



2008 Assessment of Cruise Ship Environmental Effects in Washington



June 2009
Publication no. 09-10-047

Publication and Contact Information

This report is available on the Department of Ecology's website at www.ecy.wa.gov/biblio/0910047.html

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2008 Assessment of Cruise Ship Environmental Effects in Washington

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Executive Summary

A Memorandum of Understanding (MOU) between Department of Ecology (Ecology), the NorthWest CruiseShip Association (NWCA) and the Port of Seattle was signed on April 20, 2004. This MOU covers large passenger ships that are members of the NWCA. It does not cover ships such as Alaska Marine Highway ferries, shipping vessels, small passenger ships or boats.

The MOU prohibits discharges of both black and gray water to Washington state waters from all cruise ships except discharges treated with advanced wastewater treatment systems (AWTS) and when stringent requirements are met. Such systems are being installed in cruise ships serving the Alaska market as required by the state of Alaska. AWTS provide treatment that meets or exceeds Alaska's requirements under federal law.

The MOU defines the subject waters as being consistent with Washington marine waters. It requires sampling and monitoring of wastewater discharges and allows for vessel inspections by Ecology. The MOU includes additional elements, such as:

- Sewage sludge (biomass) discharges are prohibited within 12 nautical miles from shore and within the Olympic Coast National Marine Sanctuary.
- Specific sampling regimen, testing, and reporting are required.
- Continuous monitoring for turbidity and disinfection with capability to shutdown immediately.
- Advanced notification and documentation are required from ships planning to discharge via an AWTS.
- Cruise ships must comply with Washington's more restrictive hazardous-waste laws, are prohibited from dumping garbage into state waters and may only discharge oily bilge water per regulation.

The MOU has been amended each season to incorporate needed clarifications. MOU amendments finalized on May 19, 2008:

1. Incorporating recommendations from the Washington State Department of Health virus report:
 - a. Not allow discharges within a half a mile of shellfish beds.
 - b. Define a "disinfection system upset" condition as a disinfection below levels of four log (99.99%) inactivation of norovirus and require immediate shutdown capability from an upset condition of disinfection .
 - c. Require immediate notification to the Department of Health for an upset condition.
2. Require whole effluent toxicity testing for only those vessels that have submitted documentation for continuous discharge.
3. Other minor changes for organization of the document.

The MOU continues to be a valuable tool in meeting the goal of protecting Washington's marine waters from cruise-ship waste water. The requirement for discharges to be treated with AWTS

ensures only high quality effluent is discharged. The requirement to allow vessels to be inspected leads to increased compliance. The need to understand the requirements of the MOU has called for increased communication between Ecology, and the cruise lines and vessel staff.

Most cruise lines and vessels operating under the MOU were in compliance throughout the 2008 season. Some notable successes include, sampling results for conventional pollutants continue to show excellent effluent quality, and increased waste minimization efforts.

The cruise-ship MOU has resulted in several benefits to Washington's environment:

- It ensures that we have a water-quality strategy in place for large passenger vessels.
- It increases Ecology's understanding of the operational practices of the cruise industry, and increases the cruise industry's understanding of the environmental concerns in Washington.
- It forges a new and valuable partnership between state regulators, the cruise industry and other interested parties.
- It doesn't lessen the state's authority to enforce Washington's water quality laws.

Admittedly, the MOU also has its limitations:

- Compliance is voluntary.
- Enforceability is limited to those federal and state water quality laws that continue to apply to cruise ships.
- Applicability is limited. Cruise ships that do not make a port call while in Washington waters or are not a member of the NorthWest CruiseShip Association are not covered by the MOU.
- Concerns regarding air quality are not addressed.

The Department of Ecology recommends that:

1. The MOU continue to be used as a complement to environmental regulations until state specific regulations for cruise ship waste management in Washington State are put in place.
2. Ecology continues to inspect ships that discharge in waters subject to the MOU, including closely looking at wastewater management and the management of other waste streams.
3. The parties of the MOU continue to work together on evaluating the testing protocols, results, and testing guidelines for whole effluent toxicity and make recommendation on how to proceed.
4. The cruise lines conduct a thorough review of records on an on-going basis throughout the season as well as at the end of the system to evaluate compliance, and that all recommendations made in inspection reports be implemented.

1. Introduction

1.1 Assessment report

The purpose of this report is to assess the performance of the cruise industry for environmental impacts to state waters for the 2008 cruise season. The goals of this report are to:

1. Analyze the overall compliance with the Memorandum of Understanding.
2. Evaluate the performance of the advanced wastewater treatment systems.
3. Make recommendations in relation to the matters discussed in the report.

This report also presents general background information and detailed appendices of wastewater sampling data. Issues and concerns related to the discharge of bilge and ballast water are beyond the scope of this report.

1.2 Cruise industry operations in Washington State

Celebrity Cruises, Holland America Line, Norwegian Cruise Line, Princess Cruises, and Royal Caribbean Cruises Ltd. operated regularly scheduled cruises of large ships between Seattle and Alaska. Most of these large ships have a capacity of about 2,000 to 4,200 persons on board. Regent Cruises' SEVEN SEAS MARINER made one call to Seattle in 2008. Alaska's Marine Highway runs regular cruises out of Bellingham to Alaska. The ships have a passenger/crew capacity of about 175 to 225.

This report centers on the operations of the large cruise ships that are covered under a Memorandum of Understanding (MOU); however, more is being learned about the operations of the smaller passenger vessels. Some smaller cruise lines, such as CruiseWest and Linblad Expeditions, run cruises on the Columbia and Snake Rivers, Puget Sound, and in British Columbia and Alaska. Linblad Expeditions also runs cruises through the San Juan Islands.

Large cruise ships have operated out of Seattle since 1999. The cruise business is one of the fastest growing business segments at the Port of Seattle. The Port has had two berths suitable for large vessels at Terminal 30 that will be operated from the new Terminal 91 beginning in 2009. There is one berth at Pier 66. Sailings departed Seattle on Fridays, Saturdays, Sundays, and occasionally on other weekdays between the end of April 2008 and the end of October 2008. The figure below shows the rising number of passengers enjoying Alaska-bound cruises since 1999.

