Lake Whatcom Water and Sewer District

Sudden Valley WTP Assessment Project

August 11, 2021

Project Team: Russ Porter P.E., Keith Stewart P.E.

Presentation Outline

- Project Description & Purpose
- Project History & Background Information
- Alternatives Analysis Summary
- Risk Assessment Summary
- WTP Alternatives Analysis Report
- Next Steps

Project Description & Purpose

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- South Shore Water System Assessment
  - Assess conditions at Sudden Valley WTP
  - Provide basis for decision making with regards to WTP modifications and / or continued use
    - Phase I
      - Assess existing condition of structures and equipment
    - Phase II
      - Provide alternatives analysis & recommendations

Project History & Background Info

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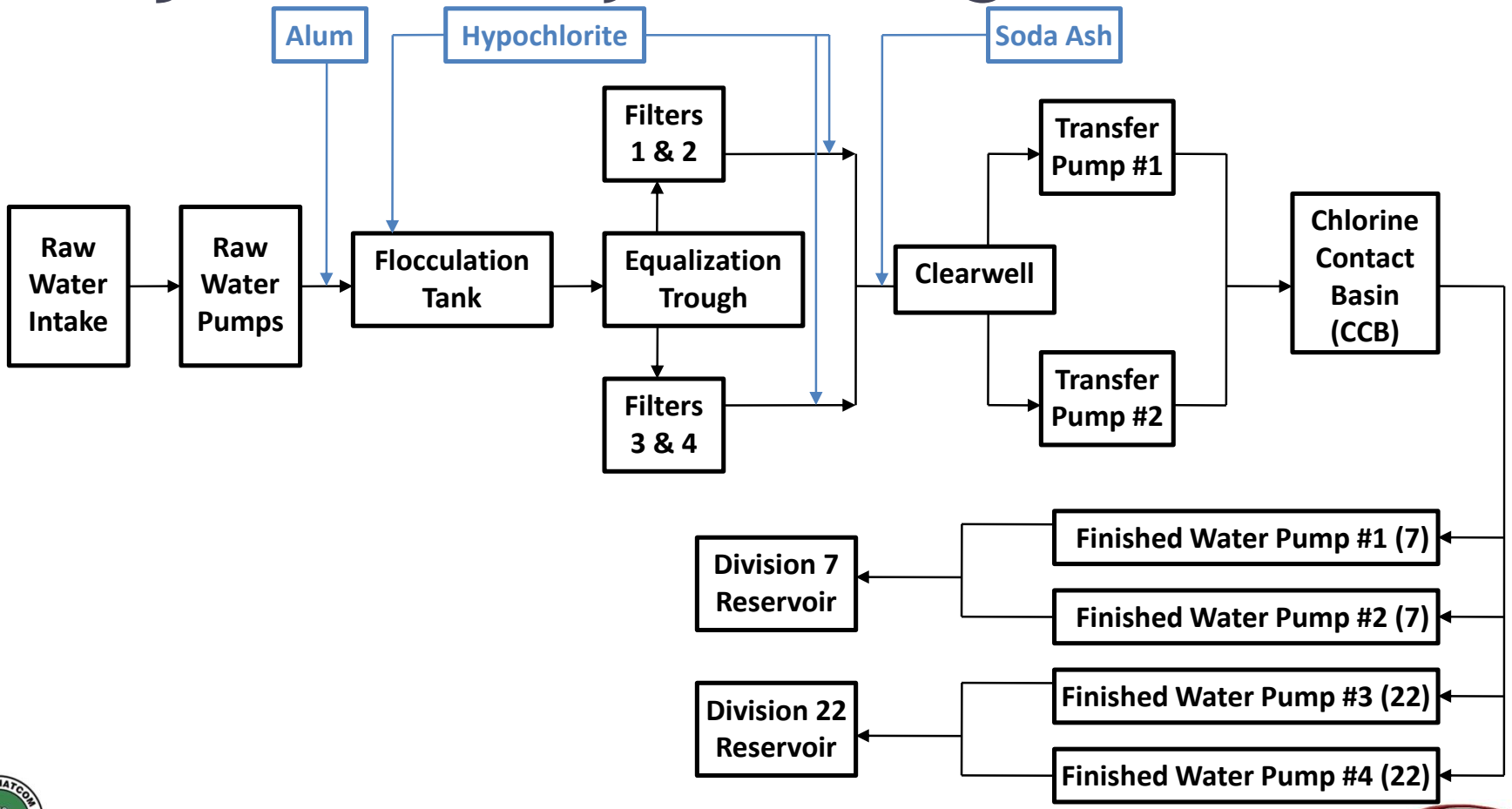
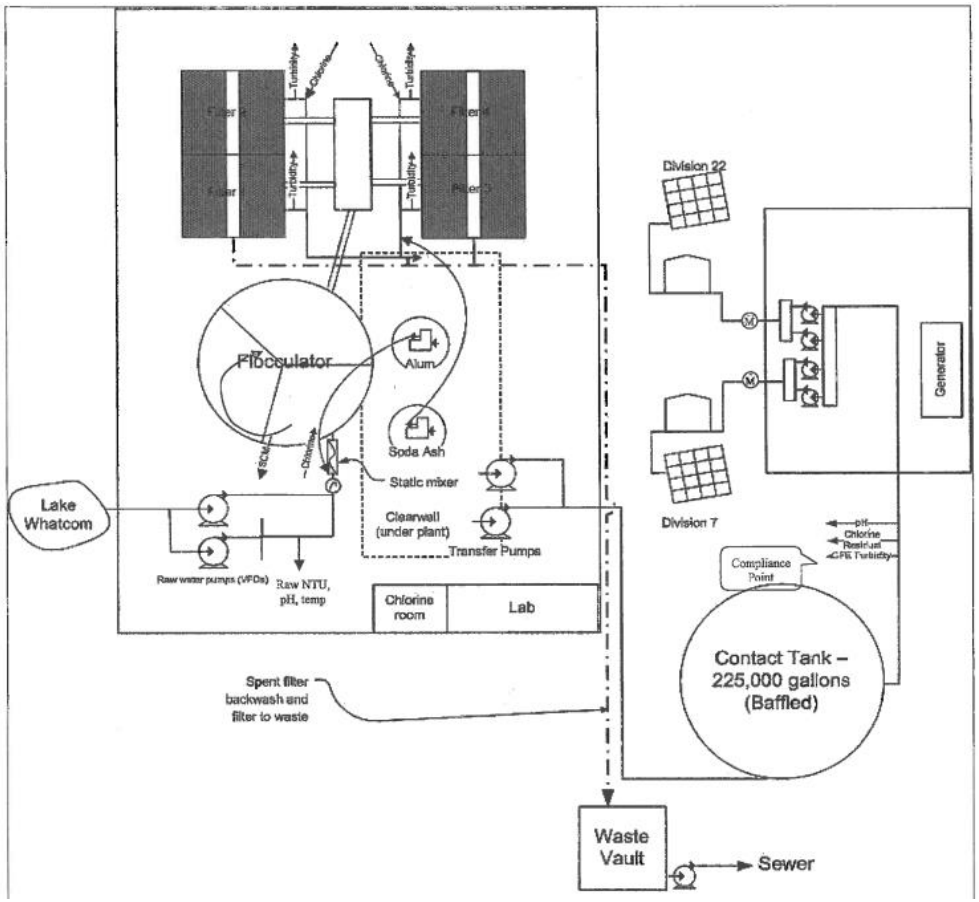
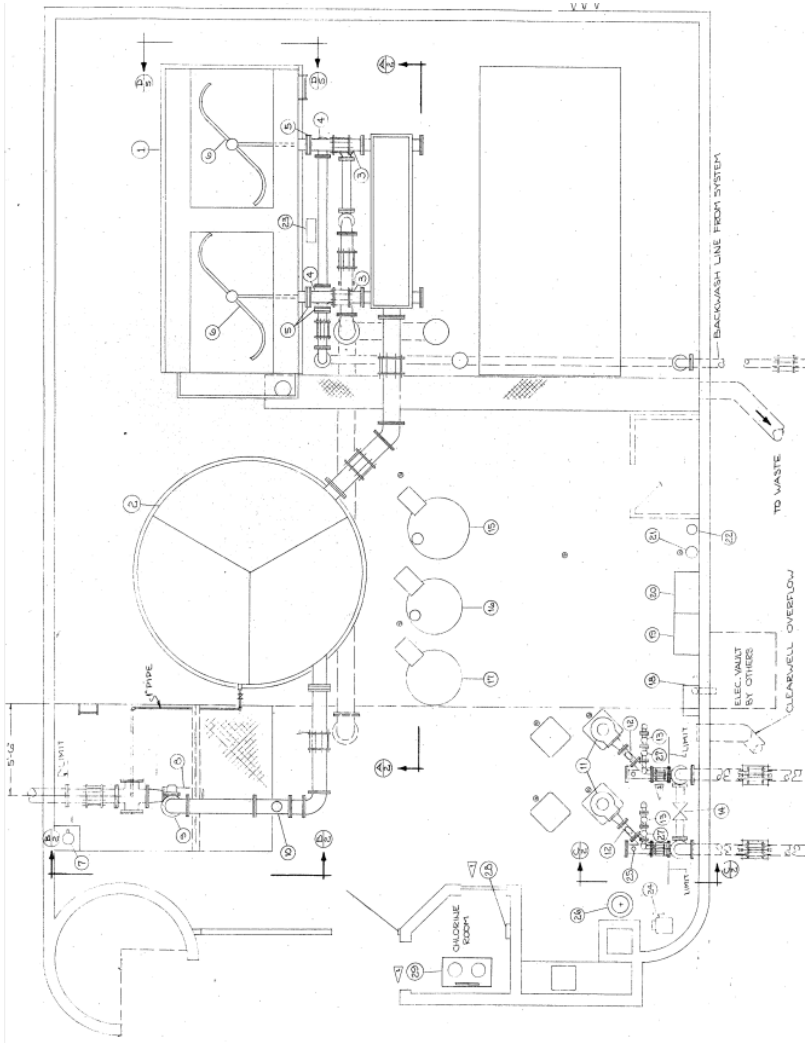
- Phase I - WTP Condition Assessment
  - Sudden Valley Water Treatment Plant

Project History & Background Info

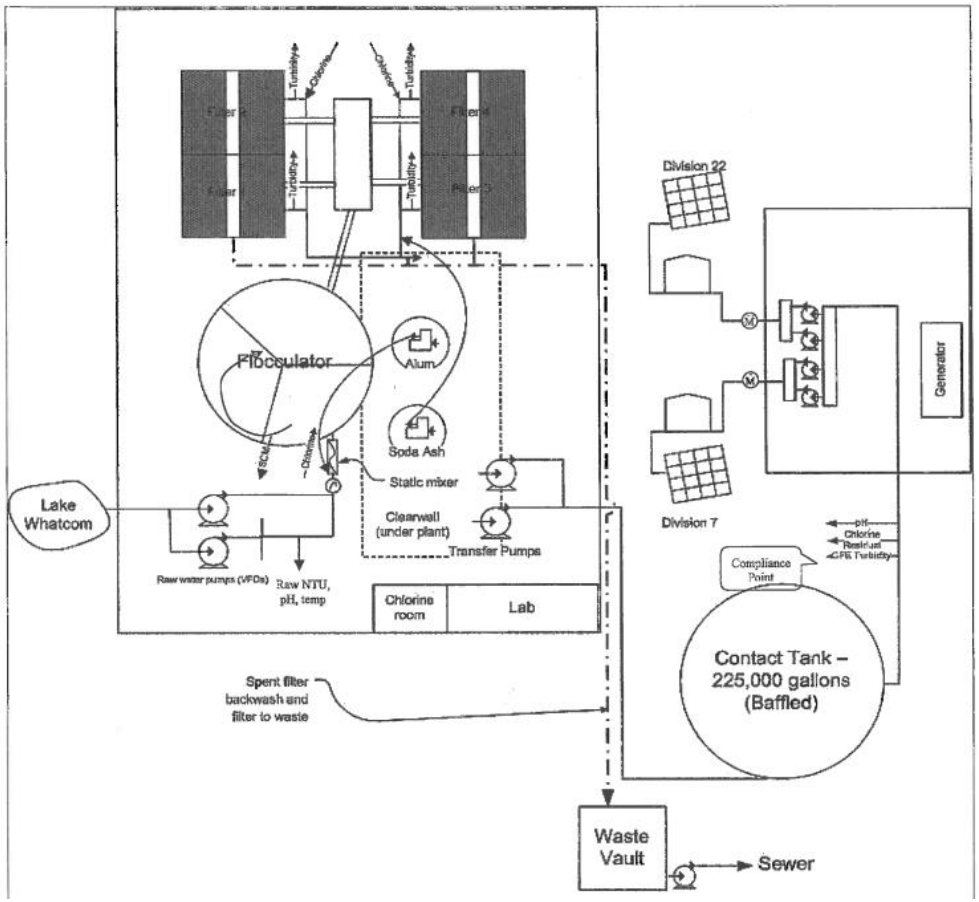




Schematic view of SV WTP Main Building.



Mechanical plan of SV WTP Main Building.



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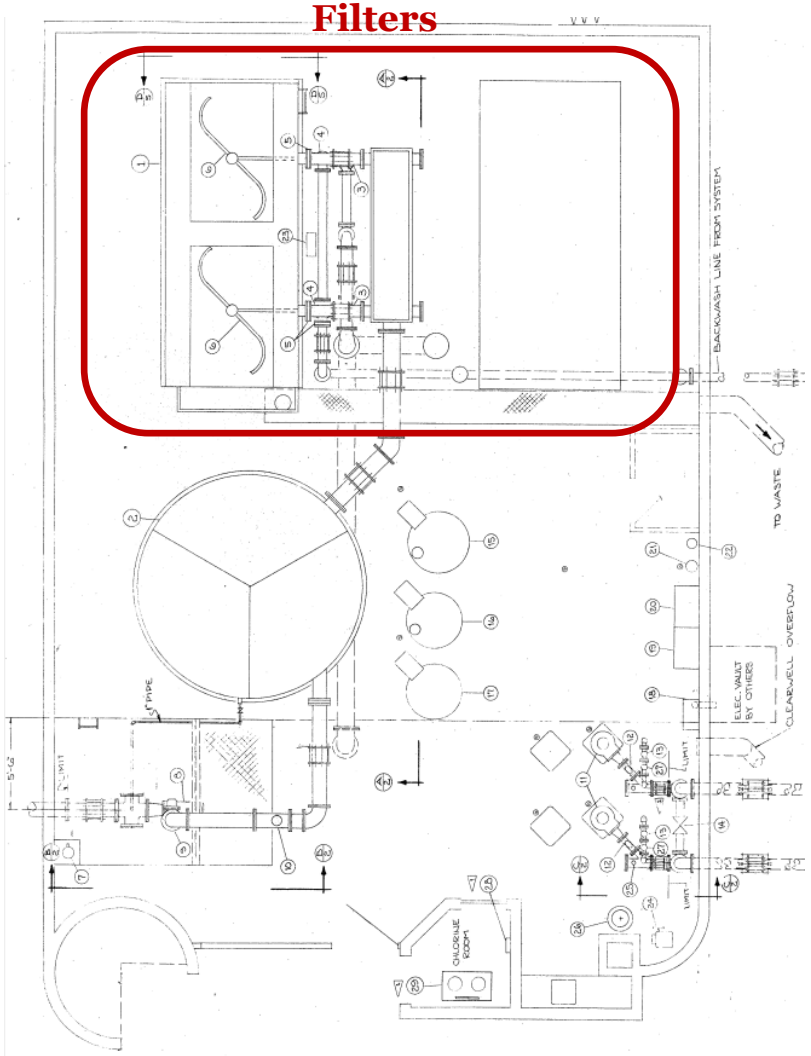
Filters



