2021 Small Cruise Ship and Ferry Wastewater Report

COMMERCIAL PASSENGER VESSEL ENVIRONMENTAL COMPLIANCE (CPVEC) PROGRAM

November 2021

Alaska Department of Environmental Conservation

Abbreviations:

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AMHS	Alaska Marine Highway System (State Ferry System)
AS	Alaska Statutes
AWTS	Advanced Wastewater Treatment Systems
BMP	Best Management Practices
BOD	Biological Oxygen Demand (sampled parameter)
BW	Blackwater
CLIA	Cruise Lines International Association
COD	Chemical Oxygen Demand (sampled parameter)
FC	Fecal Coliform (sampled parameter)
GW	Greywater
MSD	Marine Sanitation Device
ND	Non-detect value
QAPP	Quality Assurance Project Plan
SC	Specific Conductance (sampled parameter)
SCPV	Small Commercial Passenger Vessel
TSS	Total Suspended Solids (sampled parameter)
VSSP	Vessel Specific Sampling Plan

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INTRODUCTION

This report summarizes calendar year 2021 wastewater sampling results for small commercial passenger vessels (SCPVs) discharging in Alaska waters[1]. This includes small cruise ships[2] operating seasonally and Alaska Marine Highway System (AMHS) vessels intended to operate year-round. Appendix A is vessel information and Appendix B has wastewater sampling results.

Cruise ship operators cancelled their voyages to Alaska for the 2020 season due to COVID-19[3]. The 2021 season saw the return of SCPVs to the Alaska trade for the first time since the fall of 2019. In 2021, five operators registered 14 small commercial passenger vessels (SCPVs) with ADEC. Table 1 provides passenger and voyage counts for 2021. Thirteen vessels, including two AMHS vessels, intended to discharge to Alaska waters under an approved Best Management Practices (BMP) Plan[4]. One vessel, the National Geographic Orion, registered as a non-discharger but did not operate in AK waters. Appendix A, Table A1 contains the BMP plan numbers and wastewater operational status for each vessel.

Table 1. 2021 Passenger and Voyage Counts for Small Commercial Passenger Vessels

Vessel Operator	Vessel	Vessel Capacity [5]		Planned Voyages	Deviation	Completed Voyages	2021 Total Passengers [6]
		Passenger	Crew				
AMHS, State of Alaska	Kennicott	748	42				
AMHS, State of Alaska	Matanuska	498	50				
Alaskan Dream Cruises	Admiralty Dream	56	21	14	No	14	784
Alaskan Dream Cruises	Chichagof Dream	76	27	14	No	14	1064
American Cruises	American Constellation	173	46	12	No	12	2076
Lindblad/Nat. Geographic	NG Orion	102	75	6	Yes	Cancelled	0
Lindblad/Nat. Geographic	NG Quest	100	49	11	No	11	1100
Lindblad/Nat. Geographic	NG Sea Bird	62	35	13	No	13	806
Lindblad/Nat. Geographic	NG Sea Lion	62	35	12	No	12	744
Lindblad/Nat. Geographic	NG Venture	100	49	10	No	10	1000
UnCruise Adventures	S.S. Legacy	88	34	15	No	15	1320
UnCruise Adventures	Wilderness Adventurer	60	23	17	No	17	1020
UnCruise Adventures	Wilderness Discoverer	78	24	15	No	15	1170
UnCruise Adventures	Wilderness Explorer	74	26	17	No	17	1258
			Totals	**156**	**Yes**	**150**	**12,342**

[5] Based on the number of lower berths for small cruise ships (or max. passenger capacity for AMHS).

[6] Total passenger count for the season; assumes full capacity on every voyage. AMHS Itinerary varies.

[1] Alaska state water extends 3 miles from the coastline and includes the Alexander Archipelago.

[2] SCPVs have overnight accommodations (lower berths) for 50 to 249 passengers.

[3] AMHS vessels still operated. UnCruise Adventures cancelled operations in AK waters following a positive Covid-19 test on the Wilderness Adventurer (first voyage, incomplete).

[4] See 18 AAC 69.046

Thirteen SCPVs operated and discharged to AK waters in 2021, down from 17 discharging vessels in both 2018 and 2019. Discharging SCPVs are required to sample at least once during the season and AMHS vessels sample every 3 months of operation (4 samples total, assuming year around operation). In June 2021 ADEC implemented an updated sample regime to provide guidance to operators.

Sampling is necessary to:

- Verify that Marine Sanitation Devices (MSD) onboard are achieving effluent quality standards in accordance with Alaska law and their BMP Plans;
- Document the treatment systems performance and maintenance regime for future BMP Plan development; and
- Gather information on potential environmental impacts from smaller commercial vessels operating in AK waters.

Alaska law (AS 46.03.463) establishes discharge limits for fecal coliform (FC) and total suspended solids (TSS). If an exceedance of FC or TSS occurs the vessels BMP directs them to take corrective action, report to ADEC, and resample to confirm compliance. To ensure quality data, each vessel must have a Vessel Specific Sampling Plan (VSSP) and Quality Assurance Project Plan (QAPP), approved by ADEC. Deadlines for these and other required documents are listed in Table A2.

Reports and summaries for prior years can be found on the cruise program's report webpage (https://dec.alaska.gov/water/cruise-ships/cruise-reports/)

BACKGROUND

Commercial passenger ships produce two types of wastewater: blackwater (i.e., sewage) and greywater. Blackwater is wastewater from ship's toilets and medical facilities. Greywater is water from accommodations (showers/sinks), galley areas, and laundry. Any combination of blackwater and greywater will be referred to as mixed wastewater in this report, but technically it is considered blackwater.

For vessels operating in U.S. waters, Marine Sanitation Devices (MSD) must meet performance requirements[5] for US Coast Guard approval of Type II MSD systems for discharge of blackwater.

[5] Performance is measured under controlled test conditions.

