Comprehensive Wastewater Treatment Plant (WWTP) Assessment and Evaluation

Board of Selectman Meeting

June 15, 2021

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WRIGHT-PIERCE
Engineering a Better Environment

Project Scope of Services

- Conduct assessment of existing infrastructure
- Evaluate the condition, age, useful life, and efficiency of each unit process
- Develop recommended solutions to meet WWTP's 20-year needs
  - Existing processes
  - Future nitrogen and phosphorus limits
- Estimate capital, O&M, and 20-year life-cycle costs

Plant History

Original WWTP

Current WWTP

- Went online in 1964
- Upgrade completed in 1982
- Operations Building refurbishment in 2000
- Only a few minor equipment replacements since

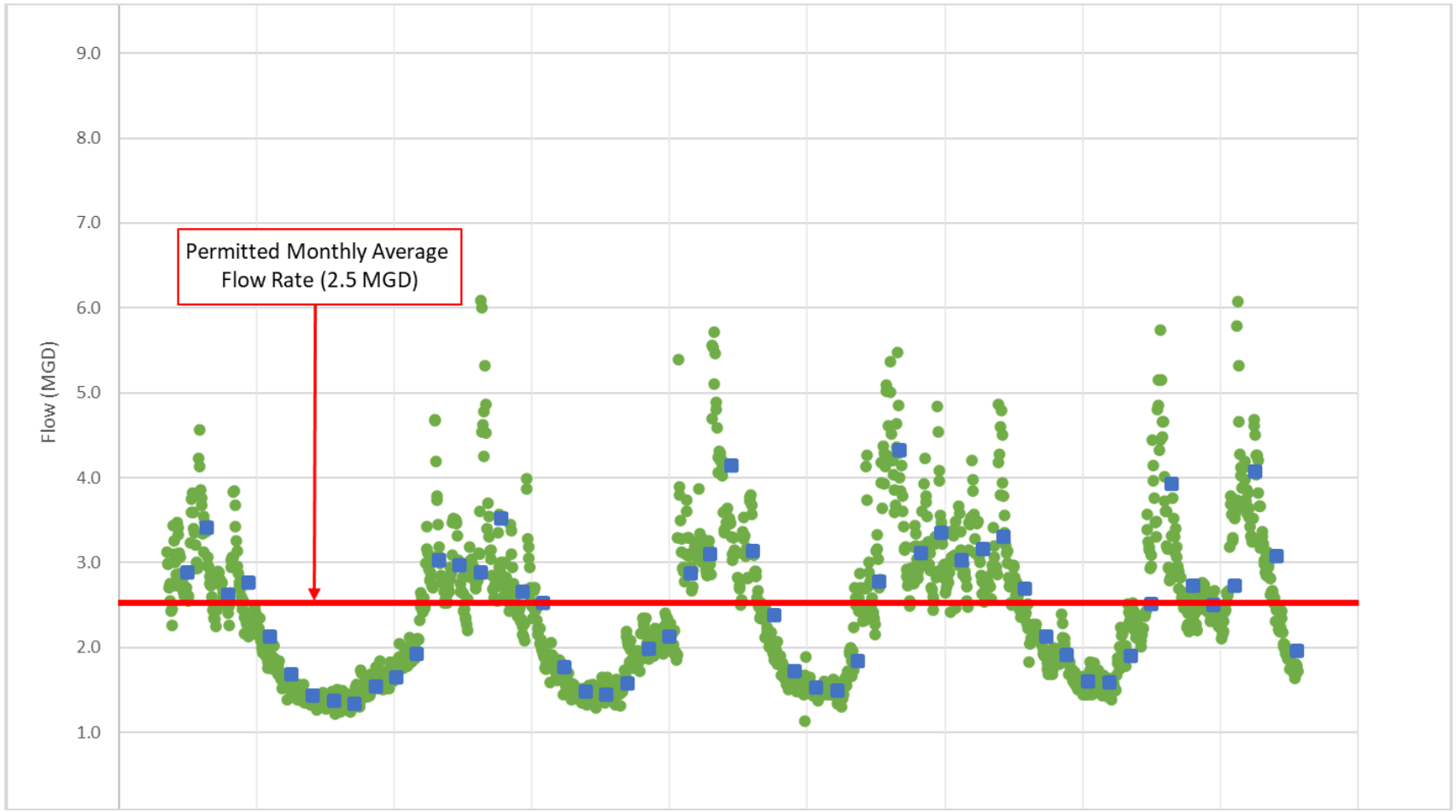
Key Driver – NPDES Permit Limits

- **Effluent Flow Limit**
- **Future Nitrogen Limit**
- **Pending Low Level Phosphorous Limit**

