



**Bamfield Inlet
Water Quality Objectives Attainment Report
2015**

Environmental Quality Section
Environmental Protection Division
West Coast Region

2015

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Approved by _____

Date Approved _____

Table of Contents

Table of Figures	3
Table of Tables.....	3
Executive Summary	4
Introduction.....	4
Changes in the Watershed Since Objectives Development	5
Sampling and Analytical Methods.....	6
Enterococci	7
Conclusions and Recommendations	10
References.....	10
Appendix 1: Water quality monitoring results	11

Table of Figures

Figure 1. Bamfield and Grappler Inlets and their associated sampling locations.	5
Figure 2. 2012 enterococci (CFU/100mL) geometric mean results for Bamfield Inlet based on 5 samples collected in a 30 day period.	7
Figure 3. 2012 enterococci (CFU/100mL) median results for Bamfield Inlet based on 5 samples collected in a 30 day period.	8
Figure 4. Comparison of Fecal Coliform counts for August 8 and September 9, 2012.	9

Table of Tables

Table 1. Water Quality Objective for Bamfield and Grappler Inlets.....	4
Table 2. Marine and freshwater sample sites in Bamfield Inlet.....	6
Table 3. Recommended water quality sampling program.	7

Executive Summary

Water Quality Objectives (WQO) were approved for Bamfield Inlet in 2012 (Epps, 2012) based on data collected between 2005 and 2008. Attainment monitoring occurred from during the summer of 2012. Attainment data and changes that have occurred in the watershed since 2008 are presented in this report. Data showed that water quality was generally not changed within the area. The development of a Liquid Waste Management Plan (LWMP) is still recommended.

Introduction

As part of the Province of British Columbia, Ministry of Environment's (MoE) mandate to manage water bodies, water quality objective reports have been created for a number of lakes, rivers and marine surface waters. These reports provide a list of objectives to protect water quality that are tailored to the specific water body for which they have been created, taking into account natural local water quality, water uses, water movement, and waste discharges. While the water quality objectives currently have no legal standing, they can direct resource managers aiming to protect the water body in question and are used as a standard against which to measure the water quality of that water body. Once objectives have been developed, periodic monitoring (every three to five years) is undertaken to determine whether they are being met.

Bamfield Inlet is located on the west coast of Vancouver Island adjacent to the Pacific Rim National Park Reserve. The community of Bamfield, situated between Bamfield and Grappler Inlets, is the gateway to tremendous opportunities for ecotourism, adventure travel, boating, whale watching, fishing and the West Coast Trail (Figure 1). During the summer months, the population of Bamfield increases substantially. There has been a growing concern over the health of the inlet and potential impacts on human health related to elevated bacteriological contamination. Objectives were approved for Bamfield in 2012, based on data collected between 2005 and 2008 (Table 1). Attainment monitoring occurred from August 2012 through September 2012. This report summarizes the attainment monitoring data.

Table 1. Water Quality Objective for Bamfield and Grappler Inlets

Time Period	Variable	Objective Value
Short-term (5-10 years)	Fecal Coliform	≤ 200 CFU/100 mL (geometric mean based on a minimum of five weekly samples collected over a 30-day period)
	Enterococci	≤ 20 CFU/100 mL (geometric mean based on a minimum of five weekly samples collected over a 30-day period)
Long-term (>10 years)	Fecal Coliform	≤ 14 CFU/100 mL (median based on a minimum of five weekly samples collected over a 30-day period)
	Enterococci	≤ 4 CFU/100 mL (median based on a minimum of five weekly samples collected over a 30-day period)

