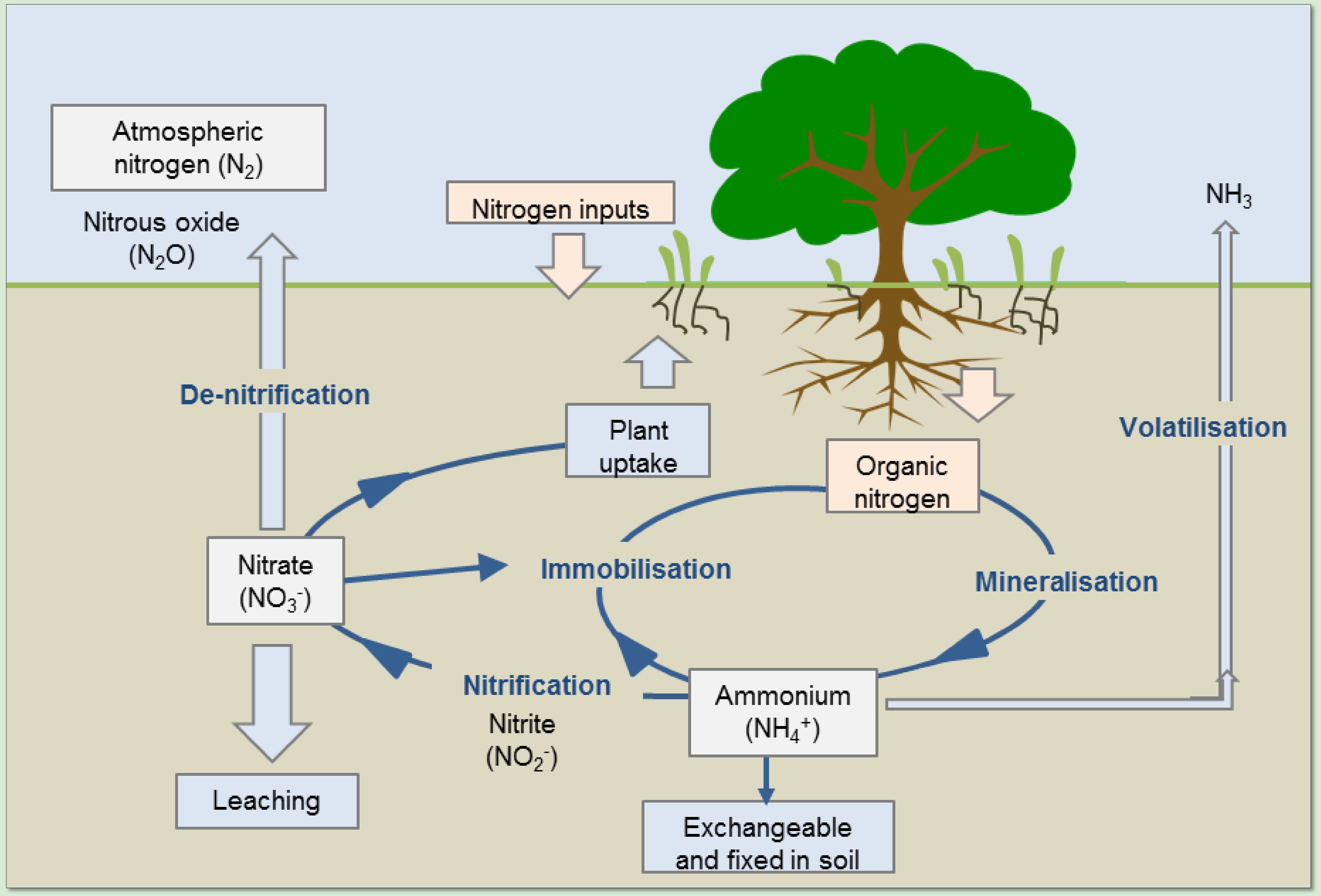
Natural Nitrate Removal in Shallow Subsurface Stream Flows

