

# Latonnell Conference, Watershed Management Alliston, Ontario

November 21, 2019

## On a Watershed Scale: Phosphorus Adsorptive Media Solutions for Phosphorus Recovery & Reuse

Ed Weinberg, PE, President ESSRE Consulting, Inc.



# Outline of the Presentation

- ❖ Technology Objectives
- ❖ ESSRE RePleNish and the Thames R. PRC Projects
- ❖ P Reuse/Recycle Roadmaps
- ❖ Cost Justifications for a P-Recovery Circular Economy

# ESSRE RePleNish Objectives

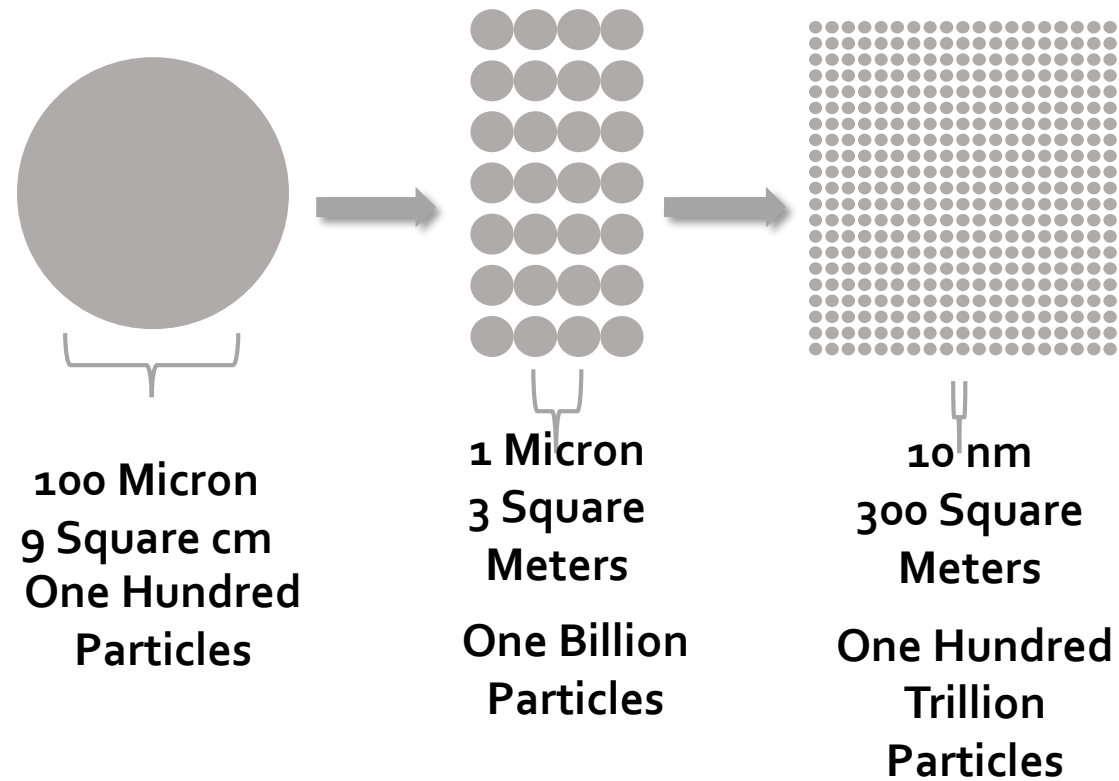
To provide on a watershed basis P reduction treatment solutions that focus on cost-effectively reducing dissolved P “leakage” from any source or pathway while producing P-rich products for safe, sustainable reuse with:

- **no chemicals** added onsite (Ca, Fe, Al, polymers)
- **no land-application** of low-grade fertilizer products
- Enhanced aquatic biodiversity = **Mitigation of HABs**
- While promoting a **circular economy** built around **P- Recovery**

