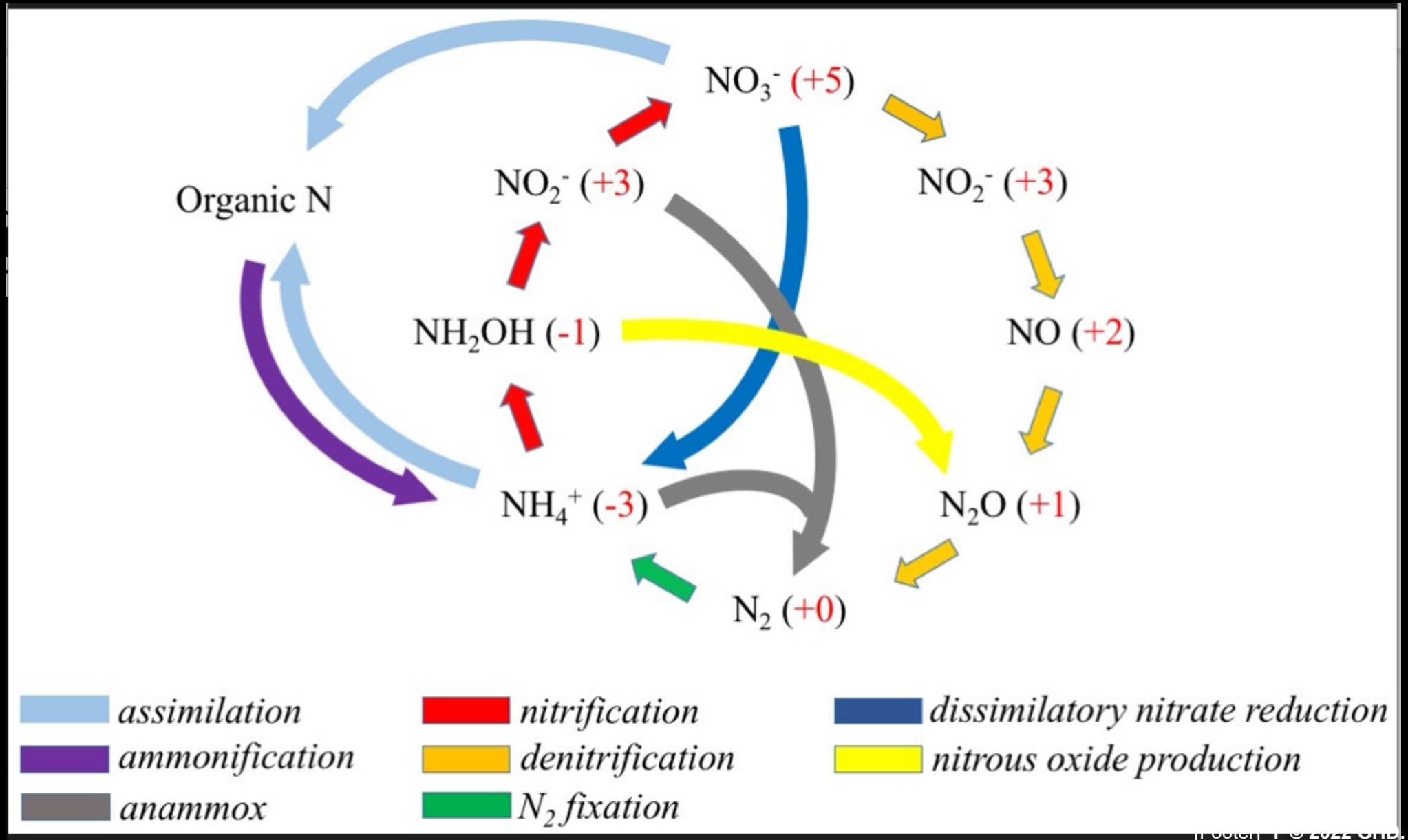
→ Sophia Dore

Enhanced Denitrification for Treatment of Nitrate Plumes Associated with Fertilizers: Laboratory and Pilot Studies

