Appendix H

JACOBS HYDRAULIC ANALYSIS TM 2023

Jacobs

Memorandum

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Subject	**Hydraulic Analysis TM**
Project	**Master Plan Hydraulic Analysis Project**
Attention	Mike Nacrelli, City of Wilsonville
From	Kristen Jackson, Jacobs
	Eliza Dunaj-Donocik, Jacobs
Reviewed By	Scott Levesque, Jacobs
	Garrett Owens, Jacobs
Date	August 31, 2023

Outline:

Acronyms and Abbreviations

AB	aerated bioreactor
DBO	design-build-operate
EL	elevation
HGL	hydraulic grade line
MBR	membrane bioreactor
mgd	million gallons per day
PHF	peak hour flow
RAS	return activated sludge
TM	technical memorandum
TOC	top of concrete
WWTP	wastewater treatment plant
WWMM	wet weather max month

1. Introduction

The City of Wilsonville (City) is completing a Wastewater Treatment Plant (WWTP) Master Plan update. The Master Plan is projecting a future peak hour flow greater than 17 million gallons per day (mgd), which will exceed the existing design peak hour flow of 16 mgd. Jacobs Engineering Group Inc. (Consultant) completed a gravity hydraulic analysis of the WWTP to check for hydraulic restrictions with a peak hour flow of 17.6 mgd plus 0.8 mgd of recycle streams.

The existing WWTP includes headworks and grit removal, stabilization basin, aeration basins, secondary clarification, UV disinfection and an outfall pipeline and diffusers. A modified WWTP is envisioned at the end of the 2045 planning period, which will implement a membrane bioreactor (MBR) process. This would require installation of fine screens downstream of the existing headworks. The existing stabilization basins would be repurposed as unaerated bioreactor tankage, and the existing aeration basins would be modified and used as aerated bioreactor tankage. Secondary clarifiers would be replaced by an immersed membrane facility.

The purpose of this technical memorandum (TM) is to document the results of the hydraulic analysis.

2. Hydraulic Model Setup

A kickoff meeting with the City, Jacobs, and Carollo was completed on July 14, 2023; notes from the meeting are included in Appendix A.

Jacobs' Replica™ hydraulic modeling software was used to perform the hydraulic evaluation for this project. Replica™ is based on a library of hydraulic blocks that are used to model treatment plant hydraulics, including blocks for pipes, fittings, pumps, equipment, storage tanks, and many others. Each block uses industry-standard equations and coefficients to calculate the pressure or gravity hydraulics occurring within the block. Replica™ also includes a library of control blocks that can be used to program the model similar to an actual treatment plant so that the model can be used as a digital twin. It is anticipated that this model will continue to be used to support facility design after this preliminary evaluation has concluded.

Several different drawing packages were used to generate a realistic hydraulic representation of the existing facilities, including the headworks, aeration basins, UV channels, and the outfall. The following drawing packages were used:

- June 2014 Wilsonville WWTP Improvements Design-Build-Operate (DBO)
- March 2017 City of Wilsonville Wastewater Treatment Plant Outfall Replacement

For all processes the following assumptions were made:

- The Darcy-Weisbach equation was used to calculate friction loss through the pipes. Cement lined ductile iron class 53 has been assumed with a roughness of 0.018 inch for existing piping and 0.0012 inch for new piping.
- All channels in the model are assumed to be finished concrete with a Manning's coefficient of 0.012.
- Orifice losses in the model were calculated using a discharge coefficient of 0.61.

Figure 1 includes the Process Flow Diagram provided by Carollo and updated by Jacobs with the modeled yard piping sizes in red.

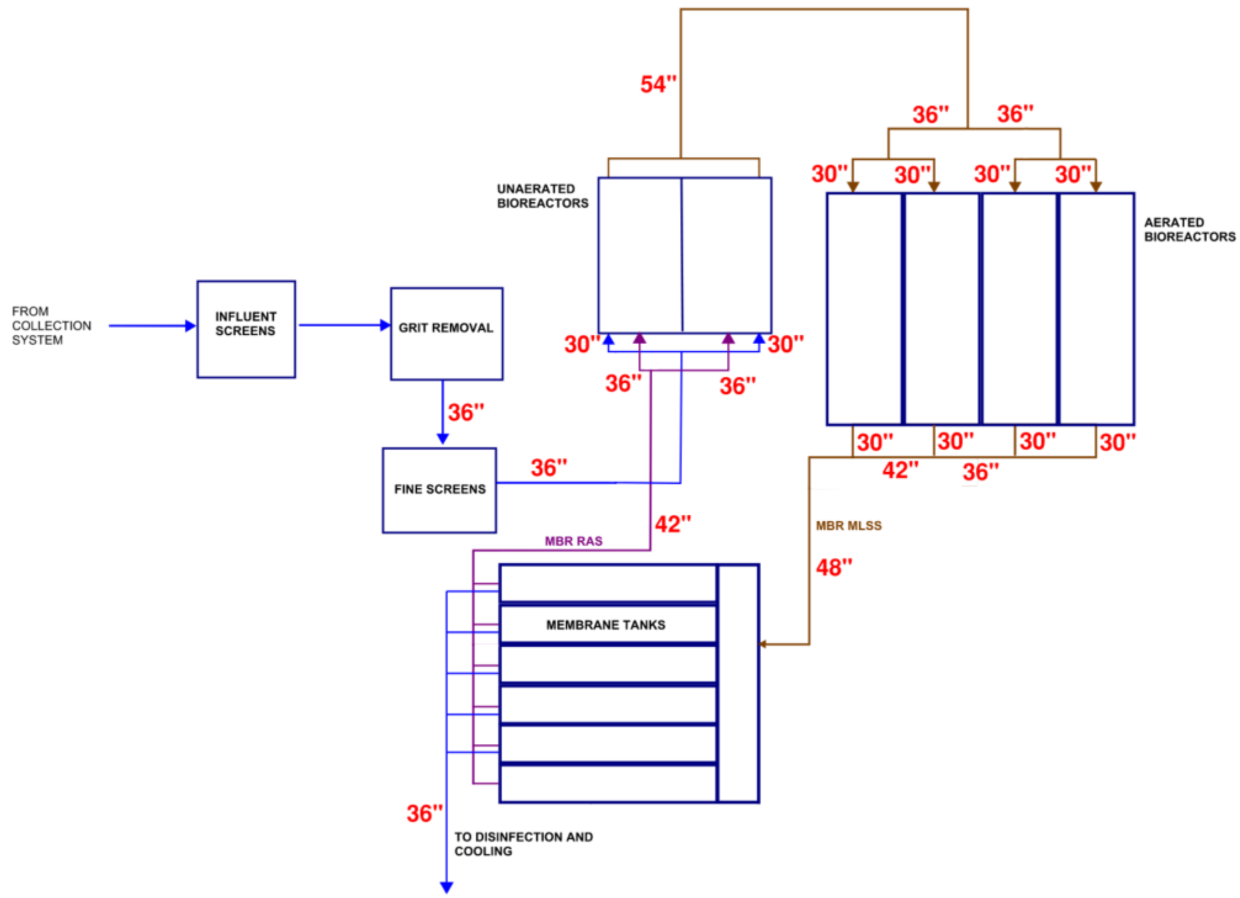

Figure 1: Process Flow Diagram with Yard Piping Sizes
PHF 17.6 mgd and 0.8 mgd recycle scenario

3. Hydraulic Model Assumptions and Results

The results of the following four hydraulic model runs are included in this section and water surface elevations are presented in Figure 2 through Figure 4.

