

# Metro District's Phosphorus Initiative

Finding the Most Effective and Sustainable Management  
Approach for Phosphorus

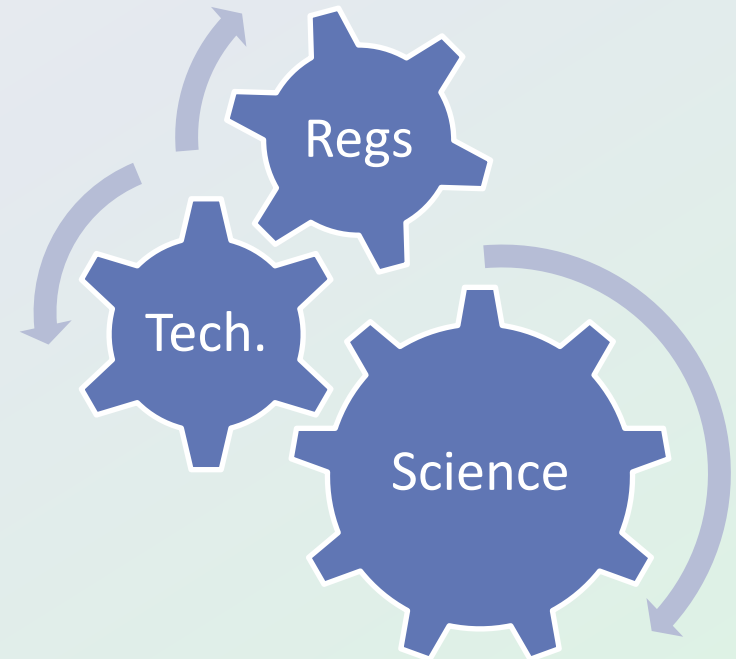





**Integrated Plan – Regulatory**



**Phosphorus Initiative – Technology /Science**





# Evaluation of Performance and Greenhouse Gas Emissions for Plants Achieving Low Phosphorus Effluents

Christine deBarbadillo, James Barnard, Mario Benisch,  
Michael Falk

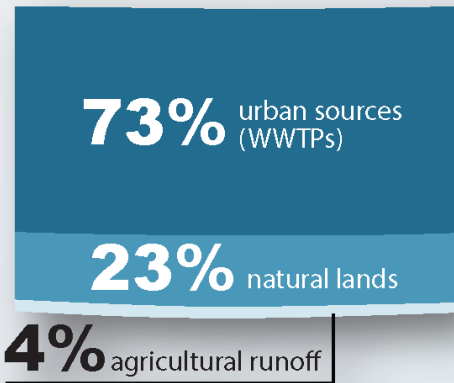
Vol. 15, 2016, DOI: [10.2166/9781780406923](https://doi.org/10.2166/9781780406923)





