Appendix L

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October 17, 2016

Attention: Lee Swanson

RE: EIA Registration 4561-3-1410 Oak Bay Hatchery Wastewater Treatment Upgrade

Dr. J.A.K. Elliott, with Cooke Aquaculture Ltd. (Cooke,) asked I respond to several of the questions posed to Mr. M. Dickie September 23, 2016 in relation to the ongoing project at Oak Bay Hatchery (the facility.) Please find responses enclosed, answered as best as possible with current information available. Further clarification is available upon request.

Enclosed responses completely supersede previous response issued by Sorensen Engineering Ltd. July 26, 2016.

Marc Sorensen

Marc Sorensen, P.Eng.

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Date
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INGÉNIEUR IMMATRICULÉ

1. Below is the referenced change of scope, taken from the Environmental Impact Assessment Registration Document dated April 17, 2015, with revisions in RED by Sorensen Engineering Ltd. It is proposed these sections 3.1 to 3.3 would replace those in the registration document.

   3.1 Project Background

   Cooke proposes to upgrade the current WTS at their Oak Bay Hatchery by installing a second drum filter to provide redundancy. ~~replacing the existing drum filter installation in order to meet regulatory compliance under paragraph 8(1) of the Water Quality Regulations Clean Environment Act.~~ The facility is currently licensed through the New Brunswick Department of Agriculture, Aquaculture and Fisheries (NB DAAF) and operates under "Approval to Operate I-8539" (the Approval), issued by the New Brunswick Department of Environment and Local Government (ND DELG), pursuant to Paragraph 8(1) of the *Water Quality Regulation – Clean Environment Act* (Appendix A). The current Approval is effective from November 1, 2013 until October 31, 2016.

   [Moved from 3.2] The Certificate of Approval (COA) for the Oak Bay Hatchery requires that total nitrogen (TN) and total phosphorus (TP) at the edge of the mixing zone must be below the levels outlined in the most recent version of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick.* The performance based standards for TN and TP are 500 µg/L and 35 µg/L respectively. Monitoring of the receiving waters indicate that these standards are being met with the current drum filter (RFM60120) in place.

   The NB Department of Environment and Local Government (NBDELG) has advised Cooke that the WTS upgrade requires registration pursuant to the Environmental Impact Assessment (EIA) Regulations (Reg. 87-83), of the *Clean Environment Act* (N.B. O.C. 87-558/1987). Projects subject to an Environmental Impact Assessment (EIA) are divided into three categories: Category I, Category II, and Category III. In proposing a significant modification to a waste disposal facility or system [Schedule A (m)], the Proponent is required to register the Project as a Category I Undertaking. This document is intended to fulfil the primary requirements for Project Registration under the legislation.

   3.2 Purpose and Need for the Project

   The primary focus of the project is to upgrade the WTS of the facility. The upgrade will provide redundancy in the event of a mechanical failure of the existing effluent drum filter. While the current drum filter provides sufficient water treatment to meet regulatory compliance, in the event of a mechanical failure there is currently no back-up system in place to prevent unfiltered effluent from being discharged.

   ~~The purpose of the Project is to upgrade the WTS in order to improve effluent water quality. The Certificate of Approval (COA) for the Oak Bay Hatchery requires that total nitrogen (TN) and total phosphorus (TP) at the edge of the mixing zone must be below the levels outlined in the most recent version of the Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick. Water quality monitoring has found that effluent sampled from the TWS outflow has shown exceedances of these parameters. It was determined that the existing drum filter was of insufficient capacity during normal operations.~~

3.3 Consideration of Alternatives

Implementing an engineered settling pond for the maximum effluent flow present at the facility was found to be unfeasible. The visible solids that were able to pass through a 60 µm drum filter screen have a settling velocity of 1.04 x 10^{-4} m/s (37 cm per hour), and to capture 70-75% of the solids would require designing for a settling velocity of 4.2 x 10^{-5} m/s (15 cm per hour). There is insufficient space available on site to provide adequate settling for solids which pass through drum filtration.

Improvements for system solids removal are made continually. In 2014 and 2015 these, with improvements to solids transfer to on-site solids holding tanks, reduced the quantity of solids and water volume sent to effluent treatment significantly. While this reduced the potential risk associated with a WTS failure, it did not eliminate it.

It was concluded that installing redundancy in the drum filtration was the most effective method for mitigating the risk of mechanical failure of the WTS.

~~In an attempt to improve effluent water quality, properly specified back-wash pumps were installed on existing system drum filters in 2014. Additionally, to minimize surges in flow to the WTS, swirl separators were modified to produce a continuous underflow. However, no improvement in system water quality was found, flushing was still necessary, and underflow was found to be uncontrolled during power failures. It was concluded that upgrading the wastewater system was the most effective method to improve effluent quality.~~

2. The scope of the project is as defined above.

4. The installation of a second RFM60120 drum filter will provide complete redundancy for the first. To minimize downtime and cost, installation of the second RFM60120 drum filter requires modification to the design detailed in the registration document.

   Please see Appendix A for drawings illustrating the currently installed RFM60120 (D-1 Drum Replacement) and drawings detailing the installation of the redundant RFM60120 drum filter (D-2) as well as the detailed site plan (L-3).

9. The TRC Response 2, dated September 23, 2016 indicates “solids are still present within the outfall area as observed during our site visit February 1, 2016 and consistently throughout the receiving Bay”.

   A request was made June 23, 2016, for any additional sample results taken by DELG to aid in the assessment of the facility. Krista Flanagan indicated, June 28, 2016, there were no additional results available (see correspondence in Appendix C). Please provide the results supporting the quoted statement.

   Please provide the method used to discern solids originating from the facility in the receiving bay.

   The installed RFM60120 drum filter is designed to remove solids larger than 60µm. The drum filter’s flow capacity has been demonstrated sufficient to maintain compliance with the Approval to Operate. The removal of all solids is not required for the facility to be compliant with the Approval to Operate. According to the Environmental Management Program for Land

Based Finfish Aquaculture in New Brunswick, only Total Nitrogen (TN) and Total Phosphorus (TP) are the “performance based standard indicators” (NBDELG, 2013).

The term “settling pond” is causing confusion. The area, in fact, acts as a catch basin for storm water runoff and provides some equalization capacity for effluent. It is not an engineering settling pond. The area will be retitled “Catch Basin” in all drawings and reports moving forward.

The Catch Basin does not meet the dimensional requirements of an engineered settling pond for the maximum flow present at the facility. The Catch Basin is not intended to act as an engineered settling pond, though some solids do settle and accumulate. Settled solids are routinely removed from the Catch Basin. Please see #10 in the “Benefit of Extra Settling” section.

We understand that the Catch Basin was larger when constructed and that it has not been intentionally reduced in size. However, the plowing of snow into the Catch Basin over the past 20+ years has infilled it somewhat.

It is important to note: the most significant surges, from E-Line, were eliminated in 2015. Cooke plan to implement the successful management practices and modifications to the other production areas when possible.

10. The installed RFM60120 drum filter has been demonstrated sufficient to meet regulatory thresholds within DELG’s Certificate of Approval to Operate (I-8539).

    The establishment of a mixing zone was not a component of the initial Registration Document and study. The Registration Document does state that a mixing zone needs to be established.

    As per the Approval to Operate (I-8539) #33 “Monitoring shall include samples taken from the outer perimeter and outside of the mixing zone as established by an inspector and approved by the Minister.”

    Since a mixing zone has not been established empirically by an inspector, regulatory samples have been taken at WQ1 (as Edge of Mixing) and WQ2 (as Control).

    Based on triplicate sampling and measurement uncertainty limitations by available chemical analysis (Maxxam and RPC), it is not possible to accurately establish a mixing zone based on empirical data. Bay monitoring shows no measurable impact at locations WQ1 to WQ6. See below under “Validation of Water Quality Analysis (June 2016)”.

    Barry Loescher, Quality Systems Specialist at Maxxam Analytics and the Chair of Environmental/Life Sciences Division of the Canadian Council of Independent Laboratories, recommends triplicate TN samples be taken and the average reported since single point samples can be highly variable. Correspondence with Barry Loescher can be found in Appendix C.

    After the July 2, 2015 response from the TRC, Cooke engaged Strum to complete the water quality study of the receiving waters, as committed to in the April 17, 2015 registration document.

In August 2015, Strum Consulting delivered to Cooke a report entitled Water Quality Baseline Study (WQBS). The study identified (6) locations in Oak Bay, which Strum felt could illustrate dispersion of the facility's effluent. Several parameters were monitored at each location, including: Total Nitrogen (TN), Total Phosphorus (TP), and TSS. A plan illustrating the locations is included in appendix A. Additionally, Strum delivered Cooke a second document entitled Water Quality Management Plan (WQMP). The WQMP is a standard operating procedure for collecting water samples in the same locations used in WQBS omitting WQ4. Water quality was monitored according to the WQMP from August to October 2015 and from May to July 2016. The results were to aid in the establishment of a mixing zone and help quantify the impact of the facility's discharge. Both the WQBS and WQMP are included in Appendix C.

It is important to bear in mind that both the WQBS and WQMP are based on single point samples taken of the receiving water body and so are erroneous. Though samples were taken at the top and bottom of the water column, values were considered independently. Conclusions based on the unreliable data must therefore be understood to be similarly erroneous.

Results from continued monitoring of the locations recommended by Strum can be found in appendix B in the document "Water Quality Monitoring TN&TP Data Sheet". Please note, only data points denoted with an (*) are triplicate.

All water samples for analysis (TP, TN, TAN, TSS, and COD) were sent to the Bedford, NS Maxxam laboratory. Total Nitrogen samples were then forwarded by Maxxam to their lab in Burnaby, BC. The lab in Bedford is unable to process TN in salt water at such low concentrations.

Samples were stored in accordance with Maxxam requirements and were typically sent within 1-3 days of sampling. Samples were placed in a fridge or on ice within an hour of sampling to maintain a sample temperature between 1°C-6°C. Sample bottles were provided by Maxxam analytics with the proper preservative included. Total nitrogen and phosphorus samples were preserved with hydro sulphuric acid (H_2SO_4) and have an estimated hold time of 28 days (if kept within the prescribed temperature). See "Sample Bottle Requirements" obtained from Maxxam in Appendix C.

Additional settling was initially considered in this project to provide additional redundancy for drum filter failure. There is insufficient space available on site to provide adequate settling for solids which pass through drum filtration. Additional settling would have no significant effect on regulated nutrient (TN or TP) discharge. Additional settling is therefore no longer be a component of the project.

Validation of Water Quality Analysis (June 2016)

Through the WQMP monitoring, discrepancies in nutrient analysis were observed with Total Phosphorus, Total Nitrogen and Total Suspended Solids. Total phosphorus concentrations across all monitoring locations averaged 0.044 mg/L, which exceeds the regulatory threshold of 0.035 mg/L. Total Nitrogen across all monitoring locations averaged 0.32 mg/L, below the regulatory limit of 0.5 mg/L. There were samples, including at WQ5, with reported TN concentrations greater than the regulatory limit of 0.5 mg/L.

Upon investigation, the laboratory conducting the total phosphorus analysis, Maxxam, do so with a reported measurement uncertainty of ±0.020 mg/L at concentrations close to 0.035 mg/L in salt water. Other laboratories, such as RPC, express similar difficulty in accurately measuring total phosphorus in salt water.

Total nitrogen analysis presented similar inaccuracy in point sampling, including with Maxxam though they report a measurement uncertainty of 0.02-0.05 mg/L. Three locations (WQ1, WQ5, and WQ6) were selected for a validation study of the total nitrogen analysis.

Triplicate sample sets were taken from each location on three consecutive days at high tide.

> Five sets were completed sampling (1) 4 L Van Dorn Bottle at each location. From each bottle (3) sub-samples were taken.
>
> Four sets were completed sampling (3) 4 L Van Dorn Bottles one after another at each location. From each bottle (1) sub-sample was taken.

The results are shown in figure 1 along with a 90% confidence interval (data can be found in appendix B in the document entitled “Triplicate TN Data Sheet”).

This indicates that there is 90% confidence that any one total nitrogen sample is ± 0.15 mg/L on average of the actual concentration. Meaning point samples of total nitrogen concentrations analysed as 0.65 mg/L may be 0.5 mg/L or lower and therefore compliant.

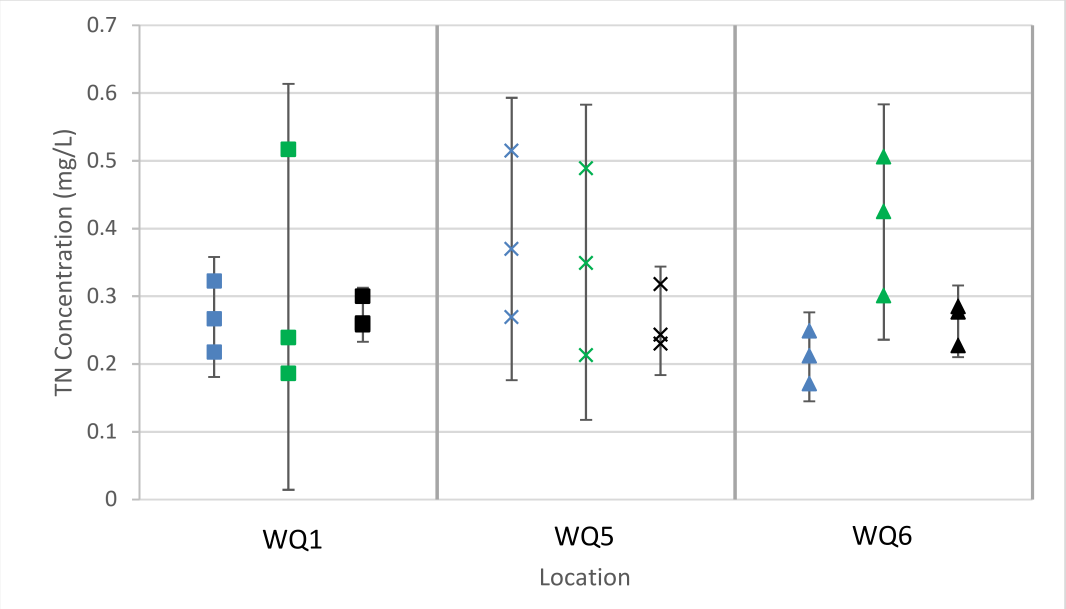


Figure 1: Results from triplicate sample tests at WQ1, WQ5, and WQ6 with 90% confidence interval. The first two sets of triplicate samples at WQ1 and WQ6 were taken from the same 4 L Van Dorn Bottle, the last set of triplicate samples at all locations as well as the second set at WQ5 were taken from three different Van Dorn Bottles at the same location, one after another.

In conclusion, during June 2016, point sampling of total nitrogen and total phosphorus at WQ1 to WQ6 was found to be an unreliable method of determining the existing nutrient concentrations in the receiving water.

Further triplicate sampling of WQ1 and WQ2 support this conclusion (see Triplicate TN Data Sheet in Appendix B).

Calculations as to how regulatory thresholds will be met

For an explanation of facility's impact on the bay, see section 26. Further clarification is available upon request.

11. Under the Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick (NBDELG, 2013), the TSS of effluent from the facility is not regulated.

Regarding particle size distribution. Based on the capture efficiency of the WTS drum filter, approximately 57% are less than 60 μm. The remaining 43% are greater than 60 μm during normal operation. This results in filtrate with an average TSS concentration less than 13 mg/L. The bay TSS is 16.9 ± 2.2 mg/L.

There was initially some variability in TSS measurements, as seen with TN, while monitoring according to the WQMP. Upon discussion with Maxxam it was concluded the variability in TSS results were likely due to sample volume. The analysis of TSS was then changed from submitting 200 mL samples to the labs, to utilizing equipment on site to analyse samples with an average volume of 4.3 L and 3.2 L for water samples taken from the bay and after the drum, respectively. Each bay sample and after drum sample contained on average 55 mg and 24 mg of solids, respectively. These were weighed with less than 2% and 6% uncertainty, respectively.

To analyse the average TSS of the facility's effluent, composite samples were collected taking 60 mL samples every 5 minutes from the drum filter discharge for a 12-hour period (two overnight periods and 2 daytime periods were monitored). Total suspended solids concentrations of the water leaving the facility were 6.9 mg/L from 7 pm to 7 am and 10.6 mg/L from 7 am to 7 pm (see "Composite Sample TSS Data Sheet" in appendix B). This is in agreement with the WQMP monitoring. The average TSS concentration of all bay water sampling locations was found to be 16.9 ± 2.2 mg/L from April-September 2016 (see "Water Quality Monitoring TN&TP Data Sheet" in appendix B). Facility discharge is therefore not negatively impacting the water quality of the receiving waters.

The implementation of a chemical treatment system, as described by Hayter et al. 2016, requires the effluent from systems be divided into two steams: concentrated and dilute. The concentrated stream containing drum filter back-wash, swirl separator and radial flow separator purges, and static filter wash down water. The dilute stream typically only includes system water overflow. E-Line is currently the only system at the facility with effluent divided into the two streams. With the dilute combined stream serving as the facility's effluent, Dr. Couturier with the Department of Chemical Engineering of the University of New Brunswick, found chemical treatment impractical for solids removal.

At Buckman's Creek Hatchery, Hayter et al. (2016) found three different chemical dose regimes were necessary for the two major systems on site. The different regimes are required because of the different solids capturing equipment in the two systems. The regimes must be managed manually. Implementing this type of system on a site with seven systems, even with effluent streams divided into concentrated and dilute, would be difficult to manage.

Dr. Couturier has studied the solids being flushed from swirl separators at the facility. Dr Couturier found the large and sudden surge of flow, generated from flushing swirl separators, produced sufficient turbulence along the tortuous path towards effluent to significantly reduce particle size.

These findings were the basis for the initiative to eliminate surge flows from Swirl Separators to effluent. In 2015 the 10’-0” diameter swirl separator in E-Line was replaced with (4) modern 6’-0” diameter Radial Flow Separators (RFS), (1) per rearing tank. Included in this project was the change from flushing solids to gently metering solids to existing solids holding tanks with a diaphragm pump. Additionally, the angle of the RFS cone bottoms are 60° compared to the 45° swirl separator cone. The 60° cones further concentrate solids and improve their removal from the unit. These changes successfully demonstrated it is possible to capture >40% of TSS generated in a system and retain them.

E-Line drum filter back wash was redirected as well. Traditionally, the drum filter back wash was plumbed to the effluent drum filter and was subject to the same tortuous path as swirl separators. The E-Line drum filter back wash is now plumbed to the existing septic tanks. This has resulted in an additional >40% of TSS generated in the system being retained.

This 2015 project successfully demonstrated it is possible to avoid sending the majority of TSS generated on site to the WTS drum filter and instead retain it offline, without the use of chemical treatment (flocculation).

The installed RFM60120 drum filter has been demonstrated sufficient to meet regulatory thresholds within DELG’s Certificate of Approval to Operate. The typical reason for implementing chemical treatment is to meet phosphorus regulatory limits when there is insufficient dilution in the receiving water. There is no proven chemical treatment method for the removal of nitrogen. Chemical treatment is not required for this site.

As mentioned in #10, both Strum WQBS and WQMP reports are based on single point samples taken of the receiving water body and so are erroneous.

Similar to the TN discharge model in #26, the receiving water encompassed by area A (shown in Appendix A) consists of approximately 950,000 m^3 of water. To increase the TSS of this water volume by 1 mg/L, 950 kg of TSS would need to be discharged in less than 12 hours (between low tide and low tide, as the aforementioned area is drained at low tide).

As TSS concentrations at WQ2 were on average 9 mg/L higher than the drum filter filtrate, and the total feed added to the system daily is less than 700 kg, it follows that the hatchery is not negatively impacting the water quality of the receiving waters. See Appendix C for “Water Quality Monitoring TSS Data Sheet”.

The facility continuously releases effluent into the intertidal area when the tide is out.

All samples were taken just after high tide, on the ebb tide.

14. Please see the following table for the planned use for each of the wells on site.

<u>On-site Wells</u>

Well	Planned Use	Additional Details	Well ID	Flow Rate* (m^3/h)
1	Production	Level monitoring to be installed		72
2	Production	New cap to be installed		
3	Back-up	Level monitoring to be installed Pump to be replaced		
4	Domestic Supply	-		?
5	Possible Observation	Either #5 or #6 to be decommissioned depending on capacity		0
6	Possible Observation		None Identified	
7	Observation/ back-up	-		46.8
8	Production	Level Monitoring Installed	0027924	
9	Decommission	-		0
10	Decommission	-		
11	Possible Salt Water	-	0046326	
12	Decommission	-		
13	Decommission	-	0017975	

*Pumping rates recorded September 26, 2016

The drawing "Well Head Locations OBH" is included in Appendix A. The drawing illustrates the location and top of well casing elevation for each well. The top of well casing elevation and water levels presented in the preliminary well testing are referenced to the NB Grid Monuments.

A timeline for decommissioning wells 9, 10, 12 and 13 will be established once approval to proceed and requirements are received from DELG.

An estimate for the pumping capacity of each production and back-up well will be determined as a component of the WSSA.

Well 9 will be decommissioned, so will not require a flow meter.

Well 4 will only be used as a domestic supply in the Tech Room only. (Perhaps a domestic flow totalizer could be sufficient.)

The (2) installed ABB Electro Magnetic Flow meters were highly recommended by Strum and others and were costly to install. They are commonly used in municipal applications. An information sheet for them is included in Appendix C ("WaterMaster FEW325 Data Sheet").

Both flow meters have been inaccurate since their installation in October 2015. Displayed values are commonly 30% higher (and sometimes more) than the actual pumping rate. This was the case during the site visit by DELG February 1, 2016.

Cooke have worked continuously with Coastal Controls and Industrial Instrumentation (CCII) to troubleshoot the issue, since their installation. Installation and water chemistry have been eliminated as potential interferences. CCII is now willing to consider the units may be calibrated incorrectly and are working to resolved the issue.

The flowmeter data is not accurate, so it should not be included in the annual report. The hardware is in place to log the flow rates when the flow meters are made accurate.

The actual pumping rates of the production wells have been periodically monitored throughout the year. The rates do not change frequently. The available data can be submitted.

Following an inventory of wells on site, no well with an ID 29110 has been found.

A preliminary assessment of production wells was conducted on August 26, 2016 and September 27, 2016.

Well #8 Data Logging

Data logging for Well #8 from June 30, 2016 to September 20, 2016 is shown in figure C.1 in Appendix C "Graphs for Well Testing". There is an apparent steady water level in the well up to June 14th at which time the water level began to decrease steadily until August 17th where it appears to level off experiencing some decrease up to September 20th. The hatchery did not significantly change water usage over this time.

Well #8 Recovery Monitoring

On August 26, 2016 the recovery of Well #8 was monitored. The well recovered 0.53 m in 13 minutes after the pump was turned off. When the pump was turned back on, the water level in the well returned to the original operating water level.

Additional Well #8 monitoring was conducted on September 27, 2016. The initial water level of the well was -1.62 m with the pumping rate maintained for the 7 days prior.

With the Well #8 water level being monitored and logged every 30 seconds, the well pump was turned off. The level increased from -1.62 m to -1.17 m (0.45 m) over 17.5 minutes. This represents the normal drawdown. The well recovered to within 5 cm of the rest water level in 5 minutes as shown in Figure C.2 in "Graphs for Well Testing" in Appendix C.

Well #1 & #2 Recovery Monitoring

The water level in Well #2 was monitored for a period of 33 minutes before turning off the pumps for both Well #1 and #2. The water level rose from an operating water level of -0.24 m to +2.05 m, a recovery of 2.29 m in 17 minutes. The water level recovered to within 5 cm of the stable water level in 4.5 minutes. The pumps were then turned back on to their original operating flow rate and the water level lowered to -0.14 m. The recovery data is shown in figure C.3 in “Graphs for Well Testing” in Appendix C.

These preliminary results are being provided to assist DELG in establishing the requirements for the WSSA. A timeline for completing the WSSA will be established once approval to proceed and requirements are received from the minister. It is understood the WSSA completion will result in the well withdrawal rate stated in the Approval to Operate being revised to reflect the historic usage, now being more accurately quantified.

15. See comments in #14 regarding WSSA timeline.

19. The shorebird survey has not yet been completed. Is this survey necessary for the completion of the EIA as the project (as described by the revised scope in #1) will not have a negative environmental effect and the facility is currently in compliance with effluent discharge regulations as per the Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick (DELG, 2013)?

    Fish and Benthic surveys have been completed by Strum Consulting and will be delivered to the TRC when received.

20. The complete ACCDC report obtained from Strum Consulting can be found in Appendix C.

22. A drawing of the site plan of the facility is included in Appendix A.

26. The regulatory thresholds for facilities with outfalls into coastal or estuarine waters are found in table 2. These thresholds are measured at the edge of effluent mixing zone with primary focus on total nitrogen as it is the limiting nutrient for primary growth (plant and algae) (NBDELG, 2013).

Table 1: Regulatory thresholds for facilities with outfalls into coastal or estuarine waters (NBDELG, 2013)

Parameter	Regulatory Threshold (mg/L)
Total Nitrogen	0.5 mg/L
Total Phosphorus	0.035 mg/L

Oak Bay Hatchery uses different types of feed for the varying stages of salmon development with a protein content ranging from 43-55%. Nitrogen can then be calculated from the protein content, as protein is 16% nitrogen. The discharge of Nitrogen and Phosphorus is directly linked to the feeding rate of the facility. Since 2012, the maximum average daily feed rate has been less than 700 kg_{FEED}/day. This maximum was used to model the nitrogen discharge.

$$TN_{FEED,MAX} < 700\,\frac{kg_{FEED}}{day} \times 55\%\,\frac{kg_{PROTIEN}}{kg_{FEED}} \times 16\%\,\frac{kg_{TN}}{kg_{PROTIEN}} < 61.6\,\frac{kg_{TN}}{day}$$

The nitrogen present in feed has three possible outcomes:

Retained by the fish (21-30%): $TN_{RETAINED,\ MAX} < 61.6\,\frac{kg_{TN}}{day} \times 22\% < 13.6\,\frac{kg_{TN}}{day}$

Dissolved excretion (49-60%): $TN_{DISSOLVED,\ MAX} < 61.6\frac{kg_{TN}}{day} \times 55\% < 34\frac{kg_{TN}}{day}$

Particulate excretion (15-30%): $TN_{PARTICULAT\ ,\ MAX} < 61.6\frac{kg_{TN}}{day} \times 19\% < 14\frac{kg_{TN}}{day}$

Two nitrogen scenarios were considered:

(1) An average of dissolved and particulate percentages was used along with a 30% solids capture efficiency of the drum filter.

$$TN_{DISCHARG\ ,\ AVG} < TN_{DISSOLVED,\ AVG} + (1 - 30\%)TN_{PARTICULATE,\ AVG}$$

$$TN_{DISCHARGE,\ AVG} < 34\frac{kg_{TN}}{day} + (1 - 30\%)14\frac{kg_{TN}}{day} < 43.8\frac{kg_{TN}}{day}$$

(2) All nitrogen in the feed is discharged (with no fish uptake and 0% drum filter capture efficiency).

$$TN_{DISCHARGE,\ MAX} < TN_{FEED,MAX} < 61.6\frac{kg_{TN}}{day}$$

The receiving water (Oak Bay) experiences extreme tidal action, at low tide the area between the facility and Spoon Island (shown in appendix A) is drained. To estimate the worst case scenario, the daily nitrogen discharge is assumed to be discharged over one tidal cycle (low tide to high tide).

The volume at high tide bounded by WQ2 (shown in appendix A) is estimated as 950,000 m^3. With nitrogen discharge evenly mixed through this volume, the increase in TN would be:

(1)

$$\Delta TN_{BAY} < \frac{TN_{DISCHARGE,\ AVG}}{V_{BAY}} < \frac{43.8\frac{kg_{TN}}{day}}{950{,}000m^3} < 0.046\frac{mg_{TN}/L}{DAY}$$

(2)

$$\Delta TN_{BAY} < \frac{TN_{DISCHARGE,\ MAX}}{V_{BAY}} < \frac{61.6\frac{kg_{TN}}{day}}{950{,}000m^3} < 0.065\frac{mg_{TN}/L}{DAY}$$

In reality, the nitrogen does not dilute evenly, rather a higher concentration is observed at the discharge point of the facility. As well, this assumes all nitrogen discharged from the facility remains within this bounded area and does not dilute further into the receiving waters.

Using this same approach, the total nitrogen and phosphorus discharge from the facility was modelled based on the mass of feed added to the systems.

Below is a table showing average feed rates and the associated predicted increases at WQ2 for 2014-2016.

Table 2: Nitrogen discharge modelling data

Year	Month	Average Daily Feed (kg/day)	Present in Feed (kg/day)	61.25% Nitrogen Discharge* (kg/day)	Expected Max. Increase @ WQ2** (mg/L)	100% Nitrogen Discharge (kg/day)	Expected Max. Increase @ WQ2** (mg/L)
2014	July	497	43.7	30.7	0.032	43.7	0.046
2014	August	567	49.9	35.1	0.037	49.9	0.053
2014	September	408	35.9	25.2	0.027	35.9	0.038
2014	October	302	26.6	18.7	0.020	26.6	0.028
2014	November	325	28.6	18.7	0.020	28.6	0.028
2015	June	242	21.3	20.1	0.021	21.3	0.030
2015	July	308	27.1	15.0	0.016	27.1	0.022
2015	August	463	40.7	19.0	0.020	40.7	0.029
2015	September	454	40.0	28.6	0.030	40.0	0.043
2015	October	453	39.9	28.1	0.030	39.9	0.042
2015	November	400	35.2	28.0	0.029	35.2	0.042
2016	June	368	32.4	22.7	0.024	32.4	0.034
2016	July	460	40.5	28.4	0.030	40.5	0.043
2016	August	612	53.9	37.8	0.040	53.9	0.057
2016	September	683	60.1	42.2	0.044	60.1	0.063

*Assuming average Dissolved Nitrogen (54.5%) and 30% drum filter capture of particulate with average nitrogen content (22.5%) (Wallin & Kakanson, 1991)

**Approximating 950,000 m^3, well mixed system in which all nitrogen is discharged between low and high tide and all nitrogen remains within area A

Based on water quality testing recommended by Strum (section 27), total nitrogen discharge ranged from 20.2-47.7 kg/day (for feeding rates of 242-683 kg/day, corresponding with predicted 21.3-60.1 kg/day for scenario 2) showing the conservative nature of this model. The water quality testing indicated there was no measurable difference in total nitrogen concentrations between WQ2, WQ3, WQ5, and WQ6, as was expected based on the feed model (see figure 2). Furthermore, no measurable difference was observed between WQ2 and WQ1. This indicates that there is no measurable effect of the facility's effluent on the bay up to and including WQ1. Total nitrogen concentrations at the effluent outfall (i.e. directly above the discharge pipe at high tide) ranged between 0.482-1.62 mg/L while total nitrogen concentrations at the drum filter outlet ranged between 5.8-13.7 mg/L. See attached data in appendix B labelled "Drum Filter Outlet and Effluent TN Data".

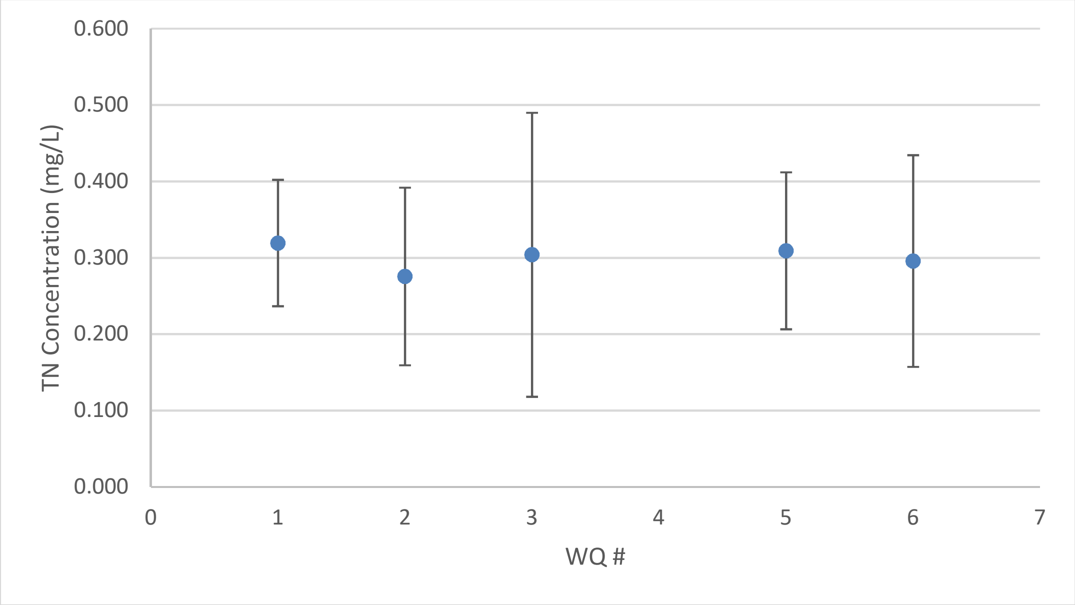


Figure 2: Average Total Nitrogen concentration with standard deviation at the different water quality points in Oak Bay receiving waters from data taken July 2015 – September 2016 (inclusive)

A phosphorus mass balance was calculated in a similar manner where the feed has a phosphorus content of 1.3% and 15-30% of the phosphorus present in the feed is retained by the fish, 16-26% is excreted in a dissolved form and 51-59% is discharged as particulate matter (Wallin & Hakanson, 1991). With similar dilution, with 700 kg_{feed}, the increase over ambient conditions in total phosphorus concentration at WQ2 was expected to be insignificant (0.0057 mg/L). This was supported by water quality monitoring results which showed no measurable difference between WQ1, WQ2, WQ3, WQ5, and WQ6. See attached data in appendix C labelled "Water Quality Monitoring TN&TP Data Sheet".

This modelling and supporting data suggests that at no point since 2013 has the discharge of regulated nutrients (as described by Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick) from Oak Bay Hatchery produced a measurable (by Maxxam or RPC) effect on receiving waters. This is further evidenced by 2016 monthly sampling in which no exceedances have been observed (See "2016 Regulatory Testing to Date 161004" and associated "Regulatory TN&TP Data Sheet" and "Regulatory TSS Data Sheet" in Appendix B).

27. Strum provided a Water Quality Management Plan which included five water quality monitoring locations around Spoon Island and Oak Bay Hatchery (see appendix C). These locations were monitored on a monthly basis from July-November 2015 and April-July 2016 in an attempt to determine the effect of the facility on the bay.

    Historic regulatory sampling locations (primarily "edge of mixing zone") were questionable when analysed. Table 4 shows total nitrogen concentrations at three regulatory sampling locations for 2015: after drum, effluent, and mixing zone.

Table 3: Total nitrogen concentrations as reported in 2015 regulatory submittals for after drum, effluent, and "mixing zone"

Total Nitrogen (mg/L)				
Month	After Drum	Effluent	Mixing Zone	Feed (kg/day)
June, 2015	6.1	4.8	5.2	242
July, 2015	7.6	5.8	6.0	308
August, 2015	8.4	0.8	0.6	463
September, 2015	8.0	< 2	< 2	454
October, 2015	No Data	0.482	0.301	453
November, 2015	9.89	1.62	0.304	400

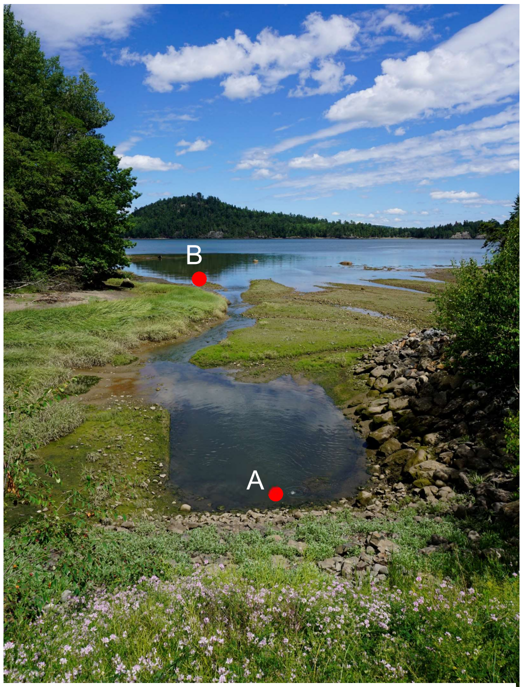


Figure 3: Effluent (A) and "edge of mixing zone" at arbitrary water's edge during ebb tide (B), locations for pre-August 2015.

In 2015, regulatory samples submitted for the so-called "edge of mixing zone" and "effluent" for June and July were taken as the tide went out, as shown in figure 3, not at high tide. This produced "mixing zone" TN concentrations essentially equal to "effluent", indicating insignificant mixing. This location did not accurately demonstrate the impact of the hatchery on the receiving water. Taking the sample as the tide went out also distorted the TN concentration at the "effluent" location as is evidenced by June and July's dilution factor (1.3 times dilution) compared to that of November (6.1 times dilution).

August-November 2015, "edge of mixing zone" samples were taken at UTM Coordinate NAD83 19N 641816, 5008448 from WQMP as recommended by Strum Consulting (see Appendix C). (Note: June-Sept 2015 TN samples were analysed by RPC with a measurement uncertainty of ±50% at TN concentrations close to 0.5 mg/L. Maxxam was used from October-November as they reported measurement uncertainties between 0.02-0.05 mg/L though this accuracy for single samples was later discredited, see #10 for more information.)

Water quality monitoring studies have shown:

1. Point sampling is not a reliable method of monitoring regulated nutrient levels in the receiving water.
2. The facility does not have an effect on the regulated nutrients in bay that is measurable by Maxxam or RPC.

Monitoring of the bay will continue with regulated nutrient samples taken monthly at WQ1, as 'Edge of Mixing' and WQ2 as 'Control Point' (see map in appendix A) until further discussion with DELG takes place.

References:

DELG. (2013, October). *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick*. Retrieved from http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/MarineAquaculture-AquacoleMarin/EnvironmentalManagementProgramLandBasedFinfish.pdf

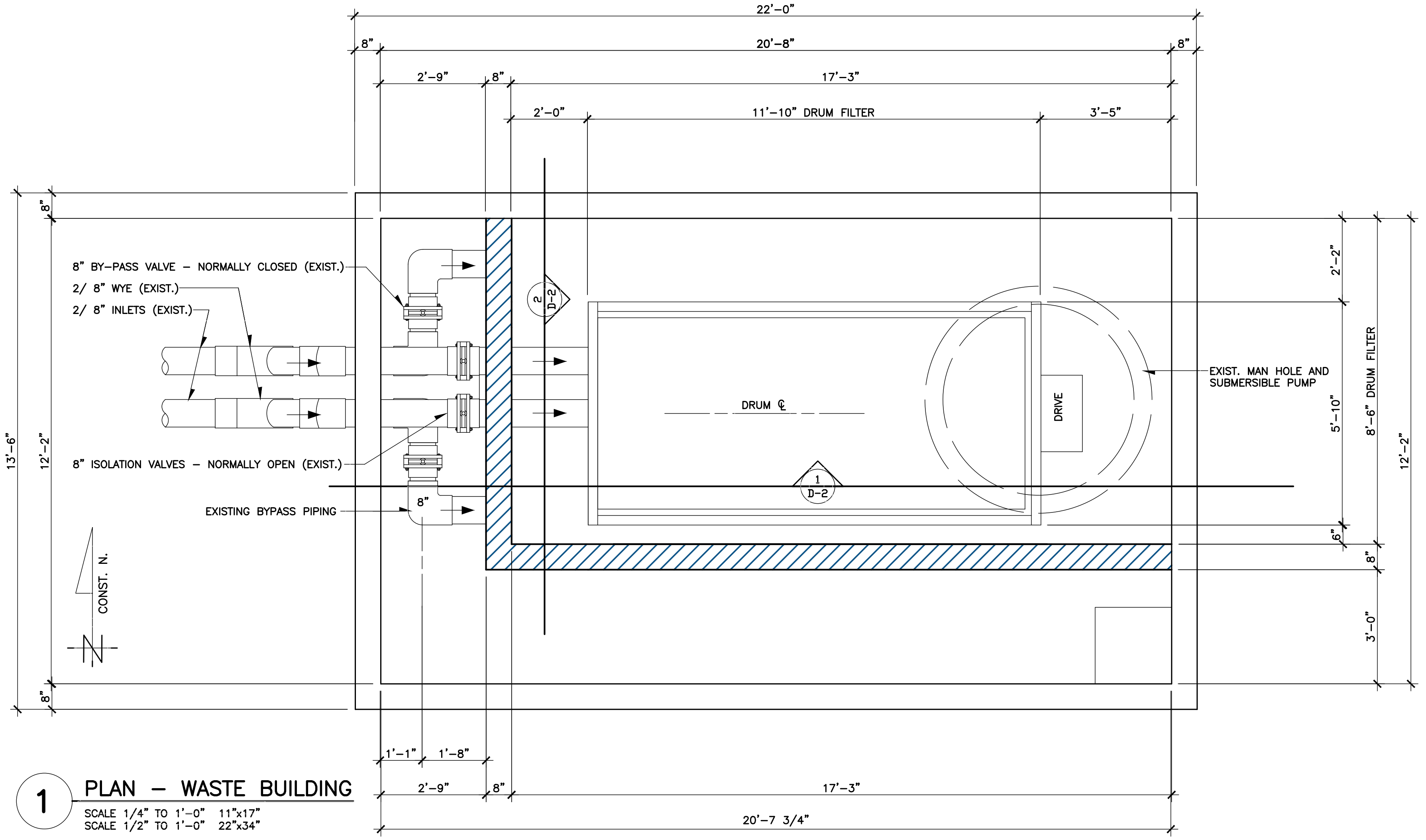
Ebeling, J. M., & Timmons, M. B. (2010). *Recirculating Aquaculture.* Ithaca: Cayuga Aqua Ventures.

Hayter, L. T., Sorensen, M., & Couturier, M. (2016). Reduction of total suspended solids and phosphorus concentrations in salmon-smolt hatchery effluent using chemical treatment. *Bulletin of the Aquaculture Association of Canada*, 18-25.

Wallin, M. and L. Hakanson, 1991. Nutrient loading models for estimating the environmental effects of marine fish farms. In Marine aquaculture and Environment, edited

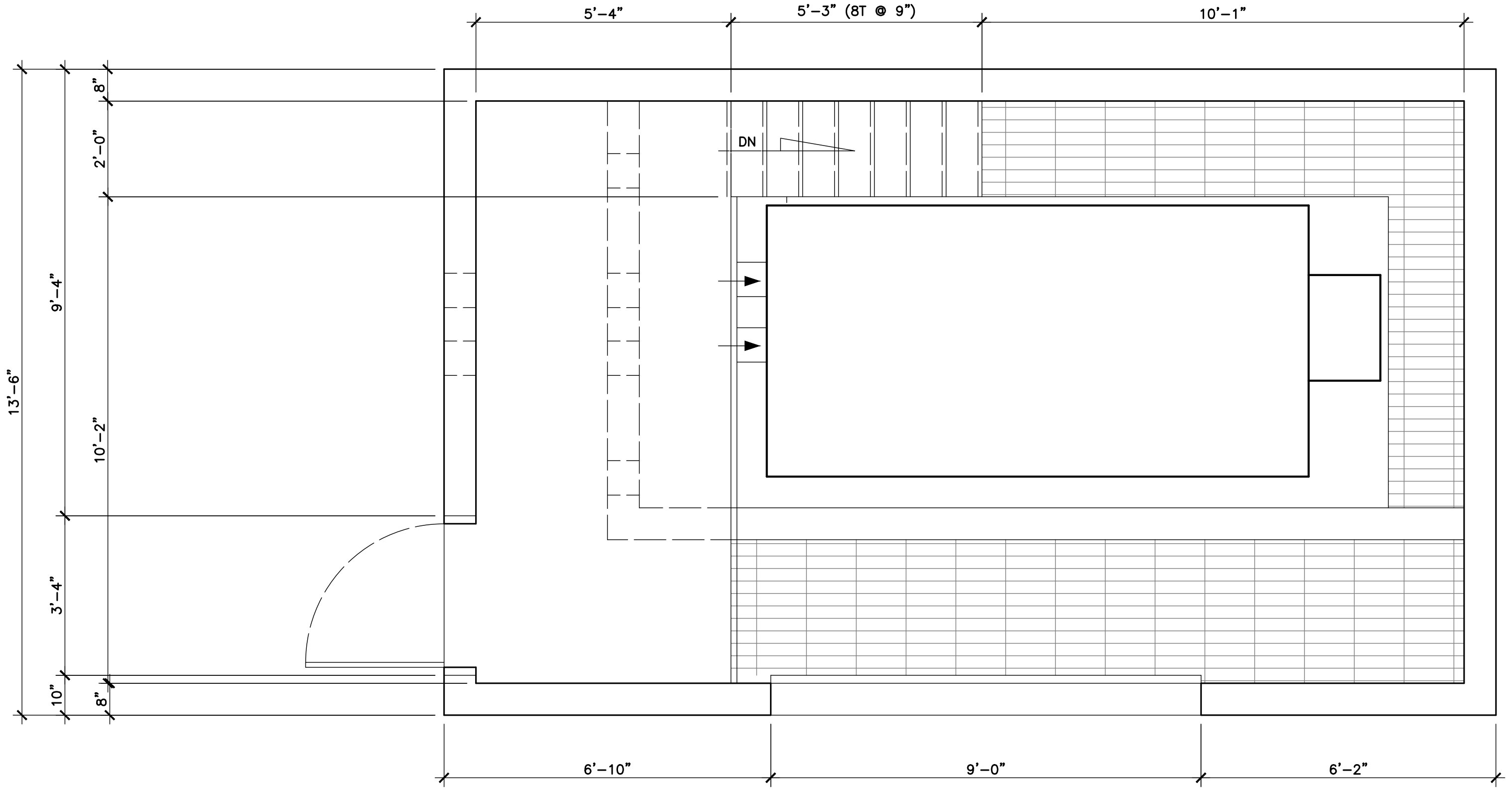
Appendix A: Drawings

- Figure A.1: Drawing of RFM60120 drum filter [D-1 RFM60120 150818]
- Figure A.2: Drawing of WTS Proposed Upgrade [D-1 WTS Upgrade 160816]
- Figure A.3: D-2 WTS Upgrade Aeration 160816
- Figure A.4: Feed modelling area “A” [L-1 OBH Receiving water area A 160725]
- Figure A.5: Well locations [L-2 Well locations 160725]
- Figure A.6: L-3 Oak Bay Site Plan 160802
- Figure A.7: Well Head Locations OBH



1 PLAN – WASTE BUILDING

SCALE 1/4" TO 1'–0" 11"x17"
SCALE 1/2" TO 1'–0" 22"x34"



2 PLAN – UPPER LEVEL

SCALE 1/4" TO 1'–0" 11"x17"
SCALE 1/2" TO 1'–0" 22"x34"

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PROJECT
OAKBAY EFFLUENT TREATMENT

LOCATION
OAK BAY HATCHERY

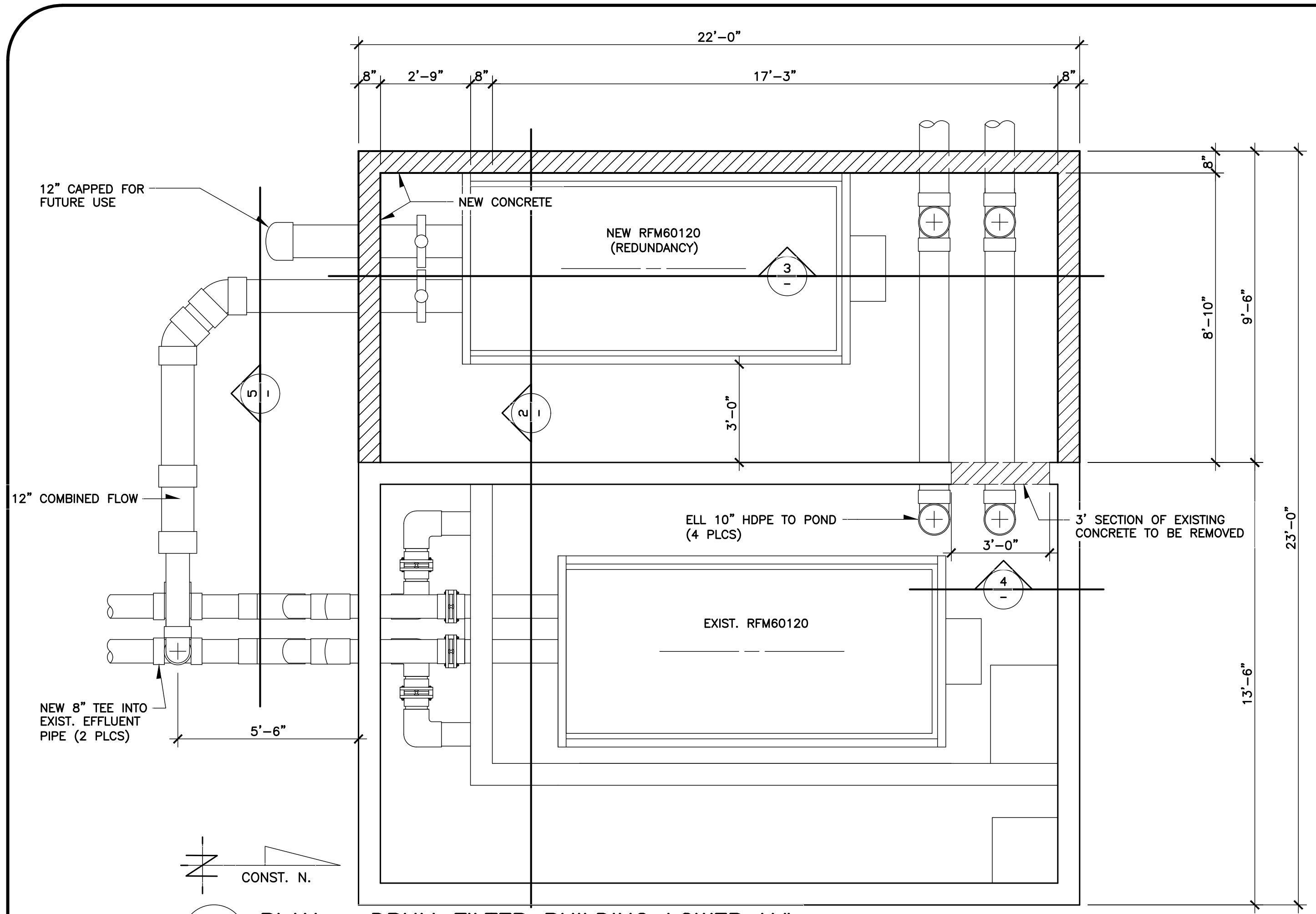
TITLE
BUILDING PLANS

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C12–01	15/10/05	–	M.D.S.	C.A.I.

