Graywater

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PAME SEG I-2020

Overview

Characterization of Graywater

Impacts of Graywater

Requirements for passenger vessel wastewater in Alaska

What can PAME do?

Why look at ship graywater?

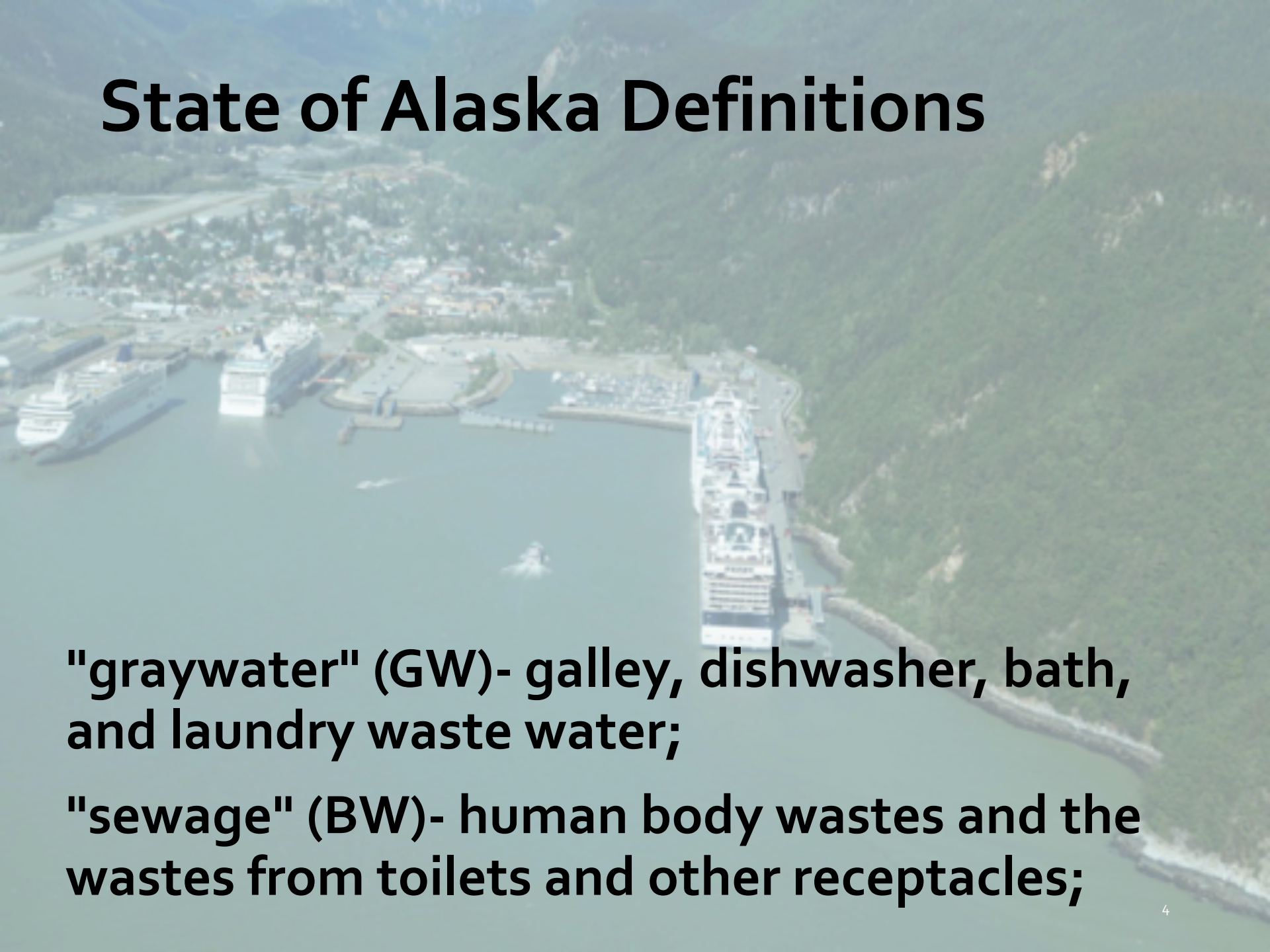
Large potential loads

Compared with local Arctic nutrient and pollutant sources

Subsistence impacts

Discharges near gathering and fishing areas, mobile sources

State of Alaska Definitions



"graywater" (GW)- galley, dishwasher, bath, and laundry waste water;

