



Final Report

District of Houston

2023 Effluent Discharge Report (PE-287)



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APPENDICES

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ACKNOWLEDGEMENTS

Thank you to Craig Close and the operations staff for their assistance in the preparation of this report.



1.0 INTRODUCTION

The District of Houston wastewater treatment plant is authorized to discharge effluent to the Bulkley River under permit PE-287 issued by the BC Ministry of Environment and Climate Change Strategy (ENV). A copy of the permit can be found in Appendix A. The permit was first issued in July, 1969 and was last amended in May, 2017. The permit indicates that the sewage treatment plant consists of:

- A sewage collection system;
- Two aerated lagoons (Cells 1 and 2);
- An alum addition system;
- A polishing lagoon (Cell 3);
- Chlorination and dechlorination facilities; and
- Outfall to the Bulkley River.

The site layout is shown in Figure 1.1.

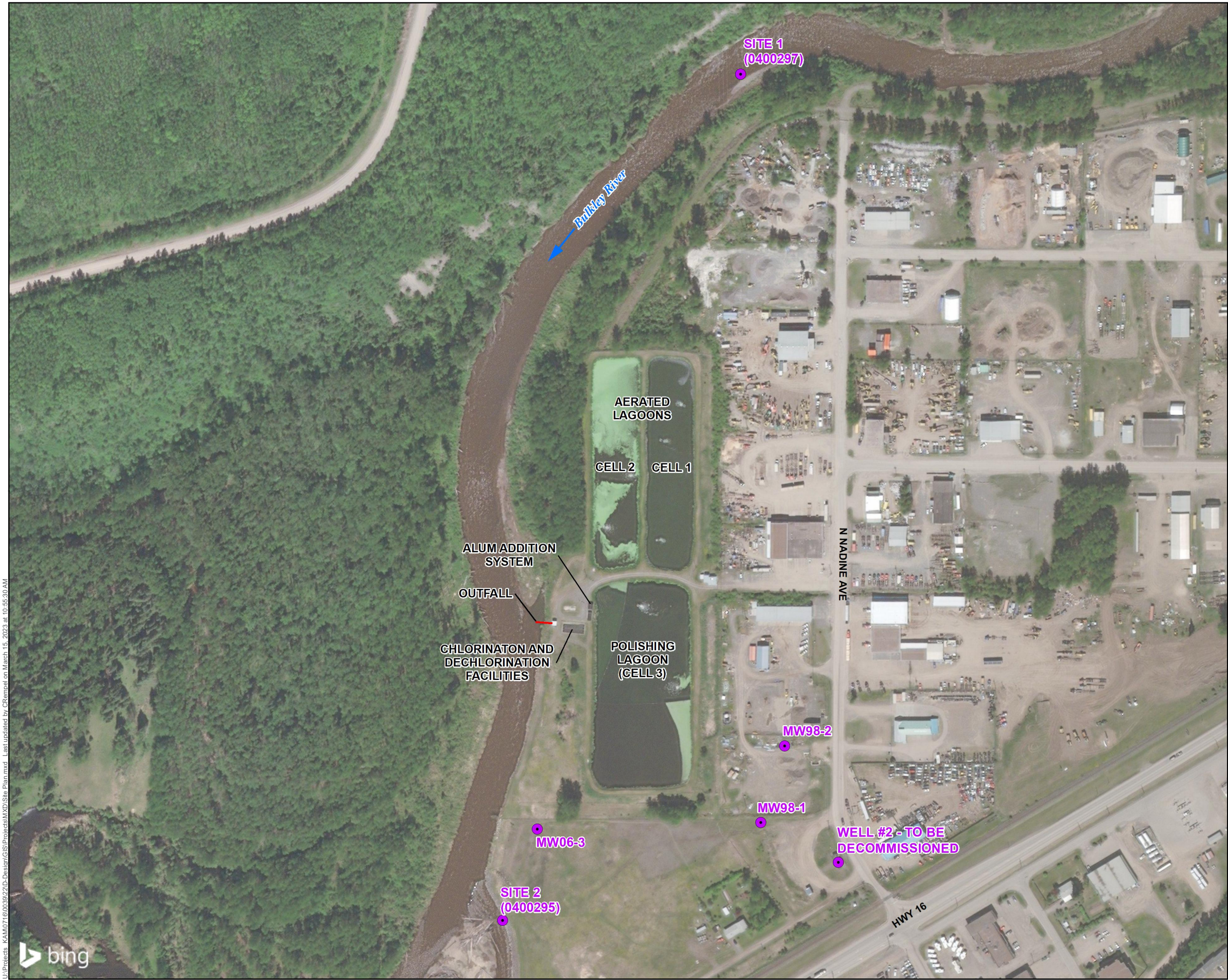
The following discharge conditions are required under this permit:

- Effluent discharge $\leq 3,200 \text{ m}^3/\text{day}$;
- 5-day biochemical oxygen demand (BOD_5) $\leq 30 \text{ mg/L}$;
- Total suspended solids (TSS) $\leq 40 \text{ mg/L}$;
- Orthophosphorus (from June 15th to October 31st annually) $\leq 1.0 \text{ mg/L}$; and
- Total chlorine residual 0 mg/L .

The permit indicates the requirement for an annual report, to be submitted to ENV before March 31st each year. This report is to include the following information:

- A summary of the results of all monitoring programs specified in the permit;
- Data interpretation and trend analysis; and
- Evaluation of the impacts of the discharge on the receiving environment in the previous year.

This document is intended to fulfill the annual report requirement.



District of Houston
Effluent Discharge Report

Wastewater Facilities
Site Plan

● Monitoring Locations

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.



Coordinate System: NAD 1983 BC Environment Albers
Scale: 1:3,250

Data Sources:
- Imagery provided by Bing.
- Monitoring locations based on coordinates provided by the District of Houston as well as previous mapping produced by AMEC Earth & Environmental in 2007.

Project #: 0716.0039.22
Author: CR
Checked:
Status:
Revision: A
Date: 2023 / 3 / 15



FIGURE 1.1

2.0 EFFLUENT MONITORING

2.1 Effluent Flow Rates

The monthly average flow data for 2023 are summarized in Figure 2.1, along with the flow data from the previous 3 years for comparison. In 2023, the annual average daily flow was 736 m³/d, with the minimum and maximum monthly flows being 463 m³/d (December) and 1,177 m³/d (May), respectively. The minimum, average, and maximum monthly flows for 2023 were lower than the corresponding minimum, average, and maximum monthly flows for both 2021 and 2022. The average and maximum flows for 2023 were higher than the corresponding average and maximum flows for 2020. For 2020, 2021, and 2022, there was an increase in the flows during the spring, with a subsequent, but lower increase in flows during the fall and into the winter. In 2023, flows increased slightly in early winter, with a further increase in the spring; however, no subsequent increase occurred in the fall/winter. Given the timing of the high flows, it is reasonable to expect that the flow changes are related to inflow and infiltration, rather than an increase in the sanitary sewage flows.

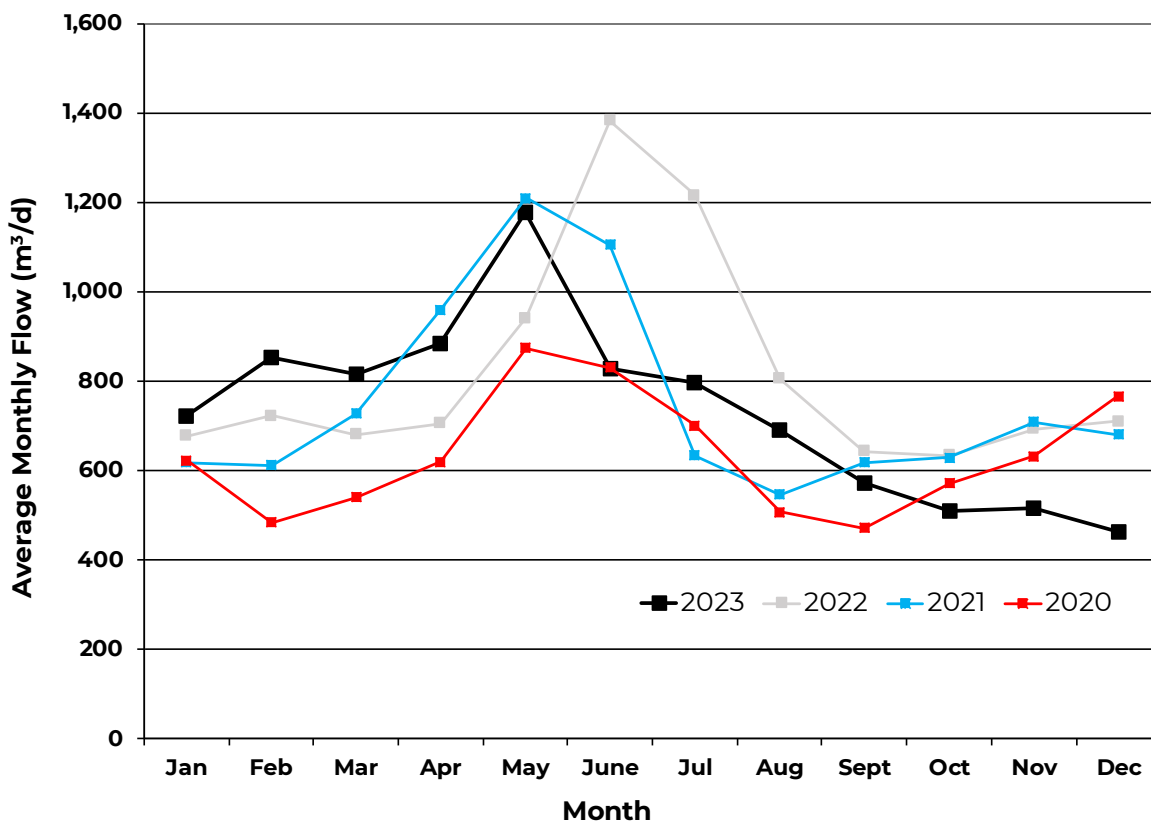


Figure 2.1. District of Houston Monthly Average Effluent Flow Summary



The maximum day flows for 2023 are summarized in Figure 2.2, along with the flows for the previous 3 years for comparison. In 2023, the maximum day flow was 1,665 m³/d (July 26th), which was lower than the maximum day flow for 2022 (1,702 m³/d) and 2021 (1,714 m³/d), but higher than the 2020 maximum day flow (1,648 m³/d). For all 4 years, the peak day flow occurred during the early spring/late summer, which would be reasonable to expect if the increase was related to inflow and infiltration as a result of factors such as snow melt, high groundwater, or precipitation. Should the flow increases be related to weather conditions, the magnitude of the flow increases will be a factor of the intensity of precipitation or snowmelt.

