VALUE ENGINEERING STUDY

OF

WARREN WASTEWATER TREATMENT

FACILITY UPGRADES

30% DESIGN

DRAFT REPORT

APRIL 2016

WRIGHT-PIERCE
Engineering a Better Environment

DRAFT

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WARREN WASTEWATER TREATMENT FACILITY UPGRADES

30% DESIGN

WARREN, RHODE ISLAND

APRIL 2016

PREPARED BY:

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WARREN WASTEWATER TREATMENT FACILITY UPGRADES

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EXECUTIVE SUMMARY

The Town of Warren, RI entered into a Consent Agreement (CA) with the Rhode Island Department of Environmental Management (DEM) to address flow and Total Nitrogen limits. The Consent Agreement requires that the Town submit Design Plans, Specifications and Order of Approval application by September 2016. Per the CA, construction is to be completed and operations initiated of the upgraded Wastewater Treatment Facility by June of 2018. As part of the ongoing design efforts, Woodard and Curran developed a Design Basis Report (approximately 30% final design completion level) to communicate the intended design intent. This document was received by Wright-Pierce on February 18, 2016.

Wright-Pierce was retained by the Town of Warren to conduct a Value Engineering (VE) assessment of the Design Basis Report. The Value Engineering analysis considered the overall intent of the proposed project, reviewed several of the major concepts/proposed facilities, and provided alternative ideas or concepts for the design team to consider. The goal of the analysis was to highlight areas where construction costs could be reduced without sacrificing the performance or long term viability of the wastewater treatment facility. Currently, the estimated project costs are $21.6 million, as estimated by the Design Team.

Wright-Pierce has identified/is recommending several value engineering ideas that should be given strong consideration by the Town and the Design Team. These ideas, if implemented, could result in approximately $1.5 million in project cost savings. Furthermore, we have identified an additional $1.0 million in potential cost savings ideas that should be vetted out by the Design Team, bringing the total potential cost saving to $2.5 million.

Our understanding is the Town has bonded $20 million to complete this project inclusive of construction cost, construction engineering and project contingency. It is our opinion that the current estimated project costs are $1.5 to $2.0 million short of the true project costs, based upon the scope of work presented in the Design Basis Report. Thus, we believe that the currently presented WWTF upgrade project will have a total project cost of $23.1 to $23.6 million prior to implementation of any of the value engineering ideas presented herein.

ES.1 REVIEW OF CURRENT ESTIMATED PROJECT COSTS

The proposed WWTF upgrade is estimated to cost $21.6 million, based on Woodard and Curran's 30% design construction estimate. This includes an estimated total construction cost of $16 million, design and construction engineering fees of $3.4 million and a project contingency of $2.2 million (a portion of which is assumed to apply to the construction cost).

Wright-Pierce is concerned that the presented estimated project costs may not reflect the true construction cost given the project scale, site constraints (i.e., proximity to adjacent structures and utilities, limited space for contractor laydown area, field trailers and site access) and construction sequencing requirements.

Woodard and Curran's construction estimate assumed a 12 month construction schedule which is not feasible given the size of the project and limited site space (i.e., there is a limit of how many people can be working in one location at one time). A 24 month construction schedule is more appropriate for the proposed project. A shorter construction schedule can be achieved. However, a significant construction cost premium would need to be applied to the project, ultimately increasing the overall project costs.

Furthermore, the estimated construction costs do not reflect inflationary costs. Typically, General Contractors estimate a project assuming current labor rates, material prices, etc. To account for assumed increases in material prices, labor wages, etc. over the duration of the project, an annual inflation rate is applied to address the expected annual increases in these items as a function of the project duration. An annual construction cost inflationary rate of 3.0% would be appropriate for this project.

A 24 month construction schedule inherently creates issues associated with the Consent Agreement. To meet the required schedule, construction would need to commence this summer, which is not feasible given the current status of the proposed design. Therefore, the Town needs to carefully consider the time needed to complete construction and if the Design Team is in

concurrence, seek adjustment to the construction schedule milestones within the Consent Agreement.

It is in Wright-Pierce's opinion that the proposed WWTF upgrade, as currently configured, are not reflective of the true cost to construct the proposed upgrades. A total project cost of $23.1 to $23.6 million is reasonable for this project. This represents a project cost increase of approximately $1.5 to $2.0 million.

ES.2 VALUE ENGINEERING ANALYSIS SUMMARY

The proposed project consists of several major features/upgrades to the WWTF to address the total nitrogen limit and meet the Town's WWTF needs over the next 20 years. Wright-Pierce reviewed the proposed project and developed a list of 37 individual value engineering ideas for the design team to consider. In general the value engineering ideas focused on reutilizing/repurposing the existing infrastructure versus the construction of new tanks and buildings. The proposed upgrade consists of several major new structures (Headworks Building, Activated Sludge Tanks, Solids Handling Building and exterior generator) shown as red boxes in Figure ES.1. The construction of these structures given their proximity to Water Street, proximity to adjacent structures and the poor subsurface conditions will be complicated and expensive. Thus, significant consideration should be given by the design team to either reduce the size of these structures or use the existing Buildings to the maximum extent possible.

FIGURE ES.1

Operations Building

The existing Operations Building, located on the northern portion of the site, is a three story building with an approximate size of 16,000 square feet. Currently, this building is used for sludge pumping, chemical storage, sludge thickening, laboratory services, maintenance and administration offices, and operations staff facilities (shower, restroom and breakroom). The proposed plan includes relocating the wastewater processes (sludge pumping, sludge thickening and chemical storage) to a new Solids Handling Building constructed on the western portion of the site. The proposed plan includes approximately $500,000 to rehabilitate this building to continue to serves as the administration and maintenance facilities. However, once completed approximately 10,000 square feet of the building won't be utilized. On a site with very limited space, 10,000 square feet of unused building space does not seem ideal.

While we agree with the design engineers desire to separate administration and laboratory spaces from wastewater processing spaces. It is our opinion that consideration should be given to repurposing the Operations Building to serves as the new Solids Handling Building and relocate

the administration and laboratory facilities to a new building constructed on site (versus constructing a new Solids Handling Building). Buildings and structures designed to accommodate wastewater processes are significantly more expensive, on a cost per square foot basis, than buildings designed to accommodate administration and laboratory functions. Thus, use the existing building and its extensive available space for wastewater processes and construct a smaller more efficient administration and laboratory building (which would not require extensive subsurface excavation and associated costs).

Headworks

The proposed upgrade includes enhancing the preliminary treatment performance at the WWTF, which we agree with. The proposed recommendation includes a new building constructed on-site to serves as screenings containment (33% of the new space) and storage space (66% of the new space). The total new building square footage is approximately 540sf with an estimated cost $130,000 or approximately $240/sf for the new building space.

Significant cost savings could be achieved by separating wastewater process functions from storage functions. We agree with the need to provide covered storage of the screenings, but a $240/sf building is not required for the storage of equipment (snowblowers, lawnmower, etc). Significant cost savings could be realized through an alternative building system (i.e., 100/sf) for equipment.

Activated Sludge Process

The proposed upgrade includes doubling the volume of the existing activated sludge tanks through the construction of new concrete aeration tanks in the southwest corner of the site in-between Water St. and the existing aeration tanks. The proposed aeration tanks will occupy all of the available real estate in that location. Furthermore, the proximity to the existing aeration tanks and Water St will make site excavation and concrete forming and placement difficult and costly. Significant consideration should be given to opportunities to reduce the size and scale of the proposed aeration tanks.

Wright-Pierce's calculations indicate that a volume reduction of these tanks can be achieved without sacrificing effluent quality or treatment performance. Considering that the new aeration tanks have an estimated construction cost of $4.5 million or approximately 1/3 of the entire project, even a small reduction in the tank volume will have a considerable impact on the overall construction cost of the facility. Potentially, a total construction cost savings of $1.3 million could be ascertained through a reduction of the activated sludge tank volume.

Solids Handling Building

The proposed WWTF upgrade includes demolishing an existing solids handling facility (1940's vintage) and replacing it with a larger solids handling facility (to allow it to include the solids processing equipment currently located in the Operations Building). Similar to other structures on this site, the construction cost of this structure is directly impacted by subsurface conditions and proximity to other structures and property boundaries. The cost to excavate and dewater this location (before the Contractor even begins to pour the concrete foundation for the new building) is currently estimated at $600,000.

Wright-Pierce recommends that the design team consider alternative methods to construct the solids handling building or alternatively consider subdividing the proposed functions of this building into smaller less costly structures. Detailed descriptions of alternative solids handling layouts have been included in the worksheets herein. Potentially a construction cost savings of $750,000 can be realized by initiating one of more of the presented ideas.

SECTION 1

INTRODUCTION

1.1 INTRODUCTION

This report has been prepared to present the Value Engineering recommendations developed during the Value Engineering (VE) review of the Design Basis Report of the Warren, RI Wastewater Treatment Facility Upgrade. The Design Basis Report developed by Woodard and Curran builds upon previous engineering studies, ongoing communication between the Town, Rhode Island Department of Environmental Management (RIDEM) and the design team (Woodard and Curran) and ongoing engineering investigations of the site (i.e., subsurface investigations). The Design Basis Report summarizes the proposed design and outlines the recommended plan moving forward. The Design Basis Report is considered the milestone document related to 30% completion of the final design.

The Value Engineering analysis considered the overall intent of the proposed project, reviewed several of the major concepts/proposed facilities, and provided alternative ideas or concepts for the design team to consider. The Value Engineering analysis did not consider previous engineering studies or decisions not contained in the Design Basis Report, rather it focused on methods and alternatives to implement the items in the Design Basis Report in a cost effective manner.

The Warren wastewater treatment facility (WWTF) was originally constructed in the 1940's and underwent a major upgrade for secondary treatment in the early 80's. There have been several modest improvements to the WWTF since the last major upgrade including changes to the sludge handling process and the disinfection system.

Current and upcoming regulatory requirements, particularly concerning nitrogen reduction will require the WWTF to meet more stringent effluent limits. The majority of the remaining mechanical and electrical equipment are over 30 years old, exceeding their design life. In addition, there are architectural, structural, mechanical, instrumentation and electrical

components that will need to be addressed to ensure that the facility meets its future requirements and to provide long term reliable operation of the WWTF. As such, the wastewater treatment plant is in need of a major renovation to address nitrogen removal and aging infrastructure and equipment.

Our understanding is the Town has bonded $20M to complete this project inclusive of construction cost, construction engineering and project contingency. Thus, the goal of this analysis is to evaluate the recommendations in the Design Basis Report and identify opportunities to reduce the associated construction costs while still providing long term operation of the WWTF.

1.2 STRUCTURE OF THE VALUE ENGINEERING REPORT

The Value Engineering Report has been organized in the following manner:

- Executive Summary - Summary of Value Engineering ideas to consider
- Section 1 - Introduction and project intent
- Section 2 – Identification of the project team, individual roles and areas of expertise.
- Section 3 – Summary of Results - Detailed worksheets were developed by the individual value engineering team members for each of the major items. These worksheets provide a description of the proposed idea and estimated cost savings associated with each idea.

1.3 PROJECT CONSTRAINTS

The assembled value engineering team identified and recommended several alternative suggestions to the proposed recommendations in the Design Basis Report. These suggestions were developed by senior engineers, each having years of experience in the wastewater field. The items evaluated and resulting suggestions are based on the information contained within the Design Basis report, supplemented with information gather during the site walkthrough and conversations with the Operations Staff.

It is our assumption that over the course of the entire project, several of the ideas presented herein may have already been considered by the Town and the Design Engineer. Furthermore, given the scope of the Value Engineering Analysis, our goal was to identify and evaluate the feasibility of the presented ideas. However, a detailed engineering review of each alternative's feasibility was not undertaken. It is recommended that the design engineering team review the alternatives presented and determine which of the presented ideas warrant further consideration or engineering analysis.

SECTION 2

VALUE ENGINEERING TEAM

2.1 INTRODUCTION

Wright-Pierce assembled a senior value engineering team to review and develop alternative concepts for the Town and the design engineer to consider. The value engineering team assembled at the WWTF on the morning of March 15th, 2016 to conduct a site walkthrough and meet with members of the Town and the design engineering firm. Following a four day intensive evaluation effort, alternative concepts and recommendations were presented to the Town and design engineering firm (March 22nd).

2.2 TEAM MEMBERS

The following team members participated in the value engineering analysis:

Paul F. Birkel, PE; Mr. Birkel is a senior vice president and a Wastewater Practice Group leader. He has over 26 years of experience in the study, design and construction of WWTF's. His expertise for this assignment is wastewater process and VE facilitation.

W. Doug Hankins, PE; Mr. Hankins serves as Wright-Pierce's secondary and advanced treatment technical advisor. He has over 18 years of experience in the study, design and construction of WWTF's. His expertise for this assignment is nutrient removal, wastewater process and VE facilitation.

Thomas Simbro, PE; Mr. Simbro is the manager of Wright-Pierce's Rhode Island office as well as a senior project manager. He has over 22 years engineering experience in project management of water, wastewater and stormwater projects including project design; facility planning and studies; construction management; permitting; and O&M manuals. His expertise for this assignment is cost estimating, project constructability and construction methods.

Daniel Pratt, PE; Mr. Pratt has over 30 years of experience as a senior architectural engineer in the Building Design Practice Group and is the team leader of the Architectural Group. His expertise for this assignment is architectural design, building codes and constructability.

David Laskey, PE; Mr. Laskey has 35 years of experience in electrical engineering and design of numerous municipal and industrial water and wastewater treatment facilities and pumping facilities. His expertise for this assignment is electrical systems.

James Papadimitriou, PE; Mr. Papadimitriou has over 23 years of experience in the design, application, implementation, and startup of instrumentation and process control systems for the water/wastewater, industrial process, and machine control markets. His expertise for this assignment is instrumentation and control systems.

Mark Cunningham, PE; Mr. Cunningham has over 28 years of experience as a senior structural engineer within the Building Design Services practice group. His responsibilities include structural design of buildings, water and wastewater treatment plants, industrial facilities, and other structures. His expertise for this assignment is structural design and constructability.

Nathaniel Batch, PE; Mr. Balch has over 29 years of experience as a mechanical engineer in the firm's Building Services Group. His areas of expertise include analysis and design of heating, ventilation, plumbing and fire suppression systems for a variety of types of projects including wastewater and water treatment facilities, pump stations, maintenance garages and laboratories,. His expertise for this assignment is mechanical and plumbing systems.