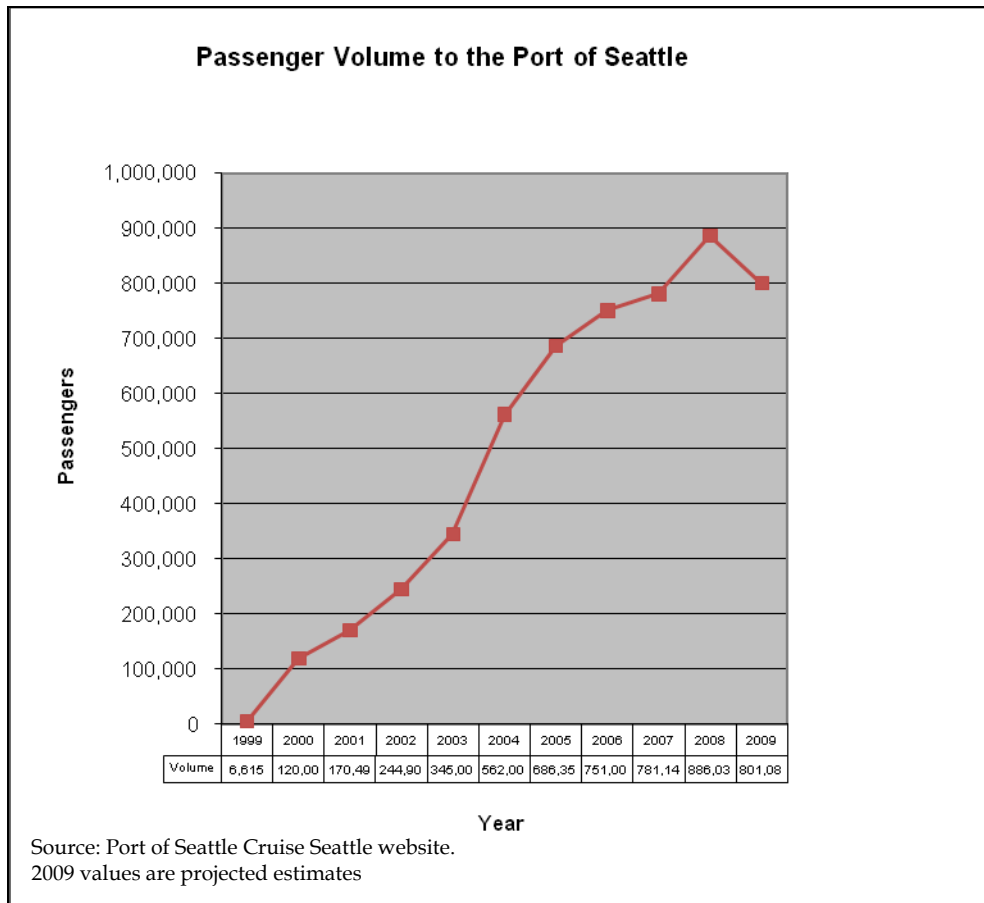


Figure 1. Passenger Volume

Cruise ships have been operating under a rather ambiguous set of environmental standards. Cruise ships and their wastewater treatment systems have been excluded from many of the U.S. environmental laws and regulations that land-based industries must meet. Recently, the Environmental Protection Agency has issued a vessel general permit for commercial vessels greater than 79 feet. The permit covers various discharge types including, but not limited to, graywater, oily bilge, pool/spa water, and ballast water. The permit does not cover blackwater unless it is combined with graywater.

Several other environmental standards may apply to certain vessels. The United States Coast Guard (USCG) certifies marine sanitation devices to meet certain operational standards for performance but does not monitor wastewater effluent quality. Large ships operate under International Convention for the Prevention of Pollution from Ships (MARPOL), an environmental treaty drafted by the International Maritime Organization (IMO). Annex IV of MARPOL addresses the disposal of sewage. The U.S. did not sign Annex IV; therefore, it is not mandatory that ships follow Annex IV in the United States. Most large ships have adopted the “Cruise Industry Waste Management Practices and Procedures” put forth by the Cruise Lines International Association (CLIA).

The NorthWest CruiseShip Association (NWCA) consisted of the following member lines during the 2008 season:

- | | |
|--------------------------|----------------------------------|
| 1. Carnival Cruise Lines | 6. Norwegian Cruise Line |
| 2. Celebrity Cruises | 7. Princess Cruises |
| 3. Crystal Cruises | 8. Regent Seven Seas Cruises |
| 4. Disney Cruise Line | 9. Royal Caribbean International |
| 5. Holland America Line | 10. Silversea Cruises |

In 2008, 100% of port calls by large vessels to Seattle were made by NWCA member ships. Table 1 below depicts the member lines, the ships visiting Seattle, the number of port calls and the persons on board.

Table 1. 2008 Cruise Ships Calling to Ports in Washington

Vessel Operator	Vessel Name	2008 Number of Port Calls ¹	Total Persons on Board ²
NWCA MEMBERS			
Celebrity Cruises	INFINITY	21	2880
Celebrity Cruises	MERCURY	11	2779
Celebrity Cruises	MILLENIUM	4	3455
Holland America Line	AMSTERDAM	19	2027
Holland America Line	OOSTERDAM	23	2648
Holland America Line	VOLENDAM	2	2079
Holland America Line	WESTERDAM	21	2648
Holland America Line	ZAANDAM	1	2107
Norwegian Cruise Line	NORWEGIAN PEARL	22	4230
Norwegian Cruise Line	NORWEGIAN STAR	21	4000
Princess Cruise Line	GOLDEN PRINCESS	21	3660
Princess Cruise Line	STAR PRINCESS	21	3800
Regent Seven Seas	SEVEN SEAS MARINER	1	1200
Royal Caribbean	RHAPSODY OF THE SEAS	17	3381
Royal Caribbean	SERENADE OF THE SEAS	2	2950
Total		207	
NON NWCA MEMBERS			
NONE			

¹ Numbers come from Port of Seattle 2008 Cruise Ship Sailing Schedule and the Port of Seattle staff.

² Numbers come from Alaska DEC 2008 Large Commercial Vessel Discharge Status. Actual # of passengers/crew may vary.

The Port of Seattle's schedule for 2009 includes a total of 207 port calls from the following vessels: Celebrity Cruises INFINITY, and Celebrity Cruises MERCURY, Holland America Line AMSTERDAM, STATENDAM, VOLENDAM, WESTERDAM AND ZAANDAM, Norwegian Cruise Line PEARL and STAR, Princess Cruises GOLDEN PRINCESS, PACIFIC PRINCESS, SAPPHIRE PRINCESS and STAR PRINCESS, Royal Caribbean RHAPSODY OF THE SEAS, and SERENADE OF THE SEAS, Residensea's THE WORLD, and Fred Olsen's BLACKWATCH. All of the vessels with the exception of Residensea's THE WORLD and Fred Olsen's BLACKWATCH which are scheduled for one port call each are part of the NorthWest CruiseShip Association.