"sewage" (BW)- human body wastes and the wastes from toilets and other receptacles;

US EPA definition

"Graywater" means galley, bath, and shower water, as well as wastewater from lavatory sinks, laundry, and water fountains

Excludes shop sinks

Graywater is included as an "incidental discharge" in the 2018 Vessel Incidental Discharge Act

MARPOL

Drainage from dishwater, shower, laundry, bath and washbasin drains

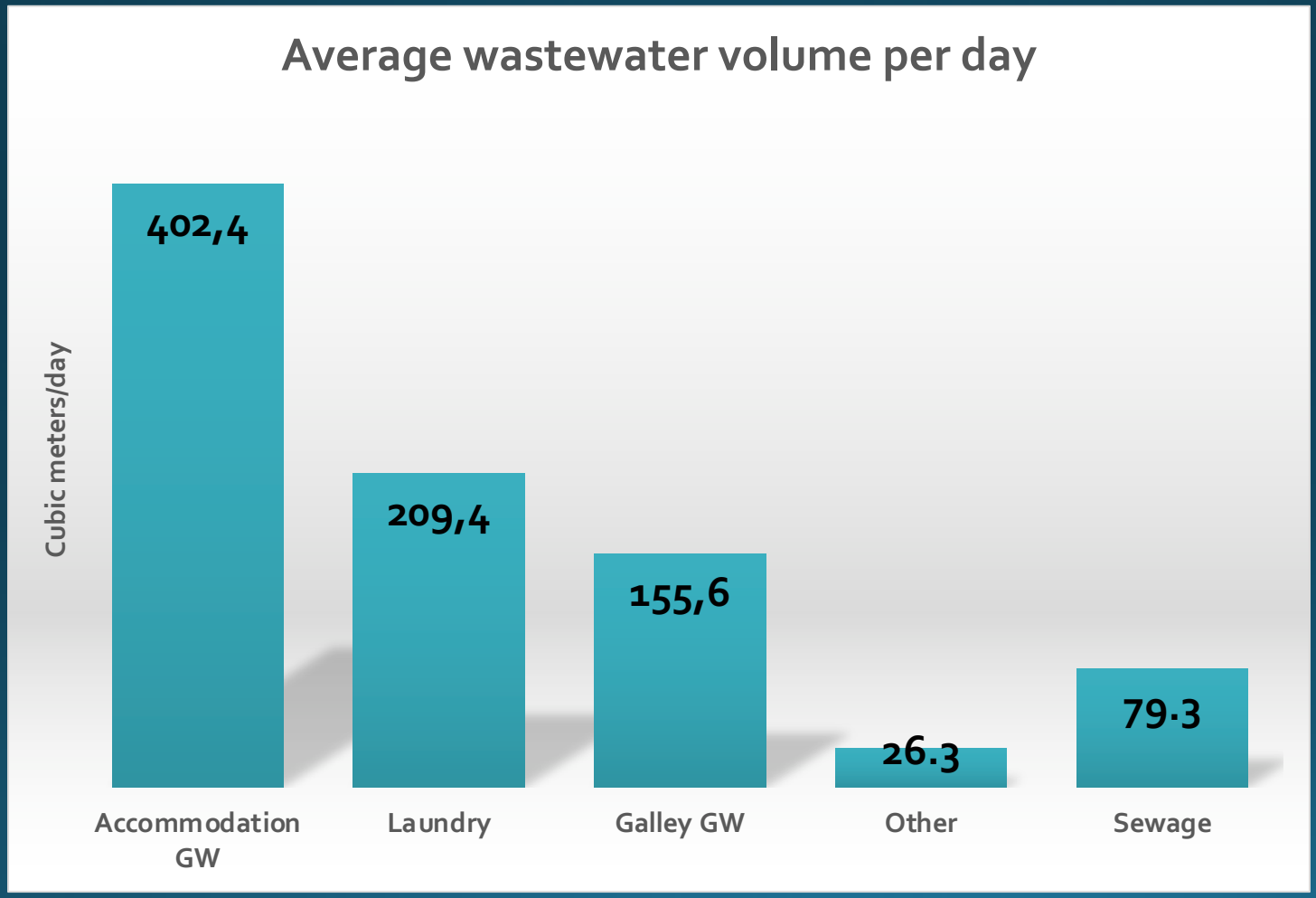
Excludes cargo spaces drainage, animal wastes

