Van Anda Water Treatment Plant

Water Quality Monitoring Report

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1 Executive Summary

Per request from the Van Anda Improvement District's (VAID) Board of Trustees, RESEAU-CMI planned and performed a sampling program to monitor the performance of the VAID water treatment system. The purpose of this year long program (April 2020 to May 2021) was to gather data and obtain insights on the performance of the system, thereby provide VAID and other stockholders with the information needed to maintain, operate, and if necessary upgrade the system. Particular attention was paid to the performance of the IEX columns, pressure drops across both self-cleaning and the cartridge filters, operating/materials requirements (salt and filters), and the higher than designed inlet flow rate.

Particle size analysis was performed to identify the cause of frequent filter clogging. In addition, different regeneration conditions were tried to boost up the performance of the IEX vessels with the help of personnel from BI Pure water. These included the regeneration of resins with longer regeneration cycles, regeneration in a caustic environment, more frequent backwashes, and customizing the regeneration flow rates. RESEAU-CMI monitored the water quality by frequent sampling to determine the performance of the WTP.

Samples were collected from different points of the system and delivered to the Sustainable Water Innovation and Research Laboratory (SWIRL) at the University of British Columbia (UBC) for various water quality analyses such as dissolved organic carbon (DOC), various anion concentrations (fluoride, chloride, nitrite, nitrate, phosphate and sulphate), ultraviolet transmittance (UVT), specific UV absorbance (SUVA), pH, turbidity, conductivity, and alkalinity. The sampling schedule was revised frequently and based on the specific monitoring goals as well as system performance.

Different issues arose over the course of monitoring program. These included malfunctioning of the self-cleaning filter or cartridge filters, higher than design water demand, high pressure drops across the system, and low regeneration efficiency. Most problems were resolved with the help of either BI Pure Water, and with the support from KWL and the RESEAU team. The sampling program and the results obtained provided the RESEAU team and the operator (Ken Soles) to try and implement different strategies to improve the performance of the IEX system, in terms of DOC removal and head loss. It was eventually determined that more aggressive regeneration (that is,

two back to back regeneration of the columns) would be more effective and result in the columns to operate longer before the need for another regeneration. In this case, two back to back regenerations of each column have led to longer operation time (up to 9 days) before observing high pressure drop in the system. Although the system is performing well with this regeneration strategy, high salt consumption and the spent brine disposal are still a concern for the community. The list of the findings is mentioned below.

1.1 Key Finding

- Inlet water flow has been persistently greater than the maximum design flow rate. Some overnight monitoring determined the water demand to be such that more than 50% of the treated water is lost for some unknown reasons, likely due to some leaks in the distribution system.
- The IEX columns provide good removal of organic carbon, especially in the first 24 hours post regeneration. However, the DOC removal drops from over 60% in the first 24 hours to nearly 25% until the next regeneration cycle. While the outlet UVT remains quite high (average value of 86%±6%) and the SUVA values mostly stay below 2 L/(m.mg), the effluent DOC concentration is higher than the 2 mg/L limit. This highlights the efficacy of IEX resins at removing higher molecular weight and more aromatic (aka coloured) compounds. In addition, the relatively lower percentage removal of DOC is largely due to greater than the design flowrate of the water as well as the presence of high concentration of sulphate in the lake water. Per below, sulphate competes with DOC in occupying the resin site.
- The IEX columns are effective at removing UV absorbing compounds. While improvement in UVT are correlated with DOC removal, the average UVT of the effluent remained consistently above 75%, with the average value being around 86%±6%. This level of UVT ensures the efficacy of the UV disinfection system. Also, with SUVA being generally below 2 L/(m.mg), the likelihood of disinfection by-products being over the regulatory guidelines is very low. It is recommended that some DBP tests be performed to confirm this.

- The regenerated ion exchange filter initially removes sulphate by more than 90%. The sulphate removal stops after 1-2 days, when the system shows small amounts of sulphate release from the columns (the outlet sulphate at an average of 46 mg/L).
- Particle size analysis performed for raw water, post-self-cleaning filter, and post-cartridge filter, suggested that most of the suspended particles in raw water have a diameter of less than 10 microns. This suggests that these particles can pass through both self-cleaning and cartridge filters.
- Significant drop in IEX performance for both IEX vessels were observed between the scheduled regeneration cycles.
- The accuracy of the flowmeter in the chlorination room and WTP room were evaluated. It concluded that the WTP water flow meter is accurate.
- Comparing both IEX filters, IEX 301 shows slightly better performance in terms of the DOC and UV absorbing compounds removal. The reason behind these differences could not be determined.

1.2 Van Anda Water Treatment Plant

VAID water treatment plant was commissioned in 2019 funded by a grant supported by RESEAU-CMI. After commissioning, RESEAU offered to monitor the performance of the water treatment plant by receiving samples regularly and testing them in the SWIRL laboratory at the University of British Columbia (UBC).

Figure 1 VAID Water Board of Trustees and RESEAU Center for Mobilizing Innovation initial meeting at Priest Lake (2016)

Figure 2 shows the schematic of the water treatment plant in VAID. The priest lake water is pumped to the water treatment plant (WTP) using one pump that is triggered by the level sensor at the water reservoir. The WTP includes two 25-micron self-cleaning strainers (STR-101 and STR-111), two 5-micron cartridge filters (F201 and F211), ion exchange filters (IEX 301 and IEX 311), and three UV disinfection reactors (UV-401, UV-411 and UV-421). Brine tank supplies brine (high concentrated salt solution) for regeneration of the ion exchange media (Purolite A860 resin®). The treated water is sent to the chlorination room for sodium hypochlorite addition, and then it is transferred to the water reservoir before sending it out to the distribution system.

IEX vessels need regeneration frequently. The regeneration is triggered by operation time, the treated volume of water, or pressure drop. The normal flow through each IEX filter is designed to be 318 L/min (84 US GPM) with a backwash and fast rinse flow of 170 L/min (45 US GPM). However, the system is currently is operating at a higher flow rate (>400 L/min)

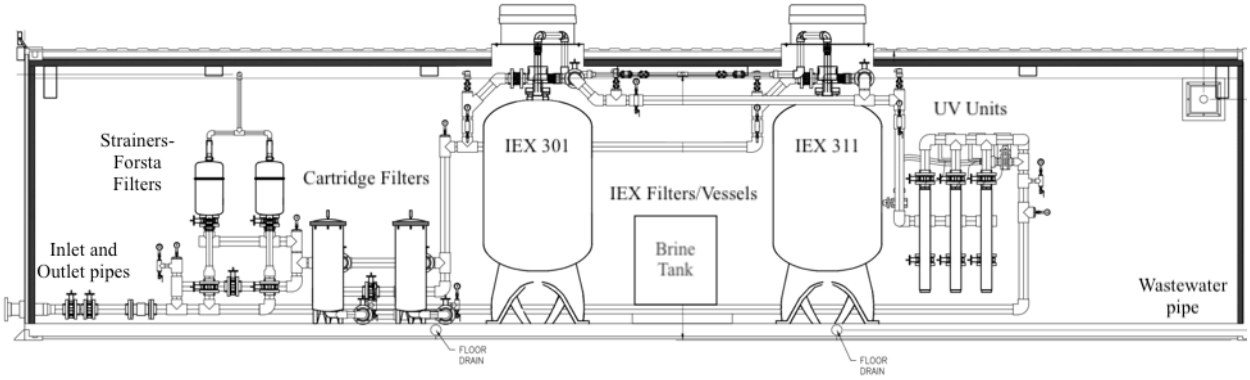

Figure 2 Schematic of the Van Anda water treatment plant.

2 Data summary

2.1 Sampling

Water samples were collected from different points at the WTP and delivered to the SWIRL at the University of British Columbia (UBC) for water quality analyses. The sampling points were determined by considering the performance of the system, the community concern, and the team suggestions. The sampling ports include raw water, post-self-cleaning filter (Forsta filter), post cartridge filter, post online IEX filter, and post UV system.

2.1.1 Monitoring Period and Sampling Schedule

The system has been under monitoring since April 2020. A summary of the sampling schedule is summarized below.

April 19, 2020 - September 11, 2020: One full set of samples including raw water, post-self-cleaning filter, post cartridge filter, post IEX vessels and post UV reactors at the convenient time for the operator.

September 12, 2020- February 18, 2021: a weekly sampling of one full set of samples as well as daily sampling from the post-online-IEX vessel.

February 26, 2021- May 2, 2021: Daily sampling from the post-online-IEX vessel and weekly sampling of raw water.

2.1.2 **Water quality parameters**

The water samples were analyzed for various water quality parameters at UBC. Dissolved organic carbon (DOC) was determined using a TOC analyzer (Sievers M5310 C) to represent natural organic matter (NOM) concentration. Various anion concentrations such as fluoride, chloride, nitrite, nitrate, phosphate and sulphate were monitored using an ion chromatography instrument (Dionex ICS- 1100). Ultraviolet (UV) transmittance was calculated based on UV absorbance at 254 nm, which was measured by UV/Vis spectrophotometer (Cary 100, Agilent Technologies). Other water qualities such as pH, turbidity, conductivity, and alkalinity were also tested at SWIRL. The pH, turbidity, conductivity, and alkalinity were measured with the HANNA instrument (HI 2002-1), a portable turbidity meter (HACH 2100Q), Oakton 35425-10, and an aquaculture photometer (HI83303, Hanna Instruments), respectively.