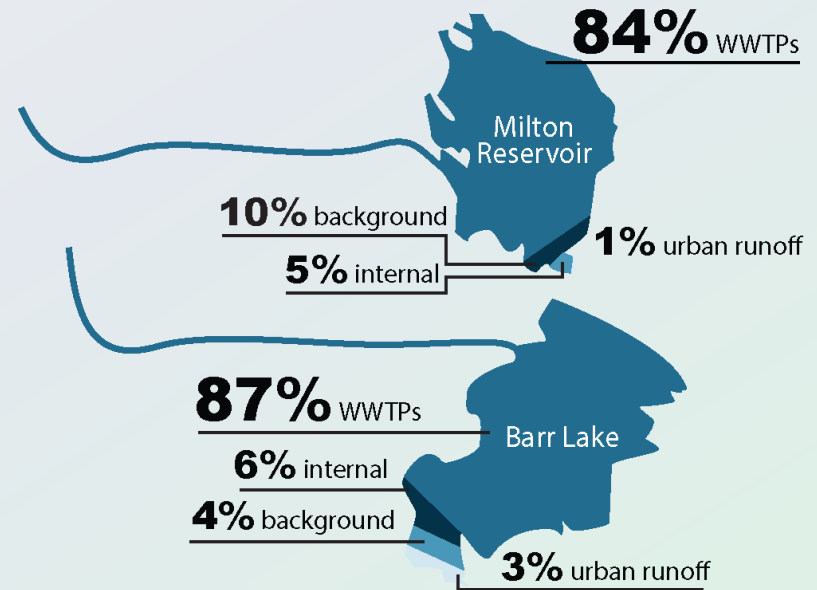
# Watershed View

## Reg. 31 – South Platte River



*Percent of phosphorus in  
South Platte River at State line*

## Barr-Milton Total Maximum Daily Load



*Current annual phosphorus loading*

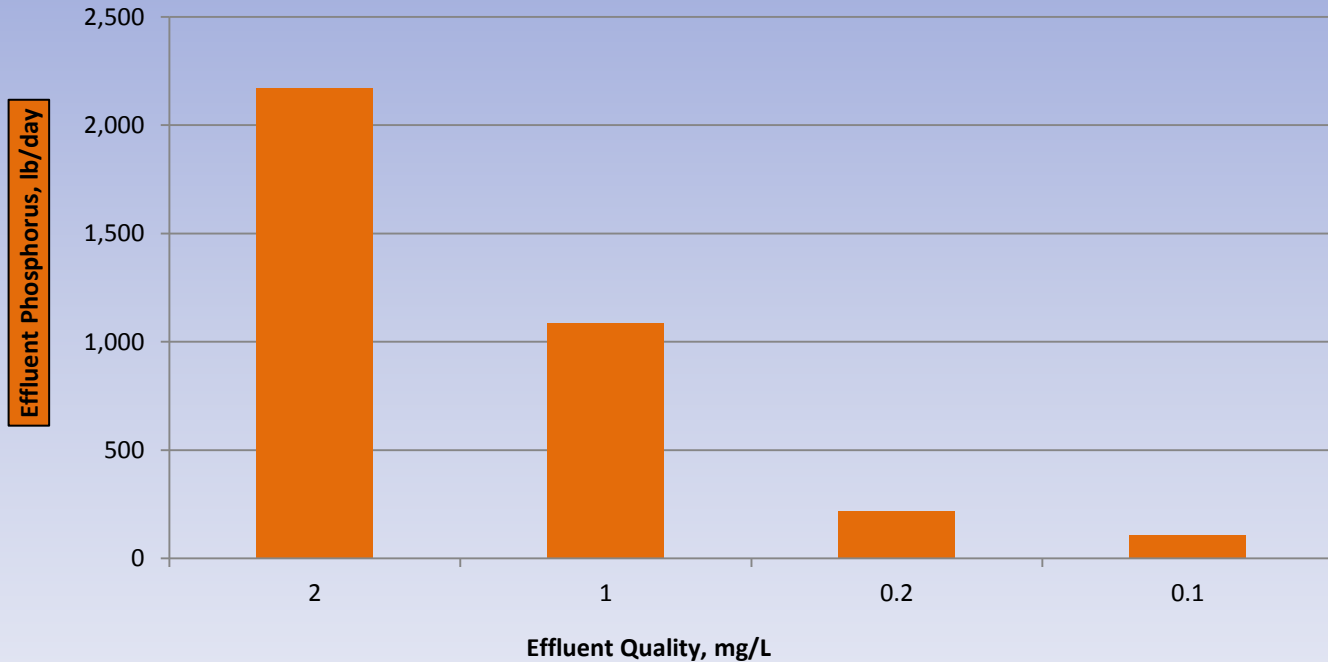
# Prioritizing Phosphorus

## Regulation

Barr-Milton  
Maximum D

Reg. 85

Reg. 31





# Remove Phosphorus from Wastewater



# Three P-Removal Steps

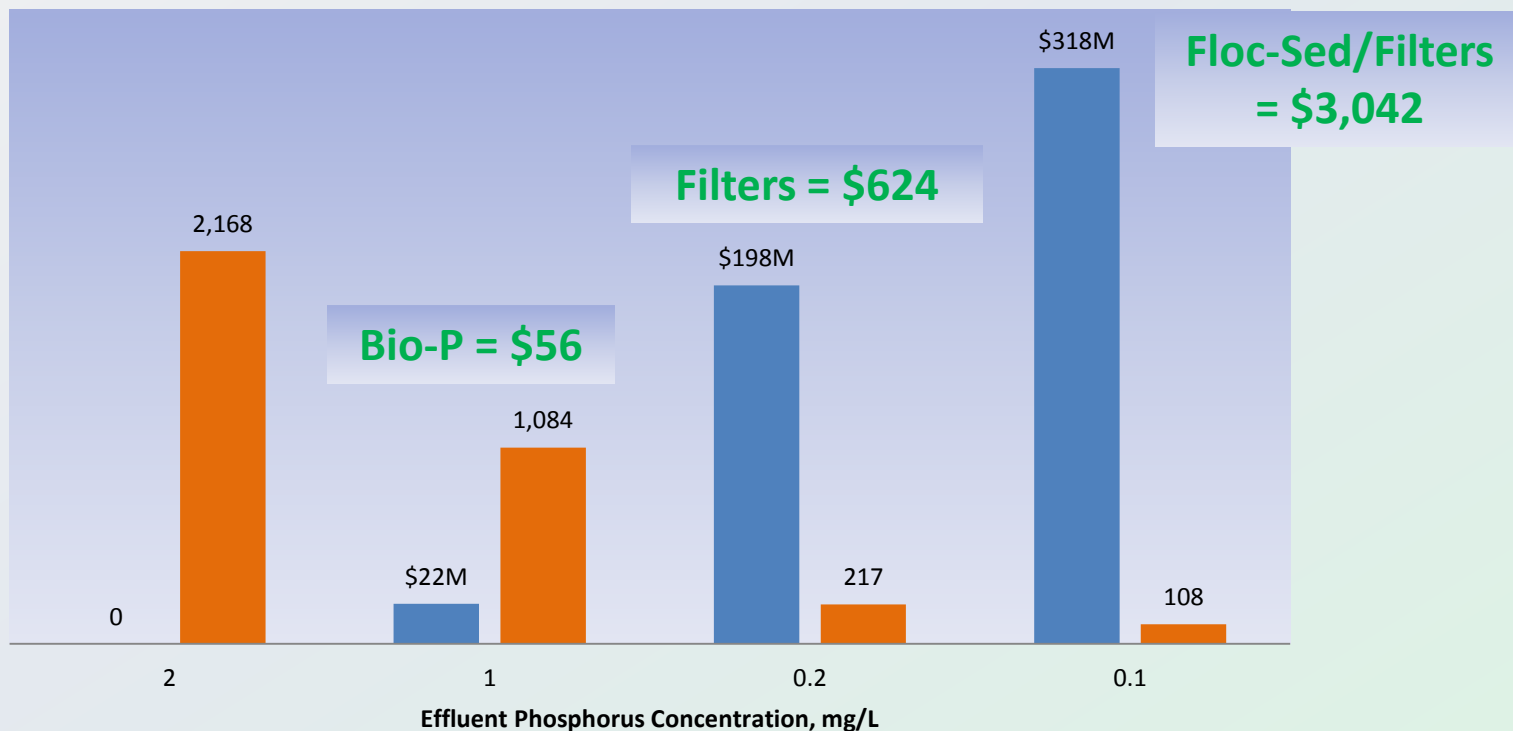
- ⚗ Biological Phosphorus Removal
- ⚗ Filtration
- ⚗ Flocculation/Sedimentation



# Cost-Benefit

■ Capital Cost (\$ Mil)

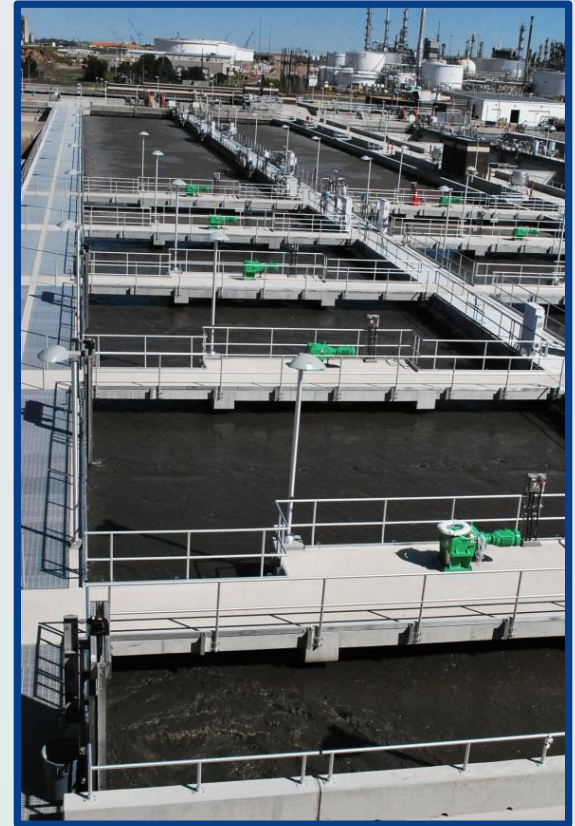
■ Effluent Phosphorus (lb/day)



