Tanbark Creek Pilot PRB Long Term Monitoring 2023-2024 Results

Cornell Cooperative Extension

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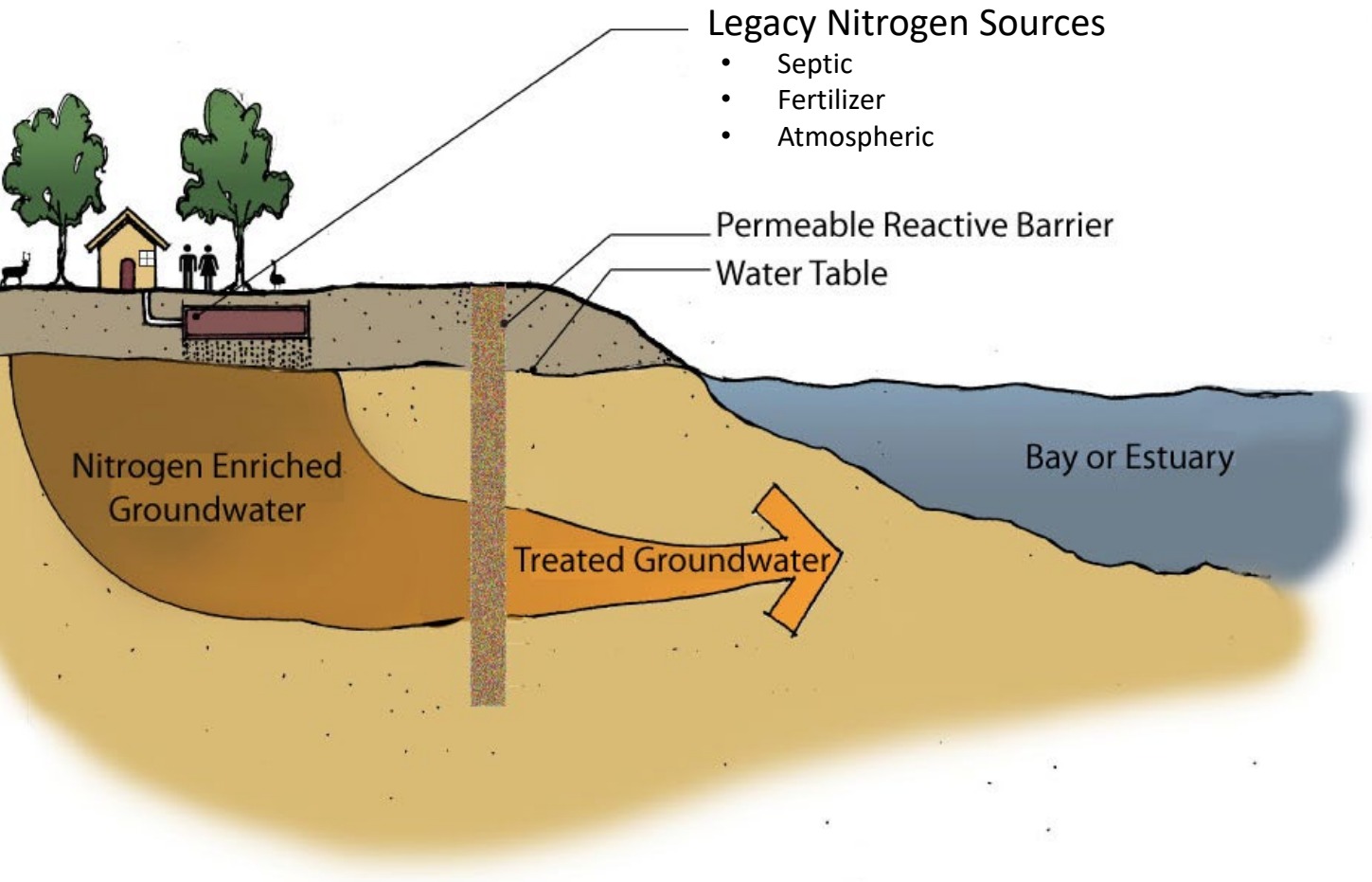
PRB Technology