SECTION 3

SUMMARY OF RESULTS

3.1 INTRODUCTION

The proposed project consists of several major features/upgrades to the wastewater treatment facility (WWTF) to address the total nitrogen limit and meet the Town's WWTF needs over the next 20 years. Wright-Pierce reviewed the proposed project and developed a list of 37 individual value engineering ideas for the design team to consider. In general, the value engineering ideas focused on reutilizing/repurposing the existing infrastructure versus the construction of new tanks and buildings.

3.2 VALUE ENGINEERING PROCESS

The value engineering process consisted of three major components or phases. A description of each component is as follows:

- **Brainstorming Session** - The first component included participants with expertise in wastewater process engineering, construction and architectural and building design services. The participants gathered at the Warren, WWTF March 15th, 2016. Background information was provided by Woodard and Curran. Project goals and constraints were provided by the Town and Woodard and Curran. The value engineering team developed a list of 37 potential value engineering ideas. These ideas are presented in Table 3-1.

- **Development Phase** – During the development phase, each idea was analyzed by one or more members of the value engineering team to determine if the alternative was viable. Concepts were dropped from consideration if they were found to be either infeasible or not cost effective. The remaining concepts were expanded to ascertain feasibly and project cost impacts.

TABLE 3-1
WARREN, RI WWTF UPGRADE (30% DESIGN)
VALUE ENGINEERING ANALYSIS

Item No.	Item Title/Description	Cost Implications			Preliminary Evaluator		
		VE Estimate of Capital Cost Savings	VE Estimate of Operational Costs Savings	VE Estimate of Life Cycle Cost Savings	Recommended	Consider	Rejected
	General Conditions						
1	Construction Period	-$626,000	N/A	N/A	X		
2	Temporary Construction Facilities	-$100,000	N/A	N/A	X		
3	Construction Sequencing	-$100,000	N/A	N/A	X		
4	Project Inflationary Costs	-$1,000,000	N/A	N/A	X		
	Headworks						
5	Screenings Building Above Grit Tank	$120,000	N/A	N/A	X		
6	Eliminate new influent mechanical screens, wash press and Building	$400,000	Not Estimated	Not Estimated		X	
7	Influent Screening opening size	Not Estimated	$5,000/yr	Not Estimated	X		
8	Grit Aeration - reduction of aeration volume	Not Estimated	Not Estimated	Not Estimated	X		
	Primary Clarifiers						
9	Submersible chopper pump for scum...instead of mixers and pumps	$120,000	Not Estimated	Not Estimated		X	
10	Septage Tank/night soil tank - Do we need to have vs direct discharge	Not Estimated	Not Estimated	Not Estimated		X	
11	Consider separate electrical room	-$5,000	Not Estimated	Not Estimated	X		
	Intermediate Pump Station						
12	Dry pit pump vs nonclog vertical - higher efficiency	N/A	Not Estimated	Not Estimated		X	
13	Pump size versus pump cycling - jockey pump	-$60,000	Not Estimated	Not Estimated		X	
14	Review air ventilation rates	N/A	Not Estimated	Not Estimated		X	
	Aeration Tanks						
15	Nutrient Removal Process Design	$1,330,000	Not Estimated	Not Estimated		X	
16	Mixer Aerator Design and Configuration	$275,000	Not Estimated	Not Estimated	X		
17	Nutrient Removal Process Alternative	N/A	N/A	N/A			X
18	Aeration Tank Configuration/Dimensions - Excavation issues	N/A	N/A	N/A			X
	Secondary Clarifier						
19	Consider suction tube vs Spiral blade	Not Estimated	Not Estimated	Not Estimated		X	
	Chlorine contact tanks						
20	Disinfection and Dechlorination Instrumentation	$50,000	Not Estimated	Not Estimated	X		
21	New independent Chemical Building	See Item No. 22 and 24				X	
	Solids Handling Building						
22	Solids Handling Building Redesign	$750,000	Not Estimated	Not Estimated	X		
23	Single gravity thickener unit versus two units	Not Estimated	Not Estimated	Not Estimated		X	X
24	Install Rotary Drum thickener in ex. Admin building	See Item #22	Not Estimated	Not Estimated	X		
25	Alternative Gravity Thickener Tank Material	$100,000	Not Estimated	Not Estimated		X	
26	Use Group Classification	N/A	N/A	N/A	X		
27	Chemical Storage - fire Protection	$11,100	N/A	N/A	X		

	Admin Building						
28	Reuse existing thickened sludge storage tank	See Item No. 22 and 24				X	
29	New exterior thickened storage tank on west side of Admin with pumps in lower level of	See Item No. 22 and 24				X	
30	New Electrical room needs outside swing doors and second egress	-$5,000	Not Estimated	Not Estimated	X		
31	Mechanical - Hydronic Piping	$260,000	Not Estimated	Not Estimated	X		
32	Mechanical - Energy Recovery	-$60,000	$23,500/yr	Not Estimated		X	
33	Fiber Optic Cable Replacement	$28,700	$1200/yr	Not Estimated		X	
	Generator						
34	Relocation to opposite side of site	$0	Not Estimated	Not Estimated	X		
	Cost Estimate						
35	Review excavation and dewatering cost estimate	Not Estimated	Not Estimated	Not Estimated		X	
36	Demolition costs	Not Estimated	Not Estimated	Not Estimated		X	
37	Storage Building	$70,000	Not Estimated	Not Estimated	X		

Individual worksheets were developed for each remaining alternative and have been included in this section. Each worksheet includes a brief narrative comparing the original and alternative design concept, supporting calculations and sketches and an opinion of potential costs savings. Table 3-1 was subsequently updated to include the opinion of costs savings and recommended action.

- **Presentation and Report Phase –** The last phase of the value engineering analysis was a presentation of alternatives to the Town and Woodard and Curran. Alternative concepts and recommendations were presented and discussed on March 22nd, 2016. A copy of the presentation has been included as an appendix to this report.

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DATE: March 25, 2016

Item # 1

		Reference or affected design document(s)
Item Title :	Cost Estimate - Construction Time	
Assigned Engineer:	Dan Pratt	Spec. Sect.:
Recommendation:	Use a longer construction period	DWG.:
		Other: Cost estimate

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$626,000	N/A	N/A
Alternative Concept	$626,000	N/A	N/A
Estimated Savings	-$626,000	N/A	N/A

Description of Baseline Concept:

The cost estimate assumes a construction period on site of 12 months. Our experience on similar projects indicates that this is not adequate time execute a project of this size and complexity. The limitations of the site and the need to phase the construction while keeping the plant in operation will be a major factor in the time needed to complete the project. Each phase in the sequence of construction will essentially be its own project. Each phase will require: planning, submittals, equipment purchase, delivery, construction, installation, testing and acceptance. Once each new system is brought on line, the contractor can move onto the next phase. Rinse and repeat.

Description of Alternative Concept:

A construction period of 21 to 24 months is more appropriate for this project. This will allow adequate time to implement the stages required to execute the project

• Longer construction period allows the flexibility in sequencing the execution of the project. • Less restrictive schedule would be attractive to more potential bidders.	• Additional costs

Recommendation:

Consider a longer construction period that is more commensurate with the scale and scope of the proposed project. Forcing the General contractor to complete this project within a 12 month period will result in a significant construction premium.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3/16/16

Item # 5

		Reference or affected design document(s)
Item Title :	New Building on Top of Headworks	
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Recommended	DWG.: Other:

Estimated Cost Impacts

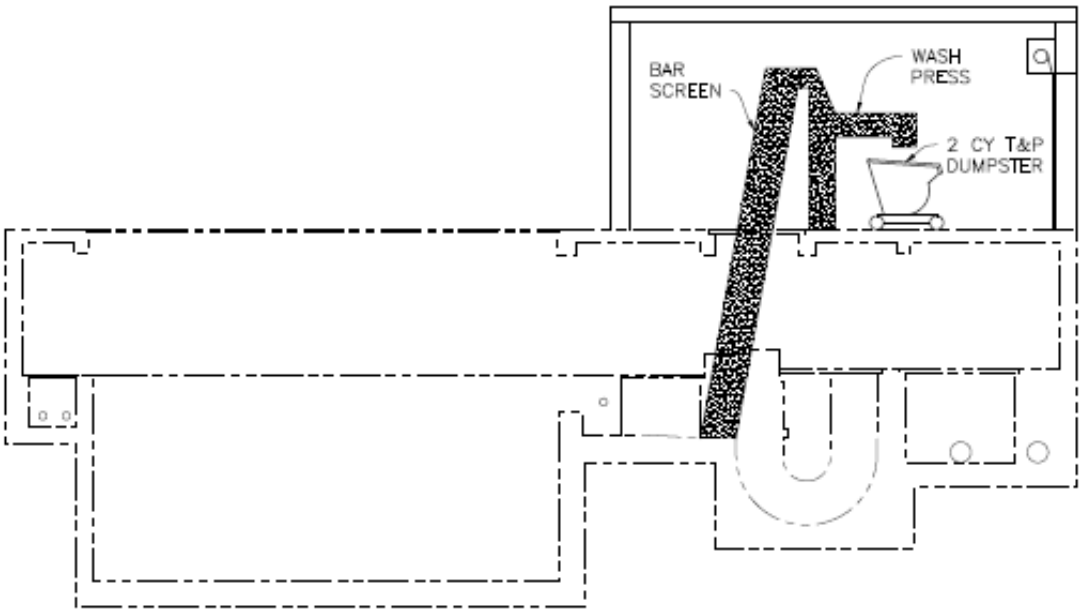
	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept		N/A	N/A
Alternative Concept		N/A	N/A
Estimated Savings	$120,000	N/A	N/A

Description of Baseline Concept:

The current proposed concept is to construct a new building directly north of the Headworks Building which would contain the Screenings and Dumpster Enclosure and Garage Storage. This new building would not be flush with the existing Headworks Building. Screenings would be removed via a mechanical bar screen in the existing channel and compacted via a wash press. From the wash press, the compacted screenings would be transported in a pipe through a wall in the Headworks Building and into the new building's Screenings and Dumpster Enclosure. In order to accomplish this, the piping runs (exposed) above-ground outside for the distance between the two buildings.

Description of Alternative Concept:

The alternative concept proposed is to construct the new building on top of the existing Headworks Building instead of adjacent to it. This proposed building would only contain the Screenings and Dumpster Enclosure and not the Garage Storage. It is proposed that the Garage Storage be constructed as a stand-alone building in a different location. Through separating these spaces, the Garage Storage can be built using lower cost materials and methods. The mechanical screen would be extended through the top of the building, with the wash press placed on top of the existing Headworks Building roof. The proposed building would be contructed directly on top of the roof of the Headworks Building. By contructing the new building above the existing Headworks Building, the exterior exposed piping (and its potential issues with freezing) would be removed. As a result of relocating the screenings removal and compaction point, odor control would only be needed in the proposed Screenings and Dumpster Enclosure and not in the Headworks Building.



HEADWORKS SECTION
SCALE: 1/8"=1'-0"

Advantages	Disadvantages
• Eliminates the cost of another CMU/split face brick structure and foundation • Reduces permitting issues and increased impervious area • Reuses existing infrastructure (no loss of site space) • Removes motor from wet environment • Removes wash press from damp, corrosive environment • Allows vehicles to pull alongside headworks for transfer of screenings • Increases ease of maintenance and improves long term reliability and service • Eliminates freezing concerns in exposed exterior piping • Eliminates concerns with headroom and large concrete beam above influent channel in the Headworks Building to accommodate the new screen and washpress • Decreases cost of Garage Storage through	• Reloaction/loss of Garage Storage for storage of miscellaneous equipment

construction of a more economical stand-alone structure • Reduces volume for odor control by approximately 35%.	

Recommendation:

This alternative is recommended

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3/16/16

Item # 6

Item Title :	Elimination of Screen, Wash-press and Building	Reference or affected design document(s)
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Not Recommended	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept		N/A	N/A
Alternative Concept		N/A	N/A
Estimated Savings	$400,000	N/A	N/A

Description of Baseline Concept:

The current proposed concept is to construct a new building directly north of the Headworks Building which would contain the Screenings and Dumpster Enclosure and Garage Storage. This new building would not be flush with the existing Headworks Building. Screenings would be removed via a mechanical bar screen in the existing channel and compacted via a wash press. From the wash press, the compacted screenings would be transported in a pipe through a wall in the Headworks Building and into the new building's Screenings and Dumpster Enclosure. In order to accomplish this, the piping runs (exposed) above-ground outside for the distance between the two buildings.

Description of Alternative Concept:

The alternative concept proposed is to do nothing and eliminate the proposed screen, wash-press and building.

The Basis of Design report indicated that the new screening system was required to protect downstream process equipment. We did not find any information regarding issues associated with rags, etc. that are impacting the current treatment process. The only new equipment being proposed are hyperbolic mixers and mixer-aerators in the activated sludge tanks.

Advantages	Disadvantages
• Eliminates construction of new screenings shed, mechanical screen and washpress equipment • Reduces operational expenses associated with the disposal of screening material	• Unknown if there is an existing ragging problem that needs to be addressed • Requires replacement of the existing grinder • The lower sparge ring of the mixer aerators might be collect rags, etc.

Recommendation:

Not Recommended

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3/16/16

Item # 7

Item Title :	Screen Size/Screenings Generated	Reference or affected design document(s)
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Recommended	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	N/A		
Alternative Concept	N/A		
Estimated Savings	N/A	$5,000/yr	

Description of Baseline Concept:

The proposed bar spacing for the new mechanical bar screen is ¼-inch. For this screen size, an estimated screenings removal of 2 CF/MG was identified in the Basis of Design report.

Description of Alternative Concept:

The Basis of Design report identified a screenings removal rate of 2 CF/MG. Based on our experience and as identified in the Vulcan Screenings Capture graph (attached Figure 2-1), we believe this assumed rate is low. A screenings removal rate of approximately 13 CF/MG is more appropriate for a ¼ bar spacing.

The alternative concept proposed is to increase the bar spacing of the mechanical bar screen to ½-inch. Using the graph and the known average daily flow through the WWTF (1.88 MGD), it is likely that screenings removal will be approximately 13 CF/MG (6.3 CY/week) with ¼-inch bar spacing. Using this resource at ½-inch bar spacing, the estimated screenings removal is 8 CF/MG (4.0 CY/week). An increase in the bar spacing will reduce the amount of material removed and ultimately disposed of off-site by 2.3 CY/week.