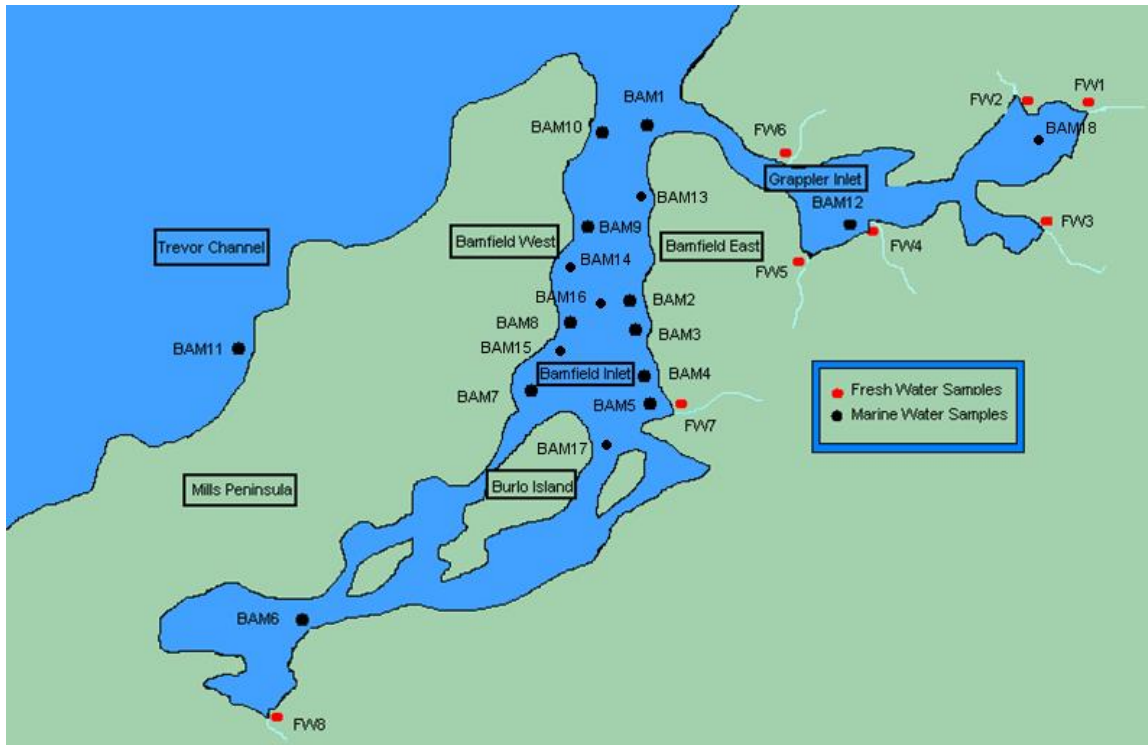


Figure 1. Bamfield and Grappler Inlets and their associated sampling locations.

Changes in the Watershed Since Objectives Development

The following are notable activities that have occurred in the watershed since 2008:

- There are a total of 12 authorized wastewater treatment systems, mostly at resorts, five or more unauthorized systems, at least 40 untreated sewage discharges to the inlet, and many on site systems consisting of drainage fields and raised mounds.
- In 2010, MOE in partnership with Vancouver Island Health Authority (VIHA), posted advisories in areas of Bamfield Inlet warning the public to avoid primary water contact.
- Alberni Clayoquot Regional District (ACRD) has commenced a review of the area's Official Community Plan (OCP), providing opportunities to review and change by-laws, zoning and development permit areas to help protect the area's water quality.
- May 2012, ACRD and their consultants (Stantec) met with MOE and VIHA representatives to discuss the ACRD study to look at remediation measures associated with wastewater discharges to the Bamfield Inlet.
- August 2012 a 150mm diameter HPDE line was constructed with the intent to pump sewage from Anacla First Nation Village to Bamfield Marine Science Center (BMSC).
- February 2013 Stantec made presentation to Bamfield Community based on the findings from their report entitled "Community of Bamfield Conceptual Study for Wastewater Treatment". The report concluded the existing wastewater practices, shown through MOE water testing, are having detrimental impacts on Bamfield Inlet; posing a public

health risk. Stantec’s conclusion, based on economic and environmental concerns, was for the community to move towards a central wastewater treatment system involving the HUU-ay-aht First Nations (HFN) and BMSC.

- In July 2013 a discussion with MOE and ACRD occurred. Follow up actions suggested by ACRD included: secure location for treatment plant, secure agreement between HFN and BMSC, and investigate opportunities for Bamfield to treat their wastewater which ultimately would lead to the development of a ‘service area’ to address problem sites (i.e. those discharging raw sewage into the inlet).

Sampling and Analytical Methods

A total of 18 marine water quality sites were sampled from August 8, 2012 through September 4, 2012 following recommendations in the Water Quality Objectives report (Table 2 and 3). Five weekly samples were collected over 30 days (5-in-30 sampling) to calculate 30-day medians and geometric means. The freshwater sites were not sampled as they were dry during the sampling period. Fecal coliforms were only sampled twice, on the first and last sampling date, as part of the requirement for determining those sites eligible for Microbial Source Tracking (MST). MST analysis requires a fecal coliform result of 40 CFU/100ml or higher. For further information on sampling methodology refer to the Bamfield WQOs report (Epps, 2012).

