

Waterbody Field Report Skagway BEACH Program Upper Taiya Inlet, Skagway, AK



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Abstract

Skagway Traditional Council (STC) and the Alaska Department of Environmental Conservation (DEC) engaged in marine pathogen monitoring at five Skagway recreational beaches between May 23rd and September 12th, 2023, collecting 14 sets of water samples for enterococci and fecal coliform bacteria analysis and one set for microbial source tracking (MST) for host species DNA markers. Additionally, for each location and sampling event, in-situ water quality parameter measurements were taken including dissolved oxygen, pH and turbidity. No exceedances of the Alaska water quality standards (WQS) were reported for contact recreation, although two beaches (Nahku Bay and the Small Boat Harbor) exceeded the most stringent WQS for consumption of raw aquatic life. MST results indicated the presence of human and avian DNA markers at Smuggler's Cove, avian markers at the Small Boat Harbor, and human markers at Airport Beach and Yakutania West. No markers were reported for Nahku Bay. Results suggest no significant sources of bacteria contamination for contact recreation, but two exceedances for consumption of raw aquatic life warrant further investigation and possibly a more visible and strategically placed port wastewater treatment facility discharge warning sign for community and visitors using the marine area. The 2023 recreational season marks the first year of the monitoring program, which will continue for a second season in 2024.



¹ Skagway Traditional Council, project #ACWA-23-12 funded by DEC from an EPA pass-through grant.

Basic Waterbody Information

Table 1. Basic Waterbody Information.

Assessment Unit ID	AK_M_1030305_004 Skagway Harbor AU		AK_M_1030305_002 Taiya Inlet AU		
EPA ID	AK568659	AK416279	AK587418	AK916382	AK622042
Assessment Unit Name	Small Boat Harbor	Airport Beach	Yakutania West	Smuggler's Cove	Nahku Bay
Location description	Located at the head of the small boat harbor between the public boat launch and private dock.	Just south of the Skagway Airport terminal on the east bank of the Skagway River estuary.	Small pocket beach on the west flank of Yakutania Point.	Small pocket beach northwest of Yakutania Point.	Approximately 1.75 miles northwest of Skagway.
Hydrologic unit code 10	1901030305				
Water Type	Marine Beach				
Area sampled	Point sample representing 0.11 miles of coastline	Point sample representing 0.31 miles of coastline	Point sample representing 0.04 miles of coastline	Point sample representing 0.05 miles of coastline	Point sample representing 0.12 miles of coastline
Time of year sampled	May 23 – September 12, 2023				

Water Quality Evaluation

Background

Skagway is located approximately 90 miles northwest of Alaska's capital city Juneau, at the northern terminus of the Taiya Inlet (Figure 1). The nearly 1,000-person year-round population quadruples during the summer tourist season, these transient employees providing services to 14,000 daily visitors arriving primarily by cruise ships between March and October.

Skagway Traditional Council (STC) is a Federally recognized Tribal government, responsible for the health and safety of indigenous citizens residing in Skagway. The STC Environmental Department (ENVI) develops programs that address priority Tribal issues identified through assessments, Council oversight, and staff working sessions. Water quality in recreational waters has been a high-ranking priority for several assessment cycles, and ENVI recognized the potential for hazardous conditions considering the potential sources of bacteria adjacent to local beaches (Figure 1).