Other sources of graywater

Definitions vary on graywater. May include or be mixed with other sources:

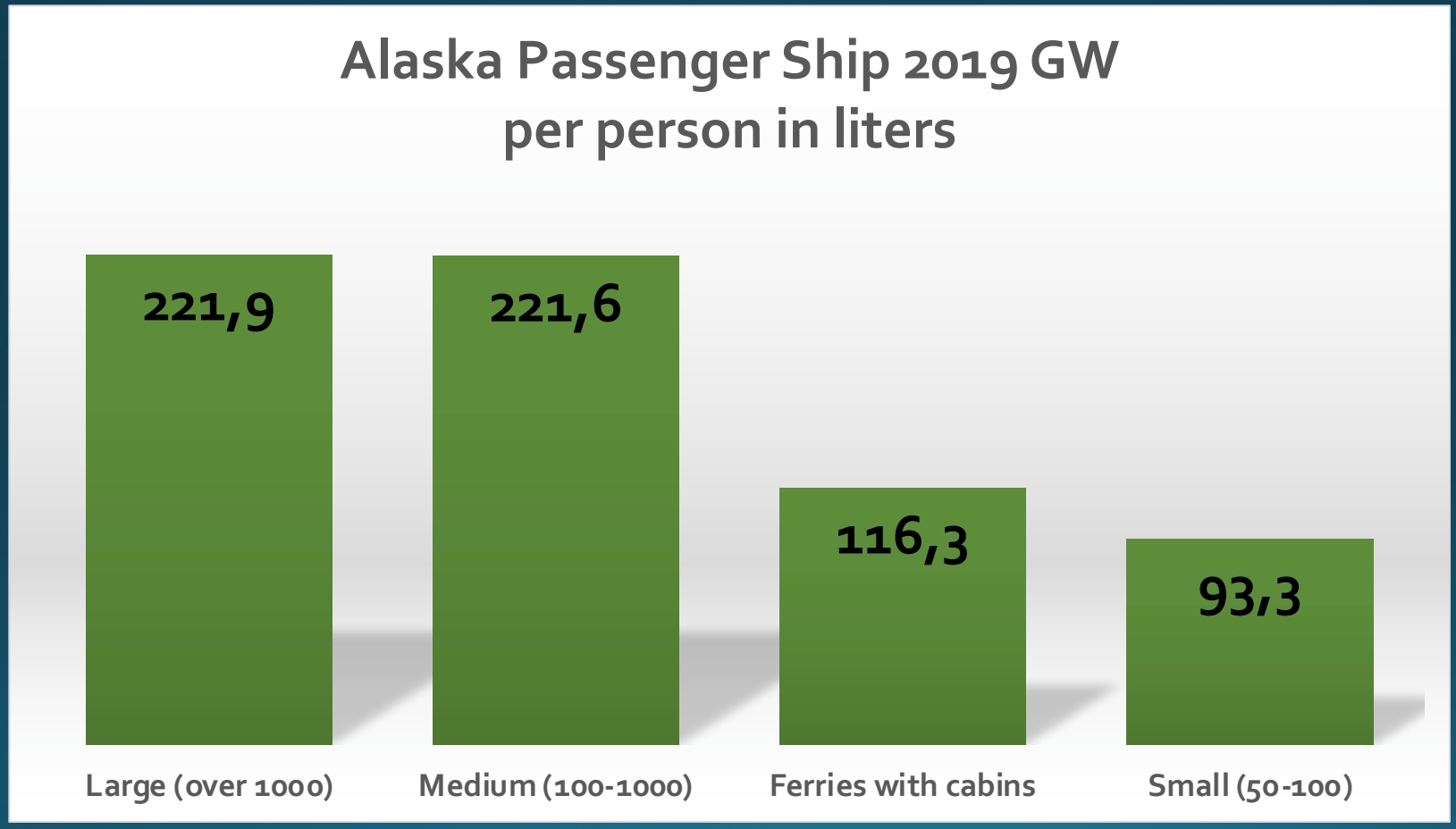
- Other non-lavatory sinks- spa, photo, other
- Floor drains
- Food pulper drainage
- Pool and spa drainage
- Condensates
- Cleaning wastewater
- Boiler water
- Ballast water (if using same tanks and pipes)