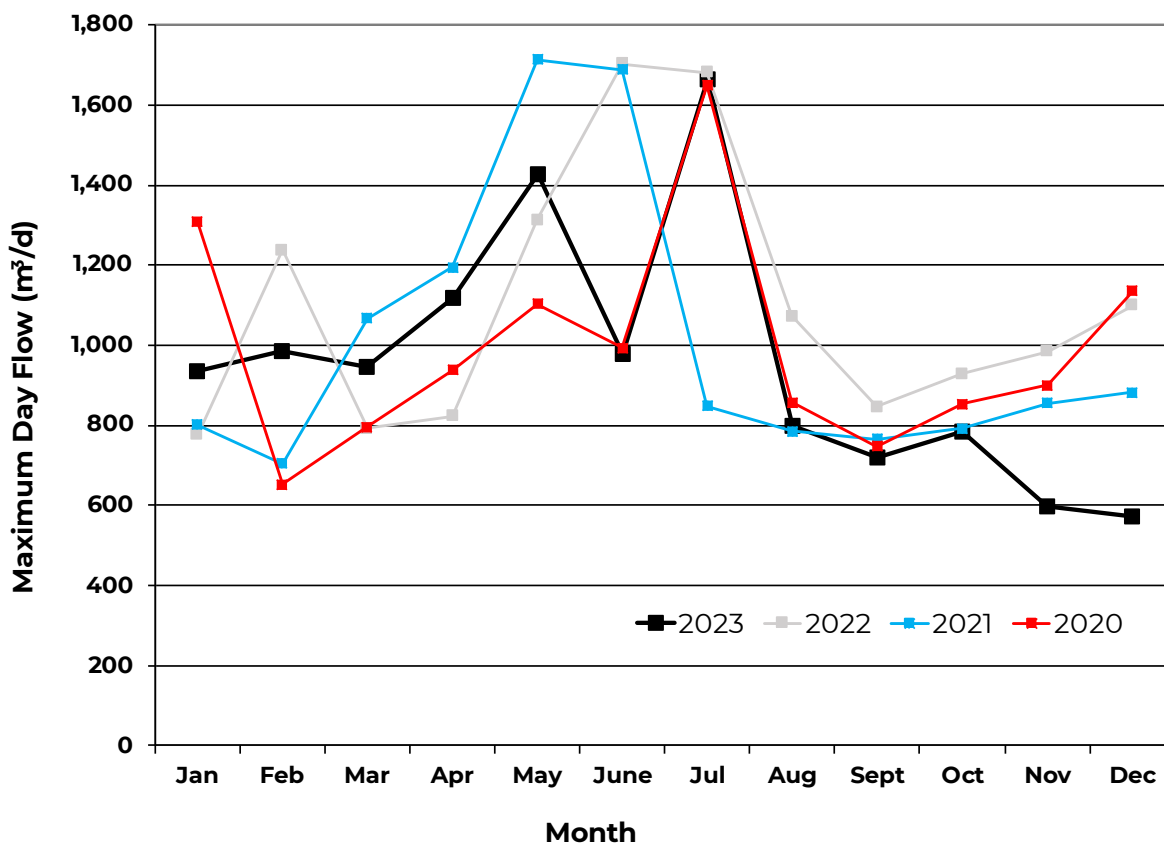


Figure 2.2. District of Houston Maximum Day Effluent Flow Summary

The permit indicates a maximum authorized rate of discharge is 3,200 m³/d. In 2023, there were no occasions when the discharge rate exceeded the maximum authorized flow.



2.2 Effluent Quality – Laboratory Analyses

2.2.1 Five-Day Biochemical Oxygen Demand (BOD₅)

Five-day biochemical oxygen demand (BOD₅) is one of the parameters regulated by the permit. Monitoring of the effluent BOD₅ concentration is required on a monthly basis. The BOD₅ data for 2023 are presented in Table 2.1. and represent a total of 12 data points. In 2023, the average BOD₅ concentration was 10.1 mg/L, and the highest BOD₅ concentration was 20.0 mg/L measured on July 5th. There was 1 occasion when the concentration was below the analytical detection limit (< 5.0 mg/L on September 6th). There were no occasions when the BOD₅ was higher than the permit requirement of BOD₅ ≤ 30 mg/L.

Table 2.1. District of Houston Effluent BOD₅ Concentrations (2023)

Date	BOD ₅ Concentration (mg/L)
January 11 th	11.0
February 8 th	11.0
March 22 nd	10.0
April 5 th	15.0
May 24 th	5.8
June 7 th	10.0
July 5 th	20.0
August 9 th	16.0
September 6 th	< 5.0
October 18 th	6.4
November 22 nd	4.9
December 13 th	8.3
Minimum	< 5.0
Average	10.1
Maximum	20.0

2.2.2 Total Suspended Solids (TSS)

Total suspended solids (TSS) is one of the parameters regulated by the permit. Monitoring of the effluent TSS concentration is required on a monthly basis. The TSS data for 2023 are presented in Table 2.2. and represent a total of 12 data points. In 2023, the average effluent TSS concentration was 7.8 mg/L, and the maximum TSS concentration was 17.0 mg/L (July 5th). There was 1 occasion when the effluent TSS concentration was below the analytical detection limit (< 1.0 mg/L on October 18th). The data presented in the table below indicate that the effluent was in compliance with the requirements of the permit (TSS ≤ 40 mg/L).



Table 2.2. District of Houston Effluent TSS Concentrations (2023)

Date	TSS Concentration (mg/L)
January 11 th	7.2
February 8 th	9.9
March 22 nd	13.0
April 5 th	11.0
May 24 th	2.8
June 7 th	6.8
July 5 th	17.0
August 9 th	7.3
September 6 th	3.0
October 18 th	< 1.0
November 22 nd	8.6
December 13 th	6.5
Minimum	< 1.0
Average	7.8
Maximum	17.0

2.2.3 Orthophosphorus

Monitoring of the effluent orthophosphorus concentration is required on a monthly basis and is regulated by the permit. The data for 2023 are summarized in Table 2.3 and represent a total of 12 data points. The average concentration of orthophosphorus in the effluent was 2.9 mg/L, and the maximum concentration was 5.3 mg/L (January 11th). The lowest concentrations were measured in July through to October, which is expected as this is when phosphorus treatment is required.

The permit requires the effluent orthophosphorus concentration to be ≤ 1.0 mg/L during the period from June 15th to October 31st. For the samples collected during this time period, there was 1 occasion when the effluent orthophosphorus concentration exceeded 1.0 mg/L (1.6 mg/L on October 18th). The compliance report for the data point can be found in Appendix B.



Table 2.3. District of Houston Effluent Orthophosphorus Concentrations (2023)

Date	Orthophosphorus Concentration (mg/L)
January 11 th	5.3
February 8 th	4.6
March 22 nd	4.4
April 5 th	5.0
May 24 th	2.8
June 7 th	2.1
July 5 th	0.95
August 9 th	0.57
September 6 th	0.33
October 18 th	1.6
November 22 nd	3.5
December 13 th	4.2
Minimum	0.33
Average	2.9
Maximum	5.3

2.2.4 Total Chlorine Residual

Monitoring of the effluent total chlorine residual concentration is required on a monthly basis according to the permit; however, the District completes this monitoring on a daily basis (standard work week) as part of the site operational practices. The data presented in Table 2.4 focus on the dates where the District collected samples for laboratory analysis, resulting in a total of 12 data points. The permit requires the samples to be taken from the outlet of the dechlorination chamber and the total chlorine residual must be 0 mg/L (i.e., complete dechlorination is required). The 2023 data are presented in Table 2.4 and indicate that the total chlorine residual concentration was not detectable throughout the year. Therefore, the data indicate that the effluent total chlorine residual was in compliance with the permit.



Table 2.4. District of Houston Total Chlorine Residual Effluent Concentrations (2023)

Date	Total Chlorine Residual Concentration (mg/L)
January 11 th	0
February 8 th	0
March 22 nd	0
April 5 th	0
May 24 th	0
June 7 th	0
July 5 th	0
August 9 th	0
September 6 th	0
October 18 th	0
November 22 nd	0
December 13 th	0

2.2.5 Nitrogen

Under the permit, monitoring for nitrogen is required monthly for the following parameters: ammonia, nitrate, and nitrite. There are no effluent quality requirements for nitrogen parameters indicated in the permit. The data for the nitrogen monitoring events are summarized in Table 2.5, and represent a total of 12 data points. Where data were below the analytical detection limit, half the detection limit was used to calculate the average concentration.

Focusing on these three parameters, ammonia was the predominant form of nitrogen in the effluent throughout 2023, with low concentrations of nitrate and nitrite. The average concentration of ammonia was 30.1 mg/L, with a maximum concentration of 45.0 mg/L (January 11th). The concentration of ammonia decreased in the September/October window, but there was no significant corresponding increase in the nitrate concentration. Therefore, it is likely that any decrease in the ammonia concentration was related to factors such as microbial/algal uptake. The consistently low concentrations of nitrate and nitrite indicate that if nitrification was occurring, then the rate was limited. A lack of nitrification is expected as the lagoons are not designed to nitrify, so there is no ability to control the onset or cessation of biological ammonia treatment. The average concentration of nitrate was 0.66 mg/L, with a maximum concentration of 1.40 mg/L (December 13th). There were no occasions in 2023 when the nitrate concentration was reported below the laboratory analytical limit (0.01 mg/L). The average concentration of nitrite in the effluent was 0.19 mg/L, and the maximum nitrite concentration was 0.88 mg/L (August 9th). For nitrite, there were 3 occasions in 2023 when the concentration was reported below the laboratory analytical detection limit of 0.01 mg/L.



Table 2.5. District of Houston Effluent Nitrogen Concentrations (2023)

Date	Concentration (mg/L)		
	Ammonia	Nitrate	Nitrite
January 11 th	45.0	0.053	0.02
February 8 th	39.3	0.085	< 0.01
March 22 nd	39.3	0.67	< 0.01
April 5 th	37.3	0.019	< 0.01
May 24 th	28.7	0.35	0.27
June 7 th	29.5	0.34	0.09
July 5 th	21.9	1.30	0.28
August 9 th	22.6	0.69	0.88
September 6 th	8.63	1.10	0.51
October 18 th	15.0	0.55	0.07
November 22 nd	35.9	1.30	0.05
December 13 th	38.4	1.40	0.05
Minimum	8.63	0.019	< 0.01
Average	30.1	0.655	0.19
Maximum	45.0	1.40	0.88

2.2.6 *E. coli*

Under the permit, monitoring for *E. coli* is required monthly. There are no quality requirements for *E. coli* indicated in the permit. The effluent *E. coli* concentrations for 2023 are summarized in Table 2.6 and represent a total of 12 data points. In 2023, a high level of disinfection was achieved throughout the year, with 7 data points being reported as below the laboratory analytical detection limit of 2 MPN/100 mL. On 1 occasion, the concentration was reported below the laboratory analytical detection limit of 20 MPN/100 mL. For the occasions when a detectable concentration was reported, these concentrations were considered to be low and representative of an effluent in which disinfection had occurred.



Table 2.6. District of Houston Effluent *E. coli* Concentrations (2023)

Date	<i>E. coli</i> Concentration (MPN/100 mL)
January 11 th	<2
February 8 th	< 2
March 22 nd	2
April 5 th	< 2
May 24 th	< 2
June 7 th	7
July 5 th	31
August 9 th	8
September 6 th	< 20
October 18 th	< 2
November 22 nd	< 2
December 13 th	< 2
Minimum	< 2
Average	5
Maximum	31

2.2.7 Dissolved Metals and Hardness

Under the permit, sampling of the following parameters is required on a monthly basis: hardness, dissolved aluminium, dissolved calcium, and dissolved magnesium. There are no quality requirements in the permit for these parameters. The data for hardness and dissolved metals are summarized in Table 2.7. There were duplicate analyses for the hardness data reported on January 11th and February 8th, and therefore, the hardness data for these dates represent average concentrations.

