



2016 Wastewater Sampling Results For Large Cruise Ships

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Alaska Department of

Environmental Conservation

Commercial Passenger Vessel Environmental Compliance Program



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1. SUMMARY

This is a report of the results of onboard sampling and laboratory testing of large cruise ship treated wastewater effluent in Alaska during 2016. This report is produced to provide information on wastewater treatment sampled results obtained under the requirements of the [2014 Large Commercial Passenger Vessel Wastewater Discharge General Permit](#) (General Permit). Tables of sample results are included in Appendix 1. Information on the sampling techniques and requirements can be found in the Methods section of this report.

Thirty large cruise ships operated in Alaska in 2016, of those twenty ships were authorized to discharge treated wastewater in Alaska, and eighteen ships discharged treated wastewater and conducted sampling. Table 1 lists large cruise ships in Alaska and their discharge status in 2016.

2. INTRODUCTION

Sampling of cruise ship effluent is a requirement under the General Permit for all large cruise ships discharging in Alaska waters. Sampling is needed to:

- Check for compliance of permit effluent limits
- Obtain information on treatment system performance for future discharge permits
- Compile information on potential environmental effects

Sample result data for cruise ships has been collected by the Department of Environmental Conservation since 2000. Reports for prior years can be found on the cruise program's report webpage.

3. METHODS

Samples are grab wastewater samples taken from a sample port prior to discharge. The number of required samples and what parameters measured are required to be analyzed are listed in the 2014 General Permit and for the US Coast Guard in the QAPP. Sampling may occur while underway or when docked. All samples were obtained in Southeast Alaska in 2016, with the majority of samples obtained in or near Juneau. Sample results presented in this report only include data collected while a cruise ship was discharging in Alaska.

The samples were taken according to requirements in the [2016 Cruise Line International Association North West and Canada Quality Assurance Project Plan for Sampling and Analysis of Treated Sewage and Graywater from Commercial Passenger Vessels](#) (QAPP). The QAPP specifies minimum requirements for sampling and analysis of wastewater. It includes a list of approved methods, sample

collection requirements, and laboratory analysis requirements. Samplers must follow the QAPP and the [Vessel Specific Sampling Plan](#) (VSSP) for each cruise ship when collecting a sample. The cruise ship program spot checked results submitted by the cruise ship operators for compliance with the QAPP and checked all results for compliance with 2014 General Permit limits.

4. RESULTS

Wastewater sample results are listed in Appendix 1 with tables for parameters with General Permit limits, conventional and nutrient results with no limits, and metals. Full results of VOCs and BNAs are available on request. This report does not include the results of receiving water and ambient water sampling taken in the harbors.

In the tables of results those values highlighted in red are exceedances of the 2014 Wastewater Discharge General Permit limits. Orange highlighted results were below a daily maximum, but were an exceedance of a monthly average limit. Dark blue highlights indicate that either no sample analysis was required or no data was received. Results below the method detection limit (MDL) are recorded as zero. Full sample suites of all QAPP listed parameters are identified as “PP” for priority pollutants, and all other samples are identified as “GP” (General Permit).