Scenario	River Level Assumption (NAVD88 datum)
All basins online	• 100-year flood elevation EL 94.0 ft • 25-year flood elevation EL 88.4 ft
One aerated bioreactor offline and one membrane tank offline	• 100-year flood elevation EL 94.0 ft • 25-year flood elevation EL 88.4 ft

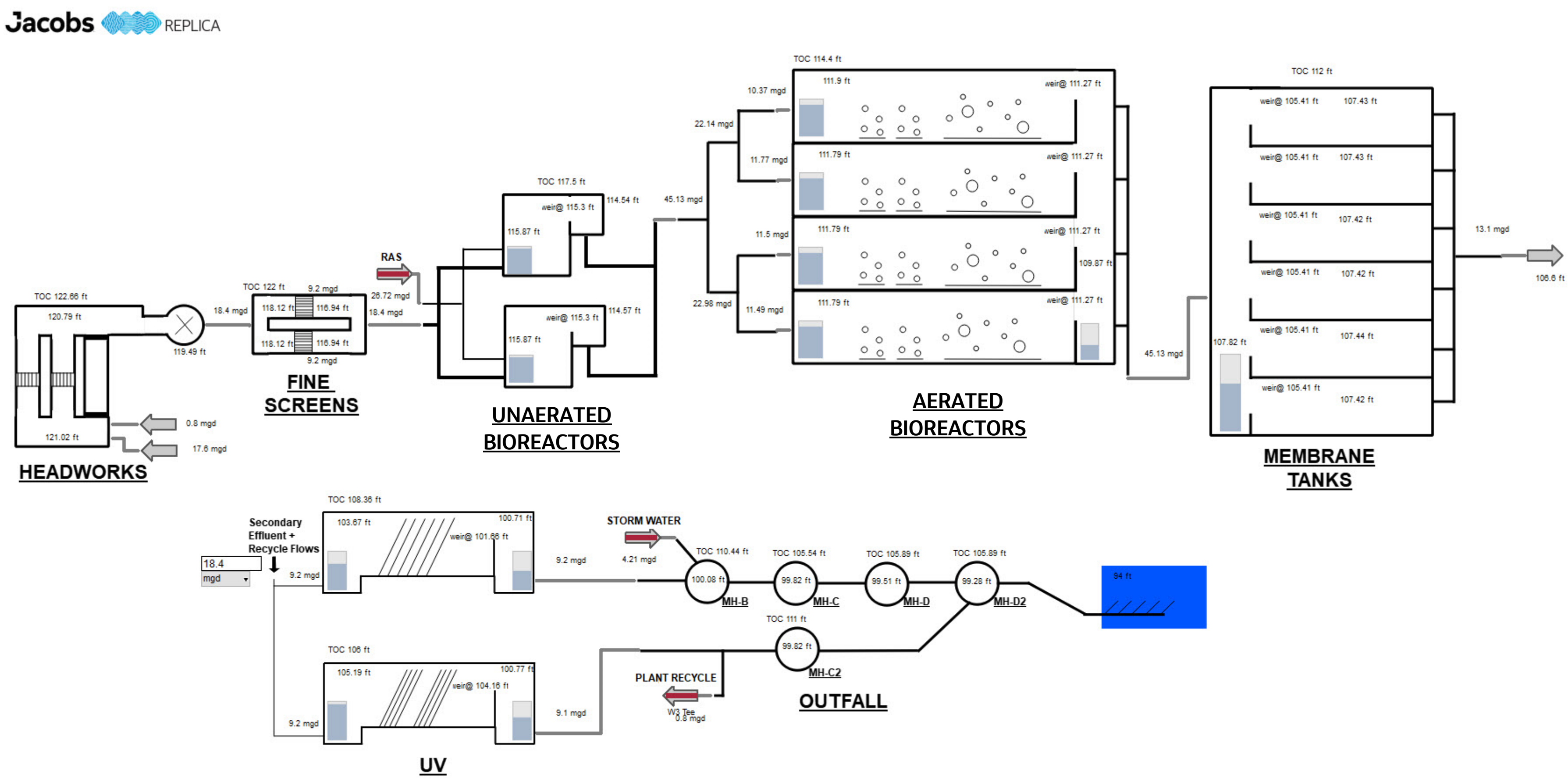

Figure 2 – Water Surface Elevations: All basins online, 100-year River Elevation

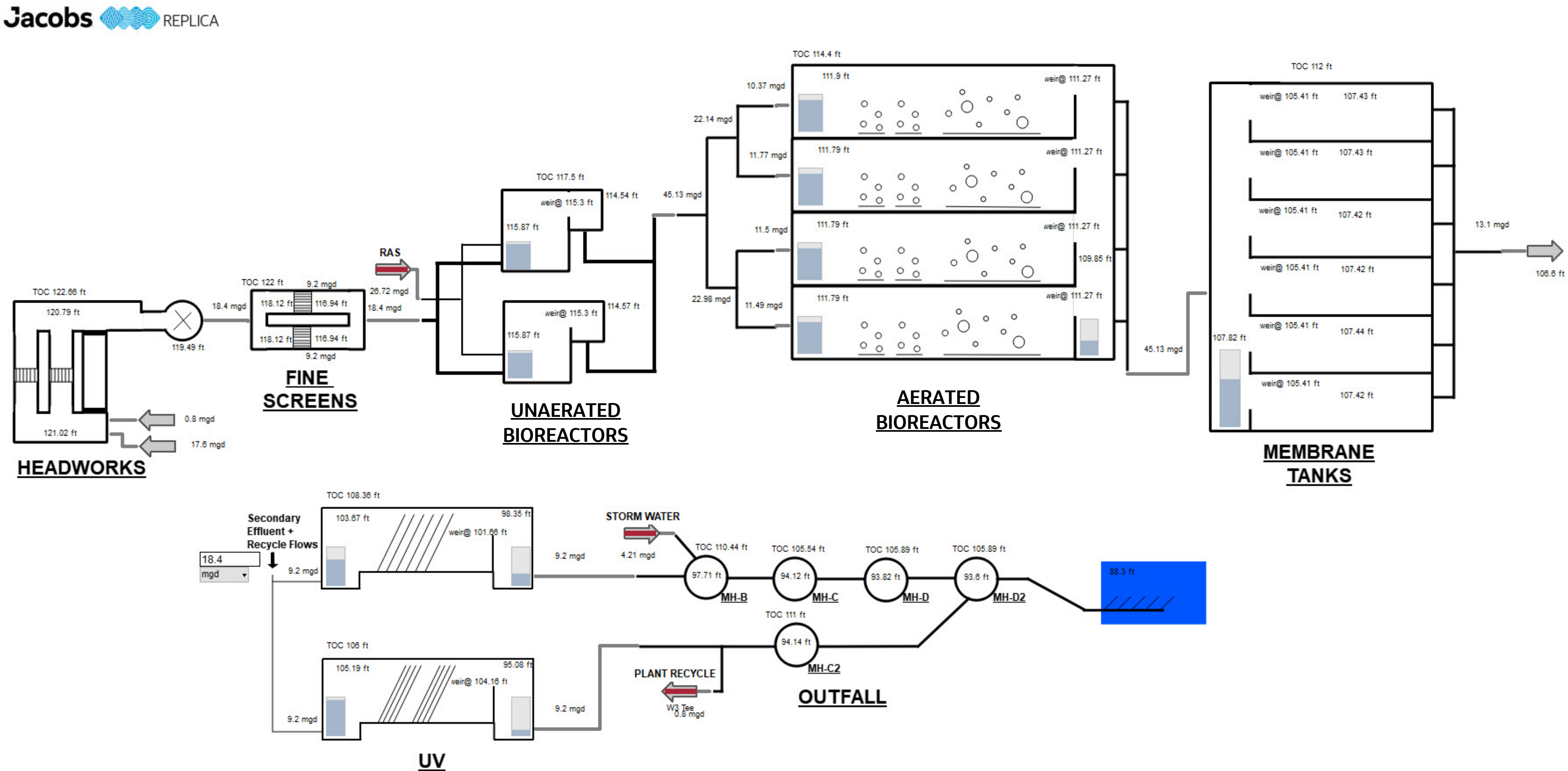

Figure 3 – Water Surface Elevations: All basins online, 25-year River Elevation

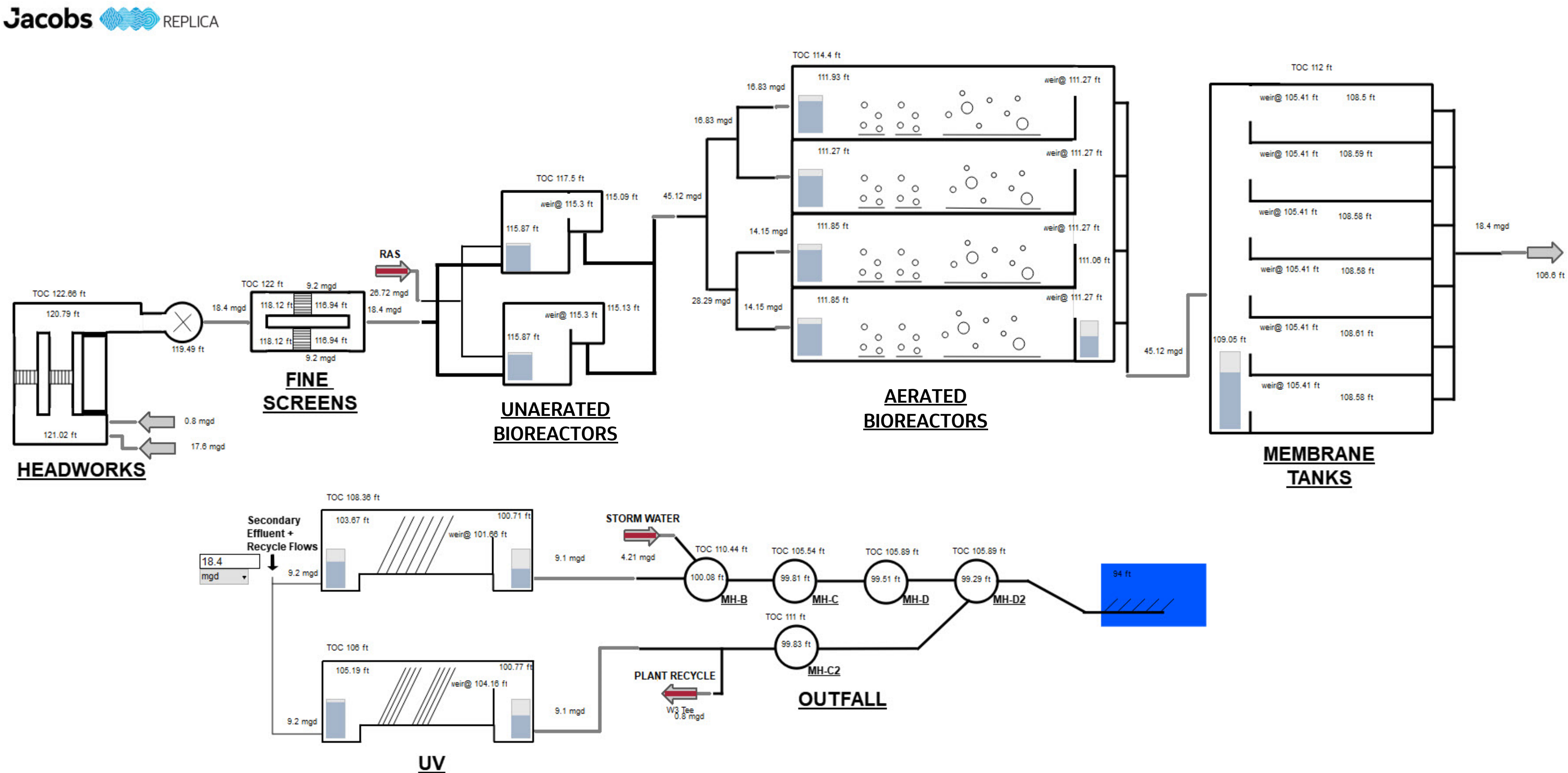

Figure 4 – Water Surface Elevations: One AB and one membrane tank offline, 100-year River Elevation

