Enhancement and Recovery of Domestic Wastewater Residuals

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BLACK & VEATCH

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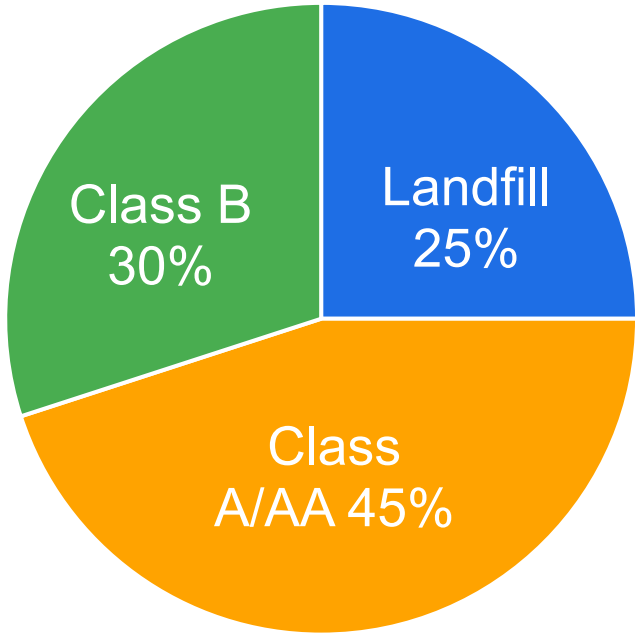
Outline

- Biosolids Management in Florida
- Florida Biosolids Regulations
  - Impact on Phosphorus Application
- Land Application in the St John River Water Management District
- Phosphorus Recovery Project
- Acknowledgements

