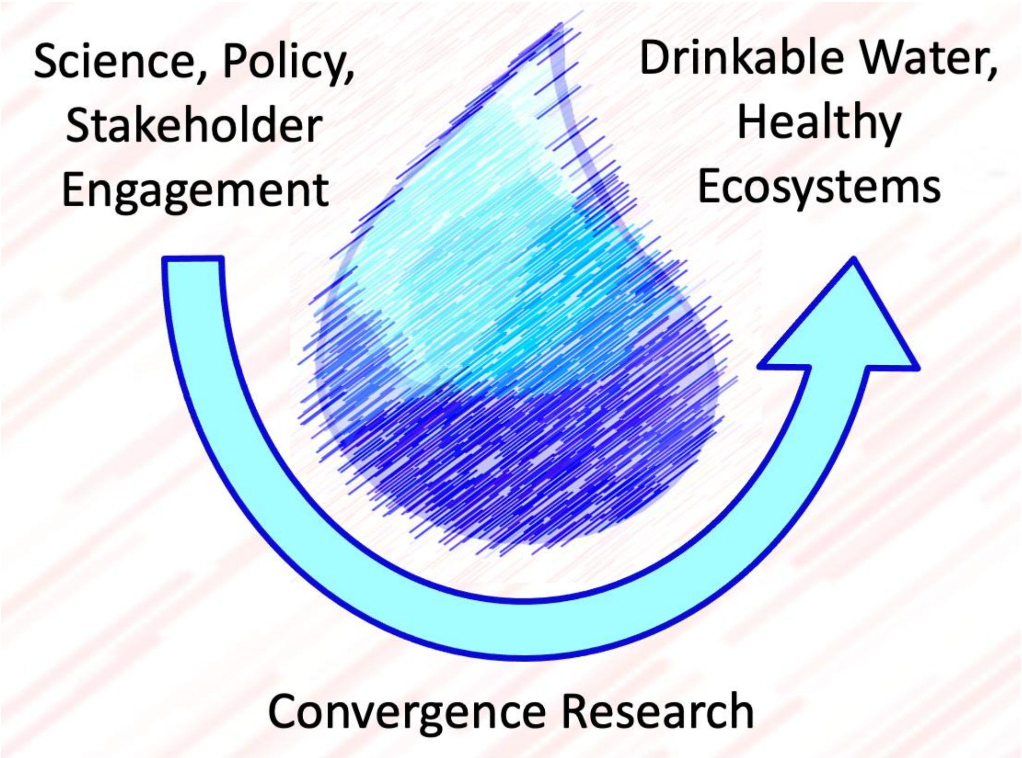
Occoquan Watershed Monitoring Laboratory



Impacts of increasing salinity sources on drinking water

5/26/26

Stanley B. Grant
Nick Prillaman Professor
Director, Occoquan Watershed Monitoring Lab
Civil and Environmental Engineering
Virginia Tech

Outline

- Occoquan Reservoir “One Water” System
- National Science Foundation Salt Project
- Reservoir Hydrology and Salt Sources
- Understanding sources and risks with interactive modeling
- “Salt pressure” as an indicator of deicer risk and tipping points
- Conclusions

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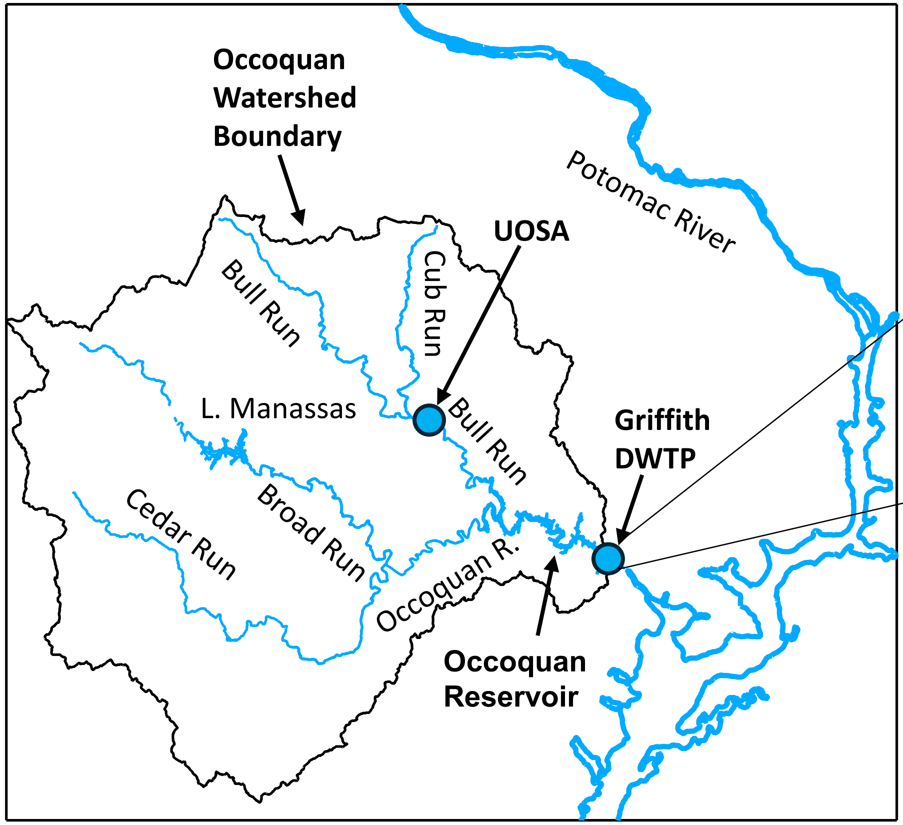
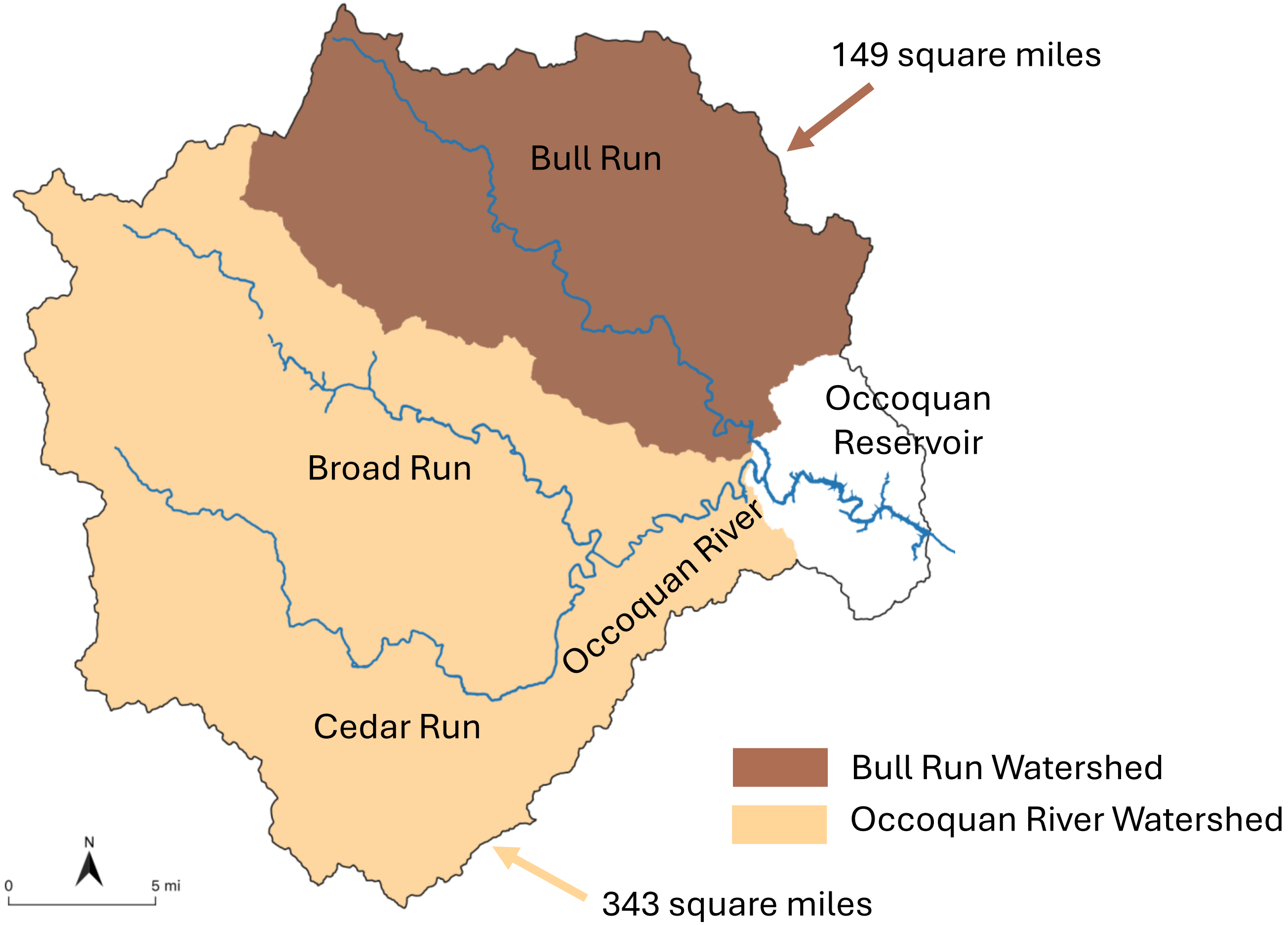
Occoquan Reservoir: Source of drinking water for up to 1 million people