Graywater volumes



1000 or more passengers, registered to discharge in Alaska in 2019

Average GW volume per person



US EPA uses an average of 177 liters

Graywater Concern

Can contain higher levels of bacteria than untreated sewage

Can have high levels of nutrients

Other pollutants can be present

1999 Alaska Cruise Ship Initiative

Concern about impact on fisheries and marine environment due to rapid growth in number of cruise ships

Examined effects of cruise ships

EPA 2008 Cruise Ship Discharge Assessment

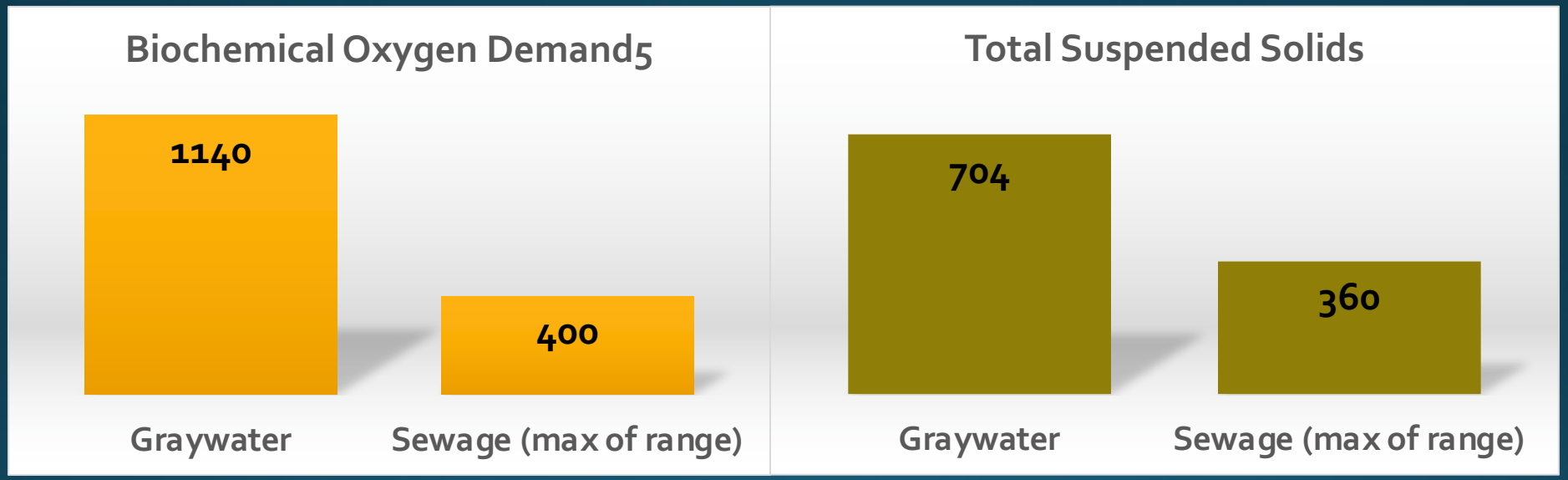
Raw Domestic Sewage	
Fecal coliform	**10,000 to 100,000** fc/100ml