Biosolids Management in Florida

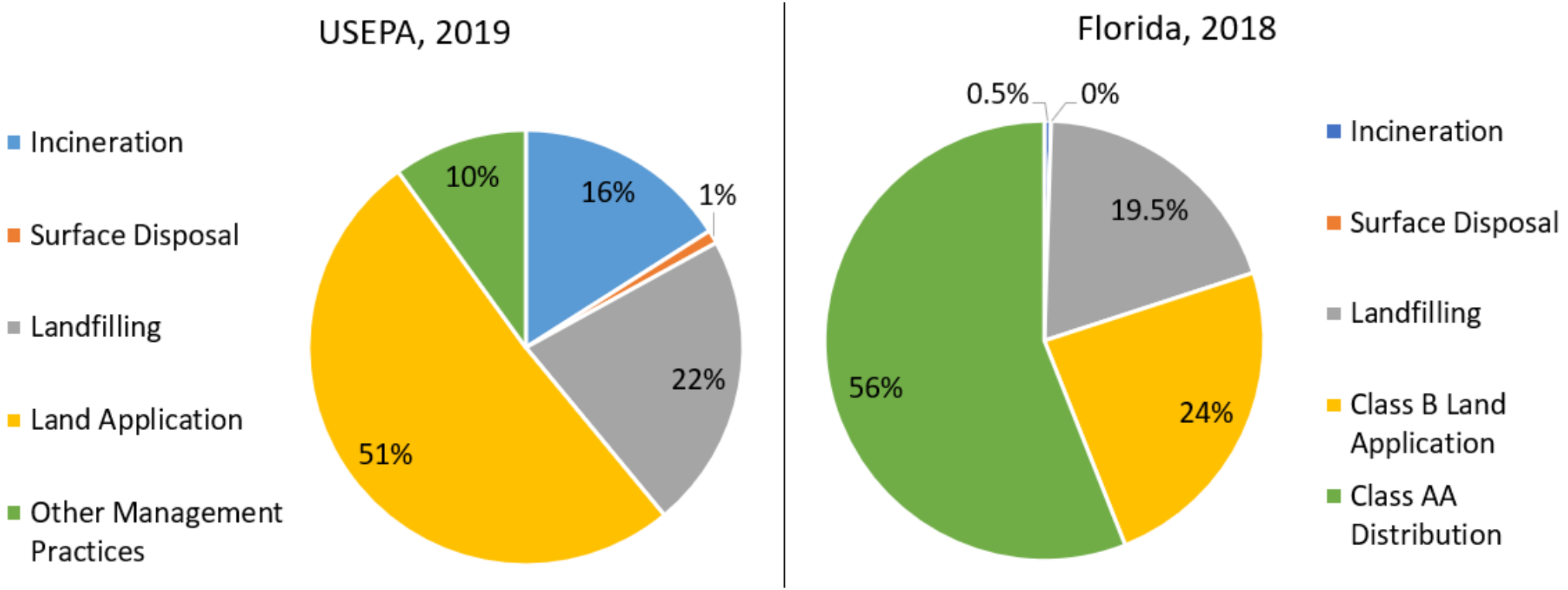
Biosolids in Florida

350,000 dry tons per year



Source: FDEP 2019 Biosolids Rulemaking presentation

Comparing Florida Practices to the Nation



- **An estimated 80% of Florida's biosolids are beneficially used; higher than the national average.**
- **56% of Florida's Biosolids are processed to meet FDEP Class AA Criteria.**