Table 2. Marine and freshwater sample sites in Bamfield Inlet

EMS ID	Site Name	Site ID	Detailed Site Description
E259797	Bamfield 1 - Biological Station	BAM1	At Bamfield Marine Station outfall
E259798	Bamfield 2 - Kingfisher Marina	BAM2	Off of Kingfisher Marina, blue roof
E259799	Bamfield 3- Red Cross Station	BAM3	Out from storm drain just south of station
E259800	Bamfield 4 - Hawkeye Marina	BAM4	In front of Hawkeye Marina
E259801	Bamfield 5 - Federal Dock	BAM5	Just south of loading area
E259813	Bamfield 6 - Head Bamfield Inlet	BAM6	At head of inlet, on east side
E259802	Bamfield 7 - McKay Bay Lodge	BAM7	At McKay Bay Lodge, north of dock
E259803	Bamfield 8 - Mills Landing Cottages	BAM8	In front of cottages
E259804	Bamfield 9 - Spore Residence	BAM9	Spore residence, blue house
E259805	Bamfield 10 - General Store	BAM10	Dock in front of general store
E259806	Bamfield 11 - Brady's Beach (reference)	BAM11	North end of swimming area
E259807	Bamfield 12 - SeaBeam Resort	BAM12	Dock in front of resort - Grappler's Inlet
E259808	Bamfield 13 - Greenhouses	BAM13	Adjacent to greenhouses near BMS
E259809	Bamfield 14 - Community Hall	BAM14	House across from Community hall
E259810	Bamfield 15 - Imperial Eagle Lodge	BAM15	Dock in front of Imperial Eagle Lodge
E259811	Bamfield 16 - Buoy Y54	BAM16	Mid-inlet next to red buoy Y54
E259812	Bamfield 17 - Burlo and Rance Islands	BAM17	Mid-inlet between Burlo and Rance islands
E259814	Bamfield 18 - Head of Grappler Inlet	BAM18	Head of Grappler inlet, out from dock
E259877	Bamfield Freshwater 7	BAM FW7	East side, south of BAM5 and federal dock
E259878	Bamfield Freshwater 8	BAM FW8	Far end of Bamfield Inlet, south BAM6

Table 3. Recommended water quality sampling program.

Sample Sites	Frequency and timing	Parameters to be measured
Bamfield and Grappler Inlets (18 sites) and 2 freshwater sites in Bamfield Inlet	August – September: five weekly samples in a 30-day period	fecal coliforms (both marine and freshwater), enterococci (marine only) and <i>E. coli</i> (freshwater only)

Objectives Attainment

Enterococci

The geometric mean values for enterococci in the Bamfield Inlet were compared to the short term water quality objective of ≤ 20 CFU/100ml for the protection of human health during primary recreational activities such as swimming (Figure 2).