1.3 Memorandum of Understanding summary

On April 20, 2004, a Memorandum of Understanding (MOU) between Ecology, the NorthWest CruiseShip Association (NWCA) and the Port of Seattle was signed. The MOU covers ships that are members of the NWCA, and therefore does not cover ships such as the Alaska Marine Highway ferries, or any of the small ships. The MOU bans cruise-ship wastewater discharges (black and gray water), except from vessels with advanced treatment systems (AWTS). AWTS provides treatment that meets or exceeds Alaska's requirements under federal law. The MOU allows continuous discharge in Washington waters from these AWTS with stringent provisions. Sewage sludge (biomass) may only be discharged more than 12 miles from shore and not within the Olympic Coast National Marine Sanctuary. The MOU specifies a sampling regime, testing, reporting and limit requirements, and requires advanced notification and documentation from ships planning to discharge. The MOU also specifies that the ships comply with Washington's more restrictive hazardous waste laws and stipulates that garbage may not be discharged in state waters.

May 19, 2008 MOU amendments included:

1. Incorporating recommendations from the Washington State Department of Health virus report:
 - a. Not allow discharges within a half a mile of shellfish beds. Include an appendix identifying the areas where bivalve shellfish beds that are recreationally harvested or commercially approved within half a mile of the shipping lanes and update annually. And include an appendix with background information on the virus related elements.
 - b. Define a "disinfection system upset" condition as a disinfection below levels of four log (99.99%) inactivation of norovirus.
 - c. Beginning in 2009, require immediate shutdown capability from an upset condition of disinfection below levels of four log (99.99%) inactivation of norovirus for all vessels that have submitted documentation to discharge.
 - d. Require immediate notification to the Department of Health for an upset condition.
2. Require whole effluent toxicity testing for only those vessels that have submitted documentation for continuous discharge.
3. Other minor changes for organization of the document.

The MOU and related documents are available on Ecology's website at:
http://www.ecy.wa.gov/programs/wq/wastewater/cruise_mou/index.html

A copy of the current MOU (Amendment No.4) is included in Appendix A.

1.4 MOU funding

Ecology, the Port of Seattle, the NWCA and its member lines finalized a process via an agreement to recover costs incurred by Ecology associated with implementing the MOU. A funding agreement for the 2006, 2007, and 2008 seasons were signed and employed. A similar

agreement for the 2009 season is being finalized and should be in place prior to the start of the 2009 sailings.

2. MOU Requirements

2.1 Description of requirements

Applicability of MOU:

The MOU applies to cruise ships that are part of the NorthWest CruiseShip Association (NWCA) and only to those member ships making a call at a port in Washington. NWCA member ships that do not make a port call in Washington are not subject to the provisions of the MOU while transiting off the Washington coast. All the ships subject to the MOU are engaged in cruise itineraries greater than one-day duration.

Great care was taken in developing the geographic area in which the terms of the MOU apply. Washington's definition of "waters of the state" reaches to the international border with Canada. The cruise industry agreed to recognize Washington's definition of state waters for the purposes of the MOU. The "Waters subject to this MOU" are defined as including the Puget Sound and the Strait of Juan de Fuca south of the international boundary with Canada. Off the west coast of Washington, "Waters subject to this MOU" include the belt of seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles, as illustrated in Appendix iii of the MOU. The definition of the "waters subject to this MOU" is inclusive of the marine waters of the state as defined in Washington law. See figure 2 below.

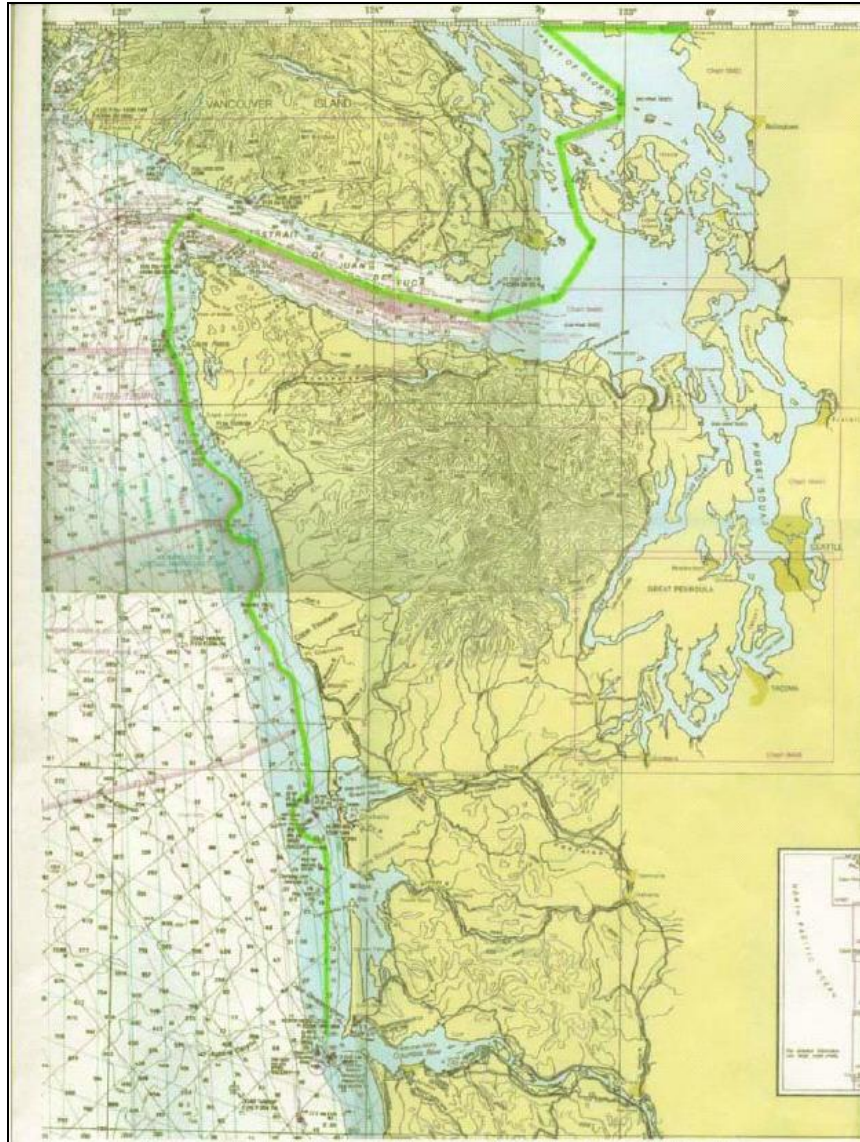


Figure 2. Map of “Waters subject to this MOU:

Wastewater discharges

The MOU defines “blackwater” as wastes from toilets, urinals, medical sinks and other similar facilities, and “graywater” as including drainage from dishwasher, shower, laundry, bath, galley drains and washbasin drains.