Table 1: 2016 Large Cruise Ship Summary

2016 Large ¹ Commercial Passenger Vessel Discharge Status and Wastewater Treatment											Rev3
Vessel Operator	Vessel Name	Passenger Capacity ²	Voyages	Total Passengers ⁴	Crew Capacity	Wastewater Treatment System	Permitted to discharge in Alaska in 2016 ³		Skagway Docks discharge permitted?		
							Underway	Stationary	Railroad	Ore	Broadway
1 Carnival Cruise Lines	<i>Carnival Legend</i>	2124	17	36,108	Unknown	Triton Type MSTP9	No	No	No	No	No
2 Celebrity Cruises	<i>Celebrity Infinity</i>	2170	17	36,890	Unknown	Zenon Zeeweed	No	No	No	No	No
3 Celebrity Cruises	<i>Celebrity Millennium</i>	2449	16	39,184	Unknown	Hydroxyl CB-100 MSD	No	No	No	No	No
4 Celebrity Cruises	<i>Celebrity Solstice</i>	3148	18	56,664	Unknown	Kruger WABAG MSD	No	No	No	No	No
5 Crystal	<i>Crystal Serenity</i>	1050	9	9,450	Unknown	Unknown	No	No	No	No	No
6 Disney	<i>Disney Wonder</i>	2834	13	36,842	920	Hamworthy MBR AWTS	Yes	No	No	No	No
7 Holland America	<i>Amsterdam</i>	1380	18	24,840	Unknown	Hamworthy MSD	No	No	No	No	No
8 Holland America	<i>Maasdam</i>	1258	9	11,322	580	Zenon AWTS	Yes	Yes	Yes	Yes	Yes
9 Holland America	<i>Nieuw Amsterdam</i>	2106	22	46,332	929	Hamworthy Bioreactor	Yes	No	No	No	No
10 Holland America	<i>Noordam</i>	1916	21	40,236	Unknown	Rochem UF MSD	No	No	No	No	No
11 Holland America	<i>Volendam</i>	1432	23	32,936	647	Zenon AWTS	Yes	Yes	Yes	Yes	Yes
12 Holland America	<i>Westerdam</i>	1916	21	40,236	Unknown	Rochem UF MSD	No	No	No	No	No
13 Holland America	<i>Zaandam</i>	1432	19	27,208	647	Zenon AWTS	Yes	Yes	Yes	Yes	Yes
14 Norwegian Cruise Line	<i>Norwegian Jewel</i>	2376	20	47,520	1100	Scanship Type II AWTS	Yes	Yes	Yes	Yes	Yes
15 Norwegian Cruise Line	<i>Norwegian Pearl</i>	2394	20	47,880	1100	Scanship Type II AWTS	Yes	Yes	Yes	Yes	Yes
16 Norwegian Cruise Line	<i>Norwegian Sun</i>	1936	20	38,720	950	Scanship Type II AWTS	Yes	Yes	Yes	Yes	Yes
17 Oceania	<i>Regatta</i>	777	12	9,324	373	Triton Water MBR AWTS	Yes	No	No	No	No
18 Ponant	<i>L'Austral</i>	264	1	264	136	Rochem Bio-fit AWTS	Yes	Yes	Yes	Yes	Yes ⁵
19 Ponant	<i>Le Soleal</i>	264	9	2,376	136	Rochem Bio-fit AWTS	Yes	Yes	Yes	Yes	Yes ⁵
20 Princess Cruise Line	<i>Coral Princess</i>	1986	18	35,748	900	Hamworthy MBR AWTS	Yes	No	No	No	No
21 Princess Cruise Line	<i>Crown Princess</i>	3080	19	58,520	1190	Hamworthy MBR AWTS	Yes	Yes - Graywater only	Yes	No	No
22 Princess Cruise Line	<i>Grand Princess</i>	2606	13	33,878	1100	Hamworthy MBR 16 AWTS	Yes	Yes - Graywater only	No	No	No
23 Princess Cruise Line	<i>Island Princess</i>	1974	18	35,532	900	Hamworthy MBR AWTS	Yes	No	No	No	No
24 Princess Cruise Line	<i>Ruby Princess</i>	3084	19	58,596	1201	Hamworthy MBR 16 AWTS	Yes	Yes - Graywater only	No	No	No
25 Princess Cruise Line	<i>Star Princess</i>	2600	19	49,400	1150	Hamworthy MBR AWTS	Yes	Yes - Graywater only	No	No	No
26 Princess Cruise Line	<i>Sun Princess</i>	2022	1	2,022	924	Hamworthy MBR AWTS	Yes	No	No	No	No
27 Prestige Cruises	<i>Seven Seas Mariner</i>	769	16	12,304	431	Hamworthy MBR 240C AWTS	Yes	No	No	No	No
28 Royal Caribbean Cruises	<i>Explorer of the Seas</i>	4000	17	68,000	Unknown	Unknown	No	No	No	No	No
29 Royal Caribbean Cruises	<i>Radiance of the Seas</i>	2502	17	42,534	Unknown	Hamann MSD	No	No	No	No	No
30 Silver Seas	<i>Silver Shadow</i>	382	19	7,258	305	Bio Epure/Marisan	Yes	No	No	No	No
Totals		481		988,124							

Vessels highlighted in gray in the above table did not discharge wastewater in Alaskan waters in 2016.

¹A large vessel has overnight accommodations for 250 or more passengers.

²Capacity is the number of lower berths and is calculated from Registration, Vessel Specific Sampling Plan, or Notice of Intent. Actual number of passenger aboard varies.

³Alaska water includes the Alexander Archipelago and extends 3 miles from the coastline. Only vessels that discharge into Alaska waters are required to sample wastewater.

⁴Assumes full capacity on every voyage

⁵Discharge at Broadway Dock allowed unless another ship is discharging at the Ore Dock