2.2 Water Quality Observations

In this section, the results and findings related to the performance of the Van Anda plant are presented.

2.3 Raw Water Characteristics

Priest Lake's water quality has been monitored since the year 2000. Table 1 provides the average values and standard deviations for water quality parameters monitored in a period between April 2020 and May 2021. The highest and lowest organic level was measured in the months of May and December, respectively (Figure 3). The influent organic concentration fluctuation is attributed to the ecological activities inside the Lake.

Table 1 Priest Lake average water quality between April 29, 2020, and May 29, 2021

Raw Water Characteristics	Value
Dissolved Organic Carbon (mg/L)	5.86 ± 0.52
UV transmittance (%)	75.0 ± 2.4
SUVA (L/(m.mg))	2.13

Sulphate Concentration (mg/L)	55.43 ± 8.5
Chloride Concentration (mg/L)	3.27 ± 0.54
Conductivity (us/cm)	287 ± 21
Alkalinity (mg/L)	83.40 ± 4.52
Turbidity	0.46 ± 0.21
pH	7.46 ± 0.09

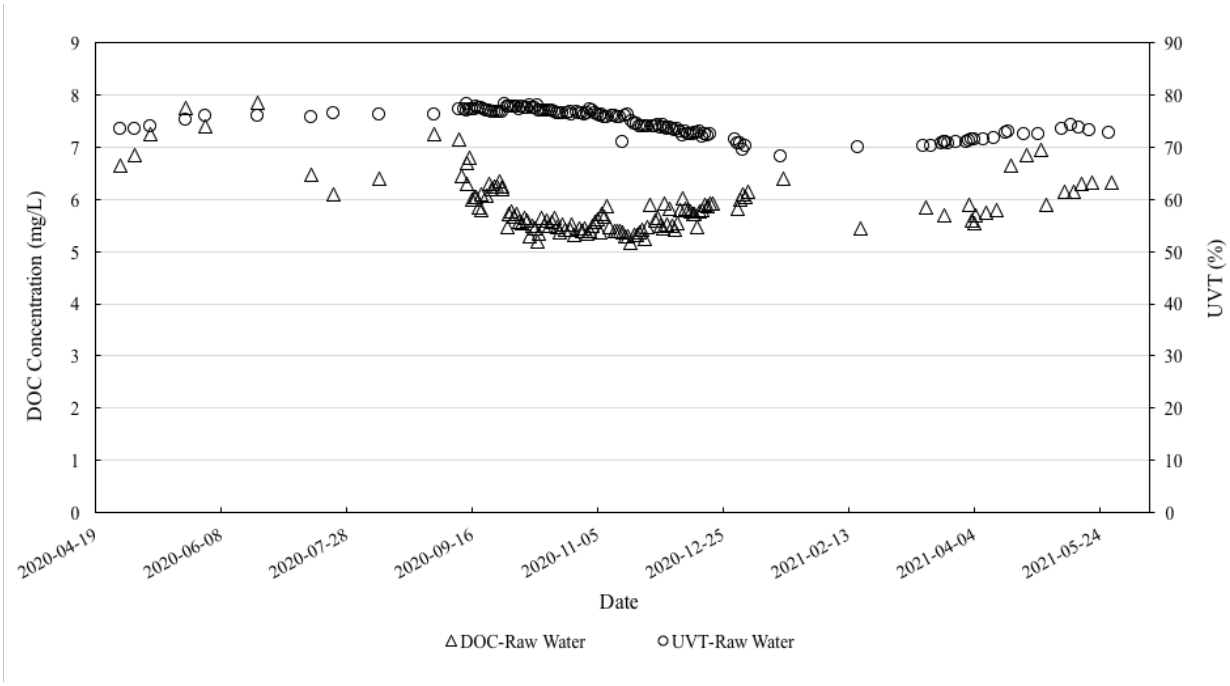

Figure 3 Raw water quality fluctuation over time between April 29, 2020, and May 29, 2021

2.4 Treated Water Characteristics

Table 2 presents the characteristics of treated water over the monitoring period. Numbers are the average of the test results. The samples were collected after an online IEX vessel, either IEX 301 or IEX 311 (Figure 4), since the UV reactors don't impact the chemical quality of the water. It should be noted that in some samples, the effluent DOC concentration is higher than the water quality criteria for total organic carbon, which is 2 mg/L for treated water and 4 mg/L for source water. The criteria should not be exceeded at any time in drinking water systems that use chlorination for disinfection

High fluctuation in the chloride ion concentration was observed (Appendix A). This is because some of the samples contained very high chloride concentrations (>100 mg/L). These samples

have been immediately taken after regeneration when there was still some brine remaining in the resin bed. High standard deviation in turbidity values is also because of sampling immediately after regeneration. Regeneration and backwash steps may have increased the turbidity of the water samples. However, except for one occasion, all the measured turbidity of the treated water was less than 1 NTU (BC water quality guideline).

Table 2 Treated water characteristics between April 29, 2020, and May 29, 2021

Treated Water Characteristics	Value
Dissolved Organic Carbon (mg/L)	3.79 ± 0.86
UV transmittance (%)	86 ± 6
SUVA ((l/m/mg))	1.68
Sulphate Concentration (mg/L)	45.92 ± 19.70
Chloride Concentration (mg/L)	15.84 ± 37.09
Alkalinity (mg/L)	77.16 ± 25.58
Turbidity	0.32 ± 0.15
pH	7.37 ± 0.26

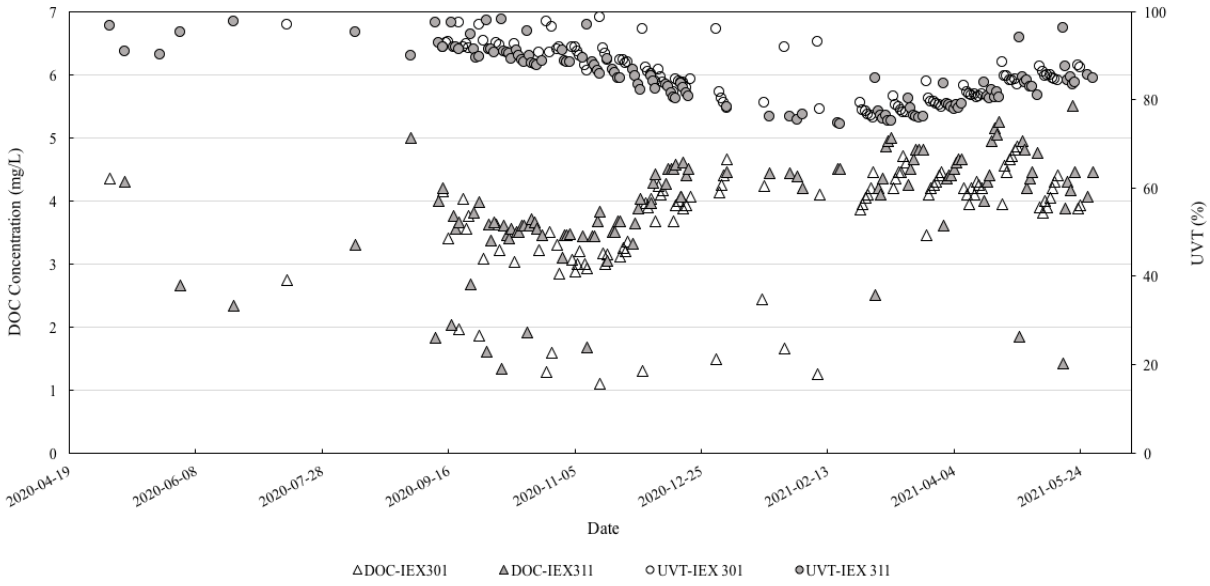

Figure 4 Treated water quality fluctuation over time between April 29, 2020, and May 29, 2021

2.5 System Performance

VAID's water treatment system was designed to remove suspended solids, dissolved organic

matters, and to provide adequate disinfection. UV disinfection and chlorination were used as the primary and secondary disinfection technique, respectively. Pre-treatment of water to achieve low DOC concentration and high UVT levels are crucial for chlorination and UV disinfection systems. Filtration along with ion exchange was used to reduce the organic level and improve the water UVT. System performance based on sulphate and DOC removal and UVT improvement is reported in this section.

In January 2021, VAID's operator started a new regeneration strategy. In this strategy, each IEX filter will be regenerated two times before being backed into the operation. This leads to a longer operation time (up to 9 days) for each vessel before observing high pressure drop. The pressure drop across the IEX filters with the new regeneration strategy was 19 ± 2 PSI. Previously vessels were under operation for less than four days, and the operator had to set them offline because of the high-pressure drop (28 ± 4 PSI) over the system. The operator was requested to take a daily sampling from February 26, 2021, so the RESEAU team was able to monitor the performance of the system over different days of operation.

2.5.1 **Dissolved Organic Carbon Removal**

Figure 5 demonstrates DOC concentration in raw water after IEX 301 and IEX 311 over the sampling period between April 2020 and May 2021. Besides affecting the taste, smell and colour of the water, high DOC concentration in chlorination systems may lead to the formation of disinfection by-products (DBPs) which are harmful to human health. The DOC level of the raw water fluctuated between 5 mg/L and 8 mg/L seasonally, and consequently, the DOC level in the treated water changed over time. Below 2 mg/L DOC concentration was measured for some samples. To understand why a few samples show a significantly lower DOC concentration, more frequent sampling was performed to study the DOC concentration changes in between two consecutive regenerations. It was found that the DOC concentration in post IEX samples is highly dependent on the sampling time. In other words, the closer the sample is taken in the post-IEX stream, the better DOC removal is observed.

