

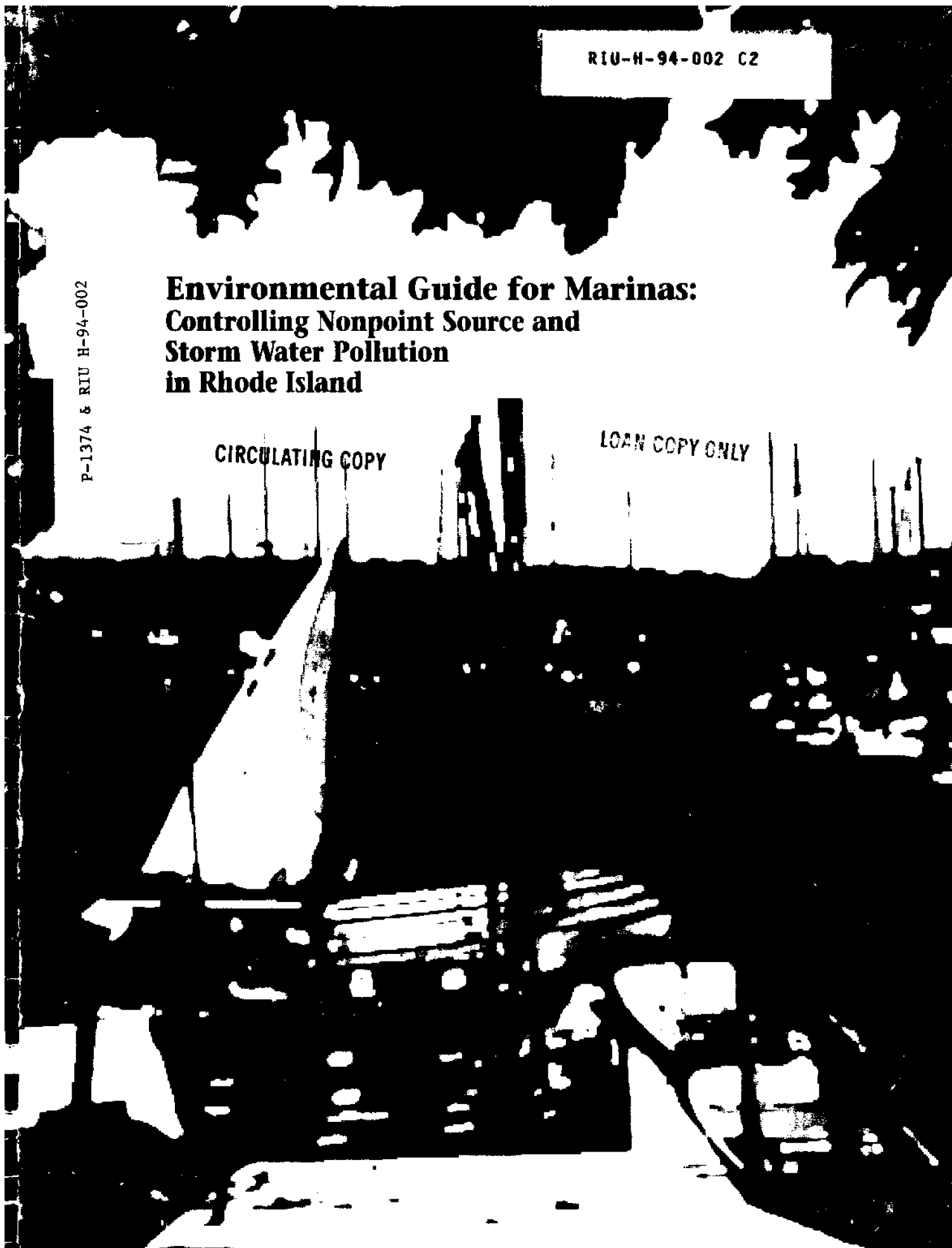
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Environmental Guide for Marinas: Controlling Nonpoint Source and Storm Water Pollution in Rhode Island

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ENVIRONMENTAL GUIDE FOR MARINAS

Controlling Nonpoint Source and Storm Water Pollution
in Rhode Island

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Coastal Resources Center

in cooperation with
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OVERVIEW