F.A.C. 62-640 Biosolids Regulation Revisions

- Effective June 21, 2021

- Class B Land Application site requirements by 2023.

Revised rule requires:

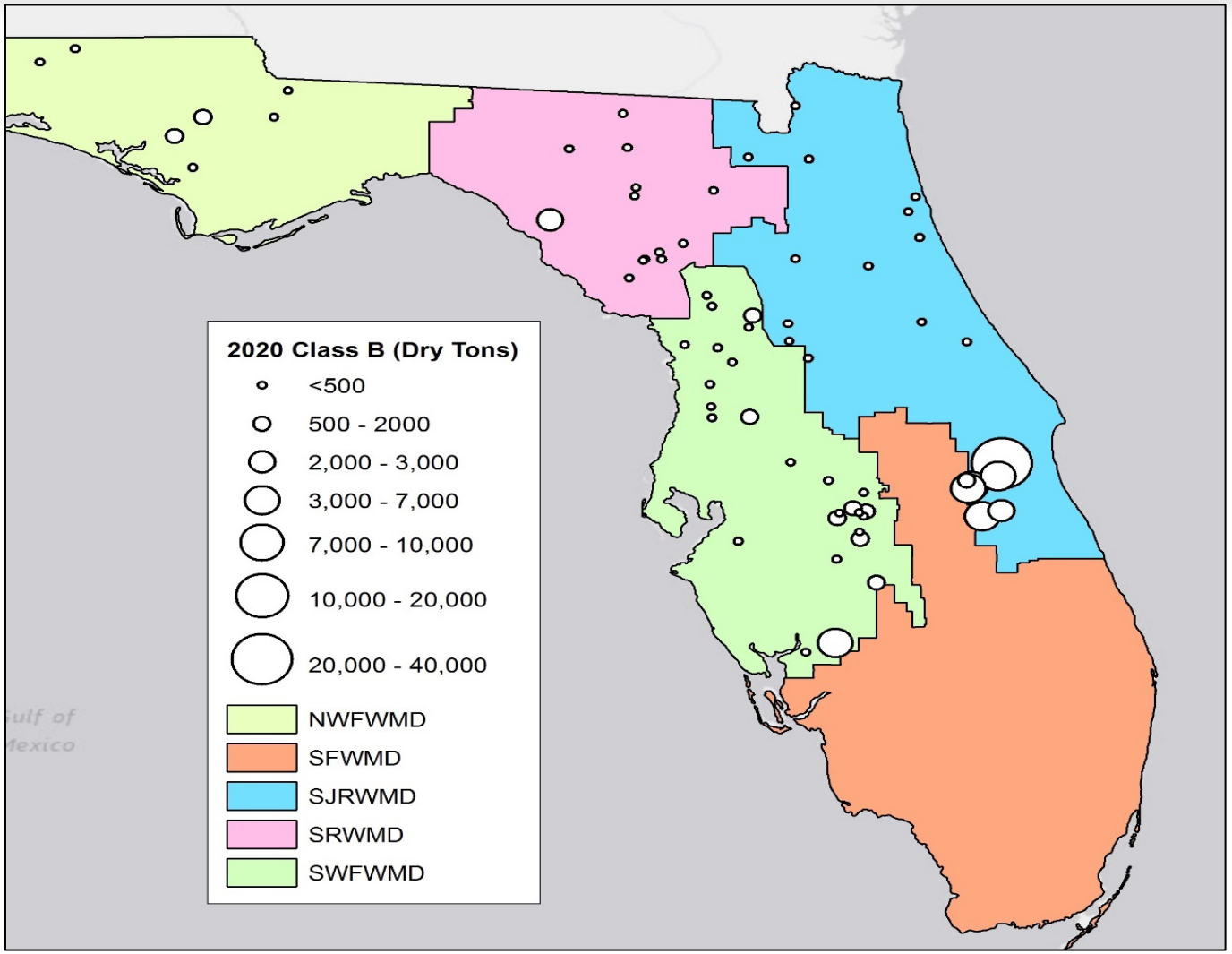
- Annual soil fertility testing.
- Enrollment in FDACS BMP program.
- No applications where the mean high-water table is within 6” of soil surface.
- Phosphorus application based on agronomic rate.
- Requires Surface Water and Groundwater monitoring.

