OWEA TECHNICAL CONFERENCE & EXPO - 2019

Modeling Saves City of Youngstown $$$ by Rethinking LTCP Strategy

June 26, 2019

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AGENDA

Introduction

Health & Safety Moment

WWTP History and the LTCP

Process and Hydraulic System Modeling

Impact on Cost and Operations

Modifications to the LTCP

Q&A

Design & Consultancy for natural and built assets

Heat Related Illness (HRI) Prevention

RECOGNIZE the 4 stages of Heat Illness

1. Heat Cramps (Discomfort)
2. Heat Syncope AKA "Heat Stress" (Fainting)
3. Heat Exhaustion (Will become life threatening if not addressed quickly)
4. Heat Stroke (Life Threatening – call 911)

Need Heat Index Support?
Get the **NIOSH (Formerly OSHA) Heat Tool app**.

Look for this icon.

Hazard controls start with effective management:

- ✓ Read and know your company's H&S Standard.
- ✓ Being hydrated in advance is critical.
- ✓ Have water onsite and require folks to routinely hydrate & replenish electrolytes.
- ✓ Provide adequate shade.
- ✓ Schedule and require routine breaks

Effective hazard controls involve ensuring water, shade, & breaks.

Heat Related Illness (HRI) Prevention

Hydrate

+

Replenish

Eat light

Monitor conditions

(NIOSH Heat App)

&

Take cooling breaks

Cooling Vest

Cooling Towels

Misting Fan

Portable shade

- ✓ 3:1 waters to electrolyte drinks
- ✓ Hydrate w/ 8 oz. water every 15 minutes

Hazard controls start with effective planning of work. PPE is your last option.

WWTP History

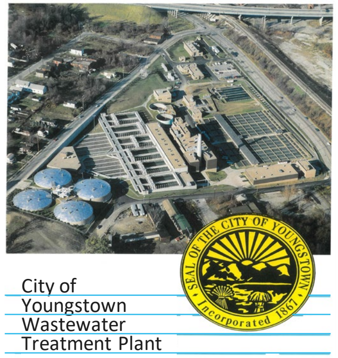
- Original WWTP was built in 1957 with preliminary treatment, primary flocculation, clarification and disinfection. Sludge processing included digestion and dewatering on vacuum filters.

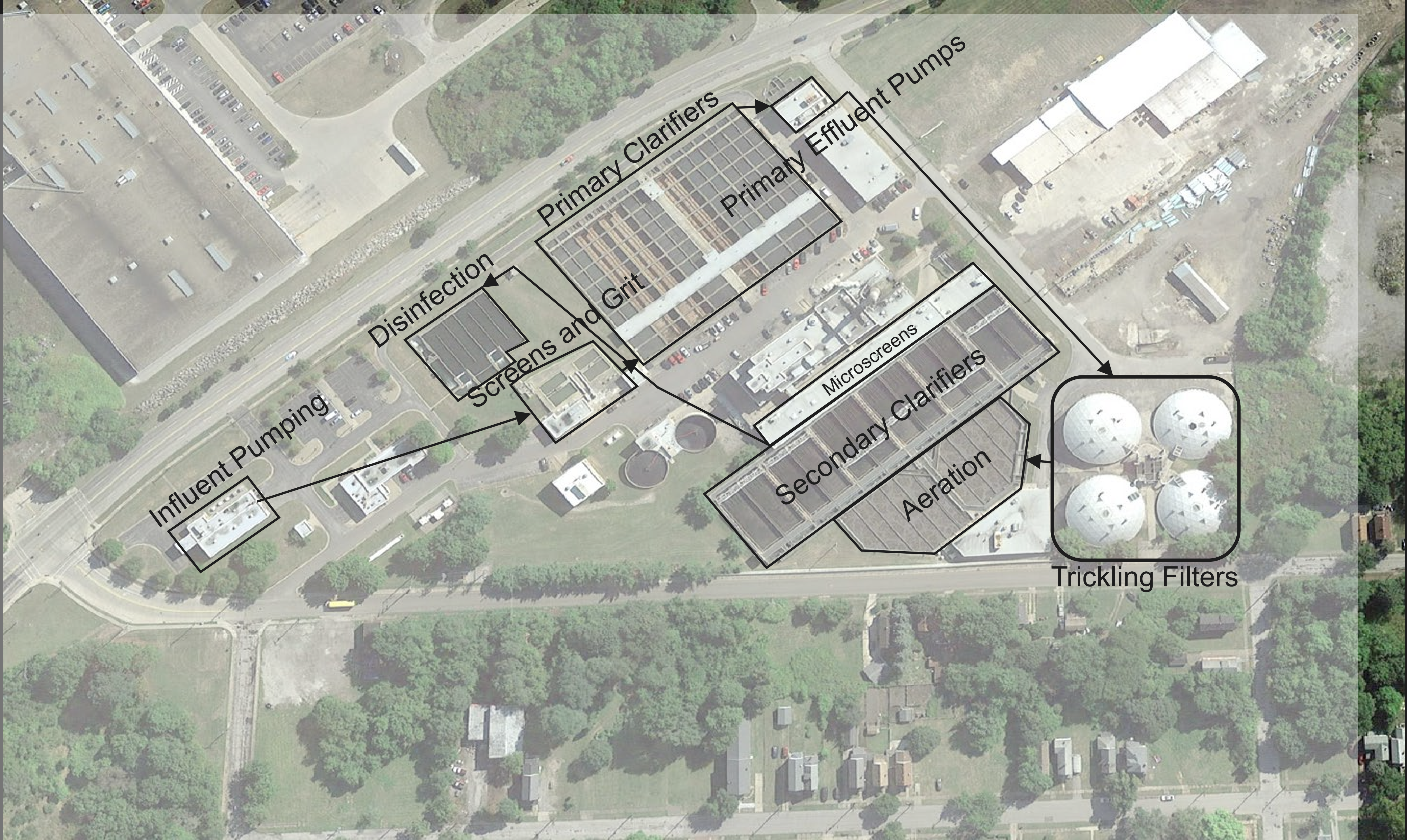
- In 1984 construction began on the modifications to the existing WWTP primary treatment systems and sludge handling processes.

- In 1985 construction on the secondary treatment improvements was started

- WWTP is rated for 35 MGD ADDF and 90 MGD PDF

- Total Project Cost $50 million





Primary Clarifiers
Primary Effluent Pumps
Disinfection
Screens and Grit
Microscreens
Secondary Clarifiers
Influent Pumping
Aeration
Trickling Filters

Long Term Control Plan (LTCP)

Expected Improvements Needed to Maintain Service

- Control Combined Sewer Overflows (CSO)
- Upgrade the WWTP to Handle 80 MGD Wet Weather Flow
- Construct 100 MGD High Rate Treatment Wet Weather Facility
- Other System Improvements

Long Term Control Plan (LTCP) 2014 Report

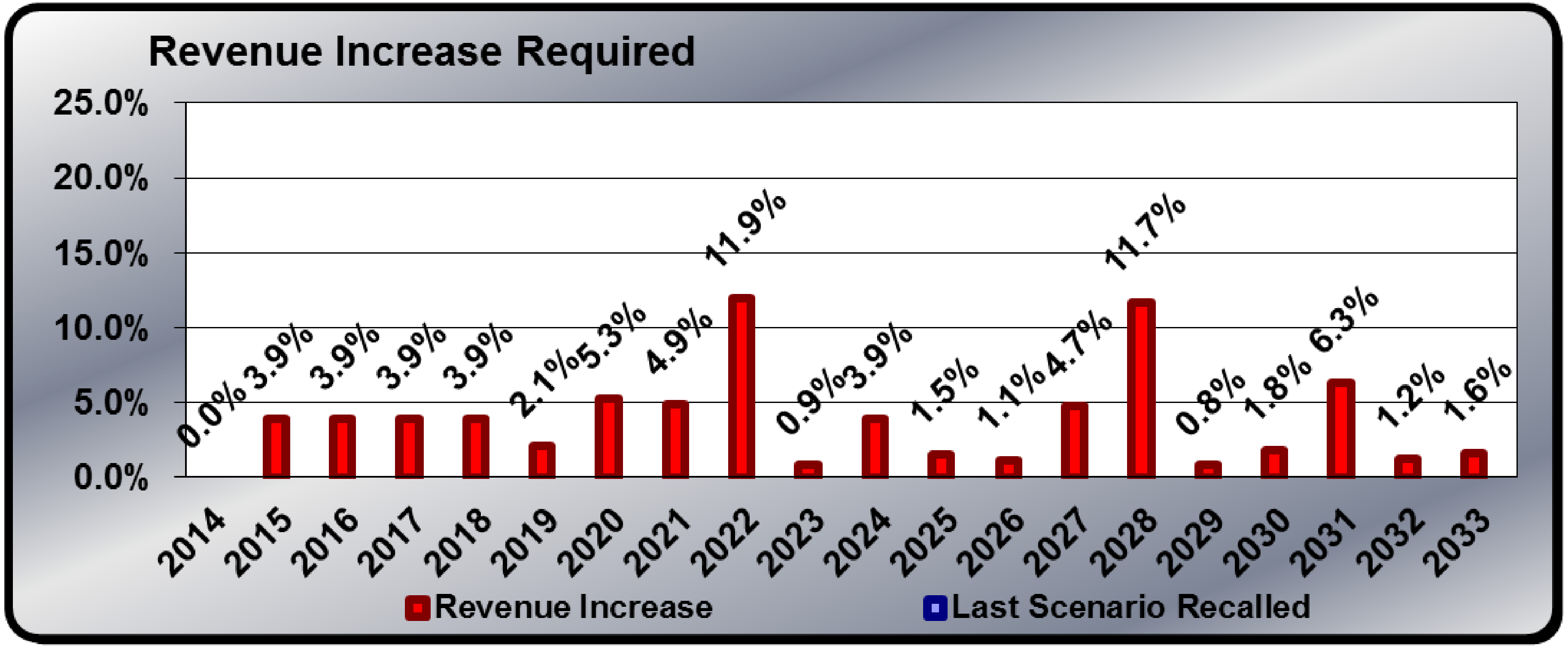
WWTP Improvements:

- Cost: $37+ million
- Finalize by March 27, 2020

Wet Weather Facility Improvements:

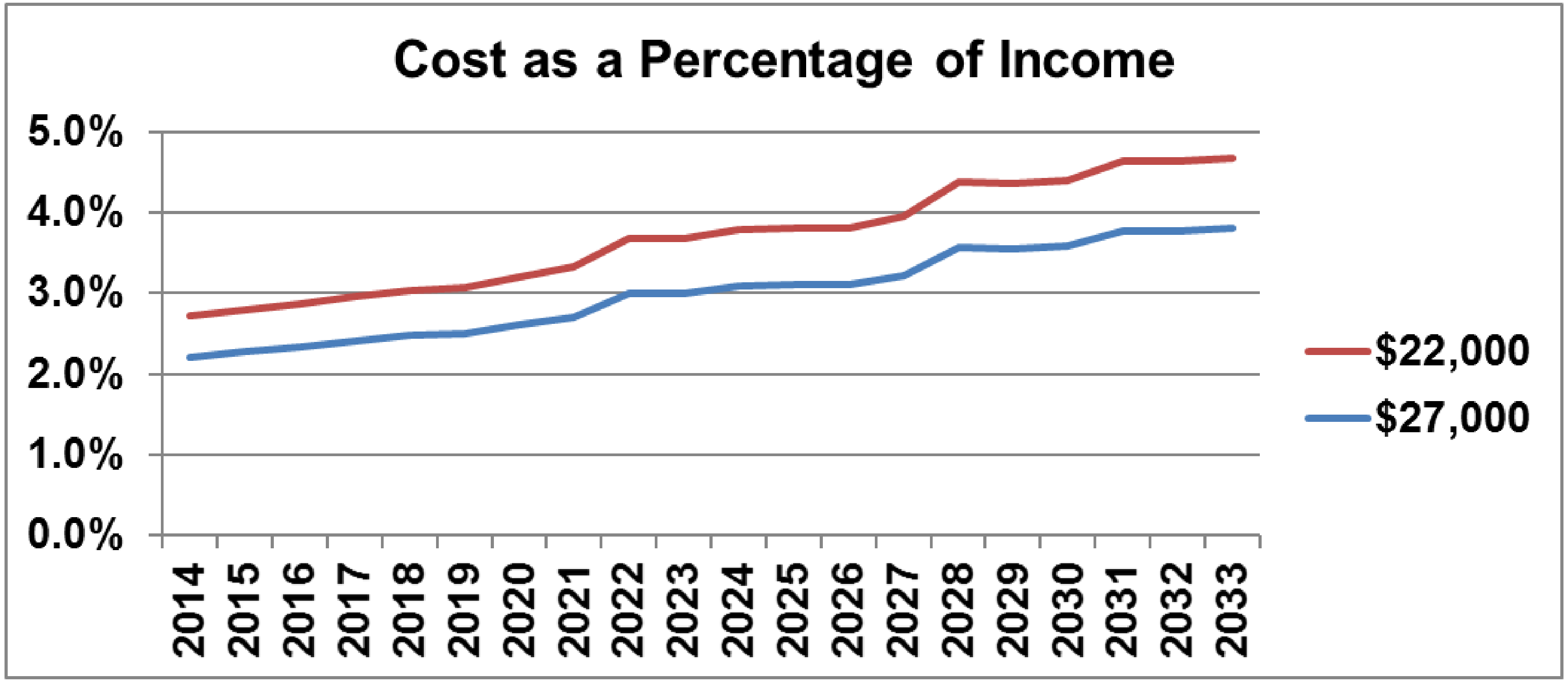
- Cost: $62+ million
- Finalize by April 20, 2029

