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Biological Phosphorus Removal Made Easy: Energy-Saving Aeration and Mixing-Upgrade Pays Quick Dividends

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VILLAGE OF VALDERS, WISCONSIN WASTEWATER TREATMENT PLANT

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INTRODUCTION

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INTRODUCTION
Valders Plant Profile

Conventional Activated Sludge

2 Sanitaire Package Plants (Mark IV)

Design Flow: 0.255 MGD

Peak Flow: 0.536 MGD

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INTRODUCTION
Valders WWTP Profile

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INTRODUCTION

Goals:

Energy-saving, process-enhancing upgrades

Minor Upgrade to Valders WWTP

- From:
  - Conventional Activated Sludge
- To:
  - Simultaneous Nitrification-Denitrification (SNDN)

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Goals

1. To begin removing both phosphorus and nitrogen biologically.
2. To avoid or minimize the need for chemicals for phosphorus removal.
3. To pay for the upgrades via reduced energy consumption by mixing with low-energy submersible propeller mixers instead of higher-energy conventional mechanical aeration.
4. To reduce maintenance by mixing with lower-energy submersible propeller mixers instead of using higher-energy air and blower-power for mixing.

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METHODOLOGY

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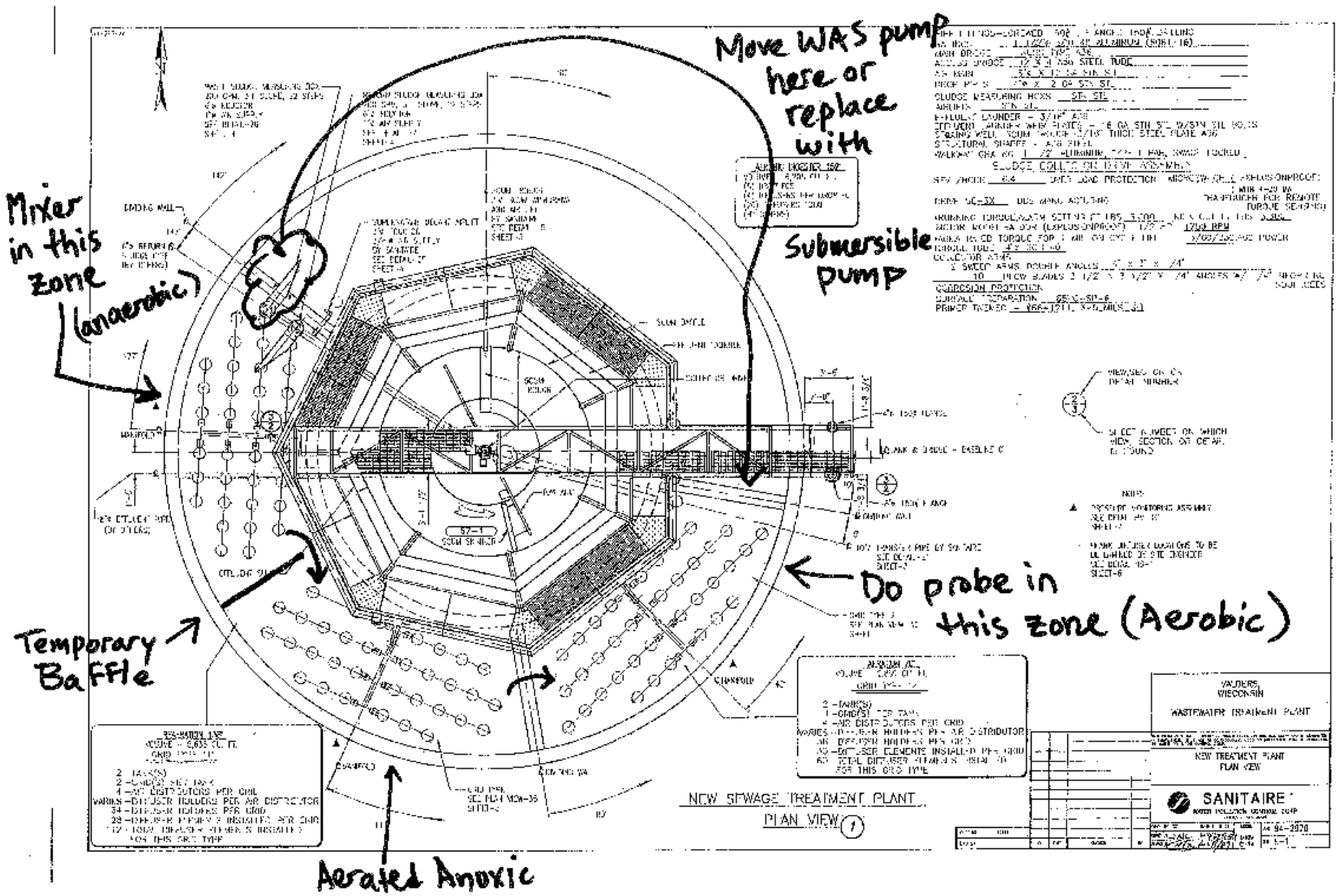
METHODOLOGY