MBR is a Membrane Bioreactor

APPENDIX 1: 2016 LARGE CRUISE SHIP WASTEWATER SAMPLE DATA

Table 3: Semi-monthly parameters and general permit limits

SemiMonthly General Permit Sample Results														Non-detects set to zero										Explanation of color codes			
Company	Vessel	Treatment System	Waste-water Type	Sample taken while	Sample Date	Type	mg/L	ug/L	ug/L	ug/L	S.U.	C	m3/hr	col. per 100 ml	mg/L	mg/L	mg/L	umhos/cm	mg/L	mg/L							
							Ammonia	Copper	Nickel	Zinc	pH	Temp	Flow rate	Fecal Coliform	TSS	BOD	Hardness	Specific Conductance	Free Chlorine	TR Chlorine							
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	5/27/2016	GP					7.57	29.4	0.3	0	0	0	0	0	0	0	0						
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	6/3/2016	GP					7.37	31.5	0.3	0	0	0	0	0	0	0	0						
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	6/17/2016	PP	41	1.1	15	220	6.94	29	13.9	0	0	0	0	63	976	0	0						
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	7/8/2016	GP					7.13	32.6	10	0	0	0	0			0	0						
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	7/22/2016	GP					7.27	32.1	NR	0	0	0	0			0	0						
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	8/5/2016	PP	46	1.7	17	250	7.43	31.2	10	0	0	0	0	40	1090	0	0						
Disney CL	Disney Wonder	Hamworthy	Mixed	Underway	8/12/2016	GP					7.35	31.1	36	0	0	0	0			0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	5/27/2016	GP	47	2.6			7.22	24.9	15.4	0	0	0	0	36	987	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	6/10/2016	PP	41	3.1	21	56	7.33	27.1	16	0	0	0	0	27	760	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	6/24/2016	GP	65	4.1			7.38	27.9	27	0	0	0	0	30	1130	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	7/8/2016	GP	56	4.3			7.39	28.4	16	0	0	0	0	35	1150	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	7/22/2016	GP	54	3.1	22	200	7.36	27.6	8	0	0	0	0	34	1140	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	8/5/2016	GP	54	9.7			7.31	28.9	15	0	0	0	0	29	1020	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	8/19/2016	GP	58	4.7			7.13	27.9	16	0	0	0	0	33	1090	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	9/2/2016	GP	42	2.9			7.21	27.1	15.7	0	0	0	0	30	883	0	0						
Holland America	Maasdam	Zenon	Mixed	Stationary	9/16/2016	GP	39	1.8			7.07	27.1	16	0	0	0	0	31	889	0	0						
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	5/10/2016	GP					7.87	29.8	12.5	0	0	0	5.4			0	0						
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	5/17/2016	PP	140	3	15	58	7.67	29.2	12.5	0	0	0	14	5.1	1580	0	0						
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	6/14/2016	GP					7.82	28.6	12.5	2	0	0	0	2.7			0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	6/21/2016	GP					7.66	28.1	12.5		0	0	0	11			0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	6/28/2016	GP					7.62	30.7	12.5	0	0	0	0				0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	7/12/2016	PP	32	0	6.6	9	7.55	30.4	12.5	0	0	0	5.1	1500	1080	0	0						
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	7/19/2016	GP					7.57	31.8	12	2	0	0	0	7.9			0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	8/2/2016	GP	120				7.75	18.6	3	0	0	0	0				0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	8/9/2016	GP					7.83	18.4	4	0	0	0	0	2.6			0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	9/6/2016	GP					7.52	30.6	4		0	0	0	7.6			0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	9/20/2016	GP					7.55	26	11.52		0	0	0	19			0	0					
Holland America	Nieuw Amsterdam	Hamworthy	Mixed	Underway	9/27/2016	GP					7.54	30.9	11.52	0		0	0				0	0					