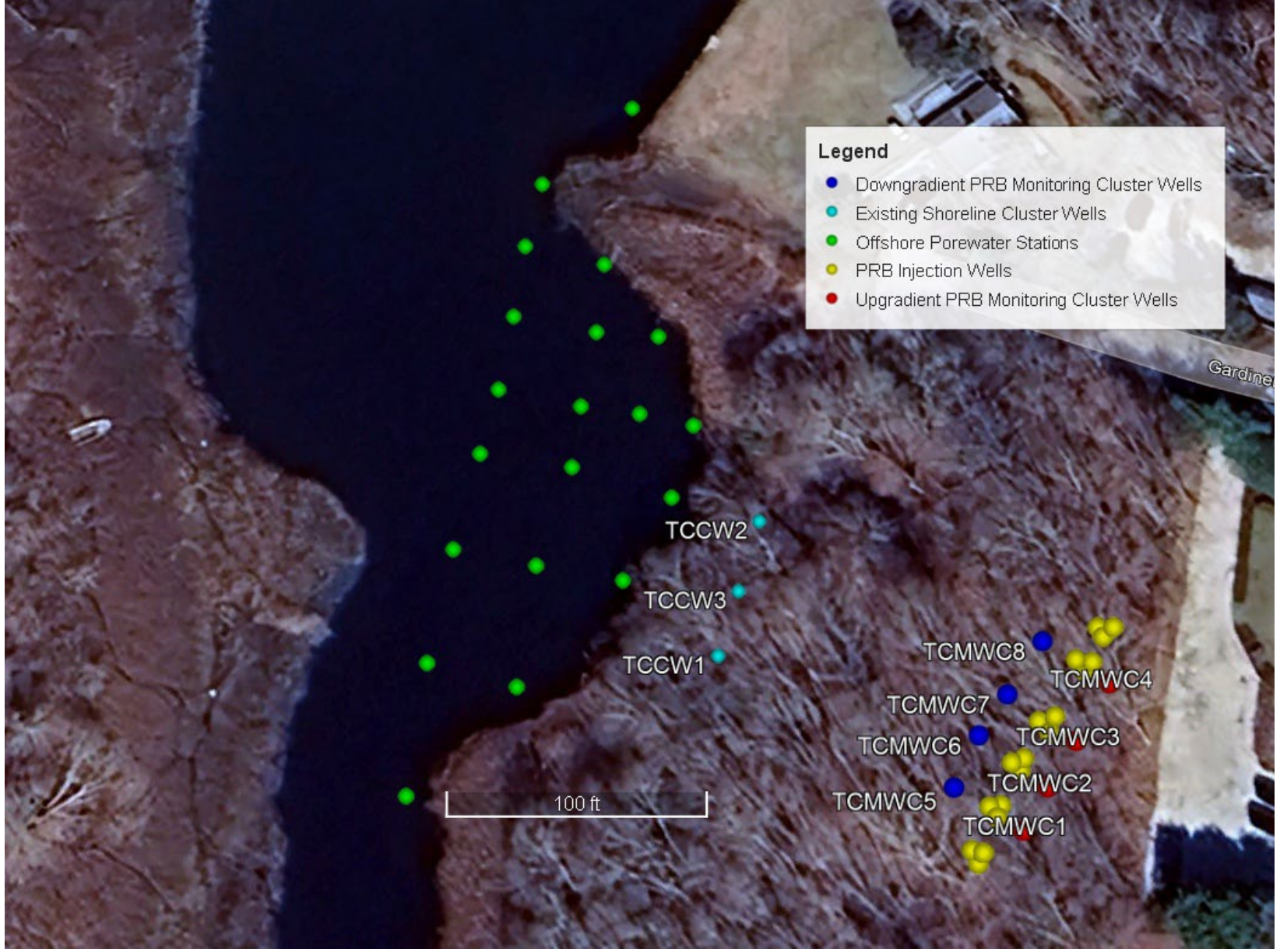
- The permeability of the barrier is higher than surrounding soil so water preferentially flows into the barrier
- Woodchips or vegetable oil provides carbon “food” for microbes which consume oxygen and then nitrate
- Microbes are already present in the soil and by providing the right conditions they perform these reactions naturally

Modified from https://capecodgreenguide.wordpress.com/permeable-reactive-barrier/

Injection of vegetable (soybean) oil below ground acts as an organic carbon source for naturally occurring microbes and creates a PRB which can passively treat and de-nitrify groundwater

Tanbark Creek Pilot PRB injection wells screened at 5-15, 15-25, and 25-35 ft

- Pilot PRB was designed by CDM Smith with data collected by CCE and CDM Smith
- First injection PRB on Long Island
- Conservative design



Tanbark Creek has six injection clusters starting with TCINJ1 in the south and moving northeast to TCINJ6. The red and blue dots indicate 2 wells within 1 ft of each other screened at 20-25 ft and 10-15 ft below grade.