More info: https://floridadep.gov/water/domestic-wastewater/content/dep-chapter-62-640-fac-rulemaking

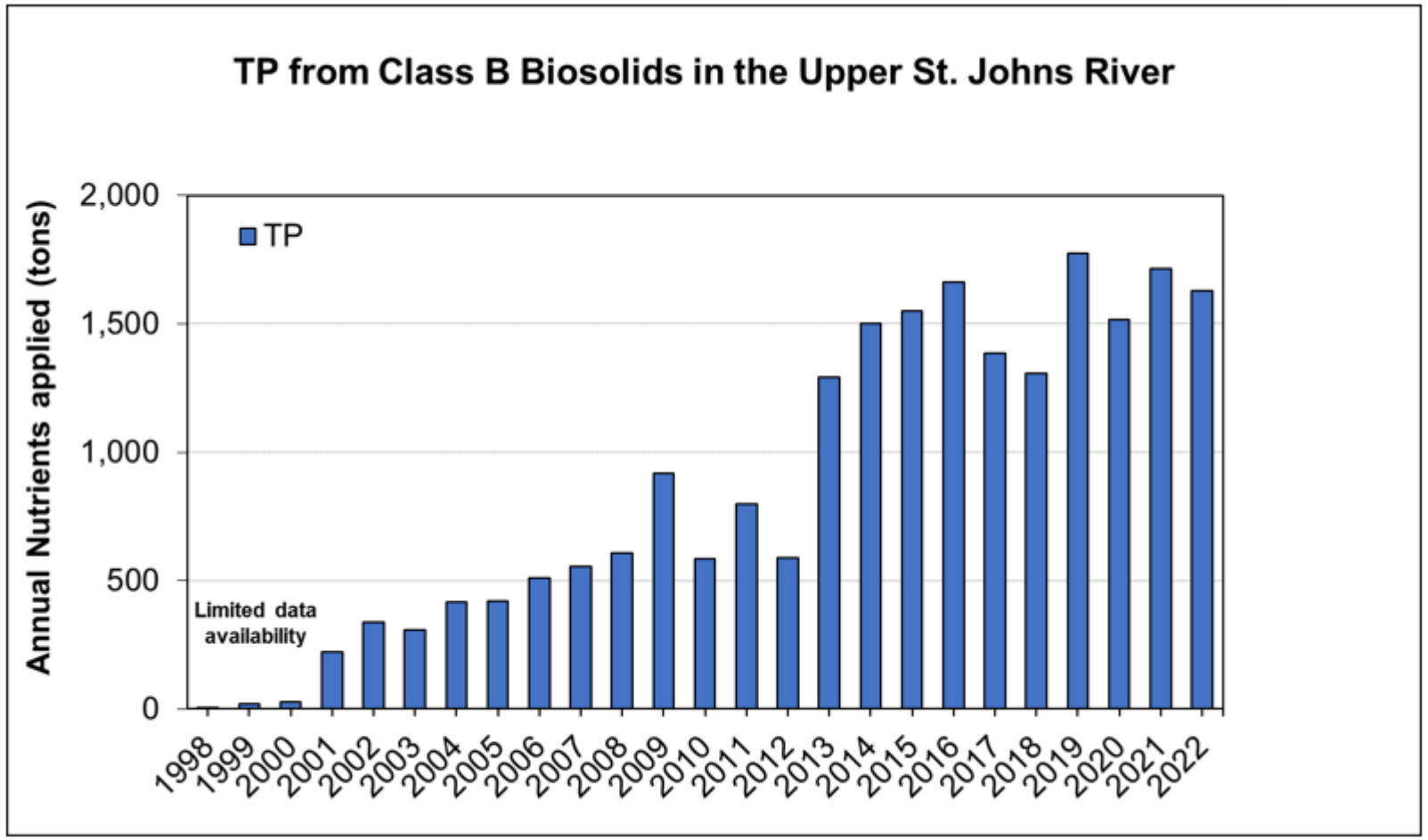
Biosolids Application Moves North

- Regulation and prohibitions virtually eliminated Class B land application program in South Florida.
- Class B Land Application moved North.