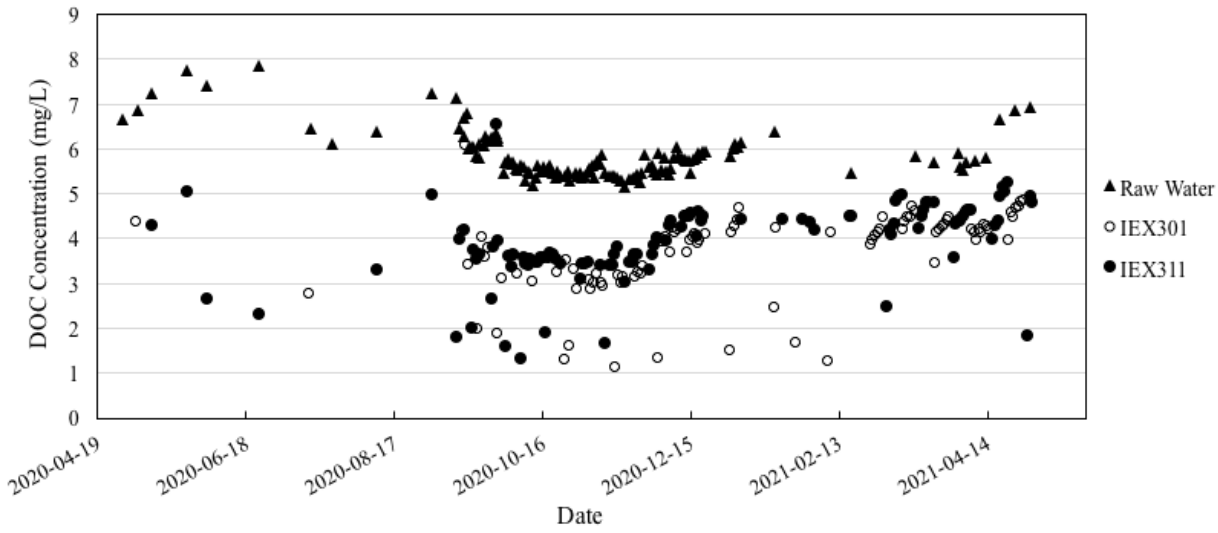

Figure 5 Performance of IEX 301 and IEX 311 vessels in respect to DOC removal

Regeneration interval impact on the DOC removal

IEX regeneration was performed by the plant water operator, RESEAU, or BIPURE engineers from a few days to 9 days intervals. DOC removal efficiency of both vessels was measured between two consecutive regeneration. Figure 6 demonstrates the DOC removal over time for both IEX 301 and IEX311. The regenerations are also marked on the plot, so the performance of the system in terms of the organic removal after regeneration is observable. As it is shown in the plot, a decreasing trend in the DOC removal was observed following each IEX regeneration.

Figure 1Figure 7 displays DOC removal after IEX 301 and IEX 311 at different days of operation. The values are the average of the different batches of samples that are shipped to UBC, and the error bars represent the standard deviations. As the figure is showing, at the initial hours of the operation, IEX vessels are very effective in removing organics, then the removal drops from more than 60% to less than 40% and remains stable for the rest of the operational days. According to this graph, IEX 301 seems to have better performance in comparison with IEX 311. However, both IEX vessels deliver more than 4 mg/L DOC for most of their operation time.

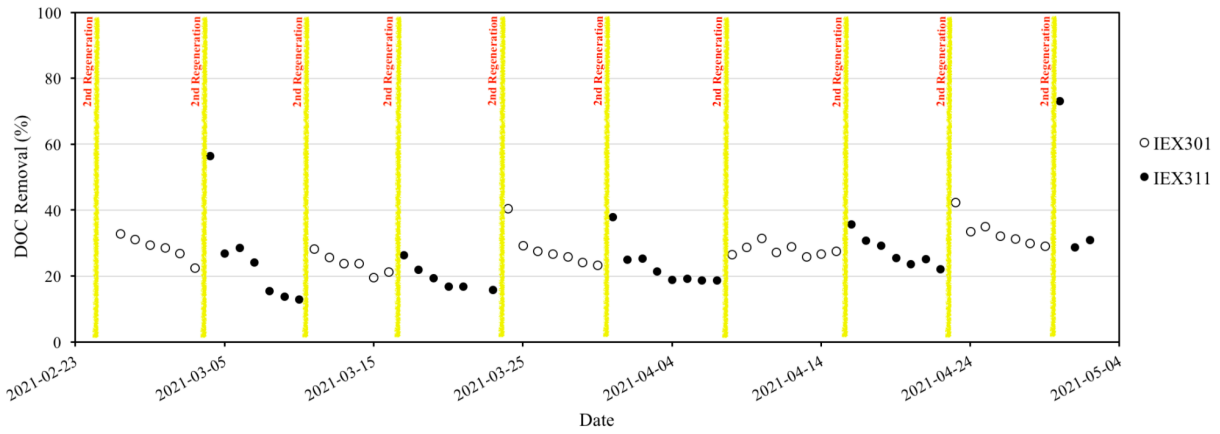

Figure 6 DOC removal of the IEX301 and IEX 311 vessels between February 26, 2021, and May 2, 2021

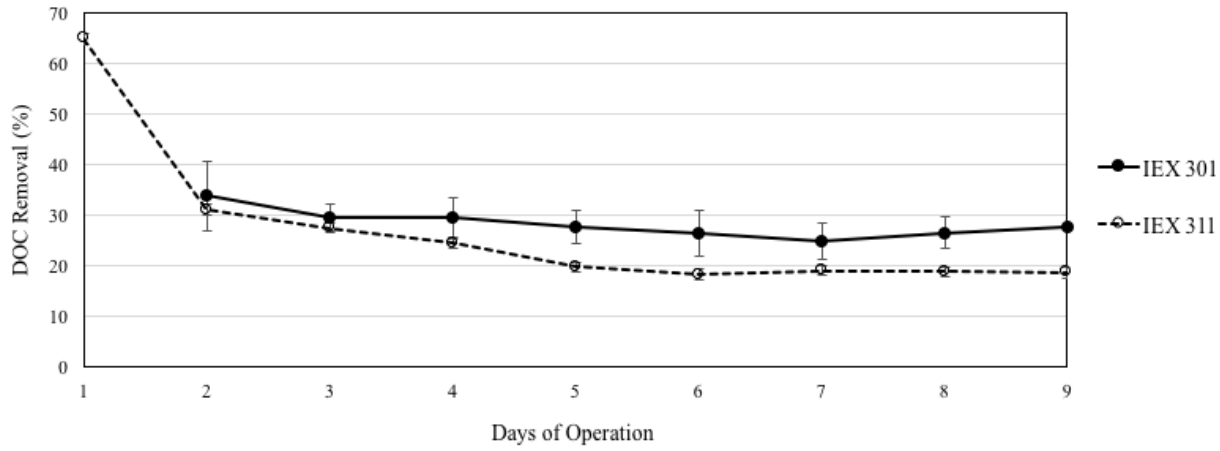

Figure 7 DOC removal of the IEX301 and IEX 311 vessels, between February 26, 2021, and May 2, 2021 (Error bars represent standard deviation)

2.5.2 **Sulphate Removal**

Figure 8 displays sulphate concentration in raw water, post IEX 301 and post IEX 311 between April 2020 and May 2021. Sulphate is considered a competitive ion in the ion exchange process as it has a higher affinity to the ion exchange resin than most organic carbon compounds. Therefore, sulphate removal is happening in parallel with DOC removal, and high levels of sulphate ions in the raw water may interfere with the water treatment performance. Priest Lake contains high levels of sulphate (55.43 mg/L), and this ion's concentrations in most of the treated water samples are in the same range as raw water, except the samples that have been taken at the initial stages of operation. Initial samples were taken after regeneration show very low-level

sulphate concentration.

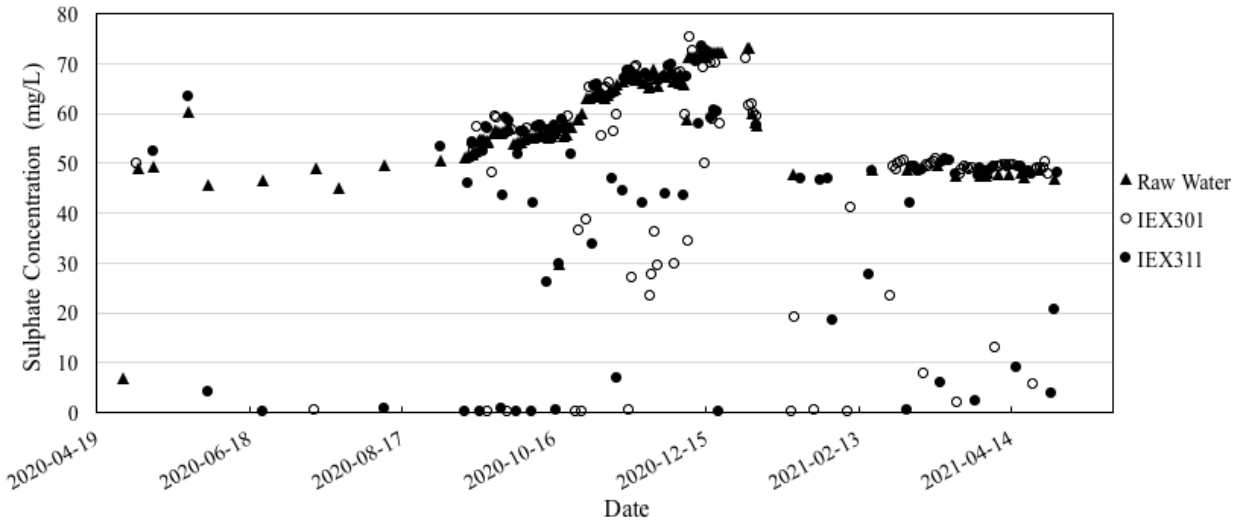

Figure 8 Sulphate concentration in raw water, after IEX301 and after IEX 311 treatment.