The average hardness was 206 mg/L, with a maximum hardness of 225 mg/L (October 18th). For the concentrations of dissolved metals, dissolved calcium and dissolved magnesium were present in higher concentrations than dissolved aluminium. The average concentration of dissolved calcium was 44.0 mg/L, with a maximum concentration of 50.4 mg/L (November 22nd). The average concentration of dissolved magnesium was 23.4 mg/L, with a maximum concentration of 27.3 mg/L (January 11th). The average concentration of dissolved aluminium was 0.129 mg/L, with a maximum concentration of 0.464 mg/L (June 7th).



Table 2.7. District of Houston Effluent Dissolved Metals and Hardness Concentrations (2023)

Date	Concentration (mg/L)			
	Hardness (as CaCO ₃)	Aluminium	Calcium	Magnesium
January 11 th	220 ¹	0.0128	41.4	27.3
February 8 th	210 ¹	0.0153	47.1	24.8
March 22 nd	200	0.0117	43.0	24.2
April 5 th	188	0.0100	36.4	22.3
May 24 th	186	0.341	40.7	20.5
June 7 th	206	0.464	43.6	23.5
July 5 th	186	0.259	39.4	21.3
August 9 th	207	0.246	45.0	22.9
September 6 th	206	0.138	45.2	22.6
October 18 th	225	0.0356	49.6	24.6
November 22 nd	217	0.0101	50.4	22.1
December 13 th	219	0.0085	46.7	24.8
Minimum	186	0.0085	36.4	20.5
Average	206	0.129	44.0	23.4
Maximum	225	0.464	50.4	27.3

¹ Represents the average hardness.

2.3 Effluent Quality – Field Measurements

Under the permit, monitoring of pH, temperature, dissolved oxygen, and specific conductance is required on a monthly basis, with all data to be representative of field testing. There is no requirement for effluent pH, temperature, dissolved oxygen or specific conductance in the permit. The data for 2023 are summarized in Table 2.8, and represent a total of 12 data points.

In 2023, the effluent pH was in the neutral range (average pH 7.31), with minimum and maximum values of 6.74 (October 18th) and 7.80 (July 5th), respectively.



Table 2.8. District of Houston Effluent Field Data (2023)

Date	Parameter			
	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductance (S/cm)
January 11 th	7.73	2.7	3.41	1.224
February 8 th	7.34	1.2	3.73	1.105
March 22 nd	7.40	1.3	3.03	1.099
April 5 th	7.34	1.2	3.17	1.035
May 24 th	7.72	17.4	3.01	0.962
June 7 th	7.00	15.6	5.62	0.976
July 5 th	7.80	19.7	4.90	0.904
August 9 th	7.03	20.4	7.40	0.997
September 6 th	6.82	15.1	5.12	0.917
October 18 th	6.74	8.1	5.33	0.911
November 22 nd	7.60	3.5	8.50	1.088
December 13 th	7.20	4.0	10.71	1.150
Minimum	6.74	1.2	3.01	0.904
Average	7.31	9.2	5.33	1.031
Maximum	7.80	20.4	10.71	1.224

The temperature fluctuated according to the ambient air conditions, with the lowest temperatures (minimum of 1.2 °C) being measured during the winter/early spring months and the highest temperatures (maximum of 20.4 °C) being measured during the summer months.

The dissolved oxygen concentration ranged from 3.01 mg/L (May 24th) to 10.71 mg/L (December 13th). The dissolved oxygen concentration can be influenced by factors such as sampling technique, sample location, and ambient air temperatures. The concentrations recorded, along with the correlating effluent BOD₅ concentrations, are indicative of sufficient air to support aerobic biological activity.

The average specific conductance was 1.031 S/cm, with a minimum measurement of 0.904 S/cm (July 5th) and a maximum measurement of 1.224 S/cm (January 11th). Conductivity is one parameter that is used to track the movement of effluent through the environment, as this parameter is not removed during domestic wastewater treatment. Fluctuations in the conductivity can occur and would be related to factors such as incoming sewage strength and dilution through inflow/infiltration.

3.0 RECEIVING ENVIRONMENT MONITORING – BULKLEY RIVER

According to the permit, monitoring of the receiving environment, the Bulkley River, is required on a monthly basis for the same parameters as the effluent, with the exception of total chlorine residual. The permit requires the receiving environment samples and effluent samples to be taken on the same day. There are two receiving environment monitoring sites: upstream 100 m of the outfall at the foot of Nadina Street from the left bank (Ministry site reference 0400297) and downstream 275 m of the outfall at the left of the bank of the stream (Ministry site reference 0400295). In 2023, receiving environment samples were taken on the same day as the effluent samples. The sections below review the upstream (U/S) and downstream (D/S) monitoring site data, including the potential for impacts as a result of the effluent release.

3.1 Dilution Ratios

In addition to the water quality monitoring, the permit requires that the District obtain weekly stream flow data for the Bulkley River at the Water Survey of Canada gauging station 08EE033, which is located approximately 4 km downstream of the outfall. Table 3.1 summarizes the estimated dilution ratio in the Bulkley River for 2023, based on data obtained by the District from the Water Survey of Canada gauging station 08EE033 and the effluent flow rates.

Table 3.1. Estimated Dilution Ratios – Bulkley River: Effluent (2023)

Month	Dilution Ratio (River: Effluent)		
	Minimum	Average	Maximum
January	546:1	688:1	1,022:1
February	417:1	542:1	629:1
March	498:1	702:1	816:1
April	259:1	689:1	1,683:1
May	968:1	4,474:1	10,735:1
June	234:1	483:1	1,026:1
July	53:1	122:1	222:1
August	27:1	82:1	147:1
September	15:1	29:1	67:1
October	75:1	228:1	879:1
November	167:1	278:1	360:1
December	213:1	335:1	494:1
Minimum	15:1	29:1	67:1
Average	268:1	668:1	1,396:1
Maximum	968:1	4,474:1	10,375:1

For 2023, the average dilution ratio was calculated to be 668:1, with the minimum (15:1) and maximum (10,375:1) dilution ratios being in the months of September and May, respectively. There has been an ongoing decrease in the available dilution potential from 2021 (average dilution of 1,661:1) to 2022 (average dilution ratio of 1,201:1), with a further decrease in 2023 (average dilution ratio of 668:1). The decrease in dilution potential is attributed to the generally low flow conditions throughout the year resulting from exceptionally dry weather conditions, with the exception of freshet flows. The highest dilution ratios occurred during the spring/early summer, corresponding with freshet, and the lowest dilution ratios occurred during the fall, which is typical for this site. However, the dilutions ratios during late August and into September 2023 were extremely low. The dilution ratio calculations are based on the assumption that there is complete mixing between the river and the effluent. The 40:1 minimum dilution ratio, which is a standard used in the BC Municipal Wastewater Regulation for secondary treated effluents, was not maintained on all occasions during 2023. There were 10 occasions recorded when the dilution ratio was below the 40:1 ratio, all of which occurred from the end of August into mid-September, based on the available river flow data. These occasions are summarized in Table 3.2 below, with the river flow and effluent flow rate included for reference.

Table 3.2. Estimated Dilution Ratios – Bulkley River: Effluent < 40:1 (2023)

Date	River Flow (m ³ /s)	River Flow (m ³ /d)	Effluent Flow (m ³ /d)	Dilution Ratio
August 28 th	0.222	19,181	678	28:1
August 30 th	0.215	18,576	677	27:1
September 1 st	0.163	14,083	651	32:1
September 5 th	0.116	10,022	573	17:1
September 6 th	0.124	10,714	720	15:1
September 8 th	0.121	10,454	600	17:1
September 13 th	0.195	16,848	695	24:1
September 15 th	0.129	11,146	622	18:1
September 19 th	0.114	9,850	583	17:1
September 21 st	0.195	16,848	617	27:1

As indicated in the table, the reduced dilution ratios corresponded predominantly with decreases in the river flow rate, not increases in the effluent flow rate. All effluent flows were below the annual average of 736 m³/d during this period.

To address dilution ratio issues, the District is currently assessing options with respect to maximizing effluent dilution and dispersion, which could include relocation of the outfall.

3.2 Receiving Environment Quality – Laboratory Analyses

3.2.1 Five-Day Biochemical Oxygen Demand (BOD₅)

Monitoring of BOD₅ in the receiving environment is required monthly. The upstream and downstream data for 2023 are summarized in Table 3.3, and represent a total of 12 data points. In 2023, for all 12 upstream and downstream data points, the BOD₅ concentration was reported below the laboratory analytical detection limit of 4 mg/L.

Table 3.3. BOD₅ Concentrations – Bulkley River (2023)

Date	BOD ₅ Concentration (mg/L)	
	Upstream	Downstream
January 11 th	< 4.0	< 4.0
February 8 th	< 4.0	< 4.0
March 22 nd	< 4.0	< 4.0
April 5 th	< 4.0	< 4.0
May 24 th	< 4.0	< 4.0
June 7 th	< 4.0	< 4.0
July 5 th	< 4.0	< 4.0
August 9 th	< 4.0	< 4.0
September 6 th	< 4.0	< 4.0
October 18 th	< 4.0	< 4.0
November 22 nd	< 4.0	< 4.0
December 13 th	< 4.0	< 4.0

There are no BC Water Quality Guidelines for BOD₅, but there are aquatic guidelines for dissolved oxygen, which is related to BOD₅. Comparison with guidelines will be included in the review of the dissolved oxygen data.

From the 2023 dataset for BOD₅, there is no indication that the effluent BOD₅ concentration had an influence on the river water quality.

3.2.2 Total Suspended Solids (TSS)

Monitoring of TSS in the receiving environment is required monthly. The upstream and downstream data for 2023 are summarized in Table 3.4, and represent a total of 12 data points. Where data were below the analytical detection limit, half the detection limit was used to calculate the average concentration.

Table 3.4. TSS Concentrations – Bulkley River (2023)

Date	TSS Concentrations (mg/L)	
	Upstream	Downstream
January 11 th	< 1.0	< 1.0
February 8 th	2.3	3.1
March 22 nd	1.0	68
April 5 th	1.7	1.9
May 24 th	7.7	18
June 7 th	1.6	1.7
July 5 th	< 1.0	<1.0
August 9 th	< 1.0	<1.0
September 6 th	< 1.0	1.1
October 18 th	< 1.0	2.4
November 22 nd	6.1	1.8
December 13 th	< 1.0	<1.0
Minimum	< 1.0	< 1.0
Average	2.0	8.3
Maximum	7.7	68.0

At both the upstream and downstream sites, the TSS concentration was low for most of the year. High TSS concentrations in the spring/early summer are typical due to elevated flows from the spring freshet scouring the river banks. The highest concentration at the upstream site was 7.7 mg/L on May 24th and the highest concentration at the downstream site was 68 mg/L, measured on March 22nd. The concentration of 7.7 mg/L at the upstream site is lower than expected for freshet conditions and is likely reflective of the drought-impacted low flows for 2023. There were 6 occasions at the upstream site and 4 occasions at the downstream site when the TSS concentration was below the analytical detection limit of 1.0 mg/L.