Advanced wastewater treatment systems (AWTS) are systems that meet the higher standards and testing regime as set out in federal law, Title XIV, Certain Alaska Cruise Ship Operations, Section 1404(c). The AWTS are systems such as the Zenon and Hamworthy membrane biological reactor ultrafiltration system, the Scanship biological reactor and ultrafiltration system, and the Rochem reverse osmosis ultrafiltration system. Table 2 identifies the type of treatment in use during the 2008 season by NWCA member ships.

Table 2. 2008 Vessels and Wastewater Treatment

Vessel Operator	Vessel Name	Blackwater (BW) Treatment System Manufacturer	Graywater (GW) Treatment System Manufacturer	Type of Treatment System
NWCA MEMBERS				
Celebrity Cruises	INFINITY	Zenon	Mixed with BW	AWTS: Zenon is a bioreactor and membrane ultrafiltration system.
Celebrity Cruises	MERCURY	Traditional MSD - Biopure	None	Non AWTS: Biopure is a marine sanitation device.
Celebrity Cruises	MILLENIUM	Hydroxyl	Hydroxyl	AWTS: Hydroxyl is a biological reactor and ultrafiltration system.
Holland America Line	AMSTERDAM	Traditional MSD - Hamworthy	None	Non AWTS: Traditional Marine Sanitation Device
Holland America Line	OOSTERDAM	Rochem	Rochem	AWTS: Rochem BW is a bioreactor and ultrafiltration; AWTS: Rochem GW is reverse osmosis ultrafiltration system.
Holland America Line	VOLENDAM	Zenon	Mixed with BW	AWTS: Zenon is a bioreactor and membrane ultrafiltration system.
Holland America Line	WESTERDAM	Rochem	Rochem	AWTS: Rochem BW is a bioreactor and ultrafiltration; AWTS: Rochem GW is reverse osmosis ultrafiltration system.
Holland America Line	ZAANDAM	Zenon	Mixed with BW	AWTS: Zenon is a bioreactor and membrane ultrafiltration system.
Norwegian Cruise Line	NORWEGIAN PEARL	Scanship	Mixed with BW	AWTS: Scanship is a biological reactor and ultrafiltration system.
Norwegian Cruise Line	NORWEGIAN STAR	Scanship	Mixed with BW	AWTS: Scanship is a biological reactor and ultrafiltration system.
Princess Cruise Line	GOLDEN PRINCESS	Hamworthy Bioreactor	Mixed with BW or held	AWTS: Hamworthy is a biological reactor and ultrafiltration system.
Princess Cruise Line	STAR PRINCESS	Hamworthy Bioreactor	Mixed with BW	AWTS: Hamworthy is a biological reactor and ultrafiltration system.
Regent Cruises	SEVEN SEAS MARINER	Hamworthy Reactor	Mixed with BW	AWTS: Hamworthy is a biological reactor and ultrafiltration system.
Royal Caribbean	RHAPSODY OF THE SEAS	Traditional MSD	None	Non AWTS: Traditional Marine Sanitation Device
Royal Caribbean	SERENADE OF THE SEAS	Scanship	Mixed with BW	AWTS: Scanship is a biological reactor and ultrafiltration system.
NON NWCA MEMBERS				
None				

The MOU prohibits discharges of untreated blackwater and untreated graywater within waters subject to the MOU from any type of treatment system. The MOU also bans discharges of treated blackwater and treated graywater unless treated with an AWTS which meets the Alaska requirements and under these terms:

- The ships are allowed to discharge \geq one nautical mile away from its berth and \geq 6 knots with the submittal of documentation and provisions including 24-hour continuous monitoring for turbidity and in 2009, UV disinfection, and emergency shutdown for treatment upsets.
- The ships are allowed to discharge within one nautical mile of berth with further documentation and provisions including 24-hour continuous turbidity or equivalent monitoring, and in 2009, UV disinfection, emergency shutdown for treatment upsets, and ultraviolet light disinfection immediately prior to discharge.

All ships discharging within waters subject to the MOU must:

- Not discharge within 0.5 miles of bivalve shellfish beds that are recreationally harvested or commercially approved to harvest. For the 2008 season, this includes three areas (President's Point, Apple Tree Cove, and Tye Shoal).
- Immediately stop all discharges when high turbidity occurs and, beginning in 2009, when a disinfection system upset occurs (and make appropriate notifications).
- Sample the effluent once per month while in Washington using a Washington state-certified laboratory.
- Meet the limitations on discharge as set in Alaska regulation.
- Split samples with Ecology upon request.
- Conduct Whole Effluent Toxicity (WET) testing once every two years for homeported vessels and once every 40 calls for other vessels (applies to continuous discharge approved vessels only).
- Provide test results provided to Alaska.
- Notify Ecology prior to sampling and allow Ecology to conduct inspections to verify compliance with the MOU (all vessels).
- Notify Ecology of any material changes made to the system.

The MOU prohibits the discharge of residual solids from the treatment system (sludge or biomass) in waters subject to the MOU, within 12 nautical miles from shore, and within the Olympic Coast National Marine Sanctuary. Residual solids are defined as including grit or screenings, ash generated during the incineration of sewage sludge and sewage sludge, which is solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works and includes scum or solids removed in advanced wastewater treatment processes. The Port of Seattle has been leading a study to evaluate the feasibility of alternative options to discharging biomass at sea.

The discharge of oily bilge water is prohibited if not in compliance with applicable federal and state laws. Vessels typically discharge at less than 15 parts per million, and some are more stringent at 10 or five parts per million.

Hazardous waste:

Per the MOU, Washington and the NWCA agreed to a uniform application procedure for the EPA national identification number under the Resource Conservation and Recovery Act (RCRA). The MOU details that Washington has the right to inspect all records upon request for hazardous waste management. NWCA member lines shall provide an annual report regarding the total hazardous waste offloaded in Washington. NWCA agrees to comply with the guidelines for certain waste streams per Washington regulations. Only Celebrity Cruises, Princess Cruises, and Royal Caribbean offloaded hazardous waste in Seattle in 2007 and did so per WAC 173-303-240.

Solid waste:

The discharge of solid waste (garbage) is prohibited in waters subject to the MOU.