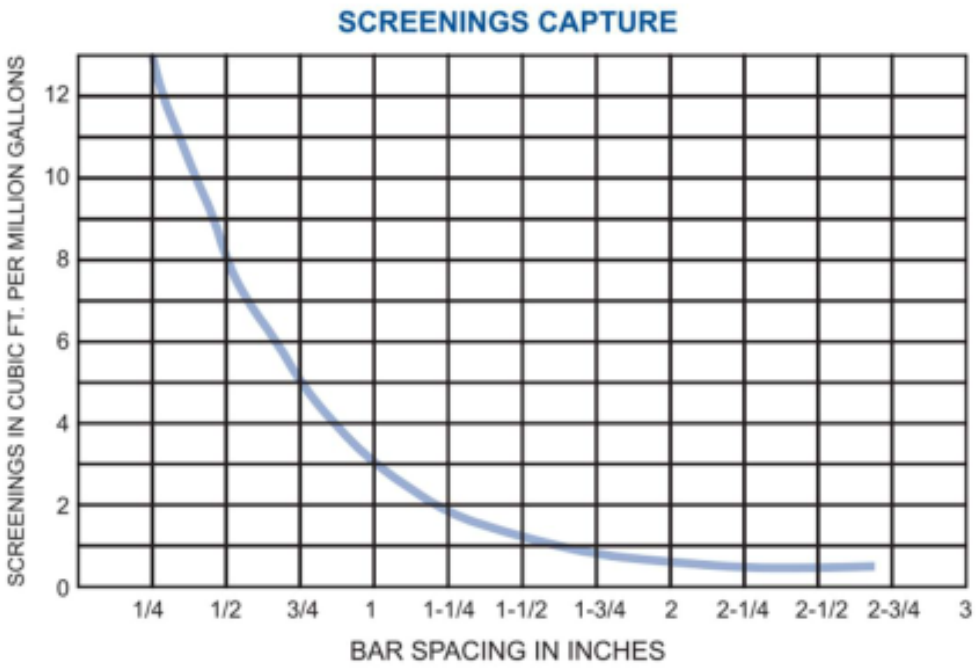
Advantages	Disadvantages
• Significantly reduces handling and disposal costs • Reduces size required for screenings disposal bin	• Increased bar spacing allow for more material to pass through the screen and continue on to other processes

Recommendation:

It is recommended that the design team strongly consider the use of a mechanical screen with a ½″ screen opening in lieu of the proposed ¼″ screen.

Figure 2-1

Vulcan Industries Screening Capture Graph



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DATE: 3/16/16

Item # 8

Item Title :	Reduction in Aeration Rate	Reference or affected design document(s)
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Recommended	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	N/A	N/A	N/A
Alternative Concept	N/A	N/A	N/A
Estimated Savings	N/A	Not Estimated	N/A

Description of Baseline Concept:

The current proposed aeration rate for the Grit Tank is 4.5 CFM/LF (142 CFM).

Description of Alternative Concept:

The alternative concept proposed is to decrease the aeration rate to 1 CFM/LF, as dictated through numerous experiences at other WWTFs. These past experiences have shown that design guidelines are excessive and tend to result in overaeration and reduction of grit removal rates. Using the 35.5-foot length of the Grit Tank, the decreased aeration supplied is 31.5 CFM. This reduction in aeration requirement would result in a corresponding reduction in the grit blower size and operating expense.

Lower airflow rates will result in an increase in the grit capture rate within the grit tanks versus the primary clarifiers.

Advantages	Disadvantages
• Reduces grit blower size • Reduces operating costs	

Recommendation:

Its is recommended that the grit aeration system be designed to allows for a reduction in the design airflow rate commensurate with 1 CFM/lf of grit tank.

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DATE: 3/16/16

Item # 9

Item Title :	Scum Well Mixers and Pumps	Reference or affected design document(s)
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Recommended	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$120,000	Not Estimated	Not Estimated

Description of Baseline Concept:

The current proposed concept is to add the following scum pumps and scum mixers to provide mixing and removal of scum in the applicable scum wells:

- One primary scum mixer and one primary scum pump to the Primary Settling Tanks scum well
- One secondary scum mixer and one secondary scum pump to Secondary Settling Tanks scum well
- One gravity thickener scum mixer and two gravity thickener scum pumps to the Gravity Thickeners scum well

Description of Alternative Concept:

The alternative concept proposed is to use submersible chopper pumps to mix and remove the scum from the previously listed scum wells. A chopper pump has the ability to provide mixing of the scum wells and removal of the scum, thereby removing the need for two separate pieces of equipment. In the Gravity Thickener scum well two submersible chopper pumps would be used in place of the two scum pumps and singular mixer.

Advantages	Disadvantages
• Eliminates the need for separate pumps and mixers • Allows for complete mixing of scum wells, effectively eliminating the potential of scum buildup on the water surface conventionally found with using mixers • Reduces the amount of controls and electrical equipment and associated maintenance associated with these appurtenances	• Increases the difficulty of maintenance due to the submersible nature of the chopper pumps

Recommendation:

This alternative should be considered

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DATE: 3-16-2016

Item # 11

Item Title :	Primary Sludge Pump Station Electrical Room	**Reference or affected design document(s)**
Assigned Engineer:	David Laskey/Dan Pratt	Spec. Sect.:
Recommendation:	Provide new wall to separate electrical equipment space from Primary Sludge Pump Station	DWG.: E-301 Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	0	N/A	N/A
Alternative Concept	$5,000	N/A	N/A
Estimated Savings	-$5,000	N/A	N/A

Description of Baseline Concept:

Present design indicates replacement of existing Motor Control Center MCC-2 with new MCC-2, to be located in the same area on ground floor level adjacent to stairway to Primary Sludge Pump Station. This area is presently open to the stairway with no wall separating the spaces. This exposes the costly equipment to moisture and fumes from the spaces below.

Description of Alternative Concept:

Separate the electrical space from the other areas.
Provide a new wall to separate the electrical equipment space on the ground floor level from the existing stairway and Primary Sludge Pump Station on the lower level. Provide a new separate entrance to the electrical equipment room. If necessary, provide new separate ventilation for the electrical room. This will isolate and protect the equipment from the fumes and moisture from below. This will decrease the maintenance required and increase the life of the equipment. It would also allow the option of letting the areas below default to Class 1 Division 2, eliminating the need to continuously ventilate.

Advantages	Disadvantages
• Provides cleaner environment for electrical equipment. • Lower operations and maintenance costs. • Provides ability to reduce air change rate in Primary Sludge Pump Station, saving on heating costs.	• Small capital cost.

Recommendation:

Locate the electrical equipment in a separate room created within the existing space to protect the equipment and provides flexibility in compliance with the ventilation requirements of NFPA 820.

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DATE: 3/16/16

Item # 13

		Reference or affected design document(s)
Item Title :	Intermediate Pump Station	
Assigned Engineer:	Paul Birkel	Spec. Sect.:
Recommendation:	Consider	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept	-$60,000		
Estimated Savings	-$60,000	Not Estimated	Not Estimated

Description of Baseline Concept:

The current proposed concept is to demolish and replace two of the three original centrifugal pumps with similar (higher capacity, 3,800 gpm each) dry pit submersible centrifugal pumps. The third pump, a smaller "jockey" pump with a capacity of 2,700 gpm, which was previously replaced is to reamin. The new pumps would be sized to meet peak hourly flows of 9.0 MGD with one of these pumps operating simultaneously with the existing smaller pump.

Description of Alternative Concept:

The alternative concept proposed is to replace two of the three original centrifugal pumps, one in kind with a similar (higher capacity, 3,800 gpm each), and one with a lower capacity dry pit centrifugal jockey pump. This new jockey pump would be of smaller capacity than the existing 2,700 gpm pump (to remain) in order to handle the frequent even lower flows at a much higher efficiency than the existing pump is capable of. In addition to these two pump replacements, a third highest capacity (3,800 gpm) pump would be installed at the existing blind flange for redundancy. Since the 100-year flood elevation is a safe distance below the pumps' elevation, the new pumps could either be dry pit submersible type (in kind with the pump to remain) or vertical non-clog type.

Advantages	Disadvantages
• Increases efficiency of system at very low flows • Increases motor efficiency (if vertical non-clog type pumps are used)	• Increased cost for additional pump

Recommendation:

Consider a four pump system versus the proposed three pump station.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3-17-16

Item # 14

Item Title :	NFPA 820 Classification - Ventilation	Reference or affected design document(s)
Assigned Engineer:	Dan Pratt	Spec. Sect.:
Recommendation:	Consider Class 1 Division 2 electrical classification for the below grade spaces	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept	Small Increase	Lower O&M	
Estimated Savings			

Description of Baseline Concept:

The proposed design includes continuously ventilating the below grade spaces to declassify them. In order to declassify these areas, NFPA 820 requires that they be continuously ventilated at 6 air changes per hour. Continues operation of these fans increases the energy consumption and decreases the life of the equipment. The high rate of ventilation will also increase the cost to heat these spaces in the winter. In the summer, continuously ventilating with humid air will increase condensation and corrosion.

Description of Alternative Concept:

Allow the below grade spaces to be electrical Class 1 Division 2 and do not continuously ventilate these areas.

At existing facilities where it would be difficult to replace the equipment, ventilation to declassify the space is often the only option. In the proposed design essentially all of the existing equipment is being replaced. Since these areas are damp, the new equipment would typically meet the Class 1 Division 2 requirements in order to protect the equipment from moisture. The remaining low voltage components could comply with NFPA 820 at a minor additional cost.

We recommend having the ability to ventilate at 6 air changes per hour during occupancy and to declassify the spaces to facilitate easy maintenance. But do not run the ventilation continuously. Our experience it that on facilities with new equipment, there is a savings in the life cycle costs with this approach.

Advantages	Disadvantages
• Lower energy costs. • Longer equipment life. • Less moisture and corrosion. • Lower life cycle cost.	• Slight increase to capital cost.

Recommendation:

Investigate the option of allowing some or all of the below grade spaces to be Class 1Division 2. Compare the life cycle cost to the current design.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: March 17, 2016

Item # 15

Item Title :	Nutrient Removal Process Design	Reference or affected design document(s)
Assigned Engineer:	Doug Hankins	Spec. Sect.:
Recommendation:	Consider	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$1.33M	Not Estimated	Not Estimated

Description of Baseline Concept:

The recommended nutrient removal process is a variable operating mode. The process will operate as a 4-stage Bardenpho process during the summer period to achieve a monthly average total nitrogen concentration of 5.0 mg/l. During the winter period, the activated sludge process will convert to an MLE process to achieve a total nitrogen concentration of 9.0 mg/l.

To achieve the required volume for year round treatment, two new activated sludge tanks are recommended. Each tank has a proposed volume of 0.345 mgal. The existing tanks each have a volume of 0.31 mgal. The total recommended activated sludge tank volume is 1.31mgal. The nutrient removal process is sized to operate in the "dry weather mode" at the maximum weekly flow rate.

During period of high flows, the process can be operated as a contact stabilization process through bypassing the primary effluent directly to the existing activated sludge tanks.

Description of Alternative Concept:

The proposed activated sludge tanks are shown to be constructed adjacent to the existing tanks in the southeast corner of the existing site. The site plan provided, including the proposed footprint of the tanks, does not accurately reflect the dimensions of the activated sludge tanks. Specifically, the proposed activated sludge tanks are bigger than what's shown on the site plan. The construction of these tanks will be very difficult and costly due to their proximity to the existing tanks, property boundaries and Water St. Furthermore, site conditions will require the need to over excavate unsuitable material, dewater and backfill the location with suitable base layers.

The proposed nutrient removal concept needs to achieve the permit conditions at the both the summer and winter operating conditions. Cost savings could be achieved through reduction of the activated sludge volume. Our process modeling analysis indicates that approximately half of the additional volume proposed is not required. The new aeration tanks would still be installed in the proposed location. However, significant cost savings would be achieved through a reduction in the amount of concrete, excavation and equipment required.

Our process model utilized the primary effluent flows and loads presented in the Basis of Design report at default modelling parameters (Table 3-5 and 3-6 in the BOD report). A detailed model calibration was not conducted as part of this VE process. At the default parameters, expected influent wastewater temperature and minimum operating SRT, the operating MLSS values were well within range to achieve sufficient treatment and removal of the MLSS in the secondary clarifiers at a maximum weekly flow rate. it was assumed that flows rates greater than the presented maximum weekly conditions, the process would switch to operate as a contact stabilization process.

A slight increase in supplemental carbon usage may be necessary with a smaller aeration tank.

Advantages	Disadvantages
- Cost savings associated with a smaller aeration tank volume. Reduced excavation, dewatering, concrete placement, mechanical items, miscellaneous metals, etc.	- The volume of the activated sludge processes has been reduced. Therefore, the process design is more aggressive than the proposed design. - An increase in the supplemental carbon usage may be required with the smaller aeration tanks.

Recommendation:

It is recommended that W&C review the process model to verify the required size of the activated sludge process. It should be noted that the W-P process model was not calibrated based on the historical performance of the activated sludge process at the Warren WWTF.

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DATE: March 17, 2016

Item # 16

Item Title :	Mixer Aerator Design and Configuration	Reference or affected design document(s)
Assigned Engineer:	William Hankins	Spec. Sect.:
Recommendation:	Recommended	DWG.: GA-501, 504 Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$275,000	Not Estimated	Not Estimated

Description of Baseline Concept:

The proposed activated sludge process consists of multiple zones in series. Each zone includes either a mixer or mixer aerator. The Basis of Design Report identifies eight mixers and 12 mixer-aerators while the cost estimate identifies 20 mixer-aerators. The cost estimate identifies the capital cost for each mixer aerator at $53K. A mixer should be approximately half of the capital cost of a mixer-aerator. Thus, the current cost estimate should be reduced by approximately $210K, if mixers are proposed.

The proposed activated sludge design incorporates four anoxic zones in series (mixers only) prior to the aerobic portion of the aeration tanks. The design also includes two post swing reactors each with a mixer-aerator.

Description of Alternative Concept:

The design of initial anoxic zone can be streamlined to eliminate the four zones in series. Three zones in series (at the equivalent volume) would eliminate two mixers and two intermediate concrete baffle walls. Three zones in series will still provide the same nutrient removal process performance and "biological selection" performance.