Holland America	Volendam	Zenon	Mixed	Stationary	5/6/2016	GP	62	2.8			7.46	25.1	10	0	0	0	2.8	40	1060	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	5/13/2016	PP	53	1.9	13	66	7.3	27.9	9.8	0	0	0	0	27	967	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	6/10/2016	GP	37	4.1			7.45	27.6	24.5	5	0	0	0	2.1	28	777	0	0					
Holland America	Volendam	Zenon	Mixed	Stationary	6/17/2016	USCG					7.17	28.2	24.5	0	0	0	0	4.5			0	0					
Holland America	Volendam	Zenon	Mixed	Stationary	6/24/2016	GP	42	1.5			7.28	28.1	30	0	0	0	0	35	748	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	7/8/2016	GP	48	1.8			7.4	29.7	30	7	0	0	0	27	796	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	7/22/2016	GP	52	4.1			7.46	29.1	21.8	0	0	0	0	32	884	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	8/5/2016	PP	79	4.2	13	90	7.48	28	30	0	0	0	0	36	1140	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	8/19/2016	GP	52	4.4			7.41	29	12.8	0	0	0	0	42	872	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	9/2/2016	GP	47	3.3			7.32	28.4	21.7	0	0	0	0	2.2	39	814	0	0					
Holland America	Volendam	Zenon	Mixed	Stationary	9/16/2016	GP	52	2.4			7.53	27	16.5	0	0	0	0	39	887	0	0						
Holland America	Volendam	Zenon	Mixed	Stationary	10/1/2016	GP	50	6.9			7.61	27.1	22	0	0	0	0	33	948	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	5/17/2016	GP	48	5.3			7.31	24.4	22	2	0	0	0	39	1210	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	5/25/2016	GP	56	2.7			7.38	26.1	19	0	0	0	0	30	1040	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	6/2/2016	PP	17	2.1	10	66	7.2	27.9	14.0	0	0	0	0	5.1	830	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	6/22/2016	GP	40	1.6			7.38	28	30	0	0	0	0	34	1020	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	7/6/2016	GP	44	8.6			7.18	28.1	12.3	0	0	0	0	38	918	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	7/20/2016	GP	45	1.5			7.44	27.6	23.9	0	0	0	0	29	969	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	8/3/2016	GP	51	1.4			7.33	27.8	27.4	0	0	0	0	32	945	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	8/11/2016	GP	37	0	9.5	42	7.24	27.3	23	0	0	0	0	53	927	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	9/8/2016	GP	33	1.1			7.2	27.1	11	0	0	0	0	51	891	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	9/14/2016	GP	45	3.3			7.45	26	24.5	0	0	0	0	33	990	0	0						
Holland America	Zaandam	Zenon	Mixed	Stationary	9/22/2016	GP					7.46	26.5	24	0	0	0	0	33	990	0	0						
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	5/10/2016	GP	25	2			6.34	27.8	24	0	0	0	0	2.7	73	762	0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	5/24/2016	GP	42	1.6			6.55	28.7	33	0	0	0	0	3	75	937	0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	6/7/2016	PP	31	1.2	5.4	37	6.6	29.2	25	0	0	0	0	3.1	64	799	0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	6/21/2016	GP	35	0.98			6.59	30.1	8	0	0	0	0	6.8	74	1040	0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	6/29/2016	USCG					6.18	30.7	NK	7	0	0	0	3			0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	7/12/2016	GP	27	2.3			6.59	29.9	29.5	12	0	0	0	4.8	13	83	853	0	0				
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	7/19/2016	GP	22	0			6.96	31	36.2	0	0	0	0	3.1	73	761	0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	8/2/2016	PP	37	2	7.3	41	6.63	31.5	37.9	0	0	0	0	5.2	70	890	0	0					
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	8/16/2016	GP	27	1.7			6.47	30.6	31.8	0	0	0	0	4	2.7	74	874	0	0				
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	9/6/2016	GP	48	0.79			6.76	29.4	30.1	2	0	0	0	4.8	32	78	988	0	0				
Norwegian CL	Norwegian Jewel	Scanship	Mixed	Stationary	9/13/2016	GP	30	1.9			6.75	29.2	33.2	0	0	0	0	5.6	3.1	74	809	0	0				
Norwegian CL	Norwegian Pearl	Scanship	Mixed	Stationary	5/7/2016	GP	46	3			7.04	24.5	32	2	0												