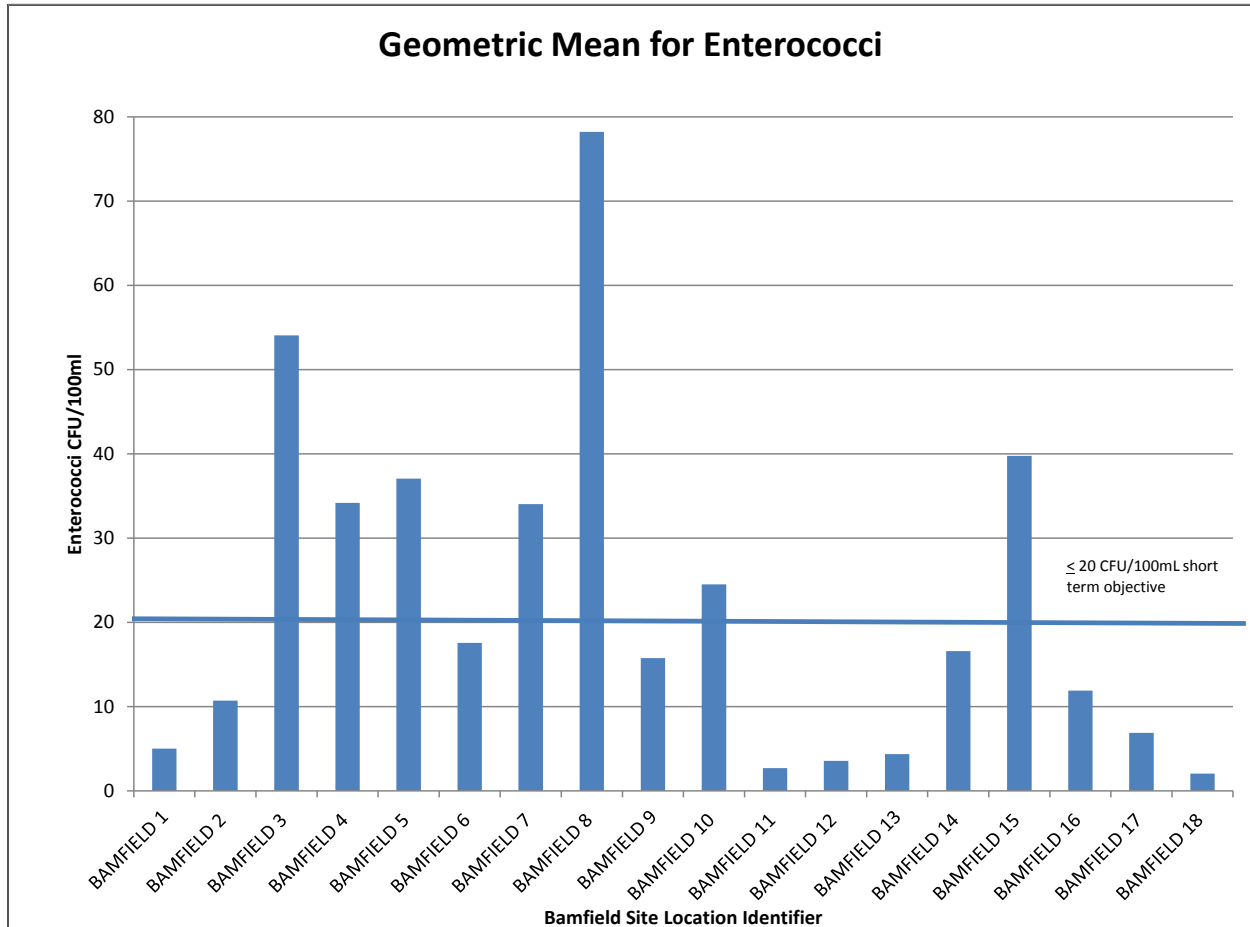


Figure 2. 2012 enterococci (CFU/100mL) geometric mean results for Bamfield Inlet based on 5 samples collected in a 30 day period.

Out of the 18 marine sites, seven did not meet the short term objective. These sites are all located within the inner Bamfield inlet area, where wastewater discharge activity occurs. The 2005-2008 enterococci results had six exceedances (four in 2006 and two in 2007) also within the inner inlet area. There appears to be a slight increase in the number of exceedances since the last sample period (2005-2008).

The median values for enterococci were compared to the long term WQO of ≤ 4 CFU/100ml for shellfish harvesting (Figure 3). All sites, with the exception of Bamfield 11 and 18 did not meet the long term water quality objective. This is very similar to the 2005-2008 data suggesting no improvements have occurred with relation to wastewater treatment. It should be noted that Bamfield 11 is the control site located outside Bamfield inlet and has always tended to have low results, as one would expect.