# Biological Phosphorus Removal

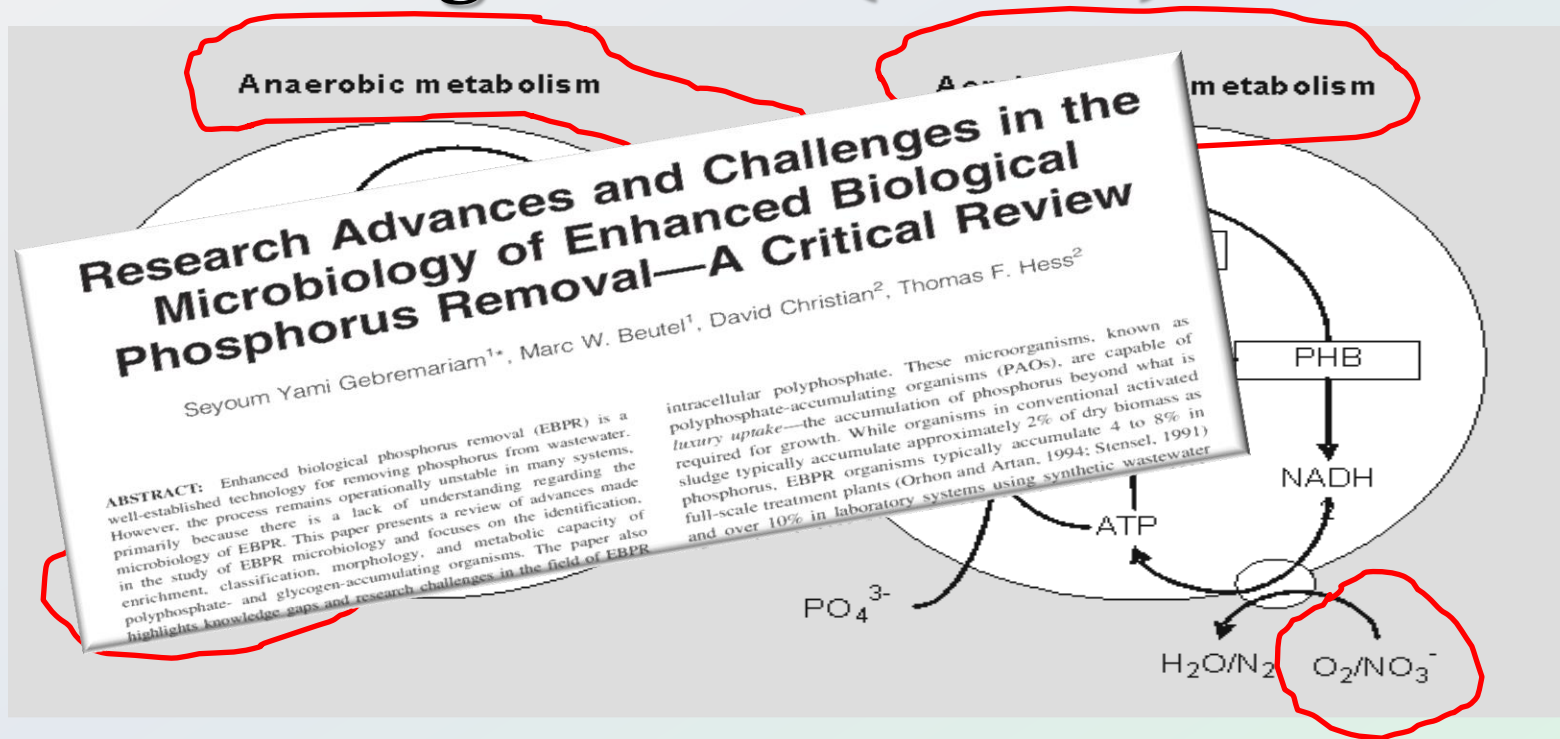


**Biological Basin  
without Bio-P**

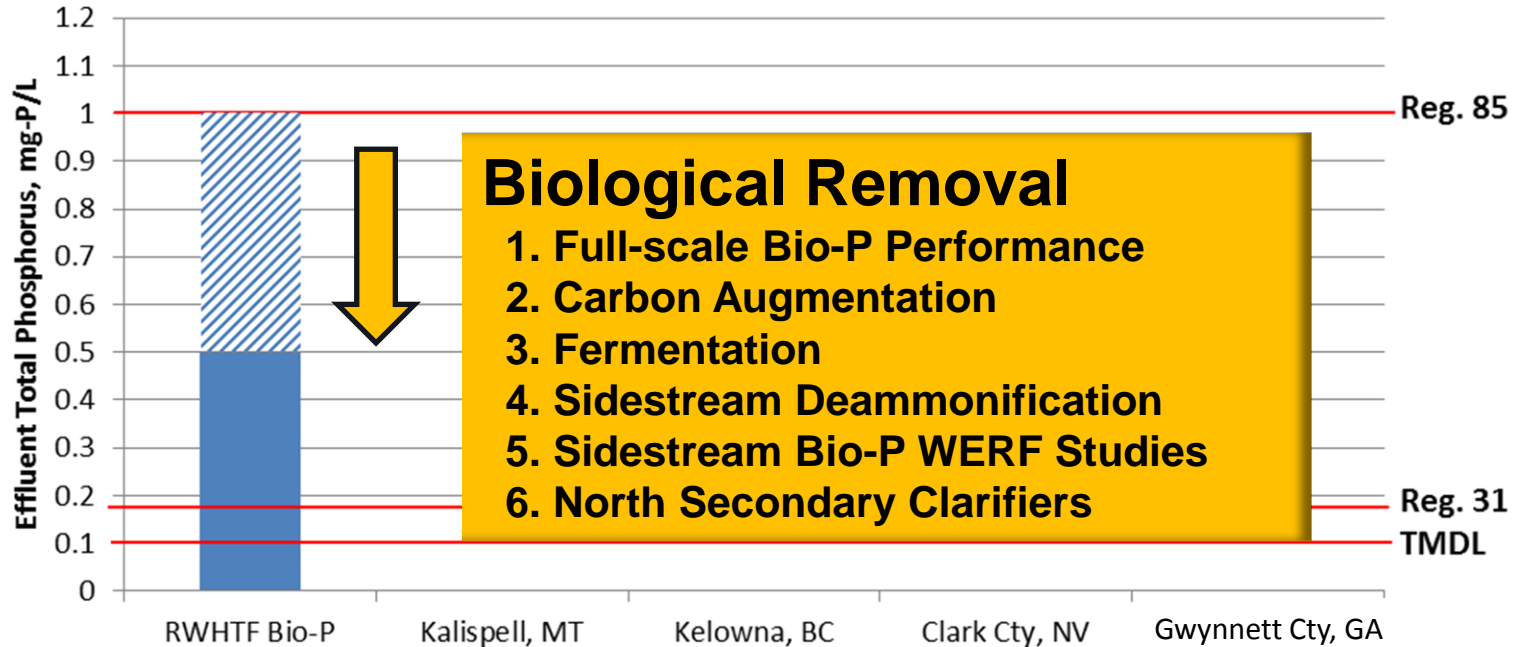


**Biological  
Basin with  
Bio-P**

# Phosphorus Accumulating Organisms (PAOs)