Greywater treatment varies depending on the vessel. AMHS and many small cruise ships process greywater through their MSD. In the Alaska trade we see three approaches to greywater discharges based on the design and limitations of the vessel:

1) All greywater is mixed with blackwater and processed/treated through the MSD (referred to as mixed in this report).
2) Greywater is collected in tanks, treated independently of the MSD, and pumped overboard (referred to as GW in this report, dedicated GW collection tanks that are treated independently of the MSD, typically chlorinated, or chlorinated then dechlorinated, and then discharged)
3) Greywater is not treated and flows directly overboard via gravity drains.

For the latter two treatment types, limited amounts of greywater may be used for processing wastewater through the MSD. Advanced Wastewater Treatment Systems used in larger cruise ships can be found on the larger SCPVs (i.e., vessels near the 250-passenger upper limit). Typically, they are not found on smaller ships due to physical constraints (stability/space), economic feasibility, or both. Based on these factors the State of Alaska implemented a Best Management Practices (BMP) program for small vessels (<250 lower berths). Wastewater treatment technologies have developed and are available in compact form factors such that new small cruise ships builds would be expected to have advanced MSD systems onboard, cost and stability still playing a role depending on vessel size.

Regulations require the BMP to include certain elements, such as inclusion of no discharge areas, (18 AAC 69.046 (c)). Though not in regulation, the Department has begun working with operators to avoid, and minimize discharges in the Port of Ketchikan.

REQUIREMENTS

Small cruise ships may not discharge sewage from a small commercial passenger vessel unless the sewage has been processed through a properly operated and maintained MSD (AS 46.03.463)[6]. Small cruise ships and ferries discharging to Alaska marine waters are required to meet standard

[6] Determination of a properly maintained MSD is described 18 AAC 69.080.

terms and conditions or seek alternative terms and conditions with BMP plans. Alaska State Statues allowing alternative terms and conditions were updated in 2017. Subsequently, regulations were updated, and multiple operators are discharging under BMPs authorized by ADEC in 2018.

Standard terms and conditions for treated blackwater, greywater, and other wastewater (AS 46.03.463, Prohibited discharges; limitations on discharges) align with the USCG limits for approved Type II MSDs, 33 CFR 159.53(b). Wastewater must contain no more than 200 FC per 100 milliliters (FC/100ml) and no more than 150 milligrams per liter (mg/L) of TSS. Traditionally blackwater has had the highest median FC results, although very high results have also been found in greywater. Ships with separate greywater discharges are required to sample treated GW in accordance with the '2021 Small Commercial Passenger Vessel Sampling Regimes[7], June 2021 Revision 1.

METHODS

Wastewater sampling consists of grab samples taken from the MSD overboard pipe (described in the VSSP) while the vessel is discharging. The VSSP also described appropriate sampling times, to ensure samples are representative of wastewater discharges into Alaska waters. In 2021 the annual VSSP approval process involved additional review to verify the status of the wastewater treatment systems and discharge regimes. This review included wastewater tanks, treatment processes, and verification of sample valve locations. This review was followed up with onboard inspections of all vessels. The sampling process must follow the requirements in the vessels approved QAPP (See Table A3). In 2021, three cruise lines operators (Lindblad Expeditions, UnCruise Adventures and Alaska Dream Cruises) and AMHS used their own Quality Assurance Project Plan (QAPP) approved by the Department. American Cruise Lines used the 2021 Cruise Line International Association (CLIA) Alaska Wastewater QAPP, developed for Large Cruise ships. The QAPP specifies minimum requirements for the collection and analysis of wastewater samples. It includes a list of approved methods, data quality objectives, and responsibilities of the parties that approve the document.

[7] see Item #5 in the Resources/Documents

Sampling may occur when the vessel is underway or docked (stationary). All samples in this report were taken in Southeast Alaska in 2021, most samples occurring in or while in-route to Juneau, to meet sample holding times requirements in the QAPP. The Compliance program reviews results submitted by the cruise ship operators for compliance with the QAPP and VSSPs.

RESULTS

Table 2 and 3 provide summary data for effluent parameters measured. 2021 wastewater sampling results are listed in Appendix B. Results are separated into two tables, based on the wastewater type sampled: Appendix B has the small vessel wastewater sampling data from laboratory reports. Table B1 is GW samples are taken from onboard tanks that contain no sewage. Most, if not all, GW bypasses the MSD and is discharged directly overboard after chlorination (some vessels also dechlorinate prior to discharge). Table B2 is BW samples which is sewage mixed with greywater or seawater. These samples are taken from the overboard discharge sample valve and are representative of end-of-pipe (EOP) discharges treated by the MSD. Non-detect (ND) values are entered as zeros[8] and summary statistics are biased low (Helsel 1990). Some vessels are sampled for nutrients, metals (dissolved and total), or priority parameters [volatile organic compounds (VOCs) and base neutral acids (BNAs)]. Table B3 provides sample results for metals and Table B4 provides priority and nutrient sampling conducted.

Table 2. 2021 Small Cruise Ship Summary Data, GW Effluent

Analyte	Units	n (count)	Minimum [1]	Maximum	Median	Average
Temp	°C	7	14.7	21.7	16.6	17.5
pH	SU	7	3.19	7.50	7.00	5.94
Free Chlorine	mg/L	7	0	2.2	0.17	0.6
Total Chlorine	mg/L	7	0	2.20	0.17	0.72
Fecal Coliform Bacteria	FC/100ml	7	0	220,000	10	31,471
Total Suspended Solids	mg/L	7	0	68	42	32
Biochemical O_2 Demand	mg/L	6	81	5,100	175	1,295

[1] Zero Values are below lab/field detection level

[8] To be consistent with large cruise ship data, requiring calculation of geometric means. Metal non-detects are still reported as NDs