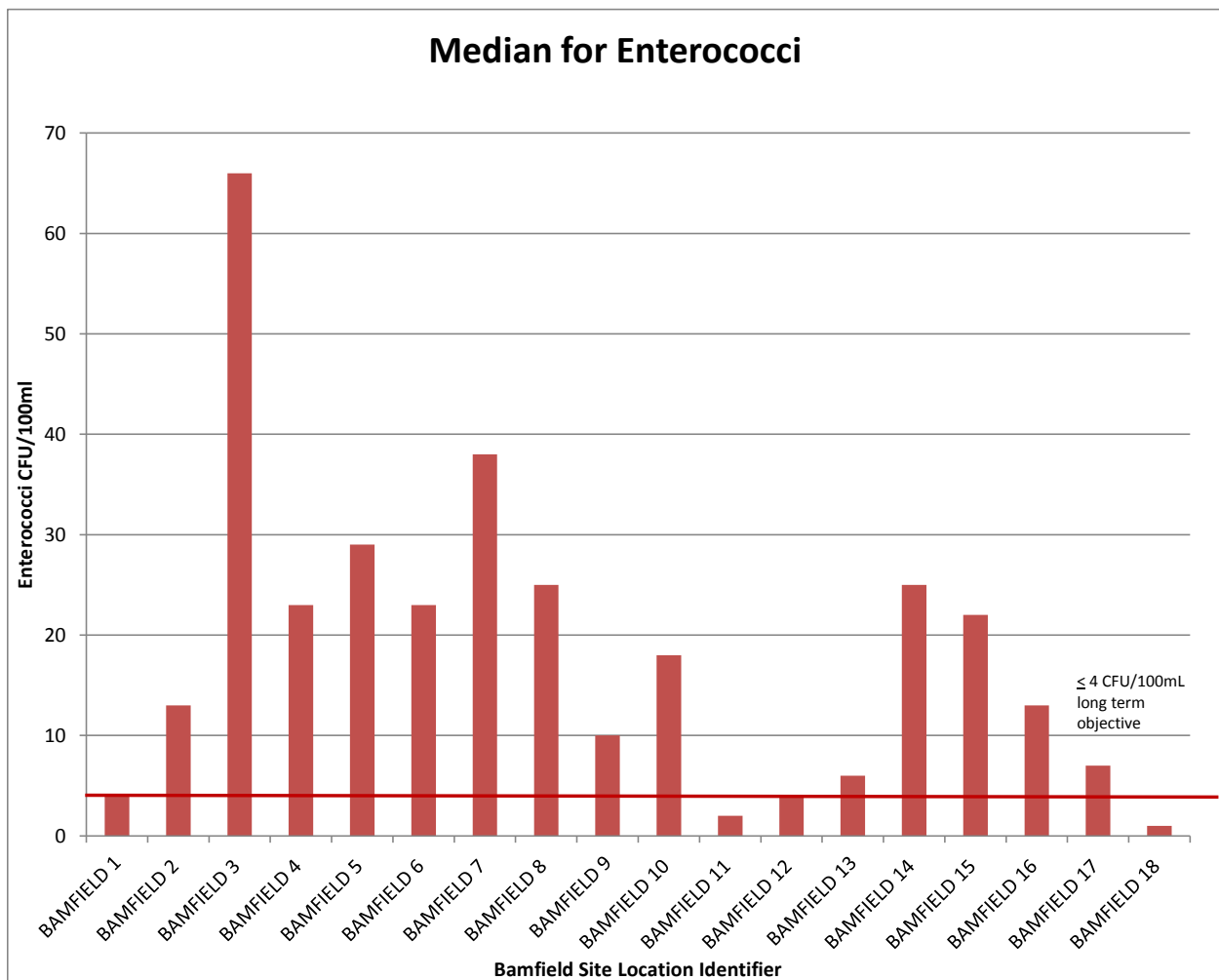


Figure 3. 2012 enterococci (CFU/100mL) median results for Bamfield Inlet based on 5 samples collected in a 30 day period.

Fecal Coliforms

The Fecal coliforms were collected in order to determine if a site was able to qualify for MST testing with a colony count criteria of ≥ 40 CFU/100ml. The sites that met this criteria were Bamfield 2, 3, 5, 6, and 18. The first three sites are located on the inner Bamfield inlet area known as 'East Bamfield', while the other two were at the head of the Bamfield and Grappler inlets.

Fecal coliform count values ranged from below detection limits (<1 CFU/100mL) to a maximum of 920 CFU/100ml (Figure 4). Interestingly, the site with the highest count in 2012 was also had

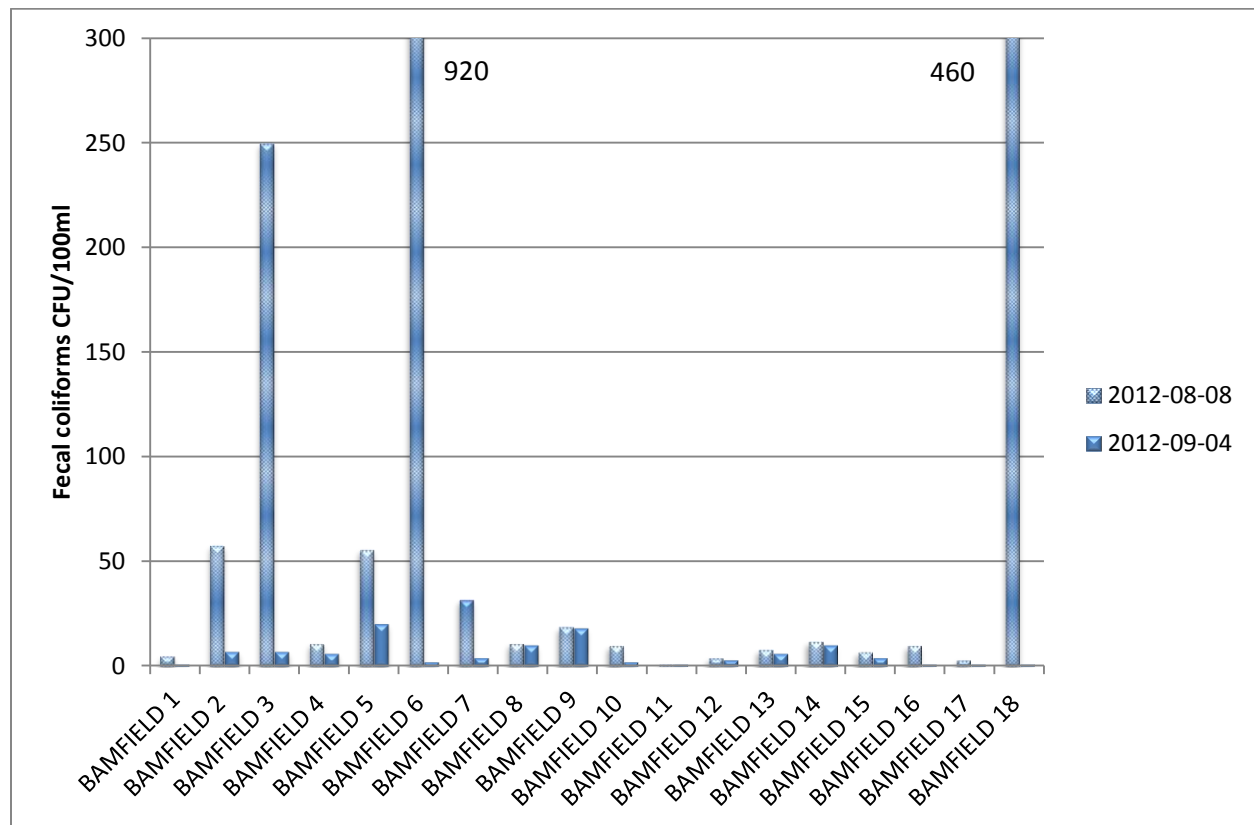


Figure 4. Comparison of Fecal Coliform counts for August 8 and September 9, 2012.