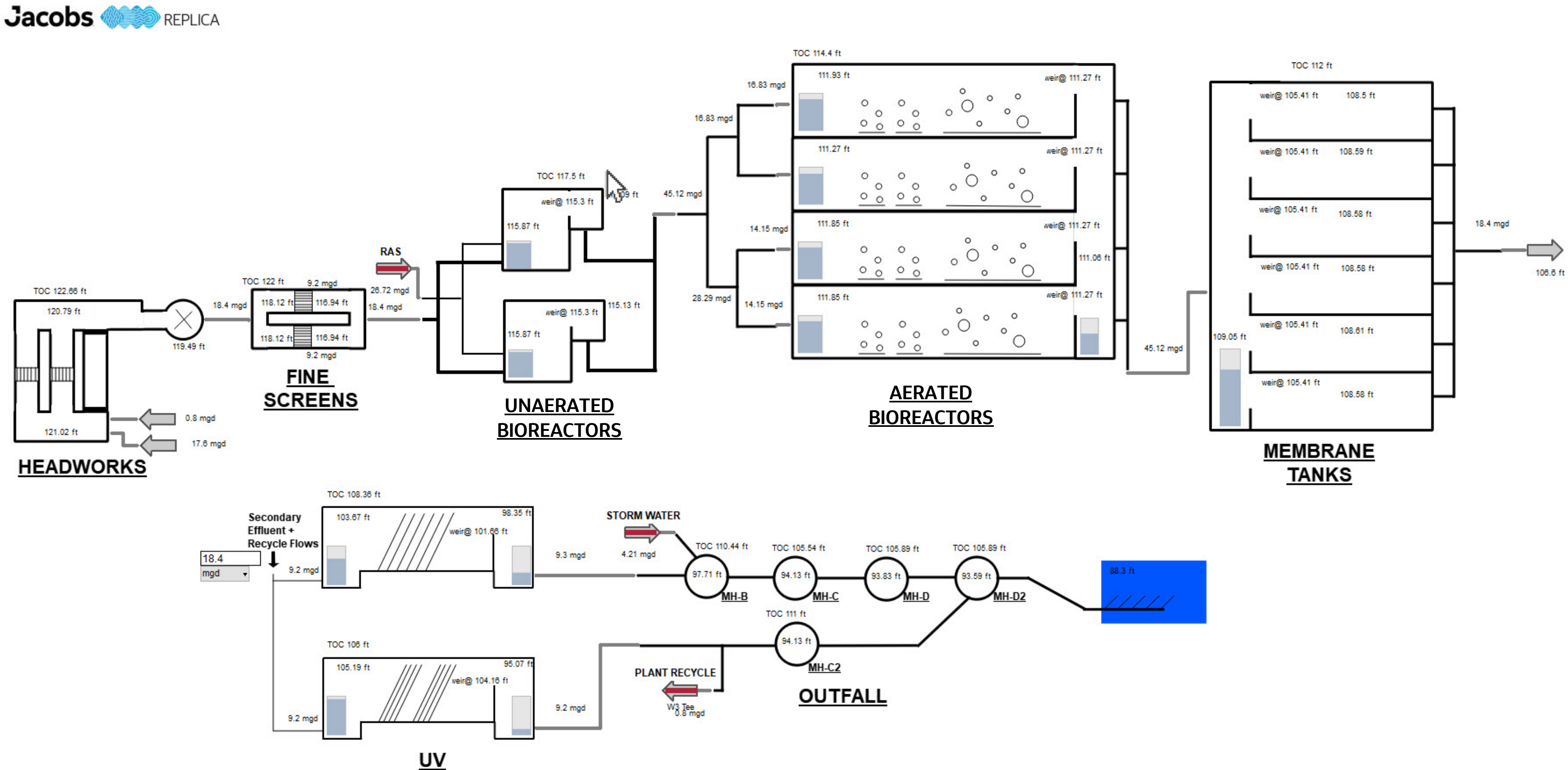

Figure 5 – Water Surface Elevations: One AB and one membrane tank offline, 25-year River Elevation

Flow Assumptions

- PHF: 17.6 mgd
- Plant recycles: 0.8 mgd
- Stormwater contribution under the 100-year and 25-year storm events: 4.2 mgd
- RAS Flow: 26.72 mgd (4 times wet weather max month flow)
  - Note: A RAS flow of 70.4 mgd (4 times peak plant flow) would require significant upgrades to existing facilities, example: a lift station before or after Fine Screens, increase TOC and effluent weirs at all bioreactors, increase some yard piping to 54-inch or larger.