2.2 Alaska requirements and certification

The U.S. Congress enacted Title XIV – Certain Alaskan Cruise Ship Operations in December 2000. The law creates wastewater standards for vessels. The regulations to implement the law (AS 46.03.460 – AS 46.03.490 and 18 AAC 69) became effective in July 2001 and November, 2002, and are enforced by the United States Coast Guard. Under the legislation, large cruise ships may discharge blackwater and graywater in Alaska while underway and law allows continuous discharge of blackwater and graywater that meet more stringent standards through a certification process. A ship approved by the U.S. Coast Guard to discharge continuously must sample their wastewater twice per month.

In August 2006, a ballot measure added new requirements to the Alaska Commercial Passenger Vessel Environmental Compliance Program. The new statute requires vessels to obtain a wastewater discharge permit for the discharge of any treated sewage, graywater, or other wastewater into marine waters of the state. The General Permit has stringent monitoring and reporting requirements as well as interim and final effluents limits.

All of the cruise ships subject to the Washington Cruise MOU are also subject to the Alaska requirements.

3. Documentation of Discharges from Advanced Wastewater Treatment Systems per the Mou

3.1 Documentation required

Discharges \geq one nautical mile and six knots:

Documentation is required for discharges from an AWTs occurring one nautical mile or more away from a ship's berth. The ship must be moving at a speed at or greater than 6 knots. The documentation must identify the type of treatment system in use on the ship, include schematic diagrams of the system and show that the system is certified by the United States Coast Guard. In addition, vessel specific information on how the ship's system meet 24-hour continuous turbidity or equivalent monitoring, documentation of system design that demonstrates emergency shut-down capacity.

Discharges within one nautical mile (continuously):

When the discharge occurs within one nautical mile of berth, the cruise ship operator is required to submit the above documentation. In addition, vessel specific information that all treated effluent will receive final polishing with ultraviolet light immediately prior to discharge, copies

of water quality test results for the past six months and a vessel specific plan that identifies storage capacities and notification procedures.

3.2 2008 approvals

Ship(s) receiving approval to discharge one mile or more from berth while traveling at a speed of 6 or more knots:

There were no requests or approvals for discharge at greater than one mile from berth and 6 knots.

Ships receiving approval to discharge while at berth or at a distance less than one nautical mile from berth (continuously):

The Norwegian Cruise Line NORWEGIAN PEARL and NORWEGIAN STAR submitted documentation that the systems were certified by the USCG for continuous discharge in Alaska for the 2008 season. Schematics and other documentation were also provided. Ecology staff reviewed the documentation and on May 12, 2008 sent a letter detailing approval for continuous discharge.

The Princess Cruise Line GOLDEN PRINCESS and STAR PRINCESS submitted documentation that the systems were certified by the USCG for continuous discharge in Alaska for the 2008 season. Schematics and other documentation were also provided. Ecology staff reviewed the documentation and on May 12, 2008 sent a letter detailing approval for continuous discharge.

Table 3. 2008 Approval to Discharge

Vessel Operator	Vessel Name	Discharging in Washington ¹ ≥ 1nm from berth and ≥ 6 knots		Discharging in Washington ¹ continuously (at berth or within 1 nm of berth)		Date Approved
		BW	GW	BW	GW	
Celebrity Cruises	INFINITY					
Celebrity Cruises	MERCURY	NO	NO	NO	NO	NA
Celebrity Cruises	MILLENIUM	NO	NO	NO	NO	NA
Holland America Line	AMSTERDAM	NO	NO	NO	NO	NA
Holland America Line	OOSTERDAM	NO	NO	NO	NO	NA
Holland America Line	VOLENDAM	NO	NO	NO	NO	NA
Holland America Line	WESTERDAM	NO	NO	NO	NO	NA
Holland America Line	ZAANDAM	NO	NO	NO	NO	NA
Norwegian Cruise Line	NORWEGIAN PEARL	YES	YES	YES	YES	May 12, 2008
Norwegian Cruise Line	NORWEGIAN STAR	YES	YES	YES	YES	May 12, 2008
Princess Cruise Line	GOLDEN PRINCESS	YES	YES	YES	YES	May 12, 2008
Princess Cruise Line	STAR PRINCESS	YES	YES	YES	YES	May 12, 2008
Regent Seven Seas	SEVEN SEAS MARINER	NO	NO	NO	NO	NA
Royal Caribbean	RHAPSODY OF THE SEAS	NO	NO	NO	NO	NA
Royal Caribbean	SERENADE OF THE SEAS	NO	NO	NO	NO	NA

BW = Black Water; GW = Gray Water; NA = not applicable

¹ Washington waters refers to the "waters subject to this Memorandum of Understanding (MOU)" as defined in the MOU signed April 20, 2004 and as amended.

4. Sampling per the MOU

4.1 Sampling required

Alaska requires twice-monthly sampling of conventional pollutants, as well as sampling of additional pollutants as part of the Alaska general permit. Per the MOU, the vessels that are approved for discharge are required to sample the quality of the treated effluent using a Washington state-certified laboratory at least one time per month while at port in Seattle during each cruise season. The cruise lines must use the sampling requirements set up by the USCG, Captain of the Port, Southeast Alaska Policy for conventional pollutants continued compliance monitoring regime. The MOU requires that the following parameters be sampled: pH, Biochemical Oxygen Demand (BOD), Fecal Coliform, Total Suspended Solids (TSS), and Residual Chlorine (RC).

Whole effluent toxicity testing

Whole effluent toxicity (WET) testing is required for vessels that are approved to discharge continuously, once every 2 years for homeported vessels (20 or more calls/turnarounds per season) and once per 40 port calls or turnarounds for all other vessels. WET testing guidelines were developed specifically for cruise ships by Ecology and are available on Ecology's website on cruise ships.

http://www.ecy.wa.gov/programs/wq/wastewater/cruise_mou/WETtestguideMOU2008.pdf

Ecology received WET test reports from two vessels taken in the 2008 season. Results were submitted for the NORWEGIAN STAR and the NORWEGIAN PEARL. WET testing was also required for the GOLDEN PRINCESS. Results were not submitted for that vessel.

Ecology's WET expert provided a synopsis of the results from the NORWEGIAN STAR AND NORWEGIAN PEARL. Ammonia levels were slightly higher for the PEARL, though the STAR had marginally more toxic results. Due to other indicators such as conductivity and the relative sensitivity of fish and mysids to the samples, another toxicant besides ammonia may be present. Surfactants from detergents or metals may be possible toxicants. Appendix B includes the synopsis provided and related material.