Long Term Monitoring Plan Overview

1. PRB performance monitoring - CCE

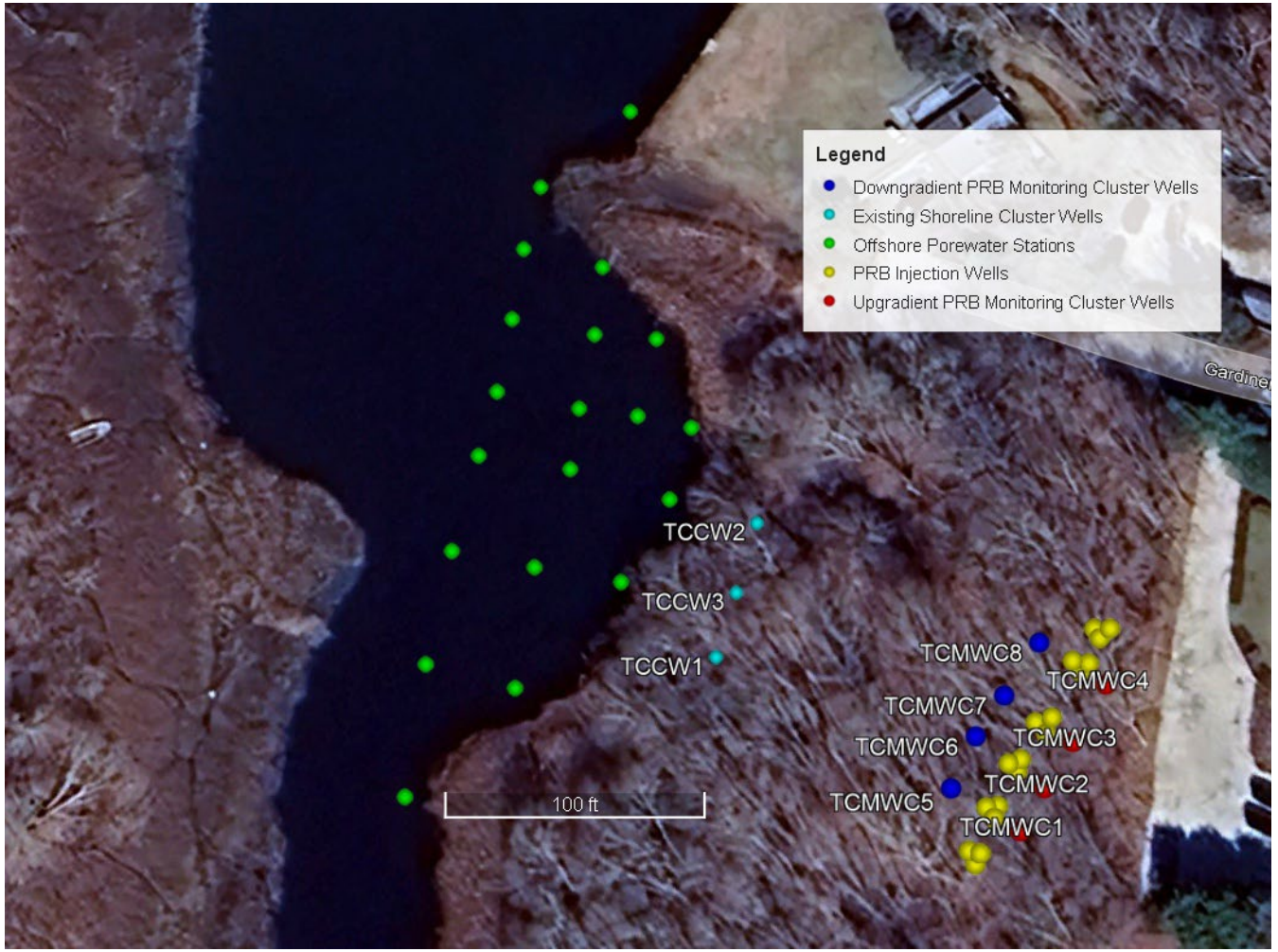
- Quarterly nitrogen monitoring of 8 well clusters (4 upgradient, 4 downgradient, 16 wells total)
- Additional analytes of interest (sulfate, sulfide, alkalinity, DOC, dissolved iron) monitored annually
- Shoreline cluster wells analyzed for N, iron, and carbon

