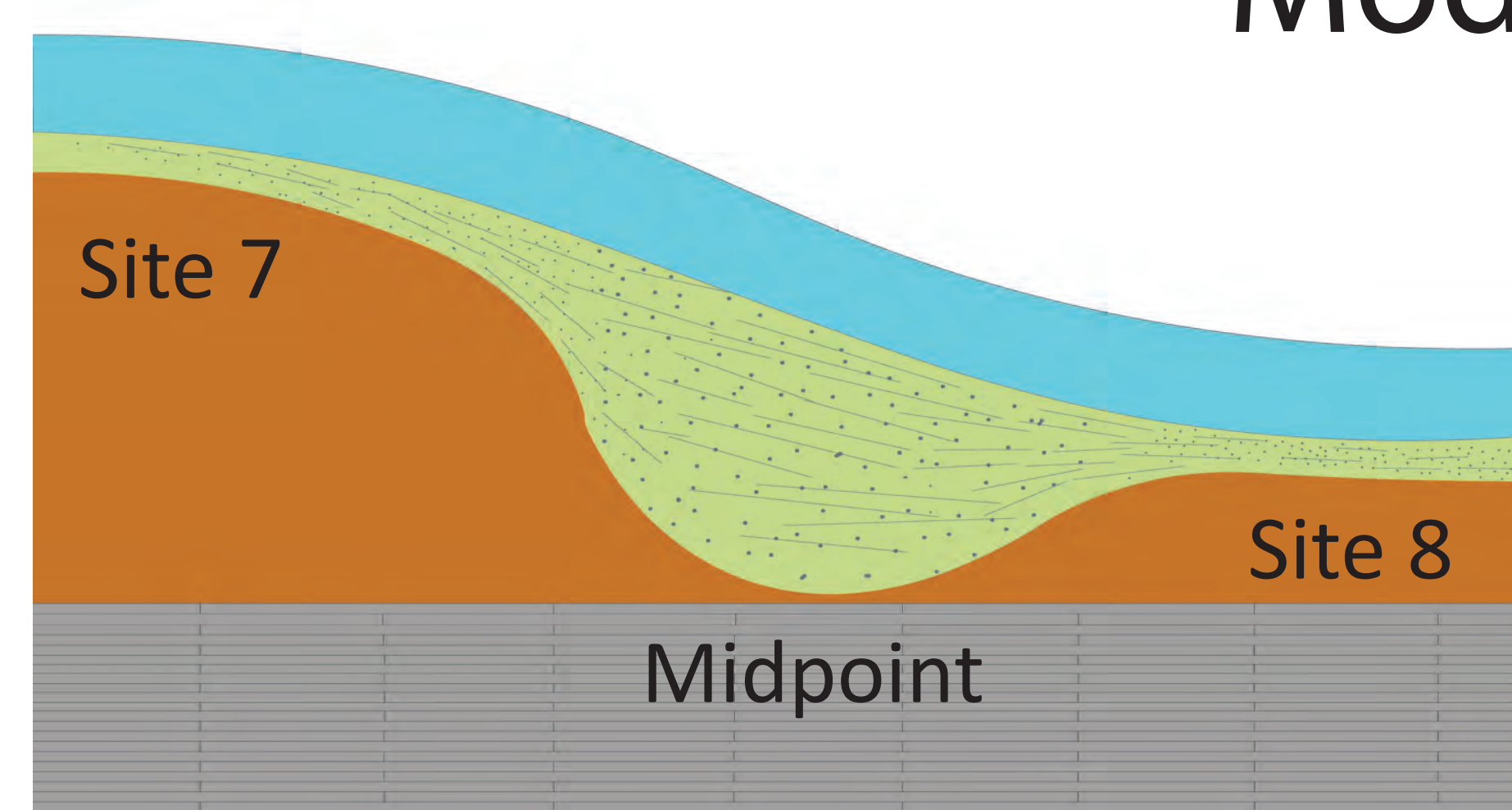


Figure 2.