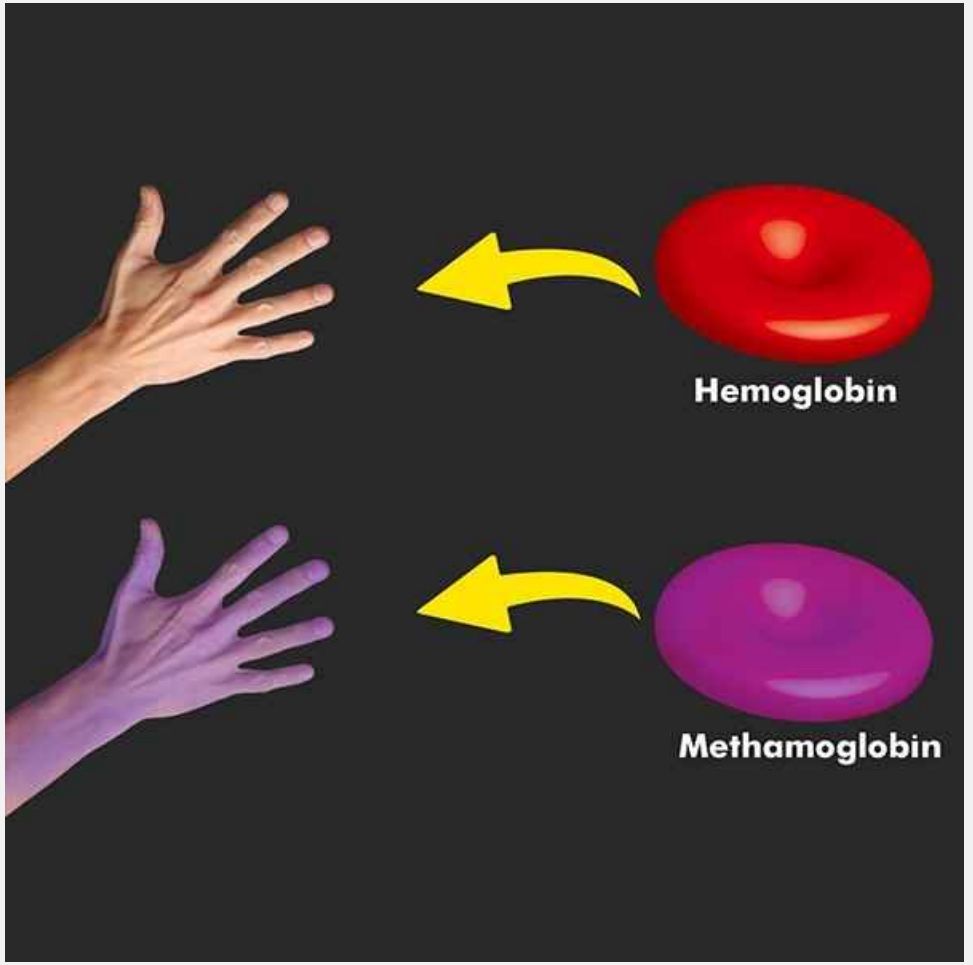
Welcome

Nitrogen Cycle



→ **Nitrate**

- Affects how blood carries oxygen
- Turns hemoglobin into methemoglobin
- Contains ferric rather than ferrous iron
- Unable to bind oxygen
- Blue baby syndrome