COSECO
LIMITED
28 YOUNG STREET, GRAND BAY–WESTFIELD, NB E5K 2P8
PHONE (506) 738–2913 FAX (506) 738–8794
EMAIL COSECO1@ROGERS.COM

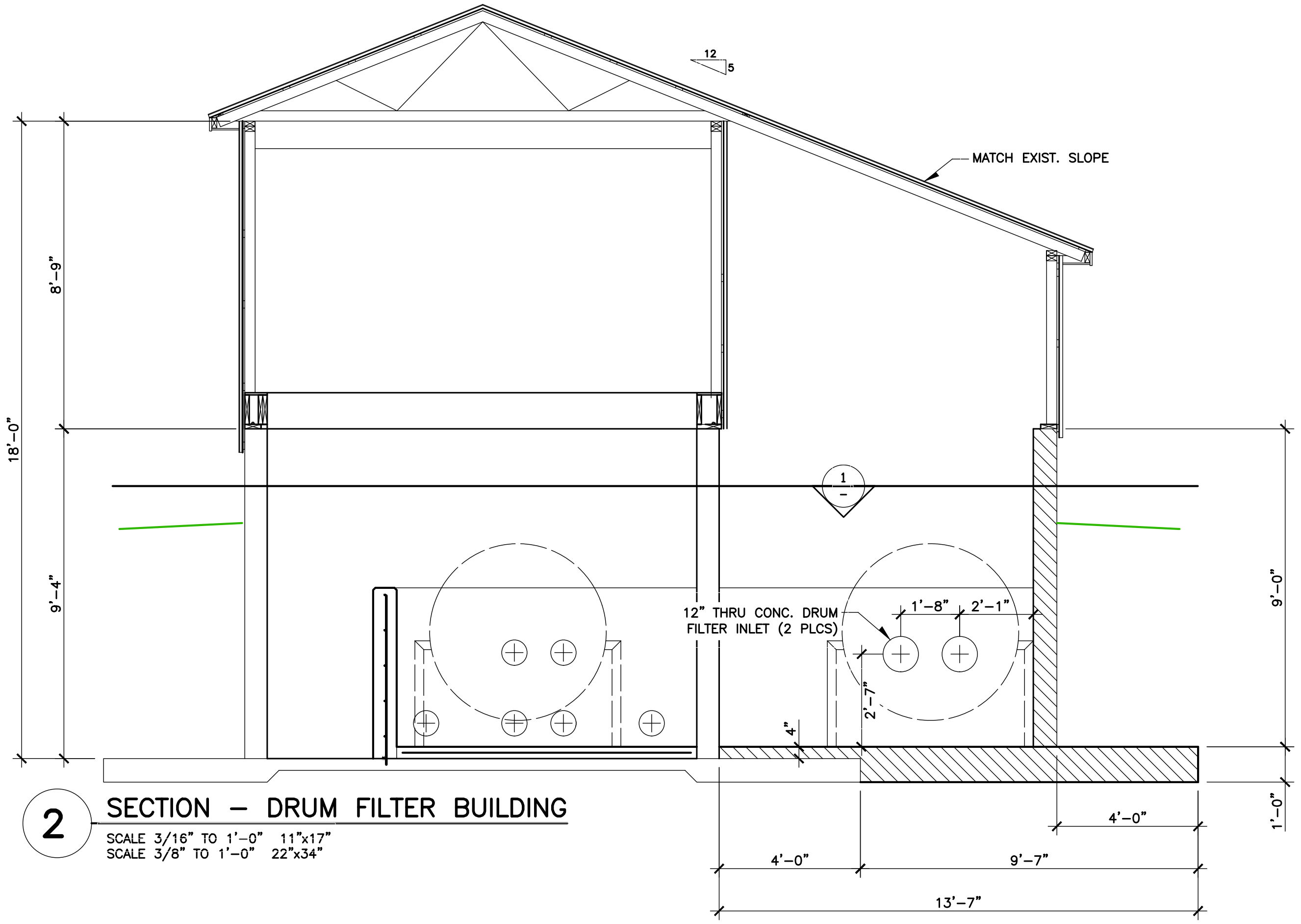
SHEET
D-1
REV. 0

REV.
1



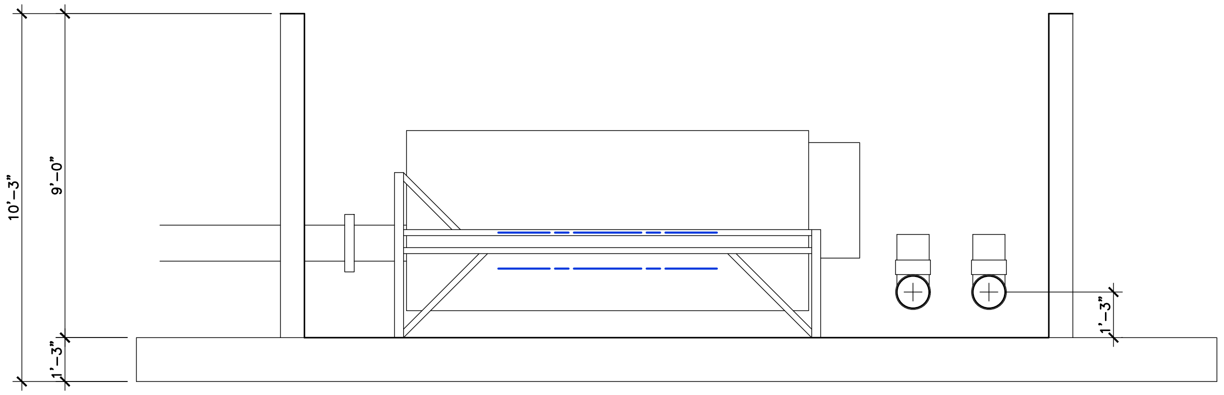
1 PLAN – DRUM FILTER BUILDING LOWER LVL

SCALE 3/16" TO 1'-0" 11"x17"
SCALE 3/8" TO 1'-0" 22"x34"



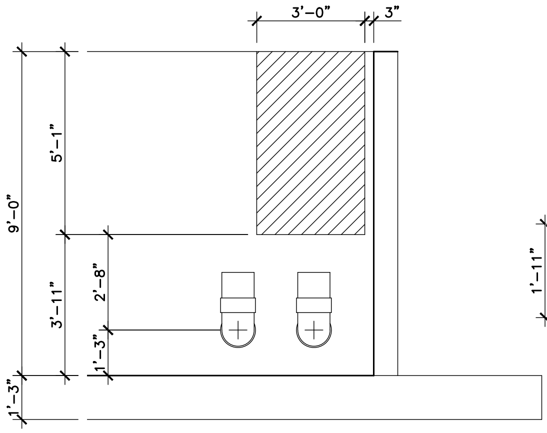
2 SECTION – DRUM FILTER BUILDING

SCALE 3/16" TO 1'-0" 11"x17"
SCALE 3/8" TO 1'-0" 22"x34"



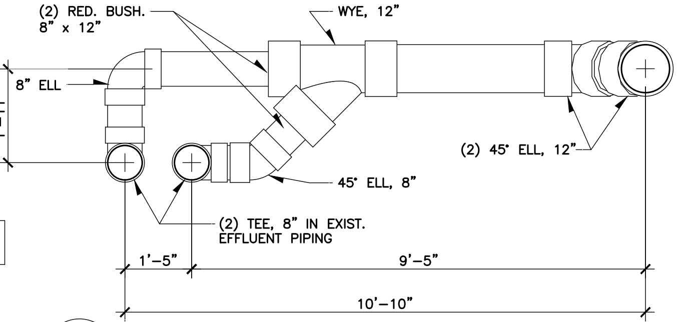
3 SECTION – DRUM FILTER BUILDING LOWER LVL

SCALE 3/16" TO 1'-0" 11"x17"
SCALE 3/8" TO 1'-0" 22"x34"



4 DETAIL – CONC. REMOVAL

SCALE 3/16" TO 1'-0" 11"x17"
SCALE 3/8" TO 1'-0" 22"x34"



5 DETAIL – EFFLUENT PIPING BRANCH

SCALE 1/4" TO 1'-0" 11"x17"
SCALE 1/2" TO 1'-0" 22"x34"

'PRELIMINARY'
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PRINTED ON: 2016/08/16

Cooke AQUACULTURE Inc.

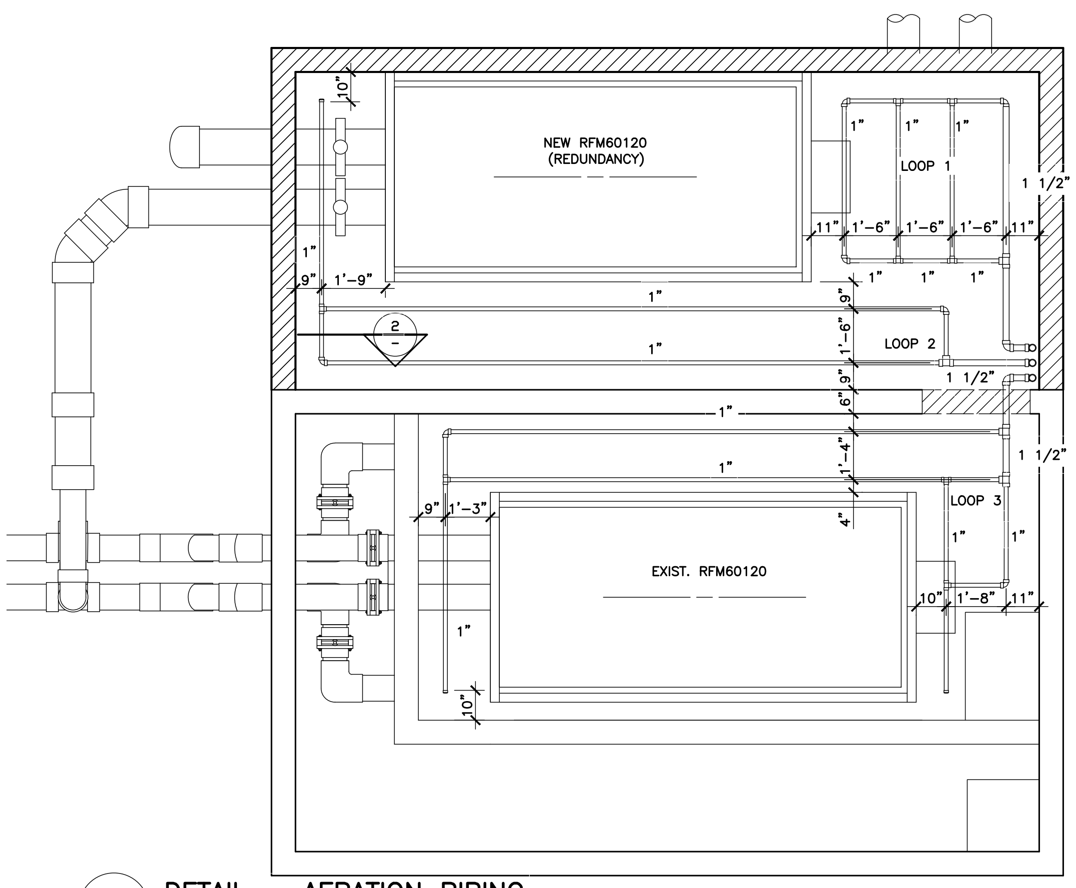
PROJECT
WATER TREATMENT SYSTEM UPGRADE
LOCATION
OAK BAY HATCHERY
TITLE
DRUM FILTER BUILDING MODIFICATION

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C16.05	16/08/16	–	L.T.H.	–

SORENG
SORENSEN ENGINEERING LTD.
145 FREDERICK ST, SAINT ANDREWS, NB E5B 1Z2
PHONE (506) 529-0093 EMAIL MARC@SORENG.CA

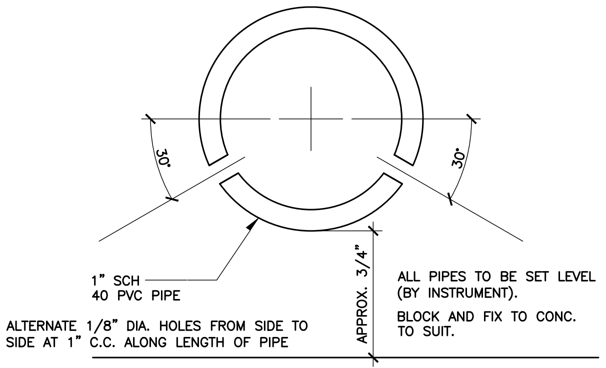
SHEET
D-1
REV. 0

REV.
1



1 DETAIL – AERATION PIPING

SCALE 3/16" TO 1'-0" 11"x17"
SCALE 3/8" TO 1'-0" 22"x34"



1" SCH 40 PVC PIPE

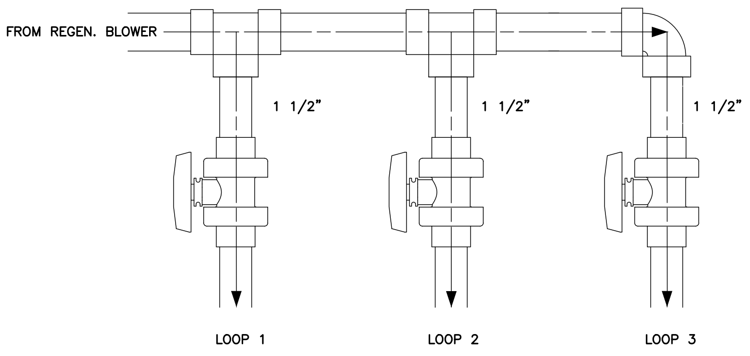
ALTERNATE 1/8" DIA. HOLES FROM SIDE TO SIDE AT 1" C.C. ALONG LENGTH OF PIPE

ALL PIPES TO BE SET LEVEL (BY INSTRUMENT).

BLOCK AND FIX TO CONC. TO SUIT.

2 HOLE LOCATIONS

SCALE 1'-0" TO 1'-0" 11"x17"
SCALE 2'-0" TO 1'-0" 22"x34"



3 AERATION MANIFOLD

SCALE 1" TO 1'-0" 11"x17"
SCALE 2" TO 1'-0" 22"x34"

'PRELIMINARY'
'NOT FOR CONSTRUCTION'

PRINTED ON: 2016/08/16

Cooke AQUACULTURE Inc.

PROJECT
WATER TREATMENT SYSTEM UPGRADE

LOCATION
OAK BAY HATCHERY

TITLE
DRUM FILTER BUILDING AERATION

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C16.05	16/08/16	–	L.T.H.	–

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D-2
REV. 0

1 PLAN – OAK BAY RECEIVING WATER AREA "A"

N.T.S.

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'NOT FOR CONSTRUCTION'

PRINTED ON: 2016/07/25

Cooke AQUACULTURE Inc.

PROJECT
OAK BAY HATCHERY EIA

LOCATION
OAK BAY HATCHERY

TITLE
OAK BAY RECEIVING WATER

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C16.05	16/07/25	–	L.T.H.	–

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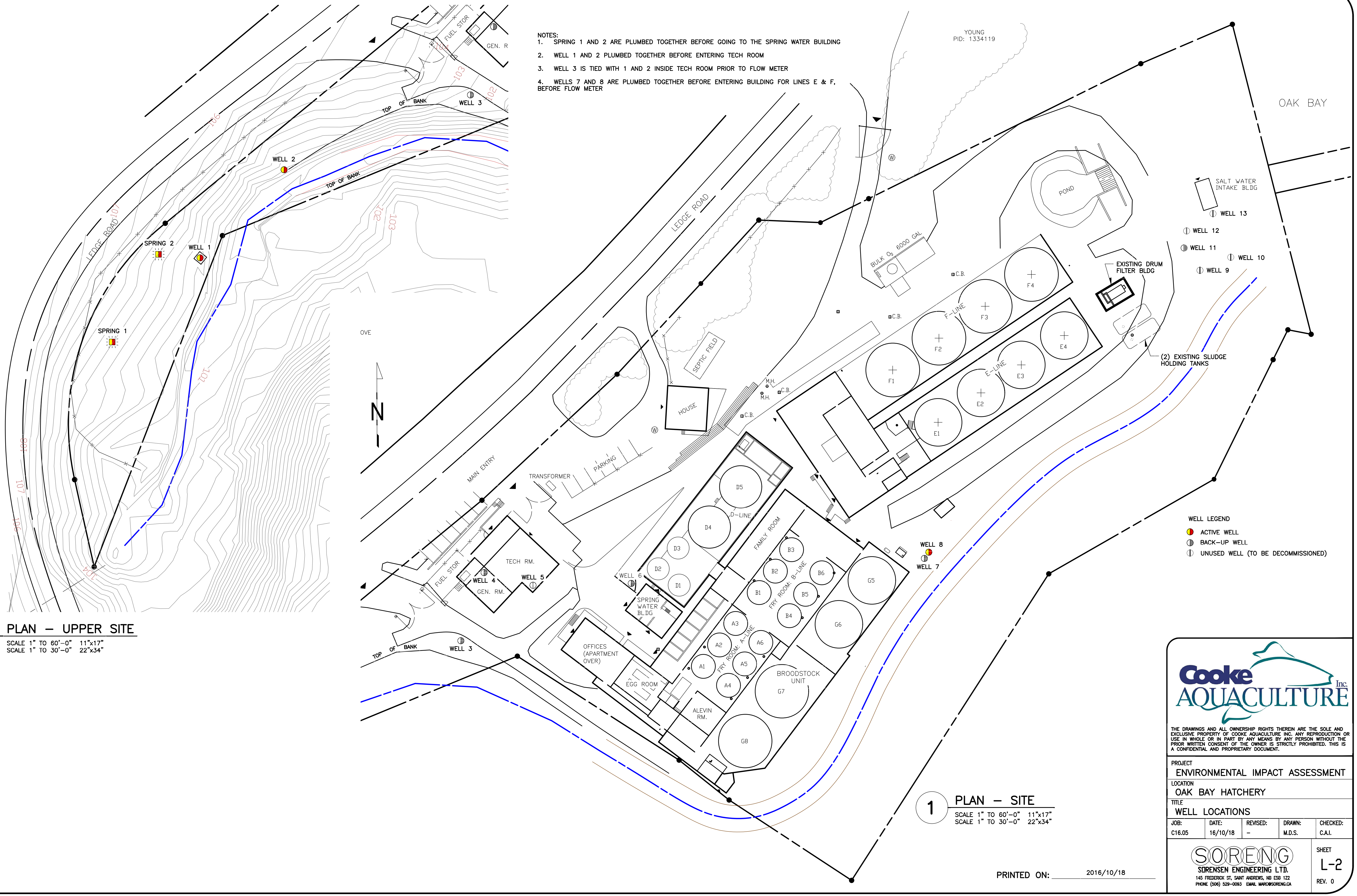
SHEET
L–1
REV. 0

NOTES:
1. SPRING 1 AND 2 ARE PLUMBED TOGETHER BEFORE GOING TO THE SPRING WATER BUILDING
2. WELL 1 AND 2 PLUMBED TOGETHER BEFORE ENTERING TECH ROOM
3. WELL 3 IS TIED WITH 1 AND 2 INSIDE TECH ROOM PRIOR TO FLOW METER
4. WELLS 7 AND 8 ARE PLUMBED TOGETHER BEFORE ENTERING BUILDING FOR LINES E & F, BEFORE FLOW METER



2 PLAN – UPPER SITE
SCALE 1" TO 60'-0" 11"x17"
SCALE 1" TO 30'-0" 22"x34"

1 PLAN – SITE
SCALE 1" TO 60'-0" 11"x17"
SCALE 1" TO 30'-0" 22"x34"

WELL LEGEND
- ◐ ACTIVE WELL
- ◐ BACK-UP WELL
- ◐ UNUSED WELL (TO BE DECOMMISSIONED)

PRINTED ON: 2016/10/18

Cooke AQUACULTURE Inc.

PROJECT
ENVIRONMENTAL IMPACT ASSESSMENT
LOCATION
OAK BAY HATCHERY
TITLE
WELL LOCATIONS

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C16.05	16/10/18	-	M.D.S.	C.A.I.

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SHEET
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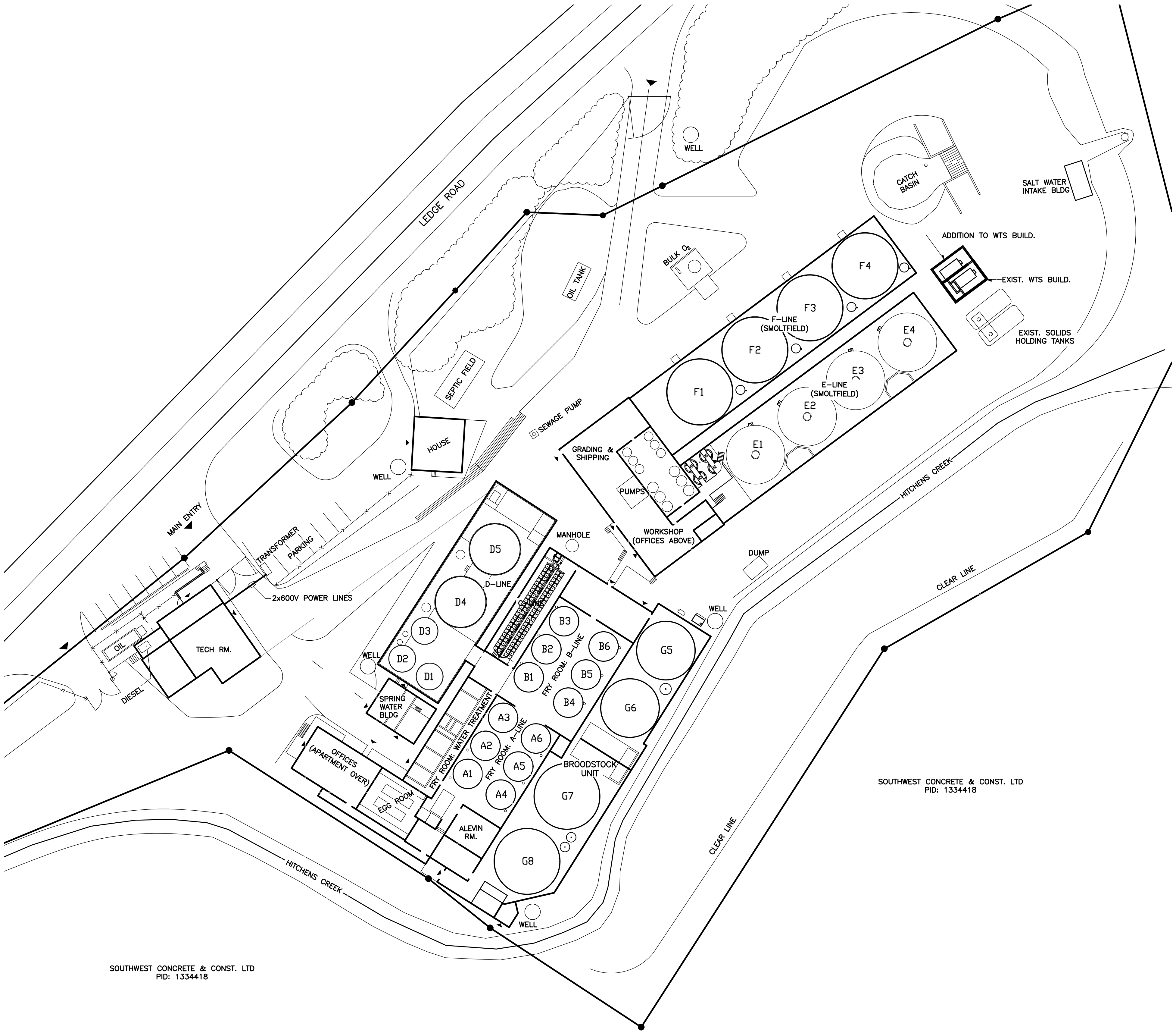

1 PLAN – OAK BAY HATCHERY

SCALE 1/64" TO 1'-0" 11"x17"
SCALE 1/32" TO 1'-0" 22"x34"

'PRELIMINARY'
'NOT FOR CONSTRUCTION'

PRINTED ON: 2016/10/05

PROJECT
OAKBAY EFFLUENT TREATMENT

LOCATION
OAK BAY HATCHERY

TITLE
SITE PLAN

JOB:	DATE:	REVISED:	DRAWN:	CHECKED:
C16.05	16/08/02	-	L.T.H.	-

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PHONE (506) 529-0093 EMAIL MARC@SORENG.CA

SHEET
L-3
REV. 0

CURVE TABLE					RADIUS POINT	
Curve	Radius	Length	Chord	Chord Bear.	Easting	Northing
CURVE1	179.882	49.260	49.107	329°50'55 "	2445211.956	7357206.870
CURVE2	53.225	59.645	56.573	19°27'01 "	2445089.687	7357177.430

Well Head 1
E: 2445063.1049 N: 7357211.7365 El: 9.04
Latitude: 45°12'47.210506" Longitude: 67°11'57.589236"

Well Head 2
E: 2445081.5130 N: 7357230.3300 El: 8.35
Latitude: 45°12'47.817967" Longitude: 67°11'56.753164"

Well Head 3
E: 2445120.2890 N: 7357245.7190 El: 9.80
Latitude: 45°12'48.327407" Longitude: 67°11'54.982457"

Well Head 4
E: 2445121.0070 N: 7357263.3030 El: 9.98
Latitude: 45°12'48.897151" Longitude: 67°11'54.956606"

Well Head 5
E: 2445135.2162 N: 7357256.2038 El: 8.00
Latitude: 45°12'48.671236" Longitude: 67°11'54.302631"

Well Head 6
E: 2445155.7540 N: 7357257.6910 El: 7.54
Latitude: 45°12'48.725225" Longitude: 67°11'53.362096"

Well Head 7
E: 2445216.7050 N: 7357262.8130 El: 5.98
Latitude: 45°12'48.908379" Longitude: 67°11'50.571104"

Well Head 8
E: 2445217.7600 N: 7357264.0380 El: 6.06
Latitude: 45°12'48.948355" Longitude: 67°11'50.523249"

Well Head 9
2445273.2880 N: 7357325.8980 El: 6.42
Latitude: 45°12'50.967686" Longitude: 67°11'48.003446"

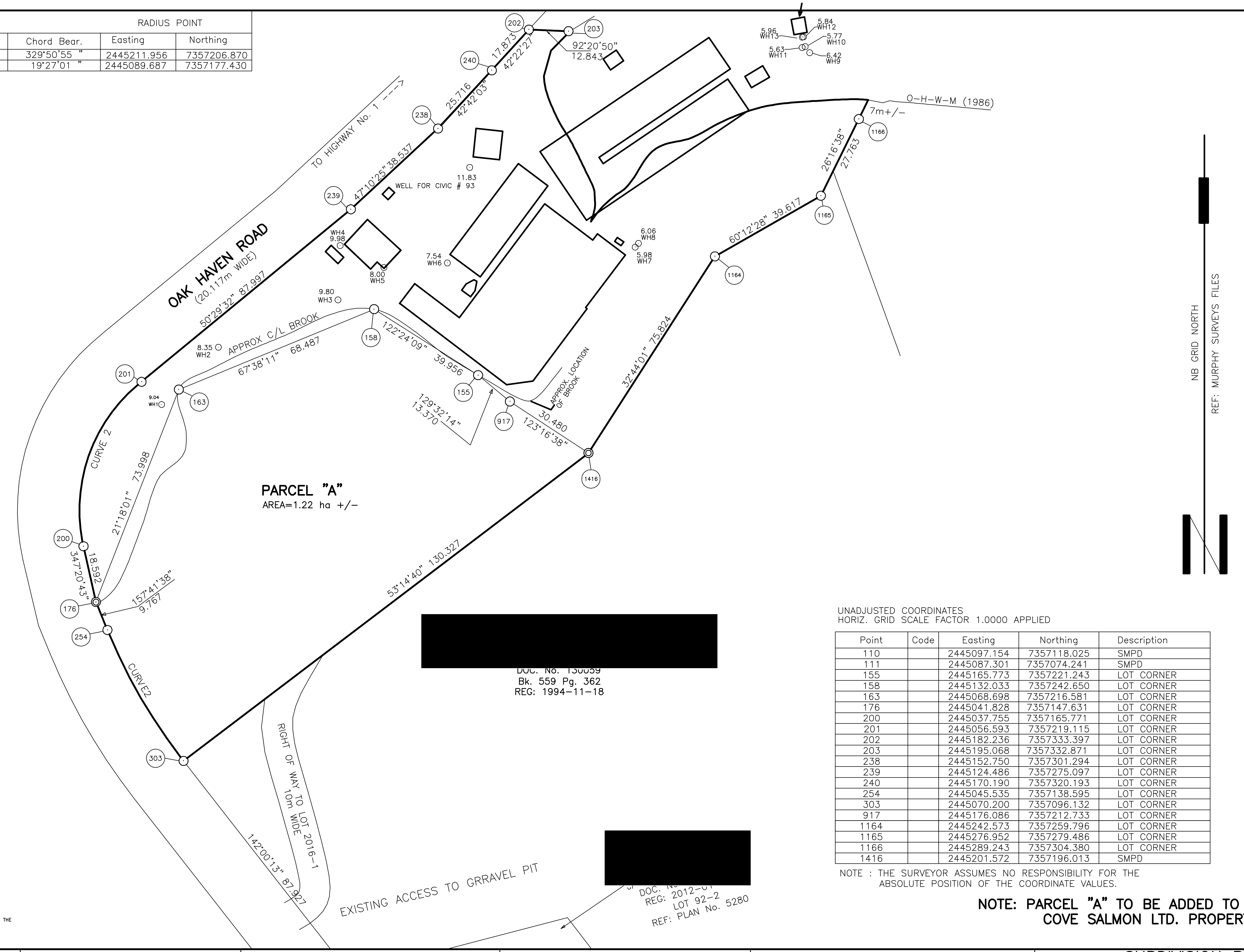
Well Head 10
E: 2445271.8350 N: 7357327.8710 El: 5.77
Latitude: 45°12'51.031180" Longitude: 67°11'48.070819"

Well Head 11
E: 2445270.8490 N: 7357327.5630 El: 5.63
Latitude: 45°12'51.020925" Longitude: 67°11'48.115879"

Well Head 112
E: 2445271.2950 N: 7357331.0130 El: 5.84
Latitude: 45°12'51.132796" Longitude: 67°11'48.096821"

Well Head 13
E: 2445270.8800 N: 7357330.9400 El: 5.96
Latitude: 45°12'51.130314" Longitude: 67°11'48.115809"

Well Head 14
E: 2445163.0270 N: 7357288.6800 El: 11.83
Latitude: 45°12'49.731010" Longitude: 67°11'53.041232"



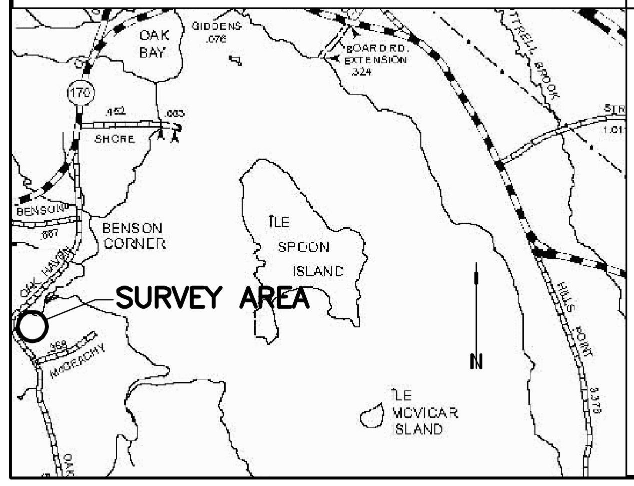
UNADJUSTED COORDINATES
HORIZ. GRID SCALE FACTOR 1.0000 APPLIED

Point	Code	Easting	Northing	Description
110		2445097.154	7357118.025	SMPD
111		2445087.301	7357074.241	SMPD
155		2445165.773	7357221.243	LOT CORNER
158		2445132.033	7357242.650	LOT CORNER
163		2445068.698	7357216.581	LOT CORNER
176		2445041.828	7357147.631	LOT CORNER
200		2445037.755	7357165.771	LOT CORNER
201		2445056.593	7357219.115	LOT CORNER
202		2445182.236	7357333.397	LOT CORNER
203		2445195.068	7357332.871	LOT CORNER
238		2445152.750	7357301.294	LOT CORNER
239		2445124.486	7357275.097	LOT CORNER
240		2445170.190	7357320.193	LOT CORNER
254		2445045.535	7357138.595	LOT CORNER
303		2445070.200	7357096.132	LOT CORNER
917		2445176.086	7357212.733	LOT CORNER
1164		2445242.573	7357259.796	LOT CORNER
1165		2445276.952	7357279.486	LOT CORNER
1166		2445289.243	7357304.380	LOT CORNER
1416		2445201.572	7357196.013	SMPD

NOTE : THE SURVEYOR ASSUMES NO RESPONSIBILITY FOR THE ABSOLUTE POSITION OF THE COORDINATE VALUES.

NOTE: PARCEL "A" TO BE ADDED TO THE KELLY COVE SALMON LTD. PROPERTY

KEY PLAN SCALE: 1:40000



GEOCODE: 2445195 7357333

ENDORSEMENTS

DEED DATA: DOC. No. 130059
Bk. 559 Pg. 362

OWNER:______________________

APPROVED

....
FOR DEVELOPMENT OFFICER
SOUTHWEST NEW BRUNSWICK
SERVICE COMMISSION

DATE

Approval valid for one year only unless filed

NOTES

1. ALL DIMENSIONS ARE IN METRES AND DECIMALS THEREOF.
2. THE PLAN HEREON HAS BEEN ARRIVED AT and/or COMPILED FROM CONSIDERATION OF SOME OR ALL OF THE FOLLOWING:
   (I) FIELD EVIDENCE
   (II) INFORMATION TAKEN FROM THE FILES OF MURPHY SURVEYS (1990) LTD.
   (III) VARIOUS DEEDS AND/OR PLANS FROM THE CHARLOTTE COUNTY REGISTRY OFFICE
3. THE INFORMATION EXPRESSED ON THIS PLAN IS ISSUED TO and MAY BE RELIED UPON SOLELY BY THE PROPERTY OWNER FOR WHOM THIS PLAN WAS PREPARED. RELIANCE ON SUCH INFORMATION BY THIRD PARTIES SHALL BE AT THEIR OWN RISK and WE ASSUME NO RESPONSIBILITY OR LIABILITY WITH RESPECT TO ANY SUCH RELIANCE.
4. P.I.D NUMBERS ARE TAKEN FROM SNB PROPERTY INDEX MAPS.

LEGEND

━	LANDS DEALT WITH THIS PLAN BOUNDED THUS
◎	STANDARD SURVEY MARKER PLACED
◉	STANDARD SURVEY MARKER FOUND
■	SQUARE IRON ROD
●	ROUND IRON ROD
FD	FOUND
⊙	CALCULATED POINT
PD	PLACED
②	LOT CORNER
▭	BUILDING
—x—x—	FENCE
m²	SQUARE METRES

ANBLS AAGNB
No. 205546

20 0 40 60
GRAPHIC SCALE – METRES 1:1000

ROBERT S. MANN, N.B.L.S. No. 357

DATE: MAY 24, 2016

DATE SURVEY COMPLETED	PLAN No.	JOB No.
MAY 24, 2016	2-3712	16061

SUBDIVISION PLAN

[redacted]

SUBDIVISION 2016-1

PARCEL "A"

OAK HAVEN ROAD
PARISH OF ST. DAVID
COUNTY OF CHARLOTTE
PROVINCE OF NEW BRUNSWICK

MURPHY SURVEYS (1990) LTD.

#9291 ROUTE 3
OLD RIDGE, N.B.
E3L 4X2

TELEPHONE No. (506) 466-1941
FACSIMILE No. (506) 466-6876

Appendix B: October 4, 2016 Water Quality Data

- Water Quality Analysis Report
  - 2015 Regulatory
  - Maxxam Reports
    - October 2015
    - November 2015
    - May 2016
    - June 2016
    - August 2016
    - September 2016
- 2016 Regulatory Testing to Date
- Composite Sample TN&TP Data Sheet
- Composite Sample TSS Data Sheet
- Regulatory TN&TP Data Sheet
- Regulatory TSS Data Sheet
- Triplicate TN Data Sheet
- Water Quality Monitoring TN&TP Data Sheet
- Water Quality Monitoring TSS Data Sheet
- After Drum and Effluent TN Data Sheet

2016 Regulatory Testing – Oak Bay Hatchery

June to September, 2016

Date	Location	TN (mg/L)	TP (mg/L)	Temp. (°C)	DO (mg/L)	pH	TAN	TSS	Flow (m^3/h)	COD (mg/L)
Regulatory Limit		0.50	0.035	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16-Jun-16	Intake	0.282	ND	7.5	8	7.10	ND		105	
	Before Drum	9.47	1.5	11	9.1	7.10	1.2	6.8		
	After Drum	7.98	0.83	11	9.4	7.10	0.76	7.04 +/- 1.26		
	Effluent	1.26	0.15	12.1	11.1	7.95	0.20		105	820
	Edge of Mixing Zone	0.248*	0.036	11.5	10.7	7.82	0.074	17.96 +/- 0.38		
	Control Station	0.105*	0.038	11.2	10.7	8.02	ND	16.97 +/- 0.37		
30-Jun-16	Intake	0.326	0.021				0.11		115	
	Before Drum	9.01	0.76	11.4	8.9			-		
	After Drum	8.60	0.68	11.4	8.9		1.2	3.87 +/- 0.70		
	Effluent	0.685	0.083	15.7	9.8	***	0.22		115	940
	Edge of Mixing Zone	0.285 ± 0.031	0.049	15.4	9	***	0.12	17.38 +/- 0.21		
	Control Station	0.272*	0.038	14.8	9.6	***	0.054	17.16 +/- 0.34		
24-Aug-16	Intake	0.825	ND	8.3	8.1	6.70	0.26		***	
	Before Drum	11.1	0.56	12	9.5	7.09		17.32 +/- 2.83		
	After Drum	12.6	0.85	12.4	10.8	7.01	1.2	11.19 +/- 0.56		
	Effluent	1.19	0.081	18.5	9.6	8.03	0.32	21.33 +/- 1.92	***	710
	Edge of Mixing Zone	0.386 ± 0.225	0.10	18.7	10.1	8.09	0.29	22.01 +/- 1.02		
	Control Station	0.348 ± 0.304	0.11	18.7	10.4	8.10	0.44	19.81 +/- 1.83		
14-Sep-16	Intake	0.582	ND	7.9	-	7.18	0.35	-	80	
	Before Drum	14.2	0.82	11.5	9.4	7.15		31.89 +/- 7.26		
	After Drum	13.7	0.64	11.6	9.2	6.99	1.3	14.13 +/- 0.26		
	Effluent	0.518	0.20	16.3	8.2	8.14	0.20	22.79 +/- 0.86	80	710
	Edge of Mixing Zone	0.339 ± 0.183	ND	16.9	9.8	8.21	0.26	21.55 +/- 3.14		
	Control Station	0.376 ± 0.424	0.23	16.9	10	8.23	0.29	17.85 +/- 0.19		

ND – Not detected by Maxxam Analytics

*** Probe not functioning

*Not in triplicate

Composite Testing Data							
Sampling Location	**Maxxam Job #**	**Date/Time**	**ID#**	**TN (mg/L)**	**ID#**	**TP (mg/L)**	**Measurement Uncertainty (+/- mg/L)**
After Drum	B6D8539, B655785	June 27, 2016 7:00 pm - 11:30 pm	102, 103	7.61	102	0.75	0.094
	B6D8539, B655785	June 28, 2016 7:00 am - 1:00 pm	113, 114	8.35	113	0.85	0.10
	B6D8539, B655785	June 28, 2016 1:00 pm - 7:00 pm	120, 121	7.76	120	0.77	0.096
	B6D8539, B655785	June 28, 2016 7:00 pm - June 29, 2016 7:00 am	123, 124	8.345	123	0.84	0.10
	B6D8539, B655785	June 29, 2016 7:30 am - 7:30 pm	134	7.97	134	0.86	0.11
	B6D8539, B655785	June 29, 2016 8:30 pm - June 30, 2016 8:30 am	141	8.39	141	0.80	0.12

Composite TSS Data

Date	Location	Volume (L)	Mass (mg)	Concentration (mg/L)
6/27/2016	Composite 7:00 pm - 11:30 pm	3.2	25	7.89
6/28/2016	Composite 7:00 am - 1:00 pm	7.6	105	13.77
	Composite 1:00 pm - 7:00 pm	8.3	86.0	10.35
6/29/2016	Composite 7:30 am - 7:30 pm	5.2	47.0	9.09
30-Jun-16	Composite 8:30 pm - 8:30 am	6.3	37	5.92

Regulatory Data - TN & TP								
Sampling Location	**Maxxam Job #**	**Date**	**ID#**	**TN (mg/L)**	**90% CI**	**ID#**	**TP (mg/L)**	**Measurement Uncertainty (+/- mg/L)**
Intake	B650760, B6C7304	6/16/2016	Intake	0.282	-	Intake	ND	-
	B655795, B6D6954	6/30/2016	Intake	0.326	-	Intake	0.021	0.020
	B6I3368, B674358	8/24/2016	Intake	0.825	-	Intake	ND	-
	B6K0974, B682125	9/14/2016	Intake	0.582	-	Intake	ND	-
Before Drum	B650760, B6C7304	6/16/2016	Before Drum	9.47	-	Before Drum	1.5	0.18
	B655795, B6D6954	6/30/2016	Before Drum	9.01	-	Before Drum	0.76	0.094
	B6I3368, B674358	8/24/2016	Before Drum	11.1	-	Before Drum	0.56	-
	B6K0974, B682125	9/14/2016	Before Drum	14.2	-	Before Drum	0.82	-
After Drum	B650760, B6C7304	6/16/2016	After Drum	7.98	-	After Drum	0.83	0.1
	B655795, B6D6954	6/30/2016	After Drum	8.6	-	After Drum	0.68	0.086
	B6I3368, B674358	8/24/2016	After Drum	12.6	-	After Drum	0.48	0.045
	B6K0974, B682125	9/14/2016	After Drum	13.7	-	After Drum	0.64	0.056
Effluent	B650760, B6C7304	6/16/2016	Effluent	1.26	-	Effluent	0.15	0.029
	B655795, B6D6954	6/30/2016	Effluent	0.685	-	Effluent	0.083	0.024
	B6I3368, B674358	8/24/2016	Effluent	1.19	-	Effluent	0.081	0.025
	B6K0974, B682125	9/14/2016	Effluent	0.518	-	Effluent	0.20	< 0.20
WQ1 Edge of Mixing Zone	B650771, B6C7308	6/16/2016	N-1	0.248	-	N-1	0.031	0.021
	B655795, B6D6954	6/30/2016	Mixing Zone	0.285	-	Mixing Zone	0.049	0.021
	B674260, B6I3368, B674358	8/24/2016	Mixing Zone, 101, 102	0.386	0.225	Mixing Zone	0.10	-
	B682122, B6K0974, B682125	9/14/2016	Mixing Zone, 101, 102	0.339	0.183	Mixing Zone	ND	-
WQ2 Control Station	B650771, B6C7308	6/16/2016	M-1	0.105	-	M-1	0.022	0.02
	B6D8539, B655785	6/30/2016	M-1	0.272	-	M-1	0.038	0.021
	B674260, B6I3368, B674358	8/24/2016	Control Station, 103, 104	0.348	0.304	Control Station	0.11	-
	B682122, B6K0974, B682125	9/14/2016	Control Station, 103, 104	0.376	0.424	Control Station	0.23	-

Regulatory Data - TSS

Date	Location	Volume (L)	Mass (mg)	Concentration (mg/L)	Average Concentration (mg/L)	Standard Deviation
6/16/2016 10:00 AM	WQ5	4.1	72	17.38	16.97	0.37
		4.1	68	16.65		
		4.1	70	16.89		
	WQ6	4.0	71	17.64	17.96	0.38
		4.0	74	18.38		
		4.1	73	17.87		
	WQ2	4.1	75	18.36	18.19	0.52
		4.2	74	17.60		
		4.1	76	18.60		
	WQ3	4.1	74	18.11	17.87	0.24
		4.1	74	17.86		
		4.1	72	17.62		
	WQ1	4.0	75	18.63	18.28	0.39
		4.1	74	17.86		
		4.1	76	18.34		
	After Drum	4.0	24	5.98	7.04	1.26
		2.5	17	6.72		
		2.6	22	8.43		
	After Catch Basin	2.1	23	10.81	10.51	0.26
		2.4	25	10.38		
		2.8	29	10.34		
6/30/2016 8:45 AM	WQ5	4.0	70	17.54	17.16	0.34
		4.0	68	16.88		
		4.0	68	17.04		
	WQ6	3.9	69	17.62	17.38	0.21
		4.0	69	17.29		
		4.1	70	17.22		
	WQ2	4.1	65	15.85	16.29	1.09
		3.9	68	17.53		
		4.1	63	15.50		
	WQ3	4.0	66	16.70	13.27	4.85
		8.1	80	9.84		
	WQ1	4.0	68	17.20	17.79	0.74
		4.0	70	17.54		
		4.0	75	18.62		
	After Drum	3.1	13	4.15	3.87	0.70
		3.3	10	3.07		
		3.4	15	4.39		
	After Catch Basin	3.1	18	5.90	5.99	0.73
		2.8	19	6.76		
		3.0	16	5.31		

Regulatory Data - TSS (Continued)						
Date	**Location**	**Volume (L)**	**Mass (mg)**	**Concentration (mg/L)**	**Average Concentration (mg/L)**	**Standard Deviation**
8/24/2016 6:00 PM	Before Drum	3.39	59	17.39	17.32	2.83
		3.43	69	20.11		
		3.80	55	14.46		
	After Drum	3.24	37	11.40	11.19	0.56
		3.51	37	10.56		
		2.24	26	11.62		
	Effluent	3.92	77	19.67	21.33	1.92
		3.88	81	20.89		
		3.54	83	23.43		
	WQ1	3.88	82	21.14	21.72	0.88
		3.62	77	21.29		
		3.43	78	22.74		
	WQ2	3.73	67	17.97	19.81	1.83
		3.73	74	19.84		
		3.65	79	21.62		
9/14/2016 10:45 AM	Before Drum	2.50	64	25.62	31.89	7.26
		2.65	80	30.22		
		2.61	104	39.84		
	After Drum	2.50	36	14.41	14.13	0.26
		2.01	28	13.91		
		2.27	32	14.07		
	After Catch Basin	4.10	63	15.36	16.52	1.65
		3.51	62	17.69		
	Effluent	3.54	84	23.71	22.79	0.86
		3.84	87	22.65		
		3.54	78	22.02		
	WQ1	3.73	78	20.92	21.55	3.14
		3.73	70	18.77		
		2.68	67	24.95		
	WQ2	3.69	66	17.88	17.82	0.19
		3.69	65	17.61		
		3.73	67	17.97		

Triplicate Data

Date	Location	Maxxam Job #	ID #	TN	Average	St. Dev	90% C.I.
28-Jun-16	Near-field (WQ1)	B655785	104	0.267	0.269	0.053	0.089
			105	0.218			
			106	0.323			
28-Jun-16	Far-field (WQ6)	B655785	107	0.249	0.211	0.039	0.066
			108	0.171			
			109	0.212			
28-Jun-16	WQ5	B655785	110	0.269	0.385	0.124	0.208
			111	0.515			
			112	0.37			
29-Jun-16	Near-field (WQ1)	B655785	125	0.239	0.314	0.178	0.300
			126	0.517			
			127	0.186			
29-Jun-16	Far-field (WQ6)	B655785	128	0.301	0.411	0.103	0.174
			129	0.425			
			129	0.506			
29-Jun-16	WQ5	B655785	131	0.489	0.350	0.138	0.233
			132	0.213			
			133	0.349			
30-Jun-16	Near-field (WQ1)	B655785	N-1	0.26	0.285	0.031	0.052
			135	0.258			
			136	0.3			
		B655795	Mixing Zone	0.321			
30-Jun-16	Far-field (WQ6)	B655785	F-1	0.227	0.263	0.031	0.053
			137	0.277			
			138	0.285			
30-Jun-16	WQ5	B655785	C-1	0.23	0.250	0.047	0.080
			139	0.243			
			140	0.318			
		B655795	Control Station	0.21			
24-Aug-16	Near-field (WQ1)	B674358	Mixing Zone	0.485	0.386	0.133	0.225
		B674260	101	0.438			
			102	0.234			
24-Aug-16	Mid-field (WQ2)	B674358	Mixing Zone	0.550	0.348	0.180	0.304
		B674260	103	0.288			
			104	0.205			
14-Sep-16	Near-field (WQ1)	B682125	Mixing Zone	0.456	0.339	0.109	0.183
		B682122	101	0.241			
			102	0.32			
14-Sep-16	Mid-field (WQ2)	B682125	Mixing Zone	0.666	0.376	0.252	0.424
		B682122	103	0.216			
			104	0.246			

Water Quality Monitoring Data TN & TP								
Sampling Location	Maxxam Job #	Date	ID#	TN (mg/L)	90% CI	ID#	TP (mg/L)	Measurement Uncertainty (+/- mg/L)
WQ1	Strum Water Quality Report	7/15/2015	SW14, SW13	0.462	-	SW14, SW13	0.08	-
	B5L2695, B593159	10/15/2015	WQ1	0.296	-	WQ1	0.049	-
	B5A4132, B5N7763	11/17/2015	WQ1	0.478	-	WQ1	ND	-
	B6A1905, B639599	5/17/2016	N-1	0.225	-	N-1	0.034	-
	B646130, B64611	6/2/2016	N-1	0.202	-	N-1	0.045	-
	B646139, B6B4597		Mixing Zone	0.314	-	Mixing Zone	0.045	-
	B650771, B6C7308	6/16/2016	N-1	0.248	-	N-1	0.031	0.021
	B6D8539, B655785	6/28/2016	104, 105, 106	0.269*	0.089	104	0.048	0.021
	B6D8539, B655785	6/28/2016	117	0.259	-	117	0.044	0.021
	B6D8539, B655785	6/29/2016	125, 126, 127	0.314*	0.300	125	0.042	0.021
	B6D8539, B655785	6/30/2016	N-1, 135, 136	0.273*	0.052	N-1	0.044	0.021
	B655795, B6D6954		Mixing Zone	0.321	-	Mixing Zone	0.049	0.021
	B674260, B6I3368, B674358	8/24/2016	Mixing Zone	0.386*	0.225	Mixing Zone	0.10	0.026
	B682122, B6K0974, B682125	9/14/2016	Mixing Zone	0.339*	0.183	Mixing Zone	ND	N/A
WQ2	Strum Water Quality Report	7/15/2015	SW16, SW15	0.382	-	SW16, SW15	0.0465	-
	B5L2695, B593159	10/15/2015	WQ2	0.245	-	WQ2	0.049	-
	B5A4132, B5N7763	11/17/2015	WQ2	0.432	-	WQ2	0.059	-
	B6A1905, B639599	5/17/2016	M-1	0.17	-	M-1	0.037	-
	B646130, B64611	6/2/2016	M-1	0.149	-	M-1	0.036	-
	B650771, B6C7308	6/16/2016	M-1	0.105	-	M-1	0.022	0.020
	B6D8539, B655785	6/30/2016	M-1	0.272	-	M-1	0.038	0.021
	B674260, B6I3368, B674358	8/24/2016	Control	0.348*	0.304	Control	0.11	0.026
	B682122, B6K0974, B682125	9/14/2016	Control	0.376*	0.424	Control	0.23	< 0.20
WQ3	Strum Water Quality Report	7/15/2015	SW18, SW17	0.442	-	SW18, SW17	0.0225	-
	B5L2695, B593159	10/15/2015	WQ3	0.242	-	WQ3	0.049	-
	B5A4132, B5N7763	11/17/2015	WQ3	0.67	-	WQ3	0.051	-
	B6A1905, B639599	5/17/2016	M-2	0.216	-	M-2	0.043	-
	B646130, B64611	6/2/2016	M-2	0.196	-	M-2	0.040	-
	B650771, B6C7308	6/16/2016	M-2	0.162	-	M-2	0.025	0.021
	B6D8539, B655785	6/30/2016	M-2	0.199	-	M-2	0.037	0.021
WQ5	Strum Water Quality Report	7/15/2015	SW22, SW21	0.356	-	SW22, SW21	0.0285	-
	B5L2695, B593159	10/15/2015	WQ5	0.328	-	WQ5	0.047	-
	B6A1905, B639599	5/17/2016	C-1	0.187	-	C-1	0.040	-
	B646130, B64611	6/2/2016	C-1	0.178	-	C-1	0.038	-
	B646139, B6B4597		Control	0.506	-	Control	0.043	-
	B650771, B6C7308	6/16/2016	C-1	0.117	-	C-1	0.03	0.020
	B650760, B6C7304		Control	0.154	-	Control	0.038	0.021
	B6D8539, B655785	6/28/2016	110, 111, 112	0.385*	0.208	110	0.04	0.021
	B6D8539, B655785	6/28/2016	119	0.461	-	119	0.037	0.021
	B6D8539, B655785	6/29/2016	131, 132, 133	0.350*	0.233	131	0.072	0.023
	B6D8539, B655785	6/30/2016	C-1, 139, 140	0.264*	0.080	C-1	0.10	0.025
	B655795, B6D6954		Control	0.210	-	Control	0.038	0.021
WQ6	Strum Water Quality Report	7/15/2015	SW24, SW23	0.4705	-	SW24, SW23	0.0255	-
	B5L2695, B593159	10/15/2015	WQ6	0.306	-	WQ6	0.047	-
	B5A4132, B5N7763	11/17/2015	WQ6	0.557	-	WQ6	0.053	-
	B6A1905, B639599	5/17/2016	F-1	0.188	-	F-1	0.043	-
	B646130, B64611	6/2/2016	F-1	0.182	-	F-1	0.038	-
	B650771, B6C7308	6/16/2016	F-1	0.115	-	F-1	0.023	0.020
	B650760, B6C7304		Mixing Zone	0.174	-	Mixing Zone	0.036	0.021
	B6D8539, B655785	6/28/2016	107, 108, 109	0.211*	0.066	107	0.038	0.021
	B6D8539, B655785	6/28/2016	118	0.225	-	118	0.039	0.021
	B6D8539, B655785	6/29/2016	128, 129, 130	0.411*	0.233	128	0.05	0.021
	B6D8539, B655785	6/30/2016	F-1, 137, 138	0.263*	0.053	F-1	0.038	0.021

**** Only data marked with (*) are triplicate samples, all other data are point samples and are not a reliable representation of actual TN concentrations

Water Quality Monitoring Data TSS (Page 1)

Date	Location	Volume (L)	Mass (mg)	Concentration (mg/L)	Average Concentration (mg/L)	Standard Deviation
5/17/2016 10:00 AM	WQ5	3.7	64	17.34	16.51	0.85
		3.8	63	16.56		
		4.0	63	15.64		
	WQ6	3.9	58	14.96	15.83	0.83
		3.9	65	16.60		
		4.1	66	15.95		
	WQ2	3.8	57	15.13	14.88	0.22
		4.1	60	14.76		
		4.1	61	14.74		
	WQ3	3.7	61	16.36	16.26	1.25
		4.0	69	17.46		
		3.9	58	14.96		
	WQ1	5.9	69	11.64	14.89	5.01
		2.8	57	20.66		
		4.8	60	12.38		
	After Drum	3.9	16	4.07	4.00	0.27
		4.1	15	3.70		
		4.0	17	4.23		
	After Catch Basin	4.9	33	6.79	6.74	1.05
		4.4	25	5.66		
		4.4	34	7.77		
6/2/2016 10:30 AM	WQ5	5.4	81	14.87	14.34	0.78
		5.8	78	13.45		
		5.9	87	14.70		
	WQ6	4.6	73	15.81	14.85	0.83
		5.2	75	14.40		
		5.1	73	14.34		
	WQ2	5.7	77	13.55	12.68	1.01
		6.0	78	12.92		
		6.4	74	11.57		
	WQ3	5.7	73	12.85	14.31	1.27
		5.0	75	15.08		
		4.7	71	14.99		
	WQ1	5.4	82	15.06	13.97	1.12
		5.9	83	14.02		
		6.4	82	12.83		
	After Drum	2.7	19	7.10	8.70	2.16
		2.6	20	7.84		
		3.3	37	11.16		
	After Catch Basin	2.7	27	10.08	15.58	6.27
		2.8	40	14.26		
		2.7	60	22.41		

Water Quality Monitoring Data TSS (Page 2)						
Date	Location	Volume (L)	Mass (mg)	Concentration (mg/L)	Average Concentration (mg/L)	Standard Deviation
6/16/2016 10:00 AM	WQ5	4.1	72	17.38	16.97	0.37
		4.1	68	16.65		
		4.1	70	16.89		
	WQ6	4.0	71	17.64	17.96	0.38
		4.0	74	18.38		
		4.1	73	17.87		
	WQ2	4.1	75	18.36	18.19	0.52
		4.2	74	17.60		
		4.1	76	18.60		
	WQ3	4.1	74	18.11	17.87	0.24
		4.1	74	17.86		
		4.1	72	17.62		
	WQ1	4.0	75	18.63	18.28	0.39
		4.1	74	17.86		
		4.1	76	18.34		
	After Drum	4.0	24	5.98	7.04	1.26
		2.5	17	6.72		
		2.6	22	8.43		
	After Catch Basin	2.1	23	10.81	10.51	0.26
		2.4	25	10.38		
		2.8	29	10.34		
6/28/2016 7:00 AM	WQ5	3.9	80	20.63	20.66	1.05
		4.0	79	19.62		
		3.7	81	21.72		
	WQ6	3.9	72	18.57	18.14	0.47
		4.3	75	17.64		
		4.1	74	18.21		
	WQ1	4.0	76	18.87	19.10	0.39
		4.0	78	19.55		
		4.0	76	18.87		
	After Drum	4.0	30	7.48	7.18	0.62
		3.6	27	7.60		
		3.6	23	6.47		
6/28/2016 7:00 PM	WQ5	4.1	69	16.98	16.55	0.37
		4.1	67	16.33		
		4.1	67	16.33		
	WQ6	4.0	74	18.55	18.45	0.69
		3.6	69	19.08		
		4.1	72	17.71		
	WQ1	4.1	70	17.22	17.50	0.40
		4.1	73	17.96		
		4.1	71	17.31		
	After Drum	4.1	29	7.07	6.76	1.45
		4.0	32	8.02		
		3.3	17	5.18		

Water Quality Monitoring Data TSS (Page 3)

Date	Location	Volume (L)	Mass (mg)	Concentration (mg/L)	Average Concentration (mg/L)	Standard Deviation
6/29/2016 8:00 AM	WQ5	4.0	66	16.70	16.15	0.59
		4.1	66	16.24		
		4.3	66	15.53		
	WQ6	4.0	64	16.04	15.67	0.35
		4.1	64	15.60		
		4.1	63	15.36		
	WQ1	4.1	65	15.70	16.01	0.42
		4.1	67	16.48		
		4.1	65	15.85		
	After Drum	2.8	26	9.30	9.02	0.62
		2.5	24	9.46		
		2.6	22	8.31		
6/30/2016 8:45 AM	WQ5	4.0	70	17.54	17.16	0.34
		4.0	68	16.88		
		4.0	68	17.04		
	WQ6	3.9	69	17.62	17.38	0.21
		4.0	69	17.29		
		4.1	70	17.22		
	WQ2	4.1	65	15.85	16.29	1.09
		3.9	68	17.53		
		4.1	63	15.50		
	WQ3	4.0	66	16.70	13.27	4.85
		8.1	80	9.84		
	WQ1	4.0	68	17.20	17.79	0.74
		4.0	70	17.54		
		4.0	75	18.62		
	After Drum	3.1	13	4.15	3.87	0.70
		3.3	10	3.07		
		3.4	15	4.39		
	After Catch Basin	3.1	18	5.90	5.99	0.73
		2.8	19	6.76		
		3.0	16	5.31		
8/24/2016 6:00 PM	Before Drum	3.39	59	17.39	17.32	2.83
		3.43	69	20.11		
		3.80	55	14.46		
	After Drum	3.24	37	11.40	11.19	0.56
		3.51	37	10.56		
		2.24	26	11.62		
	Effluent	3.92	77	19.67	21.33	1.92
		3.88	81	20.89		
		3.54	83	23.43		
	WQ1	3.88	82	21.14	21.72	0.88
		3.62	77	21.29		
		3.43	78	22.74		
	WQ2	3.73	67	17.97	19.81	1.83
		3.73	74	19.84		
		3.65	79	21.62		

After Drum and Effluent TN Data

Sampling Location	Maxxam Job #	Date	ID#	TN (mg/L)	90% CI	ID#	TP (mg/L)	Measurement Uncertainty (+/- mg/L)
After Drum	From Regulatory Submittal	7/2/2014	-	10	-	-	2.62	-
	From Regulatory Submittal	8/1/2014	-	8.2	-	-	0.65	-
	From Regulatory Submittal	9/3/2014	-	6.7	-	-	0.87	-
	From Regulatory Submittal	10/7/2014	-	7.4	-	-	1.36	-
	From Regulatory Submittal	10/30/2014	-	5.8	-	-	0.92	-
	From Regulatory Submittal	6/17/2015	-	6.1	-	-	0.46	-
	From Regulatory Submittal	7/7/2015	-	7.6	-	-	2.27	-
	From Regulatory Submittal	8/10/2015	-	8.4	-	-	1.07	-
	From Regulatory Submittal	9/15/2015	-	8	-	-	0.68	-
	From Regulatory Submittal	11/17/2015	-	9.89	-	-	0.72	-
	B676809, B629604	4/13/2016	After Drum	6.2	-	After Drum	0.40	-
	B646139, B6B4597	6/3/2016	After Drum	6.85	-	After Drum	0.50	-
	B650760, B6C7304	6/16/2016	After Drum	7.98	-	After Drum	0.83	0.10
	B6D8539, B655785	6/28/2016	101	7.9	-	101	0.63	0.080
	B6D8539, B655785	6/28/2016	116	7.89	-	116	0.74	0.093
	B6D8539, B655785	6/29/2016	122	7.91	-	122	0.64	0.082
	B6D8539, B655785	6/30/2016	After Drum	8.46	-	After Drum	0.74	0.092
	B655795, B6D6954		After Drum	8.6	-	After Drum	0.68	0.086
	B6I3368, B674358	8/24/2016	After Drum	12.6	-	After Drum	0.48	0.045
	B6K0974, B682125	9/14/2016	After Drum	13.7	-	After Drum	0.64	0.056
Effluent	Strum Water Quality Report	10/15/2015	-	0.482	-	-	0.098	-
	From Regulatory Submittal	11/17/2015	-	1.62	-	-	0.12	-
	B646139, B6B4597	6/3/2016	Effluent	0.997	-	Effluent	0.077	-
	B650760, B6C7304	6/16/2016	Effluent	1.26	-	Effluent	0.15	0.029
	B655795, B6D6954	6/30/2016	Effluent	0.685	-	Effluent	0.083	0.024
	B6I3368, B674358	8/24/2016	Effluent	1.19	-	Effluent	0.081	0.025
	B6K0974, B682125	9/14/2016	Effluent	0.518	-	Effluent	0.20	< 0.20

Appendix C: October 4, 2016 Additional Items

- Correspondence Requesting Information on Bay WQ
- Correspondence with Barry Loescher Regarding TN Sampling
- Water Quality Management Plan (Strum Consulting)
- Water Quality Baseline Study (Strum Consulting)
- Sample Bottle Requirements
- WaterMaster FEW325 Data Sheet
- Well Testing Graphs
- ACCDC Report for Oak Bay Hatchery

RE: EIA Registration 456131410 Oak Bay Hatchery Wastewater Treatment Upgrade and Water Supply Source Assessment Compliance

Flanagan, Krista (ELG/EGL) Tue, Jun 28, 2016 at 10:49 AM

To: marc@soreng.ca

Cc: "Glynn, Mark (ELG/EGL)" , "Lyons, Troy (ELG/EGL)" , "glenn.ketchum@cookeaqua.com" , "Swanson, Lee (ELG/EGL)"

Mr. Sorensen, I have consulted with my colleague in regards to your questions, and have been informed that the non-compliance is based on the results submitted by Cooke Aquaculture.