Affordability Burden Is a Challenge to LTCP Implementation



LTCP Planned and Required Rate Hikes

Affordability Burden Is a Challenge to LTCP Implementation



LTCP Planned and Required Rate Hikes

WWTP Design Approach

WWTP Secondary Treatment Process Improvements:

1. Hydraulic Model to determine the WWTP hydraulic profile/flow capacity/conveyance modifications
2. Process Model to verify treatment needs and potential upgrades
3. Design of Secondary Treatment Improvements:
   - Trickling Filters
   - Aeration Tanks
   - Final Clarifiers
   - RAS/WAS

WWTP Design Approach

WWTP Primary Effluent Pumping Station and Microscreen System Improvements:

1. Pumping of Primary Effluent to Secondary Treatment
   - Upgrade Primary Effluent Pumping Station (PEPS)
   - Construct a new Auxiliary Primary Effluent Pumping Station (APEPS)
2. Improvements to the Microscreen System
   - Not Implemented and Replaced With Disk Filters
3. Aeration Tanks Diversion Box

WWTP Design Approach

Other WWTP Improvements:

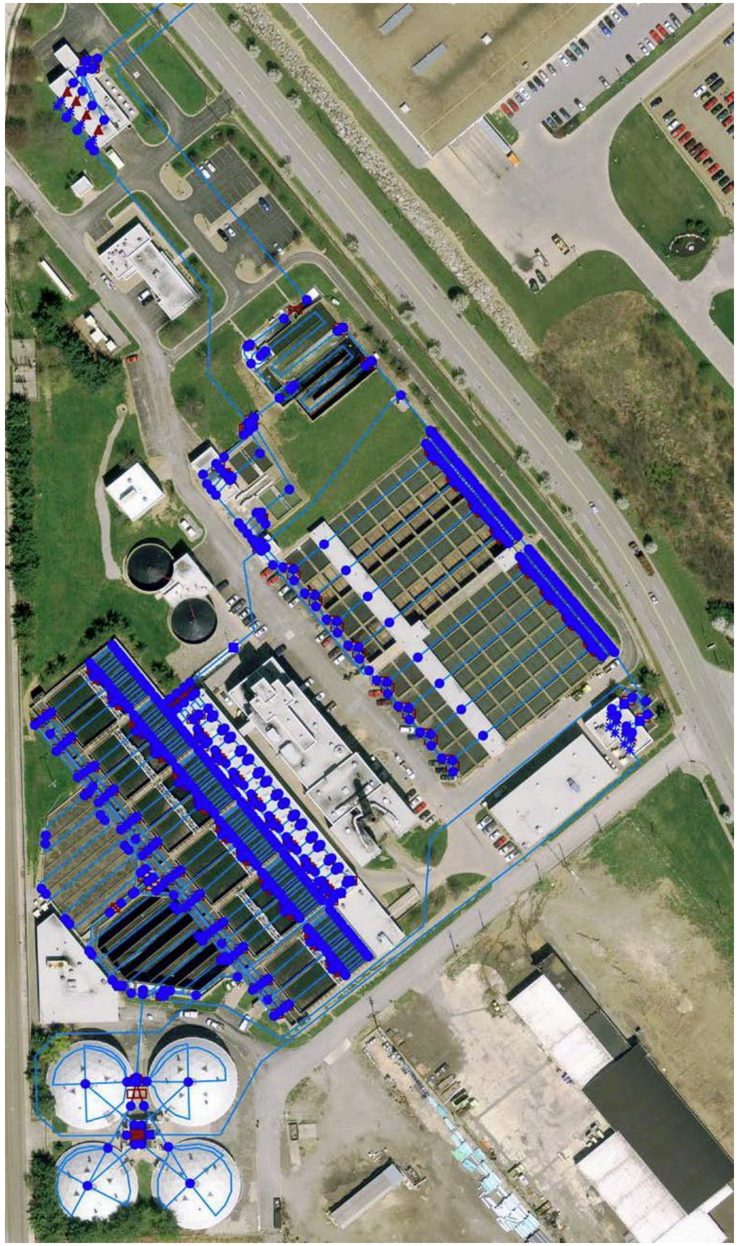
- LTCP Phase 1 - Electrical Improvements Contract A - Substation
- LTCP Phase 1 - Electrical Improvements Contract B – Electrical Distribution
- UV Disinfection Improvements Project
- Primary Settling Tanks Improvements Project

Hydraulic WWTP Model

Peak Flow Capacity 80 MGD

Wastewater Treatment Process	Existing Wet Weather Flow Rating, MGD	Planned Wet Weather Flow Capacity, MGD
Influent Pump Station and Grit Tanks	80	80
Mechanical Bar Screen (Channel Monster)	65 + (15) = 80	65 + (15) = 80
Primary Clarifiers (recycle)	80 + (10) = 90	80 + (10) = 90
Primary Effluent Pump Station (recycle)	~70	80 + (10) = 90
Primary Bypass to Chlorine	~20	0
Trickling Filters (recycle)	~70	80 + (10) = 90
Aeration (RAS)	35 + (20) = 55	50 + (30) = 80
Secondary Clarifiers	35	50
Microscreens (Backwash)	35 + (10) = 45	30 + (10) = 40
Chlorine Contact Tank	80	80

Software: InfoWorks Integrated Catchment Model (ICM)
Over 700 Nodes and 1000 Conduits / Flap Valves / Flumes / Pumps / Screens / Sluice Gates, etc.



Hydraulic WWTP Model Benefits

- Evaluate existing conditions, optimize plant performance, and review proposed plant improvements
- Simulate open channel and pressure flow conditions for both steady and unsteady flow conditions.
- Real time controls to simulate various operational controls (automatically opening/closing gates, throttling valves, variable crest weirs, etc.).
- Dynamically routing hydrographs with potential to incorporate the collection system model.

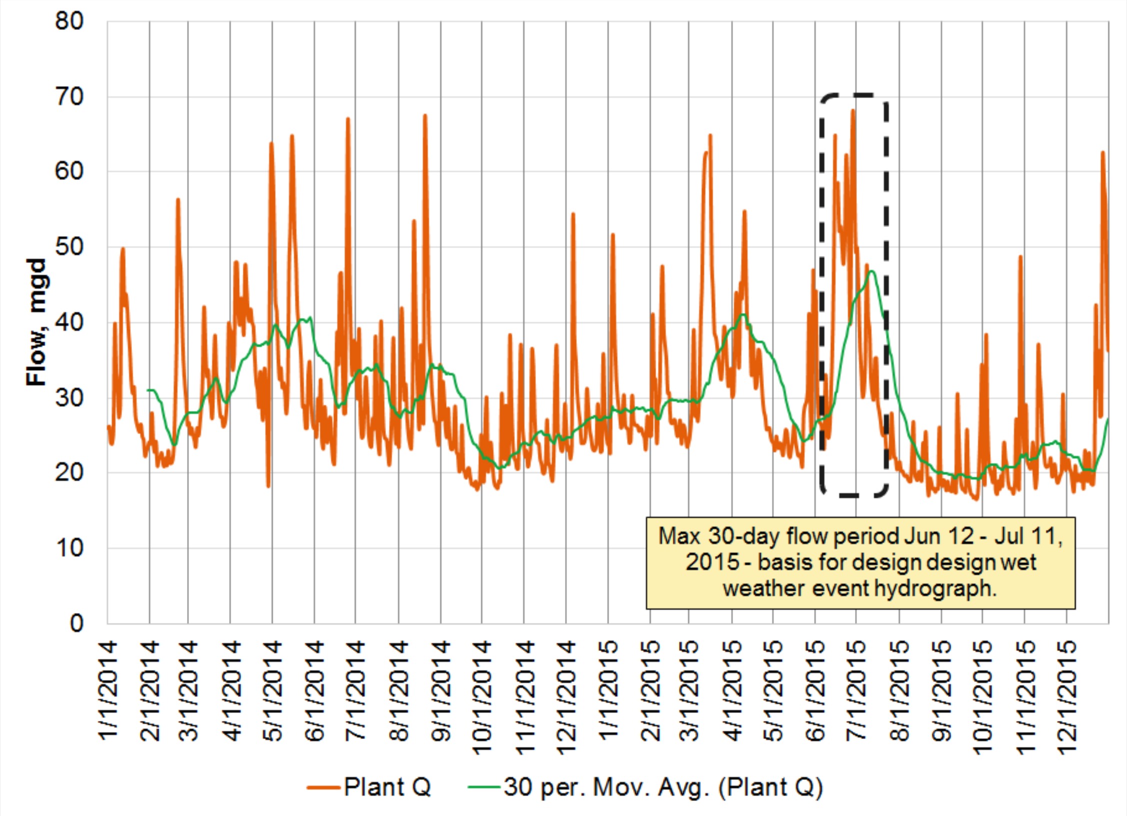
Hydraulic Issues Identified

Hydraulic Issue Identified	Proposed Solution
Hydraulically limiting inlet configuration at the Trickling Filter Effluent Pipe (Inlet Controlled) causing surcharging at the Trickling Filters	Modified effluent structure increased inlet capacity for 54-in Effluent Pipe and reduced turbulence
Aeration Leopold Flume depth sensor "deadbands" above 35 MGD and has a high headloss making it difficult to control wet weather flow splitting between aeration tanks and microscreens	Replace the Leopold Flume unit with a lower headloss measuring device with more dependable flow measurements
Desire increased processing capacity	Determined that increasing the Aeration effluent weir elevation would provide greater retention time / capacity without impacting influent & RAS water surface elevations

Process Model Objectives

1. Develop a BioWin® model of the YWWTP
2. Evaluate alternative process configurations and operating scenarios to treat up to 80 MGD peak wet weather plant influent flow and meet the existing WWTP permit limits
3. Develop estimated oxygen demands for the evaluated scenarios for use in the design of the aeration system and blower upgrades

Process Model Approach



Parameter	Plant Influent	Final Effluent
Flow	Not Reported	Daily
Temperature	Not Reported	Daily
Total Suspended Solids	5/week	5/week
Ammonia Nitrogen	Not Reported	5/week
pH, Daily Max and Min	Daily	Daily
CBOD5	5/week	5/week
Total Phosphorus	Not Reported	2/week
Total Kjeldahl Nitrogen	Not Reported	1/week
Nitrate + Nitrite	Not Reported	1/week