The design of the activated sludge process includes two post swing reactors in series in each aeration tank. These zones can be combined to a single zone without sacrificing process control/performance. Reducing the amount of mixers/mixer-aerators also eliminates internal baffle walls, electrical and control wiring, starters, etc. Each of the mixer aerators-also requires a dedicated air flow control valve, air flow meter, DO probe, control wiring and programming.

Advantages	Disadvantages
- Less mechanical units will result in lower maintenance and operational costs - Lower capital cost - Eliminates internal baffle walls - Mixer-aerator - Eliminates air flow control valve, Flow meter and dedicated DO probe - Eliminates additional structural support for each unit.	- Slight reduction in process flexibility - The new mixer and mixer-aerator units will have to increase in size and capacity.

Recommendation:

This alternative is recommended for implementation

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3/16/16

Item # 19

		Reference or affected design document(s)
Item Title :	Secondary Clarifier Mechanism	
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Consider	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	Not Estimated	Not Estimated	Not Estimated

Description of Baseline Concept:

The current proposed concept is to replace the existing rapid sludge removal mechanisms in the secondary clarifiers and replace them with spiral-blade type mechanisms. Spiral blade mechanisms require a dedicated sludge hopper for RAS suction/return piping.

Description of Alternative Concept:

The alternative concept proposed is to replace the secondary clarifiers' existing rapid sludge removal mechanisms in kind or with a Tow-Bro type mechanism. Either of these technologies would function well given the existing conditions of the clarifiers. The relatively flat bottom slope of the secondary clarifiers (1:48) is not suitable for spiral-blade type sludge removal, which generally requires a minimum bottom slope of 1:12. In addition, numerous past Wright-Pierce experiences at other WWTFs have shown that rapid sludge removal or Tow-Bro mechanisms generally have better sludge removal performance than spiral type sludge removal mechanisms.

Advantages	Disadvantages

• Eliminates need for costly adaptive measures such as modifications to piping and construction of sludge hopper • Increases clarifier settling and sludge removal performance • Address the incompatible nature of relatively flat bottom clarifiers with spiral blade mechanisms.	

Recommendation:

The design team should review the existing clarifier floor slope and consider alternative sludge removal mechanisms.

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DATE: 3/16/16

Item # 21

Item Title :	Disinfection and Dechlorination Instrumentation	Reference or affected design document(s)
Assigned Engineer:	Chelsea Dean	Spec. Sect.:
Recommendation:	Recommended	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$50,000	Not Estimated	Not Estimated

Description of Baseline Concept:

The current proposed concept is to install six chlorine residual analyzers in the Chlorine Contact Tanks at the following locations:

- One in the chlorination mixing chamber
- Two total – one at towards the head end of each of the two chlorine contact tank trains
- Two total – one near the outlet weir structure in each of the two chlorine contact tank trains
- One in the dechlorination chamber directly after the outlet weir

The above residual analyzers would be used to pace both the sodium hypochlorite pumps for chlorination and the sodium bisulfite pumps for dechlorination.

Description of Alternative Concept:

The alternative concept proposed is to only use two residual chlorine analyzers: one in the head end of each chlorine contact tank trains. Each analyzer would be located such that the flow has achieved the required 90 second contact time to fully react at the average daily flow. These two analyzers alone accurately represent the chlorine residual for pacing of both the sodium hypochlorite pumps for chlorination and the sodium bisulfite pumps for dechlorination. The remaining analysis would not be installed for the following reasons:

- One in the chlorination mixing chamber – not enough reaction time has been achieved at this point for chlorine residual data to be relevant for pacing purposes

- One point near the outlet weir of each tank (two points total) – these points are redundant and extraneous under this proposed alternative
- One in the dechlorination chamber/outlet – Though this point would be representative of the residual chlorine, installing a residual analyzer in the outlet creates an unnecessary reporting requirement if this analyzer detects a residual over the limit

Advantages	Disadvantages
• Saves significant cost (approximately $50,000) through elimination of 4 of the proposed residual analyzers • Eliminates unnecessary reporting requirement for the residual analyzer located in the dechlorination chamber/outlet	

Recommendation:

The design engineer should strongly consider the need for 6 residual chlorine analyzers. Cost savings can be achieved without sacrifing treatment performance.

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DATE: 03-16-2016

Item # 22

Item Title :	Solids Handling Building Redesign	Reference or affected design document(s)
Assigned Engineer:	Paul Birkel	Spec. Sect.:
Recommendation:	Recommended	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$750,000	Not Estimated	Not Estimated

Description of Baseline Concept:

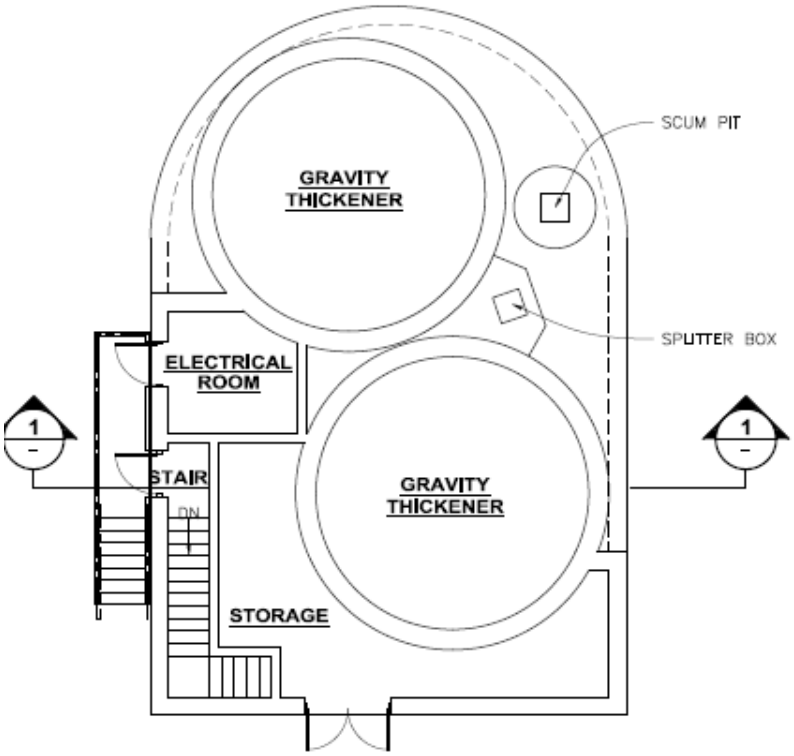
The BOD report recommends demolishing the existing Sludge Storage Building (SSB) and constructing a new Sludge Handling Building complete with chemical storage (Sodium Hydroxide, Micro C and Sodium Bisulfite) and sludge pumps located in the basement; and sludge thickening, electrical room and odor control on the first floor. Adjacent to this location on the site will be the construction of new gravity thickeners, gravity thickener flow splitter and gravity thickener scum storage tanks. Construction will require complete removal of the 1940s vintage structure and significant sheeting and dewatering of the excavation.

Description of Alternative Concept:

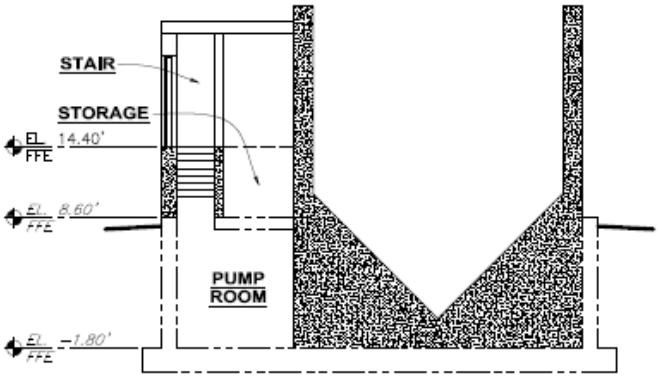
Significant excavation on site will be costly and challenging especially for a new Sludge Handling Building, on a largely filled site in such close proximity to the water. In lieu of this approach, consider repurposing the sludge storage building location. In this scenario, the new Sludge Handling Building would not be constructed but its purpose redistributed within or onto existing infrastructure onsite. The entire sludge storage building internals would be demolished both to grade and to the outside walls, preserving the perimeter of the existing foundation structure. Construct new concrete gravity thickeners within the building foundation perimeter and provide new sludge transfer pumps in the lower level. GT Splitter and scum box also accommodated within. Chemical storage and electrical distribution needs would be accommodated in a new building constructed over the existing CCT or on a foundation at grade level. A new rotary drum thickener could be installed over the existing sludge storage tank in the operations building, allowing sludge tankers to be filled as currently provided. See attached sketches.

Advantages	Disadvantages
• Maximize beneficial reuse of existing infrastructure. • Eliminate excavation on a challenging site. • Reduce likelihood of costly change orders as a result of unforeseen subsurface conditions. • Eliminate impacts from excavation on adjacent structures, climatic conditions and dewatering. • Eliminate need for costly temporary mud slab to seal sheeting and provide stable subgrade for construction. • Moves chemical storage from basement to first floor. • Grade level chemical storage allows for larger capacity tanks, reducing tanks from 3 to 2 for each chemical stored. • New structure over the Sludge Storage Building site allows maintenance equipment storage space loss from mods suggested for Headworks/Screenings building. • Decreases construction time • Reduces construction cost	• Maintains sludge thickening at Operations Building

Solids Handling Building Layout

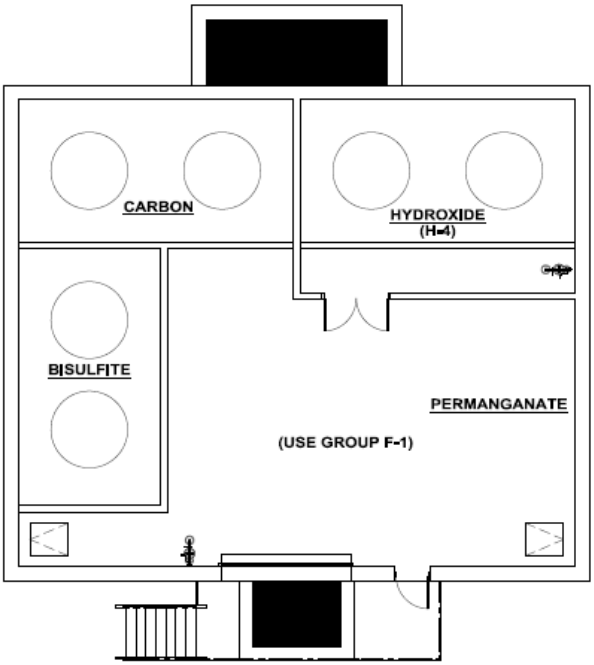


PLAN
SCALE: 1/8"=1'-0"



SECTION 1
SCALE: 1/8"= 1'-0"

Chemical Building Layout



CHEMICAL BUILDING PLAN
SCALE: 1/8"=1'-0"

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DATE: 3=16-2016

Item # 23

Item Title :	Solids Handling-Single GT	Reference or affected design document(s)
Assigned Engineer:	Paul Birkel	Spec. Sect.:
Recommendation:	Mildly Consider	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	Not Estimated	Not Estimated	Not Estimated

Description of Baseline Concept:

The Bod report recommends two 21′ diameter concrete gravity thickener tanks

Description of Alternative Concept:

Reduce costs for gravity thickeners by changing from two gravity thickener to one gravity thickener. Larger diameter, concrete construction.

Advantages	Disadvantages
• Reduces cost	• Single thickening tank, however not unlike what exists today.

Recommendation:

Consider a single gravity thickener tank if additional cost savings are desired. However, a redundant thickener/storage tank would not be provided in this alternative.

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DATE: 03-16-2016

Item # 24

Item Title :	Install Rotary Drum Thickener in ex. Admin Building	**Reference or affected design document(s)**
Assigned Engineer:	Paul Birkel	Spec. Sect.:
Recommendation:	Recommended	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	See Item #22		

Description of Baseline Concept:

The BOD report recommends a new solids Handling Building. As part of the upgrade, a new Rotary Drum Thickener is to be located in the new Sludge Handling Building.

Description of Alternative Concept:

Our alternative concept presented in Item 22 called for a new rotary drum thickener to be installed over the existing sludge storage tank in the operations building, allowing sludge tankers to be filled as currently provided.

In lieu of this, locate new Rotary Drum thickener in the second floor coil filter room of the Admin Building. Here all needed lines (sludge feed, sludge conditioning) would terminate at the RDT. Should the Town need to haul dewatered sludge cake in the future, everything would be in place to accommodate installation of a new dewatering unit on the second floor requiring minor connections. This would allow reuse of the sludge loading hopper above a trailer below. Also with this options move sludge storage to exterior of building in 10,000 gallon tank with new transfer pumps to fill tank trucks.

Advantages	Disadvantages
• Moves temporary sludge storage out of Operations building • Positions Town for possible future dewatering operation with minimal reconfiguration.	• Maintains sludge thickening at Operations Building

Recommendation:

The existing Administration Building has significant space available for the proposed sludge thickening equipment. Considerable cost savings can be achieved through re-utilization of this space. Therefore, this alternative concept is recommended.

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DATE: 03-16-2016

Item # 25

Item Title :	Solids Handling-Alternative GT Tank Material	**Reference or affected design document(s)**
Assigned Engineer:	Paul Birkel	Spec. Sect.:
Recommendation:	Consider	DWG.:
		Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$100,000	Not Estimated	Not Estimated

Description of Baseline Concept:

BOD recommends demolishing the existing Sludge Storage Building (SSB) and constructing a new Sludge Handling Building complete with chemical storage (Sodium Hydroxide, Micro C and Sodium Bisulfite) and sludge pumps located in the basement; and sludge thickening, electrical room and odor control on the first floor. Adjacent to this location on the site will be the construction of new gravity thickeners, gravity thickener flow splitter and gravity thickener scum storage tanks. Construction will require complete removal of the 1940s vintage structure and significant sheeting and dewatering of the excavation.

Description of Alternative Concept:

This concept builds on that presented in Solids Handling Item # 22.

In lieu of concrete gravity thickeners formed within the footprint of the existing sludge storage building, provide epoxy coated steel tanks.

Advantages	Disadvantages
• Decreases construction time as can be fabricated quicker onsite • Reduces construction cost	• Metal tanks that can be more susceptible to corrosion.

Recommendation:

Consider this alternative depending on existing building foundation issues and cost saving requirements.