Table 3. 2021 Small Cruise Ship & Ferry Summary Data, BW EOP Effluent

Analyte	Units	n (count)	Minimum [1]	Maximum	Median	Average
Temp	°C	34	8.0	24.9	17.3	17.1
pH	SU	34	3.38	8.42	7.49	7.15
Free Chlorine	mg/L	34	0	30	0.11	2.6
Total Chlorine	mg/L	34	0	63	0.2	5.9
Fecal Coliform Bacteria	FC/100ml	34	0	5,900,000	2,350	309,738
Total Suspended Solids	mg/L	34	12	540	97	145
Biochemical O_2 Demand	mg/L	20	13	6100	135	559
Ammonia (as N)	mg/L	8	9.0	75	45.5	41.5
Chemical Oxygen Demand	mg/L	9	400	830	560	629
Total Settleable Solids	ml/L	9	0	11	0	1.3
Oil & Grease	mg/L	9	0	61.9	0	11.6
Alkalinity (Total)	mg/L	9	95	490	230	263
Hardness (as CaCO3)	mg/L	9	47	4,500	1,800	1,605
Specific Conductance	umhos/cm	11	1,330	43,700	23,100	18,658
Total Organic Carbon	mg/L	3	0	12.4	11.4	8
Total Kjeldahl Nitrogen	mg/L	2	7.50	17	12.25	12.25
Nitrate-Nitrite (as N)	mg/L	2	0.11	0.24	0.18	0
Total Phosphorus	mg/L	2	2.55	4.44	3.50	3.50

[1] Zero Values are below lab/field detection level

EXCEEDANCES

Table 4 provides an Exceedance summary for discharging vessels sampled in 2021. The FC and TSS exceedances are direct related to a poorly functioning/non-functioning MSD/wastewater treatment system. This can result from poor maintenance, operations, and other factors. Table B5 (Appendix B) summarizes resampling that was required in 2021. Most MSD systems on small vessels incorporate chlorination/maceration into the treatment process. In addition, some vessels also include chlorine injection (and neutralization/dichlorination for some vessels) as an add-on aftertreatment. Chlorine is sampled and resampling was required for high values of chlorine in 2021 (i.e., values greater than 10 mg/L); high chlorine levels may be indicative of a poorly functioning MSD system. Although resampling for high chlorine values was not done consistently in previous years, values this year (>20 mg/L total chlorine) can be just as harmful to the environment as high fecal loads.

Blackwater (Sewage)

Thirteen vessels were sampled over 34 sampling events in 2021. Seven vessels resampled due of high FC; all seven exceeded the FC limit a second time; 3 exceeded the FC limit a third time and

three improved performance of their MSD to meet standards. Six vessels had high TSS values, typically coinciding with a high fecal event. One vessel exceeded TSS during three sample events and improved TSS on the 4th sample. The other five vessels with TSS exceedances were able to meet standards during the subsequent sample event. One vessel was required to resampled due to high total residual chlorine value (TRC=63 mg/L). Typically resamples are only required for FC or TSS exceedances, however this value was the second highest TRC recorded in our 2015-2021 sample data (n=197; less than 1% of samples are > 10 mg/L). Table B2 has BW sample results. Table 5 provides an overview of exceedances (i.e., vessel count) by year since 2015.

Greywater (holding tanks)

Four vessels had independent GW systems that were sampled in 2021. Seven samples were taken resulting in one exceedance for FC.

BMP COMPLIANCE

In 2021 the Department goal was to inspect each vessel during the Alaska season. BMPs approvals are issued from the Department form within the Wastewater Discharge Authorization Program section, commonly referred to as our permitting section.

The 2021 BMP compliance items can be divided in two distinct categories:

- BMP compliance items related to the BMP Plan conditions this includes operations conducted onboard, such as wastewater discharge record keeping and MSD maintenance/operation record keeping. These items are typically identified during field inspection conducted onboard.
- BMP MSD performance items: this includes effluent sample results used to confirm the effluent quality and proper MSD operations. These items are typically identified by the preliminary sample results and confirmed with review of the final sample report. Should additional samples be required, as the result of under performance of the MSD, these procedures will be outlined.

BMP compliance items will be outlined in the forthcoming 2021 Annual Compliance report that will be issued separately. The compliance report will include an overview of 2021 SCPV noncompliance items resulting from onboard inspections. The compliance report will summarize inspections and compliance items for 2021. Wastewater sampling and resampling is summarized

in Table B5. In 2021, 6 of the 13 SCPVs in AK waters failed to meet their sampling goals prior the end of their operating season. Two vessels left AK waters (or ended revenue service) prior to achieving acceptable sample results from their MSD effluent. Three vessels were unable to meet their sampling goals as outlined in their VSSP. One vessel, American Constellation, failed both goals. Except for the AMHS vessels none of the cruise ships were able to obtain a second routine sample (where one was required).

In general, the 2021 inspections and sample results included significant increase of non-compliance items and poor effluent quality for FC and TSS compared to the 2019 season (see Table 4 – to reiterate, no small cruise ships visited Alaska in 2020). Vessel operational changes and or vessel management changes associated with the Covid-19 pandemic likely contributed to the increase of noncompliance items. Most noncompliance items were related to the MSD/wastewater treatment system (effluent/discharge) performance. Many vessels were taken out of service for a prolonged period and placed in lay-up status following the 2019 season. In the absence of voyages (fall 2019 – spring 2021) the wastewater treatment systems and related tanks were not used, or operated at very reduced capacities (i.e., lack of passengers). MSDs and wastewater tanks not properly prepped for storage or operated at reduced loads are subject to significant bacterial aftergrowth and solids accumulation. This will result in a deteriorated wastewater influent (untreated wastewater) quality (load), which the MSD/wastewater treatment system cannot handle upon return to revenue service. These conditions in addition to new crew (i.e., chief engineer) could explain the high number of poor-quality effluent samples (high FC and TSS levels) encountered in 2021. The AMHS Ferries sample results were in line with the BMP expectations; the Matanuska had similar results to 2020 (it did not operate in 2019) and Kennicott showed improved effluent quality with no exceedances in 2021; compared to the previous two years, with one FC exceedance in 2019 and one FC exceedance in 2020.