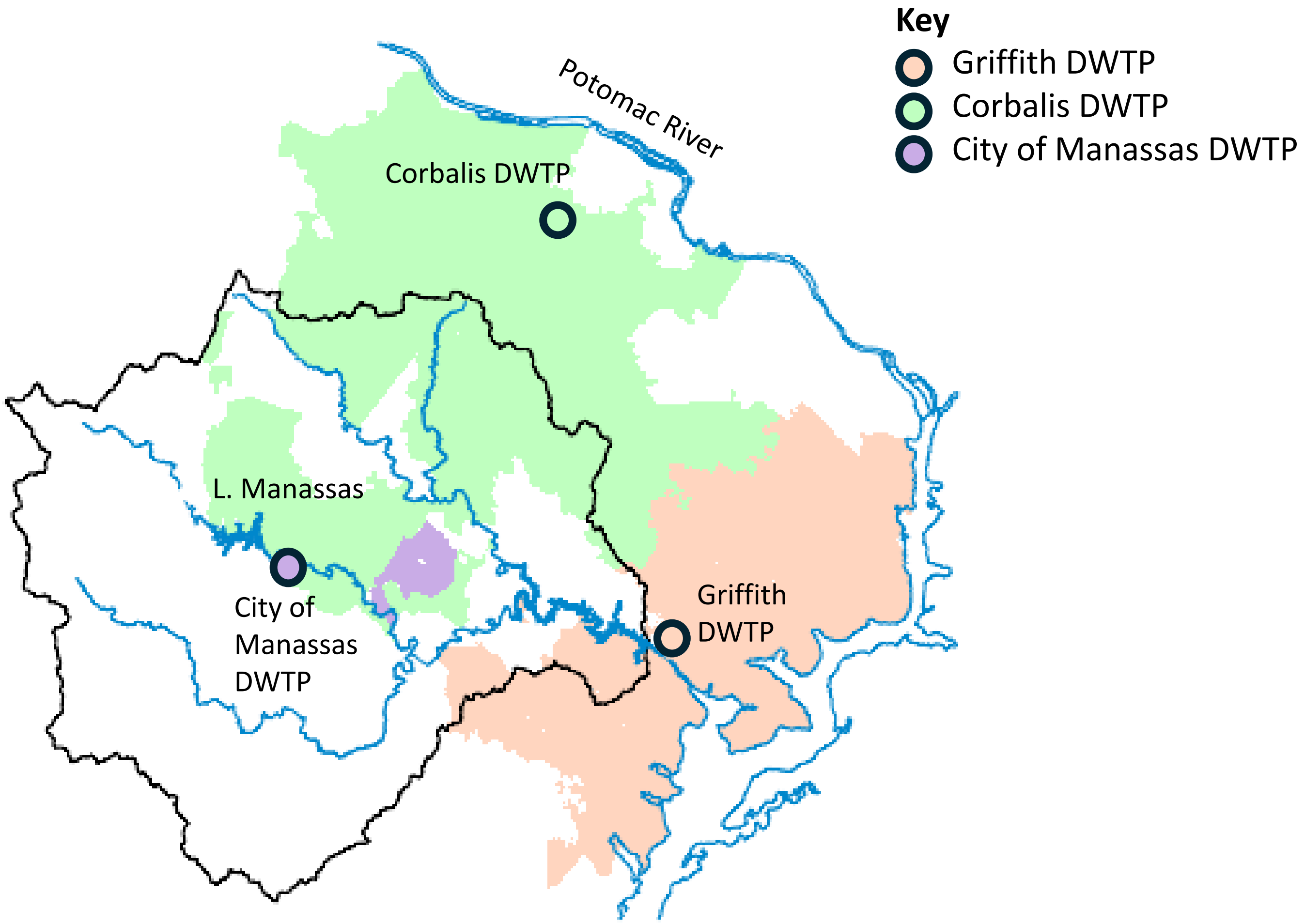
- Provides raw water for Fairfax Water's **Griffith Drinking Water Treatment Plant** (DWTP)
- One of the first and largest "One Water" systems in the United States
- Water in the reservoir is from the surrounding watersheds and a water reclamation plant (**Upper Occoquan Service Authority**, UOSA)

The Occoquan “One Water” System:
Streamflow and Urban Runoff

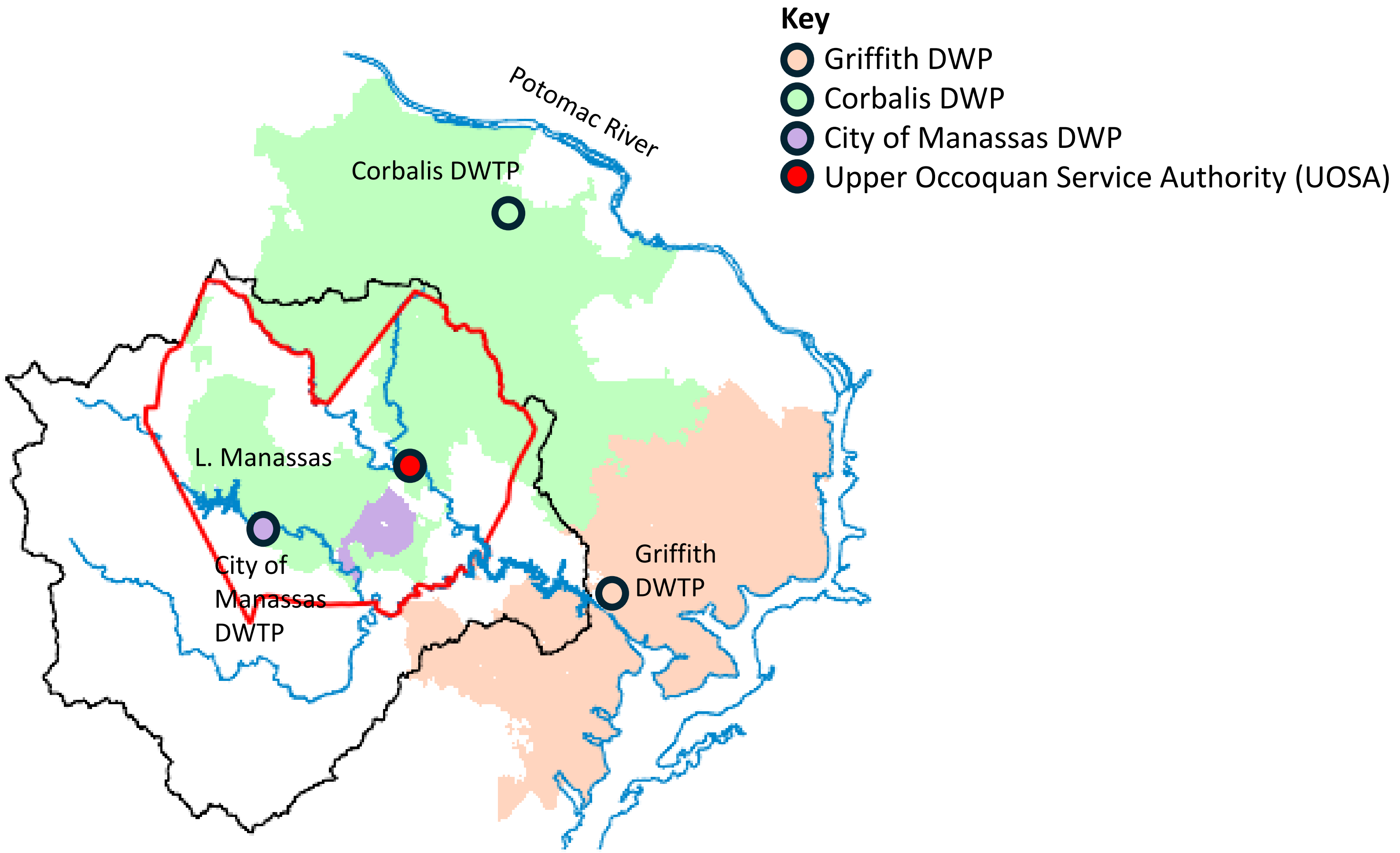


Bull Run and Occoquan River, drain ~315,000 acres (492 square miles) of mixed urban, agriculture, and forested land-use

The Occoquan “One Water” System: **Drinking Water**



The Occoquan “One Water” System:
Water Reclamation



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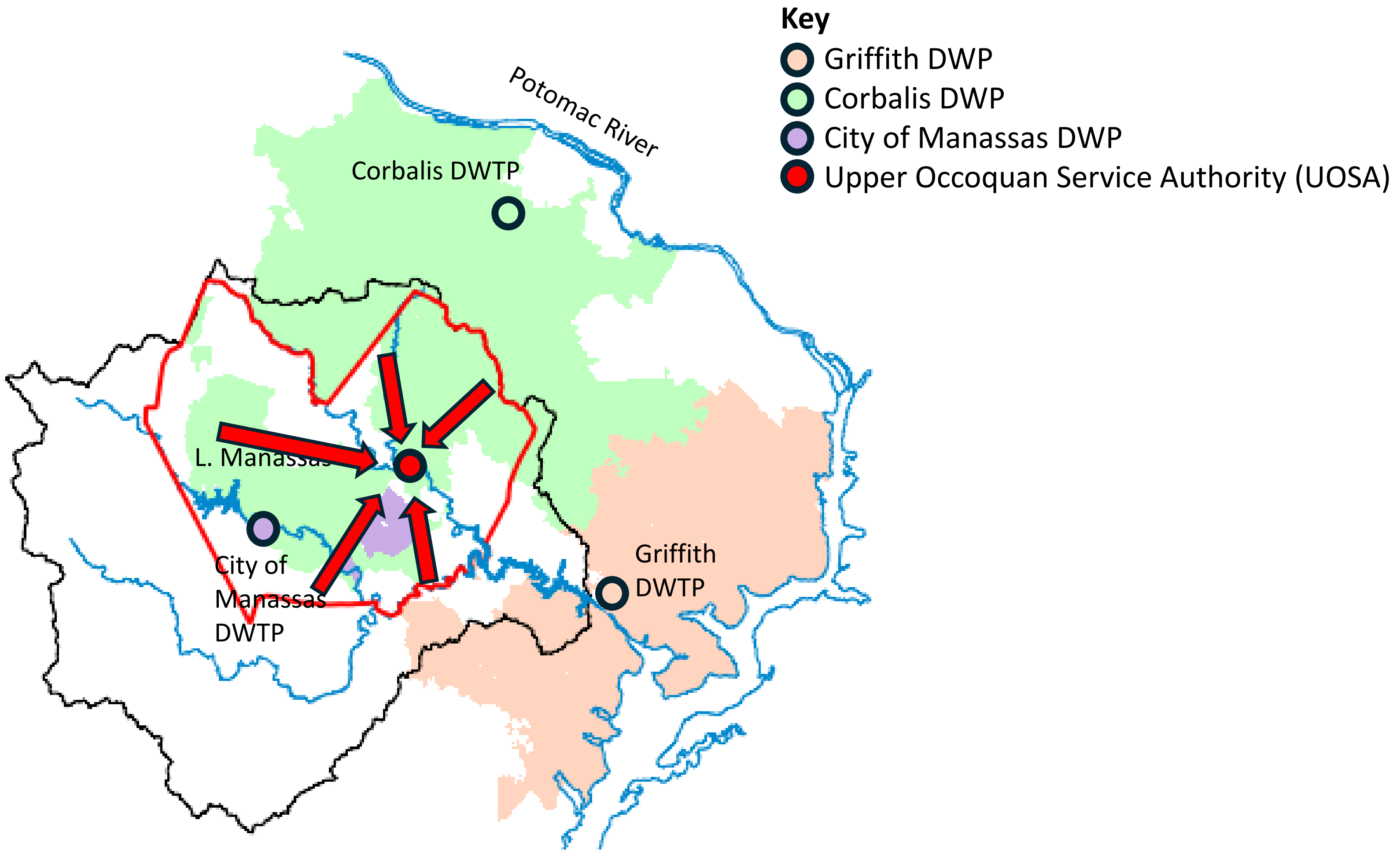