Regeneration interval impact on the Sulphate removal

Figure 9 displays the sulphate removal of both IEX filters over time after each regeneration. The performance of the system starts with very high sulphate removal after each regeneration, then drops to a very low level of removal or even releases sulphate at a very low level until the end of operation time.

Figure 10 plotted the average sulphate removal by the system at different days of operation. The same as Figure 7, values are the average of the obtained test results on the different batches of the samples and error bars represent standard deviation. Similar to DOC removal, sulphate removal also has a declining trend; however, the system is removing sulphate at a higher level (more than 90%) at the initial hours (less than 24 hours) of the operation, and then it drops to around zero after around two days. Between days two and nine of the operation, not only there is no removal happening, but also a very low level of sulphate releases from the IEX filters.

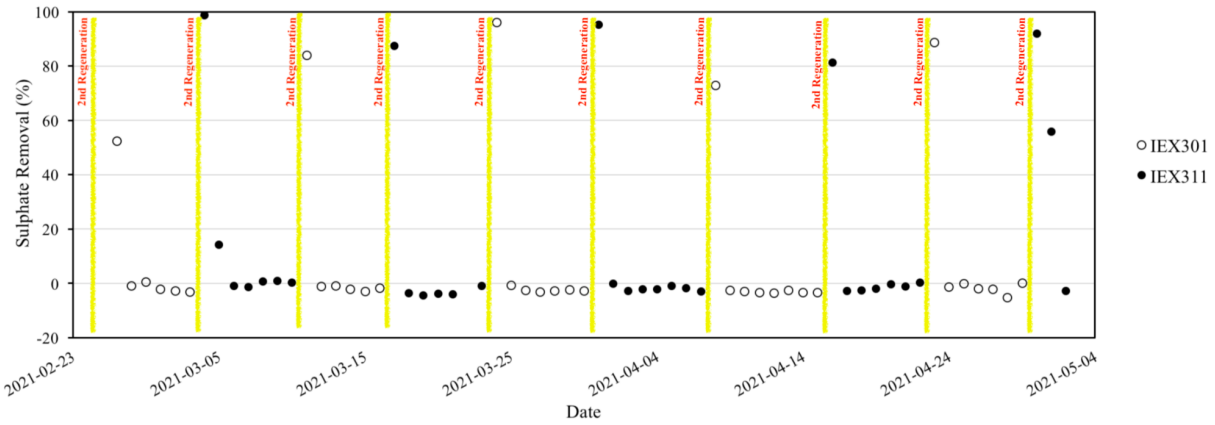

Figure 9 Sulphate removal of the IEX301 and IEX 311 vessels between February 26, 2021, and May 2, 2021

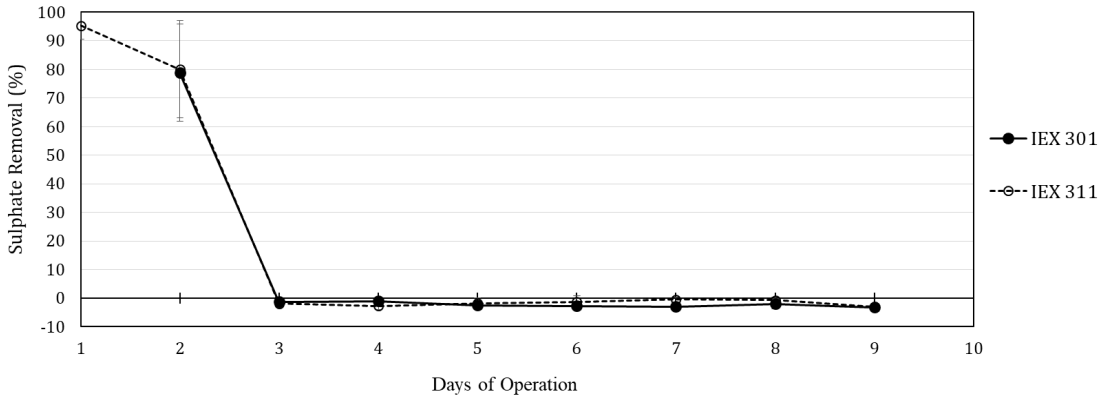

Figure 10 Sulphate removal of the IEX301 and IEX 311 vessels, between February 26, 2021, and May 2, 2021(Error bars represent standard deviation)

2.5.3 **UV Transmittance Improvement**

UV transmittance is one of the main water quality parameters. It can be affected by total suspended solids, a fraction of total organic carbon, or some certain ions in water. UV transmittance of the raw water, as well as the treated water samples after IEX 301 and IEX 311, are measured. Figure 11 presents these values over the monitoring days. The results show that the system is effective in UV absorbing compounds removal. Although the average organic carbon level in the treated water is high (3.79 ± 0.86 mg/L), high UVT (>75%) decreases the potential formation of DBPs after chlorination. However, further analysis is required to reassess any DBP in the treated water.

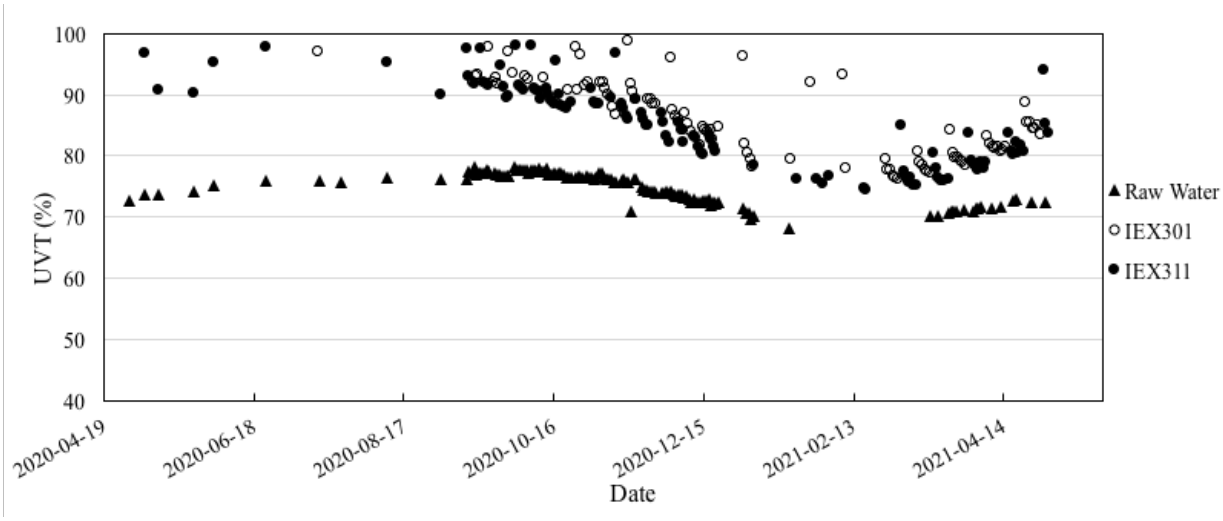

Figure 11 UV transmittance of the raw water, IEX301 and IEX311 at different sampling dates.

Regeneration Interval Impact on the UVT Improvement

UV transmittance after each IEX filter and raw water is shown over time in Figure 12. The graph shows a minor decrease in UV transmittance of the treated water over the course of the operation and in between regenerations. Figure 13 shows the average of increased UV transmittance in treated water for both IEX filters at different days of operations. IEX 301 shows a better removal in UV absorbing compounds and leads to higher UV transmittance over time compared with IEX 311.