Table 4. 2021 Exceedance Summary by Vessels

Vessel Name	WW Type	Samples Taken (Total)	2021 Exceedances (count)			VESSEL Resampled (Y/N/NR)	End of Season Status
			Fecal Coliform (>200FC /100ml)	Total Suspended Solids (>150 mg/L)	Total Chlorine[1] (>10 mg/L)		
Blackwater (Sewage)							
Admiralty Dream	BW	1	0	0	0	Not Required	Results acceptable
Chichagof Dream	BW	4	4	1	0	Yes	Did not meet standards prior to end of season
American Constellation	MIX	2	2	0	0	Yes	Did not meet standards prior to end of season
Kennicott	MIX	2	0	0	0	Not Required	Results acceptable
Matanuska	MIX	2	1	0	0	No	Results acceptable
NG Quest	MIX	3	2	1	0	Yes	Results acceptable
NG Sea Bird	BW	1	0	0	0	Not Required	Results acceptable
NG Sea Lion	BW	2	0	1	0	Yes	Results acceptable
NG Venture	MIX	3	2	1	0	Yes	Results acceptable
SS Legacy	BW	3	2	1	0	Yes	Results acceptable
Wilderness Adventurer	MIX	1	0	0	0	Not Required	Results acceptable
Wilderness Discoverer	BW	5	3	3	1	Not Required	Did not meet standards prior to end of season
Wilderness Explorer	BW	5	4	0	1	Not Required	Results acceptable
Totals (BW)		34	20	8	2		
Percent of Samples			59%	24%	6%		
Greywater Only							
Admiralty Dream	GW	2	0	0	0	Not Required	Results acceptable
Chichagof Dream	GW	3	1	0	0	Yes	Results acceptable
NG Sea Bird	GW	1	0	0	0	Not Required	Results acceptable
NG Sea Lion	GW	1	0	0	0	Not Required	Results acceptable
Totals (GW)		7	1	0	0		
Percent of Samples			14%	0%	0%		

[1] Resampling requested for Total Chlorine > 10 mg/L. State WQ standard is 0.1 mg/L.

Table 5. 2015-2021 Comparison Blackwater Effluent, Vessel Count

VESSELS	2021	2019	2018	2017	2016	2015
Vessels in AK waters (D/ND) [1]	13/1	17/2	17/1	15/1	15/1	14/1
Vessels Sampled (MSD effluent)	13	13	17	12	13	13
Vessels with FC Exceedance (>200 FC/100mL)	8	6	7	7	3	10
Vessels with TSS Exceedance (>150 mg/L)	6	3	4	4	6	5
Vessels with high Total Chlorine (>10 mg/L)	1	1	0	0	5	1

[1] D/ND: Discharge / NonDischarge vessels (based on Registration). No vessels sampled in 2020 due to Covid-19.

CONCLUSION

In 2021, effluent sampling was required for all 13 vessels that operated and discharged to AK waters. No resampling was required for 5 vessels (AMHS and three cruise ships). The other eight required resampling. Forty-one (41) small vessel wastewater samples were taken in 2021, and 25 samples had at least one exceeded parameter (FC, TSS, or TRC). Effluent sampling resulted in 21 FC exceedances (20 out of 34 for BW, and 1 out of 7 for GW). Seven vessels had FC exceedances and all seven resamples resulted a second FC exceedance. Three vessels still exceeded FC on the third sample attempt (second resample). There were eight TSS exceedances (6 of these coincided with high FC values). Three vessels failed to meet FC/TSS standards before leaving state waters or ending revenue service: American Constellation, Wilderness Discoverer, and Chichagof Dream. Biological oxygen demand (BOD) was an issue for 3 National Geographic vessels with values ranging from 1,000-6,100 mg/L for 5 sample events. It should be noted that these MSD systems are not designed to remove BOD and an exceedance does not trigger a resample. We have noted BOD as an item of concern and will work with operators to reduce high values.

Historically MSD systems on small vessels have not been able to consistently meet effluent quality standard but 2021 had the highest number of vessels with exceedances since 2015 (Table 5). To avoid a repeat of the MSD/wastewater treatment systems performance issues in 2022, the CPVEC program will require the following steps before and during the 2022 season:

- SCPVs that opt to discharge under a BMP Plan in 2022 are required:
    - Before initial arrival in Alaska waters, the vessel must provide written documentation ('proof') that the vessel wastewater treatment process related tanks, including the MSD unit, are cleaned, and inspected.
    - Before initial arrival in Alaska waters, a representative sample result (not older than 21 days) must be provided, to confirm that the MSD/wastewater treatment system, and the applicable aftertreatment systems, are working and properly operated. If the (preliminary) sample result points to a nonfunctional MSD/WW treatment system, the vessel shall perform any corrective actions necessary to properly operate the onboard MSD and schedule a resample as expeditiously as possible, with written justification if the vessel cannot be resampled prior to arrival in Alaskan waters. Vessels which do not achieve performance standards prior to

arrival in Alaska will be expected to conduct sampling as outlined in the below two items.

At the initial arrival at the first port in Alaska, an MSD/wastewater treatment system discharge representative sample must be taken to verify proper working/treatment of the generated wastewater. The results are required to be submitted to the Department within 3 days of the sample results.

- If the vessel initial sample results indicate a problem with the wastewater treatment system, the Department may require that weekly sampling and corrective action reports be submitted until acceptable results are obtained. Timely assessment, corrective actions (including vendor/manufacturer assistance), and resamples will be requested to reduce the discharge of poor-quality effluent to AK waters.

The CPVEC program will continue to work with small cruise ships and AMHS to improve overall wastewater effluent quality. Small cruise ships and state ferries continue to balance bacterial digestion processes with chlorine disinfection. Chlorine is used to sterilize effluent, but it is toxic to marine organisms and high residuals (over-dosage) must be avoided. Several vessels have installed equipment to dechlorinate the treated wastewater. For the MSD/wastewater treatment systems that rely on the chlorination aftertreatment and for GW tank treatment, de-chlorination may be required.