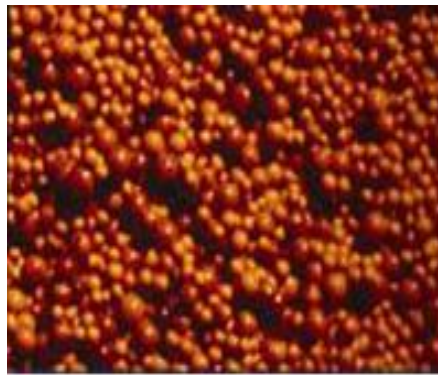


# Nanotechnology: Small Stuff, Huge Surface Area

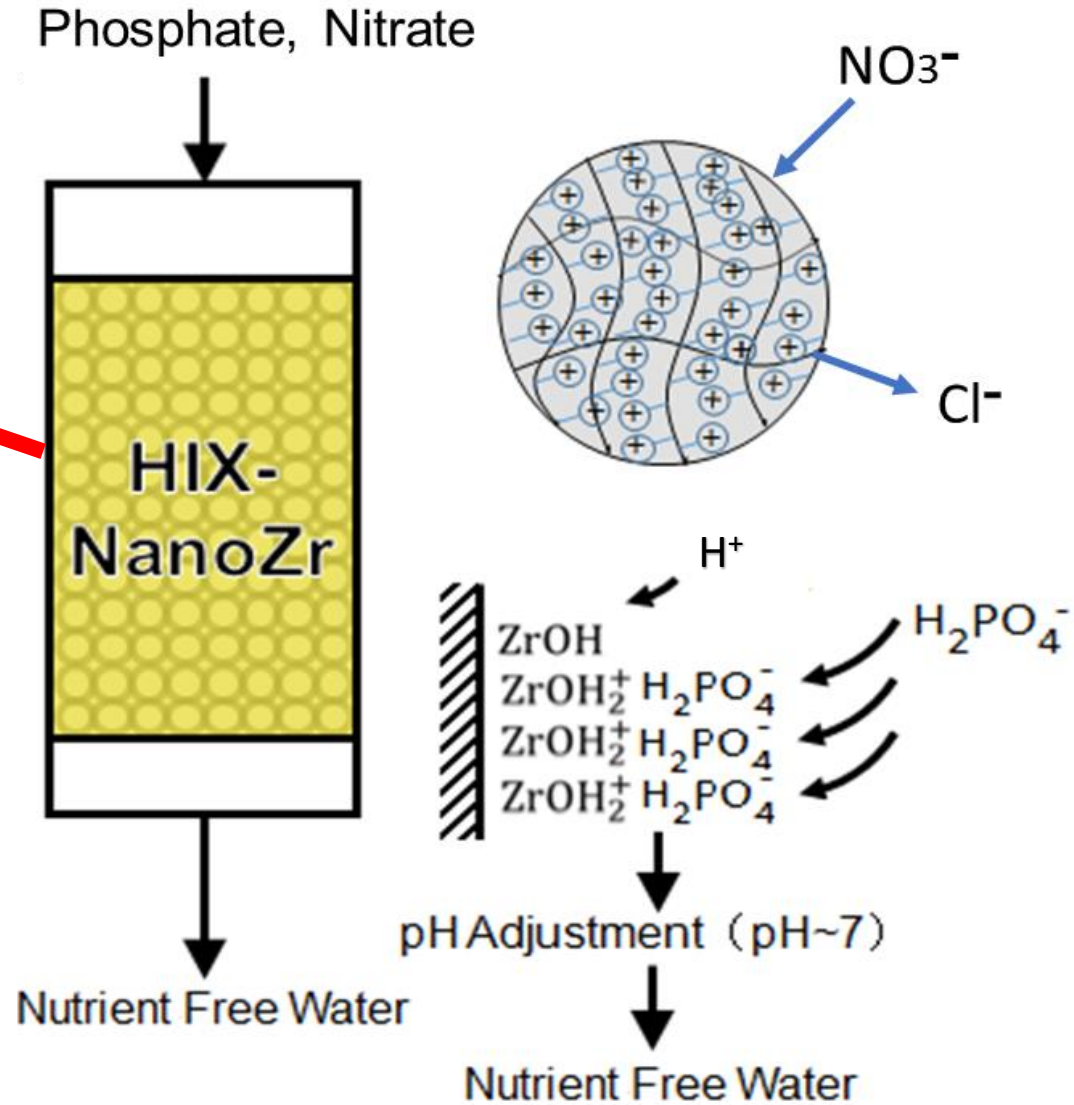
- One milligram of quartz sand



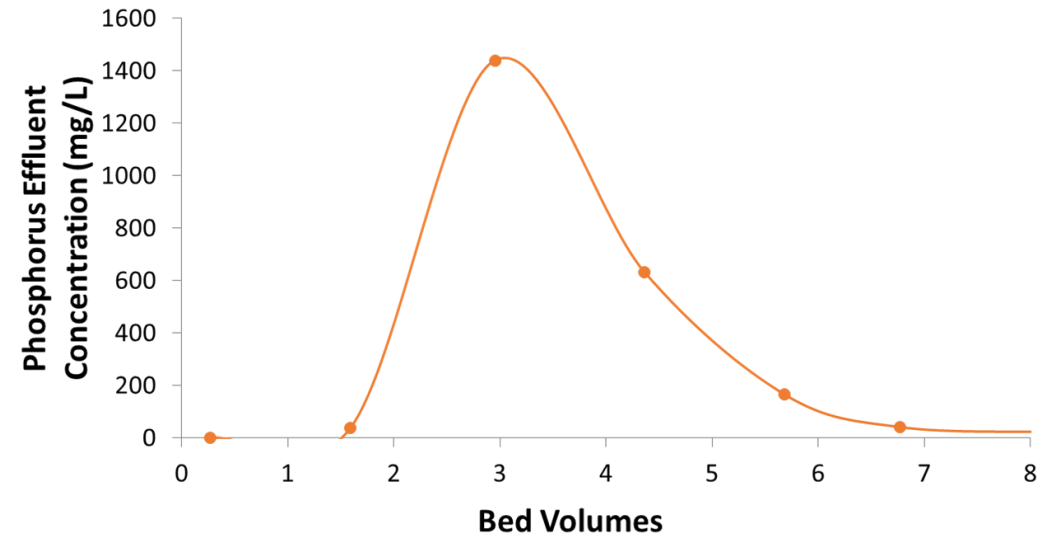
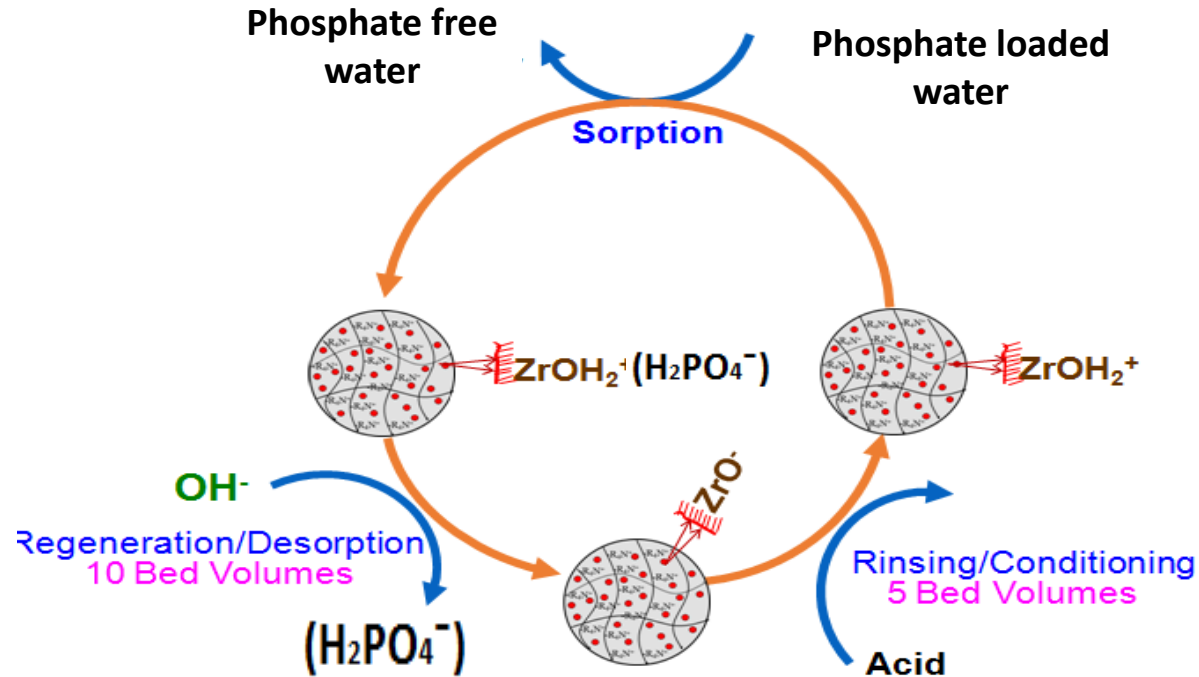
# HIX-Nano P Adsorption Removal - WWTFs



