

**APPENDIX E**

**FECAL COLIFORM SAMPLING QUALITY  
ASSURANCE AND QUALITY CONTROL  
PROGRAM  
2010**

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## APPENDIX E

### FECAL COLIFORM SAMPLING QUALITY ASSURANCE AND QUALITY CONTROL PROGRAM FOR 2010

#### 1.0 INTRODUCTION

Quality Assurance and Quality Control (QA/QC) programs are a set of protocols adopted to ensure that results of any study are valid, internally consistent and comparable with similar projects. These protocols are set out in writing and based on current and relevant research on related topics. This appendix discusses:

- field sampling methods
- sample handling procedures
- analytical procedures
- field and laboratory replication (quality control)
- data assessment

Data collected for the quality assurance program are used to ensure consistency in field handling and analytical methods. If data exceed a specified precision criterion then the lab is notified of a potential problem in the procedure and steps are taken to resolve the issue. The QA protocols presented in this appendix are based on two Capital Regional District (CRD) memorandums (Drinnan, 1995; Hutcheson, 1995).

#### 2.0 METHODS FOR FECAL COLIFORM SAMPLING

All water samples were collected in 250 mL wide-mouth polypropylene bottles supplied by the analytical laboratories (MB Laboratories Ltd. in Victoria). Bottles supplied by MB Laboratories Ltd. were washed, rinsed and autoclaved after each use and re-supplied to the CRD as needed. Labelled samples were stored in an insulated cooler with ice packs for protection from prolonged exposure to UV light and delivered the same day to the laboratory. Fecal coliform bacteria were analyzed following the procedures in Standard Methods (APHA, 1998) and reported as colony forming units per 100 mL (CFU/100 mL). However, to assist the reader the more commonly used reporting of fecal coliform per 100 milliliters (FC/100 mL) is used in this survey.

##### 2.1 Stormwater Discharge Sampling

Where possible, stormwater samples were collected from the point of discharge. Where this was not possible, the stormwater system was followed back to the nearest point where samples could be taken. A five metre inflatable boat was used to visit discharges located in areas difficult to access from the shore.

##### 2.2 Quality Assurance

###### 2.2.1 Stormwater Sample Replicates (Field Splits)

Ten per cent of the total number of samples collected were replicated in the field (field replicates) and are identified in this report as field splits. A single sample was collected in a laboratory prepared one litre (1 L) sample bottle and inverted 30 times to ensure that the sample was homogeneous. The sample was then split evenly into two separate sample bottles. The two bottles were labelled and sent to the lab for analysis as separate samples but not identified as field splits.

## 2.2.2 Quality Control Assessment

To establish the precision criteria (Section 2.2.3) for the field splits collected in 2010, 18 replicates (field splits) were analyzed for fecal coliform bacteria. Field splits were collected from six stormwater discharges on the Saanich Peninsula (the QA assessment was for the CRD Saanich Peninsula and Juan de Fuca and Southern Gulf Islands Electoral Area sampling programs). The discharges were chosen based on previous (on the Saanich Peninsula) high, moderate or low levels of fecal coliform concentrations (two discharges sampled for each category) to represent the varying fecal coliform counts that would be analyzed. The QA sampling for the assessment was for all fecal coliform samples analyzed by MB Laboratories Ltd. For 2010 summer sampling, winter fecal coliform QA data was used. The three levels of fecal coliform concentrations were selected to represent the variance in the samples analyzed during the sampling program. Three individual grab samples were taken at each of the six stations and split into two replicate 250 mL sample bottles. Three blank samples of potable water were also collected in 250 mL sample bottles as part of the assessment. All samples were supplied to the lab with individual numbers.

## 2.2.3 Calculation of Quality Assurance Results

Laboratory precision for fecal coliform analysis (e.g., a measure of consistency by the lab) is determined by analyzing several pairs of field samples (field splits). The following procedure is from Standard Methods, 20th edition (APHA, 1998).

The data are arranged in pairs (D1 and D2). The log of each field measurement is determined (L1, L2) and the difference (range) in the log value between each pair of field splits is calculated:  $R = (L2 - L1)$ . An average range (Mean-R) is then determined for all of the pairs.