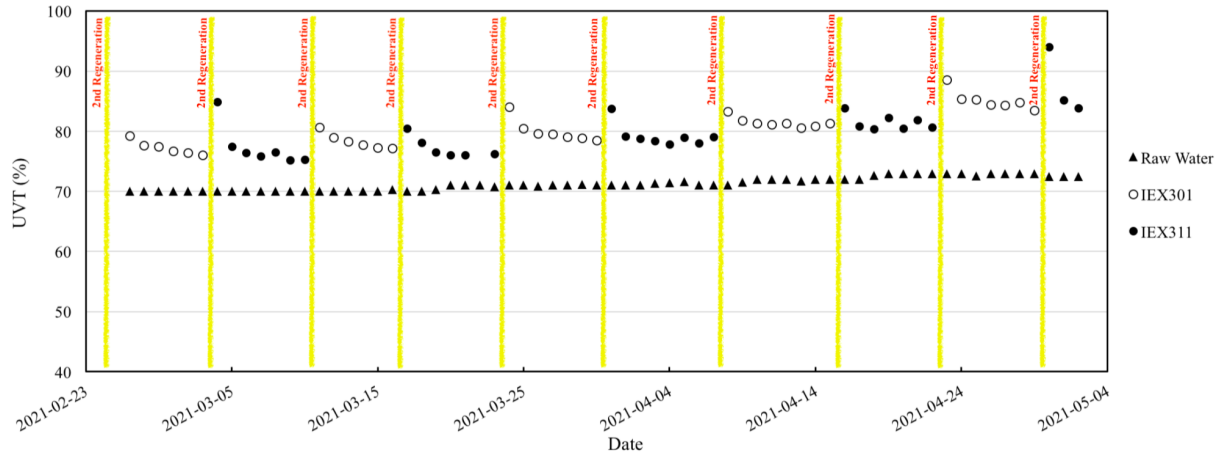

Figure 12 UV transmittance of raw water and IEX301 and IEX 311 treated water, between February 26, 2021, and May 2, 2021

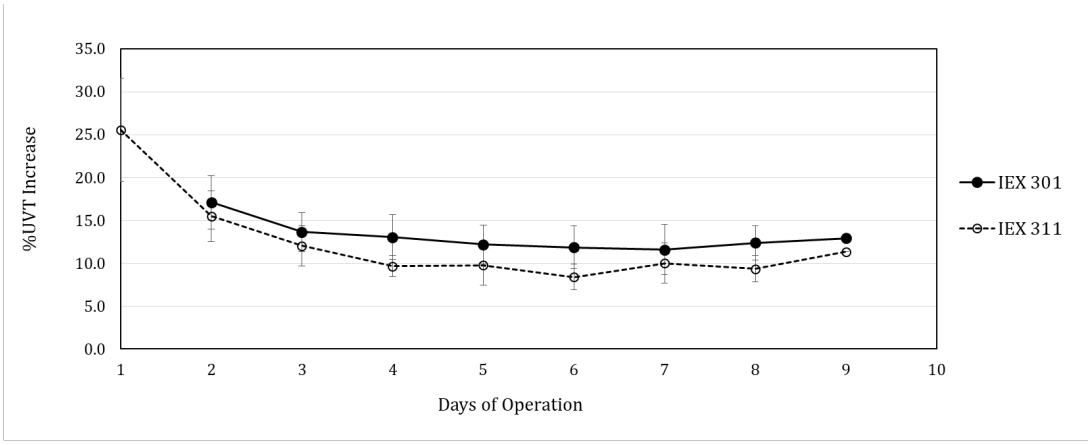

Figure 13 UV transmittance improvement after IEX301 and IEX 311 vessels, between February 26, 2021, and May 2, 2021 (Error bars represent standard deviation)

2.6 Regeneration with Caustic Impact

Following a meeting call from the community about the high-pressure drop for IEX vessels, BI pure water, RESEAU, Kerr Wood Leidal, and the BoT had a meeting to discuss the potential short-term solutions. It was decided to perform an extended regeneration with a mixture of salt and caustic to break down any potentially formed biofilm on the IEX resins. Regeneration with caustic was performed on October 26 and 27, 2020, on IEX 301 and IEX 311, respectively. The regeneration performance was checked by monitoring the colour change (Figure 14) and the salt concentration of the regeneration's waste. Each vessel's regeneration took around 3 hrs.

Figure 14 Regeneration waste's colour change after the IEX 301 regeneration (October 26, 2020)

A significant improvement in pressure drop (from more than 30 psi to less than 20 psi) was observed after the extended regeneration with caustic. However, the regeneration did not impact the DOC removal significantly.

2.7 Filters Performance Analysis

Three water samples were collected on September 8, 2020, from raw water, post-self-cleaning filter, and post cartridge filter. These samples were tested for particle size distribution over two

ranges (coarse - ~8-200 microns and fine - ~1.5 - 32 microns). Count per mL test is reported on both ranges for these three samples. Figure 15 shows the particle size distribution for the samples. It should be noted that the self-cleaning filter was equipped with a 25-micron filter and the cartridge filter had a 10-micron filter.

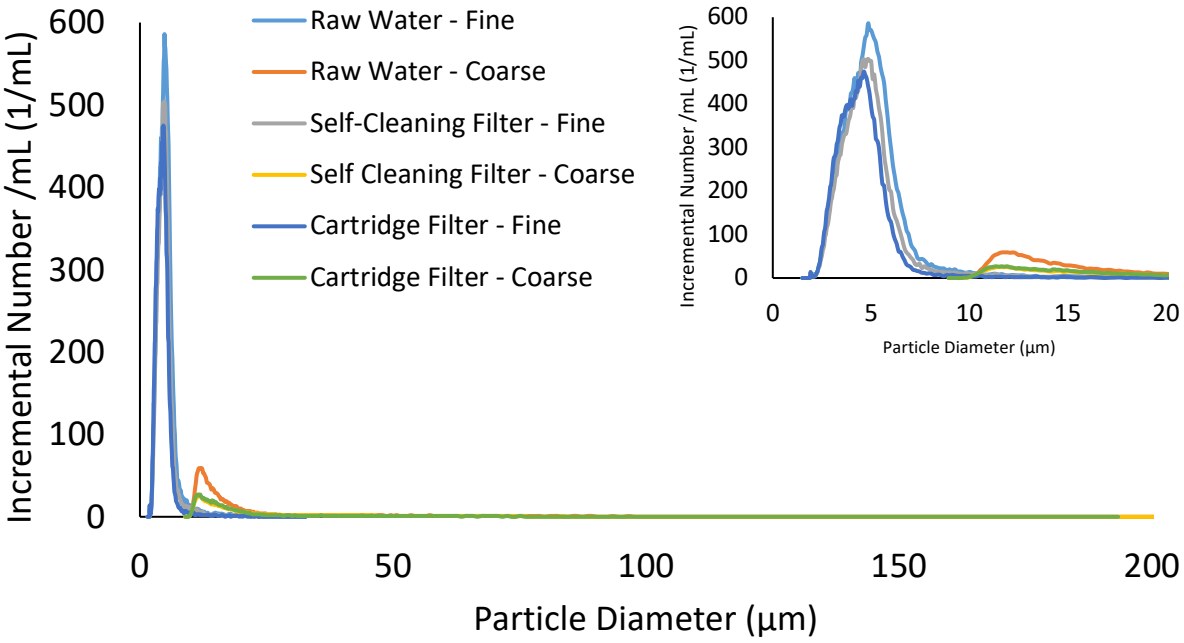

Figure 15 Particle size distribution of raw water, post-self-cleaning filter, and post cartridge filter samples

2.8 Water Plant Inlet Flowmeter Accuracy

A discrepancy between two flowmeters, one in the water treatment main room and the other one in the chlorination room, was observed. The accuracy of the chlorination room's flow metre and the plant flow meter was checked by a bucket test. Ken provided a cube (1 m^3 water container), and by using a walkie-talkie, three water doses were applied, i.e. 1000L, 800L, and 800L. The volume was consistent with the plant main room's flow meter, but the chlorination room was reading 200 Gal, 160 Gal, and 160 Gal, respectively. This discrepancy was expected since the chlorination room flow meter reads a fluctuating number between 90-130 GPM during the measurement (video is available).

During the night, a leak test was performed by Jeff and Ken, and a 40 cm drop was recorded in 1 hr. It translates to 238 L/min water taken from the reservoir from 11 pm-12 am! The community

confirms that since most of the people are asleep during the time, we can consider this as a leak.

Considering the proper accuracy of the plant's water flow meter, the community consumption was much higher than the designed flow rate. The designed flow rate is 318 L/min, while the consumption rate is more than 400 L/min for most of the time (figure). The community board of trustees was informed about a possible leak in the distribution system and advised to address the leaks before any potential decision about the system expansion or retrofitting.

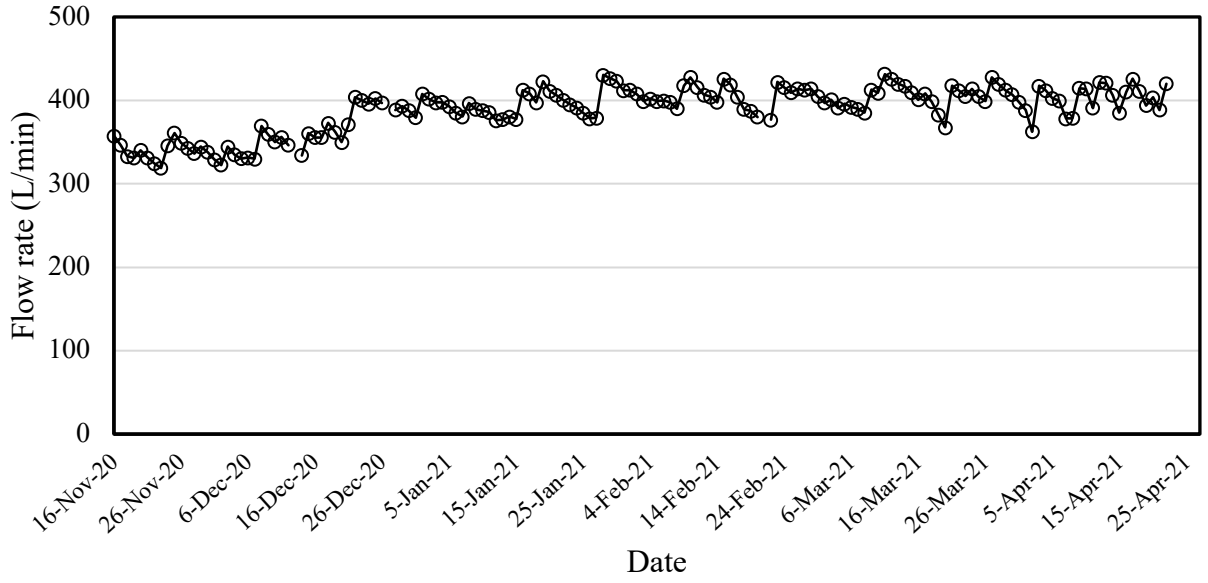

Figure 16 Inlet water flow rate measured with online flowmeter

2.9 Pressures Drop of Each Module

Pressure drop across the self-cleaning filter (Forsta filter), cartridge filter and IEX filters are plotted over monitoring days (Figure 17). Obviously, IEX filters result in higher PSIDs than cartridge and Forsta filters. The minimums in the plot are related to recorded values after regeneration of IEX filters or cleaning and replacing the Forsta and cartridge filters. Also, Figure 18 shows the pressure at different points of the system, Forsta filter (point 100), the cartridge (point 200), IEX (point 300), UV (Point 400), Outlet (point 500).