HIX(Fe)-Nano Resin



# P-Recovery & Reuse via Nano-Enhanced Media Regeneration

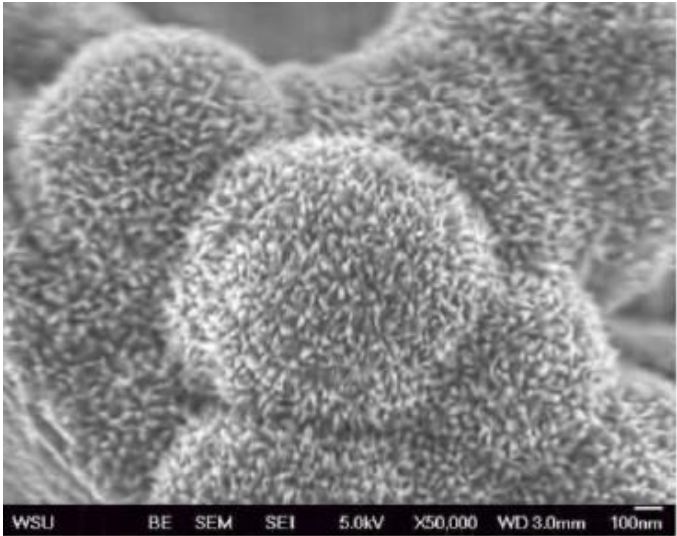
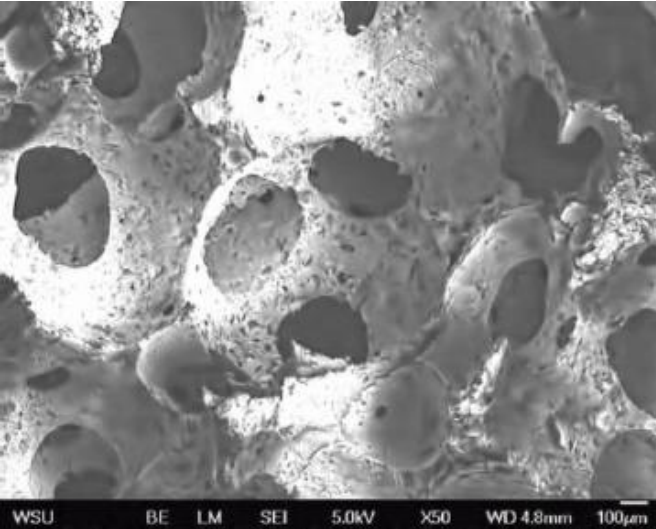


**Patent-pending regeneration and rinsing processes will generate liquid, customized NPK formulations for hydroponic and greenhouse growers.**