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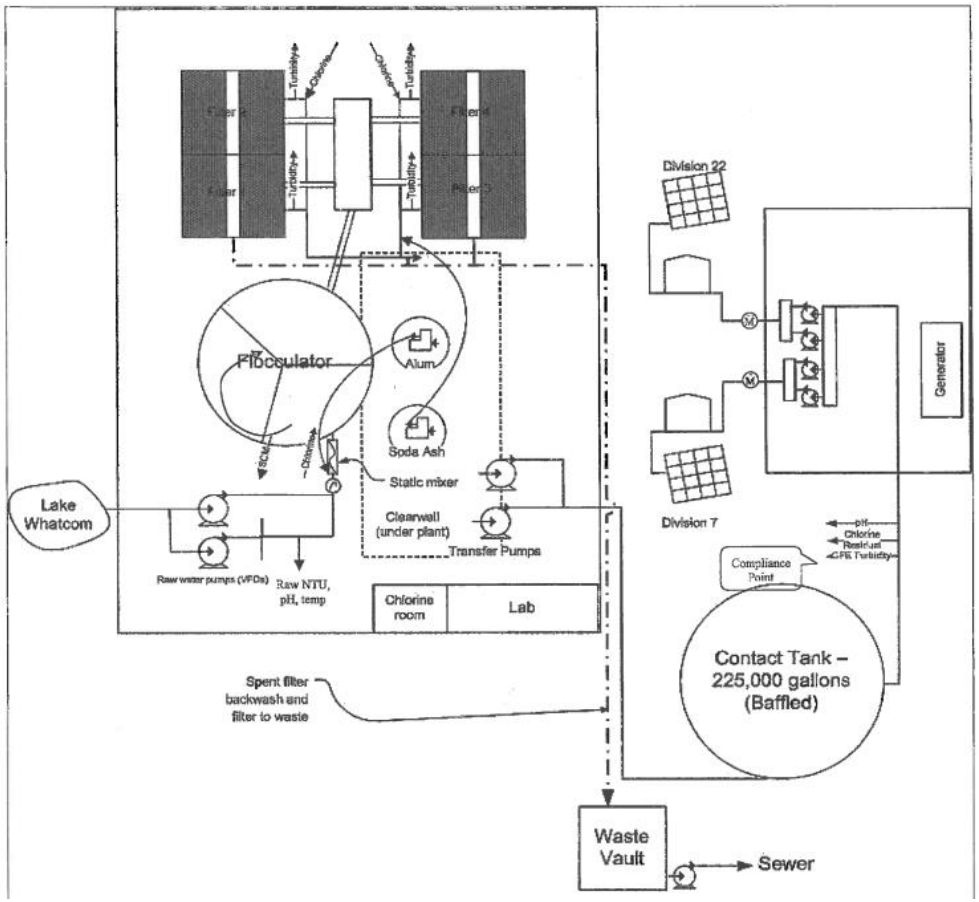

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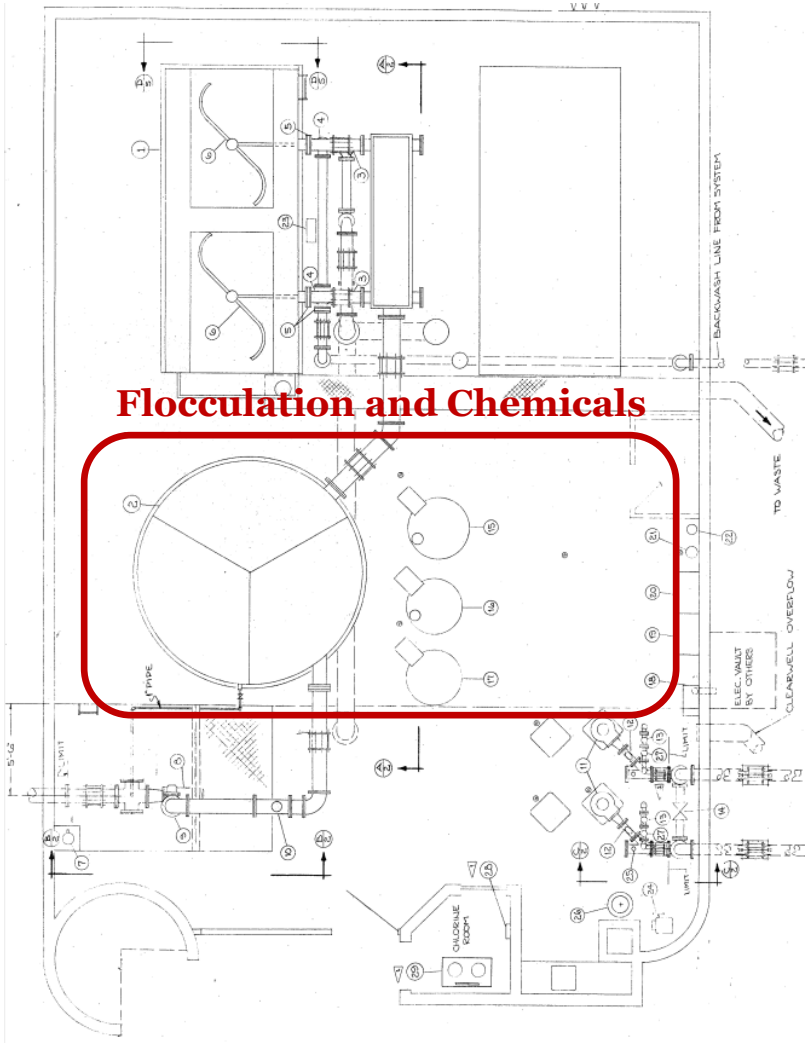

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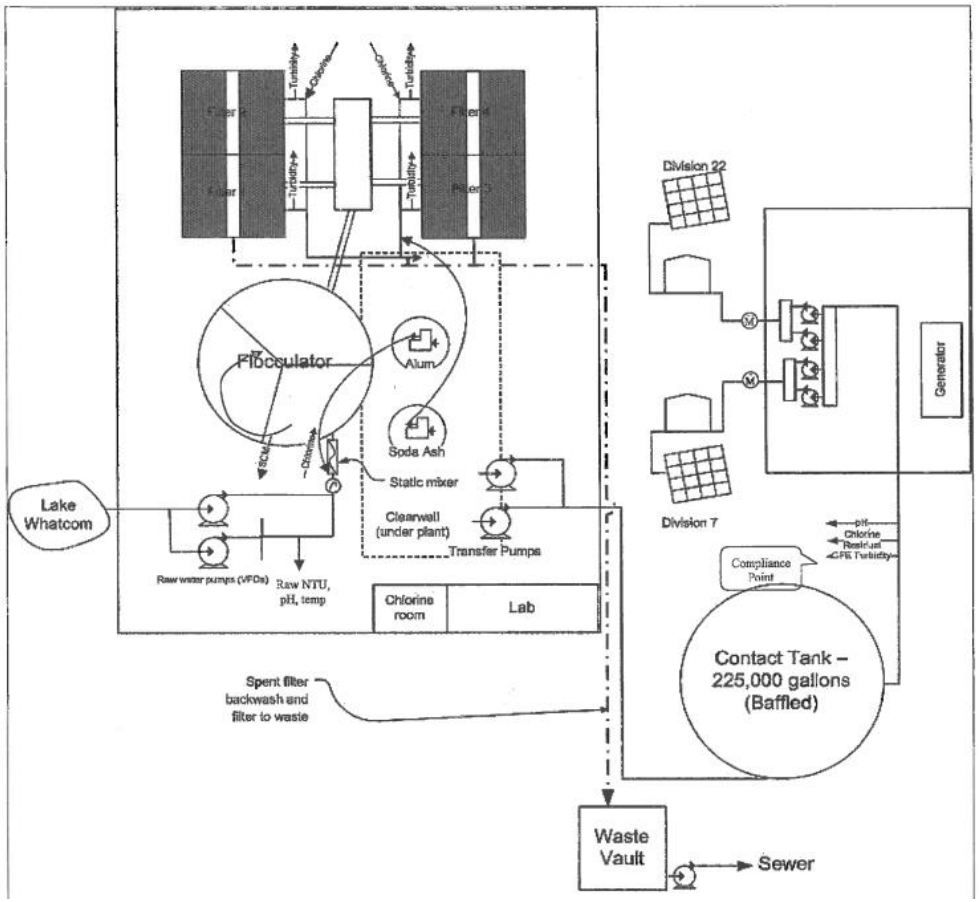

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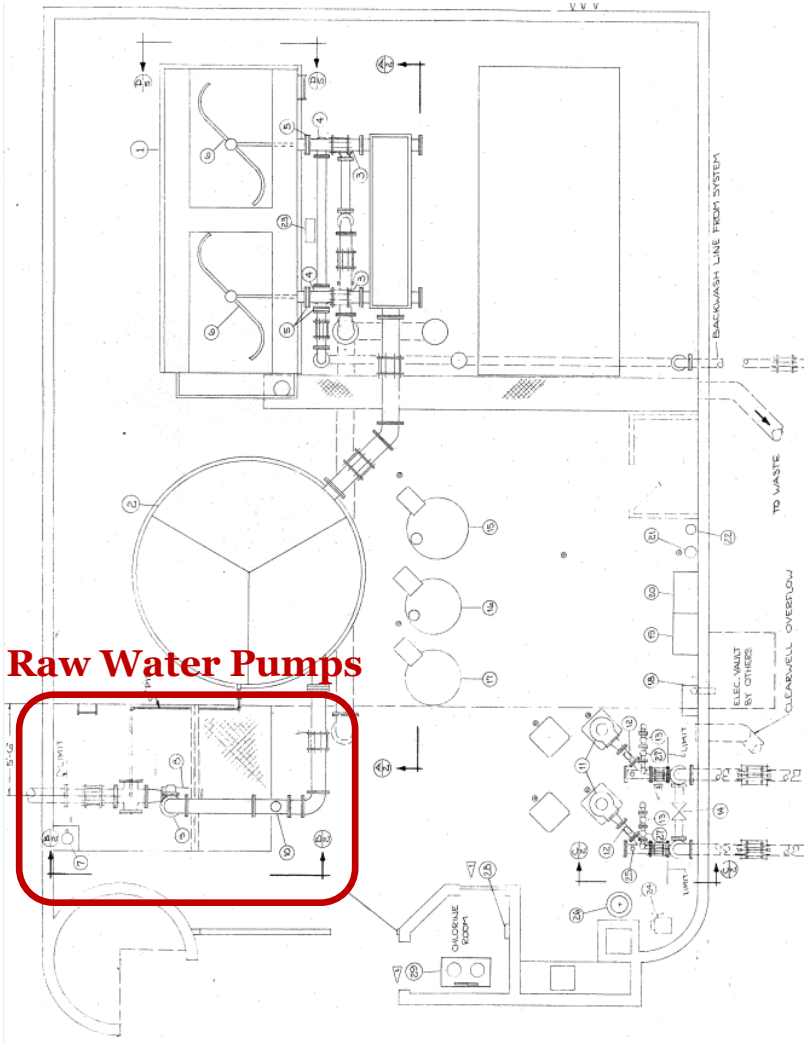

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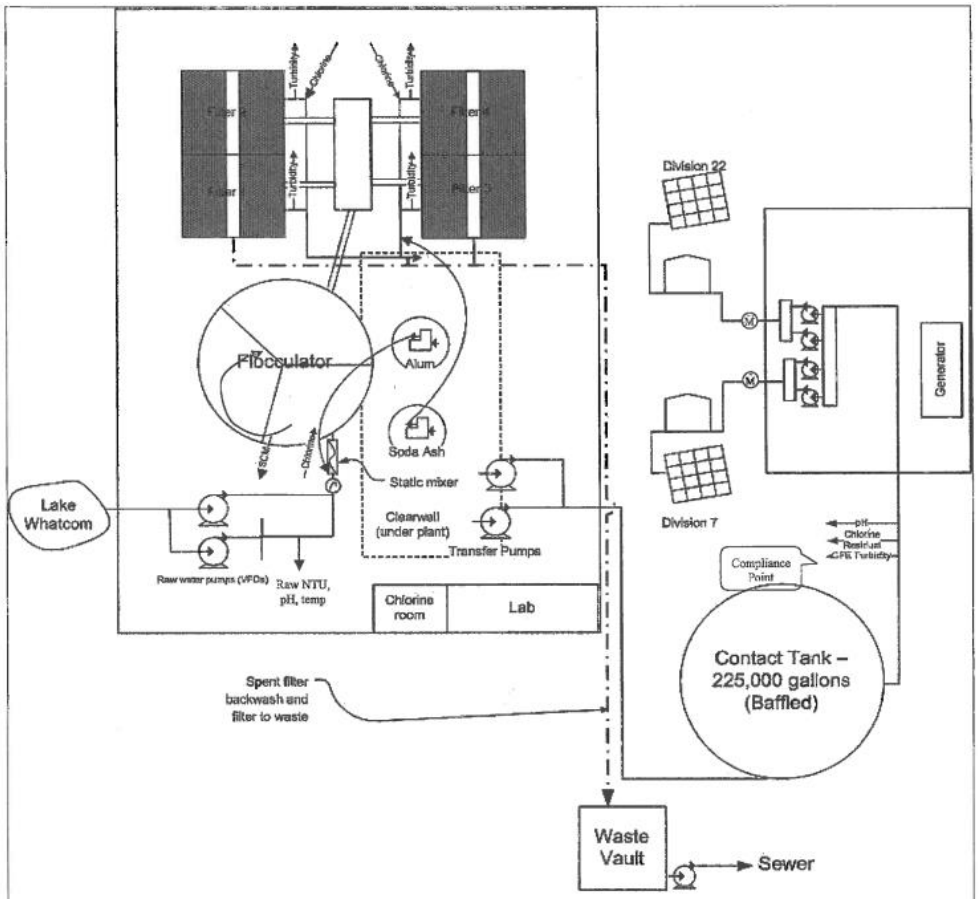