2. PRB carbon injection longevity monitoring - CCE

- Annual soil boring collection - analysis for soybean oil

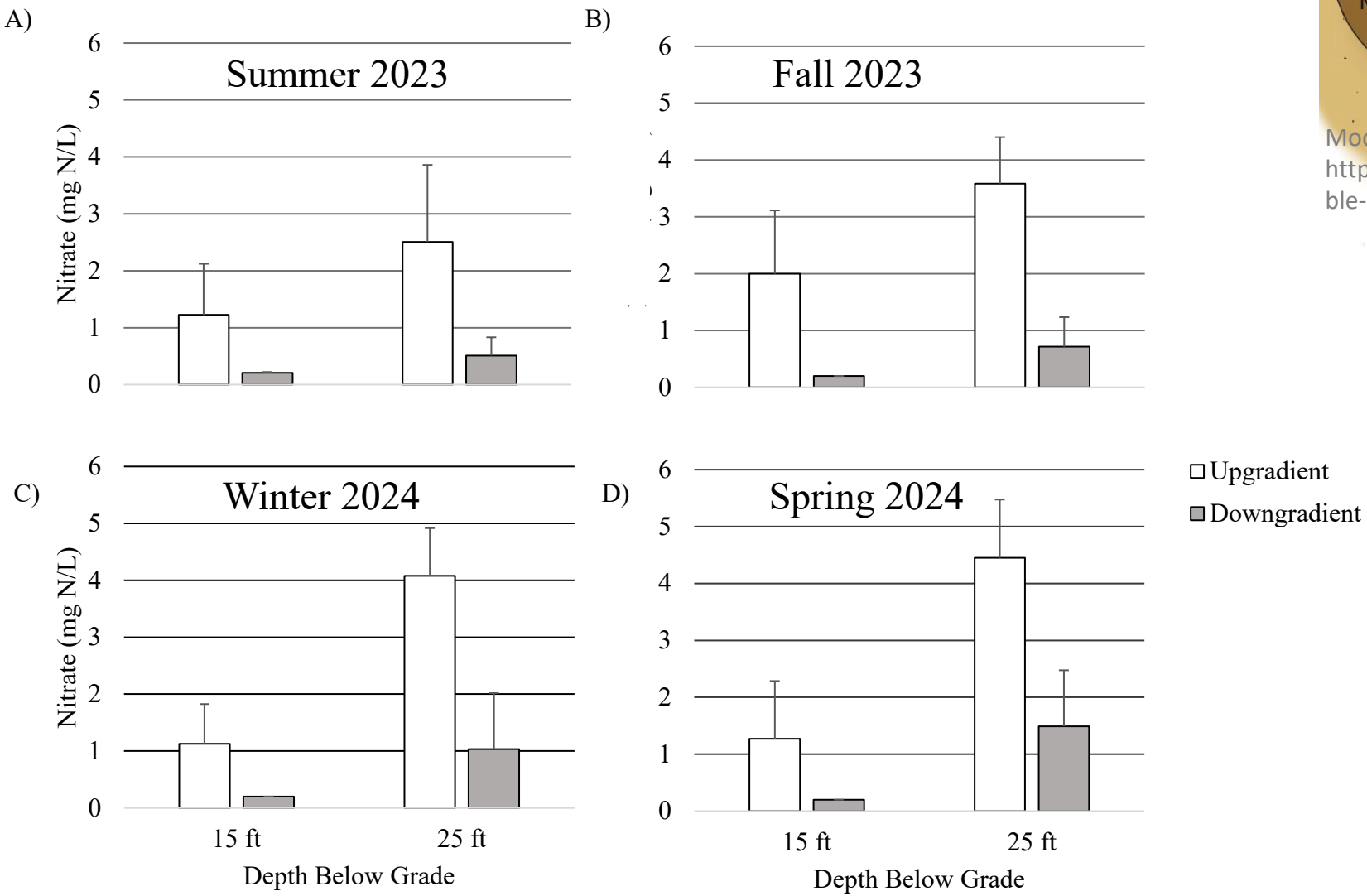
3. Tanbark Creek water quality monitoring - CLEAR