# Nano-Enhanced Adsorptive Media SEM & Product Photos

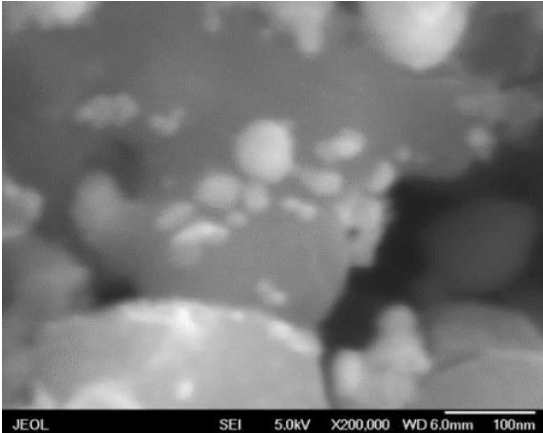
## PO4 Sponge – MetaMateria

Interconnecting Pore Structure 20-100 nm Nano Crystals Added



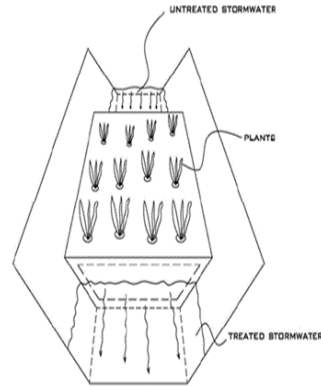
SmartSpongeHM

AbTech Industries



# Non-Point Source P: Farm Field Surface and Buffer Devices

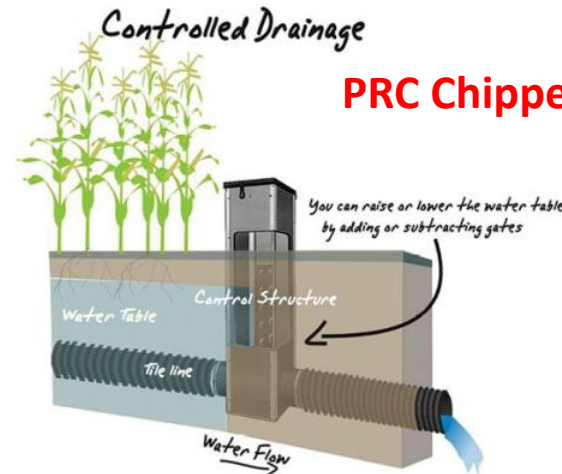
## Bioswale and Hickenbottom Tubes



## PRC Chippewa First Nation



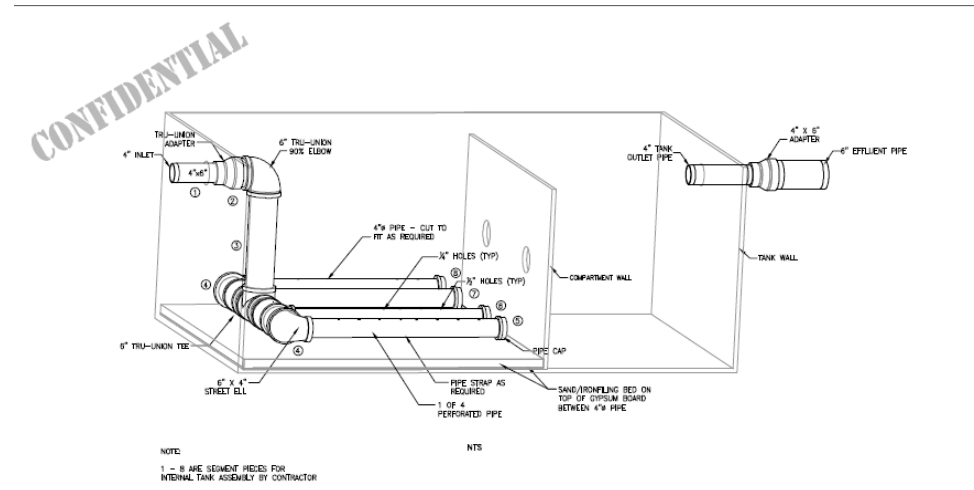
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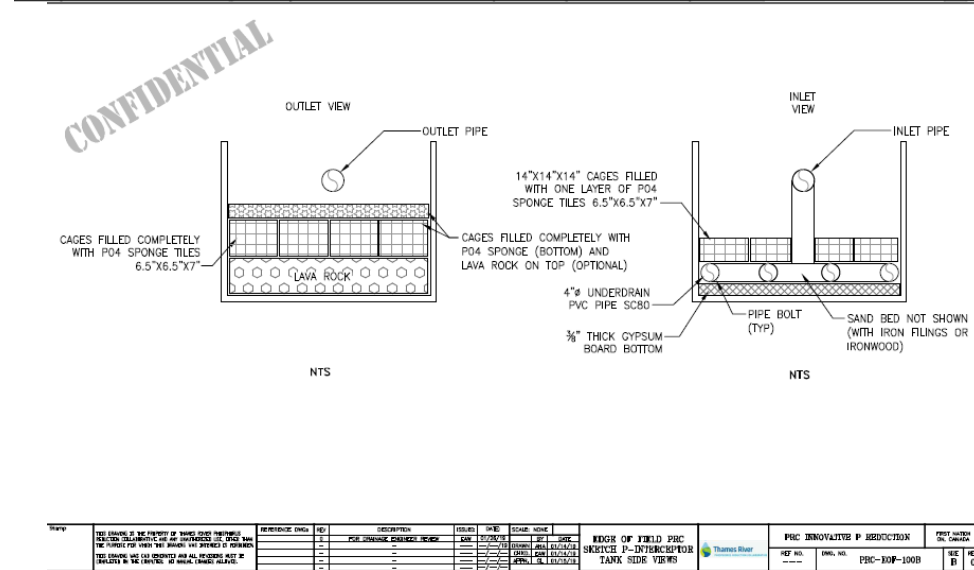
## PRC Chippewa First Nation