Two Sites with Nitrate in Groundwater

Site 1. Fertilizer Manufacturing Site in Canada

Two Sites with Nitrate in Groundwater

Site 1. Fertilizer Manufacturing Site in Canada

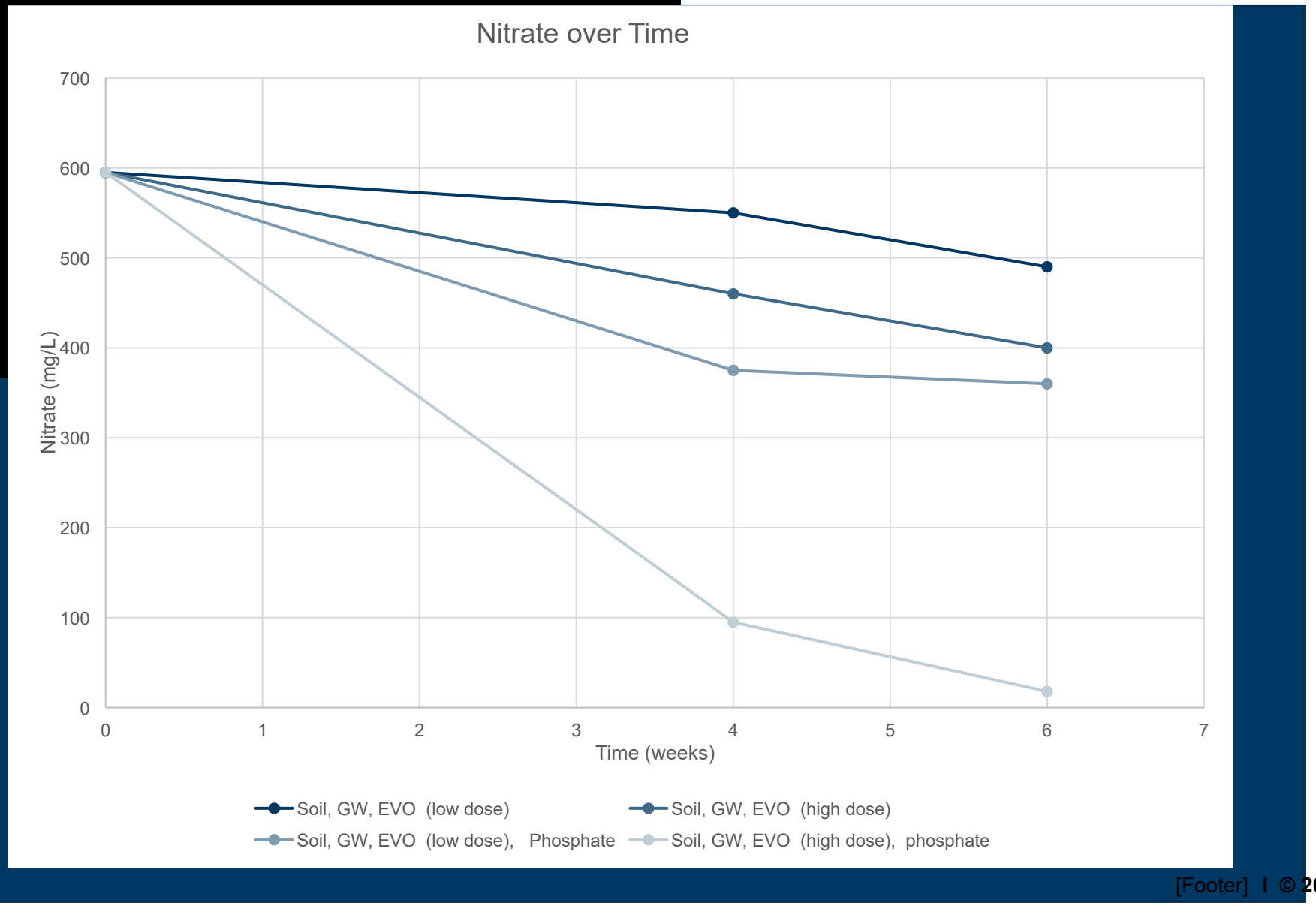
Strategy

- **Enhance anaerobic conditions so that nitrate will be