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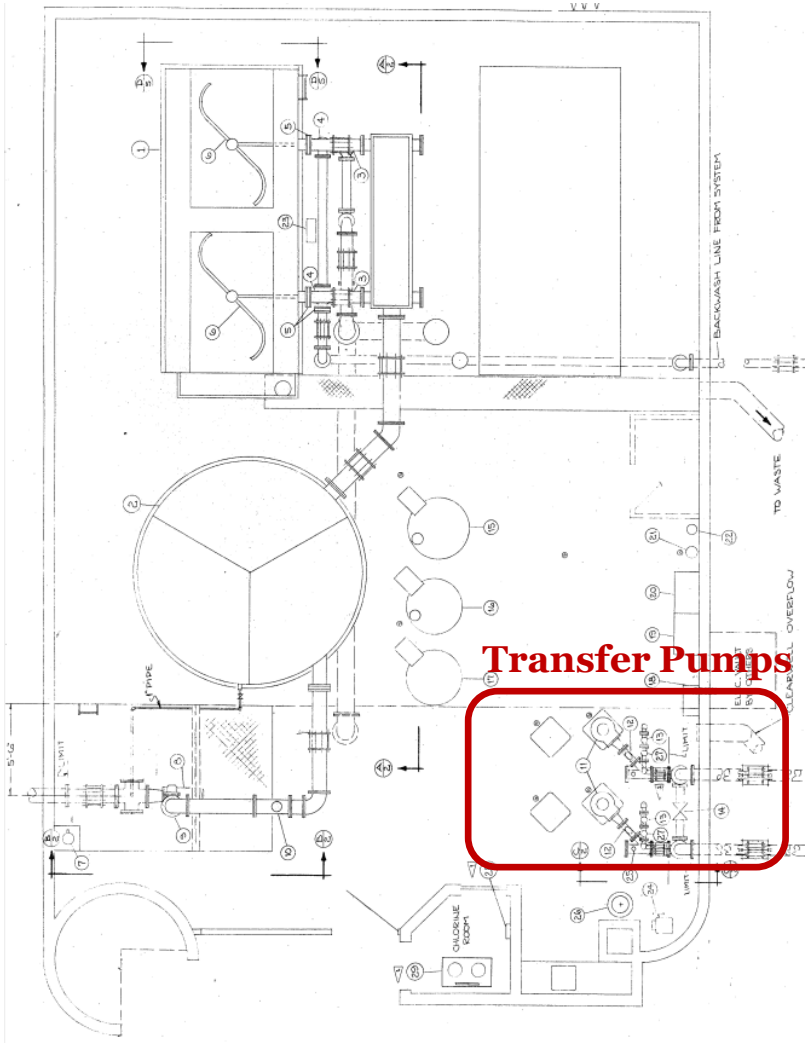

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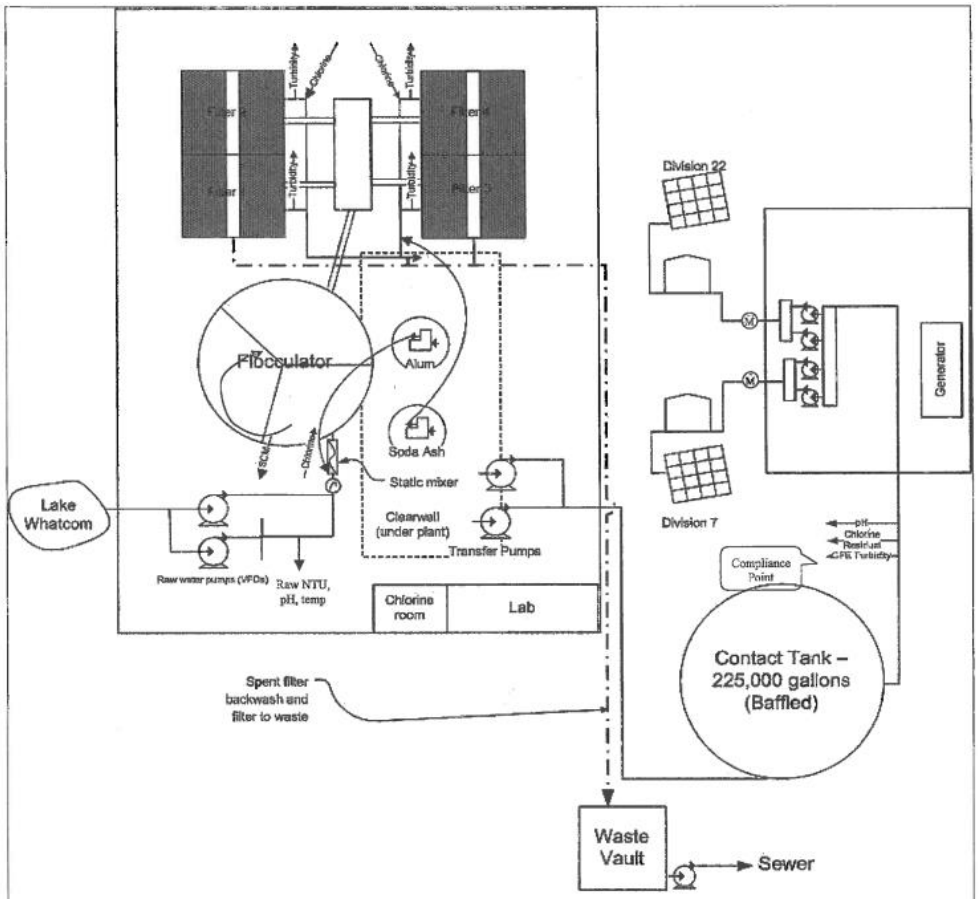

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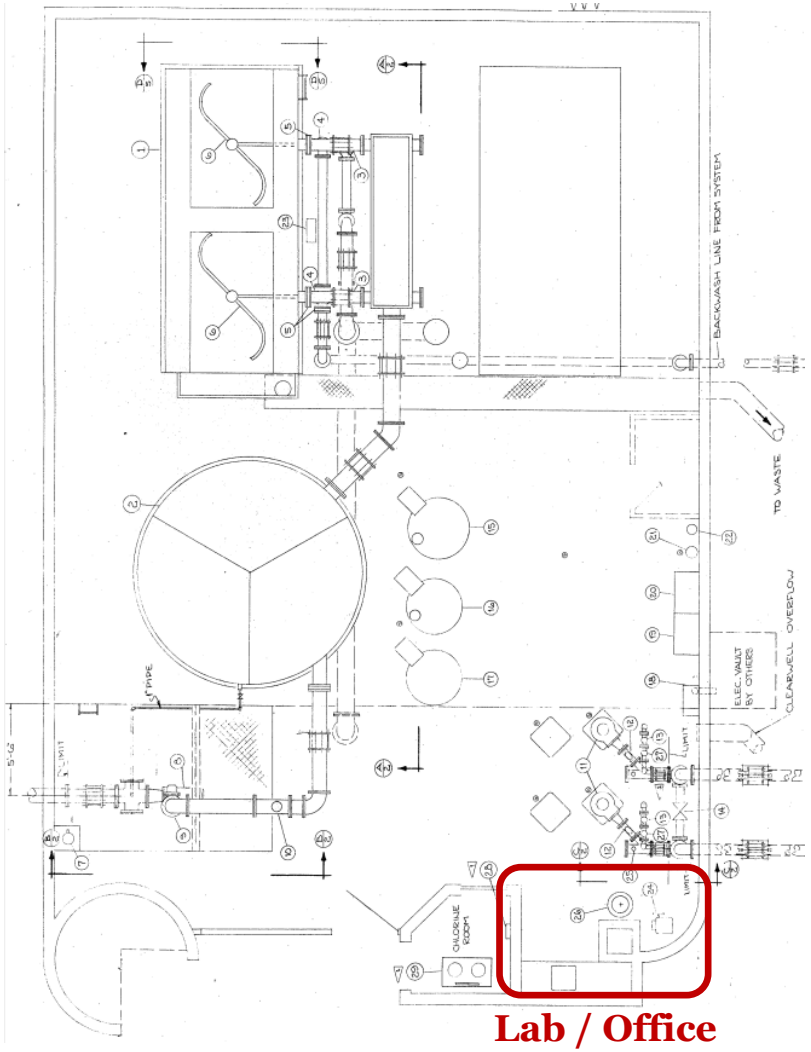

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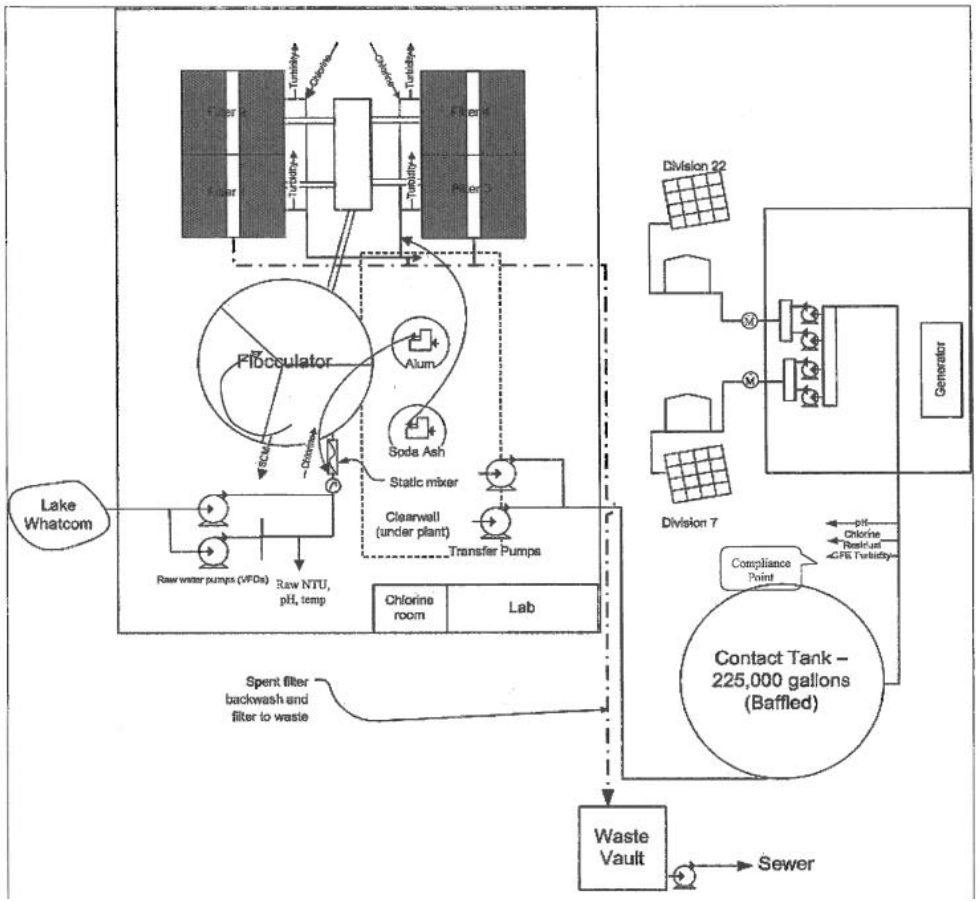

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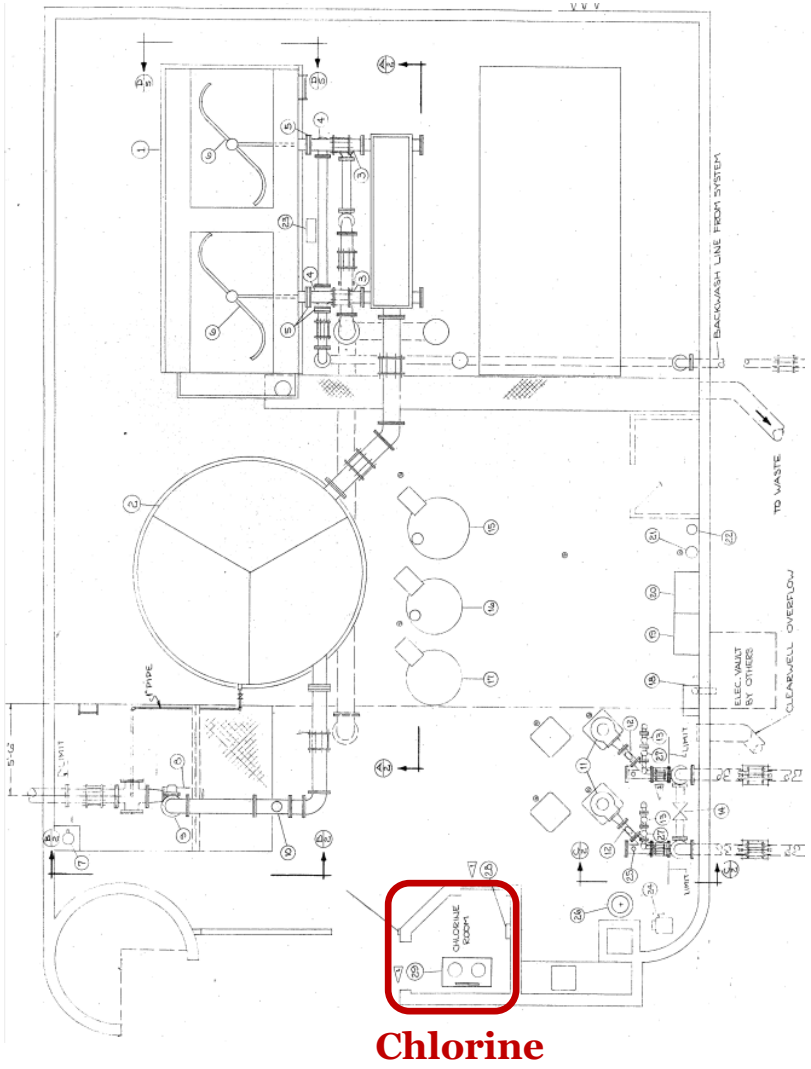

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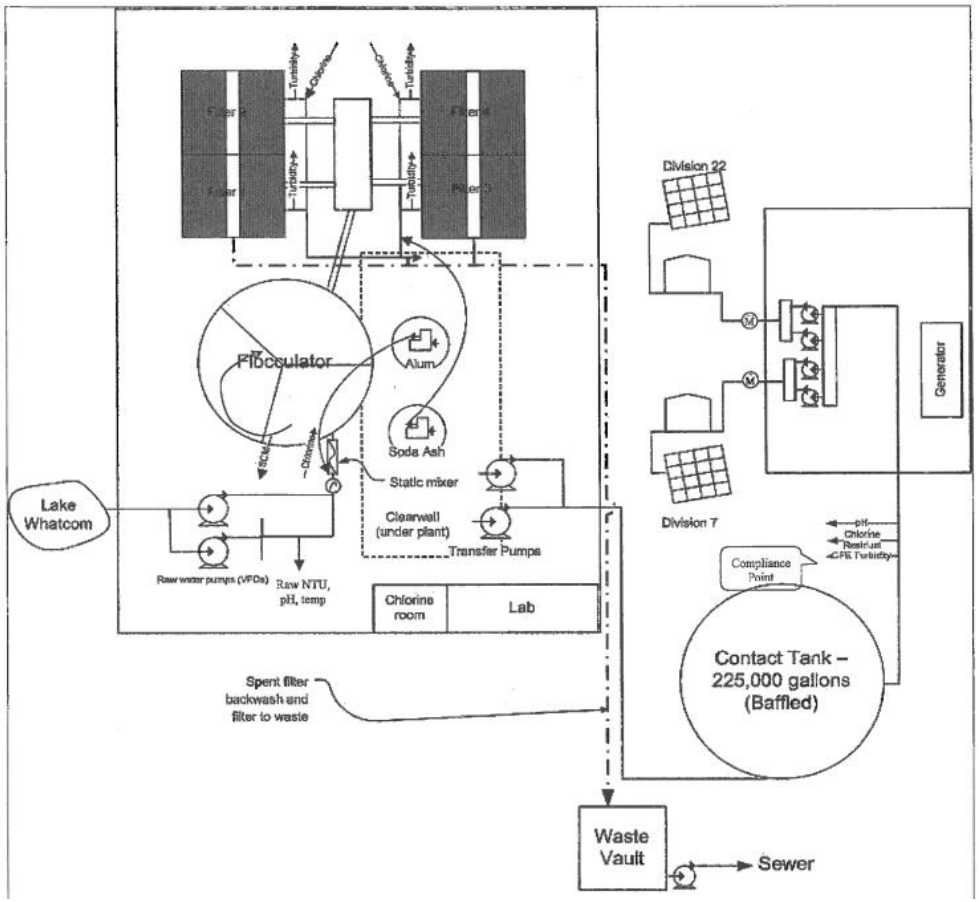