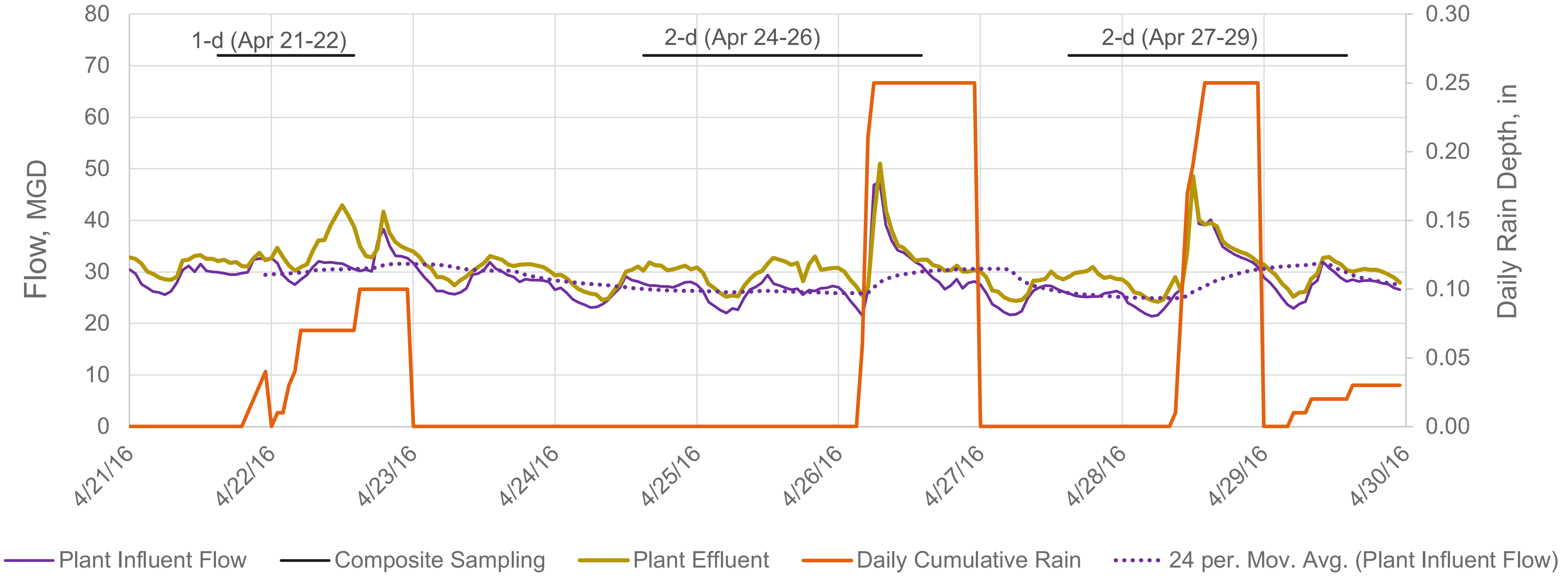
Used Historical Data and Supplemented with Additional Field Sampling

Process Model Approach

	Flow	TSS		CBOD5	
	MGD	mg/L	lb/d	mg/L	lb/d
Min Day	16.5	119	16,400	68.	9,400
Min Week (7-d)	17.0		20,700		13,300
Min Month (30-d)	19.2		25,300		17,200
Average Day	29.2	134	32,800	94	22,900
Max Month (30-d)	46.9		43,300		28,800
Max Week (7-d)	58.9		57,700		32,000
Peak Day	68.2	134	76,300	70	39,700
2014 Annual Average	29.9	137	32,300	101	23,500
2015 Annual Average	28.5	152	33,400	105	22,300

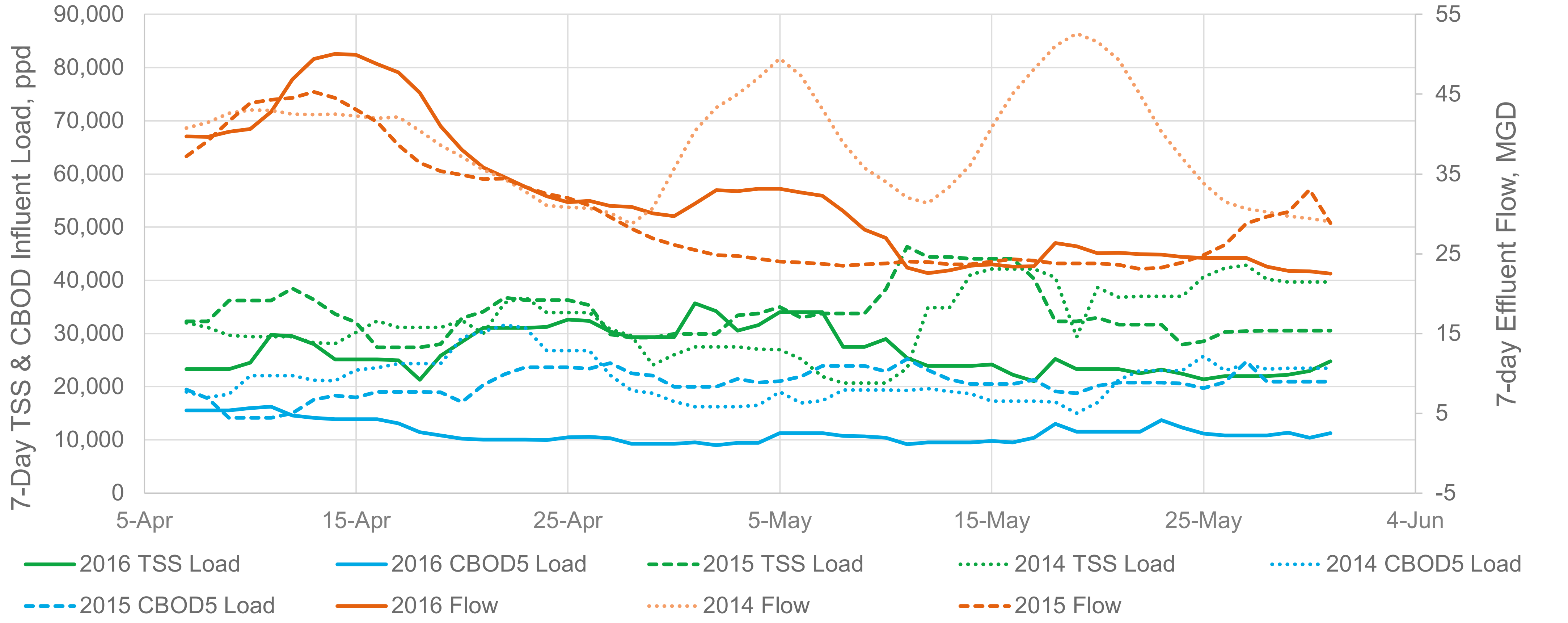
Used Historical Data and Supplemented with Additional Field Sampling

Process Model Approach



Rainfall and Plant Flows During the April 2016 Sampling Events

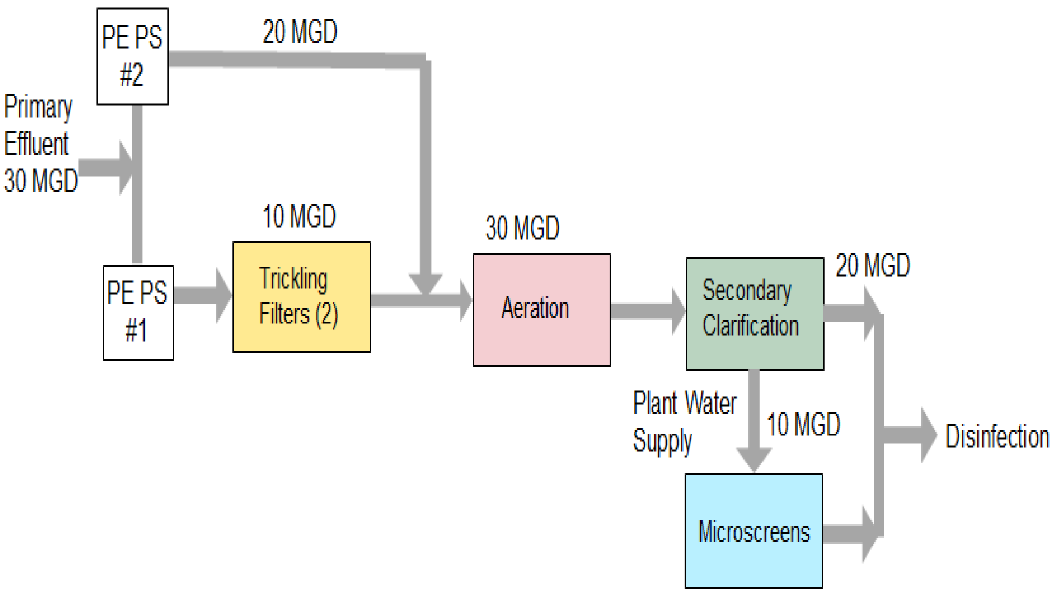
Process Model Approach

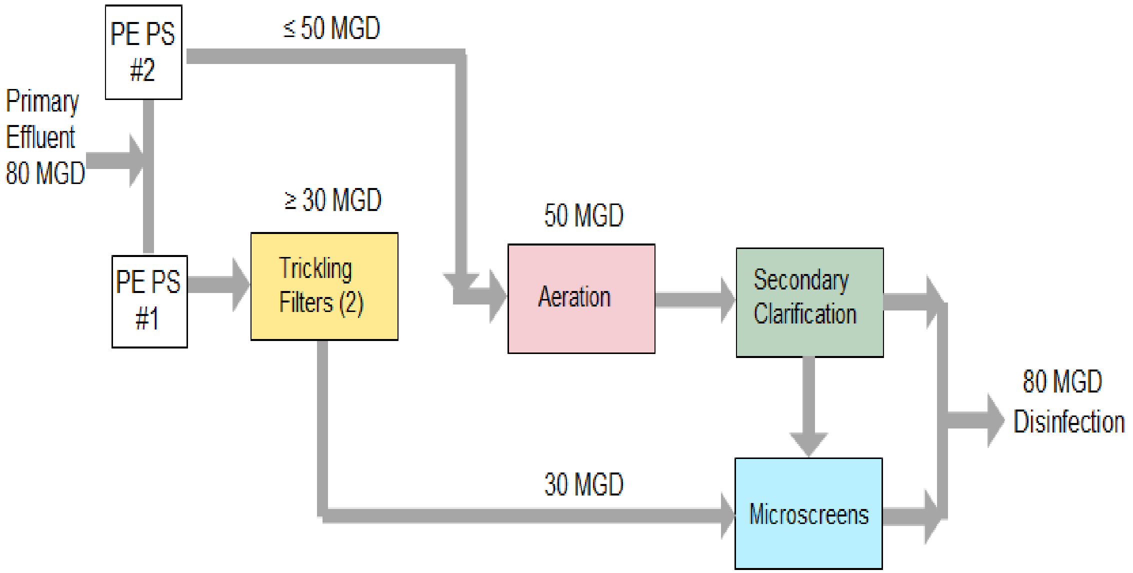


WWTP Flow and Influent TSS and CBOD Load Trends for April-May of 2014 2015 and 2016

Two Trickling Filter Operations Initial Proposal

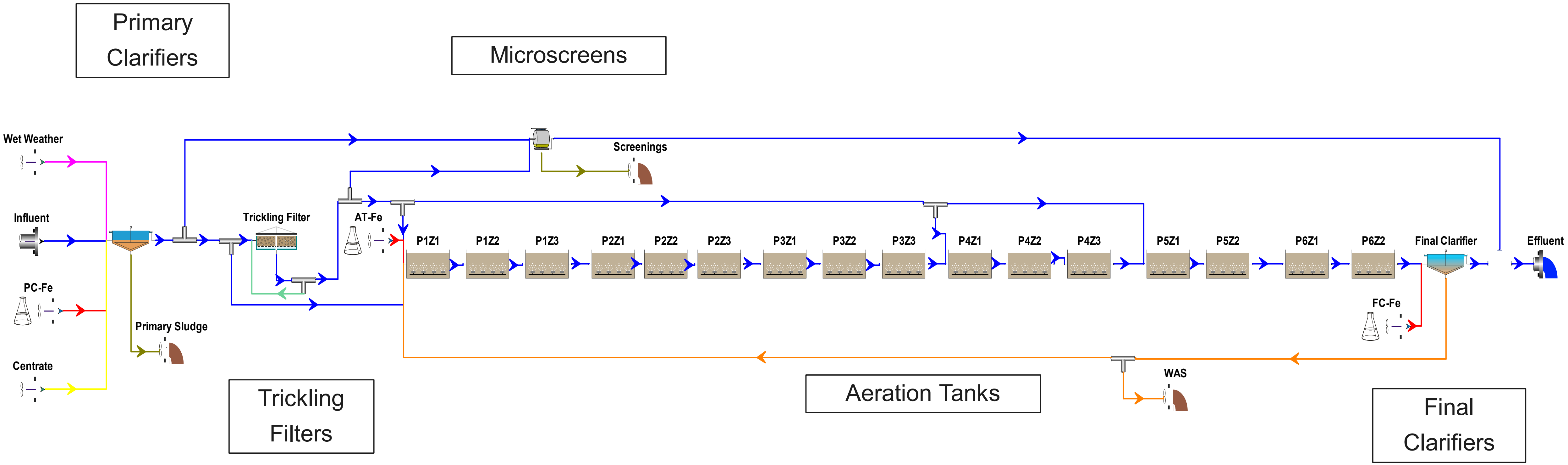
Two Trickling Filter Dry Weather Operation