converted to nitrogen gas by native bacteria**

Treatability Study

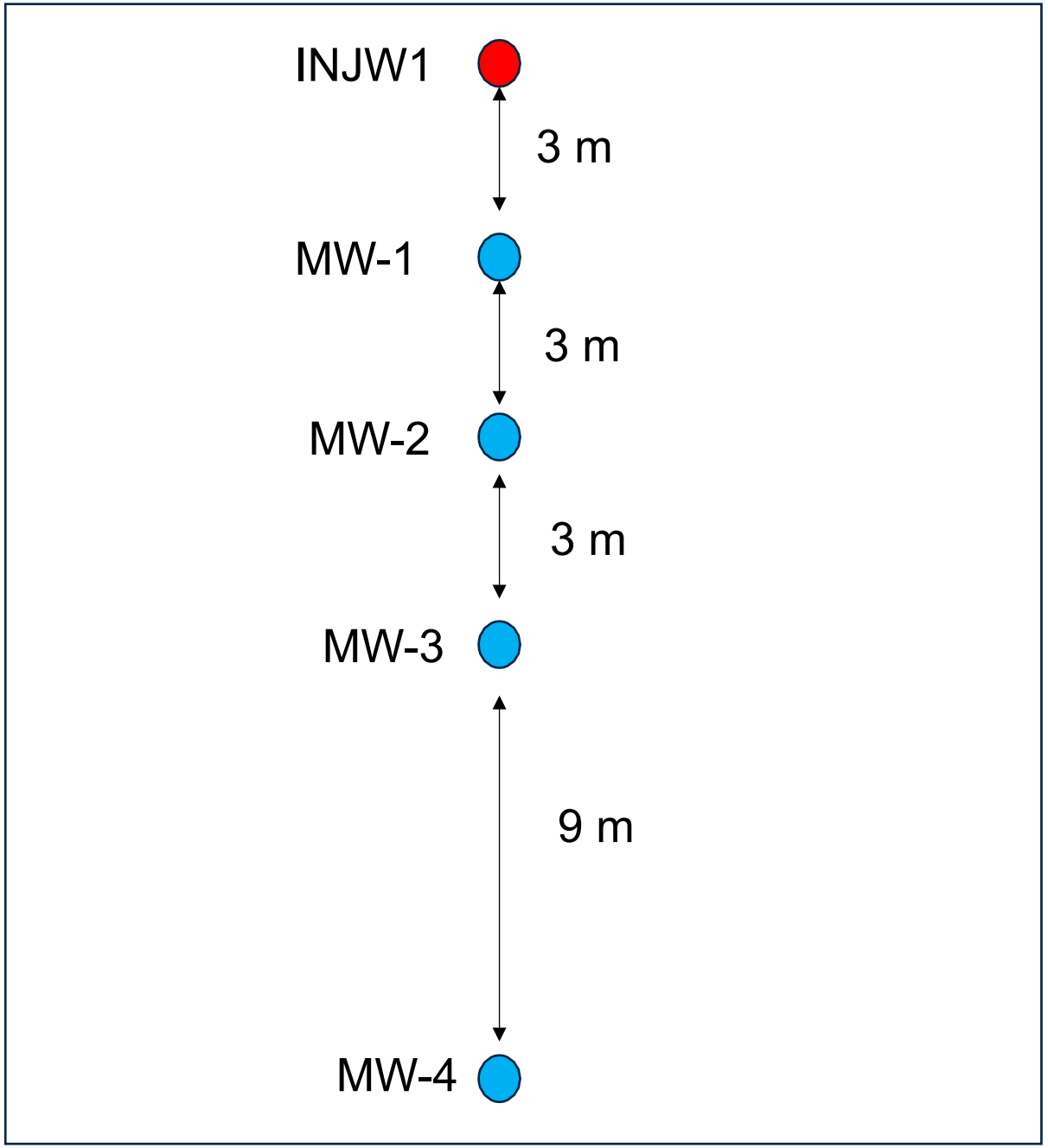
- Microcosms were set up containing soil and groundwater from the Site
- High and low doses of emulsified vegetable oil were tested with and without the addition of phosphate