Headworks – existing facility

- Assumed two 1/4-inch screens for screening upstream of Fine Screen Facility (both duty). The WWTP currently has one 1/4-inch screen installed and one 3/8-inch screen installed. There is some uncertainly to the height of the currently installed screens. The future bar field elevation should extend above the max upstream water surface elevation.
- Information provided from Kusters-Water (Appendix B) at 8.8 mgd through each screen, 35% blinding, Bar sizing: 6mm x 3mm x 40mm.
  - Velocity through screen openings: 2.47 ft/s
  - Headloss: 0.93 inches
  - Downstream Water Level: 6.09 feet
  - Downstream Velocity: 0.64 ft/s
  - Upstream Velocity: 0.63 ft/s
- Assume 36-inch piping between Headworks and Fine Screens (existing piping between Headworks and Stabilization Basins was 30-inch).
- At PHF 17.6 mgd and 0.8 mgd recycle the Headworks screens and grit removal systems are unsubmerged.

Fine Screens – new facility

- Hydro Dyne vendor supplied two scenarios (Appendix C) – “Fixed D1 Condition” was modeled with 11.7-inch of head loss.
- Two duty plus one standby unit.
- Assume 36-inch piping between Fines Screens and the Unaerated Bioreactors (existing piping between Headworks and Stabilization Basins was 30-inch).
- No intermediate pump station is included between fine screens and bioreactors.

- The Fine Screen facility elevations were set by the Unaerated Bioreactor HGL with one aerated bioreactor and one membrane tank offline.

Unaerated Bioreactors – existing facility (existing Stabilization Basins)

- Assume flow leaves the facility through a new effluent channel with weir that is full basin width, and demolish the existing 20-inch telescoping valves.
- To reduce headloss, the RAS was assumed to enter the unaerated bioreactors separate from the fine screen effluent. Each flow splits hydraulically using pipe and fitting symmetry.
- TOC remains the same (Existing TOC 117.5-feet). There is 1.6 feet of freeboard in the Stabilization Basin, which is considered acceptable for unaerated MBR process bioreactors.

Splitter box – existing facility

- To reduce headloss, the splitter box was removed from use. Flow from the unaerated bioreactors splits hydraulically using pipe and fitting symmetry.

Aerated Bioreactors – existing facility

- Assume the addition of a future 4th AB that matches the dimensions of the existing ABs, including extension of the combined effluent channel.
- TOC remains the same (Existing TOC EL 114.44-feet). Freeboard is about 2.5 ft which is less than greenfield MBR design but considered acceptable.
- Assume all baffles are removed inside the reactors to reduce headloss.
- Lower Effluent weirs to EL 111.27-feet (Existing 111.44-feet). Existing concrete may be impacted depending on the top elevation of the existing concrete to which the weir is attached.
- Assume connection of yard piping to the side of the existing effluent channel, the invert of the pipes even with the bottom of the effluent channel.
- Remove the clarifier splitter box from use.

Membrane Tanks – new facility

- 6 membrane tanks (5 duty + standby at peak flow).
- Model assumes a “pump from” scenario (RAS pumped from membrane tanks to bioreactors), the other option is a “pump to” scenario (mixed liquor pumped from bioreactors to membrane tanks).
- The Membrane Tank facility elevations were set so that there was a minimum of 2-inches of free overflow at the aerated bioreactor effluent weirs with one aerated bioreactor and one membrane tank offline.

- TOC 112-feet allows for a minimum of 3.5-feet of freeboard under the scenarios included. Existing grade near the site of the future Membrane Facility is EL 108-feet to 109-feet.
- Flow split between Membrane Tanks takes place hydraulically.
- Other than the wall opening for the inlet isolation gate, headloss across Membrane Tanks is negligible.
- Permeate pumps will send flow to UV.
- RAS pumps will recirculate RAS to the unaerated bioreactors.

UV – existing facility

- Assume replace both channels with a Trojan Signa unit per 7/28/2023 quote from Trojan with headloss of 2.56-inches at peak flow (Appendix D).
- The Trojan quote includes a 35-inch width Trojan Signa unit. The UV1 channel is 48-inches (per scaling on 2014 DBO drawings) and UV2 channel width is 30-inches. An updated quote from Trojan should be acquired to accommodate the existing width of the UV2 channel, although the headloss would be similar for hydraulic modeling purposes.
- Model assumes flow split control with a flow meter and control valve on the influent pipe to each channel.
- No changes to existing TOC. However, under the PHF 17.6 mgd and 0.8 mgd recycle scenario, there are UV flooding issues caused by downstream hydraulic restrictions. One solution could be to raise the floor and walls of the UV system. See the Outfall section for more detail.

Outfall – existing facility

- Headloss in the outfall diffuser risers was modeled per the Tideflex valve information (Appendix E).
- The 24-inch piping between MH-B and the 42-inch outfall is a hydraulic restriction for 17.6 mgd PHF plus 4.2 mgd stormwater flow contribution. There are several options to relieve the restriction:
    - A parallel 18-inch stormwater-only pipeline.
        - At 100-year flood EL UV1 can pass 5.5 mgd and UV2 can pass 9.2 mgd.
    - Upsize outfall piping from 24-inch to 36-inch between MH-B and a future MH-E that is located in the stretch of 42-inch outfall piping.
        - At 100-year flood EL UV1 and UV2 can each pass 9.2 mgd.

- In the future when the capacity is required, demolish and install UV at a higher elevation and leave outfall piping in place. Manhole covers along the outfall pipe may need to be bolted down.

4. Summary and Conclusions

- At PHF 17.6 mgd and 0.8 mgd recycle scenario the headworks screens and grit removal systems are unsubmerged.
- The 24-inch piping between MH-B and the 42-inch outfall downsteam of MH-D2 is a hydraulic restriction for the PHF 17.6 mgd and 0.8 mgd recycle scenario. There are several options that could relieve the restriction.
- A RAS flow of 26.72 mgd (4 times wet weather max month) can be accommodated at the WWTP with moderate upgrades to the existing stabilization basin/splitter structure, aeration basins, and yard piping.
- A RAS flow of 70.4 mgd (4 times peak hour) can be accommodated at the WWTP with the addition of a lift station, significantly raising the aeration basins and associated stabilization basin/splitter structure, and significantly upsizing yard piping.

Appendix A

Jacobs

Subject	**Project Kickoff**
Project Name	City of Wilsonville WWTP Master Plan Hydraulic Analysis Project
Prepared by	Kristen Jackson
Location	Zoom (virtual call)
Date/Time	July 14, 2023, 9:30 a.m.- 10:30 a.m.
Participants	Wilsonville: Mike Nacrelli Jacobs: Kristen Jackson, Scott Levesque Carollo: Ann Conklin, Dave Price

Agenda:

Duration	Agenda Topic	Lead
5 min.	**1) Introductions**	**Jackson**
5 min.	**2) Review Jacobs Scope**	**Jackson**
30 min.	**3) Coordination Needed** • Is there a process flow schematic showing the proposed plant configuration? • At the end of the project will there be a conventional activated sludge (CAS) process in parallel with MBR? • What is the bioreactor configuration for the proposed MBR process (zones, baffle walls, internal mixed liquor pumping)? • What provisions are included in the proposed configuration to facilitate future phosphorus removal? • How will the current return activated sludge flow (RAS) stabilization tankage be used in the proposed MBR process? • What maximum RAS flow is envisioned for the proposed MBR process? • What type of fine screen is envisioned? • What yard pipe sizes are envisioned?	**Jackson**
5 min.	**4) Schedule**	**Jackson**
5 min.	**5) Other Items?**	**Jackson**

Attachments:

- Approved Scope of Work

Action Items (compiled from below)
Ann/Carollo will send to Kristen/Jacobs the PFD for the buildout scenario process flow schematic (PFD) showing the proposed flow configuration
Ann/Carollo will send to Kristen/Jacobs the bioreactor configuration for the proposed MBR process (zones, baffle walls, internal mixed liquor pumping)
Ann/Carollo to share with Kristen/Jacobs the design criteria around future phosphorus limits (based on Tri City)
Ann/Carollo will send Kristen/Jacobs the vendor name and headloss assumption for the fine screen
Ann/Carollo can send to Jacobs the future yard piping sizes
Ann/Carollo will get a new quote from Trojan for Signa with updated PHF (9.6 or 8.8 mgd) and 0 mg/l TSS (per buildout scenario)
Decisions Made (compiled from below)
Buildout Scenario PHF for modeling: 17.6 mgd
Can regroup the team the last week of July with Ann/Carollo, the first week in August meet with the whole group (Dave back from PTO).