Appendix B includes a comparison table of cruise ship WET testing results since 2005 to on-land treatment plant WET test results. On-land treatment plant results with samples with total ammonia less than 11 milligrams per liter tended to be consistently nontoxic in acute results. 47% of the on-land treatment plants samples in the 11-30 mg/l total ammonia range had some level of acute toxicity to fish. 20% of the on-land treatment plant samples in the 11-37 mg/l total ammonia range had some level of acute toxicity to daphnids. On-land treatment plant samples with total ammonia >37 mg/l tended to always be acutely toxic to daphnids. For on-land treatment plants, ammonia toxicity is readily eliminated by dilution in all of these cases.

For all of the cruise ship WET tests on file, the cruise ship WET test samples have had total ammonia levels in the range of 15.4- 52.9. All but two results had total ammonia levels above

30 mg/l. Ammonia levels can be higher than in municipal effluents because cruise ships practice water conservation measures and therefore are treating a much more concentrated, and smaller volume of wastewater than a comparable sized municipality. As with the on-land treatment plants, ammonia toxicity in cruise ship discharges may be readily eliminated by dilution.

It is the unionized ammonia in the sample which is toxic. Unionized ammonia increases with pH and temperature. Therefore, total ammonia numbers will only be loose predictors of toxicity and lab test results will be difficult to relate to environmental effects.

A study is being finalized (preliminary results out now) from Alaska Department of Environmental Conservation/EPA on dilution from cruise ships while stationary. Preliminary analysis indicates that the average dilution factor at a distance between 5 to 15 meters away from the cruise ships ranged from a factor of 22 to 50.

Copies of the cruise ship WET test reports can be provided upon request.

4.2 Sampling Data

Sampling results were received for the cruise ships that were approved for discharge in waters subject to the MOU:

- Norwegian Cruise Line's PEARL and STAR
- Princess Cruises GOLDEN PRINCESS and STAR PRINCESS

Sampling results were compared to the limits established by Alaska/the Washington Cruise MOU and are also compared to Washington's water quality standards. Sampling results are summarized for all data received in Appendix C.

Table 4 below shows the results for the cruise ships during the approval period and within Washington/Alaska voyages.

Table 4. Sample Results - Cruise Ships Approved for Discharge into Washington Waters

SHIP: NORWEGIAN PEARL							
		pH	BOD	TSS	Chlorine Residual	Fecal Coliform	Comments
		St. Units	mg/l	mg/l	mg/l	#/100 ml	
MOU/Alaska Limits ¹		6-9	30/45	30/45	10 ug/l	20 / 40	
WA State Water Quality Standards ²		7.0-8.5	NA	NA	13 / 7.5 ug/l	14 / 43	
Sample Date	Location/ Lab						
5/13/08	Juneau/Admiralty	6.18	3.9	5	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
5/18/08	Seattle/Pace Analytical	6.1	14.0	ND< 2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
6/3/08	Juneau/Admiralty	6.74	2.1	2.4	ND< 0.10	ND< 1	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
6/8/08	Seattle/Pace Analytical	6.2	11	8	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
6/17/08	Juneau/Admiralty	6.75	3.46	7	ND< 0.10	8	MIXED BLACK AND GRAY OVERBOARD
6/24/08	Juneau/Admiralty	6.8	13	6	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
7/13/08	Seattle/Pace Analytical	6.3	19	2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
7/15/08	Juneau/Admiralty	6.76	3.2	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
7/22/08	Juneau/Admiralty	6.75	3.2	6	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD

8/12/08	Juneau/Admiralty	6.67	2.9	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
8/17/08	Seattle/Pace Analytical	6.6	22	2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
8/19/08	Juneau/Admiralty	6.53	3.0	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/2/08	Juneau/Admiralty	6.75	< 2.0	7	< 0.10	< 2	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
9/9/08	Juneau/Admiralty	6.77	ND< 0.5	6	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/14/08	Seattle/Pace Analytical	6.4	27	ND< 2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
	MINIMUM	6.1	ND	ND	ND	ND	met Seattle sampling requirement
	AVERAGE		8.7	3.9	0.10		
	MAXIMUM	6.8	27	8	0.10	8	
	GEOMETRIC MEAN					1.5	

SHIP: NORWEGIAN STAR							
		pH	BOD	TSS	Chlorine Residual	Fecal Coliform	Comments
		St. Units	mg/l	mg/l	mg/l	#/100 ml	
MOU/Alaska Limits¹		6-9	30/45	30/45	10 ug/l	20 / 40	
WA State Water Quality Standards²		7.0-8.5	NA	NA	13 / 7.5 ug/l	14 / 43	
Sample Date	Location/ Lab						
5/13/08	Juneau/Admiralty	7.01	5.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
5/17/08	Seattle/Pace Analytical	6.8	38.0	2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
6/3/08	Juneau/Admiralty	6.69	5.6	4	ND< 0.10	ND< 1	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
6/3/08	Juneau/Admiralty	6.69	5.4	3.2	ND< 0.10	ND< 1	MIXED BLACK AND GRAY unannounced sampling (BLIND DUPLICATE)
6/7/08	Seattle/Pace Analytical	6.9	13	4	ND< 0.10	8	MIXED BLACK AND GRAY OVERBOARD
6/17/08	Juneau/Admiralty	6.71	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
6/24/08	Juneau/Admiralty	6.63	8	8	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
7/12/08	Seattle/Pace Analytical	6.8	30	4	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
7/15/08	Juneau/Admiralty	6.79	7	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
7/29/08	Juneau/Admiralty	6.84	4.7	7	ND< 0.10	12	MIXED BLACK AND GRAY OVERBOARD
8/12/08	Juneau/Admiralty	6.66	8.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
8/16/08	Seattle/Pace Analytical	6.6	65	4	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
8/19/08	Juneau/Admiralty	6.71	9.1	ND< 1.0	ND< 0.10	2	MIXED BLACK AND GRAY OVERBOARD
8/26/08	Juneau/Admiralty	6.76	12.9	11	ND< 0.10	4	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
9/2/08	Juneau/Admiralty	6.60	8.1	4	ND< 0.10	*	MIXED BLACK AND GRAY OVERBOARD
9/6/08	Seattle/Pace Analytical	6.60	7	ND< 1.0	ND< 0.10	8	MIXED BLACK AND GRAY OVERBOARD
9/9/08	Juneau/Admiralty	6.5	8.3	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/16/08	Juneau/Admiralty	6.73	18.4	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
*fecal coliform analysis demonstrated confluent growth, so results not quantifiable. Re-sample ordered.							
	MINIMUM	6.5	ND	ND	ND	ND	met Seattle sampling requirement
	AVERAGE		14.2	3.3	0.10		
	MAXIMUM	7.01	65	11	0.10	12	
	GEOMETRIC MEAN					1.8	