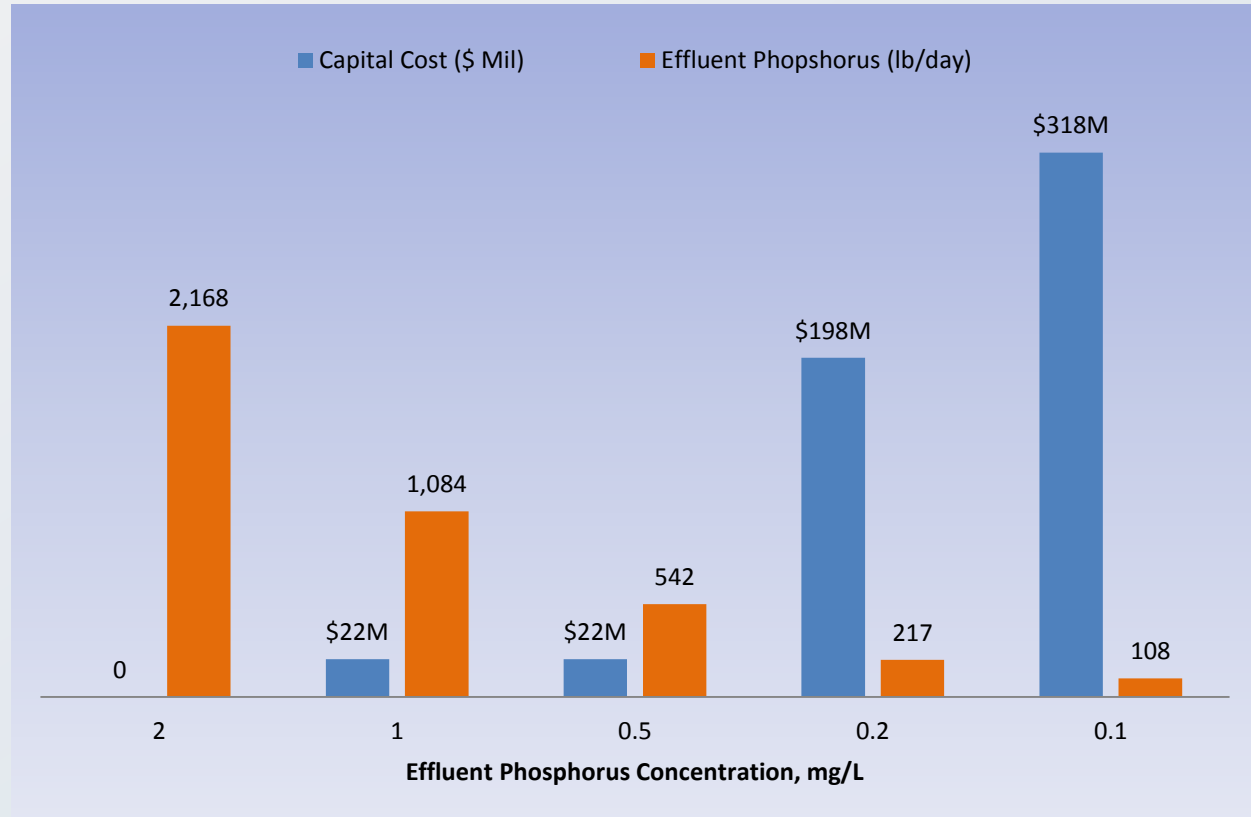
# Initiative Studies/Goals



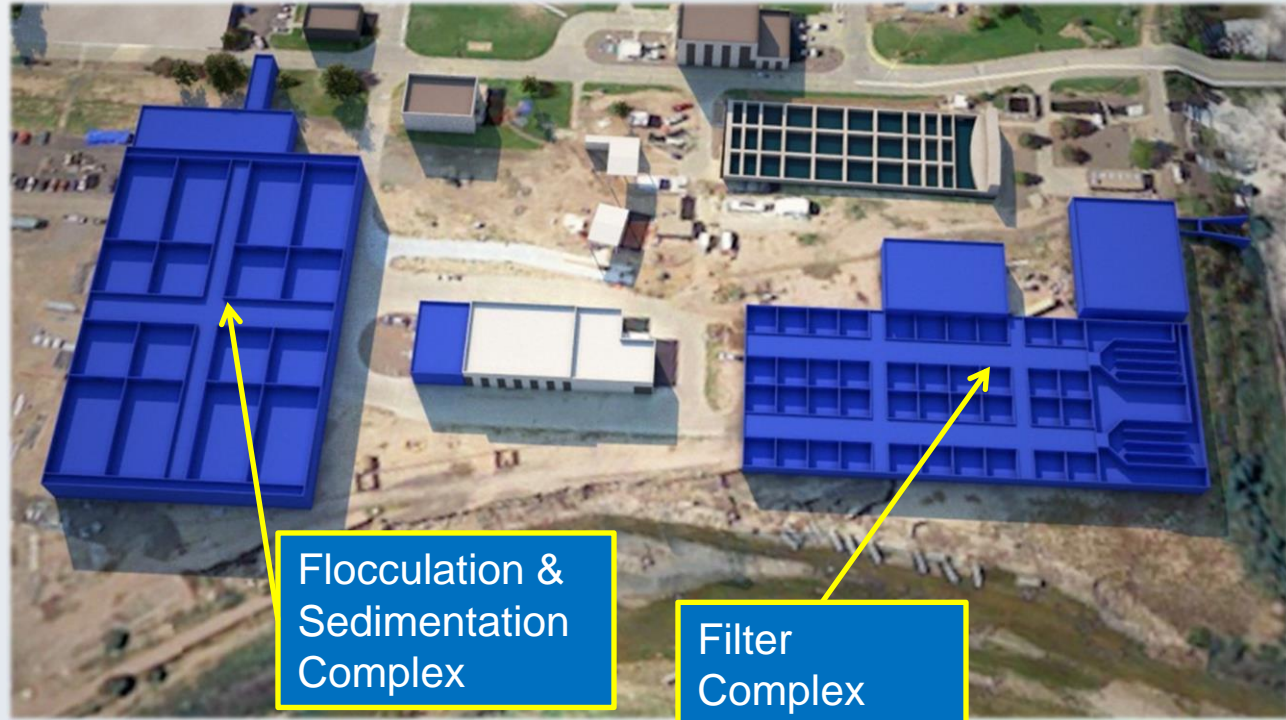
Reference Installations Adapted from WEF/WERF Study Quantifying Nutrient Removal Technology Performance, 2011 (NUTRIR06k)