Treatability Study

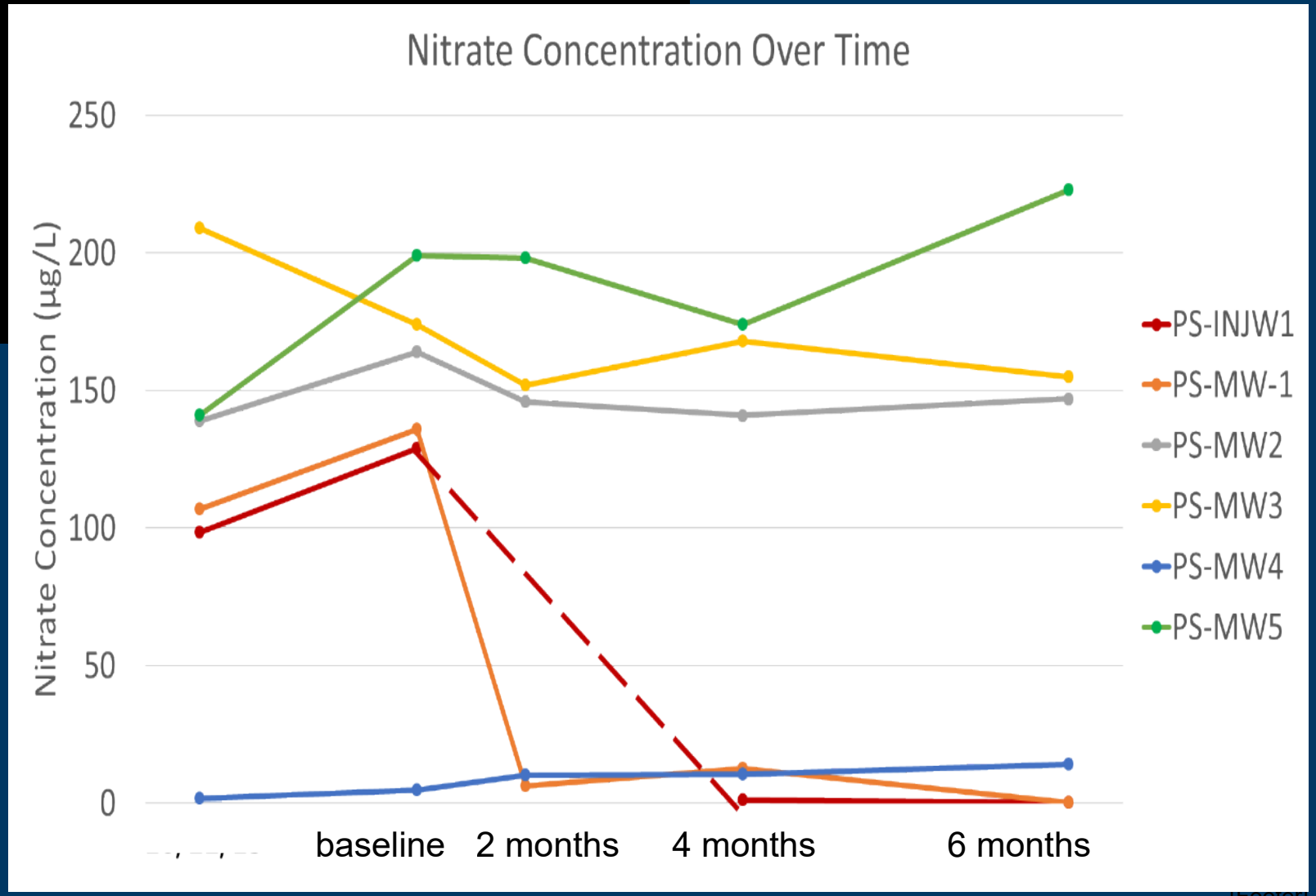


Pilot Study

- A pilot study was then performed in the area of highest nitrate concentration at the Site
- One injection well and 4 monitoring wells were installed in the pilot study area
- EVO and sodium phosphate were injected into the injection well
- Monitoring was performed prior to injection and 2, 4, and 6 months post injection