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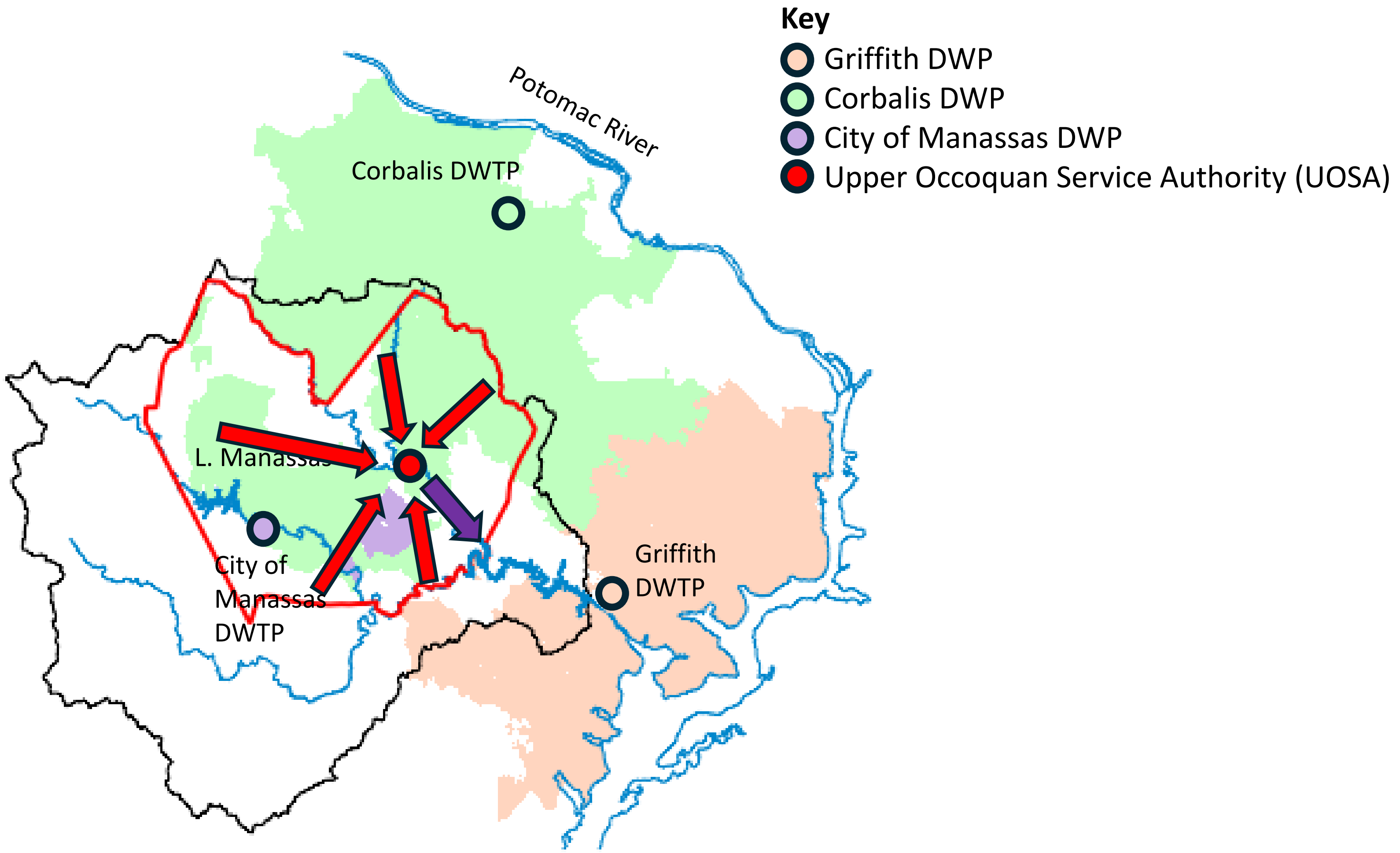
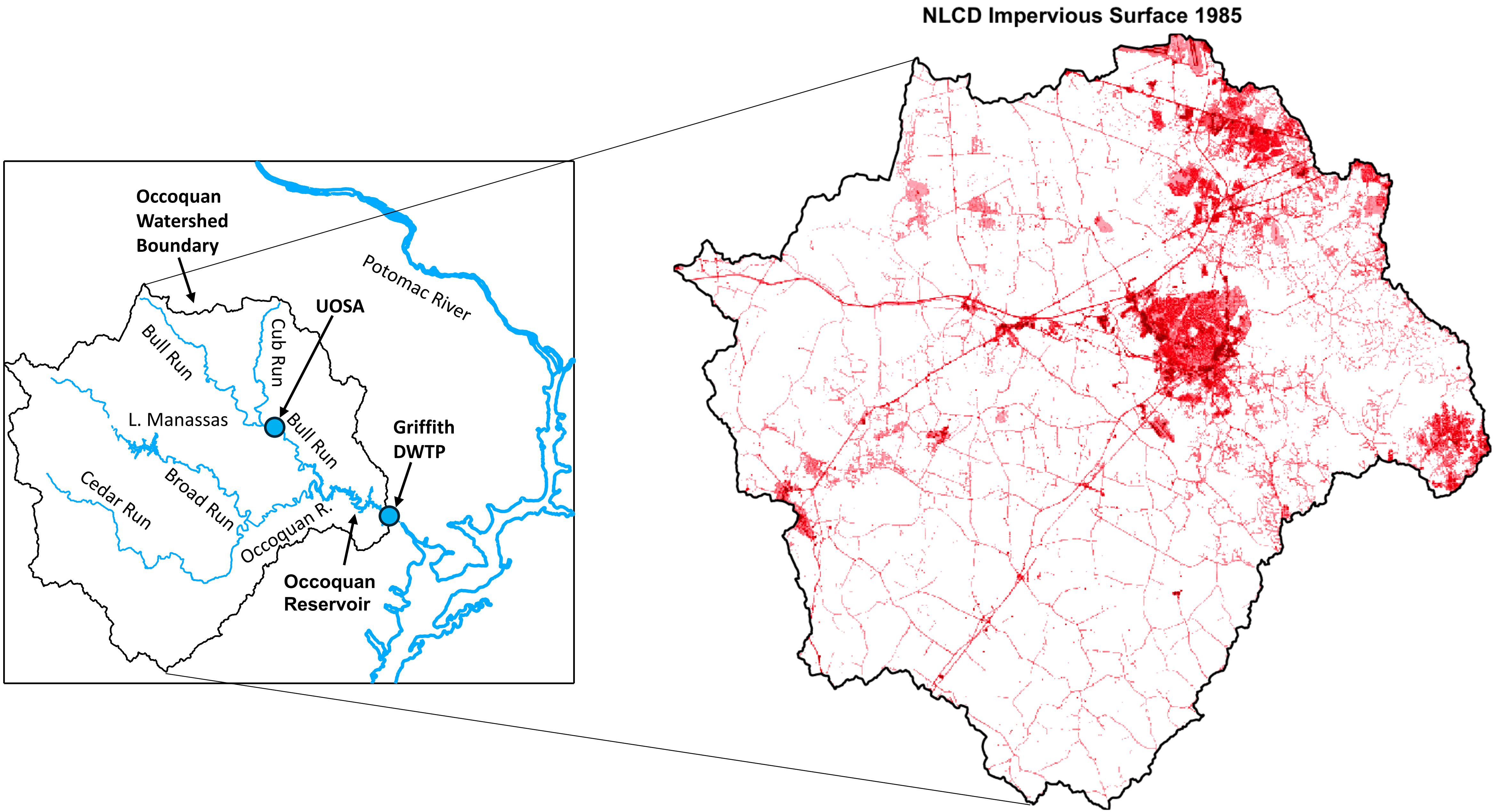
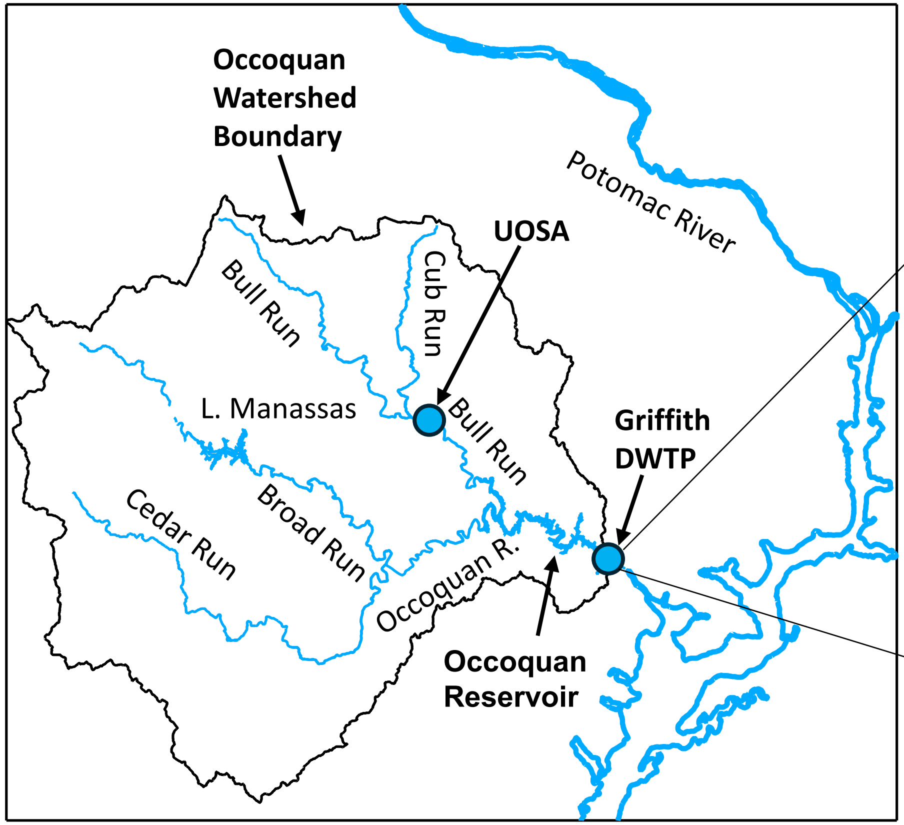
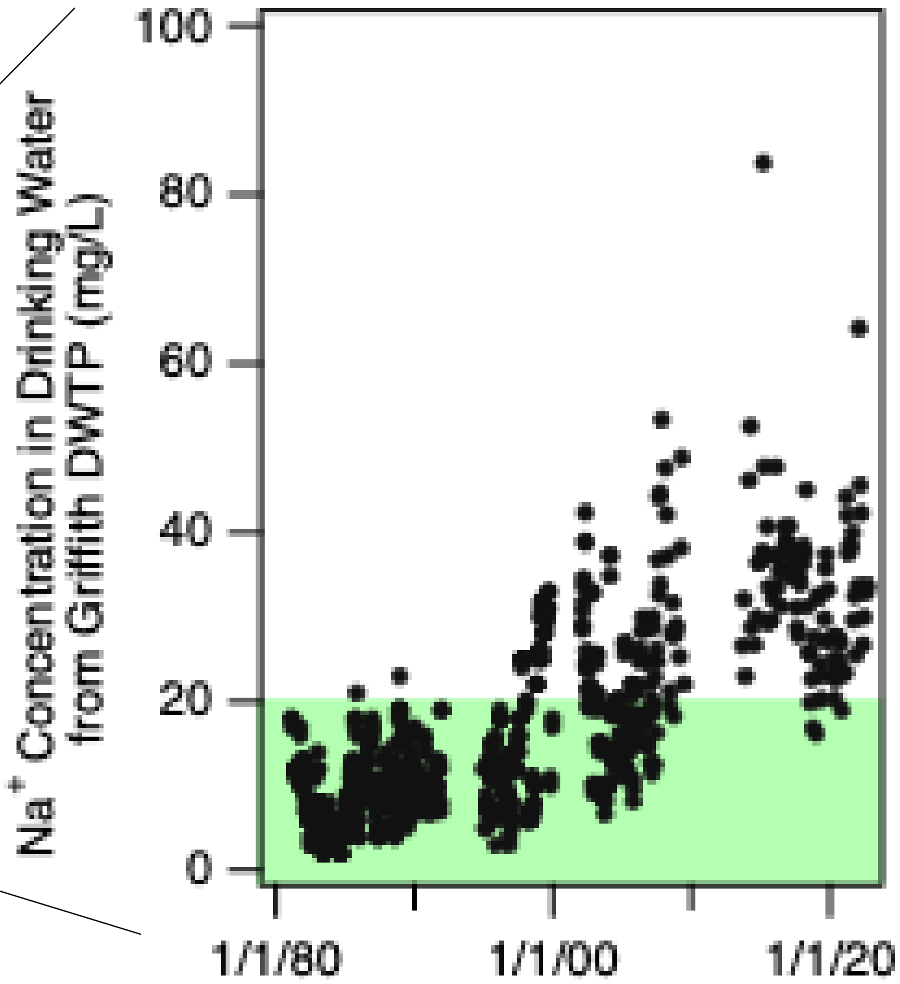