Effluent Characteristic Parameter	Current Monthly Average	Anticipated Future Monthly Average	Comments
Flow Limit	2.5 MGD	2.5 MGD	DEP/EPA not likely to permit flow increase
Ammonia Nitrogen October 1 – March 31 April 1 – May 31 June 1 – September 30	 3.3 mg/l 2.5 mg/l 1.0 mg/l	 3.3 mg/l 2.5 mg/l 1.0 mg/l	
Total Nitrogen	None	8.0 mg/l (report lbs./day)	Timing of New Limit? Seasonal vs Year-Round Future Limit?
Phosphorus Total April 1 – October 31 November 1 – March 31	 0.2 mg/l (report lbs./day) 1.0 mg/l (report lbs./day)	0.1 mg/l (report lbs./day)	Timing of New Limit? Represents "Limit of Technology"

Influent Flow Rate

Rockland WWTP Influent Flow Rate



- **Permitted Flow Rate**
  - **2.5 MGD (monthly average)**
  - **Not likely to be increased**
- **Monthly reported flow rate values (blue squares) greater than 2.5 MGD (red line) represent a violation of the current NPDES permit**

Existing Infrastructure Assessment

- Last upgrade was 1977-1982
- Current age of most equipment is 40 years
  - Some critical items recently replaced by Suez
- Most equipment has a 25-year service life
- Critical items
  - Electrical infrastructure
  - Mechanical aerators

Typical Equipment Service Life Summary

Equipment Description	Service Life (Years)
Air Relief Valve	10
Blower	25
Clarifier Bridge	30
Chemical Feed System	10
Concrete Structure, Building, Basin, Drywell/Wetwell	60
Drive Mechanism	20
Electrical Equipment	30
Electric Panel	25
Electrical System	25
Generator	35
Grounds	300
Heating, Ventilating, and Air Conditioning	15
Instrumentation and Controls	10
Lab and Kitchen Equipment	20
Maintenance/Tools	10
Motor	20
Office Equipment	20
Odor Control System	15
Process Equipment	20
Piping	50
Pumps	20
Safety Equipment/Gear	10
Slide Gate	30
Tank	25
Transformer, Transfer Switch	25
Valve - All	25
VFD, Motor Starter	20
Vehicle	10

Influent Screening and Primary Clarification

Activated Sludge System and Mechanical Aerators

Nitrification Settling Tanks and Anaerobic Digester Cover

Dewatering Equipment and Standby Power Generator

Evaluation of Existing Infrastructure

Key Findings

- Other than some new rotating equipment (i.e., pumps), about 95% of all equipment is well past its life expectancy. Includes process, electrical, plumbing and HVAC systems.
  - If some of the critical items fail at the plant, it could be catastrophic (inability to get parts given their age). This includes the electrical systems and aeration equipment/systems.
  - Water intrusion into existing electrical systems/ductbanks, corrosive atmosphere, and code compliance
  - Poor condition of HVAC and architectural systems could accelerate failure
- Significant structural cracking throughout the plant, in particular the nitrification tanks, secondary settling tanks, and pumping galleries
- Code related issues - NEC and NFPA

Analysis of "Near Term Flows and Loads"

