Downers Grove Sanitary District

Wastewater Treatment Center

Nutrient Study

Nick Menninga, P.E., BCEE
Derek Wold, P.E., BCEE
Amanda Poole, P.E.

January 23, 2014

BAXTER & WOODMAN Consulting Engineers

OUTLINE

Downers Grove Sanitary District

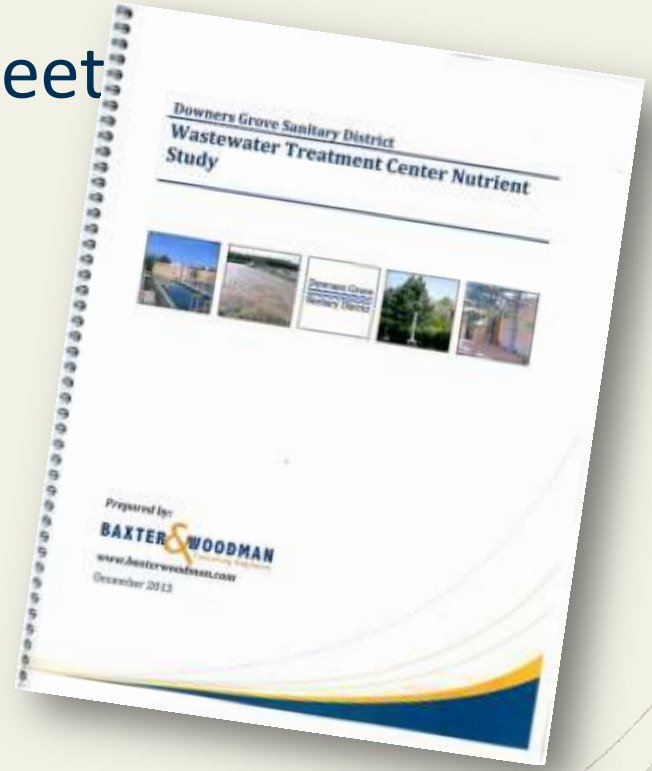
- ✓ Background
- ✓ Study Purpose and Scope
- ✓ Chemical Phosphorus Removal
- ✓ Biological Phosphorus Removal
  - Computer Model of Plant Process
  - A/O Process Evaluation
- ✓ Recommendations
- ✓ Future Considerations

BACKGROUND: DRAFT NPDES CONDITION

- NDPES permit is currently expired
- Draft NPDES Permit Special Condition
  - *Maintain membership with DRSCW*
  - *Phosphorus feasibility study*
    - *Improvements to meet 1.0 mg/L TP*
    - *Interim measures to reduce TP*

SCOPE OF WORK

- ✓ Goal: satisfy NPDES Condition
- ✓ Evaluate improvements to meet a TP Limit of 1 mg/L
  - Interim
  - Permanent
- ✓ Phosphorus Removal Only
- ✓ Excess Flow Not Evaluated

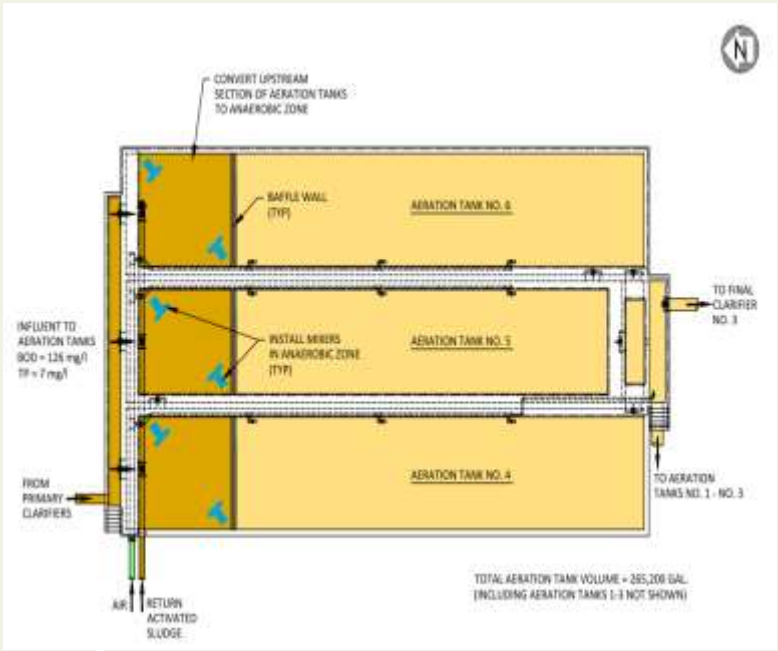


Background: DGSD overview

- 11/22 MGD average/peak full treatment capacity
- Primary clarification
- Single-stage nitrification
- Tertiary sand filtration
- Anaerobic digestion
- Sludge dewatering and aging
- Excess flow primary and disinfection to 110 MGD total