NLCD Impervious Surface 1985
Occoquan
Watershed
Boundary
UOSA
Potomac River
Bull Run
Cub Run
L. Manassas
Bull Run
Griffith
DWTP
Cedar Run
Broad Run
Occoquan R.
Occoquan
Reservoir

Rising Sodium in Griffith Drinking Water





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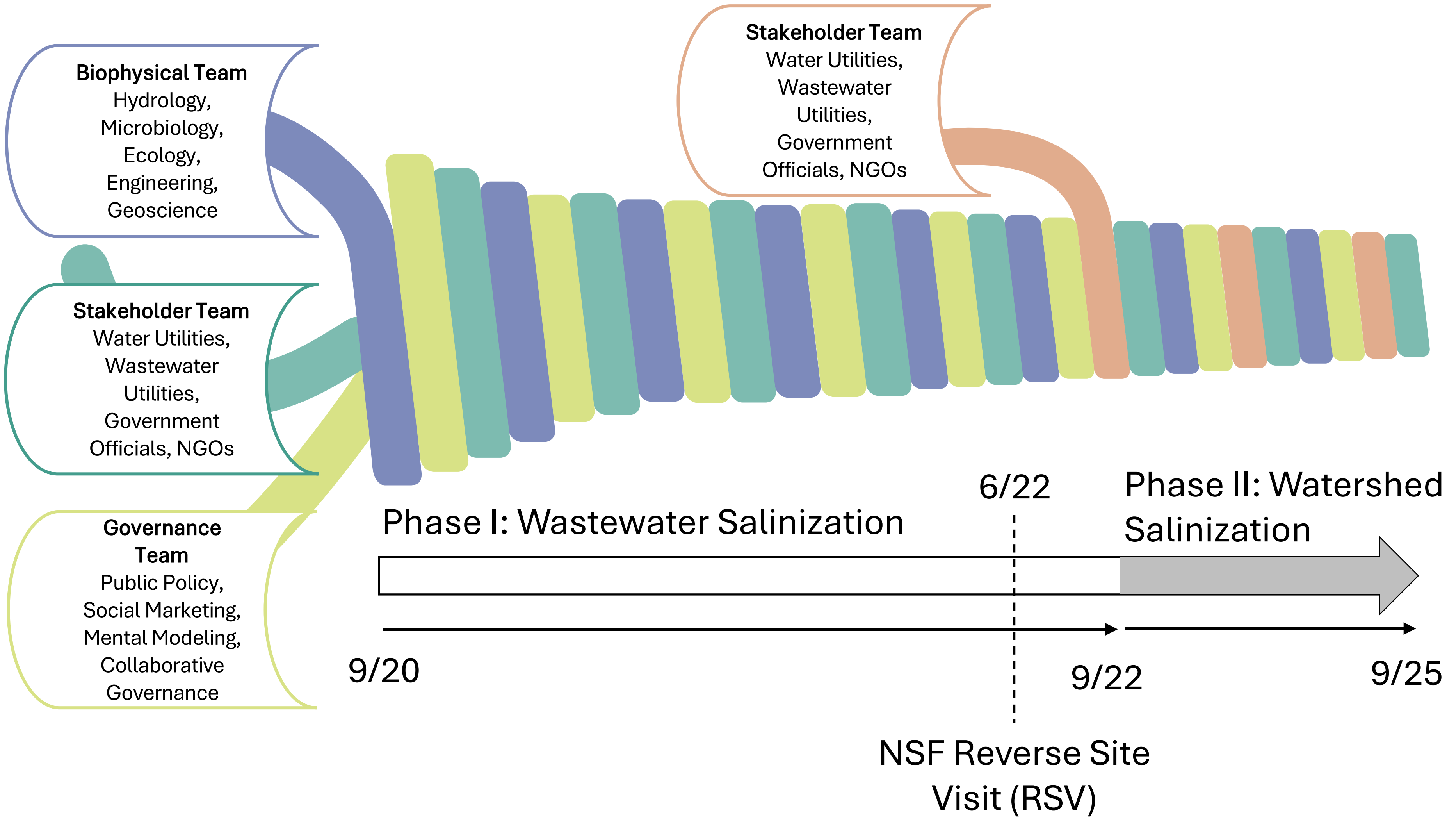
National Science Foundation Growing Convergence Research Salinity Project



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Article | Published: 19 April 2021

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Shantanu V. Bhide, Stanley B. Grant ✉, Emily A. Parker, Megan A. Rippy, Adil N. Godrej, Sujay Kaushal, Greg Prelewicz, Niffy Saji, Shannon Curtis, Peter Vikesland, Ayella Maile-Moskowitz, Marc Edwards, Kathryn G. Lopez, Thomas A. Birkland & Todd Schenk