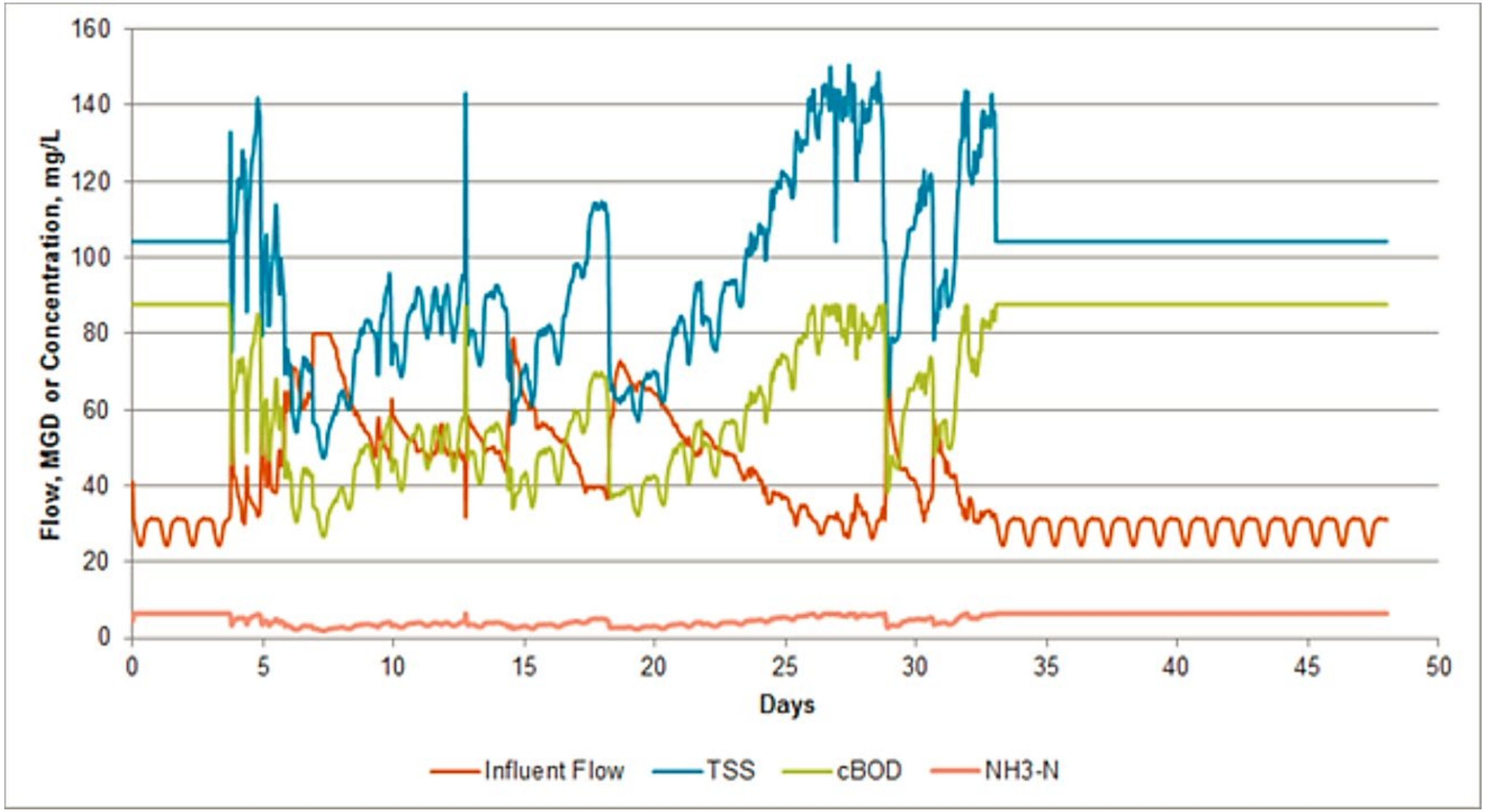


Two Trickling Filter Peak Wet Weather Operation

Process Model Developed to Represent Current and Proposed WWTP Operations



Actual Wet Weather Influent Flow and Concentrations Provide Realistic Model Input



Proposed Modification – Process Modeling Results

Modeling compared operation and predicted performance of proposed strategy with two trickling filters vs. LTCP with four trickling filters

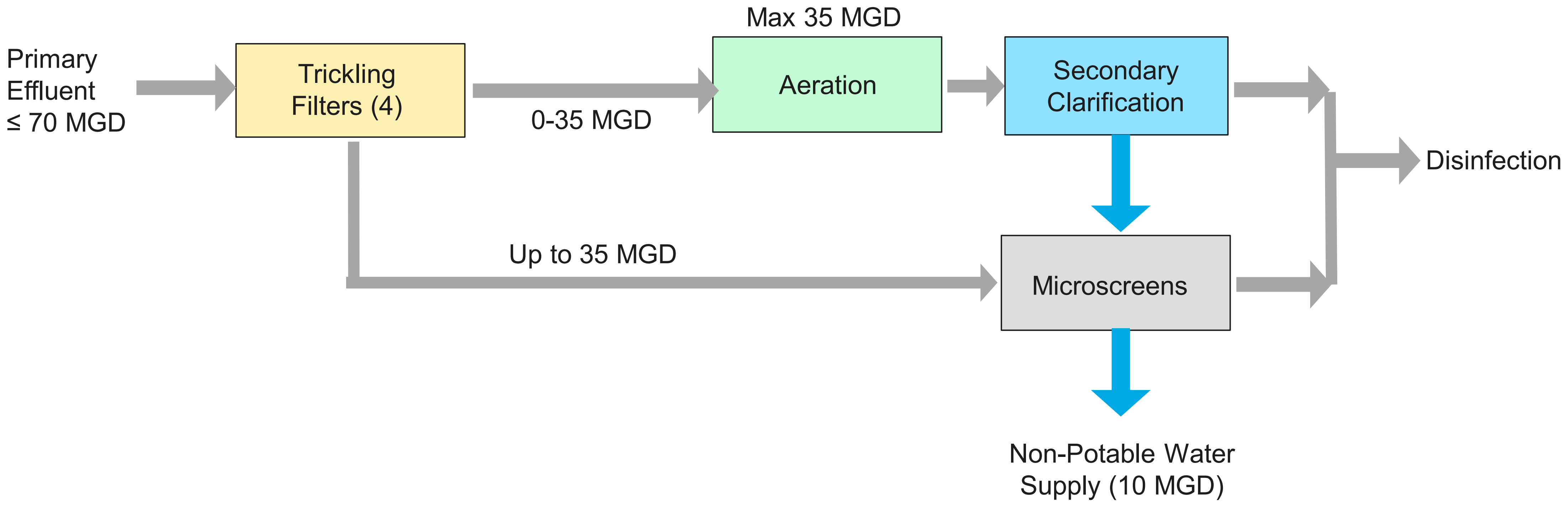
Scenario		AT Flow	TSS		CBOD5		NH3-N		FC SLR	FC SOR
		Max	7d	30d	7d	30d	7d	30d	Max	Max
		MGD	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	lb/d/sf	gpd/sf
4TFs	Plug Flow	35	13	13	10	8	1.7	1.4	16.7	733
2 TFs	Step Feed	50	21	18	7	5	1.4	1.2	34.7	950
Permit/Operating Limits		-	30	20	17	10	4.5	3.0	35	1000

Predicted Combined Effluent Quality and Clarifier Loading Rates

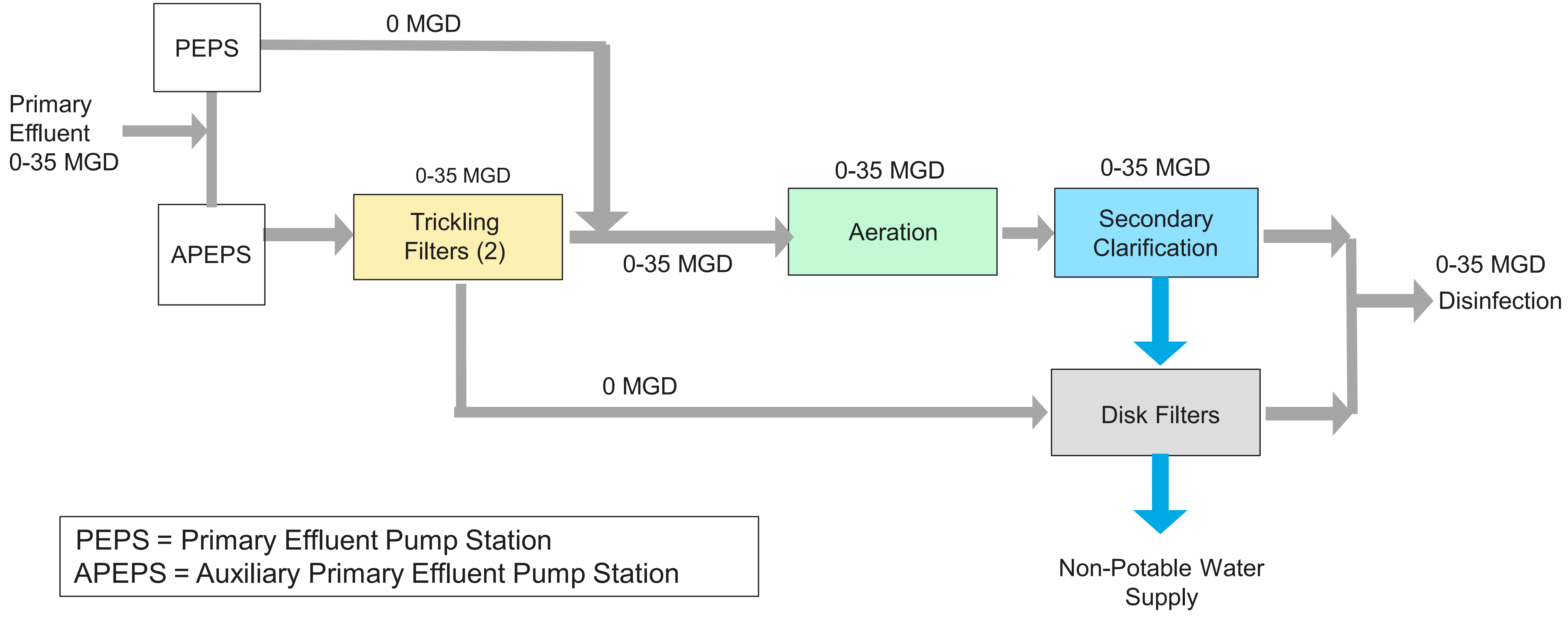
Secondary Treatment Design & Operation Aspects Reviewed and Supported Through Process Modeling

	LTCP	Proposed
Aeration System	Upgrade in kind	Step Feed Aeration: • Higher peak flow treated in ATs • Longer SRT for improved nitrification reliability • Operational Flexibility • More robust, improved post-storm recovery • Allows reduced peak clarifier solids loading
Final Clarification	Upgrade in kind	• Extended surface area • Increased capacity • Improved solids withdrawal
Microscreens	Upgrade in kind	• Replaced with Disk Filters