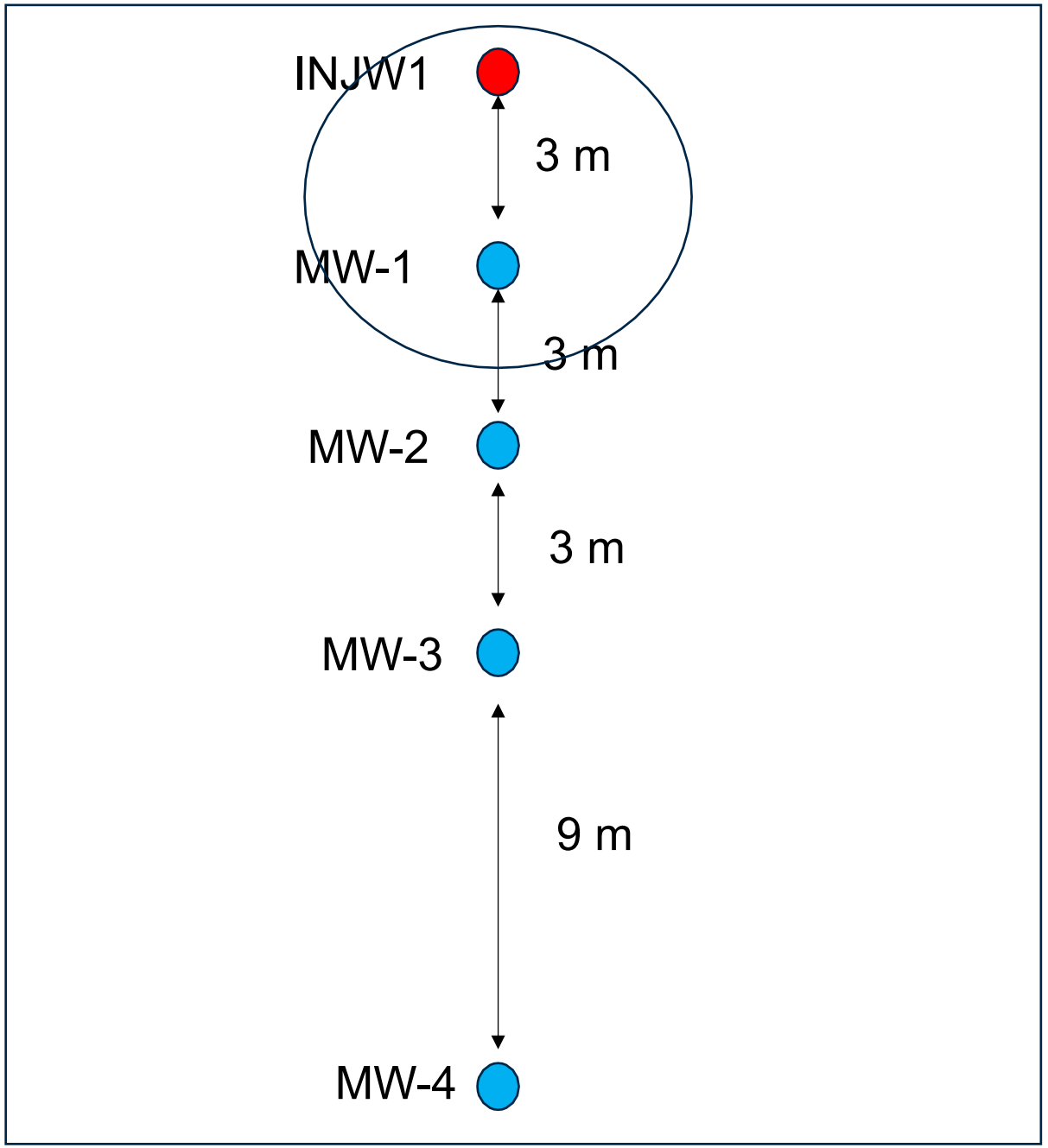


Pilot Study



Pilot Study

- Greater than 99 percent treatment of nitrate was observed in the injection well and in the monitoring well located 3 m away from the injection well
- This treatment was recommended for full scale application



Two Sites with Nitrate in Groundwater

Site 2. Poultry Site in New Mexico

Two Sites with Nitrate in Groundwater

Site 2. Poultry Site in New Mexico

- **Elevated nitrate concentrations.**
- **Site is part of a regional nitrate plume associated with other livestock operations in the area.**
- **Local groundwater regulations required that nitrate concentrations are lowered without increasing concentrations of iron and manganese.**