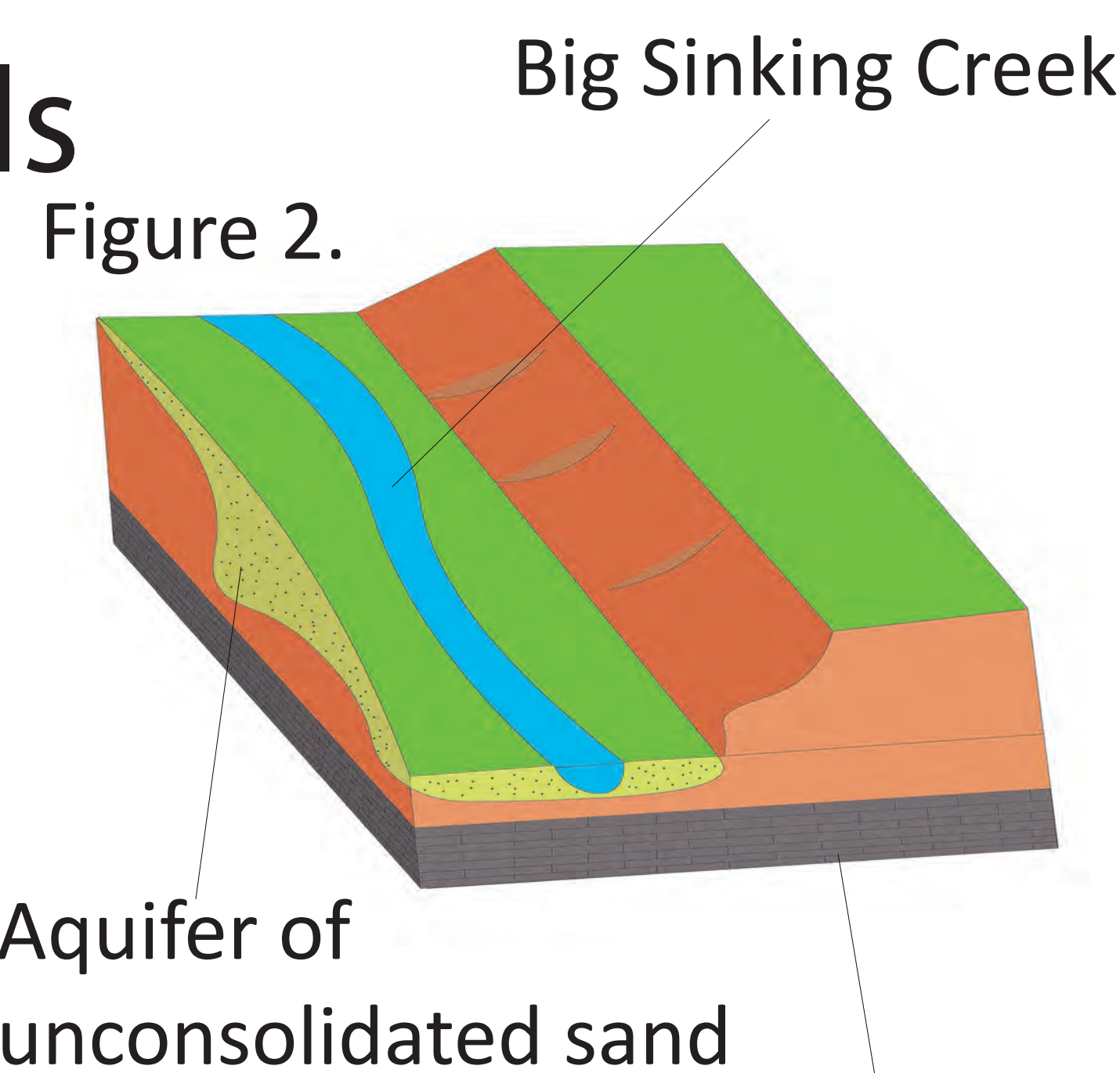


Figure 3.