Regards, Krista Flanagan, EIT

Coordinator / Coordinateur

Impact Management Branch / Direction de la gestion des impacts

Department of Environment and Local Government / Ministère de l'Environment et Gouvernements Locaux

Tel: (506) 4535305

Email: Krista.Flanagan@gnb.ca

From: Marc Sorensen [mailto:marc@soreng.ca] Sent: Thursday, June 23, 2016 4:23 PM

To: Swanson, Lee (ELG/EGL)

Cc: Lyons, Troy (ELG/EGL); Mitchell Dickie; Glenn Ketchum

Subject: RE: EIA Registration 456131410 Oak Bay Hatchery Wastewater Treatment Upgrade and Water Supply Source Assessment Compliance

Lee, regarding letter addressed to Mitch Dickie dated June 9, 2015. The province has assessed the Oak Bay Hatchery as out of compliance with the thresholds identified in the DELG Environmental Management Program for Land Based Aquaculture in New Brunswick.

Is this assessment based solely on the 2015 Annual Monitoring Report submitted by Cooke Aquaculture on January 25, 2016?

Or, did DELG take additional samples to verify the reported results and aid in the assessment? If so, can you share the results including concentration, sampling location and lab used for analysis?

Thanks, Marc Sorensen 5065290093

Triplicate Analyis

1 message

Barry Loescher <BLoescher@maxxam.ca> Tue, Oct 4, 2016 at 8:08 PM
To: Lionel Hayter <lionel@soreng.ca>

Hello Lionel

Regarding your triplicate analysis of seawater for total nitrogen. This is the recommended procedure for samples where larger than normal variability might be expected due to the difficult matrix. Statistically, the best estimate of the true value is the mean of the three results.

I trust this clarifies the matter. If anything further is required, please do not hesitate to contact me directly.

Sincerely

BARRY LOESCHER, PhD PChem
Quality Systems Specialist

Office 250 325 8887 / Mobile 250 713 4244

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WATER QUALITY MANAGEMENT PLAN
OAK BAY HATCHERY

August 14, 2015

Strum
CONSULTING

August 14, 2015

Mr. Mitch Dickie
Cooke Aquaculture Ltd.
669 Main Street
Blacks Harbour, NB   E5H 1K1

Dear Mr. Dickie,

Re: Water Quality Management Plan
Oakbay Hatchery

Attached is the Water Quality Management Plan prepared for the Oak Bay Hatchery

We trust this report to be satisfactory at this time. Once you have had an opportunity to review this correspondence, please contact us to address any questions you may have.

Thank you,

Heather Mosher

Heather Mosher, MSc.
Environmental Scientist
hmosher@strum.com

Shawn Duncan, BSc.
Vice President
sduncan@strum.com

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TABLES

APPENDICES

1.0 INTRODUCTION

Strum Consulting was retained by Cooke Aquaculture (Cooke) to develop a Water Quality Management Plan (WQMP) for their Oak Bay Hatchery (the Hatchery) in Oak Haven, NB. The WQMP will ultimately aid in providing a consistent and replicable approach to monitoring effluent quality and water quality of the receiving environment.

The WQMP is designed to provide a standard operating procedure (SOP) for water sample collection required by their Approval to Operate and to aid with:

- The establishment of an effluent mixing zone within Oak Bay;
- The determination of the impact of wastewater effluent on the water quality of Oak Bay; and
- The identification of any non-compliances in regards to water quality with the Approval to Operate.

2.0 BACKGROUND

The Approval to Operate (#I-8539) requires that the level of total nitrogen (TN) and total phosphorus (TP) at the edge of the established mixing zone is in accordance with the performance based standard (PBS) variables listed in Table 2.10 of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick* (NB DELG, 2013). Although total suspended solids (TSS) is not listed as a requirement in the Approval, it is included in the WQMP as it is of special interest to provincial regulators. However, TSS is unique from TN and TP as the guideline thresholds outlined by the Canadian Council of Ministers of the Environment (CCME) are relative to the baseline values and are different for short term (less than 24 hours) and long term (more than 24 hours) events. The PBS thresholds for TN and TP, and the CCME guideline for TSS, are as follows:

PBS Variable	**Threshold**
Total Phosphorus (TP)	0.5 mg/L
Total Nitrogen (TN)	0.035 mg/L

CCME Guidelines (CCME 2007)	
Total Suspended Solids (TSS) – short term (24 hrs or less)	5 mg/L above background
Total Suspended Solids (TSS) – long term (greater than 24 hrs)	5 mg/L above background

An environmental baseline study (EBS) was completed in July 2015 and analyzed water quality for TN, TP, and TSS from various locations throughout Oak Bay. The results from the EBS were used to identify baseline conditions within Oak Bay and influence the location of a control site.

Total Nitrogen (TN)
The EBS identified elevated TN values throughout Oak Bay with some exceedances occurring on the ebb tide. The results of the EBS suggest that there are a number of factors influencing TN values in Oak Bay that get incorporated into the water column during high tide and that any exceedances observed throughout Oak Bay are not solely due to the influence of effluent from the Hatchery. The EBS identified baseline values for TN in Oak Bay between 0.215 mg/L to 0.686 mg/L.

Total Phosphorus (TP)
The EBS identified a high number of exceedances in TP within close proximity to the Hatchery. For this reason, TP is of concern and should be monitored closely. The results of the EBS suggested that the TP values observed on the opposite side of Spoon Island, between 0.025 mg/L to 0.030 mg/L, should be used as baseline values.

Total Suspended Solids (TSS)
The EBS identified TSS values between 3.2mg/L to 15 mg/L throughout the bay to be used as baseline TSS values.

Table 1 highlights the guideline and baseline variables for TN, TP, and TSS in Oak Bay.

Table 1: Guideline and Baseline variables for TN, TP, and TSS

Variable	**Guideline Threshold**	**Baseline[3]**
TN	0.5 mg/L[1]	0.215 mg/L to 0.686 mg/L
TP	0.035 mg/L[1]	0.025 mg/L to 0.030 mg/L
TSS - long term	5 mg/L[2]	3.2 mg/L to 15 mg/L
TSS – long term	25 mg/L[2]	3.2 mg/L to 15 mg/L

[1] NB DELG, 2013
[2] CCME 2007
[3] Based on results of the EBS, 2015

3.0 SAMPLE REQUIREMENTS

The Approval requires monthly sampling at five stations (Table 2, below). Although the Approval only requires monthly sampling, more frequent sampling is recommended to aid in the establishment of a mixing zone and to capture different stages of operation at the hatchery. Until non-compliance issues are amended, at least bi-monthly and possibly weekly sampling should be completed.

Table 2: Sampling Locations and Frequency

Location ID		Sample Location	Required Sampling Frequency	WQMP Recommended Sampling Frequency
Station 1		Hatchery water intake	Monthly	Monthly
Station 2		Effluent water prior to entry into settling pond	Monthly	Bi-monthly or more
Station 3		Effluent water at point of discharge from settling pond	Monthly	Bi-monthly or more
Station 4	N-1	Oak Bay: Edge of mixing zone	Monthly	Bi-monthly or more
	M-1			
	M-2			
	F-1			
Station 5	C-1	Oak Bay: Control station	Monthly	Bi-monthly or more

Sample locations for Station 1, Station 2, and Station 3 are the same as those previously sampled for monthly monitoring. Station 4 and Station 5 have been changed to better provide support for effluent mixing in Oak Bay (Table 3, below, Drawing 1, Appendix A). Four new sample locations have been provided for Station 4: one near-field, two mid-field, and one far-field location which correspond with the water quality sampling locations in the EBS. The EBS also identified a new control site (Station 5) which better represents baseline conditions.

Table 3: Marine Sampling Locations for Station 4 and Station 5

Sample ID		Sample Location	UTM Coordinates NAD83 19N		Corresponding EBS Location
			X	Y	
Station 4	4N-1	Near-field	641816	5008448	WQ1
	4M-1	Mid-field	642347	5008536	WQ2
	4M-2		642534	5008150	WQ3
	4F-1	Far-field	642500	5009296	WQ6
Station 5	5C-1	Control	643322	5008895	WQ5

4.0 STANDARD OPERATING PROCEDURE

4.1 Scope

To comply with the requirements of the Approval and to provide consistency between sampling events, the SOP should be followed during each sampling event. Table 4 outlines the required sampling parameters at each location.

Table 4: Required Sampling Parameters

Sample Location		Sampling Parameters						
		Temp	**DO**	**pH**	**Flow**	**TP**	**TN**	**TSS**
		°C	% and mg/L		L/min	mg/L	mg/L	mg/L
Station 1					X			
Station 2		X	X	X	X	X	X	X
Station 3		X	X	X	X	X	X	X
Station 4	4N-1	X	X	X		X	X	X
	4M-1	X	X	X		X	X	X
	4M-2	X	X	X		X	X	X
	4F-1	X	X	X		X	X	X
Station 5	5C-1	X	X	X		X	X	X

4.2 Materials

The required equipment/materials for this procedure are:

- Sample containers
- YSI unit
- Flow meter
- Cooler and ice
- Camera
- Waterproof field book
- Pencils
- Waterproof marker
- Sampling location map
- Boat
- Anchor
- Paddles
- Life jacket
- Boat safety equipment

Sample containers should be supplied from an analytical laboratory to ensure that they have been cleaned according to recommended methods. Sample containers may be ordered pre-labeled for convenience. Containers required are as follows:

- 1 x 100 ml glass amber bottle with preservative (TN)
- 1 x 100 ml glass amber bottle with preservative (TP)
- 1 x 500 ml plastic bottle (TSS)

4.3 Sampling Procedure: Station 1-3

The sampling procedure is as follows:

1. Using the provided map and/or GPS, pinpoint the sampling location.
2. Note general site observations in a field book or on field data sheets (Appendix B), including:
    a. Location ID
    b. Time
    c. General weather conditions
    d. Air temperature
    e. Water level and surface conditions
    f. Any unusual circumstances (i.e. higher than normal water flow, swirl separator flushing, drum filter backwash)
3. Place YSI into the water and allow values to stabilize. Record temperature, pH, and DO (in % saturation and mg/L) in a field book or on field data sheet.
4. Using the flow meter, measure flow following manufacturer's directions and record result in a field book or on field data sheet.
5. Label sample bottle with the Location ID and date if they are not pre-labeled.
6. Fill sample bottles ensuring that none of the preservative escapes by holding the samples vertically in the water or filling the 500 mL plastic bottle and pouring water into the amber bottles in the boat.
    a. The inner portion of sample containers and caps should not be touched under any circumstances.
    b. Avoid the inclusion of particles such as leaves and detritus when collecting a sample.
    c. Keep all sampling equipment clean.
7. Place sample bottles in a cooler with ice, ensuring that they do not break.
8. Samples should be sent to the laboratory as soon as possible but may be stored for up to 7 days, depending on laboratory protocol. In the interim they should be stored in a cool, dark place and kept below 10°C.
9. Upon completion, field notes should be scanned, entered into a digital spreadsheet, and saved.

4.4 Sampling Procedure: Station 4-5

Water quality sampling should be completed at all five marine sampling locations (Station 4 and 5) during the ebb tide as close to high tide as possible. Sampling locations are indicated on Drawing 1 in Appendix A and tide cycles should be checked prior to planning the sampling program.

1. Using the provided map and/or GPS, pinpoint the sampling location.
2. Anchor the boat at the sampling site.
3. Secure all sampling equipment.

4. Note general site observations in a field book or on field data sheets, including:
    a. Location ID
    b. Time
    c. General weather conditions
    d. Air temperature
    e. Water level and surface conditions
    f. Any unusual circumstances (i.e. unnatural water colour/odour, excessive algae, indications of foreign substances, signs of fish kills)
5. Place YSI into the water and allow values to stabilize. Record temperature, pH, and DO (in % saturation and mg/L) in a field book.
6. Label sample bottle with the Location ID and date, if they are not pre-labeled.
7. Fill sample bottles ensuring that none of the preservative escapes by holding the samples vertically in the water or filling the 500 mL plastic bottle and pouring water into the amber bottles in the boat.
    a. The inner portion of sample containers and caps should not be touched under any circumstances.
    b. Avoid the inclusion of particles such as leaves and detritus when collecting a sample.
    c. Keep all sampling equipment clean.
8. Place sample bottles in a cooler with ice, ensuring that they do not break.
9. Samples should be sent to the laboratory as soon as possible but may be stored for up to 7 days, depending on laboratory protocol. In the interim they should be stored in a cool, dark place and kept below 10°C.
10. Upon completion, field notes should be scanned, entered into a digital spreadsheet and saved.

5.0 STATEMENT OF QUALIFICATIONS AND LIMITATIONS

This Report (the “Report”) has been prepared by Strum Consulting (“Consultant”) for the benefit of Cooke Aquaculture (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations, and conclusions contained in the Report (collectively, the “Information”):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represents Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- was prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental, or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental, or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed in writing by Consultant and Client
- as required by law
- for use by governmental reviewing agencies

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss, or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations forms part of the Report and any use of the Report is subject to the terms hereof.

Should additional information become available, Strum requests that this information be brought to our attention immediately so that we can re-assess the conclusions presented in this report. This report was prepared by Heather Mosher, MSc., Environmental Scientist, and was reviewed by Shawn Duncan, BSc., Vice President.

6.0 REFERENCES

NBDELG (New Brunswick Department of Environment and Local Government). 2013. Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick. Accessed from http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/MarineAquaculture-AquacoleMarin/EnvironmentalManagementProgramLandBasedFinfish.pdf

CCME (Canadian Council of Ministers of the Environment). 2014. Water Quality Guidelines for the Protection of Aquatic Life. Accessed from http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=218#aql_marine_concentration

APPENDIX A
WATER QUALITY SAMPLING LOCATION MAP
(DRAWING 1)

Notes:

1. Reference: New Brunswick Digital Topographic Mapping. GeoGratis Digital NTS Map 21G03.
2. Projection: NAD83(CSRS), New Bruswick Stereographic

Legend:

- ○ Monitoring Locations
- ☐ Adjacent Properties
- ⬚ Project Site Boundaries
- ━ Major Roads and Highways
- — Public Roads
- – – Limited Use Road
- – - Trail / Access Road
- ► Watercourse
- ▭ Building
- ▨ Quarry
- 🟩 Provincial Park
- 🟪 Provincial Significant Wetland
- ▨ General Wetland
- 🟦 Water Bodies

Water Quality Monitoring Locations

Strum
CONSULTING

Date: April 2015	Project #: 15-5278
Scale: 1:8,000	Drawing #: 1
Drawn By: H. Serhan	
Checked By: H. Mosher	

APPENDIX B
FIELD DATA SHEET

WATER QUALITY FIELD SAMPLING SHEETS

Date: **Samplers:**

General Weather Conditions:

ID	Time	Observations	Field Parameters	
Station 1			Flow	
Station 2			Flow	
			Temp (°C)	
			pH	
			DO (%) (mg/L)	
Station 3			Flow	
			Temp (°C)	
			pH	
			DO (%) (mg/L)	
ID	**Time**	**Water Level and Surface Conditions**	**Field Parameters**	
Station 4: N-1			Temp (°C)	
			pH	
			DO (%) (mg/L)	
Station 4: M-1			Temp (°C)	
			pH	
			DO (%) (mg/L)	
Station 4: M-2			Temp (°C)	
			pH	
			DO (%) (mg/L)	
Station 4: F-1			Temp (°C)	
			pH	
			DO (%) (mg/L)	
Station 4: C-1			Temp (°C)	
			pH	
			DO (%) (mg/L)	

August 20, 2015

Mr. Mitchell Dickie
Cooke Aquaculture
669 Main Street
Blacks Harbour, NB   E5H 1K1

Dear Mr. Dickie,

Re: Water Quality Environmental Baseline Study
Oak Bay Hatchery, Oak Haven, NB

Strum Consulting was retained by Cooke Aquaculture to conduct an Environmental Assessment which included an environmental baseline assessment at their Oak Bay Hatchery in Oak Haven, NB (Drawing 1, attached). The objective of the study was to determine environmental baseline conditions for benthic habitat, fish, and water quality within Oak Bay. This report outlines the results of the water quality assessment.

INTRODUCTION

The Oak Bay Hatchery includes a broodstock rearing operation for gamete production and incubation room for housing salmon eggs. All wastewater is treated through drum filtration prior to being discharged into Oak Bay. The facility is licensed through the New Brunswick Department of Agriculture, Aquaculture, and Fisheries (NB DAAF) and operates under 'Approval to Operate I-8539' (COA), issued by the New Brunswick Department of environment and Local Government (NB DELG) and effective from November 1, 2013 until October 31, 2016.

The COA requires monthly water quality sampling events at five locations around the hatchery at a 'Level 1' effort as listed in Table 2.10 of the *Environmental Management Program for Land Based Finfish Aquaculture in New Brunswick* (NB DELG, 2013) (the Regulations), including at the edge of an established mixing zone. The COA states that the level of total nitrogen (TN) and total phosphorus (TP) at the edge of the mixing zone is in accordance with the performance based standard (PBS) variables listed in the Regulations. However, a mixing zone has not been established for the facility and water samples from the current sampling locations are out of compliance for TN and TP. In response, Strum was retained to complete a water quality study to identify baseline water quality conditions and aid in the identification of proper sampling locations for the monthly water quality sampling required by the COA.

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METHODOLOGY

Field sampling was completed July 15, 2015, during the flood and ebb tide. Using a Van Dorn bottle, water samples were collected from the top and bottom of the water column at six locations around Oak Bay for a total of 24 samples (Drawing 1). Sampling time and water depth was recorded with each sampling. A handheld YSI unit was used to record temperature, conductivity, salinity, dissolved oxygen, total dissolved solids, and pH during the ebb tide.

Samples were analyzed for TN, TP, total suspended solids (TSS), total ammonia nitrogen (TAN), and chemical oxygen demand (COD). TN and TP are both required sampling parameters in the COA. TSS is a required sampling parameter and although compliance with TSS is not stated in the COA, it is of special interest to provincial regulators and its guideline thresholds are outlined by the Canadian Council of Ministers of the Environment (CCME). TAN and COD are currently not required sampling parameters in the COA. However, they were included in the study as further non-compliances may require that monthly sampling is increased from a ‘Level 1’ effort to a ‘Level 2’ effort which would include sampling for TAN and COD.

Water quality values were compared against surface water results collected during monthly sampling by Cooke employees at the outflow pipe from the setting pond into Oak Bay.

RESULTS

Total Nitrogen (TN)

Values for TN varied from 0.215 mg/L to 0.686 mg/L (Table 1, below). Four (4) samples, collected from WQ1, WQ3, WQ4, and WQ6, exceeded the PBS threshold of 0.500 mg/L. Additional high values (greater than 0.400 mg/L), although not in exceedance, were observed at all sampling locations except for WQ2, which did not have a sample higher than 0.400 mg/L. All of the exceedances were collected on the ebb tide.

Although monthly monitoring observed TN values as high as 8.2 mg/L, the wide spread distribution of high TN values throughout the bay suggests that a number of influences are impacting water TN values, not just hatchery effluent. Additionally, the higher values in ebb tide samples suggests that the sources of nitrogen are incorporated into the water column during high tide.

Total Phosphorus (TP)

Values for TP varies from 0.021 mg/L to 0.095 mg/L (Table 1). Ten (10) samples exceeded the PBS threshold of 0.035 mg/L; seven (7) samples were collected from WQ1 and WQ2, two (2) samples from WQ4 and one (1) sample from WQ6. No exceedances were observed at WQ3 and WQ5.

The results of the samples taken in June 2015 from the effluent pond outflow into the bay observed a TP value of 0.69 mg/L and monthly monitoring values obtained from Cooke noted TP values as high as 2.62 mg/L. It is probable that TP values will vary with the type of effluent being released from the hatchery. During periods of high flow, drum filter bypass, surges, and swirl separator flushes, TP values in hatchery effluent will be higher.

The lack of exceedances observed at WQ3 suggest that the exceedance at WQ4 is irrespective of hatchery effluent. However, the high number of exceedances at WQ1 and WQ2 is of concern and TP should continue to be monitored closely in both the effluent and within Oak Bay. For TP analyses, WQ5 should be used as a control site and its values of 0.025 mg/L – 0.030 mg/L as a baseline for future monitoring activities.

Total Suspended Solids (TSS)

TSS results showed high bottom values which may be a result of the substrate being stirred up during sampling. Therefore, bottom samples were disregarded and further analysis was done only on the surface samples. Surface TSS values varied from 3.2 mg/L to 15 mg/L (Table 1). The highest value, 15 mg/L, was observed at WQ5, on the opposite side of Spoon Island to the hatchery.

If the TSS values are used as baseline values around Oak Bay, then the TSS value taken from the effluent pond discharge pipe in June, 2015 of 6.8 mg/L is within the acceptable limit of a 5 mg/L increase for long-term exposure. However values from monthly monitoring events collected by Cooke employees vary between 7 mg/L to 128 mg/L. CCME guidelines limit a maximum increase of 25 mg/L for short-term exposure, and outflow values of 128 mg/L greatly exceeds this value.

As in the case with TP, TSS values will vary with the type of effluent being released from the hatchery. It is likely that standard operations do not result in an exceedance in TSS thresholds, however, events that result in effluent bypassing drum filtration is of particular concern. TSS monitoring should continue observing both TSS in hatchery effluent and within Oak Bay.

Chemical Oxygen Demand (COD)

Values for COD varied between 640 mg/L and 1200 mg/L (Table 1). The regulations do not identify any thresholds for COD (NB DELG, 2013). Values greater than 900 mg/L were observed at all sites.

Total Ammonia Nitrogen (TAN)

Values for TAN varied between 0.065 mg/L and 0.27 mg/L (Table 1). The regulations do not identify any thresholds for TAN (NB DELG, 2013). Values varied between 0.065 mg/L (WQ5) and 0.270 mg/L (WQ6). All sites had values below the reportable detection limit of 0.050 mg/L.

Oak Bay Water Quality					Lab Parameters					Field Parameters							
					TN (mg/L)	TP (mg/L)	TSS (mg/L)	COD (mg/L)	TAN (mg/L)	Sample Depth (m)	Temperature (°C)	DO (%)	DO (mg/L)	TDS (mg/L)	Salinity (ppt)	pH	Conductivity (µS/cm)
Sample Locations	**WQ1**	**Flood**	**SW2**	**Top**	0.276	0.036	8.5	910	0.072	0	15.5	127.3	10.49	28815	29.79	7.14	37552
			SW1	**Bottom**	0.432	0.054	21	**640**	0.220	1.97							
		Ebb	**SW 14**	**Top**	**0.686**	0.082	8.8	910	0.096	0							
			SW 13	**Bottom**	0.238	0.078	67	1000	ND	3.96							
	WQ2	**Flood**	**SW4**	**Top**	0.285	0.025	4.0	950	ND	0	14.3	150.9	12.76	29763	29.68	7.66	36447
			SW3	**Bottom**	0.369	0.038	30	760	ND	3.27							
		Ebb	**SW16**	**Top**	0.365	0.041	4.3	1100	0.150	0							
			SW15	**Bottom**	0.399	0.052	50	1100	ND	4.45							
	WQ3	**Flood**	**SW6**	**Top**	0.342	0.026	4.2	1000	0.130	0	14.9	147.3	12.31	29971	29.94	7.73	37166
			SW5	**Bottom**	0.492	0.030	4.2	1100	0.250	3.70							
		Ebb	**SW18**	**Top**	0.597	0.024	4.2	1000	0.230	0							
			SW17	**Bottom**	0.287	**0.021**	5.8	1100	ND	4.45							
	WQ4	**Flood**	**SW8**	**Top**	0.231	0.028	**3.2**	700	ND	0	14.0	139.9	11.73	29159	29.01	7.91	35384
			SW7	**Bottom**	0.474	**0.095**	41	**1200**	0.097	5.05							
		Ebb	**SW20**	**Top**	0.526	0.036	8.8	960	0.100	0							
			SW19	**Bottom**	0.300	0.033	5.8	1000	ND	5.45							
	WQ5	**Flood**	**SW10**	**Top**	0.239	0.027	5.2	930	0.110	0	14.8	138.3	11.95	29997	29.96	7.92	37114
			SW9	**Bottom**	0.243	0.025	6.8	910	ND	5.80							
		Ebb	**SW22**	**Top**	0.227	0.027	**15.0**	970	0.090	0							
			SW21	**Bottom**	0.485	0.030	7.3	840	**0.065**	5.05							
	WQ6	**Flood**	**SW12**	**Top**	**0.215**	0.029	7.4	940	ND	0	15.6	133.6	11.11	29666	26.68	7.90	37467
			SW11	**Bottom**	0.455	0.044	33	**1200**	ND	5.30							
		Ebb	**SW24**	**Top**	0.523	0.023	7.4	**1200**	**0.270**	0							
			SW23	**Bottom**	0.418	0.028	7.8	990	ND	5.38							
Settling Pond Effluent[5]					<1 - 8.2	0.069 - 2.620	6.0 - 59.0	34	0.47								
Regulatory Guidelines					0.5	0.035	-	-	-	-	-	-	-	-	-	-	-

Table Notes:

1. Highest and lowest values are bolded
2. Values exceeding regulatory thresholds are highlighted in red
3. TSS values highlighted in grey have been disregarded
4. Regulatory guideline thresholds were taken from NB DELG, 2013
5. Setting pond effluent ranges are taken from Cooke monthly monitoring results

CONCLUSION AND RECOMMENDATIONS

Water quality sampling results indicate that the Oak Bay Hatchery is currently out of compliance for TSS during high flow events (e.g. flushing of the swirl separators and backwash of drum filters) and for TP. The results of this sampling do not indicate that wastewater effluent from the hatchery is increasing TN values above regulatory levels.

It is recommended that effluent quality and water quality in Oak Bay continue to be monitored in order to determine the complete impact of wastewater effluent on the receiving environment. Additionally, an established effluent mixing zone is required to fully assess non-compliance issues and continued water quality monitoring may aid in its determination.

If you have any questions, please contact us.

Thank you,

Heather Mosher

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Notes:

1. Reference: New Brunswick Digital Topographic Mapping. GeoGratis Digital NTS Map 21G03.
2. Projection: NAD83(CSRS), New Bruswick Stereographic

Legend:

○ Water Quality Samples
☐ Adjacent Properties
▭ Project Site Boundaries
▬ Major Roads and Highways
— Public Roads
— — Limited Use Road
— — Trail / Access Road
► Watercourse
☐ Building
▨ Quarry
🟩 Provincial Park
🟪 Provincial Significant Wetland
▨ General Wetland
🟦 Water Bodies

Water Quality Sampling Locations

Strum
CONSULTING

Date: August 2015
Project #: 15-5278
Scale: 1:8,000
Drawing #: 1
Drawn By: H. Serhan
Checked By: H. Mosher

RESULTS OF ANALYSES OF WATER

Maxxam ID		AQP738		AQP739	AQP741	AQP741			AQP742		
Sampling Date		2015/07/15		2015/07/15	2015/07/15	2015/07/15			2015/07/15		
COC Number		N/A		N/A	N/A	N/A			N/A		
	Units	**SW1-JL15**	**RDL**	**SW2-JL15**	**SW3-JL15**	**SW3-JL15 Lab-Dup**	**RDL**	**QC Batch**	**SW4-JL15**	**RDL**	**QC Batch**
Inorganics											
Total Chemical Oxygen Demand	mg/L	640	100	910	760		100	4113838	950	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.22	0.050	0.072	ND		0.050	4115474	ND	0.050	4115479
Total Phosphorus	mg/L	0.054	0.020	0.036	0.038		0.020	4116921	0.025	0.020	4116921
Total Suspended Solids	mg/L	21	1.0	8.5	30		2.0	4114923	4.0	1.0	4114923
Total Kjeldahl Nitrogen	mg/L	0.19	0.10	0.31	0.35	0.26	0.10	4114884	0.34	0.10	4114884

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP743	AQP744	AQP744	AQP745	AQP746	AQP747	AQP748		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A	N/A		
	Units	**SW5-JL15**	**SW6-JL15**	**SW6-JL15 Lab-Dup**	**SW7-JL15**	**SW8-JL15**	**SW9-JL15**	**SW10-JL15**	**RDL**	**QC Batch**
Inorganics										
Total Chemical Oxygen Demand	mg/L	1100	1000		1200	700	910	930	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.25	0.13		0.097	ND	ND	0.11	0.050	4115479
Total Phosphorus	mg/L	0.030	0.026		0.095	0.028	0.025	0.027	0.020	4116921
Total Suspended Solids	mg/L	4.2	4.2		41	3.2	6.8	5.2	1.0	4114923
Total Kjeldahl Nitrogen	mg/L	0.22	0.32	0.29	0.32	0.25	0.29	0.27	0.10	4114887

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP749	AQP749	AQP750	AQP751	AQP752	AQP753		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15		
COC Number		N/A	N/A	N/A	N/A	N/A	N/A		
	Units	**SW11-JL15**	**SW11-JL15 Lab-Dup**	**SW12-JL15**	**SW13-JL15**	**SW14-JL15**	**SW15-JL15**	**RDL**	**QC Batch**
Inorganics									
Total Chemical Oxygen Demand	mg/L	1200		940	1000	910	1100	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	ND	ND	ND	ND	0.096	ND	0.050	4115479
Total Phosphorus	mg/L	0.044		0.029	0.078	0.082	0.052	0.020	4116921
Total Suspended Solids	mg/L	33		7.4	67	8.8	50	1.0	4114923
Total Kjeldahl Nitrogen	mg/L	0.32		0.30	0.30	0.58	0.43	0.10	4114887

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

RESULTS OF ANALYSES OF WATER

Maxxam ID		AQP754		AQP755		AQP756	AQP756		AQP757		
Sampling Date		2015/07/15		2015/07/15		2015/07/15	2015/07/15		2015/07/15		
COC Number		N/A		N/A		N/A	N/A		N/A		
	Units	**SW16-JL15**	**RDL**	**SW17-JL15**	**QC Batch**	**SW18-JL15**	**SW18-JL15 Lab-Dup**	**QC Batch**	**SW19-JL15**	**RDL**	**QC Batch**
Inorganics											
Total Chemical Oxygen Demand	mg/L	1100	100	1100	4113916	1000	1100	4113916	1000	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.15	0.050	ND	4115479	0.23		4115479	ND	0.050	4115479
Total Phosphorus	mg/L	0.041	0.020	0.021	4116921	0.024		4116921	0.033	0.020	4116921
Total Suspended Solids	mg/L	4.3	2.0	5.8	4114923	4.2		4114923	5.8	1.0	4114931
Total Kjeldahl Nitrogen	mg/L	0.52	0.10	0.35	4114887	0.36		4117378	0.26	0.10	4117378

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP758	AQP758			AQP759		AQP760	AQP761		
Sampling Date		2015/07/15	2015/07/15			2015/07/15		2015/07/15	2015/07/15		
COC Number		N/A	N/A			N/A		N/A	N/A		
	Units	**SW20-JL15**	**SW20-JL15 Lab-Dup**	**RDL**	**QC Batch**	**SW21-JL15**	**RDL**	**SW22-JL15**	**SW23-JL15**	**RDL**	**QC Batch**
Inorganics											
Total Chemical Oxygen Demand	mg/L	960		100	4113916	840	100	970	990	100	4113916
Nitrogen (Ammonia Nitrogen)	mg/L	0.10	0.081	0.050	4115474	0.065	0.050	0.090	ND	0.050	4115479
Total Phosphorus	mg/L	0.036		0.020	4116922	0.030	0.020	0.027	0.028	0.020	4116922
Total Suspended Solids	mg/L	8.8		1.0	4114931	7.3	2.0	15	7.8	1.0	4114931
Total Kjeldahl Nitrogen	mg/L	0.27		0.10	4117378	0.18	0.10	0.26	0.19	0.10	4117378

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
ND = Not detected

Maxxam ID		AQP762		
Sampling Date		2015/07/15		
COC Number		N/A		
	Units	**SW24-JL15**	**RDL**	**QC Batch**
Inorganics				
Total Chemical Oxygen Demand	mg/L	1200	100	4119016
Nitrogen (Ammonia Nitrogen)	mg/L	0.27	0.050	4115479
Total Phosphorus	mg/L	0.023	0.020	4116922
Total Suspended Solids	mg/L	7.4	1.0	4114931
Total Kjeldahl Nitrogen	mg/L	0.29	0.10	4117378

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		MT7019	MT7020		MT7021		MT7022		
Sampling Date		2015/07/15	2015/07/15		2015/07/15		2015/07/15		
COC Number		08412354	08412354		08412354		08412354		
	UNITS	**SW1-JL15 (AQP738)**	**SW2-JL15 (AQP739)**	**QC Batch**	**SW3-JL15 (AQP741)**	**QC Batch**	**SW4-JL15 (AQP742)**	**RDL**	**QC Batch**
Nutrients									
Total Nitrogen (N)	mg/L	0.432	0.276	7984903	0.369	7984901	0.285	0.020	7984903

RDL = Reportable Detection Limit

Maxxam ID		MT7023	MT7024		MT7025	MT7026		MT7027		
Sampling Date		2015/07/15	2015/07/15		2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354	08412354		08412354	08412354		08412354		
	UNITS	**SW5-JL15 (AQP743)**	**SW6-JL15 (AQP744)**	**QC Batch**	**SW7-JL15 (AQP745)**	**SW8-JL15 (AQP746)**	**QC Batch**	**SW9-JL15 (AQP747)**	**RDL**	**QC Batch**
Nutrients										
Total Nitrogen (N)	mg/L	0.492	0.342	7984901	0.474	0.231	7984903	0.243	0.020	7984901

RDL = Reportable Detection Limit

Maxxam ID		MT7028		MT7029	MT7030	MT7030		MT7031		
Sampling Date		2015/07/15		2015/07/15	2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354		08412354	08412354	08412354		08412354		
	UNITS	**SW10-JL15 (AQP748)**	**QC Batch**	**SW11-JL15 (AQP749)**	**SW12-JL15 (AQP750)**	**SW12-JL15 (AQP750) Lab-Dup**	**QC Batch**	**SW13-JL15 (AQP751)**	**RDL**	**QC Batch**
Nutrients										
Total Nitrogen (N)	mg/L	0.239	7984903	0.455	0.215	0.231	7984901	0.238	0.020	7984903

RDL = Reportable Detection Limit

Maxxam ID		MT7032	MT7033	MT7034	MT7035		MT7036		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354	08412354	08412354	08412354		08412354		
	UNITS	**SW14-JL15 (AQP752)**	**SW15-JL15 (AQP753)**	**SW16-JL15 (AQP754)**	**SW17-JL15 (AQP755)**	**QC Batch**	**SW18-JL15 (AQP756)**	**RDL**	**QC Batch**
Nutrients									
Total Nitrogen (N)	mg/L	0.686	0.399	0.365	0.287	7984903	0.597	0.020	7984901

RDL = Reportable Detection Limit

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		MT7037	MT7038	MT7039	MT7040	MT7040		MT7041		
Sampling Date		2015/07/15	2015/07/15	2015/07/15	2015/07/15	2015/07/15		2015/07/15		
COC Number		08412354	08412354	08412354	08412354	08412354		08412354		
	UNITS	**SW19-JL15 (AQP757)**	**SW20-JL15 (AQP758)**	**SW21-JL15 (AQP759)**	**SW22-JL15 (AQP760)**	**SW22-JL15 (AQP760) Lab-Dup**	**QC Batch**	**SW23-JL15 (AQP761)**	**RDL**	**QC Batch**
Nutrients										
Total Nitrogen (N)	mg/L	0.299	0.526	0.485	0.227	0.230	7984903	0.418	0.020	7984901
RDL = Reportable Detection Limit										

Maxxam ID		MT7042		
Sampling Date		2015/07/15		
COC Number		08412354		
	UNITS	**SW24-JL15 (AQP762)**	**RDL**	**QC Batch**
Nutrients				
Total Nitrogen (N)	mg/L	0.523	0.020	7984903
RDL = Reportable Detection Limit				

Maxxam
A Bureau Veritas Group Company

SAMPLING GUIDE & BOTTLE REQUISITION FORM

Fax your request 902-420-8612 or call Shipping Department 902-420-0203e251 or 1-800-565-7227

Company: ____ Attention: ____

Address (for Courier):____

Phone: ____________________________ Fax: __________________________ Maxxam Project Manager ___________________

Date Required: _________________ Proj# _______________for Billing Rush or Remote Shipments which are charged back to client.
(Shipments are rush if Purolator 9am or 10:30am charges apply, Shipments are remote if Purolator Express Service takes 3 days.)

Special Shipping Instructions :

Customized COC's, Pre-printed labels & Pre-packed bottle kits available, ask your Project Manager

SOIL TESTS	**Container**	**Preservative Description/Comments**	**Hold Time**	**#Samples** **If cases specify**
RBCA-Hydrocarbons –BTEX Note11 -Extractable	2 x 40 mL vials w MeOH 60 mL glass	BTEX(C_6-C_{10}): Methanol Extractables (C_{10}-C_{32}) and Moisture : None	28d 14d	
VOCs (EPA 8260) – Note11	2 x 40 mL vials w MeOH	Methanol	28d	
Organics (PCB, EPA 8270, etc.) Inorganic Metals (not including Mercury) Mercury	250 mL glass	Organics Metal Scan Mercury	14d 6m 28d	
Sulfide	120 mL glass		7d	

WATER TESTS	**Container**	**Preservative Description/Comments**	**Hold Time**	**#Samples** **If cases specify**
Organic Halides AOX,TOX,EOX,TX	500 mL amber glass		7d	
BOD	500 mL plastic		48hr	
COD/TKN/Ammonia/Phenol/TOC/Total P	100 mL amber glass	50% H_2SO_4 to pH<2	28d	
Coliform (Total /Fecal/E.coli) Note5	300 mL sterile plastic	Sodium Thiosulphate (for sewage Note4)	24hr	
Cyanide	60 mL amber glass	NaOH to pH>12	14d	
Fluoride	200 mL plastic	No Preservative required	28d	
Fractionation TPH Volatile Extractable	3x40 mL glass 2x1 L amber glass	Sodium Bisulfate - Fill to top (no air bubble) Sodium Bisulfate - Fill to neck & cap	14d 14d	
Glycol (Total)	3x40 mL vials	Sodium Bisulfate - Fill to top	14d	
Hexavalent Chromium	125 mL plastic	2.5 mL $(NH_4)_2SO_4/NH_4OH$	28d	
Haloacetic Acid	3x40 mL glass	4mg Ammonium Chloride – Fill to Top	14d	
Mercury	100 mL glass	$K_2Cr_2O_7$ in 17% HNO_3	28d	
Metals –Trace (if Seawater Note7)	120 mL plastic	2ml 18% HNO_3 Note2	Note3	
RBCA Volatile / BTEX Note1 Extractable Hydrocarbon	3x40 mL glass 2x250 mL glass	Sodium Bisulfate - Fill to top (no air bubble) Sodium Bisulfate - Fill to neck & cap	14d 14d	
Oil&Grease-Gravimetric (IR Note8)	2x1 L amber glass	HCl, Fill to neck & cap	28d	
PCB's	2x250 mL glass	Fill to neck & cap	7d	
Pesticides &PCB's (Carbamates Note6)	500 mL amber glass	Fill to neck & cap	7d	
pH	200 mL plastic	Fill to top and cap	Note9	
PAH's	2x250 mL glass	Fill to neck & cap	7d	
Radon Note10	Sealed 250ml glass jar	No Headspace	7 d	
RCAp 30 (General Chemistry)	200 mL,120mL& 1X100mL	200ml no preservative (note3), 120ml HNO_3 preservative(note2) 1*100ml bottle with 50% H2SO4 pH<2	Note3	
RCAp MS(General Chem&Metals)	200 mL,120mL& 1X100mL	200ml no preservative (note3), 120ml HNO_3 preservative(note2) 1*100ml bottle with 50% H2SO4 pH<2	Note3	
Sulfide (H2S)	250 mL plastic	zinc acetate/NaOH	7d	
Tannin & Lignin	500 mL plastic	Fill to neck & cap	7d	
TSS	500 mL plastic	(except marine waters use 1 L plastic)	7d	
Semi VolatileOrganicsEPA625	2x1 L amber glass	Fill to neck & cap	14d	
Semi VolatileOrganicsEPA625 **(Chlorinated source)**	2x1 L amber glass	Sodium Thiosulfate Fill to neck & cap	14d	
VOC (EPA624,THMs)	3x40 mL glass	Sodium bisulfate, Fill to top (no air bubble)	14d	
VOC,THM **Chlorinated source**	3x40 mL glass	Sodium Thiosulfate,Fill to top Note1	14d	

See Notes on page 2. All samples to be kept cold, and for organic samples minimize exposure to light.

Other Tests	Description	**#Required**
Lead on Swab	Ghost Swab (4.75in X 4.75in)	
Metals in Air	Matched Weight MCE (37mm) Filters ($12.25 each)	
Air Testing	Matched Weight PVC (37mm) Filters ($12.25 each)	
Asbestos in air	MCE (25mm)	
Hydrocarbons	400/200mg Charcoal tube (JUMBO)	
PCB's in Oil	20 mL glass vial	

Other Supplies	**#Required**
Field ID labels	
0.45um Filter *(filtering metals,*$1.50ea)	
Coolers/ Ice Packs	
Sample submission forms	
Customized COC's	
Pre-printed Labels, Bottle Kits	

NOTES

1. Biodegradation of VOC’s in chlorinated drinking water is expected to be low. Sodium Thiosulfate treatment is generally sufficient for chlorinated drinking waters. To prevent biodegradation of **non**drinking chlorinated water samples, further HCl preservation will give the best results. For additional HCl preservation, fill bottle, then after swirling sample to dissolve sodium thiosulfate and give time for reducing agent to react with free chlorine, add HCl to lower pH to 2.0 .

2. If dissolved metals are desired, samples should be field filtered and acidified to pH < 2 with nitric acid. If field filtration is not feasible, the samples should be submitted to the laboratory unacidified with a request for lab filtration and acidification - **do not acidify unfiltered samples for dissolved metals**.

3. RCAp parameters and general water quality holding times vary considerably. Although a holding time of 28 days is considered acceptable for a “snapshop” of water quality, individual tests may have holding times ranging from 24 hours to 6 months. Fill sample containers to overflowing and cap tightly. Please contact the Customer Service Department with any questions regarding preservation and holding times for specific analytes.

4. Transport Canada has specific regulations regarding the shipment and handling of sewage samples. Samples must be taken in fully-closed sewage bottles sealed within a durable plastic bag containing absorbent material and placed in a rigid shipping container. Requisitions are to be attached to the outside of the plastic bag.

5. Coliform samples must normally be received within 24 hours of collection. Samples not delivered to lab within one hour of collection should be transported at a temperature below 10
C , samples older than one hour arriving at a temperature >15C are not normally tested. Samples should be received at the laboratory before 3 PM Monday to Friday to ensure processing. Samples arriving, weekends or a day before a holiday will be subjected to a surcharge. A completed coliform requisition form, including date and time sampled, must accompany each sample.

6. If Carbamate analysis is required, a 3mL vial of Chloroacetic Acid Buffer solution is added to bottle shipment. This Chloroacetic acid is added to sample bottle prior to taking sample.

7. For trace metals in Seawater, 2 *500mL acid washed plastic bottles are used. Samples are preserved at the lab, once preserved hold time is 6 months.

8. If Oil & Grease by the Infrared Method is required then two 500mL bottles H_2SO4 preserved are required.

9. For best results, pH should be tested in the field within 15 min. For non-legal samples and for information only pH samples can be brought to the lab for analysis.

10. Please contact the Customer Service Department to provide information on sampling for Radon in water.

11. Bottle order for BTEX or VOCs in soil also includes one TerraCore sampler per sample.

Data sheet DS/WM–EN Rev. U

WaterMaster
Electromagnetic flowmeter

Measurement made easy

The perfect fit for all water industry applications

One solution for all your needs

- designed for use in all water and waste water applications, from sewage plants to distribution networks

State-of-the-art technology

- revolutionary data storage enables transmitter interchange and commissioning without the need for re-configuration
- self-calibrating transmitter with ultra-low temperature coefficient for highest accuracy

Versatile and simple configuration

- 'Through-the-Glass' (TTG) configuration eliminating the need to remove the cover
- smart key based functionality
- 'Easy Setup' function

VeriMaster in situ verification software option

- enables the customer to perform in situ verification of the flowmeter system

Unparalleled service ability

- fault-finding Help texts on the display
- minimized downtime with replaceable electronics cartridges

MID and OIML R49 approved with R49 self-checking

- Type-approved to accuracy Class 1 and Class 2 for any pipe orientation and bidirectional flows
- Type P-approved continuous self-checking of the sensor and transmitter to ensure the highest accuracy and long term performance

Innovative sensors for all applications

- optimized full-bore series for optimum turndown / low pressure drop, irrigation applications
- full-bore series for general-purpose water metering applications
- reduced-bore series for high turn down applications, for example, leakage
- buriable sensors eliminating the need for costly chamber construction

HART, PROFIBUS DP and MODBUS

- Full system and PLC integration

The Company

ABB is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a world leader in process automation technology our worldwide presence, comprehensive service and application-oriented know-how make ABB a leading supplier of flow measurement products.

Introduction

Setting the standard for the Water Industry

The WaterMaster range, available in sizes 10 to 2400 mm ($^{3}/_{8}$ to 96 in.), is designed specifically for use on the many diverse applications encountered in the Water and Waste-water industry. The modular design concept offers flexibility, cost-saving operation and reliability while providing a long service life and exceptionally low maintenance.

Integration into ABB asset management systems and use of the self-monitoring and diagnostic functions increase the plant availability and reduce downtimes.

VeriMaster – the verification tool

An easy-to-use utility, available through the infra red service port, it uses the advanced self-calibration and diagnostic capability of WaterMaster, coupled with fingerprinting technology, to determine the accuracy status of the WaterMaster flowmeter to within ±1 % of its original factory calibration. VeriMaster also supports printing of calibration verification records for regulatory compliance.

Diagnostic functions

Using its diagnostic functions, the flowmeter monitors both its own operability and the process. Limit values for the diagnostic parameters can be set locally. When these limits are exceeded, an alarm is tripped. In the event of an error, diagnostic-dependent help text appears on the display and this considerably simplifies and accelerates the troubleshooting procedure.

In accordance with NAMUR NE107, alarms and warnings are classified with the status of 'Maintenance Required', 'Check Function', 'Failure' and 'Out of Specification'.

Flow performance

Utilizing its advanced filtering methods, the WaterMaster improves accuracy even under difficult conditions. WaterMaster has an operating flow range with ±0.4 % accuracy as standard (±0.2 % optional) in both forward and reverse flow directions.

Easy and quick commissioning

'Fit-and-Flow' data storage inside WaterMaster eliminates the need to match sensor and transmitter in the field. On initial installation, the self-configuration sequence automatically replicates into the transmitter all calibration factors, meter size and serial numbers, as well as customer site-specific settings, eliminating the potential for error.

Intuitive, convenient navigation

The 'Easy Setup' function reliably guides unpracticed users through the menu step by step. The smart key based functionality makes handling a breeze – it's just like using a cell phone. During configuration, the permissible range of each parameter is indicated on the display and invalid entries are rejected.

Universal transmitter – powerful and flexible

The backlit display can be rotated easily without the need for tools. The contrast is adjustable and the display fully-configurable. The character size, number of lines and display resolution (number of decimal points) can be set as required. In multiplex mode, several different display options can be pre-configured and invoked one after the other.

The smart modular design of the transmitter unit enables easy disassembly without the need to unscrew cables or unplug connectors. HART is used as the standard communications protocol. Optionally, the transmitter is available with PROFIBUS DP or MODBUS communication.

Assured quality

WaterMaster is designed and manufactured in accordance with international quality procedures (ISO 9001) and all flowmeters are calibrated on nationally-traceable calibration rigs to provide the end-user with complete assurance of both quality and performance of the flowmeter.

WaterMaster – always the first choice

WaterMaster sets the standard for the water industry. The specification, features and user benefits offered by this range are based on ABB's worldwide experience in this industry and they are all targeted specifically to the industry's requirements.

Submersible and buriable

WaterMaster sensors have a rugged, robust construction to ensure a long, maintenance-free life under the arduous conditions experienced in the Water and Waste Industry. The sensors are, as standard, inherently submersible (IP68, NEMA 6P), thus ensuring suitability for installation in chambers and metering pits that are susceptible to flooding.

A unique feature of the WaterMaster sensors is that sizes DN40 to DN2400 ($1^1/_2$ to 96 in. NB) are buriable; installation simply involves excavating to the underground pipe, fitting the sensor, cabling back to the transmitter and then backfilling the hole.