# PRC E-O-F Tile Drainage Applications



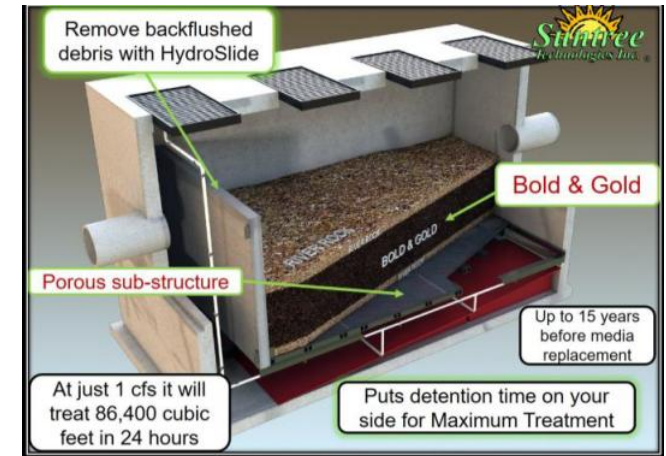
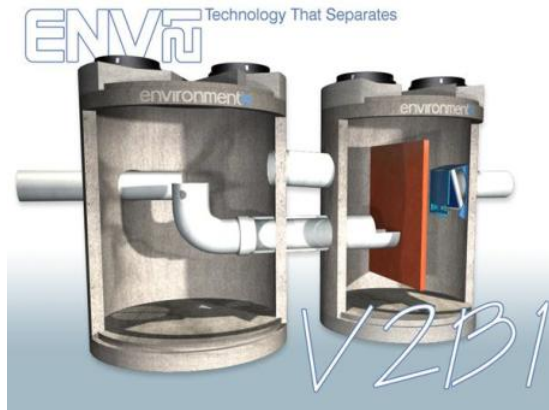
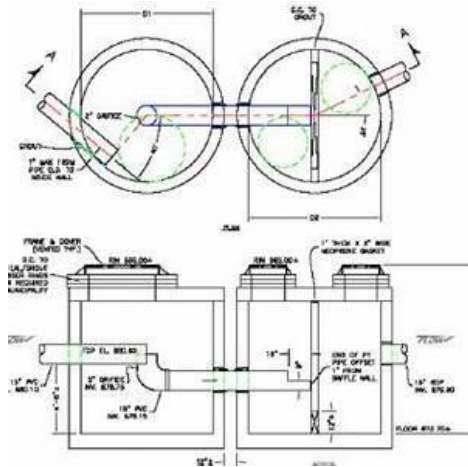
REV	DESCRIPTION	DATE	BY	CHKD	APP'D
1	ISSUED FOR CONSTRUCTION	10/20/18	JL	MS	
2	REVISED TO ADD 4" DIA. INLET	11/15/18	JL	MS	
3	REVISED TO ADD 4" DIA. OUTLET	11/15/18	JL	MS	
4	REVISED TO ADD 4" DIA. INLET AND OUTLET	11/15/18	JL	MS	



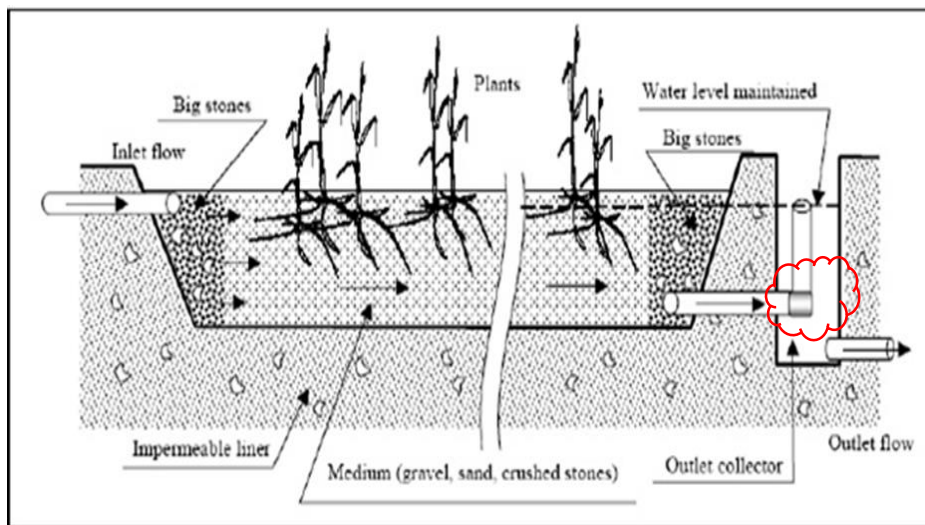
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# Non-Point Source: SWTD & Septic Systems