- In 2022, approximately 78 percent of Florida's Class B biosolids were applied in the St. John River Water Management District.
  - Approximately 80,000 dry tons.

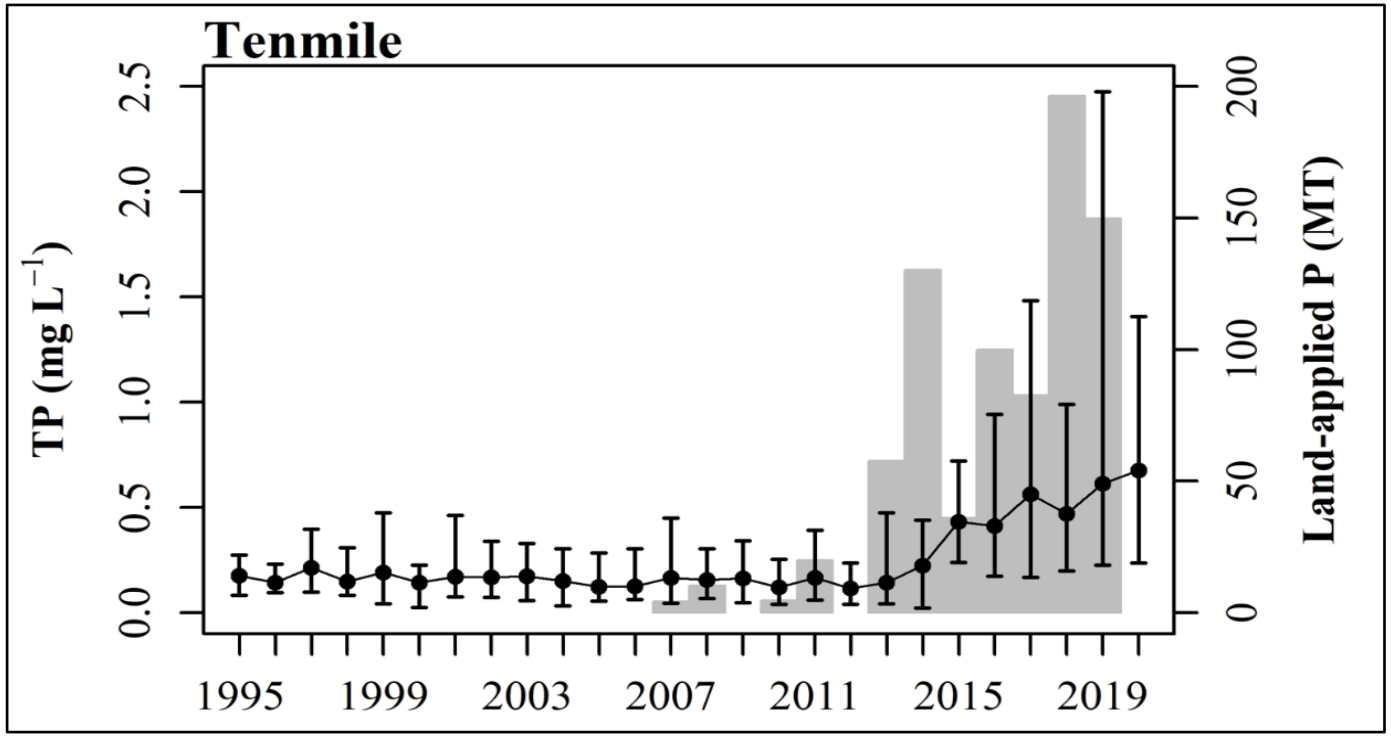
Class B biosolids land application programs in the five Water Management Districts