Graywater Averages	Fecal coliform
ADEC/EPA 2000-2001	**2,950,000**
Accommodations (2004 EPA)	**36,700,000**
Galley (2004 EPA)	**29,100,000**
Laundry (2004 EPA)	**7,940**

Source: US EPA Cruise Ship Discharge Assessment Report, 2008
EPA842-R-07-005

Graywater compared with raw sewage

EPA 2004 large cruise ship graywater sampling



In mg/l. Flow weighted averages of untreated graywater, compared with domestic sewage range

Source: US EPA Graywater discharges from vessels
EPA800-R-11-001, November 2011

Pollutants found in graywater
2000—2003 in Alaska

- Tetrachloroethylene (PERC)
- Silver and mercury
- Oils and grease
- Dissolved metals
- Cleaning chemicals
- Chlorine and other disinfectants
- Other priority pollutants

Periodic sampling for these is required in Alaska, improvements in reducing or eliminating pollutants has been noted in sample results

Alaska Cruise Ship Program

Wastewater monitoring and permitting

Air emissions monitoring

Waste offloads

Research

Alaska State and Federal Territorial Waters

Distance from Land

3 Nautical Miles (Alaskan Waters)

12 Nautical Miles (US Territorial Seas)

0 100 200 400 600 800 1,000

Nautical Miles

Where a large cruise ship can discharge depends on the type of discharge and how it is covered by state and federal laws and regulations. For example, Title XIV (the "Wurkowski law") allowed the state of Alaska to regulate wastewater discharge for large cruise ships within Alaskan waters and also within some areas in the Alexander Archipelago that are outside of 3 nautical miles but within US territorial waters.

Alaska passenger vessel wastewater

Approval needed to discharge BW and GW
(permit needed if over 250 berths)

Sampling required if discharging

Sampling plans, required records

Inspections, Ocean Rangers (2007-2019)

Enforcement

Advanced Wastewater Treatment System (AWTS)

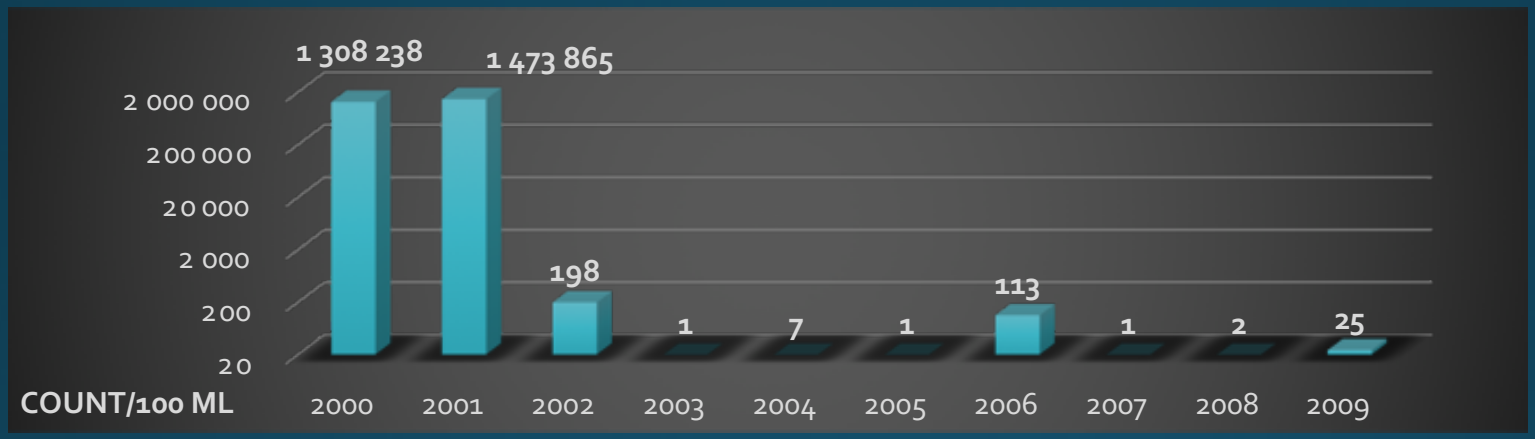
Designed to meet the EPA secondary wastewater treatment standards