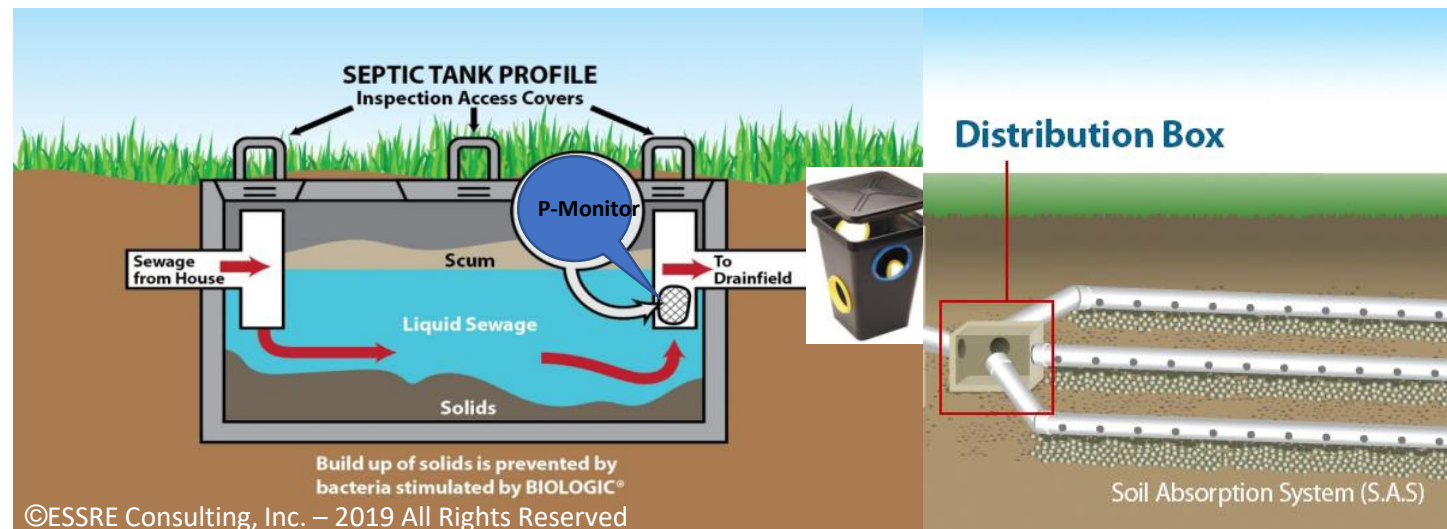
## Multi-Compartment Tank



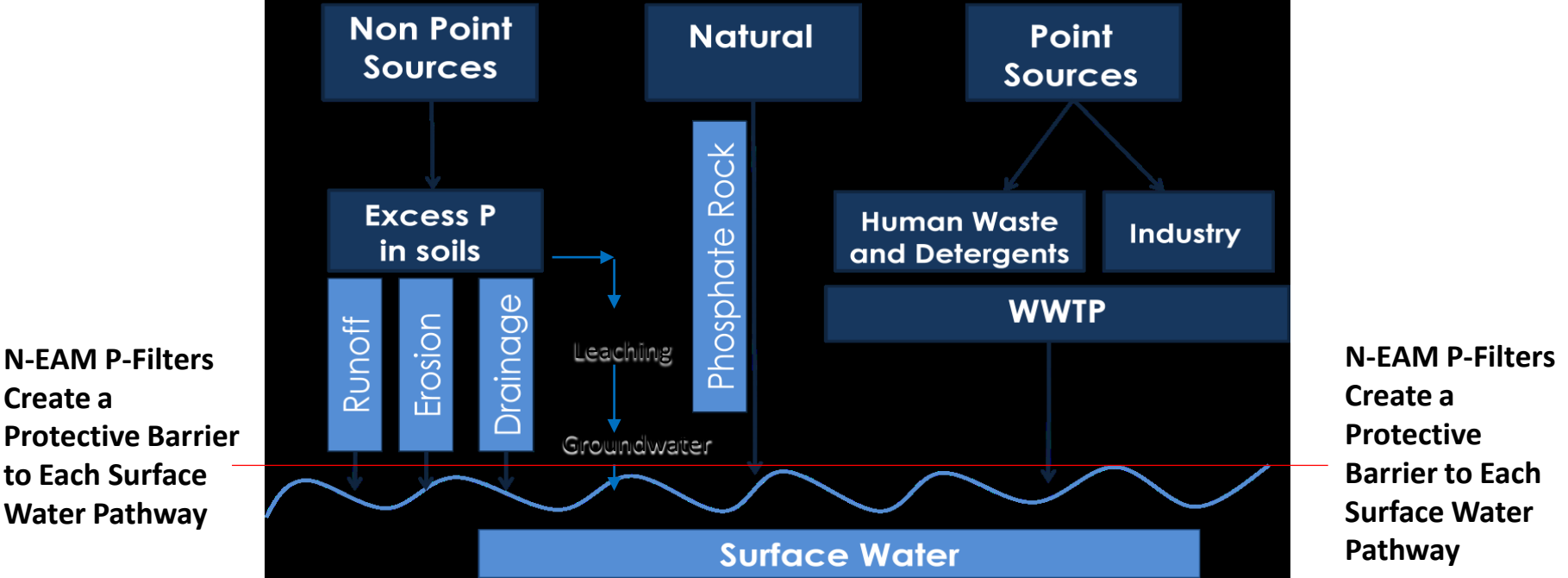
## Bioretention Cells



## Residential Septic



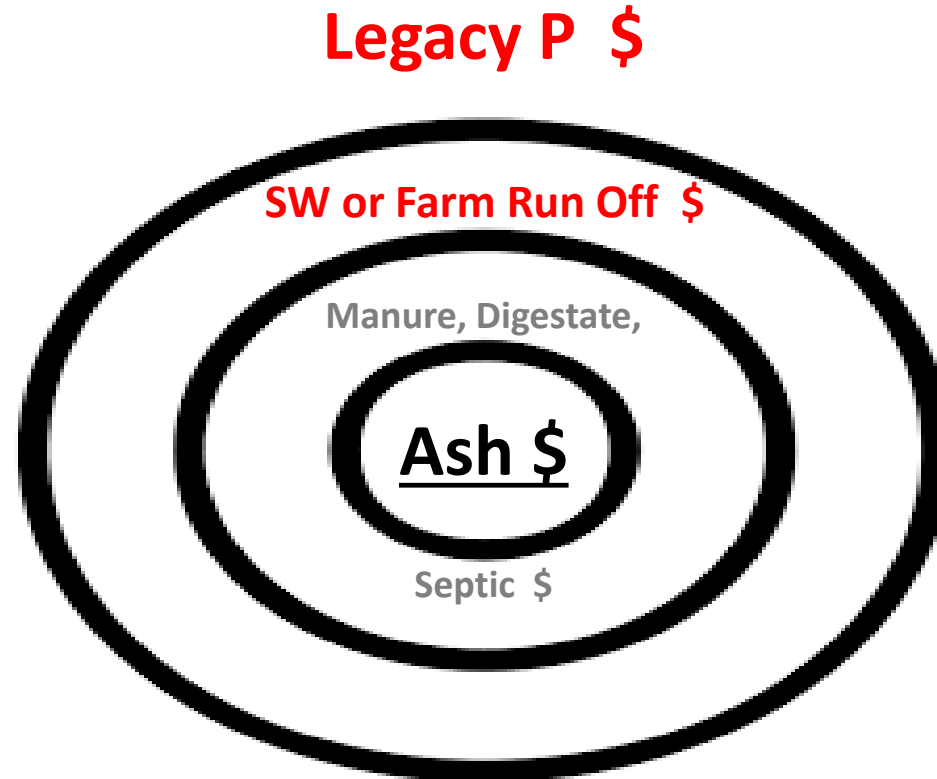