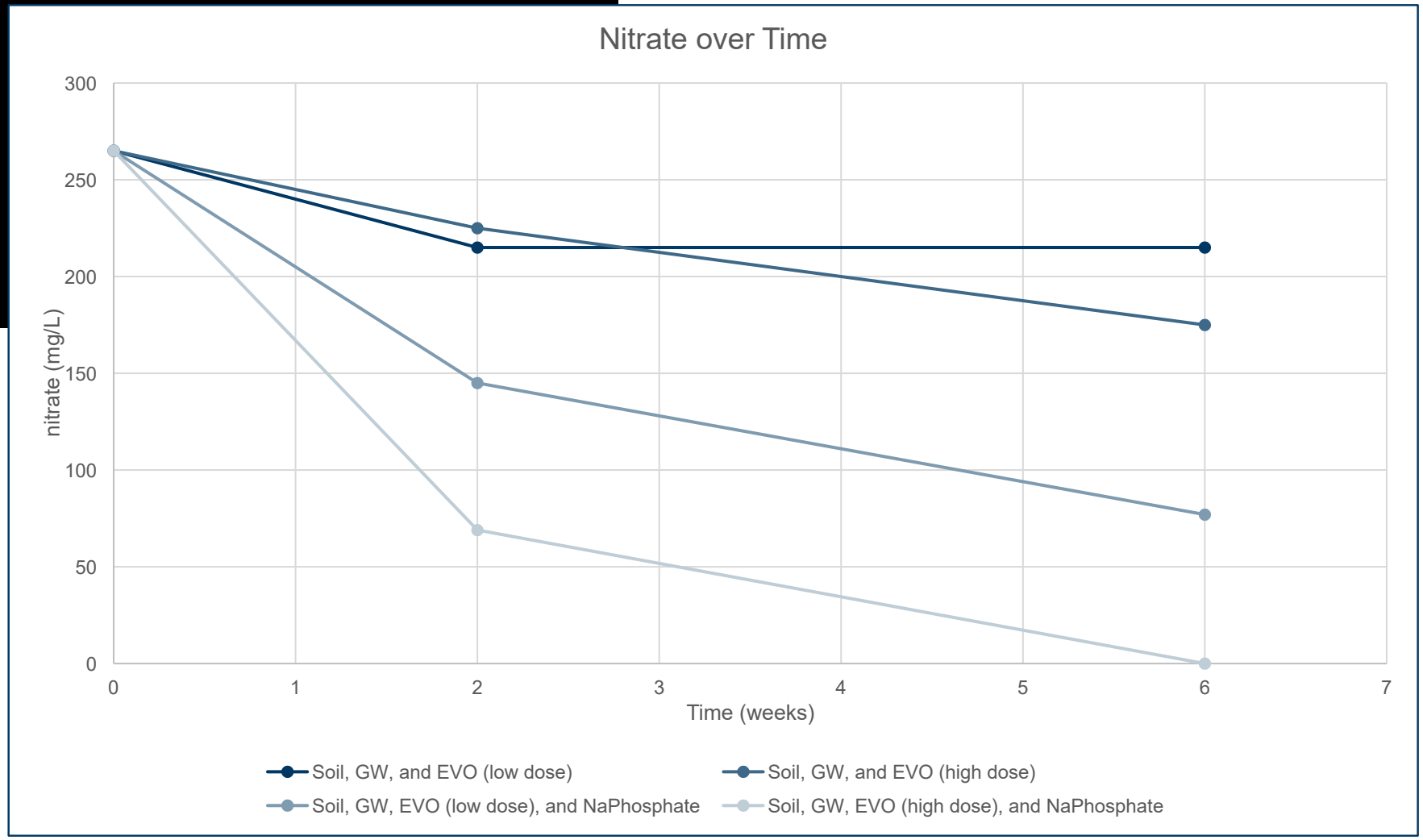
Strategy

- **Enhance anaerobic conditions so that nitrate will be converted to nitrogen gas by native bacteria**

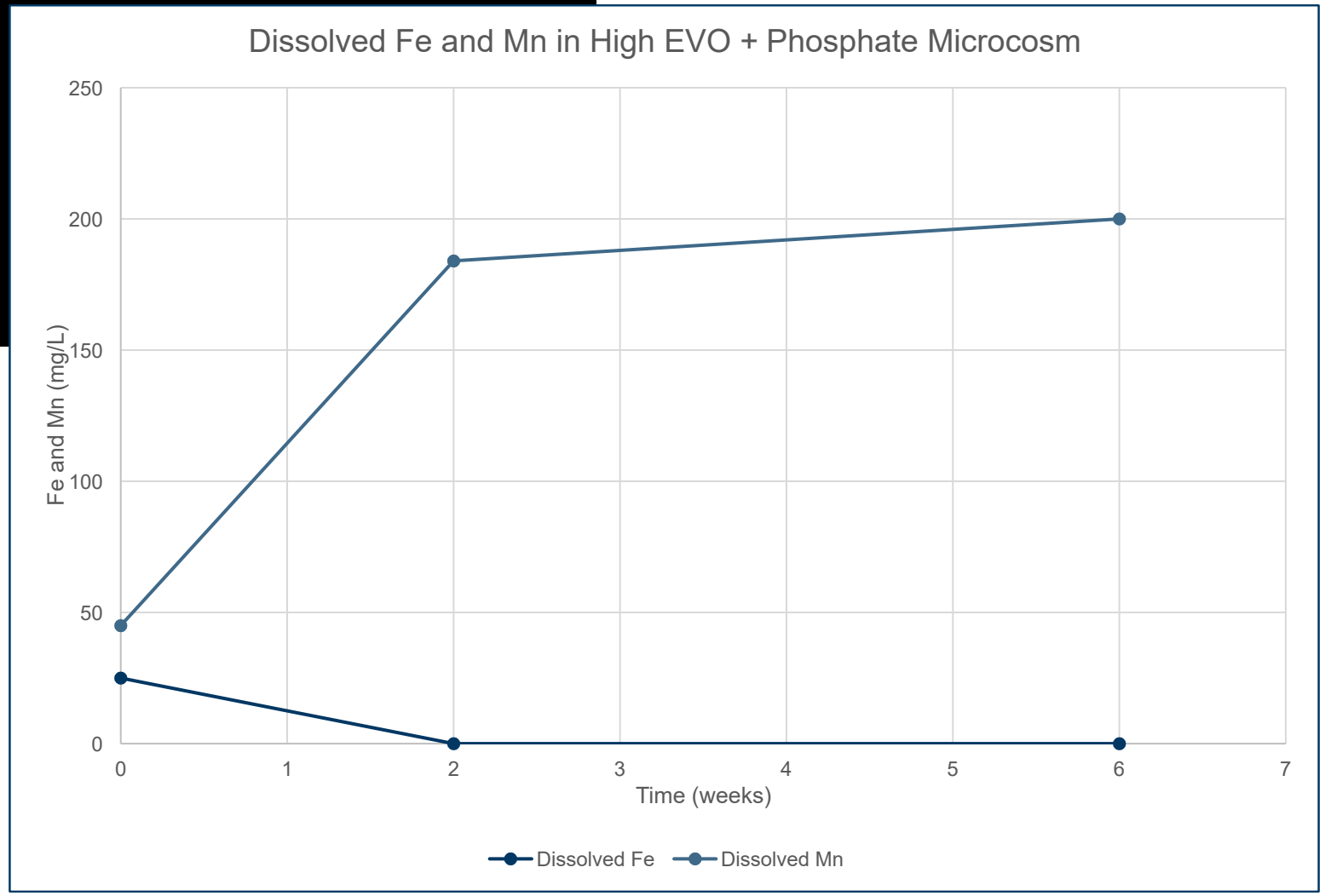
Treatability Study

- Microcosms were set up containing soil and groundwater from the Site
- High and low doses of emulsified vegetable oil were tested with and without the addition of phosphate