WWTP Current Operations

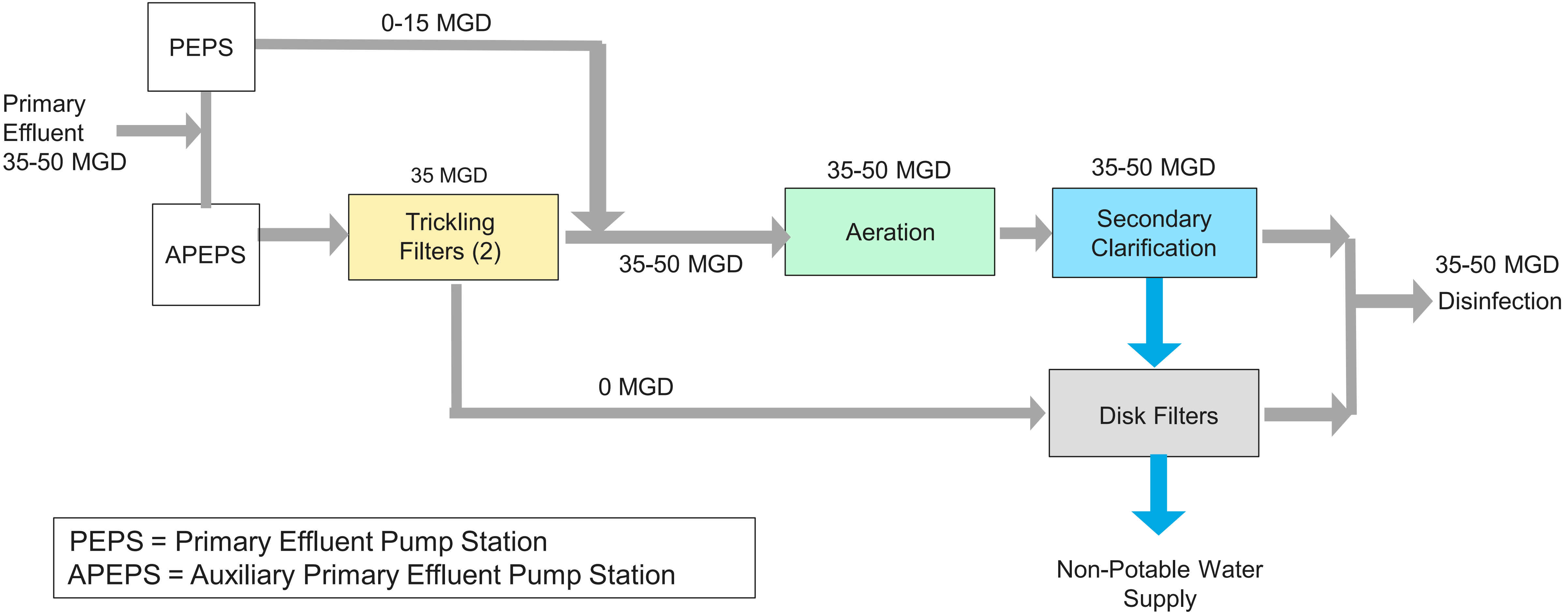


Proposed Modification 2 TFs
Process Flow Diagram – Dry Weather 0-35 MGD



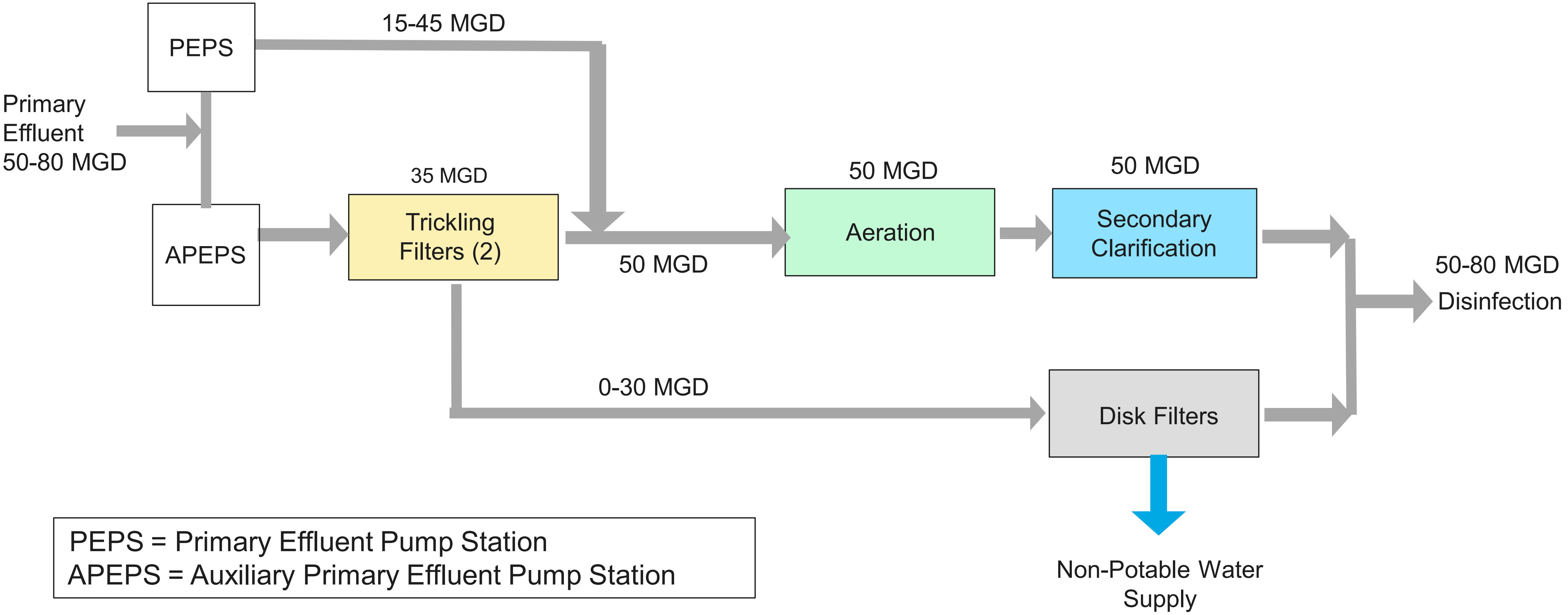
PEPS = Primary Effluent Pump Station
APEPS = Auxiliary Primary Effluent Pump Station

Proposed Modification 2 TFs
Process Flow Diagram – Wet Weather 35-50 MGD



PEPS = Primary Effluent Pump Station
APEPS = Auxiliary Primary Effluent Pump Station

Proposed Modification 2 TFs
Process Flow Diagram – Wet Weather 50-80 MGD



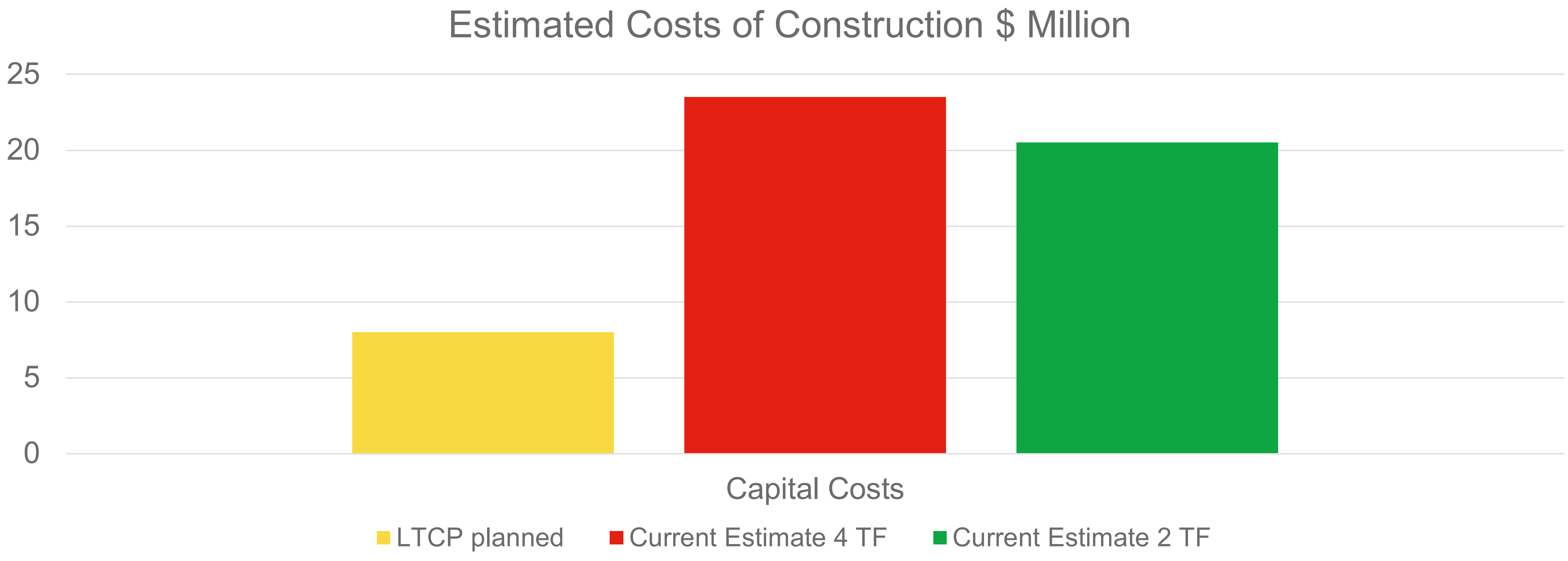
PEPS = Primary Effluent Pump Station
APEPS = Auxiliary Primary Effluent Pump Station

Process Modeling Conclusions

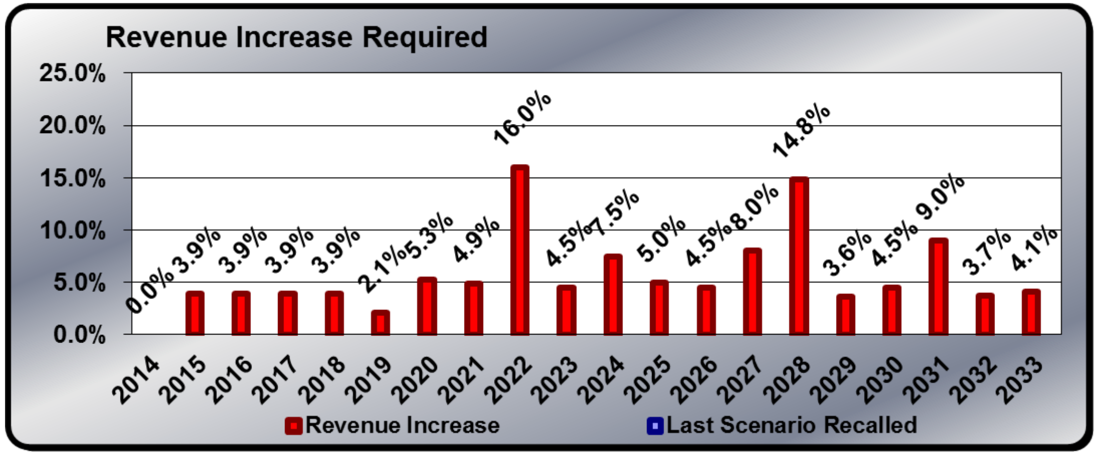
Proposed modifications to LTCP provide:

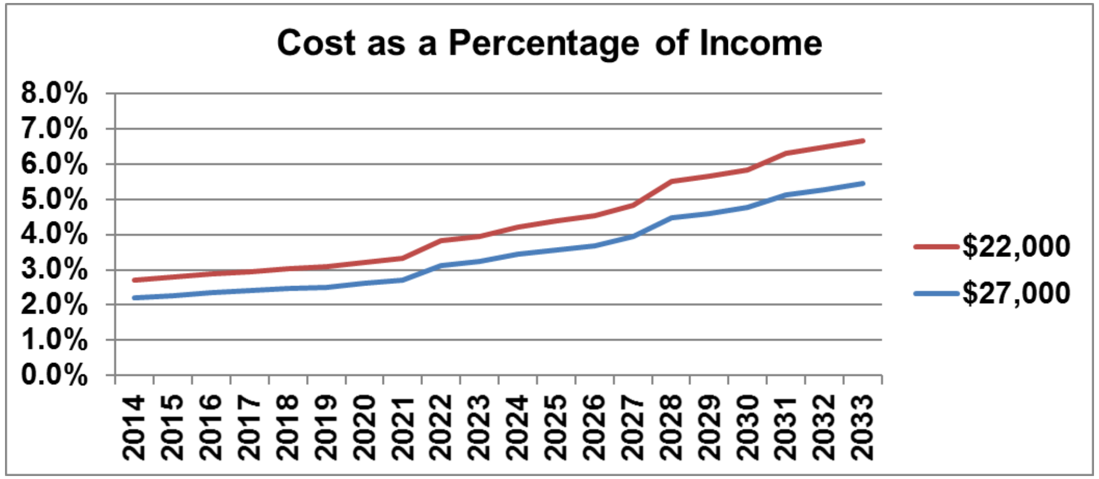
- Equivalent biological treatment
- Permit compliance (loading and concentration)
- Consent order compliance (schedule)
- More reliable and flexible operations modes
- Opportunities for controlling costs
- Current capital and O&M costs significantly elevated from proposed LTCP estimate