SemiMonthly General Permit Sample Results

Company	Vessel	Treatmen t System	Waste- water Type	Sample taken while	Sample Date	Type	Non-detects set to zero														
							mg/L	ug/L	ug/L	ug/L	S.U.	C	m3/hr	col. per 100 ml	mg/L	mg/L	mg/L	umhos/cm	mg/L	mg/L	
							Ammonia	Copper	Nickel	Zinc	pH	Temp	Flow rate	Fecal Coliform	TSS	BOD	Hard- ness	Specific Conductance	Free Chlorine	TR Chlorine	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	5/15/2016	GP					8.01	30.8	14.0	0	0	6.1			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	5/26/2016	GP					7.86	28.5	22	7	0	2.9			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	6/4/2016	PP	79	3.3	12	53	7.91	28.5	14	0	0	2.6	170	2300	0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	6/14/2016	GP					7.47	28.4	24.1	0	0	0			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	7/14/2016	GP					7.85	31.1	15	0	0	4.8			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	7/25/2016	GP					8.14	32.1	11	0	0	0			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	8/13/2016	GP					7.85	33	11.4	0	0	3.3			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	8/23/2016	PP	56	1.2	12	19	7.68	30.5	12	0	0	2.8	130	1900	0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	9/2/2016	GP					7.75	31	9	550	0	5.6			0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	9/11/2016	GP					7.6	29.7	NR	0	0				0	0	
Princess CL	Grand Princess	Hamworthy	Mixed	Underway	9/13/2016	GP					7.91	28.1	18	0	0	4.3			0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	5/14/2016	GP	0	3.6			7.3	26.9	11.7	0	0	4.4	760	7860	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	5/23/2016	GP	0	3.8			7.23	28	11	0	0	2	130	1788	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	6/3/2016	PP	1.8	2.4	14	70	7.46	27.9	13.92	0	0	0	250	3200	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	6/14/2016	GP	0	3.7			6.87	28.1	13.3	0	0	0	480	5000	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	7/14/2016	GP	0	2.1			7.3	29.6	16	0	0	0	410	4280	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	7/24/2016	GP	0	0.84			7.08	30.4	18	0	0	0	110	1310	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	8/3/2016	PP	0	1.6	13	33	7.38	28.7	7.2	0	0	3.3	240	2730	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	8/23/2016	GP	0				7.16	29	12	0	0	0		842	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	9/1/2016	GP	0	1.4			7.24	29.6	14	50	0	0	720	6880	0	0	
Princess CL	Grand Princess	Hamworthy	Graywater	Stationary	9/11/2016	GP	2.1	0.93			7.18	28.2	18	0	0	0	320	3580	0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	5/15/2016	GP					7.59	37.6	14.4	0	0	16			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	5/22/2016	GP					7.62	34.5	15	0	0	13			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	6/5/2016	PP	120	1.4	5.8	7.3	7.56	35.9	15	3	0	40	59	1490	0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	6/19/2016	GP					7.64	39.5	7.2	0	0	0			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	6/26/2016	GP					7.64	36.2	13.2	0	0	7.2			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	7/10/2016	GP					7.21	37	13.2	0	0	0			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	7/24/2016	GP					7.19	37.8	13.2	0	0	0			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	8/7/2016	GP					7.11	36.8	13.2	0	0	2.5			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	8/14/2016	PP	32	1.4	4.6	31	7.1	37.8	13.2	0	0	5	52	819	0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	9/4/2016	GP					7.3	37.5	14.4	0	0	2.9			0	0	
Princess CL	Island Princess	Hamworthy	Mixed	Underway	9/11/2016	GP					7.49	36.9	14.4	0	0	2.8			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	5/12/2016	GP					8.11	28.9	13.8	0	0	3.7			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	5/19/2016	GP					8.2	28.7	15.7	0	0	5.9			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	6/2/2016	PP	130	13	8.1	65	7.48	25.2	43.2	0	0	57	37	1490	0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	6/16/2016	GP					7.81	31.4	135.7	0	0	0			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	6/22/2016	GP					8.29	30.5	22.3	0	0	0			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	7/7/2016	GP					7.61	31.8	10.5	0	0	0			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	7/21/2016	GP					7.77	30.9	16.4	0	0	0			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	8/11/2016	PP	160	23	9	110	7.99	28.9	15.7	0	0	9.6	52	1920	0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	8/25/2016	GP					7.73	29.9	15.3	0	0	0			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	8/31/2016	GP	95				7.87	31.9	12.4	0	0	3.5			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	9/8/2016	GP					7.69	28.6	12.2	0	0	9.2			0	0	
Princess CL	Ruby Princess	Hamworthy	Mixed	Underway	9/15/2016	GP					7.94	27.9	16.7	0	0	0			0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	5/11/2016	GP	2.8	16			6.98	29.7	86.4	0	0	3.5	23	341	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	5/18/2016	GP	0	16			6.56	30.5	13.0	0	0	7.9	15	273	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	6/1/2016	PP	4.6	21	7.9	120	7.05	28.1	1.4	0	0	0	29	455	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	6/15/2016	GP	0	11			6.97	31.2	86.4	0	0	0	84	971	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	7/6/2016	GP	32	17			7.47	31.7	1080	0	0	0	50	709	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	7/20/2016	GP	0.59	12			7.35	32	6.5	0	0	3.2	52	570	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	8/10/2016	PP	3.4	14	11	150	6.95	29.9	15.7	0	0	0	58	799	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	8/24/116	GP	0	12			6.73	30	15.2	0	0	0	110	1310	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	9/7/2016	GP	2.8	9.2			6.07	30	15.2	0	0	0	19	306	0	0	
Princess CL	Ruby Princess	Hamworthy	Graywater	Stationary	9/14/2016	GP	0	8.3			6.97	31.1	198	0	0	0	29	397	0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	5/24/2016	GP					7.42	32.9	27.8	7	0	15			0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	5/25/2016	GP					7.45	32.9	39.7	17	0	58			0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	6/7/2016	PP	150	0	8.3	7	7.95	29.9	27.1	0	4.8	120	54	1390	0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	6/15/2016	GP					6.67	29.6	29.3	0	0	0	18		0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	7/13/2016	GP					8.11	35.1	8.3	0	0	120			0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	7/27/2016	GP					8.24	34.2	30	0	0	60			0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	8/10/2016	PP	60	1.1	9.9	15	6.83	36.3	21.6	0	0	7.4	28	369	0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	8/17/2016	GP					8.19	36	25.9	5	0	19			0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	9/7/2016	GP					8.08	32.3	26.6	3	0	11			0	0	
Princess CL	Star Princess	Hamworthy	Mixed	Underway	9/14/2016	GP					7.93	31.7	33.7	5	0	7.9			0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	5/18/2016	PP	3.7	1.7	13	31	6.93	30	28.1	0	0	15	30	490	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	5/24/2016	GP	1.2	1.2			6.67	31.3	19.7	5	0	17	12	225	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	6/1/2016	GP	1.9	2.1			7.07	29.7	18	0	0	27	35	304	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	6/7/2016	GP	4.1	1.1			6.84	32.3	20.0	0	0	30	16	236	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	7/13/2016	GP	0	1.6			6.72	32.6	19.4	0	0	7.8	86	986	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	7/27/2016	GP	1.9	1.3			6.96	33	19.6	0	0	7.8	24	294	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	8/10/2016	GP	4.1	1.4			6.87	35.2	16.6	0	0	8.4	48	682	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	8/16/2016	GP	0.67	1.3	7.5	15	6.66	32.8	21.4	0	0	5.7	12	199	0	0	
Princess CL	Star Princess	Hamworthy	Graywater	Stationary	8/24/2016	USCG					6.67	31.2	17.2								

Table 4: Semi-seasonal nutrients and other conventional parameters with no General Permit Limits