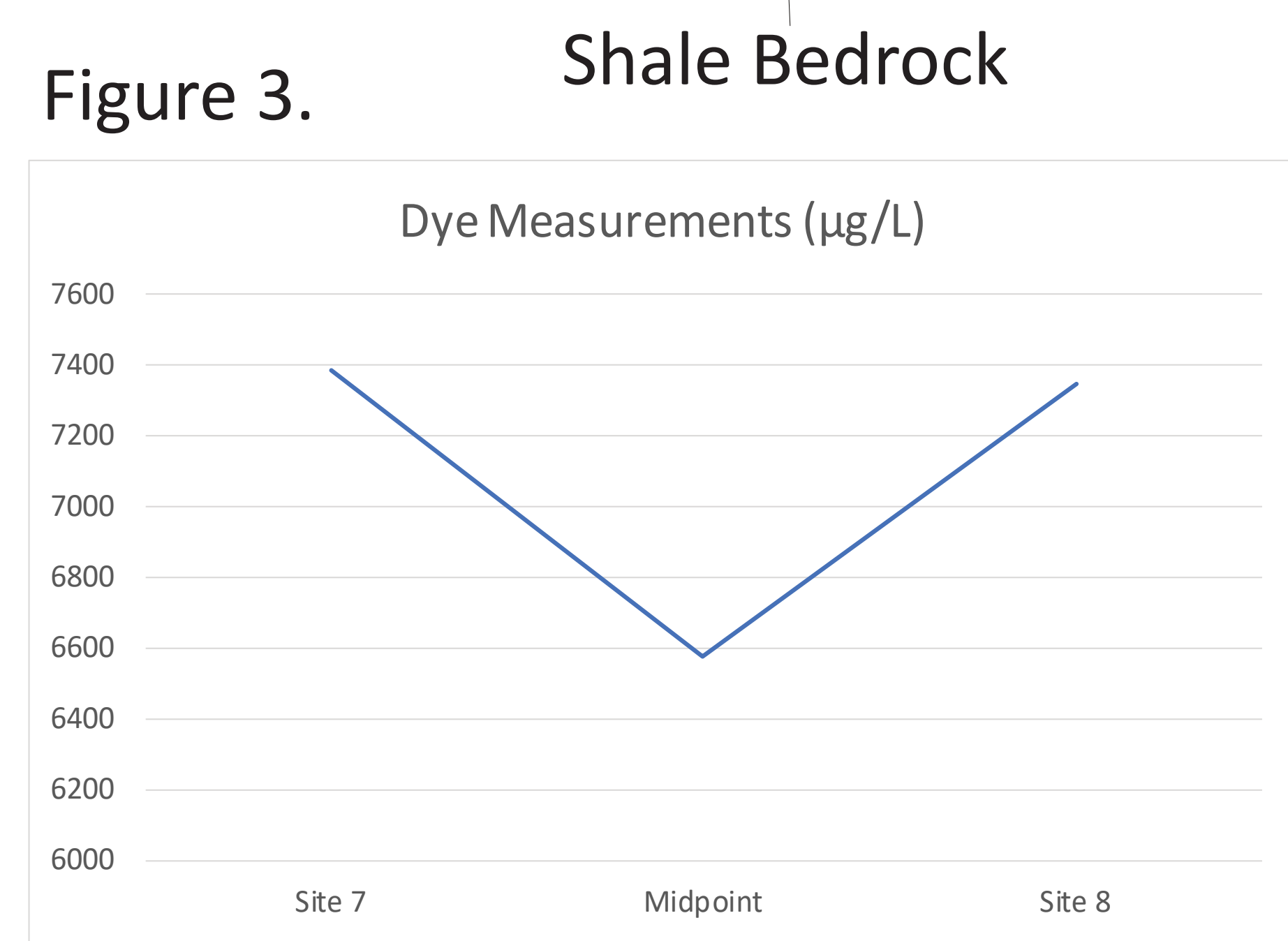


Figure 4.