Meeting Notes:

- Future PHF: 17.6mgd
- Carollo wants to know per the hydraulics if they need intermediate pumping
- Is there a process flow schematic showing the proposed plant configuration? – Ann/Carollo will send to Kristen/Jacobs the PFD for the buildout scenario
- At the end of the project will there be a conventional activated sludge (CAS) process in parallel with MBR? – no, all flow will go thru the MBR system in the buildout scenario for capacity needs
- What is the bioreactor configuration for the proposed MBR process (zones, baffle walls, internal mixed liquor pumping)? – Ann/Carollo will send to Kristen/Jacobs (screened secondary influent and RAS are going to the selector basins (current stabilization basin), LE bioreactor configuration, RAS providing the nitrogen return)
- What provisions are included in the proposed configuration to facilitate future phosphorus removal? – chemical addition during the summer months in the MBR (not doing Bio-P). Assumed phosphorous limits similar to Tri City, Ann/Carollo to share what those are with Kristen/Jacobs. ~ 0.3 mg/L total P, which is similar to Tri City
- How will the current return activated sludge flow (RAS) stabilization tankage be used in the proposed MBR process? – still included in the process, the use will be based on what is shown on the PFD (influent + RAS)
- What maximum RAS flow is envisioned for the proposed MBR process? – Ann/Carollo wants to plan for 4Q at all flows, but will wait to see what the hydraulics can handle (PHF may be too much and can only pass PDF).
- What type of fine screen is envisioned? – assumption from a similar project. Ann/Carollo will send Kristen/Jacobs the vendor name and headloss assumption.
- What yard pipe sizes are envisioned? – Ann/Carollo has preliminary sizing, can send to Jacobs

- Future disinfection system – Ann/Carollo will get a new quote from Trojan for Signa with updated PHF and 0 mg/l TSS (per buildout scenario). Ann/Carollo to check if the revised 2045 DW PDF is this less than 17.6 mgd divided by two.
    - Updated flow could be 17.6 – 8.0 = 9.6mgd (if not upgrading both channels)
    - Or updated flow 17.6 / 2 = 8.8 mgd both channels (if upgrading both channels)
- With MBR system, UV transmittance may improve (because MBR is running at a longer SRT), also membrane filtrate will have 0 mg/L TSS. Both of these things will improve UV capacity.
- Schedule – City providing an update to City Council on August 21st (due Aug 8). Last week of July regroup with Ann/Carollo, first week in August meet with the whole group.
- Other items? None.

SCOPE OF WORK

Hydraulic Analysis for the City of Wilsonville, Oregon

Statement of Work, Compensation and Payment Schedule

A. Project Description

The City of Wilsonville (City) is completing a Wastewater Treatment Plant (WWTP) Master Plan update. The Master Plan is projecting around 2040 a peak hour flow greater than 17 mgd, which will exceed the existing design peak hour flow of 16 mgd. Jacobs Engineering Group Inc. (Consultant) will complete a gravity hydraulic analysis of the WWTP to check for hydraulic restrictions with a peak hour flow greater than 17 mgd. The WWTP includes: headworks and grit removal, stabilization basin, aeration basins, secondary clarification, UV disinfection and an outfall pipeline and diffusers.

B. Schedule

The anticipated schedule of the Hydraulic Analysis is projected to be 3 months and will be completed prior to August 31, 2023 assuming notice-to-proceed is received by June 1, 2023. The Consultant is to prepare a baseline schedule with deliverable delivery dates, see Task 1.

C. Scope of Work

The Consultant's scope of work for the Hydraulic Analysis is divided into the following major tasks:

Task 1 - Project Management
Task 2.1 – Hydraulic Analysis
Task 2.2 – UV Hydraulic Analysis
Task 2.3 – Dynamic Hydraulic Analysis (Optional)

Task 1: Project Management

The objective of this task is to plan and execute the project as described, in accordance with the schedule, budget, and quality expectations that are established.

The following activities will be included in this task:

- Develop a work plan and project instructions, include a QA/QC plan.
- Hold status meeting calls as needed with the City's project manager to discuss schedule, budget, the direction of the project and any needed information or data. Decisions and action items will be documented. Project will be monitored for potential changes.
- Manage the quality control review of all work activities and project deliverables; note that execution of the QA/QC program will be completed under the appropriate task.
- Prepare and submit monthly narrative report, invoice, and schedule update.

Deliverables:

- Project instructions including QA/QC plan and baseline schedule.
- Monthly narrative report and invoice.
- Completed change management forms, as needed.
- Kickoff meeting with the City. Includes agenda and summary notes of decisions and action items.

Assumptions:

- Assume 2 hours per month of effort for the Project Manager to coordinate project activities during the 3-month project period.
- Assume 2 hours total for status meeting virtual calls, to be used as needed during the project, each attended by Project Manager.
- Assume 2 invoices.
- Kickoff meeting to include 2 members of Jacobs virtually, and not to exceed 1-hour in duration.

Task 2.1: Hydraulic Analysis

Jacobs completed hydraulic modeling (with Jacobs HYDRO™ software) for the Wilsonville WWTP as part of the 2012 Design Build Operate (DBO) expansion project. This Task involves updating the WWTP plant gravity hydraulic model with updated facility information since the DBO project, adding future facilities per the 2023 Master Plan Update, and running the new peak hour flow scenario with the buildout peak hour flow (PHF) as determined by the WWTP Master Planning Analysis, and identify hydraulic restrictions.

- Create a whole plant Replica™ hydraulic model using plant record drawings, and assumed headloss through item such as the headworks screens. For future facilities that have not been built yet, assume design parameters consistent with the 2023 Master Plan Update, or if not available, use industry standard design values. The model will be calibrated against the existing Hydro model and plant data.
- Include in the model recent WWTP upgrades: outfall improvements, AB improvements, and the disk filter material change. Also, include the following future facilities:
    - New influent fine screens
    - Intermediate pumping to the aeration basins or lowering the HGL in the existing aeration basins (City to provide direction on which scenario to model)
    - 3rd aeration basin
    - 5 new membrane bioreactor (MBR) filters with effluent permeate pumps that will pump to the UV system
    - Future Trojan Signa UV system per 2/15/22 quote
- Model will begin at the headworks screens and end at the outfall in the Willamette River.
- Run the updated model with the following 2 scenarios with the Willamette River 25-Year flood stage and the 100-Year flood stage:
    - Build out PHF, as determined by the WWTP Master Planning Analysis
    - Average dry weather design flow
    - Assume 2 model scenarios specific for the grit removal basin (example, how much flow would need to be bypassed to maintain acceptable freeboard under top of wall with the buildout PHF scenario).
- Hydraulic criteria: Check for weir submergence at the 25-year flood stage and no overtopping of basins at the 100-year flood stage.

Deliverable:

- Technical Memorandum (TM) summarizing the analysis and the identified areas of concern.

