Center for **C**omprehensive, optima**L** and **E**ffective **A**batement of **N**utrients (**CLEAN**)

Impact of Urban Water Conservation on Receiving Water Body Nutrient Quality

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May 4, 2017

The CLEAN Center

EPA Centers for Water Research on National Priorities Related to a Systems View of Nutrient Management

- Established in 2013
- One of 4 national centers
- The only center with irrigated agriculture components

Mission of CLEAN

Create knowledge

Build capacity

Forge collaboration

To develop and demonstrate sustainable **solutions** for reduction of nutrient pollution

Water Demand Reduction

Indoor and Outdoor Conservation

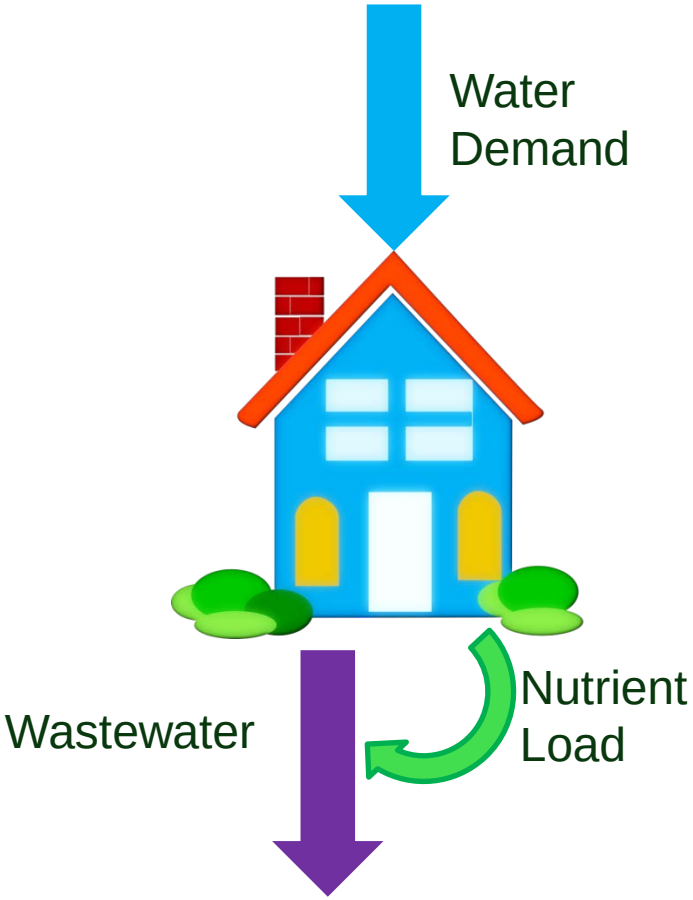
Graywater Reuse

Stormwater Use

Effluent Reuse

Water Conservation Impacts

No Conservation



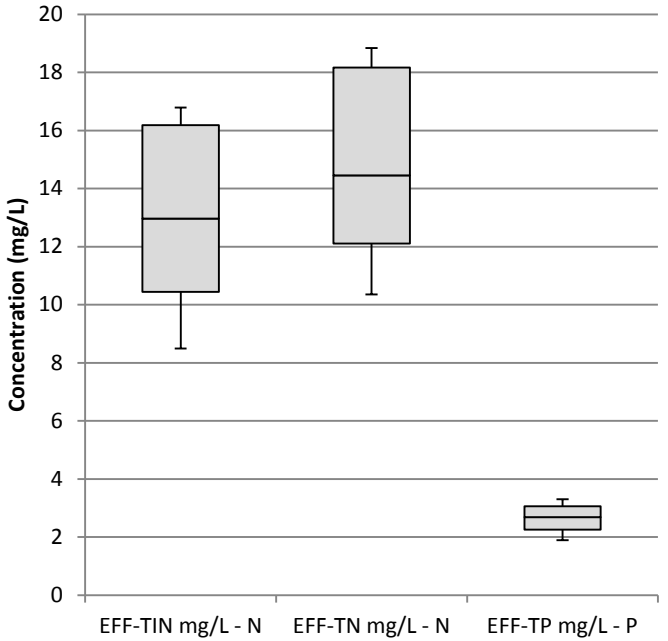
Conservation

Result is more concentrated wastewater

Boulder 75th St WWTF Case Study

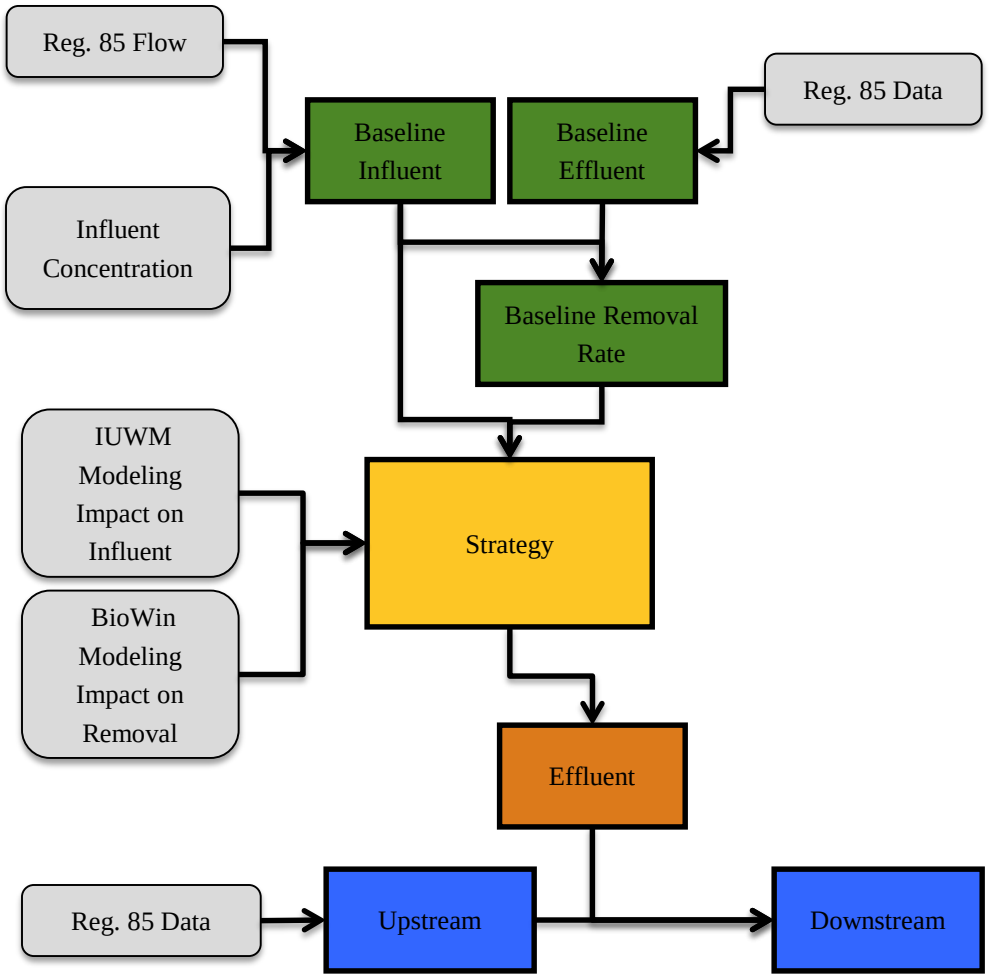
- 75th St WWTF serves Boulder, CO
- Permitted capacity
  = 25 MGD
- Average operating flow = 15.2 MGD (Reg. 85 Data)
- Biological Nutrient Removal – 4 Stage Bardenpho