SHIP: GOLDEN PRINCESS							
		pH	BOD	TSS	Chlorine Residual	Fecal Coliform	Comments
		St. Units	mg/l	mg/l	mg/l	#/100 ml	
MOU/Alaska Limits¹		6-9	30/45	30/45	10 ug/l	20 / 40	
WA State Water Quality Standards²		7.0-8.5	NA	NA	13 / 7.5 ug/l	14 / 43	
Sample Date	Location/ Lab						
5/12/08	Juneau/Admiralty	8.16	ND< 0.5	ND< 1.0	ND< 0.10	12	MIXED BLACK AND GRAY OVERBOARD
5/15/08	Juneau/Admiralty	6.98	2.7	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
5/19/08	Juneau/Admiralty	6.96	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
6/7/08	Seattle/Pace Analytical	7.3	12	2	ND< 0.10	2	MIXED BLACK AND GRAY OVERBOARD
6/9/08	Juneau/Admiralty	7.12	3.9	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
6/16/08	Juneau/Admiralty	7.44	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
6/30/08	Juneau/Admiralty	7.47	3.2	ND< 1.0	ND< 0.10	2	MIXED BLACK AND GRAY OVERBOARD
7/7/08	Juneau/Admiralty	7.34	2.3	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD

7/12/08	Seattle/Pace Analytical	7.0	13	2	ND< 0.10	4	MIXED BLACK AND GRAY OVERBOARD
7/21/08	Juneau/Admiralty	7.34	2.8	ND< 1.0	ND< 0.10	4	MIXED BLACK AND GRAY OVERBOARD
8/11/08	Juneau/Admiralty	7.15	3.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
8/16/08	Seattle/Pace Analytical	7.3	14	2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
8/18/08	Juneau/Admiralty	7.38	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/1/08	Juneau/Admiralty	7.62	20.2	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/8/08	Juneau/Admiralty	7.32	3.3	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/13/08	Seattle/Pace Analytical	7.2	24	ND< 2	ND< 0.10	4	MIXED BLACK AND GRAY OVERBOARD
	MINIMUM	6.96	ND	ND	ND	ND	met Seattle sampling requirement
	AVERAGE	6.7	1.1	0.10			
	MAXIMUM	8.16	24	2	0.10	12	
	GEOMETRIC MEAN					1.7	

SHIP: STAR PRINCESS							
		pH	BOD	TSS	Chlorine Residual	Fecal Coliform	Comments
		St. Units	mg/l	mg/l	mg/l	#/100 ml	
MOU/Alaska Limits¹		6-9	30/45	30/45	10 ug/l	20 / 40	
WA State Water Quality Standards²		7.0-8.5	NA	NA	13 / 7.5 ug/l	14 / 43	
Sample Date	Location/ Lab						
5/14/08	Juneau/Admiralty	6.98	6.4	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
5/28/08	Juneau/Admiralty	7.11	4	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
6/8/08	Seattle/Pace Analytical	6.9	15	6	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
6/18/08	Juneau/Admiralty	6.88	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
6/25/08	Juneau/Admiralty	6.67	6.8	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
7/13/08	Seattle/Pace Analytical	6.7	15	2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
7/16/08	Juneau/Admiralty	6.61	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
7/17/08	Juneau/Admiralty	6.76	3.4	ND< 1	ND< 0.10	< 2	MIXED BLACK AND GRAY unannounced sampling (+ priority pollutants)
8/13/08	Juneau/Admiralty	7.25	4	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
8/17/08	Seattle/Pace Analytical	7.1	29	ND< 2	ND< 0.10	2	MIXED BLACK AND GRAY OVERBOARD
8/20/08	Juneau/Admiralty	7.15	3.7	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/3/08	Juneau/Admiralty	7.35	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/10/08	Juneau/Admiralty	7.43	ND< 0.5	ND< 1.0	ND< 0.10	ND< 1	MIXED BLACK AND GRAY OVERBOARD
9/14/08	Seattle/Pace Analytical	7.4	29	ND< 2	ND< 0.10	< 2	MIXED BLACK AND GRAY OVERBOARD
	MINIMUM	6.61	ND	ND	ND	ND	met Seattle sampling requirement
	AVERAGE		8.5	1.6	0.10		
	MAXIMUM	7.4	29	6	0.10	2	
	GEOMETRIC MEAN					1.2	

ND = Non Detect, value in box is the detection level. Unannounced sampling includes other parameters not listed above.

BOD = Biochemical Oxygen Demand - or organics; TSS = Total Suspended Solids

mg/l = milligrams per liter; ug/l = micrograms per liter; #/100 ml = coliforms per 100 milliliters

¹MOU/Alaska limits from Title XIV, Certain Alaska Cruise Ship Operations, Section 1404(c) /40CFR 133.102

BOD and TSS: 30-day average shall not exceed 30 mg/l, 7-day average shall not exceed 45 mg/l

Fecal Coliform: geometric mean of any 30-day period shall not exceed 20 fecal coliform/100 ml and not more than 10% of the samples exceed 40 fecal coliform/100 ml

²Washington State Water Quality Standards for Surface Waters of the State of Washington Chapter 173-201A WAC

Fecal Coliform: shall not exceed a geometric mean of 14 colonies/100 ml and not more than 10% of a samples shall exceed a geometric mean of 43 colonies/100 ml

pH: 7-8.5 with a human-caused variation within less than 0.2

chlorine: 13 ug/l is the acute limit (1-hour average); 7.5 ug/l is the chronic limit (4-day average)

For the ships that discharged from the AWTS's, the results were in compliance with the Washington MOU and Alaska limits. However, when the samples were compared to Washington's water quality standards, pH would have violated the standards at the point of discharge. The discharges from the cruise ships does not account for a mixing zone. On-land

sewage treatment plants do have mixing zones. The results from the cruise ships for the parameters listed as above are generally as good as or better than most of the on-land plants. Random unannounced samples were taken by the Alaska Department of Environmental Conservation in Alaska throughout the season. The samples taken included other parameters than the conventional pollutants detailed in Table 4. Copies of laboratory results received by Ecology can be obtained through Ecology's public disclosure office.

The sample results submitted by the lines included some results for other parameters required as part of the Alaska General Permit including copper, zinc, nickel, and ammonia. These results are included in Appendix C.

Table 5 below compares the various advanced wastewater treatment systems results as averaged. All result received are included in the averages.