Assumptions:

- City to provide the updated peak hour flow, if appropriate, prior to Jacobs conducting model runs.
- City to provide information/data to allow for model updating:

- Upgrades since completion of the Design-Build-Operate (DBO) project
  - Future upgrades outlined in the 2023 Draft Master Plan.
  - The buildout peak hour flow (PHF) as determined by the WWTP Master Planning Analysis, anticipated to be between 17 and 18 mgd.
- TM not to exceed 20 pages.
- Deliverable includes a table with hydraulic grade line values for each process element, but does not include an updated hydraulic profile drawing sheet.
- Excludes process capacity evaluation.

Task 2.2: UV Hydraulic Analysis (Optional)

Include the following hydraulic model run(s) for the future Trojan Signa UV system per 2/15/22 quote.

- Two additional runs at the UV system (Assume both UV systems online for both runs):
  - Determine the river level scenario with the build out PHF where the water surface elevation exceeds the disinfection treatment depth requirement.
  - Determine the river flood stage with the build out PHF where the UV system overtops.

Deliverable:

- Notes documenting the results.

Assumptions:

- Work will not commence unless authorized in writing by the City.
- Assume this task can be completed in 2 weeks from fulfillment of data requests from the City.
- Assume 2 model runs total of the UV system.
- Assume that this work will be completed after completion of Task 2.1.

Task 2.3: Dynamic Hydraulic Analysis (Optional)

Include the following hydraulic model run(s):

- Sustained build out PHF or the Willamette River level greater than the 100 year flood level until overtop the first basin (example – a more extreme event from climate change).
- Diurnal flow curve (to be provided by the City in excel). Check for weir submergence at the 25-year flood stage.
- Add additional model runs for Phase 1 or Phase 2 of the MBR conversion projects. Check for weir submergence at the 25-year flood stage and no overtopping of basins at the 100-year flood stage:
  - Build out PHF.
  - Average dry weather design flow.

Deliverable:

- Notes documenting the results

Assumptions:

- Work will not commence unless authorized in writing by the City.
- City to provide the diurnal flow curve within 2 weeks of beginning this task, based on real or theoretical data.
- Assume this task can be completed in 4 weeks from fulfillment of data requests from the City.
- Assume that this work will be completed after completion of Task 2.1.
- Includes 6 additional model runs total.

Appendix B

Jackson, Kristen

From: George Kellum <George.Kellum@kusterswater.com>
Sent: Friday, August 11, 2023 7:36 AM
To: Jackson, Kristen
Cc: victor@pedroni-co.com
Subject: [EXTERNAL] RE: Multirake Bar Screen system - headloss question

Kristen,

Yes, Victor is correct. The opening was changed from 3/8" to ¼" about six years ago. Please note, that with this change, the bar sizing also changed from 8mm x 4mm x 40mm to 6mm x 3mm x 40mm. With the requested upstream water level (6'-2") assumed at 35% blinding I get the following data at 8.8 MGD. The below data also assumes that the bar field extends 12" above the max upstream water level. Based on what I'm seeing, the bar field extends to about 5'4". Ideally, we would get the water level down below the top of the bar field elevation, or we would retrofit the bar field to be longer.

- Velocity through screen openings: **2.47 ft/s**
- Headloss: **0.93 in.**
- Downstream Water Level: **6.09 ft**
- Downstream Velocity: **0.64 ft/s**
- Upstream Velocity: **0.63 ft/s**

Best Regards,

George Kellum
Sales Manager – Municipal Products
Kusters Water Division

zima
Jagenberg Group

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From: Jackson, Kristen <Kristen.Jackson@jacobs.com>
Sent: Wednesday, August 9, 2023 8:05 PM
To: George Kellum <George.Kellum@kusterswater.com>
Cc: victor@pedroni-co.com
Subject: [Ext] Multirake Bar Screen system - headloss question

Hi George,
I just left you a voicemail – Victor pointed me your way.

I am interested in headloss information about your WT/FSM Model HUR 457x75/8 Multirake Bar Screen system. I have general product data, but I am specifically interested in headloss under the following conditions:

- Channel width = 42 inches
- Channel depth = 92 inches
- Screen angle = 75 degrees from horizontal
- Bar spacing = 8 mm between bars
- Bars = 4 mm x 40 mm
- Peak flow = 8.8 mgd
- Upstream water depth = 74 inches (18-inch freeboard)
- Blinding = 35% blinding

Victor mentioned that 1.4" screens were actually installed, not the 3/4" screens described below? Let me know, thanks!

WILSONVILLE WWTP IMPROVEMENTS DBO

CH2M Hill P.O. No. 425034-2210

SECTION 44 42 30 – INFLUENT SCREENING SYSTEM

(2) WT / FSM MODEL HUR 457x75/8 MULTIRAKE BAR SCREENS
(2) SPW 300x800 SCREENINGS WASHER COMPACTOR
(1) BAR SCREENS SLUICE TROUGH

TECHNICAL DATA & DESIGN PARAMETERS -
WT/FSM HUR 457x75/8 MULTIRAKE BAR SCREEN

Screen	WT/FSM HUR 457x75/8 Multirake Screen
Maximum Design Flow	8 MGD
Headloss at Max. Flow	Max. 24" headloss @ 35% blinding
Channel Width	42"
Channel Depth	92"
Rake Lifting Capacity	Per 12" of rake: Minimum 7 cu. ft./hour wet screenings
Bar Spacing	3/8" (8mm) open space between bars
Bar Size	8mm x 4mm x 40mm
Screen Discharge Height	[discharges to sloping trough, see layout drawing]
Screen Angle	75 degrees from horizontal
Screen Drive Horsepower	3 HP
Motor Rating	Non-classified area; screens are outdoors and feature motor space heaters

Thanks,
Kristen

Kristen Jackson, PE (she/her) | Jacobs | Water Engineer
Direct: 503.736.4318 | Mobile: 503.462.2426 | kristen.jackson@jacobs.com
2020 SW 4th Avenue, Suite 300 | Portland, OR 97201 | USA