APPROVED, PENDING AND FUTURE SEWER BUILDOUT

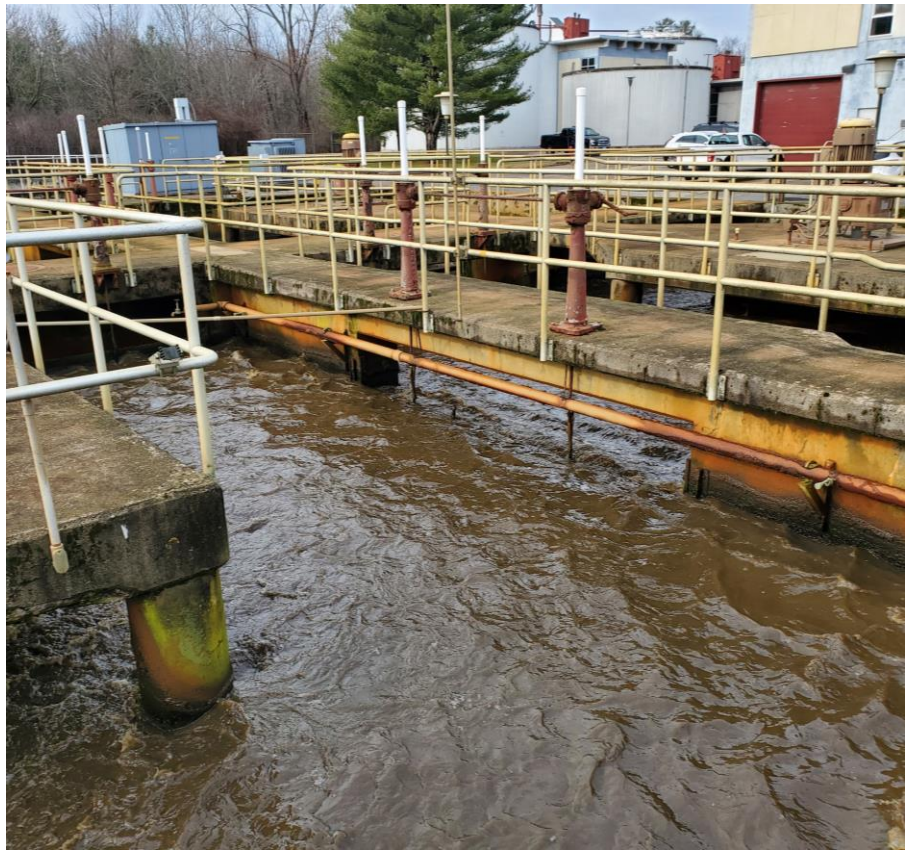
FLOWS AND LOADS

Parameter	Flow		BOD_5			TSS		
	MGD	P.F.	mg/L	lbs/day	P.F.	mg/L	lbs/day	P.F.
Minimum Day		0.00		0	0.00		0	0.00
Title 5 Unit Flows	0.23	1.67	200	392	1.67	200	392	1.67
Annual Average	0.14	-	200	235	-	200	235	-
Maximum Month	0.19	1.35	200	317	1.35	200	317	1.35
Maximum Month Loading	0.19	1.35	200	317	1.35	200	317	1.35
Maximum Day (98th %)	0.28	2.00	200	470	2.00	200	470	1.20
Maximum Day (100th %)	0.28	2.00						

Parameter	Temperature		NH3-N			Total Phosphorus		
	C	P.F.	mg/L	lbs/day	P.F.	mg/L	lbs/day	P.F.
Minimum Day			0	0	0.00		0	0.00
Title 5 Unit Flows			26	52	1.67	7.00	14	1.67
Annual Average			26	31	-	7.00	8	-
Maximum Month			26	42	1.35	7.00	11	1.35
Maximum Month Loading								
Maximum Day (98th %)								
Maximum Day (100th %)								

- Can WWTP handle currently approved and pending sewer connections?
- The plant as originally designed can treat the additional flow and load
- The plant in its current condition should be considered well past its current life expectancy
  - An immediate upgrade is recommended to maintain successful treatment of current flows and loads
  - If an immediate upgrade is not completed, successful treatment of current or any additional flow will be severely compromised

Future Nitrogen and Phosphorus Permit Limits



Key Findings

- The existing plant, through equipment replacement, cannot achieve compliance with the anticipated future nitrogen and phosphorus limits
- Expansion of the activated sludge process is required for future nitrogen removal compliance
  - Approximately $4.0M in construction cost
- Installation of a new tertiary treatment process and chemical facilities is required to meet the pending total phosphorus limit
  - Approximately $7.0M in construction cost