Vessel	Sample Date	E. coli	Chemical O ₂ Demand	Hexane Extractable Material	Total Organic Carbon	Alkalinity (Total)	Hardness	Nitrite/Nitrate as N	Total Phosphorus	Total Kjeldahl Nitrogen	Total Settable Solids
	Detection Limit	1	5.00	5.00	1.00	5.00	5.00	0.50	0.05	1.00	0.10
	Units	/100ml	mg/l	mg/l	mg/l	mg/l	mg/L	mg/L	mg/l	mg/l	ml/l
Disney Wonder	6/17/16	0	40	0	8.7	250	63	0	4.85	52	0
Disney Wonder	8/5/16	0	42	0	8.5	250	40	0	1.9	33	0
Maasdam	6/10/16	0	50	0	0	250	27	0	0	44	0
Maasdam	7/22/16	0	44	0	13	300	34	0	0	60	0
Nieuw Amsterdam	5/17/16	0	80	0	12	500	5.1	0	14	110	0
Nieuw Amsterdam	7/12/16		260	0	4.6		1500	0	0	28	0
Nieuw Amsterdam	7/19/16	0									
Nieuw Amsterdam	8/2/16					450		0	8.52	110	
Volendam	5/13/16	0	53	0	13	300	27	0.3	0.6	53	0
Volendam	8/5/16	0	45	0	16	400	36	0	2	70	0
Volendam	10/1/16	0					33	0	5.4	51	
Zaandam	6/2/16	0	37	0	13	160	51	0.16	0.253	19	0
Zaandam	8/11/16	0	27	0	11	250	53	0.23	0	36	0
Le Soleal	6/25/16	0	29	0	0	78	23	0	1.84	12	0
Le Soleal	7/9/16	0	32	0	6.9	35	36	0	1.75	24	0
Vessel	Sample Date	E. coli	Chemical O ₂ Demand	Hexane Extractable Material	Total Organic Carbon	Alkalinity (total)	Hardness	Nitrite/Nitrate as N	Total Phosphorus	Total Kjeldahl Nitrogen	Total Settable Solids
	Detection Limit		5.00	5.00	1.00	5.00	5.00	0.50	0.05	1.00	0.10
	Units	/100ml	mg/l	mg/l	mg/l	mg/l	mg/L	mg/L	mg/l	mg/l	ml/l
Norwegian Jewel	6/7/16	0	40	0	14	130	64	0.13	0	32	0
Norwegian Jewel	8/2/16	0	63	0	17	170	70	0.19	0	35	0
Norwegian Pearl	5/17/16	1	76	0	23	200	36	0	0	42	0
Norwegian Pearl	8/9/16	2	54	0	22	200	21	0	0	60	0
Norwegian Sun											
Coral Princess	6/8/16	0	97	0	27	250	80	2.2	14	73	0
Coral Princess	8/3/16	1	240	0	24	450	610	0	2.21	74	0
Crown Princess-GW	5/23/16	0	93	0	27	70	15	0	0	3.7	0
Crown Princess-GW	8/15/16	0	42	0	8.8	72	14	0	0.215	1.2	0
Crown Princess	5/24/16	0	130	0	38	500	30	0	3.87	92	0
Crown Princess	8/2/16	0	110	0	25	500	42	0.27	16.5	170	0
Grand Princess-GW	6/3/16	0	24	0	3.4	50	250	0	0	2.4	0
Grand Princess-GW	8/3/16	4.1	81	0	15	70	240	0	0	0.78	0
Grand Princess	6/4/16	18	53	0	16	300	170	3.8	5.11	39	0
Grand Princess	8/23/16	2	86	0	15	140	130	3.4	3.22	38	0
Vessel	Sample Date	E. coli	Chemical O ₂ Demand	Hexane Extractable Material	Total Organic Carbon	Alkalinity (Total)	Hardness	Nitrite/Nitrate as N	Total Phosphorus	Total Kjeldahl Nitrogen	Total Settable Solids
	Detection Limit		5.00	5.00	1.00	5.00	5.00	0.50	0.05	1.00	0.10
	Units	/100ml	mg/l	mg/l	mg/l	mg/l	mg/L	mg/L	mg/l	mg/l	ml/l
Island Princess	6/5/16	6.3	120	0	40	450	59	0	9.98	120	0
Island Princess	8/14/16	0	50	0	18	250	52	0	8.83	31	0
Ruby Princess-GW	6/1/16	0	17	0	7.1	64	29	0	0.353	6	0
Ruby Princess-GW	8/10/16	0	0	0	5.7	55	58	4.8	0.416	3	0
Ruby Princess	6/2/16	0	150	0	48	450	37	0	9.38	110	0
Ruby Princess	8/11/16		66	0	27	600	52	4.3	12.8	140	0
Ruby Princess	8/31/16	0				450		2.5	0.734	120	
Star Princess-GW	5/18/16	0	50	0	16	60	30	0	0.7	4.6	0
Star Princess-GW	8/16/16	0	26	0	6.3	50	12	0	0	1.2	0
Star Princess	6/7/16	0	320	0	110	450	54	0.39	8.23	86	0
Star Princess	8/10/16	0	59	0	8.2	300	28	0	0	3.4	0
Regatta-Port	5/23/16	1	82	0	13	170	24	62	3.3	0	0
Regatta-Port											
Regatta-Starboard	5/23/16	0	52	0	13	60	47	93	10	0	0
Regatta-Starboard	7/19/16	0	55	0	10	250	59	68	10.3	0	0
Seven Seas Mariner	5/22/16	0	83	0	23	300	39	4.4	9.72	12	0
Seven Seas Mariner	8/14/16	0	59	0	22	150	54	1.5	2.66	4	0
	MAX	18	320	0	110	600	1500	93	16.5	170	0
	MIN	0	0	0	0	35	5.1	0	0	0	0
	MEDIAN	0	54	0	13	250	39.5	0	1.95	37	0