Increase of Class B land application programs in the St. John River Water Management District



District Water Quality Concerns



Canion et al. 2022. Lake and Reservoir Mgmt. 38(3) 215 - 217

SJRWMD Took Action

- **The District with the support of FDEP developed a project to evaluate the benefit of Phosphorous recovery from Class B biosolids**

St. Johns River Water Management District

Phosphorus Recovery Study

Project Overview

Task A:
Florida Statewide Information Needs Assessment

- To understand current biosolids management in Florida and potential changes in management due to changes in regulation.

Task B:
Phosphorus Recovery Technologies Evaluation

- To summarize proven and promising technologies for Phosphorus recovery that could be feasible in Florida.

Task C:
Modeling and Life Cycle Analysis

- To evaluate the cost and efficiency of the selected P-recovery technologies through a Life Cycle Analysis (LCA).

Task A: Needs Assessment Survey

- Gauge utilities' understanding of changes in regulations.
- Obtained feedback from utilities regarding their current biosolids management practices.
- Obtained feedback on drivers and preferences for different technological solutions to biosolids management.

- **Good response to the survey.**
  - 60 utilities responded
    - Representing 92 of 479 permitted facilities.
    - Those 92 WRFs represent 23 percent of the permitted flow in Florida;
      - 600 Million Gallons per Day (MGD) of 2,597 MGD.

Task B: Technology Evaluation

- Ranked technologies based on suitability for Florida utilities.
- Developed criteria for ranking with District input.
  - Phosphorus Reduction Performance
  - Maturity of Technology
  - Proven Application at WRFs of similar size
  - Compatibility with WRRF Processes
  - Technology Configuration/WRRF Requirements
  - Final Product Quality
  - Implementation Challenges
  - Relative Costs

Criteria	Scoring	Alt. 1 Pearl with WASSTRIP by Ostara (USA)	Alt. 2 Pearl Fx by Ostara (USA)	Alt. 3 MagPrex by CNP (Germany)	Alt. 4 PhosPAQ by Ovivo (France)	Alt. 5 NuReSys by Nutrient Recovery Systems (Belgium)	Alt. 6 EloVac-P by Ovivo (France)	Alt. 7 Composting (ASP, in vessel, or Windrow?)	Alt. 8 Thermal Drying (rotary, paddle, belt?)
Relative Performance of P-recovery Technology									
TP % decrease in biosolids	10	9	8	4		9			
Treatment recovery through	10	9	8	4	7	8	9		
Product type	10	10	7	5		7		8	8
Product value	10	10	7	5				8	8
Product marketing and distribution	10	10	8	5		8		8	8
Total Score	50	48	38	23	7	32	9	24	24
Normalized Score	10	9.6	7.6	4.6	1.4	6.4	1.8	4.8	4.8
Full Score	10								
Weighting	20								
Weighted Score	20	19.2	15.2	9.2	2.8	12.8	3.6	9.6	9.6
Technology Considerations									
Maturity of technology	10	7	8	8	4	8	4	10	10
Scale of application		Large	Small-Medium	Large	Large	Large	Small-Medium	Small-Medium	Large
Compatibility with process	10	6	8	4	8	8	8	10	8
Technology configuration	10	6	8	8	8	6	8	10	10
Influent and effluent limitations	10	6	8	8	8	7		8	6
Total Score	40	25	32	28	28	29	20	38	34
Normalized Score	10	6.3	8.0	7.0	7.0	7.3	5.0	9.5	8.5
Full Score	10								
Weighting	20								
Weighted Score	20	12.5	16.0	14.0	14.0	14.5	10.0	19.0	17.0