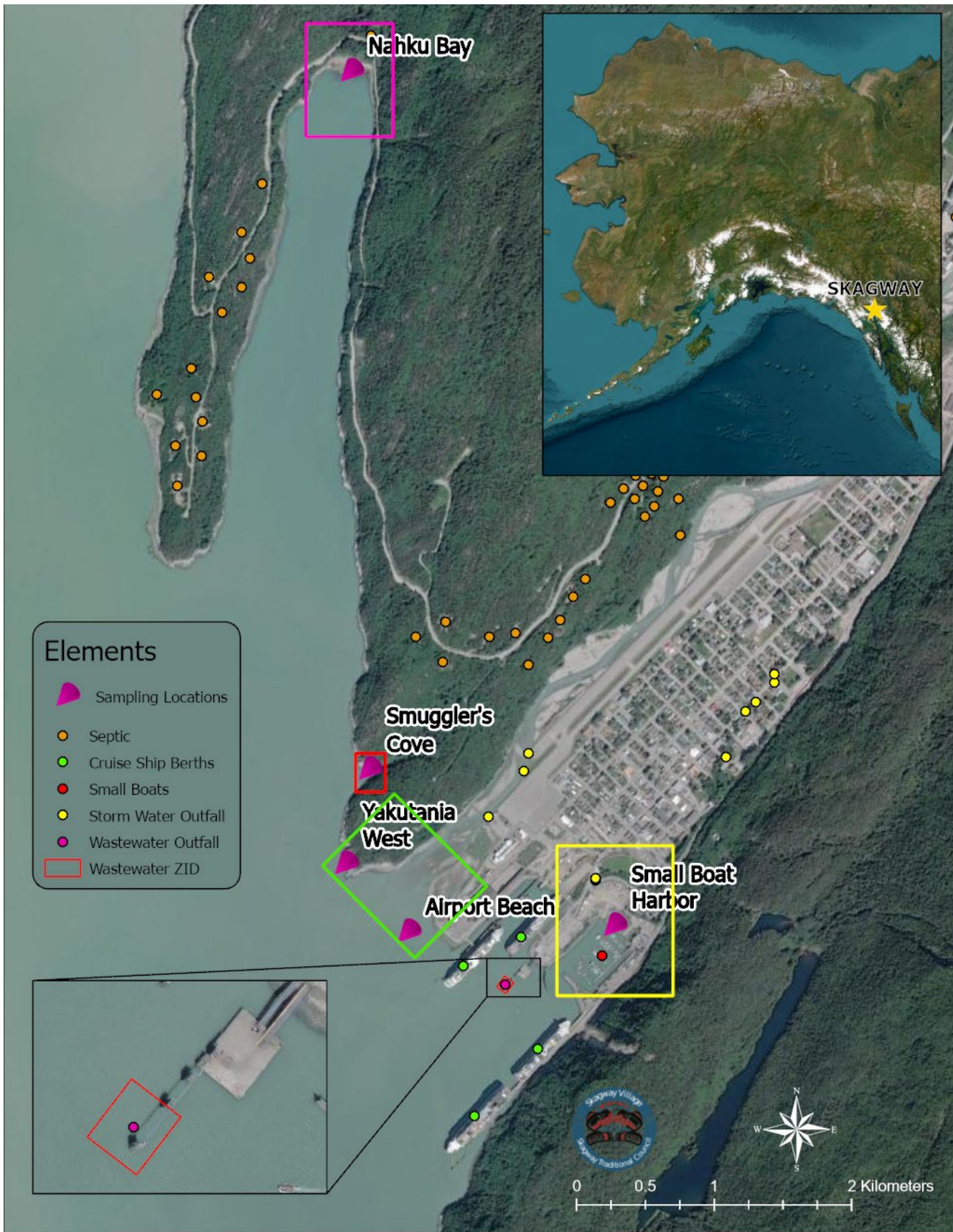


Figure 1. Overview map of BEACH sampling locations and potential sources of bacteria; colored insets are in Figure 2.



Figure 2. Detailed insets from Figure 1 with sample locations indicated by a purple cone: 2a. Nahku Bay; 2b. Smuggler's Cove; 2c. Airport Beach and Yakutania West; 2d. Small Boat Harbor.

Most of Skagway's residents live within a city grid where municipal water and sewer are provided, while a smaller percentage of residents live along the coastal Dyea Road and rely on cisterns and septic systems. A small boat harbor with slips for 104 vessels is located in the farthest east basin of the waterfront, bordered by a peninsula housing the state ferry terminal and dock. The Municipality of Skagway (MOS) wastewater treatment facility also uses this dock to discharge treated wastewater effluent into the Taiya Inlet. The MOS wastewater treatment facility has an Environmental Protection Agency (EPA) 301(h) permit waiver² requiring primary treatment before discharging³. Berths for four large cruise ships are located on three docks at the waterfront, and around half the ships that visit Skagway are permitted to discharge wastewater into the harbor, although it is unknown the percentage of ships that actively discharge into the harbors. A stormwater network managed by MOS collects overland flow from the city grid and discharges into Pullen Creek and the Skagway River. Domestic dogs are common in Skagway, and a small population of resident marine mammals and seabirds is complemented twice annually by a large influx of stopover migratory waterfowl.

ENVI staff assisted the Alaska Department of Environmental Conservation (DEC) in completing an initial Beaches Environmental Assessment and Coast Health (BEACH) survey of Skagway recreation beaches, and five locations were identified as Tier 1⁴ priorities to be sampled during the 2023 – 24 recreational seasons (Figure 2). STC and DEC co-authored a quality assurance project plan (QAPP)⁵, communication plan², and listserv database, and ENVI established a contract with DEC-approved Admiralty Environmental laboratory in Juneau to perform bacteria analyses on collected water samples.

Objectives

The objectives for this project are to:

- Monitor selected public-use marine beaches for fecal indicator organisms (i.e., fecal coliform and enterococci bacteria) during periods of high recreational use.
- Notify the public when indicator organisms exceed Alaska Water Quality Standards (WQS)⁶.

² Document can be found at ["NPDES Permit Fact Sheet for Skagway Wastewater Treatment Plant – WA0020010 – July 2023" \(epa.gov\)](https://www.epa.gov/npdes/npdes-permit-fact-sheet-for-skagway-wastewater-treatment-plant-wa0020010-july-2023)

³ In some cases, a dilution allowance or mixing zone is permitted within a receiving water. A mixing zone is a limited area or volume of water where initial dilution of a discharge takes place and within which certain WQS may be exceeded. Under the 301(h) program this mixing area is referred to as the zone of initial dilution, or ZID. In accordance with 18 AAC 70.240, DEC authorizes mixing zones in Taiya Inlet for copper, dissolved oxygen, temperature, total residual chlorine, enterococcus bacteria, fecal coliform bacteria, and whole effluent toxicity contained in the discharge from the Skagway wastewater treatment facility. The mixing zones are defined as follows: The chronic mixing zone has a dilution of 28:1 and is defined as a rectangular area with a length of 6.1 meters and width of 7.4 meters centered over the diffuser with the length oriented perpendicular to the diffuser. The acute mixing zone has a dilution of 16:1 and is defined as a rectangular area with a length of 4.5 meters and width of 6.4 meters centered over the diffuser with the length oriented perpendicular to the diffuser.