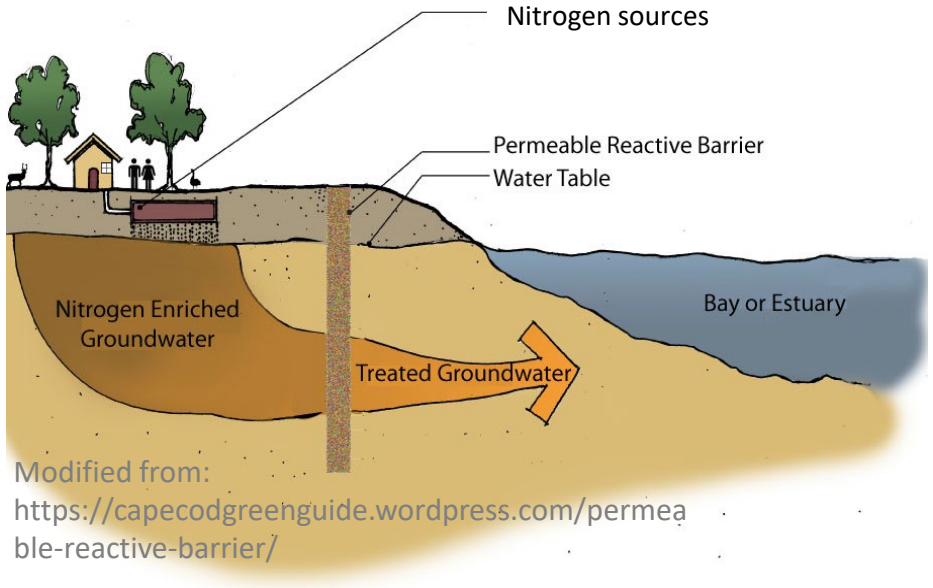
- Bi-annual porewater/surface water sampling for nitrogen at pre-established stations
- Bi-annual SGD rate with seepage meter over the tidal cycle
- Expanded porewater survey in grid pattern across the cove once during the year



2023-2024 Tanbark Creek Pilot PRB Long Term Performance Monitoring

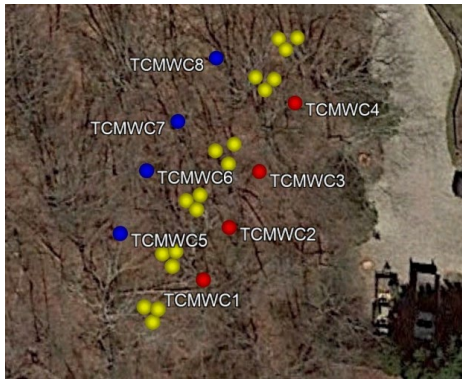
Data collected and analyzed by Cornell Cooperative Extension

