TECHNICAL MEMORANDUM

Plant Effluent Quality While Bypassing Primary Clarifiers 1-4

PREPARED FOR:	City of Spokane
COPY TO:	Kristen Griebel/CH2M Craig Massie/CH2M
PREPARED BY:	Bradley Eagleson/CH2M Bill Leaf/CH2M
DATE:	June 21, 2017, REVISED January 31, 2018

Background

The Spokane Riverside Park WRF (RPWRF) Next Level of Treatment (NLT) upgrades, including the replacement of isolation gates for Primary Clarifiers (PC1-4), and replacement of the PC1-4 influent flow meter, necessitate taking PC1-4 off-line during construction for a period of approximately 3 weeks in early November 2018 following the 2018 critical season ending October 31. PC1-4 isolation gates are currently marginally operable and may leak when closed, so replacement of these gates to allow PC1-4 maintenance is a high priority. Based upon analysis completed in "Hydraulics of Removing Primary Clarifier 5 Bypass Pipeline from the Project" provided to the city on September 23, 2016 it is possible under conditions not exceeding 52 MGD influent flow to bypass this flow through the new Primary Clarifier 5 (PC5) into the five Aeration Basins (AB1-4&6), without bypassing flow to the stormwater clarifiers (SC5-6). This memorandum evaluates treating this influent flow without primary clarification for the proposed 3-week period.

Influent flow rates of 52 MGD are significantly higher than the max month flow rates of 39.3 MGD during the critical season, but slightly lower than the 72.3-MGD maximum day flow rate over a 2-year interval as reported in the 2016 Phase 1 construction documents. The previous memorandum stated that during an extreme stormflow event the contractor would be required to have the ability to remove temporary construction systems and allow flow to resume to PC1-4. This stipulation will remain as an assumption for this memorandum.

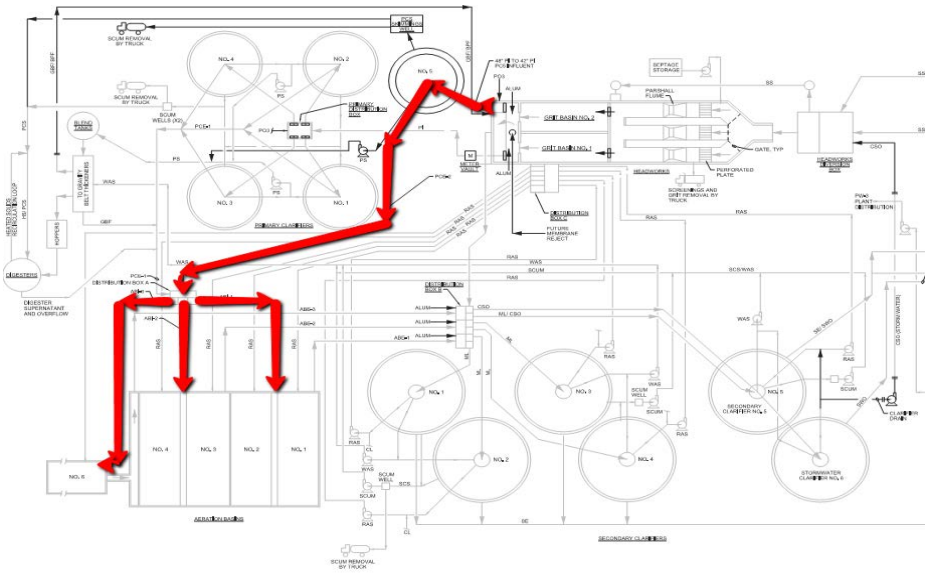

Figure 1.2: Schematic showing how PC1-4 bypass.

Assumptions

This analysis has been completed using CH2M's Professional Process Design (Pro2D2™) software to estimate the effluent quality when PC1-4 are offline. Pro2D2™ is a steady-state and dynamic whole plant simulator that has been used to model the RPWRF. An existing model based upon the maximum month flows, and used to develop past construction documents, was used as the starting point for this analysis.

No changes are proposed to chlorination and dechlorination, therefore the existing treatment methods for total residual chlorine and fecal coliform bacteria will still be capable of meeting permitted limits.

No changes are expected to the current effluent concentrations of cadmium, lead or zinc resulting in compliance with the permit limitations, but these should be monitored as some removal is normally provided through the Chemically Enhanced Primary Treatment (CEPT) system. CEPT would be off-line during this time period.

Additional assumptions carried over from the September memo include:

- A cofferdam is installed in the grit basin effluent channel, 15 feet from the south wall of the grit basin effluent channel, to allow the 84-in PCI influent gate to be installed, the flow meter to be replaced, and the gates in the primary clarifier distribution box to be replaced.
- Installation of the cofferdam reduces the bypass weir length to 34-ft 5-in.
- Grit Basin 1 effluent gate G-10DP01A will be closed during construction to isolate flow upstream of the cofferdam. Closing this gate restricts flow to Grit Basin 1. The gate can be opened to allow flow to PC1-4, downstream of the cofferdam.
- PC 1-4 are empty and offline.
- Control of flow to PC1-4 can be achieved through opening and closing the grit basin effluent gate G-10DP01A.
- PC5's mechanism is installed.
- AB6 drain pumps can pump out of AB6 to Distribution Box A (A-box) at a rate up to 23 MGD (11.5 MGD [8000 gpm] per pump). Steady state is achieved at 15 MGD, the limiting flow to AB 6. Using the drain pumps to pump from AB 6 to A-box will insure that the combined sewer flow receives

secondary treatment through Aeration Basins 1-4, rather than discharging directly to the secondary clarifiers.