ECEC21

Abigail Heath

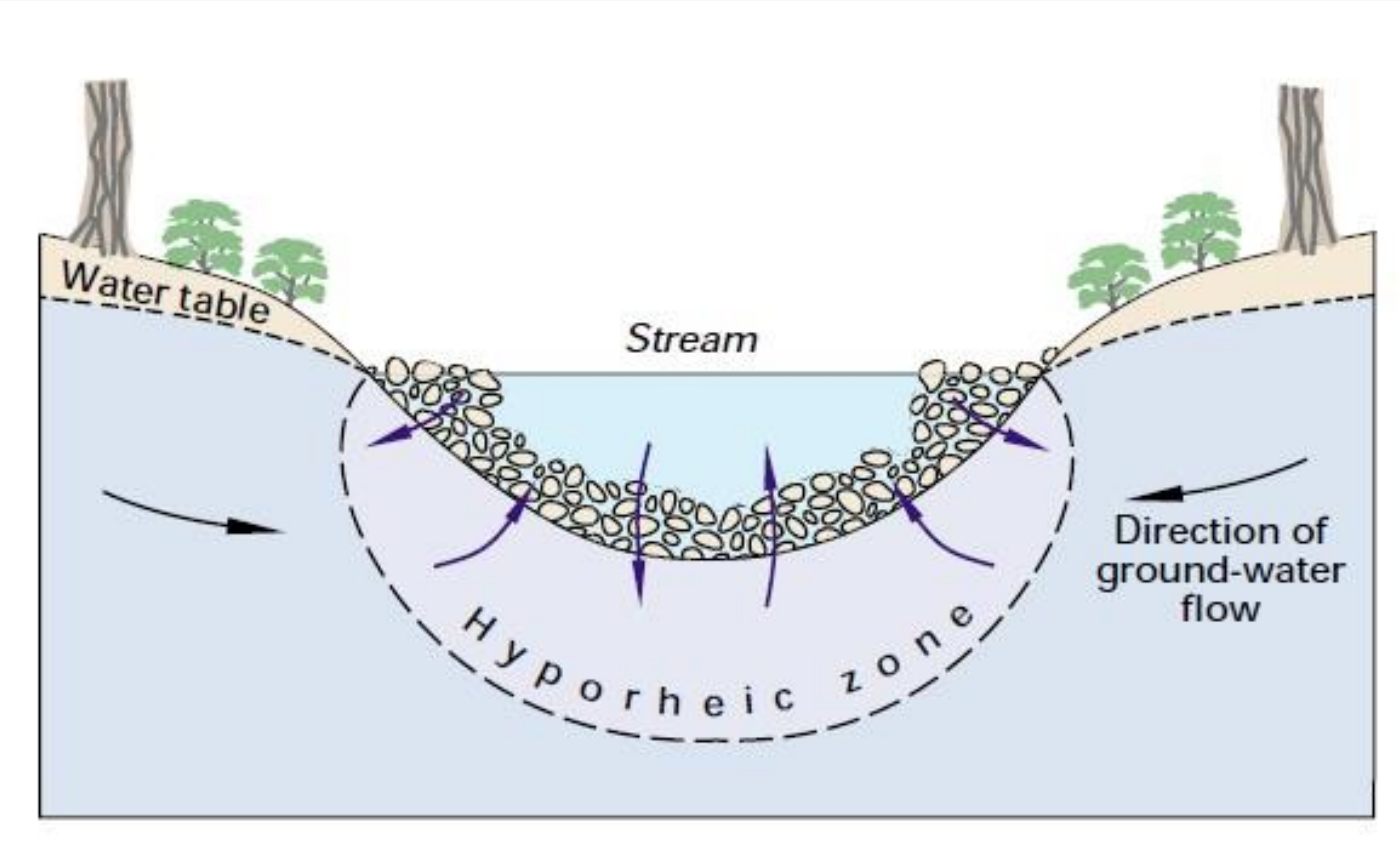
Too much of a good thing?



(Scanlan, n.d.)

(Yates, 2019)

Streams Can Help: The Hyporheic Zone (HZ)



(USGS, n.d.)

Research Questions

1) What percent of water contributing to hyporheic flow in a stream originates from surface water flow and groundwater flow?
2) What is the trend of nitrate removal depth-wise and laterally in the subsurface below streams?
3) How far does stream hyporheic flow extend into riparian subsurface storage and how does this contribute to the removal of nitrate or lack thereof seen in question #2?

