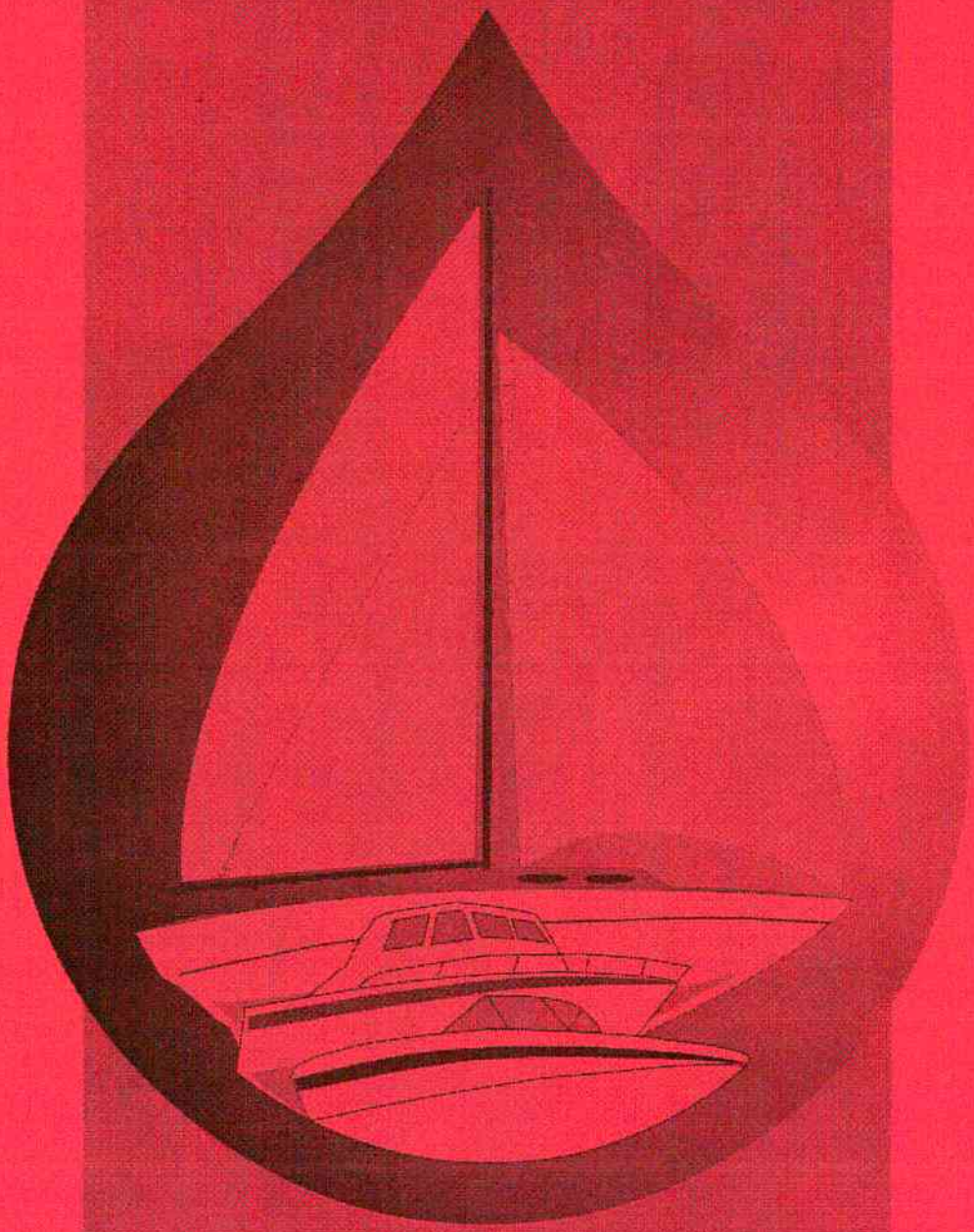
EFFECTS OF BOAT WASTE DISPOSAL AT MUNICIPAL WASTEWATER TREATMENT FACILITIES



OREGON STATE MARINE BOARD
1995

EFFECTS OF BOAT WASTE DISPOSAL AT MUNICIPAL WASTEWATER TREATMENT FACILITIES

OREGON STATE MARINE BOARD

BOARD MEMBERS

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MARCH 1995

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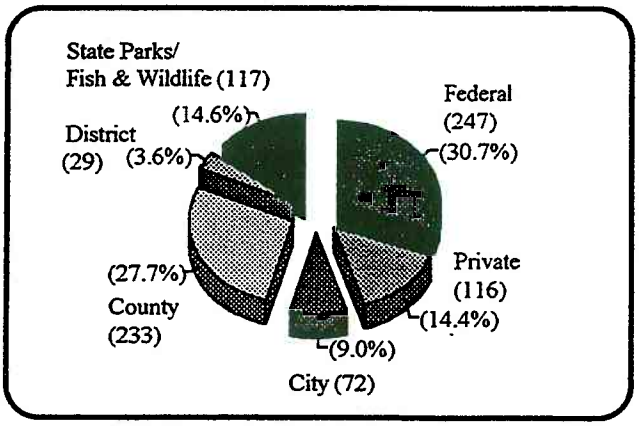
CHAPTER 1 - INTRODUCTION

BACKGROUND FOR THIS STUDY

There are over 800 boating facilities in Oregon, ranging from Hammond Mooring Basin on the Columbia River in the northwest corner of the state; to Three Forks Access on the Owyhee River in the southeast; to the Port of Brookings Harbor on the Chetco River in the southwest; to Dug Bar on the Snake River in the northeast corner of the state. Each facility is unique with its own type of boat access ramp, parking availability, moorage, restrooms, and camping, fuel and supplies availability.

The operation of these boating facilities is provided by local governments, counties, port commissions, districts, state and federal agencies, and finally the private sector. State agencies include Oregon State Parks and Oregon Fish and Wildlife. Federal agencies include the U.S. Forest Service, U.S. Corps of Engineers, U.S. Fish and Wildlife, Bureau of Land Management, and the Bureau of Reclamation. The management of boating access sites by jurisdiction type is shown on Figure 1-1, which follows:

Management of Boating Access Sites by Jurisdiction Type



Purpose of this Study

The purpose of this study is to present information on the best means to dispose of recreational boat waste in Oregon. The tasks of the study include characterizing boat waste; determining treatment options available for disposal of boat waste; presenting the results of a wastewater treatment plant survey; and developing conclusions, recommendations and guidelines for boat waste disposal.

Characterization of boat waste has included researching previous studies; researching the characteristics of similar wastes like recreational vehicle waste and septage; researching the types and uses of commercially available additives for holding tanks and portable toilets; and finally performing a sampling program at three marinas in Oregon. The marinas included:

1) Kane's Hideaway Marina at Detroit Lake,
2) Tomahawk Bay Moorage on the Columbia River, and
3) Charleston Boat Basin on Coos Bay.

The determination of treatment options available included research into options available to treat boat waste, both on-site treatment systems such as septic tank leach fields and off-site systems such as municipal treatment facilities.

A wastewater treatment plant survey was conducted during August and September 1994 and the results are part of this study. The survey determined specific data about the treatment facility; what type of problems the facility currently has with high-strength waste; and finally what modifications are needed to accept boat waste. A computer database was established for the survey results.

Finally, this study contains conclusions, recommendations and guidelines. The guidelines include the recommended process to follow to determine the best means to dispose of recreational boat waste in Oregon.

FEDERAL AND STATE RULES AND REGULATIONS

Federal

Major milestones in the history of federal water quality legislation include:

Rivers and Harbors Act	1899	Prohibited discharge of refuse into waterways that would interfere with navigation without obtaining a permit from the U.S. Army Corps of Engineers.
Water Pollution Control Act	1948	Provided federal financial assistance to local governments for construction of municipal wastewater treatment facilities.
Federal Water Pollution Control Act	1956	Provided additional federal funding.
Water Quality Act	1965	Required states to develop state water quality standards for interstate waters.
Federal Water Pollution Control Act Amendments (Public Law 92-500)	1972	Greatly increased federal financial assistance for municipal wastewater treatment facilities. Instituted national permit (NPDES) system for point sources.
Clean Water Act (Public Law 95-217)	1977	Encouraged states to accept delegation of the national permit system. For Oregon this was the DEQ.
Municipal Wastewater Treatment Construction Grant Amendments	1981	Reduced federal funding for municipal wastewater treatment facilities.
Water Quality Act (Public Law 100-4)	1987	Phased out federal grants for municipal wastewater treatment facilities.
Clean Vessel Act (Public Law 102-587)	1992	Provided federal financial assistance to states to install facilities to handle boat waste.

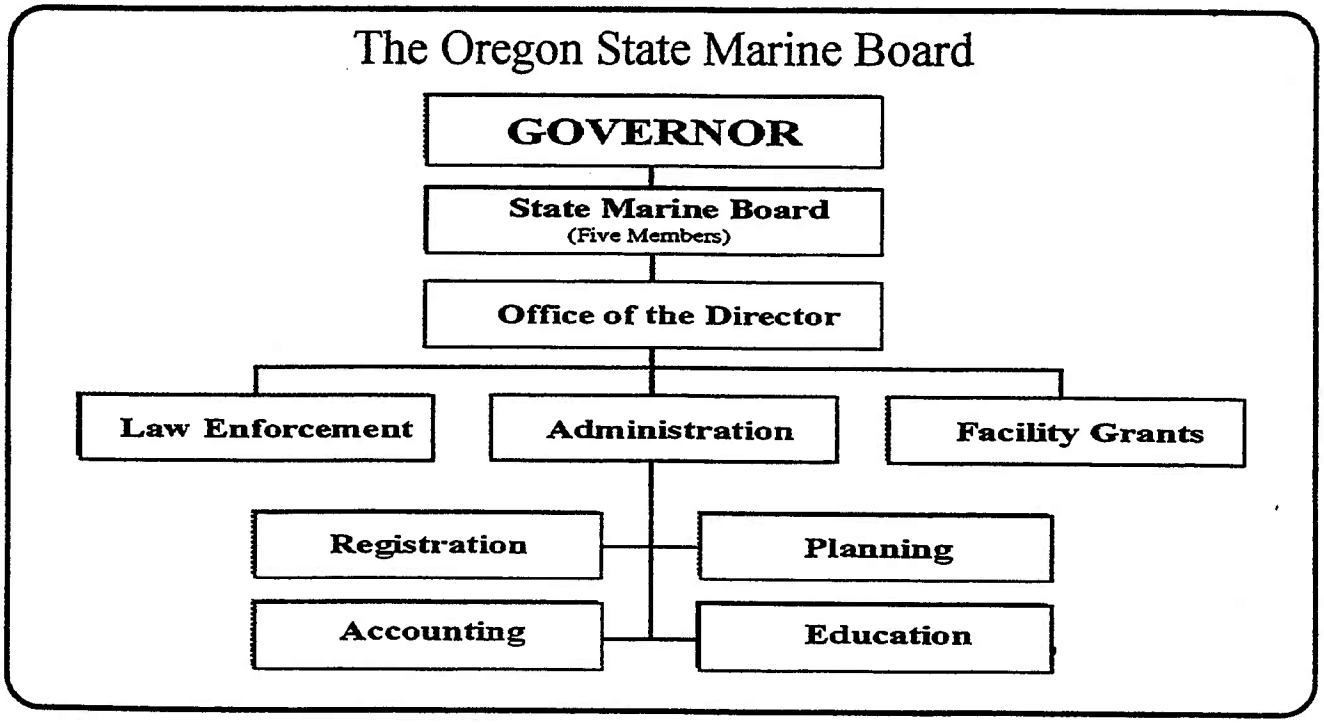
The U.S. Fish and Wildlife Service subsequently published the "Clean Vessel Act: Pumpout Station and Dump Station Technical Guidelines" on March 10, 1994. The U.S. Fish and Wildlife Service administers the Clean Vessel Act grant program. A copy of the technical guidelines can be found in the appendices of this study.

State of Oregon

In Oregon, two state agencies are responsible for the proper disposal of boat waste; the Oregon State Marine Board and the Oregon Department of Environmental Quality (DEQ).

Oregon State Marine Board

The Oregon State Marine Board is responsible for boat registration, boat operation rule making, marine law enforcement and boater education. The Marine Board also funds the development of boat facilities. The organizational chart for the Marine Board is shown on Figure 1-2, which follows:



The mission statement of the Marine Board is:

> "Oregon's Boating Agency...dedicated to safety, education and access in an enhanced environment."

The Marine Board has developed the "Six-Year Statewide Boating Facilities Plan" for 1993 to 1999. Table 1-1 shows the historic and projected changes in key boating indicators from 1980 to the year 2000. This six-year plan lists the boating facility needs by county. The projected needs include boat waste disposal facilities, which contain pumpout stations, portable toilet dump stations and sewer pipelines.

In Oregon, the discharge of wastewater from marine toilets is prohibited on all freshwater lakes, impoundments and reservoirs that are not accessible by boat from the ocean. The discharge of untreated wastewater is only permitted beyond the 3 mile limit. The use of approved marine sanitation devices is required on the Columbia, Willamette and Snake Rivers and on the navigable portions of all coastal rivers.

Pumpout and portable toilet dump stations are available at over 20 marina locations around the state.

Oregon Department of Environmental Quality

The Oregon Department of Environmental Quality (DEQ) was established in 1969 and is responsible for water pollution control and water quality improvements in the state. The DEQ has established rules and regulations for septic tank leach field systems, wastewater collection systems, and wastewater treatment facilities.

BOAT WASTE DISPOSAL CHALLENGE IN OREGON

Oregon is somewhat unique in the nation when dealing with boating and boat waste disposal, and this is largely due to the diverse topographical features of the

Historic and Projected Changes in Key Boating Indicators (1980-2000)

Indicator	1980	1990	2000
Registered Boats	135,000	175,000	225,000
Boat Characteristics			
Boat Length			
Less than 12 ft.	19,124	23,103	27,000
12-15 ft. (Note 1)	61,818	72,240	75,000
16-19 ft. (Note 1)	38,000	58,000	90,000
20-27 ft. (Note 1)	12,124	17,103	29,000
28-39 ft. (Note 2)	2,052	2,644	2,500
40-64 ft. (Note 2)	262	427	600
Greater than 65 ft. (Note 2)	5	26	40
Average Boat Length (ft.)	15	18	21
Average Boat Width (ft.)			
20 ft. length	6	7	8
30 ft. length	10	12	14
40 ft. length	12	15	18
50 ft. length	14	18	22
Average Boat Height			
(30-50 ft. boats)	7-9	8-11	9-12
Engine Size (HP)	50	90	120
Trailer Length (ft.)	35	40	45
Trailer Axle (Percent)			
Single Axle	75	55	30
Tandem	20	40	60
Triple	2	5	10
Boating Activity			
Typical Season of Use	Memorial Day to Labor Day	Late April to End of Sept.	April to October
Use By Activity (Percent)			
Fishing	62	55	50
Cruising	13	17	20
Skiing	12	13	14
Sailing	7	8	9
Average Days of Use	21	25	30
Distance Traveled to Access (Miles)	28	35	42
Time Spent in Water (Hr.)	3.5	4	4.5
Average Party Size	3	3	4
Average Distance Traveled By Boat (Note 3)	18	21	24
Average Fuel Consumed Per Trip (Gal)	6.8	7	7.2
Average Dollars Expended Per Trip	$450	$500	$550

Notes: 1. Moved By Trailer
2. Wet Slip or Moorage
3. Round Trip Distance per Day (Miles), Not Including Trolling

state. Oregon's diverse water features include coastal bays and estuaries; inland lakes, reservoirs and rivers; and metropolitan riverside developments. Because of these diverse features, boat waste disposal in Oregon is a challenge.

Location of Marinas

Marinas located in metropolitan areas such as the City of Portland may have close access to the municipal wastewater collection system; however the lack of available land space may cause the installation of pump stations and sewers to be very costly.

Marinas located in rural areas of Oregon may have plenty of land but there may be no local wastewater collection system. In addition, the local water quality standards adopted by the state may be such that construction of an on-site sewage disposal system is prohibited, leaving the only option to be installing a holding tank that is periodically pumped out by a septage hauler.

Marinas located at coastal communities and those located in storage reservoirs also face the challenge of fluctuating water levels, with changing tides and reservoir operational changes. Changing water levels will provide a challenge to the design, installation and maintenance of pumpout stations, wastewater pump stations and sewer systems that connect to either on-site systems or municipal wastewater systems.

Boat Size

The size of boat is also part of the challenge. Generally boats less than 16 feet in length carry no toilet facilities, and these boaters will need either convenient shoreside restrooms or floating restrooms anchored toward the middle of the lake. Floating restrooms are periodically towed to shore for removal of the waste; either by a septage hauler or by pumping the waste into an on-site system or municipal system.

Boats from 16 feet to 26 feet generally have portable toilets and there is a need at the marina for a dump station for the boater's use. Dump stations are shoreside devices where the contents of a portable toilet can be easily placed.

Boats larger than 26 feet have holding tanks that store the waste from the toilets on the boat. Boat holding tanks can vary in volume from 10 to 50 gallons, or greater. Convenient pumpout stations or pumpout services are needed for these boaters to properly dispose of their waste. Pumpout stations are devices located at the dock of a marina that pumps or receives human body waste out of a boat holding tank or from a pumpout service. A pumpout service is typically a private company that has a pumpout system (pump and tank) on a small boat and for a fee will come to the boat, pump out the contents of the boat holding tank, and dispose of the waste at the marina pumpout station.

ACKNOWLEDGEMENTS

The authors of this study want to acknowledge the assistance of Sam Knapp of Tomahawk Pumpout Service, Don Youst of Charleston Marina and Ray Crist of the U.S. Forest Service Detroit Ranger Station. The sample collection phase and interviews for information on holding tank chemical additives could not have taken place without their time and assistance.

CHAPTER 2 - CHARACTERISTICS OF BOAT WASTE

The characterization of boat waste for this study has included a sampling program for 1994, a review of previous studies about boat waste, a review of previous studies about similar high-strength waste, and a review of chemical additives available for boat owners.

The conclusion of the 1994 sampling program is that boat waste found in Oregon is very similar to that found in previous studies. It is a high-strength waste very similar to recreational vehicle waste and septage. Boat waste sampled as part of this study has the following average characteristics:

Biochemical Oxygen Demand	=	2,990 mg/l (milligrams per liter)
Chemical Oxygen Demand (COD)	=	8,020 mg/l
Soluble COD	=	5,140 mg/l
Total Suspended Solids	=	1,600 mg/l
Volatile Suspended Solids	=	1,370 mg/l

This study also concludes that most boaters using additives for holding tanks utilize either a formaldehyde or enzyme type.

HEALTH AND SAFETY CONSIDERATIONS OF BOAT WASTE

It is important to realize that boat waste contains principally human waste and as such can contain pathogenic organisms. These organisms vary widely in their impact on human health, from causing minor health problems to causing death.

As such, the handling, treatment, sampling, and eventual disposal must be done by people who are trained in proper health and safety techniques. A discussion of these techniques is not included in this study.

PREVIOUS STUDIES

EPA Study by Robins and Green, 1974

The "Development of On-Shore Treatment System for Sewage from Watercraft Waste Retention System" was prepared by the Environmental Protection Agency (EPA) in 1974. This study characterized waste and chemical additives associated with recreational watercraft, evaluated the toxicity of additives to treatment plant processes, and performed field testing of wastewater treatment equipment operating on boat waste.

This study analyzed 65 waste samples collected at 16 marina locations in California and Nevada. The boats sampled from included powerboats, sailboats and houseboats. For a sampling category containing both powerboats and sailboats, the study found an average BOD of 2,710 mg/l, an average COD of 6,180 mg/l and an average TSS of 2,860 mg/l.

Recreational Vehicle Study by Charles Brown, 1982

The "Treatability of Recreational Vehicle (RV) Wastewater at Highway Rest Areas" was prepared by Charles Brown as a Master's Thesis at the University of Washington.

This study analyzed 21 composite samples of RV waste collected at three RV dump stations in Western Washington. The purpose of the study was to determine the treatability of RV waste using conventional treatment systems for highway rest areas. The study found an average BOD of 3,110 mg/l, an average COD of 8,230 mg/l and an average TSS of 3,120 mg/l.

This study concluded that high-strength waste may cause accelerated formation of a drainfield clogging mat and recommended doubling the size of drainfields for RV waste when compared to domestic waste.

Recreational Vehicle Study by Pearson, etal, 1984

The "Onsite Disposal of Restroom and Recreational Vehicle Wastes" was published in the Transportation Research Record 995 in 1984.

This study presented survey results from 28 roadside rest areas in California on the volume and strength of wastewater generated at restrooms and dump stations. The study was conducted from 1978 to 1980. This study found a BOD of 3,080 mg/l, a COD of 6,210 mg/l, and a TSS of 3,850 mg/l.

This study concluded that septic tanks should be sized to provide 1.5 to 30 days detention of RV wastewater, compared to 1.5 days for a domestic wastewater septic tank system.

EPA Handbook on Septage Treatment and Disposal, 1984

This handbook was published by the Environmental Protection Agency (EPA), to present a full range of alternatives for treatment and disposal of septage. Septage is defined as the liquid and solid material pumped from a septic tank or cesspool during cleaning. It is a high-strength waste.

This study presented "suggested design values" for septage waste; a BOD of 7,000 mg/l, a COD of 15,000 mg/l, and a TSS of 15,000 mg/l.

1994 OREGON MARINE BOARD SAMPLING PROGRAM

For this study, 20 samples of boat waste were taken at three locations in Oregon, during the months of May through September 1994. The locations were the Tomahawk Bay Moorage in Portland, Kane's Marina at Detroit Lake, and the Charleston Marina at Coos Bay. The location, date and sample type are shown on Table 2-1.

TABLE 2-1

BOAT WASTE SAMPLING SOURCES

#	Sample Location	Date	Sample Type
1	Tomahawk Bay Moorage-Portland	26-May-94	Pumpout Service
2	Tomahawk Bay Moorage-Portland	31-May-94	Pumpout Service
3	Tomahawk Bay Moorage-Portland	02-Jun-94	Boat Holding Tank
4	Tomahawk Bay Moorage-Portland	02-Jun-94	Boat Holding Tank
5	Tomahawk Bay Moorage-Portland	02-Jun-94	Pumpout Service
6	Tomahawk Bay Moorage-Portland	15-Jun-94	Pumpout Service
7	Tomahawk Bay Moorage-Portland	15-Jun-94	Pumpout Service
8	Tomahawk Bay Moorage-Portland	15-Jun-94	Pumpout Service
9	Tomahawk Bay Moorage-Portland	02-Jul-94	Boat Holding Tank
10	Tomahawk Bay Moorage-Portland	02-Jul-94	Boat Holding Tank
11	Tomahawk Bay Moorage-Portland	02-Jul-94	Boat Holding Tank
12	Tomahawk Bay Moorage-Portland	02-Jul-94	Boat Holding Tank
13	Kane's Marina - Detroit Lake	08-Jul-94	Pumpout Station
14	Kane's Marina - Detroit Lake	08-Jul-94	Pumpout Station
15	Kane's Marina - Detroit Lake	30-Jul-94	Pumpout Station
16	Kane's Marina - Detroit Lake	30-Jul-94	Pumpout Station
17	Charleston Marina - Coos Bay	20-Aug-94	Boat Holding Tank
18	Charleston Marina - Coos Bay	20-Aug-94	Boat Holding Tank
19	Kane's Marina - Detroit Lake	09-Sep-94	Pumpout Station
20	Kane's Marina - Detroit Lake	09-Sep-94	Pumpout Station

The purpose of the sampling program was threefold:

1) Determine composition of boat waste typically found in Oregon to both compare with previous studies on boat waste and similar high-strength waste, and to use in the determination of guidelines for disposal of boat waste at municipal wastewater treatment facilities.

2) To use the preliminary analytical results from the sampling program as part of the wastewater treatment plant survey, which is in Chapter 3.

3) To provide information on the types and usage of chemical additives used in boat holding tanks and portable toilets.

Sampling Procedure and Parameters Tested

Approximately 500 milliliters were collected for each sample and placed in a plastic sampling container provided by the analytical laboratory. The analytical laboratory was Waterlab of Salem, Oregon. Samples were generally delivered to the lab the same day collected or within 24-hours. Samples were iced when the delivery time to the lab approached the 24 hour mark.

The analytical parameters tested consisted of biochemical oxygen demand (BOD5), chemical oxygen demand (COD), soluble chemical oxygen demand (Soluble COD), total suspended solids (TSS), and volatile suspended solids (VSS). All analytical results are given in terms of weight per unit volume, or milligrams per liter (mg/l).

The analytical parameters chosen for this study were selected because they are commonly used in the wastewater industry to determine the characteristics of wastewater. The BOD, COD, and Soluble COD all give an indication of the amount and type of organic matter present in wastewater. The TSS and VSS give an indication of the amount and type of solid material present. These parameters are explained in the definition section of this study; however, more detailed information follows:

Biochemical Oxygen Demand (BOD)

The BOD test is the mostly widely used parameter of organic pollution applied to both wastewater and surface water. The test simply measures the amount of dissolved oxygen used by microorganisms (seed) in the biochemical oxidation of organic matter over a 5-day period. The BOD test is significant because it is used to determine the approximate quantity of oxygen that will be required to stabilize the waste at a wastewater treatment plant. Typical domestic wastewater has a BOD of 200 mg/l, whereas high strength waste can have BODs in the range of 1,000 to over 10,000 mg/l.

Chemical Oxygen Demand (COD)

The COD, like the BOD, is used to measure the content of organic matter in wastewater. Unlike the BOD, the COD uses chemicals to determine the oxygen requirement of a waste. This allows the COD to be used to determine the organic matter in a waste that is toxic to biological life. The COD of waste is generally higher than the BOD because more compounds can be chemically oxidized than can be biologically oxidized. For many wastes, there can be found a consistent correlation between the BOD and COD, which is very useful since the COD test is run in a few hours, whereas the BOD test is run over a 5 day period. Domestic wastewater typically has a COD of 500 mg/l and like the BOD high-strength wastewater can have COD's in the range of 1,000 to over 10,000 mg/l.

Soluble Chemical Oxygen Demand (Soluble COD)

The Soluble COD test measures the dissolved portion of the COD. This will tell whether the organic matter present is dissolved or suspended. This is useful for the wastewater industry since the suspended portion is generally removed at a treatment plant by a physical method and the dissolved portion removed by a biological treatment method. The sizing of wastewater treatment units will vary depending on the proportion of soluble organic matter to total.

Total Suspended Solids (TSS)

The most important physical characteristic of wastewater is its total solids content. This is the amount of solid matter that is 1 micron or larger in size and generally is the matter that can be removed by settling. The remainder of the solid matter is either dissolved or colloidal.

Volatile Suspended Solids (VSS)

The volatile suspended solids is a measurement of the organic content of the suspended solids. Generally, with domestic sources of wastewater, the VSS is seventy-five percent of the TSS.

Sampling from Tomahawk Bay

Tomahawk Bay Moorage is located on the Columbia River on Hayden Island, east of Interstate 5, and is privately operated. The 12 samples collected for this study were obtained with the assistance of Tomahawk Island Pumpout Service. Samples were obtained from individual boat holding tanks and from the holding tank on the pumpout boat.

Tomahawk Island Pumpout Service provides services to live-a-boards and boats moored on both a per call basis and a monthly subscription service. Boat waste collected by the pumpout service is pumped into the shore pumpout at Tomahawk Marina and from there goes into the City of Portland wastewater collection system. In turn the waste is treated at the Columbia Boulevard Treatment Plant, with discharge of treated effluent into the Columbia River.

Sampling from Kane's Hideaway Marina

Kane's Hideaway Marina is located on Detroit Lake, at the City of Detroit, south of Highway 22. The marina is privately operated, however the boat pumpout station's holding tank is maintained by the U.S. Forest Service. The pumpout station is located away from shore on a dock and the waste pumped out of boat

holding tanks is pumped to a 1,000 gallon shoreline holding tank. The holding tank is pumped out about four times a year by Stayton Septic Service.

Boat waste from both boat holding tanks and portable toilets goes into the shoreline holding tank. There is no cost to boaters to use this boat waste facility.

The samples obtained from Kane's Marina were obtained from the holding tank, with the assistance of U.S. Forest Service personnel from the Detroit Ranger District.

Sampling from Charleston Marina

Charleston Marina is located west of Coos Bay and is operated by the Oregon International Port of Coos Bay. There are two pumpout stations for use by boaters and there is no cost to the boaters for this service. Waste from the pumpout station goes into the local municipal wastewater collection and treatment system.

The samples obtained from the Charleston Marina were obtained from sailboats at the marina with the assistance of the marina manager.

Results and Discussion

The individual sampling results are shown on Table 2-2 for the 20 samples. Also shown are the average of the samples plus the standard deviation. The TSS and VSS results could not be obtained by the laboratory for the second sample taken at Charleston because the sample was saturated with Sodium Bicarbonate (baking soda). The boat owner was using baking soda as an additive for the boat waste holding tank. The laboratory could not obtain consistent results for these tests, so none are shown.

A graphical comparison for all the sampling results for the five parameters tested is shown on Figures 2-1 (A) and (B).

TABLE 2-2

BOAT WASTE SAMPLING RESULTS

Sample Number	Sample Location	BOD5 (mg/l)	COD (mg/l)	Soluble COD(mg/	TSS (mg/l)	VSS (mg/l)
1	Tomahawk Bay	1,515.6	3,796.0	1,296.0	1,790.5	1,600.7
2	Tomahawk Bay	4,056.0	14,340.0	10,800.0	673.1	517.6
3	Tomahawk Bay	674.0	1,475.0	525.0	413.0	404.8
4	Tomahawk Bay	6,225.0	11,815.0	4,005.0	3,000.0	2,826.0
5	Tomahawk Bay	2,118.0	5,715.0	2,070.0	2,257.3	2,051.9
6	Tomahawk Bay	2,617.5	5,738.0	2,978.0	1,720.0	1,462.0
7	Tomahawk Bay	5,224.9	10,596.0	4,790.0	4,167.0	3,700.3
8	Tomahawk Bay	5,859.9	10,712.0	4,992.0	3,993.0	3,469.9
9	Tomahawk Bay	2,241.0	4,758.0	4,050.0	536.4	472.6
10	Tomahawk Bay	3,480.0	6,104.0	4,566.0	687.5	662.8
11	Tomahawk Bay	1,849.0	3,478.0	2,822.0	323.1	300.2
12	Tomahawk Bay	3,336.0	15,909.0	2,926.0	7,803.0	6,219.0
13	Kane's Marina	4,788.0	8,854.0	8,256.0	255.0	2.6
14	Kane's Marina	5,040.0	8,808.0	7,716.0	250.0	2.5
15	Kane's Marina	1,182.8	4,050.0	2,390.0	408.0	343.9
16	Kane's Marina	922.5	3,880.0	2,770.0	337.0	299.0
17	Charleston	447.0	2,286.0	1,482.0	1,066.0	1,055.3
18	Charleston	5,554.0	31,090.0	28,150.0		
19	Kane's Marina	1,485.0	3,545.5	3,203.0	350.0	346.5
20	Kane's Marina	1,186.5	3,477.5	3,003.0	346.7	343.2
	Average	2,990.0	8,020.0	5,140.0	1,600.0	1,370.0
	Minimum	447.0	1,475.0	525.0	250.0	2.5
	Maximum	6,225.0	31,090.0	28,150.0	7,803.0	6,219.0
	Standard Deviation	1,860.0	6,620.0	5,810.0	1,910.0	1,590.0

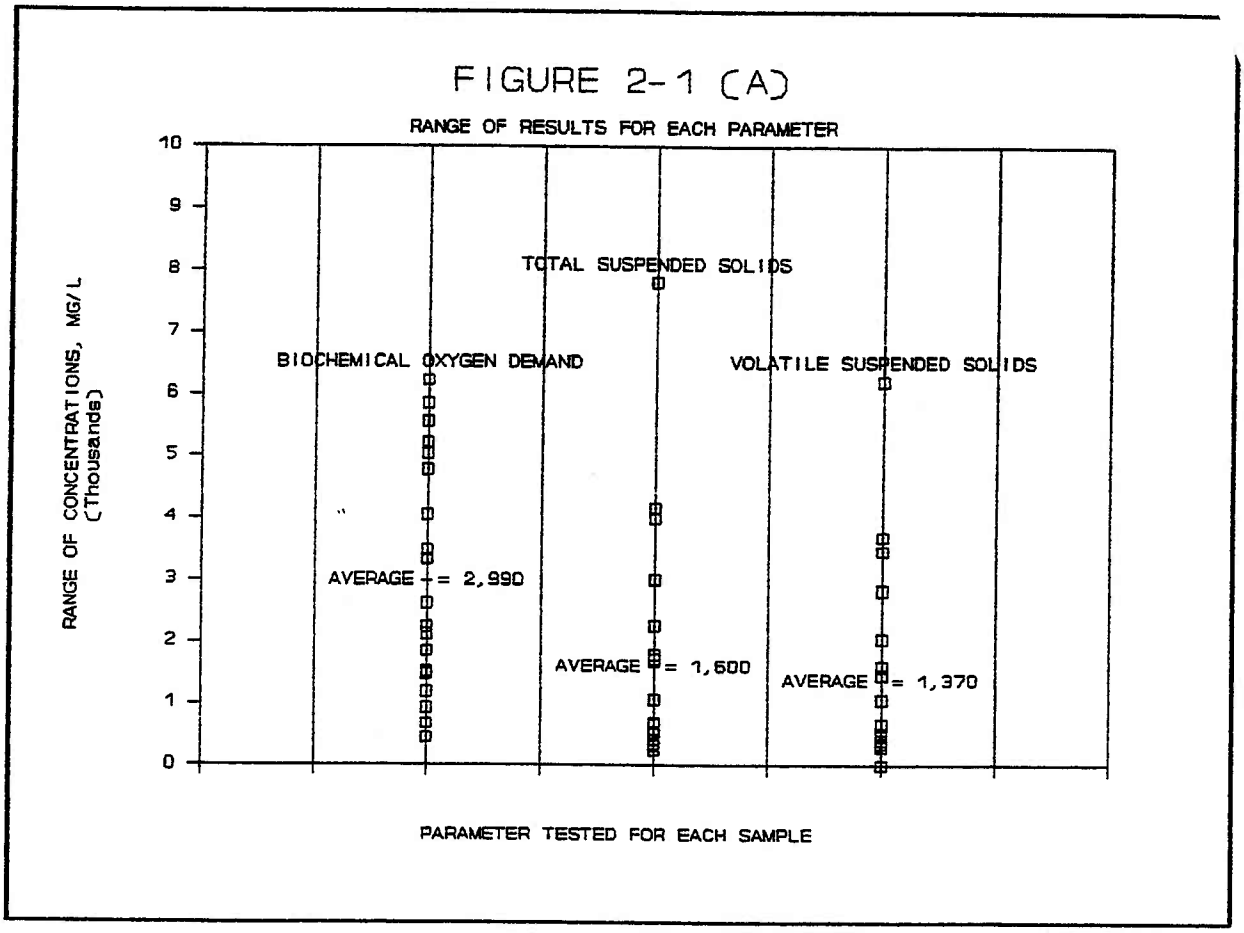


FIGURE 2-1 (A)
RANGE OF RESULTS FOR EACH PARAMETER
RANGE OF CONCENTRATIONS, MG/L
(Thousands)
10
9
8
7
6
5
4
3
2
1
0
TOTAL SUSPENDED SOLIDS
BIOCHEMICAL OXYGEN DEMAND
VOLATILE SUSPENDED SOLIDS
AVERAGE = 2,990
AVERAGE = 1,600
AVERAGE = 1,370
PARAMETER TESTED FOR EACH SAMPLE

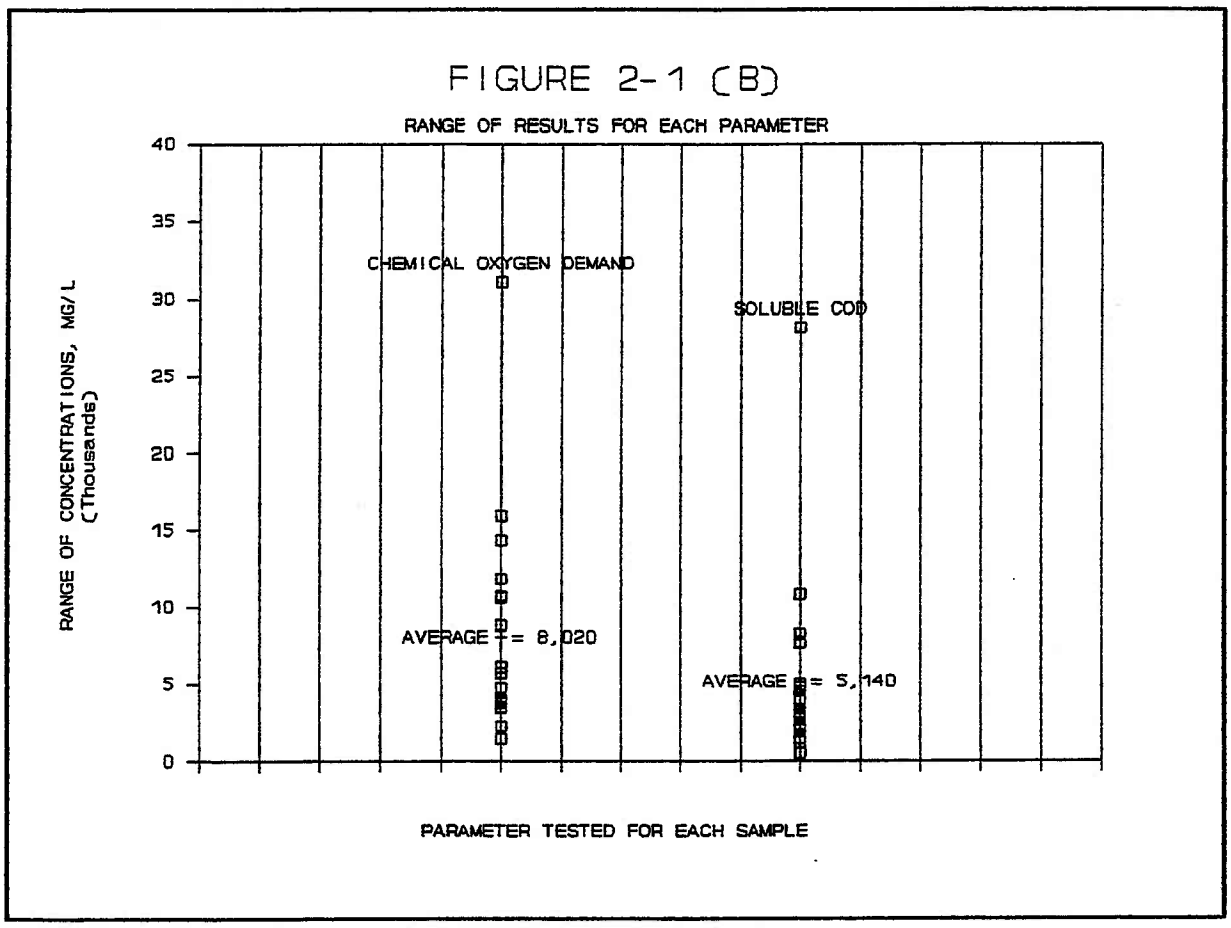


FIGURE 2-1 (B)
RANGE OF RESULTS FOR EACH PARAMETER
RANGE OF CONCENTRATIONS, MG/L (Thousands)
40
35
30
25
20
15
10
5
0
CHEMICAL OXYGEN DEMAND
SOLUBLE COD
AVERAGE = 8,020
AVERAGE = 5,140
PARAMETER TESTED FOR EACH SAMPLE

Table 2-3 compares the results of this study with previous studies on both boat waste and recreational vehicle waste. All parameters tested compare very well with the previous studies. The range of values found in this study also compare very well with previous studies.