Capital Plan Changes Since LTCP Estimate Present a Cost Challenge for Youngstown



Actual Costs 4 Trickling Filters Present Highest Burden on Rates

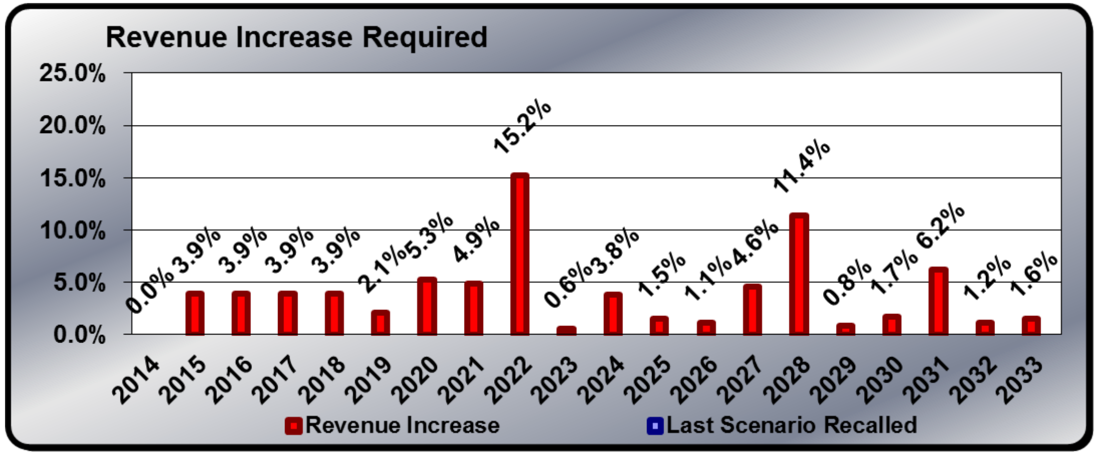


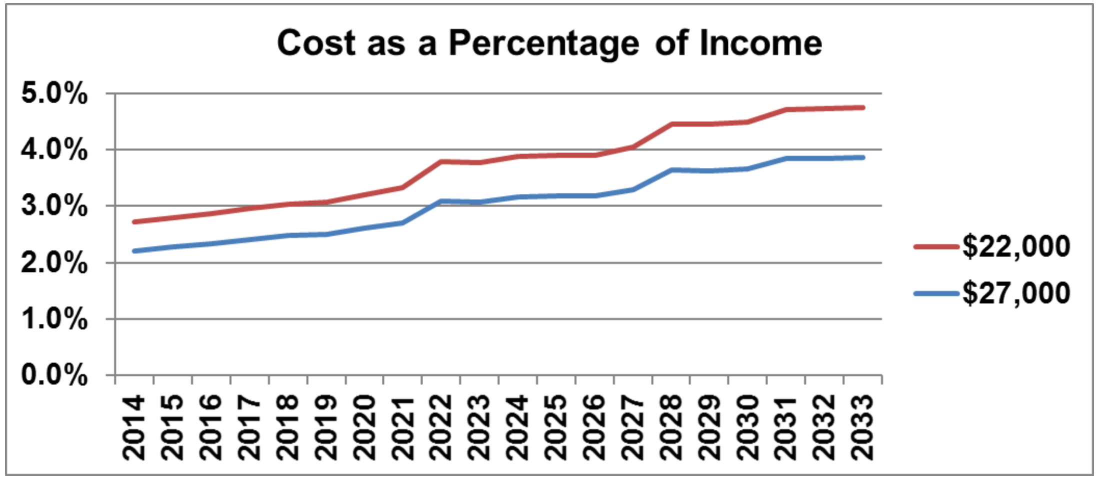


60% design estimates cost ~$15M over LTCP estimate

Current Planned and Required Rate Hikes with 60% design cost

Actual Costs 2 Trickling Filters Burden on Rates Comparable to LTCP plan





Does not include potential $1M/yr O&M savings

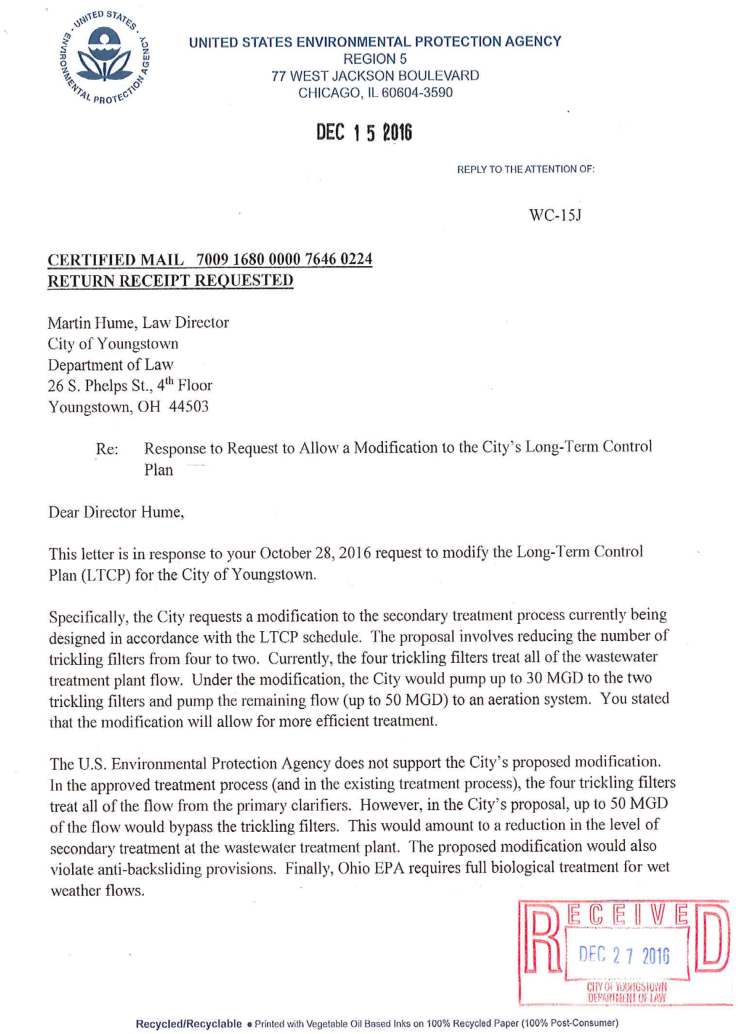
Current Planned and Required Rate Hikes For Preferred Alternative

LTCP Implementation Success Relies on the Flexibility to Adopt Latest Technologies

- ✓ Most LTCPs adopt different technologies than those originally proposed. Approval is typically granted if treatment limits meet permit and CSO policy goals.
- ✓ New technologies will become available (as was often discussed during LTCP negotiation)
- ✓ Improvements that reduce O&M cost and increase operational flexibility are more sustainable if population does not grow
- ✓ Youngstown has an acknowledged “high burden” for existing rates
- ✓ Costs of required and desired improvements may have been underestimated in LTCP effort

LTCP Modification Process

1. Teleconference to update EPA about findings – June 13, 2016
2. Letter from City requesting a non-material modification to the LTCP
3. December 15, 2016 EPA rejected proposed modification (anti-backsliding provisions)
4. Meeting with EPA in January 25, 2017
5. June 22, 2017 approval was granted
6. Approval included Performance Criteria, Demonstration of Treatment and Schedule


UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

DEC 15 2016

REPLY TO THE ATTENTION OF:

WC-15J

CERTIFIED MAIL 7009 1680 0000 7646 0224
RETURN RECEIPT REQUESTED

Martin Hume, Law Director
City of Youngstown
Department of Law
26 S. Phelps St., 4th Floor
Youngstown, OH 44503

Re: Response to Request to Allow a Modification to the City's Long-Term Control Plan

Dear Director Hume,

This letter is in response to your October 28, 2016 request to modify the Long-Term Control Plan (LTCP) for the City of Youngstown.

Specifically, the City requests a modification to the secondary treatment process currently being designed in accordance with the LTCP schedule. The proposal involves reducing the number of trickling filters from four to two. Currently, the four trickling filters treat all of the wastewater treatment plant flow. Under the modification, the City would pump up to 30 MGD to the two trickling filters and pump the remaining flow (up to 50 MGD) to an aeration system. You stated that the modification will allow for more efficient treatment.

The U.S. Environmental Protection Agency does not support the City's proposed modification. In the approved treatment process (and in the existing treatment process), the four trickling filters treat all of the flow from the primary clarifiers. However, in the City's proposal, up to 50 MGD of the flow would bypass the trickling filters. This would amount to a reduction in the level of secondary treatment at the wastewater treatment plant. The proposed modification would also violate anti-backsliding provisions. Finally, Ohio EPA requires full biological treatment for wet weather flows.

RECEIVED
DEC 27 2016
CITY OF YOUNGSTOWN
DEPARTMENT OF LAW

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LTCP Modification Process

Youngstown WWTP: Control Measures and Design and Performance Criteria

Project	Description	CSOs/SSOs Controlled	Design Criteria	Secondary Effluent Performance Criteria		Critical Milestones
Youngstown WWTP Upgrades	1. Renovate two Trickling Filters (TFs). 2. Rehabilitate Aeration Basins and convert to step feed. 3. Rehabilitate microscreens.	Increases treatment rate to reduce all CSOs	All flow of 80 MGD undergoes secondary treatment All Primary Effluent (PE) flows up to 35 MGD shall receive full treatment (primary, TF, then Aeration Basins). At PE flows between 35 MGD and 50 MGD, PE flow to the TFs and then to Aeration shall be 35 MGD, with the remaining PE flow to the Aeration basins. At PE flows between 50 MGD and 80 MGD, TF flow shall remain at 35 MGD, flow through Aeration shall remain at 50 MGD, flow to the microscreens from the TFs shall be (PE flow – 50) MGD, and PE flow direct to Aeration shall be 15MGD +(PE flow – 50) MGD.	Conventional organic loading = 40 lbs CBOD5/d/1000 cf		1. Substantial Completion WWTP Improvements, March 27, 2020
				Daily monitoring requirements [i,ii,iii]		
				Nitrogen, Ammonia CBOD5 pH	7-day average i. $CBOD_5$ – 17 mg/L ii. NH_3 – 4.5 mg/L iii. pH – Within limits of 6.5 and 9 30-day average i. $CBOD_5$ – 12 mg/L ii. NH_3 – 3.0 mg/L iii. pH – Within limits of 6.5 and 9	
	Trans-Flow clarifier modification		Retrofit traveling bridge clarifiers with Trans-Flow technology.	Total Suspended Solids	7-day average i. TSS – 30 mg/L 30-day average i. TSS – 20 mg/L	

i. Daily monitoring requirements for F/M, SRT, MLSS/MLSSV, and influent BOD5 in Aeration Basin.
ii. Continuous monitoring of Dissolved Oxygen in Aeration Basin.
iii. Daily monitoring of PE BOD5 and Trickling Filter effluent BOD5 under wet and dry weather conditions.

LTCP Modification Process: Demonstration of Treatment

Sampling schedule - The City shall perform sampling from April 1, 2020 through May 30, 2021 when operating its new approved treatment renovations to determine the effectiveness of treating flows during wet weather events. The City shall perform this sampling to demonstrate that it meets Performance Criteria specified in its modification proposal for flows from 35 MGD to 80 MGD prior to discharge from Outfall 001. By February 1, 2021, if the City determines that the sampling period of April 1, 2020 through May 30, 2021 is not sufficient to determine compliance with the Performance Criteria because of inadequate sampling events, the City may request, within 30 days, that EPA and Ohio EPA allow for an additional period of sampling, not to exceed a year. If EPA and Ohio EPA agree that additional sampling is needed, EPA and Ohio EPA shall approve, in writing, an additional period of sampling.

Effluent quality for WWTP - Wastewater Treatment Plant Performance Criteria specified in Paragraph 2, is to be sampled as a composite daily, or continuously for pH. Samples shall be collected and analyzed according to 40 CFR Part 136.

a) 7-day average - The following not to exceed 7-day average values are included in Performance Criteria for total WWTP effluent:
   i. $CBOD_5$ – 17 mg/liter
   ii. TSS – 30 mg/liter
   iii. NH_3 – 4.5 mg/liter
   iv. pH – Within limits of 6.5 and 9

   The 7-day average shall apply to any 7 consecutive days of operation.

a) 30-day average - The following not to exceed 30-day average values are included in Performance Criteria for total WWTP effluent:
   i. $CBOD_5$ – 12 mg/liter
   ii. TSS – 20 mg/liter
   iii. NH_3 – 3.0 mg/liter
   iv. pH – Within limits of 6.5 and 9

   The 30-day average shall apply to any 30 consecutive days of operation.