Task B: Technology Evaluation

Overall Score (out of 100)	Alternative	Comments
66.8	Composting (ASP system)	No P-recovery but reduces %WEP
66.2	Pearl Fx™ by Ostara	N/A
65.8	NuReSys by Schwing Bioset	N/A
64.3	Thermal Drying (belt dryer system)	No P-recovery but reduces %WEP
64.2	Pearl® with WASSTRIP by Ostara	N/A
58.0	MagPrex™ by CNP	N/A
54.8	PhosPAQ™ by Ovivo	N/A
54.8	EloVac®-P by Ovivo	N/A
N/A	CalPrex™ by CNP	Not scored. Pilot-scale only

Four Phosphorus recovery technologies selected for further evaluation.

Two management practices selected for further consideration.

Task C: Modeling and Life Cycle Analysis

- Used process modeling to estimate the amount of P that will be recovered from the biosolids.
- Estimated change in the availability of the P based on changes in the biosolids characteristics.
- Developed a LCA to estimate the cost of P-recovery technologies.
  - LCA used capital and O&M costs to estimate the life cycle cost.

Clearwater NE WRF

- 13.5 MGD Capacity
- Biological Phosphorus Removal
- Anaerobic Digestion

Winter Garden WRF

- 4.75 MGD Capacity
- Biological Phosphorus Removal
- Aerated solid holding tanks

Modeling of Phosphorus Technologies

- A mass balance for Winter Garden and Clearwater WRFs was developed to analyze the solids composition and predict phosphorus recovery based on the four selected technologies.

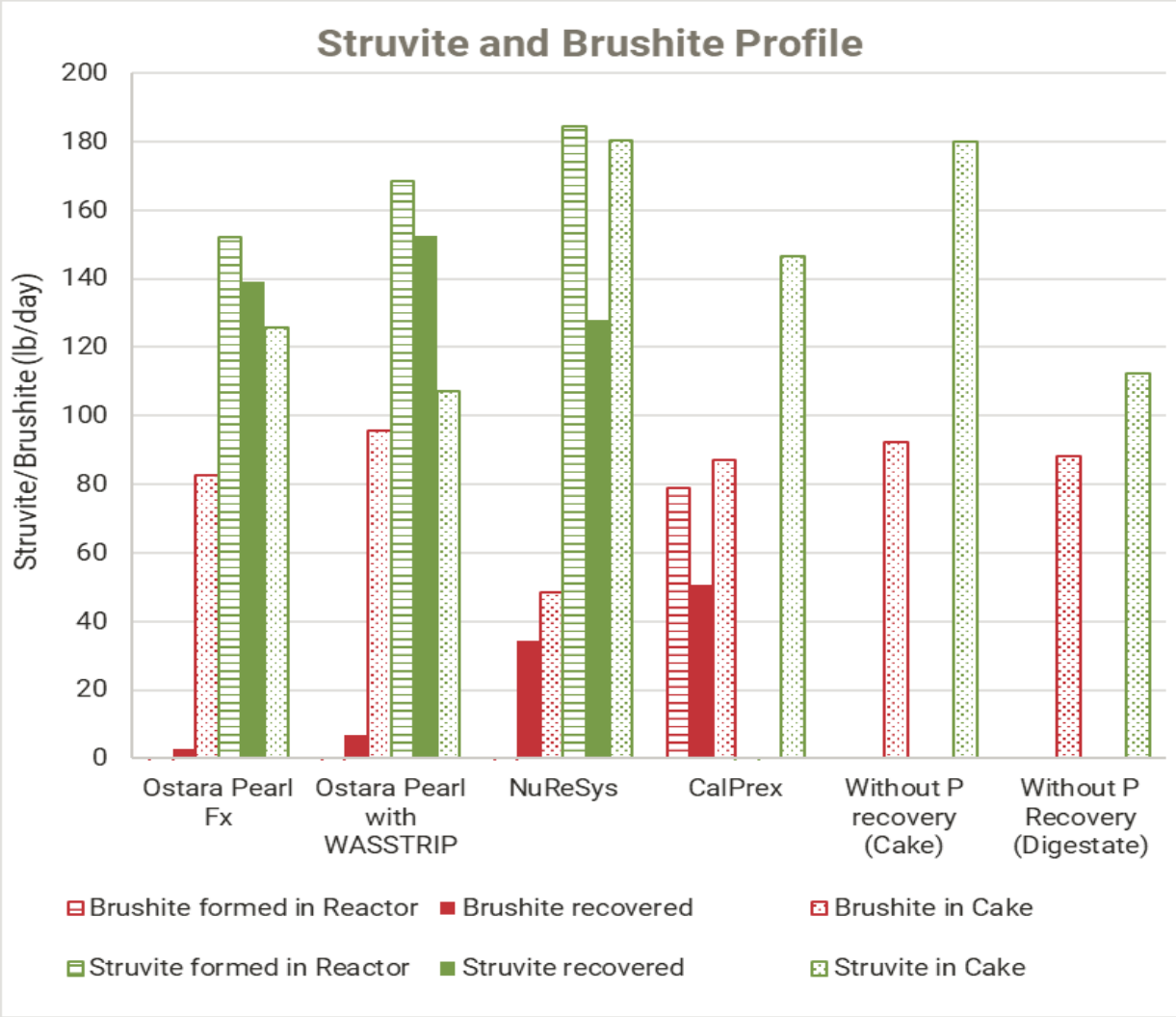
- Modeled the four selected technologies:
  1. Pearl Fx™ by Ostara
  2. Pearl® with WASSTRIP by Ostara
  3. NuReSys by Schwing Bioset
  4. CalPrex™ by CNP/Centrisys