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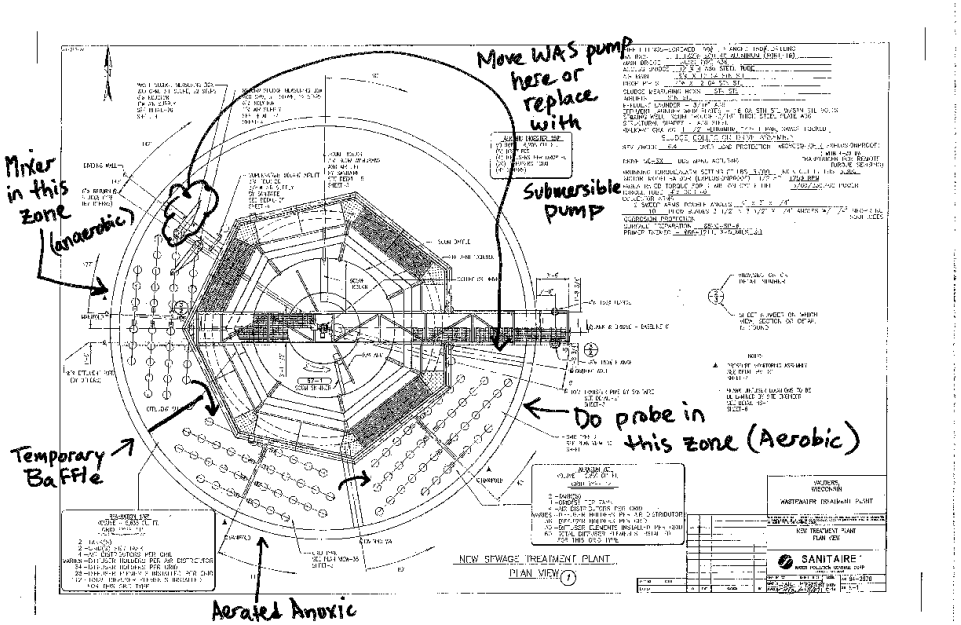
METHODOLOGY

The existing conventional 2-zone aeration basin was sub-divided and re-purposed into 3 zones:

- 1) Anaerobic
- 2) Aerated-Anoxic
- 3) Oxic/Aerated zones

This arrangement, also known as A3O or SNDN, creates conditions for both phosphorus-removal and nitrogen-removal.



Divider wall added

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METHODOLOGY

A baffle-wall was added to subdivide one zone into two, for a total of three biological treatment zones.

Divider wall added

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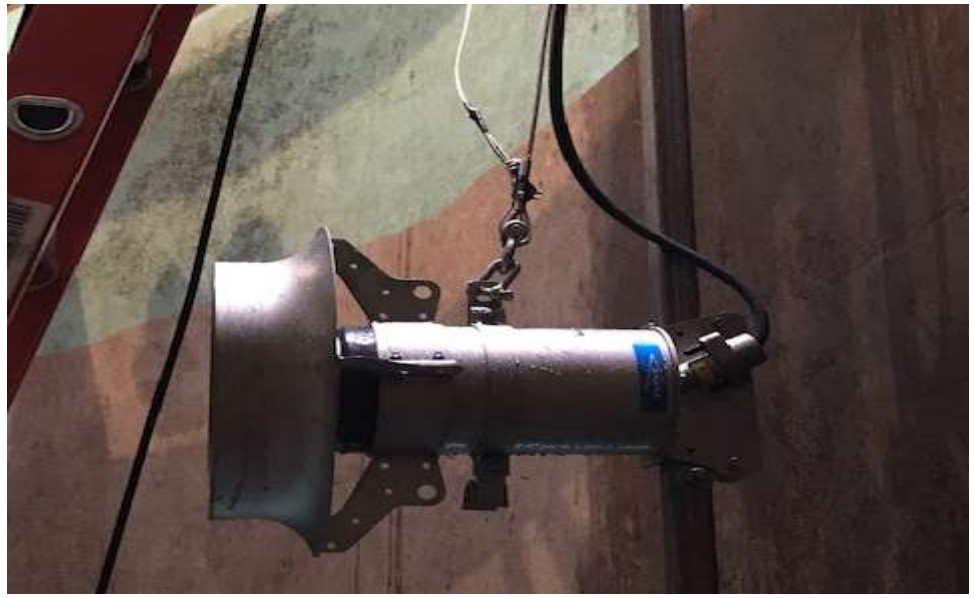
METHODOLOGY

The first zone, Anaerobic, we equipped with a high-efficiency submersible horizontal low-speed adjustable-thrust propeller mixer.