Source: https://bouldercolorado.gov/water/wastewater-treatment



Source: Regulation 85 Reported Data
n = 12

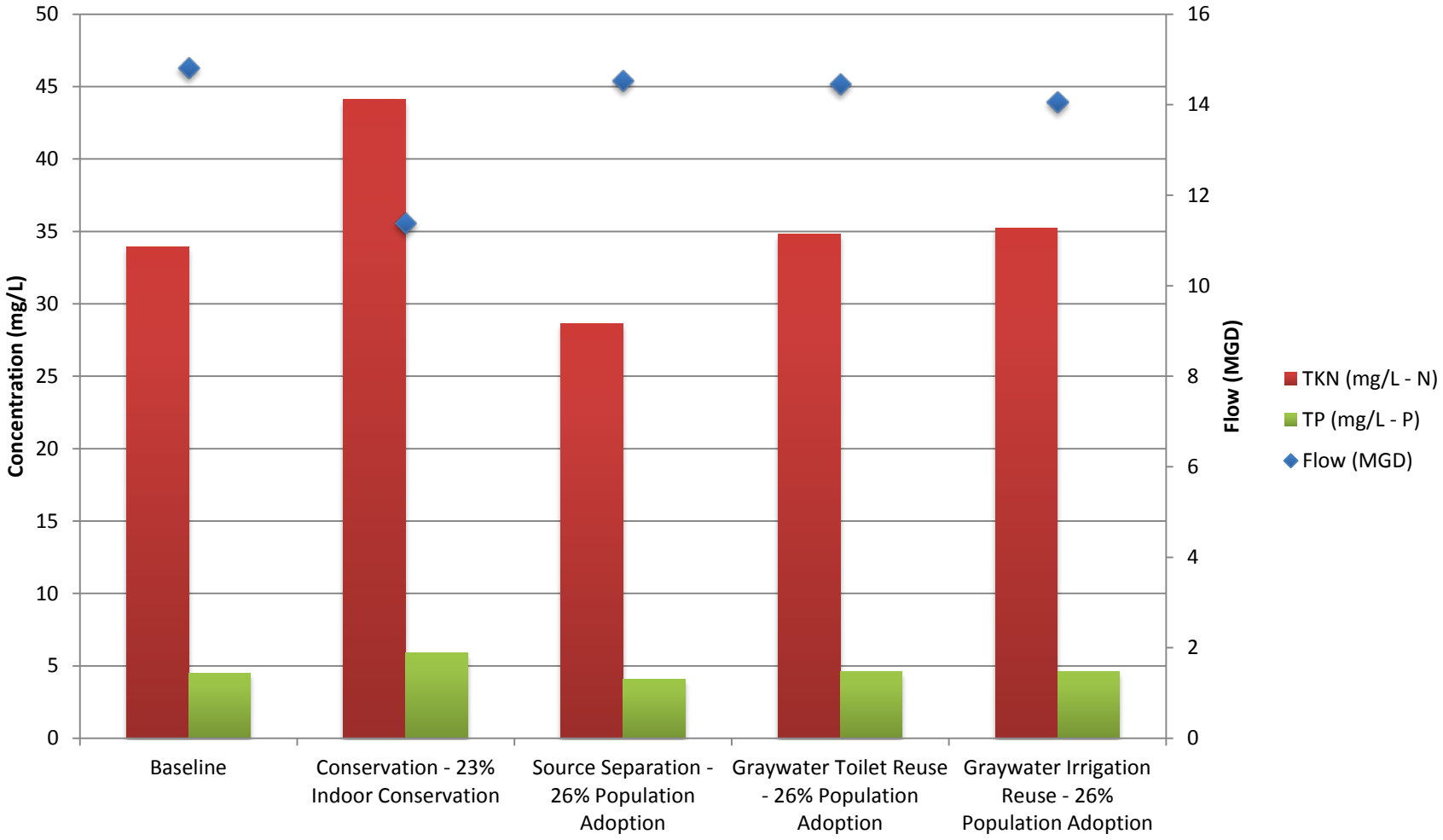
Approach


Reg. 85 Flow
Influent Concentration
Baseline Influent
Baseline Effluent
Reg. 85 Data
Baseline Removal Rate
IUWM Modeling Impact on Influent
BioWin Modeling Impact on Removal
Strategy
Effluent
Reg. 85 Data
Upstream
Downstream