Result of the Modeling

- Phosphorus recovery benefits from:
  - Biological Phosphorus removal in the liquid treatment process.
  - Anaerobic digestion, which allows phosphorus release without significant chemical addition.
  - As a result, we will focus on the data generated for The Clearwater WRF (Bio P and AD).

P-Recovery – Clearwater NE

- Ostara Pearl with WASSTRIP had the highest struvite recovery (153 dlb/day struvite).
- Reduction in Total Phosphorus (TP) concentration:
  - Ostara Pearl with WASSTRIP reduced cake TP by 30%.
  - Ostara Pearl Fx reduced cake TP by 25%.
  - NuReSys reduced cake TP by 24%.
  - CalPrex reduced cake TP by 23%.

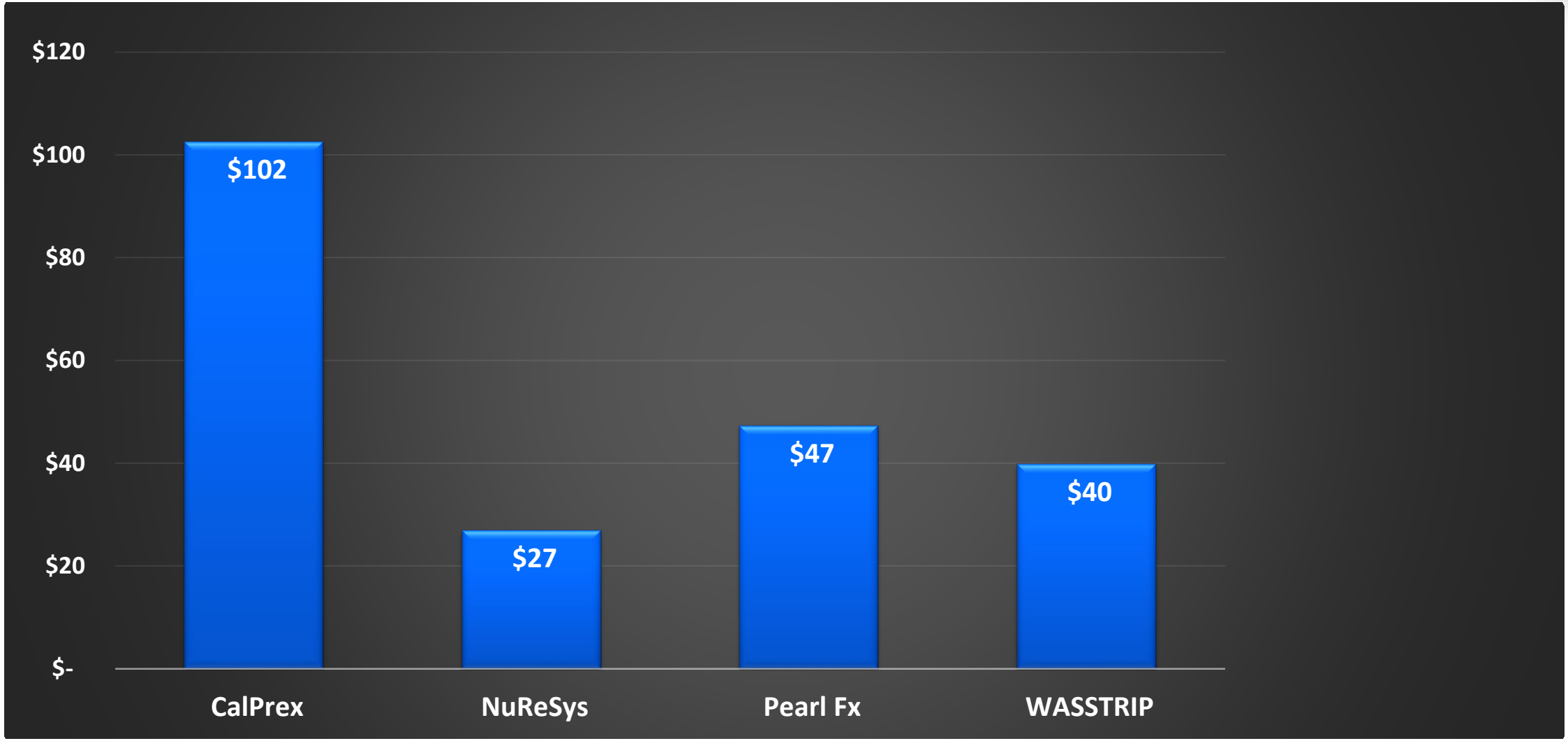


Cost per pound of TP Recovered

- Phosphorus recovery costs include:
  - Include the capital cost and operating costs of the recovery units only.

- Phosphorus recovery costs do not include:
  - Cost of Biological Phosphorus removal in the liquid treatment process.
  - Cost of anaerobic digestion.
  - Cost of land application programs.

Life Cycle Analysis:
Cost per pound of TP Recovered ($/lb TP Recovered)



Recommendations

Phosphorus-Recovery Recommendations

- Phosphorus-recovery may be a viable technology for WRFs with Bio-P and anaerobic digestion.
  - There are 17 WRFs with Bio-P and Anaerobic Digestion in Florida.
  - These 17 WRFs represent ~570 MGD out of the 2,600 MGD permitted capacity in the state, 22 percent.

- *If funding is available through the FDEP, piloting one or more of the selected technologies could help the understanding the feasibility and efficiency of these technologies.*

Class AA Recommendations

- There are advantages associated with Class AA Products.
  - Composting and thermal drying are attractive technologies for regionalization.
  - Composting can be a viable alternative for all WRF solids.
  - Increasing the solids concentration of the product reduces the amount of Phosphorus that is immediately available to crops or runoff.

- *It is recommended that FDEP include public / private partnerships when considering funding support for Class AA programs.*

Best Management Practices

Compliance with regulations and other BMPs helps to control runoff and prevent the nutrients in the biosolids or other fertilizer products from reaching surface waters.

- Buffer zones, or setbacks, are important to limit the runoff where biosolids are land applied.
- Sites that have shallow groundwater should be avoided when applying biosolids since those present a greater potential for groundwater contamination.
- *It is recommended that a Stakeholder Engagement Program be developed.*

Acknowledgments

Acknowledgements

- SJRWMD for their expertise, support and efforts with this project, outreach in the state and the data provided.
- FDEP for the financial support of this and other water quality-related projects.
- Clearwater Northeast Reclamation Facility
- Winter Garden Reclamation Facility

Thank you