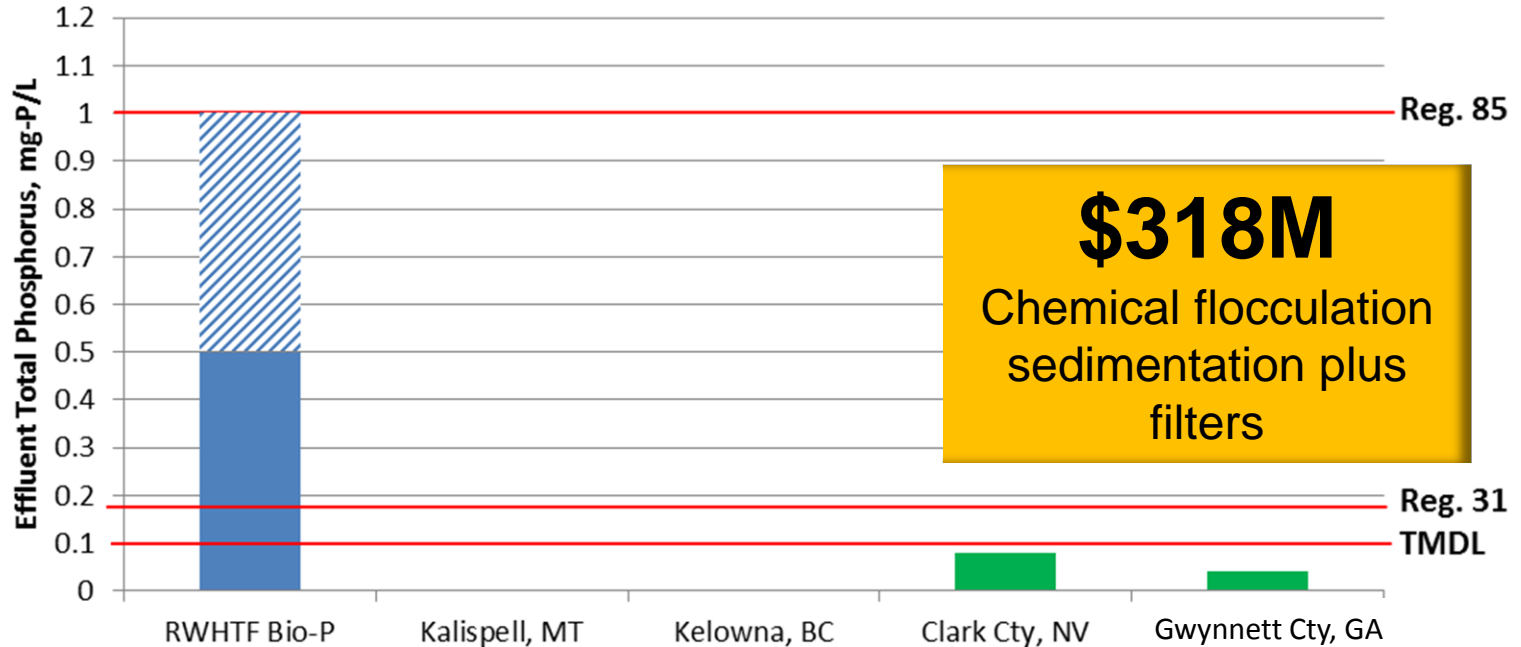
# Cost-Benefit



# Tertiary Facilities

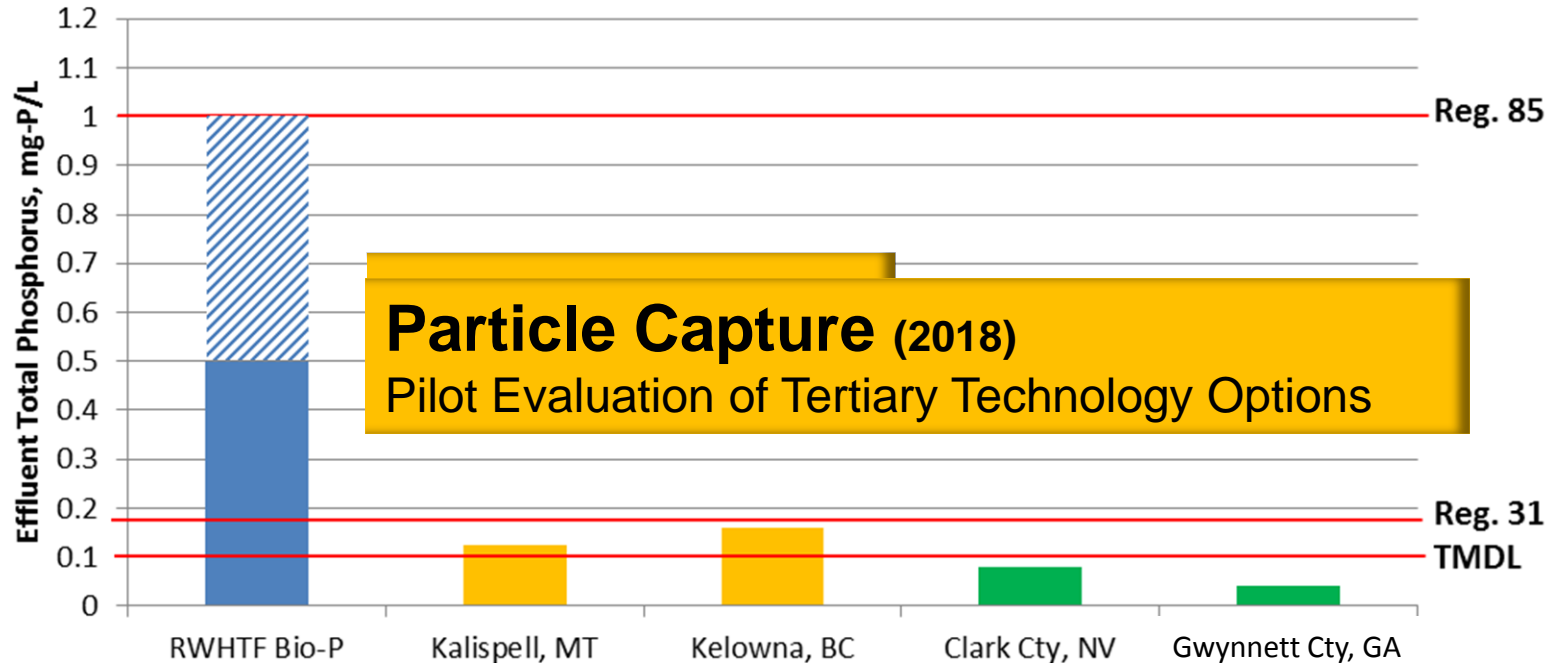


# Initiative Studies/Goals



Reference Installations Adapted from WEF/WERF Study Quantifying Nutrient Removal Technology Performance, 2011 (NUTRIR06k)