In 2023, there was 1 occasion when the TSS concentration was higher at the upstream site compared to the downstream site, and there were 7 occasions when the concentration was higher at the downstream site. There were 4 occasions when the concentrations were the same. Apart from March 22nd and May 24th, the data indicate no significant difference between the upstream and downstream data. It is expected that there was a sampling or laboratory error for the downstream data point for March 22nd, as there were no corresponding increases in the concentrations of the other parameters analyzed for this date.



There are BC Water Quality Guidelines for TSS. Focusing on the fisheries guidelines, the guideline is based on an acceptable increase in TSS over the background concentration, with the conditions for clear water being different to turbid water. For the data where there was an increase at the downstream site, there was 1 occasion when the increase was above the guideline range (March 22nd). As mentioned, it is expected that there was a sampling or laboratory error for the downstream data point for March 22nd, as there were no corresponding increases in the concentrations of the other parameters analyzed for this date. Given the low TSS concentration in the effluent for this date (13.0 mg/L), it is reasonable to assume that the downstream increase was not related to the effluent release, but was a factor of sampling or analytical factors.

Given the lack of consistent variability in the river TSS concentrations and the low effluent TSS concentrations, there is no clear indication of an impact to the downstream TSS concentration as a result of effluent release.

3.2.3 Orthophosphorus

Monitoring of orthophosphorus in the receiving environment is required monthly. The upstream and downstream data for 2023 are summarized in Table 3.5, and represent a total of 12 data points.

Table 3.5. Orthophosphorus Concentrations – Bulkley River (2023)

Date	Orthophosphorus Concentration (mg/L)	
	Upstream	Downstream
January 11 th	< 0.05	0.26
February 8 th	< 0.05	0.06
March 22 nd	0.25	0.36
April 5 th	< 0.05	0.10
May 24 th	< 0.05	< 0.05
June 7 th	< 0.05	< 0.05
July 5 th	< 0.05	< 0.05
August 9 th	< 0.05	< 0.05
September 6 th	< 0.05	< 0.05
October 18 th	< 0.05	< 0.05
November 22 nd	0.49	0.09
December 13 th	< 0.05	0.12

In 2023, the orthophosphorus concentration was reported below the analytical detection limit for 10 of the upstream data points and 6 of the downstream data points. The analytical detection limit was 0.05 mg/L on all occasions. This detection limit is considered high for a natural waters in BC and a lower detection limit would be more appropriate when assessing the potential for impacts as a result of an effluent release. There are limitations with respect to laboratory availability and accessibility for this part of British Columbia. The District has reviewed the laboratory options, and the preferred approach is to continue to send samples to the closer laboratory rather than increase this risk of having no accredited analyses as a result of missed holding times should the samples be sent to a larger laboratory located further away.

There was 1 occasion when the concentration was higher at the upstream site compared to the downstream site, 5 occasions when the concentration was higher downstream, and 6 occasions when the concentrations were the same. For the higher downstream events, the reported concentrations for February and April were close to the analytical detection limit, and the concentrations for January and March below the maximum background (upstream) concentration of 0.49 mg/L (recorded in November). There were no occasions during the period from June 15th to October 31st when the river concentrations upstream or downstream of the outfall were above the analytical detection limit, with alum dosing resulting in reduced effluent orthophosphorus concentrations. While there are no apparent impacts to the downstream river concentrations during phosphorus treatment, the data for the winter and early spring suggest a potential influence from the effluent release, though the significance of the difference between concentrations is questionable given laboratory and field variability.

There are no BC Water Quality Guidelines for phosphorus, but there are aquatic and recreational use guidelines for algal growth, which can be influenced by the presence of phosphorus. There are no data or photographs available for algal growth during the monitoring events.

3.2.4 Nitrogen

Monitoring of ammonia, nitrate, and nitrite in the receiving environment is required monthly. The upstream and downstream data for 2023 are summarized in Table 3.6, and represent a total of 12 data points. For data which were below the analytical detection limit, half the detection limit was used to calculate the average concentrations.

For ammonia, which was the predominant form of nitrogen in the effluent, the highest concentration at the upstream site was 0.08 mg/L (April 5th) and the highest concentration at the downstream site was 0.95 mg/L (March 22nd). On all occasions the ammonia concentrations were higher at the downstream site compared to the upstream site. The upstream ammonia concentration was reported as below the laboratory analytical detection limit of 0.03 mg/L for 3 events. There were no occasions when the concentration was reported as below the detection limit at the downstream site. The data suggest there is a trend of higher concentrations downstream, with the increase being lowest during the freshet. The highest downstream concentrations occurred during the beginning of 2023, during the winter and early spring. The possible influence of the effluent release on the downstream ammonia concentrations was also observed previously in 2020, 2021, and 2022.

For nitrate, the highest concentration at the upstream site was 0.690 mg/L (May 24th) and the highest concentration downstream site was 0.260 mg/L (March 22nd). There were 5 occasions when the nitrate

concentration was higher upstream, and 7 occasions when the concentration was higher downstream. There were 3 occasions at the upstream site when the nitrate concentration was reported below the analytical detection limit of 0.01 mg/L. Nitrate was only present in the effluent in trace amounts, so a direct correlation between the downstream concentration and the effluent release is questionable; however, there may be an indirect correlation between the downstream concentration and the effluent through the biological conversion of ammonia to nitrate in the river.

For nitrite, which is an unstable intermediate compound, apart from 1 case at the downstream site (September 7th), all concentrations at both the upstream and downstream sites were reported below the analytical detection limit of 0.01 mg/L.

Table 3.6. Nitrogen Summary – Bulkley River (2023)

Date	Ammonia (mg/L)		Nitrate (mg/L)		Nitrite (mg/L)	
	U/S	D/S	U/S	D/S	U/S	D/S
January 11 th	0.03	0.78	0.13	0.11	< 0.01	< 0.01
February 8 th	0.04	0.87	0.090	0.10	< 0.01	< 0.01
March 22 nd	0.05	0.95	0.24	0.26	< 0.01	< 0.01
April 5 th	0.08	0.36	0.062	0.066	< 0.01	< 0.01
May 24 th	< 0.03	0.07	0.69	0.030	< 0.01	< 0.01
June 7 th	0.04	0.11	0.014	0.011	< 0.01	< 0.01
July 5 th	0.05	0.32	< 0.01	0.032	< 0.01	< 0.01
August 9 th	< 0.03	0.27	< 0.01	0.031	< 0.01	< 0.01
September 6 th	< 0.03	0.59	0.018	0.092	< 0.01	0.02
October 18 th	0.03	0.25	< 0.01	0.023	< 0.01	< 0.01
November 22 nd	0.04	0.25	0.017	0.013	< 0.01	< 0.01
December 13 th	0.03	0.24	0.082	0.020	< 0.01	< 0.01
Minimum	< 0.03	0.07	< 0.01	0.011	< 0.01	< 0.01
Average	0.04	0.42	0.11	0.066	< 0.01	0.006
Maximum	0.08	0.95	0.69	0.26	< 0.01	0.02

There are BC Water Quality Guidelines for ammonia, nitrate and nitrite. Focusing on the fisheries guidelines which are the most stringent, the guideline for ammonia varies depending on the temperature and pH, and relates to both acute (short-term) and chronic (long-term) effects. Table 3.7 below summarizes the outcome of each monitoring event for the upstream and downstream sites with respect to the acute (maximum) and chronic (average) toxicity. The chronic guideline is intended to represent the average concentration of 5 samples taken on a weekly basis within a 30 day period, not a



single grab sample, which is the case for the District data. Apart from 1 occasion at the downstream site, when the single sample concentration (0.87 mg/L in February) was above the chronic guideline, all data were below acute guidelines. The data indicate that there were no concerns with respect to either acute or chronic toxicity at either the upstream or downstream sites.

Table 3.7. Comparison of Bulkley River Ammonia Data with BC Water Quality Guidelines (2023)

Date	Temperature (°C)	pH	Ammonia (mg/L)	Aquatic Guideline (mg/L)
Upstream				
January 11 th	2.0	8.67	0.03	Maximum: 1.32 Average: 0.254
February 8 th	2.5	8.15	0.04	Maximum: 3.99 Average: 0.768
March 22 nd	2.1	8.19	0.05	Maximum: 4.04 Average: 0.777
April 5 th	2.2	8.22	0.08	Maximum: 4.04 Average: 0.777
May 24 th	11.6	7.94	< 0.03	Maximum: 6.88 Average: 1.32
June 7 th	11.5	6.92	0.04	Maximum: 21.4 Average: 1.81
July 5 th	17.4	7.04	0.05	Maximum: 19.5 Average: 1.53
August 9 th	17.3	7.63	<0.03	Maximum: 10.7 Average: 1.54
September 6 th	11.7	6.78	< 0.03	Maximum: 22.5 Average: 1.81
October 18 th	7.5	7.05	0.03	Maximum: 19.5 Average: 1.88
November 22 nd	2.5	7.75	0.04	Maximum: 8.88 Average: 1.71
December 13 th	1.5	7.70	0.03	Maximum: 10.5 Average: 2.03
Downstream				
January 11 th	0.9	7.36	0.78	Maximum: 16.0 Average: 2.05
February 8 th	0.9	8.16	0.87	Maximum: 4.09 Average: 0.788

Table 3.7. Comparison of Bulkley River Ammonia Data with BC Water Quality Guidelines (2023)
(continued...)

Date	Temperature (°C)	pH	Ammonia (mg/L)	Aquatic Guideline (mg/L)
Downstream (continued . . .)				
March 22 nd	0.6	7.93	0.95	Maximum: 7.71 Average: 1.48
April 5 th	1.9	7.92	0.36	Maximum: 7.60 Average: 1.46
May 24 th	10.9	7.83	0.07	Maximum: 8.18 Average: 1.57
June 7 th	11.5	6.97	0.11	Maximum: 20.2 Average: 1.81
July 5 th	17.3	6.95	0.32	Maximum: 19.5 Average: 1.53
August 9 th	16.7	7.54	0.27	Maximum: 12.2 Average: 1.54
September 6 th	12.5	6.58	0.59	Maximum: 24.1 Average: 1.80
October 18 th	7.8	7.08	0.25	Maximum: 19.5 Average: 1.88
November 22 nd	1.9	7.61	0.25	Maximum: 12.0 Average: 2.03
December 13 th	1.1	7.79	0.24	Maximum: 9.12 Average: 1.75

There are BC water quality guidelines for nitrate, with the guideline for the protection of aquatic life being the most stringent. The guidelines recommend a maximum nitrate concentration of 32.8 mg/L and an average nitrate concentration of 3.0 mg/L. The average concentration represents chronic toxicity and is based on 5 weekly samples collected within a 30-day period. The 2023 river data indicate that the acute (maximum) and chronic (average) guidelines were met for nitrate upstream and downstream of the outfall.