The 1974 EPA Study found for powerboats and sailboats that BOD values ranged from 30 to 9,230 mg/l; COD values ranged from 1,160 to 15,420; TSS values ranged from 72 to 9,050 mg/l; and VSS values ranged from 63 to 6,910 mg/l. It is interesting to note the wide range of values found in the 1974 EPA Study as well as this study, and yet the averages compare favorably. This is probably due to the nature of sampling small volumes (holding tanks). Additional waste and/or water in each holding tank would make the resulting waste either stronger or weaker (diluted). And yet when twenty samples are averaged together the extreme values are dampened, with good average numbers.

Figures 2-2, 2-3, and 2-4 give a graphical comparison of BOD, COD, and TSS results for this study, the 1974 EPA Study, the 1984 Brown Study, and domestic wastewater. The domestic wastewater values are those normally found in wastewater from municipalities that do not have much industrial wastewater. The reference is from Metcalf and Eddy, Inc., 1972.

ADDITIVES

Additives are chemicals added to boat holding tanks and portable toilets to reduce or eliminate offensive odors created by the waste disposed in these units. Over the years the types of additives available has changed. Zinc salts were once very prevalent, but now are not available due to their toxic nature to the environment. California prohibited the sale or use of zinc additives in 1978.

Today, the prevalent additives are ones containing chemical combinations of formaldehyde, enzymes, dyes and perfumes. Formaldehyde type additives are used to stop any biological activity in the wastewater and thus prevent odors. The formaldehyde is supposed to kill any biological microorganisms in the waste that generate odor causing compounds as they normally work.

TABLE 2-3

COMPARISON OF WASTEWATER CHARACTERISTICS FROM VARIOUS SOURCES

SOURCE LOCATION	BOD (mg/l)	COD (mg/l)	SOLUBLE COD(mg/l)	TSS (mg/l)	VSS (mg/l)
Oregon State[1] Marine Board Study Average	2,990	8,020	5,140	1,600	1,370
Oregon State[1] Marine Board Study Range	447 to 6,225	1,475 to 31,090	525 to 28,150	250 to 7,803	2.5 to 6,219
Federal Register 1994 (BW)	1,700 to 3,500				
EPA Robins & Green 1974 (BW)	2,710	6,180		2,860	2,310
Brown, etal 1984 (RV)	3,110	8,230	2,930	3,120	2,460
Pearson 1980 (RV)	3,080	6,210		3,850	3,330
Sealand 1990 (RV)	3,000 to 6,000	15,000 to 18,000		13,000 to 15,000	
Brestad, etal 1971 (RV)	1,840 to 7,590	5,600 to 22,000		1,120 to 20,500	1,020 to 18,400

(1) Results from 1994 Oregon State Marine Board Study.

(BW) Sample from study of recreational boat waste.

(RV) Sample from study of recreational vehicle waste.

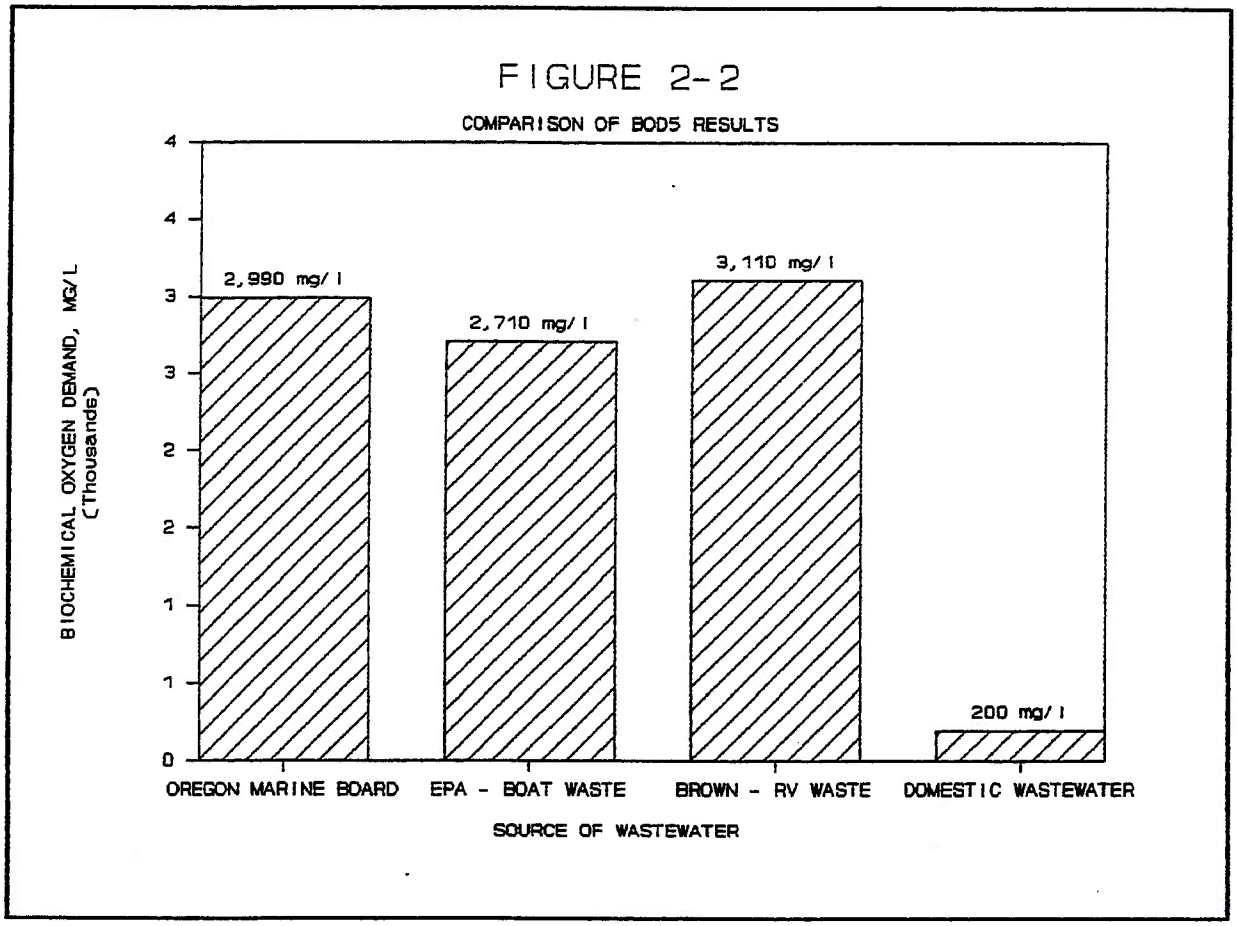


FIGURE 2-2
COMPARISON OF BOD5 RESULTS
BIOCHEMICAL OXYGEN DEMAND, MG/L
('Thousands')
4
4
3
3
2
2
1
1
0
2,990 mg/l
2,710 mg/l
3,110 mg/l
200 mg/l
OREGON MARINE BOARD
EPA - BOAT WASTE
BROWN - RV WASTE
DOMESTIC WASTEWATER
SOURCE OF WASTEWATER

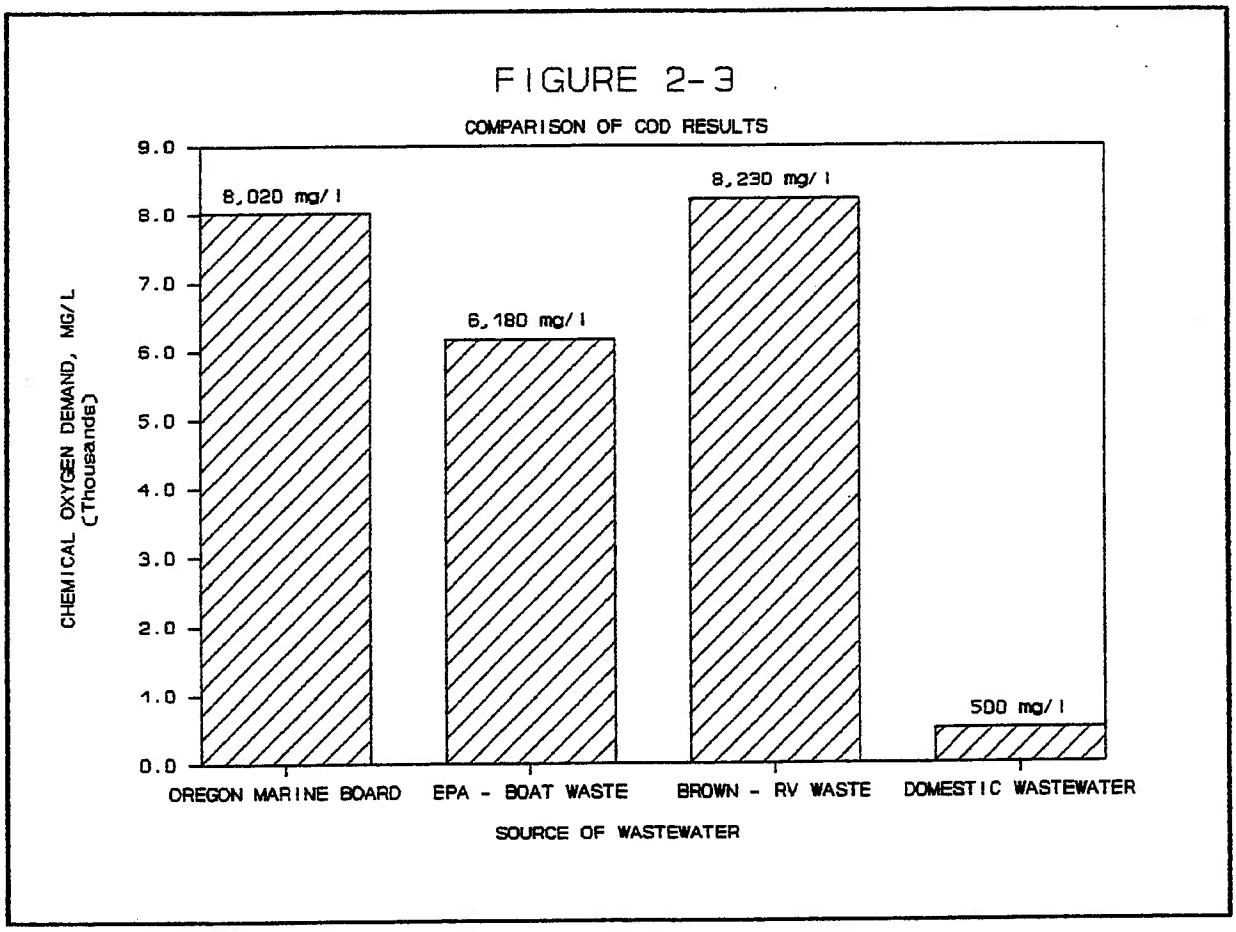


FIGURE 2-3
COMPARISON OF COD RESULTS
CHEMICAL OXYGEN DEMAND, MG/L
(Thousands)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
8,020 mg/l
6,180 mg/l
8,230 mg/l
500 mg/l
OREGON MARINE BOARD
EPA - BOAT WASTE
BROWN - RV WASTE
DOMESTIC WASTEWATER
SOURCE OF WASTEWATER

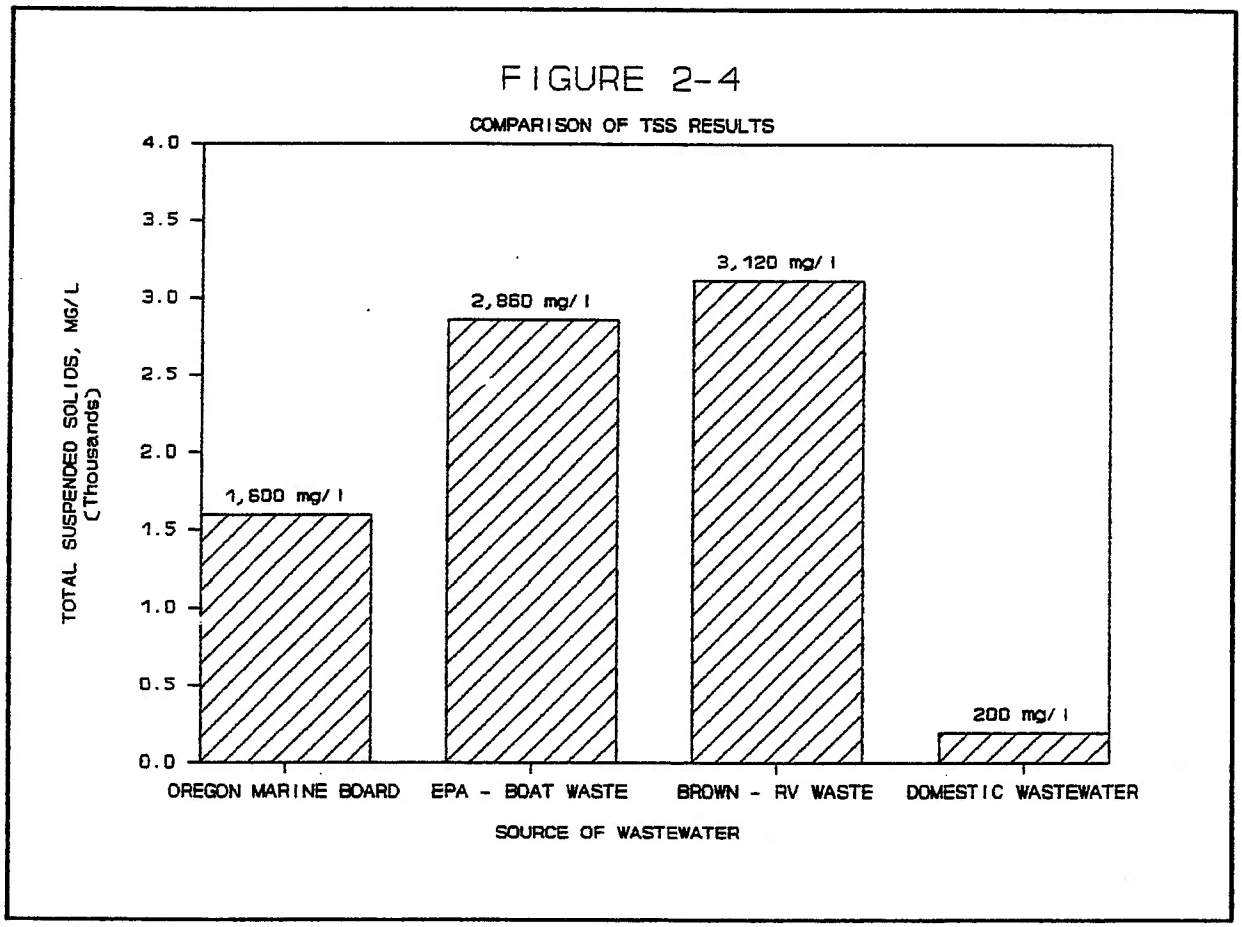


FIGURE 2-4
COMPARISON OF TSS RESULTS
TOTAL SUSPENDED SOLIDS, MG/L (Thousands)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1,600 mg/l
2,860 mg/l
3,120 mg/l
200 mg/l
OREGON MARINE BOARD
EPA - BOAT WASTE
BROWN - RV WASTE
DOMESTIC WASTEWATER
SOURCE OF WASTEWATER

Enzyme additives work just the opposite by promoting biological activity in order to liquefy the wastes and eliminate odors. In this case the enzymes (provided to treat the waste) do not generate odor causing compounds.

Previous Studies

The toxicity of chemical additives to wastewater treatment plants will be discussed in Chapter 3. Here, a discussion will be presented of the types of additives found during previous studies.

EPA Study by Robins and Green, 1974

Because this study was prepared in 1974, zinc compounds were still in use. Otherwise, this study found there are three basic types of active ingredients in additives; 1) zinc salts, 2) formalin or paraformaldehyde, and 3) quaternary ammonium compounds. Dyes and perfumes are also used to mask the offending odors and offending color of the wastewater. Several new products were discovered to be marketed to replace zinc additives, and these included various compounds like phenols, chlorine and enzymes. The study also discovered that all additives are toxic if ingested and are also harmful to skin and eyes, which means that care in handling is required. This information was determined by contacting nine companies from a list of known manufacturers of bacteriostatic chemicals. A questionnaire was sent to each company.

This study concluded that formaldehyde and quaternary ammonium additives become toxic to wastewater systems at higher concentrations. The treatability of boat waste is a function of the concentration of chemical additive and the wastewater characteristics.

Recreational Vehicle Study by Charles Brown, 1982

This study found three major types of additives on the market; 1) formaldehyde, 2) pH buffer, and 3) enzymes. The author surveyed 178 RV owners and discovered 67 percent used some form of formaldehyde, 13 percent used an enzyme additive,

and the remainder used either no additive or pine oil, pH buffers, soap, quaternary ammonium, aspirin or zinc sulfate.

1994 Survey Result

The 1994 Study performed an informal survey during sample collection at the three marina locations to determine which additives are available and used in Oregon. At the Tomahawk Bay Moorage in Portland, enzyme type additives are the only ones used and were the only ones available at the local marina supply store. The information on additives used by boat owners was provided by Tomahawk Pumpout Service, who assisted with the boat waste sampling at Tomahawk Bay.

At Kane's Hideaway Marina, samples were taken directly from the pumpout station holding tank and individual boat owners were not surveyed. It was noted that the store at the marina did not have any boat waste additives for sale. It was also noted during sampling that some of the samples from the holding tank were blue in color. It can be assumed that these samples contained an additive made up of a dye.

At Charleston Marina, three boat owners were surveyed whose boats had holding tanks and who used a chemical additive. One boat owner used an enzyme type, one used a deodorant type, and the third used baking soda (sodium bicarbonate) as an additive to his holding tank.

Finally, an inspection was made of a well-known sporting goods store in Salem, to discover which types of additives are available. There were five types of additives for sale, with three using formaldehyde as the primary ingredient, one using an enzyme as the primary ingredient and one using coconut oil as the primary ingredient.

VOLUME OF BOAT WASTE

The volume of boat waste from a marina facility has been estimated by various studies and will be presented in this section. The two volumes of use are the total annual (seasonal) volume of boat waste generated at a marina and the peak day boat waste volume generated typically during a holiday weekend. The total annual volume generated is useful in the design of holding tank facilities, where connection to either an onsite septic tank system or to a municipal wastewater collection system is not an available option. The total annual volume of boat waste generated will indicate the number of times the holding tank must be pumped out by a septic service.

The peak day boat waste volume will indicate the worst case potential impact of boat waste on either the on-site system or on the municipal collection and treatment facility. Treatment facilities must be sized and operated to properly handle the peak day volume of wastewater it receives.

1992 State of Maryland Study

This study was prepared by Buchart-Horn, Inc. and Versan, Inc. for the State of Maryland Department of the Environment in March, 1992. The study was titled "A Survey of the Quantity, Characteristics, and Potential Impacts of Boat Pumpout Waste Generated within the Chesapeake Bay Region of Maryland". The study indicated that for the area there were approximately 52,460 boats with the potential to store and dispose of boat waste. This potential includes boats with either installed toilets or with portable toilets. The boat occupancy rates found during a telephone survey were 12% for weekdays, 42% for weekends and 57% for holiday weekends. The average occupancy rate was 21%. The study also suggested 3.0 gallons per day of waste per person per boat, an average 3.3 occupants for each boat, and a resulting daily boat waste generation rate of 9.9 gallons per occupied boat.

This resulted in a total boat waste volume of 62,000 gallons per day during the weekday, 220,000 gallons per day for a weekend, and 300,000 gallons per day for

a holiday weekend. The study indicates these numbers are conservative because they are based on the assumption that all boats in use whether at the dock or at sea will generate wastewater which is held for discharge into a pumpout facility.

1992 New England Coastal Marine Pumpout Survey

This study was prepared by the International Marina Institute for the U.S. Environmental Protection Agency, Region I, Boston, Massachusetts. It estimated for a typical pumpout station that four boats were pumped out on a high use day, with the "highest" one-day pumpout total of 8 boats. Over the boating season 115 pumpouts occurred.

The average volume of sewage pumped from a holding tank was 22 gallons. 76% of all the boats in the marina facility had onboard toilets.

1993 New York and Connecticut Study

This study was prepared by Jay Tanski of the New York Sea Grant Program Cornell Cooperative Extension and was partially funded by the U.S. Environmental Protection Agency. The title was " Development of a Directory of Boater Pumpout Facilities and an Assessment of Pumpout Operations and Use in New York and Connecticut Marine Waters.

This survey indicated the average volume from a pumpout of a single boat was approximately 19 gallons. The average number of boats pumped out on a high use day was 5.3 per pumpout facility generating an average of 69 gallons of waste per day per facility in peak periods. The highest peak day volume was 500 gallons at one facility. The study suggested that these lower volumes should prevent upsets to treatment facilities from shock loading.

Other Studies

The 1994 "Pumpout Station and Dump Station Technical Guidelines" prepared by the U.S. Fish and Wildlife Service recommends using a 40% boat occupancy rate during peak periods. A 1990 Rhode Island Sea Grant study indicated a 50% peak boat occupancy rate.

The Oregon Marine Board's "Six-Year Statewide Boating Facilities Plan" (1993-1999) indicates an average occupancy rate of 21% for 1980. This agrees with the 1992 Maryland Study.

In summary, the greatest impact of boat waste from a marina on a municipal wastewater treatment plant will occur during the peak use time. Peak use periods are typically holiday weekends during the summer months and would include Memorial Day Weekend, the Fourth of July, and Labor Day Weekend.

The steps to determine the peak day volume of boat waste from a marina include:

1) Estimate the number of boats with the potential to store and dispose of boat waste. This should include boats with onboard toilets and holding tanks, and boats with portable toilets.

2) Estimate the occupancy rate during the peak usage period. Previous studies indicate this ranges from 40% to 57%.

3) Estimate the number of boats pumped out during the peak day (This number is site specific).

4) Estimate the volume of high-strength waste per pumpout from each boat. Previous studies indicate from 19 to 22 gallons per boat for boats with holding tanks and 3 to 5 gallons per boat for boats with portable toilets.

5) Estimate the total volume per day by multiplying the number of pumpouts per day by the volume of boat waste per pumpout.

CHAPTER 3 - TREATMENT AND DISPOSAL OF BOAT WASTE

Introduction

This chapter will review previous studies and reports that examined the impacts of high-strength waste on wastewater treatment facilities, including on-site septic tank drain-field systems. High-strength waste includes waste from recreational vehicles, septic systems and recreational boat waste. This chapter will also present results of a survey prepared in 1994 by the Oregon Marine Board of municipal wastewater treatment facilities. The survey was taken to determine which municipal wastewater treatment facilities already accept high-strength waste such as boat waste; how high-strength waste impacts these facilities; and what improvements are needed for these facilities to accept boat waste from marinas. Lastly, this chapter will present various options available for the treatment and disposal of boat waste.

PREVIOUS STUDIES

EPA Study by Robins and Green, 1974

This study was prepared by FMC Corporation, San Jose, California, for the Environmental Protection Agency, July 1974, and was titled "Development of On-Shore Treatment System for Sewage from Watercraft Waste Retention System". The study evaluated the toxicity of boat waste additives to wastewater treatment plant processes and performed field testing of full-scale treatment equipment operating on boat waste. The study determined the treatability of wastewater containing chemical additives.

Respirometer studies were conducted using high-strength waste with zinc, formaldehyde, and a quaternary ammonium chemical additive. The respirometer studies were performed on activated sludge wastewater mixtures made to determine the respiration rates as function of total suspended solids and chemical additive concentration. Formaldehyde additives had varying effects on activated sludge.

The study concluded that boat waste containing formaldehyde additives had a greater (easier) treatability than additives containing zinc or quaternary ammonium chemical additives. Low formaldehyde concentrations will be biodegradable as nutrients and large concentrations will be toxic.

The study set up and operated a pilot plant using the activated sludge process. The process was simulated in a 55 gallon drum reactor, using the "fill and draw" technique to simulate diurnal flow patterns in plug flow plants. The objective was to determine the level of chemical additives that the activated sludge treatment process can tolerate without reducing its efficiency. The study concluded that the maximum nontoxic concentration of formaldehyde was 100 to 120 mg/L. Above this concentration range, effluent quality, removal efficiency and cell yield values decreased. The study also concluded the normal dilution required for formaldehyde is 1:220 based on manufacturers recommended usage dosages in boat holding tanks. This means for each 10 gallons of high-strength boat waste containing formaldehyde as an additive, 2,200 gallons on water (or weaker wastewater) would be required to dilute the waste to a level acceptable to a treatment plant using the activated sludge process.

WPCF Article by Novak, etal, 1990

"The Effect of Boat Holding Tank Chemicals on Treatment Plant Performance" was published in the Research Journal of the Water Environment Federation (formerly the Water Pollution Control Federation) in the May/June issue in 1990. This study evaluated the effects of shock loadings of boat holding tank chemical additives on wastewater treatment processes, including the activated sludge process and the septic-tank drain-field system. Three different chemicals were studied, consisting of formaldehyde, paraformaldehyde, and dimethylimino ethylene dichloride polymer. The effects of these chemicals were determined by monitoring COD removal and suspended solids discharge, and the rate of recovery after a shock loading.

Bench scale activated sludge reactors and septic tank systems were used. The effluent from the activated sludge systems were monitored for COD to evaluate the impact of various dosages of chemical additives. The mixed liquor volatile suspended solids (MLVSS), sludge volume index (SVI), and specific oxygen uptake rate (SOUR) were measured for the activated sludge systems. COD and suspended solids in the effluent of the septic-tank system were monitored to evaluate their performance.

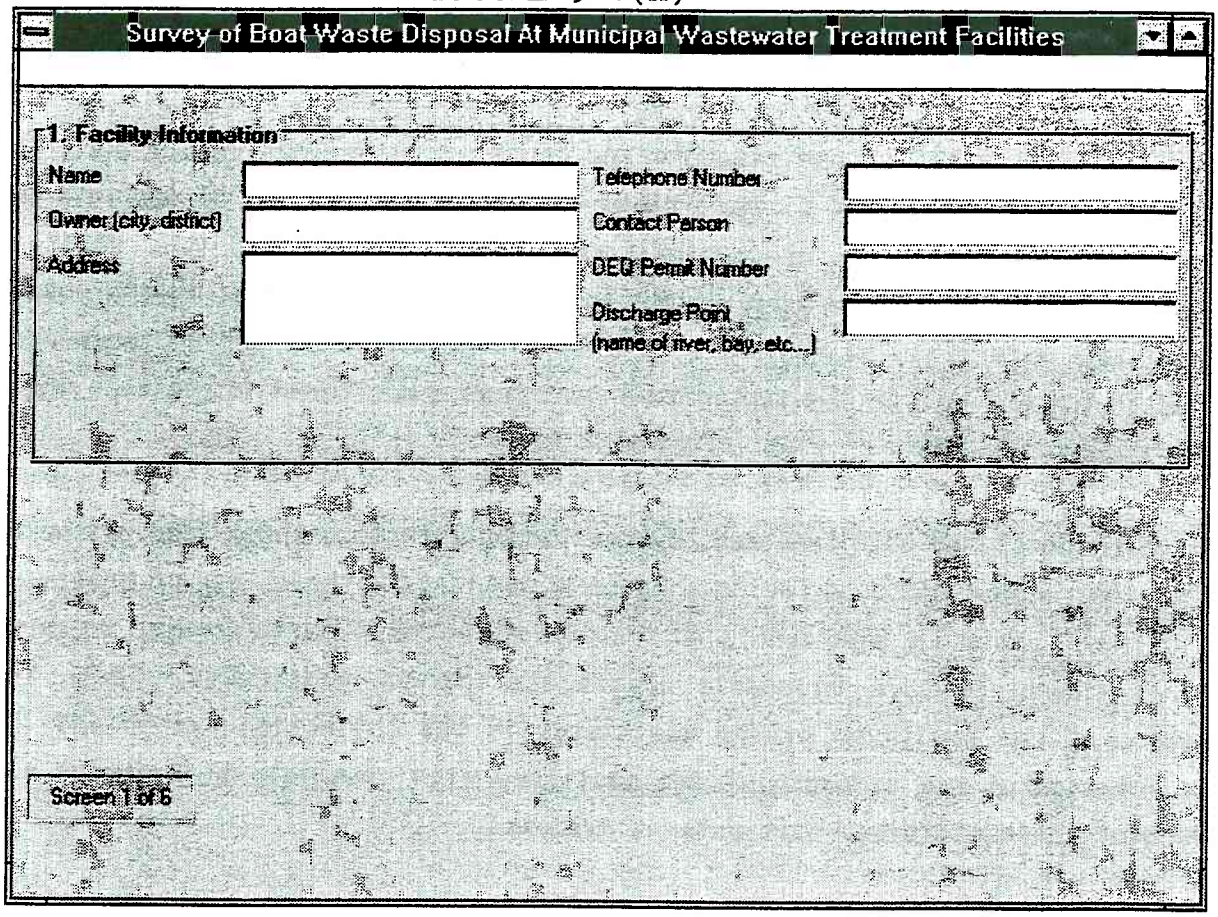
This study concluded both treatment systems could withstand shock loadings up to 25% of the recommended dose for holding tank chemicals without loss of treatment efficiency. The study also concluded that most treatment plants located to serve marinas should be able to handle boat waste without difficulty. Both the dilution of the additives by the wastewater in the collection system and the deterioration of the strength of the additives with time help to minimize the impact of these additives on treatment systems.

1994 MUNICIPAL TREATMENT PLANT SURVEY

As part of this study, the Oregon Marine Board developed a survey for municipal wastewater treatment plants or publicly owned treatment works (POTW's). The survey was prepared to gain information on the impacts of recreational boat waste on POTW's in Oregon.

The survey contained 12 sections with questions on the treatment facility; the type of treatment provided; the level of treatment provided; the type of wastewater collection system; treatment plant size and service population; the acceptance of high-strength wastes; existing problems caused by high-strength waste; problems with chemical additives; location preference to accepting boat waste; and plant modifications needed to accept boat waste. A copy of the survey is shown in Figures 3-1(A), (B), and (C).