Nature Sustainability **4**, 699–707 (2021) | Cite this article

communications earth & environment

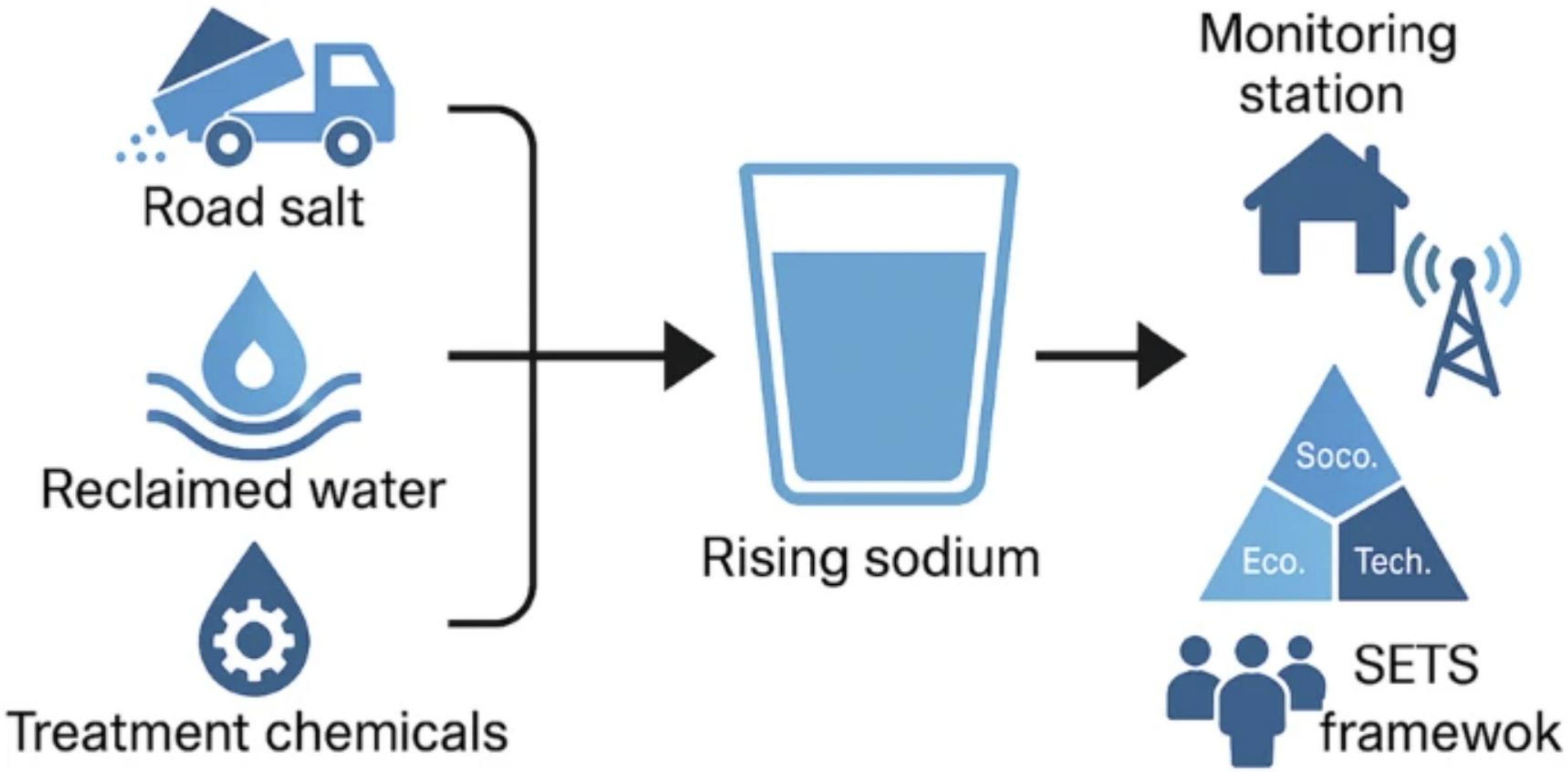
Article | Open access | Published: 05 January 2026

Social-ecological-technological drivers of freshwater salinization in the Occoquan Reservoir, United States

Stanley B. Grant ✉, Shantanu V. Bhide, Anne Spiesman, Shalini Misra, Megan A. Rippy, Christopher S. Galik, Thomas A. Birkland, Todd Schenk, Sujay S. Kaushal, Peter Vikesland, William Knocke, Admin Husic, Harold Post, Chad Coneway, Greg Prelewicz, Brian Steglitz, Bethany Laursen, Kristin Rowles, Shannon Curtis & Ashley Studholme

Communications Earth & Environment **7**, Article number: 133 (2026) | Cite this article

Graphical Abstract



Grant, Bhide et al. (2026) "Social-ecological-technological drivers of freshwater salinization" *Nature Communication Earth and Environment, 7, 133.*

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ELSEVIER

Water Research

Volume 288, Part B, 1 January 2026, 124652

Transit times link pollution sources to drinking water quality in a "One Water" system

Shantanu V. Bhide [a,1], Stanley B. Grant [a,1], Paolo Benettin [b], Megan A. Rippy [a], Ahmed Monofy [a], Kirin E. Furst [a], Sydney Shelton [c], Sujay S. Kaushal [c], Shalini Misra [d], Peter J. Vikesland [e], Erin R. Hotchkiss [f], Anne Spiesman [g], Greg Prelewicz [g], Todd Schenk [h], Harold Post [a], Dongemei Alvi [a], Brian Steglitz [i], Admin Husic [a]

ELSEVIER

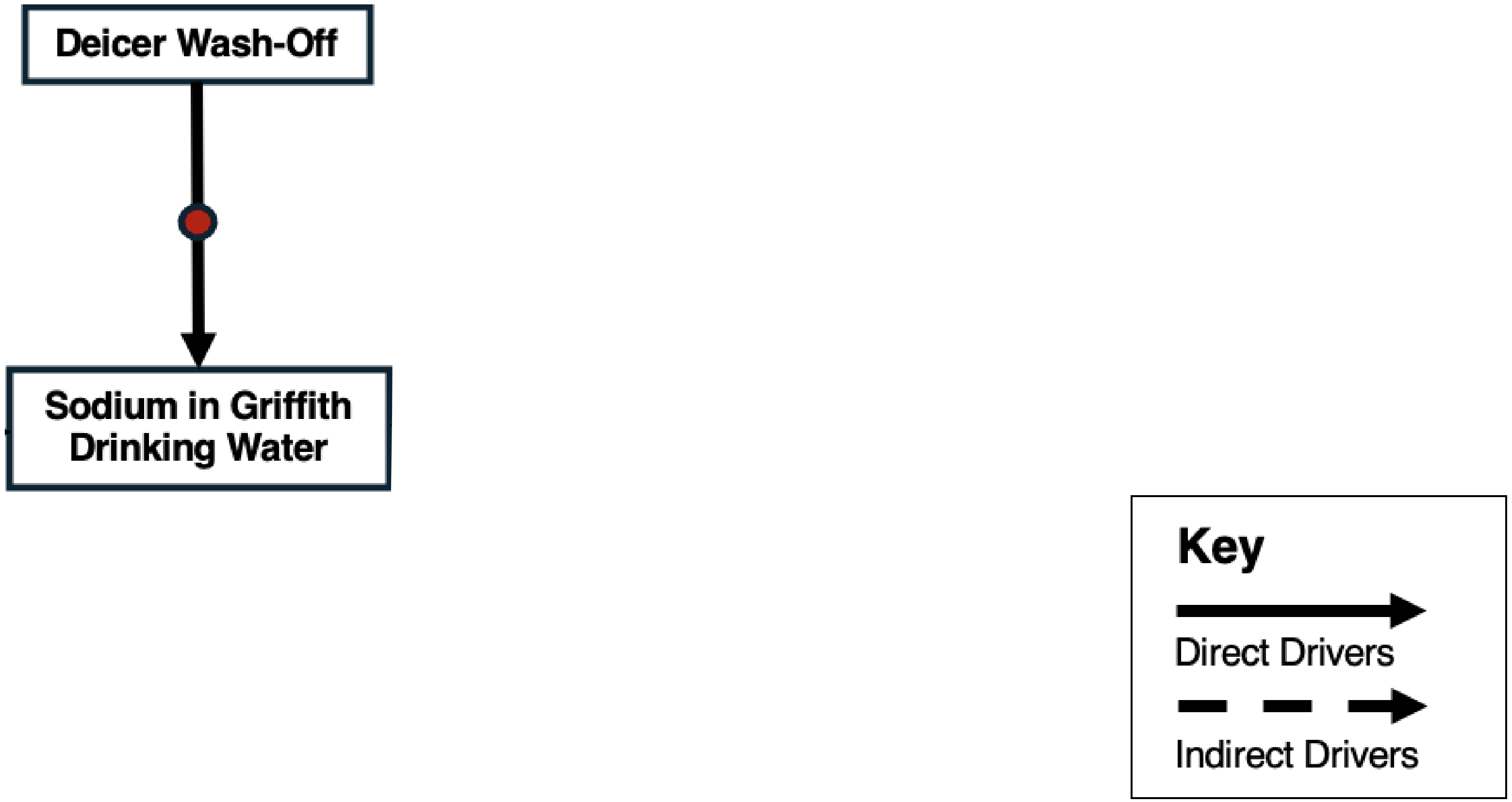
Water Research

Volume 297, 1 June 2026, 125692

Transit time modeling framework for predicting freshwater salinization in urban catchments

Shantanu V. Bhide [a,1], Stanley B. Grant [a,1], Kevin McGuire [b], Karen Prestegaard [c], Sujay S. Kaushal [c], Andrew J. Sekellick [d], Megan A. Rippy [a], Todd Schenk [e], Shannon Curtis [f], Jesus D. Gomez-Velez [g], Erin R. Hotchkiss [h], Peter Vikesland [i], Siddharth Saksena [i]

From analysis to action…



Grant, Bhide et al. (2025) "Drinking Water Salinization is a Social-Ecological-Technological System (SETs) Challenge" in revision for *Nature Communication Earth and Environment*.

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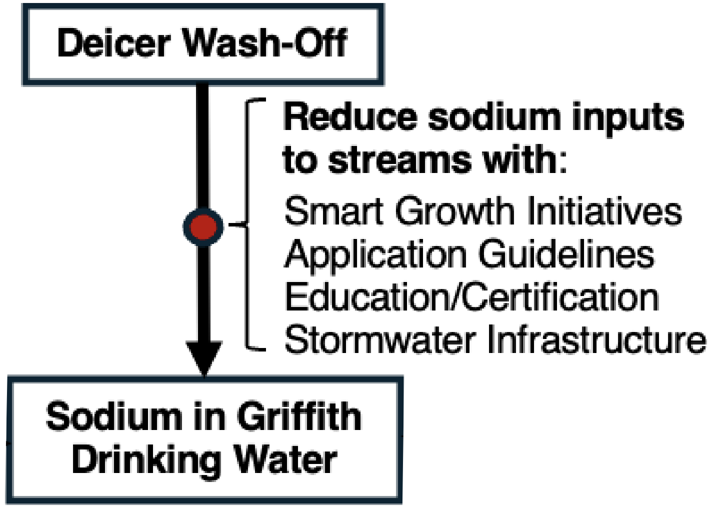
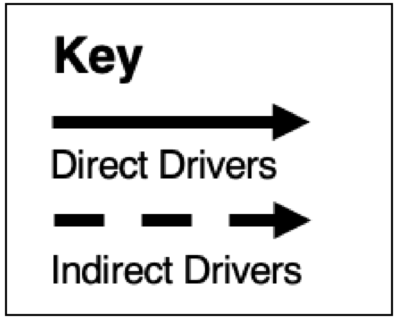


Rebecca Murphy's talk, "Drinking Water impacts—Northern Virginia" (tomorrow morning!)