# RePleNish Roadmap: Nano-Enhanced Phosphorus Adsorbent Media Provides a P Barrier



Adapted from Wind, 2007

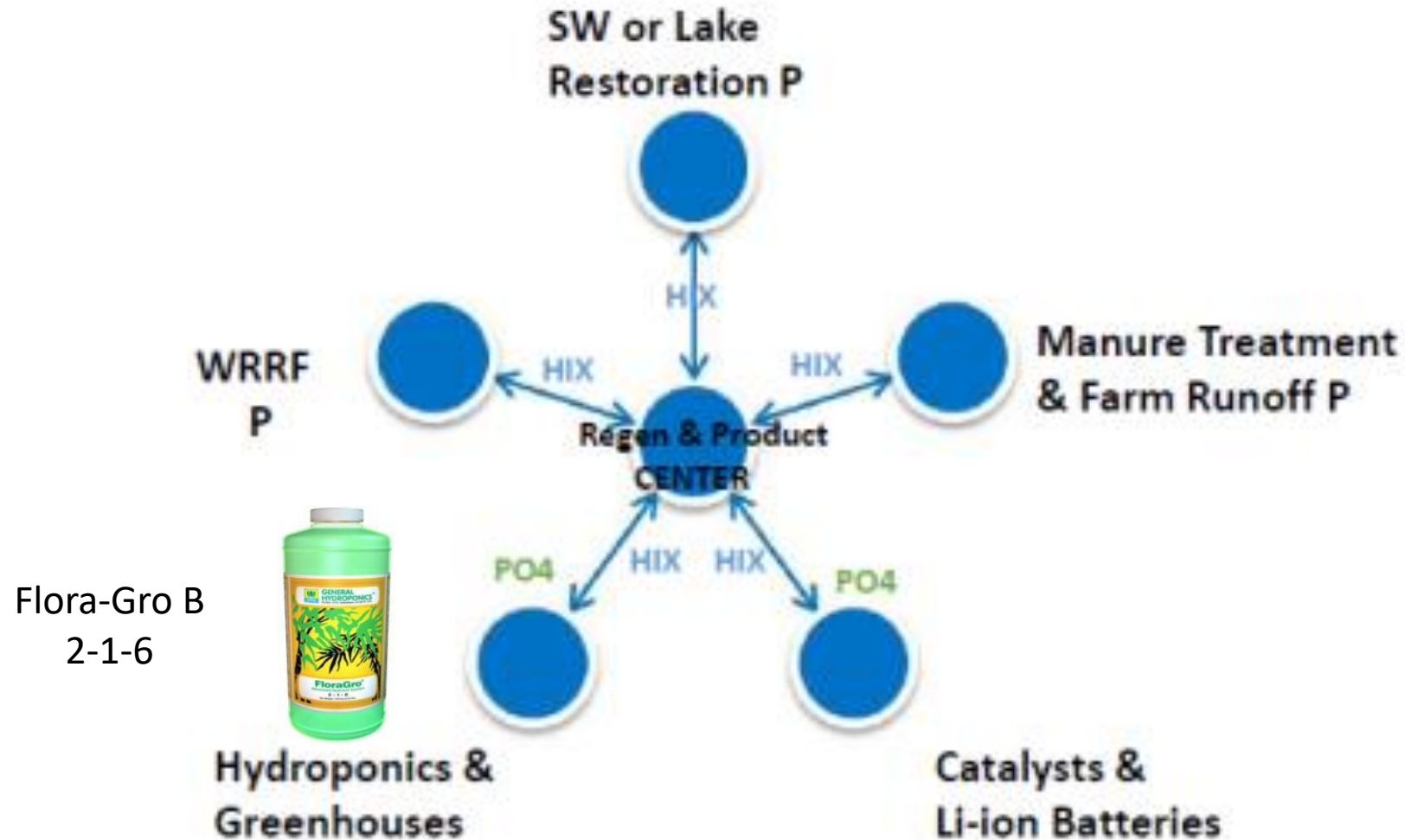
**P-Reduction by N-EAM Mitigates HABs for Restoration of Impaired Fresh Waters**