FIGURE 3-1(A)


Survey of Boat Waste Disposal At Municipal Wastewater Treatment Facilities
1. Facility Information
Name
Owner (city, district)
Address
Telephone Number
Contact Person
DEQ Permit Number
Discharge Point (name of river, bay, etc...)
Screen 1 of 6

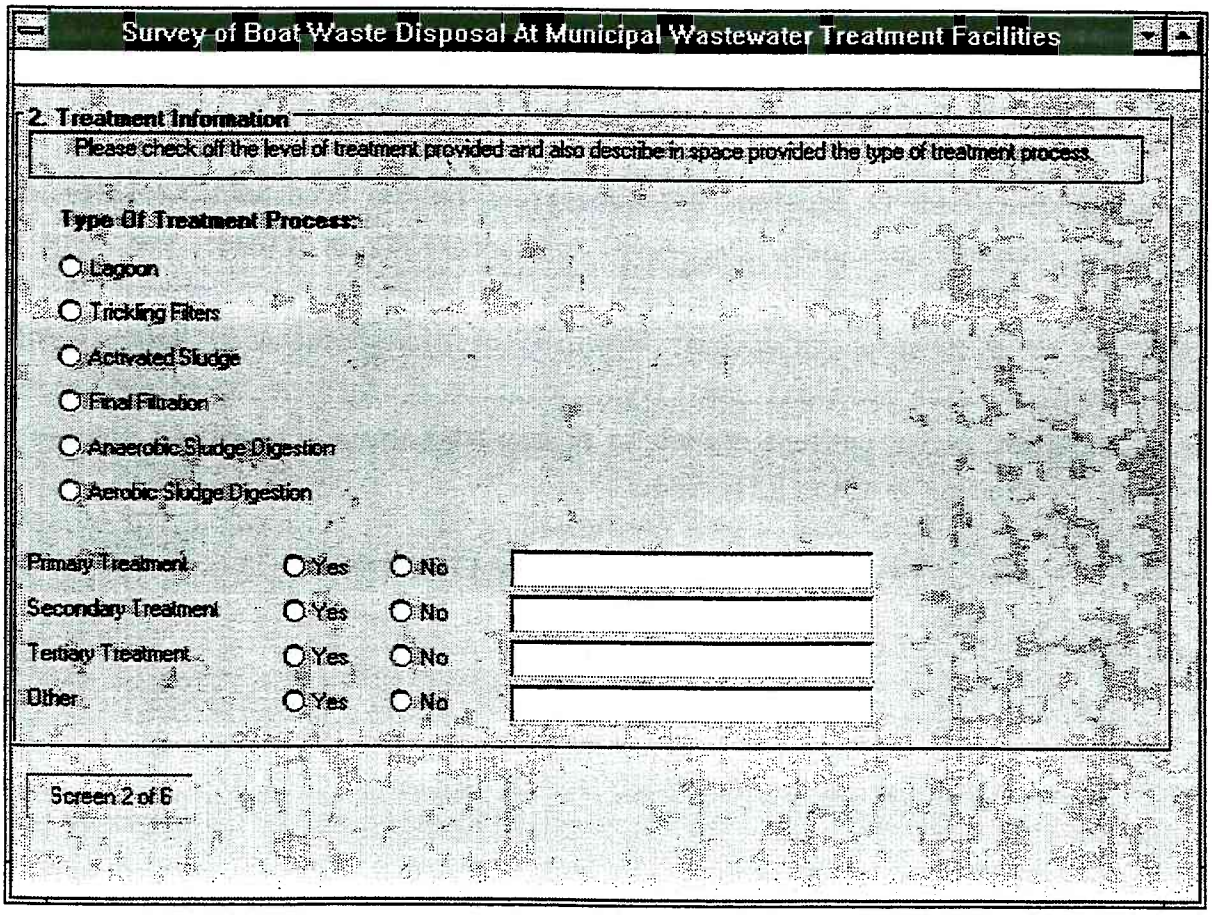
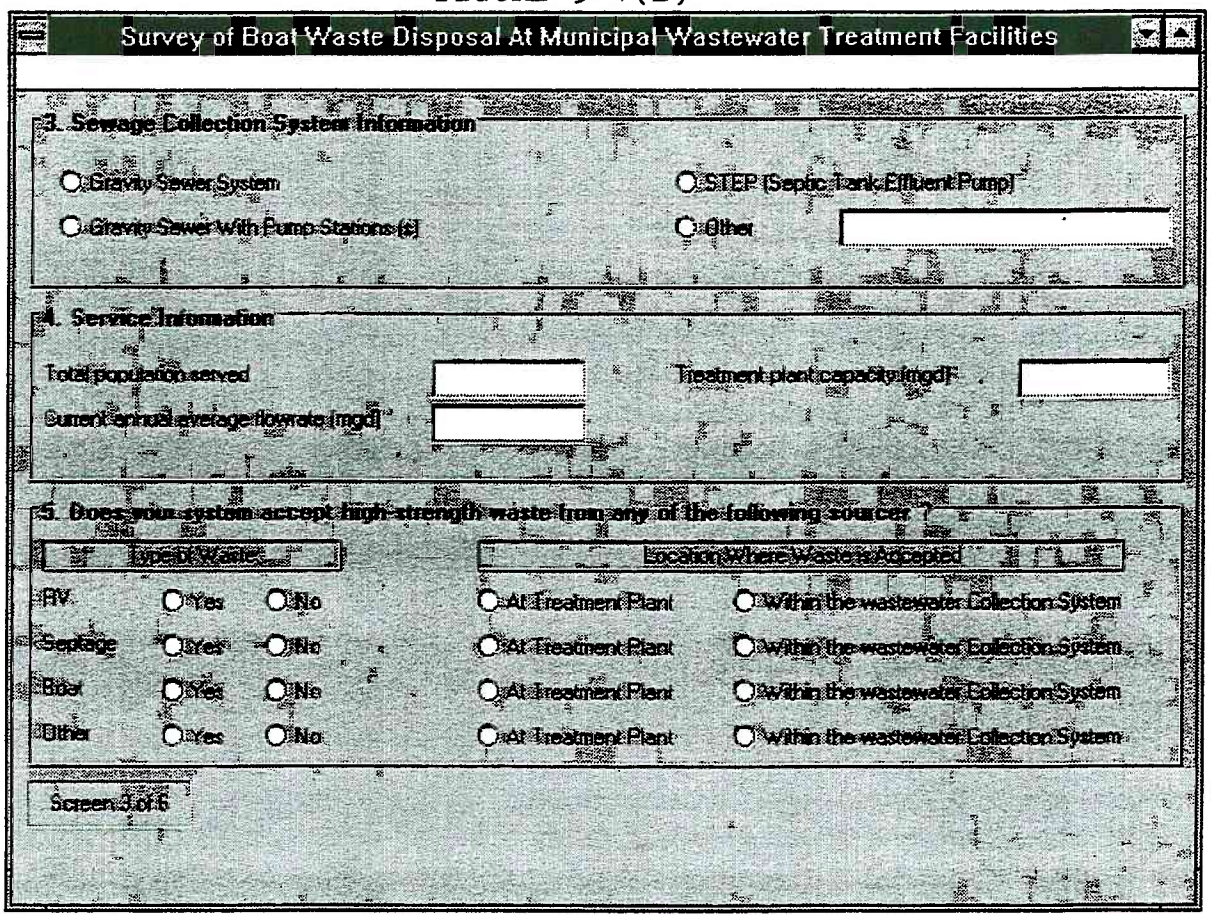

Survey of Boat Waste Disposal At Municipal Wastewater Treatment Facilities
2. Treatment Information
Please check off the level of treatment provided and also describe in space provided the type of treatment process.
Type Of Treatment Process:
Lagoon
Trickling Filters
Activated Sludge
Final Filtration
Anaerobic Sludge Digestion
Aerobic Sludge Digestion
Primary Treatment
Secondary Treatment
Tertiary Treatment
Other
Yes
No
Screen 2 of 6

FIGURE 3-1(B)


Survey of Boat Waste Disposal At Municipal Wastewater Treatment Facilities
3. Sewage Collection System Information
Gravity Sewer System
STEP (Septic Tank Effluent Pump)
Gravity Sewer With Pump Stations (s)
Other
4. Service Information
Total population served
Treatment plant capacity (mgd)
Current annual average flowrate (mgd)
5. Does your system accept high-strength waste from any of the following sources ?
Type of Waste
Location Where Waste is Accepted
RV
Yes
No
At Treatment Plant
Within the wastewater Collection System
Septage
Yes
No
At Treatment Plant
Within the wastewater Collection System
Boat
Yes
No
At Treatment Plant
Within the wastewater Collection System
Other
Yes
No
At Treatment Plant
Within the wastewater Collection System
Screen 3 of 6

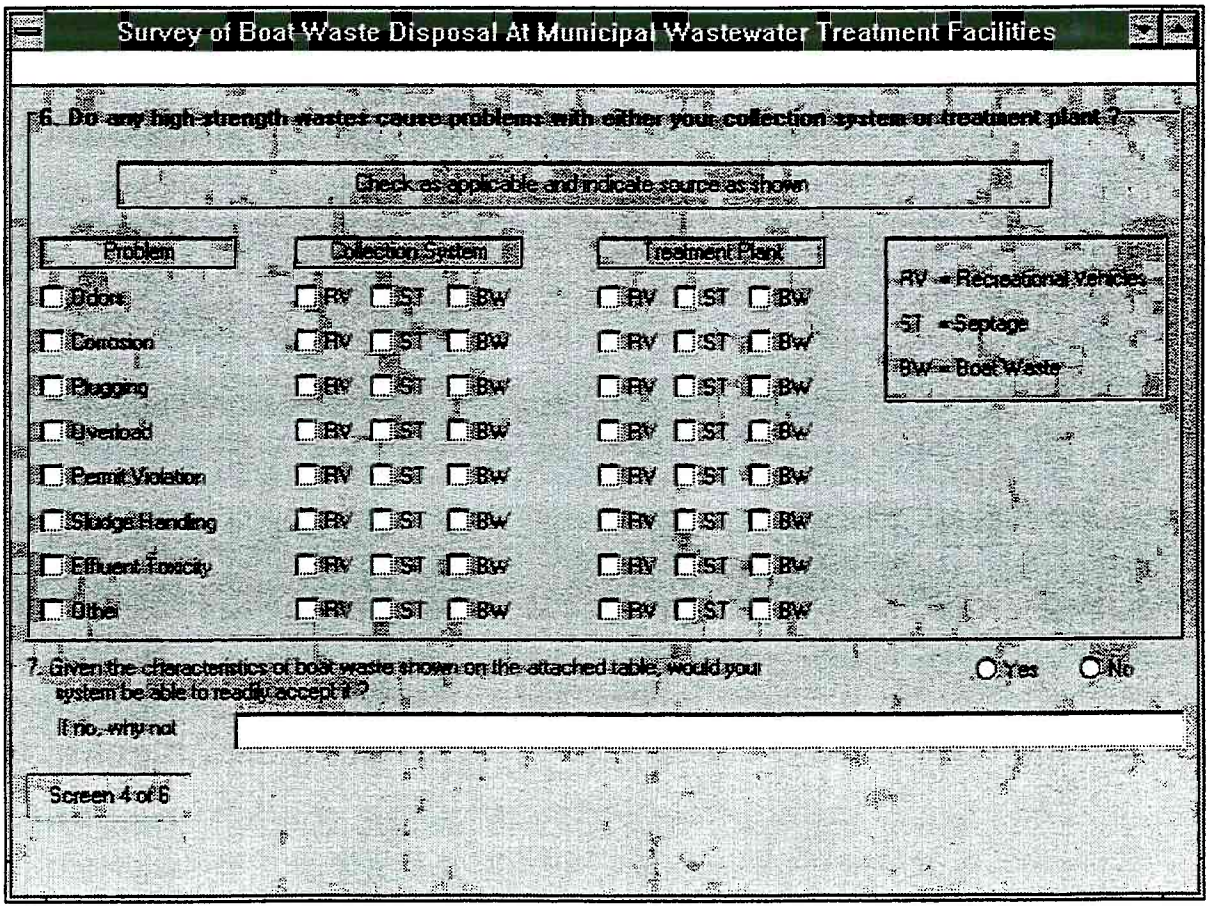
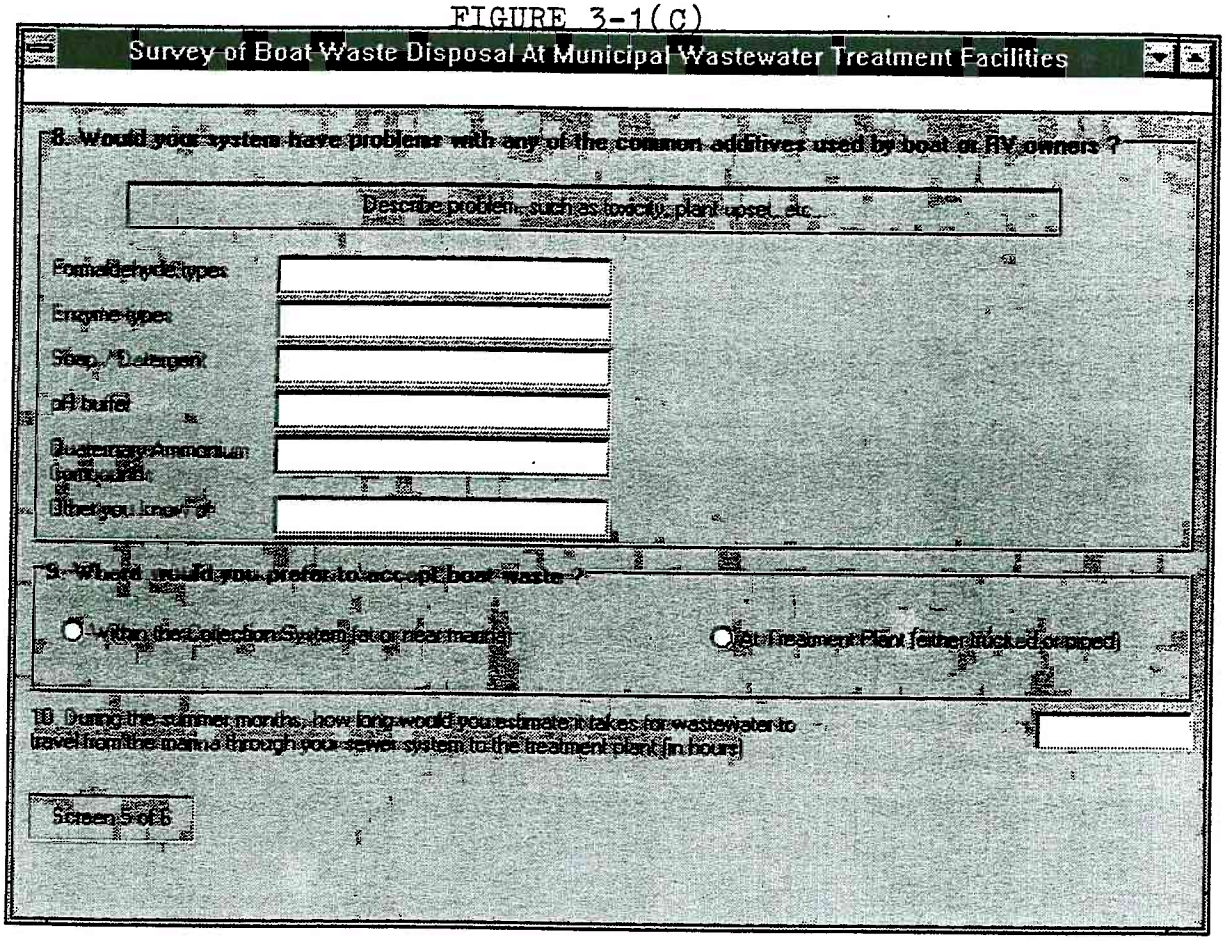
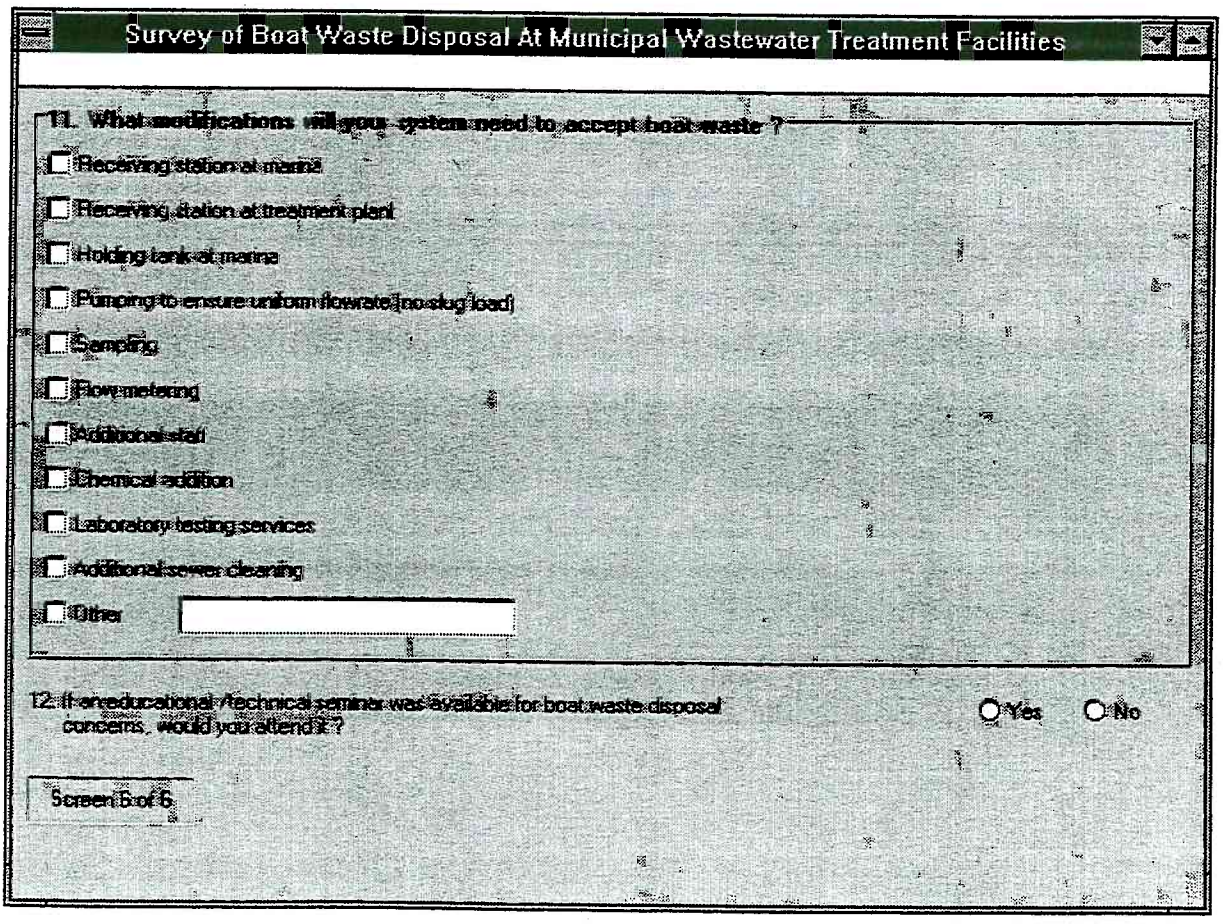

Survey of Boat Waste Disposal At Municipal Wastewater Treatment Facilities
6. Do any high-strength wastes cause problems with either your collection system or treatment plant ?
Check as applicable and indicate source as shown
Problem
Collection System
Treatment Plant
Odors
Corrosion
Plugging
Overload
Permit Violation
Sludge Handling
Effluent Toxicity
Other
RV
ST
BW
RV = Recreational Vehicles
ST = Septage
BW = Boat Waste
7. Given the characteristics of boat waste shown on the attached table, would your system be able to readily accept it ?
Yes
No
If no, why not
Screen 4 of 6

FIGURE 3-1(C)


Survey of Boat Waste Disposal At Municipal Wastewater Treatment Facilities
8. Would your system have problems with any of the common additives used by boat or RV owners ?
Describe problem, such as toxicity, plant upset, etc.
Formaldehyde type:
Enzyme type:
Soap, Detergent:
pH buffer:
Other you know of:
9. Where would you prefer to accept boat waste ?
At Treatment Plant (either intercept or pipe)
10. During the summer months, how long would you estimate it takes for wastewater to travel from the marina through your sewer system to the treatment plant (in hours)
Screen 5 of 6


Survey of Boat Waste Disposal At Municipal Wastewater Treatment Facilities
11. What modifications will your system need to accept boat waste ?
Receiving station at marina
Receiving station at treatment plant
Holding tank at marina
Pumping to ensure uniform flowrate (no slug load)
Sampling
Flow metering
Additional staff
Chemical addition
Laboratory testing services
Additional sewer cleaning
Other
12. If an educational /technical seminar was available for boat waste disposal concerns, would you attend it?
Yes
No
Screen 6 of 6

As mentioned, the survey was developed during the summer of 1994 and was sent to 146 POTW's during August, 1994. It was estimated the survey would take no longer than 15 minutes for the person to complete. The surveys were returned to the Oregon Marine Board during September, 1994. 101 surveys have been returned, which is approximately 70%.

A computer database has been established as part of this study by the Oregon Marine Board to contain the survey questions and responses. The database has several benefits:

1) Custom reports can be prepared which show in a tabular form the survey results.

2) Custom graphs, such as bar charts, can also be prepared which show the survey results.

3) Queries can be electronically prepared on the survey results. For example, a list can be prepared which shows the types of problems small treatment plants (less than 100,000 gpd) have with high-strength waste. The database would list just those particular responses.

4) This database can be electronically compared with other databases. Information gathered from other surveys can be added to the results of this survey to give the user additional information.

5) An electronic database allows easier updating in the future as additional information is discovered.

6) An electronic database is easily accessible by Marine Board staff involved in the planning, design and construction of marina facilities.

Survey Results

This section will discuss the results of the 1994 Survey. More detailed information on the survey results can be found in the appendices as well as at the office of the Marine Board. The reader needs to be aware that for certain questions the total number of responses will not add up to the total survey responses. This is because some survey respondents did not answer each and every question. In addition, some interpretation has been made of survey responses.

Wastewater Facility Information:

Sections 1 through 4 of the survey asked background questions about the POTW. Section 1 asked about name, address, etc. Sections 2 and 3 asked about the type of wastewater treatment process and the level of treatment provided. The types of treatment processes included lagoons, trickling filters, activated sludge, and final filtration. These are the majority of general treatment options at POTW's. In addition, the type of sludge digestion was also asked, whether anaerobic (covered and heated tank) or aerobic (open to the atmosphere). Figure 3-2 shows the responses to this question. The majority of POTW's responding to the survey use the activated sludge process for treating wastewater, followed by lagoons and trickling filters. Final filtration is generally used as a final treatment process stage in order to provide a higher level of treatment. The plants responding to the sludge digestion question were split almost evenly in their responses.

Figure 3-3 shows the responses to the level of treatment question. In Oregon, the level of treatment provided by a POTW is usually dictated by the discharge permit issued by the Department of Environmental Quality (DEQ). The majority of respondents provide secondary treatment of wastewater, which is the most common found in the United States. Secondary treatment requires the removal of 85% of both the BOD and TSS. For a treatment plant serving a municipality, the typical wastewater has BOD and TSS values of about 200 mg/l each. Thus, 85% removal will result in effluent values of 30 mg/l for both BOD and TSS.

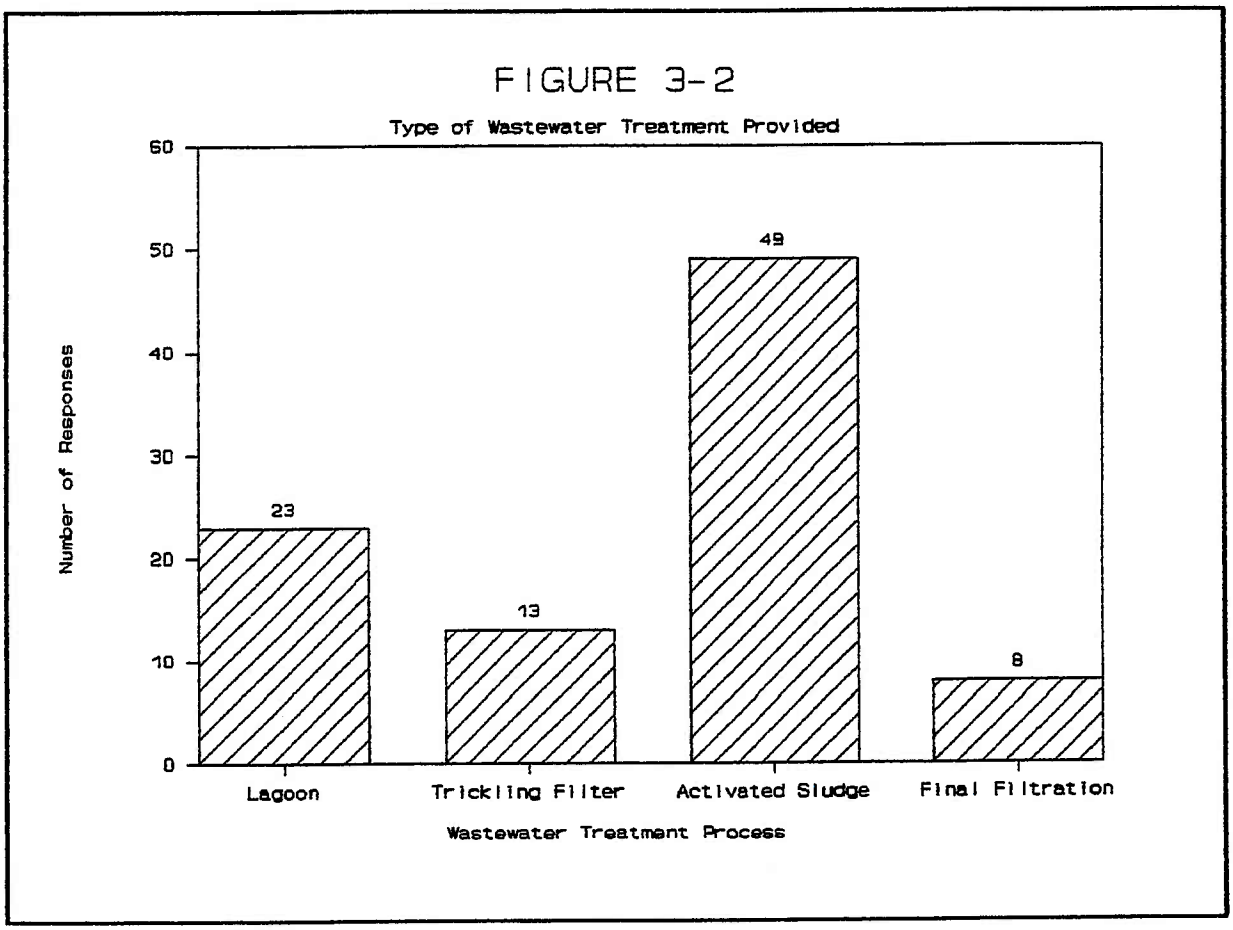


FIGURE 3-2
Type of Wastewater Treatment Provided
Number of Responses
60
50
40
30
20
10
0
23
13
49
8
Lagoon
Trickling Filter
Activated Sludge
Final Filtration
Wastewater Treatment Process

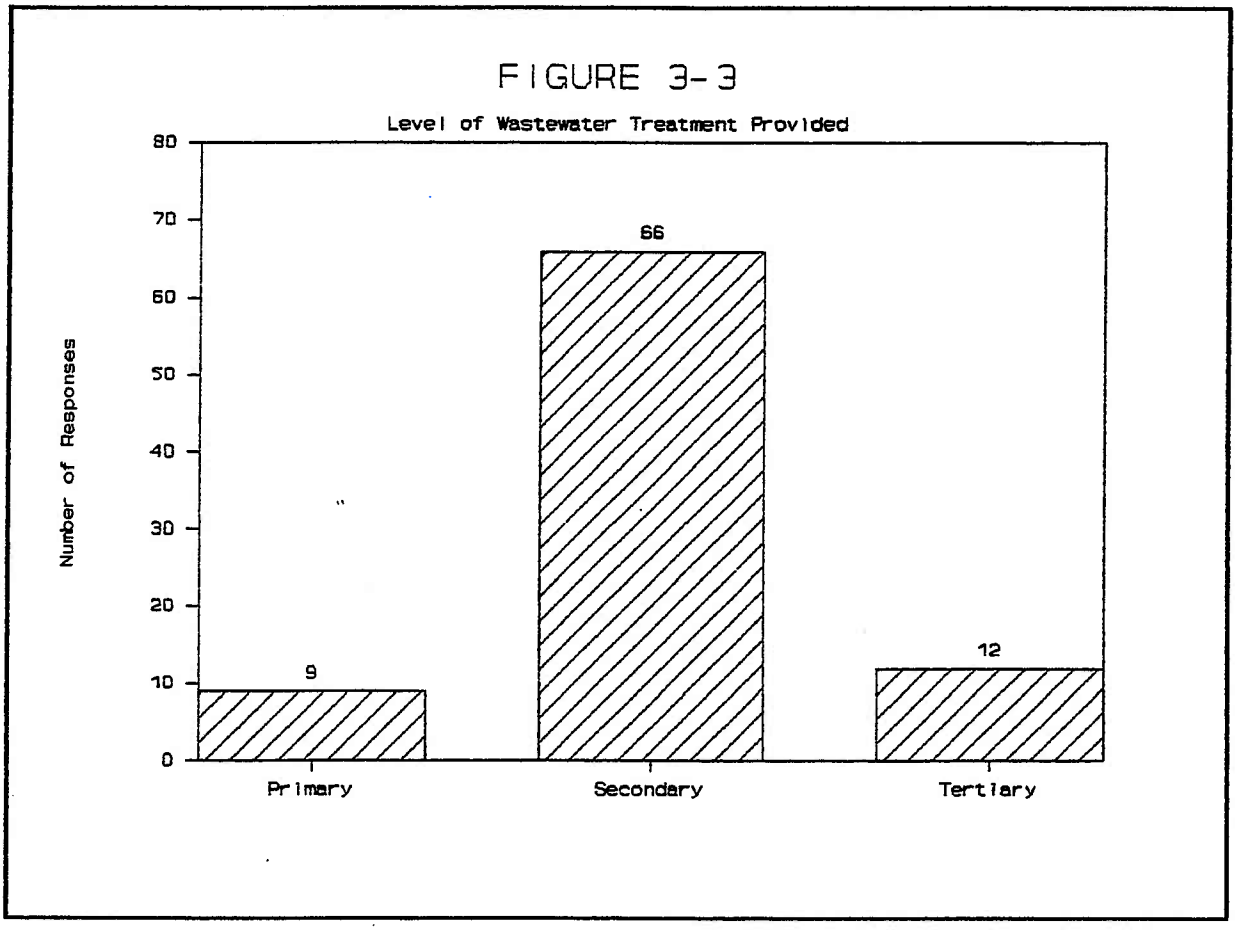


FIGURE 3-3
Level of Wastewater Treatment Provided
Number of Responses
80
70
60
50
40
30
20
10
0
9
66
12
Primary
Secondary
Tertiary

Section 4 asked for information on the type of wastewater collection system. Choices included gravity sewer systems; gravity sewer systems with pump stations; septic tank effluent pump (STEP) systems; or other. STEP systems are wastewater collection systems that pump the effluent from individual septic tanks to a community treatment plant. They are commonly installed where the individual septic tanks have failed and are causing water quality problems. As shown on Figure 3-4, and as expected, the vast majority of respondents are served by gravity sewer systems with pump stations.

High-Strength Wastes:

Sections 5 and 6 of the survey asked if the POTW's currently accept high-strength waste into their systems and if so what common problems do they cause. The three types of high-strength waste listed in the survey were recreational vehicles, septage and boat waste. The results of the question about the types of waste accepted is shown on Figure 3-5. The majority of respondents accept waste from RV's.

Problems with High-Strength Wastes:

The types of problems caused by high-strength wastes include odors, corrosion, plugging, system overload, permit violations, sludge handling, effluent toxicity, and others. The results of this survey question are shown on Figure 3-6. About a third of the survey respondents indicate they have problems with both odors and overloading that are caused by high-strength wastes. The majority of the odor problems associated which high-strength waste are at the treatment plant and are caused by septage. The majority of overloading problems associated with high-strength waste are also at the treatment plant and are caused by septage.

Plugging was the third most severe problem caused by high-strength wastes, with about 19% of the respondents experiencing this problem. The location of this problem was fairly evenly split between the treatment plant and the collection system. The source of high-strength waste causing plugging was mostly RV and septage.