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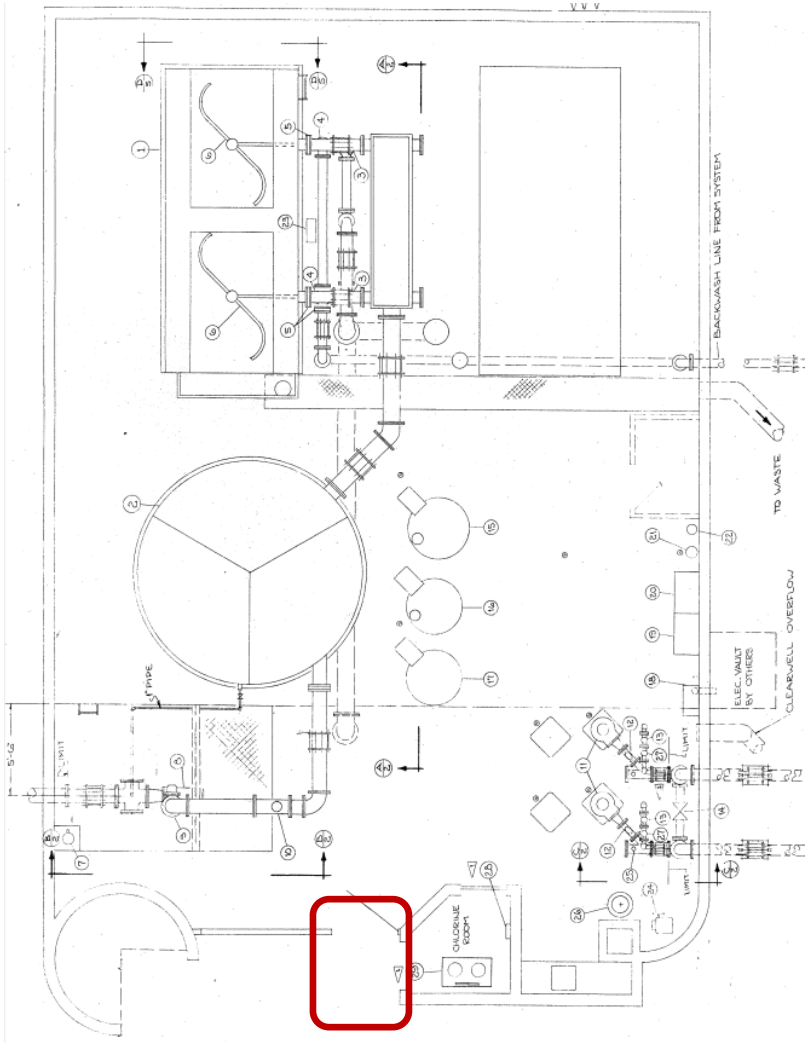

Single Door

Mechanical plan of SV WTP Main Building.

Project History & Background Info

- Phase I - WTP Condition Assessment
  - Assessed existing buildings and process in Feb. 2020
    - Process, Electrical, Structural, HVAC
  - Assessment Report completed in July 2020
  - Identified both high and low priority improvements
    - Structures were in good condition
    - Treatment is effective, but some components showing signs of age and use
    - Lack of available space
    - Anchoring and supports need seismic upgrades
    - Minor to moderate corrosion and/or deterioration
    - Some lack of redundancy puts WTP at risk

TABLE 3-1

Sudden Valley WTP High Priority Modifications Summary

Modification	Location[1]	Discipline[2]
Conduct chlorine disinfection system alternatives analysis	MB	P
Chlorine gas system modifications	MB	P
Alum storage and metering pump system modifications	MB	P
Soda Ash storage and metering pump system modifications	MB	P
Conduct backwash system alternatives analysis	MB	P
Replace existing clearwell and CCB level switches	MB	P
Replace corroded steel supports	MB	S
Prepare and coat steel tanks (Floc, Soda Ash, and Filters 1/2)	MB	S
Install seismic bracing for electrical conduit, electrical equipment, and treatment equipment	MB/FPB	S
Complete detailed structural evaluation	MB/FPB	S
Relocate existing laboratory electrical equipment	MB	A
Remove soil cover, vegetation growth, and organic debris from building exterior and roof	MB	A
Provide water upgrades to safety shower and eyewash	MB	A
Add fire and smoke alarm system	MB/FPB	A
Investigate current heating schedule	MB/FPB	M
Combine all existing plant records into a single as-built planset	MB/FPB	E
Complete a comprehensive electrical system audit	MB/FPB	E
Remove chemicals and metering equipment away from MCCs	MB	E
Review historical peak demand electrical consumption	MB/FPB	E
Replace MCC1 and MCC2 with new, current technology	MB/FPB	E
Replace MCC3 to address panel and interior component corrosion	MB	E

(1) MB = WTP Main Building. FPB = Finished Water Pump Building. CCB = Chlorine Contact Basin.

(2) P = Process, S = Structural, A = Architectural, M = Mechanical, and E = Electrical.

TABLE 3-2

Sudden Valley WTP Recommended Modifications Summary

Modification	Location[1]	Discipline[2]
Modify/repair existing flocculation tank	MB	P
Provide new grout floor within raw water pump pit	MB	P
Drain and clean the clearwell	MB	P
Procure spare backwash flow meter	MB	P
Procure dedicated confined space equipment for the WTP	MB	P
Install additional access ladder to Filters 1 and 2 and Filters 3 and 4	MB	P
Revise CT calculations to include clearwell and BE of 0.1	MB	P
Revise piping and conduit above flocculation tank	MB	P
Provide additional Operator In Trouble alarming equipment	MB/FPB	P
Replacing existing tube-style level alarm at flocculation tank	MB	P
Procure a spare finished water pump motor	FPB	P
Replace existing pressure gauges	FPB	P
Improve the visibility of the existing clearwell hatch	MB	P
Complete a performance test of the raw water, transfer, and finished water pumps	MB/FPB	P
Prepare and coat exposed ceiling rebar	MB	S
Address deficiencies found in 2016 seismic report	CCB	S
Perform formal CCB coating inspection	CCB	S
Address deteriorating conditions in restroom	MB	A
Investigate additional site security measures	MB/FPB	A
Remove heavy organic debris from roof	FPB	A
Repair wall seepage above MCC3	MB	A
Repair seepage/leaks at storefront window assemblies	MB	A
Modify floor to promote drainage to existing trench drain	MB	A
Revise existing storefront window to provide larger door opening	MB	A
Relocate stored filter media and other supplies equipment	MB	A
Conduct energy and heat audit	MB/FPB	M
Repair crack in generator exhaust piping	FPB	M
Conduct annual load testing for existing generator	FPB	E
Replace existing fluorescent light fixtures with LED equipment	MB/FPB	E
Replace AC backed system with DC backed systems	MB/FPB	E
Consolidate existing electrical panelboards	MB/FPB	E
Reroute floor mounted electrical conduit	MB/FPB	E
Reroute field wiring within grey/blue wall mounted panels	MB	E
Modify transfer pump pad based on long-term operations strategy	MB	E
Fuel tank relocation investigation	FPB	E

(1) MB = WTP Main Building. FPB = Finished Water Pump Building. CCB = Chlorine Contact Basin.

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Project History & Background Info

- Phase II - WTP Alternatives Analysis
  - Incorporate Assessment recommendations and analyze various treatment alternatives
  - A la carte approach
    - Pumping, seismic, structural, and coatings
    - Chemical, disinfection, filtration, and backwash
  - Board presentations for involvement/education
  - Final Alternatives Analysis Report
    - Assessment Report
    - Board & Staff input
    - Financial Analysis information
    - Recommendations for District implementation

Project Goals

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- Phase II - Alternatives Analysis
  - G1 - Maintain exceptional WQ performance record

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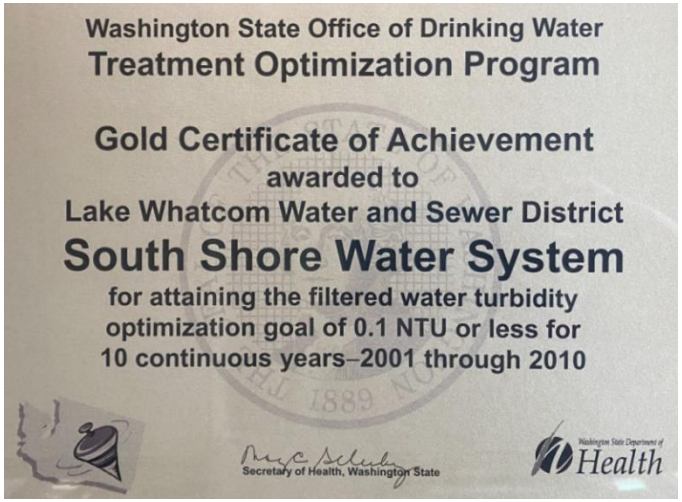

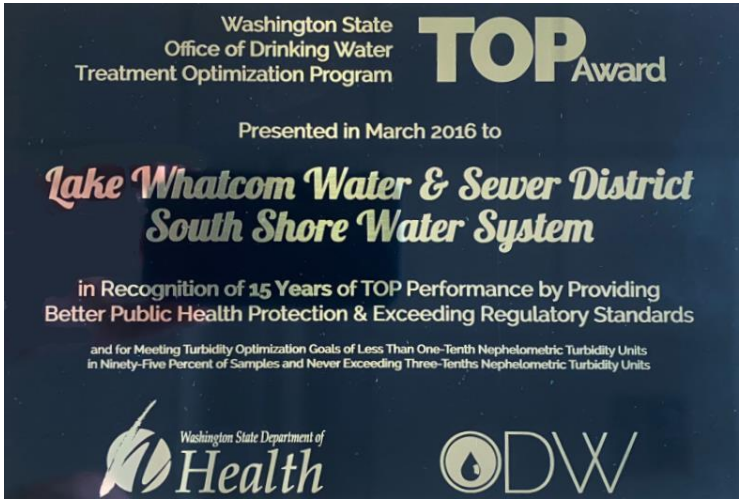

Project Goals

- Phase II - Alternatives Analysis
  - G1 - Maintain exceptional WQ performance record
  - G2 - Accommodate immediate need for additional space and separation of chemicals/electrical equipment

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- Phase II - Alternatives Analysis
  - G1 - Maintain exceptional WQ performance record
  - G2 - Accommodate immediate need for additional space and separation of chemicals/electrical equipment
  - G3 - Provide adequate equipment and process redundancy

Project Goals

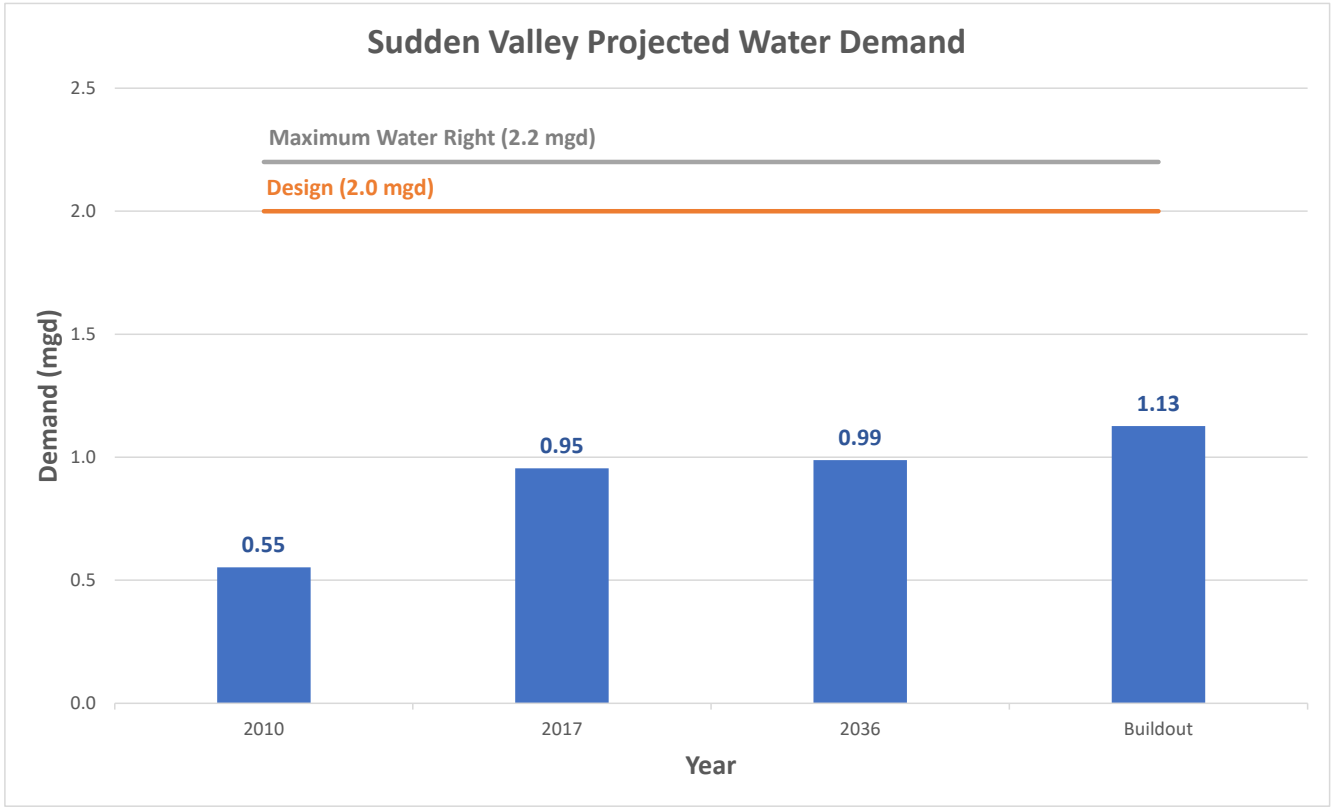
- Phase II - Alternatives Analysis
  - G1 - Maintain exceptional WQ performance record
  - G2 - Accommodate immediate need for additional space and separation of chemicals/electrical equipment
  - G3 - Provide adequate equipment and process redundancy
  - G4 - Improve access and flexibility for equipment repair/rehabilitation and/or future expansion

Project Goals

- Phase II - Alternatives Analysis
  - G1 - Maintain exceptional WQ performance record
  - G2 - Accommodate immediate need for additional space and separation of chemicals/electrical equipment
  - G3 - Provide adequate equipment and process redundancy
  - G4 - Improve access and flexibility for equipment repair/rehabilitation and/or future expansion
  - G5 - Provide capacity for full buildout flow (2.0 mgd)