Since the beginning of the CPVEC program and implementation of the small cruise ship BMPs several vessels have shown improvements and more consistent performance of their MSD units. Unfortunately, for the 2021 season it became evident that some ships continue to exceed standards for FC, TSS, and chlorine. These systems are not designed to treat BOD, but perhaps high values can be minimized.

In 2021, two major compliance issues were identified that warrant 2022 oversight that is focused to avoid a repeat of the 2021 issues. The small vessel compliance focus / actions for the 2022 season include:

1) MSD Wastewater treatment system operational instructions: accessible operational instruction for the wastewater treatment system must be onboard. This includes a trouble shooting process, action-plans, and other documented elements that support good operation

practices of the wastewater treatment system. A copy of this documentation must be on file with CPVEC and submitted before the vessel arrives in Alaska waters. Most vessels already have these plans in place.

FC and TSS levels: multiple vessels had FC exceedances that resulted from influent bacterial loads and the influent 'solids load". In addition, some vessels struggled with maintaining sufficient chlorine levels. By correcting the mechanical and process issues and/or increasing the dosage of chlorine used the vessels were able to reduce the FC levels. Relying on additional chlorine often resulted in overdoing and high total chlorine values. Several vessels required multiple re-sample events to correct and improve the performance. About 25% of blackwater samples contained high chlorine levels; TRC > 5 mg/L (see Table B2 in Appendix B), while AKWQS are exceeded at 0.10 mg/L.

Raising the chlorine dosage was in many cases a temporary means to reduce FC levels, and not an effective method to improve MSD/wastewater treatment system performance. A more structural approach is required to improve the effluent performances. This includes the tanks cleaning, pre-season performance sampling, initial arrival sampling, and finally more specific operational instructions for the operators, including process monitoring and troubleshooting. The vessels will need to work within their ADEC approved BMP plans to diagnose and conduct corrective actions to improve overall effluent quality entering Alaska waters.

2) Process Sampling Monitoring: The vessels typically do not engage in frequent MSD/wastewater treatment system process monitoring by sampling. Vessel could improve their wastewater treatment process by regular (daily) sampling and adjusting the process parameters (e.g., de-sludging, chlorine injection, pH etc.). Although 'process sampling" on board is not the same as the regulatory sampling it does help to support the process and could identify issues early. Manufacturer/vendor recommended MSD maintenance and operational instructions must be adhered too, this item will again be included onboard inspections conducted in 2022.

References

Helsel, D.R. (1990). Less than obvious; statistical treatment of data below the detection limit. Environ. Sci. Technol 24(12);1767-1774.

RESOURCES/DOCUMENTS

1) Alaska Department of Environmental Conservation (ADEC) Cruise Ship Program
   http://dec.alaska.gov/water/cruise-ships/

2) Small Cruise Ship Discharge Options
   http://dec.alaska.gov/water/cruise-ships/cruise-smallship/

3) Alaska Cruise Ship Laws and Regulations
   http://dec.alaska.gov/water/cruise-ships/laws-regs/

4) 2021 CLIA Wastewater Sampling Quality Assurance Project Plan
   http://dec.alaska.gov/water/cruise-ships/cruise-operator/

5) 2021 Small Commercial Vessel Sampling Regimes
   http://dec.alaska.gov/water/cruise-ships/cruise-registration/ (Other Documents section)

6) Sample reports and summaries from previous years
   http://dec.alaska.gov/water/cruise-ships/cruise-reports/

APPENDIX A: SMALL PASSENGER VESSEL INFORMATION

Table A1: 2021 Wastewater Treatment and Discharges from SCPVs[1] in AK Waters

	Vessel Operator	Vessel Name	Wastewater Treatment System [2]		Units	Best Management Practices Plan	Discharge to AK waters [3]		GW Treatment [4]
			Manufaturer	Model			BW	GW	
1	AMHS, State of Alaska	*Kennicott*	Orca	Model II 500	3	C0-012-2019	Yes - Mixed		
2	AMHS, State of Alaska	*Matanuska*	Omnipure	15MX	3	C0-015-2019	Yes - Mixed		
3	Alaskan Dream Cruises	*Admiralty Dream*	Omnipure	12M	1	00-018A-2018	Yes	Yes	chlorination
4	Alaskan Dream Cruises	*Chichagof Dream*	Orca	Model II A-500	1	00-018A-2018	Yes	Yes	chlorination
5	American Cruises	*American Constellation*	MarineFAST	BMS D-9S	1	00-038-2018	Yes - Mixed		
6	Lindblad/Nat. Geographic	*NG Orion ND*	Triton	MSTP 7 Standard	1	N/A	No	No	
7	Lindblad/Nat. Geographic	*NG Quest*	G&O Bioreactor	BR-37000 BG-V	1	C0-039-2021	Yes - Mixed		
8	Lindblad/Nat. Geographic	*NG Sea Bird*	Omnipure	12MX	1	C0-025-2021	Yes	Yes	chlorination/dechlorination
9	Lindblad/Nat. Geographic	*NG Sea Lion*	Omnipure	12M	1	C0-026-2021	Yes	Yes	chlorination/dechlorination
10	Lindblad/Nat. Geographic	*NG Venture*	G&O Bioreactor	BR-37000 BG-V	1	C0-040-2021	Yes - Mixed		
11	UnCruise Adventures	*S.S. Legacy*	Red Fox	RF-2000-FP	1	C0-036-2021	Yes	Yes	Untreated, Gravity Drains
12	UnCruise Adventures	*Wilderness Adventurer*	Omnipure	12MX	1	C0-036-2021	Yes - Mixed		
13	UnCruise Adventures	*Wilderness Discoverer*	Headhunter	TW-HMX-6004LP	2	C0-036-2021	Yes - Mixed		
14	UnCruise Adventures	*Wilderness Explorer*	Headhunter	TW-HMX-6004LP	2	C0-036-2021	Yes	Yes	Untreated, Gravity Drains

Vessels highlighted in gray (and indicated by 'ND') have registered as non-discharge vessels for the 2021 Cruise Ship Season.