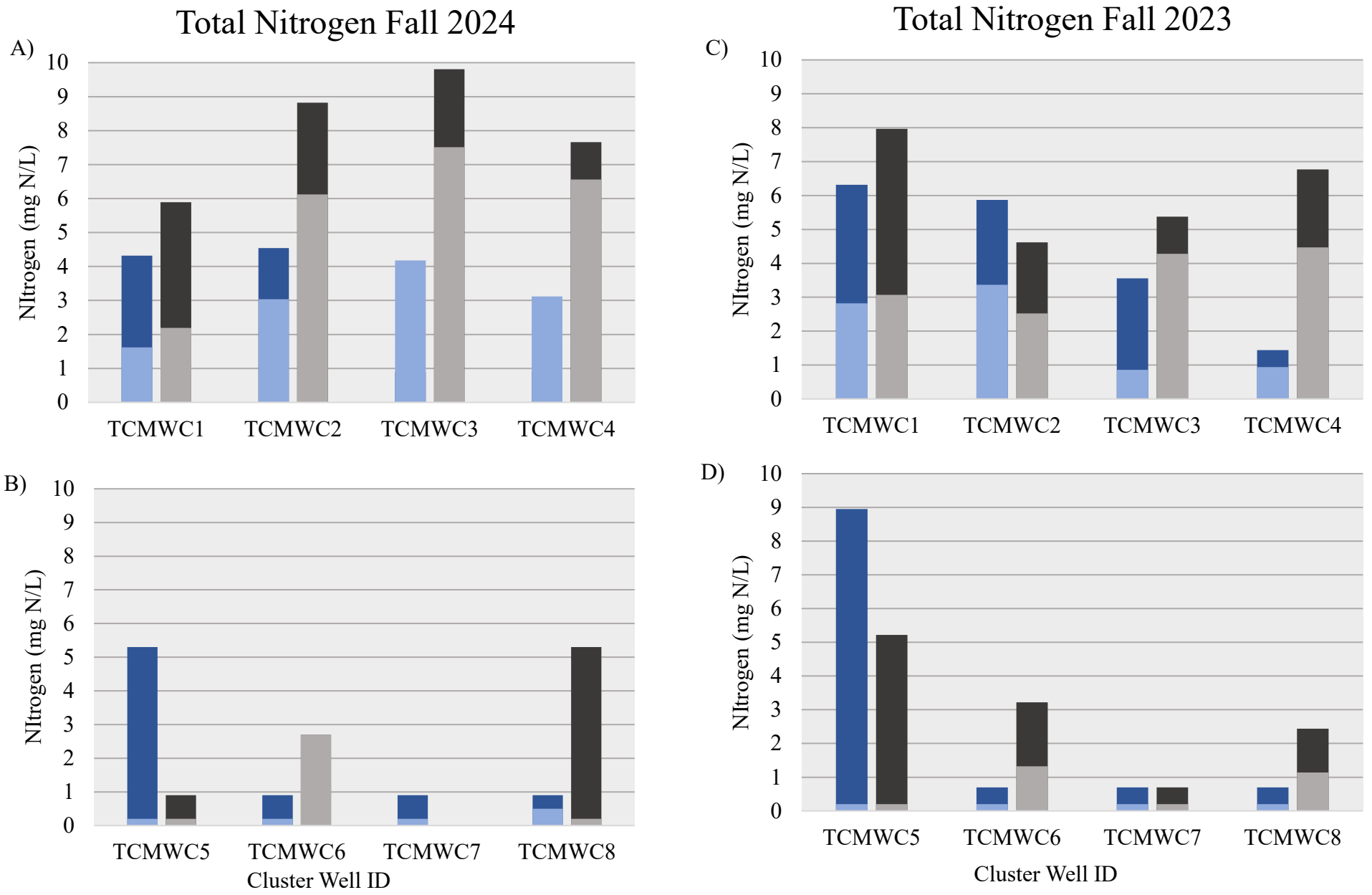




- Completed first year of quarterly monitoring of pilot injection-style permeable reactive barrier (PRB)
- Nitrate concentration upgradient of the PRB (untreated groundwater) is moderately elevated throughout the monitoring period
- On average 83% nitrate removal
- Pilot PRB is functioning as expected & removing 40-105 lbs N as nitrate per year