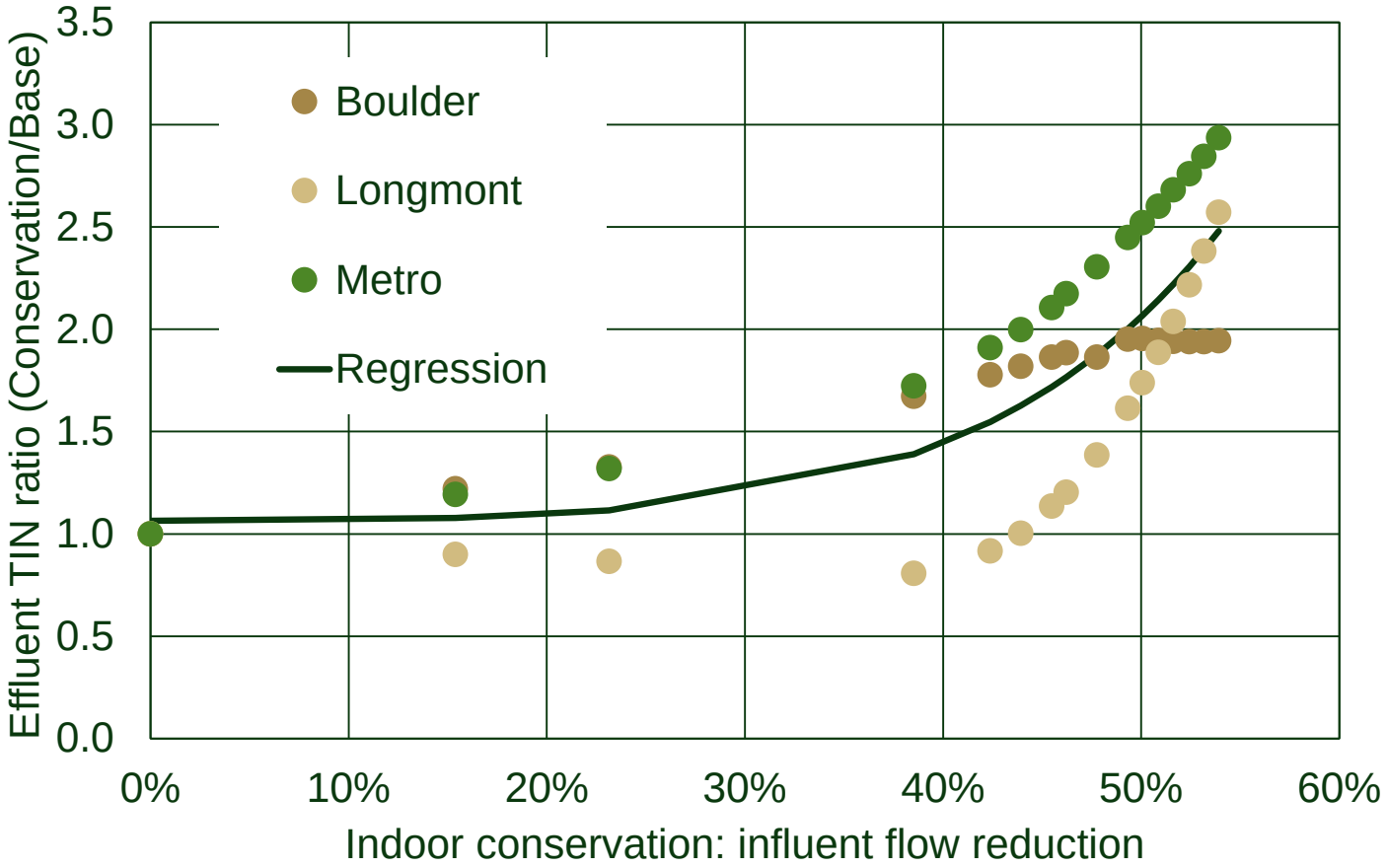
Modeling Approach

- BioWin modeling of WWTP's for source control, reuse and conservation scenarios
  - **Indoor Conservation**
    - *15-54% flow reduction*
    - *Constant contaminant loading*
  - **Urine Separation**
    - *5%, 15%, 30%, 75% and 100% population adoption*
      - Flow change = 10 gallons/person/day
    - *Loading adjusted assuming 11 g N/person/day and 1 g P/person/day*
  - **Graywater Reuse**
    - *5%, 15%, 30%, 75% and 100% population adoption*
      - Toilets: 12 gallons/person/day
      - Irrigation: 25 gallons/person/day
    - *Loading adjusted according to literature estimates*