OPTIONS FOR TOTAL PHOSPHORUS REMOVAL

Two options for phosphorus removal:



Chemical

Biological

BAXTER & WOODMAN Consulting Engineers

CHEMICAL PHOSPHORUS REMOVAL

Chemical Precipitation of Phosphorus

- Advantages – simple process
- Disadvantages – costly operation, less sustainable
- Capital Costs: $500,000
- Annual O&M Costs: $540,000 total
  - $415,000 chemicals
  - $125,000 sludge

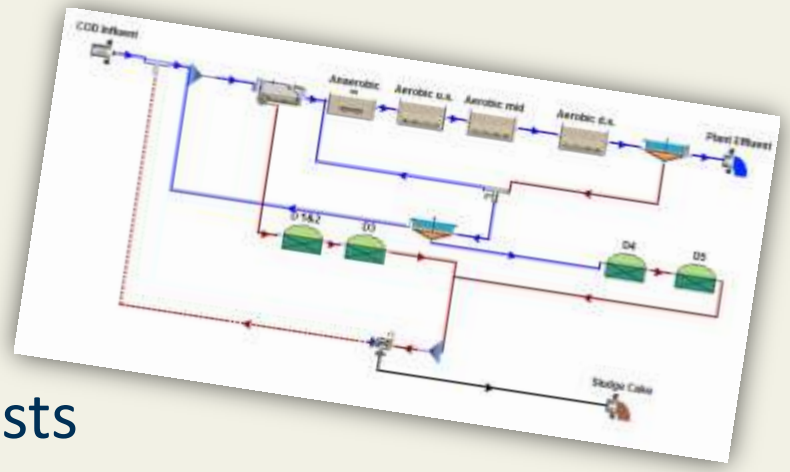
BIOLOGICAL PHOSPHORUS REMOVAL

Biological Nutrient Removal

- Advantages – Lower O&M costs, more sustainable
- Disadvantages – Less reliable, still under development
- Costs – Depend on design goals.
  - *Interim project in existing footprint: $500,000 capital, $10,000 annual O&M*
  - *1 mg/l limit, $3 million capital, $20,000 annual O&M. Could be lower with on-site R&D.*

BIOLOGICAL PHOSPHORUS REMOVAL

Challenge: How to control the cost of EBPR?



- Biowin Model
- Substrate availability of VFAs
- Minimize capital and O&M costs
- Goal: determine optimum combination of biological and/or chemical addition
- Capacity and nitrification issues