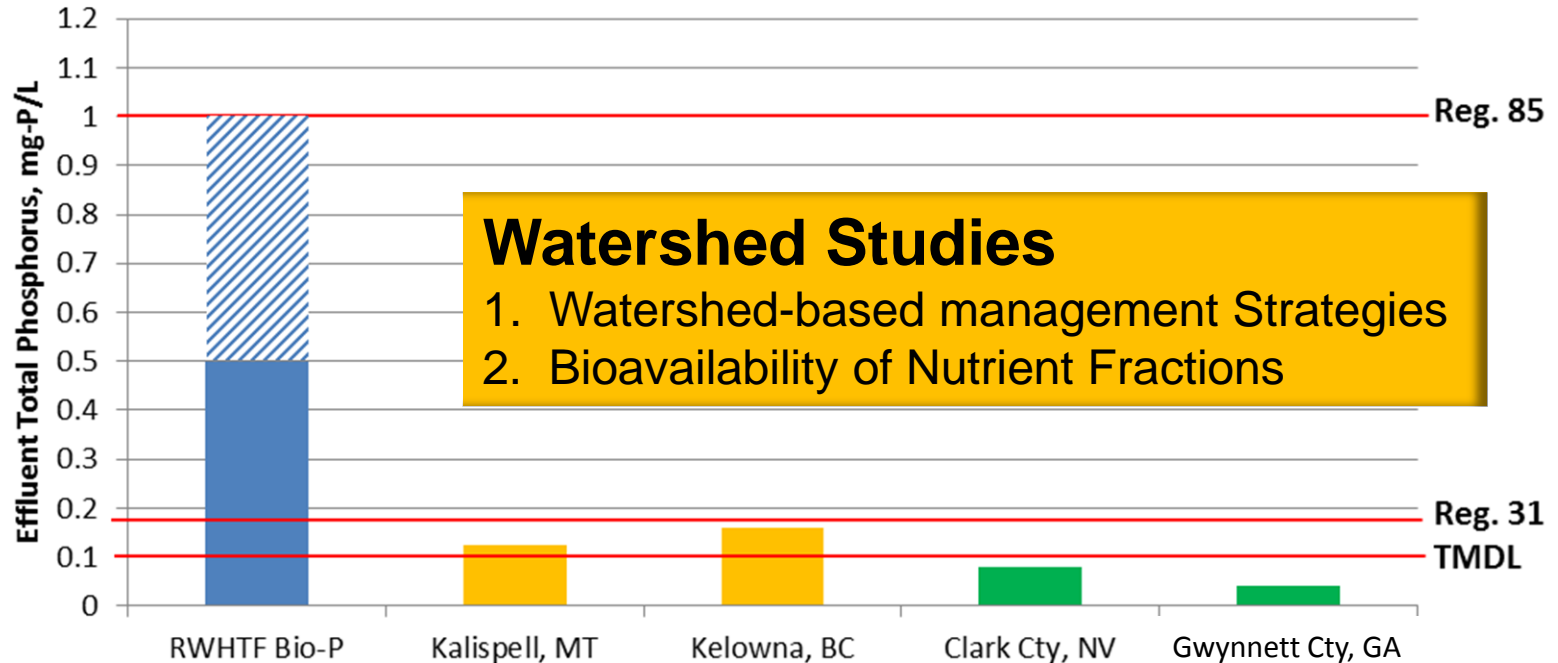
# Initiative Studies/Goals



Reference Installations Adapted from WEF/WERF Study Quantifying Nutrient Removal Technology Performance, 2011 (NUTRIR06k)



# Initiative Studies/Goals



Reference Installations Adapted from WEF/WERF Study Quantifying Nutrient Removal Technology Performance, 2011 (NUTRIR06k)