⁴ More information on the BEACH program can be found at <https://dec.alaska.gov/water/water-quality/beach-program/>

⁵ QAPP, FAQs, Handbook, and other resources are available at <https://dec.alaska.gov/water/water-quality/beach-program/skagway/>

⁶ 18 AAC 70(14)(B)(i) Water Quality Standards amended as of November 13, 2022. Appendix A highlights applicable criteria.

Quality Assurance Review

ENVI Field staff adhered to protocols and standard operating procedures (SOPs) as defined by the project QAPP. A total of 16 sampling events were scheduled, and 14 sets of samples were successfully collected and delivered to Admiralty Environmental for a completeness total of 88%. Three sets of samples were collected (6-28-23, 8-15-23, and 9-6-23) but not delivered to the lab due to inclement weather; in-situ parameters were measured for all sites on these days except for Yakutania West and Smuggler's Cove on 8-15-23, these sites omitted for the sake of time. All holding times and temperatures were within acceptable range and no discrepancies, errors, data qualifiers, or QC flags were reported. Calibration/verification was performed prior to and following each event on the Hach turbidimeter, and pre-sampling calibration was performed on the YSI Pro Quatro handheld unit for each event as per the manufacturer's recommendation. Calibrations logs and verification records were completed for the monitoring program. One rotating duplicate sample for enterococci and fecal coliform was collected for each sampling day, and all results were below or at low magnitude values for bacteria. Relative percentage difference values for duplicate samples were all within acceptable limits.

Methods

Five Tier 1 beaches were monitored between May 23 and September 12, 2023 (Table 1, and Figures 1 and 2). Field staff collected a single grab sample of marine water from each beach weekly in laboratory-provided containers, plus one rotating duplicate sample, for enterococci (ASTM D6503-99) and fecal coliform (SM 9222D) analyses. A calibrated Hach turbidimeter was used to measure in-situ turbidity at each site, and a calibrated YSI Pro Quatro multiparameter unit was used to measure in-situ water temperature, salinity, dissolved oxygen, and pH. Air temperature was measured using a calibrated NIST lollipop thermometer. Modified EPA Marine Sanitary Surveys were completed at each beach for every sampling event. Grab samples were also collected on September 12, 2023, between 9:00 am to 12:00 pm from each location and submitted to LuminUltra labs for microbial source tracking (MST) analysis for human, canine, and avian DNA markers. Samples were collected in the morning hours to meet flight and analytical methods holding times.

All beach samples were packed into a hard-sided cooler with blue ice packs to maintain a temperature range between 4.0 and 10.0 °C, and hand-delivered to Alaska Seaplanes for transport to Juneau. Samples were submitted to Admiralty Environmental by a DEC partner in Juneau within the requisite 6-hour holding time, allowing two hours for laboratory staff to prepare and perform the analyses. MST samples were delivered to a FedEx facility in Juneau prior to the 10:30 am cutoff time for overnight freight and shipped to LuminUltra Technologies Ltd. in Maryland within the 48-hour holding time.

Results

Most results were non-detect for enterococci and fecal coliform. However, the WQS for fecal coliform of 'harvesting for consumption of raw mollusks or other raw aquatic life' and the seasonal geometric mean was exceeded at two beach sites, Nahku Bay and Small Boat Harbor.

The ‘harvesting for consumption of raw mollusks or other raw aquatic life’ for fecal coliform is exceeded if more than 10% of the samples is greater than 31 CFU/100ml. The seasonal geometric mean for fecal coliform is exceeded if the geometric mean of all the recreational season samples is greater than 14 CFU/100ml. Two beach sites exceeded 14% (2 samples out of 14 samples) for the individual samples and seasonal geometric mean criteria (Figures 3 – 5, and Table 2).

- Nahku Bay on 6-6-23 (180 CFU/100ml) and on 8-30-23 (68 CFU/100ml); geometric mean of 20.71 CFU/100ml.
- Small Boat Harbor on 6-14-23 (54 CFU/100ml) and on 7-6-23 (58 CFU/100ml); geometric mean of 17.43 CFU/100ml.

Table 1. Fecal coliform results summary showing percentages of WQS individual and seasonal geometric mean exceedances in red.

Analyte	Site	Individual Criteria ⁷	% of Samples Exceeding Threshold	Geometric Mean Criteria	30-day Geometric Mean Result
Enterococci (MPN/100 mL)	Nahku Bay	130 MPN/100ml	0%	35 MPN/100ml	ND (5.00)
	Airport Beach		0%		8.27
	Small Boat Harbor		0%		8.71
	Smuggler’s Cove		0%		5.74
	Yakutania West		0%		ND (5.00)
Analyte	Site	Individual Criteria	% of Samples Exceeding Individual Criteria	Seasonal Geometric Mean Criteria	Seasonal Geometric Mean Result
Fecal Coliform (CFU/100 mL)	Nahku Bay	31 CFU/100ml	14%	14 CFU/100ml	20.71
	Airport Beach		0%		4.43
	Small Boat Harbor		14%		17.43
	Smuggler’s Cove		0%		3.29
	Yakutania West		0%		3.71

ND = not detected, used ½ detection limit to calculate the geometric mean (5.00)

Field staff filled out sanitary surveys at each location weekly; however, to meet shipping and holding time requirements all sampling events took place in the early morning (0500 – 1000) which may have skewed survey results.