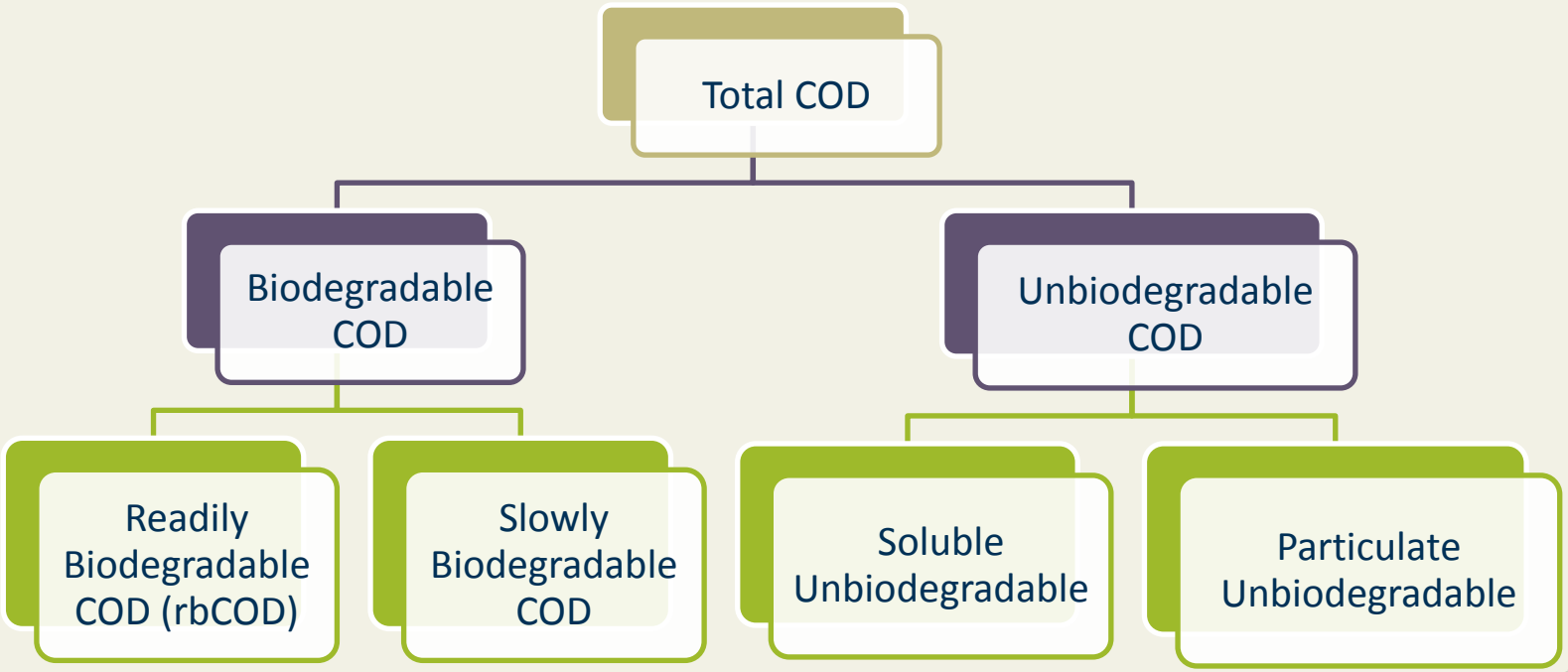
BIOLOGICAL PHOSPHORUS REMOVAL

Biowin Model

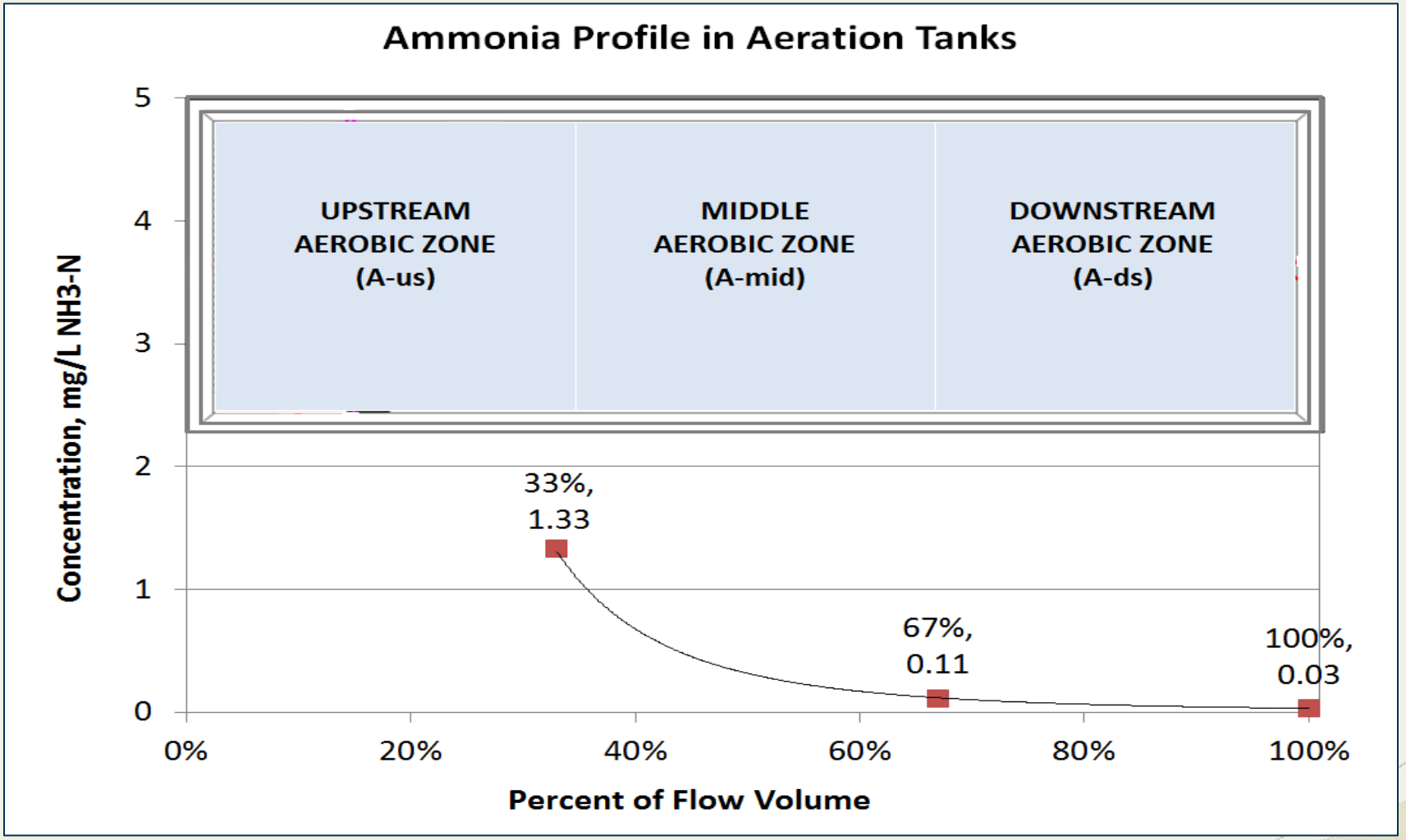
- Establish a baseline of existing operation
  - Collect data
  - Calibrate model
  - Verify model
- Model EBPR Scenarios
  - A/O Selected from several options