LTCP Modification Process: Demonstration of Treatment

WWTP Operation Monitoring - Youngstown must also monitor and report the following plant parameters to facilitate the evaluation of the modified system's performance:

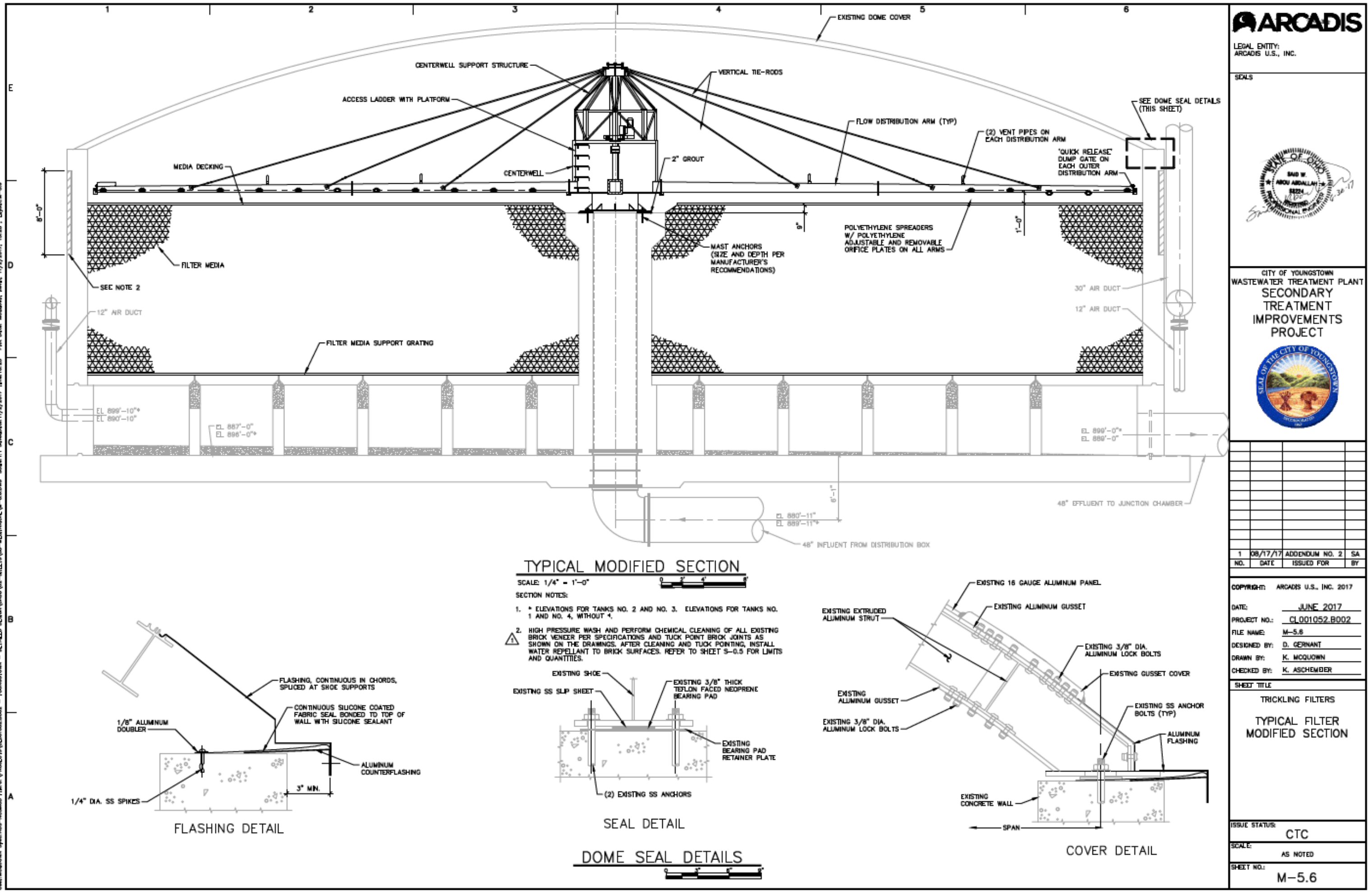
a) Primary effluent (PE) flow directed to the trickling filters (TFs). Monitor continuously.
b) TFs effluent flow to the Aeration Basins. Monitor continuously.
c) PE flow direct to the Aeration Basins. Monitor continuously.
d) Activated sludge (final clarifier) effluent flow and microscreen flow. Monitor both continuously.
e) Aeration Basin Mixed Liquor Suspended Solids and Mixed Liquor Volatile Suspended Solids (MLSS/MLVSS) and influent BOD5 to calculate food to microorganism ratio (F/M), organic loading rate (volumetric) and solids retention time (SRT). To be carried out daily.
f) Aeration Basin Dissolved Oxygen (DO) level, monitor continuously.
g) TF effluent BOD5, carried out daily, monitored as a composite sample.

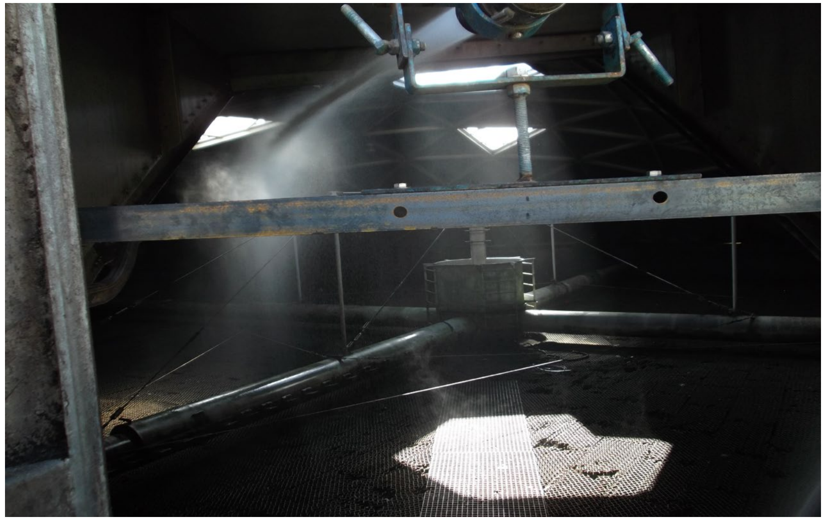
Report - By June 30, 2021, Youngstown shall submit to EPA and Ohio EPA for review, comment, and approval a report that contains the following.

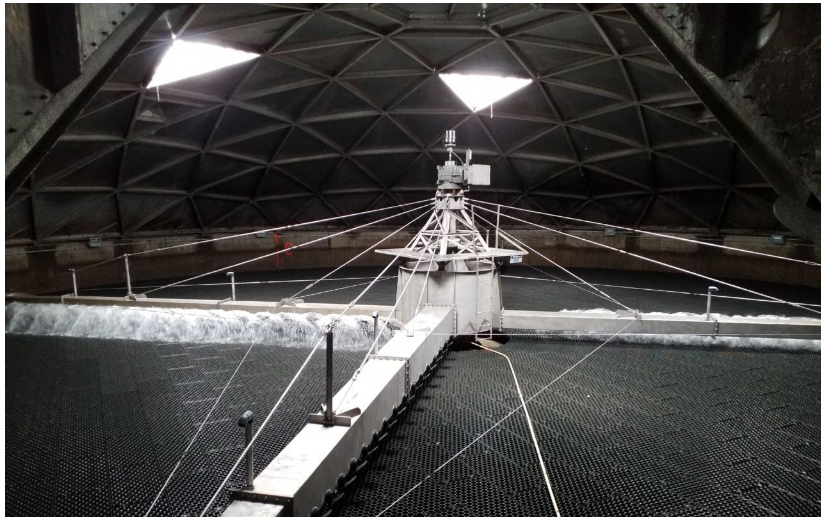
a) The relevant information and supporting documentation that demonstrates that Youngstown sampled and analyzed the values from the WWTP in accordance with Section A paragraphs 2 and 3, above.
b) The results of the sampling, including, but not limited to, the evaluation of whether the sampling results at the WWTP meets all Performance Criteria in section A for treating flows in accordance with the modification proposal.
c) All operational and performance monitoring data collected during sampling pursuant to Section A paragraphs 2 and 3, provided as attachments; and
d) An analysis of additional feasible measures identified during the sampling that can be taken to maximize treatment at the WWTP. The analysis shall: (i) describe in detail such additional or alternative measures to maximize treatment, including the measures' predicted impact on the WWTP; (ii) estimate the capital and operation and maintenance costs of the additional or alternative measures; and (iii) recommend those additional or alternative control measures for Youngstown to construct or install that will allow Youngstown to maximize treatment.

ARCADIS Design & Consultancy for natural and built assets

What's next







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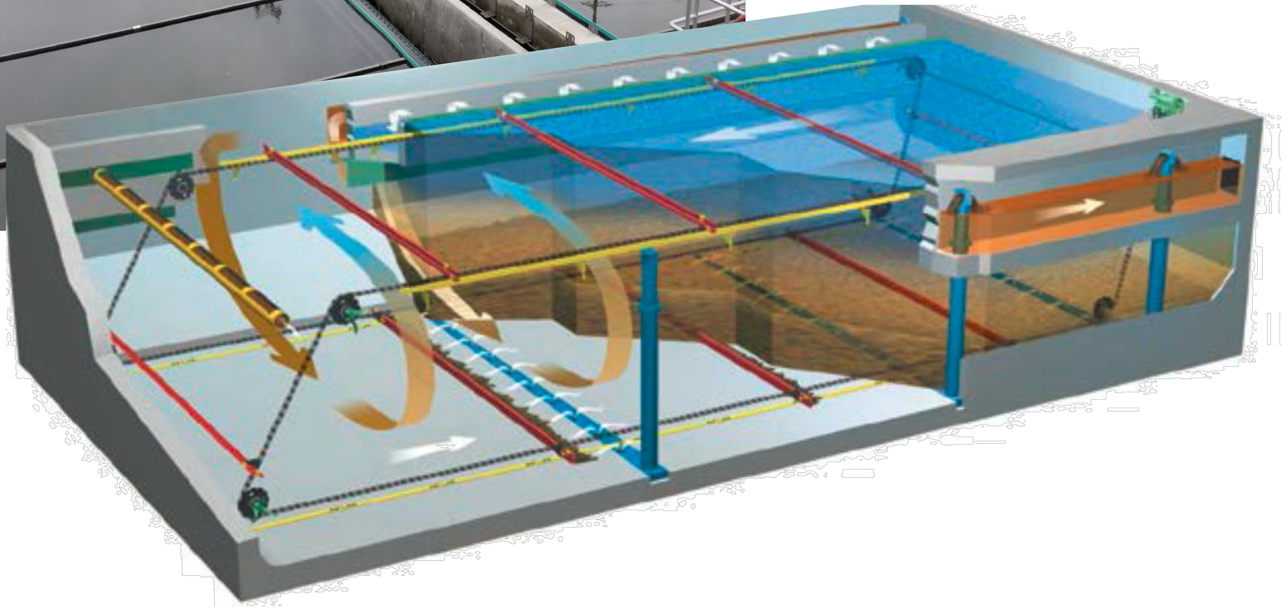