In-situ parameters performed as expected with typical seasonal and geographical variance (Table 3). Skagway’s location at the northern terminus of the Taiya Inlet combined with consistent southern winds in the summer and significant glacial runoff from two major rivers causes freshwater to pile up on the northern shorelines – summertime salinity is often below 1 ppt. Turbidity at the three

⁷ 18 AAC 70(14)(B)(i) Water Recreation, contact recreation, and 18 AAC 70(14)(D) Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life

locations closest to the Skagway River estuary registered higher averages than at the Small Boat Harbor and Nahku Bay, likely a result of river sediment.

Table 2. In-situ measurement summary.

Analyte	Site	Mean	Median	Range
Air Temperature (°C)	Nahku	11.7	12.1	7.4 - 15.0
	Small Boat Harbor	13.4	13.7	8.0 - 19.0
	Airport Beach	13.3	13.4	7.7 - 21.9
	Yakutania West	13.4	13.5	9.4 - 16.6
	Smuggler's Cove	12.9	12.9	8.8 - 16.0
Water Temperature (°C)	Nahku	10.9	10.5	7.3 - 15.1
	Small Boat Harbor	10.1	10.4	7.3 - 12.0
	Airport Beach	9.0	8.8	5.4 - 12.0
	Yakutania West	9.9	10.1	7.5 - 12.6
	Smuggler's Cove	10.2	10.5	7.8 - 12.7
Salinity (ppt)	Nahku	6.1	5.7	0.0 - 17.8
	Small Boat Harbor	6.8	6.9	1.9 - 14.4
	Airport Beach	4.7	4.2	0.0 - 15.4
	Yakutania West	6.1	5.3	0.5 - 12.4
	Smuggler's Cove	6.1	5.6	0.5 - 17.5
pH	Nahku	7.9	8.0	6.6 - 8.5
	Small Boat Harbor	7.7	7.7	7.3 - 8.3
	Airport Beach	7.9	7.9	7.6 - 8.5
	Yakutania West	8.1	8.1	7.5 - 8.5
	Smuggler's Cove	8.0	8.1	7.6 - 8.4
DO (mg/L)	Nahku	11.0	11.2	9.7 - 12.3
	Small Boat Harbor	9.8	10.0	7.2 - 12.1
	Airport Beach	11.2	11.0	10.1 - 12.7
	Yakutania West	11.3	11.3	10.5 - 12.4
	Smuggler's Cove	11.1	11.0	10.3 - 12.2
Turbidity (NTU)	Nahku	18.3	14.1	4.5 - 74.3
	Small Boat Harbor	17.8	10.9	4.0 - 53.3
	Airport Beach	27.6	23.4	5.5 - 63.1
	Yakutania West	26.2	23.2	6.2 - 88.0
	Smuggler's Cove	32.4	27.3	5.8 - 76.7

MST analysis revealed the presence of human and avian markers at several sites but no indication of canine-sourced bacteria (Table 4). The only quantifiable markers were found at the Small Boat Harbor and Smuggler's Cove, both avian. Human markers were present but not quantifiable at Airport Beach, Yakutania West, and Smuggler's Cove.

Project data including in-situ measurements and sanitary survey results can be obtained from DEC Southeast staff in Juneau, AK.

Table 3. MST analytical results, all sites.

Site	Bacteroidetes	Result ⁸
Nahku Bay	Human	ND
	Canine	ND
	Avian	ND
Small Boat Harbor	Human	ND
	Canine	ND
	Avian	3.87E+03
Airport Beach	Human	DNQ
	Canine	ND
	Avian	ND
Yakutania West	Human	DNQ
	Canine	ND
	Avian	ND
Smuggler's Cove	Human	DNQ
	Canine	ND
	Avian	6.34E+03