the highest count in 2006 – Bamfield 6, head of the Bamfield Inlet. The second highest count in 2012 was observed at Bamfield 18 - head of the Grappler Inlet. The majority of the remaining sites with elevated counts were observed central to Bamfield Inlet where the population is the highest throughout the year. This pattern of distribution is consistent with the fecal coliform count numbers from 2005 and 2006.

The August sampling date had overall higher count values than the September sampling date. There may be a couple of reasons for this. Firstly, the August 8 day is in the middle of the summer and prime tourist season, which means that there was a strong likelihood that

Bamfield had a surge in population. September 4 was after the Labour Day long weekend and there were probably less people within the village and hence, less sewage discharge. Secondly, some precipitation would slightly increase the dilution within the area. In the week prior to August 8 there was very little precipitation, an average of 0.3mm of rain. The week before September 4 did see a little more precipitation, with an average of 1.7mm (Environment Canada, 2015).

The fecal coliform count values could not be compared to the short or long term water quality objectives outlined in the 2012 Bamfield Inlet Technical Report as the objectives are based on geometric means and medians that require a minimum sampling of five weekly samples collected over a 30 day period.

All five samples tested for MST were positive for General *Bacteroides* which indicates that there is fecal contamination without being able to determine a specific source. One sample, Bamfield 5, had a '1 of 2 possible markers present' for human fecal matter and this sample also had a 'faint' reading for both human and pig fecal matter. As the result was faint and it is known that pig primers for one of the markers is known to cross-prime with ruminant animals (PESC, 2006), the level of confidence in this result is low.

Conclusions and Recommendations

Both enterococci and Fecal coliform testing in the area did not show any significant improvement in sewage contamination within the area, and therefore it is recommended that water quality monitoring continue. As there has been little development in a community strategic plan to deal with waste management, recommendations would be the same as suggested in the 2012 technical report. That is, that the Village of Bamfield partner with Alberni-Clayoquot Regional District, the Huu-ay-aht First Nation, and the Bamfield Marine Station to develop a LWMP to provide a cost effective sewage collection system. This could maintain and improve the future economic opportunities within the community by protecting both human and environmental health.

References

Epps, Deborah. 2012. Water Quality Assessment and Objectives for Bamfield Inlet: technical report. Environmental Protection Division and Water Stewardship Division, British Columbia Ministry of Environment, Victoria, B.C.

Environment Canada. 2015. National Climate and Data Information Archive. http://www.climate.weatheroffice.gc.ca/Welcome_e.html. Accessed on May 8, 2015.

PESC (Pacific Environmental Science Centre), 2006. Bacterial Source Tracking results submitted to MOE.