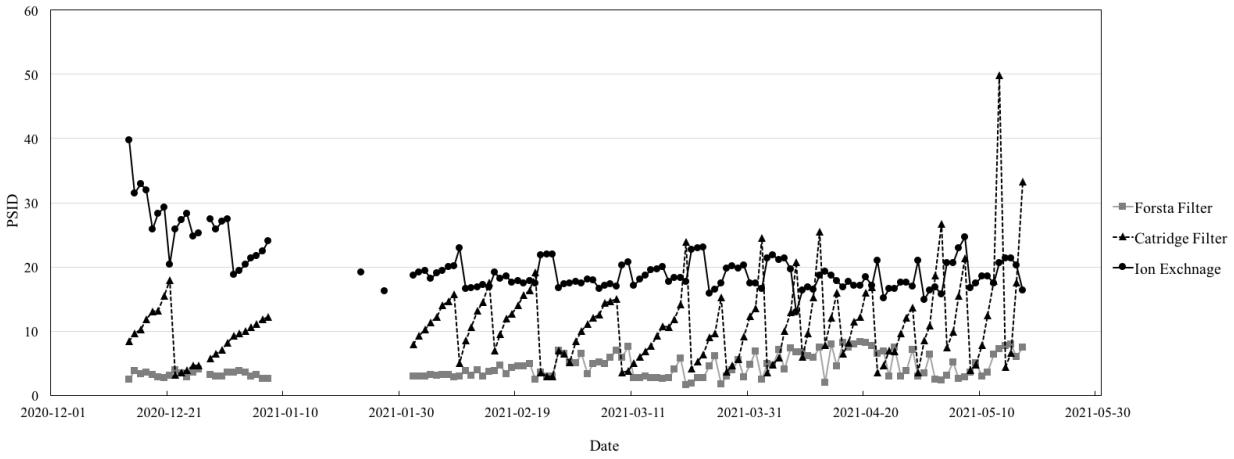

Figure 17 Pressure drop across the Forsta filter, cartridge filter and IEX filter

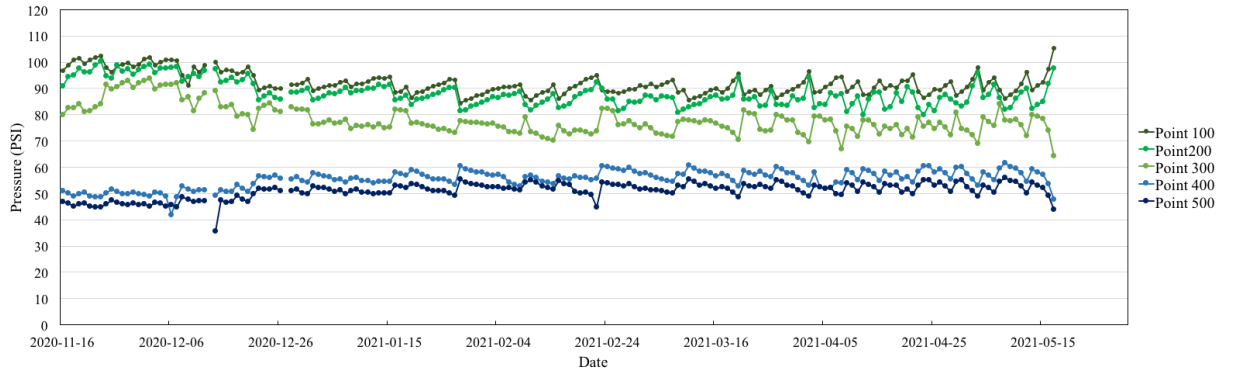

Figure 18 Pressure at different points of the system

3 Appendix

Date	DOC (mg/L)			UVT (%)			Turbidity (NTU)			**Chloride (mg/L)**			**Sulphate (mg/L)**			**Alkalinity (mg/L CaCO3)**			**Regeneration Schedule**
	Raw Water	IEX 301	IEX 311	Raw Water	IEX 301	IEX 311	Raw Water	IEX 301	IEX 311	**Raw Water**	**IEX 301**	**IEX311**	**Raw Water**	**IEX 301**	**IEX 311**	**Raw Water**	**IEX 301**	**IEX 311**	
29-04-20	6.65			73			0.46												
05-05-20	6.85	4.35		74		97													
11-05-20	7.25		4.3	74		91	0.4	0.33	0.24										
25-05-20	7.75			74		90													
02-06-20	7.4		2.65	75		95													
23-06-20	7.85		2.33	76		98	0.35	0.47	0.33										
14-07-20	6.47	2.74		76	97		0.69	0.28											
23-07-20	6.1			76			1.02												
10-08-20	6.4		3.3	76		95	0.46		0.47										
01-09-20	7.25		5	76		90	0.42		0.3										
11-09-20	7.15		1.82	76		98	0.32		0.22	3.14		129.7	51.1		0.1	86		0	Regeneration on both IEXs
12-09-20	6.45		4	77		93			0.2	3.16		3.36	51.42		46.03	85		92	
13-09-20																			
14-09-20	6.7		4.2	77		92	0.62		0.23	3.23		3.26	52.09		54.34	86		86	
14-09-20	6.3			78	92		1.12			3.18	3.45		51.91	53.62		88	87		Regeneration on IEX 311
15-09-20	6.8			77	93		0.69	0.47		3.23	3.35		52.39	52.51		86	87		
16-09-20	6	3.4		77	93					3.37	3.33		54.5	57.05					
17-09-20	6.05		2.02	77		98				3.37		120.82	54.76		0.15				Regeneration on IEX 301
18-09-20	6.05		3.75	77		92				3.34		3.48	54.67		52.27				
19-09-20	5.85		3.55	78		92				3.34		3.34	54.64		57.28				
20-09-20	6.1		3.65	78		92				3.3		3.33	54.37		56.94				
20-09-20	5.8	1.96		78	98					3.31	121.11		54.14	0.09					
21-09-20																			Regeneration on IEX 311
22-09-20	6.08	4.02		77	92		0.3	0.18		3.41	3.68		55.93	48.06		86	93		2nd Regeneration on IEX 311
23-09-20	6.29	3.56		77	93		0.38	0.37		3.4	3.45		56.76	59.16		86	86		
24-09-20	6.19	3.76		77	92		0.31	0.22		3.41	3.41		56.45	58.8		85	84		
25-09-20	6.24		2.68	77		95	0.34		0.22	3.49		64.03	55.98		0.9	84		68	Regeneration on IEX 301
26-09-20	6.24		3.81	77		91	0.42		0.25	3.42		4.01	56.25		43.37	85		97	
27-09-20	6.34			77		90	0.41		0.25	3.43		3.48	56.72		59.18	84		87	
28-09-20	6.19		3.97	77		90	0.64		0.25	3.43		3.41	57.15		58.47	85		85	
28-09-20	6.24	1.86		77	97		0.36	0.25		3.44	127.82		56.84	0.09		85	12		Regeneration on IEX 311
29-09-20																			
30-09-20	5.47	3.08		78	93		1.65	0.21		3.36	3.37		54.01	56.4		85	85		
01-10-20	5.71		1.61	78		98	0.42		0.2	3.37		132.15	53.86		0.13	84		0	
02-10-20	5.76		3.61	78		91	0.4		0.22	3.35		3.56	54.15		51.89	84		88	
03-10-20	5.66		3.37	78		91	0.26		0.23	3.38		3.38	54.22		56.26	85		85	
04-10-20	5.71		3.66	78		91	0.32		0.21	3.35		3.35	54.72		56.34	84		84	Regeneration on IEX 301
04-10-20							0.33												
05-10-20	5.57	3.61		78	93			0.29		3.35	3.45		55.22	55.42		83	86		
06-10-20	5.54	3.21		77	92					3.35	3.3		55.09	56.79		86	87		Regeneration on IEX 311
07-10-20	5.64		1.34	78		98					3.31	136.45	55.11		0.14	85		0	