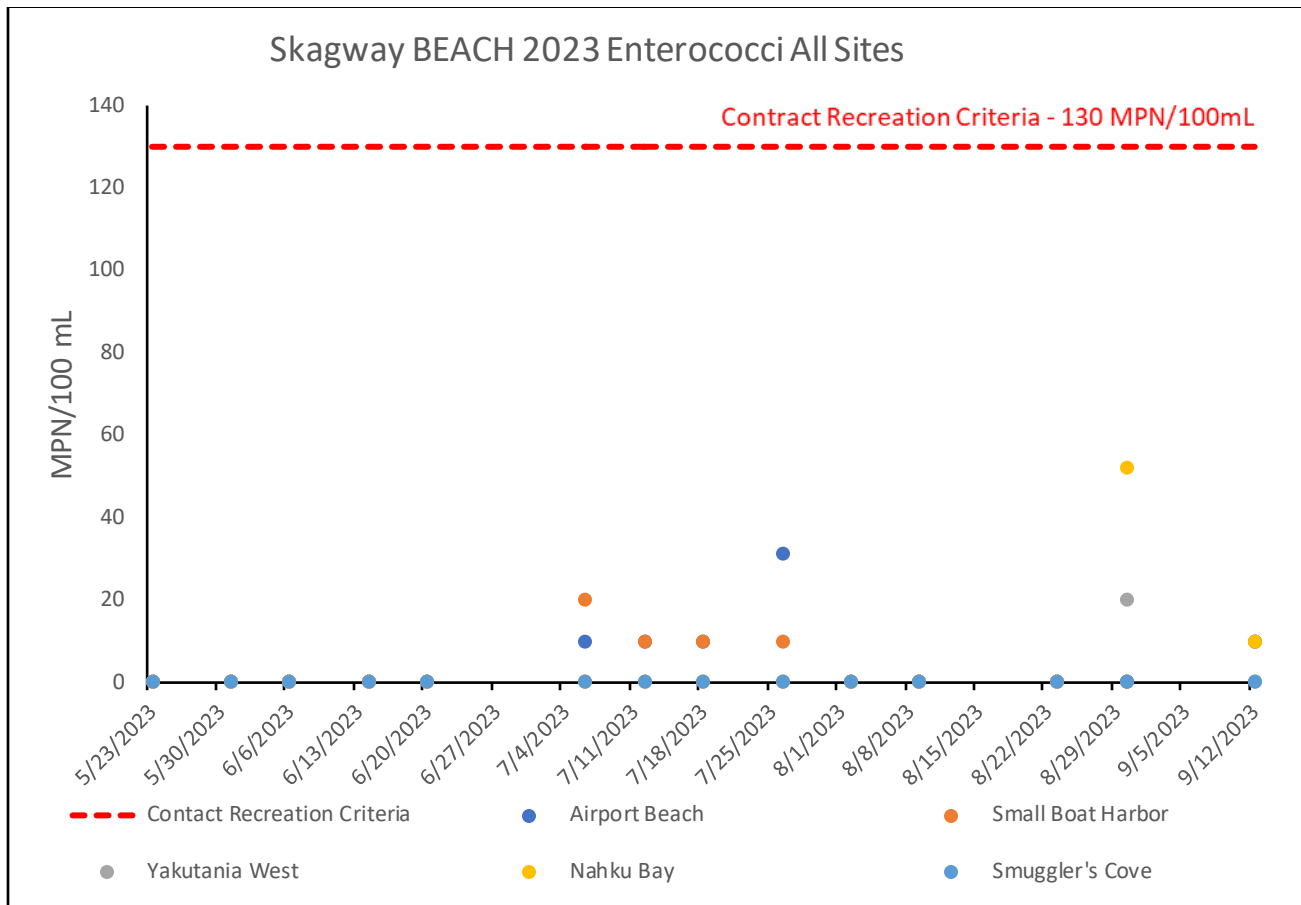


Figure 3. Enterococci analytical results, all sites.