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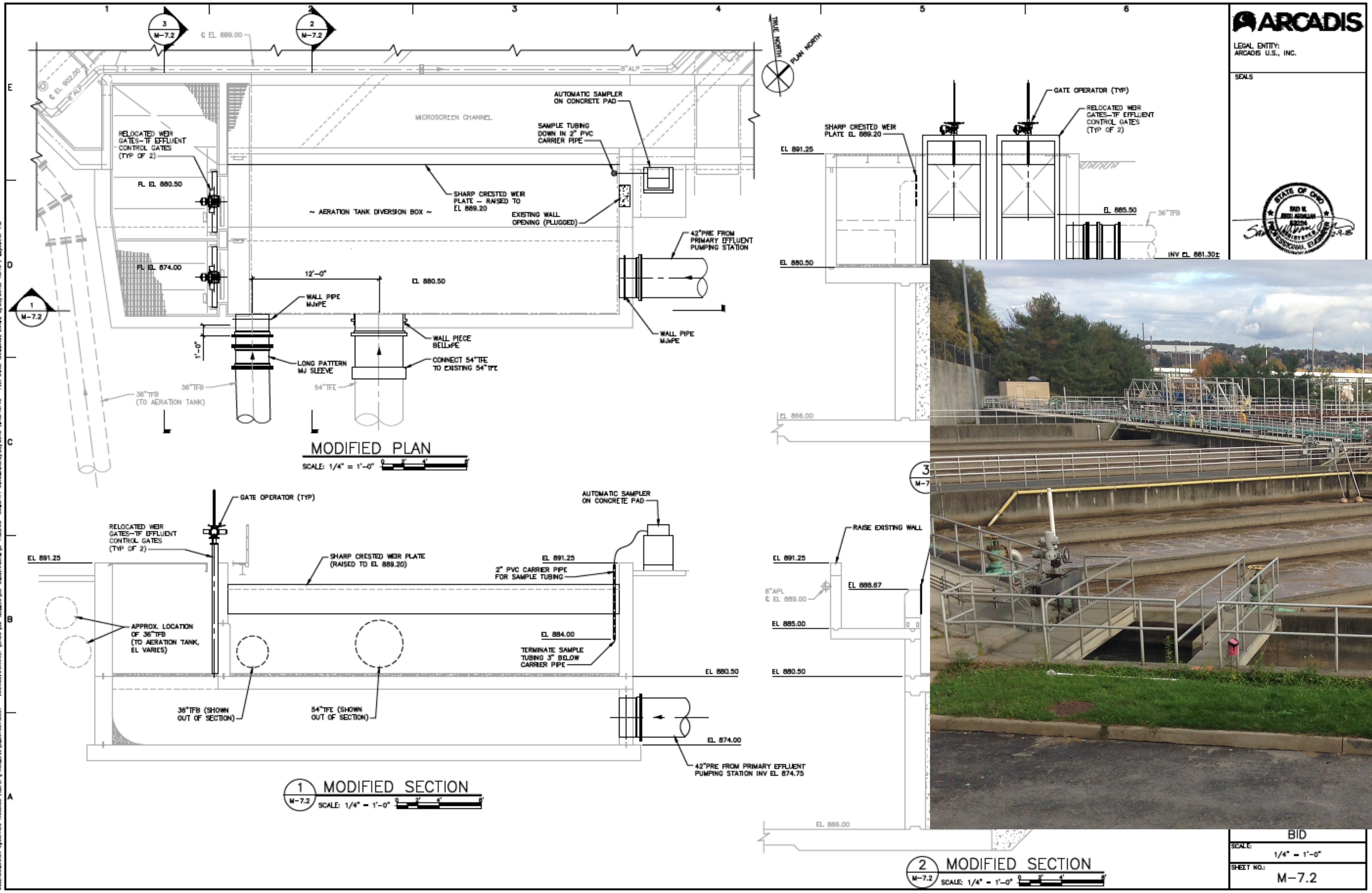
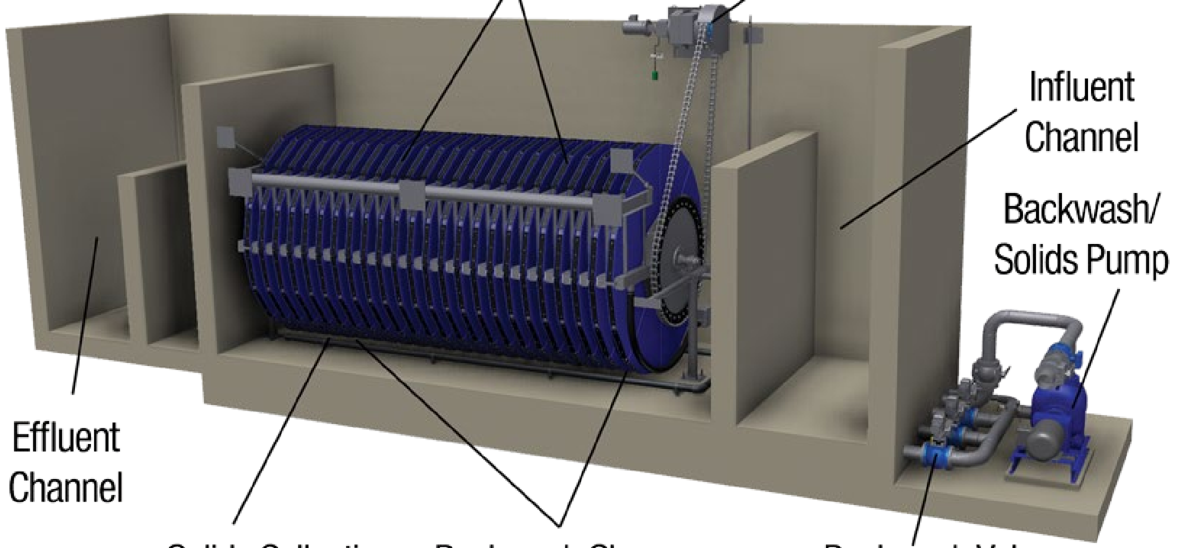
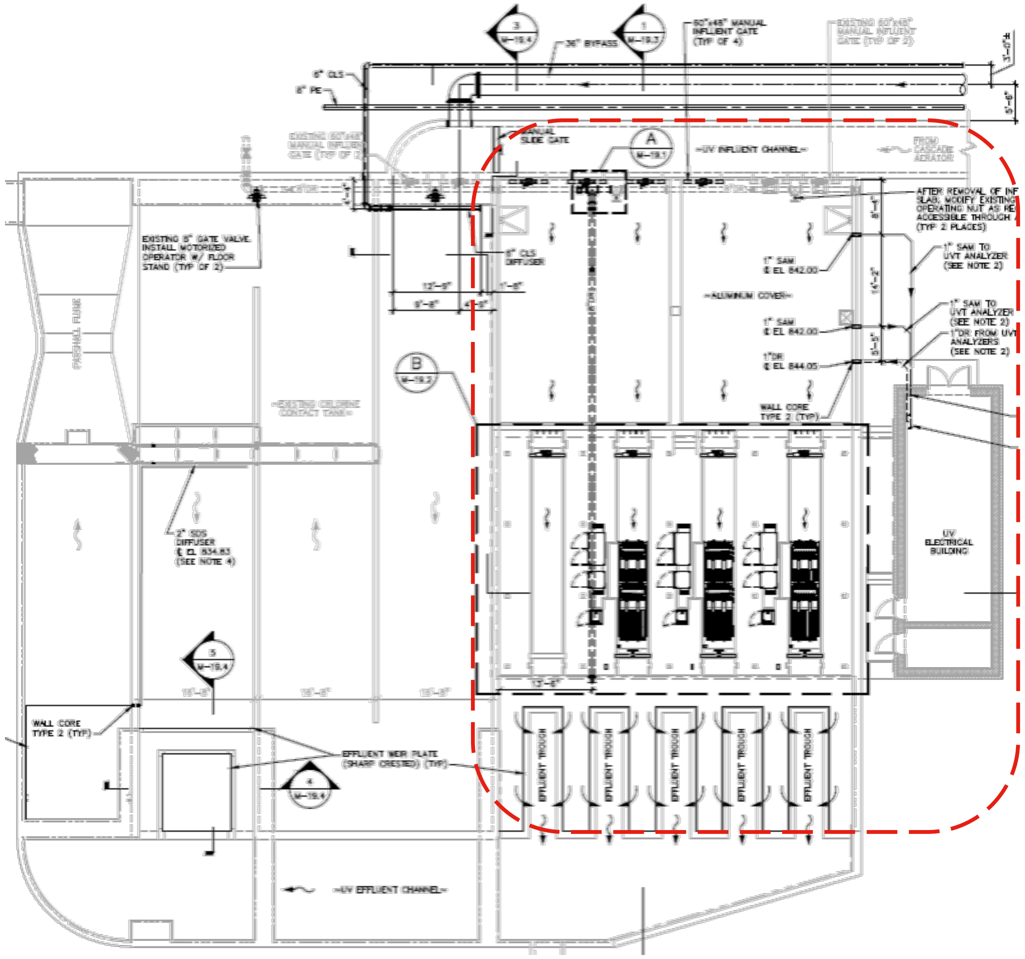

ARCADIS
LEGAL ENTITY: ARCADIS U.S., INC.
SEALS
MICROSCREEN CHANNEL
AUTOMATIC SAMPLER ON CONCRETE PAD
SAMPLE TUBING DOWN IN 2" PVC CARRIER PIPE
RELOCATED WEIR GATES–TF EFFLUENT CONTROL GATES (TYP OF 2)
FL EL 880.50
~ AERATION TANK DIVERSION BOX ~
SHARP CRESTED WEIR PLATE – RAISED TO EL 889.20
EXISTING WALL OPENING (PLUGGED)
42"PRE FROM PRIMARY EFFLUENT PUMPING STATION
FL EL 874.00
12'–0"
EL 880.50
WALL PIPE MJxPE
WALL PIECE BELLxPE
LONG PATTERN MJ SLEEVE
CONNECT 54"TFE TO EXISTING 54"TFE
36"TFB (TO AERATION TANK)
MODIFIED PLAN
SCALE: 1/4" = 1'–0"
GATE OPERATOR (TYP)
SHARP CRESTED WEIR PLATE (RAISED TO EL 889.20)
EL 891.25
2" PVC CARRIER PIPE FOR SAMPLE TUBING
APPROX. LOCATION OF 36"TFB (TO AERATION TANK, EL VARIES)
EL 884.00
TERMINATE SAMPLE TUBING 3" BELOW CARRIER PIPE
EL 880.50
36"TFB (SHOWN OUT OF SECTION)
54"TFE (SHOWN OUT OF SECTION)
EL 874.00
42"PRE FROM PRIMARY EFFLUENT PUMPING STATION INV EL 874.75
MODIFIED SECTION
SCALE: 1/4" = 1'–0"
SHARP CRESTED WEIR PLATE EL 889.20
EL 885.50
INV EL 881.30±
RAISE EXISTING WALL
EL 888.67
EL 885.00
MODIFIED SECTION
BID
SCALE: 1/4" = 1'–0"
SHEET NO.: M–7.2

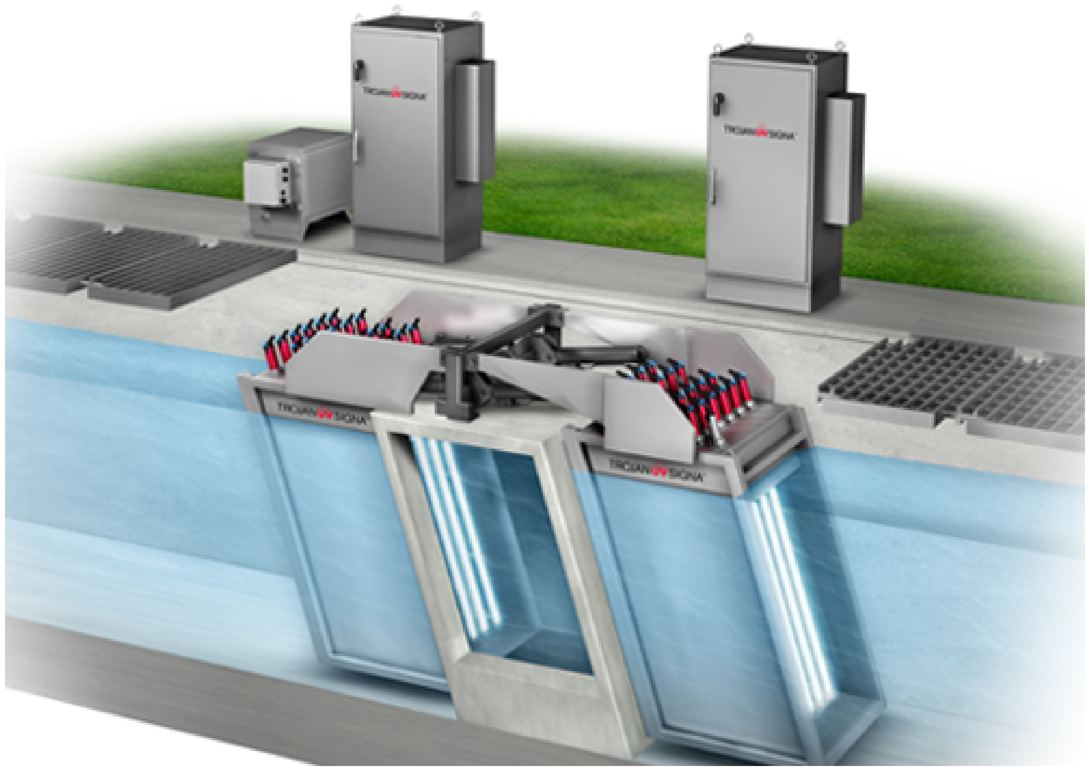
What's next


Cloth Media Disks
Drive Motor
Influent Channel
Backwash/ Solids Pump
Effluent Channel
Solids Collection Manifold
Backwash Shoes
Backwash Valve

What’s next



36" BYPASS
60"x48" MANUAL INFLUENT GATE (TYP OF 4)
8" CLS
8" PE
MANUAL SLIDE GATE
UV INFLUENT CHANNEL
FROM CASCADE AERATOR
EXISTING 8" GATE VALVE. INSTALL MOTORIZED OPERATOR W/ FLOOR STAND (TYP OF 2)
8" CLS DIFFUSER
1" SAM
ALUMINUM COVER
1" SAM TO UVT ANALYZER (SEE NOTE 2)
WALL CORE TYPE 2 (TYP)
EXISTING CHLORINE CONTACT TANK
UV ELECTRICAL BUILDING
EFFLUENT WEIR PLATE (SHARP CRESTED) (TYP)
EFFLUENT TROUGH
UV EFFLUENT CHANNEL



ARCADIS Design & Consultancy for natural and built assets

Questions/Discussion