# Manage Phosphorus Once It's Removed

1



2

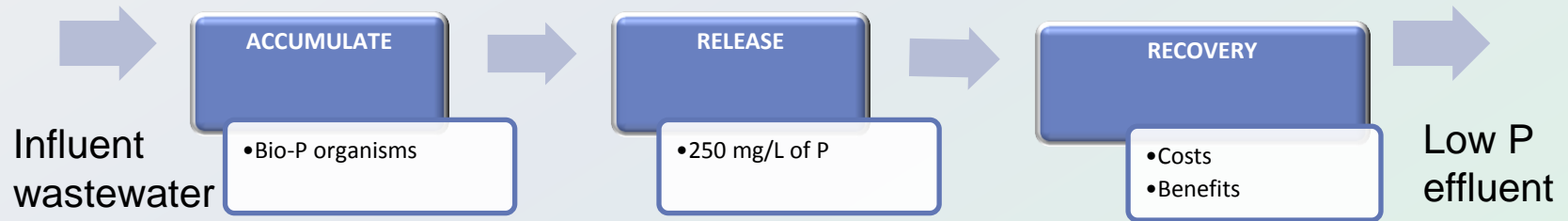


3



Colorado Phosphorus Index

# Three P-Management Steps



A new  
recovered  
resource



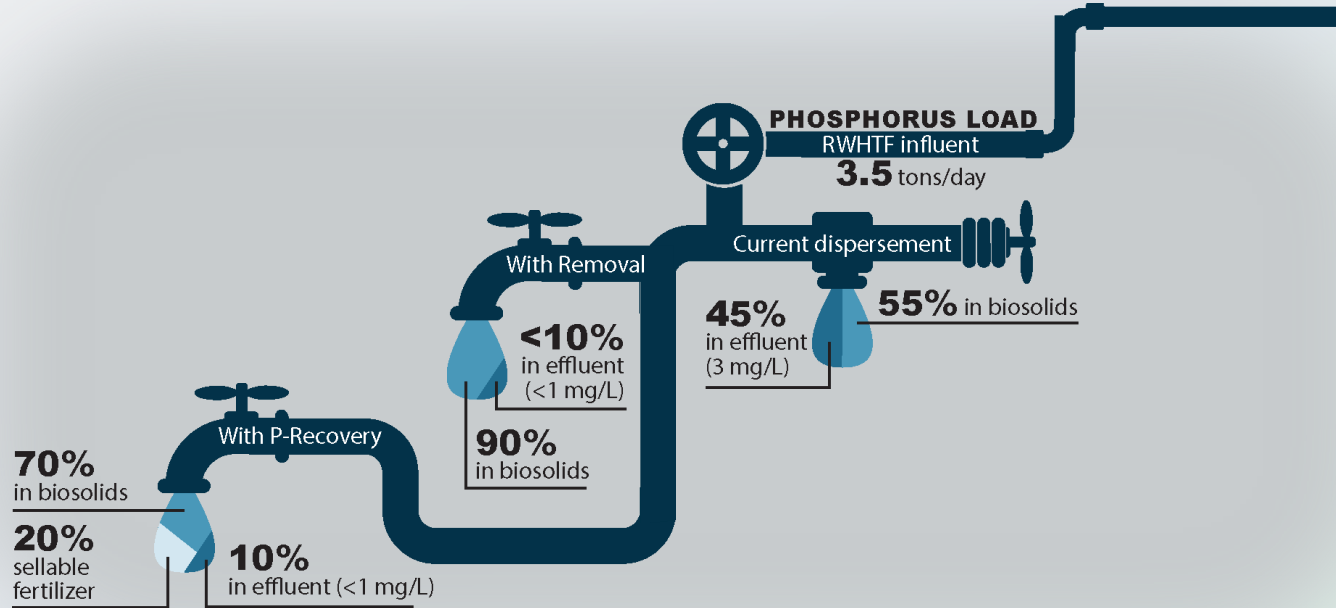
*Adapted from WERF Project NTRY1R12*

# Phosphorus Recovery Evaluation Criteria

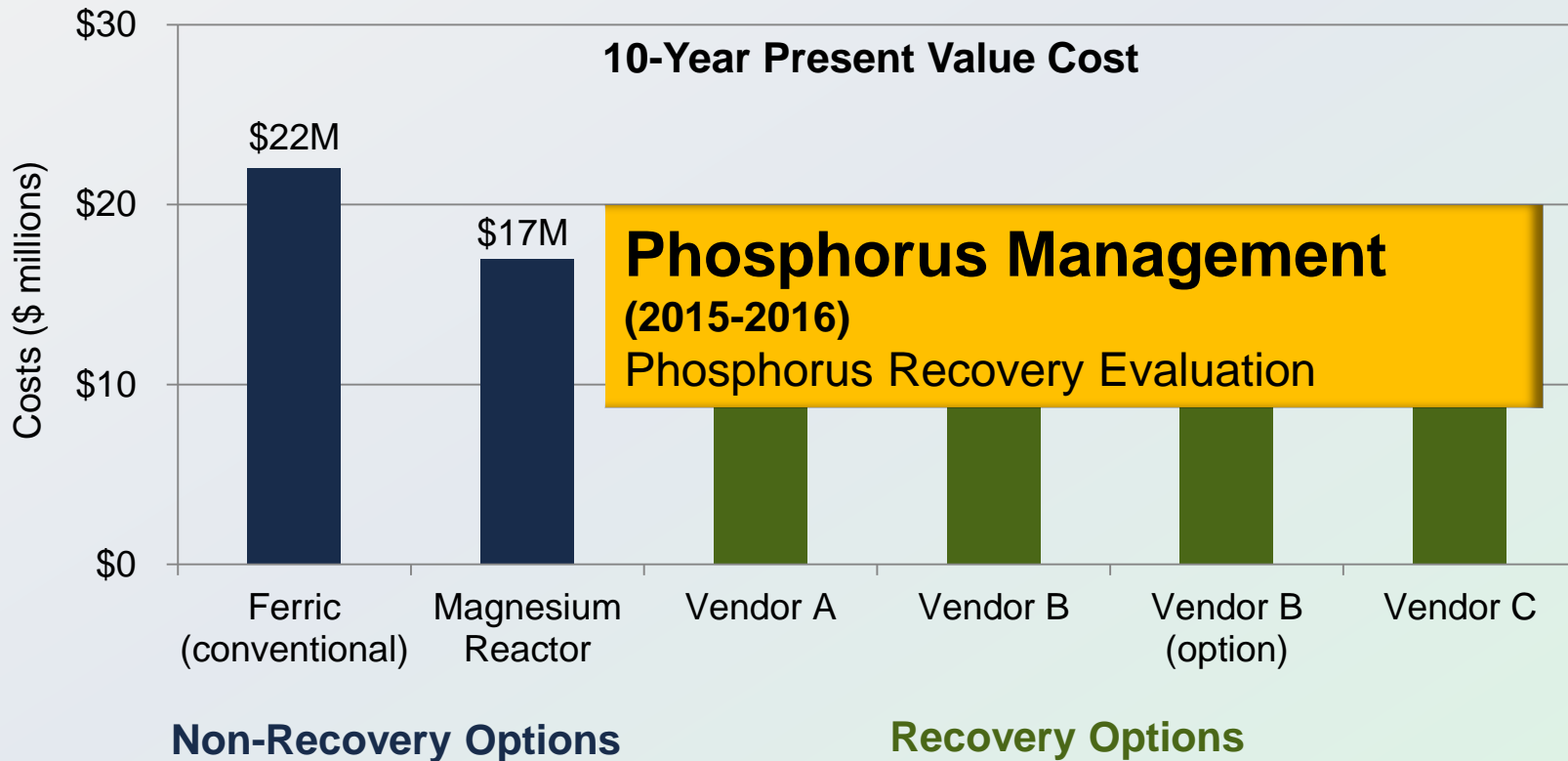
- ✓ Enhance mainstream Bio-P reliability
- ✓ Mitigate nuisance struvite on equipment/pipes
- ✓ Achieve chemical and energy savings
- ✓ Reduce phosphorus content in biosolids to help nitrogen land application rates
- ✓ Minimize sludge production
- ✓ Recover a resource for society