08-10-20	5.59		3.6	78		91				3.32		3.85	55.12		41.85	87		95	
09-10-20	5.3		3.45	78		91				3.31		3.32	55.49		57.25	86		85	
10-10-20	5.5		3.4	78		91				3.32		3.3	55.54		57.55	87		86	Regeneration on IEX 301
11-10-20	5.45		3.55	77		89				3.32		3.32	55.98		57.43	85		86	
11-10-20																			
12-10-20	5.2	3.02		77	93					3.33	3.38		55.43	56.49		86	85		Regeneration on IEX 311
12-10-20																			
13-10-20	5.35		3.5	78		91				3.31		6.2	55.51		25.98	86		109	
14-10-20	5.65		3.5	77		90	0.44		0.18	3.27		3.31	55.06		56.76	86		85	
15-10-20	5.5		3.6	77		89	0.38		0.2	3.33		3.32	55.3		56.72	85		85	
16-10-20	5.6		3.6	77		89	0.39		0.18	3.32		3.32	56.06		57.59	87		86	Regeneration on IEX 311
17-10-20	5.5		1.91	77		96	0.47		0.3	3.32		123	56.59		0.38	86		19	
18-10-20	5.56		3.6	77		90	0.45		0.2	7.24		7.27	29.83		29.84	81		107	
19-10-20	5.65		3.7	77		88	0.32		0.21	3.33		3.31	57.19		58.83	85		86	
20-10-20	5.46		3.65	77		88	0.21		0.3	3.55		3.26	55.34		56.87	85		87	
21-10-20	5.36		3.56	77		88	0.25		0.17	3.26		3.29	55.79		57.23	87		86	
22-10-20	5.51	3.22		77	91		0.22	0.17		3.26	3.26		57.38	59.12		86	84		
23-10-20	5.41		3.46	77		89	0.3		0.19	3.23		3.44	57.12		51.75	86		92	
24-10-20																			
25-10-20	5.41	1.28		76	98		0.34	0.22		3.23	138.45		58.72	0.14		87	7		
26-10-20	5.51	3.51		77	91		0.31	0.27		3.23	4.02		58.90	36.21		85	106		
27-10-20	5.31	1.59		76	97			0.2		3.27	107.63		59.97	0.11		90	34		
28-10-20							0.33	0.24	0.21										Regeneration on IEX 301
29-10-20	5.45	3.3		77	92		0.37	0.2		3.28	4.24		63.01	38.51		88	108		
30-10-20	5.4	2.85		77	92		0.28	0.22		3.27	3.29		62.95	65.06		87	86		
31-10-20	5.45		3.1	76		91	0.35		0.3	3.25		9.32	63.41		33.7	87		106	Regeneration on IEX 301
01-11-20	5.35		3.45	76		89	0.36		0.27	3.33		3.30	63.64		65.44	87		87	
02-11-20	5.4		3.45	76		89	0.46		0.27	3.27		3.30	63.63		65.76	87		87	
03-11-20	5.50		3.47	77		88	0.49		0.2	3.32		3.25	63.24		64.12				
04-11-20	5.57	3.07		77	92		0.27	0.18		3.31	3.51		63.32	55.18					Regeneration on IEX 311
05-11-20	5.63	2.87		77	92		0.27	0.19		3.30	3.29		63.11	64.66					
06-11-20	5.37	3.00		76	91		0.37	0.18		3.31	3.31		63.52	65.18					
07-11-20	5.73	3.20		76	90		0.37	0.41		3.31	3.30		64.16	66.11					
08-11-20	5.67		3.43	76		90	0.91		0.49	3.31		4.21	64.67		46.75				
09-11-20	5.87	3		76	88		0.47	0.37		3.30	12.56		64.78	56.27					
10-11-20	5.47	2.93	1.67	76	87	97				3.36	11.37	125.05	65.94	59.51	6.91	83	80	0	Regeneration on IEX 301 and IEX311
11-11-20																			
12-11-20	5.4		3.43	76		89				3.32		6.12	66.33		44.53	82		97	Regeneration on IEX 301
13-11-20	5.4		3.43	76		88				3.36		3.39	67.04		67.099	83		77	
14-11-20	5.4		3.67	76		87				3.35		3.35	67.68		68.52	83		82	
15-11-20	5.37	1.1	3.83	76	99	86			0.18	3.35	148.59	3.41	67.78	0.19	68.42	82	0	83	
16-11-20	5.3	3.17		71	92		0.39	0.27		3.36	6.53		67.04	26.97		84	117		
17-11-20	5.3	3		76	90		0.33	0.17		3.32	3.37		66.83	68.97		84	82		
18-11-20	5.16	3.14	3.04	76	89	89	0.43	0.21	0.3	3.23	3.25	6.14	67.13	69.47	67.25	88	86	84	Regeneration on IEX 311
19-11-20																			
20-11-20	5.32		3.5	75		87	0.39		0.35	3.18		5.36	66.17		41.87	85		104	
21-11-20	5.32		3.5	75		86	0.66		0.34	3.25		3.25	66.03		68.04	86		86	
22-11-20	5.38		3.67	74		85	0.42		0.25	3.21		3.24	65.16		67.19	88		85	
23-11-20	5.42	3.11	3.67	74	89	85				3.25	9.03	3.22	65.45	23.26	67.3	86	117	88	Regeneration on IEX 301

24-11-20	5.25	3.24		74	89			0.19		3.21	7.69		68.93	27.55		86	117		
25-11-20	5.47	3.19		74	88			0.24		3.58	11.61		66.96	35.93		88	130		Regeneration on IEX 301
26-11-20	5.89	3.35		74	88			0.3		3.55	7.60		65.64	29.25		86	112		
27-11-20																			
28-11-20	5.60		3.32	74		87			0.19	3.55		5.81	67.94		67.44	87		86	Regeneration on IEX 311
29-11-20	5.63		3.64	74		85	0.43		0.24	3.57		8.77	67.43		43.68	87		101	
30-11-20	5.50		3.88	74		83	0.38		0.24	3.53		3.54	68.07		69.58	86		84	
01-12-20	5.44		4.03	74		82	0.37		0.3	3.52		3.53	68.44		69.79	84		85	
02-12-20	5.92	1.31		74	96		0.46	0.58	0.31	3.51	169.52		66.31			86	2		Regeneration on IEX 301
03-12-20	5.53	3.97		74	87		0.47	0.4		3.60	7.83		66.95	29.48		86	112		
04-12-20	5.82	3.90		73	86		0.42	0.27		3.51	3.49		66.18	67.80		86	84		
05-12-20	5.49	4.03	3.97	74	86	85	0.42			3.51	3.49	4.82	66.30	68.19	67.25	86	85	84	Regeneration on IEX 311
06-12-20	5.43		4.29	74		84				3.49		9.45	65.92		43.64	85		96	
07-12-20	5.56	3.67	4.42	73	84	82				3.48	9.75	3.50	58.80	59.62	67.32	88	87	88	Regeneration on IEX 301
08-12-20	5.80	4.23		74	87					3.35	7.45		71.22	34.07		84	110		
09-12-20	6.03	4.10		73	85		0.43	0.27		3.35	3.52		71.22	75.11		84	83		
10-12-20	5.83	4.17		72	84		0.57	0.26	0.36	3.35	3.35		71.22	72.32		83	83		Regeneration on IEX 311
11-12-20	5.80		4.27	73		83	0.37		0.33	3.35		5.72	71.22		70.41	85		80	
12-12-20	5.77		4.50	73		83	0.53		0.28	3.35		4.17	71.22		57.92	83		95	
13-12-20	5.73		4.50	73		81	0.48		0.29	3.35		3.43	71.22		73.47	84		83	
14-12-20	5.73	3.67	4.50	72	82	80	0.6	0.32	0.25	3.35	5.32	3.36	71.22	69.12	72.13	84	84	83	Regeneration on IEX 301
15-12-20	5.47	3.93	4.57	73	85	80				3.35	5.23	3.30	71.22	49.87	72.63	82	98	82	
16-12-20	5.77	4.00		73	84					3.30	5.12		72.24	71.57		85	84		
17-12-20	5.80	4.07	4.07	73	84	84				3.30	6.16	9.08	72.24	70.06	58.94	84	84	84	Regeneration on IEX 311
18-12-20	5.90	3.87	4.60	72	84	83		0.34	0.22	3.30	8.57	7.63	72.24	58.77	60.76	85	87	104	Regeneration on IEX 301
19-12-20	5.87	3.93	4.40	72	83	82	0.3	0.34	0.33	3.30	3.19	3.76	72.24	69.84	60.39	84	86	84	Regeneration on IEX 311
20-12-20	5.93		4.50	72		81	0.4		0.4	3.30		135.77	72.24		0.14	81		81	
21-12-20	5.93	4.07		72	85		0.34	0.25		3.30	3.56		72.24	57.65		82	89		
22-12-20																			Regeneration on IEX 311
23-12-20																			
24-12-20																			Regeneration on IEX 301
25-12-20																			
26-12-20																			
27-12-20																			Regeneration on IEX 311
28-12-20																			Regeneration on IEX 311
29-12-20																			Regeneration on IEX 301
30-12-20																			Regeneration on IEX 301
31-12-20	5.83	1.49		71	96		0.37	0.47		0.26	0.29		73.00	70.78		85	3		
01-01-21	6.00	4.13		71	82		0.45	0.29		0.26	0.27		73.00	61.47		83	84		
02-01-21	6.10	4.25		71	80					3.14	3.18		60.07	61.70		79	78		Regeneration on IEX 311
03-01-21	6.05	4.40		70	79		0.43	0.75		3.09	3.12		58.12	59.93		78	74		
04-01-21	6.15	4.65	4.45	70	78	78	0.33			3.11	3.10	5.31	57.54	59.20	57.50	78	76	74	
05-01-21																			
06-01-21																			Regeneration on IEX 301
07-01-21																			Regeneration on IEX 311
08-01-21																			
09-01-21																			
10-01-21																			
11-01-21																			