BIOLOGICAL PHOSPHORUS REMOVAL

rbCOD Sampling



BASELINE MODEL RESULTS

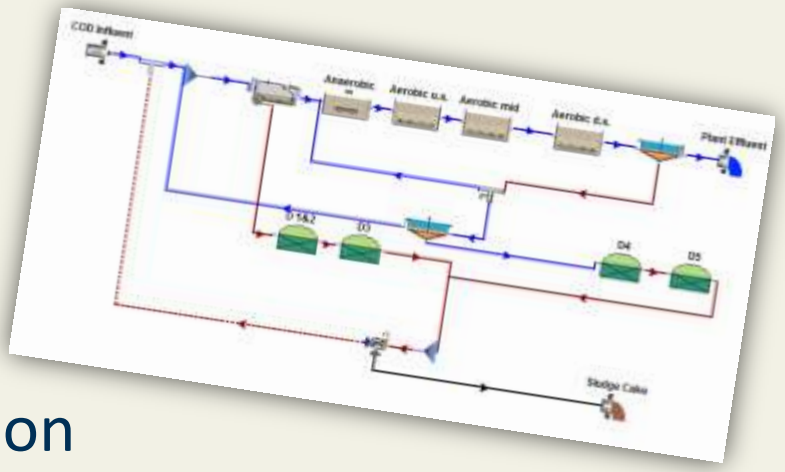


BAXTER & WOODMAN Consulting Engineers

BIOLOGICAL PHOSPHORUS REMOVAL

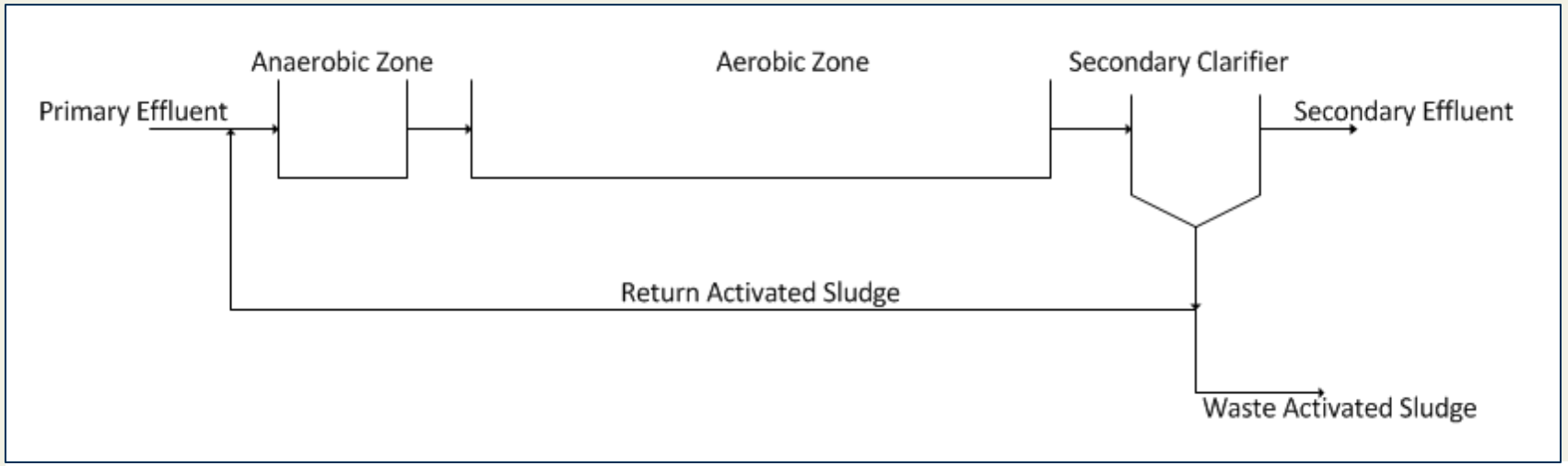
A/O Process

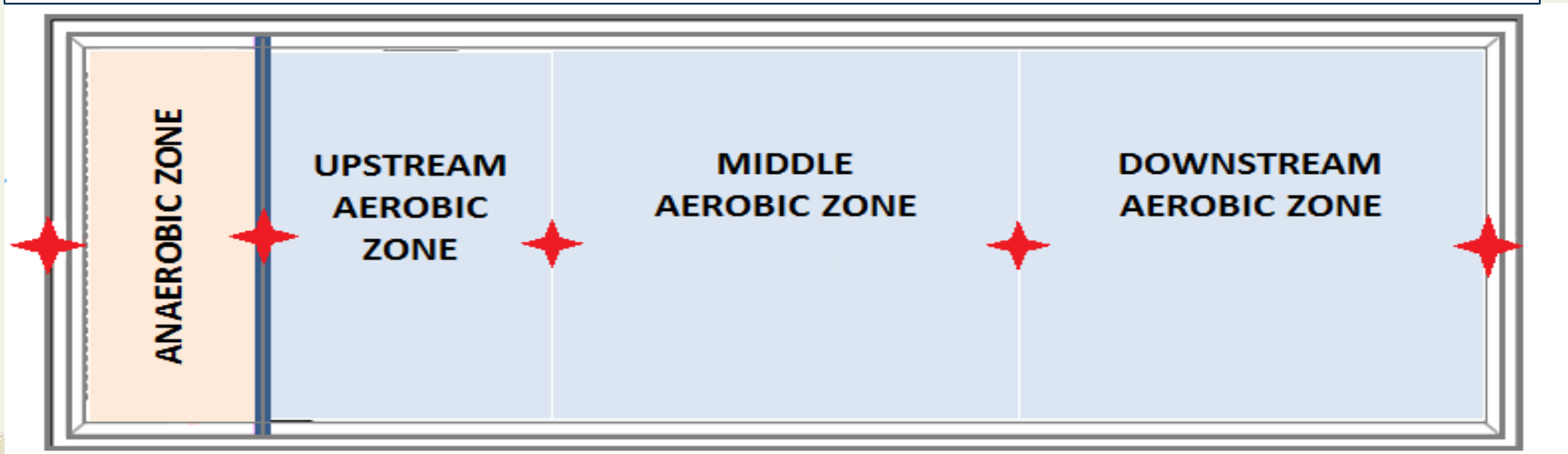
- Define
- Simplest BioP Process
- Effective for TP
- Maximizes space for nitrification
- Can be used as a swing zone in the future



BIOLOGICAL PHOSPHORUS REMOVAL:

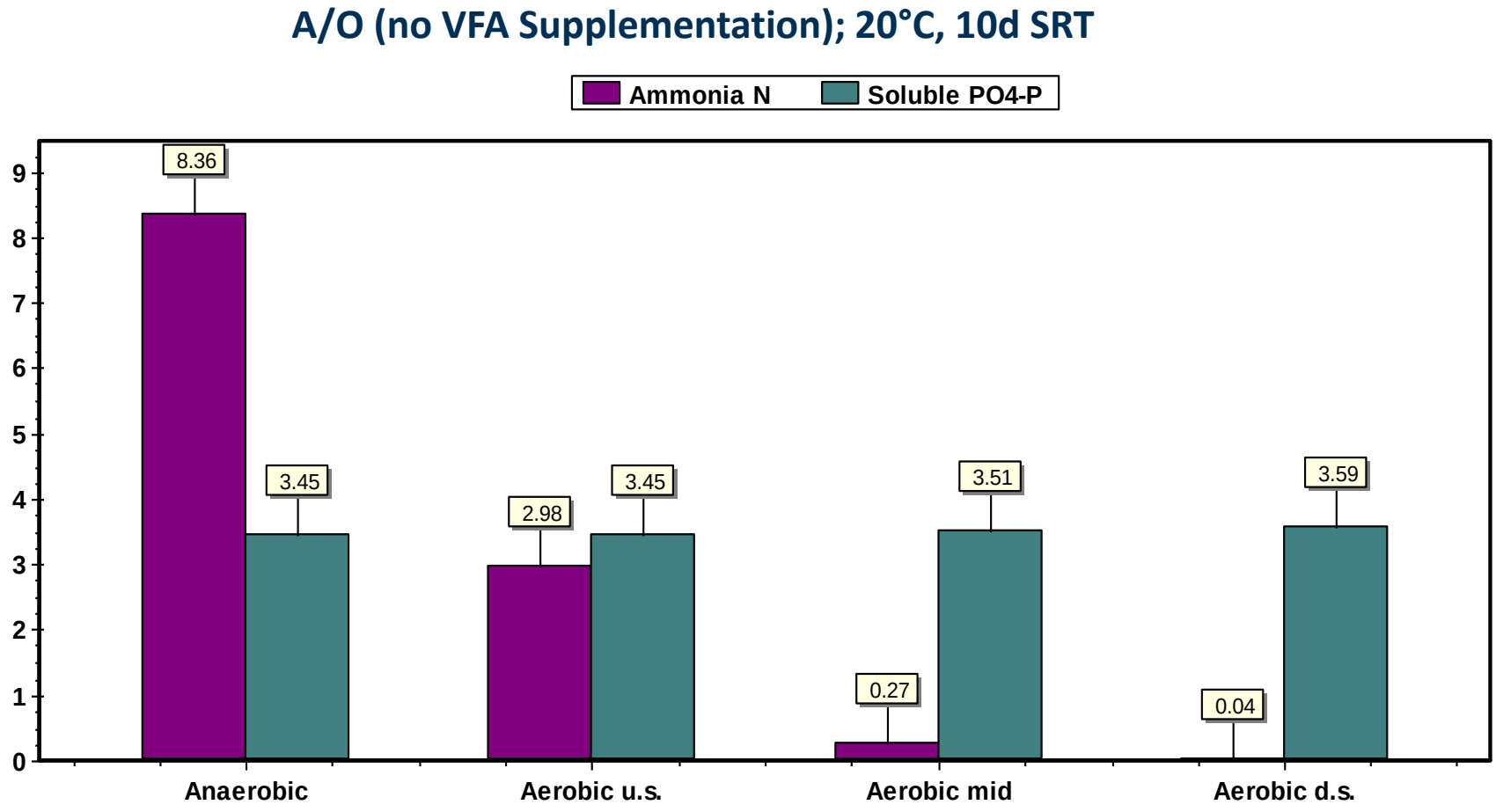
A/O PROCESS





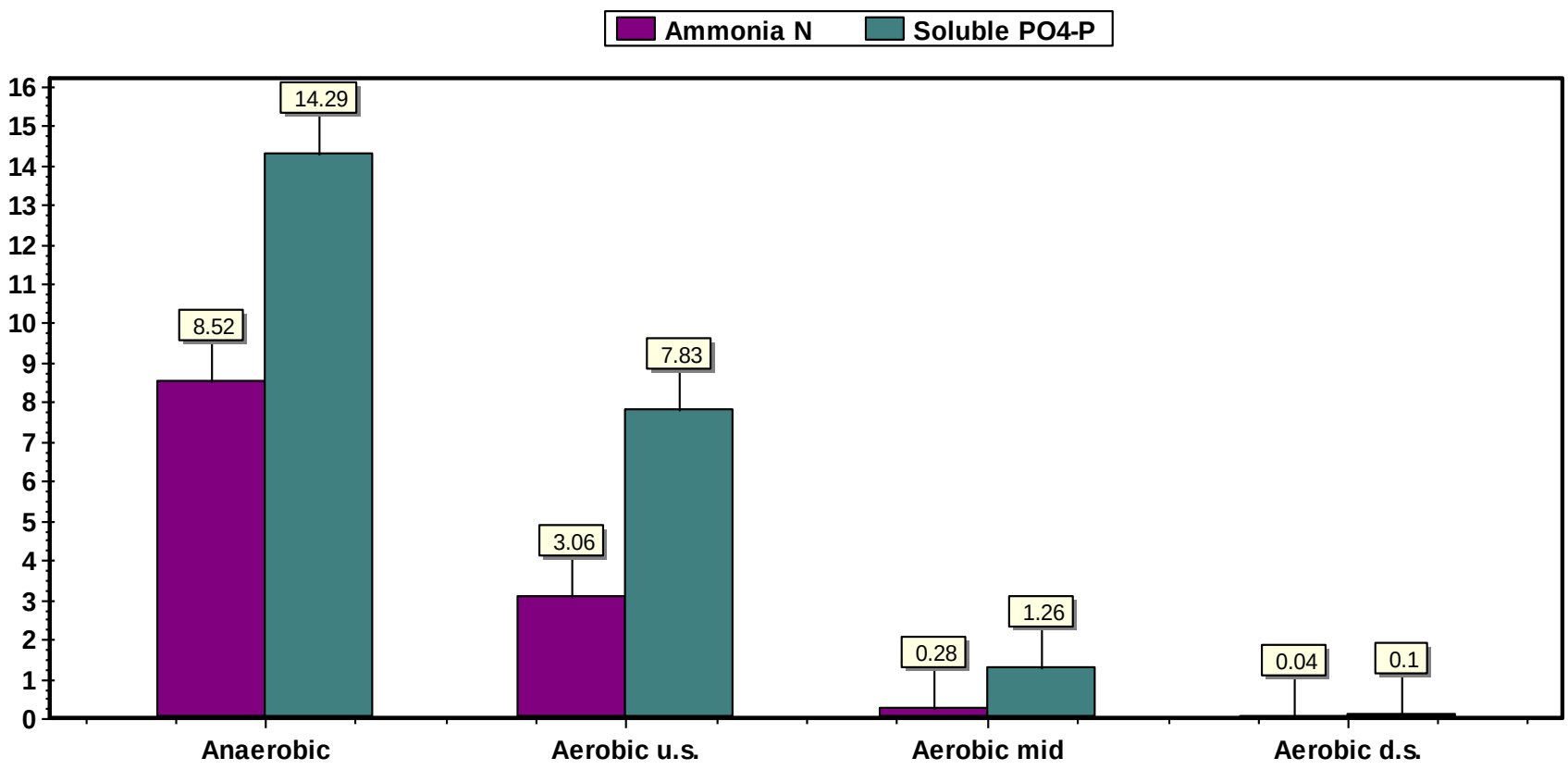
BIOLOGICAL PHOSPHORUS REMOVAL:

A/O PROCESS



BIOLOGICAL PHOSPHORUS REMOVAL:

A/O PROCESS



Modeling Results

- Model Performance

Process	A/O	A2/O
TP	< 0.45 mg/L	< 0.5 mg/L
TN	< 11 mg/L	< 7 mg/L
NH_3-N	< 0.5 mg/L	< 2 mg/L

BIOLOGICAL PHOSPHORUS REMOVAL

VFA Supplementation Options:

- Carbon Addition
- Primary Sludge Fermentation

RECOMMENDATIONS

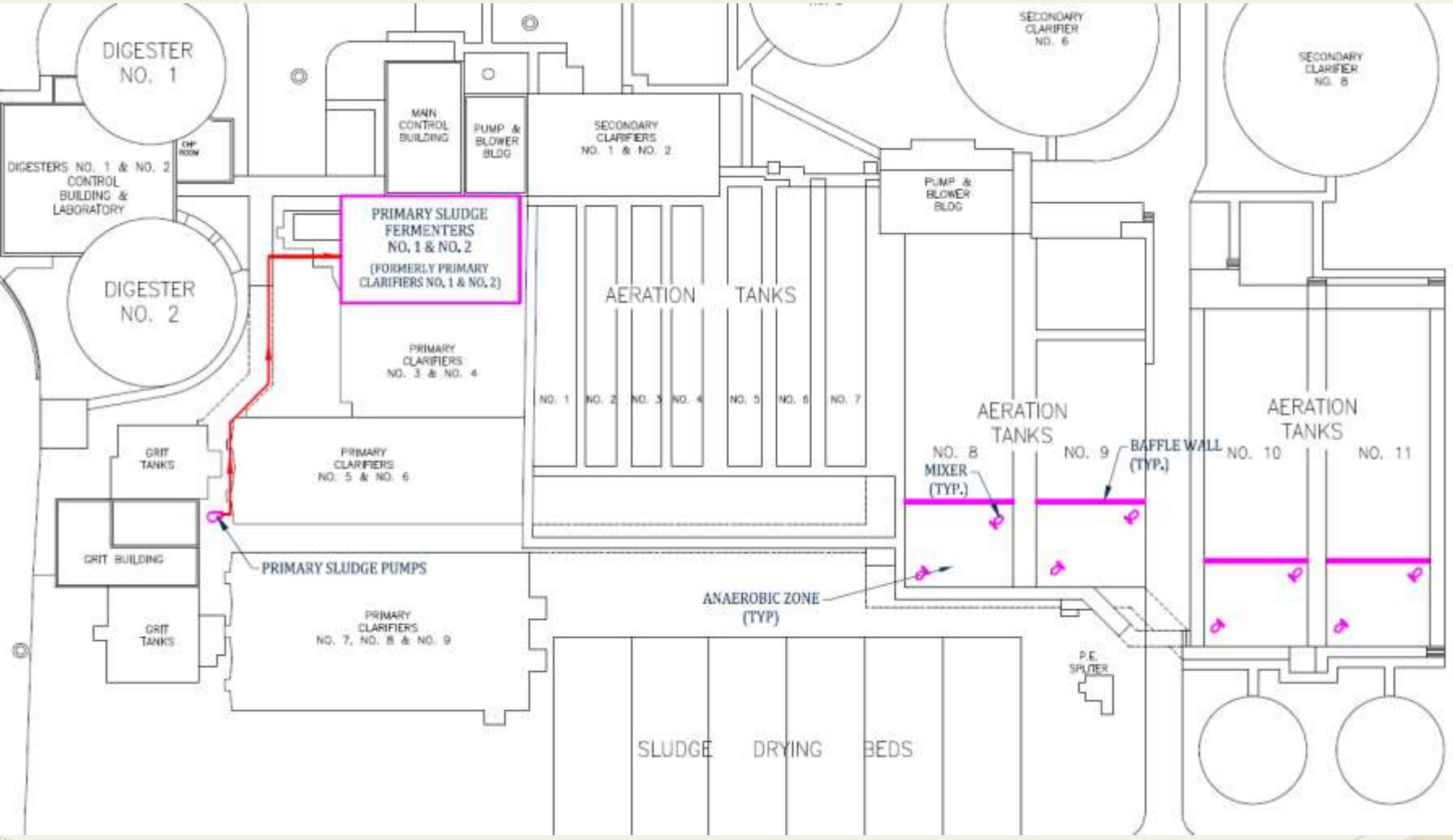
Part / Scope	Costs	
	Capital*	Annual
Phase 0: Primary Sludge Fermentation Trial	-	-
Phase 1: Convert to an A/O Process	$593,000	$10,750
Phase 2: Convert Primary Clarifiers No. 1 & 2 to Primary Sludge Fermenters	$1.84 million	$8,900**
Phase 3: Backup Chemical Feed System	$575,000	N/A
Total	**$3.01 million**	**$19,650**

NEEDED TO MEET 1 MG/L?

* Capital costs include engineering and a 10% contingency.

** The costs for Phase 2 assume sufficient VFAs are produced for EBPR to meet an effluent phosphorus concentration of 1mg/L. Otherwise, the District should re-evaluate chemical polishing versus dedicated primary sludge fermentation tanks.

RECOMMENDATIONS: Phase 1 and 2



BAXTER & WOODMAN Consulting Engineers

FUTURE CONSIDERATIONS

If primary sludge fermentation does not produce sufficient VFAs

- Re-evaluate the cost-effectiveness of
  - VFA addition with Primary Sludge Fermentation
  - Chemical Phosphorus Removal
    - Polishing and Full Treatment
- Struvite Harvesting

QUESTIONS

Nick Menninga, P.E.
nmenninga@dgsd.org

Derek J. Wold, P.E.
dwold@baxterwoodman.com