There are BC water quality guidelines for nitrite, with the guideline for the protection of aquatic life being the most stringent. These guidelines recommend a maximum nitrite concentration of 0.06 mg/L and an average concentration of 0.02 mg/L, for waters with low chloride concentrations, which is assumed for the Bulkley River. The average concentration represents chronic toxicity and is based on 5 weekly samples collected within a 30 day period. In 2023, there was 1 occasion (September 6th) when the nitrite



concentration was equivalent to the chronic guideline; however, the data point represents a single sample. This is also the most stringent guideline, as there were no river chloride data available. Thus, the 2023 river data indicate that the acute (maximum) and chronic (average) guidelines were met for nitrite upstream and downstream of the outfall.

3.2.5 *E. coli*

Monitoring of *E. coli* in the receiving environment is required monthly. The upstream and downstream data for 2023 are summarized in Table 3.8, and represent a total of 12 data points. In 2023, there was 1 occasion (December 13th) when the *E. coli* concentration was reported as below the analytical detection limit of 2 MPN/100 mL at both sites.

Table 3.8. *E. coli* Concentrations – Bulkley River (2023)

Date	<i>E. coli</i> Concentration (MPN/100 mL)	
	Upstream	Downstream
January 11 th	8	2
February 8 th	23	4
March 22 nd	4	2
April 5 th	33	110
May 24 th	70	27
June 7 th	110	49
July 5 th	22	23
August 9 th	49	79
September 6 th	140	200
October 18 th	110	33
November 22 nd	13	2
December 13 th	<2	<2
Minimum	<2	<2
Average	49	44
Maximum	140	200
Geometric Mean	24	14

The *E. coli* concentration varied throughout the year, with the maximum concentration of 200 MPN/100 mL being measured at the downstream site on September 6th. This was also the date when the highest upstream concentration was reported (140 MPN/100 mL). In 2023, there were 7 occasions when the upstream concentration was higher than the downstream concentration and 4 occasions when the downstream concentration was higher than the upstream concentration. The data indicate a similarity

in *E. coli* concentrations at the two sites. Given the similarity in concentration at the upstream and downstream sites and the low effluent *E. coli* concentrations, there is no indication of a measurable impact on the downstream *E. coli* concentrations as a result of effluent release.

For *E. coli*, there are BC water quality guidelines for primary contact recreational use. The guideline indicates that the maximum *E. coli* concentration should be ≤ 200 counts/100 mL as a geometric mean of at least 5 samples, and ≤ 400 counts/100 mL as a maximum of any single sample. The geometric mean at the upstream site was 24 MPN/100 mL and the geometric mean at the downstream site was 14 MPN/100 mL. The maximum single sample *E. coli* concentration was 200 MPN/100 mL, measured at the downstream site. Therefore, there were no occasions for the 2023 dataset when the *E. coli* concentration was higher than either of the guidelines for primary contact recreational uses.

3.2.6 Dissolved Metals and Hardness

Monitoring of hardness and the dissolved forms of aluminium, calcium and magnesium in the receiving environment is required monthly under the permit. The upstream and downstream data for 2023 are summarized in Table 3.9, and represent a total of 12 data points. There were duplicate analyses for the hardness data reported on January 11th and February 8th, and therefore, the hardness data represent the average concentrations for these dates.

Table 3.9. Dissolved Metals and Hardness Concentrations – Bulkley River (2023)

Date	Concentration (mg/L)			
	Hardness (as CaCO ₃)	Dissolved Aluminium	Dissolved Calcium	Dissolved Magnesium
Upstream				
January 11 th	103	0.0058	26.7	8.91
February 8 th	107	< 0.005	28.3	9.45
March 22 nd	106	0.0079	26.7	9.07
April 5 th	94.7	0.0128	21.4	8.29
May 24 th	56.7	0.0636	14.7	4.86
June 7 th	69.0	0.0253	18.1	5.78
July 5 th	84.0	0.0072	20.6	7.89
August 9 th	87.9	0.0057	22.0	8.00
September 6 th	101	0.0124	25.4	9.12
October 18 th	98.7	0.0107	25.2	8.67
November 22 nd	106	0.0112	28.1	8.68
December 13 th	103	< 0.005	26.8	8.77
Minimum	56.7	< 0.005	14.7	4.86
Average	93.0	0.0140	23.7	8.12
Maximum	107	0.0636	28.3	9.45

Table 3.9. Dissolved Metals and Hardness Concentrations – Bulkley River (2023) (continued...)

Date	Concentration (mg/L)			
	Hardness (as CaCO ₃)	Dissolved Aluminium	Dissolved Calcium	Dissolved Magnesium
Downstream				
January 11 th	103	0.0053	24.7	9.57
February 8 th	111	< 0.005	29.2	10.1
March 22 nd	107	0.0070	27.4	9.45
April 5 th	95.3	0.0132	21.9	8.45
May 24 th	52.3	0.0918	13.5	4.50
June 7 th	69.5	0.0318	18.3	5.80
July 5 th	86.9	0.0082	21.8	7.89
August 9 th	90.1	0.0094	22.5	8.26
September 6 th	114	0.0213	27.3	11.0
October 18 th	97.1	0.0128	24.9	8.47
November 22 nd	85.0	0.0197	22.3	7.10
December 13 th	91.8	0.0056	23.5	8.04
Minimum	52.3	< 0.005	13.5	4.50
Average	91.8	0.0191	23.1	8.22
Maximum	114	0.0918	29.2	11.0

In 2023, the hardness was similar at the upstream and downstream monitoring sites. At the upstream site, the average hardness was 93.0 mg/L, with a maximum hardness of 107 mg/L (February 8th). At the downstream site, the average hardness was 91.8 mg/L, with a maximum hardness of 114 mg/L (September 6th). There were 4 occasions when the upstream hardness was higher than the downstream hardness, there were 7 occasions when the downstream hardness was higher than the upstream hardness, and there was 1 occasion when the concentrations were the same. Given the similarity between the upstream and downstream concentrations and that the hardness of the effluent was in the order of 200 mg/L, there is no indication of any measurable impact on the downstream hardness due to the effluent release.

The concentrations of dissolved aluminium averaged 0.0140 mg/L (maximum of 0.0636 mg/L in May) at the upstream site and 0.0191 mg/L (maximum of 0.0918 mg/L in May) at the downstream site. There were 3 occasions in 2023 when the dissolved aluminium concentration was higher at the upstream site compared to the downstream site, 8 occasions when the concentration was higher at the downstream site, and 1 occasion when the concentrations were the same (below the analytical detection limit of 0.005 mg/L).



For dissolved calcium, the average concentration was 23.7 mg/L at the upstream site (maximum of 28.3 mg/L in February) and 23.1 mg/L at the downstream site (maximum of 29.2 mg/L in February). There was little difference between the upstream and downstream concentrations throughout the year.

The average concentrations of dissolved magnesium at the upstream and downstream sites were 8.12 mg/L and 8.22 mg/L, respectively. The maximum dissolved magnesium concentration at the upstream site was 9.45 mg/L, with 11.0 mg/L recorded at the downstream site. There were 4 occasions when the upstream concentration was higher than the downstream concentration, there were 7 occasions when the downstream concentration was higher than the upstream concentration, and 1 occasion when the concentrations were the same.

Overall, based on the similarity between the upstream and downstream data for aluminium, calcium and magnesium, there is no indication of a downstream impact to water quality as a result of effluent release.

There are no BC water quality guidelines for dissolved aluminium, but there are guidelines for total aluminum that are based on site-specific water chemistry (pH, dissolved organic carbon (DOC), and hardness). There are also no aquatic life guidelines for hardness, calcium, or magnesium. However, hardness, or the concentration of calcium and magnesium ions, is known to ameliorate the effect of certain metals on aquatic organisms.

3.3 Receiving Environment Quality - Field Measurements

Monitoring of pH, temperature, dissolved oxygen, and specific conductance was completed monthly, as required in the permit. The upstream and downstream data for 2023 are summarized in Table 3.10, and represent a total of 12 data points. There are BC water quality guidelines for the protection of aquatic life for pH, temperature, and dissolved oxygen, which are discussed below.

The BC water quality guidelines for pH indicate that the pH of the Bulkley River is expected to be within the 6.5 to 9 range. In 2023, the pH ranged from 6.78 to 8.67 at the upstream site, with an average pH of 7.67. At the downstream site, the average pH was 7.48, ranging from 6.58 to 8.16. Therefore, the pH upstream and downstream was within the aquatic life guidelines.

The BC water quality guidelines for temperature focus on specific fish species and the potential for temperature changes to occur. Temperatures were comparable at the upstream and downstream monitoring sites. The greatest temperature difference between the two sites was around 1.6 °C (February 8th), with the higher temperature being measured at the upstream site. Ambient air temperatures and the effect of sunlight/shading tend to have the greatest influence on water temperatures and temperature deviations.

For dissolved oxygen, BC water quality guidelines are based on life stages as buried embryo/alevin require a higher dissolved oxygen concentration than free-swimming aquatic life. The guidelines indicate minimum dissolved oxygen concentrations of 9 mg/L (instantaneous reading) and 11 mg/L (average over 30 days) for buried embryo/alevin and minimum concentrations of 5 mg/L (instantaneous reading) and 8 mg/L (average over 30 days) for other life stages. A comparison can be made with respect to the guideline instantaneous readings; however, since the District data represent grab samples taken once monthly, a direct comparison cannot be made with the guideline 30-day average concentrations. All data



were above the minimum concentration of 5 mg/L for all other life stages, regardless of the monitoring location. However, the minimum concentration of 9 mg/L for buried embryo/alevin was not met on 3 occasions at the upstream site (May 24th, July 5th, and September 6th) and on 2 occasions at the downstream site (July 5th and September 6th). For the average concentrations, it is reasonable to assume that while the concentration of 8 mg/L was likely met for most of the year at both locations, except during extreme warm weather months, this was likely not the case for the 11 mg/L guideline for buried embryo/alevin. The ability to meet the water quality guidelines for dissolved oxygen is likely more a factor of natural river conditions rather than being related to the effluent release.

Table 3.10. Bulkley River Field Data (2023)

Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductance (S/cm)
Upstream				
January 11 th	8.67	2.0	10.84	0.247
February 8 th	8.15	2.5	10.39	0.247
March 22 nd	8.19	2.1	10.89	0.223
April 5 th	8.22	2.2	11.86	0.225
May 24 th	7.94	11.6	8.25	0.135
June 7 th	6.92	11.5	9.75	0.195
July 5 th	7.04	17.4	8.63	0.216
August 9 th	7.63	17.3	9.09	0.217
September 6 th	6.78	11.7	7.94	0.262
October 18 th	7.05	7.5	10.17	0.211
November 22 nd	7.75	2.5	11.46	0.247
December 13 th	7.70	1.5	10.35	0.234
Minimum	6.78	1.5	7.94	0.135
Average	7.67	7.5	9.97	0.222
Maximum	8.67	17.4	11.86	0.262
Downstream				
January 11 th	7.36	0.9	10.16	0.262
February 8 th	8.16	0.9	10.76	0.251
March 22 nd	7.93	0.6	10.54	0.260
April 5 th	7.92	1.9	11.76	0.229
May 24 th	7.83	10.9	9.47	0.121
June 7 th	6.97	11.5	9.65	0.159



Table 3.10. Bulkley River Field Data (2023)

Date	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductance (S/cm)
Downstream (continued . . .)				
July 5 th	6.95	17.3	8.36	0.273
August 9 th	7.54	16.7	9.37	0.233
September 6 th	6.58	12.5	7.47	0.383
October 18 th	7.08	7.8	10.00	0.220
November 22 nd	7.61	1.9	12.26	0.198
December 13 th	7.79	1.1	10.66	0.218
Minimum	6.58	0.6	7.47	0.121
Average	7.48	7.0	10.04	0.234
Maximum	8.16	17.3	12.26	0.383

The river field data indicate a consistency between the conditions upstream and downstream of the District’s wastewater treatment plant outfall. Any differences between the upstream and downstream sites are more likely to be influenced by natural factors such as sunlight/shading and river currents than the effluent release.



