# Memorandum

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| Project Name: Resolute Bay Wastewater | Project #: FRE-00240783-A0 | /File No: |
| To: Bhabesh Roy, P.Eng. | From: Stephen Bliss, P.Eng. | |
| Date: 2017 November 23 | | |
| Subject: Fecal Coliform Limit Determination | | |
| Prepared By: Stephen Bliss | | |
| Distribution: Bhabesh Roy, P.Eng. | | |

This technical Memo is to provide the Government of Nunavut with direction regarding the determination of a fecal coliform limit for the sewage effluent discharged from the Hamlet of Resolute Bay. The Water Licence (#3BM-RUT 1520) lists two (2) conditions to consider: 1) wastewater flows >600 Lcd; and 2) wastewater flows between 150 Lcd and 600 Lcd.

For Flows >600 Lcd:

| Parameter | Maximum concentration of any Grab |
|---|---|
| $BOD_5$ | 80mg/L |
| Total Suspended Solids | 70 mg/L |
| Oil and Grease | No Visible sheen |
| pH | Between 6 and 9 |
| Fecal Coliforms | To be determined in accordance with Part D |

For Flows between 150 Lcd and 600 Lcd:

| Parameter | Maximum concentration of any Grab |
|---|---|
| $BOD_5$ | 120mg/L |
| Total Suspended Solids | 80 mg/L |
| Oil and Grease | No Visible sheen |
| pH | Between 6 and 9 |
| Fecal Coliforms | To be determined in accordance with Part D |

The determination of a fecal coliform limit was to be based on eight (8) grab samples collected from June through September 2017 (4 months X 2 per month). Results were received from seven (7) grab samples collected on June 25, June 30, July 14, August 17, August 29, October 29 and November 6. Based on the results from the seven samples, 6 of 7 would have met the BOD requirements for both flow conditions; and 6 of 7 would have met the TSS requirements for both flow conditions. The pH was within the required range for all 7 samples. Fecal coliform counts ranged from 190 to 380,000 cfu (colony forming units)/100mL.

In general, fecal coliform measurements are used to determine the potential for the presence of disease-causing micro-organisms. This is particularly important if the effluent is being discharged to a recreational area

(people becoming in contact with the water, e.g., swimming, boating, etc.) and/or if the area is used to provide a food source, particularly shell fish.

The collection system at Resolute Bay consists of a utilidor (piped) system. Due to the potential for freezing within the collection system, a quantity of "bleed" water is used to prevent the sewer lines from freezing. This is evident in the concentrations of $BOD_5$ and TSS as reported in the sample analyses; the values are lower than expected for municipal wastewater. And as a result, and noted above, the results are generally favourable. However, the fecal coliform counts are greater than generally allowed for discharge to a receiving body of water. Effluent fecal coliform counts are usually expected to be <1,000 cfu/100mL upon discharge; an Environmental Risk Assessment (ERA) of the receiving body of water is generally undertaken to better define the fecal coliform limit.

At Resolute Bay, due to the cold environmental conditions, recreational water activities would be minimal. As well, where the wastewater flows are relatively small compared to the size of the receiving body, the mixing zone at the point of discharge should be small (the limits of the mixing zone would be defined where the measurable concentrations of any of the parameters would equal background concentrations).

The requirement to define a fecal coliform limit is essentially to address the question of what are the negative impacts of the presence of fecal coliform and if there is a presence, what is the maximum concentration/quantity that should be allowed. This memo does not address the negative impacts (if any) at Resolute Bay.

However, defining a fecal coliform limit can be accomplished through several methods. The most stringent limit to be defined would be to satisfy public safety due to either the recreational use of the water or the ability to harvest food within the discharge zone. This may not be a factor at Resolute Bay.

Keeping in line that the current effluent quality is being achieved without any treatment (most of the samples meet the current $BOD_5$ and TSS limits), defining a corresponding fecal coliform limit is possible. The presence of coliforms is generally related to the presence/concentration of suspended solids. The lower the concentration of solids, generally the lower the coliform counts. Of the seven (7) samples from 2017, regression analysis was performed on the TSS versus coliform counts. The calculated Correlation Coefficient (R) was determined to be 0.91 versus an expected value of 0.874 (1% level of significance) which implies there is a correlation between TSS and FC counts. Using the results from the 2017 data, FC limits would be defined as follows:

For Flows >600 Lcd:

| Parameter | Maximum concentration of any Grab |
|---|---|
| $BOD_5$ | 80mg/L |
| Total Suspended Solids | 70 mg/L |
| Oil and Grease | No Visible sheen |
| pH | Between 6 and 9 |
| Fecal Coliforms, cfu/100mL | 220,000 |

For Flows between 150 Lcd and 600 Lcd:

| Parameter | Maximum concentration of any Grab |
|---|---|
| $BOD_5$ | 120mg/L |
| Total Suspended Solids | 80 mg/L |
| Oil and Grease | No Visible sheen |
| pH | Between 6 and 9 |
| Fecal Coliforms, cfu/100mL | 255,000 |

Based on the seven (7) results from 2017, these values would have been met 85% of the time. (Note: many northern communities have, as a limit, a value of 1 X $10^6$ cfu/100mL.) If the intent is to have zero exceedances, either a higher limit will have to be considered, or a method of disinfection will be required.