Project Goals

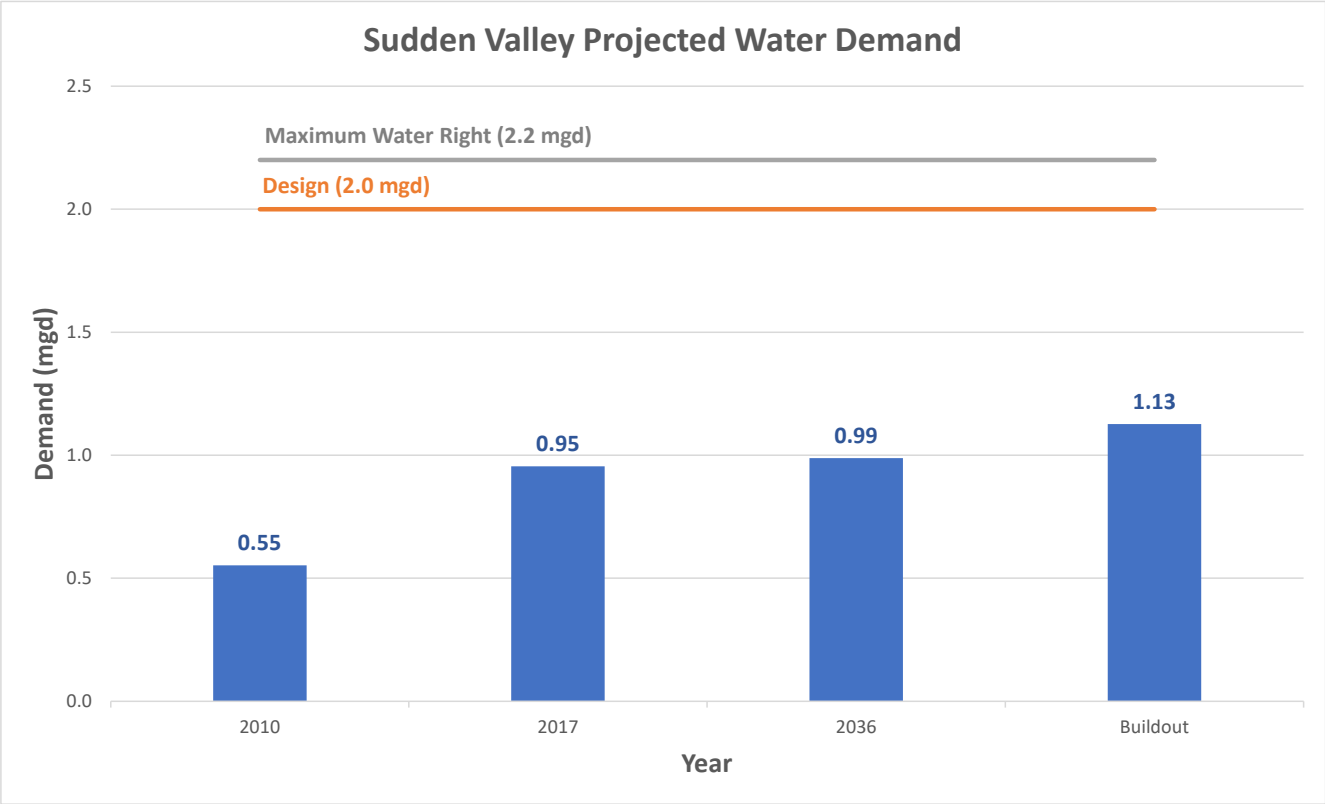
- Phase II - Alternatives Analysis
  - G5 - Provide capacity for full buildout flow (2.0 mgd)



Project Goals

- ***During recent main break (January), the District leaked an additional 0.2 mgd***
- ***Best estimates are that the Geneva/SV areas are ~85 percent of buildout***

- Phase II - Alternatives Analysis
  - G5 - Provide capacity for full buildout flow (2.0 mgd)



Project Goals

- Phase II - Alternatives Analysis
  - G1 - Maintain exceptional WQ performance record
  - G2 - Accommodate immediate need for additional space and separation of chemicals/electrical equipment
  - G3 - Provide adequate equipment and process redundancy
  - G4 - Improve access and flexibility for equipment repair/rehabilitation and/or future expansion
  - G5 - Provide capacity for full buildout flow (1,400 gpm)
  - G6 - Provide treatment equipment for 30 or 50-year time period

Project History & Background Info

- Phase II - WTP Alternatives Analysis
  - Incorporate Assessment recommendations and analyze various treatment alternatives
  - A la carte approach
    - Pumping, seismic, structural, and coatings
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  - Incorporate Assessment recommendations and analyze various treatment alternatives
  - **A la carte approach**
    - **Pumping, seismic, structural, and coatings**
    - **Chemical, disinfection, filtration, and backwash**
  - Board presentations for involvement/education
  - Final Alternatives Analysis Report
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    - Financial Analysis information
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Alternatives Analysis Summary

Alternatives Analysis Summary

- Pump Performance – TM1
  - Pump flow and pressure testing
    - Recommendations: Plan for replacement of FWP and TP. Replace RWPs.

- CCB Coatings Assessment – TM2
  - Assess existing interior and exterior coatings
    - Recommendations: Replace interior/exterior coatings within 5 years, complete seal welding, replace vent, complete security improvements.

Alternatives Analysis Summary

- Seismic Assessment – TM3
  - Tier 2/3 seismic analysis
    - Recommendations: Complete structural modifications for FWP Bldg. and non-structural modifications for Main and FWP Bldgs.

- Chemical Systems – TM4
  - Alum & Soda Ash modifications
    - Recommendations: Replace alum tank and pumps, replace soda ash mixer & pumps, relocate chemicals to new, separate building.

Alternatives Analysis Summary

- Filter Systems– TM5
  - Media filter modifications
    - Recommendations: Continue use of rapid rate mixed media filtration, rehabilitate existing Filters 1/2.

- Disinfection – TM6
  - Chlorine disinfection and chlorine contact time
    - Recommendations: Utilize gas chlorine or OSHG in new building, construct replacement CCB and rehabilitate existing CCB.

Alternatives Analysis Summary

- Backwash Systems– TM7
  - Backwash system modifications
    - Recommendations: Repurpose existing CCB to backwash storage and implement backwash recycle.

- Structural & Architectural – TM8
  - Space and Structural modifications
    - Recommendations: If additional space is desired/warranted, construct new, separate building to supplement existing structures.

Risk Assessment Summary

Risk Assessment Summary

- Risk Assessment – TM9
  - Quantitative assessment of risk of failure
  - Scoring based on numerical scale of likelihood for failure and severity if failure occurs
    - Score = Likelihood (1-5) * Severity (1-5)
  - Treatment processes broken down into components
    - Raw water intake,
    - Raw water pumps,
    - Etc.

Risk Assessment Summary

- Risk Assessment

Component	Impact(s)	Confined Space or Health & Safety Hazard?	Likelihood	Severity	Combined Score	Rank
Raw water intake	Loss of production, no service.	Y	2	2	4	15
Raw water pumps	Loss of production, no service.	Y	3	3	9	6
Raw water instrumentation	DOH non-compliance, regulatory action	N	2	1	2	17
Alum delivery system	Decrease in water quality, increase in maintenance	Y	4	4	16	1
Flocculation tank	DOH non-compliance, decrease in water quality, increase in maintenance	N	3	3	9	6

Risk Assessment Summary

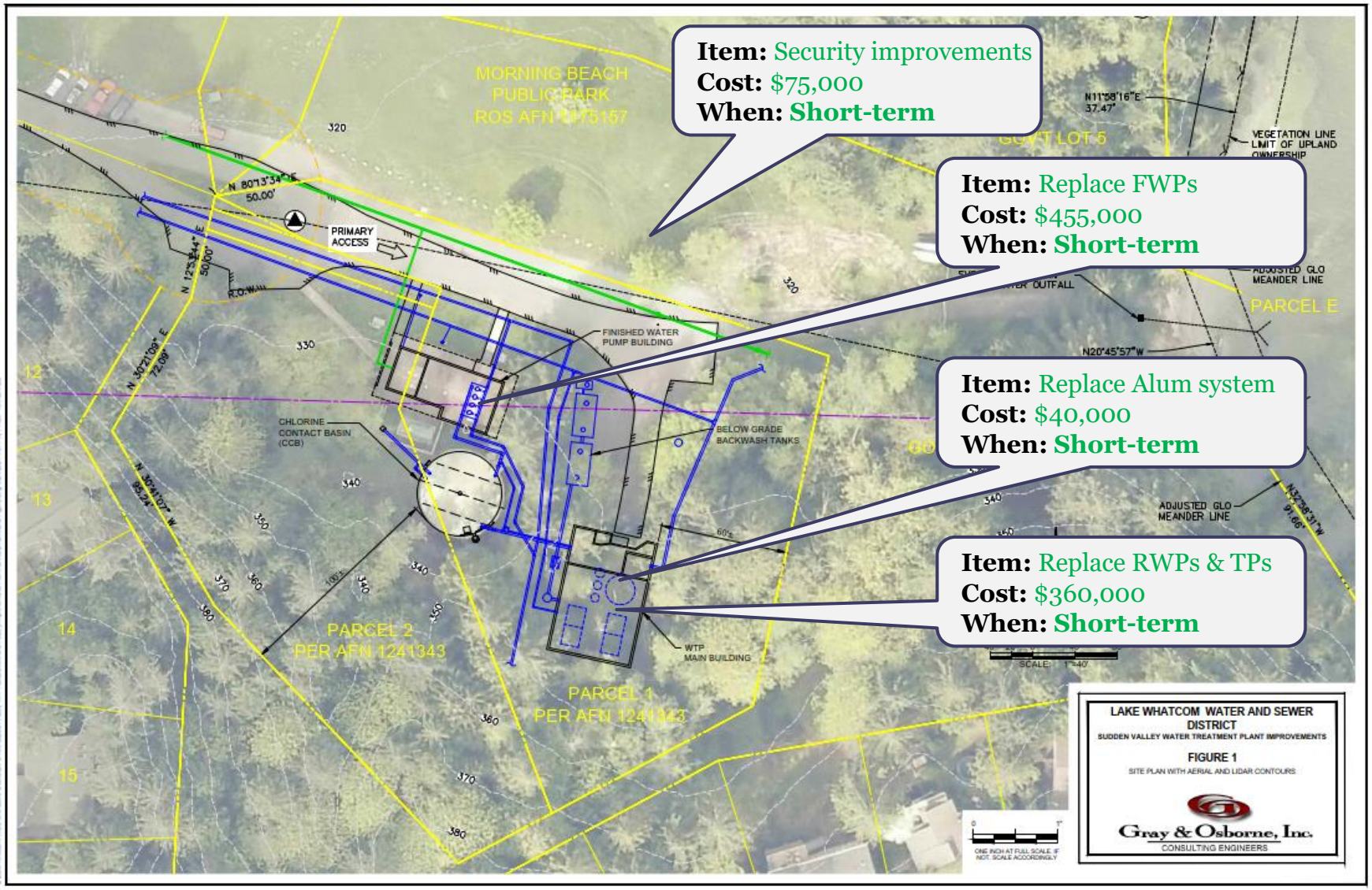
- Risk Assessment

High Risk	Moderate Risk	Low Risk	Minimal Risk
Alum delivery system	Raw water pumps	Raw water intake	Raw water instrumentation
Chlorine contact basin	Filters 1 & 2	Filters 3 & 4	Clearwell
	Clearwell transfer pumps	WTP Main Bldg. electrical	Finished water instrumentation
	Cl Disinfection system	WTP FWP Bldg. electrical	WTP Main Bldg. piping
	Soda Ash delivery system		WTP FWP Bldg. piping
	Finished water pumps		Auxiliary generator
	Flocculation tank		
	WTP SCADA		
	WTP Security		

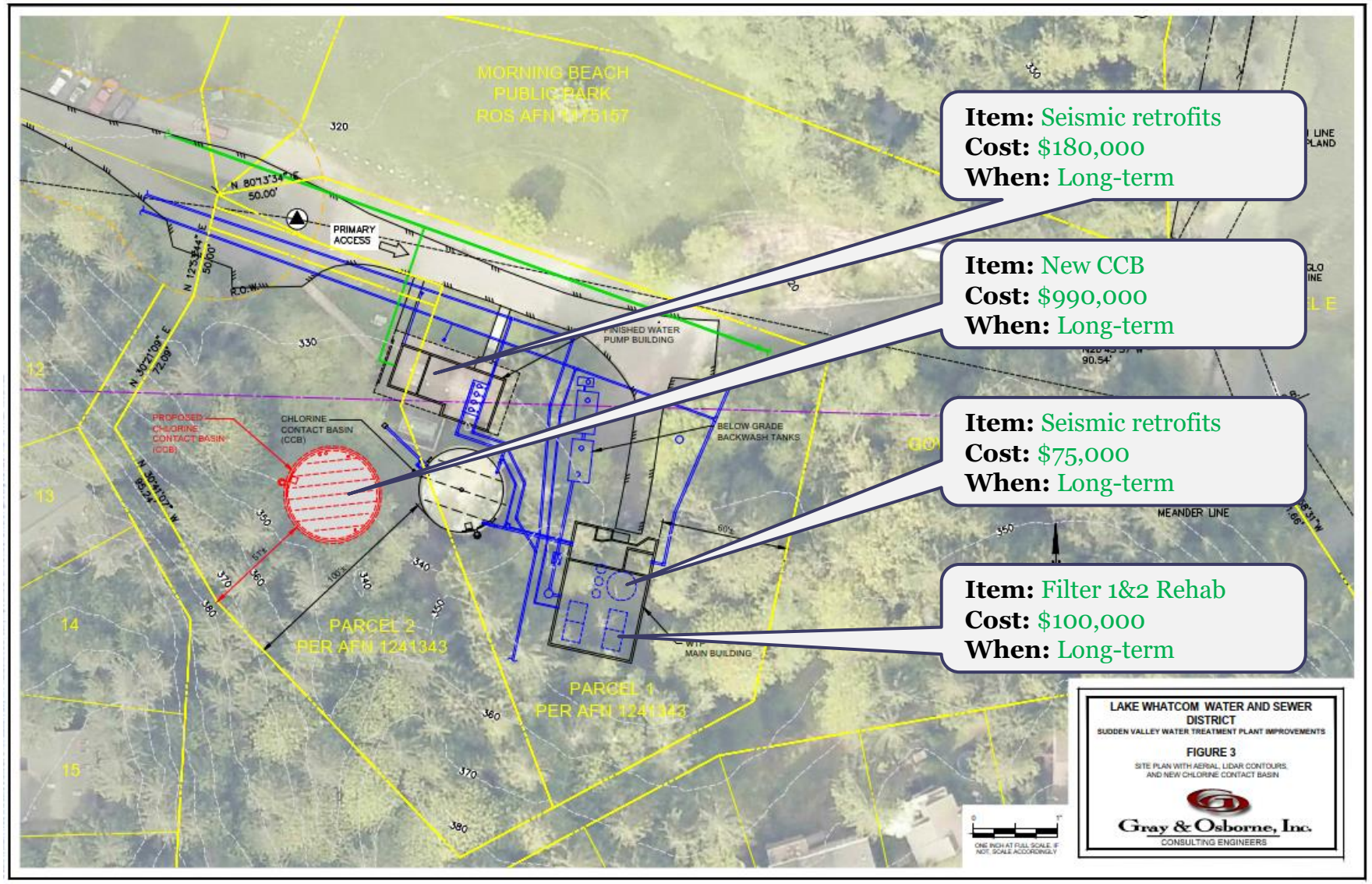
WTP Alternatives Analysis

WTP Alternatives Analysis

- Introduction
- Description of Existing Facilities
- Background and Project History
  - Technical memorandum summary
  - Risk assessment summary
- WTP Modification Alternatives
  - Minimum
  - Medium
  - Maximum
- Summary and Recommendations



WTP Alternatives Analysis - Minimum (ST)



WTP Alternatives Analysis – Minimum (LT)

WTP Alternatives Analysis – Minimum

Short Term Improvements (<10 years)

- Replace finished water pumps
- Replace transfer pumps
- Replace raw water pumps
- Alum system improvements
- Site security improvements