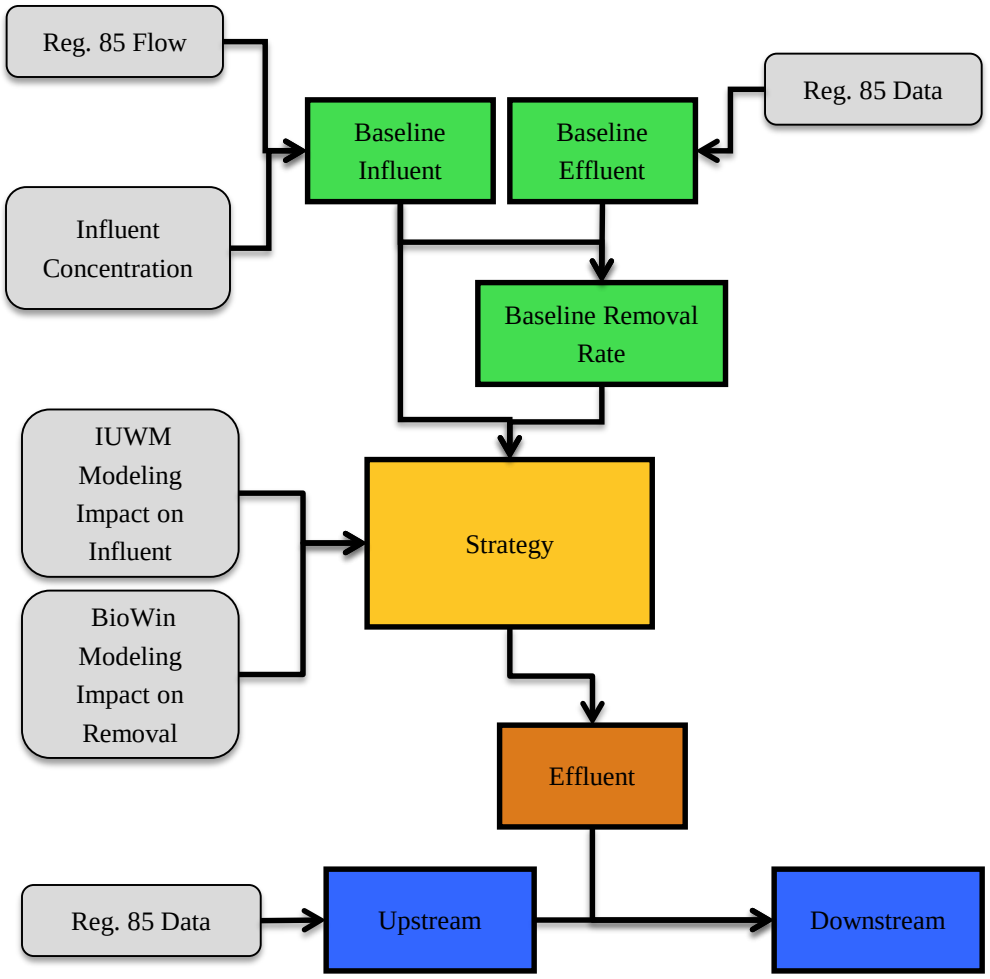
Impact of Practice to WW Influent Quality