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DATE: 3-17-16

Item # 26

Item Title :	Use Group Classification	Reference or affected design document(s)
Assigned Engineer:	Dan Pratt	Spec. Sect.:
Recommendation:	Use the use group for code analysis	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	N/A	N/A	N/A

Description of Baseline Concept:

The Basis of Design Report does not contain adequate information on the classification of the spaces to determine code compliance. The report indicates that much of the facility is a Utility Use Group so therefore does not need to be handicapped accessible. This classification is only applies to spaces that do not fit in any other use group. These spaces are actually Factory Use (F-1). It does not change the accessibility requirements, because the regulations do not require equipment spaces that are not open to the public to be accessible.

Correctly classifying the Use Group does have an impact on other code requirements. For example, the Lower Level of the proposed Sludge Storage Building is a Hazardous Use Group due to the Sodium Hydroxide. It is acceptable to let the entire area default to that classification, but it must meet the requirements of that Use Group which are more stringent then a Factory Use Group. The maximum common path of travel, the distance from any point in the space to the stairway door, is 25 feet for a Hazardous Use. It does not appear that this can be achieved without an additional stair as second means of egress from the Lower Level.

Description of Alternative Concept:

Assign a Use Group Classification to each area at the facility to determine the specific code requirements.

In the example above, a simple solution would be to enclose the Sodium Hydroxide within a separate room. The walls would be fire rated as required for a separation between an H-4 Use and F-1Use. The remaining area in the Lower Level would then be an F-1 Use. The common path of travel limit for an F-1 Use without a sprinkler is 75 feet. This would make the current layout with a single stairway comply with the code.

Advantages	Disadvantages
• Clearly defines the code requirements targeted for each space. • Limit application of more stringent code requirements to only areas where needed. • Improves safety for the staff.	

Recommendation:

Assign a Use Group Classification to the areas at the facility to determine the code requirements. Then look for options to limit the impact to existing structures and the need to build additional infrastructure.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3-17-16

Item # 27

Item Title :	Chemical Storage – Fire Protection	Reference or affected design document(s)
Assigned Engineer:	Dan Pratt	Spec. Sect.:
Recommendation:	Provide fire protection only where needed.	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$12,600		
Alternative Concept	$1,500		
Estimated Savings	$11,100	N/A	N/A

Description of Baseline Concept:

The Basis of Design Report indicates that a fire protection system will be provided at all chemical storage areas within the new Sludge Storage Building. The building code only requires fire protection at chemicals that are rated as a Hazardous Use Group. Of the chemicals proposed only Sodium Hydroxide is rated as a hazardous chemical by the building code. Sodium Hydroxide is classified as a corrosive and storage areas are classified as a Hazardous Use Group, specifically H-4.

Description of Alternative Concept:

Separate the hazardous chemical and provide fire protection only at that space.
Locate the Sodium Hydroxide in a separate room and use a limited area sprinkler system for just this space versus all of the chemical areas. A limited area sprinkler system is a very simple system used to address isolated hazards and does not need to comply with the requirements of NFPA 13. The system is directly tied into the domestic potable water supply in the building. This would eliminate the need for additional site piping, Siamese connection, and riser. Since it uses the domestic water supply, the water pressure available on site is not an issue. With low water pressure, an NFPA 13 sprinkler system would require boosting the water pressure with a water storage tank and fire pumps on site.

Advantages	Disadvantages
• Lower cost due to less fire protection area and using a less complex system. • Existing water pressure is not a concern so there is no need to boost the water pressure on site. • Lower operations costs since almost no annual testing required.	

Recommendation:

Locate the Sodium Hydroxide in a separate fire rated room and provide a simple limited area sprinkler system in that room only.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3-16-2016

Item # 30

Item Title :	Operations Building New Electrical Room NEC Egress Requirements	**Reference or affected design document(s)**
Assigned Engineer:	David Laskey	Spec. Sect.:
Recommendation:	Provide second means of egress from new Electrical Room. Provide new out-swing doors with panic hardware.	DWG.: **E-103** Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept	$5,000		
Estimated Savings	-$5,000	N/A	N/A

Description of Baseline Concept:

Present design indicates a new Electrical Room will be provided in the Operations Building by partitioning the existing Maintenance Room into two rooms, with the west half of the room becoming the new Electrical Room. Design drawings indicate that the existing in-swing doors will remain. A second means of egress from the Electrical Room has not been indicated to be provided.

Description of Alternative Concept:

National Electrical Code (NEC) Article 110.26 (C) requires a second means of egress from the new Electrical Room, based upon the electrical equipment amperage ratings and physical size of the equipment. In addition, all doors leading from the new Electrical Room must open in the direction of egress and must be provided with listed panic hardware.

Advantages	Disadvantages
• New Electrical Room will comply with NEC requirements for personnel egress and safety. • New second means of egress will allow direct access to main circuit breaker disconnecting means by first responders in the event of an emergency, without requiring significant travel through Operations Building. • Improves safety for staff and fire responders.	

Recommendation:

Provide new second means of egress from the new Electrical Room which leads to the exterior of the building. Replace existing doors with new doors which open in the direction of egress. Provide all doors with listed panic hardware.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: March 16, 2016

Item # 31

Item Title :	Mechanical – Hydronic Piping	Reference or affected design document(s)
Assigned Engineer:	Nat Balch	Spec. Sect.:
Recommendation:	Recommended	DWG.: N/A Other: Basis Report

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$321,400		
Alternative Concept	$64,280		
Estimated Savings	$257,121	Not Estimated	Not Estimated

Description of Baseline Concept:

The design proposes replacing the entire heating system, including boilers, piping, unit ventilators, pumps, valves and controls.

Description of Alternative Concept:

Consider retaining the existing hydronic piping system. Pressure-test to 60 PSI to verify tightness, and repair/replace leaking joints selectively where needed. Replace boilers, pumps, expansion tank, unit heaters, valves and controls. Selectively replace/restore pipe insulation. This will reduce the piping replacement cost up to 80%.

Advantages	Disadvantages
Concentrates mechanical system expenditures on equipment which has a +/- 20-year operating life. Reduces project cost.	Requires additional research/analysis during design phase.

Recommendation:

It is recommended that selective demolition and replacement of the hydronic piping be considered versus a complete plant wide replacement.

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DATE: March 16, 2016

Item # 32

Item Title :	Mechanical – Energy Recovery	Reference or affected design document(s)
Assigned Engineer:	Nat Balch	Spec. Sect.:
Recommendation:	Consider	DWG.: N/A Other: Basis Report

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$60,000		
Alternative Concept	$120,000		
Estimated Savings	-$60,000	$23,500/year	Not Estimated

Description of Baseline Concept:

Providing Dx packaged rooftop air conditioning with hydronic heat, ductwork, insulation, controls, etc., over a 4,500 s.f. area would incur an initial cost of approximately $60,000, for a 12-ton system. This approach would cost an estimated $47,000 per year to operate.

Description of Alternative Concept:

Providing Dx packaged rooftop air conditioning with hydronic heat, ductwork, insulation, controls, etc., with energy recovery over a 4,500 s.f. area would incur an initial cost of approximately $120,000, for a system with much smaller heating and cooling components. This system would cost an estimated $23,500 per year to operate, for a 5.1 year cost/payback.

Advantages	Disadvantages
More efficient Less energy consumption Greener	Higher initial installation cost More complex system Higher maintenance

Recommendation:

Consider, if capital funds are available.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3/16/16

Item # 33

Item Title :	Fiber Optic Cable Replacement	Reference or affected design document(s)
Assigned Engineer:	James Papadimitriou, P.E.	Spec. Sect.:
Recommendation:	Replace fiber optic communications with 5GHz Wireless Ethernet	DWG.: I-001 Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$31,200	$1,200	
Alternative Concept	$2,500	$0	
Estimated Savings	$28,700	$1,200	Not Estimated

Description of Baseline Concept:

Baseline concept has approximately 1,200 feet of 12 pair of multi-mode fiber optic cable in 3″ PVC conduit in duct bank. There are currently 4 wireless access points NOT dedicated to the SCADA Network communications. There is 1 access point dedicated to SCADA.

Description of Alternative Concept:

Alternate concept has the REMOVAL approximately 2,500 feet of 12 pair of multi-mode fiber optic cable in 3″ PVC conduit in duct bank. It also calls for the replacement of proposed access points with Wireless 5 GHz 802.11a/n/ac Ethernet Protocol with up to 1.3 Gbps data rate.

Advantages	Disadvantages
• Lower Installation Cost • Higher degree of flexibility in adding new access points • Mesh network for reliability	• Possible lower bandwidth at high amounts of data.

Recommendation:

Replace fiber optic communication with high speed access points for SCADA network at 5GHz with 802.11a/n/ac protocol and up to 1.3GHz speeds.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3-16-2016

Item # 40

Item Title :	Relocate New Standby Generator to West End of Operations Building	**Reference or affected design document(s)**
Assigned Engineer:	David Laskey	Spec. Sect.:
Recommendation:	Relocate new Standby Generator to west end of Operations Building	DWG.: E-020 Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$280,000		
Alternative Concept	$280,000		
Estimated Savings	$0		

Description of Baseline Concept:

The present design proposes to locate the new 750kW Diesel Standby Generator at the east end of the existing Operations Building. The generator would be located adjacent to the proposed new Pad-Mount Transformer between the building and the fence along Water Street. Both the transformer and the generator would be installed on top of a large concrete foundation to raise them above flood elevation.

Description of Alternative Concept:

Locate the new Standby Generator in the area to the west of the existing Operations Building, along the fence line between the Operations Building and the Chlorine Contact Tank. Provide separate underground feeders from the generator to the proposed new 2000 Amp Switchboard. Because this area is at a higher elevation than the east end of the Operations Building, the concrete foundation would not require as much height or material. The proposed new Pad-Mount Transformer could remain between the building and the fence along Water Street. Because the conductor lengths from the generator to the switchboard would be approximately the same with either location, it is not expected that this relocation will result in significant electrical cost savings.

Advantages	Disadvantages
• Cost savings associated with less materials used in the generator foundation. • Significantly smaller foundation required at the east end of the Operations Building along Water Street. • Reduced potential for generator noise issues with generator located away from Water Street. • Separation of normal electrical service equipment and conductors from standby power equipment and conductors, reducing potential for simultaneous failure of both electrical sources.	• Loss of one parking spot next to the Operations Building.

Recommendation:

Consider relocating the new Standby Generator to the area to the west of the existing Operations Building, along the fence line between the Operations Building and the Chlorine Contact Tank.

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS

DATE: 3-17-16

Item # 37

Item Title :	Storage Building	Reference or affected design document(s)
Assigned Engineer:	Dan Pratt	Spec. Sect.:
Recommendation:	Recommended	DWG.: Other:

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept	$100,000		
Alternative Concept	$30,000		
Estimated Savings	$70,000		

Description of Baseline Concept:

The design includes a Screenings Container/Storage Building most of which is dedicated to storage.

Description of Alternative Concept:

Alternate location for storage.

Combining a process space with storage results in a costly building type. Separating these two functions provides flexibility in options for meeting the storage needs. Typically a storage building can be much simpler. One option is to construct a very simple wood framed building that would not have significant excavation or foundation costs.

Advantages	Disadvantages
• Lower cost • Simpler Building more flexibly in locating on site. • Decreased construction time.	

Recommendation:

Consider separating the screenings and storage functions. Provide a simple building for storage.

APPENDIX A

PROJECT OVERVIEW (W&C ES)

EXECUTIVE SUMMARY

This Design Basis Report (DBR) describes Woodard & Curran's evaluations and recommendations for improvements to the Warren Wastewater Treatment Facility (WWTF). The preparation of this report is important for satisfying a requirement of the Consent Agreement (RIA-410) with the Rhode Island Department of Environmental Management (DEM). The Consent Agreement lays out a specific schedule for the planning, design and construction of improvements to the WWTF for the Town to come into compliance with the Rhode Island Pollution Discharge Elimination System (RIPDES) discharge permit.

The Town completed the planning phase required by the Consent Agreement with the DEM approval of the Facilities Plan Amendment Report in September 2014. The current phase is for the Town to complete the design and permitting of the upgrades to the WWTF. This DBR represents an important milestone toward completing the design phase in that it describes the basis for the detailed engineering effort. The DBR builds upon the evaluations and recommendations provided in the Facility Plan Amendment and advances the design of the upgrades to approximately the 30 percent complete level. This DBR includes the following improvements:

- New screening equipment at the headworks
- In-kind replacement of weirs, sludge pumping and collection equipment, and scum collection equipment at the primary pump station and primary settling tanks.
- New pumps at the intermediate pump station to increase the capacity.
- Construction of new reactor tanks, equipment and modifications to the existing secondary reactor tanks to provide biological nitrogen removal (BNR).
- Upgrades to the secondary settling tank mechanisms, weirs and baffles.
- Replacement of the chlorine contact tank weirs; new instrumentation and a new sodium bisulfite feed system.
- In-kind replacement of the plant water system pumps.
- A new sludge handling facility with gravity co-thickening of primary sludge and waste activated sludge (WAS). The new sludge handling facility will include new sludge transfer pumps, a rotary drum thickener, chemical feed systems, and odor control. The existing sludge storage tank and building are to be demolished and sludge processing will be eliminated from the operations building basement, enhancing safety and efficiency.
- Architectural and structural rehabilitation of existing structures and buildings throughout the facility
- Replacement of existing heating, ventilation, air conditioning and plumbing.
- New electrical service, transformer, emergency generator, switch gear and motor control centers.
- Upgrades and expansion of the instrumentation and control systems.

It is noted that through the preliminary engineering effort, Woodard & Curran has refined and modified the recommendations from the Facility Plan as follows:

- Obtained additional existing conditions information through a hazardous materials survey, a topographical site survey, a geotechnical evaluation, and internal structural inspections of process tanks.
- Additional flow and pollutant load analysis utilizing additional data gathered since the Facility Plan to confirm (with slight modifications) the design parameters.
- Process valve and piping replacements: The Facility Plan did not include replacement of piping and valves; this DBR includes replacement of valves, sludge suction piping and recommends ultrasonic testing during detailed design with selective replacement.