- A water surface elevation in Distribution Box A of 1728.26 was used to determine the hydraulic grade line through the PC5 flow path.
- The maximum water surface elevation in the grit chamber effluent channel is maintained at 1738.33.
- The manholes along the 72-in headworks screen bypass pipeline are rated for pressurized operation.
- Aeration basins 1-4 and 6 in combinations of any four of these five basins would be online during the bypass (a combination totaling 12 MG or 13 MG, as basins 1-4 are 3 MG each and basin 6 is 4 MG)
- Modifications to AB1-4 to create anoxic zones and thus decrease the aerobic volume of the tanks may or may not not be made at the time this bypass would occur.
- Existing RAS chlorination would be available for filamentous organism control if needed.

More details regarding these assumptions are included in the September memorandum.

Results

An initial analysis using the Pro2D2™ model has shown that the RPWRF, with flow bypassing PC1-4 (not exceeding 52 MGD), is capable of meeting its effluent permit as required in WA-002447-3 for BOD_5, TSS, pH, and total ammonia (NH_3-N). Anticipated values are in Table 1.1. There may be some operational changes to watch for and manage: possible formation of foam and scum, filamentous algae growth, and adjustments to the MLSS concentration. If the planned improvements to the aeration basins including anoxic selectors are in place the plant staff would have this as a tool to control filaments. Additionally, plant staff can dose RAS with chlorine to control filaments for the planned 3-week bypass. In the event that the planned aeration basin modifications are not in place, RAS chlorination would be the means to limit filamentous organism growth.

Additional impacts may be seen in the performance of the digesters and solids treatment due to the different nature of WAS compared to the primary sludge/WAS blend currently digested. The digesters are suited for the anaerobic digestion of 100% WAS, and more alkalinity can be expected. However, the sudden change in bypassing primary treatment may result in some foaming in the aeration basins that could be transferred to the digestion process. In addition, greases normally removed in primary treatment will pass to the aeration basins which could result in a decrease in volatile solids reduction in the digesters and related digester gas formation. Some supplemental natural gas use by the boilers may be needed to maintain digester temperature. These parameters should be monitored as the transition occurs. Table 1.1 shows a comparison of predicted plant effluent performance with the primary clarifiers in service and off line.

Table 1.1: Summary of the effluent quality with and without the primary clarification. Initial conclusions show that the system will be able to meet the permitted effluent quality

	Influent	Units	Plant Effluent		
			Primaries Offline	Primaries Online	Permit
Flow	52	MGD	53.1	53.2	
BOD_5	140	mg/L	4.5	7.5	30
TSS	142	mg/L	20	20	45
NH_3-N	23	mg/L	2.5	0.9	3.1
TP	3	mg-p/L	0.60[1]	0.5	0.63 (April-October)

MLSS	--	mg/L	3780	3400	--

1) With PC1-4 out of service the CEPT system will be offline, resulting in an increase in effluent TP. This temporary operation is planned for November 2018 during the non-critical season where TP removal is not required.

Operation of the aeration basins with the primaries offline will result in more sensitivity to fluctuations in the sludge volume index (SVI). An analysis of the operation of aeration basins 1-4 and 6 in combinations of any four of these five basins online (a combination totaling 12 MG or 13 MG, as basins 1-4 are 3 MG each and basin 6 is 4 MG) and secondary clarifiers using solids flux theory can be used to understand the impacts of variations in SVI levels and MLSS concentrations. The SVI measurements can be used with reasonable accuracy to predict the thickening characteristics of suspended growth biological wastewater treatment plant sludges (Daigger, 1995). SVI can be correlated to settling behavior of sludge and can be used to make conclusions about how the system will react to variations in the quality of the sludge. Generally, values between 0-150 mL/g have good settling characteristics whereas values above 150 mL/g indicate potential bulking due to increased filamentous growth (Parker et al., 2001). With the SRT held constant, there will be adequate capacity in the aeration basins when the SVI value is between 1- 270 mL/g. When the Primary Clarifiers are offline the SRT needs to be reduce by approximately 50% allowing the MLSS concentration to be approximately 3700 mg/L. This provides for adequate capacity within the aeration basin, assuming that the SVI stays below 145 mL/g. The MLSS and SVI will need to be monitored during the 3-week operation of aeration basins only. Adjustments to the SRT or control measures for sludge bulking may need to be implemented if these parameters appear to compromise secondary clarifier performance.

Works Cited

Parker, D. S., D.J. Kinnear, and E. J. Wahlberg (2001) “Review of Folklore in Design and Operation of Secondary Clarifiers,” Journal of Environmental Engineering, vol. 127, pp. 476-484

Glen T. Daigger (1995) “Development of refined clarifier operating diagrams using an updated settling characteristic database” Water Environment Research, vol. 67, No. 1 pp 95-100