Appendix 1: Water quality monitoring results

Location	Site number	Date	Enterococci CFU/100ml	Fecal Coliform CFU/100ml
BAMFIELD 1 - BIOLOGICAL STATION	BAMFIELD 1	08-Aug-12	4	5
BAMFIELD 1 - BIOLOGICAL STATION	BAMFIELD 1	21-Aug-12	4	N/A
BAMFIELD 1 - BIOLOGICAL STATION	BAMFIELD 1	28-Aug-12	1	N/A
BAMFIELD 1 - BIOLOGICAL STATION	BAMFIELD 1	30-Aug-12	200	N/A
BAMFIELD 1 - BIOLOGICAL STATION	BAMFIELD 1	04-Sep-12	1	1
BAMFIELD 2 - KINGFISHER MARINA	BAMFIELD 2	08-Aug-12	62	58
BAMFIELD 2 - KINGFISHER MARINA	BAMFIELD 2	21-Aug-12	1	N/A
BAMFIELD 2 - KINGFISHER MARINA	BAMFIELD 2	28-Aug-12	35	N/A
BAMFIELD 2 - KINGFISHER MARINA	BAMFIELD 2	30-Aug-12	13	N/A
BAMFIELD 2 - KINGFISHER MARINA	BAMFIELD 2	04-Sep-12	5	7
BAMFIELD 3 - RED CROSS	BAMFIELD 3	08-Aug-12	280	250
BAMFIELD 3 - RED CROSS	BAMFIELD 3	21-Aug-12	66	N/A
BAMFIELD 3 - RED CROSS	BAMFIELD 3	28-Aug-12	250	N/A
BAMFIELD 3 - RED CROSS	BAMFIELD 3	30-Aug-12	25	N/A
BAMFIELD 3 - RED CROSS	BAMFIELD 3	04-Sep-12	4	7
BAMFIELD 4 - HAWKEYE MARINA	BAMFIELD 4	08-Aug-12	5	11
BAMFIELD 4 - HAWKEYE MARINA	BAMFIELD 4	21-Aug-12	23	N/A
BAMFIELD 4 - HAWKEYE MARINA	BAMFIELD 4	28-Aug-12	1230	N/A
BAMFIELD 4 - HAWKEYE MARINA	BAMFIELD 4	30-Aug-12	55	N/A
BAMFIELD 4 - HAWKEYE MARINA	BAMFIELD 4	04-Sep-12	6	6
BAMFIELD 5 - FEDERAL DOCK LOADING ZONE	BAMFIELD 5	08-Aug-12	45	56
BAMFIELD 5 - FEDERAL DOCK LOADING ZONE	BAMFIELD 5	21-Aug-12	29	N/A
BAMFIELD 5 - FEDERAL DOCK LOADING ZONE	BAMFIELD 5	28-Aug-12	315	N/A
BAMFIELD 5 - FEDERAL DOCK LOADING ZONE	BAMFIELD 5	30-Aug-12	10	N/A
BAMFIELD 5 - FEDERAL DOCK LOADING ZONE	BAMFIELD 5	04-Sep-12	17	20

Location	Site number	Date	Enterococci CFU/100ml	Fecal Coliform CFU/100ml
BAMFIELD 6 - HEAD OF BAMFIELD INLET	BAMFIELD 6	08-Aug-12	40	920
BAMFIELD 6 - HEAD OF BAMFIELD INLET	BAMFIELD 6	21-Aug-12	19	N/A
BAMFIELD 6 - HEAD OF BAMFIELD INLET	BAMFIELD 6	28-Aug-12	23	N/A
BAMFIELD 6 - HEAD OF BAMFIELD INLET	BAMFIELD 6	30-Aug-12	96	N/A
BAMFIELD 6 - HEAD OF BAMFIELD INLET	BAMFIELD 6	04-Sep-12	1	2
BAMFIELD 7 - MCKAY BAY LODGE	BAMFIELD 7	08-Aug-12	38	32
BAMFIELD 7 - MCKAY BAY LODGE	BAMFIELD 7	21-Aug-12	10	N/A
BAMFIELD 7 - MCKAY BAY LODGE	BAMFIELD 7	28-Aug-12	220	N/A
BAMFIELD 7 - MCKAY BAY LODGE	BAMFIELD 7	30-Aug-12	42	N/A
BAMFIELD 7 - MCKAY BAY LODGE	BAMFIELD 7	04-Sep-12	13	4
BAMFIELD 8 - MILLS LANDING COTTAGES	BAMFIELD 8	08-Aug-12	7	11
BAMFIELD 8 - MILLS LANDING COTTAGES	BAMFIELD 8	21-Aug-12	22	N/A
BAMFIELD 8 - MILLS LANDING COTTAGES	BAMFIELD 8	28-Aug-12	2000	N/A
BAMFIELD 8 - MILLS LANDING COTTAGES	BAMFIELD 8	30-Aug-12	380	N/A
BAMFIELD 8 - MILLS LANDING COTTAGES	BAMFIELD 8	04-Sep-12	25	10
BAMFIELD 9 - SPORE RESIDENCE	BAMFIELD 9	08-Aug-12	10	19
BAMFIELD 9 - SPORE RESIDENCE	BAMFIELD 9	21-Aug-12	17	N/A
BAMFIELD 9 - SPORE RESIDENCE	BAMFIELD 9	28-Aug-12	6	N/A
BAMFIELD 9 - SPORE RESIDENCE	BAMFIELD 9	30-Aug-12	106	N/A
BAMFIELD 9 - SPORE RESIDENCE	BAMFIELD 9	04-Sep-12	9	18
BAMFIELD 10 - GENERAL STORE	BAMFIELD 10	08-Aug-12	18	10
BAMFIELD 10 - GENERAL STORE	BAMFIELD 10	21-Aug-12	130	N/A
BAMFIELD 10 - GENERAL STORE	BAMFIELD 10	28-Aug-12	210	N/A
BAMFIELD 10 - GENERAL STORE	BAMFIELD 10	30-Aug-12	9	N/A
BAMFIELD 10 - GENERAL STORE	BAMFIELD 10	04-Sep-12	2	2
BAMFIELD 11 - BRADY'S BEACH	BAMFIELD 11	08-Aug-12	1	1