The WaterMaster family

Overview of the WaterMaster

A wide range of features and user benefits are built into WaterMaster as standard:

- bi-directional flow
- unique self-calibrating transmitter (patented) for the ultimate in stability and repeatability
- OIML-type continuous self-checking, with alarms, ensures both sensor and transmitter accuracy
- true electrode and coil impedance measurement
- comprehensive simulation mode
- universal switch-mode power supply (options are available for AC and DC supplies)
- comprehensive self-diagnostics compliant with NAMUR NE107
- programmable multiple-alarm capability
- bus options: HART (4 to 20 mA), PROFIBUS DP (RS485), MODBUS (RS485)
- 3 configurable pulse / frequency and alarm outputs
- advanced infrared service port supports remote HMI, HART, cyclic data out and parameter download
- VeriMaster in situ verification software available as option
- read-only switch and ultra-secure service password for total security

OIML / MID approved

WaterMaster has been type tested and Internationally approved to the highest accuracy class 1 and 2 for cold and hot potable water meters – OIML R49-1 (Organisation Internationale de Métrologie Légale). For full details, OIML R49 is available to download from www.oiml.org. Its requirements are very similar to other International standards, such as EN14154 and ISO4064.

WaterMaster has been assessed by type approval at the National Measurement Office (NMO) to OIML R49 and passed to the very highest accuracy designations for sizes DN40 to DN200 ($1^1/_2$ to 8 in. NB).

The approval is for:

- Class 1 and Class 2 accuracy (calibration option)
- Environmental class T50 for water temperatures of 0.1 to 50 °C (32.18 to 122 °F)
- Electromagnetic Environment E2 (10 V/m)
- Any pipe orientation
- 5 Diameters upstream pipe
- 0 Diameters downstream pipe
- Pressure Loss Class <0.25 bar (3.62 psi)
- Integral or remote transmitter (<200 m [<656 ft.] cable)
- DN40 to DN200 ($1^1/_2$ to 8 in. NB), bi-directional flow

A major advance in WaterMaster is the self-checking capabilities that meet and exceed the R49 requirements and is the first electromagnetic flowmeter to be approved to OIML Type P permanent self checking during normal operation (not just at startup) and alarm indication for:

- transmitter and sensor status, with an accuracy alarm
- program ROM and RAM status
- double, independent storage of totalizer values, in both the sensor and transmitter non-volatile memories
- display test

The OIML R49-1 certificate of conformity is available from:

http://www.abb.com/product/seitp330/b42ec2377d3293cd
c12573de003db93b.aspx

WaterMaster is also approved under the EU Measuring Instruments Directive (MID) 2004/22/EC, that covers putting into use water flowmeters for certain applications. MID WaterMaster is secured against tamping and is available as an option, along with fingerprinting for ABB VeriMaster in situ verification product, with certificate printout to ±1 % accuracy.

WaterMaster certificates of EC type-examination of a measuring instrument are available from:

http://www.abb.com/product/seitp330/b42ec2377d3293cd
c12573de003db93b.aspx

Superior control through advanced sensor design

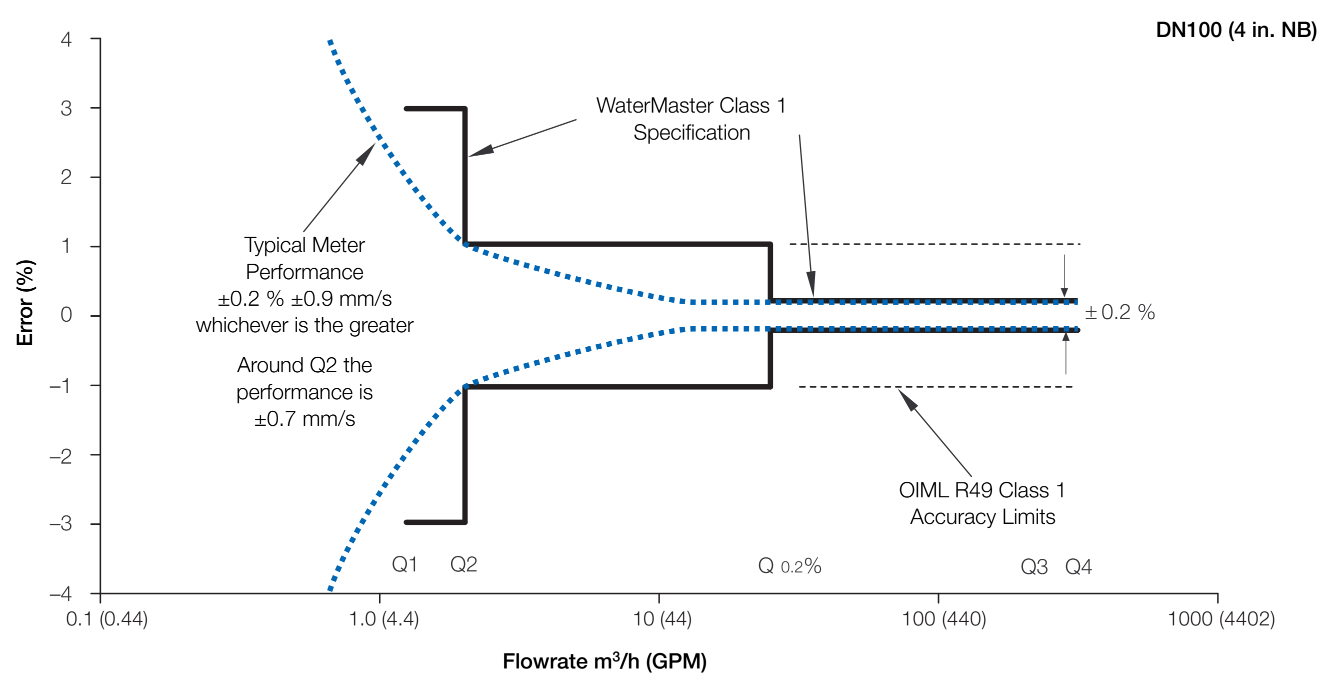
The innovative, patented octagonal sensor design improves flow profile and reduces up- and down-stream piping requirements for the most commonly used sizes of 40 to 200 mm ($1^1/_2$ to 8 in.). This optimized full bore meter provides impressive results in the most difficult of installation requirements.

WaterMaster sensors are also available in reduced-bore geometries giving the ultimate in low-flow performance with a very high turn-down range.

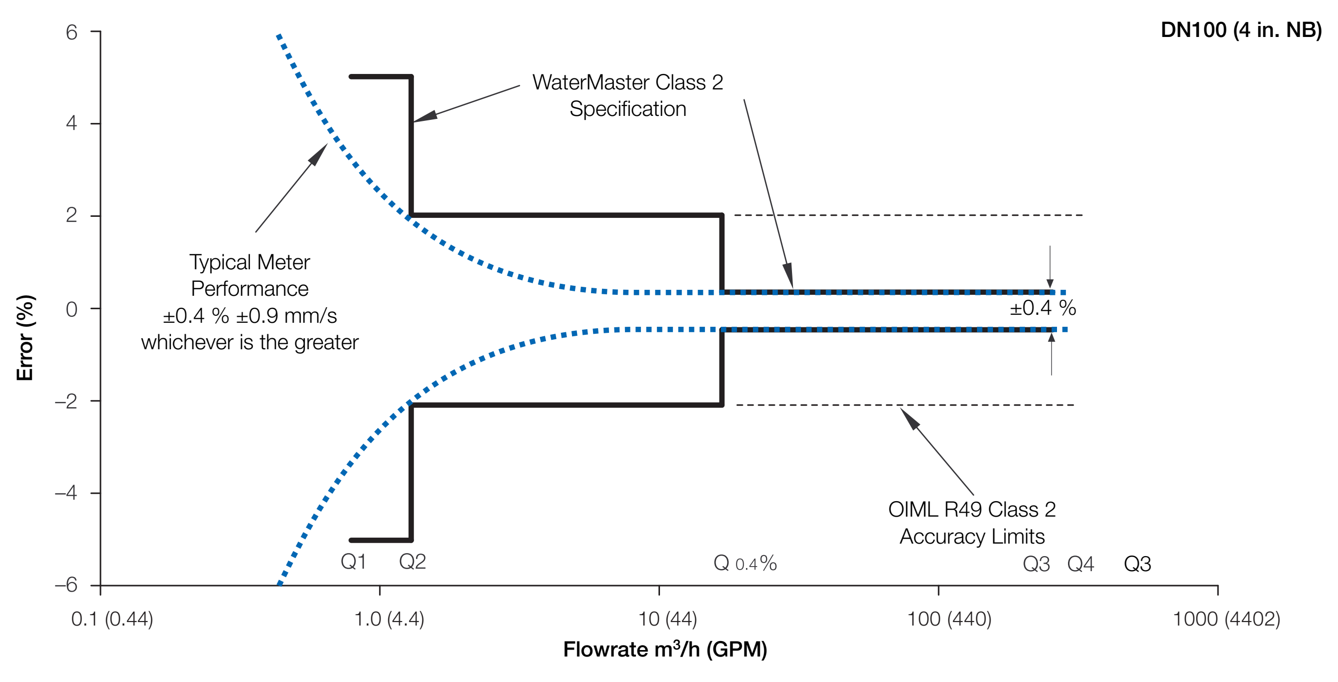
The unique design of the reduced-bore sensor conditions the flow profile in the measuring section so that distortions in the flow profile, either upstream or downstream, are flattened. The result is excellent in situ flowmeter performance, even with very bad hydraulic installation conditions.

Specification

WaterMaster specification to OIML R49 Class 1



WaterMaster specification to OIML R49 Class 2



Although OIML R49 does not define the flow accuracy below Q1, WaterMaster continues to measure flow at lower flow rates down to a cutoff velocity of ±5 mm/s (±0.2 in./s). The accuracy between cutoff and Q1 is typically ±0.9 mm/s (±0.04. in./s).

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – m^3/h

			Standard Calibration – 0.4 % Class 2			High Accuracy Calibration – 0.2 % Class 1		
DN	Q4	Q3	$Q_{0.4\%}$	Q2	Q1	$Q_{0.2\%}$	Q2	Q1
10	3.1	2.5	0.167	0.013	0.008	0.31	0.02	0.012
15	7.88	6.3	0.42	0.032	0.02	0.79	0.05	0.03
20	12.5	10	0.67	0.05	0.032	1.25	0.08	0.05
25	20	16	1.1	0.08	0.05	2	0.13	0.08
32	31.25	25	1.67	0.13	0.08	3	0.20	0.13
40*	50	40	4.2	0.2	0.13	6	0.32	0.2
50*	79	63	4.2	0.32	0.20	7.9	0.5	0.32
65*	125	100	6.7	0.5	0.32	12.5	0.8	0.5
80*	200	160	10.7	0.81	0.51	16	1.3	0.8
100*	313	250	16.7	1.3	0.79	25	2	1.25
125*	313	250	16.7	1.3	0.79	25	2	1.25
150*	788	630	42	3.2	2.0	63	5	3.2
200*	1,250	1,000	67	5.1	3.2	100	8	5
250	2,000	1,600	107	8.1	5.1	160	13	8
300	3,125	2,500	167	12.7	7.9	250	20	12.5
350	5,000	4,000	267	20.3	12.7	400	32	20
400	5,000	4,000	267	20.3	12.7	400	32	20
450	7,875	6,300	420	32	20	630	50	32
500	7,875	6,300	420	32	20	630	50	32
600	12,500	10,000	667	51	32	1000	80	50
700	20,000	16,000	1600	102	64	1600	160	100
750	20,000	16,000	1600	102	64	1600	160	100
30 in (760)	20,000	16,000	1600	102	64	1600	160	100
800	20,000	16,000	1600	102	64	1600	160	100
900	31,250	25,000	2500	160	100	2500	250	156
1000	31,250	25,000	2500	160	100	2500	250	156
42 in	31,250	25,000	2500	160	100	2500	250	156
1100	31,250	25,000	2500	160	100	2500	250	156
1200	50,000	40,000	4000	256	160	4000	400	250
1350	78,750	63,000	6300	403	252	6300	630	394
1400	78,750	63,000	6300	403	252	6300	630	394
1500	78,750	63,000	6300	403	252	6300	630	394
60 in (1500)	78,750	63,000	6300	403	252	6300	630	394
1600	78,750	63,000	6300	403	252	6300	630	394
1650	78,750	63,000	6300	403	252	6300	630	394
1800	125,000	100,000	10000	640	400	10000	1000	625
1950	125,000	100,000	10000	640	400	10000	1000	625
2000	125,000	100,000	10000	640	400	10000	1000	625
2200	200,000	160,000	16000	1024	640	16000	1600	1000
2400	200,000	160,000	16000	1024	640	16000	1600	1000

* OIML R49 Certificate of Conformance to Class 1 and Class 2, with OIML R49 and MID versions available.

Note. OIML R49–1 allow Class 1 only for meters with $Q_3 \geq 100$ m^3/h. Meters outside this range have been tested and conform to Class 1.

WaterMaster optimized full-bore meter (FEV) / full-bore meters (FEF, FEW) flow performance – gal/min

			Standard Calibration 0.4 % Class 2			High Accuracy Calibration 0.2 % Class 1		
NPS/NB (DN)	Q4	Q3	$Q_{0.4\%}$	Q2	Q1	$Q_{0.2\%}$	Q2	Q1
$^{3}/_{8}$ (10)	13.8	11	0.73	0.06	0.035	1.38	0.09	0.053
$^{1}/_{2}$ (15)	34.7	27.7	1.85	0.14	0.09	3.48	0.22	0.14
$^{3}/_{4}$ (20)	55	44	2.94	0.22	0.14	5.5	0.35	0.22
1 (25)	88	70.4	4.7	0.35	0.22	8.8	0.57	0.35
1 $^{1}/_{4}$ (32)	137.6	110	7.3	0.57	0.35	13.2	0.88	0.57
1 $^{1}/_{2}$ (40)	220	176	18.5	0.89	0.56	26.4	1.41	0.88
2 (50)	347	277	18.5	1.41	0.88	34.7	2.22	1.39
2 $^{1}/_{2}$ (65)	550	440	29.4	2.24	1.40	55.0	3.52	2.20
3 (80)	881	704	47.0	3.58	2.24	70.4	5.64	3.52
4 (100)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
5 (125)	1,376	1,101	73.4	5.59	3.49	110	8.81	5.50
6 (150)	3,467	2,774	185	14.1	8.81	277	22.2	13.9
8 (200)	5,504	4,403	294	22.4	14.0	440	35.2	22.0
10 (250)	8,806	7,045	470	35.8	22.4	704	56.4	35.2
12 (300)	13,759	11,007	734	55.9	34.9	1,101	88.1	55.0
14 (350)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
16 (400)	22,014	17,611	1,174	89.5	55.9	1,761	141	88.1
18 (450)	34,673	27,738	1,849	141	88.1	2,774	222	139
20 (500)	34,673	27,738	1,849	141	88.1	2,774	222	139
24 (600)	55,036	44,029	2,935	224	140	4,403	352	220
27/28* (700)	88,057	70,446	7,045	451	282	7,045	704	440
29 (750)	88,057	70,446	7,045	451	282	7,045	704	440
30 (760)	88,057	70,446	7,045	451	282	7,045	704	440
32 (800)	88,057	70,446	7,045	451	282	7,045	704	440
36 (900)	137,590	110,072	11,007	704	440	11,007	1,100	688
39/40* (1000)	137,590	110,072	11,007	704	440	11,007	1,100	688
42 (1050)	137,590	110,072	11,007	704	440	11,007	1,100	688
44 (1100)	137,590	110,072	11,007	704	440	11,007	1,100	688
48 (1200)	220,143	176,115	17,611	1,127	704	17,611	1,761	1,101
52 (1350)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
54 (1400)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
60 (1500)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
66 (1600)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
68 (1650)	346,726	277,381	27,738	1,775	1,110	27,738	2,773	1,733
77 (1800)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
77 (1950)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
78 (2000)	550,358	440,287	44,029	2,818	1,761	44,029	4,403	2,752
84 (2200)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403
96 (2400)	880,573	704,459	70,446	4,509	2,818	70,446	7,045	4,403

*Size is dependent on flange specification

WaterMaster reduced-bore meter (FER) flow performance – m^3/h (gal/min)

				Class 2 specification				Class 1 specification			
Size		Q_4	Q_3	$Q_{0.4\%}$	Q_2	Q_1	R	$Q_{0.2\%}$	Q_2	Q_1	R
mm	in.	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)		m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	m^3 / h (Ugal / min)	
40	$1^{1}/_{2}$	31 (138)	25 (110)	0.83 (1.05)	0.063 (0.28)	0.04 (0.18)	630	1.7 (7.48)	0.1 (0.44)	0.063 (0.28)	400
50	2	50 (220)	40 (176)	1.0 (4.40)	0.1 (0.44)	0.063 (0.28)	630	2.0 (8.8)	0.16 (0.7)	0.1 (0.44)	400
65	$2^{1}/_{2}$	79 (347)	63 (277)	1.6 (7.04)	0.16 (0.7)	0.1 (0.44)	630	3.2 (10.56)	0.25 (1.1)	0.16 (0.7)	400
80	3	125 (550)	100 (440)	2.0 (8.80)	0.25 (1.1)	0.16 (0.7)	630	4.0 (17.6)	0.4 (1.76)	0.25 (1.1)	400
100	4	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400
125	5	200 (880)	160 (704)	3.2 (10.56)	0.41 (1.8)	0.25 (1.1)	630	6.4 (28)	0.64 (2.8)	0.4 (1.76)	400
150	6	500 (2200)	400 (1760)	8.0 (35.20)	1.0 (4.4)	0.63 (2.77)	630	16 (70.4)	1.6 (7)	1.0 (4.4)	400
200	8	788 (3470)	630 (2770)	13.0 (57.2)	1.6 (7.04)	1.0 (4.4)	630	25 (110)	2.5 (11)	1.6 (7)	400
250	10	1250 (5500)	1000 (4400)	20 (88)	2.5 (11.01)	1.6 (7)	630	40 (176)	4.0 (17.6)	2.5 (11)	400
300	12	2000 (8810)	1600 (7045)	32 (140.8)	4.1 (18.05)	2.5 (11)	630	64 (281.6)	6.4 (28)	4.0 (17.6)	200
350	14	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200
375	15	2000 (8810)	1600 (7045)	32 (140.8)	6.4 (28.18)	4.0 (17.6)	400	64 (281.6)	12.8 (56)	8.0 (35.2)	200
400	16	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200
450	18	3125 (13760)	2500 (11007)	50 (220)	10 (44)	6.3 (27.7)	400	100 (440)	20 (88)	12.5 (55)	200
500	20	5000 (22014)	4000 (17610)	80 (352)	16 (70.45)	10 (44)	400	160 (70.4)	32 (141)	20 (88)	200
600	24	7875 (34670)	6300 (27740)	126 (554.4)	25.2 (110.9)	15.8 (70)	400	252 (1108)	50.4 (222)	31.5 (138.7)	200

Specification – sensor

Functional specification

Pressure limitations

As per flange rating – non approved
PN16 for OIML R49, MID Approved

Pressure equipment directive 97/23/EC

This product is applicable in networks for the supply, distribution and discharge of water and associated equipment and is therefore exempt.

Temperature limitations

Ambient temperature	
Remote transmitter	–20 to 70 °C (–4 to 158 °F)
Integral transmitter	–20 to 60 °C (–4 to 140 °F)
Process temperature	See table below. 0.1 to 50 °C (32.2 to 122 °F) – OIML R49 T50 Approved

			Medium temperature °C (°F)	
Code	**Lining**	**Flange material**	**Minimum**	**Maximum**
FEF, FEW3	Hard rubber	Carbon steel	–10 (14)	90 (194)
		Stainless steel	–10 (14)	90 (194)
FEW1	PTFE	Carbon steel	–10 (14)	130 (266)
		Stainless steel	–25 (–13)	130 (266)
FEW3	PTFE	Carbon steel	–10 (14)	130 (266)
		Stainless steel	–10 (14)	130 (266)
FEW3	Elastomer	Carbon steel	–5 (23)	80 (176)
		Stainless steel	–5 (23)	80 (176)
FEF, FER	Elastomer	Carbon steel	–6 (21)	70 (158)
FEV	Polypropylene		–6 (21)	70 (158)

IP rating

IP68 (NEMA 6) to 7 m (20 ft.) depth
Note. Not sizes DN10 to DN32 (⅜ – 1¼ in. NB)

IP67 (NEMA 4X) – DN10 to DN32 (⅜ – 1¼ in. NB)

Buriable (sensor only)

FEV, FEF and FEW – DN450 to 2400 (18 to 96 in. NB) to 5 m (16 ft.) depth

Conductivity

>5µS cm^{-1}

Transmitter mounting

Integral (not FEF) or remote

Electrical connections

20 mm glands

½ in. NPT
20 mm armored glands

Sensor cable

ABB WaterMaster cable available in two forms – standard and armored
Maximum length 200 m (660 ft.)

Physical specification

Wetted parts

Electrode material

Stainless steel 316 L / 316 Ti

Super-austenitic steel

Hastelloy® C-22 and Hastelloy ^{C4}

(other electrode materials available on request)

Potential equalizing rings

Minimum of 1 recommended

Lining material / potable water approvals

			Potable Water Approvals					
Code	**Size Range**	**Liner**	**WRAS**	**WRAS 60°C**	**ACS**	**DVGW**	**NSF**	**AZ/ NZS 4020**
FEW1	DN10 – 32 (⅜ – 1¼ in. NB)	PTFE	4					
FEW3	DN10 – 600 (⅜ – 24 in. NB)	PTFE						
FEW3	DN40 – 2400 (1½ – 96 in. NB)	Elastomer	4					4
FEW3	DN40 – 2400 (1½ – 96 in. NB)	Hard rubber	4	4		4	NSF approved material	
FEV	DN40 – 200 (1½ – 8 in. NB)	Poly-propylene	4		4	4	NSF-61	4
FEF	DN250 – 600 (10 – 24 in. NB)	Elastomer	4		4	4	NSF-61	4
FEF	DN250 – 600 (10 – 24 in. NB)	Hard rubber	4	4		4	NSF approved material	
FER	DN40 – 600 (1½ – 24 in. NB)	Elastomer	4		4	4		4

*Size is dependent on flange specification

Lining protection plates

Not required

Installation conditions (recommended)

	Straight pipe requirements	
	Upstream	Downstream
FEW / FEF	5 x DN	2 x DN
FEV	5x DN	0 x DN
FER	0 x DN	0 x DN

Pressure loss

Negligible at Q3	All full bore meters
<0.25 bar (<3.62 psi) at Q3	FEV (DN40 to 200 [1½ to 8 in. NB])
<0.63 bar (<9.13 psi) at Q3	FER (DN40 to 600 [1½ to 24in. NB])

Non-wetted parts

Flange material

Carbon steel	DN20 to DN2400 ($^3/_4$ to 96 in. NB)
Stainless steel	DN10 to DN2400 ($^3/_8$ to 96 in. NB)
SG iron	FEV – DN40 to DN150 [1 $^1/_2$ to 6 in. NB) FER – DN40 to DN150 [1 $^1/_2$ to 6 in. NB)

Housing material

Carbon steel	FEV – DN40 to 200 (1$^1/_2$ to 8 in. NB) FEW – DN450 to 2400 (18 to 96 in. NB)
Plastic	FEF – DN250 to 600 (10 to 24 in. NB)
Aluminium	FEW – DN10 to 400 ($^3/_8$ to 16 in. NB)

Terminal box material

Polycarbonate

Cable gland material

Plastic, brass

Paint specification

Paint coat ≥70 µm thick RAL 9002 (light grey)

Specification – transmitter

Functional specification

Power supply

Mains	85 to 265 V AC @ <7 VA
Low voltage	24 V AC +10 % /–30 % @ <7 VA
DC	24 V ±30 % @ <0.4 A

Supply voltage fluctuations within the specified range have no effect on accuracy

Digital Outputs (3)

Rating 30 V @ 220 mA, open collector, galvanically isolated *

Maximum output frequency 5250 Hz

1 off dedicated to Alarm / Logic, programmable function

2 off configurable to either Pulse / Frequency or Alarm/Logic function

Current output – HART FEX100 variant

4 to 20 mA or 4 to 12/20 mA, galvanically isolated *

Maximum loop resistance 750 Ω

HART protocol Version 5.7 (HART registered)

Signal levels compliant with NAMUR NE 43 (3.8 to 20.5 mA)

Low alarm 3.6 mA, High alarm 21.8 mA

Additional accuracy

±0.1 % of reading

Temperature coefficient: typically <±20 ppm/°C

RS485 Communications – PROFIBUS FEX100-DP variant

Registered name: FEX100-DP

RS485 (9.6kbps to 1.5Mbps), galvanically isolated

DPV0, DPV1

PA Profile 3.01

Standard idents: 9700, 9740, 9741

FEX100-DP specific ident: 3431

3 Concurrent MS2 master connections

RS485 Communications – MODBUS FEX100-MB variant

MODBUS RTU protocol

RS485 (9.6kbps to 115.2kbps), galvanically isolated

Electrical connections

20 mm glands $^1/_2$ in. NPT, 20 mm armored glands

Temperature limitations

Ambient temperature	–20 to 60 °C (–4 to 140 °F)
Temperature coefficient	Typically <±10 ppm/°C @ Vel ≥0.5 mls

Environmental protection

Humidity: 0 to 100 %

Rating: IP67 (NEMA 4X) to 1m (3.3 ft.) depth

Tamper-proof security

Write access prevented by internal switch combined with external security seals for MID applications

Languages

English, French, German, Italian, Spanish, Polish

Infrared service port

USB adapter (accessory), USB 1.1. and 2.0 compatible

Driver software for Windows 2000, XP, 7 (32-bit) and Vista

Housing material

Powder-coated aluminium with glass window

Paint specification

Paint coat ≥70 µm thick RAL 9002 (light grey)

Transmitter vibration testing

Vibration level: 7 m/s^2

Frequency range: 20 to 150 Hz

No. of sweeps in 3 orthogonal planes: 20

Undetectable shift in transmitter span or zero performance

Hazardous approvals (HART variant only)

FM & FMc Class 1 Div 2

(FM listing NI / 1 / 2 / ABCD / T4, S / II, III / 2 / FG /T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32 [$^3/_8$ to 1$^1/_4$ in.NB])

(FMc listing NI / 1 / 2 / ABCD / T4, DIP / II, III / 2 / FG /T4, Ta=60C; Type 4X, IP67 – for transmitter and integral mounting Ta=70C, Type 6P, IP68 – for remote sensor type, IP67 on DN10 to 32 [$^3/_8$ to 1$^1/_4$ in.NB])

FET, FEV, FEW and FEF DN700 to 2200 (27/28* to 84 in. NB) only

*Size is dependent on flange specification

ATEX* Zone 2, 21 & 22

II 3 G Ex nA IIC T5 Gc
II 2 D Ex tb IIIC T100°C Db
TA = –20°C to +60°C (integral transmitter)
TA = –20°C to +70°C (remote sensor)

IECEx* Zone 2, 21 & 22

Ex tb IIIC T100°C Db
Ex nA IIC T5 Gc
TA = –20°C to +60°C (integral transmitter)
TA = –20°C to +70°C (remote sensor)

*FEW, FEV, FET and FEF ≥700 (27/28 in. NB) only

Declaration of Conformance

Copies of CE certification will be available on request.

WaterMaster has OIML R49 Certificate of Conformity to accuracy class 1 and 2 (FEV DN40 to 200 [1$^1/_2$ to 8 in.NB]). Copies of accuracy certification are available on request.

WaterMaster (FEV DN40 to 200 [1$^1/_2$ to 8 in.NB]) has been type examined under directive MID 2004/22/EC, Annex MI-001. Copies of this certificate are available on request.

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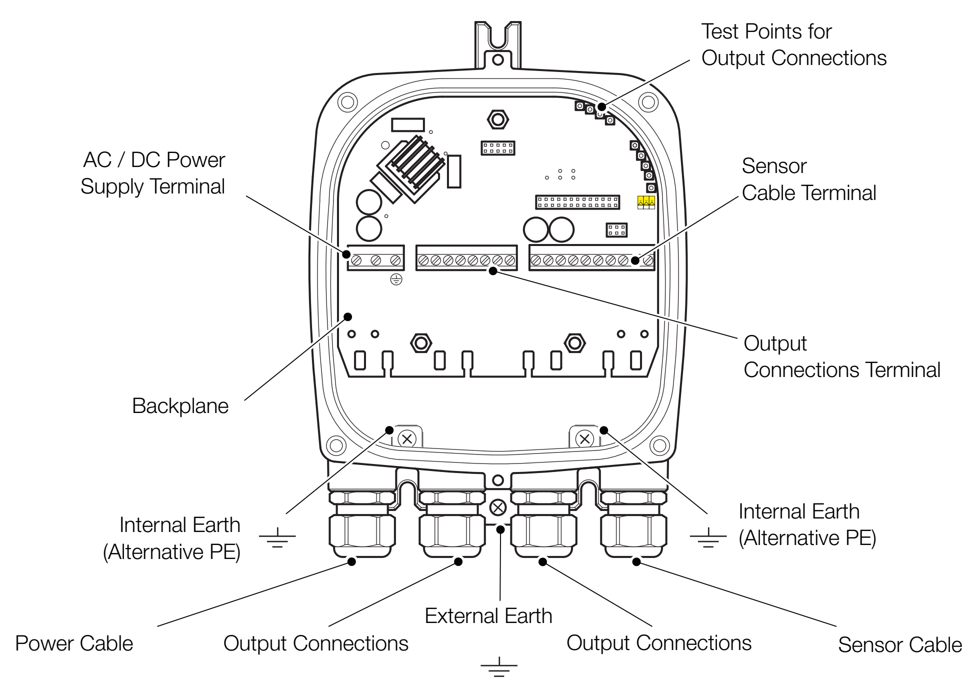
* When installed, do not leave galvanically isolated circuits (pulse and current) floating.

Transmitter connections

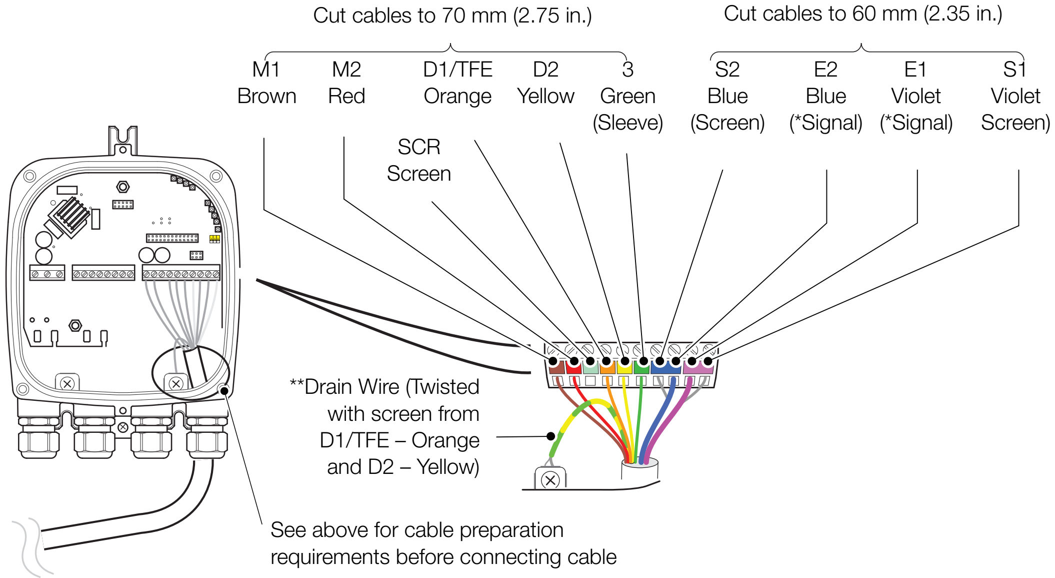
Transmitter terminal connections overview

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and safety precautions – refer to the User Guide OI/FET100–EN.



Cable gland / conduit entry (Remote transmitter shown)

Sensor cable terminal connections and recommended cable lengths



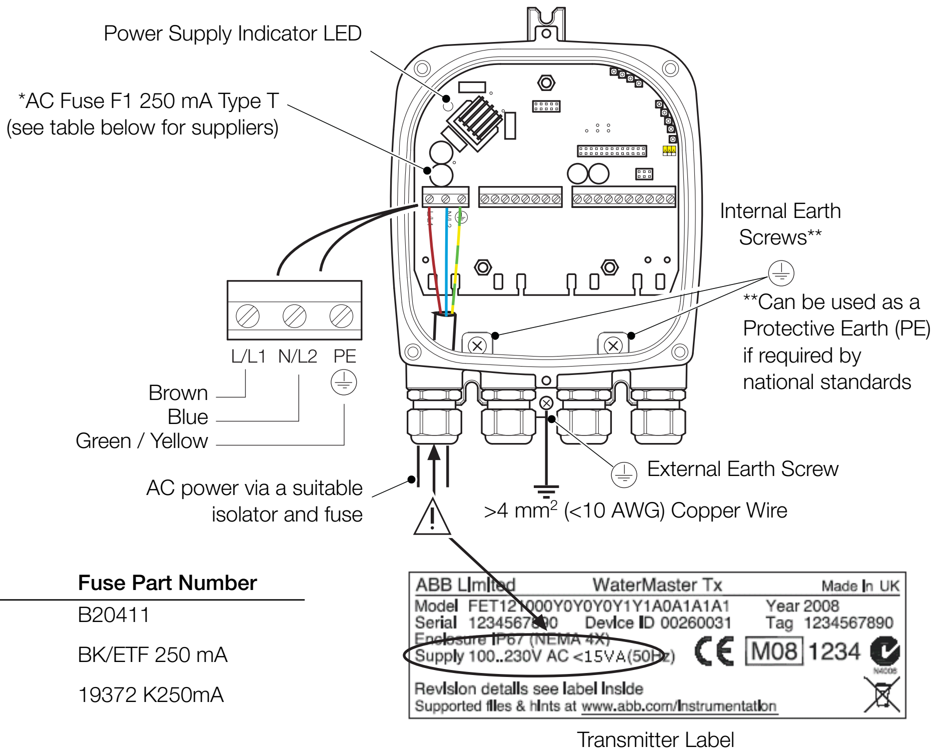
*Inner wire

**For cathodically-protected systems (or if the transmitter enclosure does not have an earth screw) connect the drain wire to terminal SCR.

Sensor cable connections at transmitter terminal block – remote transmitter

Power supply connections

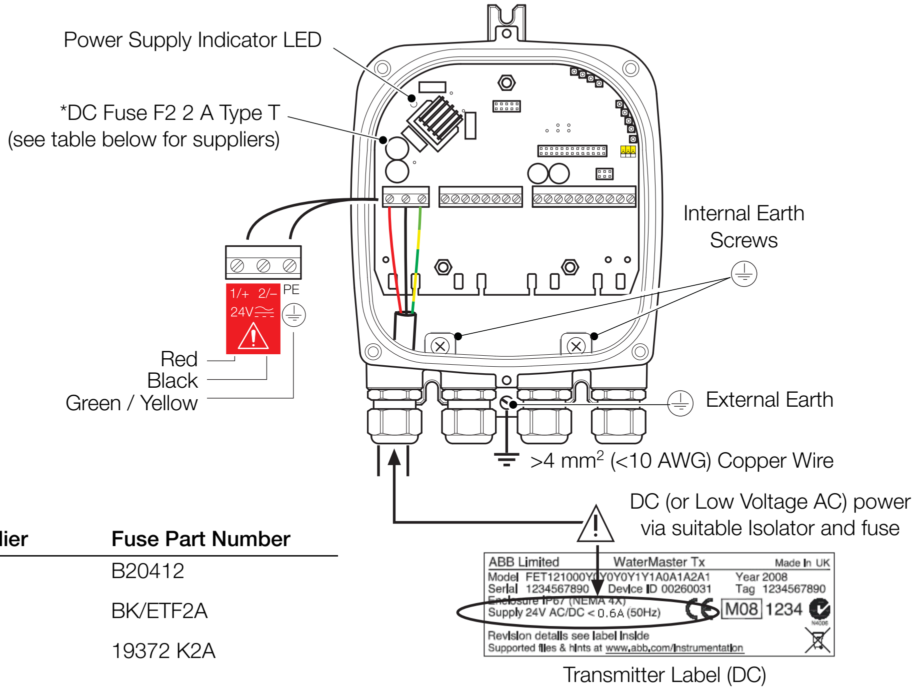
AC power supply



*Fuse Supplier	Fuse Part Number
ABB	B20411
Bussmann	BK/ETF 250 mA
Wickmann	19372 K250mA

AC power supply connections

DC (and low voltage AC) power supply



*Fuse Supplier	Fuse Part Number
ABB	B20412
Bussmann	BK/ETF2A
Wickmann	19372 K2A

DC (and low voltage AC) power supply connections

Configuration DIP switches

Three configuration DIP switches are mounted on the transmitter backplane board.

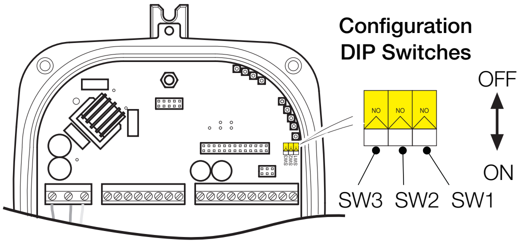
These are factory-set as follows:

- Remote transmitter – all OFF
- Integral transmitter – SW3 ON

For MID-compliant flowmeters the read-only / MID protection switch is set to 'ON' to ensure the meter is secure from tampering.

For HART software versions prior to 01.02.XX, this switch (set after commissioning) prevents login via the keypad or bus at any security level.

From HART software version 01.03.XX onwards and for all PROFIBUS software versions, on MID meters, all metrological-related parameters are locked and inaccessible at the Service level. Standard and Advanced user level parameters can still be modified via the HMI or bus.



DIP Switch Functions

SW1 – Read-only / MID Protection

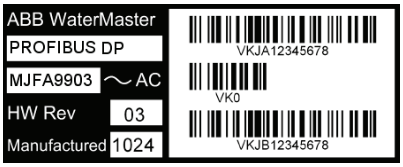
SW2 – (Future Product)

SW3 – Internal Sensor Memory

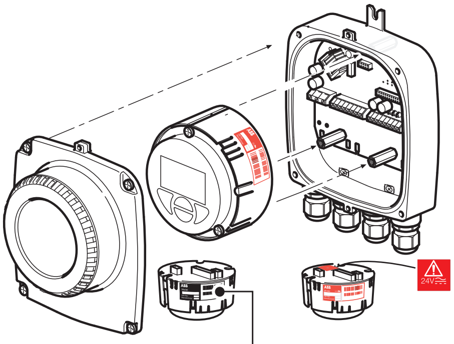
Configuration DIP switches

Transmitter module identification

> **Note.** The communications bus type is HART FEX100 if not specified on the transmitter module label. An example of the PROFIBUS FEX100-DP variant transmitter module label is shown below.



PROFIBUS FEX-100P Label



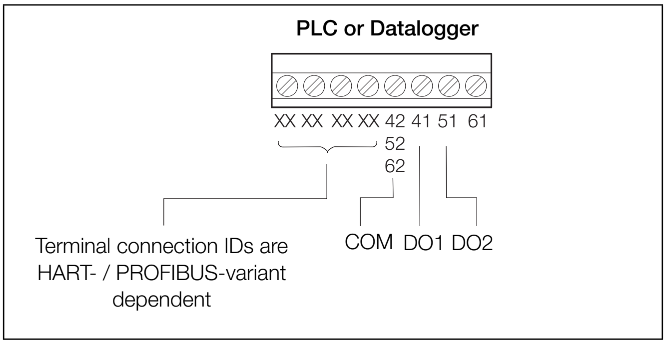
Red Label on DC (and Low Voltage AC) Converter Module

Black Label on AC Converter Module

Transmitter module identification

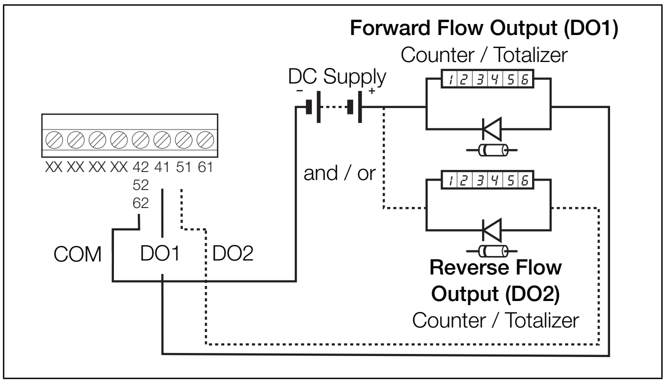
Output connections

Frequency outputs

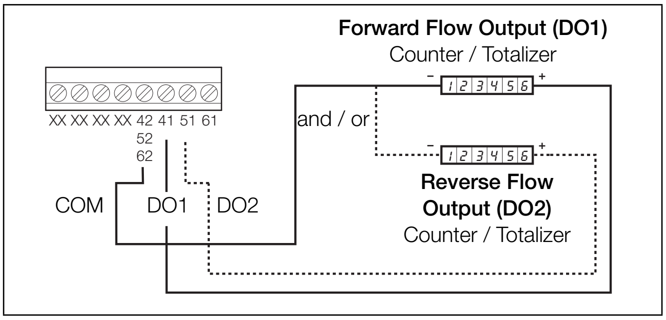


PLC / Datalogger connections

Note. Digital outputs DO1 and DO2 are polarity sensitive. The common (negative) connection for these outputs is designated 'COM'.

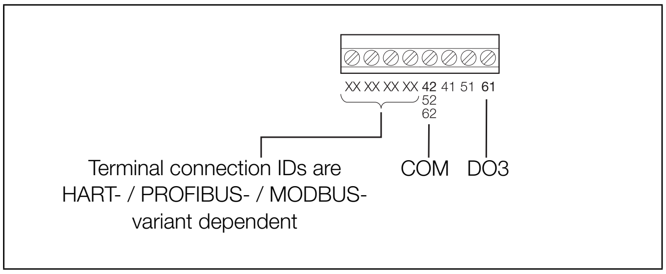


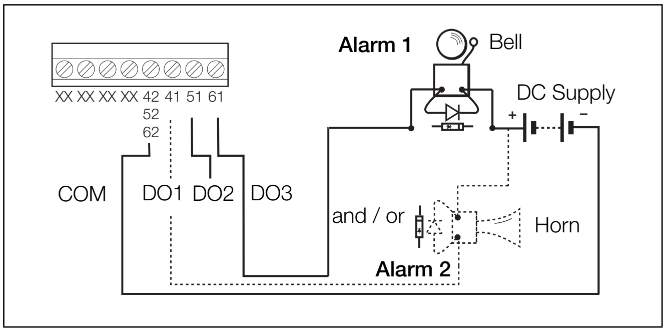
Electromechanical connections



Telemetry / Electronic counters connections

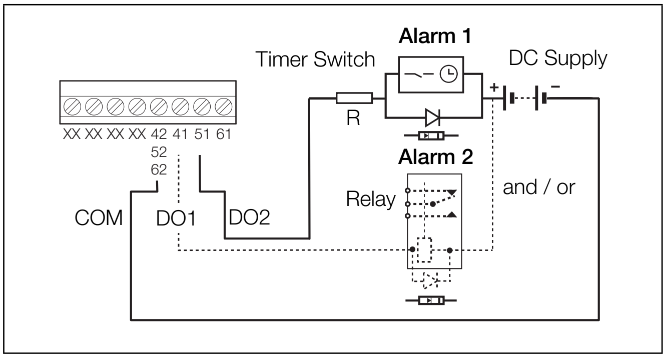
Alarm outputs





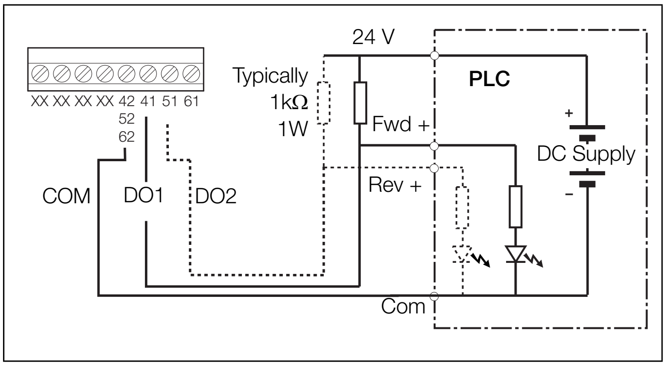
Note.

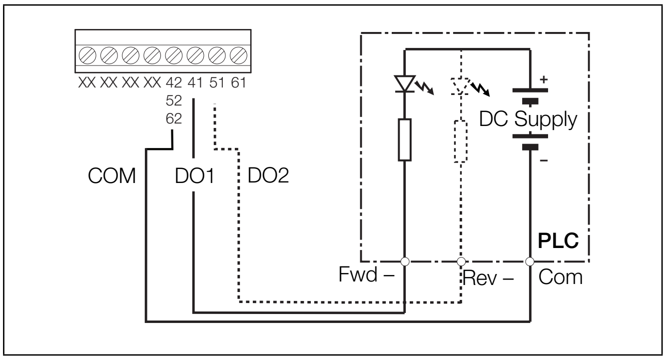
- Normal alarm / logic output is from DO3 (terminal 61). DO1 (41) and DO2 (51) can also be configured as alarms if required but are then NOT available as frequency / pulse outputs as shown in *Electromechanical connections* and *Telemetry / Electronic counters connections*, opposite.
- Bell and horn shown for example only. Any suitable alarm device may be used (for example, lamp, siren, buzzer etc.).



Note. Relay and timer switch shown for example only.

PLC interface

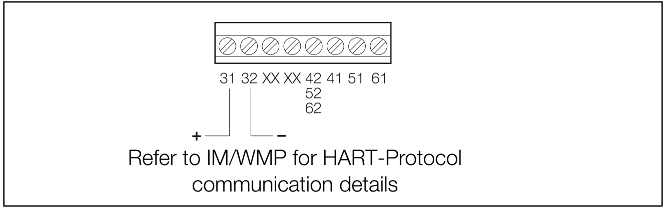




Note.

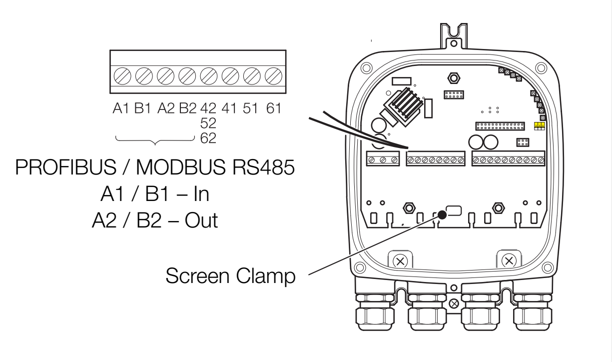
- WaterMaster digital outputs are NPN optocoupled transistors used as switches.
- Maximum allowed voltage at collector is 30 V DC
- Maximum allowed current across transistor is 220 mA.

Current output (4 to 20 ma) – HART (FEX100) variant



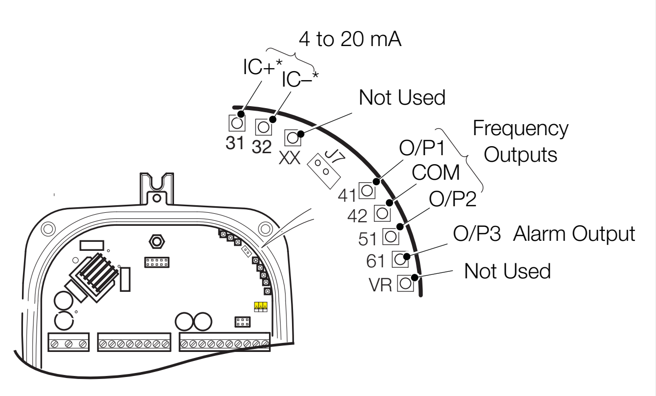
Current output (4 to 20 mA) – HART (FEX100) variant

RS485 communications – PROFIBUS (FEX100-DP) and MODBUS (FEX100-MB) variants



Test point access

Note. A typical DVM probe can access (fit) the PCB's test holes.



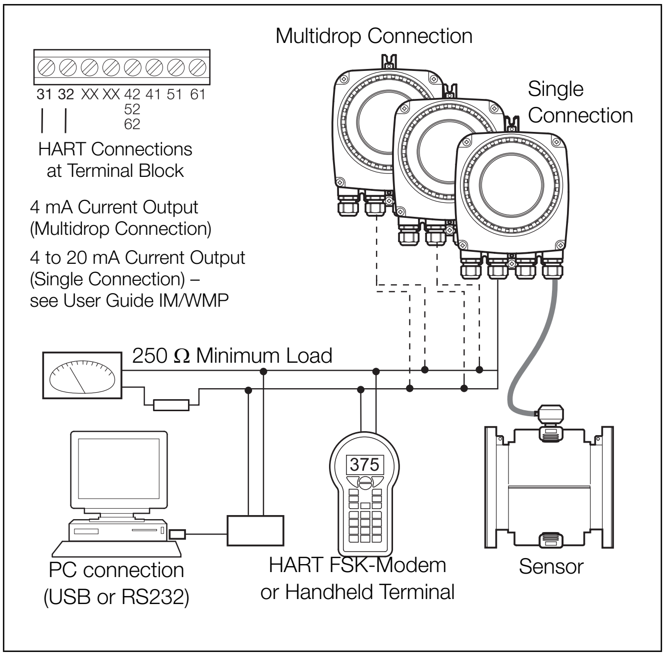
*These 2 test points are connected on the HART FEX100 backplane only (they are present on the PROFIBUS FEX100-DP / MODBUS FEX100-MB backplane but not connected)

Digital communication

The transmitter has the following options for digital communication.

HART protocol

The unit is registered with HART Communication Foundation.



HART protocol	
Configuration	Directly on the Device Software Asset Vision Basic (+ HART -DTM)
Transmission	Install a HART modem (FSK [Frequency Shift Keyed]-Modem) for HART-Communication when connecting to a PC. The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector
Max. signal amplitude	1.2 mA
Current output load	Min. 250Ω, max. = 560Ω
Cable	AWG 24 twisted
Max. cable length	1500 m (4921 ft.)
Baud rate	1.200 baud

System integration

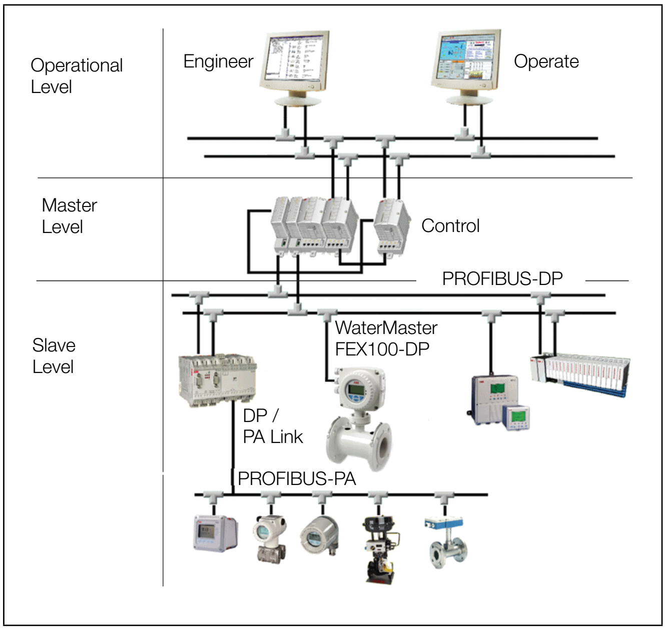
WaterMaster can be integrated into control systems and configuration devices using any Frame application, such as ABB AssetVision or similar third-party applications. ABB Device Type Managers (DTMs) for WaterMaster provide a unified structure for accessing device parameters, configuring and operating the devices and diagnosing problems. FDT (Field Device Tool) technology standardizes the communication and configuration interface between all field devices and host systems.

PROFIBUS DP protocol

PROFIBUS is a manufacturer-independent, open Fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standard EN 50170.

PROFIBUS DP ID no.	0x3431
Alternative standard ID no.	0x9701 or 0x9741
Configuration	Directly on the device Software Asset Vision Basic (+PROFIBUS DP-DTM)
Transmission signal	Accuracy to IEC 61158-2
Cable	Shielded, twisted cable (accurate to IEC 61158-2, types A or B)

All devices are connected in a bus structure ('line') as shown in below. Up to 32 stations (master or slaves) can be linked to create one 'segment', although it is recommended not to install more than 16 devices on a single segment. Each end of a segment must be terminated by an active bus terminating resistor. Both bus terminators must always be powered to ensure fault-free operation, therefore it is strongly recommended that they are connected to a back-up power supply. The use of bus amplifiers (repeaters) and segment couplers can be used to extend the network.



System integration

The GSD file for WaterMasters specifies the device-specific Ident No. 3431. It conforms to the PROFIBUS standard, providing a clear and comprehensive description of each instrument in a precisely defined format.

This enables the system configuration tool to use the information automatically when configuring a PROFIBUS bus system.

The ABB GSD file (Ident No. 3431) is divided into 2 sections:

- General specifications

  Identification of the device, together with hardware and software versions, baud rates supported and the possible time intervals for monitoring times.

- DP slave-related specifications

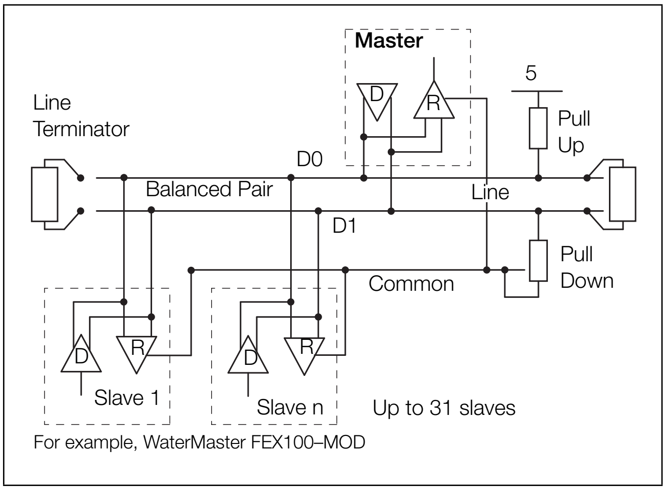
  Information about the user parameter block for device-specific configuration and modules containing details of the input and output data that can be exchanged cyclically with a PROFIBUS master.