The precision criterion is calculated by multiplying the Mean-R by 3.27 and is rounded to one decimal place.

The log range (R) is calculated for each of the field splits and compared to the precision criterion, to determine whether the sample is acceptable or not, according to the following criteria:

- Acceptable (A) - If the calculation is less than the precision criterion, then the field data are within normal variability.
- Unacceptable (U) - If the calculation is greater than the precision criterion, then the field data are outside of the normal variability. All data collected after the last "acceptable" set of data should be discarded and no further analysis should be done until the source of the problem is identified by the lab.

It is important not to put too severe an interpretation on the results from the QA calculation, especially when they are close to the "unacceptable" guideline. Each result represents a value within a 95% confidence interval, which gets proportionately larger as the actual result gets smaller. Therefore, one can expect, through randomness, 5% of the samples to be outside of the precision criterion. Also, any fecal coliform count under 200 is considered too small an amount to accurately calculate or compare to a precision criterion (APHA, 1998). It is also important to note that discharges with fecal coliform counts lower than 200 FC/100 mL receive a low public health concern rating.

The results should be rounded to one decimal place and compared to the precision criterion (e.g., 0.3). If the calculated value from the duplicate results still exceeds the criterion (e.g., 0.35 or greater) then an informal investigation of the laboratory should be initiated. If only a few duplicates are unacceptable (e.g., one out of every 20 pairs of duplicates) the lab is probably meeting the guideline.

The overall process is intended to act as an alarm, alerting the study group to potential problems with the sampling and analytical procedures. As part of the review, the following elements are considered:

- the number of pairs exceeding the criterion
- the actual fecal coliform value of the pairs of data
- field notes on the "field split" procedure
- comments from the laboratory

### **3.0 RESULTS**

#### **3.1 Quality Assurance Results**

For the 2010 QA programs, 18 pairs of stormwater samples were collected in January and March of 2010 from six discharges having high, moderate or low levels of fecal coliform bacteria. The samples were sent to the lab for analysis of the fecal coliform concentration and the data used to calculate the precision criteria.

##### **3.1.1 Blanks**

In 2010, three blank samples (Greater Victoria tap water) were submitted to the lab as part of the QA/QC and analyzed for fecal coliform bacteria. All blanks were reported as having <10 FC/100 mL. Therefore, the results meet the QA requirements.

##### **3.1.2 Precision Criteria**

Table 1 shows the lab results of the 18 pairs of samples used to determine the precision criteria for 2010 stormwater monitoring program. It should be noted that during the 2010 QA sampling period it was difficult to obtain a second set of moderate concentrations despite repeated attempts. Therefore it was decided to count the lone moderate rating twice in order to have 18 replicates. The calculated precision criterion for this laboratory, using these 18 sets of duplicates, was 0.364. For comparison with subsequent field replicates this result was rounded to 0.4.

##### **3.1.3 Field Splits**

###### **Wet Weather Sampling**

Table 2 presents the results for the ten field splits collected during the wet period (winter) of 2010 stormwater sampling program. The data were compared to the precision criterion of 0.4, as described in Section 3.1.2. Four of the ten field splits analyzed exceeded the precision criterion. However, the three splits had fecal coliform counts below 200 FC/100 mL. Fecal coliform counts lower than 200 FC/100 mL are not expected to meet the precision criteria due to the small numbers (refer to Section 2.3.4). The remaining splits only marginally exceeded the criterion (0.45). Therefore, the results meet the QA requirements for the winter of 2010.

###### **Dry Weather Sampling**

Table 3 presents the results for the eight field splits collected during the dry period (summer) of 2010 stormwater sampling program. The data were compared to the precision criterion of 0.4, as described in Section 3.1.2. Of the eight field splits analyzed, five exceeded the precision criterion. However, three splits had fecal coliform counts below 200 FC/100 mL. Fecal coliform counts lower than 200 FC/100 mL are not expected to meet the precision criteria due to the small numbers (refer to Section 2.3.4). The other exceedences prompted an investigation into lab procedures, however nothing was identified. The two splits that exceeded have counts that are similar enough that they are binned the same as part of our discharge rating methods; therefore, the results are acceptable for the purpose of the program in 2010. However, careful attention will be paid to subsequent results.