- Screenings storage: the Facility Plan included outdoor storage of screenings; this DBR provides an enclosure for screenings. This enclosure is also intended to store plant equipment such as lawn mowers, snow blowers, forklift, etc.
- Primary sludge pumps: the Facility Plan recommended double disk primary sludge pumps; this DBR recommends recessed impeller pumps.
- Primary settling tank collector mechanisms: the Facility Plan recommended replacement of collector mechanisms in the two of the six tanks; this DBR recommends replacement of all six.
- Reactor mixing and aeration: the Facility Plan recommended submersible mixers and fine bubble diffusers for mixing and aeration; this DBR recommends hyperbolic mixers for anoxic zones and mixer/aerators for aerobic and swing (aerobic or anoxic depending on operation mode) zones.
- Secondary settling tank flow distribution: the Facility Plan recommended a flow distribution structure between the reactors and the settling tanks; this DBR recommends eliminating the flow distribution structure.
- Sludge handing building size: the size of the sludge handling building has increased in this DBR from what was planned for in the Facility Plan. The increase in size was needed to accommodate additional chemical storage not anticipated at the planning stage.

Based on the preliminary engineering contained herein, Woodard & Curran estimates the total project capital cost at $21.7 million with a construction cost for the recommended improvements of $20 million.

APPENDIX B

VE PRESENTATION

Value Engineering Session
Warren, RI WWTF Upgrade

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Presentation Overview

- Expectations from Value Engineering process
- Scope/procedure
- Considerations/alternatives by unit process
- Answer questions
- Summarize

Expectations

- Presentation – Big Picture Overview
- Present ideas/opinions of cost savings
- Answer questions on concepts
- Intent for W&C to dive into the comments to determine feasibility
- Provide written report with all items within two weeks

Procedure

- Initial brainstorming session
  - 42 unique ideas
- Detailed analysis of approximately 1/3rd of the ideas
- Report will contain the brainstorming ideas, detailed analysis and opinion of value/cost impacts

Item No.	Item Title/Description
	General Conditions
1	Construction Period
2	Temporary Construction Facilities
3	Construction Sequencing
	Headworks
4	Screenings Building Above Grit Tank
5	Eliminate new influent mechanical screens, wash press and Building
6	Influent Screening opening size
7	Grit Aeration - reduction of aeration volume
8	Primary Clarifiers
9	Submersible chopper pump for scum...instead of mixers and pumps
10	Septage Tank/night soil tank - Do we need to have vs direct discharge
11	Consider separate electrical room
	Intermediate Pump Station
12	Dry pit pump vs nonclog vertical - higher efficiency
13	Pump size versus pump cycling - jockey pump
14	Review air ventilation rates
	Aeration Tanks
15	Nutrient Removal Process Design
16	Mixer Aerator Design and Configuration
17	Nutrient Removal Process Alternative
18	Aeration Tank Configuration/Dimensions - Excavation issues
	Secondary Clarifier
19	Consider suction tube vs Spiral blade
	Chlorine contact tanks
20	Chemical Building over CCT - Carbon, Bisulfite and Caustic
21	Disinfection and Dechlorination Instrumentation
22	New chemical building
23	GT inside in CCT and UV inside other tank
24	Don't pump chemical pumps under chemical piping
25	Less but larger chemical bulk tanks
	Solids Handling Building
26	Gravity thickeners inside existing footprint with transfer pumps
27	Gravity thickeners as steel tanks within existing footprint
28	Single gravity thickener vs two
29	Piston pumps for sludge transfer vs double disk
30	Relocate chemical to upper level to reduce lower level excavation
31	Solids handling building basement chemical ventilation issues
32	Solids Handling lower level fire protection - Fire pump
33	Building classification use group
	Admin Building
34	Rotary drum thickeners in upper level of admin building, polymer
35	Reuse existing thickened sludge storage tank
36	New exterior thickened storage tank on west side of Admin with pumps in lower level of admin building
37	New Electrical room needs outside swing doors and second egress
38	Mechanical - Hydronic Piping
39	Mechanical - Energy Recovery
	Generator
40	Relocation to opposite side of site
	Cost Estimate
41	Review excavation and dewatering cost estimate
42	Demolition costs

Procedure

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WARREN, RI WWTF UPGRADE (30% DESIGN) VALUE ENGINEERING ANALYSIS	DATE:	March 17, 2016
	Item #	

Item Title :	Mixer Aerator Design and Configuration	Reference or affected design document(s)	
Assigned Engineer:	William Hankins	Spec. Sect.:	
		DWG.:	GA-501, 504
Recommendation:		Other:	

Estimated Cost Impacts

	Capital Cost	Present Worth of O&M Cost	Total Present Worth Cost
Baseline Concept			
Alternative Concept			
Estimated Savings	$275,000		

Description of Baseline Concept:

The proposed activated sludge process consists of multiple zones in series. Each zone includes either a mixer or mixer aeration. The Basis of Design Report identifies eight mixers and 12 mixer-aerations while the cost estimate identifies 20 mixer-aerations. The cost estimate identifies the capital cost for each mixer aeration at $33K. A mixer should be approximately half of the capital cost of a mixer-aeration. Thus, the current cost estimate should be reduced by approximately $210K if mixers are proposed.

The proposed activated sludge design incorporates four anoxic zones in series (mixers only) prior to the aerobic portion of the aeration tanks. The design also includes two post swing reactors each with a mixer-aeration.

Description of Alternative Concept:

The design of initial anoxic zone can be streamlined to eliminate the four zones in series. These zones in series (at the equivalent volume) would eliminate two mixers and two intermediate concrete baffle walls. These zones in series will still provide the same nutrient removal process performance and "biological selection" performance.

The design of the activated sludge process includes two post swing reactors in series in each aeration tank. These zones can be combined to a single zone without sacrificing process control/performance. Reducing the amount of mixers/mixer-aerations also eliminates internal baffle walls, electrical and control wiring, starters, etc. Each of the mixer aerations also requires a dedicated air flow control valve, air flow meter, DO probe, control wiring and programming.

To
Date
Page 2 of 2

Advantages	Disadvantages
- Less mechanical units will result in lower maintenance and operational costs - Lower capital cost - Eliminates internal baffle walls - Mixer-aeration - Eliminates air flow control valve, flow meter and dedicated DO probe - Eliminates additional structural support for each unit.	- Slight reduction in process flexibility - The new mixer and mixer-aeration units will have to increase in size and capacity.

Performance Assessment:

Criteria	Preliminary Analysis
Economic	
Operability	
Flexibility	
Staffing Requirements	
Energy Use	

Recommendation:

Big Picture Themes

- Finite amount of Capital Expenditure
  - $20M bond
- Facility Plan Concept
  - Reasonable approach
- Reduce capital cost while meeting Town's objectives
- Re-use existing infrastructure where applicable

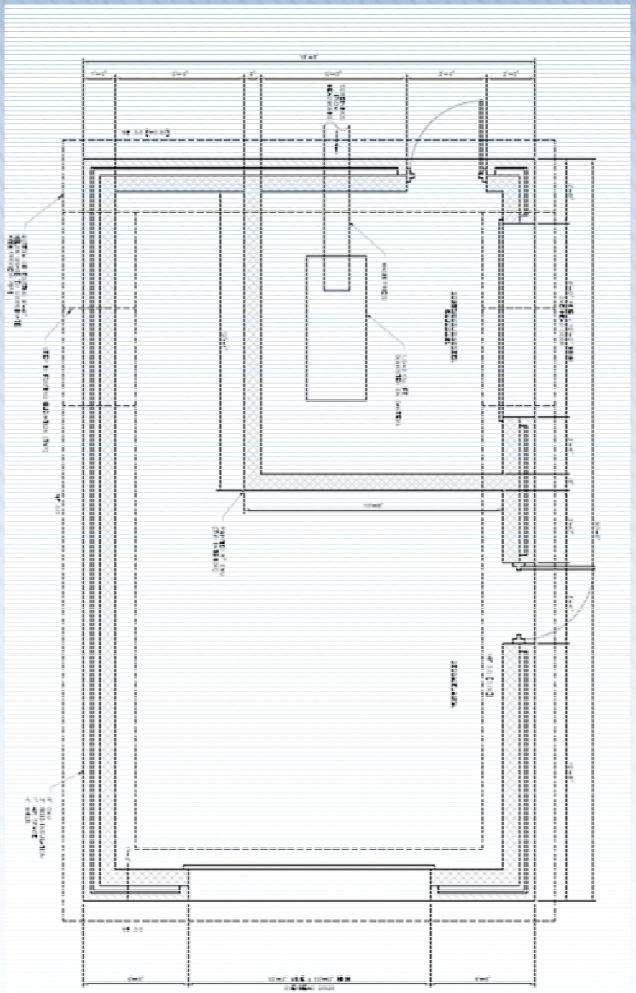
Construction Cost Estimate

- Considerations
  - Construction schedule
    - 12 months versus 24 months
  - Site Constraints
    - premium for laydown areas
    - Construction sequencing
    - tight site working conditions
    - plant access/sludge removal during construction
  - Cost of Money
    - Inflation / mid term adjustment

- Cost Impacts
  - 12% to 15% light
  - $1.5 to $2 million higher….

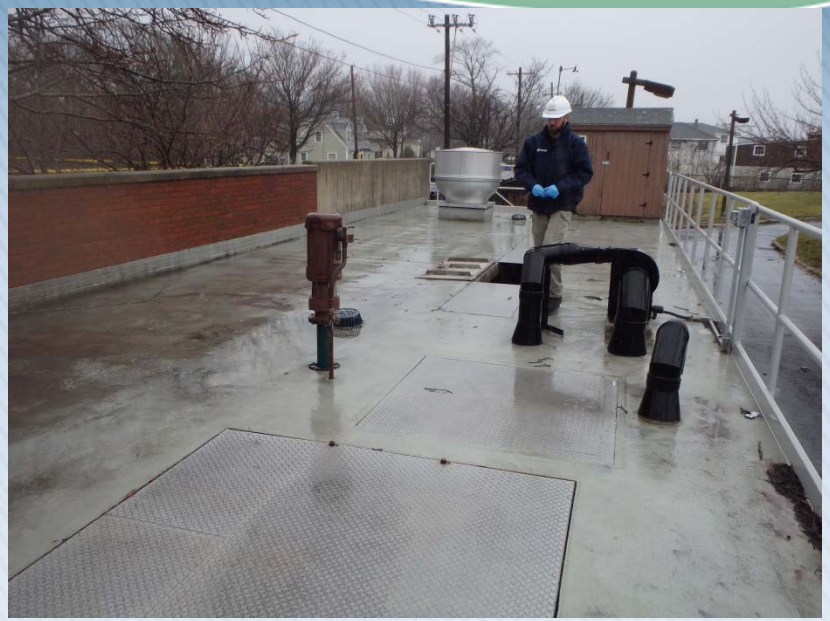
Headworks Area

- Considerations
  - Screen removal rates
    - ¼″ screen opening
    - Additional 5 cy/week
  - Additional screenings for offsite disposal
  - Expensive building system for storage
- Alternative
  - Consider not installing a new mechanical screen
  - Consider ½″ screen size opening
- Cost Impacts
  - ½″ screen size - $5,000/yr
  - Screening room size

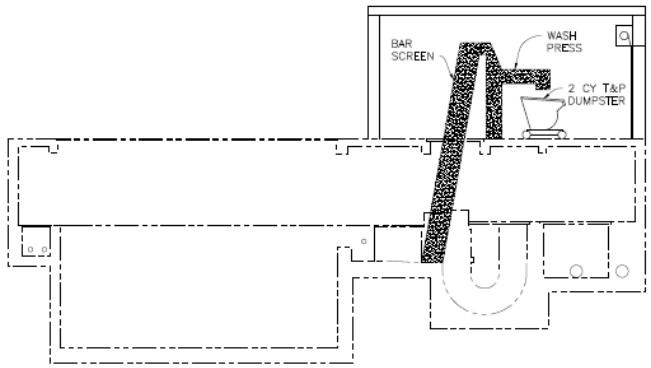


Headworks

- Considerations
  - Building site impacts
  - Limited space for equipment and maintenance activities
  - Wet corrosive area for washpress
  - Odor control volume



- Alternative
  - Construct new screening building above tanks
  - Longer screen to new "dry" area above with tipping container

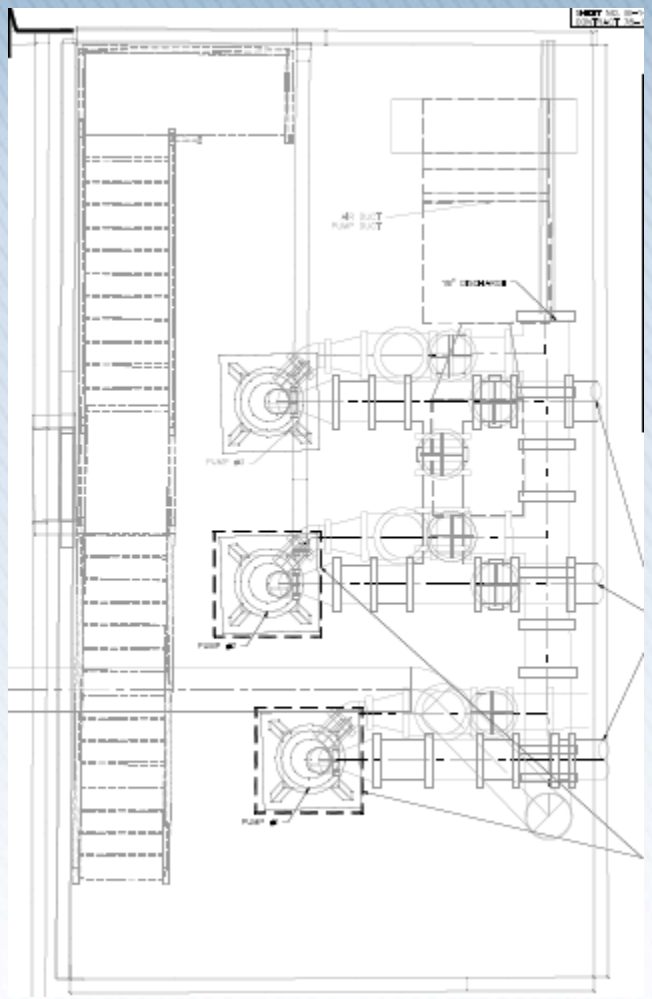


HEADWORKS SECTION
SCALE: 1/8"=1'-0"