Parameter not sampled
Not discharging

Non-detects set to zero or ND

Table 5: Full Suite Semi-seasonal Metal Sample Results

		Semi seasonal Metal Samples																									
Vessel	Date	Antimony (TR)	Antimony dissolved	Arsenic (TR)	Arsenic dissolved	Beryllium (TR)	Beryllium dissolved	Cadmium (TR)	Cadmium dissolved	Chromium (TR)	Chromium diss	Copper (TR)	Copper diss	Lead (TR)	Lead, diss	Mercury (Total)	Nickel (TR)	Nickel, diss	Selenium (TR)	Selenium, dissolved	Silver (TR)	Silver, diss	Thallium (TR)	Thallium, dissolved	Zinc (TR)	Zinc, diss	
Disney Wonder	6/17/16	0	0	0	0	0	0	0	0	1.4	0	1.2	1.1	1	0	0	16	15	1.2	0	0	0	0	0	220	220	
Disney Wonder	8/5/16	0	0	0	0	0	0	0	0	1.2	1.4	1.8	1.7	0	1.4	0	17	17	1	1	0	0	0	0	240	250	
Maasdam	6/10/16	0	0	1.1	0	0	0	0	0	1	3	3.1	3.1	0	0	0	22	21	3	2.4	0	0	0	0	57	56	
Maasdam	7/22/16	0	0	0	2	0	0	0	0	2.2	1.8	3.1	3.1	0	0	0	22	22	4.6	6.5	0	0	0	0	66	200	
Nieuw Amsterdam	5/17/16	0	0	0	0	0	0	0	0	3.3	1.5	4.7	3	0	0	0	16	15	1.8	1.3	0	0	0	0	59	58	
Nieuw Amsterdam	7/12/16	0	0	19	20	0	0	0	0	1.1	0	3.2	0	0	0	0	6	6.6	59	94	0	0	0	0	9.8	9	
Volendam	5/13/16	0	0	0	0	0	0	0	0	0	1.4	2	1.9	0	0	0	13	13	1.9	0	0	0	0	0	65	66	
Volendam	8/5/16	0	0	0	0	0	0	0	0	0	1.2	4.5	4.2	0	0	0	12	13	1.7	1.4	0	0	0	0	86	90	
Zaandam	6/2/16	0	0	1	0	0	0	0	0	1.6	1.8	2	2.1	0	0	0	11	10	2.4	2.1	0	0	0	0	63	66	
Zaandam	8/11/16	0	0	1.4	0	0	0	0	0	0	0	1.2	0	0	0	0	10	9.5	3.3	2.1	0	0	0	0	43	42	
Norwegian Jewel	6/7/16	0	0	0	0	0	0	0	0	0	1.1	1.4	1.2	0	0	0	5	5.4	0	0	0	0	0	0	33	37	
Norwegian Jewel	8/2/16	0	0	0	0	0	0	0	0	0	0	1.8	2	0	0	0	7.5	7.3	0	0	0	0	0	0	37	41	
Norwegian Pearl	5/17/16	0	0	0	0	0	0	0	0	2	1.3	2.8	1.8	0	0	0	4.8	4.8	0	0	0	0	0	0	53	52	
Norwegian Pearl	8/9/16	0	0	0	1.1	0	0	0	0	0	0	2.8	1.5	0	0	0	5.1	4.8	0	0	0	0	0	0	55	55	
Norwegian Sun																											
Le Soleal	6/25/16	0	0	0	1	0	0	0	0	1.9	0	2.1	2	0	0	0	7.9	7.9	1.3	1.1	0	0	0	0	110	120	
Le Soleal	7/9/16	0	0	0	1.2	0	0	0	0	0	2.6	16	17	0	0	0	19	20	1.4	1.6	0	0	0	0	1200	1300	
Coral Princess	6/8/16	0	0	1.5	0	0	0	0	0	1.5	2.8	8.7	8.5	0	0	0	14	13	2.8	2.5	0	0	0	0	48	49	
Coral Princess	8/3/16	0	0	11	8.9	0	0	0	0	1	1.2	3.5	2.3	0	0	0	7.6	7.7	37	33	0	0	0	0	24	22	
Crown Princess-GW	5/23/16	4.6	4.1	0	0	0	0	0	0	1.4	0	0	0	0	0	0	12	11	0	1.2	0	0	0	0	8.7	6.4	
Crown Princess-GW	8/15/16	0	0	0	0	0	0	0	0	1.2	1	1.2	1.9	0	0	0	15	15	0	1	0	0	0	0	20	21	
Crown Princess	5/24/16	1.8	2.8	0	0	0	0	0	0	0	2	5.3	5.5	0	0	0	9.4	10	1.4	1.9	0	0	0	0	40	38	
Crown Princess	8/2/16	0	0	1.5	1.9	0	0	0	0	1.2	1.1	2.9	4.3	0	0	0	11	11	2.2	2.2	0	0	0	0	41	51	