Long Term Improvements (>10 years)

- WTP Main Building seismic retrofits
- Finished Water Pump Building seismic retrofits
- Rehabilitate Filter 1&2
- New 0.3 MG CCB

WTP Alternatives Analysis - Minimum

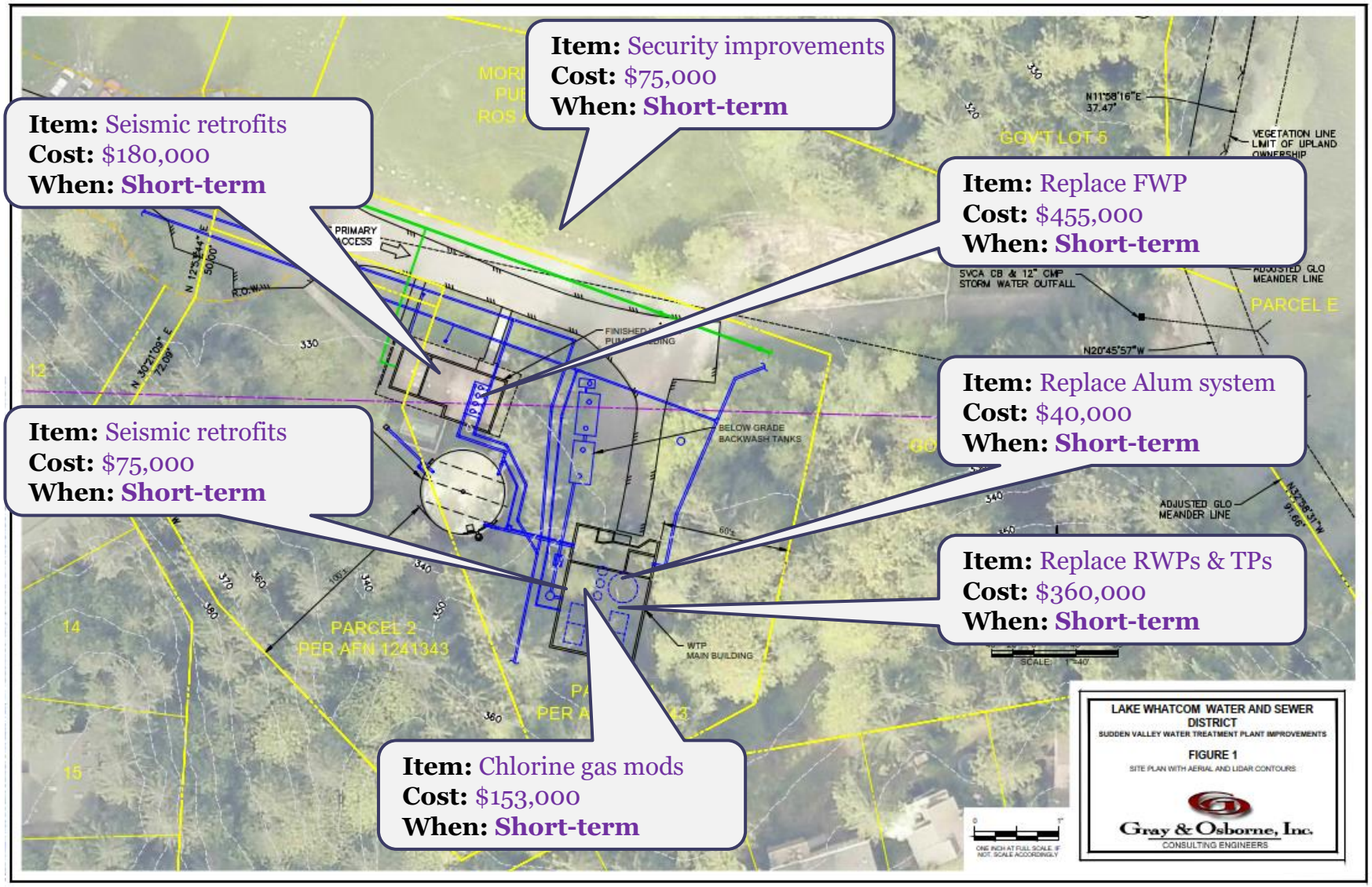
Short Term Improvements	Cost
• Replace finished water pumps	• $455,000
• Replace transfer pumps	• $210,000
• Replace raw water pumps	• $150,000
• Alum system improvements	• $40,000
• Site security improvements	• $75,000
▫ Contingency, Tax, Project Administration	• $915,000
SUBTOTAL	**$1,845,000**

WTP Alternatives Analysis - Minimum

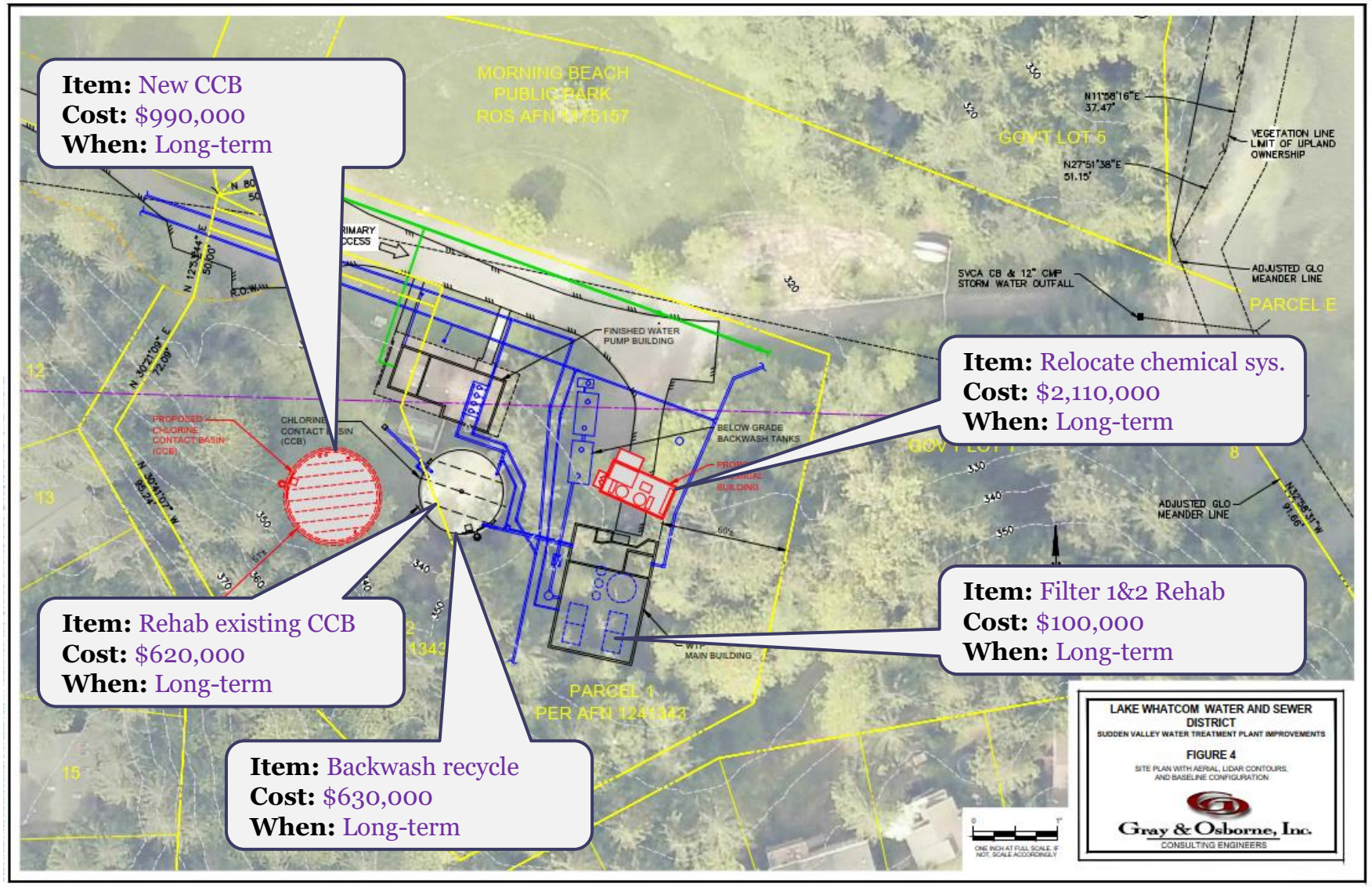
Long Term Improvements	Cost
• WTP Main Building seismic retrofits	• $75,000
• Finished Water Pump Building seismic retrofits	• $180,000
• Rehabilitate existing Filters 1 & 2	• $100,000
• New 3.0 MG welded steel CCB	• $990,000
▫ Contingency, Tax, Project Administration	• $1,277,000
SUBTOTAL	**$2,668,000**

WTP Alternatives Analysis - Minimum

Long Term Improvements	Cost
• WTP Main Building seismic retrofits	• $75,000
• Finished Water Pump Building seismic retrofits	• $180,000
• Rehabilitate existing Filters 1 & 2	• $100,000
• New 3.0 MG welded steel CCB	• $990,000
▫ Contingency, Tax, Project Administration	• $1,277,000
SUBTOTAL	**$2,668,000**
Short Term Improvements	**$1,845,000**
TOTAL	**$4,513,000**



WTP Alternatives Analysis - Medium (ST)



WTP Alternatives Analysis - Medium (LT)

WTP Alternatives Analysis – Medium

Short Term Improvements (<10 years)

- Replace finished water pumps
- Replace transfer pumps
- Replace raw water pumps
- WTP Main Building seismic retrofits
- Finished Water Pump Building seismic retrofits
- Chlorine gas modifications
- WTP Security improvements

Long Term Improvements (>10 years)

- Chemical addition system improvements
- New 0.3 MG CCB
- Rehabilitate existing filters
- Rehabilitate existing CCB
- Backwash recycle implementation

WTP Alternatives Analysis - Medium

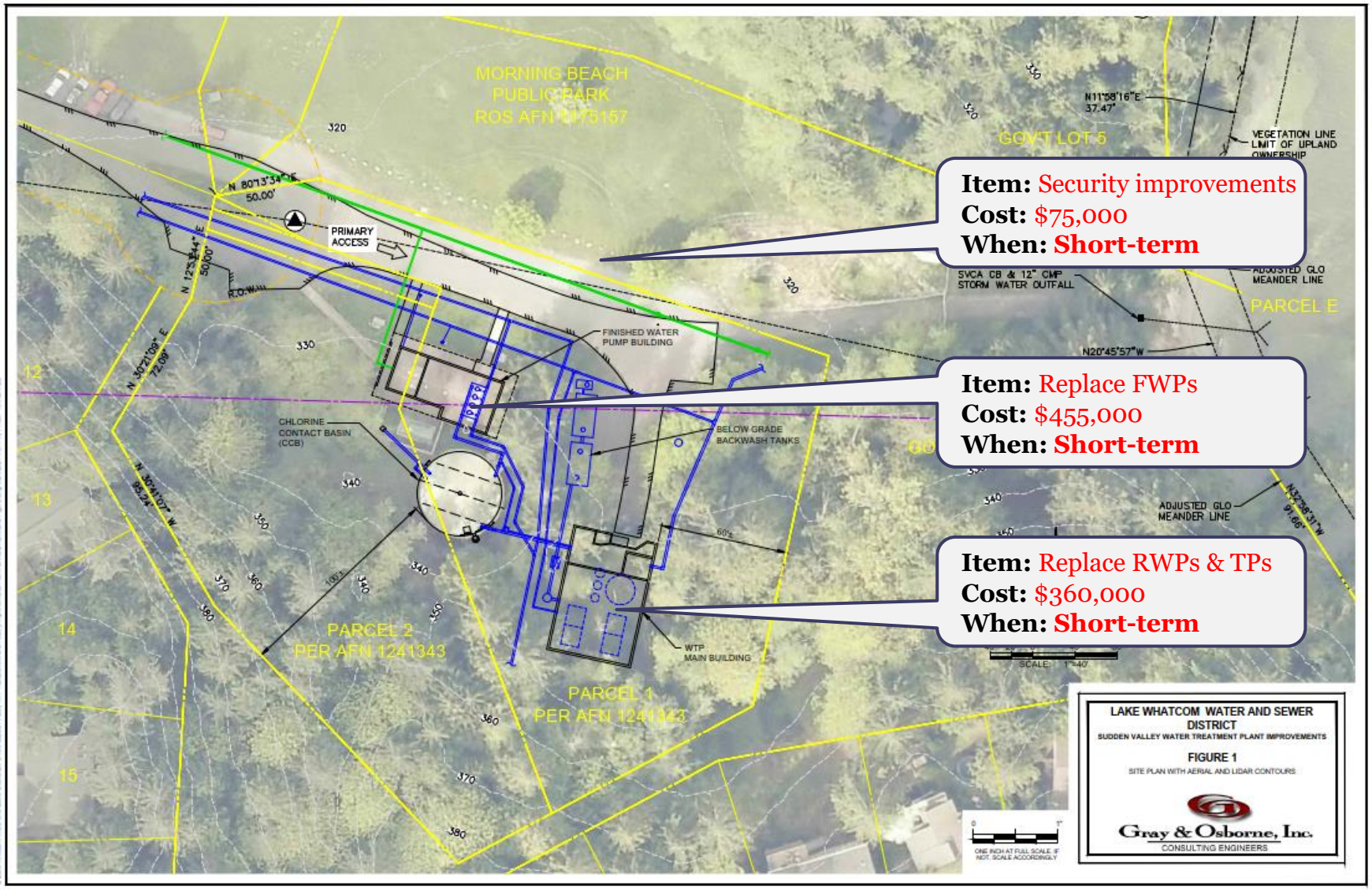
Short Term Improvements	Cost
Replace finished water pumps	$455,000
Replace transfer pumps	$210,000
Replace raw water pumps	$150,000
WTP Main Building seismic retrofits	$75,000
Finished Water Pump Building seismic retrofits	$180,000
Chlorine gas modifications	$153,000
WTP Security improvements	$75,000
Contingency, Tax, Project Administration	$1,277,000
SUBTOTAL	**$2,575,000**