Recommendations

- The Rockland WWTP is in need of an immediate upgrade to address aging infrastructure, equipment, and pending/future permit limits
- Majority of the equipment was installed as part of the 1977 upgrade and is now 40 years old and well beyond the end of its useful life
- Most WWTPs undergo comprehensive upgrades every 25 years to address worn out, failed, and aging equipment and systems

Comprehensive WWTP Upgrade

- Comprehensive Upgrade
  - All improvements required over next 20 years
  - Existing equipment/infrastructure replacement
  - Nitrogen removal
  - Phosphorus removal
- Existing equipment/infrastructure needs to be addressed NOW

Total Project Cost Estimate – Comprehensive Upgrade

PROJECT COMPONENT		COST
CONSTRUCTION		$38,240,000
CONSTRUCTION CONTINGENCY	5.0%	$1,910,000
ENGINEERING SERVICES	20.0%	$7,648,000
MATERIALS TESTING	0.5%	$191,000
ASBESTOS & LEAD PAINT ABATEMENT		$0
DIRECT EQUIPMENT PURCHASE		$0
LAND ACQUISITION/ EASEMENTS		$0
LEGAL/ ADMINISTRATIVE	1.0%	$382,000
SUBTOTAL		**$48,371,000**
FINANCING	1.5%	$726,000
ENGINEER'S ESTIMATE OF PROJECT COST[2]		$49,100,000

- **Total Project Cost Estimate: $49M**
  - **Equipment/infrastructure: $35M**
  - **Nitrogen removal: $5.0M**
  - **Phosphorus removal: $9.0M**
- **If Town desires to refurbish anaerobic digestion process**
  - **Add $3.0M to $5.0M to total project cost estimate**

What's Next?

- Annual I/I mitigation
- Comprehensive Wastewater Management Plan (CWMP)
  - July 2021 start
  - 10-12-month duration
  - Satisfy requirement to acquire 0% DEP SRF loan for nutrient portion
- Pump station upgrades – 2021 start
- WWTP upgrade design services
  - July 2022 start
  - 18-month duration
- Construction of upgrades
  - April 2024 start
  - 24-month duration

MILESTONE	DATE
Completion of the WWTP Evaluation	Winter 2021
Town Appropriates CWMP Funding at Annual Town Meeting	May 2021
CWMP Development and Completion	July 2021 – June 2022
Town Appropriates Design Phase Funding at Annual Town Meeting	May 2022
Preliminary Design Phase Engineering Begins	July 2022
DEP SRF Loan Project Evaluation Form (PEF) Submitted	August 2022
Preliminary Design Report (30% design completion)	December 2022
Draft DEP SRF Loan Intended Use Plan (IUP) Notification	December, 2022
Final DEP SRF Loan IUP	January 2023
Final Design and Permitting Begins	January 2023
SRF Application Submission (90% Design completion)	By October 15, 2023
100% Design and Permitting Complete	December, 2023
DEP Issues Project Approval Certificate (PAC)	By December 31, 2023
Bidding	January 2024 - March 2024
Start Construction	April 2024
Substantial Completion of Construction	February - March 2026
Final Completion of Construction	April 2026
One-year Warranty Period	April 2027

Funding Opportunities

MASSACHUSETTS
CLEAN WATER TRUST

- MA Clean Water Trust (DEP) CWSRF loan program
  - Standard loan is ~2% interest
  - Nutrient reduction projects can qualify for 0% interest
  - Loan opportunities are becoming more competitive
  - Solicitations due every August
- American Rescue Plan Grants
  - COVID 19 relief funding
- American Jobs Plan
  - Job creation focused on infrastructure
- Others

THANK YOU

Recommendations – Current Maintenance Practices

- It should be noted that Suez has replaced various high priority pieces of equipment at the WWTP to maintain successful operation of the plant. While certainly beneficial and something that should be continued moving forward, these equipment replacements do not eliminate or delay the need for a comprehensive upgrade.