Treatability Study



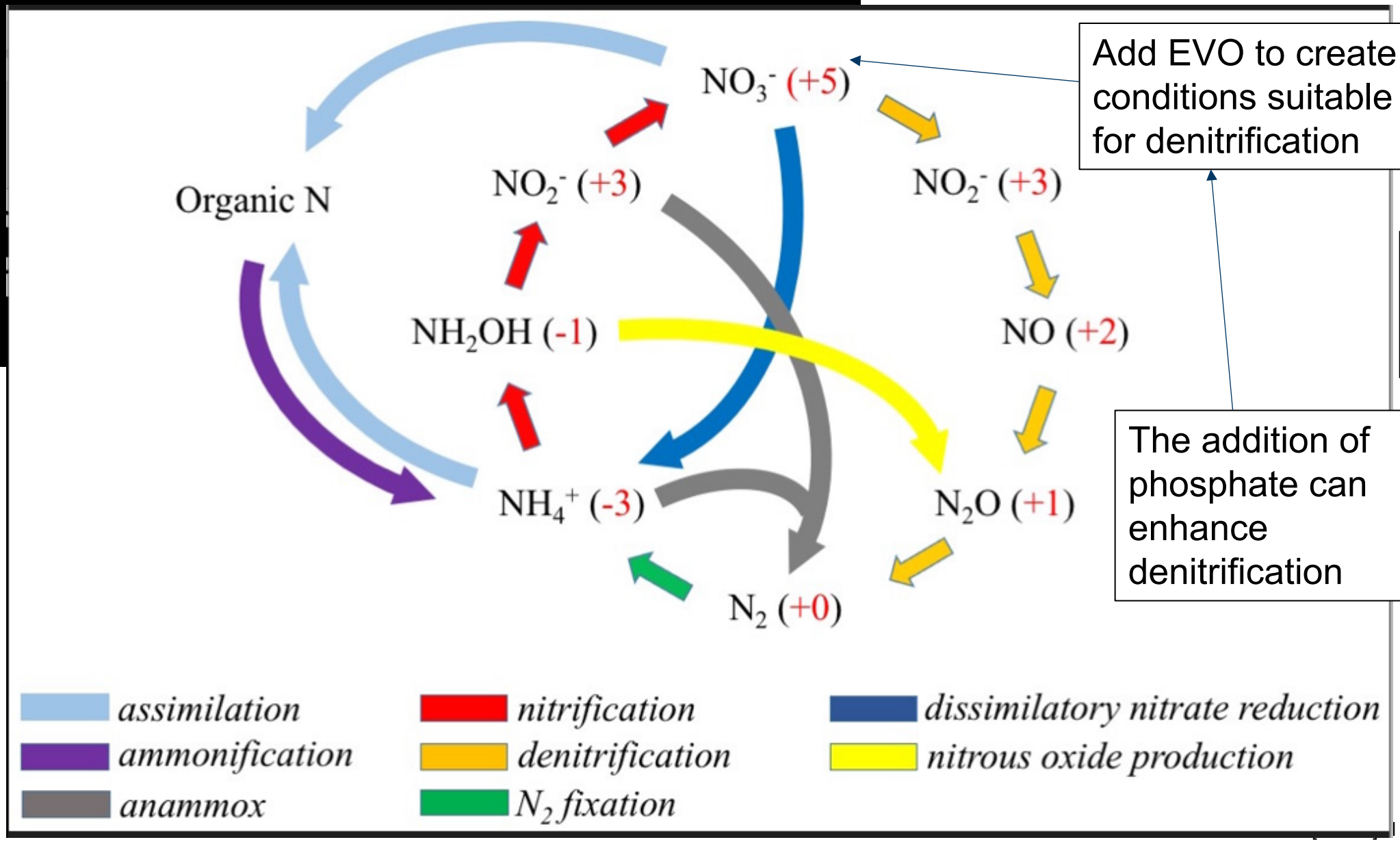
Treatability Study



Treatability Study

- Nitrate was reduced to non detect levels in high EVO treatment with phosphate added
- Concentration of dissolved Fe did not increase
- An increase in the concentration of dissolved Mn was observed

Lessons Learned



Add EVO to create conditions suitable for denitrification

Possible solubilization of Fe and Mn

The addition of phosphate can enhance denitrification