4.0 GROUNDWATER MONITORING

The permit requires groundwater monitoring to identify potential environmental impacts related to the effluent release to the receiving environment, with the data analysis and evaluation to be included in the annual report. Monitoring of the groundwater is required due to the loss of wastewater to the ground from Cell #3 as a result of the limitations of the clay liner. The groundwater monitoring program was developed in 2021 and was implemented towards the end of 2022. Monitoring involves recording groundwater depth and sampling for several water quality parameters at 3 wells biannually, in the spring and fall. The monitoring wells are described below (please refer to Figure 1.1 for monitoring well locations):

- **MW98-1** (upper and lower) as a down-gradient well between Cell #3 and Well #2
- **MW98-2** (upper and lower) as a background well
- **MW06-3** as a down-gradient well between Cell #3 and the Bulkley River

MW98-1 is required to be monitored until Well #2, which is part of the District's potable water system, is decommissioned. Well #2 is used for emergency purposes only and is mandated under Northern Health Authority that a boil water advisory be issued if the well is used. Well #2 was not decommissioned in 2023.

The 2023 data from the groundwater monitoring program are summarized in Table 4.1 and represent samples taken on May 30th (May) and November 20th (Nov). The groundwater elevation data indicate that the direction of flow would be from MW98-2 towards MW98-1 and MW06-3.

The water quality data indicate a potential influence from the effluent on the ammonia concentration at MW06-3, with ammonia being present at concentrations that were higher than the background conditions during the spring and fall monitoring events. The ammonia concentrations in the groundwater at MW06-3 (4.98 mg/L and 5.26 mg/L for the respective spring and fall monitoring events) were significantly less than the effluent concentrations for the months of May and November (28.7 mg/L and 35.9 mg/L, respectively), with the decrease in ammonia likely being a factor of dilution with groundwater. At MW98-1 lower, the nitrate concentrations during the spring and fall were elevated over background concentrations, with nitrate concentrations at MW98-1 upper being lower than background concentrations. This is consistent with the identified loss of wastewater to the ground from Cell #3.

For the spring event, the orthophosphorus concentration at MW06-3 was higher than the background well, which was reported as being below the analytical detection limit. However, for the fall event the orthophosphorus concentration at the background well (MW98-2 upper) was higher than the orthophosphorus concentration recorded at MW06-3. While the conductivity at MW06-3 was higher compared to background for the fall monitoring event, the significance of the difference between the measurements is uncertain. In all cases, concentrations of *E. coli* were reported below the analytical detection limit.



Table 4.1: Groundwater Data Summary (2023)

Parameter	MW98-1 Lower		MW98-1 Upper		MW98-2 Lower		MW98-2 Upper		MW06-3	
	May	Nov	May	Nov	May	Nov	May	Nov	May	Nov
Groundwater Elevation (m)	587.28	586.56	587.28	586.56	587.40	586.83	587.40	586.83	586.23	586.12
Ammonia (mg/L)	0.04	<0.03	0.03	<0.03	0.05	<0.03	0.05	<0.03	4.98	5.26
Nitrate (mg/L)	0.650	0.759	0.007	0.012	0.145	0.152	0.040	0.050	<0.005	<0.005
Nitrite (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Orthophosphorus (mg/L)	<0.05	0.15	<0.05	0.10	<0.05	0.06	<0.05	0.36	0.20	0.32
E. coli (#/100 mL)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
pH	6.61	6.78	6.40	6.43	6.81	6.61	6.58	6.49	6.56	6.81
Temperature (°C)	7.8	10.0	8.0	8.1	6.4	9.2	7.8	7.4	6.8	7.8
Dissolved Oxygen (mg/L)	2.90	1.38	1.16	1.15	1.26	1.58	1.37	1.56	1.50	1.14
Conductivity (S/cm)	0.486	1.123	0.489	0.534	1.072	0.472	0.546	0.470	0.755	0.743

5.0 SUMMARY AND RECOMMENDATIONS

The information presented in this report is summarized below:

- In 2023, the average effluent flow was 736 m³/d, with a maximum day flow of 1,665 m³/d. There was a slight increase in the flows in the early winter, with a further increase in the spring. There were no occasions when the discharge rate exceeded the permit requirement of 3,200 m³/d.
- In 2023, the average effluent BOD₅ concentration was 10.1 mg/L, with a maximum concentration of 20.0 mg/L. There were no occasions when the effluent BOD₅ concentration was higher than the permit requirement of ≤ 30 mg/L.
- In 2023, the average effluent TSS concentration was 7.8 mg/L, with a maximum concentration of 17.0 mg/L. All data points were below the permit requirement of ≤ 40 mg/L.
- The lowest orthophosphorus concentrations occurred in the summer/early fall, as a result of the addition of alum to the treatment process. There was 1 occasion in 2023 when the effluent orthophosphorus concentration exceeded the permit requirement of ≤ 1.0 mg/L during the specified time period from June 15th to October 31st. The downstream river data indicate a low potential for the non-compliant effluent to have had an impact on river orthophosphorus concentrations, with the downstream river orthophosphorus concentration being reported below the analytical detection limit.
- For all samples in 2023, the total chlorine residual met the requirement of being reduced below the detection limit prior to effluent discharge.
- Ammonia was the predominant form of nitrogen in the effluent, with low concentrations of nitrate and nitrite.
- The effluent *E. coli* concentrations indicated that a high level of disinfection was achieved through the year, with most of the data points being below the detection limit.
- The average dilution ratio between the Bulkley River and the effluent was 668:1. There has been an ongoing decrease in the available dilution potential from 2021 to 2023, with the decrease in dilution potential attributed to the generally low flow conditions throughout the year resulting from exceptionally dry weather conditions. The lowest dilution ratio for 2023 was 15:1 in September. A minimum dilution ratio of 40:1 is a standard used in the BC Municipal Wastewater Regulation and was not maintained on 10 recorded occasions in 2023 for the period from the end of August to mid September. The maximum dilution ratio was 10,735:1 and occurred in May. To address dilution ratio issues, the District is currently assessing options with respect to maximizing effluent dilution and dispersion, which could include relocation of the outfall.
- With respect to upstream and downstream data, there is an indication of impacts as a result of the effluent release on orthophosphorus concentrations during the winter/early spring (i.e., when there is no phosphorus treatment) and ammonia concentrations. There is an on-going trend of increased downstream ammonia concentrations that has been observed in previous years. In 2023, there were no concerns with respect to the acute (maximum) or chronic (average) BC water quality guidelines for aquatic life and ammonia. However, the chronic guidelines are intended to be based on an



average over a 30 day period, which is not the case for this dataset. There were no concerns with respect to the recreational use guidelines or the other aquatic life guidelines and the effluent release.

- With respect to the groundwater, the potential influence of the effluent was observed for the groundwater at MW06-3, which is located between the lagoons and the river. At MW98-1 lower, which is located between the lagoon and Well #2, the nitrate concentrations were elevated over background concentrations.

Based on the data review, the following are recommended:

1. Consider taking photographs of the substrate at the upstream and downstream receiving monitoring sites for all events. This will help to evaluate if algae are present and if there are any differences in algal growth between the upstream and downstream locations.
2. Consider sampling river chloride concentrations along with nitrite to assess toxicity in relation to water quality guidelines.
3. If possible, review the analytical detection limits for the receiving environment samples, in case the local laboratory can complete these analyses at lower detection limits. Lower detection limits are typically used for receiving environment samples and provide additional information on the potential for changes between sites. Examples of suitable analytical detection limits are summarized below.

Ammonia	0.005 mg/L
Nitrate	0.005 mg/L
Orthophosphorus	0.003 mg/L



APPENDIX A

Permit PE-287



May 23, 2017

Tracking Number: 358934
Authorization Number: 287

REGISTERED MAIL

District of Houston
3367 12th Street
Box 370
Houston B.C. V0J 1Z0

Dear Permittee:

Enclosed is Amended Permit 287 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the Permit. An annual fee will be determined according to the Permit Fees Regulation.

This Permit does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the Permittee. This Permit is issued pursuant to the provisions of the *Environmental Management Act* to ensure compliance with Section 120(3) of that statute, which makes it an offence to discharge waste, from a prescribed industry or activity, without proper authorization. It is also the responsibility of the Permittee to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

The Director may require the Permittee to repair, alter, remove, improve or add to existing works, or to construct new works, and to submit plans and specifications for works specified in this authorization.

The Director may require the Permittee to conduct monitoring, and may specify procedures for monitoring and analysis, and procedures or requirements respecting the handling, treatment, transportation, discharge or storage of waste.

The Director may amend any requirements under this section, including requiring increased or decreased monitoring based on data submitted by the Permittee and any other data gathered in connection with this authorization.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30

Ministry of Environment

Environmental Protection Division
Regional Operations Branch
Authorizations - North

Mailing Address:
#325, 1011 – 4th Avenue
Prince George, BC V2L 3H9

Telephone: 250 565-6135
Facsimile: 250 565-6629
Website: www.gov.bc.ca/env

days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this Permit will be carried out by staff from the Environmental Protection Division's Regional Operations Branch. Plans, data and reports pertinent to the Permit are to be submitted by email or electronic transfer to the Director, designated Officer, or as further instructed.

Yours truly,

A handwritten signature in black ink, appearing to be 'D. Bings', with a large, stylized loop at the end.

Daniel P. Bings
for Director, *Environmental Management Act*
Authorizations - North

Enclosure

cc: Environment Canada



MINISTRY OF
ENVIRONMENT

PERMIT

287

Under the Provisions of the Environmental Management Act

DISTRICT OF HOUSTON
3367 12TH STREET
HOUSTON, BC
V0J 1Z0

is authorized to discharge effluent to the Bulkley River from a sewage treatment plant located in Houston, British Columbia, subject to the requirements listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may lead to prosecution.

This Permit supersedes and replaces all previous versions of Permit PE-287 issued under Section 14 of the *Environmental Management Act*.

Capitalized terms referred to in this authorization are defined in the attached Glossary. Other terms used in this authorization have the same meaning as those defined in the *Environmental Management Act* and applicable regulations.

Where this authorization provides that the Director may require an action to be carried out, the Permittee must carry out the action in accordance with the requirements of the Director.

1. AUTHORIZED DISCHARGE

1.1 Authorized Source

This section applies to the discharge of effluent from an aerated sewage lagoon system to the Bulkley River. The site reference number for this discharge is E103798.

- 1.1.1** The maximum authorized rate of discharge is 3,200 cubic metres per day.

