# Appendix M

NATECH Letter Report on EDO's

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**March 23, 2017**

**Mr. Stephen Pyke, P. Eng.**
**Associate Senior Environmental Engineer**
Opus International Consultants (Canada) Limited,
80 Bishop Drive,
Fredericton, N.B.
E3C 1B2

Re: **Additional preliminary EDO calculations for the Chipman WWTP**

**Dear Stephen**:

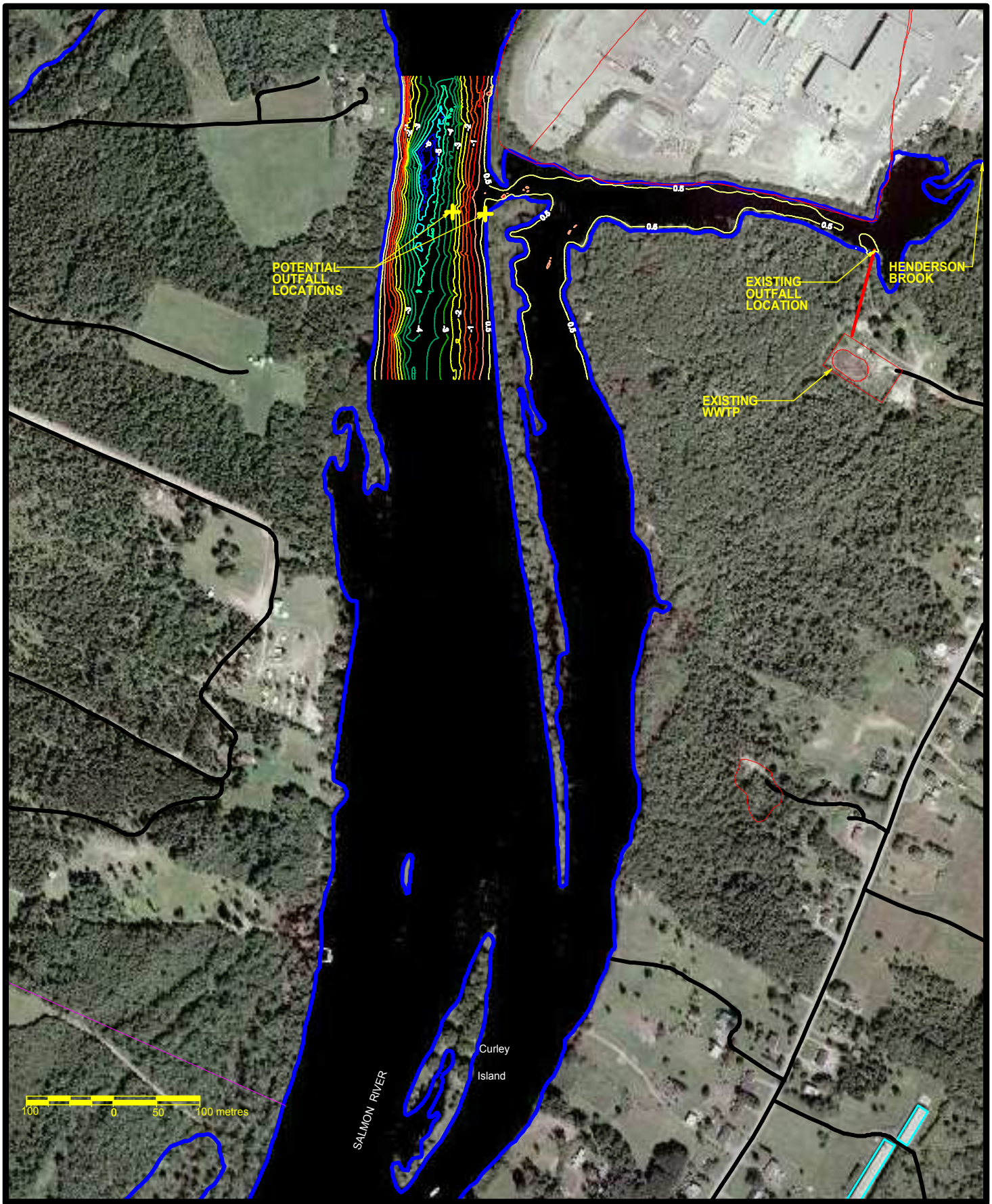
It is our understanding that your are designing upgrades for the Chipman wastewater treatment plant, and that you are considering extending the outfall into the Salmon River. To meet your requirements, we carried out additional calculations to determine how site-specific Effluent Discharge Objectives (EDOs) for the Chipman WWTP would likely change if the outfall was extended into the main channel of the Salmon River, where a much greater dilution is available, compared to Henderson Brook (see Figure 1).

**1. Worst -case scenario:**

We assume that the effluent flows and river flows calculated in the Environmental Risk Assessment (NATECH, 2014) are valid for the purpose of this preliminary assessment. The worst-case scenario for dilution for a discharge into the Salmon River is defined as follows:

- A seven day-ten year low flows of 2,200 L/s in the Salmon River.