WTP Alternatives Analysis - Medium

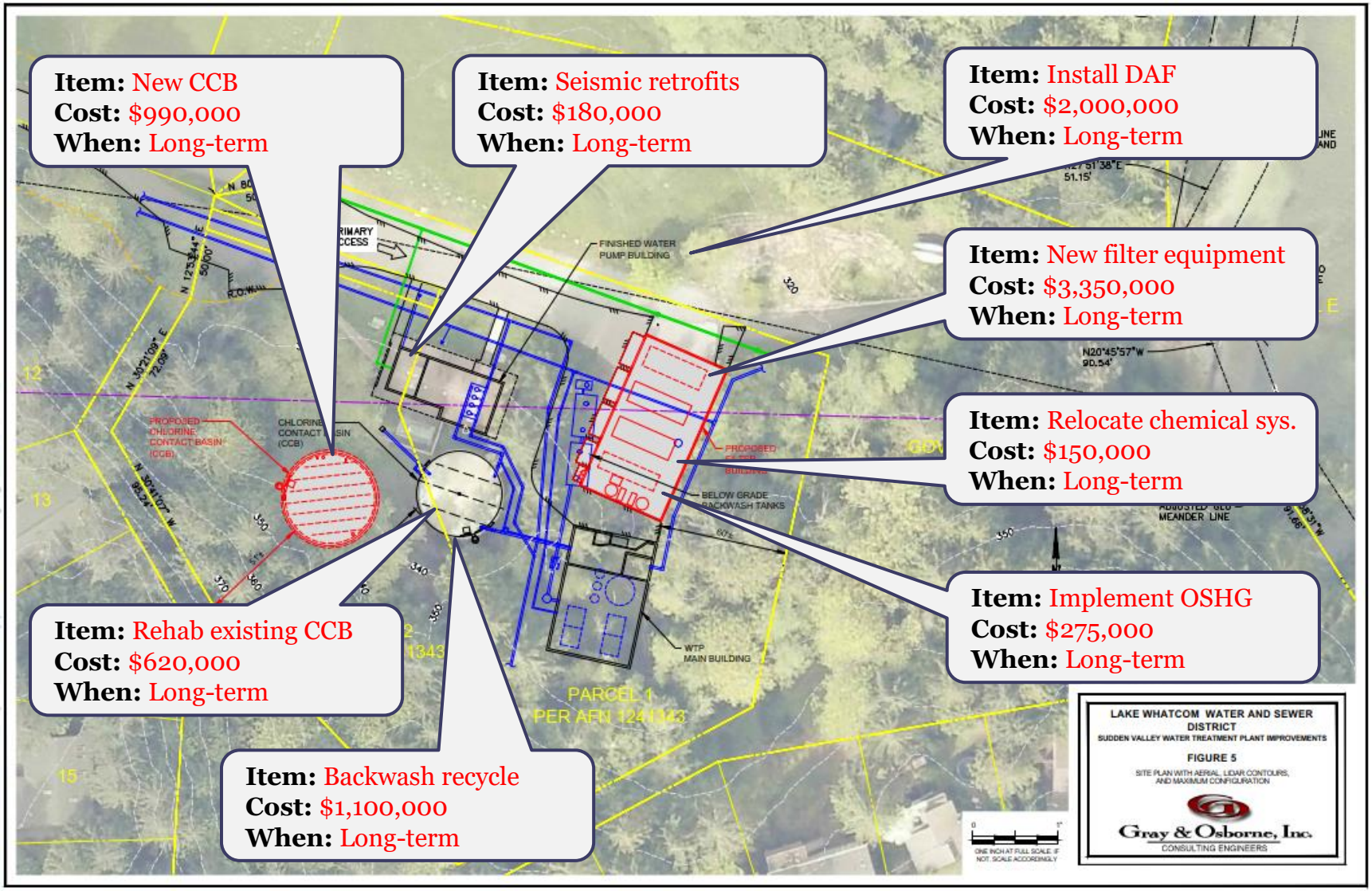
Long Term Improvements	Cost
• Chemical addition system improvements	• $2,110,000
• New 3.0 MG welded steel CCB	• $990,000
• Rehabilitate existing filters	• $100,000
• Rehabilitate/repurpose existing CCB	• $620,000
• Implement backwash recycle improvements	• $630,000
▫ Contingency, Tax, Project Administration	• $4,378,000
SUBTOTAL	**$8,828,000**

WTP Alternatives Analysis - Medium

Long Term Improvements	Cost
• Chemical addition system improvements	• $2,110,000
• New 3.0 MG welded steel CCB	• $990,000
• Rehabilitate existing filters	• $100,000
• Rehabilitate/repurpose existing CCB	• $620,000
• Implement backwash recycle improvements	• $630,000
▫ Contingency, Tax, Project Administration	• $4,378,000
SUBTOTAL	**$8,828,000**
Short Term Improvements	**$2,575,000**
TOTAL	**$11,403,000**



WTP Alternatives Analysis - Maximum (ST)



WTP Alternatives Analysis - Maximum (LT)

WTP Alternatives Analysis – Maximum

Short Term Improvements (<10 years)

- Replace finished water pumps
- Replace transfer pumps
- Replace raw water pumps
- WTP Security improvements

Long Term Improvements (>10 years)

- FWP Building seismic retrofits
- Chemical addition system improvements
- New 0.3 MG CCB
- New mixed media filters
- Implement OSHG disinfection
- Rehabilitate existing CCB
- Implement backwash recycle
- Install DAF technology

WTP Alternatives Analysis - Maximum

Short Term Improvements	Cost
• Replace finished water pumps	• $455,000
• Replace transfer pumps	• $210,000
• Replace raw water pumps	• $150,000
• WTP Security improvements	• $75,000
▫ Contingency, Tax, Project Administration	• $875,000
SUBTOTAL	**$1,765,000**

WTP Alternatives Analysis - Maximum

Long Term Improvements	Cost
FWP Building seismic retrofits	$180,000
Chemical addition system improvements	$150,000
New 3.0 MG welded steel CCB	$990,000
New mixed media filters	$3,350,000
Implement OSHG disinfection	$275,000
Rehabilitate existing CCB	$620,000
Implement backwash recycle	$1,100,000
Install DAF technology	$2,000,000
Contingency, Tax, Project Administration	$8,665,000
SUBTOTAL	**$16,832,000**

WTP Alternatives Analysis - Maximum

Long Term Improvements	Cost
• FWP Building seismic retrofits	• $180,000
• Chemical addition system improvements	• $150,000
• New 3.0 MG welded steel CCB	• $990,000
• New mixed media filters	• $3,350,000
• Implement OSHG disinfection	• $275,000
• Rehabilitate existing CCB	• $620,000
• Implement backwash recycle	• $1,100,000
• Install DAF technology	• $2,000,000
▫ Contingency, Tax, Project Administration	• $8,665,000
SUBTOTAL	**$16,832,000**
Short Term Improvements	**$1,765,000**
TOTAL	**$18,597,000**

WTP Alternative Analysis - Goals

Alternative	Cost	G1	G2	G3	G4	G5	G6	Total	Rank
Minimum	$4.5M	10	0	6	2	10	5	**33**	**3**
Medium	$11.4M	10	5	7	5	10	7	**44**	**2**
Maximum	$18.6M	10	7	8	8	10	9	**52**	**1**

G1 - Maintain exceptional WQ performance record
G2 - Accommodate immediate need for additional space and separation of chemicals/electrical equipment
G3 - Provide adequate equipment and process redundancy
G4 - Improve access and flexibility for equipment repair/rehabilitation and/or future expansion
G5 - Provide capacity for full buildout flow (1,400 gpm)
G6 - Provide treatment equipment for 30-50 year time period

*** Scores above relate how well each alternative accomplishes a particular goal. The higher the score, the more successfully the alternative accomplishes the goal.*

WTP Alternative Analysis - Goals

Alternative	Cost	G1	G2	G3	G4	G5	G6	Total	Rank
Minimum	$4.5M	10	0	6	2	10	5	**33**	**3**
Medium	$11.4M	10	5	7	5	10	7	**44**	**2**
Maximum	$18.6M	10	7	8	8	10	9	**52**	**1**

What does this do to utility rates?

WTP Alternative Analysis

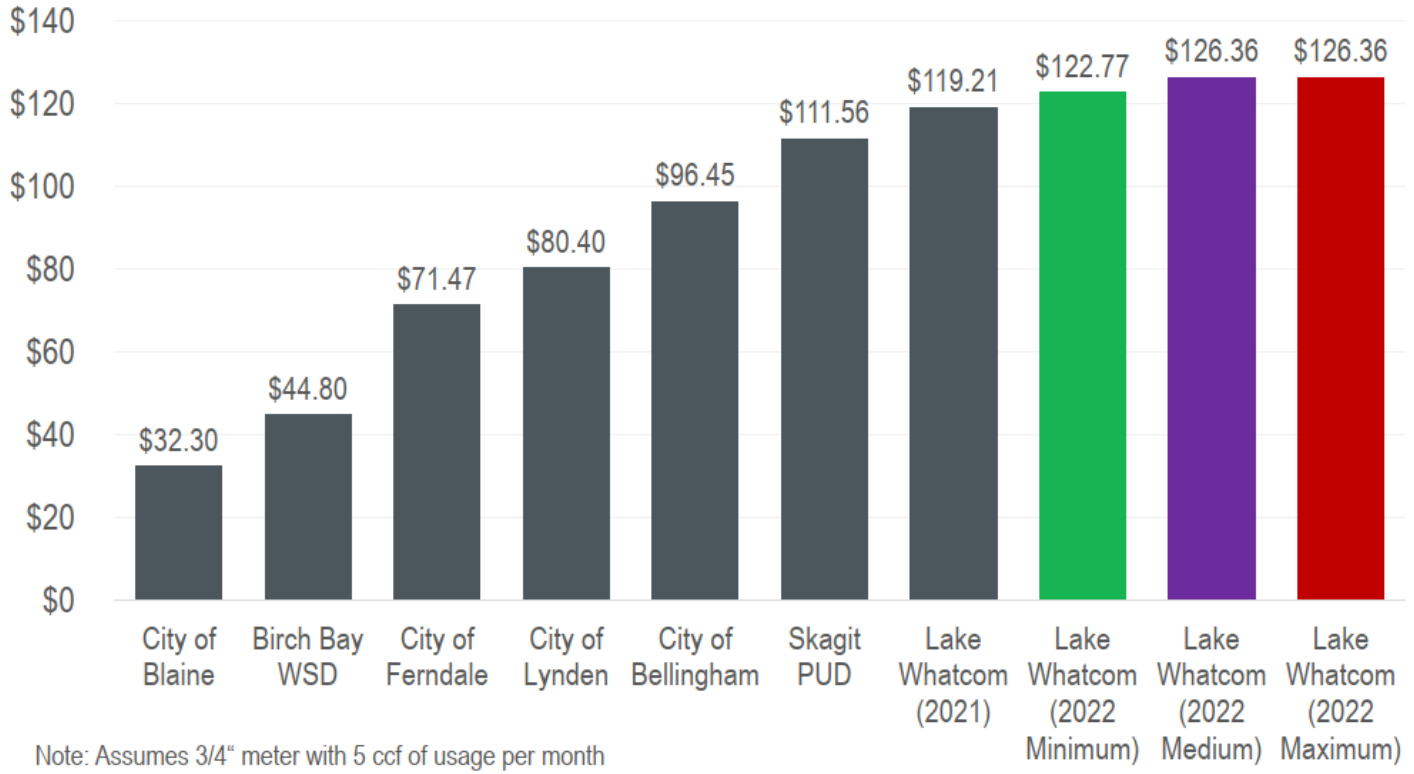
Metric	Scenario 1	Scenario 2	Scenario 3
Capital (inflated)	$13.4 million	$23.3 million	$26.5 million
Debt	$4.75 million	$11.75 million	$13.25 million
Increases	2022-40: 3% / yr.	2022-24: 6% / yr. 2025-2040: 3% / yr.	2022-25: 6% / yr. 2026-2040: 3% / yr.

Three years of 6% increases / yr.

Four years of 6% increases / yr.

WTP Alternative Analysis

Single-Family Bi-Monthly Water Rates

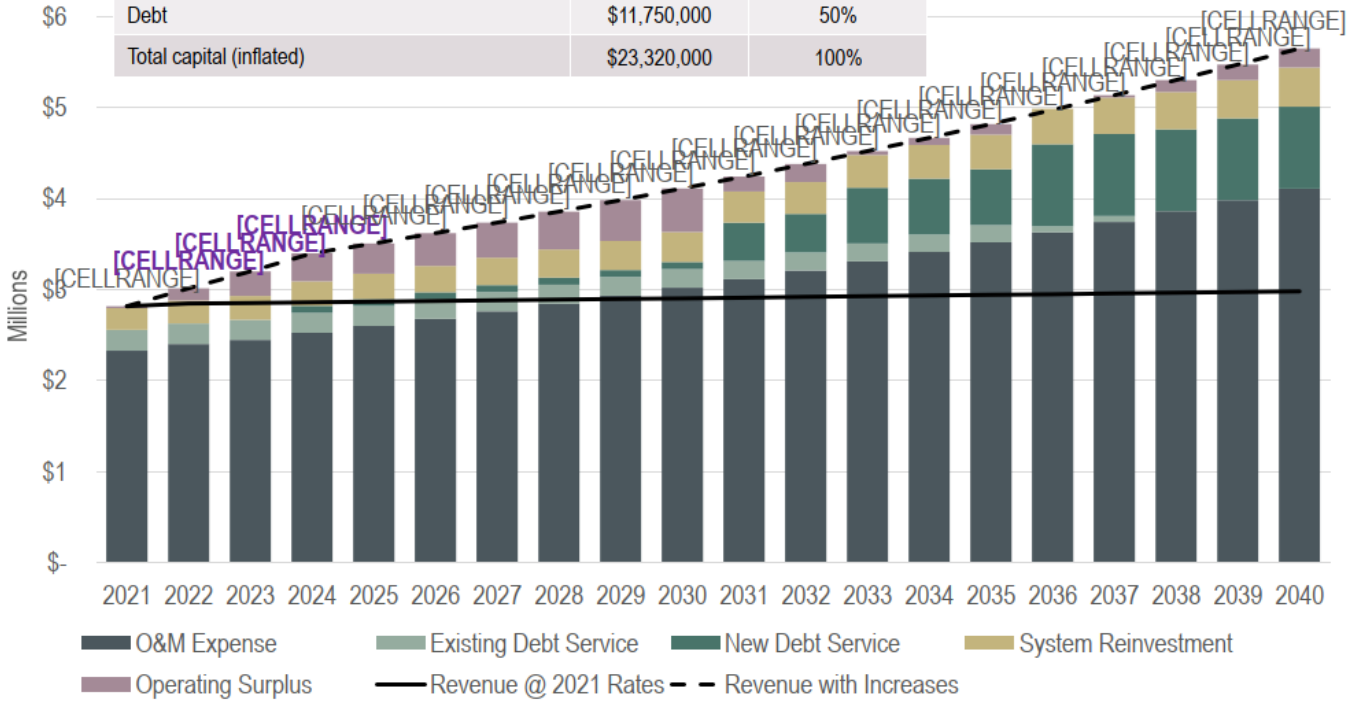


Note: Assumes 3/4" meter with 5 ccf of usage per month

WTP Alternative Analysis

Revenue Requirement: Medium SVWTP

Capital Funding Sources	Cost (inflated)	%
Cash (Reserves, system investment, GFCs, etc.)	$11,570,000	50%
Debt	$11,750,000	50%
Total capital (inflated)	$23,320,000	100%



WTP Alternative Analysis - Goals

Alternative	Cost	G1	G2	G3	G4	G5	G6	Total	Rank
Minimum	$4.5M	10	0	6	2	10	5	**33**	**3**
Medium	$11.4M	10	5	7	5	10	7	**44**	**2**
Maximum	$18.6M	10	7	8	8	10	9	**52**	**1**

Given:

- ***Capital cost***
- ***Debt service***
- ***Rate impacts***
- ***Goal accomplishments***

Recommendation:

- ***MEDIUM Alternative***

Next Steps

- *Board Informational Presentation*
  - *August 11, 2021 @ 630PM*
- Board Input Meeting and Discussion
  - August 25, 2021 @ 800AM
- Prepare *DRAFT* Alternatives Analysis Report
  - District review & comment
  - Board review & comment
- Modify and Finalize Alternatives Analysis Report

Questions?

Supplemental Slides

Alternatives Analysis Summary

- Pump Performance – TM1
  - Pump flow and pressure testing

Raw Water Pumps – Raw Water Pump 2 is original (1972) and near the end of its recommended useful life.

Transfer Pumps – Pumps are original (1992) and near the end of their recommended useful life.