Study Area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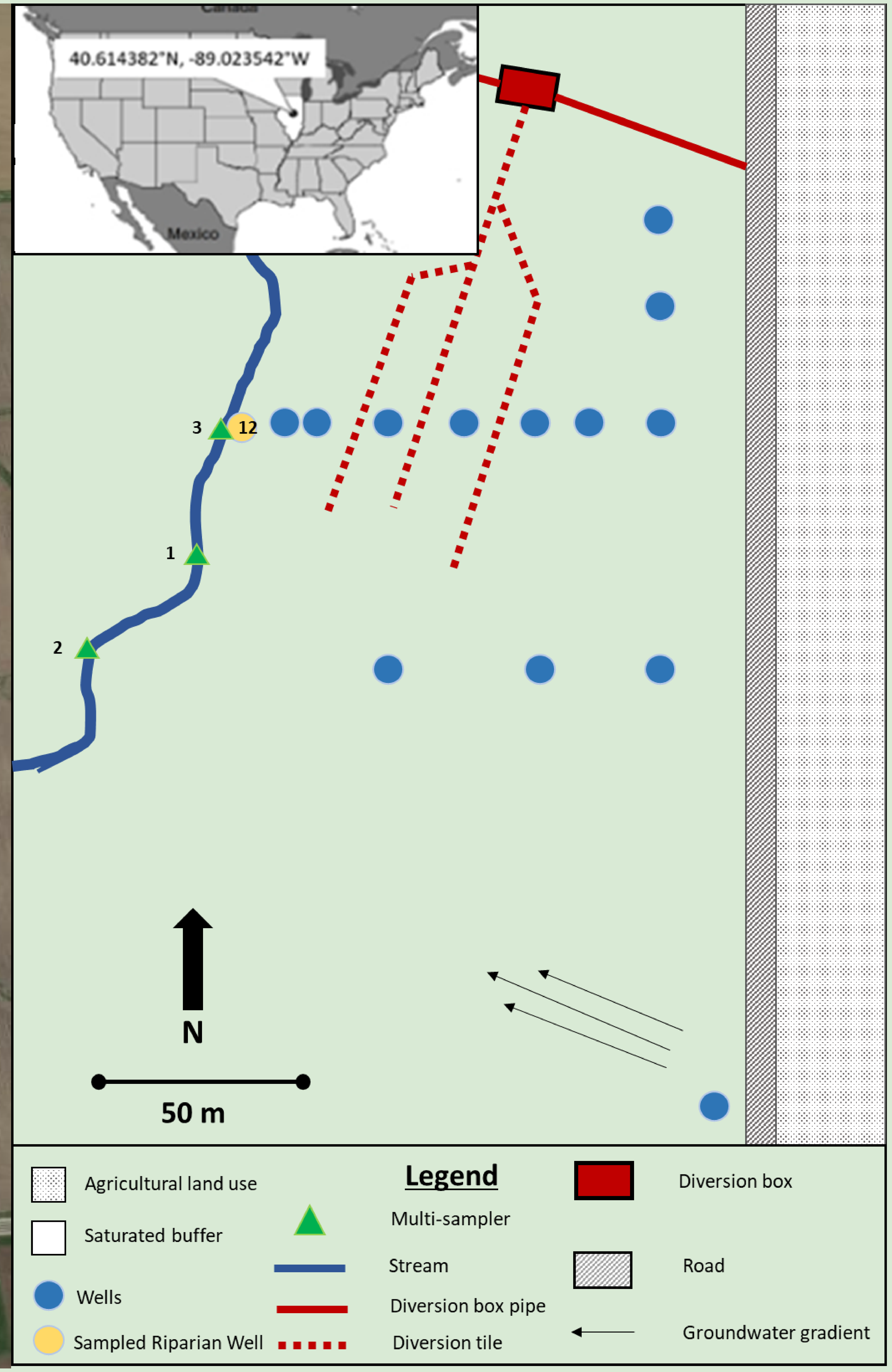

40.614382°N, -89.023542°W
Mexico
3
12
1
2
N
50 m
Legend
Agricultural land use
Saturated buffer
Wells
Sampled Riparian Well
Multi-sampler
Stream
Diversion box pipe
Diversion tile
Diversion box
Road
Groundwater gradient

Methods: Collect Water Samples in and around the Stream

Methods: Analyze these Water Samples

- Analyze these samples for nitrate and other major anions (chloride, bromide, and sulfide) using the ISU Ion Chromatograph
- Also test for dissolved oxygen levels and temperature in-field using a YSI probe.

(American Assay Laboratories, n.d.)