The WaterMaster GSD file (ABB_3431.gsd) is available for download from the ABB website at: www.abb.com/fieldbus (follow the link for PROFIBUS DP field devices).

MODBUS protocol

MODBUS is an open standard that is owned and administered by an independent group of device manufacturers called the Modbus Organization (www.modbus.org).

Using the MODBUS protocol, devices from different manufacturers exchange information on the same communications bus without the need for special interface equipment. WaterMaster FEX100-MB follows the specification for Modbus Over Serial Line V1.02, using 2-wire TIA/EIA-485 (RS485) physical layer.



Cable Properties

The end-to-end length of the trunk cable must be limited. The maximum length depends on the Baud rate, the cable (gauge, capacitance or characteristic impedance), the number of loads on the daisy chain and the network configuration (2-wire or 4-wire).

For 9600 Baud rate and AWG26 (or wider) gauge, the maximum length is 1000 m (3280 ft.). Where 4-wire cabling is used as a 2-wire cabling system the maximum length must be divided by 2. The tap cables must be short, never more than 20 m (65.6 ft.). If a multi-port tap is used with n derivations, each one must have a maximum length of 40 m (131 ft.) divided by n.

The maximum serial data transmission line length for RS485 systems is 1200 m (3937 ft.). The lengths of cable that can be used are determined by the cable type, typically:

- Up to 6 m (19.7 ft.) – standard screened or twisted pair cable.
- Up to 300 m (984 ft.) – twin twisted pair with overall foil screen and an integral drain wire – for example, Belden 9502 or equivalent.
- Up to 1200 m (3937 ft.) – twin twisted pair with separate foil screens and integral drain wires – for example, Belden 9729 or equivalent.

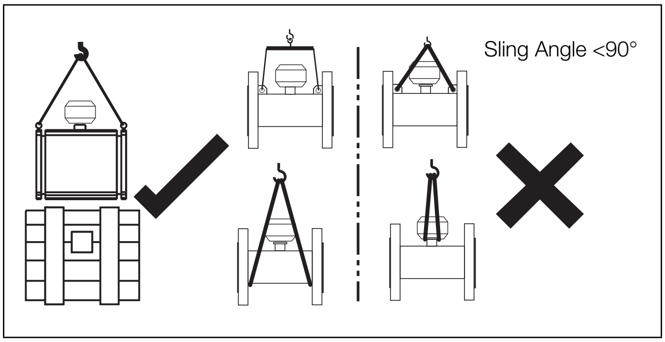
Category 5 cables may be used for RS485-MODBUS to a maximum length of 600 m (1968 ft.). For the balanced pairs used in an RS485-system, a characteristic impedance with value higher than 100Ω is preferred especially for 19200 and higher Baud rates.

Installation requirements

This section is intended to give an overview of installation of a flowmeter. For Installation requirements, technical information and Health and Safety precautions refer to User Guide OI/FEF/FEV/FEW–EN.

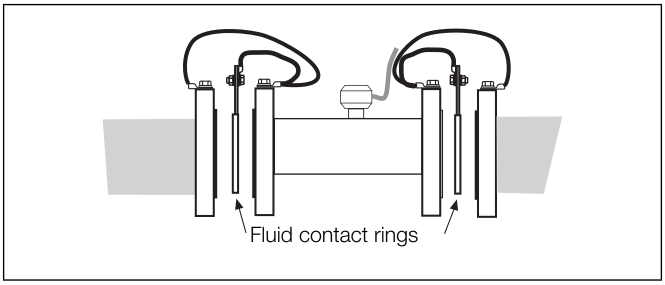
Unpacking the flowmeter

Care must be taken when lifting the flowmeter to use the lifting hooks provided or sling under the body of the meter. Never lift using the terminal connection box of the sensor cable as this will cause damage and invalidate warranty.



Grounding

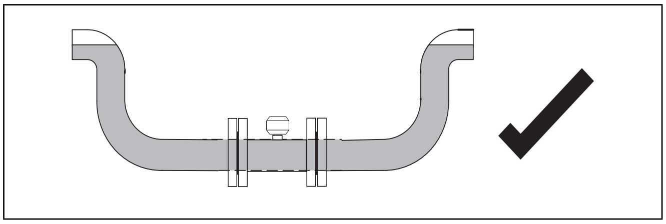
The flowmeter sensor must be cross-bonded to the upstream and downstream pipes and fluid. For technical reasons, this potential should be identical to the potential of the metering fluid. For plastic or insulated lined pipelines, the fluid is grounded by installing a minimum of 1 earthing rings. When there are stray potentials present in the pipeline, an earthing ring is recommended on both ends of the meter sensor.



Mounting

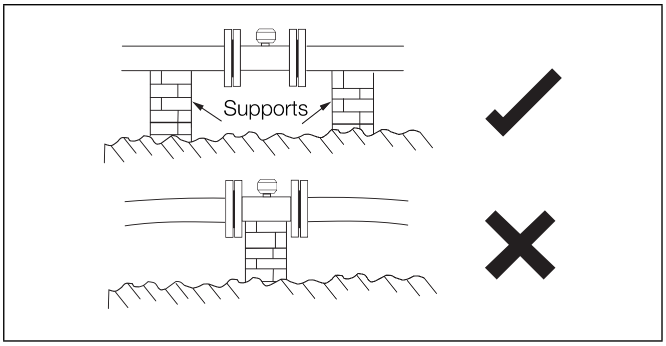
The installation conditions shown below must be observed to achieve the best operational results.

The sensor tube must always be completely full.

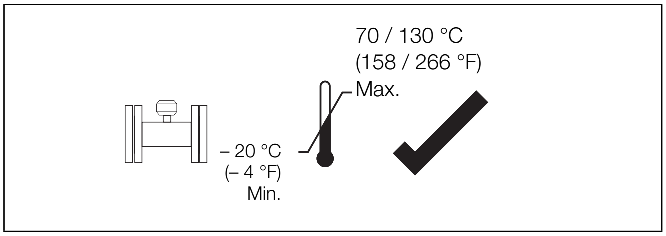


The flow direction must correspond to the identification plate. The device measures the flowrate in both directions. Forward flow is the factory setting.

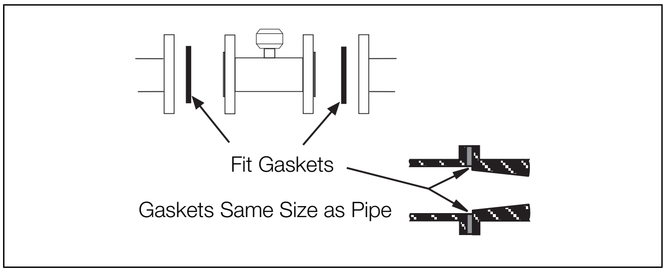
The devices must be installed without mechanical tension (torsion, bending). If required support the pipeline.



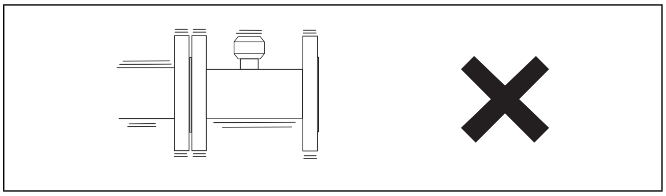
The flange seals must be made from a compatible material for the fluid and fluid temperatures if required.



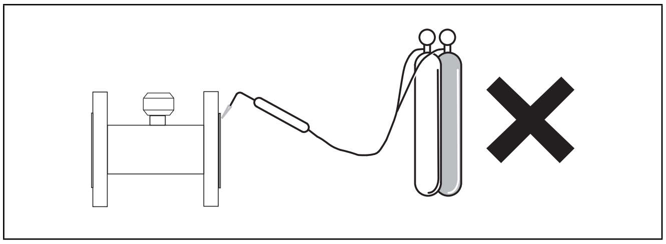
Seals must not extend into the flow area since possible turbulence could influence the device accuracy.



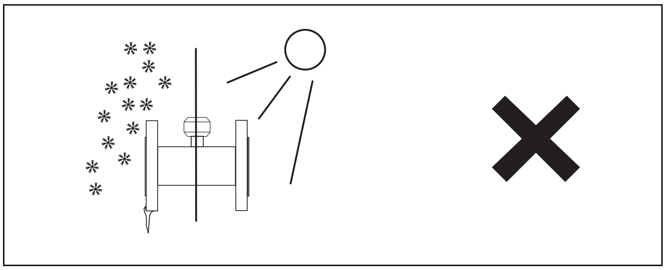
The pipeline may not exert any unallowable forces and torques on the device, such as vibration.



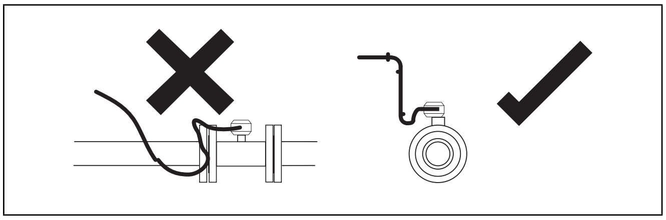
The flowmeter must not be submitted to any localized heat during installation; take care to remember this is a measuring instrument.



The flowmeter must not be exposed to direct sunlight or provide for appropriate sun protection where necessary.

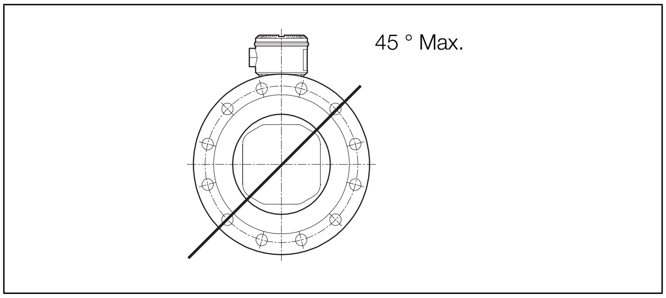


The cable to the flowmeter should be installed neatly or within a conduit, both loose or conduit should have a u shape below the terminal connection box height to allow any water run off to avoid any capillary action into the flowmeter sensor.



Electrode axis

Electrode axis should be horizontal if at all possible or no more than 45° from horizontal.



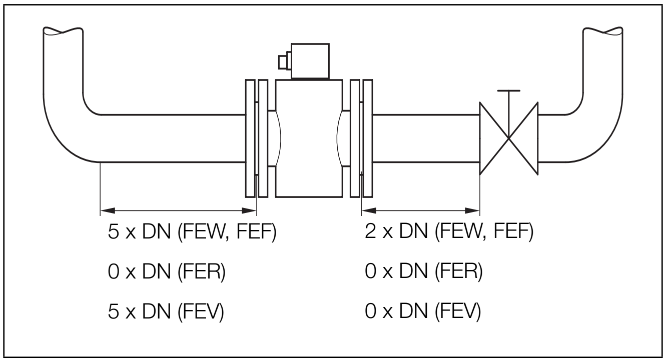
Upstream and Downstream pipe sections

The metering principle is tolerant of the flow profile.

- Wherever possible do not install fittings (for example, manifolds, valves) directly in front of the flowmeter sensor.
- Butterfly valves should be installed so that the valve plate does not extend into the flowmeter sensor.
- Valves or other turn-off components should be installed in the Downstream pipe section.

Experience has shown that, in most installations, straight upstream sections 3 x DN long and straight downstream sections 2 x DN long are normally sufficient. We would recommend conditions of 5 x DN straight upstream and 2 x DN straight downstream where possible.

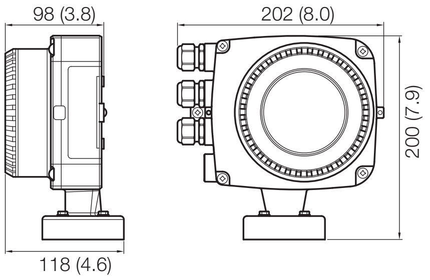
For reduced-bore meters (FER), these straight pipe sections are often not necessary.



Transmitter dimensions

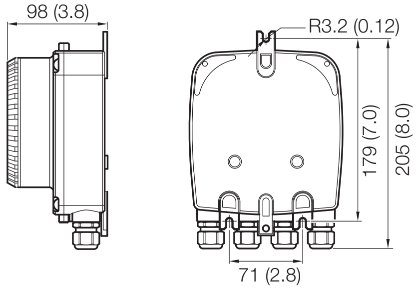
Integral transmitter

Dimensions in mm (in.)



Remote transmitter

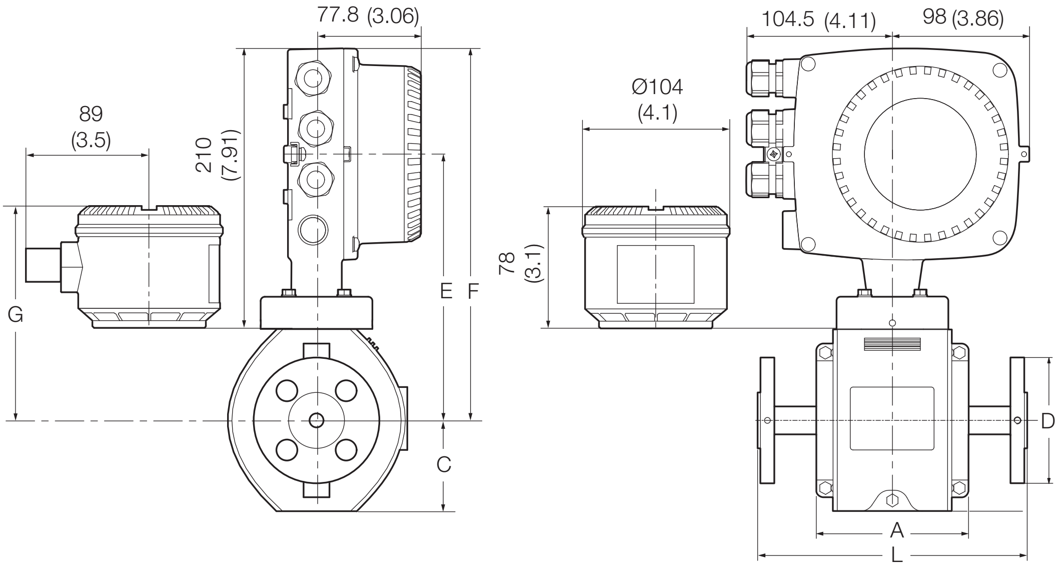
Dimensions in mm (in.)



Sensor dimensions

FEW – DN10 to 125 ($^3/_8$ to 5 in. NB)

Dimensions in mm (in.)



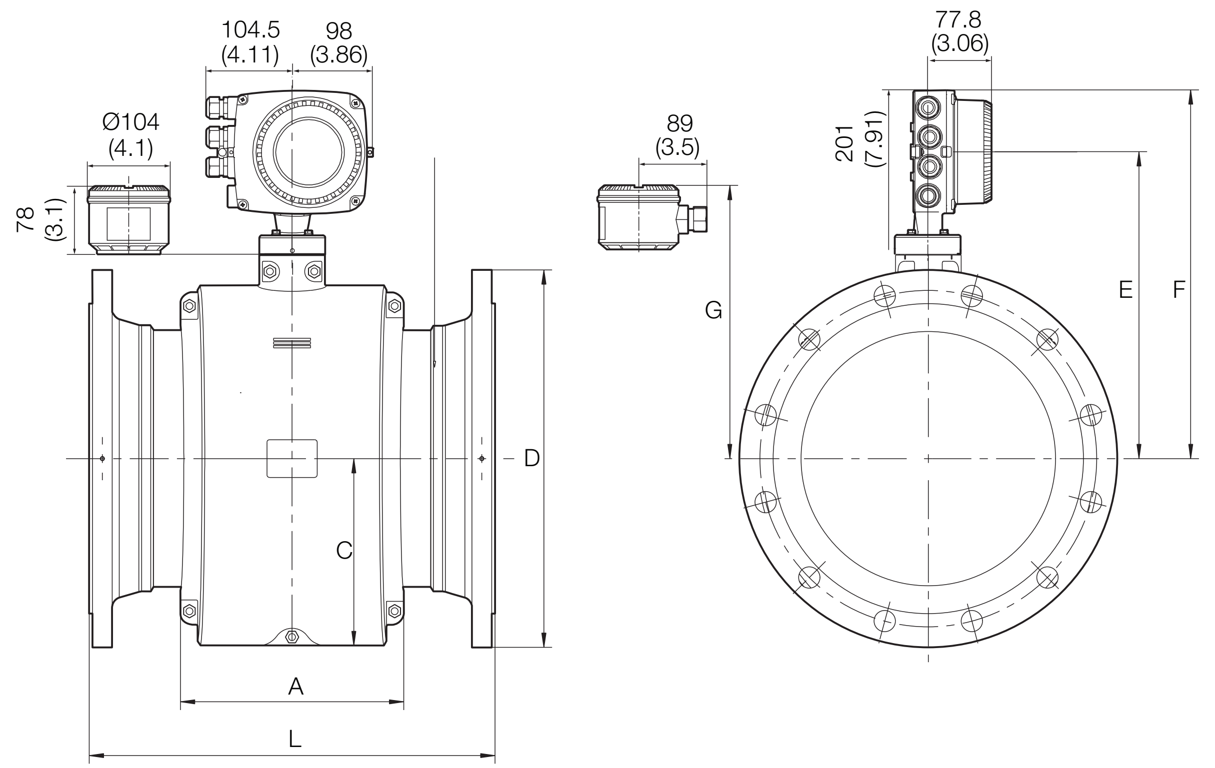
DN10 to 125 ($^3/_8$ to 5 in. NB) (FEW)

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	Process connection type	D	L	F	C	E	G	A	Integral	Remote
DN10 ($^{3}/_{8}$ in.)	JIS10K	90 (3.54)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	6 (13)	4 (9)
	PN10 to 40	90 (3.54)								
	ASME B16.5 CL150	90 (3.54)								
	ASME B16.5 CL300	96 (3.78)								
DN15 ($^{1}/_{2}$ in.)	PN10 to 40	95 (3.74)								
	JIS5K	80 (3.15)								
	JIS10K	95 (3.74)								
	ASME B16.5 CL300	95 (3.74)								
	ASME B16.5 CL150	90 (3.54)								
DN20 ($^{3}/_{4}$ in.)	PN10 to 40	105 (4.13)							8 (18)	6 (13)
	JIS5K	85 (3.35)								
	JIS10K	100 (3.94)								
	ASME B16.5 CL300	115 (4.53)								
	ASME B16.5 CL150	98 (3.86)								
DN25 (1 in.)	PN10 to 40	115 (4.53)	200 (7.87)	268 (10.55)	82 (3.23)	193 (7.6)	148 (5.83)	113 (4.45)	9 (20)	7 (15)
	JIS5K	95 (3.74)								
	JIS10K	125 (4.88)								
	ASME B16.5 CL300	125 (4.88)								
	ASME B16.5 CL150	108 (4.25)								
DN32 (1$^{1}/_{4}$ in.)	PN10 to 40	140 (5.51)		275 (10.83)	92 (3.62)	200 (7.87)	155 (6.10)	113 (4.45)	10 (22)	8 (18)
	JIS5K	115 (4.53)								
	JIS10K	135 (5.31)								
	ASME B16.5 CL300	135 (5.31)								
	ASME B16.5 CL150	117 (4.61)								
DN40 (1$^{1}/_{2}$ in.)	PN10 to 40	150 (5.91)							11 (24)	9 (20)
	JIS5K	120 (4.72)								
	JIS10K	140 (5.51)								
	ASME B16.5 CL300	155 (6.10)								
	ASME B16.5 CL150	127 (5.00)								
DN50 (2 in.)	PN10 to 40	165 (6.5)		281 (11.06)	97 (3.82)	206 (8.11)	161 (6.34)	115 (4.53)	12 (26)	10 (22)
	JIS5K	130 (5.12)								
	JIS10K	155 (6.10)								
	AS4087 PN16	150 (5.91)								
	AS4087 PN35	165 (6.50)								
	ASME B16.5 CL150	152 (5.98)								
	ASME B16.5 CL300	165 (6.50)								
DN65 (2$^{1}/_{2}$ in.)	PN10 to 40	185 (7.28)		292 (11.50)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	13 (29)	11 (24)
	JIS5K	155 (6.10)								
	JIS10K	175 (6.89)								
	AS4087 PN16	165 (6.50)								
	AS4087 PN35	185 (7.28)								
	ASME B16.5 CL150	178 (7.01)								
	ASME B16.5 CL300	190 (7.48)							15 (33)	13 (29)
DN80 (3 in.)	PN10 to 40	200 (7.87)		292 (11.5)	108 (4.25)	217 (8.54)	172 (6.77)	104 (4.09)	17 (37)	15 (33)
	JIS5K	180 (7.09)								
	JIS10K	185 (7.28)								
	AS4087 PN16	185 (7.28)								
	AS4087 PN35	205 (8.07)								
	ASME B16.5 CL150	190 (7.48)								
	ASME B16.5 CL300	210 (8.28)							19 (42)	17 (37)
DN100 (4 in.)	PN10 to 16	220 (8.66)	250 (9.84)	314 (12.36)	122 (4.8)	239 (9.41)	194 (7.64)	125 (4.92)	19 (42)	17 (37)
	PN25 to 40	235 (9.25)							23 (51)	21 (46)
	JIS5K	200 (7.87)							19 (42)	17 (37)
	JIS10K	210 (8.27)								
	AS4087 PN16	215 (8.46)								
	AS4087 PN35	230 (9.06)							23 (51)	21 (46)
	ASME B16.5 CL300	255 (1.04)							30 (66)	28 (62)
	ASME B16.5 CL150	229 (9.00)							21 (51)	19 (42)
DN125 (5 in.)	PN10 to 16	250 (9.84)		324 (12.76)	130 (5.12)	249 (9.8)	204 (8.03)	125 (4.92)	22 (48)	20 (44)
	PN25 to 40	270 (10.63)							29 (64)	27 (59)
	JIS5K	235 (9.25)							22 (48)	20 (44)
	JIS10K	250 (9.84)								
	ASME B16.5 CL150	254 (10.00)								
	ASME B16.5 CL300	280 (11.02)							35 (77)	33 (73)

DN10 to 125 ($^{3}/_{8}$ to 5 in. NB) (FEW) dimensions / weights

FEW – DN150 to 400 (6 to 16 in. NB)

Dimensions in mm (in.)

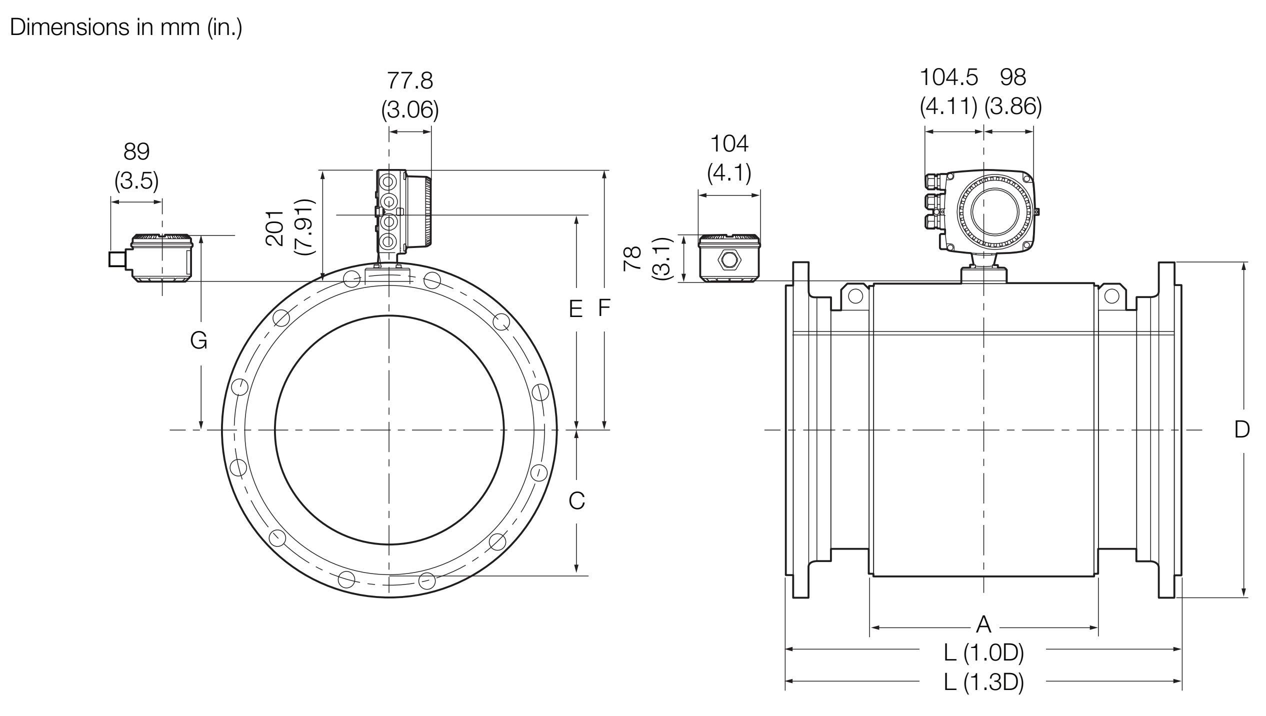


DN150 to 400 (6 to 16 in. NB) (FEW)

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L**	**F**	**C**	**E**	**G**	**A**	**Integral**	**Remote**
DN150 (6 in.)	PN10 to 16	285 (11.22)	300 (11.81)	371 (14.61)	146 (9.88)	296 (11.65)	251 (9.88)	166 (6.54)	33 (73)	31 (68)
	PN25 to 40	300 (11.81)							39 (86)	37 (81)
	JIS5K	265 (10.43)							33 (73)	31 (68)
	JIS10K	280 (11.02)								
	AS4087 PN16	280 (11.02)								
	AS4087 PN35	305 (11.81)							39 (86)	37 (81)
	ASME B16.5 CL300	320 (12.60)							47 (103)	45 (99)
	ASME B16.5 CL150	279 (10.98)							33 (73)	31 (68)
DN200 (8 in.)	PN10	340 (13.39)	350 (13.78)	411 (16.18)	170 (6.69)	336 (13.23)	291 (11.46)	200 (7.87)	41 (90)	39 (86)
	PN16	340 (13.39)								
	PN25	360 (14.17)							55 (121)	53 (117)
	PN40	375 (14.76)							65 (143)	63 (139)
	AS4087 PN16	335 (13.19)							41 (90)	39 (86)
	AS4087 PN35	370 (14.57)							65 (143)	63 (139)
	JIS5K	320 (12.60)							41 (90)	39 (86)
	JIS10K	330 (12.99)								
	ASME B16.5 CL300	380 (14.96)							72 (158)	70 (154)
	ASME B16.5 CL150	345 (13.58)							50 (110)	48 (106)
DN250 (10 in.)	PN10	395 (15.55)	450 (17.72)	426 (16.77)	198 (7.80)	351 (13.82)	306 (12.05)	235 (9.62)	61 (134)	59 (130)
	PN16	405 (15.94)							65 (143)	63 (139)
	PN25	425 (16.73)							84 (185)	82 (180)
	PN40	450 (17.72)							95 (209)	93 (205)
	AS4087 PN16	405 (15.94)							65 (143)	63 (139)
	AS4087 PN35	430 (16.93)							95 (209)	93 (205)
	JIS5K	385 (15.16)							65 (143)	63 (139)
	JIS10K	400 (15.75)								
	ASME B16.5 CL300	445 (17.52)							105 (231)	103 (227)
	ASME B16.5 CL150	405 (15.94)							70 (154)	68 (150)
DN300 (12 in.)	PN10	445 (17.52)	500 (19.69)	449 (17.68)	228 (8.98)	374 (14.72)	329 (12.95)	272 (10.71)	74 (163)	72 (158)
	PN16	460 (18.11)							80 (176)	78 (172)
	PN25	485 (19.09)							100 (220)	98 (216)
	JIS5K	430 (16.93)							80 (176)	78 (172)
	JIS10K	445 (17.52)								
	AS4087 PN16	455 (17.91)								
	AS4087 PN35	490 (19.29)							130 (286)	128 (282)
	ASME B16.5 CL300	520 (20.47)							150 (330)	148 (326)
	ASME B16.5 CL150	485 (19.09)							105 (231)	103 (227)
	PN40	515 (20.28)	600 (23.62)						130 (286)	128 (282)
DN350 (14 in.)	PN10	505 (19.88)	550 (21.65)	464 (18.27)	265 (10.43)	389 (15.31)	344 (13.54)	322 (12.68)	95 (209)	93 (205)
	PN16	520 (20.47)							110 (242)	108 (238)
	PN25	555 (21.85)							145 (319)	143 (315)
	JIS5K	480 (18.90)							95 (209)	93 (205)
	JIS10K	490 (19.29)								
	AS4087 PN16	525 (20.67)							130 (286)	128 (282)
	AS4087 PN35	550 (21.65)							185 (407)	183 (403)
	ASME B16.5 CL300	585 (23.03)							140 (308)	138 (304)
	ASME B16.5 CL150	535 (21.06)							105 (231)	103 (227)
	PN40	580 (22.83)	650 (25.59)						195 (429)	193 (425)
DN400 (16 in.)	PN10	565 (22.24)	600 (23.62)	506 (19.92)	265 (10.43)	431 (16.97)	386 (15.20)	322 (12.68)	103 (227)	101 (222)
	PN16	580 (22.83)							126 (277)	124 (273)
	PN25	620 (24.41)							170 (374)	168 (370)
	JIS5K	540 (21.26)							103 (227)	101 (223)
	JIS10K	560 (22.05)							116 (255)	114 (251)
	AS4087 PN16	580 (22.83)							154 (339)	152 (335)
	AS4087 PN35	610 (24.02)							302 (664)	300 (660)
	ASME B16.5 CL300	650 (25.59)							265 (583)	263 (578)
	ASME B16.5 CL150	600 (23.62)							175 (385)	173 (381)
	PN40	660 (25.98)	650 (25.59)						258 (568)	256 (564)

DN150 to 400 (6 to 5 in. NB) (FEW) dimensions / weights

FEW – DN450 to 2400 (18 to 96 in. NB)



DN450 to 2400 (18 to 96 in. NB) (FEW)

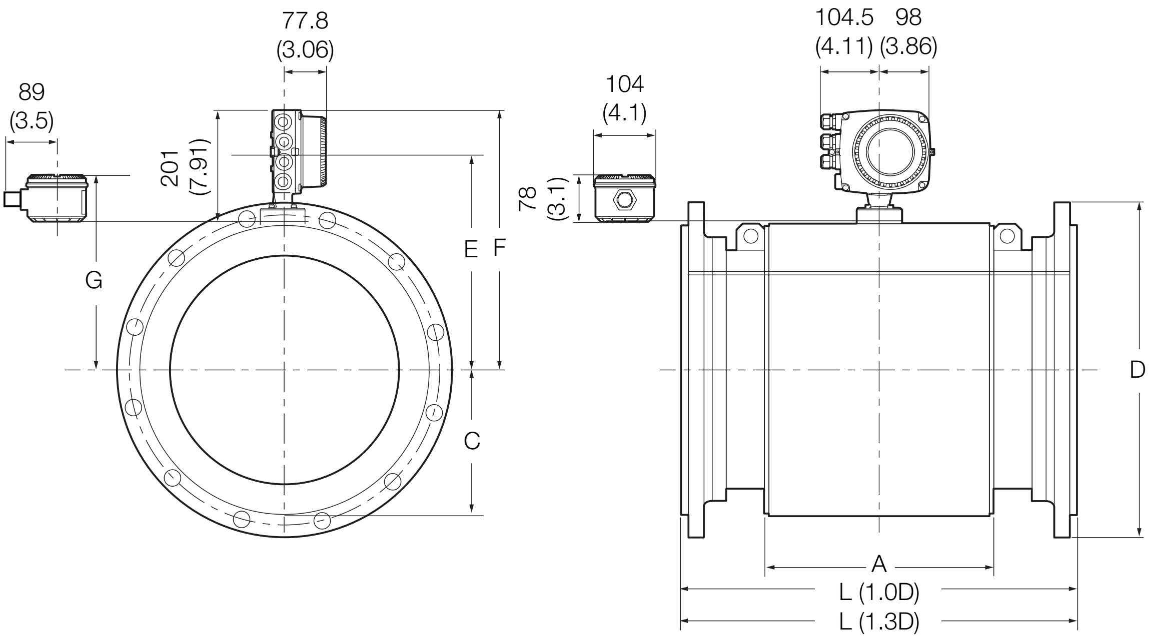
		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	Process connection type	D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN450 (18 in.)	PN10	615 (24.21)	N/A	600 (23.62)	514 (20.24)	310 (12.20)	439 (17.28)	394 (15.51)	328 (12.91)	173 (381)	171 (377)
	PN16	640 (25.20)								188 (414)	186 (410)
	JIS5K	605 (23.82)								165 (364)	163 (359)
	JIS10K	620 (24.41)								177 (390)	175 (386)
	AS4087 PN16	640 (25.20)								232 (511)	230 (507)
	AS4087 PN35	675 (26.57)								328 (723)	326 (718)
	ASME B16.5 CL300	710 (27.95)								368 (811)	366 (807)
	ASME B16.5 CL150	635 (25.00)								250 (551)	248 (547)
	PN25	670 (26.38)	N/A	686 (27.01)						245 (540)	243 (536)
	PN40	685 (26.97)								315 (694)	313 (690)
DN500 (20 in.)	PN10	670 (26.38)	N/A	600 (23.62)	514 (20.24)	310 (12.20)	439 (17.28)	394 (15.51)	367 (14.45)	190 (418)	188 (413)
	PN16	715 (28.15)								240 (528)	238 (524)
	JIS5K	655 (25.79)								190 (418)	188 (413)
	JIS10K	675 (26.57)									
	AS4087 PN16	705 (27.76)								290 (638)	288 (634)
	AS4087 PN35	735 (28.94)								435 (957)	433 (953)
	ASME B16.5 CL150	700 (27.56)								300 (660)	298 (656)
	ASME B16.5 CL300	775 (30.51)	N/A	762						490 (1080)	488 (1076)
	PN25	730 (28.74)	N/A	700						300 (661)	298 (657)
	PN40	755 (29.72)	N/A	762						392 (864)	390 (860)
DN600 (24 in.)	PN10	780 (30.71)	N/A	800 (31.50)	565 (22.24)	361 (14.21)	490 (19.29)	445 (17.52)	469 (18.46)	284 (626)	282 (622)
	PN16	840 (33.07)								318 (700)	316 (695)
	PN25	845 (33.27)								460 (1012)	458 (1008)
	JIS5K	770 (30.31)								275 (605)	273 (600)
	JIS10K	795 (31.30)								306 (673)	304 (668)
	AS4087 PN16	825 (32.48)								382 (840)	380 (835)
	AS4087 PN35	850 (33.46)								452 (994)	450 (990)
	ASME B16.5 CL300	915 (36.02)								550 (1210)	548 (1205)
	ASME B16.5 CL150	815 (32.09)								425 (935)	423 (930)
	PN40	890 (35.04)	N/A	890						600 (1320)	598 (1316)

DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights

		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	Process connection type	D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN700 (28 in.)	JIS 5K	875 (34.45)	700 (27.56)	910 (35.83)	604 (23.77)	403 (15.87)	528 (20.79)	488 (19.21)	444 (17.48)	216 (475)	214 (471)
	JIS 10K	905 (35.63)								282 (620)	280 (616)
	PN6	860 (33.86)								225 (495)	223 (491)
	PN10	895 (35.24)								303 (667)	301 (662)
	PN16	910 (35.83)								337 (741)	335 (737)
	AWWA C207 CLASS B	927 (36.50)								249 (548)	247 (543)
	AWWA C207 CLASS D	927 (36.50)								280 (616)	278 (612)
	AS4087 PN16	910 (35.83)								359 (790)	357 (785)
	AS2129 TABLE-D	910 (35.83)								263 (579)	261 (574)
	AS2129 TABLE-E	910 (35.83)								337 (741)	335 (737)
	PN25	960 (37.80)								471 (10.36)	469 (1032)
	PN40	995 (39.17)								586 (1289)	584 (1285)
	AWWA C207 CLASS E	927 (36.50)								472 (1038)	470 (1034)
	AWWA C207 CLASS F	1035 (40.75)								715 (1573)	713 (1569)
	AS4087 PN35	935 (36.80)								539 (1186)	537 (1181)
	ASME CL150 SERIES A	925 (36.42)								503 (1107)	501 (1102)
	ASME CL150 SERIES B	835 (32.87)								323 (711)	321 (706)
	ASME CL300 SERIES B	920 (36.22)								631 (1388)	629 (1384)
DN750 (30 in.)	JIS 5K	945 (37.20)	750 (29.52)	990 (38.98)	630 (24.79)	429 (16.89)	554 (21.81)	514 (20.23)	444 (17.48)	251 (552)	249 (548)
	JIS 10K	970 (38.19)								327 (719)	325 (715)
	AWWA C207 CLASS B	984 (38.74)								273 (601)	271 (596)
	AWWA C207 CLASS D	984 (38.74)								344 (757)	342 (752)
	AS4087 PN16	995 (39.17)								467 (1027)	465 (1023)
	AS2129 TABLE-D	995 (39.17)								340 (748)	338 (744)
	AS2129 TABLE-E	995 (39.17)								454 (999)	452 (994)
	AWWA C207 CLASS E	984 (38.74)								496 (1091)	494 (1087)
	AWWA C207 CLASS F	1092 (43.99)								790 (1738)	788 (1734)
	AS4087 PN35	1015 (39.96)								663 (1459)	661 (1454)
	ASME CL150 SERIES A	985 (38.78)								544 (1197)	542 (1192)
	ASME CL150 SERIES B	885 (34.84)								320 (704)	318 (700)
	ASME CL300 SERIES B	990 (38.98)								748 (1646)	746 (1641)
DN800 (32 in.)	JIS 5K	995 (39.17)	800 (31.49)	1040 (40.04)	654 (25.74)	453 (17.83)	578 (22.76)	538 (21.18)	542 (21.34)	280 (616)	278 (612)
	JIS 10K	1020 (40.16)								364 (801)	362 (796)
	PN6	975 (38.39)								294 (647)	292 (642)
	PN10	1015 (39.96)								406 (893)	404 (889)
	PN16	1025 (40.35)								469 (1032)	467 (1027)
	AWWA C207 CLASS B	1060 (41.73)								328 (722)	326 (717)
	AWWA C207 CLASS D	1060 (41.73)								408 (898)	406 (893)
	AS4087 PN16	1060 (41.73)								530 (1166)	528 (1162)
	AS2129 TABLE-D	1060 (41.73)								386 (849)	384 (845)
	AS2129 TABLE-E	1060 (41.73)								519 (1142)	517 (1137)
	PN25	1085 (42.72)								615 (1353)	613 (1349)
	PN40	1140 (44.88)								866 (1905)	864 (1901)
	AWWA C207 CLASS E	1060 (41.73)								634 (1395)	632 (1390)
	AWWA C207 CLASS F	1150 (45.28)								897 (1973)	895 (1969)
	AS4087 PN35	1060 (41.73)								751 (1652)	749 (1648)
	ASME CL150 SERIES A	1060 (41.73)								700 (1540)	698 (1536)
	ASME CL150 SERIES B	940 (37.01)								406 (893)	404 (889)
	ASME CL300 SERIES B	1055 (41.54)								933 (2053)	931 (2048
DN900 (36 in.)	JIS 5K	1095 (43.11)	900 (35.43)	1170 (46.06)	705 (27.7()	504 (19.84)	629 (24.76)	589 (23.19)	570 (22.44)	369 812)	367 (807)
	JIS 10K	1120 (44.09)								445 (979)	443 (975)
	PN6	1075 (42.32)								390 (858)	388 (854)
	PN10	1115 (43.90)								502 (1104)	500 (1100)
	PN16	1125 (44.29)								589 (1296)	587 (1291)
	AWWA C207 CLASS B	1168 (45.98)								417 (917)	415 (913)
	AWWA C207 CLASS D	1168 (45.98)								493 (1085)	491 (1080)
	AWWA C207 CLASS E	1168 (45.98)								827 (1819)	825 (1815)
	AWWA C207 CLASS F	1270 (50.00)								1150 (2530)	1148 (2526)
	AS4087 PN16	1175 (46.26)								706 (1553)	704 (1549)
	AS2129 TABLE-D	1175 (46.26)								514 (1131)	512 (1126)
	AS2129 TABLE-E	1175 (46.26)								694 (1527)	692 (1522)
	PN25	1185 (46.65)								819 (1802)	817 (1797)
	PN40	1250 (49.21)								1158 (2548)	1156 (2543)
	AS4087 PN35	1185 (46.65)								1044 (2297)	1042 (2292)
	ASME CL150 SERIES A	1170 (46.06)								961 (2114)	959 (2110)
	ASME CL150 SERIES B	1055 (41.54)								595 (1309)	593 (1305)
	ASME CL300 SERIES B	1170 (46.06)								1147 (2523)	1145 (2519)

DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights (Continued)

Dimensions in mm (in.)



…DN450 to 2400 (18 to 96 in. NB) (FEW)

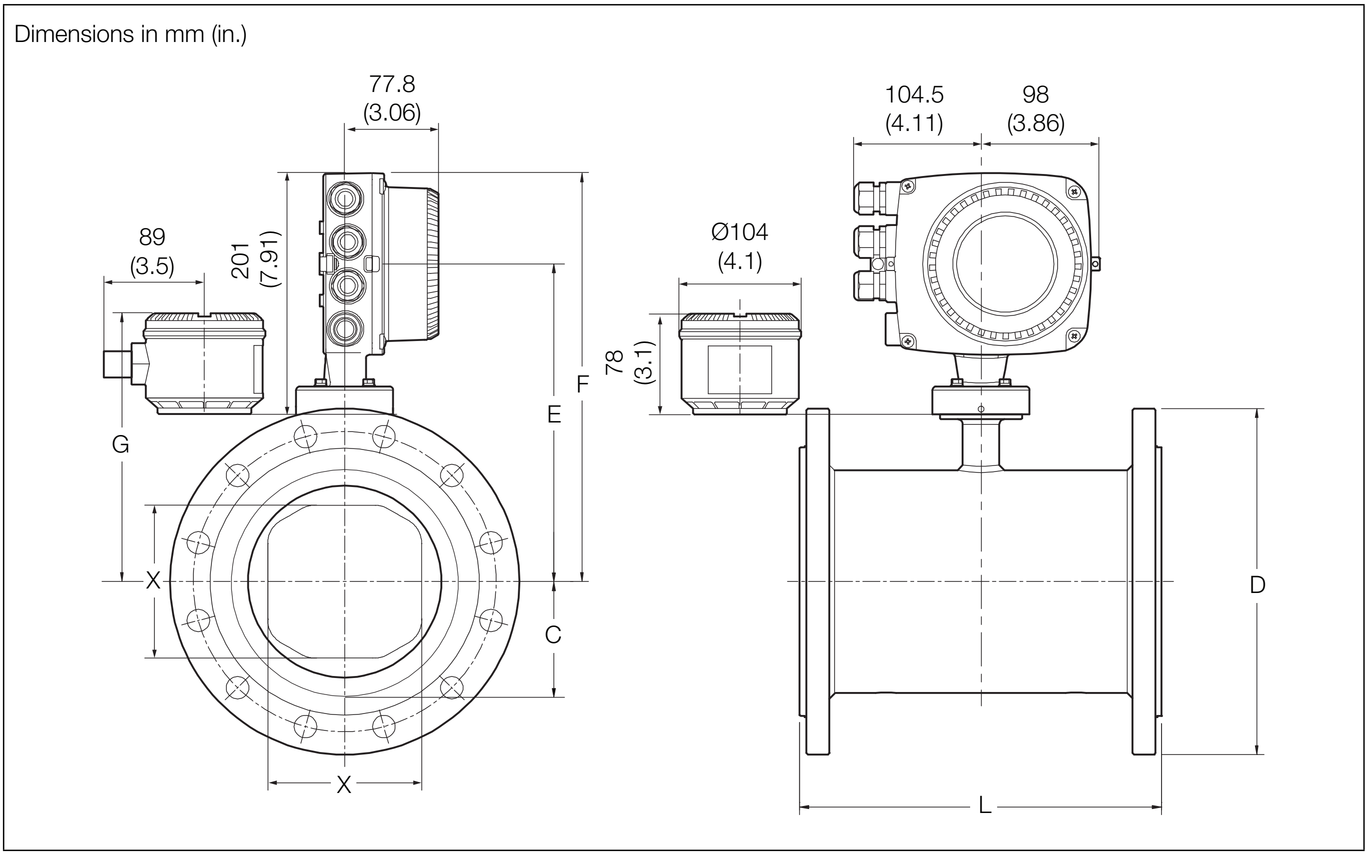
		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L (1.0D)**	**L (1.3D)**	**F**	**C**	**E**	**G**	**A**	**Integral**	**Remote**
DN1000 (40 in.)	JIS 5K	1195 (47.05)	1000 (39.37)	1300 (51.18)	755 (29.71)	554 (21.81)	679 (26.73)	639 (25.16)	624 (24.57)	441 (970)	439 (966)
	JIS 10K	1235 (48.62)								572 (1258)	570 (1254)
	PN6	1175 (46.26)								466 (1025)	464 (1021)
	PN10	1230 (48.43)								674 (1483)	672 (1478)
	PN16	1255 (49.41)								879 (1934)	877 (1929)
	AWWA C207 CLASS B	1289 (50.75)								503 (1107)	501 (1102)
	AWWA C207 CLASS D	1289 (50.75)								659 (1450)	657 (1445)
	AWWA C207 CLASS E	1289 (50.75)								1028 (2262)	1026 (2257)
	AWWA C207 CLASS F	1378 (54.25)								1367 (3007)	1365 (3003)
	AS4087 PN16	1255 (49.41)								831 (1828)	829 (1824)
	AS2129 TABLE-D	1255 (49.41)								610 (1342)	608 (1338)
	AS2129 TABLE-E	1255 (49.41)								833 (1833)	831 (1028)
	PN25	1320 (51.97)								1207 (2655)	1205 (2651)
	PN40	1360 (53.54)								1413 (3109)	1411 (3104)
	AS4087 PN35	1275 (50.20)								1244 (2737)	1242 (2732)
	ASME CL150 SERIES A	1290 (50.79)								1149 (2528)	1147 (2523)
	ASME CL300 SERIES A	1240 (48.82)								1349 (2968)	1347 (2963)
	ASME CL150 SERIES B	1175 (46.26)								738 (1624)	736 (1619)
	ASME CL300 SERIES B	1275 (50.20)								1487 (3271)	1485 (3267)
DN1050 (42 in.)	AWWA C207 CLASS B	1346 (5299)	1050 (41.33)	1365 (53.74)	808 (31.82)	608 (23.92)	733 (28.84)	693 (27.28)	624 (24.57)	564 (1241)	562 (1236)
	AWWA C207 CLASS D	1346 (5299)								669 (1472)	667 (1467)
	AWWA C207 CLASS E	1346 (5299)								1143 (2515)	1141 (2510)
	AWWA C207 CLASS F	1448 (57.01)								1568 (3450)	1566 (3445)
	ASME CL150 SERIES B	1225 (48.23)								809 (1780)	807 (1775)
	ASME CL150 SERIES A	1345 (52.95)								1289 (2836)	1287 (2831)
	ASME CL300 SERIES A	1290 (50.79)								1527 (3359)	1525 (3355)
	ASME CL300 SERIES B	1335 (52.56)								1704 (3749)	1702 (3744)
DN1100 (44 in.)	JIS 5K	1305 (51.38)	1100 (43.30)	1430 (56.30)						510 (1122)	508 (1118)
	JIS 10K	1345 (52.95)								689 (1516)	687 (1511)
	AWWA C207 CLASS B	1403 (55.24)								615 (1353)	613 (1349)
	AWWA C207 CLASS D	1403 (55.24)								807 (1775)	805 (1771)
	AWWA C207 CLASS E	1404 (55.26)								1205 (2651)	1203 (2647)
	AWWA C207 CLASS F	1505 (59.25)								1719 (3782)	1717 (3777)

…DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights

		Dimensions in mm (in.)								Approx. weight in kg (lb)	
DN	Process connection type	D	L (1.0D)	L (1.3D)	F	C	E	G	A	Integral	Remote
DN1200 (48 in.)	JIS 5K	1420 (55.91)	1200 (47.24)	1560 (61.42)	860 (33.85)	659 (25.94)	784 (30.87)	744 (29.29)	802 (31.57)	651 (1432)	649 (1428)
	JIS 10K	1465 (57.68)								967 (2127)	965 (2123)
	PN6	1405 (55.31)								710 (1562)	708 (1558)
	PN10	1455 (57.28)								1107 (2435)	1105 (2431)
	PN16	1485 (58.46)								1363 (2999)	1361 (2994)
	AWWA C207 CLASS B	1511 (59.49)								772 (1698)	770 (1694)
	AWWA C207 CLASS D	1511 (59.49)								999 (2198)	997 (2193)
	AWWA C207 CLASS E	1511 (59.49)								1458 (3208)	1456 (3203)
	AWWA C207 CLASS F	1651 (65.00)								2400 (5280)	2398 (5276)
	AS4087 PN16	1490 (58.66)								1253 (2757)	1251 (2752)
	AS2129 TABLE-D	1490 (58.66)								1023 (2251)	1021 (2246)
	AS2129 TABLE-E	1490 (58.66)								1272 (2798)	1270 (2794)
	PN25	1530 (60.24)								1559 (3430)	1557 (3425)
	PN40	1575 (62.01)								2133 (4693)	2131 (4688)
	AS4087 PN35	1530 (60.24)								2115 (4653)	2113 (4649)
	ASME CL150 SERIES A	1510 (59.45)								1707 (3755)	1705 (3751)
	ASME CL300 SERIES A	1465 (57.68)								2163 (4759)	2161 (4754)
	ASME CL150 SERIES B	1390 (54.72)								1085 (2387)	1083 (2383)
	ASME CL300 SERIES B	1510 (59.45)								2352 (5174)	2350 (5170)
DN1350 (54 in.)	AWWA C207 CLASS B	1683 (66.26)	1350 (53.15)	1755 (69.09)	955 (37.59)	754 (29.69)	879 (34.61)	839 (33.03)	902 (35.51	981 (2158)	979 (2154)
	AWWA C207 CLASS D	1683 (66.26)								1213 (2669)	1211 (2664)
	AWWA C207 CLASS E	1683 (66.26)								1942 (4272)	1940 (4268)
DN1400 (56 in.)	PN6	1630 (64.17)	1400 (55.11)	1820 (71.65)						1085 (2387)	1083 (2383)
	PN10	1675 (65.94)								1731 (3808)	1729 (3804)
	PN16	1685 (66.34)								1770 (3894)	1768 (3890)
	ASME CL150 SERIES B	1600 (62.99)								1593 (3505)	1591 (3500)
	PN25	1755 (69.09)								2368 (5210)	2366 (5205)
	PN40	1795 (70.67)								3086 (6789)	3084 (6785)
	ASME CL150 SERIES A	1745 (68.70)								2556 (5623)	2554 (5619)
	ASME CL300 SERIES A	1710 (67.32)								3376 (7427)	3374 (7423)
	ASME CL300 SERIES B	1765 (69.49)								3758 (8268)	3756 (8263)
DN1500 (60 in.)	JIS 5K	1730 (68.11)	1500 (59.05)	1950 (76.77)	1065 (41.92)	864 (34.02)	989 (38.94)	949 (37.36)	910 (35.83)	1029 (2264)	1027 (2259)
	JIS 10K	1795 (70.67)								1504 (3309)	1502 (3304)
	ASME CL150 SERIES B	1725 (67.91)								2031 (4468)	2029 (4464)
	AWWA C207 CLASS B	1854 (72.99)								1229 (2704)	1227 (2699)
	AWWA C207 CLASS D	1854 (72.99)								1514 (3331)	1512 (3326)
	AWWA C207 CLASS E	1854 (72.99)								2544 (5597)	2542 (5592)
	ASME CL150 SERIES A	1855 (73.03)								3084 (6785)	3082 (6780)
	ASME CL300 SERIES A	1810 (71.26)								3875 (8525)	3873 (8521)
	ASME CL300 SERIES B	1880 (74.02								4181 (9198)	4179 (9194)
DN1600 (64 in.)	PN6	1830 (72.05)	1600 (62.99)	2080 (81.89)	1066 (41.96)	865 (34.06)	990 (38.98)	950 (37.4)	1000 (39.37)	1434 (3155)	1432 (3150)
	PN10	1915 (75.39)								2525 (5555)	2523 (5551)
	PN25	1975 (77.76)								3201 (7042)	3199 (7038)
	PN16	1930 (75.98)								2768 (6090)	2766 (6085)
	PN40	2025 (79.72)								4375 (9625)	4373 (9621)
DN1650 (66 in.)	AWWA C207 CLASS B	2032 (80.00)	N/A	2145 (84.45)	1116 (43.94)	915 (36.02)	1040 (40.94)	1000 (39.37)	1000 (39.37)	1504 (3309)	1502 (3304)
	AWWA C207 CLASS D	2032 (80.00)								2025 (4455)	2023 (4451)
DN1800 (72 in.)	PN6	2045 (80.51)	N/A	2340 (92.13)	1181 (46.50)	980 (38.58)	1105 (43.50)	1065 (41.93)	1100 (43.31)	1853 (4077)	1851 (4072)
	PN10	2115 (83.27)								3180 (6996)	3178 (6992)
	PN16	2130 (83.86)								3657 (8045)	3655 (8041)
	PN25	2195 (86.42)								4422 (9728)	4420 (9724)
	AWWA C207 CLASS B	2197 (86.50)								1773 (3901)	1771 (3896)
	AWWA C207 CLASS D	2197 (86.50)								2387 (5251)	2385 (5247)
DN1950 (78 in.)	AWWA C207 CLASS B	2362 (92.99)	N/A	2535 (99.80)	1291 (50.81)	1090 (42.91)	1215 (47.83)	1175 (46.26)	1180 (46.46)	2309 (5080)	2307 (5075)
	AWWA C207 CLASS D	2362 (92.99)								3037 (6681)	3035 (6677)
DN2000 (80 in.)	PN6	2265 (89.17)	N/A	2600 (102.36)						2581 (5678)	2579 (5674)
	PN10	2325 (91.54)								4254 (9359)	4252 (9354)
	PN16	2345 (92.32)								4556	4554
	PN25	2425 (95.47)								5896	5894
DN2100 (84 in.)	AWWA C207 CLASS B	2534 (99.76)	N/A	2730 (107.48)	1395 (54.91)	1194 (47.01)	1319 (51.93)	1279 (50.35)	1180 (46.46)	2641 (5810)	2639 (5806)
	AWWA C207 CLASS D	2534 (99.76)								3487 (7671)	3485 (7667)
DN2200 (88 in.)	PN6	2475 (97.44)	N/A	2860 (112.60)					1330 (52.36)	3363 (7399)	3361 (7394)
	PN10	2550 (100.39)								5795	5793
DN2400 (96 in.)	PN6	2685 (105.71	N/A	3120 (122.83)	1495 (58.85)	1294 (50.94)	1419 (55.87)	1379 (54.29)	1450 (57.09)	4100 (9020)	4098 (9016)
	PN10	2760 (108.66)								6968	6966