Effluent TIN normalized concentration ratio



Approach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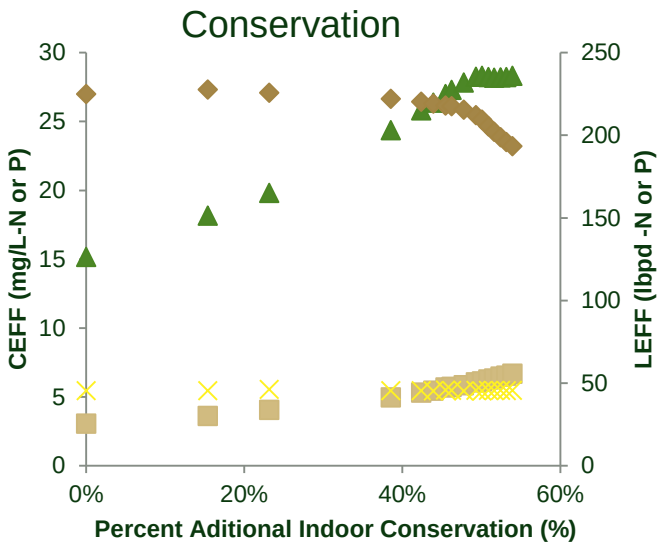
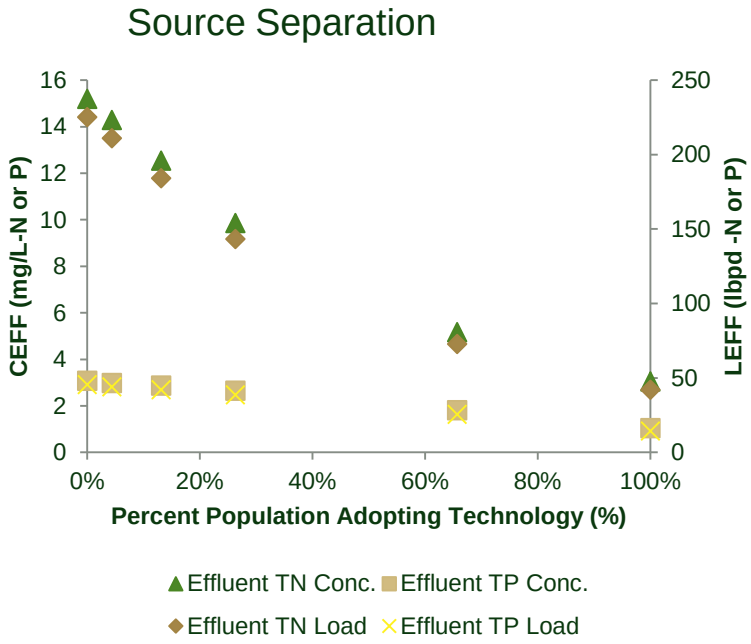
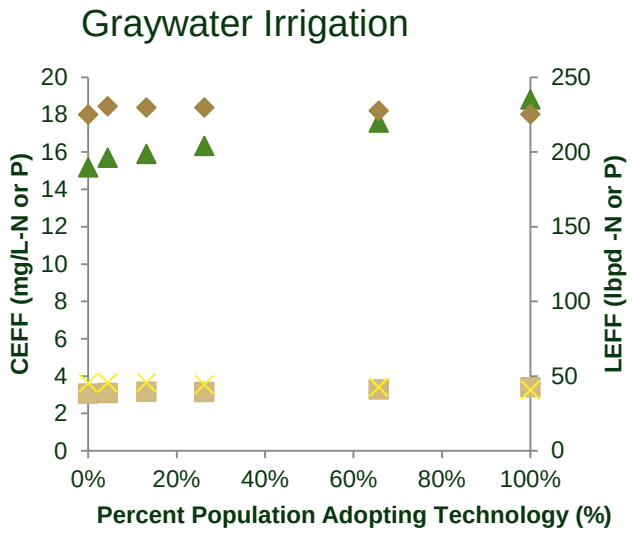
Impact of Practices on Effluent Discharge