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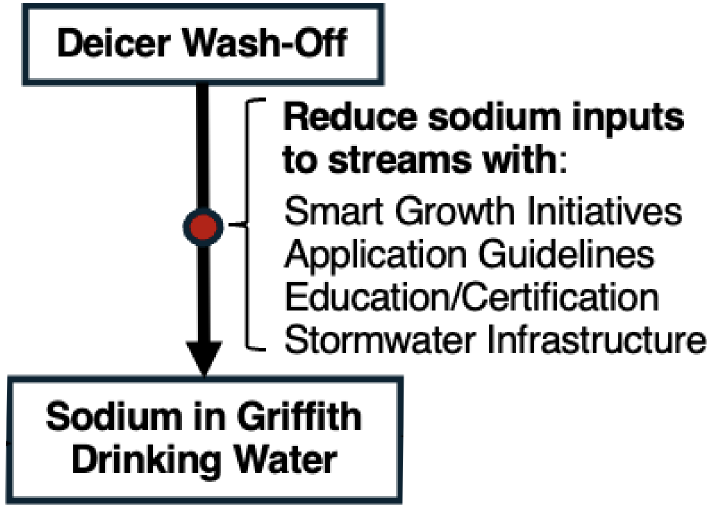

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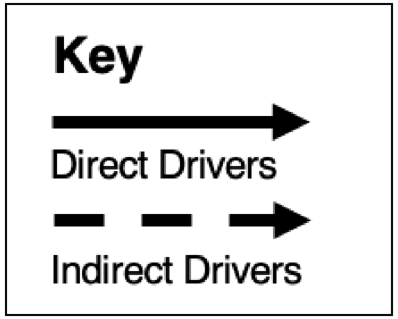

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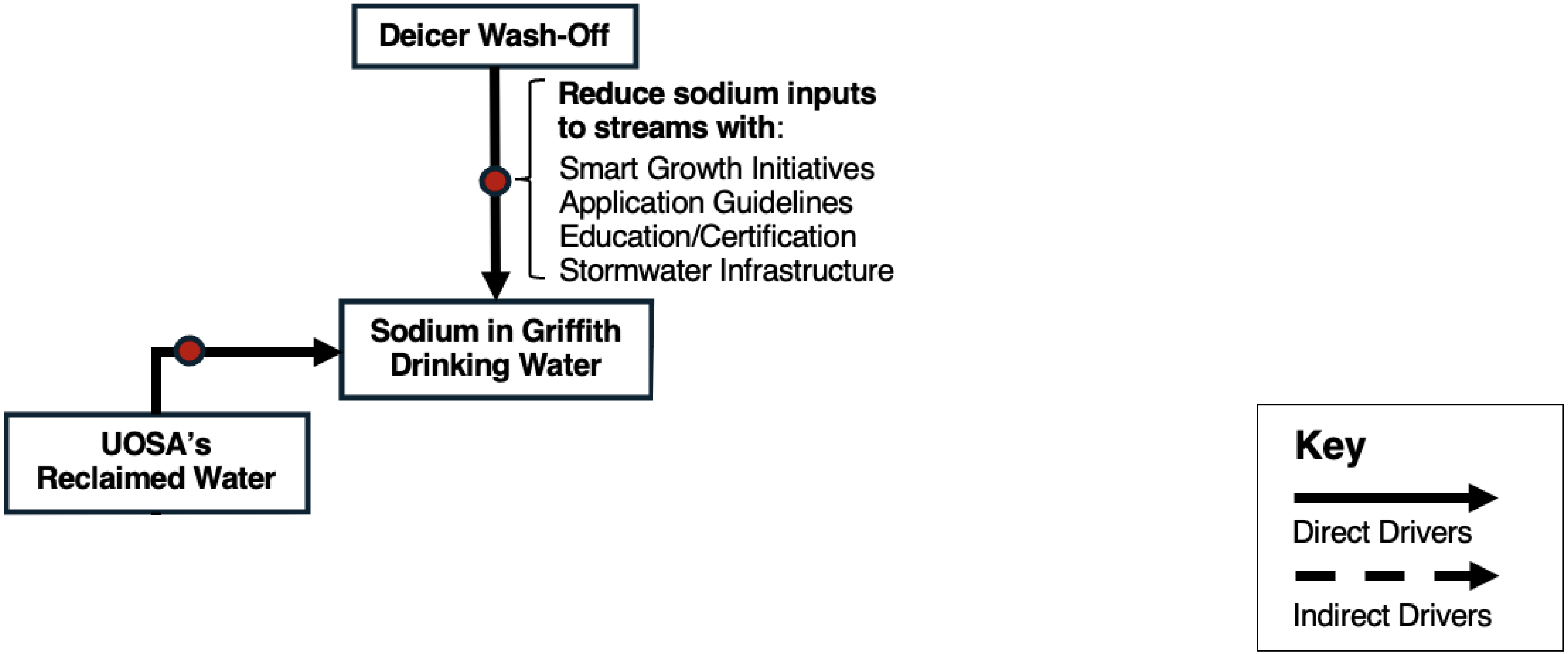

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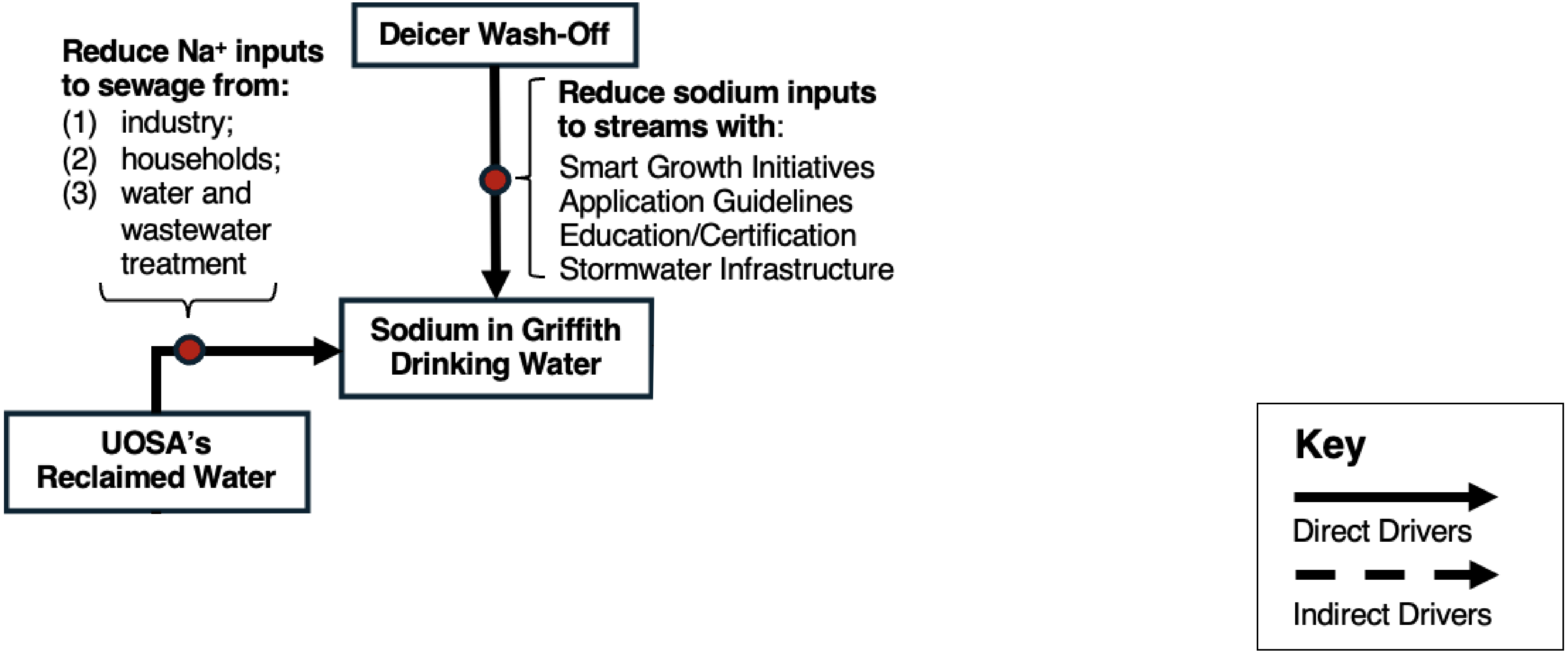