# P-Recovery/Reuse Targets: Following the P by Source Concentration

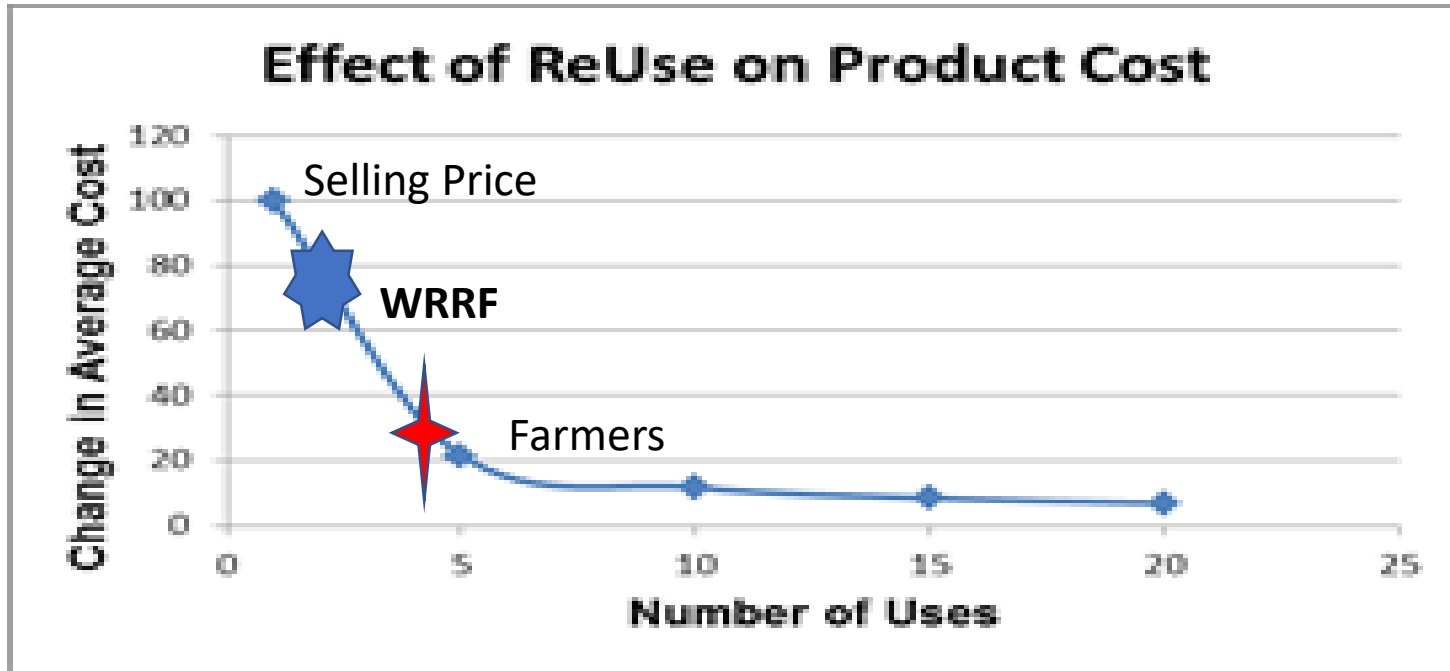


Ash is Equivalent to Phosphate Rock, Example Europe's Ash2Phos

# Putting It All Together: ESSRE RePLeNish HUB and SPOKE Model



# Regenerable Media Lowers Usage Cost



For Example, 5 Regenerations lowers the cost 80%;  
**20 regens lowers the cost 95%.**

On average for the **N-E PAMs** the regeneration cost is about **15%** of the **original purchase price**. This combined with the **concentrating effect** of regeneration output make a compelling business case for a **circular economy built around RePleNish P Removal/Recovery/Reuse**

# Key Take Aways

- Watershed Scale Solution to Phosphorus Pollution Using Nano-enhanced Adsorptive Media
- Point and Non-point Sources; Urban or Ag Pathways; and Legacy P
- Dilute or Concentrated P Removal
- Regenerable Media Key to Nutrient Recovery & Low Overall Product Cost
- Enhanced P Stewardship Possible via Removal, Recovery, Reuse, Recycle and Redistribution (6R's)
- P-based Liquid Products Promote a Circular Economy Built Around P-Recovery

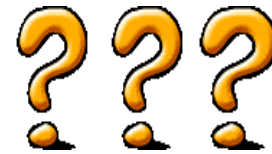
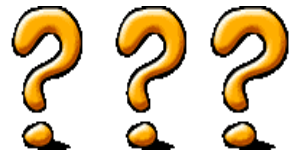
**Latornell Conference  
Watershed Management Day 3  
Alliston, ON Nov. 21, 2019**

**| On a Watershed Scale: Phosphorus  
| Adsorptive Media Solutions for  
| Phosphorus Recovery & Reuse**



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## QUESTIONS



**Old Proverb: Great Things Come in Small Packages**