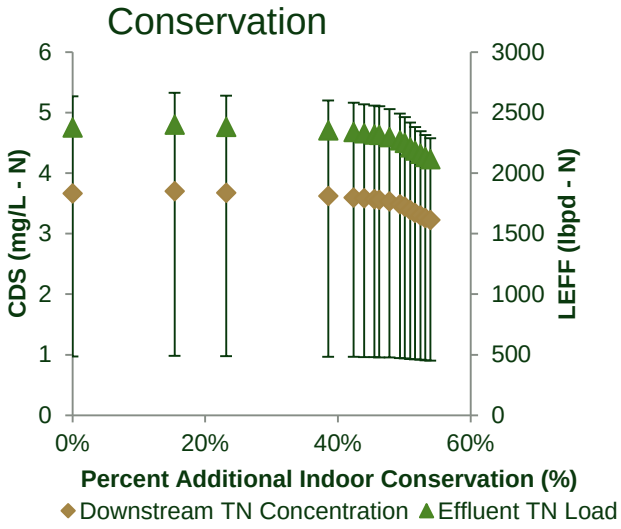


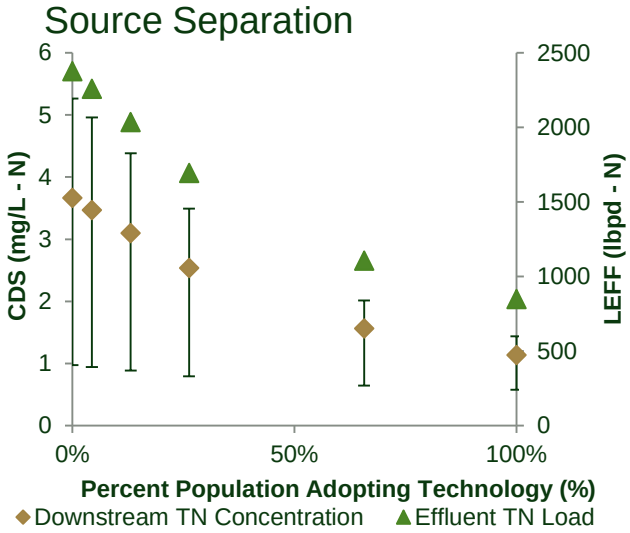


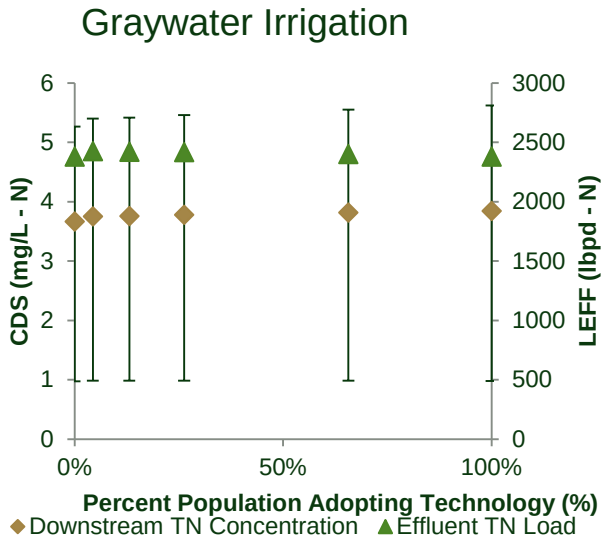


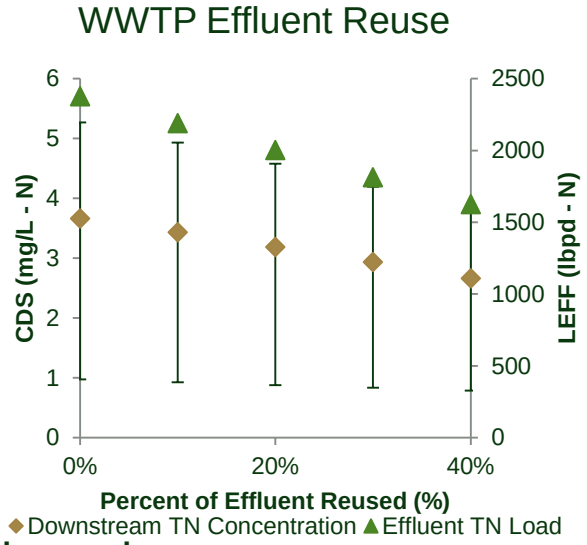
- Conservation practices result in increase in nutrient discharge concentration
- Source separation decreases effluent discharge