Grand Princess-GW	6/3/16	0	0	0	2.8	0	0	0	0	1.9	2.2	5.2	2.4	0	0	0.38	16	14	11	11	0	0	0	0	66	70	
Grand Princess-GW	8/3/16	0	0	3.6	3	0	0	0	0	1.9	2.2	1.5	1.6	0	0	0	13	13	13	11	0	0	0	0	33	33	
Grand Princess	6/4/16	0	0	2.1	0	0	0	0	0	2.5	2.1	3.3	3.3	0	0	0.35	12	12	7.1	7.2	0	0	0	0	51	53	
Grand Princess	8/23/16	0	0	1.9	2	0	0	0	0	1.4	1.6	1.2	1.2	0	0	0	12	12	4.4	5.1	0	0	0	0	20	19	
Island Princess	6/5/16	0	0	0	1.3	0	0	0	0	1.3	1.3	0	1.4	0	0	0	6	5.8	0	2.1	0	0	0	0	8.8	7.3	
Island Princess	8/14/16	0	0	2	1.5	0	0	0	0	0	0	1.6	1.4	0	0	0	4.7	4.6	2.6	1.7	0	0	0	0	34	31	
Ruby Princess-GW	6/1/16	0	0.9	0	0	0	0	0	0	8.8	1.4	210	21	11	0.75	0	13	7.9	1.3	1.2	0	0	0	0.048	440	120	
Ruby Princess-GW	8/10/16	0	0	0	0	0	0	0	0	0	0	27	14	1.6	0	0	12	11	2.4	1.9	0	0	0	0	200	150	
Ruby Princess	6/2/16	0	0	1.2	0	0	0	0	0	2.2	2.1	15	13	0	0	0	8.4	8.1	2	0	0	0	0	0	62	65	
Ruby Princess	8/11/16	0	0	1.9	1.9	0	0	0	0	0	0	22	23	0	0	0	9.2	9	2	2	0	0	0	0	110	110	
Star Princess-GW	5/18/16	0	0	0	0	0	0	0	0	0	2.5	3.2	1.7	0	0	0	11	13	0	0	0	0	0	0	36	31	
Star Princess-GW	8/16/16	0	0	0	0	0	0	0	0	0	0	1.4	1.3	0	0	0	7.8	7.5	0	0	0	0	0	0	14	15	
Star Princess	6/7/16	0	0	0	1.2	0	0	0	0	1.1	1.8	0	0	0	0	0	8.4	8.3	0	2.1	0	0	0	0	4.1	7	
Star Princess	8/10/16	3.7	4	0	0	0	0	0	0	0	0	1.3	1.1	0	0	0	10	9.9	0	0	0	0	0	0	14	15	
Regatta-Port	5/23/16	0	0	1.4	0	0	0	0	0	3.4	4.4	75	65	0	0	0	13	12	1.4	1.7	0	0	0	0	190	160	
Regatta-Starboard	5/23/16	0	0	0	0	0	0	0	0	2.7	2.9	87	31	1.3	0	0	16	13	1.3	1.3	0	0	0	0	140	110	
Regatta-Starboard	7/19/16	0	0	1.6	2.2	0	0	0	0	1.3	1.1	33	17	0	0	0	7.8	7.5	1.5	1.9	0	0	0	0	58	42	
Seven Seas Mariner	5/22/16	0	0	2.4	2.2	0	0	0	0	0	0	12	11	0	0	0	7.9	8.4	1.1	1.2	0	0	0	0	82	79	
Seven Seas Mariner	8/14/16	0	0	4.1	2.8	0	0	0	0	0	0	17	4.8	0	0	0	9.1	8.6	1.2	1.1	0	0	0	0	94	44	
	MAX	4.6	4.1	19	20	0	0	0	0	8.8	4.4	210	65	11	1.4	0.38	22	22	59	94	0	0	0	0.048	1200	1300	
All results in micrograms/L (ug/L)																											
Non detects recorded as zero																											

APPENDIX 2: REFERENCES

Alaska Department of Environmental Conservation (ADEC) Cruise Ship Program

http://www.dec.state.ak.us/water/cruise_ships/index.htm

2014 Large Cruise Ship General Permit

http://dec.alaska.gov/water/cruise_ships/gp/2014gp.html

Quality Assurance Project Plan

http://dec.alaska.gov/water/cruise_ships/pdfs/2016_CLIA-NWC_QAPP.pdf

Alaska Cruise Ship Laws and Regulations

http://www.dec.state.ak.us/water/cruise_ships/Law_and_Regs/index.htm

Sample reports from prior years

http://www.dec.state.ak.us/water/cruise_ships/reports.htm