[1] Small commercial passenger vessels have overnight accommodations for 50 to 249 passengers (based on lower berths).

[2] Nondischarging vessels are not required to provide treatment system information. AWTS=Advanced Wastewater Treatment System (not typical on small vessels).

[3] Alaska water extends 3 miles from the coastline and inlcudes the Alexander Archipelago

[4] Not all vessels process GW through the MSD system. Gravity drains flow directly overboard.

Table A2: 2021 Requirements and Deadlines for Small Commercial Passenger

Document	Authority	Due Date
PRE-SEASON Requirements:		
REGISTRATION & Notarized Signature Page	AS 46.03.461, 18 AAC 69.010	March 1st
Non-hazardous Solid Waste Offloading and Disposal Plan	AS 46.03.475(e)(1), 18 AAC 69.035	March 1st
Hazardous Waste and Substance Offloading Plan	AS 46.03.475(e)(2), 18 AAC 69.040	March 1st
Requirements if Discharging IN ALASKAN WATERS:		
Quality Assurance Project Plan (QAPP) **[1]** (Approved QAPPs are valid for up to 3 years)	AS 46.03.465(b), 18 AAC 69.025	March 1st
Best Management Practices(BMP) Plan **[1, 2]** (Approved BMPs are valid for up to 5 years)	AS 46.03.462(k)	March 1st
Vessel Specific Sampling Plan (VSSP) (VSSPs are approved annually and valid for the season)	AS46.03.465 (b), 18 AAC 69.030	A 2021 VSSP is required 21 days before sampling.
Wastewater Sampling - LAB RESULTS	18 AAC 69.055	21 days after analytical testing is complete
OTHER Requirements:		
MSD Documentation (Maintenance, Daily Logs), Discharge Logs, & other BMP documents required to be maintained onboard.	18 AAC 69.045	Upon Request from ADEC-CPVEC
Voyage Report and Deviation Report to document any changes to the number of voyages or deviations from waste plans	18 AAC 69.015, 18 AAC 69.065	November 15th

[1] Deadline is for new plans. Vessel may have a valid approved plan on file.

[2] If a BMP is not submitted, a permit to discharge is needed which meets the terms and conditions of Alaska statue 46.03.462(b).

Table A3: 2021 ADEC Approved QAPPs for Small Commercial Passenger Vessels

2021 Season - Small Commercial Passenger Vessels, ADEC Approved QAPP

Vessel Operator	Vessel Name	Quality Assurance Project Plan (QAPP) for Sampling & Analysis of Treated Wastewater	Field Parameters Measured by: [1]
ADOT&PF	*Kennicott*	Alaska Marine Highway System fleetwide QAPP -- February 2018	Admiralty Environmental
	Matanuska		
Alaskan Dream Cruises	*Admiralty Dream*	Alaskan Dream Cruises fleetwide QAPP -- April 2019	Vessel crew
	Chichagof Dream		
American Cruise Lines	*American Constellation*	2021 CLIA Alaska QAPP	Admiralty Environmental
Lindblad Expeditions	*National Geographic Quest*	Lindblad Expeditions fleetwide QAPP -- April 2019	Vessel crew
	National Geographic Sea Bird		
	National Geographic Sea Lion		
	National Geographic Venture		
UnCruise Adventures	*S.S. Legacy*	UnCruise Adventures fleetwide QAPP -- March 2020	Admiralty Environmental
	Wilderness Adventurer		
	Wilderness Discoverer		
	Wilderness Explorer		

[1] All analytes other than field parameters were processed by Admiralty Environmental or one of their designated subcontractor labs.

APPENDIX B: WASTEWATER RESULTS

Table B1. 2021 Greywater Sampling: Small Cruise Ship

Analyte[1, 2]					Field				Convention I		
					Temp	**pH**	**Free Chlorine**	**Total Chlorine**	**Fecal Coliform Bacteria**	**Total Suspended Solids**	**Biochemical O_2 Demand**
Units				**Sample IP/UW (InPort/ Underway)**	°C	SU	mg/L	mg/L	FC/100ml	mg/L	mg/L
Alaska Marine Water Quality Standards, AS 46.03.463, or Secondary Treatment Standard.			WW Type		N/A	6.5-8.5	N/A	0.0075	200	150	60
Vessel Name	**Date**	**Sample #**									
Admiralty Dream	7/10/21	AE 26893	GW	UW	14.7	6.50	1.08	2.20	100	68	170
Admiralty Dream	7/10/21	AE 26893	GW	UW	16.1	7.00	2.2	2.2	0	0	81
Chichagof Dream	6/21/21	AE 26777	GW	UW	21.7	7.50	0	0	0	48	140
Chichagof Dream	6/21/21	AE 26777	GW	UW	19.3	7.10	0	0	**220,000**	46	180
Chichagof Dream	8/13/21	AE 27099	GW	UW	18.7	7.10	0	0	180	42	
NG Sea Bird	7/16/21	AE 26888	GW	UW	16.6	3.19	0	0	10	22	5,100
NG Sea Lion	7/10/21	AE 26885	GW	UW	15.5	3.21	0	0	10	0	2,100

[1] Parameter not Analyzed or "No Data"

[2] **Exceeds standards.** BMP requires corrective action and resample for FC & TSS exceedances