**Table 1. Laboratory Quality Assurance Exercise Results for 2010**

CRD Data, Batch Samples: 18 pairs, January 15 and March 11, 2010						
Discharge No.	Pair No.	1 <sup>st</sup> Duplicate D1	2 <sup>nd</sup> Duplicate D2	Log D1 L1	Log D2 L2	Range of Logs (Rlog) (Log L1 - Log L2)
428	1	12	12	1.07918	1.07918	0.00000
	2	16	12	1.20412	1.07918	0.12494
	3	21	16	1.32222	1.20412	0.11810
458A	4	18800	17600	4.27416	4.24551	0.02865
	5	29600	16800	4.47129	4.22531	0.24598
	6	19200	13600	4.28330	4.13354	0.14976
3021A	7	1800	1800	3.25527	3.25527	0.00000
	8	2800	2200	3.44716	3.34242	0.10474
	9	1400	1000	3.14613	3.00000	0.14613
3035C	10	32	23	1.50515	1.36173	0.14342
	11	14	14	1.14613	1.14613	0.00000
	12	30	18	1.47712	1.25527	0.22185
3016	13	800	800	2.90309	2.90309	0.00000
	14	600	400	2.77815	2.60206	0.17609
	15	1400	400	3.14613	2.60206	0.54407
3100	16	1	1	0.00000	0.00000	0.00000
	17	1	1	0.00000	0.00000	0.00000
	18	2	2	0.30103	0.30103	0.00000
Mean - R <sub>log</sub> (Sum R <sub>log</sub> /18)						0.11132
Precision Criterion (3.27 x Mean-R <sub>log</sub> )						0.36401

**Table 2. Laboratory Quality Assurance Results – Wet Period – 2010**

Date	Flow Number	Fecal Coliform Counts for Field Splits	Log	Log Range	A/U
18-Feb-10	416	4	1.39	0.41	A
		6	1.79		
18-Feb-10	468	0	0.00	0.00	A
		0	0.00		
31-Mar-10	3022	36	3.58	1.99	U*
		263	5.57		
26-Mar-10	3060	6	1.79	1.10	U*
		2	0.69		
17-Feb-10	3078B	23	3.14	0.16	A
		27	3.30		
26-Mar-10	3082	36	3.58	0.41	A
		24	3.18		
16-Feb-10	3119	20	3.00	0.64	U*
		38	3.64		
11-Mar-10	3134	910	6.81	0.21	A
		740	6.61		
31-Mar-10	3146	2200	7.70	0.45	U
		1400	7.24		

**Table 3. Laboratory Quality Assurance Results – Dry Period – 2010**

Date	Flow Number	Fecal Coliform Counts for Field Splits	Log	Log Range	A/U
26-Aug-10	428	116	4.75	1.64	U*
		600	6.40		
26-Aug-10	458A	28	3.33	0.58	U*
		50	3.91		
9-Sep-10	3021A	3200	8.07	0.00	A
		3200	8.07		
15-Sep-10	3036	1000	6.91	0.92	U
		400	5.99		
15-Sep-10	3052	6	1.79	0.85	U*
		14	2.64		
10-Sep-10	3085	6	1.79	0.00	A
		6	1.79		
17-Sep-10	3105	400	5.99	0.69	U
		200	5.30		
8-Oct-10	416	1000	6.91	0.22	A
		800	6.68		

A/U = Acceptable/ Unacceptable

\* Any fecal coliform count under 200 is considered too small an amount to meet a precision criterion (APHA, 1992). However, any discharge lower than 200 FC/100 mL receives a lower rating for public health concern.

#### 4.0 CONCLUSIONS

All requirements for the Stormwater, Harbours and Watersheds program QA/QC program were carried out in 2010. All QA/QC results were acceptable for rating stormwater discharges for public health concerns.

#### 5.0 REFERENCES

APHA, 1998. American Public Health Association, American Water Works Association, Water Pollution Control Federation, 20th Edition. Standard Methods for the Examination of Water and Wastewater.

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