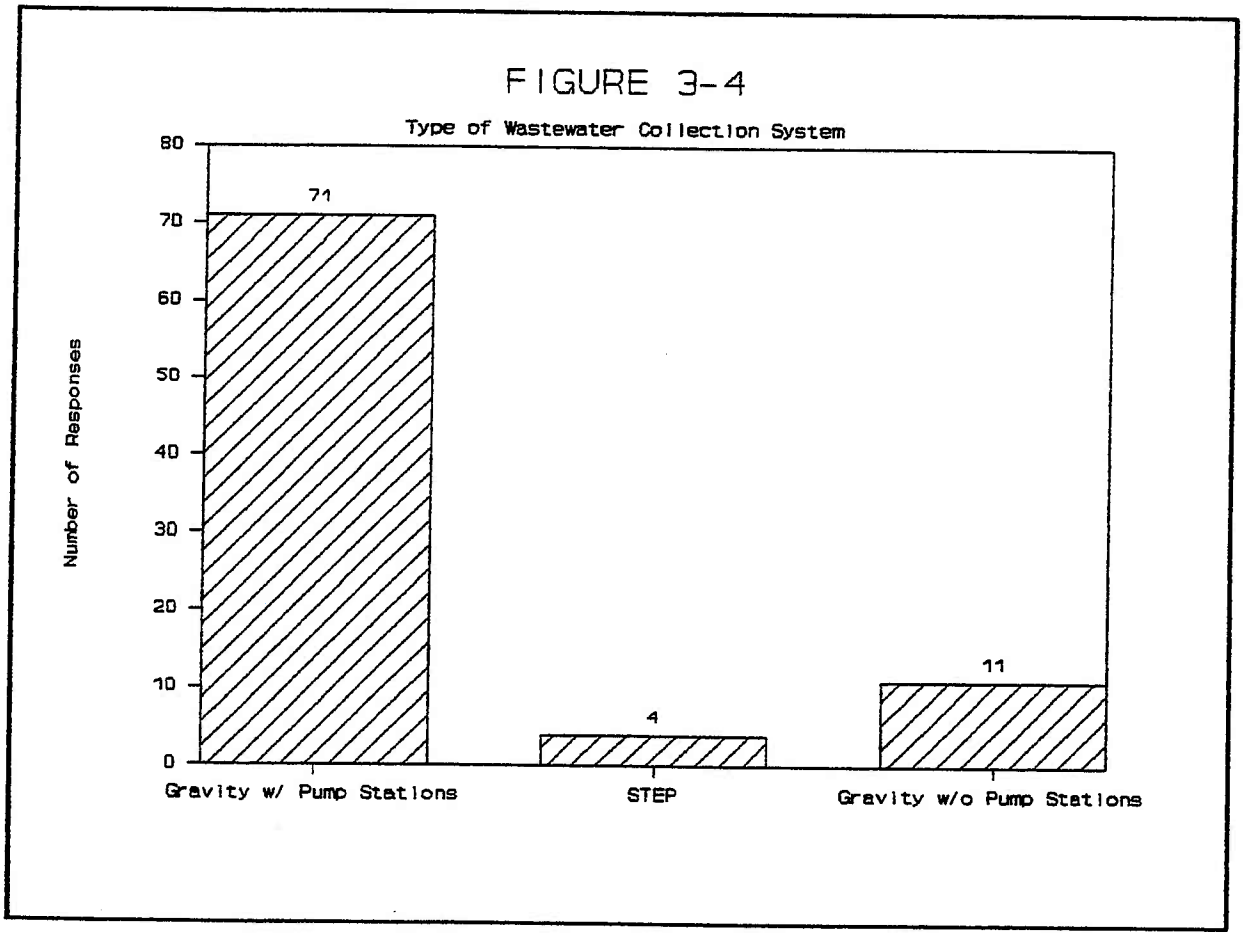


FIGURE 3-4
Type of Wastewater Collection System
Number of Responses
80
70
60
50
40
30
20
10
0
71
4
11
Gravity w/ Pump Stations
STEP
Gravity w/o Pump Stations

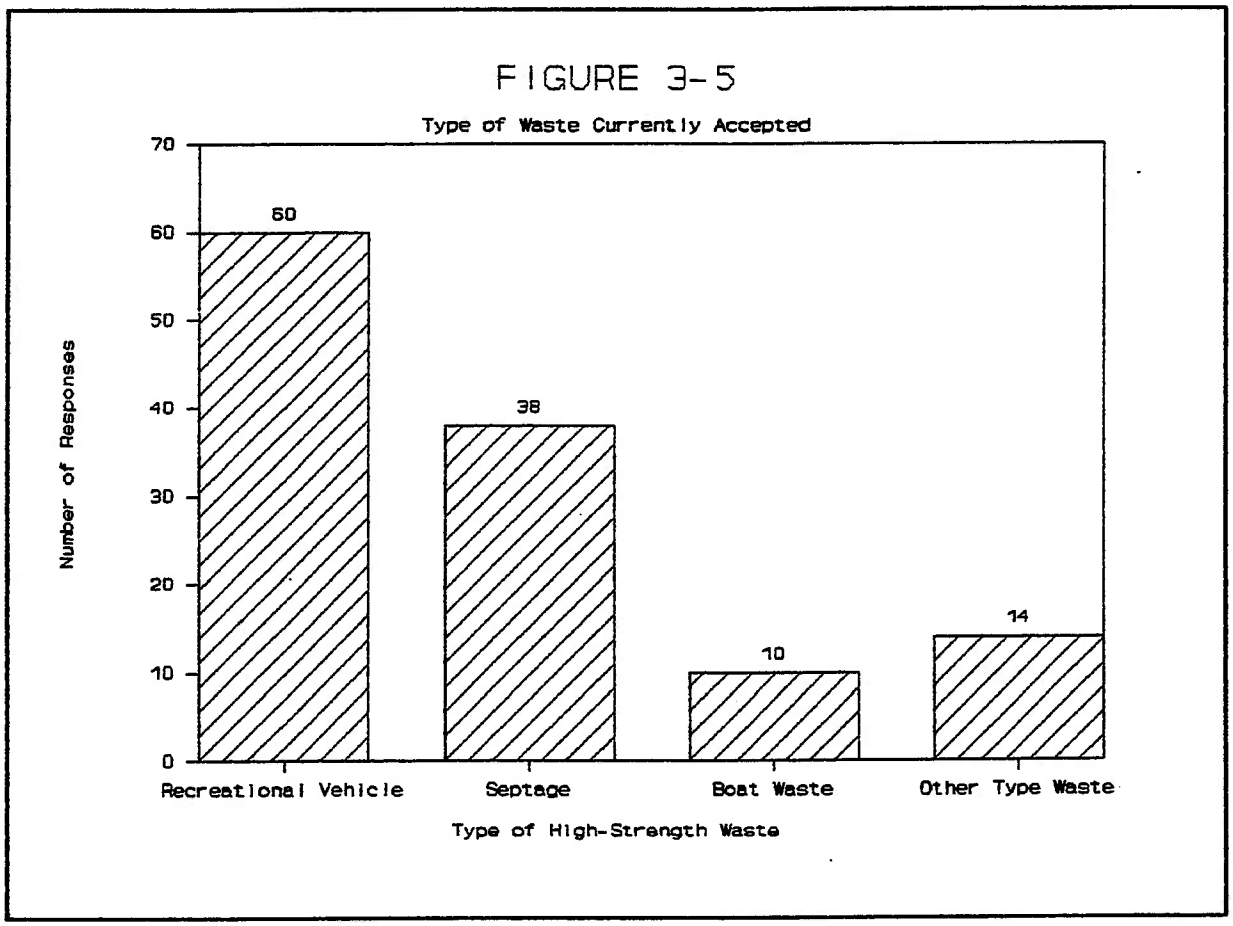


FIGURE 3-5
Type of Waste Currently Accepted
70
60
50
40
30
20
10
0
Number of Responses
60
38
10
14
Recreational Vehicle
Septage
Boat Waste
Other Type Waste
Type of High-Strength Waste

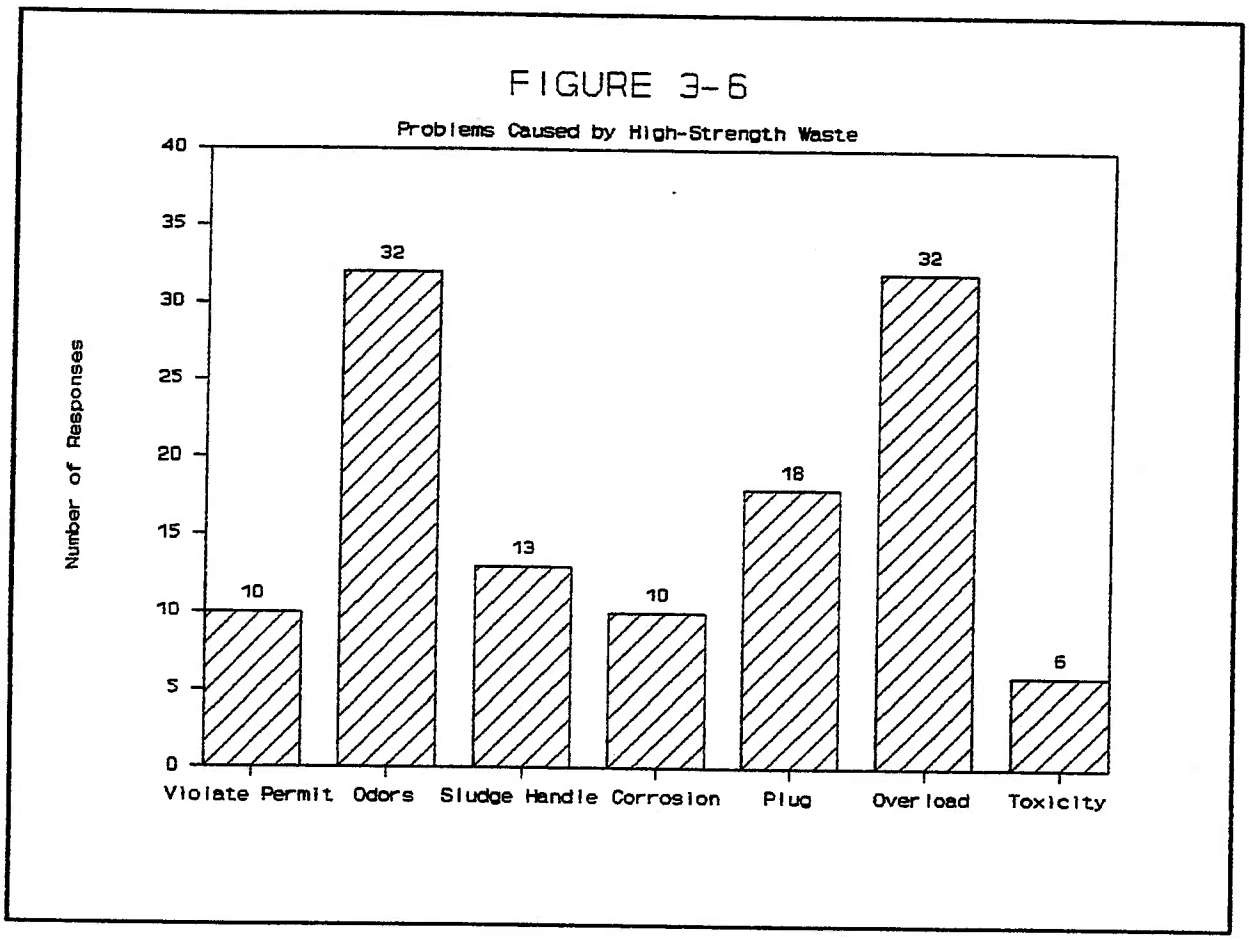


FIGURE 3-6
Problems Caused by High-Strength Waste
Number of Responses
40
35
30
25
20
15
10
5
0
10
32
13
10
18
32
6
Violate Permit
Odors
Sludge Handle
Corrosion
Plug
Overload
Toxicity

Between 10 and 13 percent of the respondents have problems with corrosion, sludge handling and permit violations caused by high-strength waste. The location of these problems were fairly evenly split between the collection system and the wastewater treatment plant. The source was mostly RV and septage high-strength wastes.

About 6% of the respondents have problems with effluent toxicity caused by high-strength wastes. Effluent toxicity can cause problems with biomonitoring requirements for POTW's. This can lead to permit violations and corrective action.

Section 7 asked if the respondents system would be able to handle boat waste. A preliminary copy of Table 2-3 was included with the survey to give them an idea of the nature of boat waste. This included preliminary results from the 1994 boat waste sampling program, including values for BOD, COD, TSS, and VSS. The majority of the respondents replied that they could accept boat waste.

Problems with Additives:

Section 8 asked whether the respondent's system would have problems with any of the common additives used by boat or recreational vehicle owners; including formaldehyde, enzymes, soap/detergents, pH buffers, quaternary ammonium and any others. The respondents indicated that about half would have problems with formaldehyde; one-third would have problems with soap/detergents or ammonium compounds; and 17% to 18% would have problems with enzymes or pH buffers.

Section 9 asked if the respondents would prefer to accept boat waste at the treatment plant or within the collection, such as near the marina. The majority (59%) of respondents would prefer to accept boat waste within the collection system.

Section 10 asked for an estimate of the time for wastewater to travel from the marina through the collection system to the treatment plant. Response values

ranged from less than 30 minutes to over 8 hours.

Modifications Needed:

Section 11 asked what modifications would be required to the municipal wastewater system in order to accept boat waste. This included both the collection system and the treatment plant. The list of modifications included receiving stations, holding tanks, pump stations, sampling, metering, staff, chemicals, laboratory testing, sewer cleaning, and any others the respondent believed were necessary.

The responses to this question are shown on Figure 3-7. The results indicate that approximately 45% of the respondents see a need for marina receiving stations, uniform pumping (prevent slug loading) and/or sampling equipment. 36% need marina holding tanks and/or flow metering equipment. Additional laboratory services are needed by 25% of the respondents. Between 10% and 16% of the respondents need additional staff, chemicals to add to the waste, sewer cleaning, and/or treatment plant receiving stations, to properly handle boat waste.

Finally, section 12 asked if the respondent would attend an educational/technical seminar for boat waste disposal concerns. The majority of respondents answered yes.

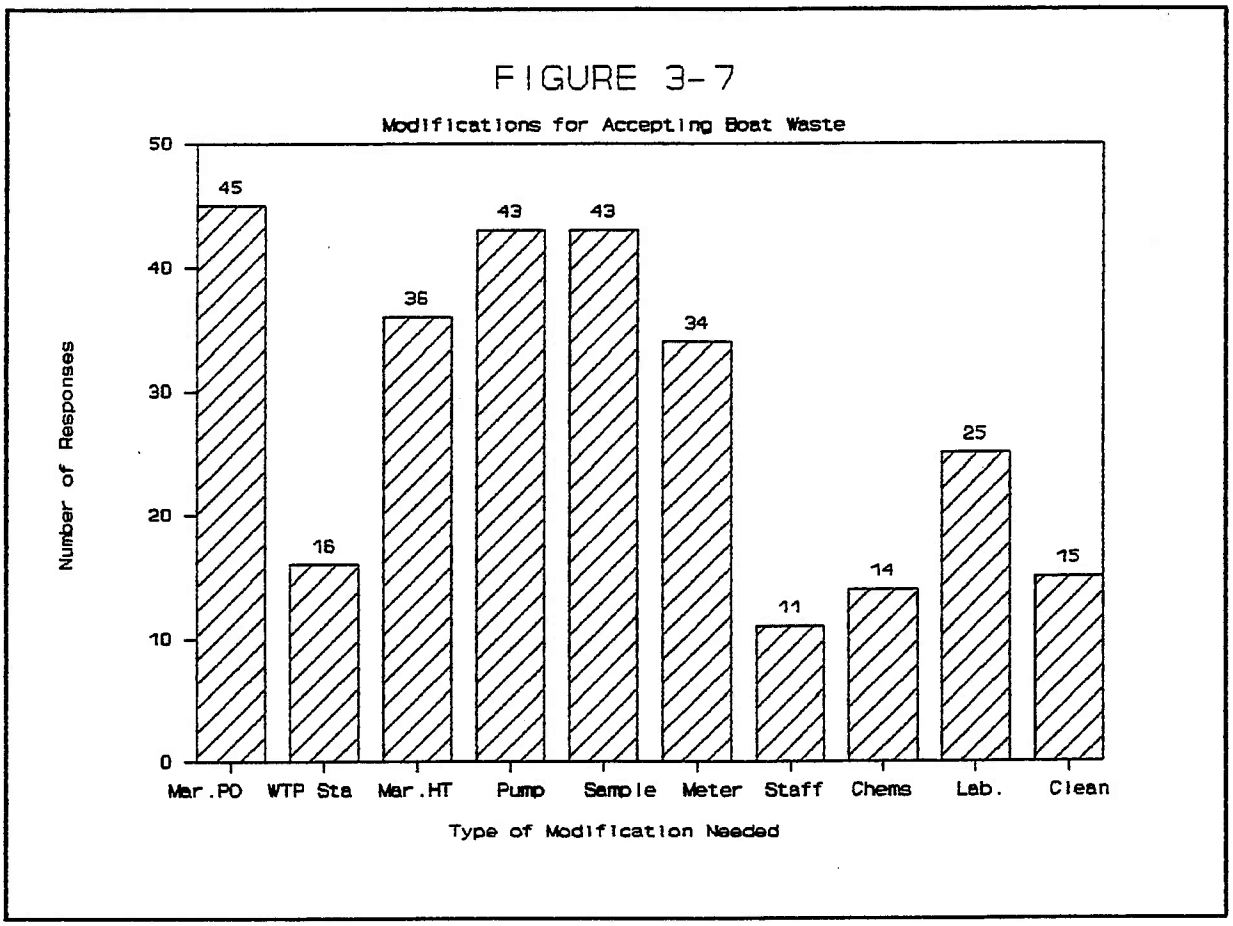


FIGURE 3-7
Modifications for Accepting Boat Waste
Number of Responses
50
40
30
20
10
0
45
16
36
43
43
34
11
14
25
15
Mar.PO
WTP Sta
Mar.HT
Pump
Sample
Meter
Staff
Chems
Lab.
Clean
Type of Modification Needed

Survey Responses by Treatment Plant Capacity:

As mentioned previously, one benefit of having the survey results entered in a computer database is its ability to perform queries on the data. Because each respondent was asked to give the treatment plant capacity, a query was made on the database to sort all responses by capacity. Four capacity ranges were chosen; 1) capacity less than 0.1 mgd (<100,000 gpd); 2) capacity from 0.1 to 1.0 mgd; 3) capacity greater than 1.0 mgd to 10.0 mgd; and 4) capacity greater than 10.0 mgd. These are typical capacity ranges for wastewater treatment facilities.

Appendix F contains the results of the database query for the following nine survey questions.

2a. Type of wastewater treatment provided.
2b Level of wastewater treatment provided.
3. Type of collection system.
5. Acceptance of high-strength waste.
6. Problems with high-strength waste.
8. Problems with chemical additives.
9. Preferred location to receive boat waste.
10. Travel time from marina to treatment plant.
11. Modifications needed to accept boat waste.

TREATMENT AND DISPOSAL OPTIONS AVAILABLE

The treatment and disposal options for boat waste available in Oregon, can be classified into two categories;

1) On-Site Treatment and Disposal
2) Off-Site Treatment and Disposal

The decision to select a particular system should be based on a sound engineering analysis; taking into account marina location, availability of a municipal

wastewater collection and treatment system, soil conditions, water quality standards, cost, and ownership.

On-Site Treatment and Disposal

On-site treatment and disposal options are those where boat waste from a pumpout station or dump station is treated at or near the marina and disposed of either 1) with discharge to navigable waters, or 2) with no discharge to navigable waters. "Navigable water" means any surface water, such as a stream, lake, or river. "Non-navigable water" discharge systems include spray irrigation systems, subsurface disposal systems and others. In other words, an on-site system is one where the owner and operator of the marina also owns and operates the wastewater treatment and disposal system.

For this study, on-site systems will also include holding tanks, in order to be consistent with the Oregon Administrative Rules that manage on-site sewage disposal systems. Sewage disposal service companies are also discussed because they pump out and dispose of the contents of holding tanks.

A Water Pollution Control Facilities (WPCF) Permit is required to construct and operate a disposal system with no discharge to navigable waters. A National Pollutant Discharge Elimination System (NPDES) Permit is required by the DEQ to construct and operate a disposal system with discharge to navigable waters.

On-Site Sewage Disposal Systems:

"On-Site Sewage Disposal System" is defined by the DEQ as meaning "any existing or proposed on-site sewage disposal system including, but not limited to a standard subsurface, alternative, experimental or non-water carried sewage disposal system, installed or proposed to be installed on land of the owner of the system or on other land as to which the owner of the system has the legal right to install the system." A standard subsurface system consists of a septic tank, distribution unit, and gravity-fed absorption facility. An alternative

system includes aerobic systems, holding tanks, sand filters, and a few other systems.

Because boat waste is a high-strength waste, it does not meet the definition of "Residential Strength Wastewater" of the DEQ. "Residential Strength Wastewater" means "the primary sewage effluent from a septic tank which does not exceed the following parameters: Biochemical Oxygen Demand (BOD) of 300 mg/L; Total Suspended Solids (TSS) of 150 mg/L; Total Kjeldahl Nitrogen (TKN) of 180 mg/L; and Fat, Oil & Grease (EPA Method 413.1) of 25 mg/L. Other contaminants may also be present in the wastewater, however, they should not exceed the concentrations or quantities normally found in residential sewage."

Because boat waste is stronger than residential strength wastewater, an on-site sewage disposal system for boat waste must be constructed and operated under a renewable Water Pollution Control Facilities (WPCF) Permit.

The planner or designer of on-site boat waste treatment and disposal facilities are encouraged to contact the Oregon Department of Environmental Quality to find out the specific requirements for the various on-site sewage disposal systems. The DEQ is in the process of revising the Oregon Administrative Rules for On-site Sewage Disposal. Local governmental agencies may be authorized by the DEQ to assume some responsibility and jurisdiction in the permitting of WPCF facilities.

Chapter 340 of the Oregon Administrative Rules contains many detailed rules and regulations for the planning, design, installation and operation of on-site sewage disposal systems. As such, this study has not attempted to present these rules in detail and the reader is referred to them for specific information.

Holding Tanks:

Holding Tanks are defined as "a watertight receptacle designed to receive and store sewage to facilitate disposal at another location." Holding tanks must also operate under a WPCF permit, issued by the DEQ. Holding tanks are only

allowed if all of the following conditions are met:

1) The site is not approved for installation of a standard subsurface system; and

2) No community or area-wide sewerage system is available or expected to be available within five (5) years; and

3) The tank is intended to serve a small industrial or commercial building, or an occasional use facility such as a county fair or a rodeo; and

4) Unless otherwise allowed by the Department, the projected daily sewage flow is not more than two hundred (200) gallons; and

5) Setbacks as required for septic tanks can be met.

Temporary holding tanks may be allowed in areas under the control of a city or other legal entity, if the city will extend sewer service to the site within five (5) years. Temporary holding tanks may also be allowed to serve a temporary construction site.

Sewage Disposal Service:

"Sewage Disposal Service" is defined by the Oregon Administrative Rules as:

1) The installation of on-site sewage disposal systems (including the placement of portable toilets), or any part thereof; or

2) The pumping out or cleaning of on-site sewage disposal systems (including portable toilets), or any part thereof; or

3) The disposal of material derived from the pumping out or cleaning of on-site disposal systems (including portable toilets); or

4) Grading, excavating, and earth-moving work connected with the operations described in subsection 1) above.

Sewage disposal services must be licensed by the DEQ. The Oregon Administrative Rules contain requirements for proper pumping and cleaning; equipment used for the services; vehicles used for hauling waste; and final disposal of pumpings.

Off-Site Treatment and Disposal

For the purposes of this study, an off-site treatment and disposal system is one where the boat waste is pumped or piped into a wastewater collection system owned and operated by someone other than the marina operator, such as a municipal wastewater treatment system. The first step when planning or designing an off-site system is to contact the agency to determine their specific requirements about permitting, design standards, construction standards and operational standards.

Information from this Study:

Information required by the agency may include location of pumpout station or dump station, and information on waste volume and characteristics. This study should be made available to the agency as it contains information on both waste volume and characteristics. The person planning or designing the boat waste facility will need to estimate the volume of boat waste on both an annual basis (or seasonal) and a peak day basis (holiday weekend).

Survey response information should also be made available to the agency. Knowing about problems with high-strength waste that other municipalities have experienced will be very helpful to the agency planning a new sewer service. Modifications that other municipalities will need to make in order to accept boat waste will also be helpful to the agency. Some of these modifications may be required of the marina and some modifications may be made by the municipality.

Permitting:

Many larger municipalities have a pretreatment program that is part of their NPDES permit from the DEQ. As such, the connection of a marina facility may require a permit from the municipality with corresponding monitoring, sampling and reporting requirements. The marina may be required to monitor and record the volume of waste discharged into the municipal system, as well as periodically sample and test the waste for certain parameters, such as BOD and TSS.

ALLOWABLE VOLUME OF BOAT WASTE

The volume of boat waste that a municipal wastewater treatment plant can safely handle can be estimated based on either toxicity impacts on the treatment plant or based on plant capacity. The lowest volume determined from either toxicity or capacity is the limiting one.

Each of these estimations are based on two different criteria and should not be confused with the other.

Toxicity Impacts on Treatment Plants

Toxicity of boat waste additives was previously discussed in this report. A study by the Maryland Department of the Environment (Buchart-Horn, 1992) recommended dilutions for boat waste containing various additives, based on various treatment processes. The additives included formaldehyde and paraformaldehyde; detergents, cleaning agents, and disinfectants (QAC's); and zinc compounds. The treatment processes included the activated sludge process, trickling filter process, anaerobic digestion, and septic tanks. Additives containing formaldehyde and paraformaldehyde required the greatest dilution for the activated sludge, trickling filter, and anaerobic digestion processes. Dilutions for zinc compounds are not discussed here because they are no longer used. For septic tanks, the QAC additives require the greatest dilution.

For municipal wastewater treatment facilities that utilize the activated sludge or trickling filter processes, and treat boat waste containing formaldehyde and paraformaldehyde, the Buchart-Horn study recommended the boat waste be diluted 7:1 with domestic waste. This would lower the additive concentration from 400 mg/L (concentration found in boat waste) to 50 mg/L (concentration that would not impact treatment process).

For wastewater treatment facilities that have anaerobic digestion and treat boat waste containing formaldehyde or paraformaldehyde, the Buchart-Horn study recommended the boat waste be diluted 13:1 with domestic waste. This would lower the additive concentration from the 400 mg/L to 30 mg/L (concentration that would not impact the digestion process). Although the anaerobic digestion process typically treats wastewater sludges produced at wastewater treatment plants, the dilution recommendations are given here because high solids content boat waste may be pumped directly into anaerobic sludge digesters.

For septic tank systems the Buchart-Horn study recommended that boat waste be diluted 5:1 to lower the additive concentration (QAC's) from 120 mg/L (concentration recommended for boat holding tanks) to 20 mg/L (concentration that would not impact the septic tank system).

Table 3-1 shows the maximum volume of boat waste a wastewater treatment plant could accept and not exceed the dilution recommendations for boat waste additives. The table is based on 1) the wastewater treatment process used, 2) the treatment plant flowrate and 3) the previously discussed dilution requirements.

For example, an activated sludge plant treating 50,000 gallons per day of wastewater could only accept 7,000 gallons per day of boat waste and not exceed the 7:1 dilution recommendation. For anaerobic digestion the flowrate is the flowrate into the digester and not the plant wastewater flowrate. Sludge flowrates are generally less than 1% of the plant wastewater flowrate.

The reader is referred to the Buchart-Horn study for more detailed information on toxicity.

TABLE 3-1

VOLUME OF BOAT WASTE IMPACTING PLANT TOXICITY
FOR VARIOUS TREATMENT SYSTEMS (GALLONS PER DAY)

Plant Flowrate (gallons per day)	Activated Sludge or Trickling Filter	Anaerobic Sludge Digestion	Septic Tank Drainfield System
10,000	1,400	770	2,000
50,000	7,000	3,850	10,000
100,000	14,000	7,700	20,000
500,000	70,000	38,500	N/A
1,000,000	140,000	77,000	N/A

Treatment Plant Capacity Impacts

Wastewater treatment plants have designed capacities for flowrate, biochemical oxygen demand (BOD) and total suspended solids (TSS). High strength boat waste added to a treatment facility can have a detrimental impact on plant capacity, especially for BOD and TSS. The very nature of boat waste being a high strength waste means the boat waste volume will generally be small and not have a negative impact on flowrate capacity. Flowrate capacity of a treatment plant mainly involves the capacity of pumps, clarifiers, aeration basins, and disinfection systems.

For BOD and TSS, the plant capacity involves aeration basins and accessory equipment (blowers), secondary clarifiers, trickling filters, sludge removal mechanisms and pumps, sludge digesters, and sludge (biosolids) reuse equipment.

Table 3-2 has been developed to estimate the volume of boat waste a treatment plant could accept and not exceed its capacity. In other words, how much boat waste would it take to use up the remaining capacity of a treatment plant. The table is based on 1) plant capacity, 2) percent capacity of the plant, and 3) the strength of boat waste discovered during this study.

Using the same example, lets say the plant treating 50,000 gallons per day has a capacity of 100,000 gallons per day. This means the plant is at 50% capacity and so could accept 3,300 gallons per day of boat waste before reaching capacity for BOD. In this example the limiting volume is the 3,300 gallons per day from the capacity calculation.

Generally, the capacity impacts will govern over the toxicity impacts, unless above normal concentrations of additives are anticipated from a marina.

On the other hand, a domestic treatment plant that is highly under loaded may reach the toxicity limit before the capacity limit. An example could be a package plant serving a new residential area near a marina that is being evaluated for boat waste facilities. When first started the plant may only be at 10% to 20% capacity. Because the plant has plenty of remaining capacity, the toxicity limit will probably be reached before the capacity limit.

Both Tables 3-1 and 3-2 should be used as a guide by treatment plant operators. The actual volume of boat waste a particular treatment plant could accept should be determined based on more detailed information.

TABLE 3-2

VOLUME OF BOAT WASTE IMPACTING PLANT CAPACITY[1]
(GALLONS PER DAY)

Plant Capacity (gpd)	Percent Capacity of Treatment Plant [BOD][2]			Percent Capacity of Treatment Plant [TSS][3]		
	50%	75%	90%	50%	75%	90%
10,000	330	165	67	625	310	125
50,000	1,650	825	335	3,125	1,550	625
100,000	3,300	1,650	670	6,250	3,100	1,250
500,000	16,500	8,250	3,350	31,250	15,500	6,250
1,000,000	33,000	16,500	6,700	62,500	31,000	12,500

(1) Assumes treatment plant designed for 200 mg/L BOD and 200 mg/L TSS.
(2) Assumes boat waste BOD = 2,990 mg/L.
(3) Assumes boat waste TSS = 1,600 mg/L.

CHAPTER 4 - CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

This section of the study will include conclusions drawn from the sampling program and municipal treatment plant survey.

Sampling Program Conclusions

Boat waste sampled and tested in Oregon during 1994 had the following characteristics:

Biochemical Oxygen Demand	=	2,990 mg/l
Chemical Oxygen Demand	=	8,020 mg/l
Soluble Chemical Oxygen Demand	=	5,140 mg/l
Total Suspended Solids	=	1,600 mg/l
Volatile Suspended Solids	=	1,370 mg/l

Boat waste contains potentially detrimental additives including formaldehyde, enzymes, dyes and perfumes.

Boat waste should not negatively impact wastewater collection systems and treatment plants if the designer of the boat waste facility heeds the modifications suggested by the survey respondents.

Municipal Wastewater Treatment Plant Survey Conclusions

Boat waste can cause the following problems to municipal collection and treatment facilities; including odors, corrosion, plugging, overloading, permit violations, sludge handling, effluent toxicity, and others.

The 1994 wastewater treatment plant survey results indicate that odors and overloading are the greatest problems caused by high-strength waste, followed in

order by plugging, sludge handling, corrosion, permit violations and finally toxicity.

Modifications needed for municipal wastewater collection and treatment facilities to accept boat waste include; receiving stations at either the marina or treatment plant, holding tanks at marina, uniform pumping, sampling, flow metering, additional staffing, chemical addition, laboratory testing, additional sewer cleaning, and others.

The 1994 wastewater treatment plant survey results indicate that marina receiving stations, uniform pumping and sampling are the greatest modifications needed to accept boat waste; followed in order by marina holding tanks, flow metering, lab testing, treatment plant receiving stations, sewer cleaning, chemical additions and finally additional staffing.

Regulatory Conclusions

Boat waste does not meet the criteria established by the Department of Environmental Quality (DEQ) for "residential strength wastewater" and as such is defined as a high-strength waste.

On-site wastewater treatment systems will require either a Water Pollution Control Facilities (WPCF) permit or a National Pollutant Discharge Elimination System (NPDES) permit from the DEQ.

Holding tanks for high-strength boat waste will require a WPCF permit from the DEQ.

Connection of a boat waste pumpout station directly to a municipal wastewater collection system or treatment facility will require obtaining a permit from the local agency.

General Conclusions

Boating marinas may or may not be conveniently located to be served by municipal wastewater conveyance and treatment systems.

A computer database containing the results of the entire wastewater treatment plant survey results has been established at the Oregon Marine Board.

Not enough information is available in the literature to estimate the volume of boat waste from marinas that serve a mixture of small boats with no toilets, boats with portable toilets, and boats with on-board toilets.

RECOMMENDATIONS

This section will include recommendations drawn from the study for planners and designers, wastewater treatment operators, and the Marine Board.

Planners and Designers

Planners and designers of boat waste handling facilities to be connected to municipal wastewater systems should utilize the computer database to determine specific information from similar municipal systems; including size, type and level of treatment.

Marina pumpout stations should be easily accessible by the boats they are to serve.

On-site treatment systems like septic-tank drainfields may need to be oversized to accommodate the high-strength characteristics of boat waste.

Planners and designers of on-site boat waste treatment systems should contact the DEQ for information on obtaining proper discharge permits.

Corrosion resistive materials should be considered in the design of boat waste facilities.

Where boat waste is hauled directly to smaller treatment facilities, the designer should consider providing a storage tank where the boat waste can be pumped from the truck and then slowly pumped into the treatment plant to avoid shock loading.

Wastewater Treatment Plant Operators/Owners

Wastewater treatment plant operational staff should review the survey results to learn about impacts from proposed boat waste facilities.

Oregon State Marine Board

This study should be distributed to wastewater treatment plant operators and owners. The Oregon Marine Board is planning to provide education and training through education materials training seminars. The Pacific Northwest Pollution Control Association (PNPCA) annual conference (Fall) and the annual wastewater short-school held at Clackamas Community College (Spring) are two training opportunities.

The Oregon Marine Board may want to conduct a study to more accurately determine the volume of boat waste from marinas found in Oregon. This will help the planners and designers of future boat waste handling facilities.

CHAPTER 5 - GUIDELINES

This chapter includes guidelines for planners and designers of boat waste handling facilities. It also contains an example to follow to determine if a wastewater treatment plant can safely handle boat waste from a marina.

PLANNERS AND DESIGNERS

Planners and designers of boat waste handling facilities for marinas should consider both on-site and off-site wastewater treatment systems. The decision to select a particular system should be based on a sound engineering analysis; taking into account marina location, availability of a municipal wastewater collection and treatment system, soil conditions, water quality standards, cost, and ownership.

Planners and designers of boat waste handling facilities should use the information found in this study to estimate the character and volume of boat waste from a marina. The volume of boat waste will be the most difficult component to estimate. Over estimating may lead to overly conservative treatment systems.

Planners and designers of boat waste handling facilities should contact the DEQ and the local authority to determine the type of permits necessary for the proposed treatment system.

Planners and designers of boat waste handling facilities should utilize the Oregon Marine Board's computer database to discover detailed information about the impacts of boat waste on municipal wastewater treatment facilities.

On-site wastewater systems include standard septic-tank drainfield systems, alternative systems and holding tanks. On-site systems will require a permit from the DEQ. Components of on-site systems may need to be oversized to accommodate the high-strength nature of boat waste.

Off-site wastewater systems include connecting to a municipal wastewater treatment facility. Examples of potential problems from boat waste and possible modifications to alleviate them can be found in the survey results section of this study.

EXAMPLE CALCULATION

This study recommends following these steps to determine whether a treatment plant can handle boat waste from a particular marina:

1) Estimate both the peak day and average volumes of boat waste generated by the marina;

2) Determine if the estimated volumes will have a toxicity impact on the treatment plant; and

3) Determine if the estimated volumes will have a capacity impact on the treatment plant.

1. Estimate Volume of Boat Waste

The volume of boat waste will be estimated for a proposed marina which will have a single pumpout station and a single dump station for portable toilets. It is assumed the boat holding tank pumpout will yield 20 gallons per boat and a portable toilet will yield 4 gallons per boat. The number of uses of both the pumpout station and the dump station is estimated in Table 5-1.

High, medium and low usage rates are estimated for this example to show the expected variation at a marina due to specific site conditions, such as location and time of year.

TABLE 5-1 PUMPOUT STATION AND DUMP STATION USAGE ESTIMATION			
Usage Rates	Peak Day (weekend)	Weekday	Total Per Week (rounded off)
High	24 uses per day	10 uses per day	100 per week
Medium	12 uses per day	5 uses per day	50 per week
Low	6 uses per day	1-2 uses per day	20 per week

The volume and daily flowrates of boat waste are then estimated as shown in Table 5-2, using 20 gallons per pumpout station use and 4 gallons per portable toilet. The average flowrate is the average for the entire week. The peak flowrate would occur during the weekend when boating activity is greatest.

TABLE 5-2 ESTIMATED VOLUME OF BOAT WASTE						
Rate	Total Usage per Week	Pumpout Volume (gals)	Dump Volume (gals)	Total Volume (gals)	Average Flowrate (gpd)	Peak Flowrate (gpd)
High	100	2,000	400	2,400	350	580
Medium	50	1,000	200	1,200	175	290
Low	20	400	80	480	70	145

Thus a marina with a single pumpout station and a single dump station could generate an average of between 70 and 350 gallons per day of boat waste and a peak day volume ranging from 145 to 580 gallons.

2. Determine Toxicity Impact on Wastewater Treatment Plant

In this example, the peak day flowrate range of 145 to 580 gallons is compared with the volumes of boat waste in previous Table 3-1. The peak day flowrate is used because over a 3-day weekend, the wastewater treatment plant could receive this volume of boat waste each day.

Table 3-1 is shown here again for information (Table 5-3). This table shows the volume of boat waste a particular treatment system could receive and not experience a toxicity impact (plant upset or system failure).

TABLE 5-3

VOLUME OF BOAT WASTE IMPACTING PLANT TOXICITY FOR VARIOUS TREATMENT SYSTEMS (GALLONS PER DAY)

Plant Flowrate (gallons per day)	Activated Sludge or Trickling Filter	Anaerobic Sludge Digestion	Septic Tank Drainfield System
10,000	1,400	770	2,000
50,000	7,000	3,850	10,000
100,000	14,000	7,700	20,000
500,000	70,000	38,500	N/A
1,000,000	140,000	77,000	N/A

In this example, the 145 to 580 gallons per day of boat waste should not have an impact on even a small 10,000 gallon per day treatment plant. As discussed in Chapter 3 this is primarily due to the dilution the boat waste receives from the domestic wastewater.

3. Determine Capacity Impact on Wastewater Treatment Plant

In this example, the flowrate range of 70 to 350 gallons is compared with the volumes of boat waste in Table 3-2. This table listed the volume of boat waste that would impact a treatment plant's capacity. Table 3-2 is repeated here for clarity (Table 5-4). In the case of evaluating treatment plant capacity, average boat waste volumes are used and not the peak day volumes. This is because the plant capacities shown in Table 5-4 are assumed to be average plant capacity.

Table 5-4 shows the volume of boat waste that could negatively impact a treatment plant, at various plant capacities. For example, a 100,000 gpd capacity treatment plant, which is currently treating 90,000 gpd (90% capacity), could only treat an additional 670 gpd of boat waste before the plant would reach capacity.