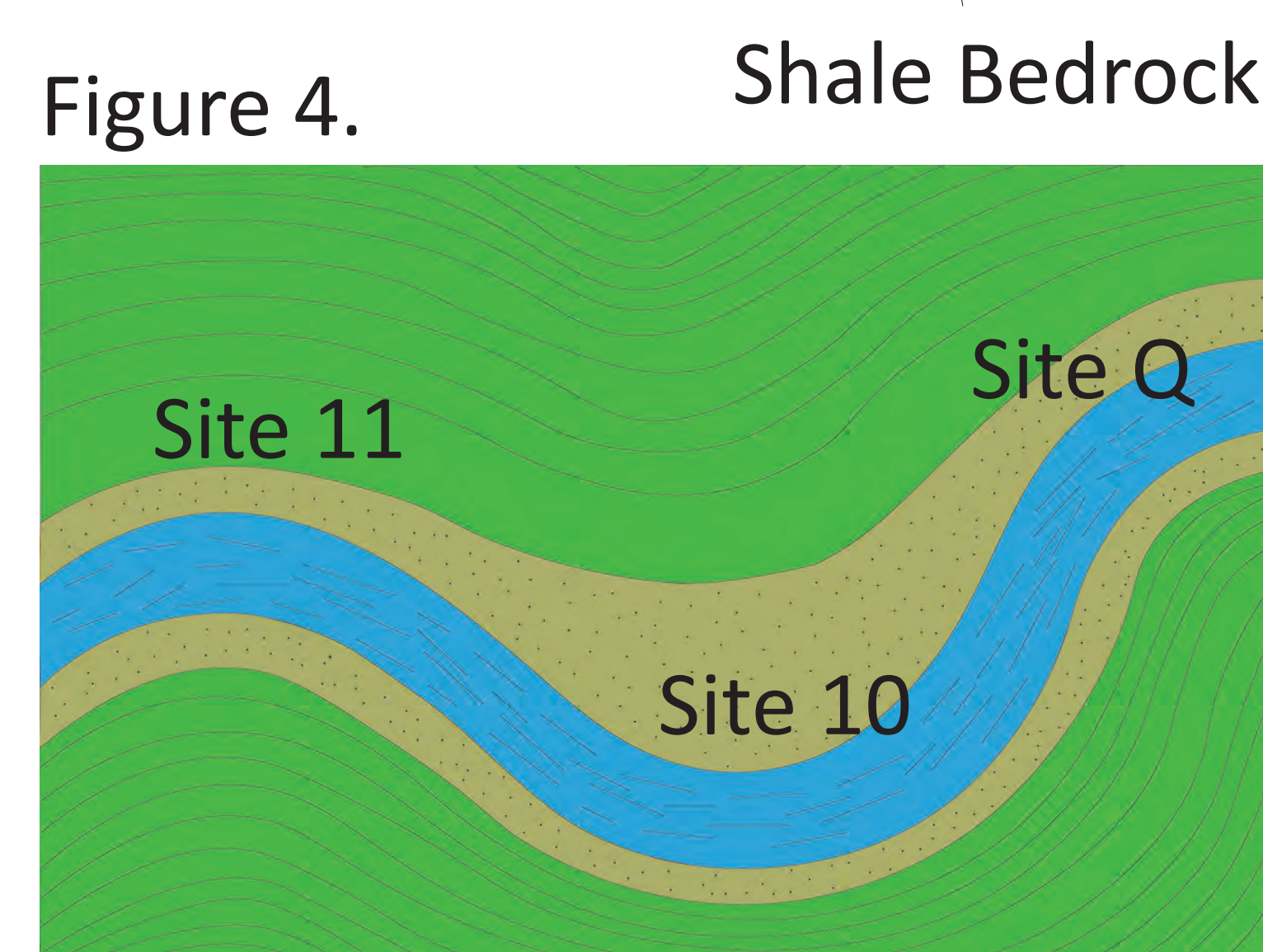


Figure 1. A lateral view of the midpoint aquifer. Figure 2. A 3d model of the Big Sinking Creek along with the midpoint aquifer. Figure 3. Shows the amount of dye concentration at each part of the stream. Figure 4. Sites Q, 10, and 11. Water is being stored in the unconsolidated sand at the point bar.

Conclusion

Groundwater is being stored in two locations throughout the stream. The discharge slowing down at site 10 suggests that there is groundwater being stored at this site within the unconsolidated sand. A significant decrease in dye concentration at the midpoint suggests that groundwater is being stored at the midpoint of the stream. Knowledge of water storage throughout eastern Kentucky is important to locate possible sources of fresh groundwater. Using methods such as dye tracing and discharge measurements can help to locate more aquifers for drinking.

References

- Fetter, C. W. (2018). *Applied Hydrogeology: Fourth Edition*. Waveland Press.
- Tobin, B. W., Zhu, J., Webb, S., & Fox, J. F. 2023, January. Seasonality of Flow Paths and Storm Responses In a Fluvio-Karst System. *In Proceedings of the 17th Sinkhole Conference*. National Cave & Karst Research Institute. <https://par.nsf.gov/servlets/purl/10488835>. p. 159-165.