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Appendix C

Great White Center Flow Screen Equipment Sizing

HYDRO DYNE ENGINEERING

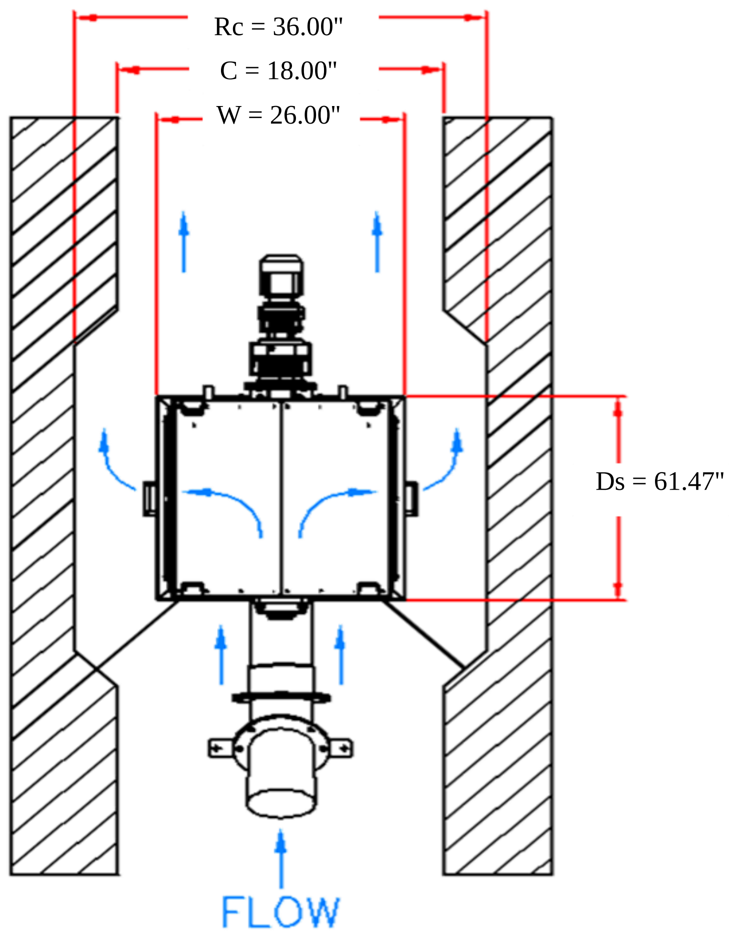
Tel: 813-818-0777 Fax: 813-818-0770

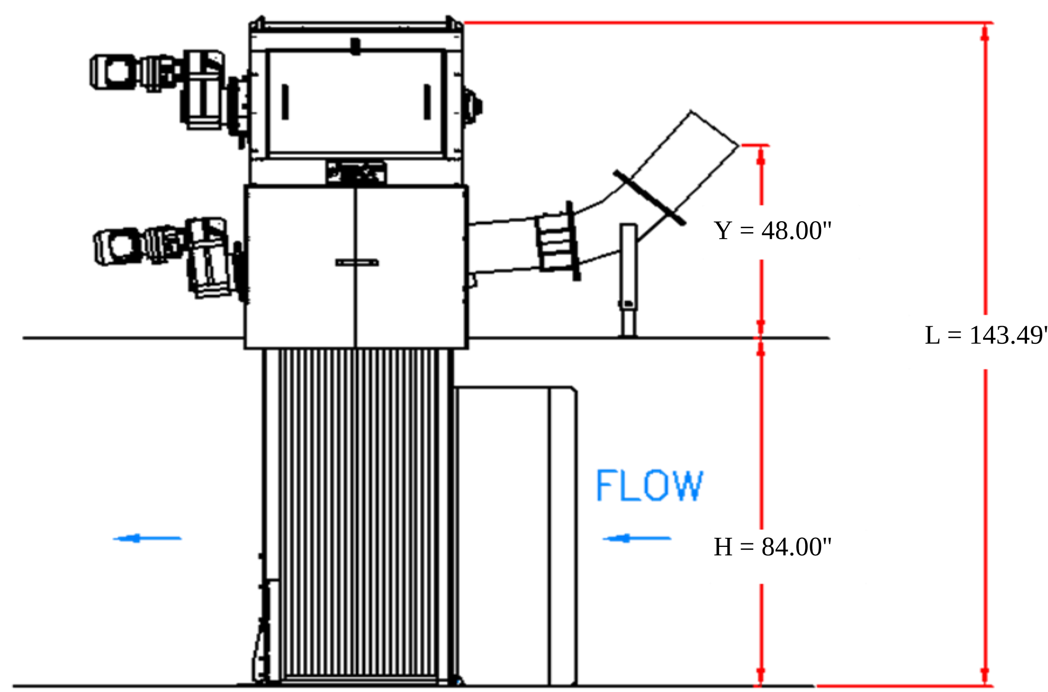
Project: Wilsonville, OR
Date: 7/18/2023
Rep: JBI
By: RH **Checked:** JMB

Model # **CF** 26 – 61 – 143 – 2 – P

Channel Dimensions:		English Units	SI Units
C	Channel Width	18.00 in	457 mm
H	Channel Height	84.00 in	2134 mm
Rc	Recess Width,	36.00 in	914 mm
Rd	Channel Recess Depth	81.47 in	2069 mm
TC	Height from Grade to Top of Channel	0.00 in	0 mm

Equipment Dimensions:		English Units	SI Units
L	Length of Screen	143.49 in	3645 mm
W	Width of Screen	26.00 in	660 mm
Ds	Depth of Screen	61.47 in	1561 mm
Y	Discharge Height from the Compactor	48.00 in	1219 mm
Screen Grid Parameters:			
S	Grid Opening Spacing	Perf 2mm metal	
Obs	Percent of Screen Obstructed 75 %	Hook Link	12 ga
OA_{eff}*	Effective Percent of Grid Opening 11.55 %	Straight Link	12 ga





NOTE: * Effective Percent of Grid Opening = Percent of Grid Opening at 2mm Opening × (1 - Proposed 75% of Screen Obstructed).

Great White Center Flow Screen Hydraulic Performance

HYDRO DYNE ENGINEERING

Tel: 813-818-0777 Fax: 813-818-0770

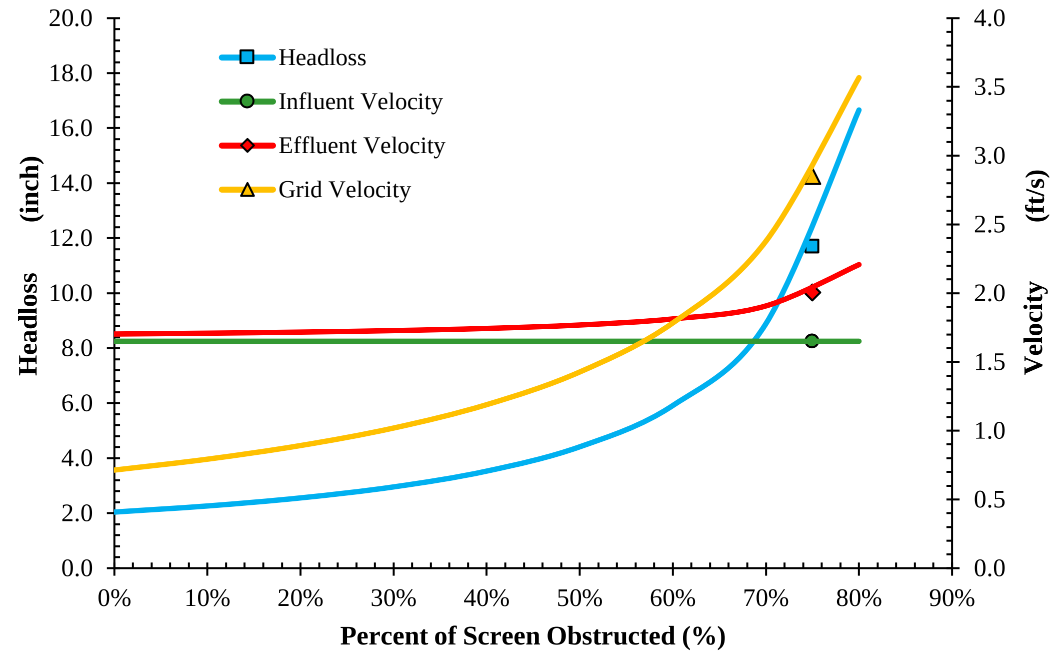
Project: Wilsonville, OR
Date: 7/18/2023
Rep: JBI
By: RH **Checked:** JMB

Model # **CF** 26 − 61 − 143 − 2 — P

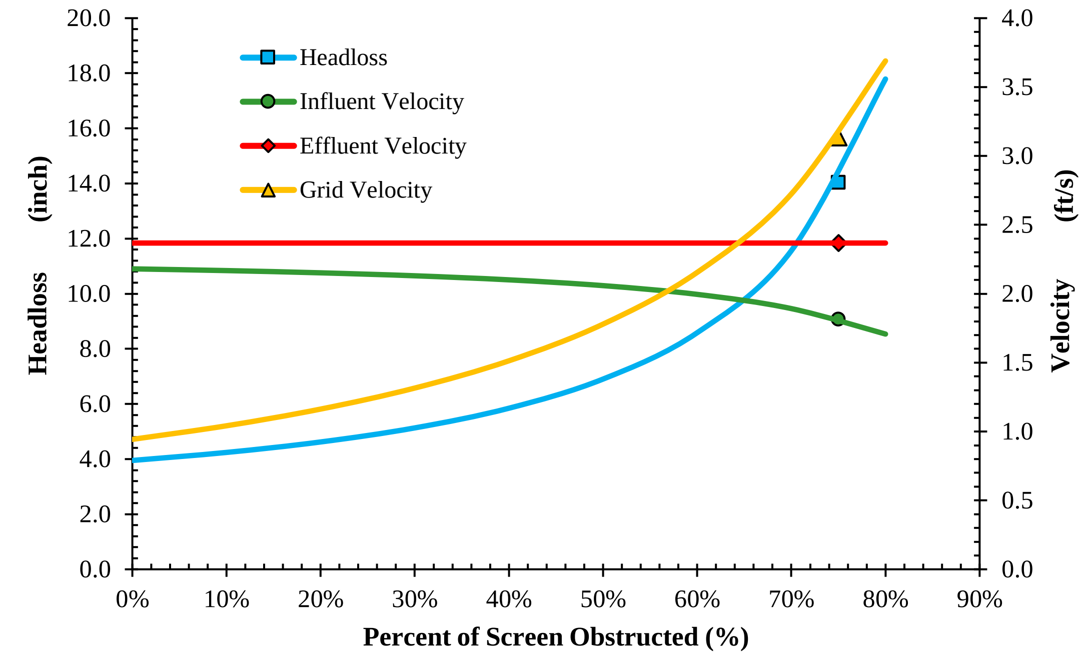
Fixed D_1 Condition @ 75% Obs		English Units		SI Units	
Q	Flow Rate	8.80 MGD	6111 gpm	386 L/s	33312 m^3/d
D_1	Upstream Water Depth	66.00 in		1676 mm	
D_2	Downstream Water Depth	54.30 in		1379 mm	
ΔH	Total Headloss	11.70 in		297 mm	
F	Freeboard	18.00 in		457 mm	
V_1	Influent Channel Velocity	1.65 ft/s		0.50 m/s	
V_T	Throat Velocity of Screen	2.31 ft/s		0.70 m/s	
V_G	Velocity Through Grid	2.85 ft/s		0.87 m/s	
V_{Re}	Recess Zone Velocity	2.55 ft/s		0.78 m/s	
V_2	Effluent Channel Velocity	2.01 ft/s		0.61 m/s	