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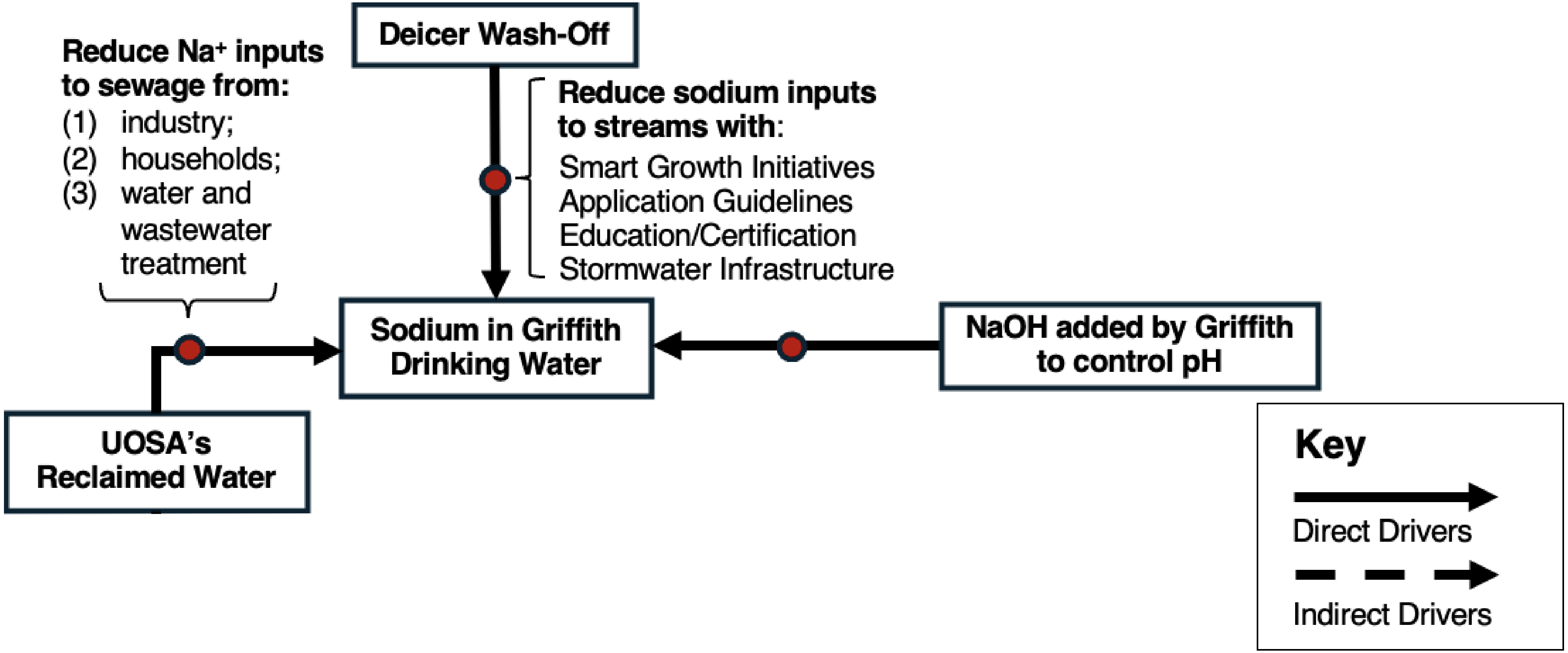

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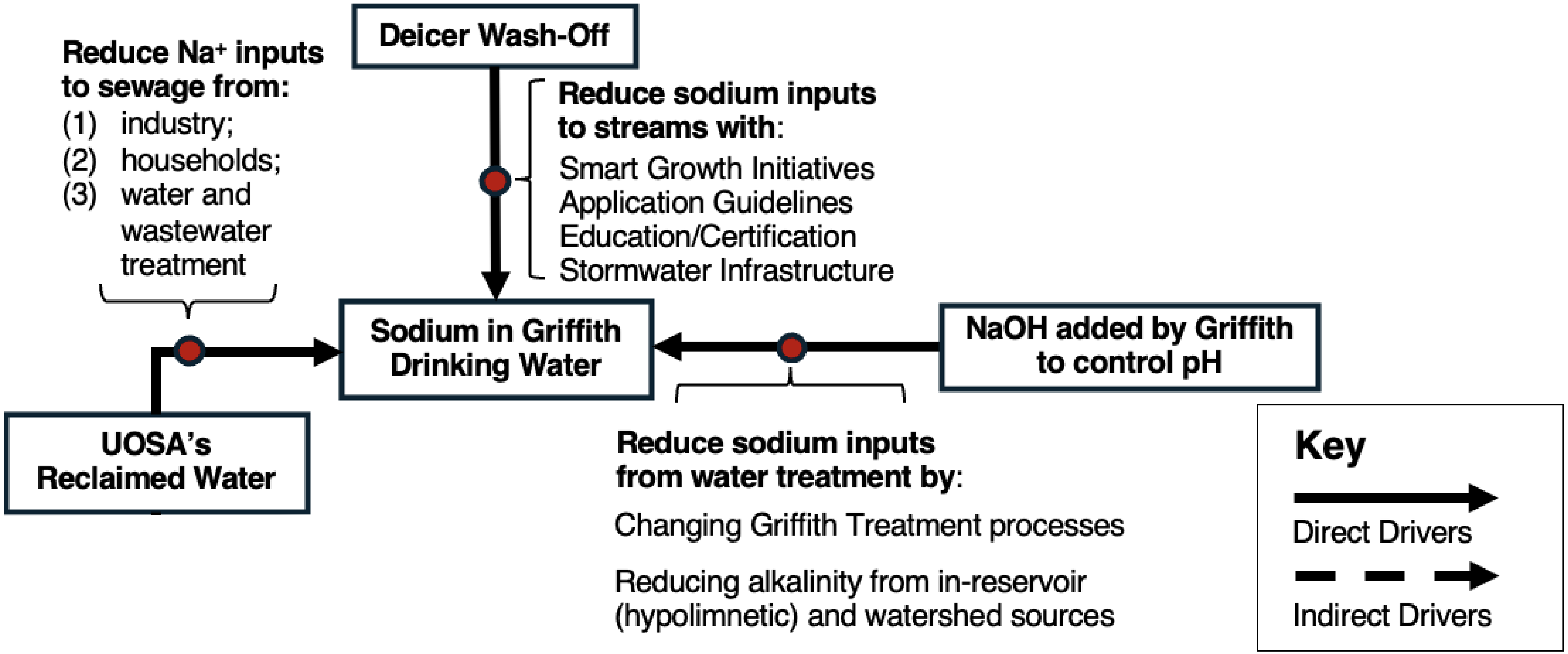

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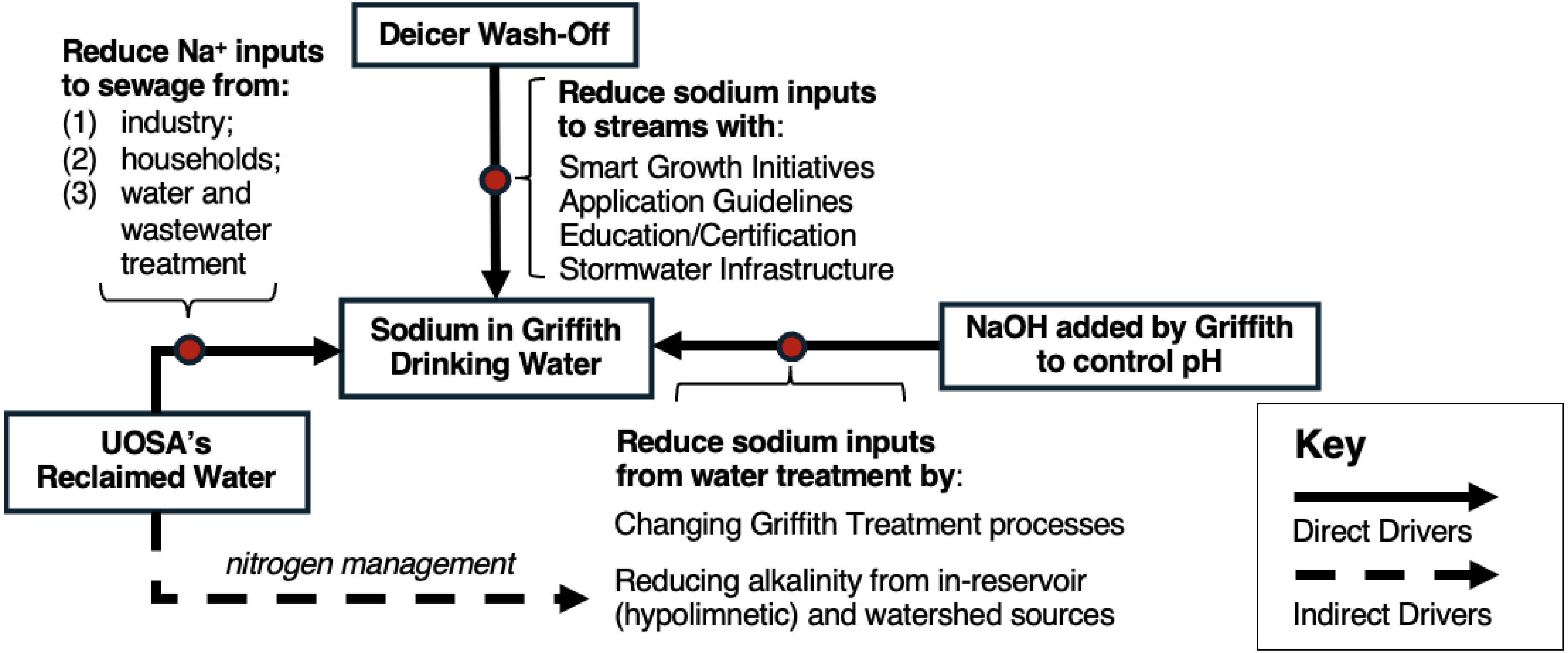