…DN450 to 2400 (18 to 96 in. NB) (FEW) dimensions / weights (Continued)

FEV – DN40 to 200 (1$^{1}/_{2}$ to 8 in. NB)



DN40 to 200 (1$^{1}/_{2}$ to 8 in. NB) (FEV)

		Dimensions in mm (in.)						Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L**	**F**	**E**	**G**	**X**	**Integral**	**Remote**
DN40 (1$^{1}/_{2}$ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	185 (7.28)	137 (5.39)	30 (1.18)	12.8 (28.16)	11.8 (25.96)
	ASME B16.5 CLASS 150								
	AS2129 TABLE D, E, F								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	261 (10.28)	186 (7.32)	138 (5.43)	38 (1.5)	13.75 (30.25)	12.75 (28.05)
	ASME B16.5 CLASS 150								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.04)	205.5 (8.09)	157.5 (6.2)	61 (2.4)	17.2 (37.84)	16.2 (35.64)
	ASME B16.5 CLASS 150								
	AS4087 PN16, 21								
	AS2129 TABLE D, E, F								
DN100 (4 in.)	EN1092-1 PN10, 16, 25, 40	225 (8.86)	250 (9.84)	300.5 (11.83)	225.5 (8.88)	177.5 (6.98)	70 (2.76)	19.3 (42.5)	18.3 (40.3)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN150 (6 in.)	EN1092-1 PN10, 16, 25, 40	300 (11.81)	300 (11.81)	333.5 (13.13)	258.5 (10.18)	210.5 (8.29)	103 (4.06)	35.1 (77.2)	34.1 (75)
	ASME B16.5 CLASS 150								
	AS4087 PN16								
DN200 (8 in.)	EN1092-1 PN10, 16	375 (11.76)	350 (13.78)	358.7 (14.12)	283.7 (11.17)	235.7 (9.28)	150 (5.91)	67 (147.4)	66 (145.2)
	ASME B16.5 CLASS 150								
	AS2129 TABLE C, D, E, F								
	AS4087 PN14, 16, 21								

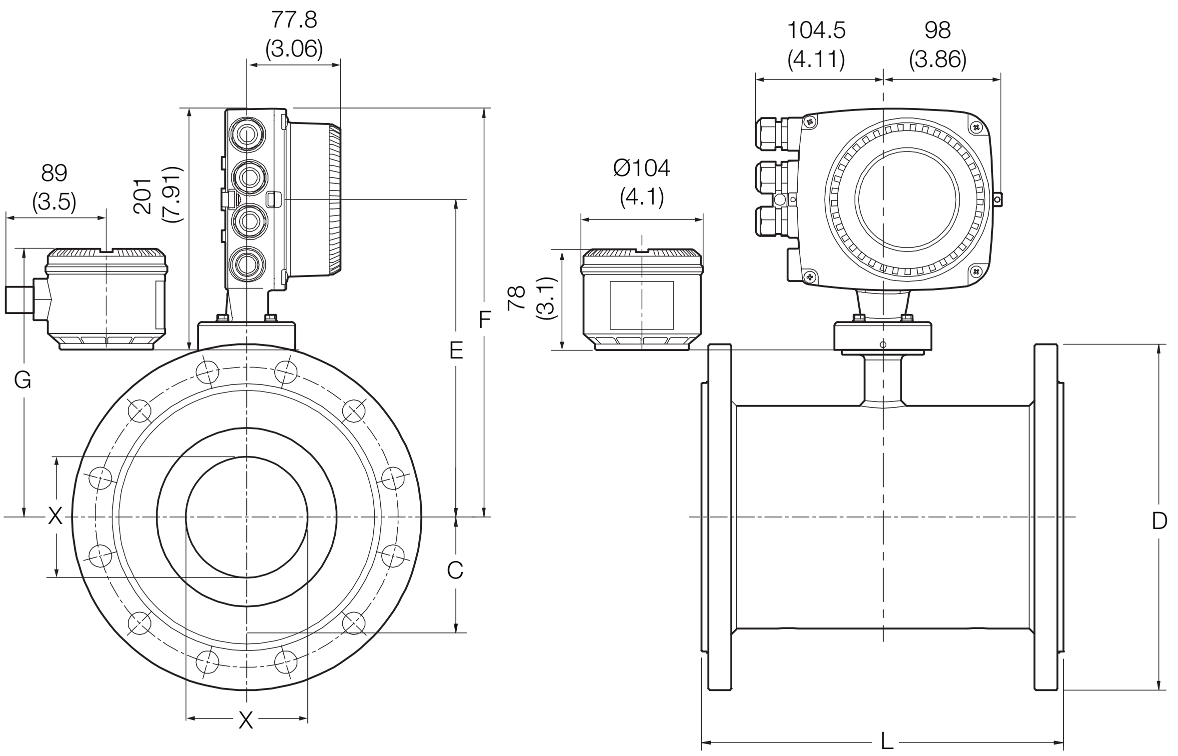
WaterMaster integral / remote FEV – DN40 to 200 (1$^{1}/_{2}$ to 8 in.) cast iron sensor dimensions / weights

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	Process connection type	D	L	F	C	E	G	X	Integral	Remote
DN40 (1$^{1}/_{2}$ in.)	EN1092-1 PN10, PN40	150 (5.91)	200 (7.87)	260 (10.24)	30.4 (1.20)	185 (7.28)	138 (5.43)	30 (1.18)	12 (27)	11 (24)
	ASME B16.5 CLASS 150	127 (5.00)								
	JIS 10K	140 (5.51)								
	AS2129 TABLE F	140 (5.51)								
	AS2129 TABLE C D E	135 (5.31)								
	AS4087 PN14	135 (5.31)								
DN50 (2 in.)	EN1092-1 PN10, PN16	165 (6.50)	200 (7.87)	270 (10.63)	38.3 (1.51)	195 (7.68)	146 (5.75)	38 (1.50)	13 (29)	12 (27)
	ASME B16.5 CLASS 150	152.4 (6.00)								
	JIS 10K	155 (6.10)								
	AS4087 PN21	165 (6.50)								
	AS2129 TABLE F	165 (6.50)								
	AS2129 TABLE C D E	150 (5.91)								
	AS4087 PN14, PN16	150 (5.91)								
DN65 (2$^{1}/_{2}$ in.)	AS4087 PN14, PN16	165 (6.50)	200 (7.87)	275 (10.83)	45.2 (1.78)	200 (7.87)	152 (5.98)	48 (1.89)	15 (33)	14 (31)
	AS2129 TABLE C D E	165 (6.50)								
	EN1092-1 PN10	185 (7.28)								
	EN1092-1 PN16	185 (7.28)								
DN80 (3 in.)	EN1092-1 PN10, PN16	200 (7.87)	200 (7.87)	280 (11.02)	51.5 (2.03)	205 (8.07)	156 (6.14)	61 (2.40)	16 (36)	15 (33)
	ASME B16.5 CLASS 150	190 (7.48)								
	JIS 7.5K	211 (8.31)								
	JIS 10K	185 (7.28)								
	AS2129 TABLE C D E	185 (7.28)								
	AS4087 PN14, PN16	185 (7.28)								
	AS2129 TABLE F	205 (8.07)								
	AS4087 PN21	205 (8.07)								
DN100 (4 in.)	EN1092-1 PN10, PN16	220 (8.66)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	196.8 (7.75)	70 (2.76)	19 (42)	18 (40)
	ASME B16.5 CLASS 150	228.6 (9.00)								
	JIS 7.5K	238 (9.37)								
	JIS 10K	210 (8.27)								
	AS2129 TABLE C D	215 (8.46)								
	AS4087 PN14, PN16	215 (8.46)								
	AS2129 TABLE E	215 (8.46)								
	AS4087 PN21	230 (9.06)								
	AS2129 TABLE F	230 (9.06)								
DN125 (5 in.)	EN1092-1 PN10, PN16	250 (9.84)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	197 (7.76)	70 (2.76)	20 (44)	19 (42)
	ASME B16.5 CLASS 150	254 (10.00)								
	JIS 10K	250 (9.84)								
	AS2129 TABLE C D E	255 (10.04)								
	AS2129 TABLE F	280 (11.02)								
DN150 (6 in.)	EN1092 PN10, PN16	285 (11.22)	300 (11.81)	340 (13.39)	84.4 (3.32)	265 (10.43)	217 (8.54)	103 (4.06)	32 (70)	31 (68)
	ASME B16.5 CLASS 150	279 (10.98)								
	JIS 7.5k	290 (11.42)								
	JIS 10K	280 (11.02)								
	AS2129 TABLE C D	280 (11.02)								
	AS4087 PN14, PN16	280 (11.02)								
	AS2129 TABLE E	280 (11.02)								
	AS2129 TABLE F	305 (12.01)								
	AS4087 PN21	305 (12.01)								
DN200 (8 in.)	EN1092-1 PN10	340 (13.39)	350 (13.78)	365 (14.37)	109.8 (4.32)	290 (11.42)	243 (9.57)	150 (5.91)	49 (108)	48 (105)
	EN1092-1 PN16	340 (13.39)								
	ASME B16.5 CLASS 150	345 (13.58)								
	JIS 7.5K	342 (13.46)								
	JIS 10K	330 (12.99)								
	AS2129 TABLE C D	335 (13.19)								
	AS4087 PN14, PN 16	335 (13.19)								
	AS2129 TABLE E	335 (13.19)								
	AS2129 TABLE F	370 (14.57)								
	AS4087 PN21	370 (14.57)								

DN40 to 200 (1$^{1}/_{2}$ to 8 in. NB) (FEV) dimensions / weights

FER – DN40 to 300 ($1^{1}/_{2}$ to 12 in. NB)

Dimensions in mm (in.)



DN40 to 300 ($1^{1}/_{2}$ to 12 in. NB) (FER)

		Dimensions in mm (in.)						Approx. weight in kg (lb)	
DN	**Process connection type**	**D**	**L**	**F**	**E**	**G**	**X**	**Integral**	**Remote**
DN40 ($1^{1}/_{2}$ in.)	EN1092-1 PN10, 16, 25, 40 ASME B16.5 CLASS 150 AS2129 TABLE D, E, F	150 (5.91)	200 (7.87)	260 (10.24)	185 (7.28)	137 (5.39)	23.5 (0.93)	13.4 (29.5)	12.4 (27.3)
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40 ASME B16.5 CLASS 150	165 (6.50)	200 (7.87)	261 (10.28)	186 (7.32)	138 (5.43)	29 (1.14)	14.75 (32.45)	13.75 (30.25)
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40 ASME B16.5 CLASS 150 AS4087 PN16, 21 AS2129 TABLE D, E, F	200 (7.87)	200 (7.87)	280 (11.04)	205.5 (8.09)	157.5 (6.2)	47 (1.85)	21.2 (46.64)	20.2 (44.4)
DN100 (4 in.)	EN1092-1 PN10, 16, 25, 40 ASME B16.5 CLASS 150 AS4087 PN16	225 (8.86)	250 (9.84)	300.5 (11.83)	225.5 (8.88)	177.5 (6.98)	64 (2.52)	27.3 (60)	26.3 (58)
DN150 (6 in.)	EN1092-1 PN10, 16, 25, 40 ASME B16.5 CLASS 150 AS4087 PN16	300 (11.81)	300 (11.81)	333.5 (13.13)	258.5 (10.18)	210.5 (8.29)	100.2 (3.94)	27.3 (60)	26.3 (58)
DN200 (8 in.)	EN1092-1 PN10, 16 ASME B16.5 CLASS 150 AS2129 TABLE C, D, E, F AS4087 PN14, 16, 21	375 (11.76)	350 (13.78)	358.7 (14.12)	283.7 (11.17)	235.7 (9.28)	126.7 (5.00)	68 (150)	67 (147.4)

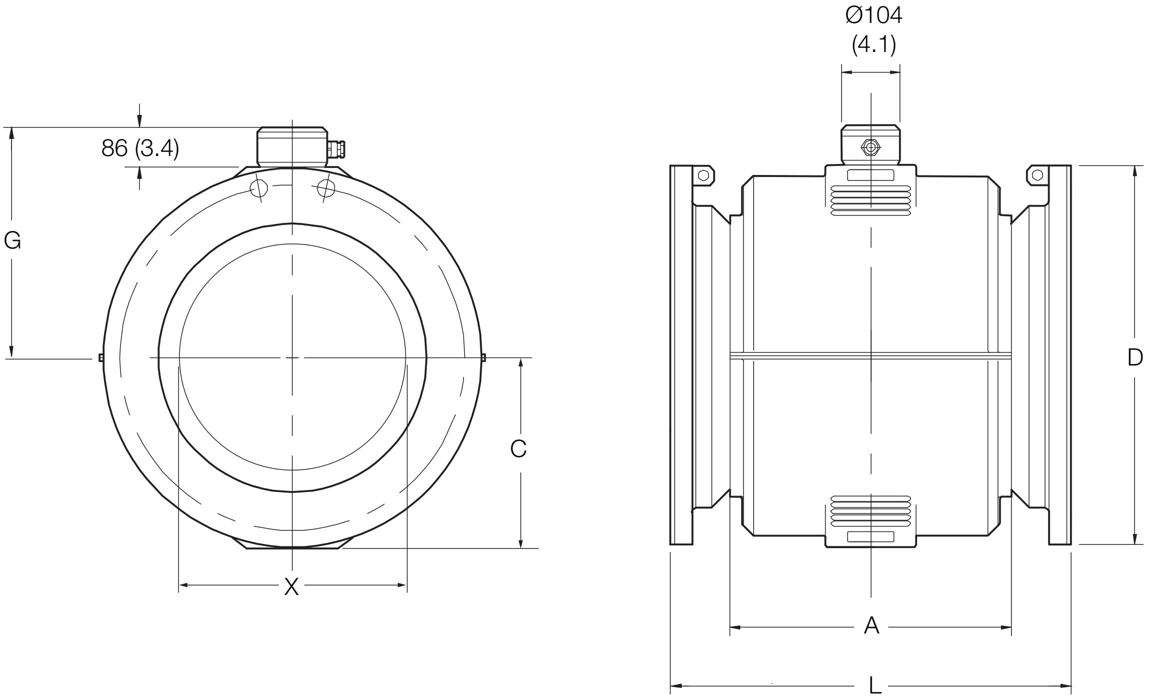
DN40 to 200 ($1^{1}/_{2}$ to 8 in.) (FER) cast iron sensor dimensions / weights

		Dimensions in mm (in.)							Approx. weight in kg (lb)	
DN	Process connection type	D	L	F	C	E	G	X	Integral	Remote
DN40 (1$^{1}/_{2}$ in.)	EN1092-1 PN10, 16, 25, 40	150 (5.91)	200 (7.87)	260 (10.24)	30.4 (1.20)	185 (7.28)	138 (5.43)	23.5 (0.93)	13 (29)	11 (24)
	ASME B16.5 CLASS 150	127 (5.00)								
	JIS 10K	140 (5.51)								
	AS2129 TABLE C D E	135 (5.31)								
	AS2129 TABLE F	140 (5.51)								
	AS4087 PN14	135 (5.31)								
DN50 (2 in.)	EN1092-1 PN10, 16, 25, 40	165 (6.50)	200 (7.87)	270 (10.63)	38.3 (1.51)	195 (7.68)	146 (5.75)	29 (1.14)	14 (31)	12 (27)
	ASME B16.5 CLASS 150	152.4 (6.00)								
	JIS 10K	155 (6.10)								
	AS4087 PN21	165 (6.50)								
	AS2129 TABLE F	165 (6.50)								
	AS2129 TABLE C D E	150 (5.91)								
	AS4087 PN14, PN16	150 (5.91)								
DN65 (2$^{1}/_{2}$ in.)	EN1092-1 PN10, 16, 25, 40	185 (7.28)	200 (7.87)	275 (10.83)	45.2 (1.78)	200 (7.87)	152 (5.98)	37 (1.46)	15 (33)	13 (29)
	ASME B16.5 CLASS 150	178 (7.00)								
	JIS10K	175 (6.89)								
	AS2129 TABLE C D E	165 (6.50)								
	AS2129 TABLE F	185 (7.28)								
	AS4087 PN14, 16	165 (6.50)								
	AS4087 PN21	185 (7.28)								
DN80 (3 in.)	EN1092-1 PN10, 16, 25, 40	200 (7.87)	200 (7.87)	280 (11.02)	51.5 (2.03)	205 (8.07)	156 (6.14)	47 (1.85)	20 (44)	18 (40)
	ASME B16.5 CLASS 150	190 (7.48)								
	JIS 10K	185 (7.28)								
	AS2129 TABLE C D E	185 (7.28)								
	AS4087 PN14, 16	185 (7.28)								
	AS2129 TABLE F	205 (8.07)								
	AS4087 PN21	205 (8.07)								
DN100 (4 in.)	EN1092-1 PN10, 16	220 (8.66)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	196.8 (7.75)	64 (2.52)	27 (59)	25 (55)
	EN1092-1 PN25, 40	235 (9.25)								
	ASME B16.5 CLASS 150	228.6 (9.00)								
	JIS 7.5K	238 (9.37)								
	JIS 10K	210 (8.27)								
	AS2129 TABLE C D	215 (8.46)								
	AS4087 PN14, 16	215 (8.46)								
	AS4087 PN21	230 (9.06)								
DN125 (5 in.)	EN1092-1 PN10, 16	250 (9.84)	250 (9.84)	320 (12.60)	63.75 (2.51)	245 (9.65)	197 (7.76)	64 (2.52)	27 (59)	25 (55)
	EN1092-1 PN25, 40	270 (10.63)								
	ASME B16.5 CLASS 150	254 (10.00)								
	JIS 10K	250 (9.84)								
	AS2129 TABLE C D	255 (10.04)								
DN150 (6 in.)	EN1092 PN10, 16	285 (11.22)	300 (11.81)	340 (13.39)	84.4 (3.32)	265 (10.43)	217 (8.54)	100.2 (3.94)	33 (72)	31 (68)
	EN1092 PN25, 40	300 (11.81)								
	ASME B16.5 CLASS 150	279 (10.98)								
	JIS 7.5k	290 (11.42)								
	JIS 10K	280 (11.02)								
	AS2129 TABLE C D	280 (11.02)								
	AS4087 PN14, 16	280 (11.02)								
	AS4087 PN21	305 (12.01)								
DN200 (8 in.)	EN1092-1 PN10, 16	340 (13.39)	350 (13.78)	365 (14.37)	109.8 (4.32)	290 (11.42)	243 (9.57)	126.7 (4.99)	50 (110)	48 (106)
	EN1092-1 PN25, 40	360 (14.17)								
	ASME B16.5 CLASS 150	345 (13.58)								
	JIS 7.5K	342 (13.46)								
	JIS 10K	330 (12.99)								
	AS2129 TABLE C D	335 (13.19)								
	AS4087 PN14, 16	335 (13.19)								
	AS4087 PN21	370 (14.57)								
DN250 (10 in.)	EN1092-1 PN10	395 (15.55)	450 (17.72)	389 (15.31)	136.8 (5.39)	313 (12.33)	268 (10.55)	153.5 (6.04)	77 (169)	75 (165)
	EN1092-1 PN16	405 (15.94)								
	EN1092-1 PN25	425 (16.73)								
	ASME B16.5 CLASS 150	405 (15.94)								
	JIS 7.5K	400 (15.75)								
	JIS 10K	400 (15.75)								
	AS2129 TABLE C D	405 (15.94)								
	AS4087 PN14, 16	405 (15.94)								
	AS4087 PN21	430 (16.93)								
DN300 (12 in.)	EN1092-1 PN10	445 (17.52)	500 (19.69)	414 (16.30)	162.2 (6.39)	338.6 (13.33)	294 (1157)	203.5 (8.01)	114 (251)	112 (247)
	EN1092-1 PN16	460 (18.11)								
	EN1092-1 PN25	485 (19.09)								
	ASME B16.5 CLASS 150	485 (19.09)								
	JIS 10K	445 (17.52)								
	AS2129 TABLE C D	455 (17.91)								
	AS4087 PN14, 16	455 (17.91)								
	AS4087 PN21	490 (19.29)								

DN40 to 300 (1$^{1}/_{2}$ to 12 in. NB) (FER) dimensions / weights

FER – DN350 to 600 (14 to 24 in. NB) remote sensor

Dimensions in mm (in.)



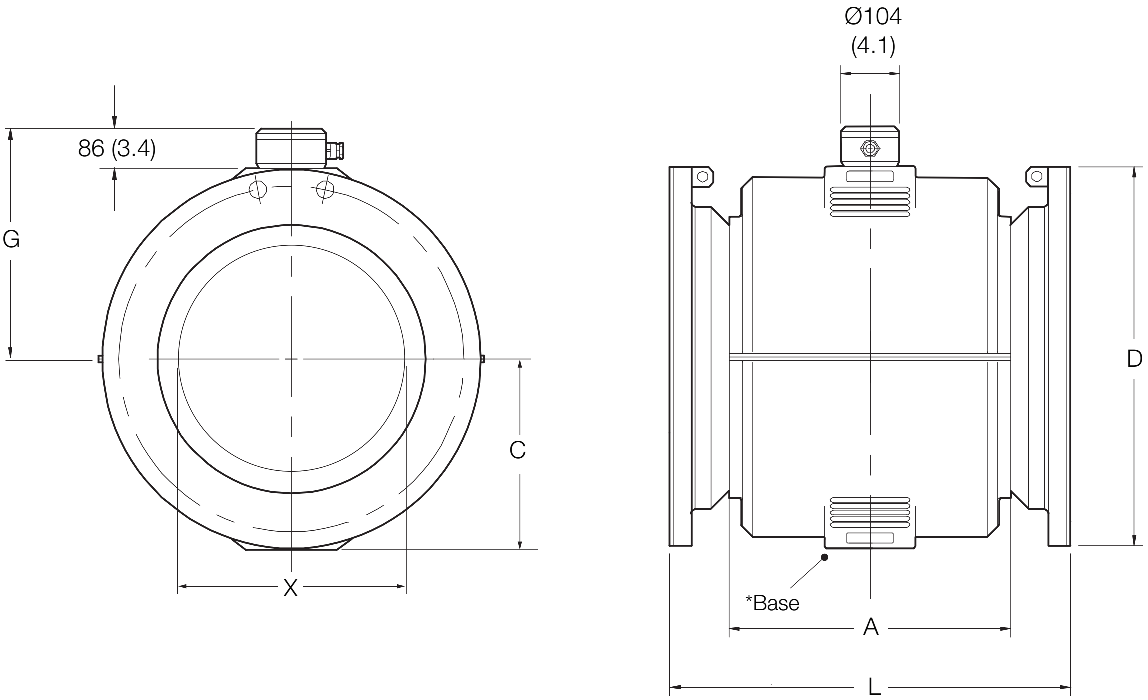
DN350 to 600 (14 to 24 in. NB) (FER) remote sensor

		Dimensions in mm (in.)								Approx. weight in kg (lb)
DN	**Process connection type**	**D**	**L**	**F**	**C**	**E**	**G**	**A**	**X**	**Remote**
DN350 (14 in.)	EN1092-1 PN10	505 (19.88)	550 (21.65)	472 (18.58)	231 (9.09)	402 (15.83)	325 (12.80)	376 (14.80)	340 (13.39)	100 (220)
	EN1092-1 PN16	520 (20.47)								
	EN1092-1 PN25	555 (21.85)								
	EN1092-1 PN40	580 (22.83)								
	JIS 5K	480 (18.90)								
	JIS 10K	490 (19.29)								
	AS2129 TABLE C D E	525 (20.67)								
	AS2129 TABLE F	550 (21.65)								
	AS4087 PN14, PN16	525 (20.67)								
	AS4087 PN21	550 (21.65)								
DN400 (16 in.)	EN1092-1 PN10	565 (22.24)	600 (23.62)	502 (19.76)	257.5 (10.14)	432 (17.01)	355 (13.98)	420 (16.54)	390 (15.35)	115 (253)
	EN1092-1 PN16	580 (22.83)								
	EN1092-1 PN25	620 (24.41)								
	EN1092-1 PN40	660 (25.98)								
	JIS 5K	540 (21.26)								
	JIS 10K	560 (22.05)								
	AS2129 TABLE C D E	580 (22.83)								
	AS2129 TABLE F	610 (24.02)								
	AS4087 PN14, PN16	580 (22.83)								
	AS4087 PN21	610 (24.02)								
DN450 (18 in.)	EN1092-1 PN10	615 (24.21)	700 (27.56)	537 (21.14)	285 (11.22)	467 (18.39)	390 (15.35)	480 (18.90)	440 (17.32)	160 (352)
	EN1092-1 PN16	640 (25.20)								
	EN1092-1 PN25	670 (26.38)								
	EN1092-1 PN40	685 (26.97)								
	JIS 5K	605 (23.82)								
	JIS 10K	620 (24.41)								
	AS2129 TABLE C D E	640 (25.20)								
	AS2129 TABLE F	675 (26.57)								
	AS4087 PN14, PN16	640 (25.20)								
	AS4087 PN21	675 (26.57)								
DN500 (20 in.)	EN1092-1 PN10	670 (26.38)	770 (30.31)	557 (21.93)	317.5 (12.50)	487 (19.17)	410 (16.14)	520 (20.47)	490 (19.29)	217 (477)
	EN1092-1 PN16	715 (28.15)								
	EN1092-1 PN25	730 (28.74)								
	EN1092-1 PN40	755 (29.72)								
	JIS 5K	655 (25.79)								
	JIS 10K	675 (26.57)								
	AS2129 TABLE C D E	705 (27.76)								
	AS2129 TABLE F	735 (28.94)								
	AS4087 PN14, PN16	705 (27.76)								
	AS4087 PN21	735 (28.94)								
DN600 (24 in.)	EN1092-1 PN10	780 (30.71)	920 (36.22)	602 (23.70)	345 (13.58)	532 (20.94)	455 (17.91)	610 (24.02)	591 (23.27)	315 (693)
	EN1092-1 PN16	840 (33.07)								
	EN1092-1 PN25	845 (33.27)								
	EN1092-1 PN40	890 (35.04)								
	JIS 5K	770 (30.31)								
	JIS 10K	795 (31.30)								
	AS2129 TABLE C D E	825 (32.48)								
	AS2129 TABLE F	850 (33.46)								
	AS4087 PN14, PN16	825 (32.48)								
	AS4087 PN21	850 (33.46)								

DN350 to 600 (14 to 24 in. NB) (FER) remote sensor dimensions / weights

FEF – DN250 to 600 (10 to 24 in. NB)

Dimensions in mm (in.)



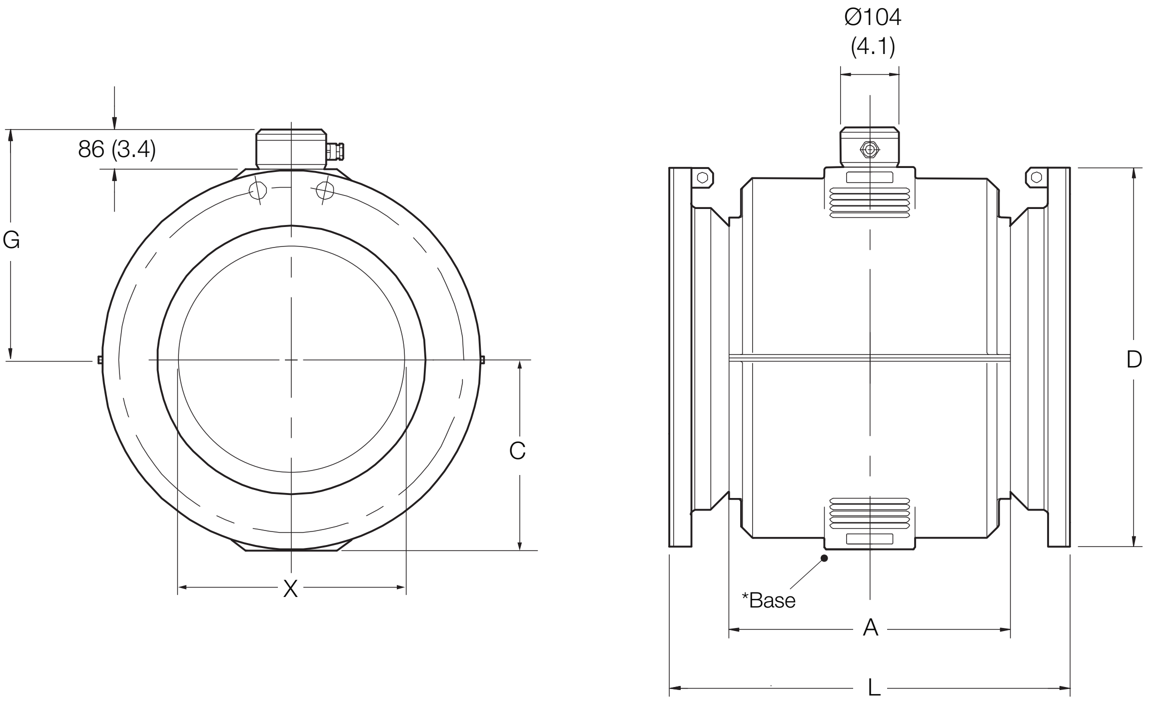
*Dimension C = centre line to base of flowmeter body

DN250 to 600 (10 to 24 in. NB) (FEF)

		Dimensions in mm (in.)						
DN	**Process connection type**	**D**	**L**	**C**	**G**	**A**	**X**	**Approx. weight in kg (lb)**
DN250 (10 in.)	ASME B16.5 CLASS 150	405 (15.94)	450 (17.72)	215 (8.46)	301 (11.85)	300 (11.81)	250 (9.84)	88 (194)
	ASME B16.5 CLASS 300	445 (17.52)	490 (19.29)					
	EN1092 -1 PN10	395 (15.55)	450 (17.72)					
	EN1092 – 1 PN16	405 (15.94)						
	EN1092 – 1 PN25	425 (16.73)	490 (19.29)					
	EN1092 – 1 PN40	450 (17.72)						
	JIS 5K	385 (15.16)	450 (17.72)					
	JIS 10K	400 (15.75)						
	AS4087 PN14, PN16	405 (15.94)						
	AS2129 TABLE C D							
	AS2129 TABLE E							
	AS4087 PN21	430 (16.93)						
	AS2129 TABLE F							
DN300 (12 in.)	ASME B16.5 CLASS 150	485 (19.09)	500 (19.69)	231 (9.09)	317 (12.48)	352 (13.86)	300 (11.81)	128 (282)
	ASME B16.5 CLASS 300	520 (20.47)	540 (21.26)					
	EN1092 – 1 PN10	445 (17.52)	500 (19.69)					
	EN1092 – 1 PN16	460 (18.11)	500 (19.69)					
	EN1092 – 1 PN25	485 (19.09)	540 (21.26)					
	EN1092 – 1 PN40	515 (20.28)	540 (21.26)					
	JIS 5K	430 (16.93)	500 (19.69)					
	JIS 10K	445 (17.52)	500 (19.69)					
	AS4087 PN14, PN16	455 (17.91)	500 (19.69)					
	AS2129 TABLE TABLE C D	455 (17.91)	500 (19.69)					
	AS2129 TABLE E	455 (17.91)	500 (19.69)					
	AS4087 PN21	490 (19.29)	500 (19.69)					
	AS2129 TABLE F	490 (19.29)	500 (19.69)					
DN350 (14 in.)	ASME B16.5 CLASS 150	535 (21.06)	550 (21.65)	257.5 (10.14)	346 (13.62)	376 (14.80)	350 (13.78)	100 (220)
	ASME B16.5 CLASS 300	585 (23.03)	570 (22.44)					
	EN1092 – 1 PN10	505 (19.88)	550 (21.65)					
	EN1092 – 1 PN16	520 (20.47)	550 (21.65)					
	EN1092 – 1 PN25	555 (21.85)	570 (22.44)					
	EN1092 – 1 PN40	580 (22.83)	570 (22.44)					
	JIS 5K	480 (18.90)	550 (21.65)					
	JIS 7.5K	530 (20.87)	550 (21.65)					
	JIS 10K	490 (19.29)	550 (21.65)					
	AS4087 PN14, PN16	525 (20.67)	550 (21.65)					
	AS2129 TABLE C D E	525 (20.67)	550 (21.65)					
	AS4087 PN21	550 (21.65)	550 (21.65)					
	AS2129 TABLE F	550 (21.65)	550 (21.65)					
	AS4087 PN35	550 (21.65)	570 (22.44)					
	AS2129 TABLE H	550 (21.65)	570 (22.44)					
DN375 (15 in.)	AS4087 PN14, PN16	550 (21.65)	550 (21.65)	257.5 (10.14)	346 (13.62)	376 (14.80)	350 (13.78)	115 (253)
	AS2129 TABLE C	550 (21.65)	550 (21.65)					
	AS4087 PN35	580 (22.83)	570 (22.44)					
DN400 (16 in.)	ASME B16.5 CLASS 150	600 (23.62)	600 (23.62)	285 (11.22)	371 (14.61)	420 (16.54)	400 (15.75)	115 (253)
	ASME B16.5 CLASS 300	650 (25.59)	620 (24.41)					
	EN1092 – 1 PN10	565 (22.24)	600 (23.62)					
	EN1092 – 1 PN16	580 (22.83)	600 (23.62)					
	EN1092 – 1 PN25	620 (24.41)	620 (24.41)					
	EN1092 – 1 PN40	660 (25.98)	620 (24.41)					
	JIS 5K	540 (21.26)	600 (23.62)					
	JIS 7.5K	582 (22.91)	600 (23.62)					
	JIS 10K	560 (22.05)	600 (23.62)					
	AS4087 PN14, PN16	580 (22.83)	600 (23.62)					
	AS2129 TABLE C D E	580 (22.83)	600 (23.62)					
	AS4087 PN21	610 (24.02)	600 (23.62)					
	AS2129 TABLE F	610 (24.02)	600 (23.62)					
	AS4087 PN35	610 (24.02)	620 (24.41)					
	AS2129 TABLE H	610 (24.02)	620 (24.41)					

DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

Dimensions in mm (in.)



*Dimension C = centre line to base of flowmeter body

…DN250 to 600 (10 to 24 in. NB) (FEF)

		Dimensions in mm (in.)						
DN	**Process connection type**	**D**	**L**	**C**	**G**	**A**	**X**	**Approx. weight in kg (lb)**
DN450 (18 in.)	ASME B16.5 CLASS 150	635 (25.00)	700 (27.56)	317.5 (12.50)	402 (15.83)	480 (18.90)	450 (17.72)	160 (352)
	ASME B16.5 CLASS 300	710 (27.95)						
	EN1092 – 1 PN10	615 (24.21)						
	EN1092 – 1 PN16	640 (25.20)						
	EN1092 – 1 PN25	670 (26.38)						
	EN1092 – 1 PN40	685 (26.97)						
	JIS 5K	605 (23.82)						
	JIS 7.5K	652 (25.67)						
	JIS 10K	620 (24.41)						
	AS4087 PN14, PN16	640 (25.20)						
	AS2129 TABLE C D	640 (25.20)						
	AS2129 TABLE E	640 (25.20)						
	AS4087 PN21	675 (26.57)						
	AS2129 TABLE F	675 (26.57)						
	AS4087 PN35	675 (26.57)						
	AS2129 TABLE H	675 (26.57)						
DN500 (20 in.)	ASME B16.5 CLASS 150	700 (27.56)	770 (30.31)	345 (13.58)	429 (16.89)	520 (20.47)	500 (19.69)	217 (455)
	ASME B16.5 CLASS 300	775 (30.51)						
	EN1092 – 1 PN10	670 (26.38)						
	EN1092 – 1 PN16	715 (28.15)						
	EN1092 – 1 PN25	730 (28.74)						
	EN1092 – 1 PN40	755 (29.72)						
	JIS 5K	655 (25.79)						
	JIS 7.5K	706 (27.80)						
	JIS 10K	675 (26.57)						
	AS4087 PN 14, PN16	705 (27.76)						
	AS2129 TABLE C D E	705 (27.76)						
	AS4087 PN21	735 (28.94)						
	AS2129 TABLE F	735 (28.94)						
	AS4087 PN35	735 (28.94)						
	AS2129 TABLE H	735 (28.94)						
DN600 (24 in.)	ASME B16.5 CLASS 150	815 (32.09)	920 (36.22)	387.5 (15.25)	472 (18.58)	610 (24.02)	600 (23.62)	315 (693)
	ASME B16.5 CLASS 300	915 (36.02)						
	EN1092 – 1 PN10	780 (30.71)						
	EN1092 – 1 PN16	840 (33.07)						
	EN1092 – 1 PN25	845 (33.27)						
	EN1092 – 1 PN40	890 (35.04)						
	JIS 5K	770 (30.31)						
	JIS 7.5K	810 (31.89)						
	JIS 10K	795 (31.30)						
	AS4087 PN14, PN16	825 (32.48)						
	AS2129 TABLE C D	825 (32.48)						
	AS2129 TABLE E	825 (32.48)						
	AS4087 PN21	850 (33.46)						
	AS2129 TABLE F	850 (33.46)						
	AS4087 PN35	850 (33.46)						
	AS2129 TABLE H	850 (33.46)						

…DN250 to 600 (10 to 24 in. NB) (FEF) dimensions / weights

Ordering information

Electromagnetic flowmeter WaterMaster – FEW11, FEW12 and FEW18

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount (DN10 to DN32 only)	**FEW11**																				
Flowmeter system – full bore, remote mount	**FEW12**	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only – for use with WaterMaster transmitter / remote	**FEW18**																				
Design																					
Non-hazardous areas		1																			
Hazardous areas		5																			
Bore diameter																					
DN10 ($^{3}/_{8}$ in.)			010																		
DN15 ($^{1}/_{2}$ in.)			015																		
DN20 ($^{3}/_{4}$ in.)			020																		
DN25 (1 in.)			025																		
DN32 ($1^{1}/_{4}$ in.)			032																		
Liner material																					
PTFE – DN10 to 32 ($^{3}/_{8}$ to $1^{1}/_{4}$ in. NB)				A																	
Electrode design																					
Standard					1																
Other					9																
Measuring electrodes material																					
Hastelloy® C-4 (2.4610)						D															
Grounding accessories																					
Not required							0														
One potential equalizing ring (stainless steel)							3														
Two potential equalizing rings (stainless steel)							4														
Other							9														
Process connection type (refer to pages 21 and 20)																					
ASME B16.5 B class 150								A1													
ASME B16.5 B class 300								A3													
ISO / EN PN40								S4													
DIN PN40								D4													
Other								Z9													
Process connection material																					
Carbon steel flanges – DN20 to 32 ($^{3}/_{4}$ to $1^{1}/_{4}$ in. NB)									B												
Stainless steel flange 1.4571 (316 Ti) – DN10 to 15 ($^{3}/_{8}$ to $^{1}/_{2}$ in. NB)									D												
Other									Z												
Usage certifications																					
Standard (without PED)										1											
Other										9											
Calibration type																					
Class 2 calibration – standard accuracy 0.4 %											A										
Class 1 calibration – high accuracy 0.2 %											B										
Extended range, class 1 calibration – high accuracy 0.2 %											N										
Extended range, class 2 calibration – standard accuracy 0.4 %											P										
Temperature range installation / ambient temperature range																					
Standard design / –20 … 60 °C (–4 … 140 °F)												1									
Nameplate																					
Adhesive													A								
Signal cable length and type																					
Without signal cable														0							
5 m (15 ft.) cable														1							
10 m (30 ft.) cable														2							
20 m (60 ft.) cable														3							
30 m (100 ft.) cable														4							
50 m (165 ft.) cable														5							
80 m (260 ft.) cable														6							
100 m (325 ft.) cable														7							
150 m (490 ft.) cable														8							
Special length or cable type														9							
Explosion protection certification																					
General purpose (non-Ex design)															A						
FM Class 1 Div. 2															G						
usFMc Class 1 Div. 2															P						
ATEX / IECEx Zone 2, 21 & 22															M						

Continued on next page…

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount (DN10 to DN32 only)	FEW11	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system – full bore, remote mount	FEW12																				
Full bore sensor only – for use with WaterMaster transmitter / remote	FEW18																				

Protection class transmitter / protection class sensor

IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable not fitted and potted to sensor	1
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable fitted and potted to sensor	7

Cable conduits*

M20 x 1.5 (plastic)	A
NPT $^1/_2$ in. (blanked when cable not fitted)	B
M20 SWA (armored)	D
M20 SWA sensor, M20 x 1.5 (plastic) power / output	F
Without	Y

Power supply

Without	0
100... 230 V AC, 50 Hz	1
24 V AC or 24 V DC, 50 Hz	2
100... 230 V AC, 60 Hz	3
24 V AC or 24 V DC, 60 Hz	4

Input and output signal type

HART + 20 mA + pulse + contact output	A
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)	G
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)	M
Without	Y

Configuration type / diagnostics type

Not required	0
Factory default/ standard	1

Options**

Accessories

Configuration lead	AC

Documentation language

German	M1	Chinese	M6
Italian	M2	Swedish	M7
Spanish	M3	Finnish	M8
French	M4	Portuguese	MA
English	M5 (default)	Danish	MF
		Norwegian	MN

Verification type

Without fingerprint	V0
VeriMaster	V3

Potable water approval

WRAS cold water approval	CWA
Without	CWY

Power supply frequency (FEW 18 only)

50 Hz	F5
60 Hz	F6

Number of testpoints (FEW 10 to 32 only)

1 Point	T1
3 Points	T3

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* For FM or FMC Approved versions, NPT only permitted.

** Add codes for options.

Electromagnetic flowmeter WaterMaster FEV11, FEV12 and FEV18

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, optimized full bore, integral mount	FEV11	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system, optimized full bore, remote mount	FEV12																				
Optimized full bore sensor only, for use with WaterMaster transmitter / remote	FEV18																				
Design																					
Non-hazardous areas		1																			
Hazardous areas		5																			
Bore diameter																					
DN40 ($1^{1}/_{2}$ in.)			040																		
DN50 (2 in.)			050																		
DN65 ($2^{1}/_{2}$ in.)			065																		
DN80 (3 in.)			080																		
DN100 (4 in.)			100																		
DN125 (5 in.)			125																		
DN150 (6 in.)			150																		
DN200 (8 in.)			200																		
Liner material																					
Polypropylene – DN40 to 200 ($1^{1}/_{2}$ to 8 in. NB)				V																	
Electrode design																					
Standard					1																
Measuring electrodes material																					
Stainless steel 316						S															
Hastelloy® C-22						C															
Super-austenitic steel						U															
Grounding accessories																					
Standard							1														
One potential equalizing ring (stainless steel)							3														
Two potential equalizing rings (stainless steel)							4														
Process connection type (refer to pages 29 and 28)																					
Flanges ASME B16.5 class 150								A1													
Flanges AS 4087 PN21 (≥ DN50 [2 in. NB])								E0													
Flanges AS 4087 PN16 (≥ DN50 [2 in. NB])								E1													
Flanges AS 4087 PN14								E2													
Flanges AS 2129 Table F								E3													
Flanges AS 2129 Table E								E4													
Flanges AS 2129 Table D								E5													
Flanges AS 2129 Table C								E6													
Flanges JIS G5527 7.5K (^{3} DN100 [4 in. NB])								J0													
Flanges JIS B2220 10K								J1													
ISO/EN PN10								S1													
ISO / EN PN16 (≥ DN50 [2 in. NB])								S2													
ISO / EN PN40 (DN40 [$1^{1}/_{2}$ in. NB] only) 16 bar rated								S4													
Process connection material																					
Carbon steel flanges									B												
Usage certifications																					
Standard										1											
Calibration type																					
Class 2 Calibration – standard accuracy 0.4 %											A										
Class 1 Calibration – high accuracy 0.2 %											B										
Extended range, class 1 calibration – high accuracy 0.2 %											N										
Extended range, class 2 calibration – standard accuracy 0.4 %											P										

Continued on next page…

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, optimized full bore, integral mount	FEV11	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system, optimized full bore, remote mount	FEV12																				
Optimized full bore sensor only, for use with WaterMaster transmitter / remote	FEV18																				
Temperature range installation / ambient temperature range																					
Standard design / –20 … 60 °C (–4 … 140 °F)												1									
Nameplate																					
Adhesive													A								
Signal cable length and type*																					
Without signal cable														0							
5 m (15 ft.) cable														1							
10 m (30 ft.) cable														2							
20 m (60 ft.) cable														3							
30 m (100 ft.) cable														4							
50 m (165 ft.) cable														5							
80 m (260 ft.) cable														6							
100 m (325 ft.) cable														7							
150 m (490 ft.) cable														8							
Special length > 150 m (> 490 ft.)														9							
Explosion protection certification																					
General purpose (non-Ex design)															A						
FM Class 1 Div. 2															G						
usFMc Class 1 Div. 2															P						
ATEX / IECEx Zone 2, 21 & 22															M						
Protection class transmitter / protection class sensor																					
IP67 (NEMA 4X) / IP67 (NEMA 4X) – integral																1					
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable not fitted and not potted																2					
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable fitted and potted																3					
Cable conduits *																					
M20 x 1.5 (plastic)																	A				
NPT $^{1}/_{2}$ in. (blanked when cable not fitted)																	B				
M20 SWA (armored)																	D				
M20 SWA sensor, M20 x 1.5 (plastic) power / output																	F				
Without																	Y				
Power supply																					
Without																		0			
100... 230 V AC, 50 Hz																		1			
24 V AC or 24 V DC, 50 Hz																		2			
100... 230 V AC, 60 Hz																		3			
24 V AC or 24 V DC, 60 Hz																		4			
Others																		9			
Input and output signal type																					
HART + 20 mA + pulse + contact output																			A		
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)																			G		
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)																			M		
Without																			Y		
Configuration type / diagnostics type																					
Without																				0	
Factory defaults / standard diagnostics																				1	

Continued on next page…

* The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered.
For FM or FMC Approved versions, NPT only permitted.

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, optimized full bore, integral mount	**FEV11**	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system, optimized full bore, remote mount	**FEV12**																				
Optimized full bore sensor only, for use with WaterMaster transmitter / remote	**FEV18**																				

Options**

Accessories

Configuration lead	AC

Documentation language

German	M1	Chinese	M6
Italian	M2	Swedish	M7
Spanish	M3	Finnish	M8
French	M4	Portuguese	MA
English	M5 (default)	Danish	MF
		Norwegian	MN

Other usage certifications

Measuring Instruments Directive (MID)	CM1
OIML R49 Calibration	CM2

Verification type

Without fingerprint	V0
VeriMaster	V3

Potable water approval

WRAS cold water approval	CWA
NSF 61 meter approval	CWC
DVGW	CWD
ACS	CWF
Without	CWY

Power supply frequency (sensor FEV18 only)

50 Hz	F5
60 Hz	F6

Number of testpoints

1 Point	T1
3 Points	T3

**Add codes for options.

Electromagnetic flowmeter WaterMaster FEF12 and FEF18

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, full bore, remote mount	FEF12	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only, for use with WaterMaster transmitter / remote	FEF18																				
Design																					
Non-hazardous areas		1																			
Hazardous areas (DN≥700 [27 in. NB])		5																			
Bore diameter																					
DN250 (10 in.)			250																		
DN300 (12 in.)			300																		
DN350 (14 in.)			350																		
DN375 (15 in.)			375																		
DN400 (16 in.)			400																		
DN450 (18 in.)			450																		
DN500 (20 in.)			500																		
DN600 (24 in.)			600																		
Others			999																		
Liner material																					
Elastomer – DN250 to 600 (10 to 24 in. NB)				K																	
Hard rubber – DN250 to 600 (10 to 24 in. NB)				H																	
Other				Z																	
Electrode design																					
Standard					1																
Others					9																
Measuring electrodes material																					
Stainless steel 316						S															
Hastelloy® C-22						C															
Super-austenitic steel (DN250 to 600 [10 to 24 in. NB])						U															
Others						Z															
Grounding accessories																					
Standard							1														
One potential equalizing ring (stainless steel)							3														
Two potential equalizing rings (stainless steel)							4														
Others							9														
Process connection type (refer to pages 35 to 33)																					
Flanges ASME B16.5 class 150								A1													
Flanges ASME B16.5 class 300								A3													
Flanges AWWA C207 class B								C1													
Flanges AWWA C207 class D								C2													
Flanges AS 4087 PN21								E0													
Flanges AS 4087 PN16								E1													
Flanges AS 4087 PN14								E2													
Flanges AS 2129 Table F								E3													
Flanges AS 2129 Table E								E4													
Flanges AS 2129 Table D								E5													
Flanges AS 2129 Table C								E6													
Flanges AS 2129 Table H								E7													
Flanges AS 4087 PN35								E8													
Flanges JIS G5527 7.5K								J0													
Flanges JIS B2220 10K								J1													
Flanges JIS B2220 5K								J2													
Flanges ISO / EN PN6								S0													
Flanges ISO / EN PN10								S1													
Flanges ISO / EN PN16								S2													
Flanges ISO / EN PN25								S3													
Flanges ISO / EN PN40								S4													
Others								Z9													
Note. DN80 to 200 (3 to 10 in. NB) available only with PN16																					
Process connection material																					
Carbon steel flanges									B												
Others									Z												
Usage certifications																					
Standard										1											
Calibration type																					
Class 2 calibration – standard accuracy 0.4 %											A										
Class 1 calibration – high accuracy 0.2 %											B										
Extended range, class 1 calibration – high accuracy 0.2 %											N										
Extended range, class 2 calibration – standard accuracy 0.4 %											P										

Continued on next page …

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system, full bore, remote mount	FEF12	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Full bore sensor only, for use with WaterMaster transmitter / remote	FEF18																				

Temperature range installation / ambient temperature range

Standard design / –20 … 60 °C (–4 … 140 °F)	1

Nameplate

Adhesive	A

Signal cable length and type*

Without signal cable	0
5 m (15 ft.) cable	1
10 m (30 ft.) cable	2
20 m (60 ft.) cable	3
30 m (100 ft.) cable	4
50 m (165 ft.) cable	5
80 m (260 ft.) cable	6
100 m (325 ft.) cable	7
150 m (490 ft.) cable	8
Special Length > 150 m (> 490 ft.) (and / or armored cable)	9

Explosion protection certification

General purpose (non-Ex design)	A

Protection class transmitter / protection class sensor

IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable not fitted and not potted	2
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable fitted and potted	3

Cable conduits**

M20 x 1.5 (plastic)	A
NPT $^1/_2$ in. (blanked when cable not fitted)	B
M20 SWA (armored)	D
M20 SWA sensor, M20 x 1.5 (plastic) power / output	F
Without	Y

Power supply

Without	0
100... 230 V AC (50 Hz)	1
24 V AC or 24 V DC (50 Hz)	2
100... 230 V AC (60 Hz)	3
24 V AC or 24 V DC (60 Hz)	4

Input and output signal type

HART + 20 mA + pulse + contact output	A
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)	G
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)	M
Without	Y

Configuration type / diagnostics type

Without	0
Factory defaults / standard diagnostics	1

Options***

Accessories

Configuration lead	AC

Documentation language

German	M1	Chinese	M6
Italian	M2	Swedish	M7
Spanish	M3	Finnish	M8
French	M4	Portuguese	MA
English	M5 (default)	Danish	MF
		Norwegian	MN

Verification type

Without fingerprint	V0
VeriMaster	V3

Potable water approvals

WRAS cold water approval	CWA
NSF 61 meter approval	CWC
DVGW	CWD
ACS	CWF
WRAS 60 °C (140 °F) water approval	CWK
Without	CWY

Power supply frequency (sensor FEF 18 only)

50 Hz	F5
60 Hz	F6

Number of testpoints

1 Point	T1
3 Points	T3

---

*Size is dependent on flange specification

**The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered – for FM or FMC Approved versions, NPT only permitted.

***Add codes for options.

Electromagnetic flowmeter WaterMaster – FEW31, FEW32 and FEW38

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	FEW31	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system – full bore, remote mount	FEW32																				
Full bore sensor only – for use with WaterMaster transmitter / remote	FEW38																				
Design																					
Non-hazardous areas		1																			
Hazardous areas		5																			
Bore diameter																					
DN10 (3/8 in.)			010																		
DN15 (1/2 in.)			015																		
DN20 (3/4 in.)			020																		
DN25 (1 in.)			025																		
DN32 (1 1/4 in.)			032																		
DN40 (1 1/2 in.)			040																		
DN50 (2 in.)			050																		
DN65 (2 1/2 in.)			065																		
DN80 (3 in.)			080																		
DN100 (4 in.)			100																		
DN125 (5 in.)			125																		
DN150 (6 in.)			150																		
DN200 (8 in.)			200																		
DN250 (10 in.)			250																		
DN300 (12 in.)			300																		
DN350 (14 in.)			350																		
DN400 (16 in.)			400																		
DN450 (18 in.)			450																		
DN500 (20 in.)			500																		
DN600 (24 in.)			600																		
DN700 (28 in.)			700																		
DN750 (29 in.)			750																		
DN760 (30 in.)			760																		
DN800 (32 in.)			800																		
DN900 (36 in.)			900																		
DN1000 (40 in.)			001																		
DN1050 (42 in.)			051																		
DN1100 (44 in.)			101																		
DN1200 (48 in.)			201																		
DN1350 (54 in.)			351																		
DN1400 (56 in.)			401																		
DN1500 (60 in.)			501																		
DN1600 (64 in.)			601																		
DN1650 (66 in.)			651																		
DN1800 (72 in.)			801																		
DN1950 (78 in.)			951																		
DN2000 (80 in.)			002																		
DN2100 (84 in.)			102																		
DN2200 (88 in.)			202																		
DN2400 (96 in.)			402																		
Others			999																		
Liner material																					
PTFE – DN10 to 600 (3/8 to 24 in. NB)				A																	
Hard rubber – DN40 to 2400 (1 1/2 to 96 in. NB)				H																	
Elastomer – DN40 to 2400 (1 1/2 to 96 in. NB)				K																	
Electrode design																					
Standard					1																
Other					9																
Measuring electrodes material																					
Hastelloy® C-4 (2.4610)						D															
Stainless steel 316Ti/316L						S															
Hastelloy C-22						C															
Grounding accessories																					
Not required							0														
Standard							1														
One potential equalizing ring (stainless steel)							3														
Two potential equalizing rings (stainless steel)							4														