Methods: Mixing Model Development

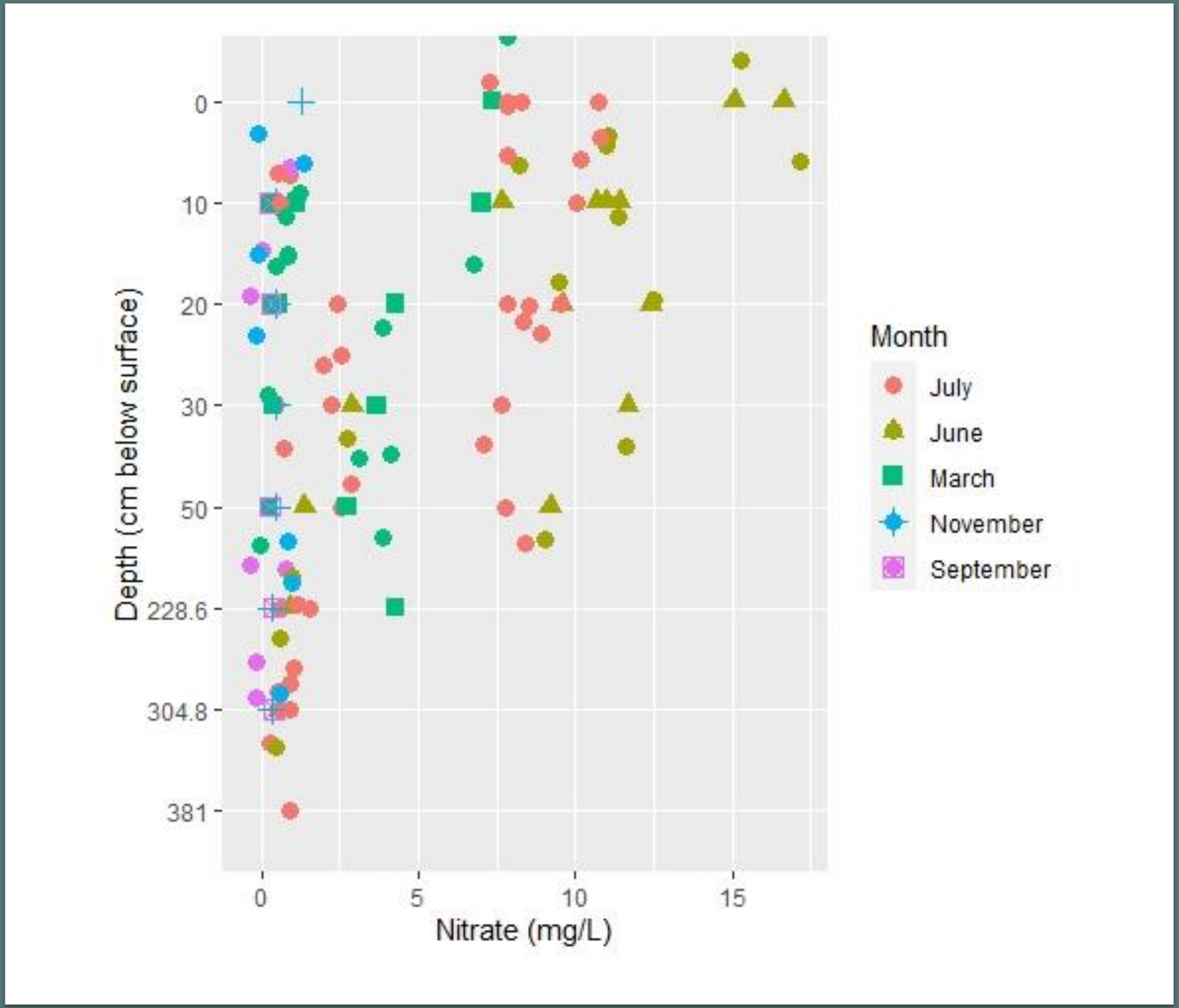
$$(Equation\ 1):\ \%SW = \frac{(Cl_{HZ} - Cl_g)}{(Cl_s - Cl_g)} \times 100$$