TABLE 5-4

VOLUME OF BOAT WASTE IMPACTING PLANT CAPACITY(1)
(GALLONS PER DAY)

Plant Capacity (gpd)	Percent Capacity of Treatment Plant [BOD](2)			Percent Capacity of Treatment Plant [TSS](3)		
	50%	75%	90%	50%	75%	90%
10,000	330	165	67	625	310	125
50,000	1,650	825	335	3,125	1,550	625
100,000	3,300	1,650	670	6,250	3,100	1,250
500,000	16,500	8,250	3,350	31,250	15,500	6,250
1,000,000	33,000	16,500	6,700	62,500	31,000	12,500

(1) Assumes treatment plant designed for 200 mg/L BOD and 200 mg/L TSS.
(2) Assumes boat waste BOD = 2,990 mg/L.
(3) Assumes boat waste TSS = 1,600 mg/L.

For the guidance example, the 70 to 350 gallons per day of boat waste should only have an impact on a very small treatment plant, such as a 10,000 gpd package plant.

In conclusion, the process outlined here can be followed to estimate the quantity of boat waste from a proposed marina wastewater system. The planner and designer may have more accurate and site specific information on usage rates than shown in Table 5-1. If so the site specific information should be used.

The guidance process also shows how to determine if a treatment plant's capacity will be impacted from the boat waste or if the boat waste will have a toxicity impact on the plant. In general, boat waste from marinas should have little impact on wastewater treatment facilities.

APPENDIX A

DEFINITIONS

DEFINITIONS

Additives	Chemicals added to boat holding tanks and portable toilets to reduce or eliminate offensive odors created by the waste disposed in these units.
BOD	The Biochemical Oxygen Demand (BOD) is the measure of the concentration of organic impurities in wastewater. The amount of oxygen required by bacteria while stabilizing organic matter under aerobic conditions, expressed in milligrams per liter, is determined entirely by the availability of material in the wastewater to be used as biological food and by the amount of oxygen utilized by the microorganisms during oxidation.
COD	The Chemical Oxygen Demand (COD) is the measure of the oxygen consuming capacity of inorganic and organic matter present in water or wastewater, expressed as the amount of oxygen consumed from a chemical oxidant in a specific test. It does not differentiate between stable and unstable organic matter and thus, does not necessarily correlate with biochemical oxygen demand.
COD (Soluble)	The Soluble Chemical Oxygen Demand (Soluble COD) is the portion of total COD that is attributable to dissolved matter in the wastewater.
Grey Water	Wastewater from sinks, showers, floor drains and washing machines. Does not contain human body wastes.

Holding Tank	Type III marine sanitation device (MSD) means any equipment for installation on board a vessel which is specifically designed to receive, retain, and discharge human body wastes.
Marina	A boating facility with ten or more wet slips and/or dry land storage.
Portable Toilet	Toilets that are not permanently installed. They are designed to be removed from a vessel and their contents emptied into shore-side receptacles such as a pumpout station.
Pumpout Station	A facility that pumps or receives human body wastes out of a holding tank installed on board vessels or from portable toilets.
Septage	Waste matter that is periodically pumped out of septic tanks, and contains both the sludge material that has settled to the bottom of the tank and the liquid wastewater in the tank.
Sewage	A combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface waster, and stormwater that may be present. In recent years, wastewater has been used more commonly than the older term sewage.
Sewerage	An older term often used to describe the facilities used for collection, treatment, and disposal of sewage.

TSS	Total Suspended Solids (TSS) is a laboratory measurement that determines the concentration of solids that are in suspension and that are largely removable by laboratory filtering.
VSS	Volatile Suspended Solids (VSS) is a laboratory measurement that determines the concentration of organic suspended solids in wastewater or other liquids, and is the quantity of solids lost on ignition of the dry solids at 600 degrees C.
Wastewater	A more modern term for the word sewage. (See sewage)
Wastewater Collection	The removal and conveyance of wastewater through underground conduits called sewers. Where the sewers carry only the household and industrial, they are called sanitary sewers.
Wastewater Treatment	The removal of contaminants from wastewater and may be accomplished by unit operations or processes, or combinations of operations and processes. Physical, biological and chemical processes are normally used.

APPENDIX B

BOAT WASTE SAMPLING RESULTS

APPENDIX B

BOAT WASTE SAMPLING RESULTS

Sample Number	Sample Location	BOD5 (mg/l)	COD (mg/l)	Soluble COD(mg/	TSS (mg/l)	VSS (mg/l)
1	Tomahawk Bay	1,515.6	3,796.0	1,296.0	1,790.5	1,600.7
2	Tomahawk Bay	4,056.0	14,340.0	10,800.0	673.1	517.6
3	Tomahawk Bay	674.0	1,475.0	525.0	413.0	404.8
4	Tomahawk Bay	6,225.0	11,815.0	4,005.0	3,000.0	2,826.0
5	Tomahawk Bay	2,118.0	5,715.0	2,070.0	2,257.3	2,051.9
6	Tomahawk Bay	2,617.5	5,738.0	2,978.0	1,720.0	1,462.0
7	Tomahawk Bay	5,224.9	10,596.0	4,790.0	4,167.0	3,700.3
8	Tomahawk Bay	5,859.9	10,712.0	4,992.0	3,993.0	3,469.9
9	Tomahawk Bay	2,241.0	4,758.0	4,050.0	536.4	472.6
10	Tomahawk Bay	3,480.0	6,104.0	4,566.0	687.5	662.8
11	Tomahawk Bay	1,849.0	3,478.0	2,822.0	323.1	300.2
12	Tomahawk Bay	3,336.0	15,909.0	2,926.0	7,803.0	6,219.0
13	Kane's Marina	4,788.0	8,854.0	8,256.0	255.0	2.6
14	Kane's Marina	5,040.0	8,808.0	7,716.0	250.0	2.5
15	Kane's Marina	1,182.8	4,050.0	2,390.0	408.0	343.9
16	Kane's Marina	922.5	3,880.0	2,770.0	337.0	299.0
17	Charleston	447.0	2,286.0	1,482.0	1,066.0	1,055.3
18	Charleston	5,554.0	31,090.0	28,150.0		
19	Kane's Marina	1,485.0	3,545.5	3,203.0	350.0	346.5
20	Kane's Marina	1,186.5	3,477.5	3,003.0	346.7	343.2
	Average	2,990.0	8,020.0	5,140.0	1,600.0	1,370.0
	Minimum	447.0	1,475.0	525.0	250.0	2.5
	Maximum	6,225.0	31,090.0	28,150.0	7,803.0	6,219.0
	Standard Deviation	1,860.0	6,620.0	5,810.0	1,910.0	1,590.0

WATERLAB CORP.

TEST RESULTS

Certified Lab # 008

2603 -12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk Marina, Portland

DATE/TIME COLLECTED: 5/26/94 7:30 PM
COLLECTED BY: Customer
DATE RECEIVED: 5/27/94
LAB REPORT #: 940527-012

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	1,515.6	mg/l	5/27/94	mb	SM5210
Chemical Oxygen Demand,Total	3,796.	mg/l	5/27/94	tpw	SM5220D
Chemical Oxygen Demand, Solubl	1,296.	mg/l	5/27/94	tpw	SM5220D
Suspended Solids	1,790.5	mg/l	5/27/94	ah	SM2540D
`atile Suspended Solids	89.4	%	5/27/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 6/02/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk #2

DATE/TIME COLLECTED: 5/31/94 7:45 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/01/94
LAB REPORT #: 940601-037

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	4,056.	mg/l	6/01/94	mb	SM5210
Chemical Oxygen Demand-Total	14,340.	mg/l	6/02/94	tpw	SM5220D
Chemical Oxygen Demand,Soluble	10,800.	mg/l	6/02/94	tpw	SM5220D
pended Solids	673.1	mg/l	6/01/94	ah	SM2540D
olatile Suspended Solids	76.9	%	6/01/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

te Reported: 6/15/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Single Boat Holding Tank

DATE/TIME COLLECTED: 6/02/94 7:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/03/94
LAB REPORT #: 940603-044

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	674.	mg/l	6/03/94	mb	SM5210
Chemical Oxygen Demand-Total	1,475.	mg/l	6/06/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	525.	mg/l	6/06/94	tpw	SM5220D
spended Solids	413.5	mg/l	6/03/94	ah	SM2540D
Volatile Suspended Solids	97.9	%	6/03/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

e Reported: 6/15/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Single Boat Holding Tank

DATE/TIME COLLECTED: 6/02/94 7:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/03/94
LAB REPORT #: 940603-043

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	6,225.	mg/l	6/03/94	mb	SM5210
Chemical Oxygen Demand- Total	11,815.	mg/l	6/06/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	4,005.	mg/l	6/03/94	tpw	SM5220D
spended Solids	3,000.	mg/l	6/03/94	ah	SM2540D
Volatile Suspended Solids	94.2	%	6/03/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

te Reported: 6/15/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Portland Tomahawk Island

DATE/TIME COLLECTED: 6/02/94 7:30 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/03/94
LAB REPORT #: 940603-045

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	2,118.	mg/l	6/03/94	mb	SM5210
Chemical Oxygen Demand-Total	5,715.	mg/l	6/06/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	2,070.	mg/l	6/06/94	tpw	SM5220D
spended Solids	2,257.3	mg/l	6/03/94	ah	SM2540D
Volatile Suspended Solids	90.9	%	6/03/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 6/15/94

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TEST RESULTS

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk Marine Pumper

DATE/TIME COLLECTED: 6/15/94 6:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/17/94
LAB REPORT #: 940617-051

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	2,617.5	mg/l	6/17/94	mb	SM5210
Chemical Oxygen Demand	5,738.	mg/l	6/20/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	2,978.	mg/l	6/20/94	tpw	SM5220D
Suspended Solids	1,720.	mg/l	6/20/94	ah	SM2540D
Volatile Suspended Solids	85.	%	6/20/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 6/28/94

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TEST RESULTS

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk Marine Pumper
DATE/TIME COLLECTED: 6/15/94 6:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/17/94
LAB REPORT #: 940617-053

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	5,224.9	mg/l	6/17/94	mb	SM5210
Chemical Oxygen Demand	10,596.	mg/l	6/20/94	tpw	SM5220D
mical Oxygen Demand-Soluble	4,790.	mg/l	6/20/94	tpw	SM5220D
Suspended Solids	4,167.	mg/l	6/20/94	ah	SM2540D
Volatile Suspended Solids	88.8	%	6/20/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

...te Reported: 6/28/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk Marine Pumper

DATE/TIME COLLECTED: 6/15/94 6:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 6/17/94
LAB REPORT #: 940617-052

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	5,859.9	mg/l	6/17/94	mb	SM5210
Chemical Oxygen Demand	10,712.	mg/l	6/20/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	4,992.	mg/l	6/20/94	tpw	SM5220D
Suspended Solids	3,993.	mg/l	6/20/94	ah	SM2540D
Volatile Suspended Solids	86.9	%	6/20/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 6/28/94

WATERLAB CORP.

TEST RESULTS

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk #1-Boat

DATE/TIME COLLECTED: 7/01/94 7:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 7/05/94
LAB REPORT #: 940705-007

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	2,241.	mg/l	7/05/94	mb	SM5210
Chemical Oxygen Demand	4,758.	mg/l	7/05/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	4,050.	mg/l	7/05/94	tpw	SM5220D
spended Solids	536.4	mg/l	7/05/94	ah	SM2540D
olatile Suspended Solids	88.1	%	7/05/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 7/17/94

WATERLAB CORP.

TEST RESULTS

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk #2-Green

DATE/TIME COLLECTED: 7/01/94 7:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 7/05/94
LAB REPORT #: 940705-008

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	3,480.	mg/l	7/05/94	mb	SM5210
Chemical Oxygen Demand	6,104.	mg/l	7/05/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	4,566.	mg/l	7/05/94	tpw	SM5220D
spended Solids	687.5	mg/l	7/05/94	ah	SM2540D
olatile Suspended Solids	96.4	%	7/05/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 7/17/94

WATERLAB CORP.

TEST RESULTS

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk-Boat #3

DATE/TIME COLLECTED: 7/02/94 7:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 7/05/94
LAB REPORT #: 940705-009

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	1,849.	mg/l	7/05/94	mb	SM5210
Chemical Oxygen Demand	3,478.	mg/l	7/05/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	2,822.	mg/l	7/05/94	tpw	SM5220D
spended Solids	323.1	mg/l	7/05/94	ah	SM2540D
olatile Suspended Solids	92.9	%	7/05/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 7/17/94

WATERLAB CORP.

TEST RESULTS

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Tomahawk-Boat #4

DATE/TIME COLLECTED: 7/02/94 7:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 7/05/94
LAB REPORT #: 940705-010

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	3,336.	mg/l	7/05/94	mb	SM5210
Chemical Oxygen Demand	15,909.	mg/l	7/05/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	2,926.	mg/l	7/05/94	tpw	SM5220D
Suspended Solids	7,803.	mg/l	7/05/94	ah	SM2540D
Volatile Suspended Solids	79.7	%	7/05/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 7/17/94

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TEST RESULTS

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Kanes Marina-Detroit Lake

DATE/TIME COLLECTED: 7/08/94 1:30 PM
COLLECTED BY: Customer
DATE RECEIVED: 7/08/94
LAB REPORT #: 940708-037

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	4,788.	mg/l	7/08/94	mb	SM5210
Chemical Oxygen Demand	8,854.	mg/l	7/08/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	8,256.	mg/l	7/08/94	tpw	SM5220D
spended Solids	255.	mg/l	7/08/94	ah	SM2540D
Volatile Suspended Solids	<1.	%	7/08/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 7/19/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Kanes Marina-Detroit Lake

DATE/TIME COLLECTED: 7/08/94 1:30 PM
COLLECTED BY: Customer
DATE RECEIVED: 7/08/94
LAB REPORT #: 940708-036

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	5,040.	mg/l	7/08/94	mb	SM5210
Chemical Oxygen Demand	8,808.	mg/l	7/08/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	7,716	mg/l	7/08/94	tpw	SM5220D
pended Solids	250.	mg/l	7/08/94	ah	SM2540D
Volatile Suspended Solids	<1.	%	7/08/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

te Reported: 7/19/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Kanes Marine,Detroit-4

DATE/TIME COLLECTED: 7/30/94 2:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 8/01/94
LAB REPORT #: 940801-005

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	1,182.8	mg/l	8/01/94	mb	SM5210
Chemical Oxygen Demand	4,050.	mg/l	8/02/94	tpw	SM5220D
emical Oxygen Demand-Soluble	2,390.	mg/l	8/02/94	tpw	SM5220D
spended Solids	408.	mg/l	8/02/94	ah	SM2540D
Volatile Suspended Solids	84.3	%	8/02/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

te Reported: 8/12/94

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Kanes Marina-#2

DATE/TIME COLLECTED: 7/30/94 2:00 PM
COLLECTED BY: Customer
DATE RECEIVED: 8/01/94
LAB REPORT #: 940801-004

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	922.5	mg/l	8/01/94	mb	SM5210
Chemical Oxygen Demand	3,880.	mg/l	8/02/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	2,770.	mg/l	8/02/94	tpw	SM5220D
Suspended Solids	337.0	mg/l	8/02/94	ah	SM2540D
Volatile Suspended Solids	89.	%	8/02/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 8/12/94

WATERLAB CORP.

TEST RESULTS

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Charlston Marina #1

DATE/TIME COLLECTED: 8/20/94 NotSpec
COLLECTED BY: Customer
DATE RECEIVED: 8/22/94
LAB REPORT #: 940822-017

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	44.7	mg/l	8/22/94	mb	SM5210
Suspended Solids	106.6 x10	mg/l	8/22/94	ah	SM2540D
Chemical Oxygen Demand	228.6	mg/l	8/22/94	tpw	SM5220D
Chemical Oxygen Demand-Soluble	148.2 FCE	mg/l	8/22/94	tpw	SM5220D
Volatile Suspended Solids	>99.	%	8/22/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 9/15/94

WATERLAB CORP.

TEST RESULTS

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Charlston Marina #2

DATE/TIME COLLECTED: 8/20/94 NotSpec
COLLECTED BY: Customer
DATE RECEIVED: 8/22/94
LAB REPORT #: 940822-018

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	5,554.	mg/l	8/22/94	mb	SM5210
Suspended Solids	See note	mg/l			SM2540D
Chemical Oxygen Demand	31,090.	mg/l	8/22/94	ah	SM5220D
Chemical Oxygen Demand-Soluble	28,150.	mg/l	8/22/94	ah	SM5220D
Volatile Suspended Solids		%			SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

Date Reported: 9/15/94

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

September 15, 1994

CUSTOMER NAME: Eckley Engineering
LAB REPORT #: 940822-018

NOTE:
This sample is supersaturated, causing a precipitate to form easily. This created inconsistent results. The Total Suspended Solids (TSS) test was run multiple times. The lowest (TSS) value obtained was 15.2 mg/liter. The highest TSS value obtained was 5,880 mg/liter. The Total Dissolved Solids of this sample was 67,550 mg/liter.

Because of the impreciseness of the TSS values, a Volatile Suspended Solids was not conducted.

WATERLAB CORP.

Certified Lab #008

TEST RESULTS

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Kane's Marina-#1

DATE/TIME COLLECTED: 9/09/94 9:00 AM
COLLECTED BY: Paul Eckley
DATE RECEIVED: 9/09/94
LAB REPORT #: 940909-004

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	1,485.	mg/l	9/09/94	mb	SM5210
Suspended Solids	350.	mg/l	9/13/94	ah	SM2540D
emical Oxygen Demand	3,545.5	mg/l	9/12/94	ah	SM5220D
Chemical Oxygen Demand-Soluble	3,203.	mg/l	9/12/94	ah	SM5220D
Volatile Suspended Solids	>99.	%	9/13/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

ce Reported: 9/16/94

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

TEST RESULTS

TO: Eckley Engineering/Paul Eckley
579 Juntura Ct., S. E.
Salem, OR 97302

ECKENG

PO#:

SAMPLE POINT: Kane's Marina-#2

DATE/TIME COLLECTED: 9/09/94 9:00 AM
COLLECTED BY: Paul Eckley
DATE RECEIVED: 9/09/94
LAB REPORT #: 940909-005

Test	Results	Units	Date	Tech	Method
Biological Oxygen Demand	1,186.5	mg/l	9/09/94	mb	SM5210
Suspended Solids	346.7	mg/l	9/13/94	ah	SM2540D
emical Oxygen Demand	3,477.5	mg/l	9/12/94	ah	SM5220D
Chemical Oxygen Demand-Soluble	3,003.	mg/l	9/12/94	ah	SM5220D
Volatile Suspended Solids	>99.	%	9/13/94	ah	SM2540

ND means No Detection at specified limit.
NA means Not Applicable

SM = "Std. Methods for the Examination of Water and Wastewater"
EPA = "Methods for the Chemical Analysis for Water and Wastes"
< = Less Than // > = Greater Than

ate Reported: 9/16/94

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

October 12, 1994

TO: Paul Eckley
579 Juntura Ct. SE
Salem, OR 97302

FROM: Beth Myers, Lab Director
Beth E. Myers

RE: QC results

Here are the QC results for early September 1994 for the tests performed on 940909-004 and 940909-005.

If you have any questions, please contact me.

WATERLAB CORP.

Certified Lab #008

2603 - 12th Street S.E.
Salem, Oregon 97302
(503) 363-0473
FAX (503) 363-8900

October 10, 1994

QC Summary
For Lab #(s): 940909-004
940909-005

Biological Oxygen Demand (BOD)
QC Control Used: ERA 9957 1X — True Value: 38.6 mg/l
95% Range: 26.6-46.7 mg/l — Results: 36.7 mg/l
Technician: mb

Chemical Oxygen Demand (COD)
QC Control Used: ERA 9956 1X — True Value: 180. mg/l
95% Range: 153-207 mg/l — Results: 185.8 mg/l
Technician: tpw

Total Suspended Solids (TSS)
QC Control Used: EPA Res 489 — True Value: 278. mg/l
95% Range: 250-284 mg/l — Results: 279.3 mg/l
Technician: ah

Total Volatile Suspended Solids (TVSS)
QC Control Used: EPA Res 489 — True Value: 115 mg/l
95% Range: 97-125 mg/l — Results: 102 mg/l
Technician: ah

Prepared by Beth E. Myers, Lab Director.

4. EVALUATION OF RESULTS

When diluted to volume according to the instructions, the samples contain the analytes at the concentrations below expressed as mg/liter. The true values, mean recoveries, standard deviations and the 95% confidence intervals are listed below. The true value represents the actual weighing and all subsequent dilutions. The 95% confidence interval represents the mean recovery ($\overline{X}$) plus or minus two standard deviations (S) and was developed using regression equations from Performance Evaluation Studies.

Analyte	QC Sample	True Value	$\overline{X}$	S	95% Confidence Interval
Filterable Residue	1	408	411	27.0	361 - 470
	2	287	290	21.7	247 - 333
Non-Filterable Residue	1	31.5	31.5	1.82	27.7 - 35.1
	2	278	267	8.70	250 - 284
Total Residue	1	439	442	29.1	384 - 500
	2	565	557	37.4	490 - 632
Volatile Non-Filterable Residue	2	115	111	7.1	97 - 125
Total Volatile Residue	2	115	111	7.1	97 - 125

ENVIRONMENTAL
RESOURCE ASSOCIATES
Arvada, Colorado 80002 1-800-ERA-0122

Certification

WasteWatR™ Quality Control Standards

Parameter	Lot No. 9956 Certified Value		Performance Acceptance Limits™	
MINERALS WasteWatR™	**mg/l**		**mg/l**	
total solids at 105 C	1050		914 - 1190	
dissolved solids at 180 C	1050		914 - 1190	
conductivity at 25 C	1640	umhos	1390 - 1890	umhos
alkalinity	99.7		88.7 - 111	
chloride	386		359 - 413	
fluoride	20.8		17.7 - 23.9	
sulfate	61.3		52.7 - 69.9	
potassium	92.8		78.9 - 107	
sodium	296		252 - 340	
pH	8.90	S.U.	8.70 - 9.10	S.U.
HARDNESS WasteWatR™	**mg/l**		**mg/l**	
TSS	80.6		68.5 - 92.7	
calcium	100		86.0 - 114	
magnesium	50.0		43.0 - 57.0	
calcium hardness as CaCO3	250		215 - 285	
hardness as CaCO3	456		392 - 520	
GREASE & OIL WasteWatR™				
Gravimetric	71.1	mg/bttl	42.7 - 88.9	mg/bttl
Infrared	85.3	mg/bttl	51.2 - 107	mg/bttl
DEMAND WasteWatR™	**mg/l**		**mg/l**	
BOD	108		74.5 - 131	
CBOD	108		74.5 - 131	
COD	180		153 - 207	
TOC	71.6		60.9 - 82.3	
total phos as P	6.51		5.60 - 7.42	
TKN	10.4		8.53 - 12.3	
NUTRIENTS WasteWatR™	**mg/l**		**mg/l**	
ammonia as N	14.4		12.1 - 16.7	
NO3 + NO2 as N	3.47		3.09 - 3.85	
PO4 as P	6.25		5.31 - 7.19	
CYANIDE & PHENOL WasteWatR™	**mg/l**		**mg/l**	
total cyanide	0.376		0.274 - 0.478	
complex cyanide	0.205		0.150 - 0.260	
weak and diss. cyanide	0.171		0.125 - 0.217	
phenol	0.139		0.106 - 0.172	
RESIDUAL CHLORINE WasteWatR™	**mg/l**		**mg/l**	
total resd. Cl2	0.664		0.498 - 0.830	
TRACE METALS WasteWatR™	**ug/l**		**ug/l**	
aluminum	706		579 - 833	
antimony	91.2		68.4 - 108	
arsenic	67.9		50.9 - 80.1	
barium	106		86.9 - 125	
beryllium	94.4		77.4 - 111	
boron	422		346 - 498	
cadmium	111		91.0 - 131	
chromium	309		253 - 365	
cobalt	117		95.9 - 138	
copper	533		437 - 629	
iron	317		260 - 374	
lead	478		392 - 564	
manganese	91.7		75.2 - 108	
mercury	7.22		5.42 - 9.03	
molybdenum	77.8		63.8 - 91.8	
nickel	456		374 - 538	
selenium	92.3		69.2 - 109	
silver	78.6		64.5 - 92.7	
strontium	156		128 - 184	
thallium	104		78.0 - 123	
vanadium	228		187 - 269	
zinc	444		364 - 524	

The ***Certified Values*** are equal to 100% of the parameters in the indicated standard.

The ***Performance Acceptance Limits*** (PALs™) are listed as guidelines for acceptable analytical results given the limitations of the USEPA methodologies commonly used to determine these parameters and closely approximate the 95% confidence interval. The PALs™ are based on data generated by your peer laboratories in ERA's InterLaB™ program using the same samples you are analyzing and data from USEPA methods, WP, WS and CLP interlaboratory studies. If your result falls outside of the PALs™, ERA recommends that you investigate potential sources of error in your preparation and/or analytical procedures. For further technical assistance, call ERA at 1-800-372-0122.

ENVIRONMENTAL
RESOURCE ASSOCIATES
Arvada, Colorado 80002 303-431-8454

Certification WasteWatR™ Quality Control Standards

Parameter	Lot No. 9957 Certified Value		Performance Acceptance Limits™	
MINERALS WasteWatR™	mg/l		mg/l	
total solids at 105 C	1230		1070 - 1390	
dissolved solids at 180 C	1230		1070 - 1390	
conductivity at 25 C	1640	umhos	1390 - 1890	umhos
alkalinity	206		183 - 229	
chloride	224		208 - 240	
fluoride	10.3		8.76 - 11.8	
sulfate	185		159 - 211	
potassium	172		146 - 198	
sodium	240		204 - 276	
pH	9.02	S.U.	8.82 - 9.22	S.U.
HARDNESS WasteWatR™	mg/l		mg/l	
TSS	59.4		50.5 - 68.3	
calcium	71.8		61.7 - 81.9	
magnesium	33.6		28.9 - 38.3	
calcium hardness as CaCO3	179		154 - 204	
total hardness as CaCO3	318		273 - 363	
GREASE & OIL WasteWatR™				
Gravimetric	39.7	mg/bttl	23.8 - 49.6	mg/bttl
Infrared	47.6	mg/bttl	28.6 - 59.5	mg/bttl
DEMAND WasteWatR™	mg/l		mg/l	
BOD	38.6		26.6 - 46.7	
CBOD	38.6		26.6 - 46.7	
COD	64.3		54.7 - 73.9	
TOC	25.8		21.9 - 29.7	
total phos as P	7.04		6.05 - 8.03	
TKN	4.19		3.44 - 4.94	
NUTRIENTS WasteWatR™	mg/l		mg/l	
ammonia as N	8.21		6.90 - 9.52	
NO3 + NO2 as N	13.3		11.8 - 14.8	
PO4 as P	9.96		8.47 - 11.5	
CYANIDE & PHENOL WasteWatR™	mg/l		mg/l	
total cyanide	0.159		0.116 - 0.202	
complex cyanide	0.0761		0.0556 - 0.0966	
weak and diss. cyanide	0.0828		0.0604 - 0.105	
phenol	0.117		0.0889 - 0.145	
RESIDUAL CHLORINE WasteWatR™	mg/l		mg/l	
total resd. Cl2	1.06		0.795 - 1.33	
TRACE METALS WasteWatR™	µg/l		µg/l	
aluminum	509		417 - 601	
antimony	216		162 - 255	
arsenic	182		137 - 215	
barium	318		261 - 375	
beryllium	87.5		71.8 - 103	
boron	323		265 - 381	
cadmium	84.5		69.3 - 99.7	
chromium	278		228 - 328	
cobalt	195		160 - 230	
copper	211		173 - 249	
iron	522		428 - 616	
lead	330		271 - 389	
manganese	240		197 - 283	
mercury	6.59		4.94 - 8.24	
molybdenum	105		86.1 - 124	
nickel	748		613 - 883	
selenium	83.3		62.5 - 98.3	
silver	77.1		63.2 - 91.0	
strontium	306		251 - 361	
thallium	47.3		35.5 - 55.8	
vanadium	163		134 - 192	
zinc	272		223 - 321	

The ***Certified Values*** are equal to 100% of the parameters in the indicated standard.

The ***Performance Acceptance Limits*** (PALs™) are listed as guidelines for acceptable analytical results given the limitations of the USEPA methodologies commonly used to determine these parameters and closely approximate the 95% confidence interval. The PALs™ are based on data generated by your peer laboratories in ERA's InterLaB™ program using the same samples you are analyzing and data from USEPA methods, WP, WS and CLP interlaboratory studies. If your result falls outside of the PALs™, ERA recommends that you investigate potential sources of error in your preparation and/or analytical procedures. For further technical assistance, call ERA at 1-800-372-0122.

APPENDIX C

WASTEWATER TREATMENT PLANT SURVEY RESULTS

2a. Type Of Treatment Provided

Date: 10/10/94

Lagoon	Trickle	Activated Sludge	Final Filtration	Anaerobic Digestion	Aerobic Digestion
No	No	Yes	No	No	No
Yes	No	No	No	No	No
No	No	No	No	No	No
No	No	No	No	No	No
No	Yes	No	No	No	No
No	Yes	No	No	No	No
No	No	No	No	No	No
No	No	No	No	Yes	No
No	No	No	No	No	Yes
No	No	No	No	No	No
No	No	No	No	No	No
No	No	No	No	No	No
No	No	No	Yes	No	No
No	No	No	No	No	No
Yes	No	No	No	No	No
No	Yes	No	No	No	Yes
No	No	No	No	No	Yes
No	No	No	No	No	No
No	Yes	Yes	No	Yes	No
No	Yes	No	No	Yes	No
No	No	Yes	No	No	No
No	Yes	No	No	No	No
No	No	No	Yes	No	Yes
Yes	No	No	No	No	No
No	No	Yes	No	No	No
No	Yes	No	No	No	No
Yes	No	No	No	No	No
No	No	Yes	No	No	No
No	No	Yes	Yes	No	Yes
No	No	Yes	No	No	Yes
Yes	No	No	No	No	No
No	Yes	No	No	No	Yes
Yes	No	No	No	No	No
No	No	Yes	No	No	Yes
No	No	Yes	No	Yes	No
No	No	Yes	No	Yes	No
Yes	No	No	No	No	No
No	Yes	No	No	No	No
No	No	Yes	No	No	No

2a. Type Of Treatment Provided

Lagoon	Trickle	Activated Sludge	Final Filtration	Anaerobic Digestion	Aerobic Digestion
Yes	No	No	No	No	No
Yes	No	No	No	No	No
Yes	No	Yes	No	Yes	No
No	No	No	No	No	No
Yes	No	No	No	No	No
No	Yes	Yes	No	No	No
No	No	Yes	Yes	Yes	No
No	Yes	No	No	No	No
No	No	Yes	No	Yes	No
No	No	Yes	No	Yes	No
Yes	No	No	No	No	No
No	No	Yes	No	No	Yes
No	No	Yes	No	No	Yes
No	No	Yes	No	No	No
No	No	Yes	No	No	Yes
Yes	No	No	No	No	No
No	No	Yes	No	No	No
No	No	Yes	No	No	No
Yes	No	No	No	No	No
No	No	Yes	No	No	No
No	No	Yes	No	Yes	No
No	No	Yes	Yes	No	Yes
Yes	No	No	No	No	No
No	No	Yes	No	Yes	No
No	No	Yes	No	Yes	Yes
No	No	Yes	No	No	No
No	No	Yes	No	No	No
Yes	No	No	No	No	No
No	No	Yes	No	No	Yes
No	No	No	No	No	No
Yes	No	Yes	No	No	Yes
No	No	Yes	No	Yes	No
Yes	No	No	No	No	No
No	Yes	Yes	No	Yes	No
No	No	Yes	No	Yes	No
No	No	Yes	No	No	Yes
No	No	Yes	No	No	Yes
No	No	Yes	No	Yes	No
No	No	Yes	No	No	No

2a. Type Of Treatment Provided

Lagoon	Trickle	Activated Sludge	Final Filtration	Anaerobic Digestion	Aerobic Digestion
No	No	Yes	No	No	No
Yes	No	No	No	No	No
No	No	No	No	Yes	No
No	No	No	No	No	No
No	Yes	Yes	No	Yes	No
No	No	Yes	No	Yes	No
No	No	Yes	No	No	Yes
No	No	Yes	No	No	No
No	No	Yes	No	Yes	No
No	No	Yes	Yes	No	Yes
No	No	Yes	No	Yes	No
No	No	Yes	No	Yes	No
No	No	No	No	Yes	Yes
Yes	No	No	Yes	No	No
Yes	No	No	No	No	No
Yes	No	No	No	No	No
No	No	Yes	Yes	No	Yes
No	No	Yes	No	No	Yes
Yes	No	No	No	No	No
23.00	**13.00**	**49.00**	**8.00**	**24.00**	**22.00**

2b. Level Of Treatment Provided

Date: 10/10/94

Primary Treatment	Secondary Treatment	Tertiary Treatment	Other Treatment
Yes	Yes	No	Yes
No	No	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	Yes
Yes	No	No	No
No	Yes	No	Yes
Yes	Yes	No	No
Yes	Yes	No	No
No	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	Yes
No	No	No	No
Yes	Yes	Yes	No
Yes	Yes	Yes	Yes
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
No	Yes	No	Yes
Yes	Yes	No	No
No	No	Yes	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	Yes
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	Yes	No
Yes	Yes	No	No
No	No	No	No
Yes	Yes	No	No
Yes	Yes	No	Yes
Yes	No	No	Yes
Yes	Yes	No	No
Yes	Yes	No	No
Yes	No	No	No
Yes	Yes	No	No
Yes	Yes	No	No

2b. Level Of Treatment Provided

Primary Treatment	Secondary Treatment	Tertiary Treatment	Other Treatment
No	No	No	No
No	No	No	No
Yes	Yes	No	No
Yes	No	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	Yes	No
Yes	Yes	No	Yes
Yes	Yes	No	No
Yes	Yes	No	No
No	Yes	No	No
No	No	No	No
No	Yes	No	No
Yes	Yes	No	No
No	No	Yes	No
No	No	No	No
No	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	Yes
No	Yes	No	No
Yes	Yes	No	No
No	Yes	Yes	No
Yes	Yes	Yes	No
No	Yes	No	No
Yes	Yes	No	No
No	Yes	No	No
No	Yes	No	No
Yes	No	No	No
Yes	No	No	No
No	No	No	No
Yes	Yes	No	No
No	Yes	Yes	Yes
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	No	No	No

2b. Level Of Treatment Provided

Primary Treatment	Secondary Treatment	Tertiary Treatment	Other Treatment
No	Yes	No	No
Yes	No	No	No
No	No	No	No
Yes	No	No	Yes
Yes	Yes	No	No
Yes	Yes	No	No
Yes	Yes	No	No
No	Yes	No	No
No	Yes	No	No
Yes	Yes	Yes	No
Yes	Yes	No	No
Yes	Yes	No	Yes
Yes	Yes	No	No
No	No	Yes	No
Yes	No	No	No
Yes	Yes	No	No
Yes	Yes	Yes	Yes
No	Yes	No	No
No	Yes	No	No
65.00	76.00	12.00	15.00

3. Sewage Collection System Information

Date: 10/10/94

Gravity Sewer System	Gravity Sewer With Pump Station(s)	STEP	Other
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
Yes	No	No	No
No	No	Yes	No
No	Yes	No	No
No	No	No	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
No	No	No	Yes
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	No	Yes	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
No	No	Yes	No
No	No	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No