12-01-21																			
13-01-21																			
14-01-21																			
15-01-21																			
16-01-21																			
17-01-21																			Regeneration on IEX 301
18-01-21	6.40	2.44		68						2.91	110.72		47.86	0.05		74	6		
19-01-21		4.23			79						4.46		47.8	18.96					
20-01-21																			Regeneration on IEX 311
21-01-21			4.44			76						4.53	47.8		46.91				
22-01-21																			
23-01-21																			
24-01-21																			
25-01-21																			Regeneration on IEX 301
26-01-21																			
27-01-21		1.65			92						121.42		47	0.18					
28-01-21								0.55											
29-01-21			4.44			76			0.33			4.45	47		46.68				Regeneration on IEX 311
30-01-21																			
31-01-21																			
01-02-21			4.39			75	0.39	0.32	0.32			4.34	46.65		46.81				Regeneration on IEX 311
02-02-21													48.8						
03-02-21			4.2			77			0.67			5.86	48.8		18.61			92	Auto Regeneration on IEX 301
04-02-21																			
05-02-21																			
06-02-21																			
07-02-21																			
08-02-21																			Regeneration on IEX 301
09-02-21		1.25			93			0.78			123.11		48.8	0.15			0		
10-02-21		4.1			78			1.28			3.47		48.8	40.92			79		
11-02-21																			
12-02-21																			
13-02-21																			
14-02-21																			Regeneration on IEX 311
15-02-21																			
16-02-21																			
17-02-21			4.5			75			0.75			3.06	48.8		27.68			76.00	
18-02-21	5.45		4.5	70		74	0.45		0.38			3.01	48.8		48.36			73.00	
19-02-21																			
20-02-21																			
21-02-21																			
22-02-21																			
23-02-21																			
24-02-21																			
25-02-21																			Regeneration on IEX 301
26-02-21		3.85			79			0.29			4.30		48.8	23.22			94		
27-02-21		3.95			78						3.16		48.8	49.21			72		
28-02-21		4.05			77			0.23			4.84		48.8	48.51			73		
01-03-21		4.1			77			0.24			3.12		48.8	49.84			74		

02-03-21		4.2			76			0.25			3.22		48.8	50.07			76		
03-03-21		4.45			76						3.07		48.8	50.35			75		Regeneration on IEX 311
04-03-21			2.5			85						99.51	48.8		0.58		21	21	
05-03-21			4.2			77						3.54	48.8		41.85		82	82	
06-03-21			4.1			76						3.11	48.8		49.24		74	74	
07-03-21			4.35			76						3.11	48.8		49.40		74	74	
08-03-21			4.85			77						3.08	48.8		48.40				
09-03-21			4.95			75						3.12	48.8		48.27				
10-03-21			5			75						3.15	48.8		48.57				Regeneration on IEX 301 and set it online
11-03-21		4.2			81						7.53		48.8	7.75					
12-03-21		4.35			79						3.24		48.8	49.35					
13-03-21		4.45			78						3.20		48.8	49.25					
14-03-21		4.45			78						3.20		48.8	49.77					
15-03-21		4.7			77						3.19		48.8	50.19					
16-03-21	5.85	4.6		70	77					3.23	3.21		49.75	50.55					Regeneration on IEX 311 and set it online
17-03-21			4.25			80						11.37	48.61		6.07				
18-03-21			4.5			78						3.34	48.61		50.28				
19-03-21			4.65	70		77				3.23		3.25	48.61		50.72				
20-03-21			4.8			76						3.22	48.61		50.40				
21-03-21			4.8			76						3.24	48.61		50.50				
22-03-21													48.61						
23-03-21	5.7		4.8	71		76	0.34		0.19	2.97		2.96	47.47		47.86	72	74		Regeneration on IEX 301 and set it online
24-03-21		3.45		71	84			0.19			13.25		47.51	1.86			99		
25-03-21		4.1		71	80			0.2			3.13		47.51	47.78			71		
26-03-21		4.2		71	80		0.33	0.17		3.01	3.05		47.51	48.65		71	72		
27-03-21		4.25			80			0.18			3.05		47.51	49.02			78		
28-03-21		4.3			79			0.2			3.00		47.51	48.84			71		
29-03-21		4.4		71	79		0.33			3.01	3.03		47.51	48.64		71	72		
30-03-21		4.45			78						3.04		47.51	48.75			76		Regeneration on IEX 311 and set it online
31-03-21			3.6			84			0.2			22.24	47.51		2.21			90	
01-04-21			4.35			79						3.17	47.51		47.50			72	
02-04-21	5.9		4.4	71		79				3.06		3.06	47.56		48.87	73		72	
03-04-21	5.6		4.4	71		78				3.05		3.05	47.42		48.39	72		72	
04-04-21	5.55		4.5	71		78				2.98		3.07	47.53		48.53	71		71	
05-04-21	5.7		4.6	72		79	0.57		0.19	3.11		3.09	47.99		48.42	72		77	
06-04-21			4.65			78			0.32			3.08	47.93		48.72			77	Regeneration on IEX 301
07-04-21			4.65			79			0.35			3.15	47.93		49.34			77	Set IEX 301 Online
08-04-21		4.2			83			0.32			5.22		47.93	12.97			100		
09-04-21	5.75	4.1		72	82		0.46	0.21		3.12	3.28		47.88	49.11		74	74		
10-04-21		3.95			81			0.27			3.12		47.87	49.21			74		
11-04-21		4.2			81			0.24			3.14		47.87	49.41			71		
12-04-21		4.1			81			0.26			3.12		47.87	49.56			75		
13-04-21	5.8	4.3		72	81					3.13	3.17		47.87	49.10		72	72		
14-04-21		4.25			81						3.16		47.93	49.56			72		Regeneration on IEX 311
15-04-21		4.2			81						3.12		47.93	49.48			73		
16-04-21			4			84						8.33	47.93		8.97			100	
17-04-21			4.3			81						3.23	47.93		49.20			72	
18-04-21			4.4	73		80				3.16		3.19	47.99		49.24	74		73	
19-04-21	6.65		4.95	73		82				3.04		3.02	47.17		48.09			75	

20-04-21			5.15			80						3.03	47.94		48.01			73	
21-04-21			5.05			82			0.34			3.08	47.94		48.41			74	First regeneration on IEX 301
22-04-21			5.25			81						3.01	47.94		47.80			75	Set IEX 301 Online
23-04-21		3.95			89						8.77		47.94	5.43			106		
24-04-21		4.55			85						3.19		47.94	48.59			75		
25-04-21	6.85	4.45		73	85					3.10	3.13		48.72	48.72			73		
26-04-21		4.65			84						3.07		47.78	48.72			75		
27-04-21		4.7			84						3.06		47.78	48.76			75		
28-04-21		4.8			85						3.18		47.78	50.24			74		First Regeneration on IEX 311
29-04-21		4.85			83						3.02		47.78	47.72			78		Second Regeneration on IEX311
30-04-21			1.85			94						200.00	47.78		3.85			13	
01-05-21	6.95		4.95	72		85				3.04		4.09	46.84		20.61			103	
02-05-21			4.8			84			0.32			3.13	46.84		48.11			80	
03-05-21	5.9		4.2			84			0.41	3.04		3.07	47.09		48.83				
04-05-21			4.35			83			0.45			3.08			48.25				First Regeneration on IEX 301
05-05-21			4.45			83			0.47			3.07			48.91				Second Regeneration on IEX 311
06-05-21																			
07-05-21			4.75			81			0.58			3.08			48.82				
08-05-21		3.9			87.6			0.51			4.00			20.04					
09-05-21		3.8			86.2			0.39			3.12			49.27					
10-05-21	6.15	4		73	85.4		0.94	0.47		3.12	3.09		47.12	49.47					
11-05-21		3.9			85.7			0.57			3.11			49.12					
12-05-21		4.05			85.7			0.6			3.10			49.83					
13-05-21		4.2			84.8			0.54			3.08			49.02					First Regeneration on IEX 311
14-05-21	6.15	4.3		74	84.8		0.77	0.57		3.07	3.11		47.19	49.07					
15-05-21		4.4			84.5			0.58			3.09			49.11					Second Regeneration on IEX 311
16-05-21																			
17-05-21	6.29		1.41	74		96.2	0.76		0.39	3.21		123.15	48.34		0.12	77		0.0	Set IEX 311 Online
18-05-21			3.87			87.5			0.41			4.60			23.85			95.0	
19-05-21			4.3			84.4			0.58			3.17			49.92			76.0	
20-05-21			4.16			85.2			0.37			3.21			49.89			77.0	First Regeneration on IEX 301
21-05-21	6.33		5.51	73		83.4	0.65		0.44	3.21		3.20	48.34		50.08	77		77.0	
22-05-21			4.45			84.0			0.38			3.21			50.37			77.0	Set IEX 301 Online
23-05-21		3.87			87.8			0.44			3.62			38.93			84.0		
24-05-21		3.92			87.2			0.48			3.26			50.48			79.0		
25-05-21																			
26-05-21																			
27-05-21			4.06			86			0.37			3.23			50.58			76	
28-05-21																			
29-05-21	6.33		4.45	73		85	0.61		0.36	3.23		3.18	48.58		50.06	77		77	
30-05-21																			