Continued on next page…

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	**FEW31**	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system – full bore, remote mount	**FEW32**																				
Full bore sensor only – for use with WaterMaster transmitter / remote	**FEW38**																				
Process connection type (refer to pages 21 to 26)																					
Flanges ASME B16.47 series B / B16.5 Class 150								A1													
Flanges ASME B16.47 series B / B16.5 Class 300								A3													
Flanges ASME B16.47 series A Class 150								B1													
Flanges ASME B16.47 series A Class 300								B3													
Flanges AWWA C207 Class B								C1													
Flanges AWWA C207 Class D								C2													
Flanges AWWA C207 Class E								C3													
Flanges AWWA C207 Class F								C4													
Flanges JIS 10K								J1													
Flanges JIS 5K								J2													
Flanges AS 4087 PN 16								E1													
Flanges AS 2129 Table E								E4													
Flanges AS 2129 Table D								E5													
Flanges AS 4087 PN 35								E8													
ISO 7005, DIN, EN 1092-1 PN6								S0													
ISO 7005, DIN, EN 1092-1 PN10								S1													
ISO 7005, DIN, EN 1092-1 PN16								S2													
ISO 7005, DIN, EN 1092-1 PN25								S3													
ISO 7005, DIN, EN 1092-1 PN40								S4													
Process connection material																					
Carbon steel flanges									B												
Stainless steel flange									D												
Usage certifications																					
Standard (without PED)										1											
Calibration type																					
Class 2 calibration – standard accuracy 0.4 %											A										
Class 1 calibration – high accuracy 0.2 %											B										
Temperature range installation / ambient temperature range																					
Standard design/ –20 … 60 °C (–4 … 140 °F)												1									
Nameplate																					
Adhesive													A								
Signal cable length and type																					
Without signal cable														0							
5 m (15 ft.) cable														1							
10 m (30 ft.) cable														2							
20 m (60 ft.) cable														3							
30 m (100 ft.) cable														4							
50 m (165 ft.) cable														5							
80 m (260 ft.) cable														6							
100 m (325 ft.) cable														7							
150 m (490 ft.) cable														8							
Special length or cable type														9							
Explosion protection certification*																					
General purpose (non-Ex design)															A						
FM Class 1 Div. 2															G						
usFMc Class 1 Div. 2															P						
ATEX / IECEx Zone 2, 21 & 22															M						

Continued on next page…

Product coding field number	1 … 5	6	7 … 9	10	11	12	13	14, 15	16	17	18	19	20	21	22	23	24	25	26	27	Options
Flowmeter system – full bore, integral mount	**FEW31**	X	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
Flowmeter system – full bore, remote mount	**FEW32**																				
Full bore sensor only – for use with WaterMaster transmitter / remote	**FEW38**																				
Protection class transmitter / protection class sensor																					
IP67 (NEMA 4X) / IP67 (NEMA 4X) – cable not fitted and not potted to sensor																1					
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable not fitted and not potted to sensor																2					
IP 67 (NEMA 4x) / IP68 (NEMA 6P) – cable fitted and potted to sensor																3					
Cable conduits **																					
M20 x 1.5 (plastic)																	A				
NPT 1/2 in. (blanked when cable not fitted)																	B				
M20 SWA (armored)																	D				
M20 SWA sensor, M20 x 1.5 (plastic) power / output																	F				
Without																	Y				
Power supply																					
Without																		0			
108.. 230 V AC, 50 Hz																		1			
24 V AC or 24 V DC, 50 Hz																		2			
100 … 230 V AC, 60 Hz																		3			
24 V AC or 24 V DC, 60 Hz																		4			
Input and output signal type																					
HART + 20 mA + pulse + contact output																			A		
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)																			G		
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)																			M		
Without																			Y		
Configuration type / diagnostics type																					
Not required																				0	
Factory default / Standard																				1	

Options***

Accessories

Configuration lead	AC

Documentation language

German	M1	Chinese	M6
Italian	M2	Swedish	M7
Spanish	M3	Finnish	M8
French	M4	Portuguese	MA
English	M5 (default)	Danish	MF
		Norwegian	MN

Lay length

ISO length – DN10 to 600 (3/8 to 24 in.) and 1.25D DN1800 to 2400 (72 to 96 in.)	JB
1.3D DN700 to 2400 (28 to 96 in.) – see dimensional pages 25, 26, 27	JK
1.0D DN700 to 1600 (28 to 64 in.) – see dimensional pages 25, 26, 27	JH

Verification type

Without fingerprint	V0
VeriMaster	V3

Potable water approval

WRAS cold water approval	CWA
DVGW	CWD
WRAS 60 °C (140 °F) water approval	CWK
NSF material approval	CWM
Without	CWY

Power supply frequency (sensor FEW38 only)

50 Hz	F5
60 Hz	F6

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* FM approval in process. FEF product still available with full FM approval

** The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered. For FM or FMC Approved versions, NPT only permitted.

*** Add codes for options.

WaterMaster FER reduced-bore sensor flowmeter series

Product coding field number	1 … 6	7 … 9	10	11	12	13	14,15	16	17	18	19	20	21	22	23	24	25	26	27	Options
WaterMaster system. Reduced-bore sensor with remote mounted transmitter	**FER121**	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
WaterMaster system. Reduced-bore sensor with integral transmitter	**FER111**																			
WaterMaster reduced-bore sensor only, remote mount, without transmitter	**FER181**																			
Bore diameter																				
DN 40 (1½ in.)		040																		
DN 50 (2 in.)		050																		
DN 65 (2½ in.)		065																		
DN 80 (3 in.)		080																		
DN 100 (4 in.)		100																		
DN 125 (5 in.)		125																		
DN 150 (6 in.)		150																		
DN 200 (8 in.)		200																		
DN 250 (10 in.)		250																		
DN 300 (12 in.)		300																		
DN 350 (14 in.)		350																		
DN 375 (15 in.)		375																		
DN 400 (16 in.)		400																		
DN 450 (18 in.)		450																		
DN 500 (20 in.)		500																		
DN 600 (24 in.)		600																		
Liner material																				
Elastomer – DN40 to 600 (1½ to 24 in. NB)			K																	
Electrode design																				
Standard				1																
Measuring electrodes material																				
Stainless steel 316					S															
Super austenitic steel (1.4529)					U															
Grounding accessories																				
1 x Stainless steel equalizing ring						3														
2 x Stainless steel equalizing rings						4														
Process connection type (refer to pages 30 and 30)																				
Flanges ANSI / ASME B16.5 / 16.47 series B Class 150	(40 / 50 / 80 / 100 / 150 … 300)						A1													
Flanges AWWA C207 Class E	(40 / 50 / 80)						C3													
Flanges JIS 7.5K	(100 / 150 … 300)						J0													
Flanges JIS 10K	(40 / 50 / 80 / 100 / 150 … 300)						J1													
Flanges AS 4087 PN 21	(50 / 80 / 100 / 150 … 600)						E0													
Flanges AS 4087 PN 16	(50 / 80 / 100 / 150 … 350 / 450 … 600)						E1													
Flanges AS 4087 PN 14	(40 / 50 / 80 / 100 / 150 … 600)						E2													
Flanges AS 2129 Table F	(40 / 50 / 80 / 100 / 150 … 600)						E3													
Flanges AS 2129 Table E	(40 / 50 / 80 / 100 / 125 / 150 … 600)						E4													
Flanges AS 2129 Table D	(40 / 50 / 80 / 100 / 150 … 300)						E5													
Flanges AS 2129 Table C	(40 / 50 / 80 / 100 / 150 … 300)						E6													
ISO 7005 PN 10 EN 1092-1	(40 … 600)						S1													
ISO 7005 PN 16 EN 1092-1	(40 … 600)						S2													
ISO 7005 PN 40 EN 1092-1	(40)						S4													
Process connection material																				
Carbon steel								B												
Usage certifications																				
Standard									1											

Continued on next page…

Product coding field number	1 … 6	7 … 9	10	11	12	13	14,15	16	17	18	19	20	21	22	23	24	25	26	27	Options
WaterMaster system. Reduced-bore sensor with remote mounted transmitter	**FER121**																			
WaterMaster system. Reduced-bore sensor with integral transmitter	**FER111**	XXX	X	X	X	X	XX	X	X	X	X	X	X	X	X	X	X	X	X	
WaterMaster reduced-bore sensor only, remote mount, without transmitter	**FER181**																			
					See previous page															

Calibration type	
Class 2 calibration – standard accuracy 0.4 %	A
Class 1 calibration – high accuracy 0.2	B
Extended range, class 1 calibration – high accuracy 0.2 %	N
Extended range, class 2 calibration – standard accuracy 0.4 %	P
Installation temperature range / ambient temperature range	
Standard design –20 … 60 °C (–4 … 140 °F)	1
Name plate	
Adhesive label	A
Signal cable length and type	
Without signal cable	0
5 m (16.4 ft)	1
10 m (32.8 ft)	2
20 m (65.6 ft)	3
30 m (98.4 ft)	4
50 m (164.0 ft)	5
80 m (262.5 ft)	6
100 m (325 ft)	7
150 m (490 ft)	8
Others	9
Explosion protection certification	
General purpose (non-Ex design)	A
Protection class transmitter / protection class sensor	
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable not fitted and not potted	2
IP67 (NEMA 4X) / IP68 (NEMA 6P) – cable fitted and potted	3
Cable conduits*	
M20 x 1.5	A
NPT $^1/_2$ in (blanked when cable not fitted)	B
M20 SWA armored (FEV121 and FEV181 only)	D
M20 SWA sensor, output and power connector (FEV121 and FEV181 only)	F
Power supply	
Without (FEV18 only)	0
100... 230 V AC, 50 Hz	1
24 V AC or 24 V DC, 50 Hz	2
100... 230 V AC, 60 Hz	3
24 V AC or 24 V DC, 60 Hz	4
Input and output signal type	
HART + 20 mA + pulse + contact output	A
PROFIBUS DP RS485 physical layer + pulse + contact output (FEV111 and FEV121 only)	G
MODBUS RTU RS485 physical layer + pulse + contact output (FEV111 and FEV121 only)	M
Without (FEV181 only)	Y
Configuration type / diagnostics type	
Without (FEV18 only)	0
Factory defaults / standard diagnostics (FEV11 and FEV12 only)	1

Options**

Documentation language

German	M1	Chinese	M6
Italian	M2	Portuguese	MA
Spanish	M3	Russian	MB
French	M4	Danish	MF
English	M5 (default)		

Verification type

Without fingerprint	V0
VeriMaster	V3

Potable water approval

WRAS cold water approval	CWA
DVGW	CWD
ACS	CWF

Power supply frequency (sensor FER18 only)

50 Hz	F5
60 Hz	F6

---

* The type of signal cable supplied (standard or armored) depends on the type of cable conduit (variant digit number 24) ordered.
For FM or FMC Approved versions, NPT only permitted.

**Add codes for options.

Electromagnetic flowmeter transmitter for WaterMaster FET10 and FET12

Product coding field number	1 … 5	6	7	8	9	10	11	12	13	14	15	Options
Transmitter module	FET10		X	X	X	X	X	X	X	X	X	
Remote transmitter	FET12											
Design												
Non-hazardous area		1										
Hazardous area		5										
Temperature range installation / ambient temperature range												
Standard design / –20 … 60 °C (–4 … 140 °F)			1									
Nameplate												
Adhesive				A								
Signal cable length												
Without signal cable					0							
Explosion protection												
Without (transmitter only)						Y						
FM Class 1 Div. 2						G						
usFMc Class 1 Div. 2						P						
ATEX / IECEx Zone 2, 21 & 22						M						
Protection class transmitter / protection class sensor												
IP67 (NEMA 4X) / IP67 (NEMA 4X)							1					
Cable conduits												
M20 x 1.5 (plastic)								A				
NPT $^1/_2$ in. (blanked when cable not fitted)								B				
M20 SWA (armored)								D				
M20 SWA sensor, M20 x 1.5 (plastic) power / output								F				
Without								Y				
Power supply												
100... 230 V AC									1			
24 V AC or 24 V DC									2			
Input and output												
HART + 20 mA + pulse + contact output										A		
PROFIBUS DP RS485 physical layer + pulse + contact output (general-purpose design only)										G		
MODBUS RTU RS485 physical layer + pulse + contact output (general-purpose design only)										M		
Configuration type / diagnostics type												
Factory defaults / standard diagnostics											1	

Options**

Accessories

Configuration lead	AC

Documentation

German	M1	Chinese	M6
Italian	M2	Swedish	M7
Spanish	M3	Finnish	M8
French	M4	Portuguese	MA
English	M5 (default)	Danish	MF
		Norwegian	MN

Other usage

Measuring Instruments Directive (MID)	CM1

*The transmitter converter module Input and Output Signal Type must match the transmitter backplane output configuration (HART or PROFIBUS) – see OI/FET100-EN.
**Add codes for options.

Common accessories

Accessory	Item Number
WaterMaster AC Fuse F1 Type T 250 mA A/S TR5	B20411
WaterMaster DC Fuse F2 Type T 2 A A/S TR5	B20412
WaterMaster Infra Red Comms Pack	MJBX9932
WaterMaster Backplane PCB Board (STD)	WATX2505
WaterMaster Sensor PCB Board	WATX2506
WaterMaster Comms Cable	WEBC2500
Signal cable for remote WaterMaster transmitter	
5 m (15 ft.)	STT4500/05
10 m (30 ft.)	STT4500/10
20 m (60 ft.)	STT4500/20
30 m (100 ft.)	STT4500/30
50 m (165 ft.)	STT4500/50
80 m (260 ft.)	STT4500/80
100 m (325 ft.)	STT4500/100
150 m (490 ft.)	STT4500/150
500 m (1650 ft.)	STT4500/500
Armored signal cable for remote WaterMaster transmitter	
5 m (15 ft.)	STT4501/05
10 m (30 ft.)	STT4501/10
20 m (60 ft.)	STT4501/20
30 m (100 ft.)	STT4501/30
50 m (165 ft.)	STT4501/50
80 m (260 ft.)	STT4501/80
100 m (325 ft.)	STT4501/100
150 m (490 ft.)	STT4501/150
500 m (1650 ft.)	STT4501/500

Acknowledgements

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Modbus is a registered trademark of the Modbus-IDA organization

HART is a registered trademark of the HART Communication Foundation

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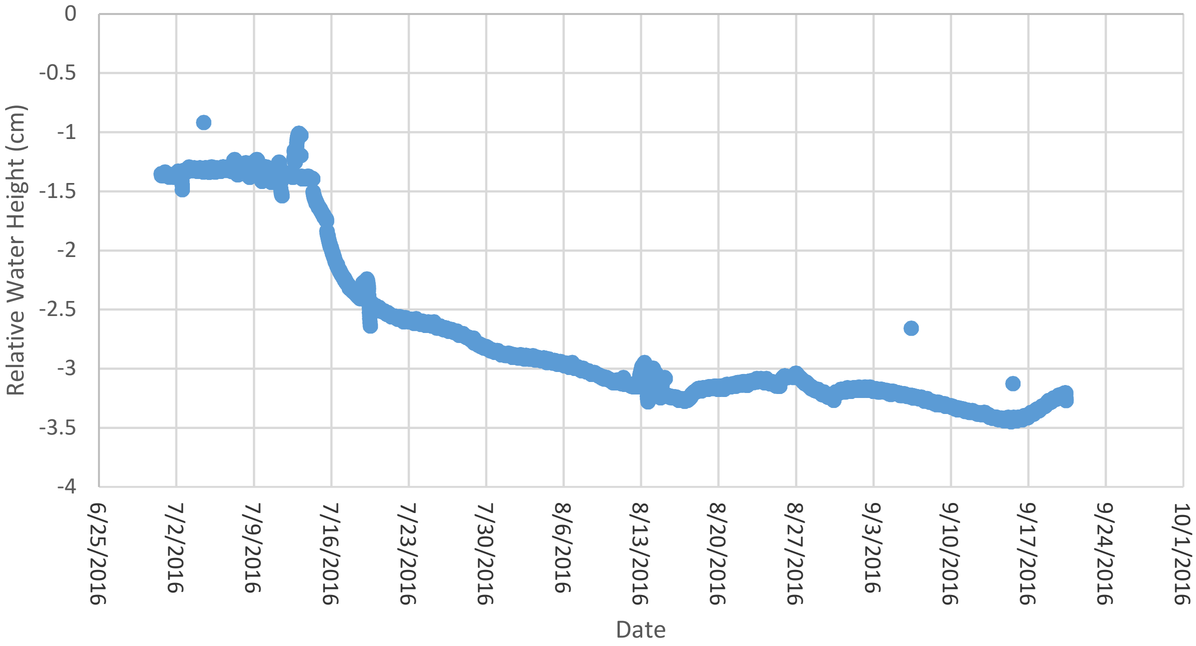


Figure C1: Well water level height from June 30, 2016 to September 20, 2016

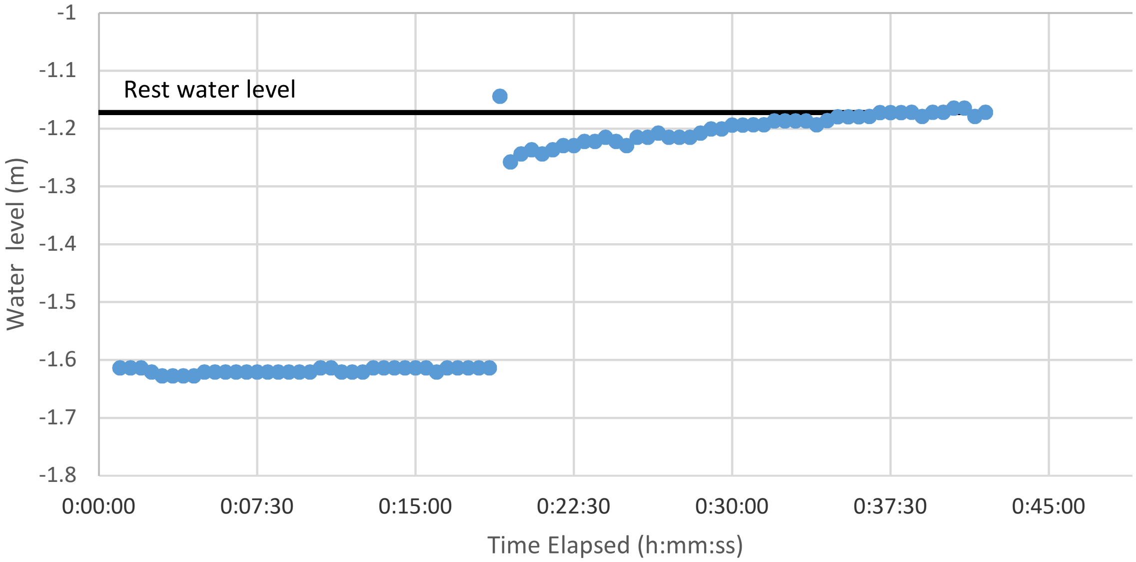


Figure C2: Well recovery data for well #8

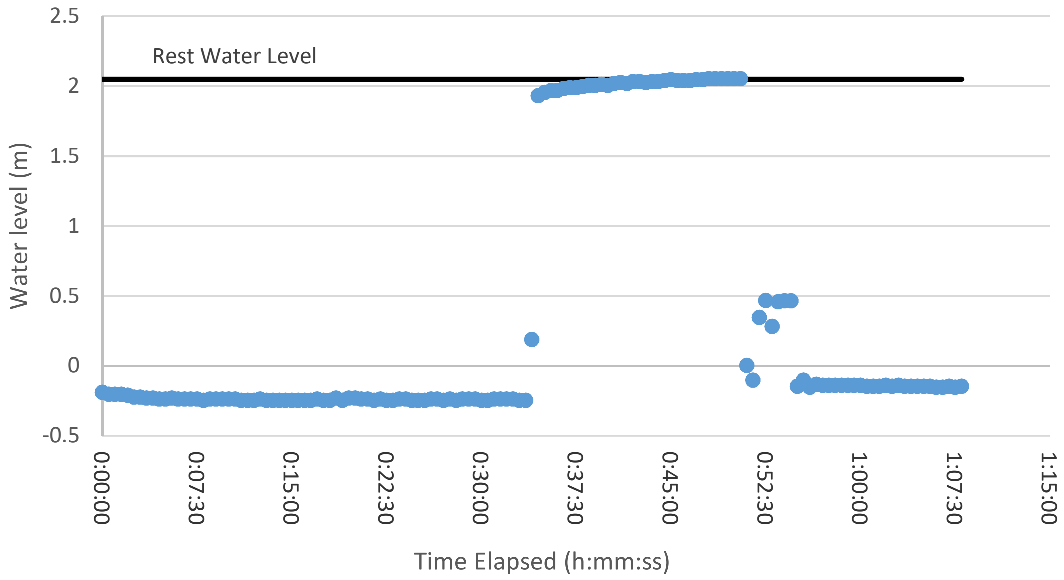


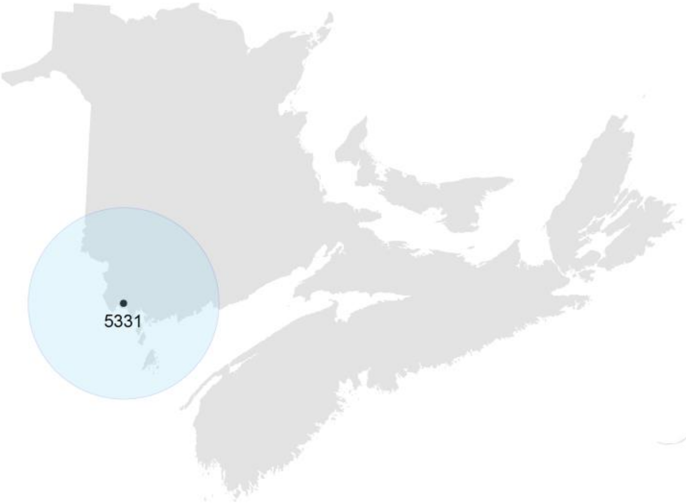
Figure C3: Well recovery data for the combined system of well #1 and #2. The smattering of data points when the pump was turned back on (around 0:52:30) was due to a delay between turning well pump #1 on and well pump #2

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada Atlantique

DATA REPORT 5331: Oak Haven Road, NB

Prepared 9 March 2015
by J. Churchill, Data Manager

CONTENTS OF REPORT



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (ACCDC) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The ACCDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the ACCDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees. URL: www.ACCDC.com.

Upon request and for a fee, the ACCDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the ACCDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	**Contents**
OakHavenRdNB_5331ob.xls	All Rare and legally protected *Flora and Fauna* within 5 km of your study area
OakHavenRdNB_5331ob100km.xls	A list of Rare and legally protected *Flora and Fauna* within 100 km of your study area
OakHavenRdNB_5331ma.xls	All *Managed Areas* in your study area
OakHavenRdNB_5331sa.xls	All *Significant Natural Areas* in your study area
OakHavenRdNB_5331ff.xls	Rare and common *Freshwater Fish* in your study area (DFO database)

1.2 RESTRICTIONS

The ACCDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting ACCDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The ACCDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) ACCDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) ACCDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an ACCDC data response.

1.3 ADDITIONAL INFORMATION

The attached file DataDictionary 2.1.pdf provides metadata for the data provided.

Please direct any additional questions about ACCDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney, Senior Scientist, Executive Director
Tel: (506) 364-2658
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Jean Breau
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Questions on the biology of Federal Species at Risk can be directed to ACCDC: (506) 364-2657, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Stewart Lusk, Natural Resources: (506) 453-7110.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Sherman Boates, NSDNR: (902) 679-6146. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NSDNR Regional Biologist:

Western: Duncan Bayne
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andersdg@gov.ns.ca

Eastern: Terry Power
(902) 563-3370
powertd@gov.ns.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Rosemary Curley, PEI Dept. of Agriculture and Forestry: (902) 368-4807.

2.0 RARE AND ENDANGERED SPECIES

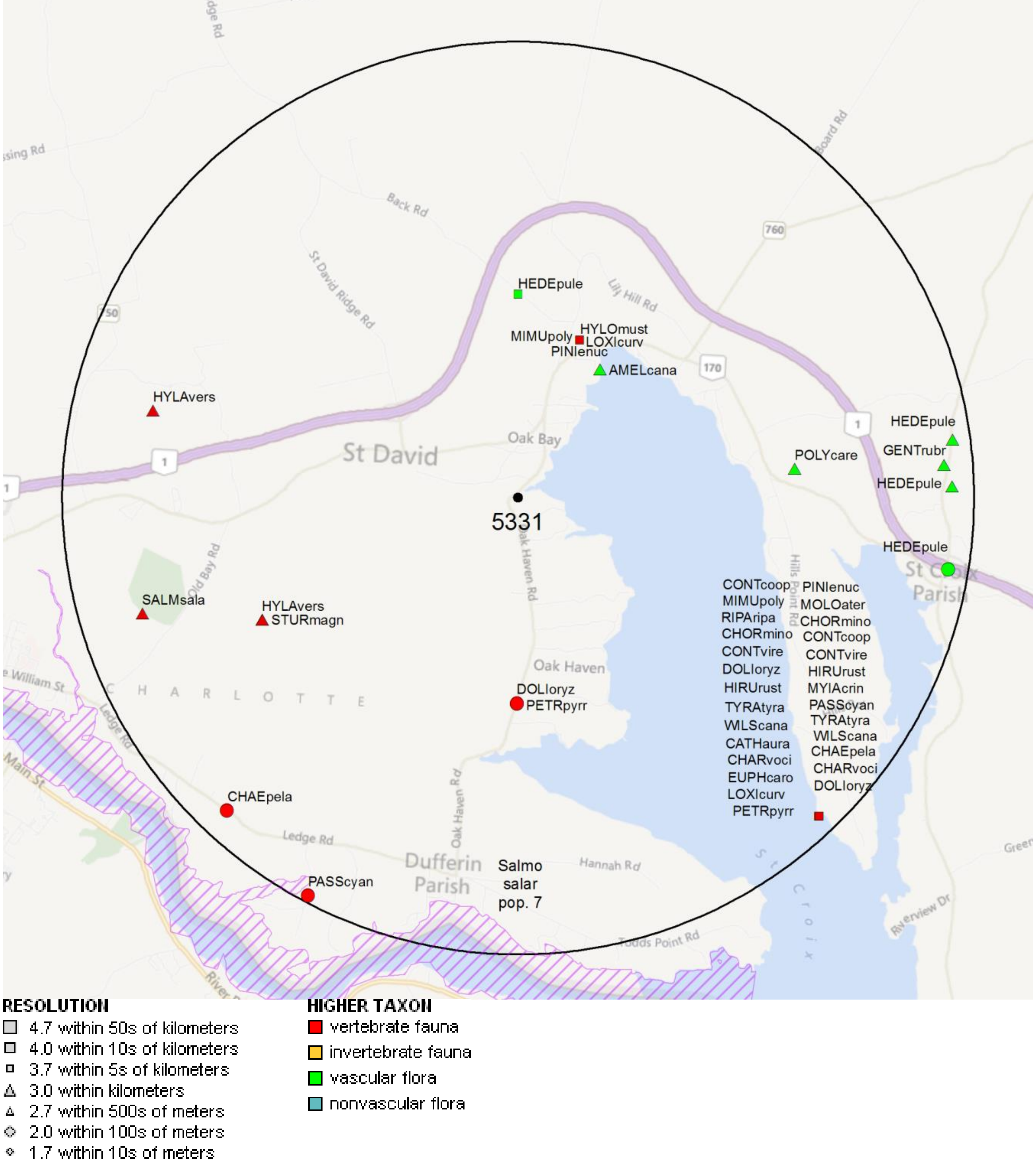
2.1 FLORA

A 5 km buffer around the study area contains 8 records of 4 vascular, no records of nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

A 5 km buffer around the study area contains 56 records of 23 vertebrate, no records of invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within 5 km of the study area.



3.0 SPECIAL AREAS

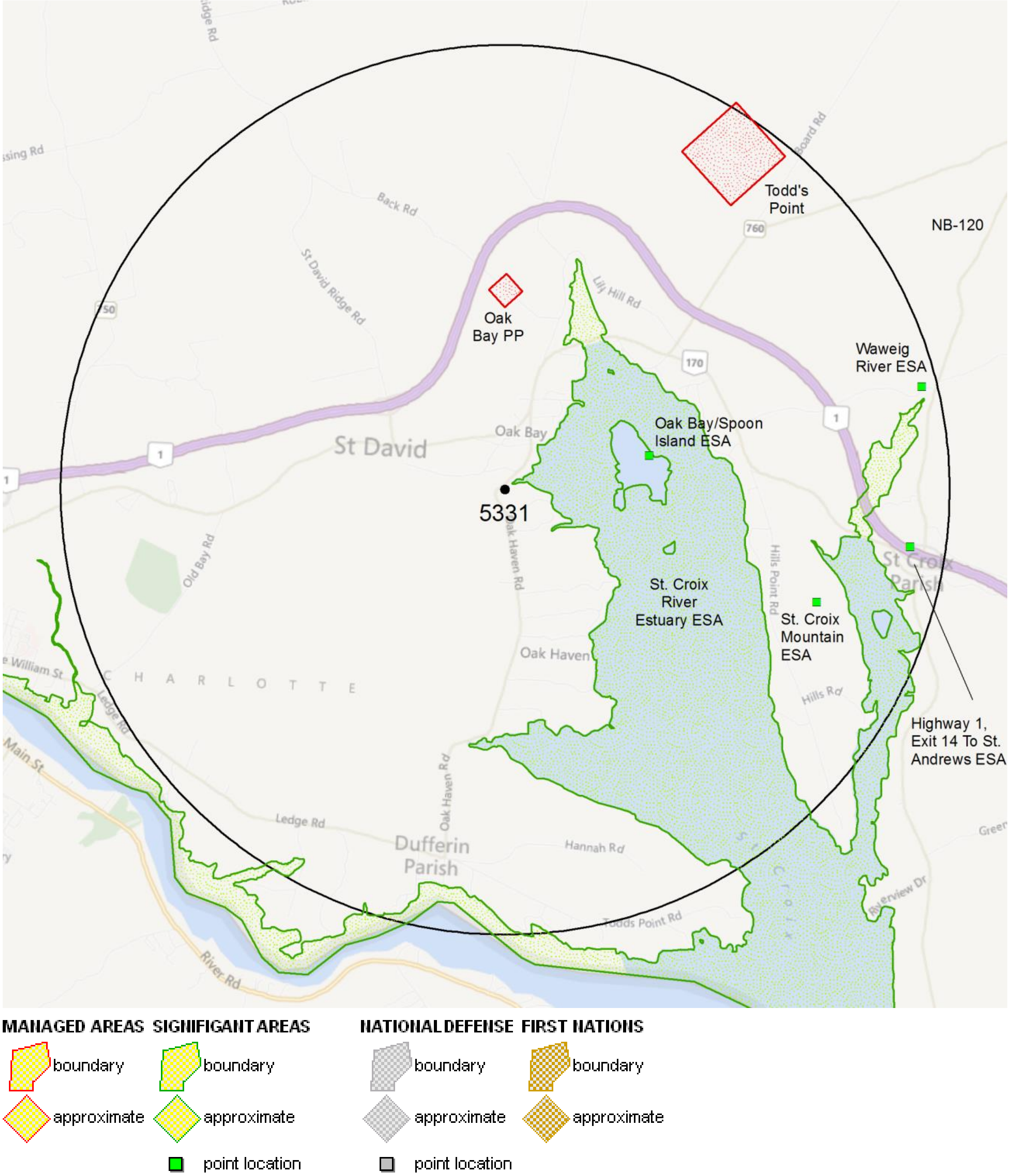
3.1 MANAGED AREAS

The GIS scan identified 2 managed areas in the vicinity of the study area (Map 3 and attached file: *ma*.xls)

3.2 SIGNIFICANT AREAS

The GIS scan identified 5 biologically significant sites in the vicinity of the study area (Map 3 and attached file: *sa*.xls)

Map 3: Boundaries and/or locations of known Managed and Significant Areas within 5 km of the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding “location-sensitive” species, section 4.3) within the 5 km-buffered area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community.

4.1 FLORA

	Scientific *Name*	**Common Name**	**COSEWIC**	**SARA**	**Prov Legal Prot**	**Prov Rarity Rank**	**Prov GS Rank**	**# recs**	**Distance (km)**
P	*Gentiana rubricaulis*	Purple-stemmed Gentian				S1	2 May Be At Risk	2	4.7 ± 1.0
P	*Hedeoma pulegioides*	American False Pennyroyal				S2	4 Secure	4	2.2 ± 2.0
P	*Polygonum careyi*	Carey's Smartweed				S2	3 Sensitive	1	3.1 ± 1.0
P	*Amelanchier canadensis*	Canada Serviceberry				S3	4 Secure	1	1.7 ± 1.0

4.2 FAUNA

	Scientific *Name*	**Common Name**	**COSEWIC**	**SARA**	**Prov Legal Prot**	**Prov Rarity Rank**	**Prov GS Rank**	**# recs**	**Distance (km)**
A	*Salmo salar pop. 7*	Atlantic Salmon - Outer Bay of Fundy pop.	Endangered			S2		1	4.5 ± 0
A	*Hylocichla mustelina*	Wood Thrush	Threatened		Threatened	S1S2B	2 May Be At Risk	1	1.9 ± 7.0
A	*Sturnella magna*	Eastern Meadowlark	Threatened		Threatened	S1S2B	2 May Be At Risk	1	3.1 ± 1.0
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B	1 At Risk	3	4.7 ± 0.0
A	*Chordeiles minor*	Common Nighthawk	Threatened	Threatened	Threatened	S3B	1 At Risk	4	4.8 ± 7.0
A	*Hirundo rustica*	Barn Swallow	Threatened		Threatened	S3B	3 Sensitive	4	4.8 ± 7.0
A	*Riparia riparia*	Bank Swallow	Threatened			S3B	3 Sensitive	1	4.8 ± 7.0
A	*Contopus cooperi*	Olive-sided Flycatcher	Threatened	Threatened	Threatened	S3S4B	1 At Risk	3	4.8 ± 7.0
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3S4B	1 At Risk	3	4.8 ± 7.0
A	*Dolichonyx oryzivorus*	Bobolink	Threatened		Threatened	S3S4B	3 Sensitive	4	2.3 ± 0.0
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B	2 May Be At Risk	1	4.8 ± 7.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern		Special Concern	S4B	4 Secure	2	4.8 ± 7.0
A	*Salmo salar*	Atlantic Salmon				S2	2 May Be At Risk	1	4.3 ± 1.0
A	*Pinicola enucleator*	Pine Grosbeak				S2S3B,S4S5N	3 Sensitive	2	1.9 ± 7.0
A	*Hyla versicolor*	Gray Treefrog				S3	4 Secure	6	3.1 ± 1.0
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	4	1.9 ± 7.0
A	*Cathartes aura*	Turkey Vulture				S3B	4 Secure	3	4.8 ± 7.0
A	*Charadrius vociferus*	Killdeer				S3B	3 Sensitive	2	4.8 ± 7.0
A	*Myiarchus crinitus*	Great Crested Flycatcher				S3B	3 Sensitive	1	4.8 ± 7.0
A	*Mimus polyglottos*	Northern Mockingbird				S3B	3 Sensitive	2	1.9 ± 7.0
A	*Passerina cyanea*	Indigo Bunting				S3B	4 Secure	2	4.8 ± 7.0
A	*Molothrus ater*	Brown-headed Cowbird				S3B	2 May Be At Risk	1	4.8 ± 7.0
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B	3 Sensitive	3	4.8 ± 7.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S3S4B	3 Sensitive	2	2.3 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting a 5 km buffer of your study area are indicated below with “YES”.

New Brunswick

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within 5 km of Study Site?
Chrysemys picta picta	Eastern Painted Turtle			No
Chelydra serpentina	Snapping Turtle	Special Concern	Special Concern	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Haliaeetus leucocephalus	**Bald Eagle**		**Endangered**	**YES**
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Endangered	No
Cicindela marginipennis	Cobblestone Tiger Beetle	Endangered	Endangered	No
Coenonympha nipisiquit	Maritime Ringlet	Endangered	Endangered	No
Bat Hibernaculum		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NB Species at Risk Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the ACCDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
26	Lepage, D. 2014. Maritime Breeding Bird Atlas Database. Bird Studies Canada, Sackville NB, 407,838 recs.
22	Erskine, A.J. 1992. Maritime Breeding Bird Atlas Database. NS Museum & Nimbus Publ., Halifax, 82,125 recs.
5	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc.
4	McAlpine, D.F., Fletcher, T.J., Gorham, S.W. & Gorham, I.T. 1991. Distribution & habitat of the Tetraploid Gray Treefrog, Hyla versicolor, in New Brunswick & Eastern Maine. Can. Field-Nat., 105 (4): 526-529. 17 recs.
3	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
2	Sollows, M.C. 2008. NBM Science Collections databases: herpetiles. New Brunswick Museum, Saint John NB, download Jan. 2008, 8636 recs.
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1	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
1	Clayden, S.R. 2007. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, download Mar. 2007, 6914 recs.
1	Dept of Fisheris & Oceans. 2001. Atlantic Salmon Maritime provinces overview for 2000. DFO.
1	Hinds, H.R. 1986. Notes on New Brunswick plant collections. Connell Memorial Herbarium, unpubl, 739 recs.
1	NSDNR website
1	Pike, E., Tingley, S. & Christie, D.S. 2000. Nature NB Listserve. University of New Brunswick, listserv.unb.ca/archives/naturenb. 68 recs.
1	Sheppard NTNB 2000

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 8227 records of 126 vertebrate and 760 records of 61 invertebrate fauna; 4860 records of 340 vascular, 180 records of 99 nonvascular flora (attached: *ob100km.xls).