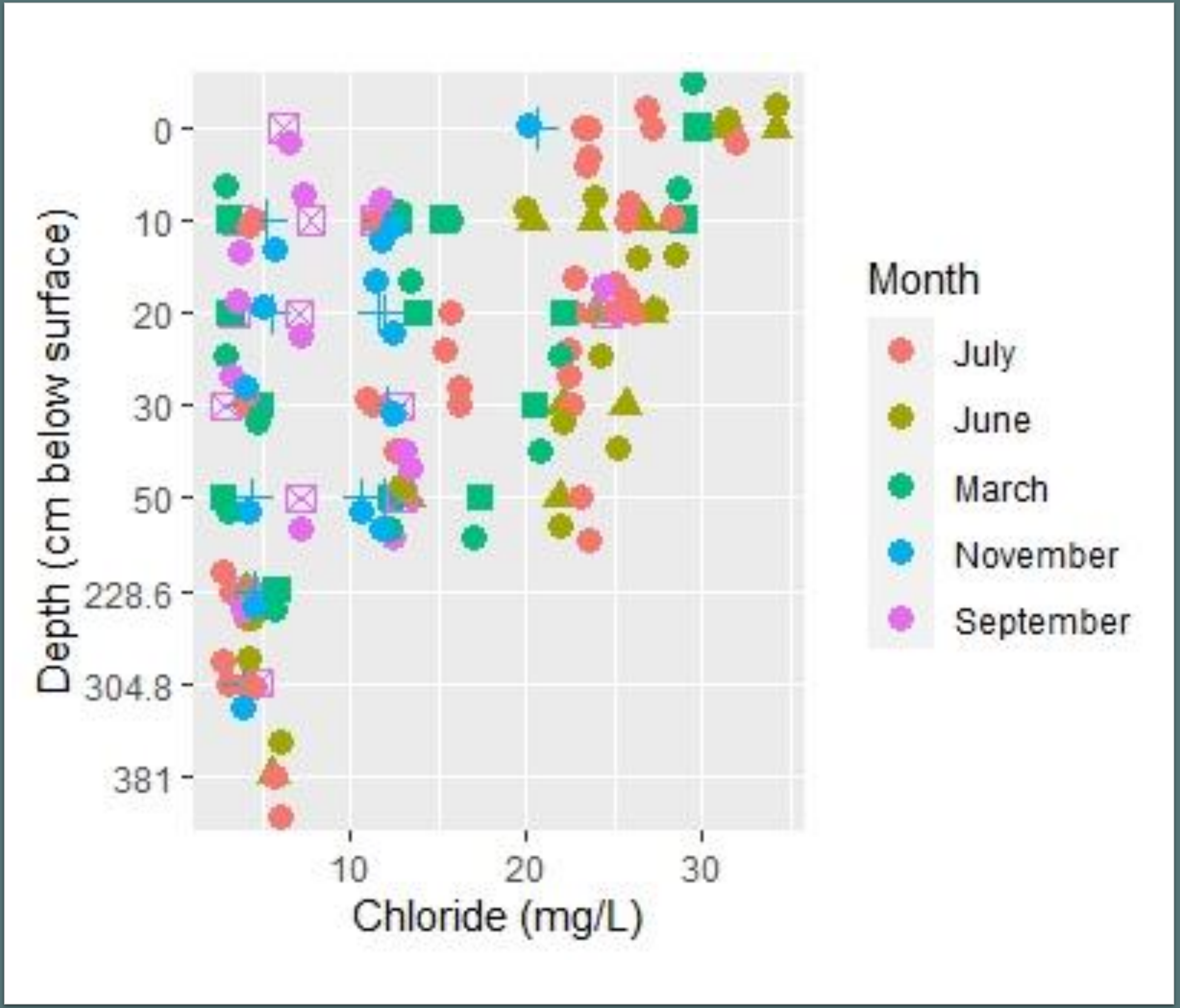
$$(Equation\ 2):\ NO_3N = \%SW\left(N_s - N_g\right) + N_g$$

%SW	Percent Surface water infiltration
Cl_{HZ}	Measured concentration of chloride in the hyporheic zone (mg/L)
Cl_g (mg/L)	Measured concentration of chloride in the groundwater (riparian well)
Cl_s	Measured concentration of chloride in the surface water (stream) (mg/L)
N_s	Measured concentration of nitrate in the surface water (stream) (mg/L)
N_g	Measured concentration of nitrate in the groundwater (riparian well) (mg/L)