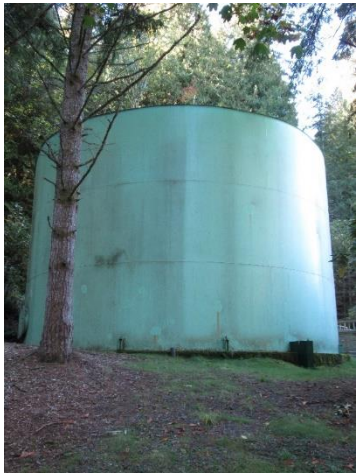
Finished Water Pumps – Pumps are original (1992) and near the end of their recommended useful life.

Alternatives Analysis Summary

- Chlorine Contact Basin Coatings – TM2
  - Interior and Exterior Coating Assessment
    - Exterior sidewall coating in fair condition
      - Recommend replacement within 5-10 years
    - Exterior roof coating in moderate/poor condition
      - Recommend replacement within 5 years
    - Interior coating in fair condition
      - Recommend replacement within 5-10 years
    - Recommendations
      - Seal welding, additional roof hatch, exterior ladder security, additional access security measures
      - New exterior and interior coating systems (<7 years)

Alternatives Analysis Summary

- Chlorine Contact Basin Coatings – TM2
  - Interior and Exterior Coating Assessment



CCB – Tank was erected in 1992.

Corrosion – Tank has several corrosion spots, some of which have been repaired.

Algae – Roof exhibits lichen and algae growth, both of which may have damaged the coatings.

Alternatives Analysis Summary

- Seismic Analysis– TM3
  - Complete Tier 2/Tier 3 Seismic analysis
    - Main Building
      - No structural deficiencies identified
      - Non-structural deficiencies include additional bracing
    - Finished Water Pump Building
      - Shear wall and diaphragm shear structural deficiencies
      - Non-structural deficiencies include additional bracing and securing existing gas piping
    - Chlorine Contact Basin (CCB)
      - Foundation ring wall deficiencies identified (BHC, 2016)
      - Nonstructural deficiencies include flexible piping connections

Alternatives Analysis Summary

- Seismic Analysis– TM3
  - Complete Tier 2/Tier 3 Seismic analysis

Seismic support – Example of piping with insufficient seismic support

Seismic support – Example of equipment with insufficient seismic support

Seismic Support – Conduit within the FWP Building with insufficient seismic bracing.

Alternatives Analysis Summary

- Chemical System– TM4
  - Alum (coagulant) & Soda Ash (pH control) system
    - Alum
      - Best coagulant for District use
      - Tank is beyond useful life, metering pump lacks redundancy and controls, tank filling is cumbersome, tank location restricts other WTP uses
    - Soda Ash
      - Best pH control for District use
      - Tank in fair condition, mixers in poor condition, access is restricted and requires significant manual labor for addition, chemical storage in building
      - Tank location restricts other WTP uses and likely contributes to corrosion of piping and other equipment
  - Recommendations
    - Replace alum tank, both metering pump systems, soda ash mixers
    - Relocate components to new chemical room/building to provide separation and reduced labor

Alternatives Analysis Summary

- Chemical System– TM4
  - Alum (coagulant) & Soda Ash (pH control) system

Alum Storage Tank – HPDE. Installed in 1992 and beyond its recommended useful life (15-17 years).

Soda Ash Storage Tank & Platform – Welded steel. Installed in 1992 and in good condition. Platform in fair condition while the mixer is in poor condition

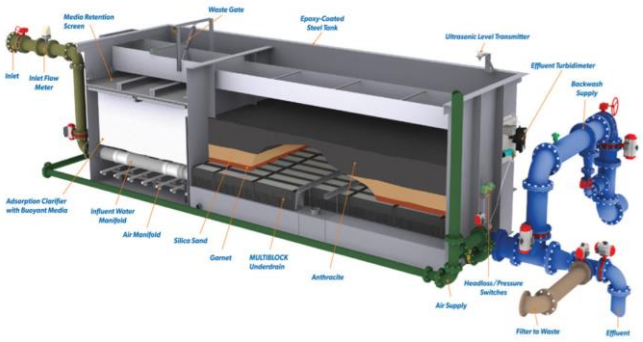
Metering Pumps – Lack of features requires daily manual calibration.

Alternatives Analysis Summary

- Filtration System– TM5
  - Filtration Alternatives
    - Status Quo
      - Rehabilitate all components for continued use in existing bldg.
    - Modified use of existing filters
      - New pretreatment, filter rehabilitation,
      - Requires new building
    - New rapid rate mixed media filter units
      - New filters with pretreatment
      - Requires new building
    - New membrane treatment filter units
      - New treatment and filtration
      - Requires new building

Alternatives Analysis Summary

- Filtration System– TM5
  - Filtration Alternatives



* Typical package filtration equipment with contact adsorption clarifier (CAC).

* Typical membrane filtration equipment

DAF – Dissolved Air Flotation treatment package.

Alternatives Analysis Summary

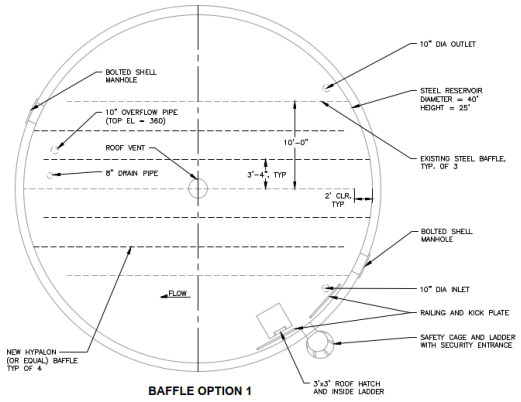
- Disinfection System– TM6
  - Gas Chlorine injection and Chlorine Contact Time
    - Disinfection
      - Gas chlorine, bulk hypochlorite, and onsite hypchlorite generation alternatives
      - Most alternatives require new building
    - Chlorine Contact
      - CCB size and BE limit flow through the WTP
      - Alternatives include reuse of existing, new larger replacement CCB, and new supplemental CCB
      - High priority item and construction sequencing must be considered to ensure distribution system supply

Alternatives Analysis Summary

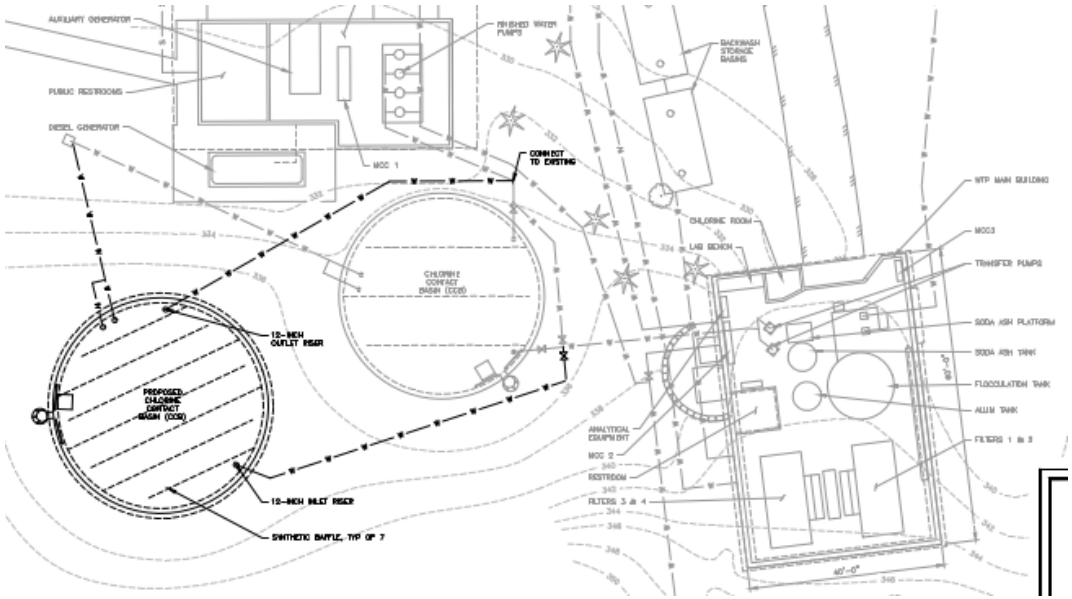
- Disinfection System– TM6
  - Gas Chlorine injection and Chlorine Contact Time

Alternatives Analysis Summary

- Disinfection System– TM6
  - Gas Chlorine injection and Chlorine Contact Time



* Proposed CCB modifications.



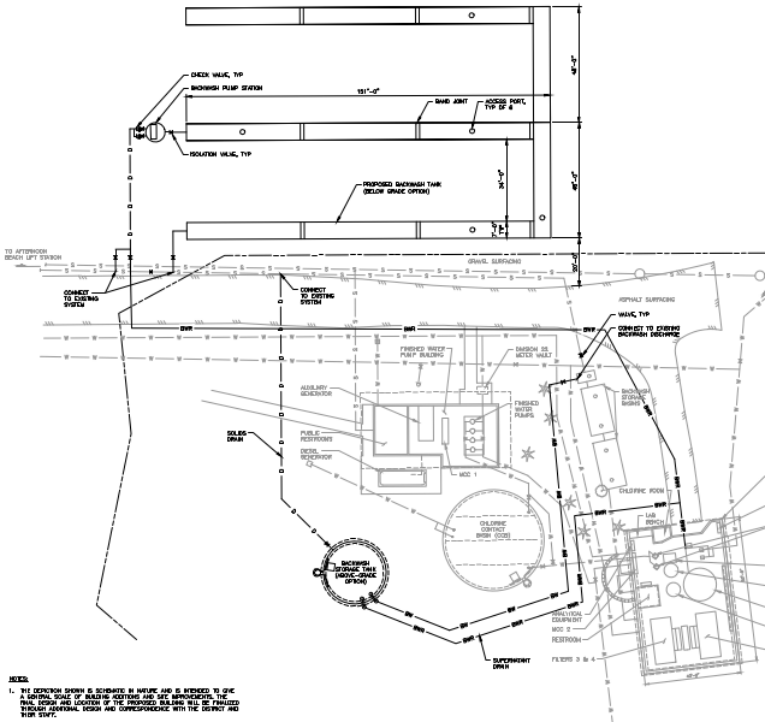
* Proposed new CCB.

Alternatives Analysis Summary

- Backwash System– TM7
  - Filter Backwash System
    - Alternatives include continued municipal sewer discharge, Lake Whatcom discharge, and recycle
      - Below and above grade options
    - Status Quo
      - Expensive, cumbersome for high demand
    - Lake Whatcom
      - Significant monitoring and permitting requirements
      - Additional chemical addition systems likely
    - Recycle
      - Moderate monitoring and permitting requirements
    - Reuse of existing CCB possible in any scenario
      - Depends heavily on desired use of existing CCB

Alternatives Analysis Summary

- Backwash System– TM7
  - Filter Backwash System



Alternatives Analysis Summary

- Structural & Architectural Components – TM8
  - WTP Main Building and FWP Building
    - WTP Main Building
      - No major structural deficiencies, some corrosion of non-structural components (MCC's, supports, piping, etc.)
      - Lacks space and access to equipment, non-compliant safety shower and eye-wash, security should be improved
      - Alternatives included expansion "up" and "out"
    - Finished Water Pump Building
      - Two structural deficiencies identified. Additional seismic bracing recommended
      - Lacks space and access for some equipment
      - No alternatives analyzed

Alternatives Analysis Summary

- Structural & Architectural Components – TM8
  - WTP Main Building and FWP Building

WTP Alternatives Analysis

- Minimum Alternative
  - Short Term Improvements
    - Finished Water Pump Replacement
      - Pumping capacity & growth analysis
      - Replace all 4 finished water pumps
      - Replace all associated MCC equipment
      - Upgrade to VFD controls
    - Budget Cost
      - $455,000
    - Other Considerations
      - DS supply during construction

WTP Alternatives Analysis

- Minimum Alternative
  - Short Term Improvements
    - Clearwell Transfer Pump Replacement
      - Replace both clearwell transfer pumps
      - Replace all associated MCC equipment
      - Upgrade to VFD controls
    - Budget Cost
      - $210,000
    - Other Considerations
      - Separate electrical room?

WTP Alternatives Analysis

- Minimum Alternative
  - Short Term Improvements
    - Raw Water Pump Replacement
      - Replace both raw water pumps
      - Replace all associated MCC equipment
    - Budget Cost
      - $150,000
    - Other Considerations
      - Separate electrical room?

WTP Alternatives Analysis

- Minimum Alternative
  - Short Term Improvements
    - Alum System Improvements
      - Replace existing alum storage tank
      - Replace existing alum metering pumps
    - Budget Cost
      - $
    - Other Considerations

WTP Alternatives Analysis

- Medium Alternative
  - Short Term Improvements
    - WTP Main Building seismic retrofits
      - Non-structural bracing recommendations
    - Budget Cost
      - $75,000
    - Other Considerations
      - Reorganization of existing space
      - Installation of new/upgraded components

WTP Alternatives Analysis

- Medium Alternative
  - Short Term Improvements
    - WTP Finished Water Pump Building seismic retrofits
      - Structural diaphragm and roofing modifications
      - Non-structural bracing recommendations
    - Budget Cost
      - $180,000
    - Other Considerations
      - Installation of new/upgraded components

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - Rehabilitate existing filters
      - Empty and inspect filters
      - Rehabilitate underdrain, piping, coatings, wash system
      - Refill with new, fresh media
    - Budget Cost
      - $100,000
    - Other Considerations
      - DS supply during construction
      - Perform during low-demand, winter months

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - New 0.3 MG chlorine contact basin
      - Replaces existing CCB
      - Provide maximum access and treatment flexibility
    - Budget Cost
      - $990,000
    - Other Considerations
      - DS supply during construction

WTP Alternatives Analysis

- Medium Alternative
  - Short Term Improvements
    - WTP security improvements
      - CCB security
      - Fencing and access control
      - Video monitoring
    - Budget Cost
      - $75,000
    - Other Considerations
      - SVCA, park and delivery vehicle access
      - New CCB or buildings?

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - Chemical Addition System Improvements
      - Replace alum tank and metering pumps
      - Replace soda ash tank and metering pumps
      - Relocate chemicals to new, standalone building
    - Budget Cost
      - $2,110,000
    - Other Considerations
      - DS supply during construction

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - New 0.3 MG chlorine contact basin
      - Replaces existing CCB
      - Provide maximum access and treatment flexibility
    - Budget Cost
      - $990,000
    - Other Considerations
      - DS supply during construction

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - Rehabilitate existing filters
      - Empty and inspect filters
      - Rehabilitate underdrain, piping, coatings, wash system
      - Refill with new, fresh media
    - Budget Cost
      - $100,000
    - Other Considerations
      - DS supply during construction
      - Perform during low-demand, winter months

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - Rehabilitate existing CCB
      - Provide seal welding, new coatings, new appurtenances
      - Install seismic retrofits and new controls
    - Budget Cost
      - $620,000
    - Other Considerations
      - Containment and environmental considerations

WTP Alternatives Analysis

- Medium Alternative
  - Long Term Improvements
    - Backwash recycle implementation
      - Repurpose CCB for backwash recycle
      - Install new controls, appurtenances and piping
      - Modify existing piping connections and WQ monitoring
    - Budget Cost
      - $630,000
    - Other Considerations
      - Permitting and DOH approval
      - Potential decrease in finished water quality