1. PRB Performance Monitoring

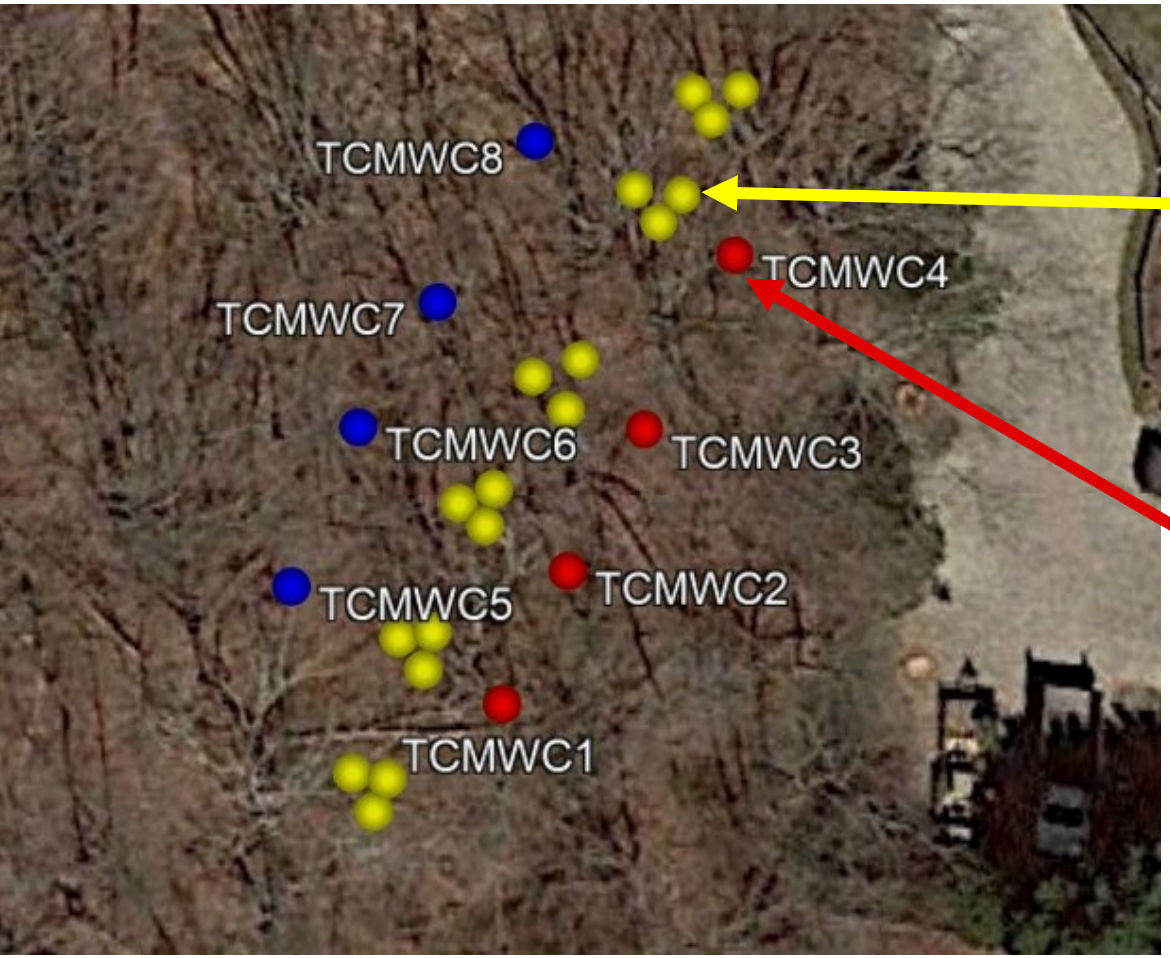




NO_3^- 10-15 ft
TKN 10-15 ft
NO_3^- 20-25 ft
TKN 20-25 ft

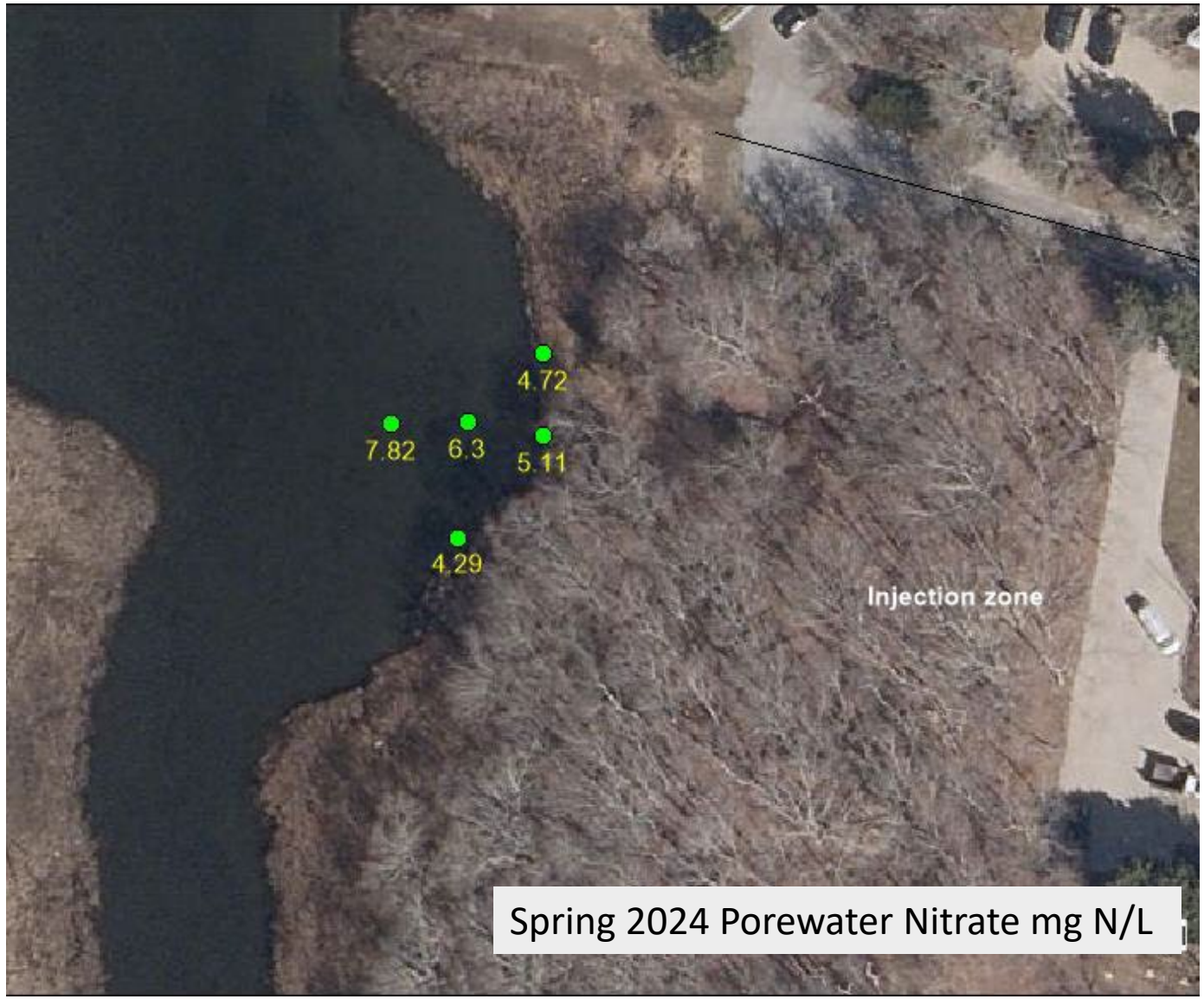
Higher max value upgradient nitrate in fall 2024 (7.51 mg N/L) compared to fall 2023 (4.47 mg N/L) and PRB reduced it to below detection in 2024