- A dry weather effluent discharge of 3.0 L/s (260 $m^3$/day) in the summer.




CHIPMAN WWTP
LOCATION MAP

NATECH
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| Date: | File: |
|---|---|
| 17/03/23 | OPC-17-01 |
| Scale: Geodetic elevations (m) | Figure: 1 |

## 2. Effluent mixing estimations:

A few preliminary test runs were done with the Cormix model to estimate how quickly the effluent may dilute into the river under the worst-case scenario. Two outfall locations were assumed:

1. An outfall pipe emerging at -3.0 m elevation, 40 m offshore, in the area where a deeper pool in the channel was surveyed in 2013. The elevation is around -5.5 m in the center of the channel in that area. Depending on the current velocity at this future outfall location and depth, the model predicts that dilution factors between 1 in 180 and 1 in 700 would be achievable within 250 m of the outfall. The effluent plume would likely remain submerged for several hundred metres.

2. If the effluent was discharged on the edge of the main channel, the dilution would be less, likely between 1 in 100 and 1 in 140 at 250 m downstream, depending on the current velocity. The effluent plume would remain at the surface of the river and would remain attached to the shoreline.

## 3. Mixing zone considerations:

In the case of the Salmon River outfall, three conditions limit the size of the mixing zone that can be allocated for the purpose of calculating effluent discharge objectives (CCME, 2009):

- ❏ A mixing zone should not occupy more than 25% of the cross-sectional area or volume of flow of a receiving watercourse, during 7 day - 10 year (7Q10) low flow conditions (Schedule B of Regulation 2002-13 under the NB Clean Water Act).
- ❏ The mixing zone cannot extend past 250 m of the outfall in any direction (NBDELG, 2012).
- ❏ A maximum dilution factor of 1 in 100 is allowed at the edge of the mixing zone (NBDELG, 2011).

The effluent dilution rate, after mixing into 25% of the river 7Q10 low flow, is calculated to be 1 in 184 under the worst-case scenario. The preliminary model predictions suggest that a 1 in 100 dilution rate should be achievable within 250 m under the worst-case scenario. Therefore the most limiting condition to define the extent of the allocated mixing zone is the 1 in 100 dilution factor.

**4. EDOs comparison with the existing outfall into Henderson Brook:**

A few parameters have end-of pipe standards, for which no dilution factor is allowed in the calculations: total residual chlorine, $CBOD_5$, TSS, unionized ammonia, E. Coli, and acute toxicity. The effluent quality in 2012-2013 did not meet the National Performance Standard (NPS) for total residual chlorine (<0.02 mg/L), and the provincial standard for E. Coli (<1000 MPN/100mL from May to October).

No significant oxygen depletion would be expected downstream of an outfall in the Salmon River due to the predicted quick dilution, therefore the NPS of less than 25 mg/L for $CBOD_5$ would be sufficient to protect the receiving environment.

For the other regulated parameters, a new set of EDOs was calculated based on the Environmental Quality Objectives for the Salmon River, and the likely dilution rate at the edge of the allocated mixing zone under the worst-case scenario (1 in 100), taking into account measured background concentrations in the river (from the 2014 ERA report). The various EDOs calculated are listed in Table 1. Most EDOs would be significantly greater with a discharge into the Salmon River, compared to the EDOs based on the existing discharge location in Henderson Brook. The effluent quality observed in 2012-2013 appeared to meet all of the EDOs calculated for the Salmon River discharge (at both locations).

The CCME Strategy mentions that EDOs do not need to be defined for parameters not detected in the effluent. For this reason we did not include a number of substances in the EDO comparison in Table 1 (Chromium, Selenium, Silver, Thallium, Uranium among the metals, and most VOCs, PAHs, PCBs, and pesticides).