Impact of Practices on Downstream Concentration



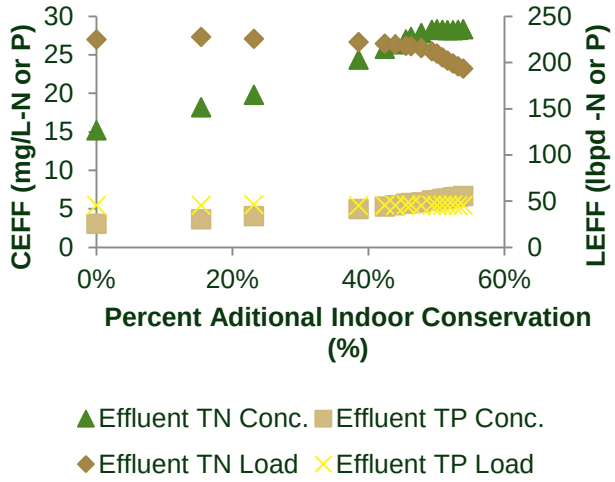






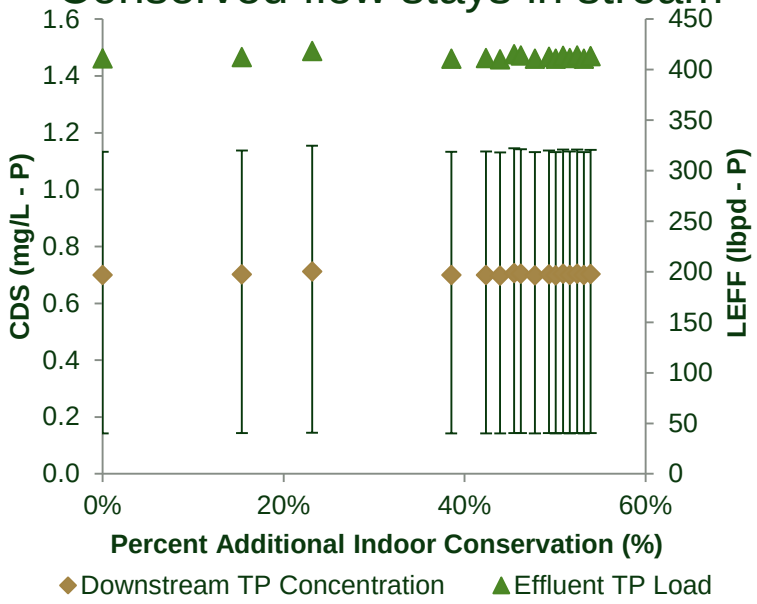
Bars indicate min and max

Conservation Impact: P

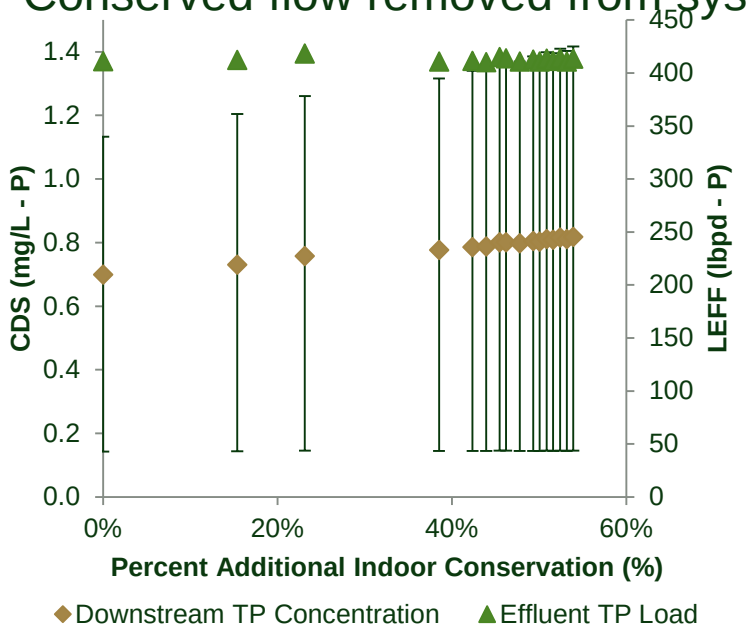


- Effluent concentration increases, but load does not substantially change

Conserved flow stays in stream



Conserved flow removed from system



Summary

- Conservation can increase effluent discharge concentrations, especially nitrogen species
  - Minimal impact to nutrient mass loads
  - Impact to downstream concentrations depends on surface water flow and mixing zone characteristics
- Municipalities encouraging conservation will need to consider impacts to POTW performance/operations
- Potential Utility Costs:
  - Energy costs of increasing SRT and aeration rate
  - Greater impact of sidestream (centrate) nutrients
  - Chemical addition for pH control
  - Labor and materials for increased sewer maintenance

Thank you.

To join stakeholder group:

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