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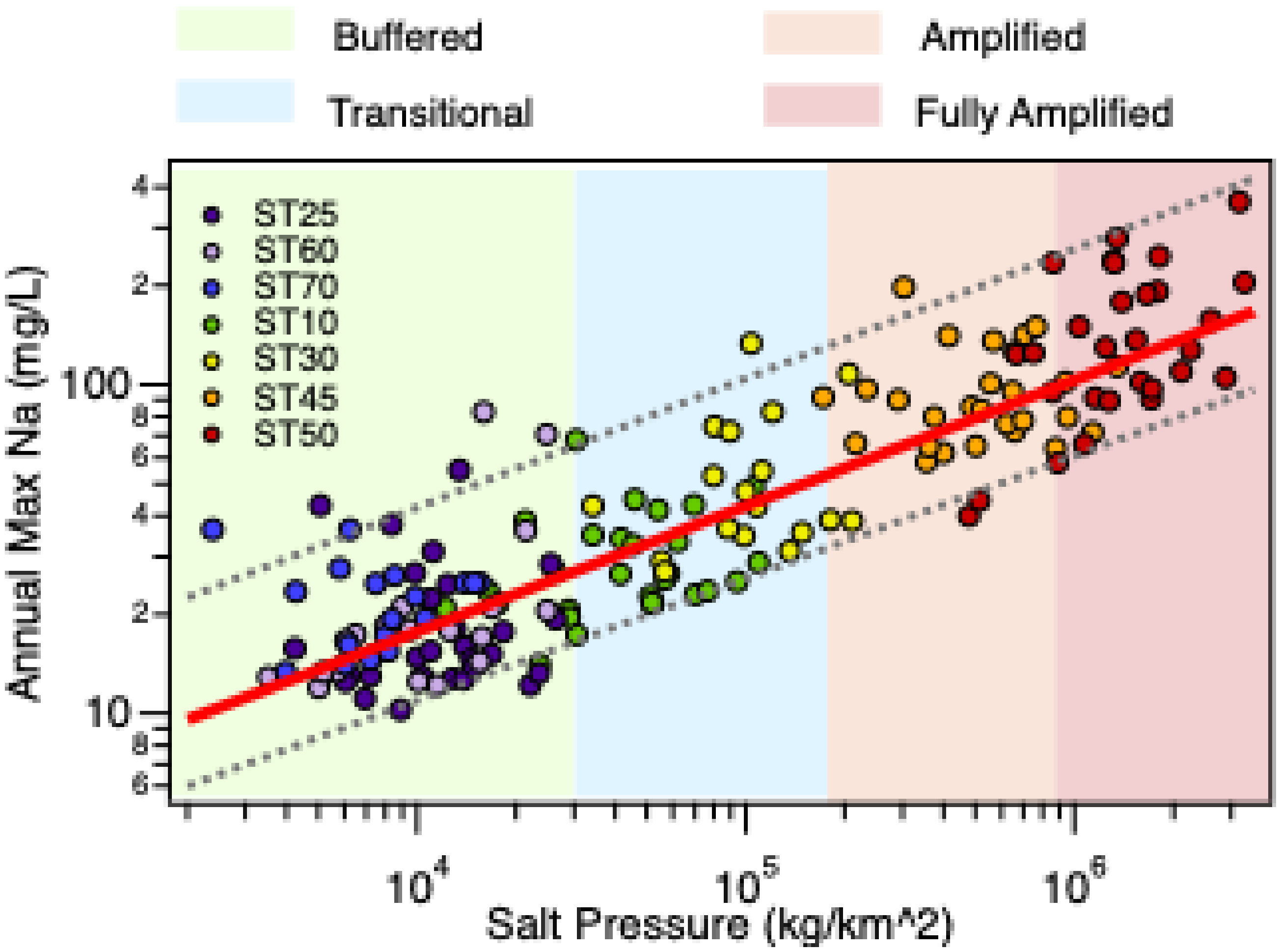
“Salt Pressure” predicts annual sodium maxima



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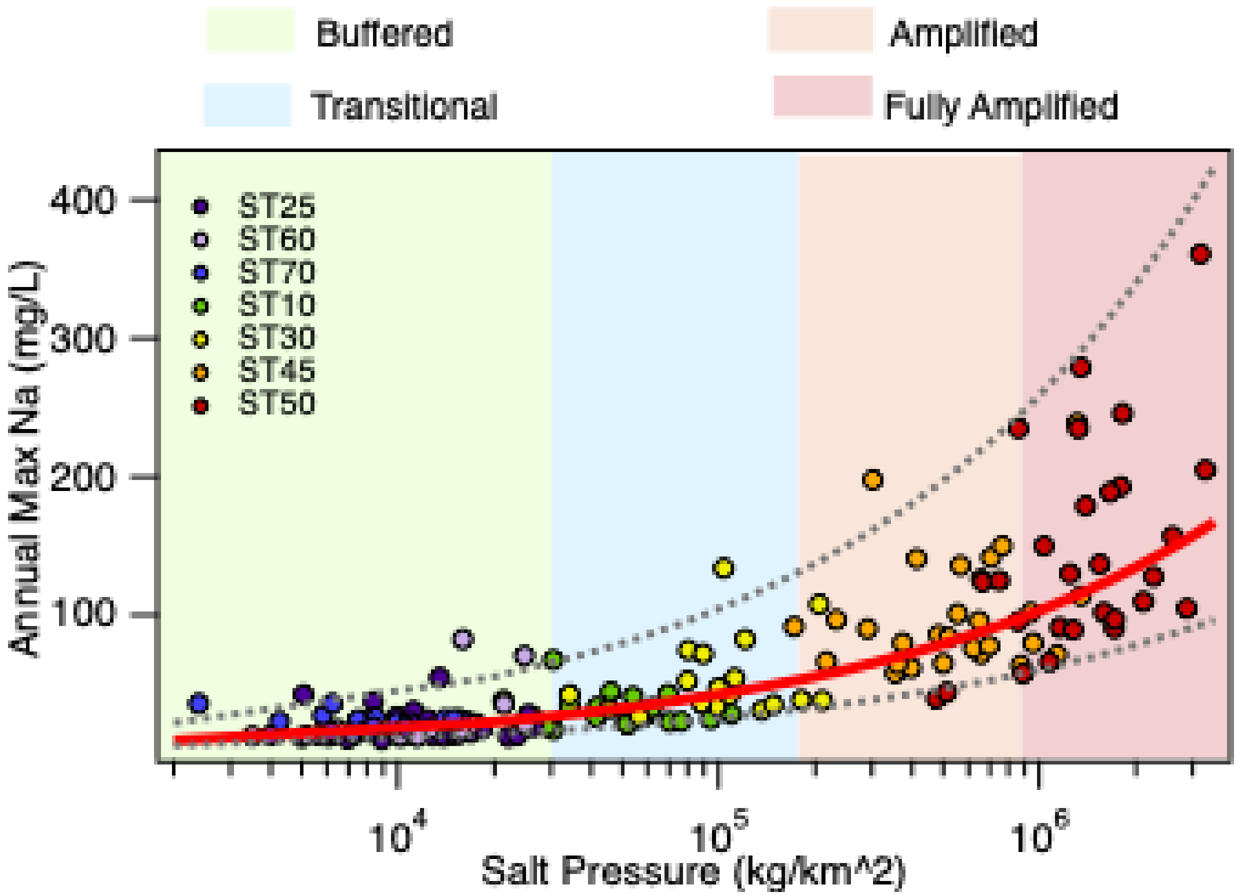

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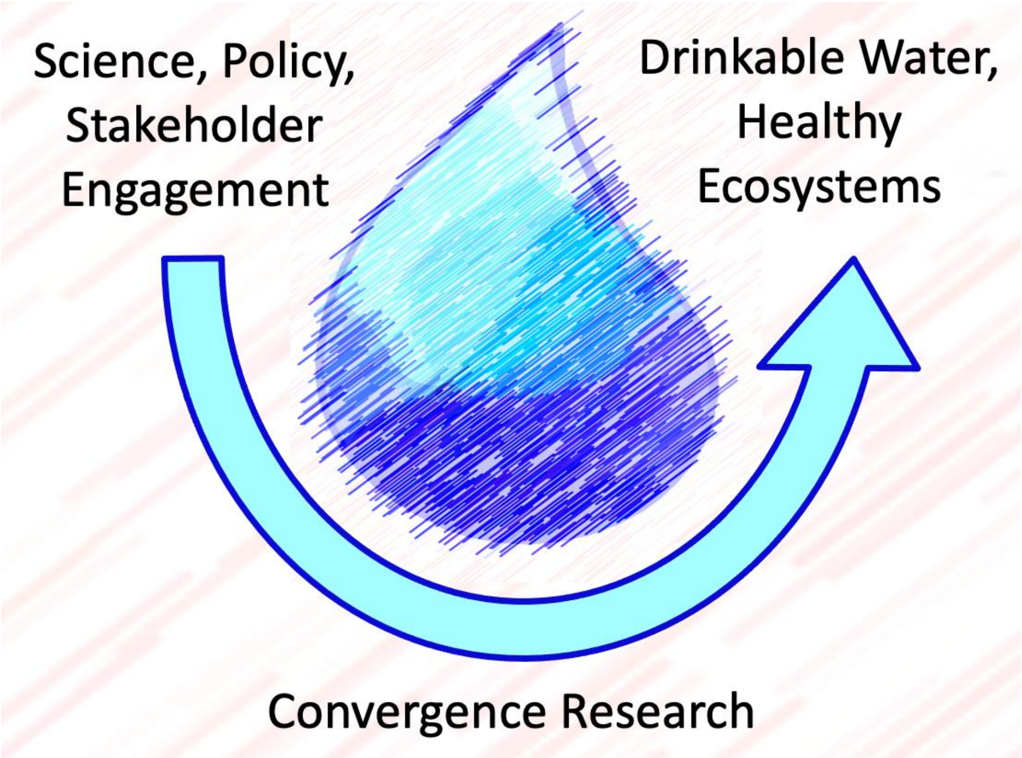
Conclusions

- Watershed inflows to the reservoir vary seasonally (lower in the summer, higher in the winter)
- Three primary sources of sodium, each with very different temporal variability and impact on Griffith drinking water quality:
  1. Winter maintenance activities (i.e., deicing) responsible for “winter bump” and extremes in finished drinking water Na^+
  2. NaOH added by Griffith increases Na^+ concentrations by ~10 to 15 mg/L
  3. UOSA’s reclaimed water leads to a second “summer bump” in finished drinking water Na^+ during periods of low watershed dilution
- Convergence research (at the intersection of geosciences, engineering, and social science) presents real opportunities to reveal risks and opportunities for addressing freshwater salinization

Occoquan Watershed Monitoring Laboratory



UOSA University: Sodium trends in the Occoquan

5/13/26

Stanley B. Grant
Professor & Director, Occoquan Watershed Monitoring Laboratory
CEE Department
Virginia Tech

“Salt Pressure”

- Annual proxy for the salt mass deposited per catchment area
- Steps:
  1. Compute daily timeseries of recommended rock salt deposition per unit impervious area (Salt Institute Guidelines + daily weather conditions)
  2. Sum up (1) over the year (=total annual recommended rock salt deposition per unit impervious area)
  3. Multiply (2) into NLCD estimates of impervious fraction for the watershed (=total annual recommended rock salt deposition per unit watershed area)
  4. Repeat for each year and sub-watershed as needed