⁸ ND = Not Detected; DNQ = Detected, not quantifiable; units are copies/100 mL

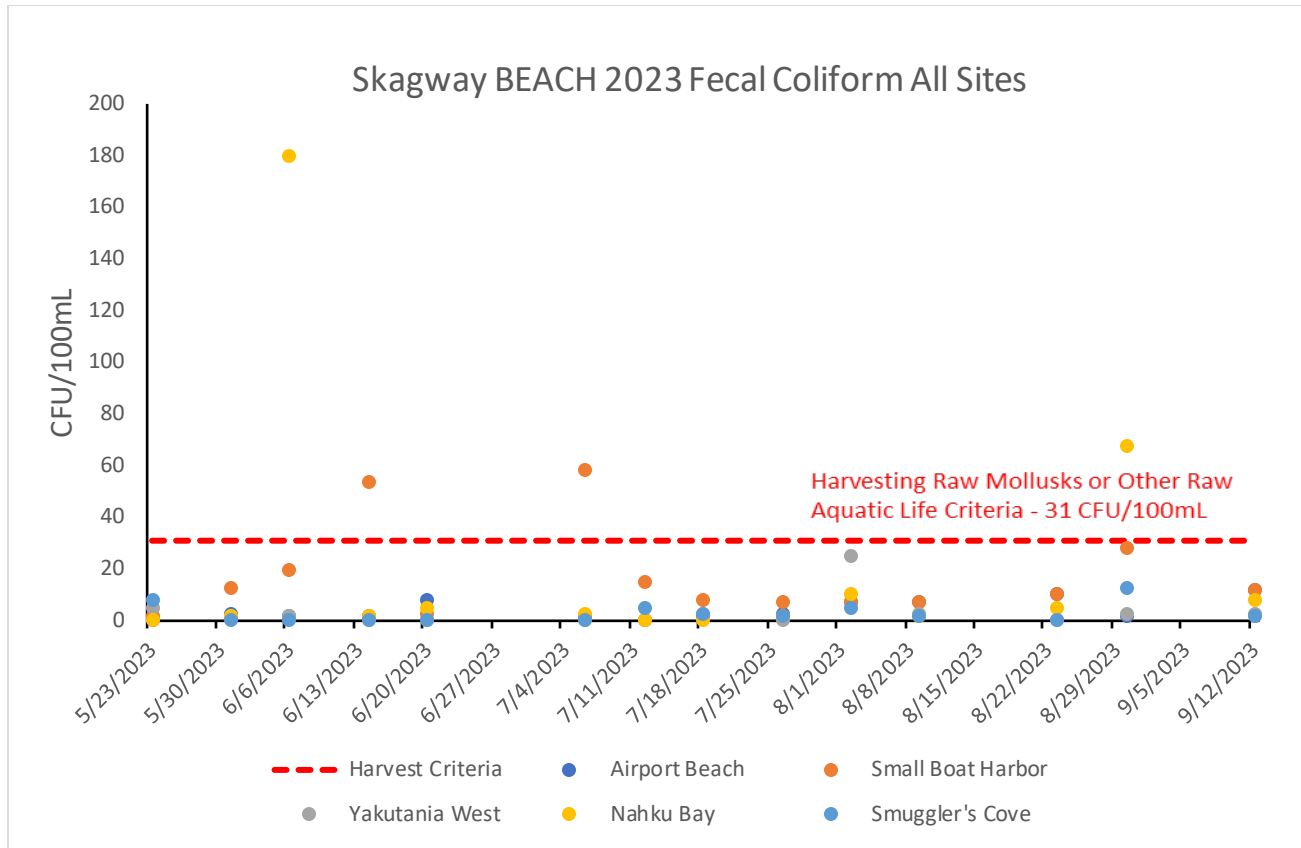


Figure 4. Fecal coliform analytical results, all sites.

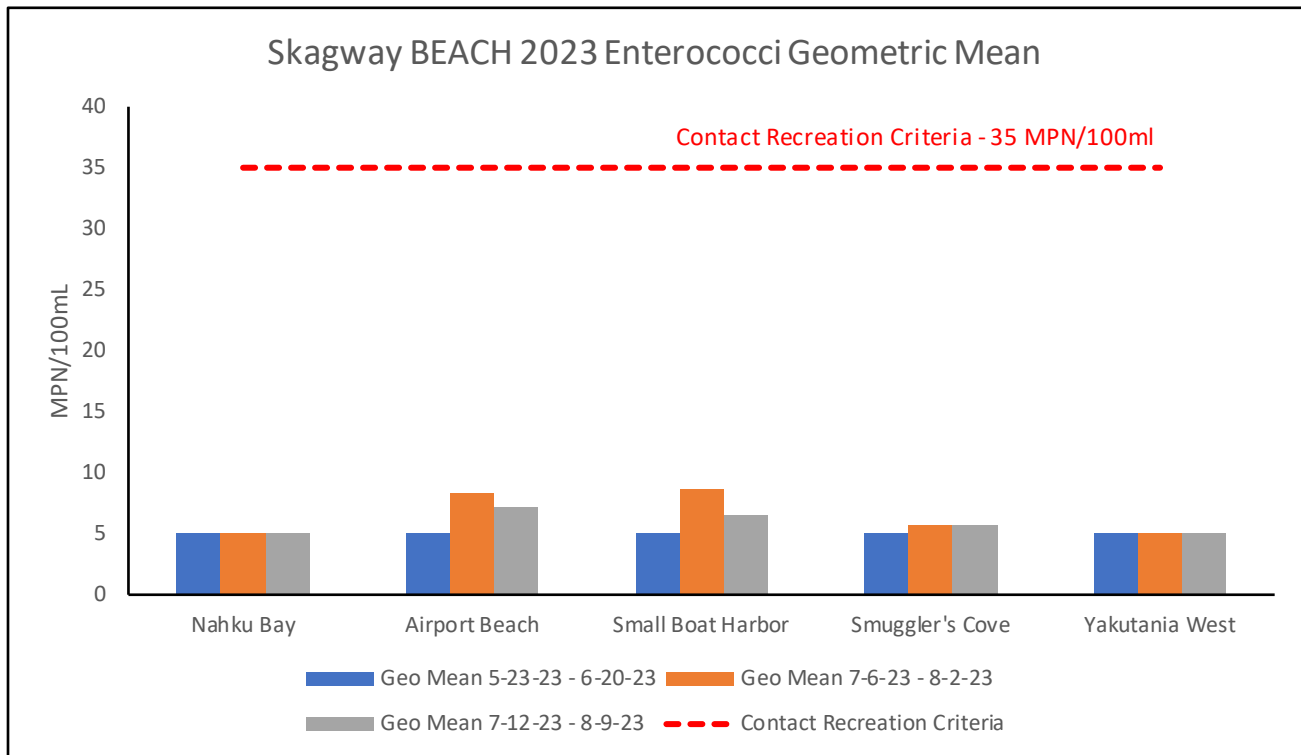


Figure 5. Enterococci rolling geometric mean, all sites.