- Cost Impacts
  - Savings of approx. $120K

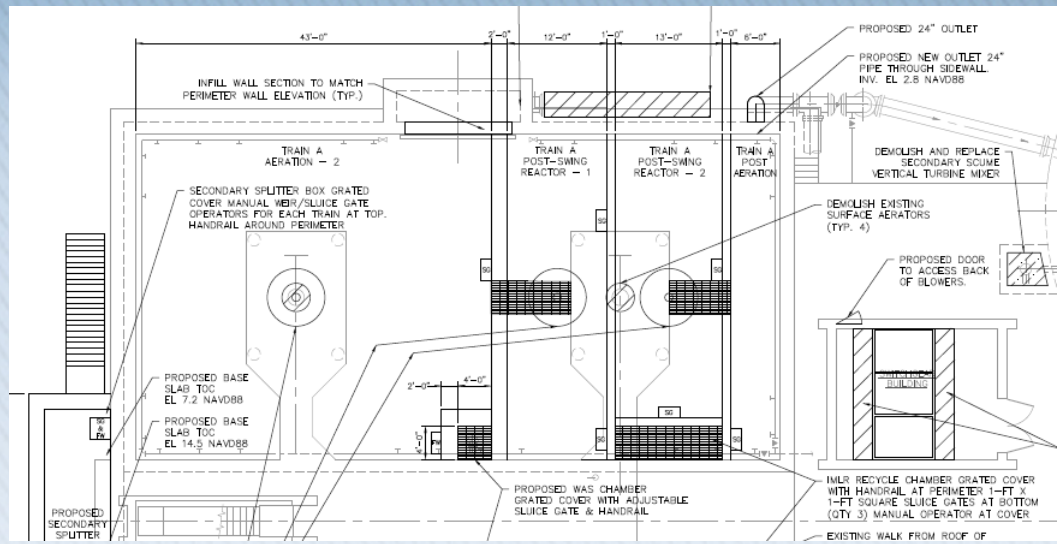
Intermediate Pump Station

- Considerations
  - Improve efficiency and reduce operating costs
- Alternative
  - Consider use of jockey pumps
  - Pump type
  - 2 small & 2 Large
- Cost Impacts
  - TBD



Activated Sludge Process

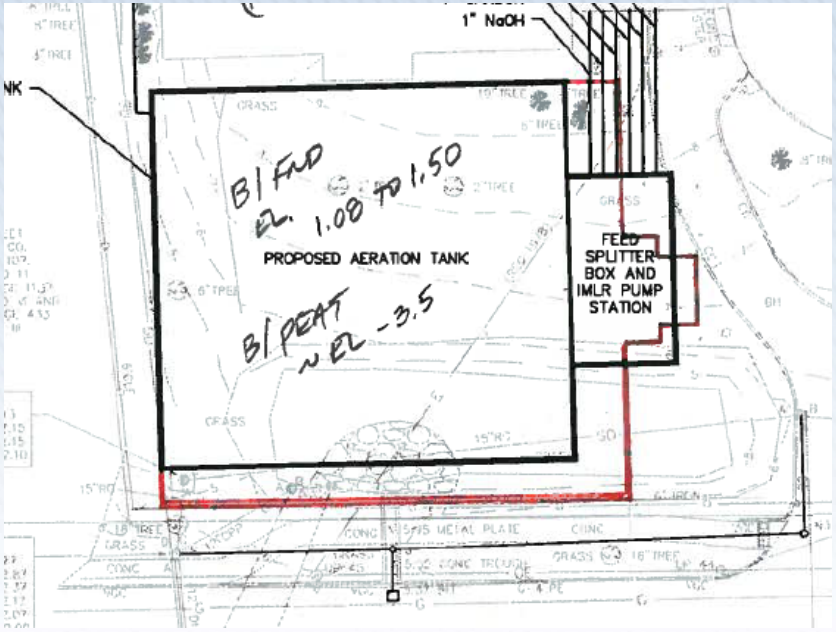
- VOM Process
  - Internal Recycle Pump Location
  - Consider surface and clarifier sludge wasting



- Step Feed Process
  - More complicated process
  - May require more supplemental carbon
  - May eliminate need for additional aeration tanks
  - Not recommended at this time, but consider if additional cost savings are required

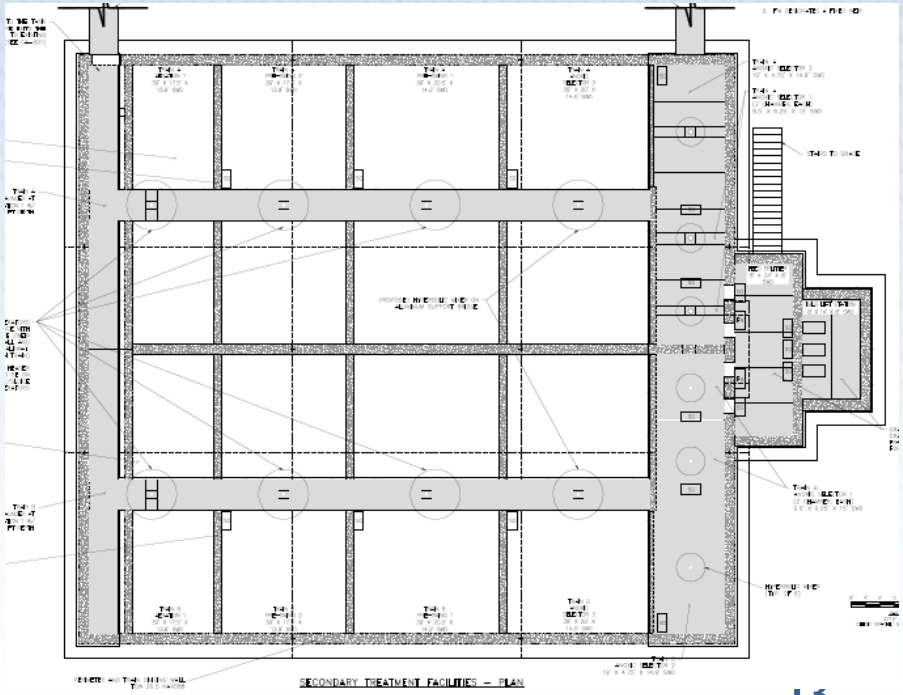
VOM Process

- Considerations
  - Constructability of aeration tanks
  - Current estimate may be low consider site constraints
- Alternative
  - Consider reducing size of aeration tanks
  - W&P: non-calibrated model
  - Bardenpho process
  - Potentially reduce required new volume by 50%
- Cost Impacts
  - Eliminate half of new aeration tanks: $1.3 million

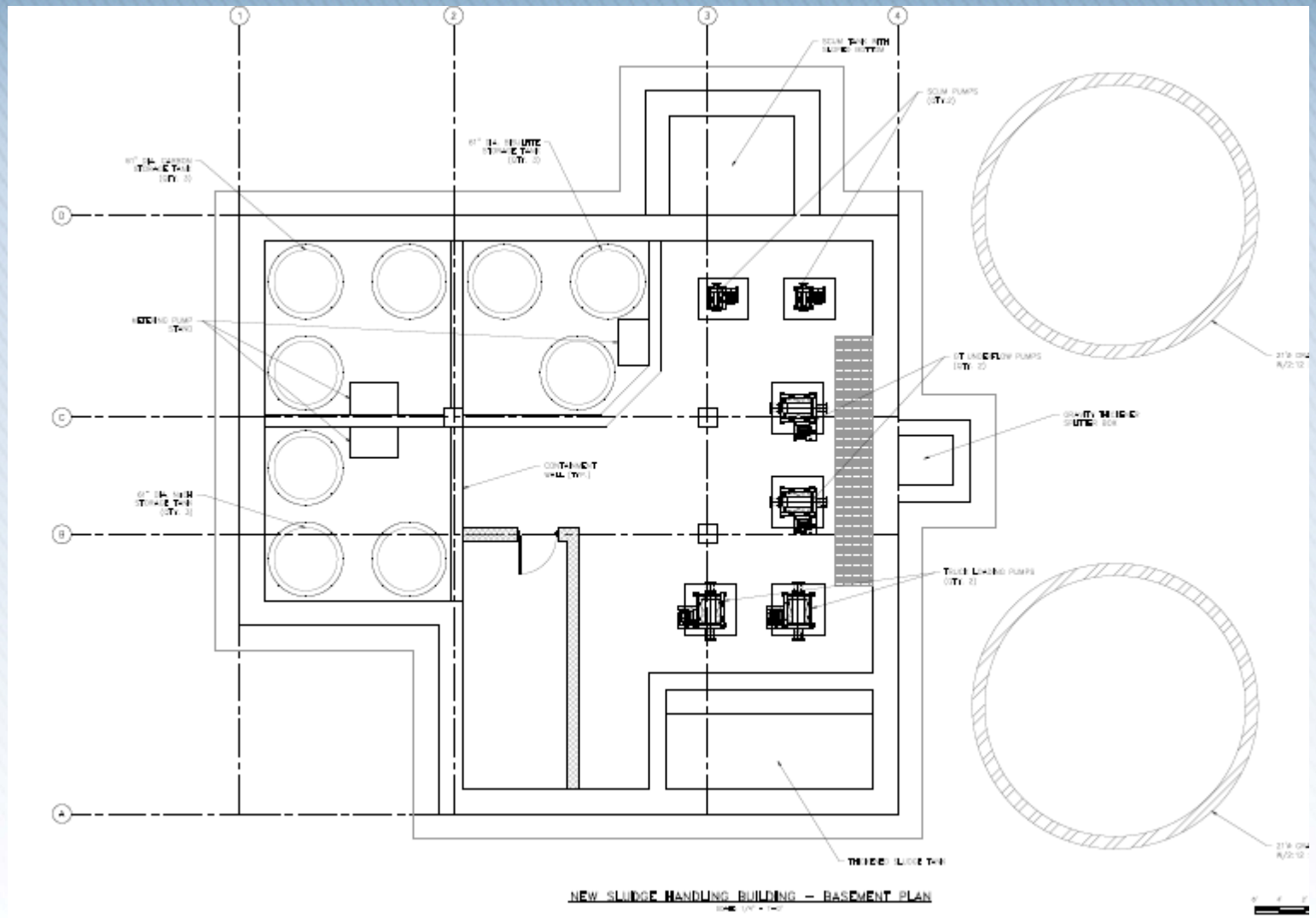


Activated Sludge Design

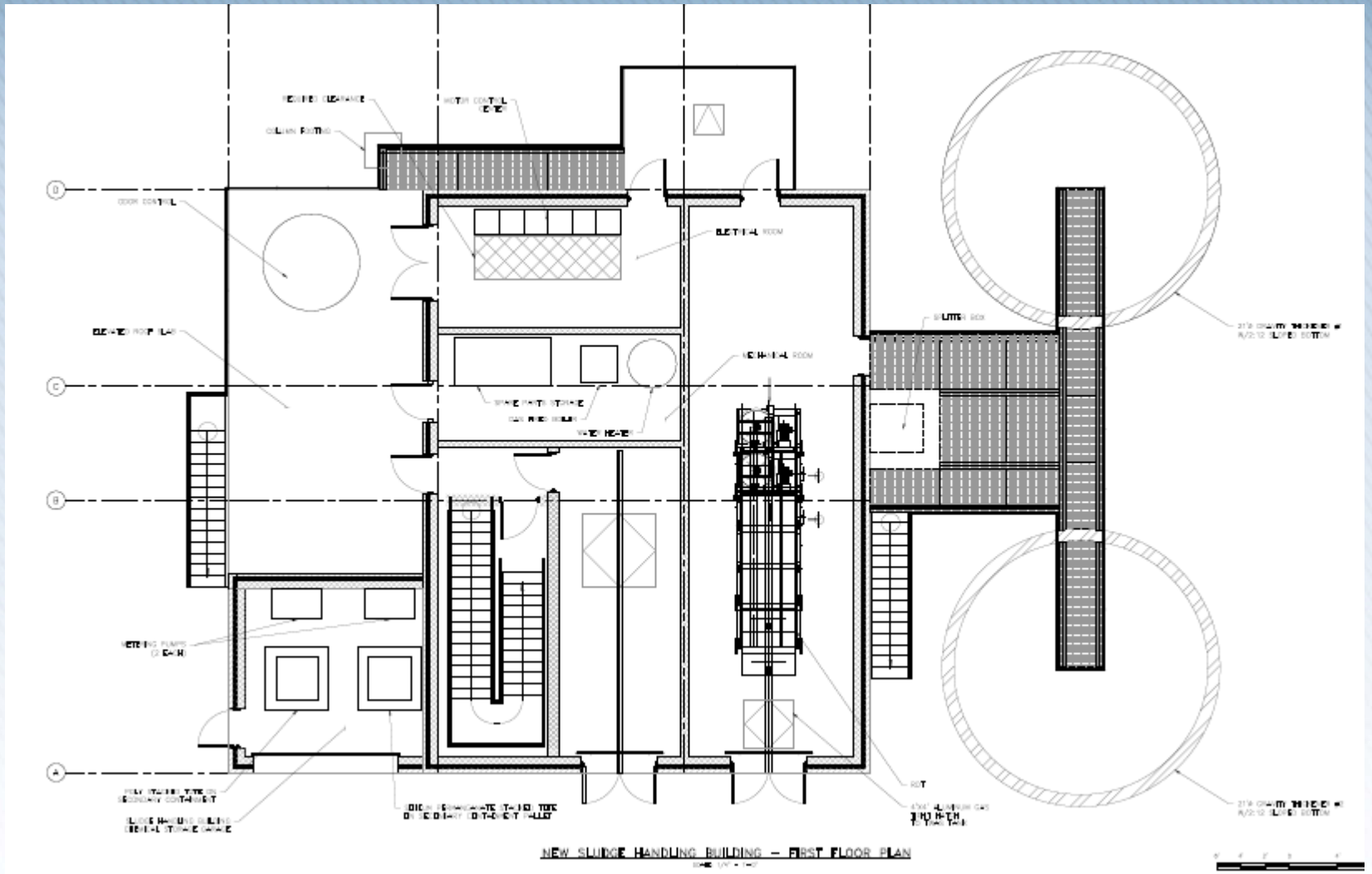
- Considerations
  - Number of mixers vs mixer-aerators
  - Each mixer-aerator requires a control valve, flow meter, DO probe and programming (capital and O&M costs)
- Alternative
  - Consider reducing number of mixer-aerators
  - Initial 3 zone selector to two zone
  - Post swing zones could be combined
- Cost Impacts
  - Cost saving potential ≈$275K