Table B2. 2021 Blackwater (Sewage) Sampling: Small Cruise Ship and AMHS Vessels

					Field				Convention I			Convention II							Nutrients			
Analyte[1, 2]					**Temp**	**pH**	**Free Cl**	**Total Cl**	**Fecal Coliform**	**TSS**	**BOD**	**Ammonia (as N)**	**COD**	**Settleable Solids**	**Oil & Grease**	**Alkalinity (Total)**	**Hardness (CaCO3)**	**S.Conductance**	**TOC**	**Kjeldahl Nitrogen**	**Nitrate-Nitrite**	**Phosphorus**
Units					°C	SU	mg/L	mg/L	FC/100ml	mg/L	mg/L	mg/L	mg/L	ml/L	mg/L	mg/L	mg/L	umhos/c	mg/L	mg/L	mg/L	mg/L
Alaska Marine Water Quality Standards, AS 46.03.463, or Secondary Treatment Standard.					N/A	6.5-8.5	N/A	0.0075	200	150	60	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vessel Name	**Date**	**Sample #**	MSD	**IP/UW**																		
Admiralty Dream	7/10/21	AE 26893	BW	UW	14.30	7.90	0.31	1.1	170	37	45											
Chichagof Dream	6/21/21	AE 26777	BW	UW	18.90	7.60	0.41	0	**2,700**	116	120											
Chichagof Dream	7/16/21	AE 26977	BW	UW	18.50	7.73	0.70	0.70	**410,000**	98												
Chichagof Dream	8/13/21	AE 27099	BW	UW	18.30	7.30	3.0	6.9	**1,600**	**324**												
Chichagof Dream	9/6/21	AE 27406	BW	UW	18.70	8.20	1.6	2.5	**420,000**	148												
American Constellation	6/14/21	AE 26753	MIX	IP	24.90	7.84	0	0	**2,600**	60	230	62	400	0	0	440	140	2,130				
American Constellation	8/4/21	AE 27139	MIX	IP	24.50	7.37	0	0	**690,000**	56	200	75	520	0	0	490	100	1,570				
Kennicott	5/12/21	AE 26548	MIX	IP	10.50	7.75	1.9	2.0	48	13	13		760	0	0	95	4,500	43,700	0			
Kennicott	8/4/21	AE 26971	MIX	IP	17.20	7.62	2.0	2.8	0	12	15							31,200				
Matanuska	6/6/21	AE 26550	MIX	IP	16.80	7.23	0	0	18	33	77	9.0	560	0	8.4	100	2,700	23,100	12.4	17	0.24	2.55
Matanuska	8/1/21	AE 26890	MIX	IP	20.50	6.65	0	0	**360**	72	120							22,200				
NG Quest	6/12/21	AE 26690	MIX	UW	17.70	7.31	0.12	0	**17,000**	**187**	260											
NG Quest	7/10/21	AE 26884	MIX	UW	8.00	7.24	0	0.3	**24,000**	96	470	60	520	0	0	360	47	1,330				
NG Quest	8/7/21	AE 27095	MIX	UW	20.72	7.63	0.21	4.4	100	**144**												
NG Sea Bird	7/16/21	AE 26888	BW	UW	16.00	4.83	0	0	10	28	6,100											
NG Sea Lion	7/10/21	AE 26885	BW	UW	15.50	3.38	0.10	0.10	100	**380**	1,600											
NG Sea Lion	8/9/21	AE 27160	BW	UW	13.80	3.96	0	0	10	12												
NG Venture	6/20/21	AE 26691	MIX	UW	17.70	6.57	0	0	**810,000**	**420**	52											
NG Venture	7/18/21	AE 26889	MIX	UW	19.40	7.25	0	0	**130,000**	104	1,000	63	770	0	62	370	160	3,010				
NG Venture	8/1/21	AE 27096	MIX	UW	17.30	7.03	0.61	2.9	100	132												
SS Legacy	5/22/21	AE 26603	BW	IP	13.50	7.69	0	0	**240,000**	172	140											
SS Legacy	6/19/21	AE 26815	BW	IP	16.70	8.03	0	0	**130,000**	90												
SS Legacy	7/17/21	AE 26918	BW	IP	16.20	5.61	5.3	10.0	90	35												
Wilderness Adventurer	6/11/21	AE 26730	MIX	IP	17.50	7.72	2.0	16.0	180	**200**	210	15	830	11	27.7	130	1,800	26,100				
Wilderness Discoverer	5/16/21	AE 26601	BW	IP	11.00	8.42	26	63	10	33	130	17	760	0	0	150	2,500	26,000				
Wilderness Discoverer	6/20/21	AE 26816	BW	IP	17.20	8.32	7.4	7.7	100	**380**												
Wilderness Discoverer	7/18/21	AE 27020	BW	IP	21.60	7.25	0.10	1.7	**3,900**	**470**												
Wilderness Discoverer	8/1/21	AE 27113	BW	IP	22.70	6.79	0	0	**5,900,000**	**540**												
Wilderness Discoverer	8/8/21	AE 27187	BW	IP	18.60	6.35	0	0	**2,100**	124												
Wilderness Explorer	5/30/21	AE 26604	BW	IP	13.2	7.93	30	34	**2,800**	68	130											
Wilderness Explorer	6/27/21	AE 26731	BW	IP	14.80	7.65	0	0	**540,000**	94	120	31	540	0.50	6.20	230	2,500	24,900	11.4	7.50	0.11	4.44
Wilderness Explorer	7/11/21	AE 26886	BW	IP	14.3	7.17	0	0	**1,200,000**	82	140											
Wilderness Explorer	7/18/21	AE 27019	BW	IP	16.10	8.07	1.7	28	**3,000**	66												
Wilderness Explorer	8/1/21	AE 27112	BW	IP	17.40	7.81	4.2	18	100	102												
NG Venture [3]	6/27/21	AE 26866	MIX	IP	18.60	6.59	0	0	**210,000**	100												

[1] Parameter not Analyzed or "No Data"

[2] **Exceeds standards.** BMP requires corrective action and resample for FC & TSS