All include some type of filtration, biological treatment, and disinfection using ultraviolet light or ozone

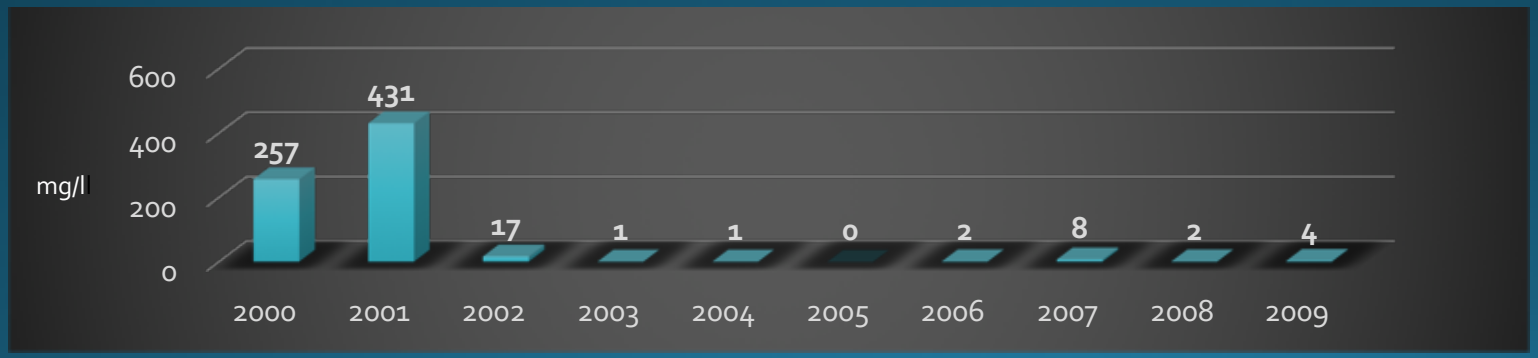
AWTS improvements in treatment

Mixed sewage and graywater

Fecal coliform Averages 2000-2009



Total Suspended Solids (TSS)



Source: ADEC sample reports

2018 Alaska AWTS Results

Graywater

- **Fecal coliform geomean of 1.5 FCU**
- **TSS average of 0.2 mg/L**
- **No chlorine detected**

Mixed sewage and graywater

- **Fecal coliform geomean of 1.3 FCU**
- **TSS average of 4.8 mg/L**
- **Chlorine detected in four samples, 1.2 mg/L max**

Reducing impacts

Holding in tanks near shore

Treatment

Source reduction and separation of sources

Reduce or eliminate toxic chemicals onboard

Educate crew and passengers

Lessons Learned in Alaska

Representative and regular sampling

Proper maintenance

Raise priority of wastewater

Graywater in the Arctic

- Graywater can have an impact greater than untreated sewage
- Treatment and/or holding near shore is possible to reduce impacts
- Graywater and other wastewaters should be studied and regulated to reduce impacts to Arctic waters and communities

Other wastewater concerns

Sewage treatment systems

Exhaust gas scrubber effluent

Other pollutants- pharmaceuticals, microplastics, etc.

What PAME can do

- Look into graywater and other wastewaters from marine vessels
- Evaluate information on graywater discharges and impacts in the Arctic, survey vessel operators
- Draft best management practices for graywater
- Look at potential spatial restrictions on graywater discharges