Solids Handling Building

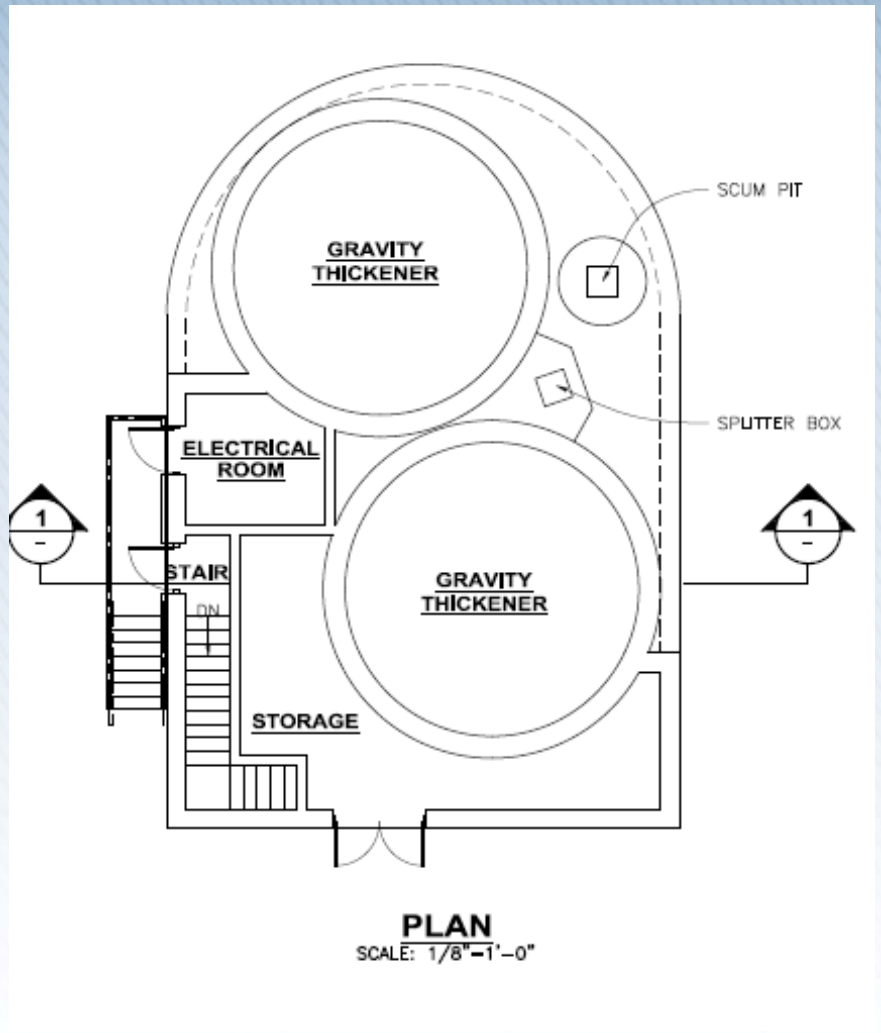


Solids Handling Building



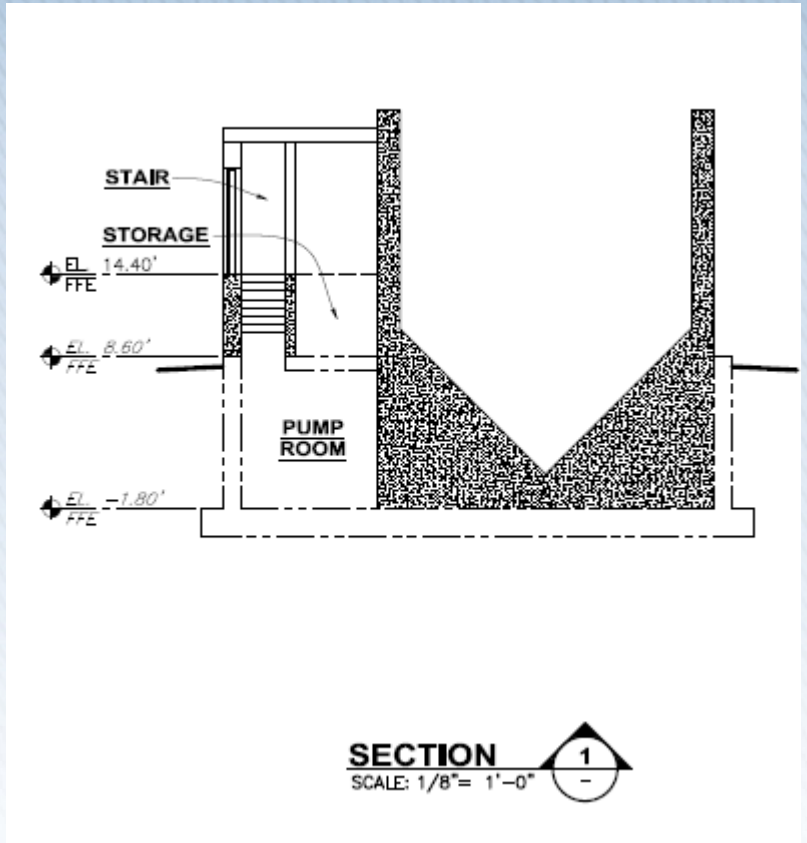
Solids Handling Building

- Considerations
  - Constructability (excavation and dewatering)
  - Cost impacts of site constraints
- Alternative
  - Consider utilizing existing building as formwork for new building/tanks
  - New gravity thickeners installed within envelope
  - Upper level electrical room
  - Upper level storage
- Cost Impacts
  - W&C estimate: ≈$525K in excavation and dewatering
  - Eliminates new foundation



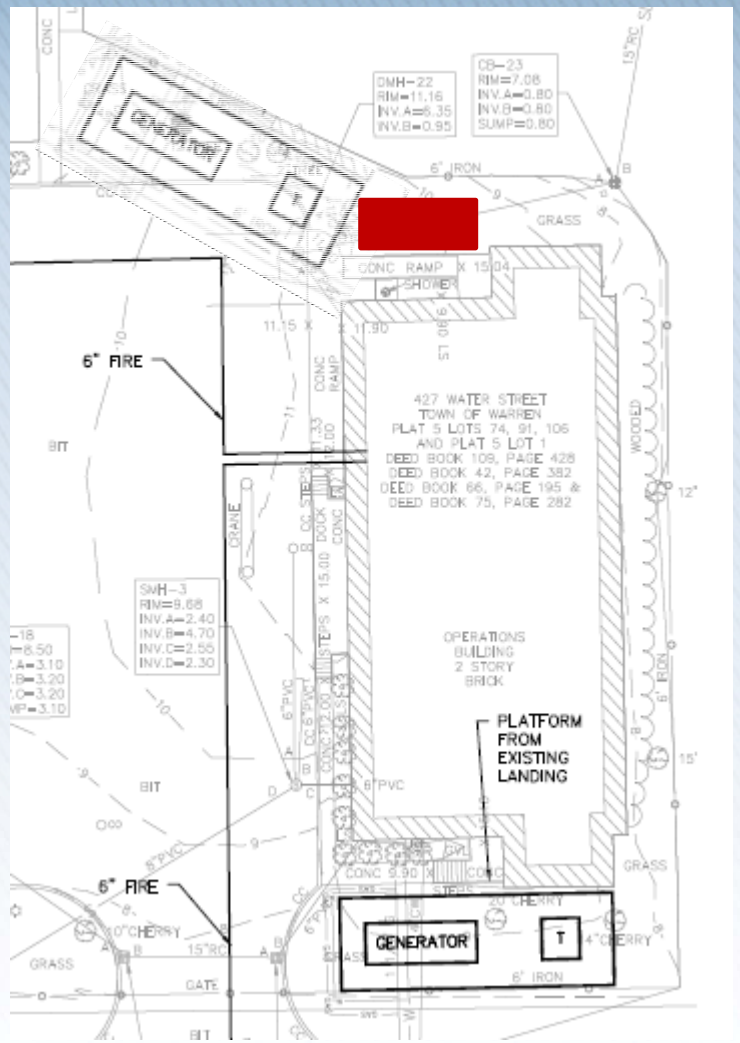
Solids Handling Building

- Alternative
  - Lower level pump room
  - Thickened sludge pumped to new RDT installed in upper level of Admin Building
- Admin Building
  - RDT installed in upper room
  - Space to expand to future dewatering if required
  - Existing sludge loading bay



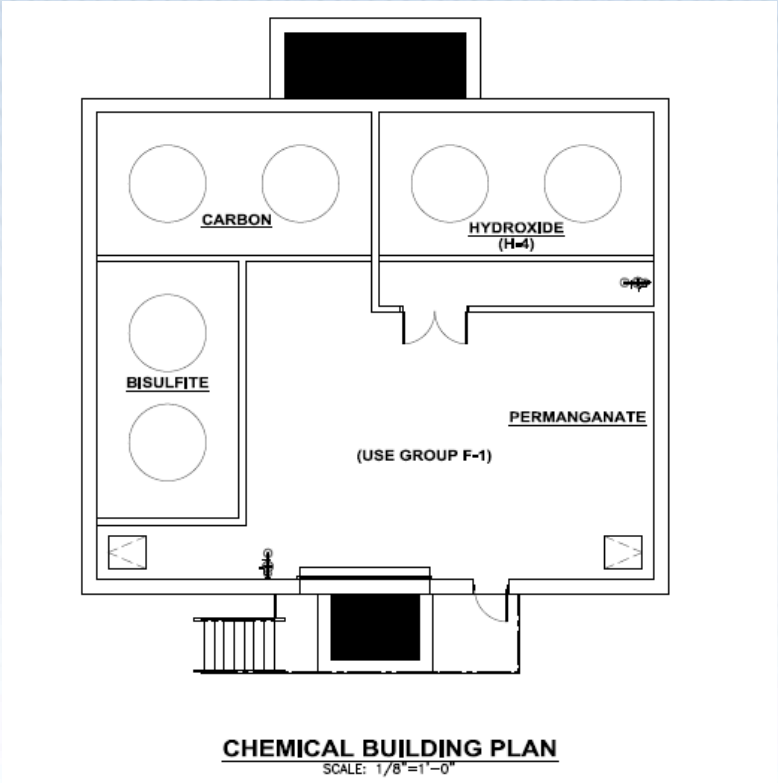
Administration Building

- Thickened Sludge Holding Tank
  - Re-use existing tank
  - Consider new precast thickened sludge tanks
  - New sludge transfer pumps in basement
- Generator
  - Alternative site location
- Cost Impacts
  - Re-use space in Admin building versus constructing new space



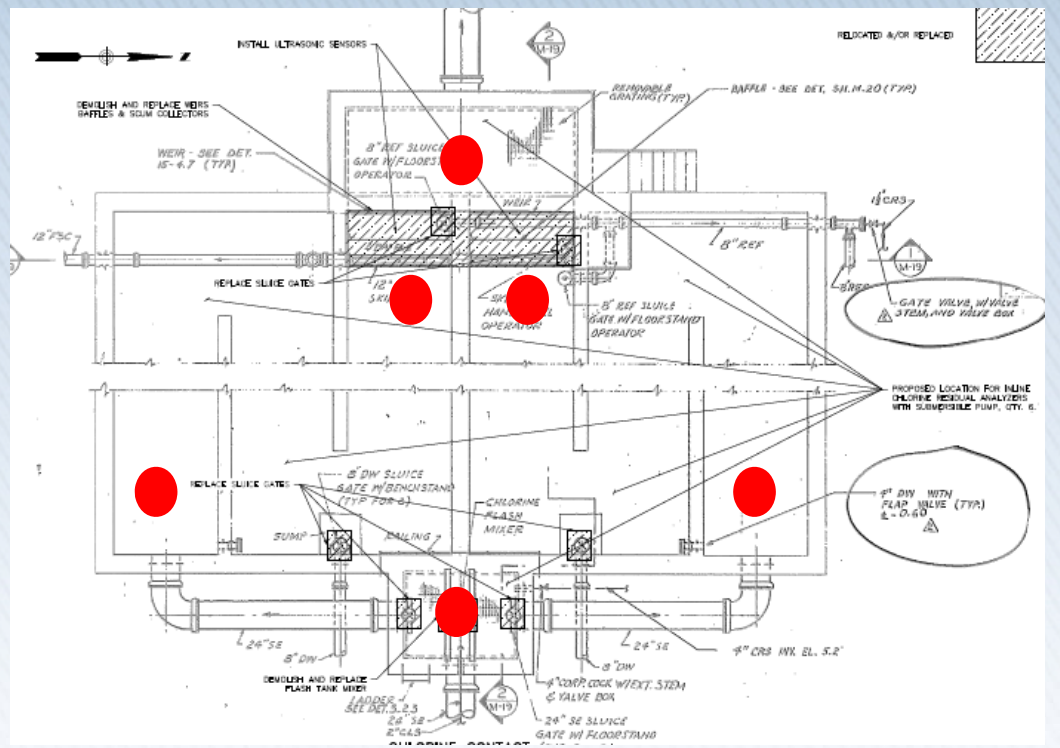
Chemical Building

- Considerations
  - Lower level storage and fire protection issues
  - Three tank design
- Alternative
  - Consider new chemical building installed over chlorine contact tanks
- Cost Impacts – Overall Solids Handling Concepts
  - Potential cost savings ≈ $750,000



Chlorine Contact Tank

- Considerations
  - Design included six chlorine residual analyzers
- Alternative
  - Consider use of two analyzers
- Cost Impacts
  - Potential cost savings of ≈ $50K



Administration Building

- Considerations
  - Approx. $545K in associated work
    - $45K in doors and windows
    - $64K in finishes (paint and drywall)
    - $100K in electrical
- Alternative
  - Consider limited renovation based on available budget

Mechanical Systems

- Considerations
  - The design proposes replacing the entire heating system, including boilers, piping, unit ventilators, pumps, valves and controls.
- Alternative
  - Consider retaining the existing hydronic piping system
  - Selective demolition based on piping condition
- Cost Impacts
  - Potential cost savings of ≈ $200K

Summary of Potential Cost Savings

	Additions	Recommended	Consider
Construction Costs	$1.5M		
Headworks		$120K	$120K
Aeration Tanks		$275K	$1.4M
Solids Handling		$750K	$750K
Chlorine Contact Tanks		$50K	$50K
Mechanical Systems		$200K	$200K
Total	**$1.5M**	**$1.4M**	**$2.5M**

Questions/Discussions

WRIGHT-PIERCE

Engineering a Better Environment