[3] Not Discharging (Recirculation Mode), Not included in Data Analysis

Table B3. 2021 Metals Results: Small Cruise Ship and AMHS Vessels

			DISSO							TOTAL							
			Arsenic (DISS)	Chromium (DISS)	Copper (DISS)	Lead (DISS)	Nickel (DISS)	Selenium (DISS)	Zinc (DISS)	Arsenic (TR)	Chromium (TR)	Copper (TR)	Lead (TR)	Nickel (TR)	Selenium (TR)	Zinc (TR)	Mercury (Total)
Units			µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg	µg/mg
Alaska Marine Water Quality Standards (chronic for marine life)			36	50 (chromium IV)	3.1	8.1	8.2	71	81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.94
Vessel Name	**Date**	**WW Type**															
American Constellation	8/4/2021	MIX	ND	1.2	3	ND	5.1	1.4	22	ND	3.8	63	ND	5.8	ND	66	ND
Kennicott	5/12/2021	MIX	ND	ND	39	ND	ND	ND	100	ND	ND	53	ND	ND	ND	110	ND
Matanuska	6/6/2021	MIX	ND	ND	210	ND	ND	ND	58	ND	ND	260	ND	ND	ND	65	ND
NG Quest	7/10/2021	MIX	3.2	1.2	25	ND	5.3	ND	80	3.2	2.4	100	ND	6.0	ND	230	ND
NG Venture	7/18/2021	MIX	2.2	1.0	91	ND	6.3	1.6	210	2.0	1.8	120	1.3	6.5	1.2	300	ND
Wilderness Adventurer	6/11/2021	MIX	ND	ND	36	ND	ND	ND	56	ND	ND	87	ND	ND	ND	190	ND
Wilderness Discoverer	5/16/2021	BW	ND	ND	38	ND	ND	ND	93	ND	ND	55	ND	ND	ND	180	ND
Wilderness Explorer	6/27/2021	BW	ND	ND	ND	ND	ND	ND	20	ND	ND	120	ND	ND	ND	94	ND

[1] ND=non-detect. **Note:** Lab analysis conducted for: Antimony, Beryllium, Cadmium, Silver, and Thallium. All results were non-detects so these metals were omitted from the table.

Table B4. 2021 Priority/Nutrient Results: Small Cruise Ship and AMHS Vessels

Vessel		American Constellation	Kennicott	Matanuska	NG Quest	NG Venture	Wilderness Adventurer	Wilderness Discoverer	Wilderness Explorer
Sample Date		8/4/2021	5/12/2021	6/6/2021	7/10/2021	7/18/2021	6/11/2021	5/16/2021	6/27/2021
SampleNo		AE 27139	AE 26548	AE 26550	AE 26884	AE 26889	AE 26730	AE 26601	AE 26731
Analyte	Units								
3/4-Methylphenol	ug/L	ND	ND	ND	170	ND	ND	8.2	9.9
Acetone	ug/L	ND	ND	ND	520	76	ND	130	ND
Benzoic Acid	ug/L	ND	ND	58	430	65	ND	150	120 *
Benzyl Alcohol	ug/L	ND	ND	ND		100	ND	ND	ND
bromoform	ug/L	ND	43	170		6.3	220	ND	ND
chloroform	ug/L	ND	ND	ND	71	150		7.8	ND
phenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND
toluene	ug/L	21	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ug/L	ND	ND	30	ND	ND	72	ND	ND
Chloromethane	ug/L	ND	ND	ND	71	23	ND	ND	ND
m,p-Xylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ug/L	ND	ND	ND	ND	6.2	16	5.6	ND
Diethyl phthalate	ug/L	ND	ND	ND	ND	ND	ND	7.2	ND
2,4,6-Trichlorophenol	ug/L	ND	ND	ND	ND	ND	ND	9.7	ND
Ethylbenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND
Ammonia (as N)	mg/L			9.0					31
Total Organic Carbon	mg/L			12.4					11.4
Total Kjeldahl Nitrogen	mg/L			17					7.5
Nitrogen, Nitrate-Nitrite (as N)	mg/L			0.24					0.11
Total Phosphorus (as P)	mg/L			2.55					4.44

[1] Parameter not Analyzed or "No Data"

*Lab flagged item for insufficient sample volume. Estimated value.

Table B5. 2021 Sampling Overview and Resampling Summary: Small Cruise Ship and AMHS Vessels

	2021 Required Samples		SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4		SAMPLE 5		SAMPLE 6	
Vessel	Required	Achieved	Date	Results	Date	Results	Date	Results	Date	Results	Date	Results	Date	Results
Admiralty Dream	1	Yes	6/26/2021	Rejected*	7/10/2021	OK								
Chichagof Dream	1	Yes	6/21/2021	FC	7/16/2021	FC	8/13/2021	FC/TSS	9/6/2021	FC/TSS	Resample Needed			
American Constellation	2	No	6/14/2021	FC	8/4/2021	FC	Resample Needed		Routine required					
Kennicott	quarterly	Yes	5/12/2021	OK	8/4/2021	OK								
Matanuska	quarterly	Yes	6/6/2021	OK	8/1/2021	OK								
NG Quest	2	No	6/12/2021	FC/TSS	7/10/2021	FC	8/7/2021	OK	Routine required					
NG Sea Bird	1	Yes	7/16/2021	OK										
NG Sea Lion	1	Yes	7/10/2021	TSS	8/9/2021	OK								
NG Venture	2	No	6/20/2021	FC/TSS	6/27/2021	FC	7/18/2021	FC	8/1/2021	OK	Routine required			
SS Legacy	1	Yes	5/22/2021	FC/TSS	6/19/2021	FC	7/17/2021	OK						
Wilderness Adventurer	1	Yes	6/11/2021	OK										
Wilderness Discoverer	1	Yes	5/16/2021	TRC	6/20/2021	TSS	7/18/2021	FC/TSS	8/1/2021	FC/TSS	8/8/2021	FC	Resample Needed	
Wilderness Explorer	3	No	5/30/2021	FC/TRC	6/27/2021	FC	7/11/2021	FC	7/18/2021	FC/TRC	8/1/2021	OK	Routine required	

Routine sample: Based on ADEC SV Sampling Regime

Exceedance/Resample

Resample required: Vessel left AK waters or Revenue Service.

Recirculation (not representative)

*Results rejected due to sample temperature on arrival at lab.