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1.1.2 The characteristics of the discharge must be equivalent to or better than:

Biochemical Oxygen Demand **30 mg/L**

Total Suspended Solids (non-filterable residue) **40 mg/L**

Ortho-Phosphorus **1.0 mg/L**
(from June 15th to October 31st annually)

Total Chlorine Residual **0 mg/L**

1.1.3 The discharge is authorized from Authorized Works, which are a sewage collection system, two aerated lagoons (cells 1 and 2), an alum addition system, a polishing lagoon (cell 3), chlorination and dechlorination facilities, outfall into the Bulkley River and related appurtenances approximately located as shown on Site Plan A.

1.1.4 The location of the facilities from which the discharge is authorized to originate is the District of Houston.

The location of the point where the discharge is authorized to occur is District Lot 339, Range 5, Coast District.

2. GENERAL REQUIREMENTS

2.1 Maintenance of Works and Emergency Procedures

The Permittee must regularly inspect the Authorized Works and maintain them in good working order.

In the event of an emergency or condition beyond the control of the Permittee which prevents effective operation of the Authorized Works or leads to an unauthorized discharge, the Permittee must take remedial action to restore the effective operation of the Authorized Works and to prevent any unauthorized discharges. The Permittee must immediately report the emergency or condition and the remedial action that has and will be taken to the RAPP line (1-877-952-7277, #7272 from mobile phone) or electronically at this link: <http://www.env.gov.bc.ca/cos/rapp/form.htm>.

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The Director may require the Permittee to reduce or suspend operations until the Authorized Works have been restored, and/or corrective steps have been taken to prevent unauthorized discharges.

2.2 Bypasses

The Permittee must not allow any discharge authorized by this authorization to bypass the Authorized Works, except with the prior written approval of the Director.

2.3 Posting of Outfall

The Permittee must erect and maintain a sign along the alignment of the outfall above the high water mark. The sign must have lettering at least 100 millimetres and bear the words SEWAGE OUTFALL. The Permittee must confirm whether the wording and size of the sign is acceptable to the Director prior to installing the sign.

2.4 Chlorination

The Permittee must maintain a chlorine residual in effluent (at the point of discharge or prior to dechlorination) between **0.3** and **1.0 mg/L** at all times and provide not less than one hour's contact time at average flow rates.

2.5 Dechlorination

The Permittee must dechlorinate effluent prior to discharge to reduce the chlorine residual below detectable limits.

2.6 Lagoon Operation

The Permittee must operate the lagoon such that:

- a. there is no overflow from the lagoons to the surrounding environment; and
- b. surface drainage is diverted away from the lagoons.

The Permittee must dispose of any residue removed from the lagoons in a manner authorized by the Director, or as authorized by regulation under the *Environmental Management Act*.

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2.7 **Facility and Operator Classification**

The Permittee in a manner and on timelines specified by the Director must have the authorized works classified (and the classification must be maintained) by the Environmental Operators Certification Program Society (Society). The Permittee must cause the authorized works to be operated and maintained by:

- a) persons certified within and according to the program provided by the Society to the satisfaction of the Director, or
- b) persons who are qualified in the safe and proper operation of the facility for the protection of the environment, as demonstrated to the satisfaction of the Director.

The Permittee must notify the Director of the classification level of the facility and certification levels of the operators, and changes of operators and/or operator certification levels within 30 days of any change.

3. **MONITORING REQUIREMENTS**

3.1 **Sampling Procedures**

The Permittee must carry out sampling in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2013 Edition (Permittee)" or most recent edition, or by alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html.

3.2 **Analytical Procedures**

The Permittee must carry out analyses in accordance with procedures described in the "British Columbia Laboratory Manual (2015 Permittee Edition)", or the most recent edition or by alternative procedures as authorized by the Director.

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A copy of the above manual is available on the Ministry web page at
www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html.

3.3 Sampling

The Permittee must maintain a sampling facility and obtain a grab samples as outlined in Section 3.4. The Permittee must take due care in sampling, storing and transporting the samples to control temperature and avoid contamination, breakage, and any other factor or influence that may compromise the integrity of the samples.

3.4 Analyses

The Permittee must complete sampling of the effluent discharge and the receiving environment on the same day.

a. Effluent Monitoring

The Permittee must obtain a grab sample once each month at maximum flow from the outlet of the Dechlorination Chamber. The sample must be analyzed for the following parameters:

Laboratory Analyses:

• Hardness • 5-Day Biochemical Oxygen Demand (mg/L) • Total Suspended Solids (non-filterable residue) (mg/L) • Ortho-phosphorus (mg/L) • Ammonia (µmol/L) • Nitrate (mg/L)	• Nitrite (mg/L) • E. Coli (CFU/100 mL) • Dissolved Aluminum (mg/L) • Dissolved Calcium (mg/L) • Dissolved Magnesium (mg/L)
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Field Measurements:

• Dissolved Oxygen (mg/L) • Temperature (°C) • pH (pH units)	• Specific Conductance (S/cm) • Residual Chlorine (mg/L)
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b. Stream Flow Monitoring of the Bulkley River

The Permittee must obtain weekly stream flow data of the Bulkley River at the Water Survey of Canada Station No. 08EE033 which is located approximately four (4) kilometres downstream of the outfall. The method of flow measurement must be acceptable to the Director. Calculate the actual dilution ratios of stream flow rates to the discharge rate.

The Permittee must maintain stream flow and dilution data, suitably tabulated, for inspection by Ministry staff.

c. Receiving Environment Monitoring

The Permittee must obtain grab samples of receiving water from the Bulkley River at the following locations:

Site 1, located 100 metres upstream of the outfall at the foot of Nadina Street from the left bank (facing downstream). Ministry site reference number 0400297.

Site 2, located 275 metres downstream of the outfall at the left of the bank of the stream. Ministry site reference number 0400295.

The Permittee must analyze the Bulkley River receiving water samples for the following parameters:

Laboratory Analyses:

• Hardness • 5-Day Biochemical Oxygen Demand (mg/L) • Total Suspended Solids (non-filterable residue) (mg/L) • Ortho-phosphorus (mg/L) • Ammonia ($\mu\text{mol/L}$)	• Nitrite (mg/L) • E. Coli (CFU/100 mL) • Dissolved Aluminum (mg/L) • Dissolved Calcium (mg/L)
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• Nitrate (mg/L)	• Dissolved Magnesium (mg/L)
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Field Measurements:

• Dissolved Oxygen (mg/L)	• pH (pH units)
• Temperature (°C)	• Specific Conductance (S/cm)

3.5 Flow Measurement

The Permittee must maintain a, suitable to the Director, a flow measuring device, and record once per day the effluent volume discharged over the previous 24-hour period. On weekends and/or statutory holidays, an average daily flow may be calculated from the total flow occurring over the weekend and/or statutory holiday. The Permittee must retain the records for inspection by Ministry staff.

3.6 Groundwater Monitoring Program

The Permittee must cause a qualified professional to develop a monitoring program and identify potential environmental impacts of the discharge to the receiving environment. The Permittee must conduct a ground water monitoring program that is satisfactory to the Director. The Permittee must install and maintain ground water monitoring wells, with the numbers, locations and design and installation details that are satisfactory to the Director.

4. REPORTING

4.1 Annual Report

The Permittee must collect and maintain data of analyses and flow measurements required under this authorization for inspection when requested by Ministry staff and submit the data for the previous month to the Director in a form satisfactory to the Director. The Permittee must make data

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submissions within 30 days of the end of the applicable calendar year during which the monitoring was carried out.

The annual report must include a summary of the results of all monitoring programs as specified in this Permit, data interpretation and trend analyses, as well as an evaluation of the impacts of the discharge on the receiving environment in the previous year. This report is to be in a format which is suitable for review by the public or other government agencies. Annual reports must be submitted to the Director by March 31 for the previous calendar year.

The Permittee must submit all data required to be submitted under this section by email to the Ministry's Routine Environmental Reporting Submission Mailbox (RERSM) at EnvAuthorizationsReporting@gov.bc.ca or as otherwise instructed by the Director. For guidelines on how to properly name the files and email subject lines or for more information visit the Ministry website:

<http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/routine-environmental-reporting-submission-mailbox>

4.2 Non-compliance Notification

The Permittee must immediately notify the Director or designate by email EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the Director, of any non-compliance with the requirements of this authorization by the Permittee and take remedial action to remedy any effects of such non-compliance. The Permittee must provide the Director with written confirmation of all such non-compliance events, including available test results within 24 hours of the original notification, unless otherwise directed by the Director.

4.3 Non-compliance Reporting

If the Permittee fails to fully comply with the requirements of this authorization, the Permittee must, within 30 days of such non-compliance, submit to the Director a written report that is satisfactory to the Director and includes, but is not necessarily be limited to, the following:

- a. all relevant test results obtained by the Permittee related to the noncompliance,

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- b. an explanation of the most probable cause(s) of the noncompliance, and
- c. a description of remedial action planned and/or taken by the Permittee to prevent similar noncompliance(s) in the future.

The Permittee must submit all non-compliance reporting required to be submitted under this section by email to the Ministry's Compliance Reporting Submission Mailbox (CRSM) at EnvironmentalCompliance@gov.bc.ca, or as otherwise instructed by the Director.

For guidelines on how to report a noncompliance or for more information visit the Ministry website:

<http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/non-compliance-reporting-mailbox>

4.4 Non-compliance Reporting and Exceedances

The Permittee must cause each data submission required by this authorization to include a statement outlining the number of exceedances of Permitted discharges that occurred during the reporting period, the dates of each such exceedance, an explanation as to the cause of the exceedances, and a description of the measures taken by the Permittee to rectify the cause of each such exceedance. If no exceedances occurred over the reporting period, the required statement may instead indicate that no exceedance of Permitted discharges occurred during the reporting period.

4.5 Spill Reporting

The Permittee must immediately report all spills to the environment (as defined in the Spill Reporting Regulation) in accordance with the Spill Reporting Regulation, which among other things, requires notification to the Provincial Emergency Program at 1-800-663-3456.

LICENCE TO PUBLISH DOCUMENTS

- a. Subject to paragraph b, the Permittee authorizes the Province to publish on the Ministry of Environment website the entirety of any Regulatory Document.

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- b. The Province will not publish any information that could not, if it were subject to a request under section 5 of the Freedom of Information and Protection of Privacy Act, be disclosed under that Act.
- c. The Permittee will indemnify and save harmless the Province and the Province's employees and agents from any claim for infringement of copyright or other intellectual property rights that the Province or any of the Province's employees or agents may sustain, incur, suffer or be put to at any time that arise from the publication of a Regulatory Document.

GLOSSARY

“Authorized Works” are a sewage collection system, two aerated lagoons (cells 1 and 2), an alum addition system, a polishing lagoon (cell 3), chlorination and dechlorination facilities, outfall into the Bulkley River and related appurtenances as stated in Section 1.1.3.

“Facility” means a sewage treatment plant located in Houston, B.C.

“Province” means Her Majesty the Queen in right of British Columbia.

“Qualified Professional” means an applied scientist or technologist specializing in an applied science or technology applicable to the duty or function, including, if applicable and without limiting this, agrology, biology, chemistry, engineering, geology or hydrogeology and who

- i. is registered with the appropriate professional organization, is acting under that organization's code of ethics and is subject to disciplinary action by that organization, and
- ii. through suitable education, experience, accreditation and/or knowledge, may be reasonably relied on to provide advice within their area of expertise.