3. Sewage Collection System Information

Gravity Sewer System	Gravity Sewer With Pump Station(s)	STEP	Other
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	No	Yes	No
No	Yes	No	No
No	No	No	No
Yes	No	No	No
No	No	No	Yes
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	No	No	Yes
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	No	No	Yes
No	Yes	No	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No

3. Sewage Collection System Information

Gravity Sewer System	Gravity Sewer With Pump Station(s)	STEP	Other
No	No	No	No
No	No	No	No
No	Yes	No	No
Yes	No	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	No	No	Yes
No	No	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
No	Yes	No	No
11.00	71.00	4.00	5.00

5. High Strength Waste

Date: 10/10/94

RV	At Plant	In Collect	Septage	At Plant	In Collect	Boat	At Plant	In Collect	Other	At Plant	In Collect
No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	Yes	Yes	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	No	Yes
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	Yes	No	Yes	No	No	No	No	No	No
Yes	No	Yes	Yes	No	No	Yes	No	No	No	No	No
Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
No	No	No	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	Yes	No	Yes	No	No	No
No	No	No	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	No	Yes	No	No	No	Yes	No	Yes
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No

5. High Strength Waste

Date: 10/10/94

RV	At Plant	In Collect	Septage	At Plant	In Collect	Boat	At Plant	In Collect	Other	At Plant	In Collect
No	No	No	Yes	Yes	No	No	No	No	No	No	No
No	No	No	Yes	No	Yes	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	Yes	No
No	No	No	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	Yes	No	Yes
Yes	No	Yes	No	No	No	No	No	No	Yes	No	Yes
Yes	Yes	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	Yes	No	Yes	No	No	Yes	Yes	No	Yes
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	Yes	No	Yes
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	Yes	No	Yes	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No

5. High Strength Waste

Date: 10/10/94

RV	At Plant	In Collect	Septage	At Plant	In Collect	Boat	At Plant	In Collect	Other	At Plant	In Collect
Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
No	No	No	Yes	No	Yes	No	No	No	No	No	Yes
Yes	No	Yes	No	No	No	Yes	No	Yes	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
No	No	No	Yes	Yes	No	No	No	No	Yes	No	Yes
Yes	No	Yes	Yes	Yes	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No	No	No	No	No	No
59.00			37.00			8.00			12.00		
	13.00	47.00		28.00	10.00		3.00	7.00		5.00	9.00

6a. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Odors	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
Yes	Yes	Yes	No	Yes	Yes	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	Yes	No
Yes	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes
No	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6a. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Odors	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	Yes	No
No	No	No	No	No	No	No
No	No	Yes	No	No	Yes	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	No	No	No	Yes	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6a. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Odors	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	Yes	No	Yes	Yes	No
No	Yes	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No
Yes	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
27.00	11.00	5.00	2.00	11.00	16.00	2.00

6b. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Corrosion	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	Yes	Yes	No
No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6b. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Corrosion	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6b. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Corrosion	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	Yes	No	Yes	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
7.00	4.00	4.00	1.00	5.00	4.00	1.00

6c. Problems With High Strength Waste

Date: 10/10/94 Page: 1

Problem	Collection System			Treatment Plant		
Plugging	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	Yes	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	Yes	No
Yes	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6c. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Plugging	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	Yes	No	No	No	No
Yes	Yes	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6c. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Plugging	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	Yes	No	No	Yes	No
No	No	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No
No	No	No	No	No	No	No
14.00	6.00	6.00	1.00	3.00	7.00	1.00

6d. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Overload	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	Yes	Yes	Yes	Yes	Yes
No	No	No	No	Yes	Yes	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
Yes	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	Yes
Yes	Yes	Yes	Yes	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6d. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Overload	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	Yes
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6d. Problems With High Strength Waste

Problem	Collection System			Treatment Plant		
Overload	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	Yes	No	Yes	Yes	No
No	No	Yes	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	No	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
27.00	11.00	5.00	2.00	11.00	16.00	2.00

6e. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Permit Violation	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	Yes	Yes	No	Yes	Yes
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	Yes	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	Yes	Yes	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6e. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Permit Violation	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6e. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Permit Violation	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	Yes	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
6.00	4.00	4.00	3.00	2.00	5.00	1.00

6f. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Sludge Handling	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	Yes	No	Yes
Yes	Yes	Yes	Yes	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6f. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Sludge Handling	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	Yes	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6f. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Sludge Handling	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	Yes	No	No	Yes	No
No	No	Yes	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
9.00	3.00	5.00	1.00	3.00	7.00	1.00

6g. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Effluent Toxicity	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	Yes	Yes	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6g. Problems With High Strength Waste

Problem	Collection System			Treatment Plant		
Effluent Toxicity	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	No	Yes	No
Yes	Yes	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6g. Problems With High Strength Waste

Problem	Collection System			Treatment Plant		
Effluent Toxicity	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	Yes	No	Yes	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	Yes	No	No	No	Yes	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
4.00	5.00	2.00	1.00	2.00	3.00	0.00

6h. Problems With High Strength Waste

Problem	Collection System			Treatment Plant		
Other	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	Yes	No	Yes	Yes	No	Yes
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6h. Problems With High Strength Waste

Date: 10/10/94

Problem	Collection System			Treatment Plant		
Other	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
Yes	No	No	No	Yes	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No

6h. Problems With High Strength Waste

Problem	Collection System			Treatment Plant		
Other	RV	ST	BW	RV	ST	BW
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
No	No	No	No	No	No	No
2.00	1.00	0.00	1.00	2.00	0.00	1.00

9. Location To Accept Boat Waste

Date: 10/10/94

Within Collection System	@WWTP
No	Yes
Yes	No
Yes	No
Yes	No
No	No
No	No
No	No
No	Yes
Yes	No
Yes	No
Yes	No
No	No
No	No
No	Yes
Yes	No
Yes	No
No	Yes
Yes	No
No	Yes
Yes	No
Yes	No
No	No
No	Yes
No	Yes
No	No
Yes	No
No	Yes
No	Yes
No	Yes
Yes	No
No	No
Yes	No
No	No
No	No
Yes	No
Yes	No
No	No
No	Yes
No	Yes

9. Location To Accept Boat Waste

Within Collection System	@WWTP
No	No
Yes	No
No	No
Yes	No
No	Yes
No	Yes
No	Yes
No	No
Yes	No
No	Yes
No	No
No	No
No	Yes
Yes	No
No	Yes
No	No
Yes	No
No	No
No	No
No	Yes
Yes	No
No	No
No	Yes
Yes	No
No	Yes
Yes	No
No	No
No	No
No	No
No	No
No	No
Yes	No
No	Yes
No	No
Yes	No
Yes	No
Yes	No
No	Yes
Yes	No
No	No

9. Location To Accept Boat Waste

Within Collection System	@WWTP
Yes	No
No	No
Yes	No
No	No
Yes	No
Yes	No
Yes	No
Yes	No
No	Yes
Yes	No
No	No
Yes	No
No	No
No	Yes
No	No
No	Yes
No	Yes
Yes	No
Yes	No
39.00	27.00

11a. Modifications Needed To Accept Boat Waste

Date: 10/10/94

Receiving Station At Marina	Receiving Station At WWTP	Holding Tank At Marina	Pumping To Ensure Uniform Flowrate	Sampling	Flow Metering
False	True	False	True	True	True
True	False	True	False	True	False
True	False	True	True	False	False
True	False	True	True	True	True
False	False	False	False	False	False
False	False	True	True	True	True
False	False	False	False	False	False
False	False	False	False	False	False
True	False	True	True	True	True
True	False	True	True	True	True
True	False	True	True	True	True
False	False	False	False	False	False
False	False	False	False	False	False
False	False	False	False	False	False
True	False	False	False	False	False
True	False	True	True	False	False
False	False	False	False	False	False
False	False	False	False	False	False
False	False	False	False	False	False
True	False	True	True	True	False
True	False	True	True	True	True
True	False	False	False	True	True
True	True	False	True	False	True
False	True	False	True	False	False
False	False	False	False	False	False
True	False	True	False	True	False
False	False	False	False	False	False
False	False	True	False	True	False
False	False	False	False	False	False
True	False	True	True	False	False
False	False	False	False	False	False
False	False	False	False	True	True
True	False	True	True	False	True
False	False	False	False	False	False
True	False	True	True	True	True
True	False	False	False	True	True
True	True	True	True	False	True

11a. Modifications Needed To Accept Boat Waste

Date: 10/10/94

Receiving Station At Marina	Receiving Station At WWTP	Holding Tank At Marina	Pumping To Ensure Uniform Flowrate	Sampling	Flow Metering
False	False	True	False	False	False
False	False	True	False	True	False
True	True	False	True	True	True
False	False	False	False	False	False
False	False	False	False	True	False
True	False	True	True	False	True
True	False	True	True	False	False
False	False	True	False	True	False
False	False	True	False	True	False
True	False	True	True	True	True
True	False	True	True	True	True
False	True	False	True	True	True
False	False	False	False	False	False
False	False	False	False	False	False
False	False	True	False	False	False
True	False	True	True	False	True
False	True	False	True	True	True
False	False	False	False	False	False
False	False	False	True	True	True
False	False	False	False	False	False
True	False	False	True	True	True
True	True	True	False	True	False
True	False	True	True	True	True
False	False	False	True	True	True
False	True	False	False	True	False
True	False	True	True	True	True
True	False	True	True	False	False
True	True	True	False	False	False
False	False	False	False	False	False
False	False	False	False	False	False
True	False	False	True	False	False
False	False	False	False	False	False
True	False	True	True	True	False
False	True	False	True	True	True
False	False	False	False	False	False
False	False	True	True	True	False
False	False	False	False	False	False

11a. Modifications Needed To Accept Boat Waste

Date: 10/10/94

Receiving Station At Marina	Receiving Station At WWTP	Holding Tank At Marina	Pumping To Ensure Uniform Flowrate	Sampling	Flow Metering
True	False	True	True	True	True
False	False	False	False	False	False
True	False	False	True	True	False
True	True	True	True	False	False
False	False	False	True	False	False
False	False	False	False	False	False
True	False	False	False	False	False
False	False	False	False	False	False
False	False	False	False	False	False
True	False	False	True	True	True
True	True	False	True	False	False
False	False	False	False	False	False
False	False	False	False	False	False
True	False	True	True	True	True
False	False	False	False	True	True
True	False	False	False	True	False
False	True	False	False	True	True
False	True	False	True	True	True
True	False	False	False	False	False
True	False	False	False	False	False
False	True	False	False	True	True
True	False	False	True	False	False
True	False	False	False	False	False
45.00	16.00	36.00	43.00	43.00	34.00

11b. Modifications Needed To Accept Boat Waste

Date: 10/10/94

Additional Staff	Chemical Addition	Laboratory Testing Services	Additional Sewer Cleaning	Other
No	Yes	Yes	No	No
Yes	No	Yes	No	Yes
No	No	No	No	No
No	No	No	No	Yes
No	No	No	No	No
No	No	Yes	Yes	No
No	No	No	No	Yes
No	No	No	No	Yes
Yes	Yes	Yes	Yes	No
Yes	Yes	Yes	Yes	No
Yes	Yes	Yes	Yes	No
No	No	No	No	No
No	No	No	No	Yes
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	Yes	Yes	No
No	No	Yes	No	No
No	Yes	No	No	No
No	No	Yes	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	Yes
No	No	No	No	Yes
No	No	Yes	No	Yes
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
Yes	No	Yes	Yes	No
No	No	No	Yes	No
No	No	No	No	No
No	Yes	Yes	Yes	No
No	No	No	No	No
Yes	No	Yes	Yes	No

11b. Modifications Needed To Accept Boat Waste

Date: 10/10/94

Additional Staff	Chemical Addition	Laboratory Testing Services	Additional Sewer Cleaning	Other
No	No	No	No	No
No	No	No	No	No
No	No	No	No	Yes
No	No	No	No	Yes
Yes	No	Yes	No	No
No	No	No	Yes	No
No	No	No	No	No
No	No	Yes	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	Yes	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	Yes
No	No	No	No	No
No	No	No	No	No
No	No	Yes	Yes	No
No	Yes	Yes	No	No
No	No	No	No	No
No	Yes	No	Yes	No
No	No	No	No	No
No	No	Yes	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	Yes	No	No	No
No	No	No	No	No
No	No	No	No	No
Yes	Yes	No	No	No
No	No	No	No	No
No	No	Yes	No	No
No	No	No	Yes	No

11b. Modifications Needed To Accept Boat Waste

Date: 10/10/94 Page: 3

Additional Staff	Chemical Addition	Laboratory Testing Services	Additional Sewer Cleaning	Other
Yes	Yes	Yes	Yes	No
No	No	No	No	No
No	Yes	No	No	No
Yes	Yes	Yes	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	No
No	No	No	No	Yes
No	No	Yes	No	Yes
No	No	No	No	Yes
No	No	No	No	No
No	No	No	No	Yes
No	No	No	No	No
No	No	No	No	No
No	No	Yes	No	No
No	No	No	No	No
No	No	No	Yes	No
No	No	No	No	No
No	No	No	No	No
Yes	Yes	Yes	No	No
No	No	No	No	No
No	No	No	No	No
11.00	14.00	25.00	15.00	15.00

APPENDIX D

U.S. FISH AND WILDLIFE SERVICE

CLEAN VESSEL ACT: PUMPOUT STATION AND DUMP STATION TECHNICAL GUIDELINES

Fish and Wildlife Service

RIN 1018–AC06

Clean Vessel Act: Pumpout Station and Dump Station Technical Guidelines

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of final guidelines.

SUMMARY: These final technical Guidelines are being published in response to section 5605, Guidance and Notification, of the Clean Vessel Act of 1992, which requires the issuance of draft technical guidelines for public comment within 3 months after the date of the enactment of this Act, and the issuance of final technical guidelines within 6 months after the date of enactment. The technical guidelines should be used by States to conduct surveys and develop plans for pumpout stations and dump stations, to develop education/information programs, and to construct pumpout stations and dump stations.

DATES: These final technical guidelines are effective April 11, 1994.

ADDRESSES: Copies of the final guidelines may be obtained by mailing a request to the Division of Federal Aid, Fish and Wildlife Service, U.S. Department of the Interior, 1849 C Street, NW. (Mailstop 140 ARLSQ), Washington, DC 20240, or by picking it up at the Division of Federal Aid, Fish

and Wildlife Service, room 140, 4401 North Fairfax Drive, Arlington, Virginia 22203.

FOR FURTHER INFORMATION CONTACT: Columbus Brown, Chief, Division of Federal Aid, (703) 358–2156.

SUPPLEMENTARY INFORMATION:

Background

Findings

The Congress found that there is currently an inadequate number of pumpout stations for Type III marine sanitation devices (MSD) (holding tanks) where recreational vessels normally operate; and, sewage discharged by recreational vessels, because of an inadequate number of pumpout stations, is a substantial contributor to localized degradation of water quality in the United States.

Purpose of the Act

The purpose of the Clean Vessel Act (Act) Pub. L. 102–587, subtitle F)" is to provide funds to States for the construction, renovation, operation, and maintenance of pumpout stations and dump stations."

Purpose of the Technical Guidelines

The purpose of these guidelines is to provide States with technical information on adequacy of and appropriate types and location of pumpout stations and dump stations, disposal of sewage from these facilities, and waters most likely to be affected by the discharge of sewage from vessels. They also provide information to the States in completing the surveys, developing plans, and developing an education/information program. The guidelines will let States know what options are available and provide them with basic information upon which to base their choices. Environmental Protection Agency (EPA) regional offices, regulatory agencies, equipment suppliers and marina operators are another valuable source of information. The guidelines, however, are not to be used as a design manual or a substitute for the preparation of a design for a specific facility.

Consultation

As required in section 5605 of the Act, the Secretary of the Interior (Interior) has consulted with the Administrator of the EPA, the Under Secretary of Commerce for Oceans and Atmosphere (NOAA), and the Commandant of the Coast Guard (USCG), in the development of these guidelines. In addition, Interior has consulted with coastal States, local municipalities, boat users, manufacturers of pumpout equipment, marina operators, conservation groups, and others in obtaining information necessary to develop these guidelines. Three scoping meetings were held in January 1993, with various constituents. A scoping document was sent to nearly 100 people, and 45 comment letters were received. Draft guidelines were published in the Federal Register June 17, 1993, Vol. 58, No. 115, pages 33447–33457, and comment letters were received. EPA, NOAA, and USCG assisted in the review of these comments and finalization of these guidelines.

Relationship to the Grant Process

The technical guidelines are interim guidelines that will be later codified. They should be used by coastal States in conducting surveys, developing plans and education/information programs, and constructing pumpout/dump stations. However, grant guidelines will be needed for States to properly apply for funds under this grant program. The grant guidelines will provide criteria for the Fish and Wildlife Service (Service) to use in prioritizing grant proposals for funding. Such information as priorities, national pumpout symbols, other signs, fee restrictions, and monitoring success of projects, will be placed in the grant guidelines. Grant guidelines are being developed separately, and were published in the Federal Register July 8, 1993, Vol. 58, No. 129, pages 36619–36623. Funds are made available through a competitive process to coastal States to complete the surveys and develop plans, and, for all States, to apply for construction grants and education funds.

Statement of Effects

These guidelines have been reviewed under EO 12866. The guidelines do not involve "taking" as described in Executive Order 12630. The guidelines allow eligible States to make decisions regarding the development and submission of proposed grants for surveys, plans, construction/renovation and education. Therefore, they are consistent with Executive Order 12612 on Federalism. The Department certifies that this document will not have a significant economic effect on a substantial number of small entities under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) The effects of these guidelines occur to agencies in the States, Puerto Rico, Guam, the Virgin Islands, American Samoa, the District of Columbia and the Northern Mariana Islands. Some small entities, mainly marina operators, may be the recipient of grants.

Summary of Comments and Recommendations

In the June 17, 1993, Notice of Public Review of Technical Guidelines, all interested parties were requested to submit comments that might contribute to the development of a final rule for a 45 day period ending August 2, 1993. Appropriate State and Federal agencies, local governments, boaters and boating organizations, marina owners/operators, marine equipment manufacturers and retailers, conservation organizations, and other interested parties were contacted and requested to comment.

A total of 8 written comment letters on the proposed guidelines were received by the Service, 4 from State agencies, 1 from a boating organization, 1 from a marina organization, 1 from a conservation organization, and 1 from a marine equipment manufacturer. All comment letters made suggestions to clarify and recommendations to modify some of the language and guidance. One verbal comment suggesting clarification was recorded from a State official. In addition to the comments received, four changes were made. The first change is in the Backgrounds. Definitions were relocated to the Technical Guidelines portion, just ahead of section 1. The second change is in the Technical Guidelines portion, section 2., first paragraph, and the Technical Guidelines portion, section 4., first paragraph, third sentence. Surveys and Plans should be submitted to the appropriate Regional Office. Addresses are provided. The third change, Technical Guidelines, section 2., is an addition to the second paragraph, first sentence, to indicate that all marinas should be surveyed. The fourth change is an addition of two paragraphs in the Information Packet, section 6., Off-Site Treatment, between the first and second paragraphs. These two paragraphs were inadvertently left out of the draft guidelines.

A total of 44 issues were identified by the commenters. The Service considered all suggestions and recommendations. This final guideline revises the proposed guidelines based on the issues raised by the commenters and makes other changes to clarify the requirements in the proposed guidelines. Those comments adopted are included in the final guidelines in the appropriate Sections. The following is a discussion of the issues raised by the commenters, the Service's responses to those issues, and a summary of changes made to the proposed guidelines.

Issue 1. Raritan Engineering Co., Inc.: Background, Findings, Raritan

Engineering said the word "may be" does not correspond to the wording in the Act, which states that "sewage discharged * * * is a substantial contributor * * *."

Response: The words "may be" have been deleted, and the word "is" has been substituted.

Issue 2. International Marina Institute (IMI): Other issues, Technical Guidelines, first paragraph, first sentence: The IMI states that the program should be handled by State administrators who know, and are known by, the marina industry. Inappropriate State program managers may not work as aggressively or successfully to facilitate pumpout installations. According to the IMI, some of the official State contacts have little or nothing to do with marinas or boat sewage controls. These contracts must move beyond traditional turf and foster inter- and intra-agency cooperation, planning and management.

Response: The Service agrees that the State should select the most appropriate State administrators to ensure the highest interest in the program, and encourages them to do so. The Service has been working closely with each State administrator identified. However, the actual selection process, according to statute, is up to the Governor of each State.

Issue 3. International Marina Institute (IMI): Technical Guidelines, first paragraph, second sentence: The IMI states that, unless the prohibition by a number of State laws to grant funds to private marinas is overcome, the intent of Congress will not be achieved. Guidelines need to be strengthened requiring grants be available to private facilities as well. The IMI said that States must identify restrictions on giving grants to private marinas in their application and what will be done to overcome this problem. States must explain in their plan how they will seek private applications and what proportion of the slip/mooring capacity is in public vs. private marinas. The IMI states that the Service should caution that inability of any State to give grants to private marinas will significantly lower that State's priority for funds. Funds should go to public and private marinas in approximate ratio to the public/private ratio in each State. Should the private marinas choose to not apply for grants during the first four years, then the IMI states that the funds should be released for use by the public sector in the fifth year of the program. Similarly, in the Information Packet, section 8. Other Information That is Considered: The IMI states that this Section should include language that such States with legal roadblocks to this public/private partnership must be required, as a condition of receiving any program funds, to change their law, and/or seek legal ways to bypass the serious impediment. IMI is very worried about this issue, and asks the Service to take affirmative action to keep private business a full partner in this program.

Response: The Service agrees that it is very important for States to overcome any prohibition of States to fund private marinas, and has added language in the Technical Guidelines portion, first paragraph, fourth sentence, and in the Technical Guidelines portion, section 4. Plans, (4)(e). States are already required to identify any restrictions to funding private marinas in the technical guidelines portion, section 4. Plans, (4)(e). The priority system identified in the final grant guidelines gives higher priority to those projects with public/private partnerships. Regarding the comment that funds should go to public and private marinas in approximate ratio to the public/private ratio and the comment that funds be released to the public sector in the fifth year if private marinas do not apply, priority will be given by the Service to those facilities that solve resource problems identified in the State's Plan rather than public/private ratios, which may not match resource problems. Regarding the suggestion that States with legal roadblocks to funding private marinas should be required to change their laws before funds will be granted to them, the Service has no legal authority to require States to change their laws.

Issue 4. Center for Marine Conservation and States Organization of Boating Access, Technical Guidelines, first paragraph, second and third sentences, "Both public and private marinas are eligible to participate in this program and should conform to these technical guidelines. Other marinas would not have to conform.": Both groups asked what other types of marinas there are other than public and private?

Response: This statement has been corrected to read that public and private marinas that participate must conform to these guidelines. Marinas that do not participate do not have to conform.

Issue 5. Center for Marine Conservation (Center): Technical Guidelines, Definitions (4) Waste reception facility: In the Center's work with vessel-generated garbage and the Marine Plastic Pollution Research and Control Act, "reception facility" refers to garbage cans, dumpsters, and recycling containers at ports and marinas. "Adequate reception facilities" are required under MPPRCA, and are referred to quite often. The Center wants to make sure that the phrase "waste reception facilities" referred to in the Clean Vessel Act guidelines is not going to confuse boaters or marina operators who are also exposed to provisions of the garbage laws dealing with garbage reception facilities. The Center suggests using another term, such as "portable toilet dump station" or "sewage reception facility".

Response: The Service agrees and has changed the term to agree with the term used in the grant guidelines: Dump stations.

Issue 6. Oregon State Marine Board (Marine Board): Technical Guidelines, Definitions (4) Dump Station: The Marine Board states that floating restrooms should be eligible for federal aid. They suggest that they are an eligible "dump station" which meets the intent of the Act to reduce vessel sewage pollution. Although landside restrooms should be ineligible, floating restrooms are not upland facilities and are used solely by boaters as dump stations. The Marine Board states that floating restrooms provide the only means to reasonably accommodate human waste from boaters using smaller recreational watercraft 12–18 ft. that do not carry portable toilets or do not have holding tanks.

Response: The Service agrees, and has added language in the guidelines to incorporate this suggestion, provided the facility is in the water, not connected to the shore.

Issue 7. International Marina Institute (IMI): Technical Guidelines, Definitions, (9) Coastal zone: the IMI suggests Printing out the full definition for coastal zone as given in the CZM Act of 1972 under Definitions.

Response: The Service agrees, and has printed it in full in the final guidelines.

Issue 8. International Marina Institute (IMI): Technical Guidelines, section 2. Surveys, Facility Survey, second paragraph, first sentence: The IMI states that survey of marinas for pumpout stations/dump stations should indicate whether the facility is public or private.

Response: The Service agrees and has added this survey question to the text.

Issue 9. Michigan Department of Natural Resources (Michigan DNR): Technical Guidelines, section 2. Surveys, second paragraph, first sentence, discussion of survey by specific coordinates: The Michigan DNR states that the Clean Vessel Act does not require the States to identify marinas by North American Datum Standard, nautical charts, etc. According to the law, section 5603 entitled "Charts (1) In General—the Under Secretary of Commerce for Oceans and Atmosphere

shall indicate, on charts published by the National Oceanic and Atmospheric Administration (NOAA) for the use of operators of recreational vessels, the locations of pumpout stations and dump stations." The Michigan DNR asks that this portion of the technical guidelines be taken out and be replaced by the specifications of the Act.

Response: The Service agrees and has rephrased this portion to agree with the Act. The Service suggests that obtaining specific coordinates for marinas may be helpful to determine location of marinas for development of plans.

Issue 10. International Marina Institute (IMI): Technical Guidelines, section 2. Boat Survey, third paragraph: The IMI states that most States do not have the ability to quickly determine which boats have toilets and what type MSD they are. The IMI states that the Service should request that the USCG require States to ask all boat owners if they have a MSD and what type, and include the data in their annual boating statistics reports. According to the IMI, States should list MSD use as part of their annual reports to the USCG and the USCG needs to correlate its own Federal documentation program (assume all documented vessels have toilets).

Response: The Service recognizes that this information may not be readily available, and has advised States in section 2. of the technical guidelines and Information Packet portion of these guidelines that reasonable estimates are acceptable. The Packet also advises States of alternative means of obtaining this information. The USCG would require legislative authority to require States to ask all boat owners if they have a MSD and include the data in their annual boating statistics report, since the purpose of the report is now boat safety. Regarding the comment that the USCG correlate its own Federal documentation, this would not result in obtaining a sufficient number of boats for the States to adequately complete their survey.

Issue 11. Oregon State Marine Board (Marine Board): Technical Guidelines, section 3., first paragraph, first sentence: The Marine Board requests the Service to add "/or". The sentence should read: "As a general guide, at least one pumpout station and '/or' dump station should be provided for every 300 to 600 boats (not considering length or toilets)." In Oregon, according to the Marine Board, the number of boats under 26 ft. is over 90% of the registered boats in the State. Therefore, the requirement of one pumpout as the sole means for vessel waste reception and not including dump stations or other means of waste disposal for every 300 to 600 boats, regardless of boat length, would be impracticable to meet in Oregon, according to the Marine Board.

Response: This formula is guidance only, not a requirement. States should use their judgment as to when this formula should be modified, or even used.

Issue 12. International Marina Institute (IMI): Technical Guidelines, section 3. Adequate Pumpouts, first paragraph, first sentence: According to the IMI, this section must be directly linked to the number and location of boat toilets. Otherwise, States may count all boats whether or not capable of holding a MSD toilet: Boat count guide for the number of pumpout stations now includes all canoes, dinghies, rowboats, etc., and all other boats without toilets, which distorts boat toilet use patterns and location of pumpout needs. The IMI states that the word "not" in the following sentence should be deleted: "As a general guide, . . . 300 to 600 boats (not considering length or toilets)." The IMI requests adding the following: "The number and location of pumpouts be based on counts of boats with toilets and/or boats 22 feet in length and larger capable of having installed MSDs."

Response: The Service agrees that canoes, dinghies, etc., should not be included in the assessment of need, and has added language to that effect. The amended method now suggested in the guidelines is a general guide only, and can be further amended by adding the language suggested by the commenter, or by any of the factors listed in that Section.

Issue 13. Oregon State Marine Board (Marine Board): Technical Guidelines, Section 3., first paragraph, second sentence: The Marine Board states that there needs to be a better breakdown of the requirement for vessel dump stations and pumpouts for marinas accommodating over 50 boats. The Marine Board suggests the following language: "Marina with 50 slips or more that are capable of mooring 26 ft. + boats install at least one pumpout station. Marinas with 50 slips or more that are capable of mooring 16–26 ft. boats install at least one pumpout or portable toilet dump station."

Response: This Section has been rewritten to incorporate the suggested language. Because the guideline is not a requirement, but guidance, which States should use or modify as needed, additional language has been added which clarifies this point. States should assess each particular situation to determine the pumpout stations and dump stations needed.

Issue 14. Oregon State Marine Board (Marine Board): Technical Guidelines, Section 3., second paragraph: The Marine Board requests adding the following to better clarify where to install waste reception facilities: "Waste reception facilities should be sited in conjunction with marinas, parking lot harbor or where vessels congregate or are used, such as transient harbors or launching ramps."

Response: The statement has been amended to better clarify where dump stations should be installed.

Issue 15. International Marina Institute (IMI): Technical Guidelines, section 4. (3) Expected Results or Benefits: To the end of that sentence the IMI requests adding "* * * and how results will be monitored and benefits will be measured."

Response: Although States have the option to monitor and measure benefits, and are encouraged to do so when necessary, requiring this step of the States goes beyond the intent of the Act and conveys an unnecessary burden to the States. There may be so many other factors, such as municipal sources of pollution, that it may be extremely difficult and expensive to measure the specific benefit of installing pumpouts. Pumpouts should be viewed as a Best Management Practice which, when installed, will help clean up the water by preventing one source of pollution.

Issue 16. International Marina Institute (IMI): Technical Guidelines, section 4. (4) (c), Approach/Strategy: The IMI suggests mentioning here or in section 8. that grants should not go for endless repairs of existing pumpouts which have proven to be located in inappropriate sites, under failed government control, or which has a history of unreasonably low use and performance. The IMI states that the State strategy must address the question of whether or not an existing pumpout station is worth upgrading, and how demonstrated problem pumpout services will be upgraded or eliminated.

Response: The Service agrees and has added language in section 4. (4) (c).

Issue 17. International Marina Institute (IMI): Technical Guidelines, section 4. (4) (d): To the list following "How States will ensure that * * *" the IMI requests adding "(iii) facilitate speedy permits for pumpout station construction or improvement." The IMI states that Federal and State agencies must facilitate, speed, and make less expensive the process of granting permits for pumpout stations. The IMI requests that the guidelines ask States to tell the Service how the permit process

will be expedited, and to document the average time it takes for a pumpout permit. The IMI believes the Service should give high priority to those States who speed the process.

Response: The Service encourages States to expedite the permit processes required by State and local governments, so that facilities will be installed as soon as possible. However, requiring the requested information is beyond the scope of the Act and the authority of the Service.

Issue 18. International Marina Institute (IMI): Technical Guidelines, section 4. (4) Approach: The IMI requests adding "(i) Describe methods to be used to measure program costs and benefits to the boating public; and (j) How the State will evaluate and monitor the program effectiveness and make changes to approaches as weaknesses and/or unanticipated opportunities become apparent." The IMI believes that program evaluation needs to be given greater emphasis, to assure quality products.

Response: Section "(i) Describe methods to measure costs and benefits * * *" is beyond the scope of the Act. Section (j) is included in the grant guidelines, § 85.42(c), which requires States to ensure that facilities are operated and maintained and used for the stated grant purpose. A paragraph at the end of section 3. of the Technical Guidelines has been added to give program evaluation greater emphasis.

Issue 19. Center for marine Conservation (Center): Technical Guidelines, section 5. Education/ Information: The Center considers education as a critical component in the ability of the Clean Vessel Act to keep boater's sewage out of the water. They are concerned that all education efforts will be done State by State, and that there is no plan for national development of model education programs or materials which can then be used by the States. With the Center's marine debris work, they have seen the effective use of a national information office, and have seen that it minimizes duplication at the State level, and enhances coordination and communication between educators. The Center believes something similar for the Clean Vessel Act would enhance the ability of the Act and reduce costly duplication.

Response: The Service is planning a workshop with Federal, State and local agencies, the marine industry, boaters, conservation organizations, and interested parties, early in 1994, to identify gaps in the education program, and responsibilities for filling those gaps. The Service encourages any organization interested to attend. Notice of the date, time, and place will be published in the Federal Register. In addition, the EPA is developing two reports on the subject, both still in draft: (1) Framework for a Public Outreach Strategy on Sewage Discharges from Boats and Marinas; and, (2) INTERIM REPORT: Summary of Federal Programs and Tools; Summary of State and Local Programs and Tools; Identification of Missing and Needed Information for Guidance Development on Boat and Marina Pollution Control; List of Contacts.

Issue 20. Oregon State Marine Board (Marine Board): Technical Guidelines, section 6. (1) (a) and (b), discharge of wastewater to treatment facilities and transport by licensed septage haulers: The Marine Board has found that time and again with Oregon there has been non-acceptance of vessel wastes by many small municipal wastewater treatment facilities. Therefore, the Marine Board recommends that USFWS or others conduct a detailed study on the effects of vessel waste treated by municipal wastewater systems and provide States technical guidance on this matter.

Response: When developing the State Plan, States are asked to identify any problems with municipal treatment plant operators accepting marine sewage. When the extent of the problem is ascertained, the Service will then consider solutions to the problem. At this time, a number of studies have been done to show that vessel sewage should not be a problem to waste treatment plants. Education may be the best tool for overcoming this perceived problem.

Issue 21. International Marine Institute (IMI): Technical Guidelines, section 7., third paragraph, after first sentence: The IMI requests adding a sentence: "When pumpouts are installed on or near boat fueling areas, explosion proof motors and switches must be used."

Response: The Service agrees and has added language to that effect.

Issue 22. International Marina Institute (IMI): Information Packet, section 1. (5) Nursery Areas: The IMI states that this section is misleading, unsupported, and subject to regulatory abuse, and should be deleted. New York State Department of Environmental Conservation (DEC): The DEC requests expanding "Nursery areas of indigenous aquatic life" in section 1., item (5) to make reference to State and Federally designated significant habitats such as are designated in Coastal Zone programs.

Response: The Service agrees that the definition is too broad and has deleted it, substituting the definition suggested by New York State DEC in the Information Packet and section 1. (5) of the technical guidelines.

Issue 23. International Marina Institute (IMI): Information Packet, section 1., Discussion of the effects of vessel sewage on these waters, first paragraph, third sentence: The IMI requests changing the word from "several" to "many" in the sentence "While vessel sewage discharges represent only one of 'several' sources * * *"

Response: The Service agrees and has made the change.

Issue 24. International Marina Institute (IMI): Information Packet, Section 1., Discussion of the effects of vessel sewage * * * second paragraph, second sentence: The IMI requests adding the word "uncooked" to text: "Humans are put at risk by eating 'uncooked' contaminated shellfish. * * *" According to the IMI, cooking kills the pathogens.

Response: Although the discussion is primarily about pathogens, cooking does not destroy all forms of contaminants. Therefore, the conservative approach is taken.

Issue 25. International Marina Institute (IMI): Information Packet, Section 1., Discussion of the effects of vessel sewage * * * second paragraph, last sentence: The IMI requests deleting "and swimming beaches" from text. According to the IMI, the statement is not true for most beaches.

Response: The Service agrees that the statement is not true for most beaches, and has modified the statement accordingly.