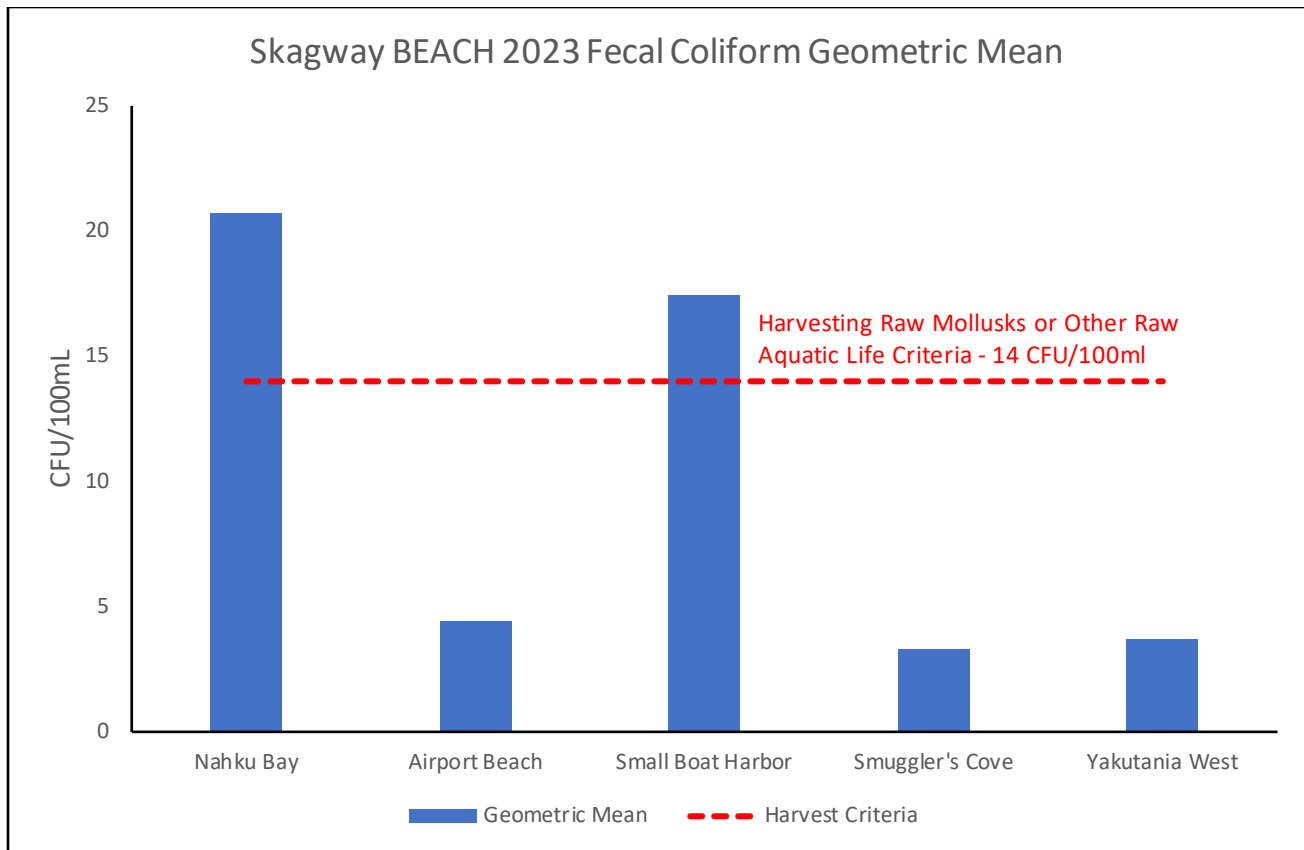


Figure 6. Fecal coliform seasonal geometric mean, all sites.

Outreach

STC and DEC developed a communication plan and released a general press release at the beginning of the monitoring season. The Alaska Beach Program website has a specific Skagway webpage highlighting an interactive map and data table with the most current beach sampling results, FAQs, and supporting project documents. During the water sampling season, DEC shared beach sampling results through a stakeholder email listserv and updated DEC website results table and interactive map as soon as analytical data was received. Facebook posts and advisory beach signage was prepared for when the contact recreational criteria exceedances occurred, however, no advisories or beach advisory sign postings were necessary during the 2023 recreational season. STC shared Beach Program information via social media and flyers posted around town prior to the monitoring season and held outreach events prior to the recreational season to share the general Beach Program and 2023 planned monitoring activities and following the recreational season to share the monitoring program results summary, potential bacteria sources, and next steps.

Conclusion

STC successfully implemented the first of two years of marine pathogen monitoring at Skagway recreational beaches, and results indicated that contact recreational activities were not negatively affected by high bacteria loads; however, limits for the harvesting of raw aquatic life for consumption were reached at both Nahku Bay and the Small Boat Harbor. Potential bacteria sources within the Small Boat Harbor are the wastewater treatment plant discharge and mixing zone and the boats in the harbor, while Nahku Bay potential bacteria sources include on-site individual septic systems. MST

analysis revealed human (Airport Beach, Yakutania Beach, Smuggler's Cove) and avian (Small Boat Harbor, Smuggler's Cove) markers in bacteria present on 9-12-23, no canine markers were reported at any site even though dog activity is present.

Recommended Next Steps

Project staff will replicate the 2023 beach monitoring effort in the summer of 2024. One minor change may be relocating the Airport Beach site, which currently requires crossing the mainstem of the Skagway River for access. This was not a safety issue in 2023 because of low river discharge but may become problematic during future high discharge flows.

STC is also concerned about the visibility of posted notices regarding the municipal wastewater treatment facility mixing zone. The permit requires that signs be posted notifying the public about the mixing zone and its risks, however, the facility mixing zone signage is poorly located and often covered by vegetation or blocked by vehicles (Figure 7). In an informal assessment of outreach participants, less than half of residents present were aware of the mixing zone and what activities should be avoided there. STC recommends improving the visibility of signage and engaging in community outreach to provide information about safety at recreational beaches within this zone.