Rare and/or endangered taxa within the 100 km-buffered area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Myotis septentrionalis*	Northern Long-eared Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	13	72.8 ± 1.0
A	*Perimyotis subflavus*	Eastern Pipistrelle	Endangered	Endangered	Endangered	S1	1 At Risk	2	84.1 ± 0.0
A	*Eubalaena glacialis*	North Atlantic Right Whale	Endangered	Endangered	Endangered	S1		6	28.5 ± 1.0
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	1 At Risk	18	79.4 ± 0.0
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered	Endangered	S1S2N	1 At Risk	4	65.9 ± 0.0
A	*Morone saxatilis*	Striped Bass	Endangered			S2	2 May Be At Risk	8	16.4 ± 1.0
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered	Endangered	S2	2 May Be At Risk	3	51.4 ± 0.0
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S2B	1 At Risk	23	58.2 ± 0.0
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered		Endangered	S3M	1 At Risk	244	17.1 ± 0.0
A	*Protonotaria citrea*	Prothonotary Warbler	Endangered	Endangered		SNA	8 Accidental	1	78.5 ± 1.0
A	*Rangifer tarandus pop. 2*	Woodland Caribou (Atlantic-Gasp├⌐sie pop.)	Endangered	Endangered	Extirpated	SX	0.1 Extirpated	2	31.8 ± 1.0
A	*Colinus virginianus*	Northern Bobwhite	Endangered	Endangered				2	85.3 ± 7.0
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered				54	6.7 ± 5.0
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened	Threatened	S1S2B	1 At Risk	19	30.2 ± 0.0
A	*Hylocichla mustelina*	Wood Thrush	Threatened		Threatened	S1S2B	2 May Be At Risk	124	1.9 ± 7.0
A	*Sturnella magna*	Eastern Meadowlark	Threatened		Threatened	S1S2B	2 May Be At Risk	22	3.1 ± 1.0
A	*Caprimulgus vociferus*	Whip-Poor-Will	Threatened	Threatened	Threatened	S2B	1 At Risk	60	6.8 ± 7.0
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Threatened	S2S3B	1 At Risk	124	4.7 ± 0.0
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Special Concern	Threatened	S2S3B	1 At Risk	14	36.1 ± 7.0
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened		Threatened	S3	4 Secure	1	74.6 ± 1.0
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S3	1 At Risk	57	9.3 ± 1.0
A	*Chordeiles minor*	Common Nighthawk	Threatened	Threatened	Threatened	S3B	1 At Risk	176	4.8 ± 7.0
A	*Hirundo rustica*	Barn Swallow	Threatened		Threatened	S3B	3 Sensitive	386	4.8 ± 7.0
A	*Riparia riparia*	Bank Swallow	Threatened			S3B	3 Sensitive	161	4.8 ± 7.0
A	*Contopus cooperi*	Olive-sided Flycatcher	Threatened	Threatened	Threatened	S3S4B	1 At Risk	164	4.8 ± 7.0
A	*Wilsonia canadensis*	Canada Warbler	Threatened	Threatened	Threatened	S3S4B	1 At Risk	475	4.8 ± 7.0
A	*Dolichonyx oryzivorus*	Bobolink	Threatened		Threatened	S3S4B	3 Sensitive	264	2.3 ± 0.0
A	*Anguilla rostrata*	American Eel	Threatened		Threatened	S5	4 Secure	34	12.8 ± 1.0
A	*Melanerpes erythrocephalus*	Red-headed Woodpecker	Threatened	Threatened		SNA	8 Accidental	1	31.5 ± 7.0
A	*Vermivora chrysoptera*	Golden-winged Warbler	Threatened	Threatened		SNA	8 Accidental	1	78.5 ± 1.0
A	*Osmerus mordax pop. 2*	Lake Utopia Smelt large-bodied pop.	Threatened		Threatened			2	31.8 ± 1.0
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Special Concern	Special Concern	Endangered	S1B	1 At Risk	122	33.1 ± 7.0
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S1B,S1N	1 At Risk	193	42.3 ± 12.0
A	*Acipenser brevirostrum*	Shortnose Sturgeon	Special Concern	Special Concern	Special Concern	S2	3 Sensitive	2	82.5 ± 10.0
A	*Balaenoptera physalus*	Fin Whale - Atlantic pop.	Special Concern	Special Concern	Special Concern	S2S3		3	67.0 ± 0.0
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Special Concern	S3	3 Sensitive	24	5.3 ± 1.0
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern	Special Concern	S3B	3 Sensitive	16	63.0 ± 7.0
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Special Concern	S3B	2 May Be At Risk	87	4.8 ± 7.0
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern			S3M	3 Sensitive	11	25.4 ± 0.0
A	*Phocoena phocoena (NW Atlantic pop.)*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern	Threatened		S4		213	9.9 ± 100.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern		Special Concern	S4B	4 Secure	222	4.8 ± 7.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Tryngites subruficollis*	Buff-breasted Sandpiper	Special Concern			SNA	8 Accidental	22	64.7 ± 0.0
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S1	1 At Risk	7	18.8 ± 1.0
A	*Sorex dispar*	Long-tailed Shrew	Not At Risk	Special Concern		S1	3 Sensitive	2	82.3 ± 1.0
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1S2B	2 May Be At Risk	11	37.7 ± 7.0
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S1S2B	2 May Be At Risk	3	64.4 ± 1.0
A	*Buteo lineatus*	Red-shouldered Hawk	Not At Risk	Special Concern		S2B	2 May Be At Risk	33	7.2 ± 7.0
A	*Fulica americana*	American Coot	Not At Risk			S2B	3 Sensitive	2	36.1 ± 7.0
A	*Chlidonias niger*	Black Tern	Not At Risk			S2B	3 Sensitive	34	23.5 ± 7.0
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3		2	53.1 ± 1.0
A	*Desmognathus fuscus (QC/NB pop.)*	Northern Dusky Salamander - QC/NB pop.	Not At Risk			S3	3 Sensitive	91	9.3 ± 1.0
A	*Megaptera novaeangliae*	Humpback Whale (NW Atlantic pop.)	Not At Risk	Special Concern		S3		3	28.5 ± 5.0
A	*Haliaeetus leucocephalus*	Bald Eagle	Not At Risk		Endangered	S3B	1 At Risk	299	4.1 ± 1.0
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	3 Sensitive	92	36.7 ± 0.0
A	*Podiceps grisegena*	Red-necked Grebe	Not At Risk			S3M,S2N	3 Sensitive	3	37.4 ± 10.0
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4		1	93.0 ± 1.0
A	*Canis lupus*	Gray Wolf	Not At Risk		Extirpated	SX	0.1 Extirpated	3	59.9 ± 1.0
A	*Lepomis auritus*	Redbreast Sunfish	Data Deficient	Special Concern		S3?	4 Secure	28	29.1 ± 10.0
A	*Puma concolor pop. 1*	Cougar - Eastern pop.	Data Deficient		Endangered	SU,SH	5 Undetermined	39	11.3 ± 1.0
A	*Lasionycteris noctivagans*	Silver-haired Bat				S1?	5 Undetermined	1	86.8 ± 1.0
A	*Bartramia longicauda*	Upland Sandpiper				S1B	3 Sensitive	40	23.8 ± 7.0
A	*Phalaropus tricolor*	Wilson's Phalarope				S1B	3 Sensitive	33	64.7 ± 0.0
A	*Leucophaeus atricilla*	Laughing Gull				S1B	3 Sensitive	6	78.5 ± 1.0
A	*Sterna paradisaea*	Arctic Tern				S1B	2 May Be At Risk	25	36.0 ± 1.0
A	*Troglodytes aedon*	House Wren				S1B	5 Undetermined	24	6.8 ± 7.0
A	*Aythya marila*	Greater Scaup				S1B,S2N	4 Secure	17	70.4 ± 1.0
A	*Uria aalge*	Common Murre				S1B,S3N	4 Secure	14	79.4 ± 0.0
A	*Alca torda*	Razorbill				S1B,S3N	4 Secure	32	47.7 ± 0.0
A	*Oxyura jamaicensis*	Ruddy Duck				S1B,S4N	4 Secure	1	70.1 ± 1.0
A	*Rissa tridactyla*	Black-legged Kittiwake				S1B,S4N	4 Secure	13	33.1 ± 7.0
A	*Butorides virescens*	Green Heron				S1S2B	3 Sensitive	16	6.8 ± 7.0
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1S2B	3 Sensitive	34	35.7 ± 0.0
A	*Gallinula chloropus*	Common Moorhen				S1S2B	3 Sensitive	13	68.9 ± 0.0
A	*Fratercula arctica*	Atlantic Puffin				S1S2B	3 Sensitive	17	46.6 ± 0.0
A	*Empidonax traillii*	Willow Flycatcher				S1S2B	3 Sensitive	48	13.8 ± 0.0
A	*Progne subis*	Purple Martin				S1S2B	2 May Be At Risk	104	6.8 ± 7.0
A	*Stelgidopteryx serripennis*	Northern Rough-winged Swallow				S1S2B	2 May Be At Risk	23	22.2 ± 7.0
A	*Prosopium cylindraceum*	Round Whitefish				S2	4 Secure	2	40.5 ± 10.0
A	*Salmo salar*	Atlantic Salmon				S2	2 May Be At Risk	36	4.3 ± 1.0
A	*Eptesicus fuscus*	Big Brown Bat				S2?	3 Sensitive	43	6.8 ± 1.0
A	*Lasiurus borealis*	Eastern Red Bat				S2?	5 Undetermined	9	18.6 ± 1.0
A	*Lasiurus cinereus*	Hoary Bat				S2?	5 Undetermined	11	6.8 ± 1.0
A	*Oceanodroma leucorhoa*	Leach's Storm-Petrel				S2B	3 Sensitive	30	46.9 ± 1.0
A	*Anas clypeata*	Northern Shoveler				S2B	4 Secure	18	73.7 ± 7.0
A	*Anas strepera*	Gadwall				S2B	4 Secure	28	63.7 ± 7.0
A	*Eremophila alpestris*	Horned Lark				S2B	2 May Be At Risk	14	21.2 ± 7.0
A	*Cistothorus palustris*	Marsh Wren				S2B	3 Sensitive	55	68.9 ± 0.0
A	*Toxostoma rufum*	Brown Thrasher				S2B	3 Sensitive	68	6.8 ± 7.0
A	*Pooecetes gramineus*	Vesper Sparrow				S2B	2 May Be At Risk	36	14.6 ± 0.0
A	*Tringa solitaria*	Solitary Sandpiper				S2B,S5M	4 Secure	127	58.2 ± 0.0
A	*Chroicocephalus ridibundus*	Black-headed Gull				S2M,S1N	3 Sensitive	2	35.9 ± 0.0
A	*Somateria spectabilis*	King Eider				S2N	4 Secure	1	20.5 ± 0.0
A	*Asio otus*	Long-eared Owl				S2S3	5 Undetermined	17	33.7 ± 7.0
A	*Tringa semipalmata*	Willet				S2S3B	3 Sensitive	124	17.2 ± 7.0
A	*Pinicola enucleator*	Pine Grosbeak				S2S3B,S4S5N	3 Sensitive	19	1.9 ± 7.0
A	*Branta bernicla*	Brant				S2S3M,S2S3N	4 Secure	71	16.4 ± 1.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Hyla versicolor*	Gray Treefrog				S3	4 Secure	101	3.1 ± 1.0
A	*Cepphus grylle*	Black Guillemot				S3	4 Secure	167	8.9 ± 16.0
A	*Loxia curvirostra*	Red Crossbill				S3	4 Secure	67	1.9 ± 7.0
A	*Coregonus clupeaformis*	Lake Whitefish				S3	4 Secure	12	44.7 ± 10.0
A	*Salvelinus namaycush*	Lake Trout				S3	3 Sensitive	6	11.8 ± 0.0
A	*Sorex maritimensis*	Maritime Shrew				S3	4 Secure	1	83.7 ± 1.0
A	*Synaptomys cooperi*	Southern Bog Lemming				S3	4 Secure	12	81.3 ± 1.0
A	*Picoides dorsalis*	American Three-toed Woodpecker				S3?	3 Sensitive	9	21.7 ± 7.0
A	*Anas acuta*	Northern Pintail				S3B	3 Sensitive	12	69.3 ± 0.0
A	*Anas americana*	American Wigeon				S3B	4 Secure	159	6.8 ± 7.0
A	*Cathartes aura*	Turkey Vulture				S3B	4 Secure	109	4.8 ± 7.0
A	*Rallus limicola*	Virginia Rail				S3B	3 Sensitive	59	13.1 ± 0.0
A	*Charadrius vociferus*	Killdeer				S3B	3 Sensitive	534	4.8 ± 7.0
A	*Larus delawarensis*	Ring-billed Gull				S3B	4 Secure	16	53.7 ± 7.0
A	*Myiarchus crinitus*	Great Crested Flycatcher				S3B	3 Sensitive	106	4.8 ± 7.0
A	*Mimus polyglottos*	Northern Mockingbird				S3B	3 Sensitive	84	1.9 ± 7.0
A	*Passerina cyanea*	Indigo Bunting				S3B	4 Secure	84	4.8 ± 7.0
A	*Molothrus ater*	Brown-headed Cowbird				S3B	2 May Be At Risk	119	4.8 ± 7.0
A	*Mergus serrator*	Red-breasted Merganser				S3B,S4S5N	4 Secure	99	8.9 ± 16.0
A	*Pluvialis dominica*	American Golden-Plover				S3M	3 Sensitive	149	19.2 ± 0.0
A	*Phalaropus fulicarius*	Red Phalarope				S3M	3 Sensitive	6	25.4 ± 0.0
A	*Melanitta nigra*	Black Scoter				S3M,S2S3N	3 Sensitive	84	8.9 ± 16.0
A	*Calidris maritima*	Purple Sandpiper				S3M,S3N	4 Secure	181	19.8 ± 9.0
A	*Bucephala albeola*	Bufflehead				S3N	3 Sensitive	137	8.9 ± 16.0
A	*Tyrannus tyrannus*	Eastern Kingbird				S3S4B	3 Sensitive	202	4.8 ± 7.0
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S3S4B	3 Sensitive	242	2.3 ± 0.0
A	*Piranga olivacea*	Scarlet Tanager				S3S4B	4 Secure	161	7.2 ± 7.0
A	*Coccothraustes vespertinus*	Evening Grosbeak				S3S4B,S4S5N	3 Sensitive	100	7.2 ± 7.0
A	*Podiceps auritus*	Horned Grebe			Special Concern	S4M,S4N	4 Secure	3	37.4 ± 10.0
A	*Morus bassanus*	Northern Gannet				SHB,S5M,S5N	4 Secure	1	35.6 ± 0.0
I	*Gomphus ventricosus*	Skillet Clubtail	Endangered	Endangered	Endangered	S1	2 May Be At Risk	39	89.7 ± 1.0
I	*Ophiogomphus howei*	Pygmy Snaketail	Special Concern	Special Concern	Special Concern	S1	2 May Be At Risk	3	27.8 ± 0.0
I	*Alasmidonta varicosa*	Brook Floater	Special Concern		Special Concern	S1S2	3 Sensitive	1	50.0 ± 0.0
I	*Lampsilis cariosa*	Yellow Lampmussel	Special Concern	Special Concern	Special Concern	S2	3 Sensitive	54	70.4 ± 0.0
I	*Danaus plexippus*	Monarch	Special Concern	Special Concern	Special Concern	S3B	3 Sensitive	73	18.5 ± 0.0
I	*Lyogyrus granum*	Squat Duskysnail	Data Deficient			S2		5	75.9 ± 0.0
I	*Erynnis juvenalis*	Juvenal's Duskywing				S1	5 Undetermined	1	72.8 ± 1.0
I	*Lycaena dorcas claytoni*	Clayton's Copper				S1	2 May Be At Risk	4	80.5 ± 0.0
I	*Somatochlora septentrionalis*	Muskeg Emerald				S1	2 May Be At Risk	1	75.5 ± 1.0
I	*Celithemis martha*	Martha's Pennant				S1	5 Undetermined	1	75.3 ± 0.0
I	*Pachydiplax longipennis*	Blue Dasher				S1	5 Undetermined	1	25.1 ± 1.0
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle				S1S2	2 May Be At Risk	2	79.3 ± 0.0
I	*Ophiogomphus colubrinus*	Boreal Snaketail				S1S2	2 May Be At Risk	34	11.8 ± 0.0
I	*Satyrium calanus*	Banded Hairstreak				S2	3 Sensitive	12	91.8 ± 0.0
I	*Satyrium calanus falacer*	Banded Hairstreak				S2	4 Secure	4	88.7 ± 1.0
I	*Callophrys henrici*	Henry's Elfin				S2	4 Secure	12	74.1 ± 0.0
I	*Strymon melinus*	Grey Hairstreak				S2	4 Secure	3	67.6 ± 1.0
I	*Cupido comyntas*	Eastern Tailed Blue				S2	4 Secure	8	61.5 ± 0.0
I	*Gomphus vastus*	Cobra Clubtail				S2	3 Sensitive	40	80.5 ± 0.0
I	*Aeshna clepsydra*	Mottled Darner				S2	3 Sensitive	12	60.5 ± 0.0
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S2	5 Undetermined	5	13.0 ± 1.0
I	*Ladona exusta*	White Corporal				S2	5 Undetermined	8	9.1 ± 1.0
I	*Hetaerina americana*	American Rubyspot				S2	3 Sensitive	14	50.0 ± 0.0
I	*Coenagrion interrogatum*	Subarctic Bluet				S2	3 Sensitive	1	83.2 ± 0.0
I	*Enallagma vesperum*	Vesper Bluet				S2	5 Undetermined	6	9.1 ± 1.0
I	*Ischnura posita*	Fragile Forktail				S2	2 May Be At Risk	6	13.4 ± 1.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
I	*Arigomphus furcifer*	Lilypad Clubtail				S2	5 Undetermined	1	97.3 ± 0.0
I	*Alasmidonta undulata*	Triangle Floater				S2	3 Sensitive	16	6.4 ± 1.0
I	*Anatis labiculata*	Fifteen-spotted Lady Beetle				S2S3	3 Sensitive	1	79.8 ± 0.0
I	*Chrysops indus*	a Tabanid Fly				S2S3	3 Sensitive	2	85.4 ± 0.0
I	*Gomphus abbreviatus*	Spine-crowned Clubtail				S2S3	4 Secure	34	21.6 ± 1.0
I	*Lestes vigilax*	Swamp Spreadwing				S2S3	3 Sensitive	34	5.9 ± 1.0
I	*Hesperia sassacus*	Indian Skipper				S3	4 Secure	4	33.7 ± 0.0
I	*Euphyes bimacula*	Two-spotted Skipper				S3	4 Secure	8	10.8 ± 1.0
I	*Lycaena hyllus*	Bronze Copper				S3	3 Sensitive	3	68.5 ± 1.0
I	*Lycaena dospassosi*	Salt Marsh Copper				S3	4 Secure	1	90.4 ± 1.0
I	*Satyrium acadica*	Acadian Hairstreak				S3	4 Secure	5	12.5 ± 0.0
I	*Callophrys polios*	Hoary Elfin				S3	4 Secure	3	85.6 ± 0.0
I	*Plebejus idas*	Northern Blue				S3	4 Secure	6	58.1 ± 0.0
I	*Plebejus idas empetri*	Crowberry Blue				S3	4 Secure	8	52.6 ± 1.0
I	*Plebejus saepiolus*	Greenish Blue				S3	4 Secure	3	34.0 ± 0.0
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	18	39.1 ± 0.0
I	*Boloria bellona*	Meadow Fritillary				S3	4 Secure	26	36.8 ± 1.0
I	*Chlosyne nycteis*	Silvery Checkerspot				S3	4 Secure	5	82.0 ± 1.0
I	*Polygonia satyrus*	Satyr Comma				S3	4 Secure	8	22.7 ± 1.0
I	*Polygonia gracilis*	Hoary Comma				S3	4 Secure	1	94.1 ± 1.0
I	*Nymphalis l-album*	Compton Tortoiseshell				S3	4 Secure	14	67.5 ± 5.0
I	*Oeneis jutta*	Jutta Arctic				S3	4 Secure	16	7.7 ± 1.0
I	*Gomphaeschna furcillata*	Harlequin Darner				S3	5 Undetermined	11	12.5 ± 1.0
I	*Dorocordulia lepida*	Petite Emerald				S3	4 Secure	20	9.5 ± 0.0
I	*Somatochlora cingulata*	Lake Emerald				S3	4 Secure	11	14.1 ± 1.0
I	*Somatochlora forcipata*	Forcipate Emerald				S3	4 Secure	20	9.1 ± 1.0
I	*Williamsonia fletcheri*	Ebony Boghaunter				S3	4 Secure	13	12.5 ± 1.0
I	*Lestes eurinus*	Amber-Winged Spreadwing				S3	4 Secure	8	32.8 ± 0.0
I	*Enallagma geminatum*	Skimming Bluet				S3	5 Undetermined	5	12.8 ± 1.0
I	*Enallagma signatum*	Orange Bluet				S3	4 Secure	6	12.8 ± 1.0
I	*Stylurus scudderi*	Zebra Clubtail				S3	4 Secure	61	29.0 ± 1.0
I	*Leptodea ochracea*	Tidewater Mucket				S3	4 Secure	30	76.6 ± 0.0
I	*Pantala hymenaea*	Spot-Winged Glider				S3B	4 Secure	5	20.7 ± 1.0
I	*Satyrium liparops*	Striped Hairstreak				S3S4	4 Secure	2	91.8 ± 0.0
I	*Satyrium liparops strigosum*	Striped Hairstreak				S3S4	4 Secure	1	97.4 ± 10.0
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	SH	1 At Risk	1	41.2 ± 1.0
N	*Degelia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Special Concern	S1	2 May Be At Risk	2	41.8 ± 5.0
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S3	5 Undetermined	13	33.0 ± 5.0
N	*Anomodon viticulosus*	a Moss				S1	2 May Be At Risk	1	87.8 ± 1.0
N	*Bryum muehlenbeckii*	Muehlenbeck's Bryum Moss				S1	2 May Be At Risk	1	82.2 ± 1.0
N	*Bryum salinum*	a Moss				S1	2 May Be At Risk	1	54.8 ± 1.0
N	*Calliergon trifarium*	Three-ranked Moss				S1	2 May Be At Risk	1	78.0 ± 0.0
N	*Dichelyma falcatum*	a Moss				S1	2 May Be At Risk	2	74.1 ± 1.0
N	*Dicranum bonjeanii*	Bonjean's Broom Moss				S1	2 May Be At Risk	1	92.5 ± 1.0
N	*Ditrichum pallidum*	Pale Cow-hair Moss				S1	2 May Be At Risk	1	72.0 ± 1.0
N	*Eurhynchium hians*	Light Beaked Moss				S1	2 May Be At Risk	1	94.1 ± 1.0
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S1	2 May Be At Risk	1	83.6 ± 0.0
N	*Meesia triquetra*	Three-ranked Cold Moss				S1	2 May Be At Risk	1	81.7 ± 0.0
N	*Plagiothecium latebricola*	Alder Silk Moss				S1	2 May Be At Risk	1	85.5 ± 0.0
N	*Racomitrium ericoides*	a Moss				S1	2 May Be At Risk	1	52.9 ± 3.0
N	*Rhytidiadelphus loreus*	Lanky Moss				S1	2 May Be At Risk	1	78.3 ± 10.0
N	*Sphagnum macrophyllum*	Sphagnum				S1	2 May Be At Risk	2	63.3 ± 0.0
N	*Sphagnum subfulvum*	a Peatmoss				S1	2 May Be At Risk	4	23.2 ± 0.0
N	*Splachnum pennsylvanicum*	Southern Dung Moss				S1	2 May Be At Risk	1	75.1 ± 0.0
N	*Tomentypnum falcifolium*	Sickle-leaved Golden Moss				S1	2 May Be At Risk	1	63.5 ± 1.0
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1	2 May Be At Risk	2	54.8 ± 1.0
N	*Coscinodon cribrosus*	Sieve-Toothed Moss				S1	2 May Be At Risk	1	88.3 ± 0.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
N	*Peltigera collina*	Tree Pelt Lichen				S1	2 May Be At Risk	1	64.3 ± 10.0
N	*Pohlia filum*	a Moss				S1?	5 Undetermined	2	74.2 ± 3.0
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S1?	5 Undetermined	3	23.2 ± 0.0
N	*Anomobryum filiforme*	a moss				S1?	5 Undetermined	1	94.1 ± 1.0
N	*Platylomella lescurii*	a Moss				S1?	5 Undetermined	1	12.0 ± 1.0
N	*Brachythecium digastrum*	a Moss				S1S2	3 Sensitive	1	94.1 ± 1.0
N	*Bryum pallescens*	Pale Bryum Moss				S1S2	5 Undetermined	2	56.4 ± 1.0
N	*Campylium radicale*	Long-stalked Fine Wet Moss				S1S2	5 Undetermined	1	94.1 ± 1.0
N	*Cynodontium strumiferum*	Strumose Dogtooth Moss				S1S2	3 Sensitive	1	6.0 ± 8.0
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S1S2	3 Sensitive	1	63.5 ± 4.0
N	*Dicranum spurium*	Spurred Broom Moss				S1S2	3 Sensitive	2	14.4 ± 0.0
N	*Anomodon tristis*	a Moss				S1S2	2 May Be At Risk	1	48.9 ± 1.0
N	*Schistostega pennata*	Luminous Moss				S1S2	3 Sensitive	1	94.1 ± 1.0
N	*Sphagnum angermanicum*	a Peatmoss				S1S2	3 Sensitive	2	49.5 ± 1.0
N	*Tortula mucronifolia*	Mucronate Screw Moss				S1S2	3 Sensitive	1	87.6 ± 0.0
N	*Cephaloziella elachista*	Spurred Threadwort				S1S3	6 Not Assessed	1	78.1 ± 5.0
N	*Jungermannia obovata*	Egg Flapwort				S1S3	6 Not Assessed	1	94.8 ± 0.0
N	*Porella pinnata*	Pinnate Scalewort				S1S3	6 Not Assessed	1	30.1 ± 1.0
N	*Reboulia hemisphaerica*	Purple-margined Liverwort				S1S3	6 Not Assessed	1	10.3 ± 1.0
N	*Amphidium mougeotii*	a Moss				S2	3 Sensitive	1	6.0 ± 8.0
N	*Buxbaumia aphylla*	Brown Shield Moss				S2	3 Sensitive	2	6.0 ± 8.0
N	*Campylium polygamum*	a Moss				S2	3 Sensitive	1	48.0 ± 1.0
N	*Cirriphyllum piliferum*	Hair-pointed Moss				S2	3 Sensitive	1	95.9 ± 1.0
N	*Cynodontium tenellum*	Delicate Dogtooth Moss				S2	3 Sensitive	1	54.3 ± 1.0
N	*Hypnum pratense*	Meadow Plait Moss				S2	3 Sensitive	1	81.3 ± 0.0
N	*Orthotrichum speciosum*	Showy Bristle Moss				S2	4 Secure	3	19.4 ± 2.0
N	*Physcomitrium immersum*	a Moss				S2	3 Sensitive	5	94.1 ± 1.0
N	*Physcomitrium pyriforme*	Pear-shaped Urn Moss				S2	3 Sensitive	3	94.1 ± 10.0
N	*Racomitrium fasciculare*	a Moss				S2	3 Sensitive	1	13.0 ± 0.0
N	*Scorpidium scorpioides*	Hooked Scorpion Moss				S2	3 Sensitive	4	78.0 ± 0.0
N	*Sphagnum centrale*	Central Peat Moss				S2	3 Sensitive	1	21.7 ± 0.0
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S2	3 Sensitive	4	54.8 ± 1.0
N	*Taxiphyllum deplanatum*	Imbricate Yew-leaved Moss				S2	3 Sensitive	1	54.3 ± 1.0
N	*Tetraplodon mnioides*	Entire-leaved Nitrogen Moss				S2	3 Sensitive	3	54.3 ± 1.0
N	*Ulota phyllantha*	a Moss				S2	3 Sensitive	1	54.3 ± 1.0
N	*Zygodon viridissimus*	a Moss				S2	2 May Be At Risk	2	9.6 ± 5.0
N	*Schistidium agassizii*	Elf Bloom Moss				S2	3 Sensitive	2	9.6 ± 5.0
N	*Nephroma laevigatum*	Mustard Kidney Lichen				S2	2 May Be At Risk	1	64.3 ± 10.0
N	*Calliergonella cuspidata*	Common Large Wetland Moss				S2S3	3 Sensitive	4	30.0 ± 10.0
N	*Didymodon rigidulus*	Rigid Screw Moss				S2S3	3 Sensitive	1	68.9 ± 8.0
N	*Cephaloziella divaricata*	Common Threadwort				S2S4	6 Not Assessed	2	10.3 ± 1.0
N	*Aulacomnium androgynum*	Little Groove Moss				S3	4 Secure	2	8.3 ± 1.0
N	*Dicranella cerviculata*	a Moss				S3	3 Sensitive	3	20.0 ± 6.0
N	*Dicranum majus*	Greater Broom Moss				S3	4 Secure	4	7.3 ± 15.0
N	*Heterocladium dimorphum*	Dimorphous Tangle Moss				S3	4 Secure	1	19.4 ± 2.0
N	*Hypnum curvifolium*	Curved-leaved Plait Moss				S3	3 Sensitive	1	9.6 ± 5.0
N	*Pleuridium subulatum*	a Moss				S3	3 Sensitive	2	90.9 ± 1.0
N	*Pogonatum dentatum*	Mountain Hair Moss				S3	4 Secure	1	54.3 ± 1.0
N	*Sphagnum torreyanum*	a Peatmoss				S3	4 Secure	4	21.3 ± 1.0
N	*Sphagnum austinii*	Austin's Peat Moss				S3	4 Secure	1	75.8 ± 1.0
N	*Tetraphis geniculata*	Geniculate Four-tooth Moss				S3	4 Secure	4	54.0 ± 0.0
N	*Trichostomum tenuirostre*	Acid-Soil Moss				S3	4 Secure	2	9.6 ± 5.0
N	*Schistidium maritimum*	a Moss				S3	4 Secure	1	54.3 ± 1.0
N	*Rauiella scita*	Smaller Fern Moss				S3	3 Sensitive	1	95.2 ± 3.0
N	*Dicranella rufescens*	Red Forklet Moss				S3?	5 Undetermined	2	74.1 ± 4.0
N	*Sphagnum contortum*	Twisted Peat Moss				S3?	4 Secure	1	95.2 ± 0.0
N	*Sphagnum lescurii*	a Peatmoss				S3?	5 Undetermined	2	21.1 ± 1.0
N	*Atrichum tenellum*	Slender Smoothcap Moss				S3S4	4 Secure	4	20.0 ± 6.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3S4	4 Secure	1	68.9 ± 8.0
N	*Brachythecium campestre*	Field Ragged Moss				S3S4	4 Secure	2	74.2 ± 3.0
N	*Brachythecium velutinum*	Velvet Ragged Moss				S3S4	4 Secure	3	7.3 ± 15.0
N	*Dicranella schreberiana*	Schreber's Forklet Moss				S3S4	4 Secure	1	94.1 ± 1.0
N	*Dicranella subulata*	Awl-leaved Forklet Moss				S3S4	4 Secure	1	72.7 ± 2.0
N	*Distichium capillaceum*	Erect-fruited Iris Moss				S3S4	4 Secure	1	56.6 ± 0.0
N	*Fissidens bryoides*	Lesser Pocket Moss				S3S4	4 Secure	1	66.4 ± 4.0
N	*Hypnum fauriei*	a Moss				S3S4	4 Secure	3	54.3 ± 1.0
N	*Isopterygiopsis muelleriana*	a Moss				S3S4	4 Secure	6	7.3 ± 15.0
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	4 Secure	1	6.0 ± 8.0
N	*Pohlia annotina*	a Moss				S3S4	4 Secure	2	19.4 ± 2.0
N	*Tortula truncata*	a Moss				S3S4	4 Secure	1	89.1 ± 1.0
N	*Racomitrium microcarpon*	a Moss				S3S4	4 Secure	1	10.7 ± 0.0
N	*Sphagnum majus*	Olive Peat Moss				S3S4	4 Secure	1	97.7 ± 5.0
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3S4	4 Secure	1	54.3 ± 1.0
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	4 Secure	1	82.7 ± 3.0
N	*Limprichtia revolvens*	a Moss				S3S4	4 Secure	2	83.5 ± 0.0
N	*Grimmia anodon*	Toothless Grimmia Moss				SH	5 Undetermined	2	89.3 ± 10.0
N	*Leucodon brachypus*	a Moss				SH	2 May Be At Risk	2	18.1 ± 100.0
P	*Juglans cinerea*	Butternut	Endangered	Endangered	Endangered	S1	1 At Risk	72	74.7 ± 1.0
P	*Polemonium vanbruntiae*	Van Brunt's Jacob's-ladder	Threatened	Threatened	Threatened	S1	1 At Risk	72	34.2 ± 1.0
P	*Symphyotrichum anticostense*	Anticosti Aster	Threatened	Threatened	Endangered	S1S3	1 At Risk	4	80.5 ± 0.0
P	*Symphyotrichum praealtum*	Willow-leaved Aster	Threatened	Threatened		SNA	7 Exotic	1	18.1 ± 1.0
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Endangered	S2	1 At Risk	22	61.7 ± 0.0
P	*Pterospora andromedea*	Woodland Pinedrops			Endangered	S1	1 At Risk	14	87.5 ± 1.0
P	*Sanicula trifoliata*	Large-Fruited Sanicle				S1	2 May Be At Risk	2	89.3 ± 0.0
P	*Antennaria parlinii*	a Pussytoes				S1	2 May Be At Risk	2	19.7 ± 0.0
P	*Antennaria howellii ssp. petaloidea*	Pussy-Toes				S1	2 May Be At Risk	4	70.5 ± 1.0
P	*Helianthus decapetalus*	Ten-rayed Sunflower				S1	2 May Be At Risk	20	88.5 ± 1.0
P	*Hieracium kalmii*	Kalm's Hawkweed				S1	2 May Be At Risk	5	53.1 ± 1.0
P	*Hieracium kalmii var. kalmii*	Kalm's Hawkweed				S1	2 May Be At Risk	7	52.4 ± 1.0
P	*Hieracium paniculatum*	Panicled Hawkweed				S1	2 May Be At Risk	2	69.4 ± 1.0
P	*Senecio pseudoarnica*	Seabeach Ragwort				S1	2 May Be At Risk	14	69.3 ± 0.0
P	*Solidago simplex var. monticola*	Sticky Goldenrod				S1	2 May Be At Risk	1	90.2 ± 0.0
P	*Symphyotrichum laeve*	Smooth Aster				S1	5 Undetermined	3	84.3 ± 1.0
P	*Cardamine parviflora var. arenicola*	Small-flowered Bittercress				S1	2 May Be At Risk	9	33.1 ± 1.0
P	*Draba arabisans*	Rock Whitlow-Grass				S1	2 May Be At Risk	6	41.5 ± 0.0
P	*Draba breweri var. cana*	Brewer's Whitlow-grass				S1	2 May Be At Risk	10	98.0 ± 0.0
P	*Draba glabella*	Rock Whitlow-Grass				S1	2 May Be At Risk	7	62.4 ± 1.0
P	*Minuartia groenlandica*	Greenland Stitchwort				S1	2 May Be At Risk	1	68.0 ± 0.0
P	*Chenopodium capitatum*	Strawberry-blite				S1	2 May Be At Risk	2	90.5 ± 1.0
P	*Chenopodium simplex*	Maple-leaved Goosefoot				S1	2 May Be At Risk	10	72.4 ± 1.0
P	*Callitriche terrestris*	Terrestrial Water-Starwort				S1	5 Undetermined	1	22.7 ± 0.0
P	*Triadenum virginicum*	Virginia St John's-wort				S1	2 May Be At Risk	7	69.7 ± 0.0
P	*Viburnum acerifolium*	Maple-leaved Viburnum				S1	2 May Be At Risk	10	15.5 ± 0.0
P	*Drosera anglica*	English Sundew				S1	2 May Be At Risk	1	81.6 ± 0.0
P	*Drosera linearis*	Slender-Leaved Sundew				S1	2 May Be At Risk	1	81.6 ± 0.0
P	*Corema conradii*	Broom Crowberry				S1	2 May Be At Risk	1	88.5 ± 10.0
P	*Vaccinium boreale*	Northern Blueberry				S1	2 May Be At Risk	1	50.8 ± 0.0
P	*Vaccinium corymbosum*	Highbush Blueberry				S1	3 Sensitive	9	11.0 ± 5.0
P	*Chamaesyce polygonifolia*	Seaside Spurge				S1	2 May Be At Risk	8	68.6 ± 0.0
P	*Desmodium glutinosum*	Large Tick-Trefoil				S1	2 May Be At Risk	1	17.0 ± 1.0
P	*Gentiana rubricaulis*	Purple-stemmed Gentian				S1	2 May Be At Risk	14	4.7 ± 1.0
P	*Lomatogonium rotatum*	Marsh Felwort				S1	2 May Be At Risk	2	47.8 ± 0.0
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S1	2 May Be At Risk	1	48.7 ± 0.0
P	*Decodon verticillatus*	Swamp Loosestrife				S1	2 May Be At Risk	3	79.2 ± 0.0
P	*Polygala verticillata var. verticillata*	Whorled Milkwort				S1	5 Undetermined	2	93.0 ± 0.0
P	*Lysimachia hybrida*	Lowland Yellow Loosestrife				S1	2 May Be At Risk	15	12.0 ± 0.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Lysimachia quadrifolia*	Whorled Yellow Loosestrife				S1	2 May Be At Risk	10	66.6 ± 1.0
P	*Ranunculus sceleratus*	Cursed Buttercup				S1	2 May Be At Risk	6	8.6 ± 1.0
P	*Crataegus jonesiae*	Jones' Hawthorn				S1	2 May Be At Risk	5	17.8 ± 1.0
P	*Waldsteinia fragarioides*	Barren Strawberry				S1	2 May Be At Risk	27	84.4 ± 0.0
P	*Galium brevipes*	Limestone Swamp Bedstraw				S1	2 May Be At Risk	3	36.7 ± 5.0
P	*Saxifraga paniculata ssp. neogaea*	White Mountain Saxifrage				S1	2 May Be At Risk	7	94.7 ± 10.0
P	*Agalinis paupercula var. borealis*	Small-flowered Agalinis				S1	2 May Be At Risk	5	92.9 ± 10.0
P	*Agalinis tenuifolia*	Slender Agalinis				S1	2 May Be At Risk	6	92.3 ± 0.0
P	*Gratiola aurea*	Golden Hedge-Hyssop				S1	3 Sensitive	2	69.5 ± 5.0
P	*Pedicularis canadensis*	Canada Lousewort				S1	2 May Be At Risk	20	15.8 ± 0.0
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S1	2 May Be At Risk	12	55.6 ± 0.0
P	*Alisma subcordatum*	Southern Water Plantain				S1	5 Undetermined	6	48.4 ± 0.0
P	*Carex backii*	Rocky Mountain Sedge				S1	2 May Be At Risk	5	97.7 ± 1.0
P	*Carex cephaloidea*	Thin-leaved Sedge				S1	2 May Be At Risk	4	79.3 ± 0.0
P	*Carex merritt-fernaldii*	Merritt Fernald's Sedge				S1	2 May Be At Risk	2	13.4 ± 0.0
P	*Carex saxatilis*	Russet Sedge				S1	2 May Be At Risk	7	86.9 ± 10.0
P	*Carex sterilis*	Sterile Sedge				S1	2 May Be At Risk	1	86.6 ± 0.0
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	2 May Be At Risk	1	90.9 ± 1.0
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	7	88.9 ± 0.0
P	*Eleocharis olivacea*	Yellow Spikerush				S1	2 May Be At Risk	3	10.0 ± 1.0
P	*Rhynchospora capillacea*	Slender Beakrush				S1	2 May Be At Risk	3	87.9 ± 0.0
P	*Sisyrinchium angustifolium*	Narrow-leaved Blue-eyed-grass				S1	2 May Be At Risk	3	86.0 ± 0.0
P	*Juncus greenei*	Greene's Rush				S1	2 May Be At Risk	1	43.1 ± 0.0
P	*Allium canadense*	Canada Garlic				S1	2 May Be At Risk	10	81.7 ± 5.0
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S1	2 May Be At Risk	1	92.6 ± 0.0
P	*Malaxis brachypoda*	White Adder's-Mouth				S1	2 May Be At Risk	5	44.3 ± 5.0
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S1	2 May Be At Risk	13	30.4 ± 0.0
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S1	2 May Be At Risk	2	92.0 ± 1.0
P	*Spiranthes casei*	Case's Ladies'-Tresses				S1	2 May Be At Risk	6	92.3 ± 0.0
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S1	2 May Be At Risk	9	32.7 ± 5.0
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S1	2 May Be At Risk	17	7.6 ± 0.0
P	*Danthonia compressa*	Flattened Oat Grass				S1	2 May Be At Risk	2	70.3 ± 0.0
P	*Dichanthelium dichotomum*	Forked Panic Grass				S1	2 May Be At Risk	18	7.1 ± 0.0
P	*Elymus wiegandii*	Wiegand's Wild Rye				S1	2 May Be At Risk	1	88.2 ± 0.0
P	*Elymus hystrix var. bigeloviana*	Spreading Wild Rye				S1	2 May Be At Risk	18	85.0 ± 0.0
P	*Glyceria obtusa*	Atlantic Manna Grass				S1	2 May Be At Risk	6	6.5 ± 10.0
P	*Sporobolus compositus*	Rough Dropseed				S1	2 May Be At Risk	17	86.1 ± 0.0
P	*Potamogeton friesii*	Fries' Pondweed				S1	2 May Be At Risk	6	78.4 ± 5.0
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	2 May Be At Risk	4	91.5 ± 1.0
P	*Potamogeton strictifolius*	Straight-leaved Pondweed				S1	2 May Be At Risk	1	99.5 ± 0.0
P	*Xyris difformis*	Bog Yellow-eyed-grass				S1	5 Undetermined	3	84.0 ± 0.0
P	*Asplenium ruta-muraria var. cryptolepis*	Wallrue Spleenwort				S1	2 May Be At Risk	3	94.2 ± 0.0
P	*Botrychium oneidense*	Blunt-lobed Moonwort				S1	2 May Be At Risk	3	70.2 ± 0.0
P	*Botrychium rugulosum*	Rugulose Moonwort				S1	2 May Be At Risk	1	28.3 ± 1.0
P	*Schizaea pusilla*	Little Curlygrass Fern				S1	2 May Be At Risk	16	65.8 ± 0.0
P	*Hieracium kalmii var. fasciculatum*	Kalm's Hawkweed				S1?	5 Undetermined	6	18.9 ± 0.0
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S1?	2 May Be At Risk	2	87.8 ± 1.0
P	*Drosera rotundifolia var. comosa*	Round-leaved Sundew				S1?	5 Undetermined	5	47.1 ± 1.0
P	*Wolffia columbiana*	Columbian Watermeal				S1?	2 May Be At Risk	3	91.5 ± 0.0
P	*Humulus lupulus var. lupuloides*	Common Hop				S1S2	3 Sensitive	5	88.0 ± 0.0
P	*Rumex aquaticus var. fenestratus*	Western Dock				S1S2	2 May Be At Risk	1	84.7 ± 1.0
P	*Saxifraga virginiensis*	Early Saxifrage				S1S2	2 May Be At Risk	14	82.1 ± 0.0
P	*Carex rostrata*	Narrow-leaved Beaked Sedge				S1S2	3 Sensitive	1	58.9 ± 0.0
P	*Potamogeton bicupulatus*	Snailseed Pondweed				S1S2	2 May Be At Risk	5	45.7 ± 0.0
P	*Selaginella rupestris*	Rock Spikemoss				S1S2	2 May Be At Risk	7	86.3 ± 0.0
P	*Listera australis*	Southern Twayblade			Endangered	S2	1 At Risk	11	61.6 ± 0.0
P	*Sanicula odorata*	Clustered Sanicle				S2	2 May Be At Risk	4	88.9 ± 0.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Pseudognaphalium macounii*	Macoun's Cudweed				S2	3 Sensitive	10	24.5 ± 0.0
P	*Solidago altissima*	Tall Goldenrod				S2	4 Secure	5	43.0 ± 0.0
P	*Solidago simplex var. racemosa*	Sticky Goldenrod				S2	2 May Be At Risk	8	85.6 ± 1.0
P	*Solidago simplex ssp. randii*	Sticky Goldenrod				S2	2 May Be At Risk	2	90.0 ± 0.0
P	*Solidago simplex*	Sticky Goldenrod				S2	2 May Be At Risk	2	89.7 ± 1.0
P	*Ionactis linariifolius*	Stiff Aster				S2	3 Sensitive	1	95.2 ± 0.0
P	*Symphyotrichum racemosum*	Small White Aster				S2	3 Sensitive	5	47.7 ± 1.0
P	*Alnus serrulata*	Smooth Alder				S2	3 Sensitive	55	14.2 ± 0.0
P	*Arabis drummondii*	Drummond's Rockcress				S2	3 Sensitive	8	86.2 ± 0.0
P	*Cardamine concatenata*	Cut-leaved Toothwort				S2	2 May Be At Risk	1	77.1 ± 1.0
P	*Sagina nodosa*	Knotted Pearlwort				S2	3 Sensitive	7	36.4 ± 0.0
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S2	3 Sensitive	1	74.8 ± 0.0
P	*Stellaria longifolia*	Long-leaved Starwort				S2	3 Sensitive	4	87.8 ± 10.0
P	*Atriplex franktonii*	Frankton's Saltbush				S2	4 Secure	1	18.1 ± 1.0
P	*Chenopodium rubrum*	Red Pigweed				S2	3 Sensitive	4	84.1 ± 0.0
P	*Callitriche hermaphroditica*	Northern Water-starwort				S2	4 Secure	2	12.8 ± 0.0
P	*Hypericum dissimulatum*	Disguised St John's-wort				S2	3 Sensitive	6	37.6 ± 1.0
P	*Lonicera oblongifolia*	Swamp Fly Honeysuckle				S2	3 Sensitive	38	20.2 ± 0.0
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S2	3 Sensitive	14	79.9 ± 1.0
P	*Viburnum lentago*	Nannyberry				S2	4 Secure	101	10.7 ± 0.0
P	*Viburnum recognitum*	Northern Arrow-Wood				S2	4 Secure	168	8.9 ± 0.0
P	*Astragalus eucosmus*	Elegant Milk-vetch				S2	2 May Be At Risk	7	78.3 ± 1.0
P	*Oxytropis campestris var. johannensis*	Field Locoweed				S2	3 Sensitive	8	79.3 ± 1.0
P	*Quercus macrocarpa*	Bur Oak				S2	2 May Be At Risk	6	17.8 ± 1.0
P	*Gentiana linearis*	Narrow-Leaved Gentian				S2	3 Sensitive	5	94.2 ± 5.0
P	*Myriophyllum humile*	Low Water Milfoil				S2	3 Sensitive	9	42.4 ± 0.0
P	*Hedeoma pulegioides*	American False Pennyroyal				S2	4 Secure	17	2.2 ± 2.0
P	*Nuphar lutea ssp. rubrodisca*	Red-disked Yellow Pond-lily				S2	3 Sensitive	7	19.9 ± 0.0
P	*Orobanche uniflora*	One-Flowered Broomrape				S2	3 Sensitive	12	56.4 ± 0.0
P	*Polygala paucifolia*	Fringed Milkwort				S2	3 Sensitive	11	6.8 ± 5.0
P	*Polygala sanguinea*	Blood Milkwort				S2	3 Sensitive	12	73.1 ± 0.0
P	*Polygala senega*	Seneca Snakeroot				S2	3 Sensitive	5	80.0 ± 1.0
P	*Polygonum amphibium var. emersum*	Water Smartweed				S2	3 Sensitive	6	29.8 ± 0.0
P	*Polygonum careyi*	Carey's Smartweed				S2	3 Sensitive	6	3.1 ± 1.0
P	*Podostemum ceratophyllum*	Horn-leaved Riverweed				S2	3 Sensitive	45	12.5 ± 0.0
P	*Anemone multifida*	Cut-leaved Anemone				S2	3 Sensitive	1	86.8 ± 0.0
P	*Hepatica nobilis var. obtusa*	Round-lobed Hepatica				S2	3 Sensitive	33	7.0 ± 0.0
P	*Ranunculus flabellaris*	Yellow Water Buttercup				S2	4 Secure	8	16.2 ± 0.0
P	*Ranunculus longirostris*	Eastern White Water-Crowfoot				S2	5 Undetermined	4	16.8 ± 1.0
P	*Crataegus scabrida*	Rough Hawthorn				S2	3 Sensitive	2	93.6 ± 0.0
P	*Crataegus succulenta*	Fleshy Hawthorn				S2	3 Sensitive	1	94.1 ± 5.0
P	*Cephalanthus occidentalis*	Common Buttonbush				S2	3 Sensitive	47	9.5 ± 0.0
P	*Salix candida*	Sage Willow				S2	3 Sensitive	2	74.6 ± 1.0
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S2	3 Sensitive	13	57.6 ± 1.0
P	*Euphrasia randii*	Rand's Eyebright				S2	2 May Be At Risk	23	33.0 ± 0.0
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S2	3 Sensitive	3	78.1 ± 100.0
P	*Dirca palustris*	Eastern Leatherwood				S2	2 May Be At Risk	7	86.6 ± 1.0
P	*Phryma leptostachya*	American Lopseed				S2	3 Sensitive	7	86.4 ± 0.0
P	*Verbena urticifolia*	White Vervain				S2	2 May Be At Risk	14	79.3 ± 1.0
P	*Viola novae-angliae*	New England Violet				S2	3 Sensitive	4	33.2 ± 1.0
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S2	3 Sensitive	43	14.9 ± 0.0
P	*Carex granularis*	Limestone Meadow Sedge				S2	3 Sensitive	7	71.8 ± 0.0
P	*Carex gynocrates*	Northern Bog Sedge				S2	3 Sensitive	10	22.2 ± 0.0
P	*Carex hirtifolia*	Pubescent Sedge				S2	3 Sensitive	23	83.2 ± 0.0
P	*Carex livida var. radicaulis*	Livid Sedge				S2	3 Sensitive	1	88.2 ± 2.0
P	*Carex prairea*	Prairie Sedge				S2	3 Sensitive	1	88.3 ± 0.0
P	*Carex salina*	Saltmarsh Sedge				S2	3 Sensitive	2	86.5 ± 1.0
P	*Carex sprengelii*	Longbeak Sedge				S2	3 Sensitive	12	86.6 ± 0.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S2	2 May Be At Risk	8	31.5 ± 0.0
P	*Carex albicans var. emmonsii*	White-tinged Sedge				S2	3 Sensitive	1	96.4 ± 0.0
P	*Carex vacillans*	Estuarine Sedge				S2	3 Sensitive	4	13.4 ± 10.0
P	*Cyperus squarrosus*	Awned Flatsedge				S2	3 Sensitive	2	92.3 ± 10.0
P	*Blysmus rufus*	Red Bulrush				S2	3 Sensitive	3	65.1 ± 0.0
P	*Elodea nuttallii*	Nuttall's Waterweed				S2	3 Sensitive	8	14.9 ± 0.0
P	*Lemna trisulca*	Star Duckweed				S2	4 Secure	1	97.1 ± 1.0
P	*Allium tricoccum*	Wild Leek				S2	2 May Be At Risk	6	89.0 ± 0.0
P	*Najas gracillima*	Thread-Like Naiad				S2	3 Sensitive	8	8.0 ± 0.0
P	*Calypso bulbosa var. americana*	Calypso				S2	2 May Be At Risk	3	92.0 ± 1.0
P	*Coeloglossum viride var. virescens*	Long-bracted Frog Orchid				S2	2 May Be At Risk	3	80.6 ± 5.0
P	*Cypripedium parviflorum var. makasin*	Small Yellow Lady's-Slipper				S2	2 May Be At Risk	6	19.6 ± 1.0
P	*Galearis spectabilis*	Showy Orchis				S2	2 May Be At Risk	4	88.5 ± 0.0
P	*Spiranthes cernua*	Nodding Ladies'-Tresses				S2	3 Sensitive	14	10.9 ± 0.0
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	3 Sensitive	8	61.9 ± 1.0
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	3 Sensitive	10	7.0 ± 0.0
P	*Elymus canadensis*	Canada Wild Rye				S2	2 May Be At Risk	15	83.8 ± 1.0
P	*Leersia virginica*	White Cut Grass				S2	2 May Be At Risk	13	84.8 ± 10.0
P	*Piptatherum canadense*	Canada Rice Grass				S2	3 Sensitive	5	40.5 ± 0.0
P	*Puccinellia phryganodes*	Creeping Alkali Grass				S2	3 Sensitive	15	5.8 ± 10.0
P	*Schizachyrium scoparium*	Little Bluestem				S2	3 Sensitive	17	79.6 ± 0.0
P	*Zizania aquatica var. aquatica*	Indian Wild Rice				S2	5 Undetermined	2	80.2 ± 0.0
P	*Stuckenia filiformis ssp. alpina*	Thread-leaved Pondweed				S2	3 Sensitive	6	88.2 ± 0.0
P	*Potamogeton richardsonii*	Richardson's Pondweed				S2	3 Sensitive	5	88.2 ± 1.0
P	*Potamogeton vaseyi*	Vasey's Pondweed				S2	3 Sensitive	10	39.3 ± 0.0
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S2	3 Sensitive	7	74.6 ± 0.0
P	*Woodwardia virginica*	Virginia Chain Fern				S2	3 Sensitive	19	50.7 ± 1.0
P	*Woodsia alpina*	Alpine Cliff Fern				S2	3 Sensitive	5	94.7 ± 0.0
P	*Selaginella selaginoides*	Low Spikemoss				S2	3 Sensitive	4	63.8 ± 0.0
P	*Toxicodendron radicans*	Poison Ivy				S2?	3 Sensitive	6	90.1 ± 1.0
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2?	3 Sensitive	3	17.6 ± 0.0
P	*Symphyotrichum novi-belgii var. crenifolium*	New York Aster				S2?	5 Undetermined	9	33.1 ± 0.0
P	*Proserpinaca palustris var. crebra*	Marsh Mermaidweed				S2?	3 Sensitive	21	12.1 ± 0.0
P	*Epilobium coloratum*	Purple-veined Willowherb				S2?	3 Sensitive	9	38.9 ± 1.0
P	*Rubus pensilvanicus*	Pennsylvania Blackberry				S2?	4 Secure	7	16.9 ± 3.0
P	*Rubus recurvicaulis*	Arching Dewberry				S2?	4 Secure	2	62.2 ± 1.0
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2?	4 Secure	2	89.1 ± 1.0
P	*Salix myricoides*	Bayberry Willow				S2?	3 Sensitive	9	31.6 ± 0.0
P	*Platanthera huronensis*	Fragrant Green Orchid				S2?	5 Undetermined	2	23.7 ± 1.0
P	*Eragrostis pectinacea*	Tufted Love Grass				S2?	4 Secure	13	6.1 ± 1.0
P	*Ceratophyllum echinatum*	Prickly Hornwort				S2S3	3 Sensitive	10	10.2 ± 0.0
P	*Elatine americana*	American Waterwort				S2S3	3 Sensitive	2	23.2 ± 0.0
P	*Bartonia paniculata*	Branched Bartonia				S2S3	3 Sensitive	4	66.0 ± 0.0
P	*Bartonia paniculata ssp. iodandra*	Branched Bartonia				S2S3	3 Sensitive	14	54.7 ± 1.0
P	*Geranium robertianum*	Herb Robert				S2S3	4 Secure	9	18.4 ± 5.0
P	*Myriophyllum quitense*	Andean Water Milfoil				S2S3	4 Secure	37	78.6 ± 0.0
P	*Rumex pallidus*	Seabeach Dock				S2S3	3 Sensitive	5	35.6 ± 0.0
P	*Galium labradoricum*	Labrador Bedstraw				S2S3	3 Sensitive	24	13.6 ± 0.0
P	*Valeriana uliginosa*	Swamp Valerian				S2S3	3 Sensitive	14	6.6 ± 1.0
P	*Carex adusta*	Lesser Brown Sedge				S2S3	4 Secure	2	67.8 ± 10.0
P	*Carex plantaginea*	Plantain-Leaved Sedge				S2S3	3 Sensitive	3	78.4 ± 1.0
P	*Juncus brachycephalus*	Small-Head Rush				S2S3	3 Sensitive	1	85.6 ± 0.0
P	*Corallorhiza maculata var. occidentalis*	Spotted Coralroot				S2S3	3 Sensitive	6	13.4 ± 0.0
P	*Corallorhiza maculata var. maculata*	Spotted Coralroot				S2S3	3 Sensitive	2	92.0 ± 1.0
P	*Listera auriculata*	Auricled Twayblade				S2S3	3 Sensitive	9	29.5 ± 0.0
P	*Potamogeton praelongus*	White-stemmed Pondweed				S2S3	4 Secure	12	16.4 ± 0.0
P	*Isoetes acadiensis*	Acadian Quillwort				S2S3	3 Sensitive	10	11.3 ± 1.0

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P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	3 Sensitive	6	33.5 ± 1.0
P	*Panax trifolius*	Dwarf Ginseng				S3	3 Sensitive	6	76.9 ± 0.0
P	*Artemisia campestris*	Field Wormwood				S3	4 Secure	2	89.7 ± 1.0
P	*Artemisia campestris ssp. caudata*	Field Wormwood				S3	4 Secure	5	68.8 ± 0.0
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3	4 Secure	5	58.1 ± 0.0
P	*Prenanthes racemosa*	Glaucous Rattlesnakeroot				S3	4 Secure	32	76.0 ± 0.0
P	*Tanacetum bipinnatum ssp. huronense*	Lake Huron Tansy				S3	4 Secure	14	79.3 ± 1.0
P	*Symphyotrichum boreale*	Boreal Aster				S3	3 Sensitive	42	6.4 ± 0.0
P	*Betula pumila*	Bog Birch				S3	4 Secure	31	25.2 ± 0.0
P	*Arabis glabra*	Tower Mustard				S3	5 Undetermined	3	79.6 ± 1.0
P	*Arabis hirsuta var. pycnocarpa*	Western Hairy Rockcress				S3	4 Secure	10	87.3 ± 1.0
P	*Cardamine maxima*	Large Toothwort				S3	4 Secure	16	84.5 ± 0.0
P	*Subularia aquatica var. americana*	Water Awlwort				S3	4 Secure	18	16.4 ± 0.0
P	*Lobelia cardinalis*	Cardinal Flower				S3	4 Secure	378	6.4 ± 0.0
P	*Stellaria humifusa*	Saltmarsh Starwort				S3	4 Secure	6	18.8 ± 5.0
P	*Hudsonia tomentosa*	Woolly Beach-heath				S3	4 Secure	3	63.2 ± 0.0
P	*Cornus amomum ssp. obliqua*	Pale Dogwood				S3	3 Sensitive	195	7.3 ± 0.0
P	*Crassula aquatica*	Water Pygmyweed				S3	4 Secure	7	69.2 ± 0.0
P	*Rhodiola rosea*	Roseroot				S3	4 Secure	34	27.2 ± 1.0
P	*Penthorum sedoides*	Ditch Stonecrop				S3	4 Secure	29	9.7 ± 0.0
P	*Elatine minima*	Small Waterwort				S3	4 Secure	54	10.1 ± 0.0
P	*Astragalus alpinus var. brunetianus*	Alpine Milk-Vetch				S3	4 Secure	4	77.1 ± 0.0
P	*Gentianella amarella ssp. acuta*	Northern Gentian				S3	4 Secure	7	67.7 ± 0.0
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	4 Secure	4	9.5 ± 1.0
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S3	4 Secure	19	30.5 ± 0.0
P	*Myriophyllum heterophyllum*	Variable-leaved Water Milfoil				S3	4 Secure	7	76.0 ± 0.0
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	4 Secure	8	20.8 ± 0.0
P	*Myriophyllum sibiricum*	Siberian Water Milfoil				S3	4 Secure	10	13.9 ± 1.0
P	*Stachys tenuifolia*	Smooth Hedge-Nettle				S3	3 Sensitive	8	87.2 ± 0.0
P	*Teucrium canadense*	Canada Germander				S3	3 Sensitive	2	69.6 ± 1.0
P	*Utricularia radiata*	Little Floating Bladderwort				S3	4 Secure	52	12.6 ± 0.0
P	*Nuphar lutea ssp. pumila*	Small Yellow Pond-lily				S3	4 Secure	4	88.2 ± 0.0
P	*Epilobium hornemannii*	Hornemann's Willowherb				S3	4 Secure	3	58.1 ± 0.0
P	*Epilobium strictum*	Downy Willowherb				S3	4 Secure	20	15.9 ± 0.0
P	*Polygonum arifolium*	Halberd-leaved Tearthumb				S3	4 Secure	11	10.5 ± 0.0
P	*Polygonum punctatum*	Dotted Smartweed				S3	4 Secure	1	62.4 ± 0.0
P	*Polygonum punctatum var. confertiflorum*	Dotted Smartweed				S3	4 Secure	16	7.8 ± 0.0
P	*Polygonum scandens*	Climbing False Buckwheat				S3	4 Secure	14	12.6 ± 0.0
P	*Littorella uniflora*	American Shoreweed				S3	4 Secure	24	16.8 ± 1.0
P	*Primula mistassinica*	Mistassini Primrose				S3	4 Secure	8	62.6 ± 0.0
P	*Pyrola minor*	Lesser Pyrola				S3	4 Secure	1	59.3 ± 0.0
P	*Clematis occidentalis*	Purple Clematis				S3	4 Secure	23	7.1 ± 0.0
P	*Ranunculus gmelinii*	Gmelin's Water Buttercup				S3	4 Secure	13	83.5 ± 0.0
P	*Thalictrum venulosum*	Northern Meadow-rue				S3	4 Secure	29	19.1 ± 0.0
P	*Agrimonia gryposepala*	Hooked Agrimony				S3	4 Secure	29	15.6 ± 0.0
P	*Amelanchier canadensis*	Canada Serviceberry				S3	4 Secure	12	1.7 ± 1.0
P	*Rosa palustris*	Swamp Rose				S3	4 Secure	38	10.0 ± 1.0
P	*Rubus chamaemorus*	Cloudberry				S3	4 Secure	51	33.0 ± 1.0
P	*Rubus occidentalis*	Black Raspberry				S3	4 Secure	18	42.9 ± 0.0
P	*Salix interior*	Sandbar Willow				S3	4 Secure	22	86.5 ± 1.0
P	*Salix nigra*	Black Willow				S3	3 Sensitive	12	66.2 ± 0.0
P	*Salix pedicellaris*	Bog Willow				S3	4 Secure	33	13.4 ± 5.0
P	*Geocaulon lividum*	Northern Comandra				S3	4 Secure	9	47.2 ± 0.0
P	*Parnassia glauca*	Fen Grass-of-Parnassus				S3	4 Secure	1	77.4 ± 10.0
P	*Limosella australis*	Southern Mudwort				S3	4 Secure	10	7.3 ± 5.0
P	*Veronica serpyllifolia ssp. humifusa*	Thyme-Leaved Speedwell				S3	4 Secure	2	81.7 ± 10.0
P	*Boehmeria cylindrica*	Small-spike False-nettle				S3	3 Sensitive	135	7.7 ± 0.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Pilea pumila*	Dwarf Clearweed				S3	4 Secure	9	77.6 ± 5.0
P	*Viola adunca*	Hooked Violet				S3	4 Secure	4	28.0 ± 1.0
P	*Viola nephrophylla*	Northern Bog Violet				S3	4 Secure	8	84.3 ± 0.0
P	*Carex arcta*	Northern Clustered Sedge				S3	4 Secure	14	23.5 ± 0.0
P	*Carex atratiformis*	Scabrous Black Sedge				S3	4 Secure	1	88.2 ± 0.0
P	*Carex capillaris*	Hairlike Sedge				S3	4 Secure	2	88.2 ± 2.0
P	*Carex chordorrhiza*	Creeping Sedge				S3	4 Secure	10	24.2 ± 0.0
P	*Carex conoidea*	Field Sedge				S3	4 Secure	14	8.1 ± 0.0
P	*Carex exilis*	Coastal Sedge				S3	4 Secure	88	48.1 ± 0.0
P	*Carex garberi*	Garber's Sedge				S3	3 Sensitive	1	61.6 ± 1.0
P	*Carex haydenii*	Hayden's Sedge				S3	4 Secure	13	19.1 ± 1.0
P	*Carex lupulina*	Hop Sedge				S3	4 Secure	50	8.1 ± 1.0
P	*Carex michauxiana*	Michaux's Sedge				S3	4 Secure	53	10.1 ± 0.0
P	*Carex ormostachya*	Necklace Spike Sedge				S3	4 Secure	7	24.7 ± 0.0
P	*Carex rosea*	Rosy Sedge				S3	4 Secure	10	81.1 ± 1.0
P	*Carex tenera*	Tender Sedge				S3	4 Secure	15	15.4 ± 0.0
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	4 Secure	22	10.2 ± 0.0
P	*Carex vaginata*	Sheathed Sedge				S3	3 Sensitive	10	9.3 ± 6.0
P	*Carex wiegandii*	Wiegand's Sedge				S3	4 Secure	32	31.1 ± 0.0
P	*Carex recta*	Estuary Sedge				S3	4 Secure	6	13.4 ± 0.0
P	*Cyperus dentatus*	Toothed Flatsedge				S3	4 Secure	35	8.6 ± 0.0
P	*Cyperus esculentus*	Perennial Yellow Nutsedge				S3	4 Secure	10	83.6 ± 1.0
P	*Eleocharis intermedia*	Matted Spikerush				S3	4 Secure	3	20.6 ± 0.0
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S3	4 Secure	4	78.3 ± 1.0
P	*Eriophorum chamissonis*	Russet Cotton-Grass				S3	4 Secure	1	79.5 ± 1.0
P	*Rhynchospora capitellata*	Small-headed Beakrush				S3	4 Secure	7	62.9 ± 0.0
P	*Rhynchospora fusca*	Brown Beakrush				S3	4 Secure	36	10.1 ± 1.0
P	*Trichophorum clintonii*	Clinton's Clubrush				S3	4 Secure	14	14.7 ± 10.0
P	*Schoenoplectus fluviatilis*	River Bulrush				S3	3 Sensitive	15	76.9 ± 1.0
P	*Schoenoplectus torreyi*	Torrey's Bulrush				S3	4 Secure	19	21.1 ± 0.0
P	*Triglochin gaspensis*	Gasp├⌐ Arrowgrass				S3	4 Secure	13	13.4 ± 1.0
P	*Triantha glutinosa*	Sticky False-Asphodel				S3	4 Secure	6	76.6 ± 5.0
P	*Cypripedium reginae*	Showy Lady's-Slipper				S3	3 Sensitive	27	20.0 ± 1.0
P	*Liparis loeselii*	Loesel's Twayblade				S3	4 Secure	20	16.1 ± 0.0
P	*Platanthera blephariglottis*	White Fringed Orchid				S3	4 Secure	16	16.1 ± 1.0
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	3 Sensitive	31	7.5 ± 0.0
P	*Bromus latiglumis*	Broad-Glumed Brome				S3	3 Sensitive	2	66.1 ± 0.0
P	*Calamagrostis pickeringii*	Pickering's Reed Grass				S3	4 Secure	103	48.1 ± 0.0
P	*Dichanthelium depauperatum*	Starved Panic Grass				S3	4 Secure	2	66.7 ± 0.0
P	*Muhlenbergia richardsonis*	Mat Muhly				S3	4 Secure	9	87.7 ± 0.0
P	*Heteranthera dubia*	Water Stargrass				S3	4 Secure	28	84.0 ± 0.0
P	*Potamogeton obtusifolius*	Blunt-leaved Pondweed				S3	4 Secure	19	9.4 ± 0.0
P	*Xyris montana*	Northern Yellow-Eyed-Grass				S3	4 Secure	25	6.8 ± 6.0
P	*Zannichellia palustris*	Horned Pondweed				S3	4 Secure	5	79.3 ± 0.0
P	*Adiantum pedatum*	Northern Maidenhair Fern				S3	4 Secure	13	72.0 ± 0.0
P	*Asplenium trichomanes-ramosum*	Green Spleenwort				S3	4 Secure	14	80.7 ± 1.0
P	*Dryopteris fragrans var. remotiuscula*	Fragrant Wood Fern				S3	4 Secure	3	84.2 ± 0.0
P	*Dryopteris goldiana*	Goldie's Woodfern				S3	3 Sensitive	16	72.0 ± 0.0
P	*Equisetum palustre*	Marsh Horsetail				S3	4 Secure	6	89.1 ± 0.0
P	*Isoetes tuckermanii*	Tuckerman's Quillwort				S3	4 Secure	17	11.3 ± 1.0
P	*Lycopodium sabinifolium*	Ground-Fir				S3	4 Secure	5	21.1 ± 1.0
P	*Huperzia appalachiana*	Appalachian Fir-Clubmoss				S3	3 Sensitive	1	89.3 ± 1.0
P	*Botrychium dissectum*	Cut-leaved Moonwort				S3	4 Secure	17	31.2 ± 5.0
P	*Botrychium lanceolatum var. angustisegmentum*	Lance-Leaf Grape-Fern				S3	3 Sensitive	13	48.9 ± 0.0
P	*Botrychium simplex*	Least Moonwort				S3	4 Secure	10	31.2 ± 0.0
P	*Polypodium appalachianum*	Appalachian Polypody				S3	4 Secure	18	29.3 ± 0.0
P	*Utricularia resupinata*	Inverted Bladderwort				S3?	4 Secure	16	42.5 ± 0.0

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Crataegus submollis*	Quebec Hawthorn				S3?	3 Sensitive	11	9.8 ± 1.0
P	*Lobelia kalmii*	Brook Lobelia				S3S4	4 Secure	21	18.9 ± 0.0
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	4 Secure	4	18.4 ± 5.0
P	*Utricularia gibba*	Humped Bladderwort				S3S4	4 Secure	37	12.6 ± 0.0
P	*Rumex maritimus*	Sea-Side Dock				S3S4	4 Secure	2	30.2 ± 1.0
P	*Potentilla arguta*	Tall Cinquefoil				S3S4	4 Secure	36	28.0 ± 1.0
P	*Cladium mariscoides*	Smooth Twigrush				S3S4	4 Secure	43	10.1 ± 0.0
P	*Spirodela polyrrhiza*	Great Duckweed				S3S4	4 Secure	12	12.9 ± 0.0
P	*Corallorhiza maculata*	Spotted Coralroot				S3S4	3 Sensitive	6	30.7 ± 0.0
P	*Potamogeton oakesianus*	Oakes' Pondweed				S3S4	4 Secure	36	9.3 ± 0.0
P	*Stuckenia pectinata*	Sago Pondweed				S3S4	4 Secure	55	12.8 ± 0.0
P	*Montia fontana*	Water Blinks				SH	2 May Be At Risk	1	46.8 ± 1.0
P	*Solidago caesia*	Blue-stemmed Goldenrod				SX	0.1 Extirpated	2	90.5 ± 1.0
P	*Celastrus scandens*	Climbing Bittersweet				SX	0.1 Extirpated	3	78.0 ± 100.0
P	*Carex swanii*	Swan's Sedge				SX	0.1 Extirpated	2	70.7 ± 1.0

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the ACCDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
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