Issue 26. International Marina Institute (IMI): Information Packet, Section 1., Discussion of the effects of vessel sewage * * * third paragraph, last 2 sentences: The IMI requests deleting the last two sentences: "Sewage discharged from holding tanks will thus increase the biological oxygen demand (BOD) in the vicinity of boats. When this occurs in poorly flushed waterbodies, the dissolved oxygen concentration of the water may decrease (Milliken and Lee, 1990." According to the IMI, this is misleading and faulty logic. If kept, the IMI requests fully qualifying this statement as to the number of holding tanks which must be dumped to make it significant.

Response: The sentences are general, informational statements. The statements have been qualified to ensure that they are not misleading.

Issue 27. North Carolina Department of Environment, Health & Natural Resources (DEHNR): Information Packet, section 1., last paragraph, first, fourth

and fifth sentences, and Information Packet, Section 6., second paragraph, last sentence: It is the DEHNR's understanding that zinc sulphate was voluntarily taken off the market 10 years ago when its degrading effects on waste treatment were discovered. According to the DEHNR, plant operators and regulators should not be given the implication that heavy metals or other severe, lingering toxics can be expected. The holding tank chemicals in use today are generally biodegradable and if even marginally diluted, have little effect on treatment systems. The DEHNR requests that the Information Packet be written to describe why the waste can be treated in existing systems rather than helping to panic regulatory agencies that are not familiar with the research, or the rate and volumes of present demands.

Response: Zinc sulphate has been deleted from the discussion, and the discussion modified in both places to indicate the lack of real problems noted from use of these chemicals.

Issue 28. International Marina Institute (IMI): The IMI requests that the Service credit IMI for its contributions in the guidelines. Information Packet, section 3., first and second paragraphs: The IMI requests the following be appended to these paragraphs: "(Ross & Amaral, 1992)", to give credit for this text to the IMI survey of New England pumpout stations mentioned previously. Information Packet, section 7., third paragraph, "Equipment failure * * * ": The IMI requests the following be appended to this paragraph: "(Ross & Amaral, 1992)". Also, Information Packet, section 8., first paragraph, Public/private partnerships: IMI totally agrees with the importance of private involvement, and requests that the record show that the 80% is based on the 1986–87 National Boating Facilities Survey IMI/URI conducted for NMMA.

Response: Credits have been added for each of the sources.

Issue 29. International Marina Institute (IMI): Information Packet, section 3., fourth paragraph, next to last sentence: The IMI requests deleting the sentence "Some States require installation of pumpouts for all new marinas.", because it may encourage regulators to mandate pumpouts everywhere without consideration of other factors, or add " * * * regardless of any measured need or lack of potential use." at the end of that sentence.

Response: The Service agrees, and has deleted the sentence.

Issue 30. International Marina Institute (IMI): Information Packet, section 3. (2): The IMI requests changing the "45%" peak occupancy rate to "40%" in the sentence "It is assumed every boat which is occupied * * * the occupancy rate during peak periods is 45%." Also, Information Packet, section 3. (3) Calculation for Estimating Need for Dump Stations, and, Calculation for Estimating Need for Pumpout Stations: The IMI recommends changing the peak occupancy rate from "45%" to "40%", to match the sentence above in section 3. (2). According to the IMI, the 45% comes from the 1989 IMI national auto parking and boat use study of 142 public and private marinas in 24 States. The highest use day (July 4th weekend) was 46% of all boats in use, but quickly dropped to 33% on non-holiday weekends. (Reference: Ross, N. Auto Parking in Marines. International Marina Institute, Wickford, RI. 1989. 13 pp. According to the IMI, holding tanks are often pumped during the week. National engineering standards for parking lot size for theaters, restaurants, and shopping malls call for using the 5th highest use day. The IMI states that it would be more reasoneble to use the 33% to be high weekend use rate. The IMI suggests using the difference between the 46% and 33% or 40%, which is the most reasonable national number in the formula calculations.

Response: The Service agrees and has made the changes in the sentence and in both calculation formulas, giving credit to the source.

Issue 31. International Marina Institute (IMI): Information Packet, section 3. (3): Hours of operation: The IMI requests adding "peak boating season" to "* * * assumes facilities will be in operation for twelve hours per day during 'peak boating season' weekends and * * *".

Response: The statement has been added to the sentence.

Issue 32. Massachusetts Department of Fish, Wildlife and Environmental Law Enforcement (DFWELE): Information Packet, section 3., Calculation for Estimating Need for Pumpout Stations: The DFWELE suggests adding open brackets and open parentheses before "No. of Boats 26'–40'", close parentheses after "No. With Holding Tanks (50%)", and close brackets after "No. of Boats 40'+", to clarify the calculation.

Response: The Service agrees and has added the brackets and parentheses.

Issue 33. North Carolina Department of Environment, Health & Natural Resources: Information Packet, section 6.: The DEHNR is concerned with the discussion of waste treatment alternatives. According to the DEHNR, relatively few marinas are in a stage of construction where major waste treatment system modifications are readily feasible. It is likely, according to the DEHNR, that a marina waste disposal system is already in place. The best use of the grants, according to the DEHNR, will be to install as many dockside pumpout units as possible. The DEHNR states that, under certain circumstances, funding new or replacement waste treatment systems may be appropriate. But in most cases, research indicates that existing systems should be able to handle anticipated loads.

Response: The Service agrees with this assessment, and encourages States to install as many pumpout stations and dump stations as are needed as the highest priority. The discussion of waste treatment alternatives is informational, and not meant to imply a priority for new or upgraded waste treatment systems.

Issue 34. International Marina Institute (IMI): Information Packet, section 6., Vessel Sewage Characterization, second paragraph, first sentence, Effects of holdings tank additives: The IMI asks the following: What are the harmful additives? What chemicals should be regulated? Where is the list of products which can be used? Is there a government sanctioned list? Who is doing testing on products for holding tanks? If no government list exists, can the Service encourage the States to regulate them? If the list exists, publish it.

Response: This paragraph is an information paragraph which characterizes chemical holding tank additives. No statement is made that they are harmful or that they should be regulated. The Service has no list of products which can be used, and there is no government sanctioned list.

Issue 35. North Carolina Department of Environment, Health & Natural Resources (DEHNR): Information Packet, section 6. On-Site Treatment: According to the DEHNR, North Carolina law does not allow holding tanks as an acceptable sewage treatment and disposal system.

Response: A statement has been added to this section cautioning that marinas should consult State law before installing any of these measures.

Issue 36. Center for Marine Conservation (Center): Information Packet, section 7., first paragraph, sixth sentence: "Stationary or portable dockside pumps cost in the range of $2,000 to $10,000, and typical complete installations may be as high as $20,000." The Center believes these numbers sound high, and requests that the Service clarify what is covered here, and separate out costs for live aboard permanent installations.

Response: This information was obtained from the marine industry. Average costs, including sewage connection and other accessories, for the first application period, were close to $20,000 per unit. Some costs were in the range of $60,000.

Issue 37, International Marina Institute (IMI): Information Packet, section 7. (1) The IMI states that stationary units can also be discharged into septic systems if the State allows. According to the IMI, their advantages also include "speed of use".

Response: Although it may be true that the unit contents may be discharged into septic systems, this type of connection is not encouraged. Speed of use has been added as an advantage.

Issue 38: International Marina Institute (IMI): Information Packet, section 7. (2) Portable units on wheels, fourth sentence: While moving about the marina requires more time, the IMI believes that also is an advantage for pumping out boats during slow weekdays, especially after a busy weekend.

Response: This advantage has been added.

Issue 39: International Marina Institute (IMI): Information Packet, section 7. (3) Portable units on a vessel, last sentence. Range of operation is not a problem, according to the IMI, since one vessel can service an entire harbor of several marinas, etc.

Response: The Service agrees. This statement has been deleted.

Issue 40: International Marina Institute (IMI): Information Packet, section 7. (4) Remote operated multi-station systems, last sentence: According to the IMI, the last sentence talks about he problems of winter freezing. Freezing affects every pumpout in northern climates, but is less of a problem for multi-station systems because they generally depend on a vacuum tank system which keeps the lines free of all standing water. The IMI recommends dropping the issue, or making a general statement such as: "All pumpout systems in northern States subject to freezing may need winterization.".

Response: The Service agrees. The statement has been deleted.

Issue 41: International Marina Institute (IMI): Information Packet, section 7., next to last paragraph, fourth sentence, under Other Factors to Consider for Pumpout Stations, "* * * and disinfect suction connection.": The IMI states that this sounds like a good idea, but how do you do it? Would not the disinfectant used, e.g., chlorine, pose a more significant threat to aquatic life than sewage bacteria inside the hose connector? Recommend dropping the words.

Response: The Service agrees. The statement has been deleted, and a suggestion added to use a dedicated system for flushing and rinsing hoses.

Issue 42: International Marina Institute (IMI): Information Packet, section 7., last paragraph, third sentence under Other Factors to Consider for Pumpout Stations: The IMI states that the statements "EPA has found * * *" the need for "maintenance contracts * * *" and "dedicated funds * * *", are misquoted from the final Nonpoint Pollution Marinas Chapter 5, boat sewage section pp 5–42 to 5–46. The IMI states that the statements are based on a preliminary practices draft which was discarded in the final text. If maintenance contracts were necessary anywhere, according to the IMI, they would be needed at the public marinas do not need such government required contracts or dedicated funds since they will fix the problem themselves or hire someone. The IMI recommends deleting the entire last sentence beginning "EPA has found * * *", or specify that this "only applies to public marinas which are unable to do their own maintenance.".

Response: The reference to EPA has been dropped. The paragraph has been kept as a suggestion.

Issue 43: International Marina Institute (IMI): Information Packet, section 8., fifth paragraph, Rental Contracts: The IMI recommends adding "waters" to the text of "(1) prohibit boat sewage discharge into the marina 'waters' to keep the water clean." to otherwise allow discharge into a pumpout or sanitary waste system.

Response: The word has been added.

Issue 44: International Marina Institute (IMI): Information Packet, section 8., fifth paragraph, Rental Contracts: The IMI is not sure marinas can legally force boat owners to covert to holding tanks (2) without new legislation since Federal law allows use of all three types of MSDs. The IMI does not feel the Service can issue (2) in the Guideline at this time without a change in Federal law.

Response: The Service agrees. The statement has been deleted.

Technical Guidelines

The Fish and Wildlife Service will administer the Clean Vessel Act grant program through State agencies only. Both public and private marinas are eligible to participate in this program and should conform to these technical guidelines if they do participate. Marinas that do not participate in this program would not have to conform to ese guidelines. The Service believes at public/private partnerships are a ry important part of the success of is program, and will give higher riority to those projects that provide ich partnership. Inability of a State to ive grants to private marinas will result n a lowering of that State's priority for funds. Those States that have legal/ administrative roadblocks are strongly encouraged to overcome them through changes in their law or procedures.

These technical guidelines should be followed when doing surveys, developing a plan and education program, and constructing pumpout stations and dump stations. Technical guidelines are presented here by section. At the end of these guidelines, an information packet is presented, which contains a general discussion of each section and provides greater detail.

Definitions

For the purposes of these technical guidelines the term: (1) *Type III marine sanitation device (holding tank)* means any equipment for installation on board a vessel which is specifically designed to receive, retain, and discharge human body wastes; (2) *pumpout station* means a facility that pumps or receives human body wastes out of Type III marine sanitation devices installed on board vessels; (3) *recreational vessel* means a vessel (a) manufactured for operation, or operated, primarily for pleasure; or (b) leased, rented, or chartered to another for the latter's pleasure; (4) *dump station* means an upland or floating waste reception facility specifically designed to receive wastes from portable toilets carried on vessels, or floating restrooms in the water, not connected to land or structures connected to the land, used solely by boaters, and does not include upland restroom facilities; (5) *marina* means a facility with ten or more wet slips and/or dry land storage; (6) *Parking lot harbor* means a harbor which is home port to many boats kept on swing moorings or in marina docks. Most of the time, most of the boats are unoccupied and unused; (7) *Transient harbor* means "destination" harbor where boaters go during day trips or berth overnight; (8) *Portable toilet* means toilets that are not installed toilets. They are designed to be removed from a vessel and their contents emptied into shoreside receptacles; (9) *Coastal zone* has the same meaning that term has in section 304(1) of the Coastal Zone Management Act of 1972 (16 U.S.C. 1453 (1). Section 1453 defines "coastal zone" as follows: "The term 'coastal zone' means the coastal waters (including the lands therein and thereunder) and the adjacent shorelands

(including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends, in Great Lakes waters, to the international boundary between the United States and Canada and, in other areas, seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only to the extend necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers or agents."

Section 1. Waters Most Likely To Be Affected by the Discharge of Sewage From Vessels

Guidelines for States to use in identifying waters most likely to be affected by the discharge of sewage from vessels are those waters frequented by large numbers of boaters and include: (1) Sheltered waters that are generally poorly flushed systems; (2) Waters identified to be of National Significance; (3) Waters of significant recreational value; (4) Waters supporting designated shellfish harvest areas; (5) State and federally designated Nursery areas of indigenous aquatic life; (6) Waters designated by the EPA as "No Discharge Areas" under section 312(f)(3) and (4) (A) & (B) of the Clean water Act, and (7) Waters that do not meet State designated usage.

Section 2. Surveys of Pumpout Stations and Dump Stations

Only coastal States are required to do a survey. Coastal States should submit surveys to the Federal Air official at the appropriate Fish and Wildlife Service Regional Office, as follows:

(1) Region 1 coastal States include California, Commonwealth of the Northern Mariana Islands, Guam, Hawaii, Oregon, and Washington: Deputy Assistant Regional Director, Division of Federal Aid, U.S. Fish and Wildlife Service, Eastside Federal Complex, 911 NE 11th Avenue, Portland, Oregon 97232–4181, (503) 231–6128.

(2) Region 2 coastal State includes Texas: Deputy Assistant Regional Director, Division of Federal Aid, U.S. Fish and Wildlife Service, P.O. Box 1306, 500 Gold Avenue, SW., Albuquerque, New Mexico 87103, (505) 766–2095.

(3) Region 3 coastal States include Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin: Deputy Assistant Regional Director, Division of Federal Aid, U.S. Fish and Wildlife Service, Bishop Henry Whipple Federal Building, 1 Federal Drive, Fort Snelling, Minnesota 55111–4056, (612) 725–3596.

(4) Region 4 coastal States include Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, and the Virgin Islands: Deputy Assistant Regional Director, Division of Federal Aid, U.S. Fish and Wildlife Service, 1875 Century Boulevard, suite 324, Atlanta, Georgia 30345, 404/679–4159.

(5) Region 5 coastal States include Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia: Deputy Assistant Regional Director, Division of Federal Aid, U.S. Fish and Wildlife Service, 300 Westgate Center Drive, Hadley, Massachusetts 01035–9589, (413) 253–8501.

Pumpout station/dump station survey: All marinas, moorages, docks, etc., should be surveyed. The survey should include whether the marina has pumpout stations, dump stations, or both; how many pumpout and dump stations; which ones are operational; and, the specific coordinates of each operational pumpout and dump station. For pumpout and dump stations not located in the above marinas, moorages, etc., such as at ramps, the specific coordinates should be obtained for these facilities also. Specific coordinates, i.e., latitude and longitude, should be reported in North American Datum 1983 (NAD 83) standard. Other alternatives include (a) State Plane Coordinate Values, and (b) A portion of a NOAA nautical chart identified by chart number, edition, and edition date that marks clearly the pumpout station/dump station. Specific coordinates for all pumpout and dump stations should be submitted to the appropriate Regional Office of the Fish and Wildlife Service for inclusion on NOAA charts. Suggested survey questions include the following for each facility: (1) Name and address of marina, moorage, dock, etc.; (2) whether the marina is public or private; (3) telephone number; (4) location of marina, etc., by county, water body and specific coordinates; (5) whether the marina has pumpout stations, dump stations, or both; (6) how many pumpout and dump stations; and, (7) whether the pumpout and dump stations are operational.

Boat survey: The survey should include the following: (1) Total number of boats by water body and county; (2) How many boats have Type III MSD holding tanks; (3) How many boats have portable toilets.

A complete survey of all boaters is not necessary. States should obtain only as much information as is necessary to determine, within reasonable confidence limits, numbers of boats, how many boats have Type III MSD holding tanks or portable toilets, and where boaters are most likely to congregate by water body and county. Sample surveys are acceptable. Recent surveys are acceptable if they answer all the questions needed.

Section 3. What Constitutes Adequate and Reasonably Available Pumpout Stations and Dump Stations in Boating Areas

As a general guide, at least one pumpout station and dump station should be provided for every 300 to 600 boats over 16 feet length overall. This is not a requirement, but guidance only, and should be modified depending on the situation. For instance, if most boats in an area are under 26 feet, many more dump stations would be required than pumpout stations. Another question is the minimum number of boats that should have pumpout stations and dump stations. Again, there is no one answer. it is suggested that marinas with 50 slips or more that are capable of mooring 26 feet + boats have access to at least one pumpout station, and marinas with 50 slips or more that are capable of mooring 16–26 feet boats have access to at least one dump station. This does not mean that every marina with 50 + slips should have a pumpout station or dump station. Where marinas are adjacent (within two miles of each other), pumpout stations can be shared. Other factors should be considered, such as whether the marina is a parking lot or transient harbor, or the amount of fuel dock use. In determining the installation of any pumpout station or dump station, such factors as boat size, boating use patterns, coastal water characteristics, sensitive areas, flushing capacity, etc., should play a large role in establishing needs for facilities. Due to the variability in each State, States must have the flexibility to provide criteria that addresses their specific needs. See the discussion in the Information Packet, section 3, for alternative approaches to determining need.

Dump stations should be sited in conjunction with pumpout stations, but should also be located where there are no pumpout stations but where boats with portable toilets congregate or are used, such as launching ramps.

Program evaluation should be given great emphasis to assure quality products. States should evaluate and monitor the program effectiveness to determine that facilities are operated and maintained, and used for their intended purpose. Changes to approaches should be made as weaknesses and/or opportunities become apparent.

Section 4. Plans for Construction Pumpout Stations and Dump Stations

Only coastal States are required to develop a plan. Coastal States should work with the recreational marina industry and others in developing the plan. Coastal States should submit the plan to the appropriate Fish and Wildlife Service Regional Office, same address as in section 2 above. Following is an outline which should be used by States when developing the plan:

(1) *Need.* This section should establish the justification for the proposed work based on (a) the results of the surveys of existing pumpout stations and dump stations and the number of recreational vessels; (b) that part of the guidance relating to determining the adequacy and reasonable availability of pumpout stations and dump stations and, (c) that part of the guidance describing the waters most likely to be affected by the discharge of sewage from vessels.

(2) *Goals and objectives.* The purpose of the plan should be to ensure the availability of adequate and reasonably available pumpout stations and dump stations to the boating public throughout the coastal zone of a State.

(3) *Expected results or benefits.* This section should describe in general how water will be improved by making pumpout and dump stations available.

(4) *Approach.* In this section, describe the following: (a) How the plan addresses all coastal zone waters of the State, and gives priority to waters most likely affected; (b) How the plan complements plans of adjacent States for shared waters; (c) The strategy for locating and constructing, renovating and maintaining pumpout and dump stations. Address the question of whether or not an existing pumpout or dump station is worth upgrading, and how demonstrated problem facilities will be upgraded or eliminated. Include the general location and priority of projects; (d) How States will ensure that (i) waste will be disposed of properly, and (ii) that municipal waste treatment plants will accept waste; (e) What proportion of the slip/mooring capacity is in public vs. private marinas, how States will seek public/private partnerships for siting, constructing and operating pumpout stations and dump stations, any issues/problems, such as legislative/regulatory barriers, and what will be done to overcome these barriers; (f) Innovative techniques to increase the availability and use of pumpout stations/dump stations; (g) Approaches to educate and inform the public and the boating industry on the sue of, and need for, disposal of vessel waste; and, (h) Total estimated cost of the Statewide plan.

Section 5. Education/Information

Guidelines for States to consider when developing an education/information plan include:

(1) *Audience:* Consider six audiences when developing your education/information program regarding vessel sewage disposal, handling, and treatment, as follows: (a) Boat owners and operators; (b) Marina owners and operators; (c) Sewage treatment plan owners and operators; (d) Federal (where applicable), State and local governmental authorities and organizations; (e) Boating supply and retailers; (f) The general public.

(2) *Communication media:* There are a variety of media that States may use for disseminating this information. Common methods to consider are: brochures, workshops/symposiums, educational videos, TV/radio, signs, boat shows, etc. Innovative methods are encouraged.

(3) *Distribution:* States have options for distribution of educational information related to boating and pumpout issues. Options include magazines, radio public interest spots, environmental groups, association and federation newsletters, National Estuary Program forums, State and local education programs, local citizens groups, and student groups. New and innovative ways of educating the boating community and the general public are encouraged.

Section 6. Appropriate Methods for Disposal of Vessel Sewage From Pumpout Stations and Dump Stations

Disposal methods will vary among States depending on a number of factors, including: State and local sanitation codes; the number of recreational vessels and where the vessels are concentrated; the availability and geographic proximity of existing treatment facilities to boating centers; and hydrogeologic characteristics, including soil types and groundwater flows towards drinking water sources and these coastal waters. Depending on these factors, States may consider the following methods: (1) Off-site treatment: (a) Discharge to a public wastewater collection system and treatment facility; (b) discharge to a holding tank with removal and transport by a person licensed to haul septage waste to a municipal septage receiving/treatment facility; (2) On-site treatment at marinas: (a) Discharge to a package treatment plant; (b) discharge to a septic system.

Section 7. Types of Marine Boat Sewage Pumpout Stations and Dump Stations That May Be Appropriate for Construction, Renovation, Operation, or Maintenance, and Appropriate Location of the Stations and Facilities Within a Marina or Boatyard

Pumpout stations and dump stations should provide an efficient means of removing sewage from boats and a means of disposing of that sewage in a safe and sanitary manner. These facilities should include all the equipment, structures, and disposal facilities necessary to ultimately discharge or dispose of boat sewage in an efficient, safe and sanitary manner without causing an actual or potential public health hazard. Pumpout stations should include equipment for rinsing boat holding tanks. Pumpout stations and dump stations should be adequate to meet the peak use demand for such services. Facilities should be operated and maintained to provide adequate service, and to be maintained to function as intended.

Pumpout stations and dump stations should be reliable, corrosion resistant, easy to use, neat and tidy to clean and use, conveniently located, with low maintenance. Pumps should be specifically designed for handling sewage. Land-based restrooms are not an acceptable option for emptying portable toilets.

All pumps should be safe, functional and efficient. Motors and switches should be ignition protected. Pumps should be able to pump against the maximum head developed by elevation change and line losses. In addition, the suction connection to the boat should be a tight fit and adjustable by adapters to service boat discharge connections. Pumps should be able to transport flows out of the holding tank. Pumps exceeding 45 gallons per minute may cause tanks to collapse.

Factors in determining pumpout station holding tank capacity include boat size and use patterns. Sizing should be done on a case-by-case basis using documented demand, if possible. Holding tanks should be designed and installed to meet local regulations.

For all vessels manufactured after December 31, 1994, a standard deck fitting for removal of sewage should be

constructed to the "International standard ISO 4567 Shipbuilding—Yachets—Waste water fittings" for holding tanks, which is a female 38.1 mm (1½") pipe size with 11 threads per 25.4 mm (inch). These threads could utilize a quick-disconnect or cam lock fitting. For existing vessels, an adapter, such as a tapered cone, should be used for non-standard deck fittings. All pumpout connectors should fit the standard deck fitting.

For all vessels manufactured after December 31, 1994, because of possible confusion between waste, fuel and water deck fittings, the deck fittings should be identified with the words "WASTE", "GAS", "DIESEL", and "WATER", and color code the fittings with black caps for waste, red caps for gas and diesel, and blue caps for water.

The ultimate location for the station should be based on the unique conditions of the marina, boatyard, mooring field or other anchorage. Stationary pumpout stations should be located for the convenience of, and to encourage boaters to use the facility. Mobile pumpout stations should have reasonable access to boaters.

Section 8. Other Information (No Technical Guidelines)

Information Packet

This information packet is not technical guidelines. It has been recommended to provide additional information to States, and to marinas and others who participate in this program. The information packet presents general information on surveys, plans, education/information, pumpout facilities and other information helpful in promoting establishment of facilities. It provides a more detailed discussion of the technical guidelines, with examples and explanations. This information packet is also by Section, which corresponds to the sections in the technical guidelines.

Section 1. Waters Most Likely To Be Affected by the Discharge of Sewage From Vessels

The following coastal waters, including the Territorial Seas, estuaries, bays, and sounds, and then U.S. lakes and rivers as defined below, are considered waters most likely to be affected by the discharge of sewage from vessels. These definitions are not ranked in priority order.

(1) Sheltered waters that are generally poorly flushed systems.

(2) *Waters of National significance:* Waters identified by the Environmental Protection Agency under the National Estuary Program, waters identified by the NOAA under the Estuarine Reserve program, and Marine Sanctuaries program where appropriate.

(3) *Waters of significant recreational value:* A water body with unusual value as a resource for outdoor recreation activities, e.g., fishing, boating, canoeing, water skiing, swimming, scuba diving, or nature observation. The significance may be in the intensity of present usage, in an unusual quality of recreational experience, or in the potential for unusual future recreational use or experience.

(4) *Shellfish harvest waters:* Waters designated as shellfish producing and harvesting areas.

(5) *Nursery areas of indigenous aquatic life:* State and federally designated significant habitats such as are designated in Coastal Zone programs.

(6) Waters designated by the EPA as "No Discharge Areas" under Section 312(f)(3) and (4)(A) & (B) of the Clean Water Act.

(7) Waters that do not meet State designated usage.

Discussion of the Effects of Vessel Sewage on These Waters

Waters previously designated by the EPA under the Clean Water Act as "No Discharge Areas" are eligible for renovation, maintenance and further construction funds under this program. The discharge of sewage from boats may degrade water quality by (1) introducing microbial pathogens into the environment and (2) locally increasing biological oxygen demand (U.S. EPA, 1985). While vessel sewage discharges represent only one of many sources of point and non-point pollution, the number of boats using coastal waters has increased substantially during the past decade. The contribution of boat sewage to total pathogen loadings and local BOD has grown proportionately.

A potentially serious problem resulting from vessel sewage discharges is the introduction of disease-carrying microorganisms from fecal matter into the coastal aquatic environment. Humans are put at risk by eating contaminated shellfish and by swimming in contaminated waters. The major disease-carrying agents are bacteria and viruses, and the most common serious ailment is acute gastroenteritis. Other waterborne diseases include hepatitis, typhoid, and cholera (Milliken and Lee, 1990). The indicators used to detect sewage pollution are not the pathogens themselves, but, rather, coliform bacteria. These bacteria are always present in the human intestinal tract and are thus considered reliable indicators of the presence of human waste (U.S. EPA, 1985). Studies conducted in Puget Sound, Long Island Sound, Narragansett Bay, and Chesapeake Bay have demonstrated that boats can be a significant source of fecal coliform bacteria in coastal waters, particularly in areas with high boat densities and low hydrologic flushing (Milliken and Lee, 1990; JRB Associates, 1980). If coliform levels exceed allowable thresholds, shellfish beds and swimming beaches may be closed to minimize the threat of public health problems. In addition, shellfish beds and some swimming beaches in the immediate vicinity of marinas are often closed because of the potential of contamination from vessel sewage discharges.

These organic-rich wastes also have the potential to depress oxygen levels as they decay in the marine environment. Biological oxygen demand is a measure of the dissolved oxygen required to decompose the organic matter in the water by aerobic processes. When the loading of organic matter increases, the BOD increases, and there is a consequent reduction in the dissolved oxygen available for respiration by aquatic organisms (U.S. EPA, 1985). Although the volume of wastewater discharged from boats is relatively small, the organics in the wastewater are concentrated, and therefore the BOD (1700–3500 mg/l) is much higher than that of raw municipal sewage (110–400 mg/l) or treated municipal sewage (5–100 mg/l) (JRB Associates, 1981). Sewage discharged from holding tanks will thus increase the BOD in the vicinity of boats. When this occurs in poorly flushed waterbodies, the dissolved oxygen concentrations of the water may decrease (Milliken and Lee, 1990). The amount of the decrease in dissolved oxygen concentrations, and therefore the significance to the water, depends on the amount of sewage discharged into the system.

Chemical additives such as chlorine and formaldehyde are used to disinfect or control odors of on-board sewage. There is little indication that these chemicals have any harmful effects on the environment. The holding tank chemicals in use today are generally biodegradable and, if even marginally diluted, have little effect on treatment systems. No heavy metals or other severe, lingering toxics can be expected. However, some discussion of possible problems should be mentioned here. Of the two major disinfectant chemicals used—chlorine and formaldehyde—only chlorine has been shown to be toxic in the aquatic environment. While formaldehyde is considered a toxic

substance, it is completely miscible in water and is readily degradable. While a direct link between MSD holding tank disinfectants and effects on the environment has not been documented, the presence of these chemicals in sufficient concentrations may be of concern (JRB Associates, 1981). Use of these chemicals as directed by the manufacturer should not result in problems. However, since the amounts of chemicals added are controlled by the boat owner or operator, excess use may occur.

Section 2. Surveys of Pumpout Stations and Dump Stations

The Clean Vessel Act of 1992 calls for surveys by coastal States within three months of notification to the States of the final technical guidelines to determine: (1) The number and location of all operational pumpout stations and dump stations at public and private marinas, mooring areas, docks, and other boating facilities within the coastal zone of a State; and (2) the number of recreational vessels in the coastal waters of the State with Type III marine sanitation devices (holding tanks) or portable toilets and the areas where those vessels congregate.

Survey information may be obtainable from the boat registration process or files; contacts with trade associations or boating organizations; from national surveys if available; or from mail or telephone surveys of boaters or marina/mooring field facility operators. Some States have surveyed boaters at marinas on high concentration days. The U.S. Coast Guard, telephone 202/267–1497, can provide the following information regarding Documented Vessels (5 net tons and larger): The vessel's port of documentation, vessel length, beam, net tonnage, and whether or not the vessel is equipped with mechanical propulsion.

Section 3. What Constitutes Adequate and Reasonably Available Pumpout Stations and Dump Stations in Boating Areas

Factors affecting pumpout use: Potential demand for pumpouts and/or dump stations is a function of several variables. First is the number of boats of a size that use sewage holding tanks or portable toilets and where they are stored. Second, accessibility of pumpouts and dump stations affects their use. Distance from routes of travel or from the home port as well as the likely waiting time once at the facility can affect the willingness of boaters to use pumpouts and dump stations. A third factor to consider is boat use. High use at moorages is related to transient versus "parking lot" customers, year-round versus seasonal users, and the frequency of overnight use of boats. High boat use is seasonal, correlated with good weather, weekends and holidays. Fourth is the fee charged, with higher use related to lower fees (Ross & Amaral, 1992).

High use of pumpouts and dump stations has also been related to aggressive management practices, active enforcement of "No Discharge Areas", perception of need by the public (related to the environmental sensitivity of the area and educational efforts), and good maintenance (Ross & Amaral, 1992).

Determining adequate and reasonably available station/facility needs: Boat numbers, boat size, boating use patterns, numbers and distribution of existing facilities, and where boats are kept during boating season (i.e., in a marina, yacht club, private dock, mooring, home on a trailer, etc.), determine the need for pumpout stations and dump stations. Moorages that receive high transient use, have mooring fields for large boats, are visited by large numbers of boats for refueling, and/or have a large number of people sleeping overnight or living on their boats should have high priority. Yacht clubs, boatyards and large capacity private docks should also be considered for priority installation of pumpouts and dump stations. Other situations that might be considered for the installation of facilities include marinas that provide fuel or service vessels equipped with MSD holding tanks. In addition to distributing stations/facilities in the above types of boating moorages, additional stations/facilities may be warranted where boat use impacts poorly flushed bays, coves, or sloughs and environmentally sensitive sites. After new facilities have been installed, subsequent patterns of use will indicate where and if additional pumpouts are needed. Periodic surveys should be conducted to ensure adequate numbers of pumpout stations and dump stations exist for boaters in the future.

Requirements for pumpout and dump stations vary by State and harbor. Some examples are as follows: Delaware requires a pumpout for marinas harboring 100 or more boats with marinas of 25–100 sharing a pumpout and those with less than 25 not required to install facilities. For New England, EPA Region I guidelines suggest a pumpout for 300–600 boats with toilets. A minimum of one pumpout per 300 boats with toilets is recommended in transient harbors with a high percentage of large vessels, while one pumpout per 600 boats with toilets should be provided in "parking lot" harbors where most boats are less than 25 feet long. In California's Richardson Bay, the pumpout guidelines is one station for every 300 boats. Launching ramps, marinas, etc., that cater to small craft (under 26 feet) or are too shallow for larger vessels may not need pumpouts, but may still require dump stations to receive portable toilet waste.

EPA's assessment (EPA, 1981) estimated that 20% of the boats between 16 and 26 feet, 50% of the boats between 26 and 40 feet, and all of the vessels over 40 feet had installed toilets with some type of MSD. So, if exact data are not available, an estimate could be calculated. The following is a method for estimating Statewide need for pumpout stations and dump stations (McKiernan, pers. comm.). It is not intended as a guide for determining requirements for a specific marina or harbor. The following assumptions underlie this method and can be adjusted where statistically valid information is available relating to a State's unique boating population characteristics.

(1) Given the availability of boat length information gathered during boat registration, assumptions can be made regarding the type of on-board sanitation equipment.

Boat length	Number with toilets (percent)	Type of system
16'–26	20	Portable toilets.
26'–40	50	Holding tanks.
40'+	100	Holding tanks.

(2) It is assumed every boat which is occupied will require service once a weekend and that the occupancy rate during peak periods is 40% (Ross, N. Auto Parking in Marinas, IMI, Wickford, RI, 1989).

(3) This method also assumes facilities will be in operation for twelve hours per day during peak boating season weekends and that the average time to service a boat's system will be 15 minutes for holding tanks and 5 minutes for portable toilets. Therefore:

Calculation for Estimating Need for Dump Stations

No. of Boats 16'-26'	×	No. With Portable Toilets	×	Peak Occupancy Rate	=	BOATS REQUIRING DUMP STATIONS		
300'		(20%)		(40%)		(24)		
Boats Served Per Hour	×	No. of Hours Of Operation Per Weekend	=	BOATS SERVED PER FACILITY			=	Dump Stations Required
(12)		(24)		(288)				

Calculation for Estimating Need for Pumpout Stations

No. of (Boats 26'-40'	×	No. With Holding Tanks (50%)	+	No. of Boats 40'+	×	Peak Occupancy Rate (40%)	=	Boats Requiring Pumpout Facilities		
Boats Served Per Hour	×	Number of Hours Of Operation Per Weekend	=	Boats Served per Pumpout					=	Pumpout Stations Required
(4)		(24)		(96)						

50 boats × 0.5 × 0.4 = 10 bo

@ 4 boats per hour = 10/4 = 2½ h to pu out boa during we

Section 4. Plans for Constructing Pumpout Stations and Dump Stations

The Clean Vessel Act calls for coastal States, within six months after notification of the final technical guidelines, to develop a plan for any construction or renovation of pumpout stations and dump stations. For efficiency of review and approval by the Fish and Wildlife Service, coastal States should complete the plan in the standardized format identified in the technical guidelines.

Section 5. Education/Information

A clearly defined education/information program that will support the timely implementation of a State plan should be presented by the State as a part of that plan. This guidance provides States with some ideas and information useful in developing an education/information program effective at informing the public, the boating community, the boating industry, local government officials, public interest groups, and other audiences the State identifies. Ultimately, the State education/information program should provide information and understanding that will encourage the use of and installation of pumpout and dump stations.

Education of the boating, marina owner, and vessel sewage handling and treatment communities is important to the potential success of this program. An effective education/information program will help to realize both short term and long term goals of the Act. The goals of education are as broad as the audiences they should be targeted to reach, yet, these goals can be achieved with increased dialogue between and information to these groups.