Figure 7. Location of the wastewater treatment facility mixing zone warning sign, indicated by a red arrow; inset shows vegetation blocking visibility.

Appendix A – AAC 70(14) Water Quality Standards amended as of November 13, 2022

Designated Use Class	Use Subclass	Criteria
(A) Water Supply	(i) aquaculture	For products normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 200 fecal coliform/100 mL, and not more than 10% of the samples may exceed 400 fecal coliform/100 mL. For products not normally cooked, the geometric mean of samples taken in a 30-day period may not exceed 20 fecal coliform/100 mL, and not more than 10% of the samples may exceed 40 fecal coliform/100 mL.
	(ii) seafood processing	In a 30-day period, the geometric mean of samples may not exceed 20 fecal coliform/100 mL, and not more than 10% of the samples may exceed 40 fecal coliform/100 mL.
	(iii) industrial	Where worker contact is present, the geometric mean of samples taken in a 30-day period may not exceed 200 fecal coliform/100 mL, and not more than 10% of the samples may exceed 400 fecal coliform/100 mL.
(B) Water Recreation	(i) contact recreation	In a 30-day period, the geometric mean of samples may not exceed 35 enterococci CFU/100 mL, and not more than 10% of the samples may exceed a statistical threshold value of 130 enterococci CFU/100 mL.
	(ii) secondary recreation	In a 30-day period, the geometric mean of samples may not exceed 200 fecal coliform/100 mL, and not more than 10% of the samples may exceed 400 fecal coliform/100 mL.
(D) Harvesting for consumption of raw mollusks or other raw aquatic life		The geometric mean of samples may not exceed 14 fecal coliform CFU/100 mL; and not more than 10% of the samples may exceed 31 fecal coliform CFU/100 mL ⁹

⁹ When fecal coliform is monitored in waters designated as state approved shellfish harvesting and growing waters, these waters are also subject to 18 AAC 34.010(19).

Appendix B – 2023 Skagway Beaches Bacteria Data Results

Table B1. Fecal coliform analytical results, all sites.

Sample Date	Airport Beach ¹⁰	Small Boat Harbor	Yakutania West	Nahku Bay	Smuggler's Cove
5/23/2023	ND	2.0	5.0	ND	8.0
5/31/2023	3.0	13	2.0	2.0	ND
6/6/2023	2.0	20	2.0	180	ND
6/14/2023	2.0	54	ND	2.0	ND
6/20/2023	8.0	3.0	ND	5.0	ND
7/6/2023	2.0	58	ND	3.0	ND
7/12/2023	ND	15	ND	ND	5.0
7/18/2023	2.0	8.0	3.0	ND	3.0
7/26/2023	3.0	7.0	ND	2.0	2.0
8/2/2023	7.0	7.0	25	10	5.0
8/9/2023	7.0	7.0	3.0	2.0	2.0
8/23/2023	10	10	ND	5.0	ND
8/30/2023	2.0	28	3.0	68	13
9/12/2023	12	12	3.0	8.0	2.0

Table B2. Enterococci analytical results, all sites.

Sample Date	Airport Beach ¹¹	Small Boat Harbor	Yakutania West	Nahku Bay	Smuggler's Cove
5/23/2023	ND	ND	ND	ND	ND
5/31/2023	ND	ND	ND	ND	ND
6/6/2023	ND	ND	ND	ND	ND
6/14/2023	ND	ND	ND	ND	ND
6/20/2023	ND	ND	ND	ND	ND
7/6/2023	10	20	ND	ND	ND
7/12/2023	ND	10	ND	ND	ND
7/18/2023	ND	ND	ND	ND	10
7/26/2023	31	10	ND	ND	ND
8/2/2023	ND	ND	ND	ND	ND
8/9/2023	ND	ND	ND	ND	ND
8/23/2023	ND	ND	ND	ND	ND
8/30/2023	ND	ND	20	52	ND
9/12/2023	10	10	ND	10	ND

¹⁰ Non-detect (ND) is reported by the analytical laboratory as <2.0 FCU/100ml.

¹¹ Non-detect (ND) is reported by the analytical laboratory as <10 MPN/100ml.

Table B3. Fecal coliform seasonal geometric mean, all sites.

Site	5/23/2023 to 9/12/2023
Nahku Bay	20.7 ¹²
Airport Beach	4.4
Small Boat Harbor	17.4
Smuggler's Cove	3.3
Yakutania West	3.7

Table B4. Enterococci 30-day rolling geometric mean, all sites.

Site	5-23-23 to 6-20-23	7-6-23 to 8-2-23	7-12-23 to 8-9-23
Nahku Bay	5.0 ¹³	5.0	5.0
Airport Beach	5.0	8.3	7.2
Small Boat Harbor	5.0	8.7	6.6
Smuggler's Cove	5.0	5.7	5.7
Yakutania West	5.0	5.0	5.0

¹² When a sample result was non-detect, ½ the Practical Quantitation Limit of fecal coliform (2.0 FC/100ml) was used to calculate the seasonal geometric mean.

¹³ When a sample result was non-detect, ½ the Practical Quantitation Limit of fecal coliform (10 MPN/100ml) was used to calculate the rolling geometric mean.