Table 1. Comparison of Effluent Discharge Objectives (EDOs) for the Chipman WWTP

| Parameter | Unit | Assumed back-ground (Salmon River) | EQO | Previously Calculated EDO (discharge in brook) | New EDO assuming a dilution factor of 1 in 100 | Average effluent quality in 2012-2013 |
|---|---|---|---|---|---|---|
| TRC | mg/L | 0 | <0.0005 | <0.02 (NPS) | **<0.02 (NPS)** | 0.4 |
| $CBOD_5$ | mg/L | 0 | DO >6.5 | <15 | **<25 (NPS)** | <8 |
| TSS | mg/L | 5 | <5 to <25 | <25 (NPS) | **<25 (NPS)** | 9 |
| $NH_3$-N unionized | mg/L | 0 | <0.019 | <1.25 (NPS) | **<1.25 (NPS)** | 0.001 |
| $NH_3$-N total | mg/L | 0.01 | <0.89 (1)<br><2.7 (2) | <1.9 (1)<br><5.8 (2) | **< 88 (1)**<br>**<269 (2)** | 0.6 (1)<br>0.3 (2) |
| Nitrate-N | mg/L | 0 | <2.9 | <6.1 | **<290** | 12.4 |
| Nitrite-N | mg/L | 0 | <0.06 | <0.13 | **<6.0** | 0.31 |
| TKN | mg/L | 0.25 | <0.50 (May-Oct.) & | <0.7 | **<25** | 1.7 |
| TP | mg/L | 0.020 | <0.035 (May-Oct.) | <0.04 | **<1.5** | 1.3 |
| pH | units | 6.5 - 7.7 | 6.5 - 9.0 | 6.7 - 9.3 | **6.5 - 11.0** | 6.3 - 8.1 |
| E. Coli | MPN/ 100mL | 100 | <1000 (May-Oct.) (End of pipe) | < 1,000 (May-Oct.) | **< 1,000 (May-Oct.)** | 79,900 (May-Oct.) |
| Cyanide | mg/L | 0 | <0.005 | <0.01 | **<0.5** | <0.01 |
| Fluoride | mg/L | 0 | <0.12 | <0.26 | **<12** | 0.43 |
| Aluminum | µg/L | 200 | <100 | <100 | **<100** | 83 |
| Arsenic | µg/L | 1 | <5 | <10 | **<400** | 1 |
| Boron | µg/L | 5 | <1,500 | <3,200 | **<149,500** | 104 |
| Cadmium | µg/L | 0.07 | <0.09 | <0.14 | **<2.1** | 0.07 |
| Copper | µg/L | 0.5 | <2 | <3.2 | **<150** | 25 |

| Parameter | Unit | Assumed back-ground (Salmon River) | EQO | Previously Calculated EDO (discharge in brook) | New EDO assuming a dilution factor of 1 in 100 | Average effluent quality in 2012-2013 |
|---|---|---|---|---|---|---|
| Iron | µg/L | 100 | <300 | <530 | **<20,000** | 220 |
| Lead | µg/L | 0.5 | <1 | <1.2 | **<50** | 0.6 |
| Mercury | µg/L | 0 | <0.026 | <0.056[1] | **<2.6** | <0.025 to 0.060 |
| Molybdenum | µg/L | 0.1 | <73 | <158 | **<7,290** | 2.7 |
| Nickel | µg/L | 0 | <25 | <52 | **<2,500** | 1.8 |
| Zinc | µg/L | 5 | <30 | <58 | **<2,500** | 39 |
| Phenantrene | µg/L | 0 | <0.4 | <0.9 | **<40** | <0.01 to 0.06 |
| Anthracene | µg/L | 0 | <0.012 | <0.03 | **<1.2** | <0.01 to 0.064 |
| Toluene | µg/L | 0 | <2 | <4 | **<200** | <0.5 to 0.5 |
| Chloroform (VOC) | µg/L | 0 | <1.8 | <4 | **<180** | <0.5 to 1.0 |
| Acute toxicity | TU | 0 | <1 (at end of pipe) | <1 | **<1** | <1 |
| Chronic toxicity | TU | 0 | <1 (at edge of mixing | <2.2 | **<100** | <1 to 1.4 |

NPS = National Performance Standard

TU = toxicity unit

(1) From June to September only

(2) Outside of the June to September period

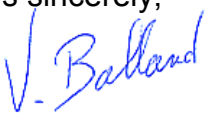
## 5. Recommendations

It is our understanding that you are planning to carry out a drilling test to determine if the soil conditions allow to install an outfall pipe emerging deep into the river channel. If drilling is feasible, the preliminary model predictions suggest that a minimum effluent dilution factor of 1 in 100 would likely be achieved within 250 m of the outfall, even during seven day-ten year low flow conditions. The EDOs would then be maximized. The only standards that the current WWTP would not meet are for total residual chlorine and for E. Coli (from May to October). It is recommended to install a UV disinfection system instead of the current chlorination/de-chlorination system to address both issues. This will also eliminate the requirement to monitor residual chlorine daily.

If the outfall cannot be installed underwater and was to terminate on the bank of the main channel instead, the model needs to be calibrated with field measurements. A dye tracer test should be carried out during low river flow conditions, to check that a 1 in 100 dilution will in fact be achieved within 250 m of the outfall under the worst-case scenario. If the worst-case dilution rate was found to be less than 1 in 100, the future EDOs listed in Table 1 would be reduced. For example, the total phosphorus EDO would decrease from <1.5 mg/L to < 0.8mg/L if the dilution decreases from 100 to 50 times (compared to an average TP concentration in the WWTP effluent of 1.3 mg/L in 2012-2013).

We trust that these calculations meets your immediate information requirements. Please do not hesitate to call, should you have any questions.

Yours sincerely,



Vincent Balland, M.Sc., P.Eng.

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