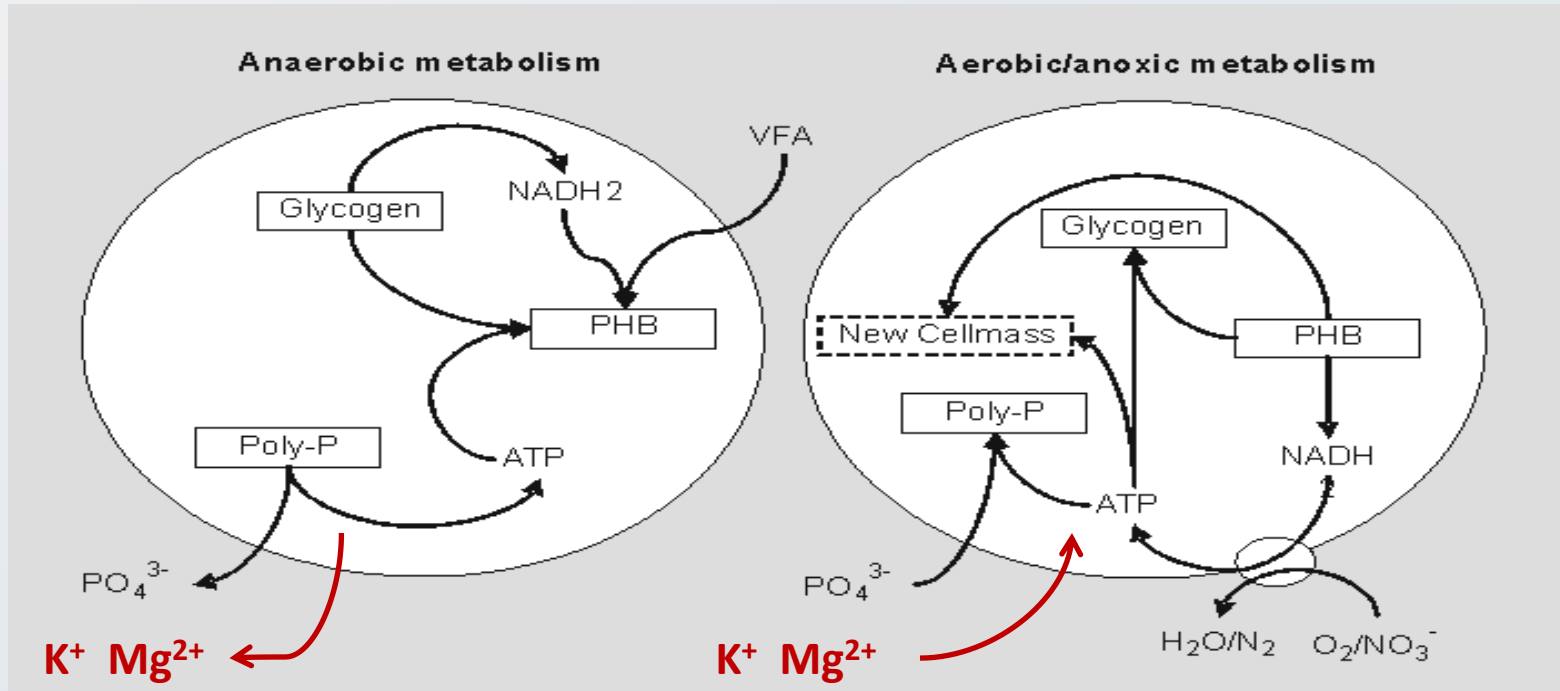
# Potential Yield



# Initiative Studies/Goals



# Phosphorus Accumulating Organisms (PAOs)

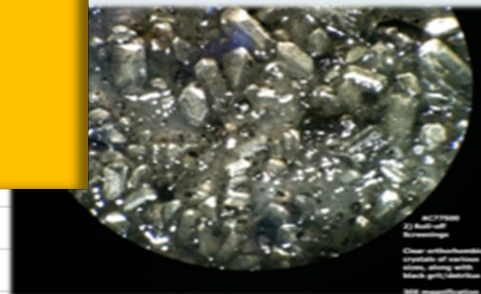
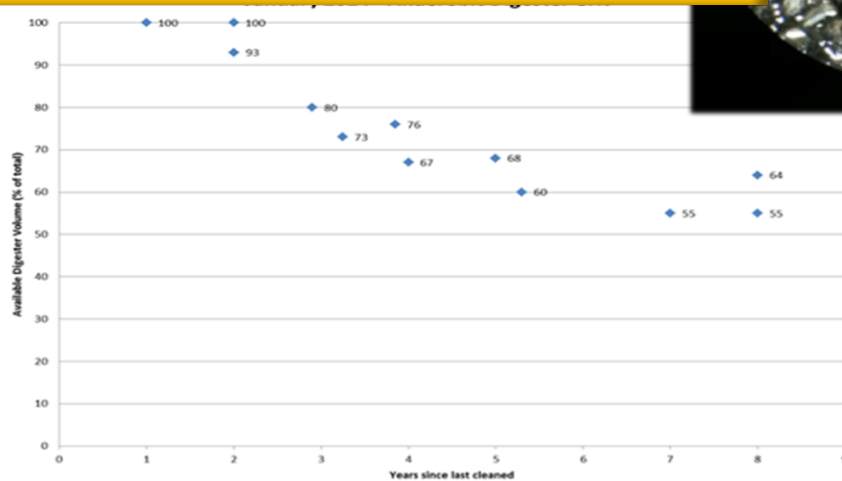


RELEASE

# Initiative Studies/Goals

## Phosphorus Management (2016)

Struvite Reduction Dewaterability  
Improvements Evaluation



17  
16  
15  
1/2/2011 4/12/2011



# Phosphorus Management (2016)

## Struvite Reduction Dewaterability Improvements Evaluation

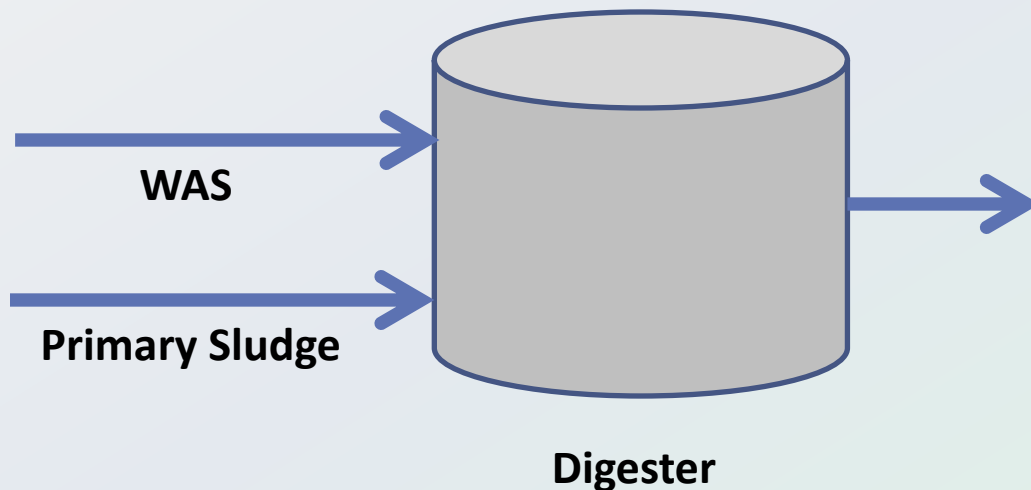


	Before	After
MgCl <sub>2</sub>		6.8ml/L
Cake	17.6%	24.6%
Polymer	32.2 lb/DT	30.9 lb/DT

# Phosphorus Management (2016)

## Struvite Reduction Dewaterability Improvements Evaluation

Magnesium-Ammonium-Phosphate (MAP)



# Find the Most Effective & Sustainable Management Approach for Phosphorus

- Minimize Phosphorus Loading to Receiving Waters
- Do it Cost Effectively and Sustainably
- Develop an Effective Phosphorus Management Scheme



# Discussion