2. PRB Carbon Injection Longevity Monitoring



- Soil samples collected 20-25 ft below grade in Fall 2024
- Lab analysis is currently being completed – testing for presence of soybean oil
- Samples have significant color difference
  - Within PRB the soil is gray
  - Upgradient of the PRB the soil is light brown
- Samples smell different

3. Tanbark Creek water quality monitoring - CLEAR



Spring 2024 Porewater Nitrate mg N/L

- No unusual deviations in field parameters including dissolved oxygen, pH and ORP in porewater or surface water
- The PRB is not negatively influencing nearby environmental conditions in the creek
- To the best of our knowledge we are the first group to try to link PRB performance with porewater quality – this PRB was designed conservatively as a pilot
- Porewater nitrogen values are similar to upgradient groundwater nitrogen values
- Porewater work in 2nd year of monitoring 2024-2025 will be expanded to better understand the spatial variability in the cove

2023-2024 Data Summary

- N data and additional analytes of interest confirm denitrification is occurring. Average nitrate removal is 83% and for 1st year of monitoring this corresponds to 40-105 lbs N as nitrate per year. The lbs removed per year is largely determined by the upgradient nitrate concentrations so if we continue to see higher upgradient nitrate, this value will increase.

- Carbon longevity monitoring confirmed the anticipated zone of influence and 2024 samples are currently being analyzed but still exhibit visual indications of presence of soybean oil

- This is a pilot PRB which was designed as a proof of concept for the carbon injection technology and is only treating a subsection (30 ft x 100 ft) of the aquifer and a much deeper and wider water column with nitrogen rich water is discharging into the cove, so this complicates interpretation of the offshore porewater data.

- Groundwater at this site is rich in ammonium and TKN which is naturally converted to nitrate in the presence of oxygen. Thus, any ammonium present in groundwater downgradient of the PRB could convert to nitrate. Any nitrate present below or around the PRB could also be discharging into the cove.

- There is potential to expand the PRB further south where very high >20 mg N/L nitrate concentrations were present during site characterization

- Communication with CDM Smith indicates they also view the PRB as highly successful!

Long Term Monitoring Plan Overview

1. PRB performance monitoring - CCE

- Quarterly nitrogen monitoring of 8 well clusters (4 upgradient, 4 downgradient, 16 wells total)
  - ☑ Summer 2023
  - ☑ Fall 2023
  - ☑ Winter 2024
  - ☑ Spring 2024

  Year 1 contract
  - ☒ Summer 2024
  - ☑ Fall 2024
  - ○ Winter 2025
  - ○ Spring 2025
  - ○ Summer 2025

  Year 2 contract
- Additional analytes of interest (sulfate, sulfide, alkalinity, DOC, dissolved iron) monitored annually
  - ☑ Fall 2024
- Shoreline cluster wells analyzed for N, iron, and carbon
  - ☑ Fall 2024

Long Term Monitoring Plan Overview

2. PRB carbon injection longevity monitoring - CCE

Annual soil boring collection - analysis for soybean oil

- ☑ Fall 2024

3. Tanbark Creek water quality monitoring - CLEAR

Bi-annual porewater/surface water sampling for nitrogen at pre-established stations

Bi-annual SGD rate with seepage meter over the tidal cycle

- ☑ Spring 2024
- ☑ Fall 2024

Expanded porewater survey in grid pattern across the cove once during the year

- ○ Summer 2025

Funding

Peconic Estuary Partnership
Town of East Hampton Natural Resources
Town of East Hampton Community Preservation Fund

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Thank you!

Questions?