All documents submitted to the Director by a Qualified Professional must be signed by the author(s).

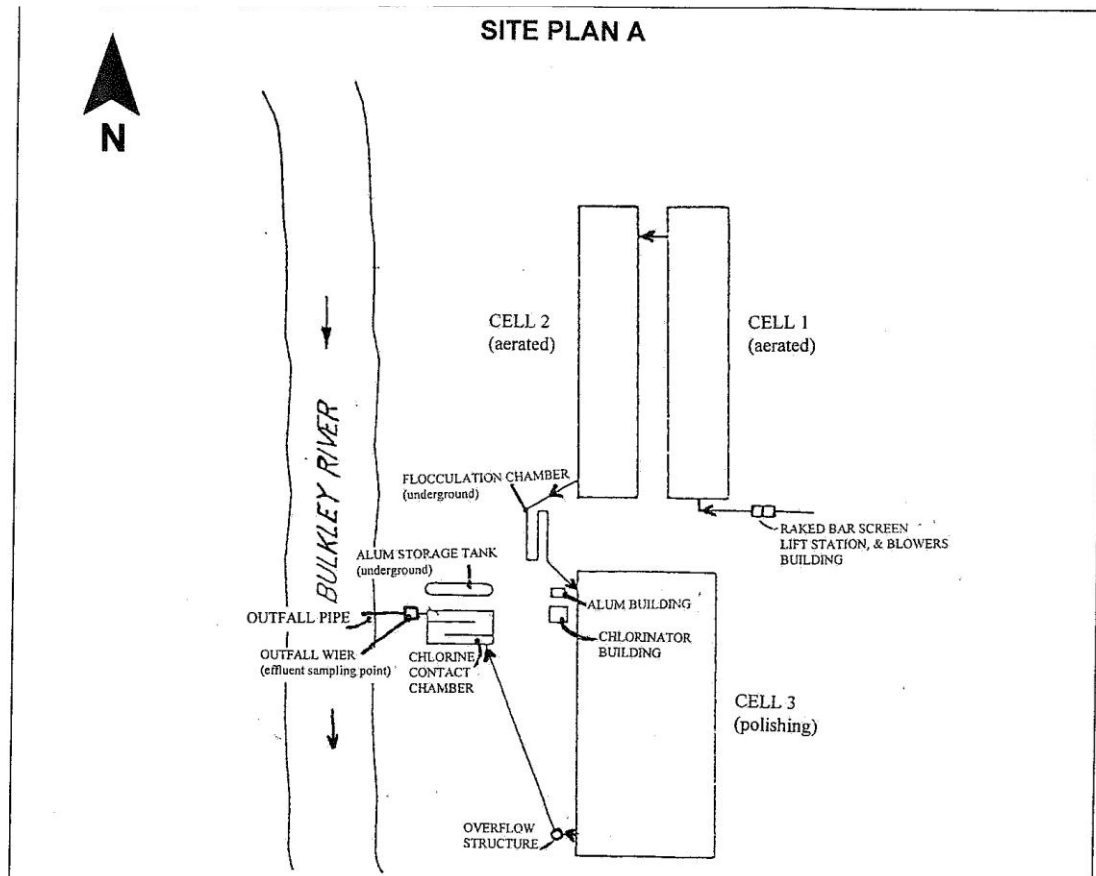
“Regulatory Document” means any document that the Permittee is required to provide to the Director or the Province pursuant to: (i) this authorization; (ii) any regulation made under the *Environmental Management Act* that regulates

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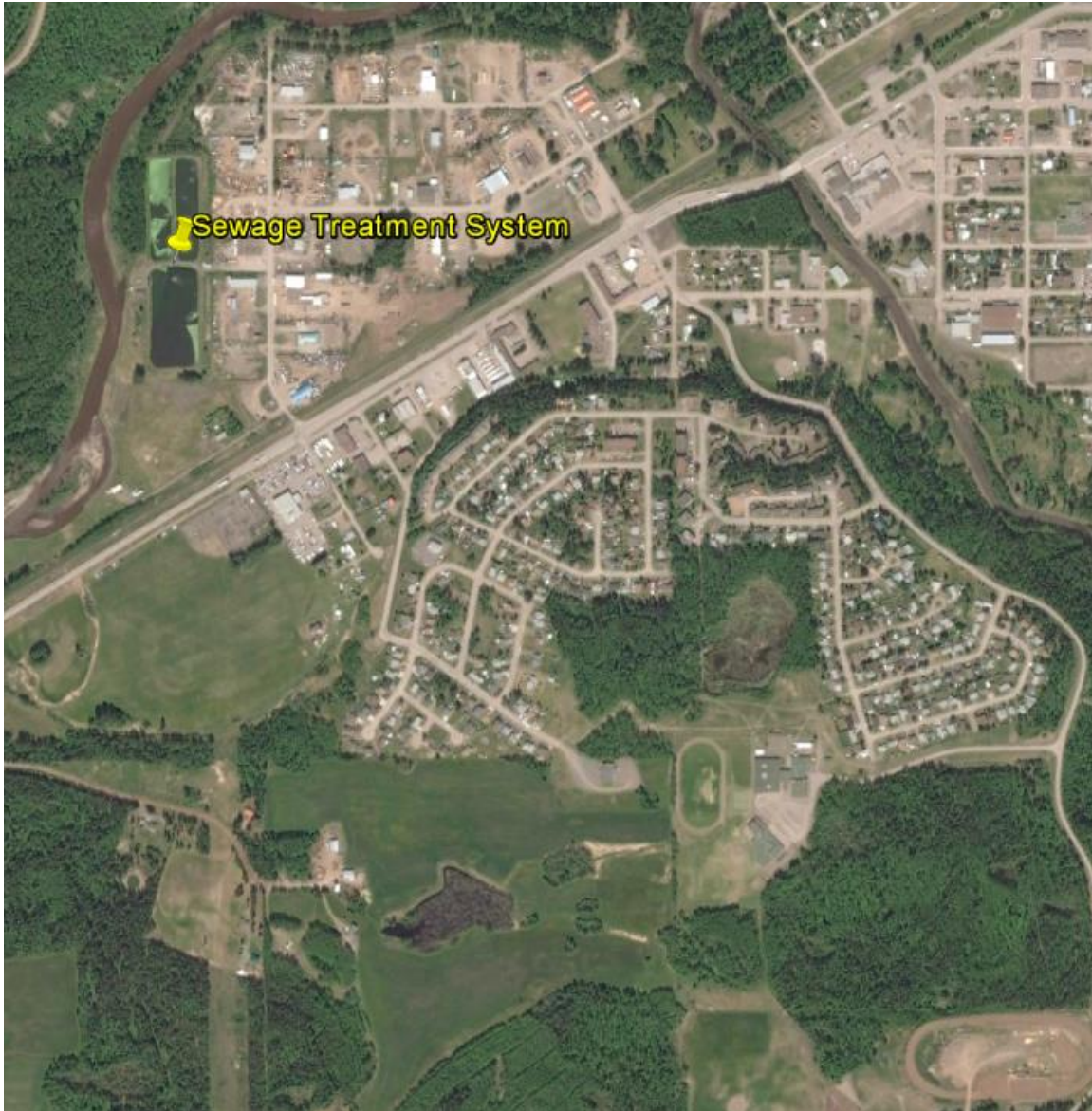
the facility described in this authorization or the discharge of waste from that facility; or (iii) any order issued under the *Environmental Management Act* directed against the Permittee that is related to the facility described in this authorization or the discharge of waste from that facility.



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LOCATION MAP



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APPENDIX B

Compliance Reports

**District of Houston**

3367 – 12th Street
Houston, BC V0J 1Z0
Ph: 250-845-2238
doh@houston.ca

Date: March 26, 2024

To: environmentalcompliance@gov.bc.ca

Subject: Compliance Report for #287 Orthophosphorus Exceedance

Attention: Compliance Report for Authorization #287. Effluent orthophosphorus exceeded permit requirements.

Date of Non-compliance: 2023-10-18:09:30

Location: District Lot 339 Range 5, Coast District. Adjacent to Bulkley River, Houston BC
Lat: 54.3936 Long: 126.6725

Nature of Non-Compliance:

Samples are collected once each month from the effluent and the Bulkley River (upstream and downstream locations). The permit requires that the effluent orthophosphorus concentration not exceed 1.0 mg/L from June 15th to October 31st. There was 1 occasion in 2023 when the effluent was above this permit requirement, as summarized in Table 1 below.

Table 1. Summary of Elevated Orthophosphorus Concentration

Date	Orthophosphorus Concentration (mg/L)
October 18 th	1.6

Initial Response:

The District was only aware that the analyses were above the permit maximum for orthophosphorus after receiving the laboratory report. As it can take up to a month from the time of sampling to receiving the laboratory report, there was no ability to resample within the same calendar month. This also delays the ability for the District to respond promptly, should effluent quality issues become apparent once the laboratory data are received.

The District takes a pro-active approach to comply with the permit orthophosphorus requirements. Due to the hydraulic retention time associated with the lagoons and the delay which can be observed between operational changes and the quality of the effluent being released, the District initiates alum dosing in April/May. Previous effluent data for July 5th, August 9th, and September 6th indicated that the orthophosphorus concentration of ≤ 1 mg/L was met and therefore, there was no indication of any concentration concerns.



District of Houston

3367 – 12th Street
Houston, BC V0J 1Z0
Ph: 250-845-2238
doh@houston.ca

The District also monitors phosphorus concentrations onsite with the data for October 18th indicating that the concentration was 0.90 mg/L, which is below the permit requirement.

Monitoring Conducted:

A range of different physical, chemical, and biological parameters are analysed for each month at the effluent and river locations. In addition to orthophosphorus, the following parameters are included in the analysis:

- BOD₅ and TSS
- Ammonia, nitrate, and nitrite
- *E. coli*
- Hardness and dissolved aluminium, calcium, and magnesium
- Dissolved oxygen
- Temperature
- pH
- Specific conductance
- Residual chlorine (effluent only)

On July 5th, August 9th, and September 6th, all other permitted parameters met the permit requirements. For downstream river samples taken on these dates and on October 18th, the orthophosphorus concentration was below the analytical detection limit of 0.05 mg/L. Therefore, there was a low risk to the Bulkley River as a result of the effluent orthophosphorus concentration being above the permit requirement.

Future Actions:

The District will continue to implement alum dosing in April/May, prior to the permit requirement coming into effect, in order to achieve compliance.

The District will continue to amend the alum dosing rate if in-house laboratory data indicate an increase and as soon as data are received from the laboratory.

The concentration of phosphorus in the effluent could also have been impacted by issues with the dosing pump and the accumulation of sludge in the polishing cell. Desludging is planned for 2023. Maintenance and repair/replacement of equipment will continue to be implemented as needed.

Attachments:

None added.

Contact Information:



District of Houston

3367 – 12th Street
Houston, BC V0J 1Z0
Ph: 250-845-2238
doh@houston.ca

Craig Close
Senior Water and Wastewater Systems Operator
Phone: 250-845-2238
Email: utilities@houston.ca

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