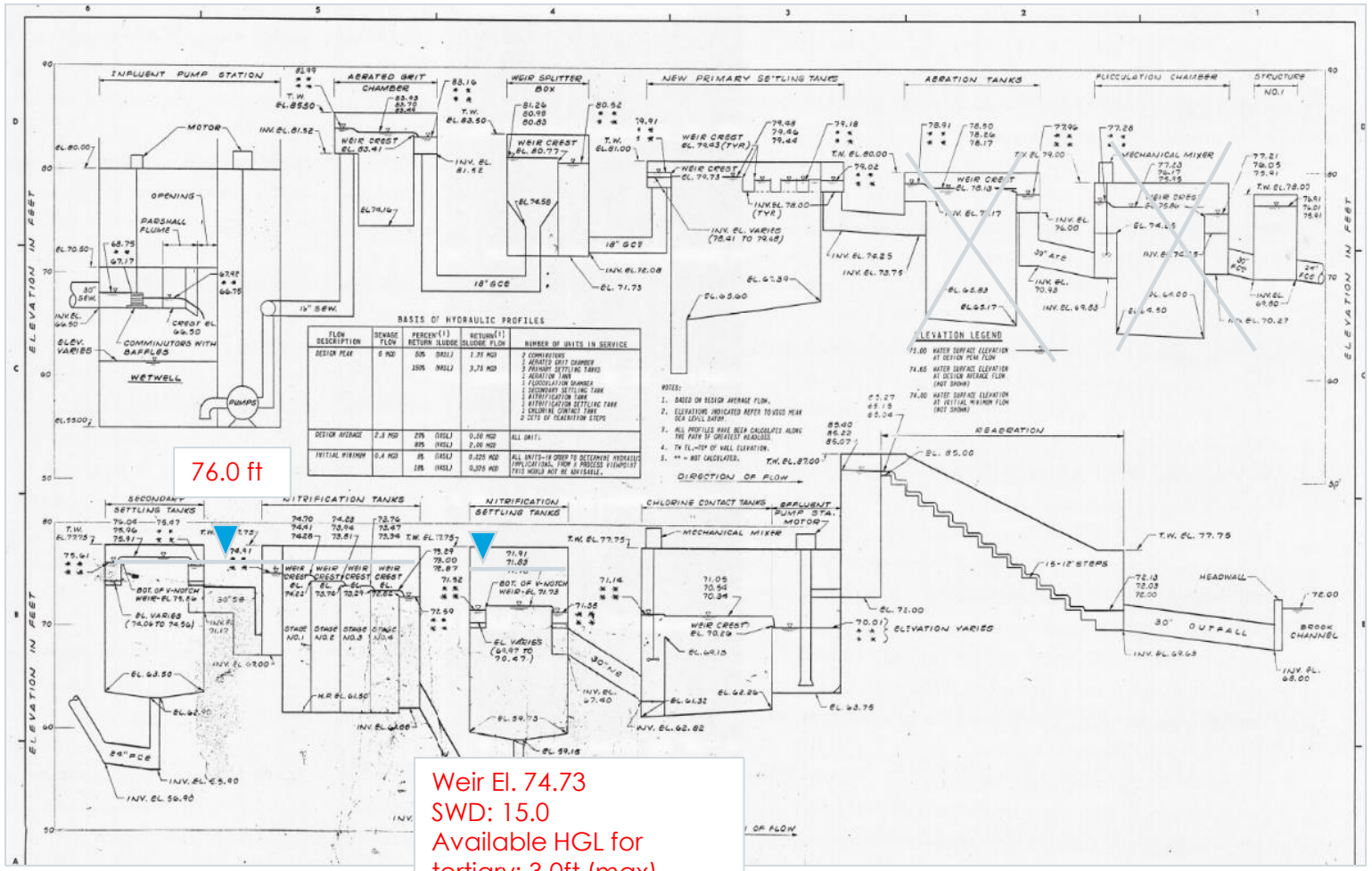
Consequences of Failure

- **The consequence of failure varies from unit process to unit process. However, there are numerous very high priority items that could have severe ramifications if failure occurred prior to an upgrade. This includes:**
  - **the influent pump station electrical system,**
  - **main electrical switchgear,**
  - **mechanical aerators,**
  - **RAS and sludge piping systems,**
  - **nitrification settling tank sludge removal mechanisms, and**
  - **various components within the anaerobic digestion complex.**

When will Failure Occur?