Six audiences should be considered when developing an education/information program regarding vessel sewage disposal, handling, and treatment, as follows: (1) Boat owners and operators; (2) Marina owners and operators; (3) Sewage treatment plant owners and operators; (4) Federal (where applicable), State and local governmental authorities and organizations; (5) Boating supply and retailers; (6) The general public.

There are a variety of media that States may have available for disseminating this information. Common methods to consider are; brochures, workshops/symposiums, educational videos, TV/radio, signs, boat shows, etc. Innovative methods are encouraged.

Issues to consider when developing education/information material targeted to a specific audience:

Issues on which education/information programs for boat owners and operators, as well as, boating supply and retailers, might focus would include: (1) Environmental impacts of boater sewage and the benefits of pumping out at a pumpout station and using a dump station; (2) How a pumpout station operates; (3) Pumpout hose connections/adapters; (4) Pumpout locations and fees; (5) "Green" boat toilet chemicals, i.e., short term biodegradable or less environmentally-damaging treatment chemicals. Encourage manufacturers through demand to market only environmentally responsible products; (6) Proper operation and maintenance of boat toilets; (7) The value of responding to boater surveys and requests for information.

Marina owners and operators are important participants in the implementation of this program. This group is making a commitment for the long term by agreeing to install, maintain, and operate pumpout and dump stations. Issues States should consider (where applicable) when developing education/information programs for marina owner and operators include: (1) Benefits to marinas under this program; (2) The application process for receiving funds to construct, renovate, maintain, and operate pumpout and dump stations; (3) What are adequate and reasonably available pumpout facilities; (4) Reasonable fees; (5) Environmental benefits of providing pumpout stations and dump stations; (6) How to obtain a permit for a municipal hookup and options for disposal of pumpout waste; (7) Where to locate pumpout and dump stations; (8) Methods of encouraging boater compliance with pumpout requirements; (9) Types of pumpouts and dump stations currently on the market; (10) Encourage manufacturers to provide demonstrations for and training of marina personnel responsible for operating these devices; (11) Highlighting Those marinas that have done an excellent job in installing and maintaining facilities.

Wastewater collected from pumpout facilities must be discharged from the

marina to an appropriate treatment facility. Waste treatment plant owners and operators should be made aware of the options available to them for receiving and treating waste from boat holding tanks and portable toilets. Issues for States to consider when developing education/information programs for wastewater treatment facility owners and operators include: (1) Effects of this waste stream on waste treatment plant's normal operations and how to mitigate any negative effects; (2) Volume of waste from boats in proportion to normal "household" loading standard; (3) Experience of waste system operators in areas designated "No Discharge".

States may find it necessary to develop education/information programs that address issues related to Federal, State and local government agencies. Issues to consider for education/information programs for this audience include: (1) Awareness of environmental requirements and enforcement options for vessel sewage disposal and treatment (particularly for incoming harbor masters); (2) Encouraging the development of technical guidelines for design, installation, and use of pumpout facilities; (3) Encouraging the appropriate Federal agencies to support a national standard on pumpout and boat fittings; (4) Environmental benefits of reducing the amount of waste water discharged from boats in localized areas, e.g., shellfish beds; (5) Encouraging vessel manufacturers to include procedures for proper operation of vessel holding tanks and shoreside pumpout facilities in new owners' manuals; (6) The value of enforcement in implementing this program; (7) Value of educating the public; (8) Informing Federal and local governments on how to access Federal informational sources, and encouraging them to do so; (9) Working with local governments to mandate, after a reasonable period of time, the installation of pumpout facilities at marinas, as a condition of marina licensure or operation.

Education of the general public has an important role to play. Issues to consider for education/information of this audience include: (1) The environmental impacts of boater waste; (2) Importance of the coastal resource; (3) Efforts by the boating community to reduce waste discharges.

States have options for distribution of educational information related to boating and pumpout issues. Options include magazines, radio public interest spots, environmental groups, association and federation newsletters, National Estuary Program forums, State and local education programs, local citizens groups, and student groups. New and innovative ways of educating the boating community and the general public are encouraged.

Representatives of the various groups could meet together at the State/local level to determine what information and education materials and strategies are needed to accomplish the objective. Private conservation and education groups could provide suggestions and materials once the needs are defined.

Section 6. Appropriate Methods for Disposal of Vessel Sewage From Pumpout Stations and Dump Stations

Introduction: The safe and sanitary disposal of vessel sewage waste must be provided for when constructing and operating pumpout stations and dump stations. Boaters will not want to spend time and money pumping out unless they can be assured that their efforts will help improve water quality.

Vessel Sewage Characterization

Vessel sewage is more concentrated than domestic sewage for almost all the standard parameters used to measure the quality of wastewater, including suspended solids, BOD, and total nitrogen. For example, the typical concentration of BOD in vessels is between 1700–3500 mg/l, while typical sanitary wastewater ranges from 110–400 mg/l for raw sewage and 5–100 mg/l for treated sewage. Raw municipal sewage has a lower concentration because people on land use more water for sanitary purposes than do people on boats. In addition, the proportion of gray water (defined as water from baths, showers and kitchens) is greater in municipal sewage, and municipal collection systems are subject to inflow and infiltration of storm water.

Another characteristic of vessel holding tank waste is the presence of chemical additives used to disinfect and deodorize the waste. These same additives are used to treat sanitary wastes in recreational vehicles (RVs), trains, and aircraft. Ideally, the odor-control chemicals should be biodegradable when diluted. These chemical additives commonly contain an active disinfectant along with dyes and perfumes. Some of the more common disinfectants include formaldehyde, paraformaldehyde, and quaternary ammonium chloride; formaldehyde is the most popular because of its effectiveness.

There is some concern from operators of small municipal and package sewage treatment plants and some marina operators with septic systems that vessel sewage holding tank waste may adversely affect performance of their sewage treatment systems by destroying the bacterial population, thereby reducing plant efficiency. A second concern, particularly of operators of municipal treatment plants operating at or near capacity, is that the additional volume of waste will cause the plant to exceed its capacity to treat wastewater effectively.

Research into the effects of chemical additives on sewage treatment processes indicates that these problems have been greatly overstated, and that, in general, most municipal sewage treatment plants can handle vessel holding tank waste without difficulty. In addition to relatively low volumes generated by sewage pumpout stations, the weekly and seasonal usage of marina facilities protects treatment systems from failing or exceeding capacity. Marinas receive their largest pumpout volumes on weekends and, in many parts of the country, only during the summer season. Therefore, treatment plants generally are able to assimilate such intermittent waste loading and no serious operational problem occurs.

Despite the negligible effects of holding tank additives on sewage treatment processes, general concern about toxic contaminants in the environment has led to the development of non-toxic, environmentally benign holding tank deodorants and disinfectants such as quarternary ammonium compounds, enzymes and adamantane. Holding tank chemicals in use today are generally biodegradable and if even marginally diluted, have little effect on treatment systems. No heavy metals or other severe, lingering toxics can be expected. States should encourage the use of these biodegradable products through education and, if necessary, regulation.

Disposal Methods

Disposal methods will vary depending on a number of factors, including: State and local sanitation codes; the number of recreational vessels and where the vessels are concentrated; the availability and geographic proximity of existing treatment facilities to boating centers; and hydrogeologic characteristics, including soil types and groundwater flows. Depending on these factors, States may consider the following methods: (1) Off-site treatment: (a) Discharge to a public wastewater collection system and treatment facility; (b) discharge to a holding tank with removal and transport by a licensed septage hauler to a municipal septage receiving/treatment facility.

(2) On-site treatment at marinas: (a) Discharge to a package treatment plant with subsequent discharge back into coastal waters (a National Pollutant Discharge Elimination System permit would be required); (b) discharge to a septic system, where no other alternative is available.

The following is a description of the relative merits of each of these methods. It should be noted that each State has its own regulations and policies regarding what it considers "appropriate" disposal methods. What one State considers appropriate or even desirable, another may prohibit.

Off-Site Treatment

There are hundreds of existing municipal wastewater treatment facilities serving coastal areas throughout the country. Most provide at least secondary treatment utilizing an activated sludge process, but they vary greatly in size and details of treatment structures, sludge handling capability, and success in meeting current permit terms and conditions. In addition, many also incorporate septage receiving and treatment facilities into the overall treatment system.

Public Wastewater Collection Systems: The best option for the safe and sanitary disposal of vessel sewage is through a direct connection to an approved wastewater treatment facility. Most municipal treatment plants should have no problem accepting vessel holding tank waste. The reletively small volume of holding tank waste, bled into the sanitary waste stream, is effectively diluted by municipal sewage. The relatively large volume of wastewater routinely handled by these plants also mitigates against plant upset, and the treatment process can also break down or volatilize certain of the trace organic chemicals. Sewage treatment plants with a long history of accepting holding tank waste have reported no problems with this practice. However, States should exercise caution in designating sewage treatment plants that are over-capacity, have operational problems, or violate permit conditions on a regular basis.

Shoreside Holding Tanks/Septage Treatment Facilities: Many boating facilities are located where connection to a wastewater collection system is difficult or infeasible. In these cases, connection of the pumpout or dump station to a shoreside holding tank is the next best option. Holding (or tight) tanks provide a means for sanitary storage of vessel sewage until it can be transported by a licensed septage hauler to an approved septic waste receiving/treatment facility. The holding tank may be above or below ground, depending on State or local requirements, but should be located on solid land and secured to minimize potential storm damage or vandalism.

Septage receiving/treatment facilities are designed specifically to pretreat these wastes before introducing them to the wastewater treatment system. Because vessel holding tank and portable toilet waste is similar in nature to domestic septage, although more concentrated with variable amounts of organic chemicals, a properly operating municipal treatment plant with septage receiving/treatment facilities should not be adversely affected by the introduction of holding tank waste.

Modifications to Wastewater/Septage Treatment Facilities: Some wastewater treatment plants and septage receiving/treatment facilities may require modification to accommodate vessel sewage. These modifications may include increased capacity, construction of adequate septage receiving/treatment facilities, holding and bleed-in facilities, pretreatment facilities, and additional analytical capability. To determine which plants have the capability to effectively process holding tank waste, and whether additional facilities (or modifications to existing ones) are required, States may need to conduct a survey of the existing capabilities and limitations of their existing sewage treatment plants. A matrix to determine these capabilities might include the following elements, for which many States have available data as file information: (1) List all sewage treatment plants; (2) Eliminate plants that are over capacity, have operational problems, or violate permit conditions regularly; (3) Evaluate the balance for existing capacity and treatment methodology; (4) Estimate the available capacity; (5) Develop a short list of candidates for vessel sewage treatment; (6) Develop list of potential needs for modifications to those plants, including: (a) Receiving stations; (b) holding/bleed-in tanks, and associated piping; (c) pretreatment needs; (d) associated sludge handling needs; and, (e) additional staff and analytical capabilities.

On-Site Treatment

On-site treatment at a marina may be a viable alternative when the marina is not located near sewer lines, when transport of waste is prohibitively expensive, when the local sewage treatment plant is unable to accept additional discharges, and when groundwater and coastal waters can be protected. Prior to installing these systems, State law should be reviewed for legality. On-site treatment eliminates the need to transport waste. However, the proliferation of small, potentially troublesome treatment systems often creates more water quality problems than the collection of vessel sewage is intended to solve, including coastal and groundwater contamination.

Package Treatment Plants

Package treatment plants offer an alternative for the treatment of both vessel sewage and waste generated by marina restrooms and other shoreside sanitary facilities. Package treatment plants are usually small, prefabricated sewage treatment plants that provide secondary treatment, generally utilizing the extended air mode of operation. In this process, treatment is accomplished by introducing air into the wastewater to encourage the growth of aerobic bacteria which digest the sewage, providing a high degree of treatment.

Discharging vessel sewage to a package treatment plant should only be considered by boating facilities with large treatment systems that can handle the increased shock loading and chemical additives present in this type of waste. The typical problems with such systems are exacerbated by the nature of holding tank waste. Like septic systems, package plants are designed to deal with sewage with a low solids content, and the treatment process itself is highly dependent on an environment that is not toxic to the treatment bacteria. Holding tank waste is concentrated, which may raise treatment and sludge handling issues. Normal difficulties with treatment variability would be worsened by the slug flow nature of the discharges to a package treatment plant, though they can be eliminated by "bleeding" the influent into the plant. In addition, the waste may contain metals and hydrocarbons which can destroy the treatment process in a small plant.

Based on these concerns, States may not want to encourage the development of a multiplicity of small sewage treatment plants, due to the variability of effluent quality as well as substantial difficulty in ensuring proper operation and maintenance of the mechanical components of such systems.

Septic Systems

Septic systems are the conventional on-site sewage treatment systems throughout the United States. They consist of a septic tank where primary treatment (physical operations) predominate. These operations are floatation, settling, and the digestion of the sludge that accumulates in the bottom of the tank. Effluent from the

tank is directed to a subsurface leaching system which provides additional treatment by establishment of a biological crust; its resultant permeability is a direct function of the BOD and suspended solids in the effluent stream. Once effluent leaves the crust zone it enters a soil environment where, if the septic system has been properly sited, a number of treatment processes will result in a high quality final effluent. The size and location of the leaching system (or drainfield) is extremely important because of the quality of the final treatment is highly dependent on the type and quantity of the soil through which the effluent will pass.

In general, septic systems are not a favorable option for the disposal of vessel sewage, because they are not designed to treat the high solids content, high strength, and possibly toxic content of these wastes. They are not very effective at removing trace organic chemicals, and are ineffective at removing nutrients. The chemical additives used to disinfect and deodorize holding tank waste may kill the bacteria that aerobically digest the sewage, allowing solids to pass through the septic tank and causing the drainfield to clog and overflow. Nutrients leaching from the drainfield may stimulate algal growth in receiving waters, which can reduce the amount of sunlight necessary for submerged aquatic vegetation to grow and use up oxygen needed for fish and other aquatic life. In marine waters nitrogen is the nutrient most likely to cause these adverse effects, while phosphorous is the problem in fresh water.

Vessel sewage should be discharged to a septic system only if no other options exist and the system is specifically designed and sited to receive such waste. This design includes: Using large tanks to manage and "bleed" in increased flows from pumpout stations; combining flows from ordinary bathroom facilities on-shore and the pumpout stations to dilute pumpout wastes; providing two septic tanks in series to help segregate solids in the first tank and increase retention time in the system; a large single drainfield or use of alternating drainfields, and proper siting to assure the leach field does not drain into the coastal waters or contaminate groundwater. In addition to following specific design criteria, septic systems should be inspected regularly and properly maintained.

Section 7. Types of Marine Boat Sewage Pumpout Stations and Dump Stations That may be Appropriate for Construction, Renovation, Operation, or Maintenance, and Appropriate Location of the Stations and Facilities Within a Marina or Boatyard

There are four basic types of pumpout stations on the market. Each one has its advantages and disadvantages. Since every marina is unique, there is no one solution that will work in all cases. Therefore, each case should be examined individually, and the pumpout that will work best in any particular situation should be selected. Costs for equipment and installation can vary greatly, depending on need for sewage lift stations to accommodate widely fluctuating tides, need for special onshore holding tanks to hold concentrated waste, cost of connection to a sewer system, and other factors. Stationary or portable dockside pumps cost in the range of $2,000 to $10,000, and typical complete installations may be as high as $20,000. Following is a list of pumpout station types with a discussion of advantages and disadvantages.

(1) *Stationary pumpout unit:* Stationary units include a connector hose and pump, and are connected directly to a local or municipal sewage treatment facility or a holding tank. The unit is usually located at the end of a pier or floating dock, often near the fueling facilities. Vessels access the pumpout station by approaching and securing to the dock or pier. Advantages are convenience, efficiency and speed of use. Principal disadvantage is that the unit restricts pumpout service to a single area of the marina, which may cause congestion.

(2) *Portable pumpout unit on wheels:* This unit may be a wheeled device, consisting of a holding tank, hose and mechanical or hand pump, that is pushed along a dock to the vessel's location to pump out vessel sewage. The advantage is the unit is brought to the boat rather than the boat to the station. When full of sewage, however, the unit can be heavy and cumbersome. Since it must be moved from boat to boat, the time required to complete the pumpout operation can be somewhat greater than that of fixed units. Being able to move the unit can also be an advantage for pumping out boats during slow weekdays, especially after a busy weekend. The unit is also limited by its storage capacity.

(3) *Portable pumpout unit on vessel:* This unit is a boat with pumpout station on board, consisting of a pump and holding tank, that may be radio-dispatched or respond to a signal flag, to pump vessel holding tanks. The advantage is the convenience of having the pumpout station come directly to the boat.

(4) *Remote operated multi-station system:* This system has a pump which transports wastes via a main sewer to central collection and treatment. This unit can provide pumpout capabilities at any number of locations throughout the marina. This system, which provides wastewater collection anytime, combines the convenience and efficiency of fixed units with the versatility offered by portables. This system must be specifically designed to individual project requirements.

There are five basic types of pumps used in pumpout systems. Following is a description of each.

(1) *Centrifugal pump (rotary or impeller types):* This pump works when sewage in its impeller is spun to the outside of the impeller by centrifugal force, which creates a low pressure area at the impeller as it pumps. Most centrifugal pumps require priming. This pump is usually employed in lift station situations.

(2) *Reciprocating pump (diaphragm and piston types):* This pump, mechanical or hand operated, creates suction by mechanically lifting a diaphragm up and pushing it down in a pump body. The diaphragm works in conjunction with two or four check valves. As the diaphragm lifts, the low pressure area under it causes sewage to be sucked into the body through the inlet check valve; when it is pushed down the pressure under the diaphragm closes the inlet check valve and forces sewage out the outlet check valve. This pump is self-priming.

(3) *Vacuum pump:* This pump does not directly contact sewage, but draws air out of a tank which creates the necessary low pressure area or vacuum to cause the sewage to flow in. When the accumulator tank is full, pressurized air enters the accumulator tank and the pressure pushes the sewage out to a sewer or holding tank. This pump allows pumping over longer distances.

(4) *Flexible vein impeller pump:* This pump has suction lift. It is easy to repair and needs no priming. A switch device is needed to prevent the pump from running dry and damaging the impeller.

(5) *Progressive cavity pump:* This pump consists of stainless steel rotor or screw surrounded by a tight fitting rubber sleeve. As the rotor turns the sewage is progressively moved to the discharge line. This pump is self-priming.

Equipment failure can occur with any of the above equipment. Most common

causes are mechanical failure, followed by clogging of hose and/or pump, loss of hose prime, and hose failure (Ross & Amaral, 1992).

In addition to pumpout stations, there are facilities to receive sewage waste from portable toilets. A dump station consists of a receiving receptacle for sewage from portable toilets, and includes associated equipment and storage tank or sewer line connection. This facility is not a land-based or floating restroom, but can be made a part of such. Floating dump stations should be considered at mooring fields and other strategic locations. The device typically includes a receiving basin, which should be a minimum of 12 inches in diameter, and with a lid that completely covers the receiving unit (to control odors and insect access), with provisions for rinsing the portable toilet following emptying of the contents. If the unit is designed to drain, the drain should be a minimum of 3 inches in diameter and equipped with an insect-tight cover. Dump stations should be equipped with a washdown system to allow cleaning of the portable toilet. The washdown system should be clearly marked as unfit for drinking water. Wand attachments may be connected to a pumpout station to empty portable toilets, rather than building a separate facility.

Following is a description of other equipment that is part of the pumpout station.

Pumpout station holding tanks: Holding tanks should be sized appropriately for the volume of sewage generated and the frequency of removal of material from the holding tank. State and local requirements may govern the size of holding tanks. Generally, a 1,500-gallon holding tank can serve up to 100 boats with holding tanks. In terms of the number of boats serviced with a normal removal schedule, the following minimum sizes are suggested:

Total number of boats serviced with holding tanks	Recommended holding tank volume (gallons)
1–20	300
21–40	600
41–60	900
61–80	1200
81–100	1500
100+	2000

Pipes/hoses: Discharge piping should be rigid or noncollapsing flexible, with locking connections. Corrugated or ribbed hoses are not recommended. The line should be watertight and appropriately fastened or secured to the dock or pier. Local building codes should be checked for specific piping requirements, but the following materials are generally accepted for pumpout station service: Polyvinyl chloride (pvc), and polyethylene. Expansion joints should be included where appropriate. Force main systems may require "thrust blocks" and other security fastenings.

Fittings: A deck fitting (sewage removal fitting) is a flanged fitting permanently mounted on the vessel and connecting to the onboard holding tank. A connector is a nozzle or coupling permanently attached to the suction hose of a pumpout station. An adapter is a fitting designed to facilitate adapting a pumpout connector to a vessel deck fitting.

When the requirement for vessels with an installed toilet to have a certified marine sanitation device went into effect under 33 CFR 159 on January 30, 1975, there was a requirement for sewage removal fittings or adapters to be 1.5 inch for boats less than 65 feet in length. The expected types of acceptable fittings included threaded, flanged, or quick disconnect fittings. However, 33 CFR 159 was amended on January 3, 1977 to allow holding tanks to be certified by definition if they store sewage and flushwater only at ambient air pressure and temperature. As a result, boats have been put on the market with many sizes of sewage removal connector fittings, requiring the use of adapters in order to assure a clean, tight connection when a pumpout occurs.

There are several adapters on the market today. A black rubber nozzle is used by most boaters. Another adapter, the fuel hose fitting or cam-activated connector, consists of a male portion which fits into the connector, and a female portion which locks onto the male portion.

A suction nozzle or fitting such as a friction nozzle (right angle preferred) or cam-activated quick connector positive locking attachment should be provided on the end of the suction hose. Adapters should be provided to fit the 1.5 inch discharge connector. A valve should be provided on the suction hose at the nozzle. A valve should be provided on the pump end of the suction line if the line is to be installed in a manner such that sewage would discharge from the line when the pump is removed for service. Positive locking connections on the end of the discharge line should be provided to prevent it from coming loose during discharge. The discharge line should be protected from freezing, and prevented from leaking into the water. Suction hoses should be equipped with a clear tubing or a sight glass on the suction end of the hose to allow the pumpout station operator to determine when the pumping is complete.

Other factors that should be considered when installing pumpout stations/dump stations include the following.

Convenient location enhances use. Stationary pumpout stations should generally be located as close to a boat off-loading point as possible and/or where boats need to maneuver the least. The end of a dock is a good location because it is accessible. Many facilities are located at the fuel dock, so boaters only have to go to one location for both of these activities. Water level changes should be considered when installing pumpout stations.

Operation and maintenance: Proper operation and maintenance of pumpout stations and dump stations are critical to provide adequate and reasonable service. An individual should be assigned responsibility for operation and maintenance of pumpout and dump stations. Consider appropriate protective clothing, such as gloves, and hand washing, to protect the operator. Washing facilities should be readily available.

Convenience for boaters and operators is a major factor. Hours of operation for pumpout stations should be keyed to general operating hours for vessels in the area. Specific maintenance and winter storage requirements depend on the system and the location. However, the following minimum maintenance is suggested to maintain sanitary conditions: Use dedicated system for flushing and rinsing hoses; flush hoses; pump clean water through the system, and empty into disposal area, never onto the ground or into the water.

An event or hour meter could be installed on the pump to monitor its use. Monitoring of pumpouts should be an integral part of a marina management program to ensure that the facilities are operating effectively. The following practices can be applied successfully to maintain pumpout facilities: arrange maintenance contracts with contractors competent in the repair and servicing of pumpout facilities; develop regular inspection schedules; maintain a dedicated fund for the repair and maintenance of facilities.

Section 8. Other Information That is Considered Necessary to Promote the Establishment of Pumpout Facilities to Reduce Sewage Discharges From Vessels and to Protect United States Waters

Public/private partnerships: Since approximately 80 per cent (based on the

1986–87 National Boating Facilities Survey, IMI/URI conducted for NMMA) of the marinas in the United States are privately owned, States are encouraged to develop partnerships, within State laws and regulations, with private marinas to construct pumpout stations at these facilities.

"No Discharge Areas": Sections 312(f)(3) and (4)(A) and (B) of the Clean Water Act of 1987 enable States to apply to the EPA for designation of certain water bodies as "No Discharge Areas". In doing so, States must meet specific criteria outlined in 40 CFR 140.4 including demonstrating to the EPA Administrator that adequate and reasonably available facilities exist for the safe and sanitary removal of boat sewage. States should not consider "adequate and reasonably available" under the Clean Vessel Act to satisfy all requirements for determining "No Discharge Areas" under the Clean Water Act. A separate review and determination would have to be made by the EPA for Clean Water Act designation of a "No Discharge Area".

Holding tank bypass: Discharge of raw sewage from a vessel in U.S. Territorial Seas (within the three mile limit) is illegal. Holding tanks are frequently bypassed with the use of valves, commonly called Y-valves. A valve may be installed on any marine sanitation device holding tank to provide for the direct discharge of raw sewage when the vessel is beyond the baseline of the Territorial Seas, which is more than three miles from shore. The valve must be secured in the closed position while operating in Territorial Seas. Use of a padlock, non-releasable wire-tie, or removal of the valve handle would be considered adequate securing of the device. The method chosen must be one that presents a physical barrier to the use of the valve or the toilet. All Y-valves should be standardized, so that the handle points in the direction that the sewage flows and/or indicates the open and closed position. The Y-valve should be place after the holding tank rather than between the toilet and holding tank.

Upland and floating restrooms: Clean, well-maintained restrooms are very desirable for boaters. Many boaters would rather use these when available than use holding tanks. Restrooms should be constructed at marinas and other strategic locations.

Rental Contracts: Marinas could add language in rental contracts to prohibit discharge of sewage into the marina waters.

Disinfectants, perfumes: Industry should produce only products which will not harm waste treatment plants or septic tanks. A symbol should be placed on the label of these products indicating they may be discharged into treatment plants or septic tanks if correctly used in a properly designed treatment system.

Additional information: For additional information on pumpout stations, refer to: (1) "A Guidebook For Marina Owners and Operators On the Installation and Operation of Sewage Pumpout Stations", Maryland Department of Natural Resources Boating Administration, Coastal Technology, Inc., February 1990; (2) "Commonwealth of Virginia Sanitary Regulations for Marinas and Boat Moorings", State Department of Health, Richmond, VA, 1990; (3) "Guidance for States and Municipalities Seeking "No Discharge Area" Designation for New England Coastal Waters", Rev. 4/92, U.S. Environmental Protection Agency, Region 1, Boston, MA; (4) "State of the Art Assessment of Boat Sewage Pumpout Program in Washington State", 12/91, Howard Edde, Inc., Bellevue, WA, for Washington State Parks and Recreation Commission, Olympia, WA. For further information on pumpout stations and dump stations, consult "Marina Pump Out Facilities", Joseph Wettemann, 1/89, and "Types of Pump Out Facilities", Natchex, 7/92.

Dated: February 11, 1994.

George T. Frampton, Jr.,

Assistant Secretary for Fish and Wildlife and Parks.

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APPENDIX E

REFERENCES

REFERENCES

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APPENDIX F

DATABASE QUERY EXAMPLE

2a. Type Of Treatment Provided

Date: 10/25/94 | **Plant Capacity Range (mgd)** |

	≤ 0.1	0.1 - 1.0	1.0 - 10.0	≥ 10
Lagoon	**3.00**	**7.00**	**3.00**	**2.00**
Trickling Filters	**1.00**	**5.00**	**3.00**	**2.00**
Activated Sludge	**2.00**	**19.00**	**21.00**	**5.00**
Final Filtration	**1.00**	**3.00**	**2.00**	**1.00**
Anaerobic Sludge Digestion	**0.00**	**6.00**	**10.00**	**6.00**
Aerobic Sludge Digestion	**0.00**	**11.00**	**11.00**	**0.00**
Total	**7.00**	**51.00**	**50.00**	**16.00**

2b. Level Of Treatment Provided

Plant Capacity Range (mgd)

	≤ 0.1	0.1 - 1.0	1.0 - 10.0	> 10
Primary Treatment	**6.00**	**17.00**	**24.00**	**10.00**
Secondary Treatment	**5.00**	**29.00**	**27.00**	**9.00**
Tertiary Treatment	**0.00**	**5.00**	**6.00**	**1.00**
Other	**2.00**	**5.00**	**6.00**	**2.00**
Total	**13.00**	**56.00**	**63.00**	**22.00**

3. Type Of Collection System

Date: 10/25/94 **Plant Capacity Range (mgd)** Page: 1

	≤ 0.1	0.1 - 1.0	1.0 - 10.0	≥ 10
Gravity Sewer System	2.00	3.00	0.00	2.00
Gravity Sewer With Pump Station(s)	6.00	24.00	27.00	8.00
STEP	0.00	2.00	1.00	1.00
Other	1.00	3.00	1.00	0.00
Total	9.00	32.00	29.00	11.00

5. High Strength Waste

Date: 10/25/94 **Plant Capacity Range (mgd)**

ACCEPTANCE		≤ 0.1	0.1 - 1.0	1.0 - 10.0	≥ 10
RV	YES	4.00	22.00	19.00	6.00
	@ WWTP	0.00	5.00	3.00	4.00
	w/i Collection	0.00	17.00	17.00	4.00
	NO	6.00	11.00	13.00	5.00
SEPTAGE	YES	2.00	8.00	12.00	7.00
	@WWTP	0.00	7.00	9.00	6.00
	w/i Collection	2.00	2.00	3.00	1.00
	NO	8.00	25.00	20.00	4.00
BOAT	YES	2.00	3.00	2.00	2.00
	@WWTP	0.00	1.00	0.00	2.00
	w/i Collection	2.00	3.00	2.00	0.00
	NO	8.00	30.00	30.00	10.00
OTHER	YES	0.00	4.00	1.00	3.00
	@WWTP	0.00	2.00	0.00	1.00
	w/i Collection	0.00	2.00	0.00	2.00
	NO	10.00	29.00	31.00	8.00
Total		8.00	37.00	34.00	17.00

6. Problems With High Strength Waste

Date: 10/25/94 | **Plant Capacity Range (mgd)** | Page: 1

PROBLEMS					
ODORS		1.00	11.00	6.00	3.00
Collection System	RV	1.00	6.00	1.00	0.00
	ST	0.00	3.00	1.00	1.00
	BW	0.00	1.00	1.00	0.00
Treatment Plant	RV	0.00	8.00	2.00	0.00
	ST	0.00	7.00	5.00	2.00
	BW	0.00	1.00	1.00	0.00
CORROSION		0.00	3.00	2.00	1.00
Collection System	RV	0.00	2.00	1.00	0.00
	ST	0.00	3.00	1.00	0.00
	BW	0.00	0.00	1.00	0.00
Treatment Plant	RV	0.00	3.00	1.00	0.00
	ST	0.00	2.00	1.00	1.00
	BW	0.00	0.00	1.00	0.00
PLUGGING		1.00	4.00	7.00	1.00
Collection System	RV	1.00	2.00	2.00	0.00
	ST	0.00	5.00	1.00	0.00
	BW	0.00	0.00	1.00	0.00
Treatment Plant	RV	0.00	1.00	1.00	1.00
	ST	0.00	2.00	3.00	2.00
	BW	0.00	0.00	1.00	0.00
OVERLOAD		0.00	10.00	6.00	0.00
Collection System	RV	0.00	3.00	1.00	1.00
	ST	0.00	4.00	0.00	1.00
	BW	0.00	1.00	1.00	1.00
Treatment Plant	RV	0.00	6.00	1.00	1.00
	ST	0.00	7.00	4.00	1.00
	BW	0.00	2.00	1.00	1.00
PERMIT VIOLATION		1.00	3.00	1.00	0.00
Collection System	RV	0.00	1.00	2.00	0.00
	ST	1.00	2.00	0.00	1.00
	BW	0.00	1.00	1.00	1.00
Treatment Plant	RV	0.00	1.00	0.00	0.00
	ST	0.00	2.00	2.00	1.00
	BW	0.00	0.00	0.00	1.00
SLUDGE HANDLING		1.00	5.00	1.00	1.00
Collection System	RV	0.00	2.00	0.00	0.00
	ST	0.00	4.00	0.00	1.00
	BW	0.00	1.00	0.00	0.00
Treatment Plant	RV	1.00	1.00	0.00	0.00
	ST	0.00	4.00	3.00	0.00
	BW	0.00	1.00	0.00	0.00
EFFLUENT TOXICITY		0.00	4.00	0.00	0.00
Collection System	RV	0.00	4.00	1.00	0.00
	ST	0.00	2.00	0.00	0.00
	BW	0.00	1.00	0.00	0.00
Treatment Plant	RV	0.00	2.00	0.00	0.00
	ST	0.00	2.00	1.00	0.00
	BW	0.00	0.00	0.00	0.00
OTHER		0.00	2.00	0.00	0.00
Collection System	RV	0.00	1.00	0.00	0.00
	ST	0.00	0.00	0.00	0.00
	BW	0.00	1.00	0.00	0.00
Treatment Plant	RV	0.00	2.00	0.00	0.00
	ST	0.00	0.00	0.00	0.00
	BW	0.00	1.00	0.00	0.00

8. Problems With Additives

Plant Capacity Range (mgd)

TYPE	≤ 0.1	0.1 - 1.0	1.0 - 10.0	≥ 10
Formaldehyde	6.00	20.00	15.00	8.00
Enzyme	0.00	7.00	6.00	4.00
Soap/Detergent	2.00	13.00	11.00	4.00
pH Buffer	1.00	8.00	7.00	2.00
Ammonium Compounds	2.00	11.00	13.00	5.00
Others	1.00	1.00	3.00	2.00

9. Location To Accept Boat Waste

Date: 10/25/94 **Plant Capacity Range (mgd)** Page: 1

TYPE	≤ 0.1	0.1 - 1.0	1.0 - 10.0	≥ 10.0
Within Collection System	6.00	14.00	14.00	5.00
@WWTP	0.00	9.00	10.00	4.00

3. Travel Time From Marina To WWTP

Date: 10/25/94 | **Plant Capacity Range (mgd)** | Page: 1

TIME	≤ 0.1	0.1 - 1.0	1.0 - 10.0	> 10.0
< 30 Minutes	**0.00**	**2.00**	**0.00**	**0.00**
0.5 - 1 hours	**1.00**	**5.00**	**4.00**	**2.00**
1 - 4 hours	**4.00**	**6.00**	**8.00**	**2.00**
4 - 8 hours	**0.00**	**3.00**	**1.00**	**0.00**
> 8 hours	**0.00**	**2.00**	**0.00**	**1.00**

11. Modifications Needed To Accept Boat Waste

Date: 10/25/94 | **Plant Capacity Range (mgd)** | Page: 1

	< 0.1	0.1 - 1.0	1.0 - 10.0	> 10.0
Receiving Station @ Marina	**4.00**	**17.00**	**16.00**	**6.00**
Receiving Station @ WWTP	**1.00**	**5.00**	**8.00**	**0.00**
Holding Tank @ Marina	**3.00**	**12.00**	**9.00**	**5.00**
Pumping To Ensure Uniform Flowrate	**3.00**	**15.00**	**16.00**	**4.00**
Sampling	**3.00**	**15.00**	**16.00**	**7.00**
Flow Metering	**2.00**	**10.00**	**10.00**	**4.00**
Additional Staff	**1.00**	**4.00**	**4.00**	**1.00**
Chemical Addition	**1.00**	**7.00**	**6.00**	**0.00**
Laboratory Testing Services	**3.00**	**8.00**	**9.00**	**4.00**
Additional Sewer Cleaning	**0.00**	**6.00**	**6.00**	**1.00**
Other	**2.00**	**3.00**	**5.00**	**2.00**

FOR FURTHER INFORMATION ABOUT THIS REPORT OR OTHER BOATING PROGRAMS OF THE MARINE BOARD PLEASE CONTACT:

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