Submitted by:

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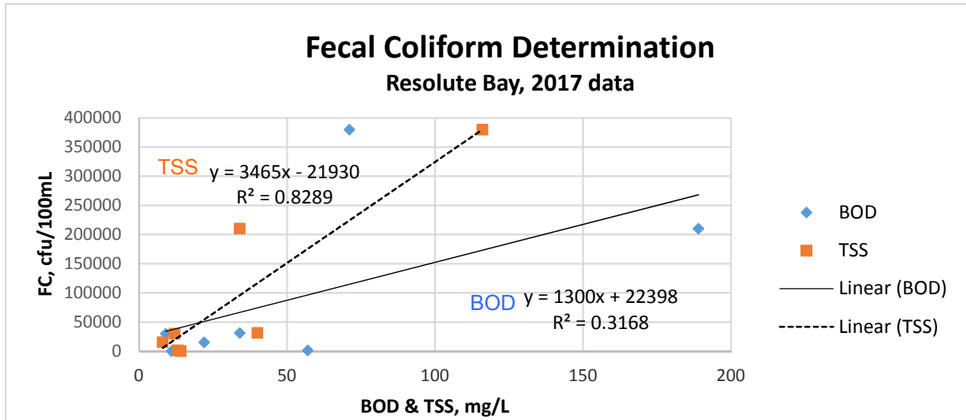
Attachments:
2017 data

EXP Services Inc.

Hamlet of Resolute Bay 2017 Wastewater Testing

| **Client Sample I.D.** | Sewage Out Fall | Sewage Outfall | Sewage Out Fall | Sewer Outfall | Sewer Outfall | Sewer Outfall | Sewer Outfall |
|---|---|---|---|---|---|---|---|
| **Lab Sample I.D.** | B17-17943-1 | B17-20153-1 | B17-22114-1 | B17-24658-1 | B17-31263-1 | B17-34252-1 | B17-34253-1 |
| **Date Collected** | 25-Jun-17 | 14-Jul-17 | 30-Jun-17 | 17-Aug-17 | 29-Aug-17 | 29-Oct-17 | 6-Nov-17 |
| **Date Received** | 28-Jun-17 | 18-Jul-17 | 2-Aug-17 | 24-Aug-17 | 17-Oct-17 | | |
| **Date Reported** | 12-Jul-17 | 24-Jul-17 | 10-Aug-17 | 30-Aug-17 | 25-Oct-17 | | |
| Parameters | | | | | | | |
| BOD | 189 | 71 | 22 | 34 | 11 | 57 | 9 |
| Total Suspended Solids | 34 | 116 | 8 | 40 | 14 | 13 | 12 |
| Hardness (as CaCO3) | 134 | 166 | 145 | 145 | 134 | | |
| Alkalinity(CaCO3) to pH4.5 | 142 | 131 | 103 | 108 | 109 | | |
| Conductivity @25°C | 479 | 465 | 362 | 383 | 352 | | |
| pH @25°C | 7.85 | 7.74 | 7.52 | 7.67 | 7.7 | | |
| Nitrite (N) | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.3 | | |
| Nitrate (N) | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.4 | | |
| Chloride | 21.2 | 21.6 | 16.3 | 15.6 | 15.2 | | |
| Sulphate | 29 | 38 | 31 | 32 | 29 | | |
| Total Organic Carbon | 12 | 8.2 | 5.2 | 7.9 | 4.1 | | |
| Ammonia (N)-Total | 17.4 | 8.24 | 1.67 | 1.7 | 4.83 | | |
| Phenolics | 0.009 | 0.004 | 0.005 | 0.002 | 0.002 | | |
| Aluminum (total) | 0.08 | 0.07 | 0.06 | 0.13 | 0.1 | | |
| Arsenic | < 0.0005 | < 0.0005 | < 0.0005 | 0.13 | < 0.0005 | | |
| Calcium | 39.3 | 49.7 | 42.2 | < 0.0005 | 40.1 | | |
| Cadmium | < 0.005 | < 0.005 | < 0.005 | 42.4 | < 0.005 | | |
| Cobalt | < 0.005 | < 0.005 | < 0.005 | < 0.002 | < 0.005 | | |
| Copper | 0.046 | 0.064 | 0.046 | < 0.005 | 0.034 | | |
| Chromium | 0.009 | < 0.002 | < 0.002 | 0.058 | < 0.002 | | |
| Iron (Total) | 0.166 | 0.102 | 0.118 | 0.211 | 0.064 | | |
| Lead | < 0.02 | < 0.02 | < 0.02 | < 0.02 | < 0.02 | | |
| Magnesium | 8.73 | 10.3 | 9.67 | 9.6 | 8.32 | | |
| Manganese (Total) | 0.01 | 0.014 | 0.012 | 0.016 | 0.018 | | |
| Mercury | < 0.00002 | < 0.00002 | < 0.00002 | < 0.00002 | < 0.00002 | | |
| Nickel | < 0.01 | < 0.01 | < 0.01 | 0.01 | < 0.01 | | |
| Potassium | 5.2 | 5.6 | 3.5 | 3.0 | 2.7 | | |
| Sodium | 24.6 | 23.9 | 18.4 | 19.3 | 16.2 | | |
| Zinc | 0.071 | 0.13 | 0.062 | 0.16 | 0.081 | | |
| Oil & Grease-Total | 19.4 | 7.9 | 12.6 | 20.1 | 6.3 | | |
| Fecal Coliform | 210000 | 380000 | 15000 | 31000 | 190 | 1500 | 30000 |

| Date | Fecal Coliform | BOD | TSS |
|---|---|---|---|
| 25-Jun-17 | 210000 | 189 | 34 |
| 14-Jul-17 | 380000 | 71 | 116 |
| 30-Jun-17 | 15000 | 22 | 8 |
| 17-Aug-17 | 31000 | 34 | 40 |
| 29-Aug-17 | 190 | 11 | 14 |
| 29-Oct-17 | 1500 | 57 | 13 |
| 6-Nov-17 | 30000 | 9 | 12 |




| For 2017 data | |
|---|---|
| FC (TSS = 80) | 255270 |
| FC (TSS = 70) | 220620 |
| | |
| $R^2$ | 0.83 |
| R | 0.91 |