This enables good mixing without aeration, yielding anaerobic conditions favorable for phosphorus release and later phosphorus uptake.

Diffuser blanks were added to each grid in each zone to decrease air and continue using the existing aeration grids.



METHODOLOGY

The second zone (Aerated-Anoxic) has the flexibility of aerating when needed to balance and provide anoxic conditions.

This balance is needed to enable conditions favorable for simultaneous nitrification-denitrification.

METHODOLOGY

The third zone, Oxic-Aerated, is fully aerated, enabling phosphorus uptake and ammonia removal.

The existing fine bubble aeration membranes were replaced and blanks were added.

Aeration is turned down and will be cycled on and off manually to create and balance anaerobic, anoxic and aerated conditions.

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RESULTS

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RESULTS

1. Treatment results: Total Phosphorus was reduced from about 2.3 ppm to below 1.0 ppm.

2. Energy savings: $2,000 annually due to high-efficiency submersible horizontal low-speed adjustable-thrust propeller mixer using less electrical power than previously used by the fine bubble aeration system. With an estimated $2,000 future annual savings, the investment is estimated to pay for itself in 6 years.

3. Maintenance cost reduction: One 2.5 horsepower mixer with adjustable speed is expected to be less costly to service and maintain vs approximately 8 times the blower power needed for mixing before.

Total P reduced from 2.3 ppm to 1.0 ppm

caption

$2000 annual savings

caption

2.5 HP vs. 10 HP

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DISCUSSION

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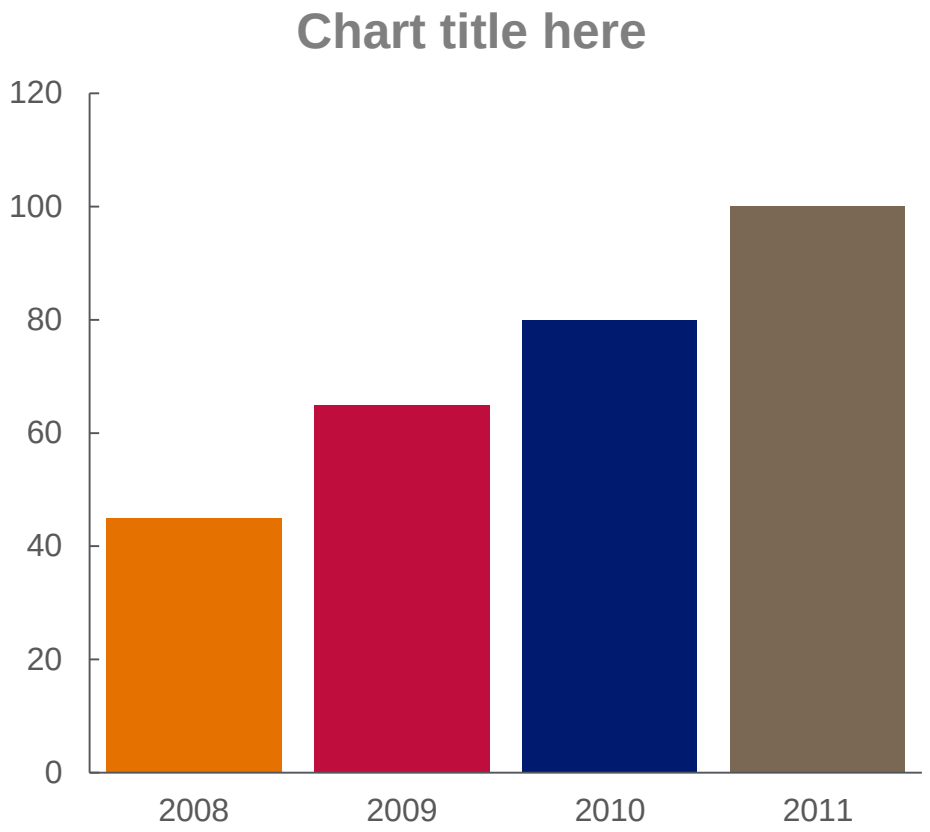
DISCUSSION

The results are impressive considering the simplicity of the changes made. The village expected the upgrades to work, but were pleasantly surprised that the phosphorus removal and energy savings were better than expected. Both Plants 1 & 2 were upgraded. In addition, the good results should lead to control and automation to optimize for even better phosphorous and nitrogen removal and more energy savings. Further low-cost upgrades like adding air valves and blower controls could generate additional improvements.



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5 CONCLUSIONS

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CONCLUSIONS

Biological phosphorus removal was better than expected. Reducing phosphorus down from 2.3 ppm to less than 1 ppm by simply adding only a mixer, a baffle-wall, new membrane diffusers, blanks, aeration system maintenance and manual air-control were low cost measures providing good results. In addition, paying for the changes with the energy savings in 6 years makes a strong case to share this practice with others.