Location	Site number	Date	Enterococci CFU/100ml	Fecal Coliform CFU/100ml
BAMFIELD 11 - BRADY'S BEACH	BAMFIELD 11	21-Aug-12	36	N/A
BAMFIELD 11 - BRADY'S BEACH	BAMFIELD 11	28-Aug-12	2	N/A
BAMFIELD 11 - BRADY'S BEACH	BAMFIELD 11	30-Aug-12	2	N/A
BAMFIELD 11 - BRADY'S BEACH	BAMFIELD 11	04-Sep-12	1	1
BAMFIELD 12 - SEABEAM RESORT	BAMFIELD 12	08-Aug-12	28	4
BAMFIELD 12 - SEABEAM RESORT	BAMFIELD 12	21-Aug-12	1	N/A
BAMFIELD 12 - SEABEAM RESORT	BAMFIELD 12	28-Aug-12	5	N/A
BAMFIELD 12 - SEABEAM RESORT	BAMFIELD 12	30-Aug-12	4	N/A
BAMFIELD 12 - SEABEAM RESORT	BAMFIELD 12	04-Sep-12	1	3
BAMFIELD 13 - GREENHOUSES	BAMFIELD 13	08-Aug-12	6	8
BAMFIELD 13 - GREENHOUSES	BAMFIELD 13	21-Aug-12	1	N/A
BAMFIELD 13 - GREENHOUSES	BAMFIELD 13	28-Aug-12	10	N/A
BAMFIELD 13 - GREENHOUSES	BAMFIELD 13	30-Aug-12	13	N/A
BAMFIELD 13 - GREENHOUSES	BAMFIELD 13	04-Sep-12	2	6
BAMFIELD 14 - COMMUNITY HALL	BAMFIELD 14	08-Aug-12	31	12
BAMFIELD 14 - COMMUNITY HALL	BAMFIELD 14	21-Aug-12	3	N/A
BAMFIELD 14 - COMMUNITY HALL	BAMFIELD 14	28-Aug-12	36	N/A
BAMFIELD 14 - COMMUNITY HALL	BAMFIELD 14	30-Aug-12	15	N/A
BAMFIELD 14 - COMMUNITY HALL	BAMFIELD 14	04-Sep-12	25	10
BAMFIELD 15 - IMPERIAL EAGLE LODGE	BAMFIELD 15	08-Aug-12	22	7
BAMFIELD 15 - IMPERIAL EAGLE LODGE	BAMFIELD 15	21-Aug-12	21	N/A
BAMFIELD 15 - IMPERIAL EAGLE LODGE	BAMFIELD 15	28-Aug-12	31	N/A
BAMFIELD 15 - IMPERIAL EAGLE LODGE	BAMFIELD 15	30-Aug-12	330	N/A
BAMFIELD 15 - IMPERIAL EAGLE LODGE	BAMFIELD 15	04-Sep-12	21	4
BAMFIELD 16 - BUOY Y54	BAMFIELD 16	08-Aug-12	38	10
BAMFIELD 16 - BUOY Y54	BAMFIELD 16	21-Aug-12	10	N/A

Location	Site number	Date	Enterococci CFU/100ml	Fecal Coliform CFU/100ml
BAMFIELD 16 - BUOY Y54	BAMFIELD 16	28-Aug-12	13	N/A
BAMFIELD 16 - BUOY Y54	BAMFIELD 16	30-Aug-12	48	N/A
BAMFIELD 16 - BUOY Y54	BAMFIELD 16	04-Sep-12	1	1
BAMFIELD 17 - BURLO & RANCE ISLANDS	BAMFIELD 17	08-Aug-12	5	3
BAMFIELD 17 - BURLO & RANCE ISLANDS	BAMFIELD 17	21-Aug-12	7	N/A
BAMFIELD 17 - BURLO & RANCE ISLANDS	BAMFIELD 17	28-Aug-12	10	N/A
BAMFIELD 17 - BURLO & RANCE ISLANDS	BAMFIELD 17	30-Aug-12	22	N/A
BAMFIELD 17 - BURLO & RANCE ISLANDS	BAMFIELD 17	04-Sep-12	2	1
BAMFIELD 18 - HEAD OF GRAPPLER INLET	BAMFIELD 18	08-Aug-12	12	460
BAMFIELD 18 - HEAD OF GRAPPLER INLET	BAMFIELD 18	21-Aug-12	1	N/A
BAMFIELD 18 - HEAD OF GRAPPLER INLET	BAMFIELD 18	28-Aug-12	3	N/A
BAMFIELD 18 - HEAD OF GRAPPLER INLET	BAMFIELD 18	30-Aug-12	1	N/A
BAMFIELD 18 - HEAD OF GRAPPLER INLET	BAMFIELD 18	04-Sep-12	1	1