Fixed D_2 Condition @ 75% Obs		English Units		SI Units	
Q	Flow Rate	8.80 MGD	6111 gpm	386 L/s	33312 m^3/d
D_1	Upstream Water Depth	60.03 in		1525 mm	
D_2	Downstream Water Depth	46.00 in		1168 mm	
ΔH	Total Headloss	14.03 in		356 mm	
F	Freeboard	23.97 in		609 mm	
V_1	Influent Channel Velocity	1.81 ft/s		0.55 m/s	
V_T	Throat Velocity of Screen	2.57 ft/s		0.78 m/s	
V_G	Velocity Through Grid	3.14 ft/s		0.96 m/s	
V_{Re}	Recess Zone Velocity	2.97 ft/s		0.91 m/s	
V_2	Effluent Channel Velocity	2.37 ft/s		0.72 m/s	

Screen Performance VS. Screen Blocking at Fixed D_1



Screen Performance VS. Screen Blocking at Fixed D_2



Appendix D

Wilsonville WWTP, OR **UV RFP** 28-Jul-23

Design Parameter:	Option A	Option B
Peak Flow Rate (MGD)	8.8	17.6
Design UV Transmittance (%)	55.0	55.0
Average UV Transmittance (%)	65.0	65.0
Total Suspended Solids (mg/L)	< 10	< 10
MS2 RED (mJ/cm^2), per NWRI 2012 with CR = 1.00	30.0	30.0
Permit Limit, shall not exceed:		
E. coli, 30-day geometric mean	126 CFU/100 mL	126 CFU/100 mL
E. coli , Maximum single grab sample	406 CFU/100 mL	406 CFU/100 mL

Existing System Configuration:	
Installed UV Equipment	Trojan UV4000
Number of Channels	1
Number of Banks/Channel	2
Channel Width (inches)	40.00
Channel Depth (inches)	As per Drawing
Channel Length (feet)	As per Drawing

Parameters	Trojan	Trojan	
Model:	UVSigna 2-Row	UVSigna 2-Row	
Design Factors:			
End of Lamp Life (EOLL) Factor	0.86	0.86	
Fouling Factor	0.94	0.94	
MS2 RED (mJ/cm^2), per NWRI 2012 with CR = 1.00	**30.0**	**30.0**	Insert actual MS2 RED value, not > 30 mJ/cm2, at design conditions with all duty banks at 100% lamp power.
Configuration:			
Number of Channels	1	2	
Total Number of Banks/Channel	3	3	
Number of UV Modules/Bank	1	1	
Number of Lamps/UV Module	10	10	
Total Number of Lamps	**30**	**60**	
Number of UV Sensors	3	6	One per bank
Number of Power Distribution Centers (PDCs)	1	1	Per channel there will be 1 - Single Panel
Number of Master Control Panels (MCPs)	0	0	
Total Power Consumption (kW)	**31.6**	**63.2**	For all Banks at 100% Power.
Headloss per Channel @ Peak Flow (inches)	**2.56**	**2.56**	

Footprints

Parameters	Trojan	
Channel:		
Length (Feet)	30.0	Do include level control weirs in the channel length value.
Width (inches)	35.0	
Width at Weir Area (inches)	TBD	Indicate the width required for the weir
Depth (inches)	7.8	
PDC Enclosure Size:		With air conditioner
Width (inches)	43.3	
Depth (inches)	28.0	
Height (inches)	80.0	
MCP Enclosure Size:		
Width (inches)	N/A	
Depth (inches)	N/A	
Height (inches)	N/A	

Costs

Parameters	Trojan	Trojan
Cost of UV System *	**$ 368,000**	**$ 626,000**

Notes:
- (blue) Highlighted cells indicate input required.
- (yellow) Highlighted cells are fixed and cannot be changed.

* Include the following:
- Typical Carollo spare parts, start-up and commissioning services, and freight to jobsite
- Include cost of weir

O&M Cost Information

Parameters	Trojan
Lamp Replacement	
Total Number of Lamps in System	30
Guaranteed Lamp Life (hours)	15000
Lamp Replacement Cost	$850
Ballast Replacement	
Total Number of Ballasts in System	15
Guaranteed Ballast Life (years)	10
Ballast Replacement Cost	$1,150
Quartz Sleeve Replacement	
Total number of Quartz Sleeves in System	30
Guaranteed Quartz Sleeve Life (years)	10
Quartz Sleeve Replacement Cost	$230
UV Intensity Sensor Replacement	
Total Number of UV Intensity Sensors in System	3
Guaranteed UV Sensor Life (years)	10
UV Intensity Sensor Replacement Cost	$1,156
Annual Cost for Duty and Reference Sensors Calibration	$750
Cleaning System - Wiper Replacement Cost	
Total Number of Automatic Cleaning Wipers in System	30
Guaranteed Wiper Life (years)	1
Wiper Replacement Cost	$28
Annual Cost for Automatic Cleaning System Consumables (Cleaning Solution, etc.)	$100

Appendix E

TIDEFLEX DIFFUSER (TFD) SYSTEM DATA ANALYSIS

MEDIA: Effluent

Density or | | lb/ft^3
Spec. Gravity | 1

FLOW RANGE:

MGD		gpm
6.75	=	4687.5
8.75	=	6076.4
11.25	=	7812.5
15	=	10416.6
25	=	17361.0
28	=	19444.3

AVAILABLE HEADLOSS@ DIFFUSER:

Minimum | | feet
Design | | feet
Maximum | | feet

MAX. BACKPRESSURE: | | feet

TFD SIZE (IN)	HYDRAULIC CODE
20	**3040**

DATE: 16-Jan-2017

CLIENT: City of Wilsonville, OR
CONTACT:

ENGINEER: CH2M Hill
CONTACT: David Wilson

PROJECT: Wilsonville WWTP Outfall Diffuser

REP: Antec Corporation
CONTACT: Matt Davidson

		PER TIDEFLEX DIFFUSER (TFD)			
*** TOTAL QUANTITY**	TOTAL FLOW (gpm)	FLOW (gpm)	**JET VELOCITY (fps)**	**HEADLOSS (feet)**	EFFECTIVE DIAMETER (in)
5	4687.5	937.5	4.6	0.3	9.2
	6076.4	1215.3	5.2	0.4	9.7
	7812.5	1562.5	6.0	0.6	10.3
	10416.6	2083.3	7.0	0.8	11.0
	17361.0	3472.2	9.3	1.3	12.4
	19444.3	3888.9	9.9	1.5	12.7