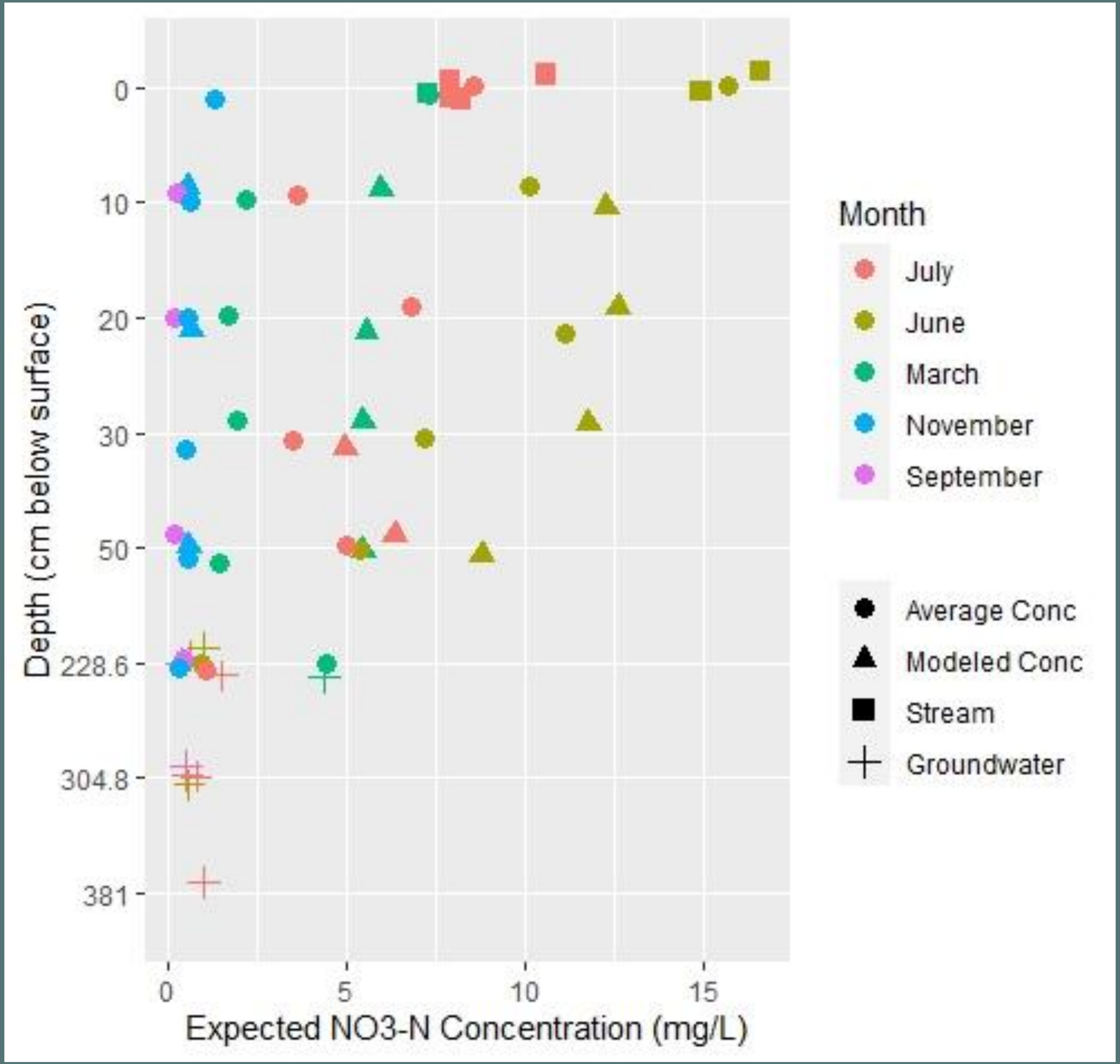
(Peterson and Hayden, 2018)

Analysis of Results: Sample Measurements





Analysis of Results: Model Estimations



Conclusions

Surface water and groundwater are mixing along the depth of the HZ in this study area.

Nitrate is being removed, potentially by a variety of processes, along the depth of the HZ.

Riparian HZ interaction in this stream is fairly limited.

This project's focus on water mixing and nitrate levels in streambeds could help to quantify the potential for shallow subsurface streambed flows to mitigate excess nitrate levels.

Acknowledgements

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Illinois Lake Management Association

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Thank you

Questions?