Table 5. Comparison of Advanced Wastewater Treatment Systems and Result Averages

Total Number of Sample Dates = 68	pH	BOD	TSS	Chlorine Residual	Fecal Coliform	Ammonia	Copper (dissolved)	Nickel (dissolved)	Zinc (dissolved)
	Standard Units	mg/l	mg/l	mg/l	#/100 ml	mg/l	µg/l	µg/l	µg/l
	AVG	AVG	AVG	AVG	Geometric Mean	AVG	AVG	AVG	AVG
Scanship	6.65	11.6	3.6	<0.10	1.6	26.5	6.25	8.10	83.4
Hamworthy	7.16	8.6	1.5	<0.10	1.6	39	43.17	10.59	161

5. Inspections

5.1 Inspections per the MOU

Eleven different vessels were inspected by Ecology staff throughout the 2008 season. A list of vessels inspected is included in Table 6. The inspections were per the MOU and included a walkthrough of the wastewater systems, a review of discharge records, a review of notification and discharge procedures, and a review of other wastestreams. The inspections typically also included sampling for vessels approved to discharge. Results are included in the inspection reports.

In general, the ship's wastewater systems were operating well and produced high quality effluent. There is more process control sampling being done on board the vessels. Discharge protocols are thorough and include verifications.

Recommendations were made for some of the vessels. One vessel was reminded that it was due for WET testing which had not yet been done yet or scheduled. It was pointed out that one vessel must not discharge, even though approved to do so until the disinfection system is

operational (current protocol on the vessel). A copy of the MOU was not available on one vessel and should be available. Two vessels had operational problems with their advanced wastewater discharge systems and held all discharges.

It was noted that during the inspections, many of the vessels have greatly increased their waste minimization efforts. Increased recycling rates, minimization of materials used, decreased water usage, and reusing more items has all contributed to the overall minimization of wastes being burned or sent to a landfill.

As not all vessels could be inspected, copies of discharge documents were requested and received for all vessels from the date of inspection till the end of the season for those inspected and for the entire season for those not inspected. Upon review, no violations of the MOU were discovered.

Copies of the inspection reports are included in Appendix D.

Table 6. 2008 Vessel Inspections

Vessels Inspected	Date Inspected
OOSTERDAM (Holland America Line)	June 7, 2008
WESTERDAM (Holland America Line)	June 22, 2008
STAR PRINCESS (Princess Cruises)	June 22, 2008
INFINITY (Celebrity Cruises)	July 18, 2008
NORWEGIAN STAR (Norwegian Cruise Line)	July 26, 2008
GOLDEN PRINCESS (Princess Cruises)	July 26, 2008
AMSTERDAM (Holland America Line)	August 22, 2008
RHAPSODY OF THE SEAS (Royal Caribbean)	August 29, 2008
NORWEIAN PEARL (Norwegian Cruise Line)	September 14, 2008
MERCURY (Celebrity Cruises)	September 22, 2008
MILLENNIUM (Celebrity Cruises)	October 1, 2008

6. Compliance

6.1 Compliance with MOU requirements

There were no reported incidents of non-compliance with any provision of the MOU.

Letters detailing compliance with the MOU from member lines are included in Appendix E.

One vessel did not conduct sampling for WET testing as is required by the MOU. The GOLDEN PRINCESS has been a homeported vessel approved for continuous discharge for both the 2007 and 2008 season. The sampling was not conducted.

7. Shellfish and Viruses

In 2007, The Washington State Department of Health issued a report from a study to examine the potential human health impacts from virus discharges from large passenger vessels. Their results indicate that, when AWTS are fully functional, viral discharges from large cruise ships should not cause illness through shellfish. However, if the treatment systems malfunction, virus discharges from cruise ships may reach some shellfish beds at levels that may lead to illness. The Department of Health report identifies recommendations to limit the risk of an unacceptable discharge. Recommendations include:

- No discharge should occur within 0.5 nautical miles of bivalve shellfish beds that are recreationally harvested or commercially approved to harvest.
- Cruise ships should withhold discharge when a system upset occurs.
- DOH should be notified immediately in the event of an AWTS upset.
- A small passenger ship study should be done to assess potential impacts of these vessels.
- The Department of Ecology should revise their 'Criteria for Sewage Works Design' to address minimum UV dosage for virus inactivation.

The full report can be found at: www.doh.wa.gov/ehp/sf/Pubs/cruise-ship-report.pdf

The recommendations were incorporated into the MOU via the 2008 amendments.

8. Conclusions

8.1 Overall

The Memorandum of Understanding continues to be a key tool in protecting water quality by having requirements in place to only allow discharges from advanced wastewater treatment systems, allowing for inspections to verify compliance, and building communication with the cruise lines and vessel staff on requirements of the MOU.

While we continue to learn more about the large passenger vessels, more information is needed in regards to the small ships including which ships are operating in Washington waters, what type of treatment systems are on board, which ships are discharging and where, and the quality of the effluent being discharged.

The majority of the lines and vessels operating with the MOU had a successful season and were in compliance throughout. The sampling results for conventional pollutants continue to show

excellent effluent quality. One cruise line did not conduct the required whole effluent toxicity testing as required.

The MOU specifies that all of the parties agree to at least one annual meeting to review the effectiveness of the MOU. The annual meeting was held on January 22, 2009. The Port of Seattle, the Department of Ecology, representatives from the NorthWest CruiseShip Association and some of its member lines (Princess Cruises, Holland America Line, and Royal Caribbean/Celebrity Cruises), the Department of Health, as well as other interested parties convened for the meeting. Agenda items included:

- Welcome and Introductions.
- Compliance with the 2008 season.
- Department of Health Report – viruses.
- Updates on Biomass, EPA Vessel Discharge Permit, MOU Amendments and MOU Funding.
- Comments/Discussion from cruise lines and interested parties.
- Looking Ahead.

The meeting notes are included in Appendix F.

Advantages to the MOU include having something in place to protect water quality, building a partnership with the cruise industry and other key stakeholders, and being able to inspect and evaluate the quality of treatment from the ships that discharge. Limitations of the MOU include the inability to effectively enforce on what is essentially a voluntary agreement, the lack of coverage under the MOU for large passenger ships that are not members of the NorthWest CruiseShip Association, and air quality issues are not currently covered in the MOU.

8.2 Recommendations

1. The Department of Ecology recommends that the MOU continue to be used as a complement to environmental regulations until state specific regulations for cruise ship waste management in Washington State are put in place.
2. Ecology recommends that Ecology continue to inspect ships that discharge in waters subject to the MOU, including closely looking at wastewater management and the management of other waste streams.
3. It is recommended that the parties of the MOU continue to work together on evaluating the testing protocols, results, and testing guidelines for whole effluent toxicity and make recommendation on how to proceed.
4. It is recommended that the cruise lines conduct a thorough review of records on an on-going basis throughout the season as well as at the end of the system to evaluate compliance, and that all recommendations made in inspection reports be implemented.

Appendices