- Time frame is unknown
- Each passing day increases risk of a failure occurring
- Professional Engineering Judgment:
  - Replace equipment/processes ASAP
  - Risk of Failure increases as a function of time
  - Risk of failure does not increase as a function of influent flow (if kept within 5% of current)
    - Plant already in violation of NPDES effluent flow limit

Plant Hydraulics – desired approach



- Keep primary clarifier at same elevation
- Raise water level in aeration tanks and secondary clarifiers
  - Increase from 12 ft. SWD to 15 ft. (A.T. and S.C.)
- 3.0 ft. available for Tertiary Process
- Eliminate piping bottlenecks
- Eliminate need for offline storage

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Anaerobic Digestion (AD) plant

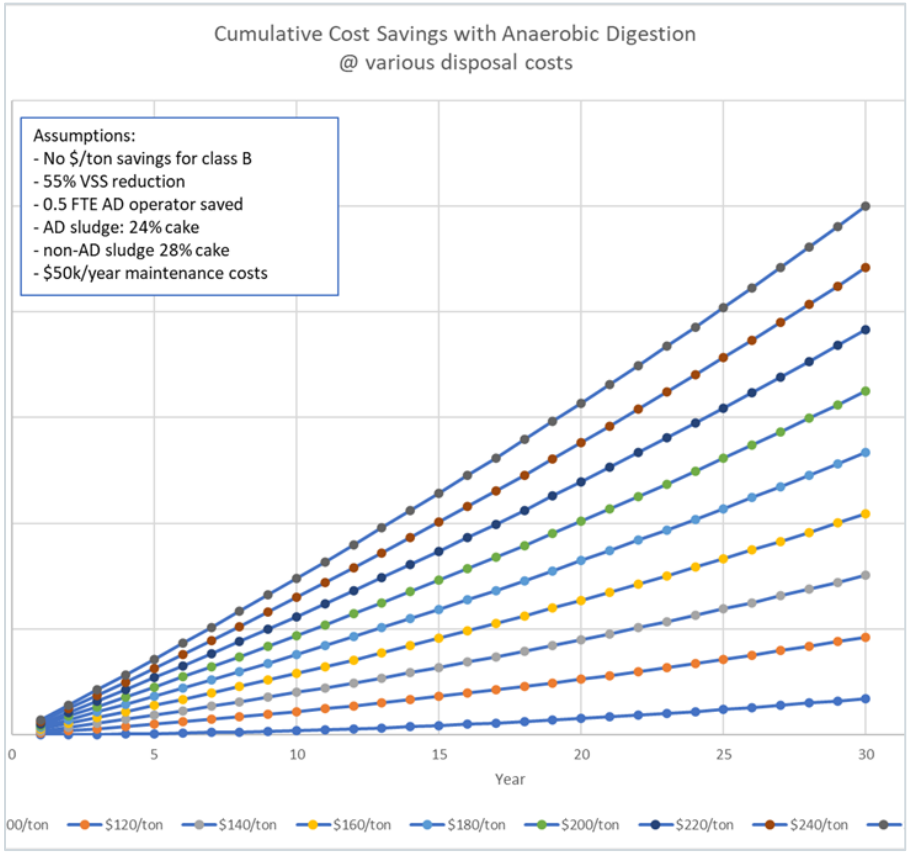
Brown and Caldwell 2018 Report

- Generally, agree with the improvements required
  - New covers, gas storage, pre-thickening step, piping, etc.
- Cost estimates are in the right ballpark

Issues

- High capital cost to make viable for long term
- High return of nitrogen loading
  - extra $ to reduce this TN loading
  - Post-AD treatment or expanded activated sludge process
- High return of phosphorus loading (extra chemistry required)

Anaerobic Digestion Cost Analysis



- **Capital cost: $6.7M**
- **Net Present Value (NPV)**
  - **How much money Rockland would save with anaerobic digestion process**
  - **$100/ton: $0.9M**
  - **$260/ton: $5.0 M**
- **Present Value (Capital cost + NPV)**
  - **$100/ton: -$3.5 M**
  - **$260/ton: $0.6 M**
- **Due to ongoing regional market volatility regarding the location and availability of sludge outlets, it is possible that a rapid increase in the sludge disposal costs to materialize in the very near future.**
- **It is recommended that further investigation be conducted at the onset of the preliminary design phase (mid 2022).**