Pollution from nonpoint sources is a national concern that needs to be addressed at the federal, state, and local levels. Nonpoint source pollution (NPS) is "caused by rainfall or snow melt moving over and through the ground and carrying natural and manmade pollutants into lakes, rivers, streams, wetlands, estuaries, other coastal waters and ground waters" (EPA, 1990). NPS is also associated with any discrete source of pollution that enters surface waters, such as hazardous material spills, excess or residue detergents and solvents, and fertilizers. Sources of nonpoint pollution regularly introduce contaminants, such as bacterial concentrations, nutrient and Biological Oxygen Demand (BOD) loading, suspended solids, and petroleum products. Studies show that these contaminants have significant effects on water quality as it relates to fin- and shellfishing and recreational activities, such as boating and swimming. In extreme cases, this pollution can have economic impacts on the tourism, recreational boating, and fishing industries as water quality decreases.

Currently, federal and state government agencies are working to build upon existing management policies and practices to minimize the effects of nonpoint sources of pollution. To support and build upon this initiative, this document has been created. It is based upon experience gained in designing and testing best management practices (BMPs) at selected model recreational boating facilities. This document will provide guidance to the managers of recreational boating facilities to reduce NPS associated with marina operations. Although this document is not regulatory in nature, it provides the reader with a selection of practices that, when applied correctly and appropriately in an Operations and Maintenance Program (OMP), should help the recreational boating facility conform with nonpoint source pollution regulations. Throughout the document, recreational boating facilities will be used interchangeably with marinas, yacht clubs, and boatyards. For the purposes of this document recreational boating facilities includes any dock, pier, wharf, float, floating business, or combination of such facilities that service five or more recreational boats as a commercial enterprise or in association with a club (Olsen, 1983).

NONPOINT SOURCE POLLUTION CONTROLS

Activity surrounding nonpoint source regulation has been spurred by the enactment of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). The reauthorization establishes section 6217 specifically to address the abatement of nonpoint source pollution in coastal waters. Section 6217 is enforced by requiring states with approved coastal zone management (CZM) programs to develop a coastal nonpoint source pollution control program (CNPCP) that contains enforceable policies. A state's plan must conform with management measures established by the Environmental Protection Agency (EPA) and The National Oceanic and Atmospheric Administration (NOAA). Section 6217(g)(5) defines management measures as:

economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives.

Failure to comply will result in the state's losing a portion of its federal funding under section 306 of the Coastal Zone Management Act (CZMA) and section 319 of the Clean Water Act. In developing the management measures and associated best management practices, EPA established five working groups:

- (1) urban, construction, highways, airports/bridges, and septic systems;
- (2) agriculture;
- (3) forestry;
- (4) marina and recreational boating; and,
- (5) hydromodification and wetlands.

Each group worked with EPA and NOAA to develop acceptable management measures and recommended best management practices. The final outputs from these working groups are in EPA's document, *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, issued in January, 1993. States with approved coastal zone management programs had 30 months from this date to receive approval for their CNPCP.

The CNPCP should augment existing state nonpoint source pollution programs and coastal zone management programs. According to the EPA, "Section 6217 is to strengthen the links between Federal and State coastal zone management and water quality programs and to enhance the State and local efforts to manage land use activities that degrade coastal waters and coastal habitats." State programs must, by statute, "coordinate closely with existing Clean Water Act programs and with approved coastal zone management plans." These requirements form a nexus between federal and state Clean Water Act and CZMA programs, fostering working relationships to develop and administer the CNPCP.

RHODE ISLAND NONPOINT SOURCE POLLUTION CONTROLS

In Rhode Island, the two agencies responsible for developing and administering the CNPCP are the Coastal Resource Management Council (CRMC) and the Department of Environmental Management (RI DEM). The CRMC administers the state's approved Coastal Zone Management program and uses funding from section 306 of the Coastal Zone Management Act. RI DEM has a wide range of missions, authorities, and funding sources, a part of which is section 319 of the Clean Water Act.

This document was created at a time when the State of Rhode Island, through the Department of Environmental Management, the Department of Administration's Division of Planning, (RI DOP) and the Coastal Resource Management Council, is developing its CNPCP in accordance with the requirements of CZARA. The CNPCP must be approved and operating by July 1995. This network of agencies is also working to update the state's existing Nonpoint Source Management Plan, completed in 1989 in accordance with Section 319 of the Clean Water Act. This plan identifies control measures and management approaches for categories of nonpoint pollution and it outlines a framework for local and state coordination in nonpoint source abatement activities (RI DEM, 1989).

ABATING NONPOINT POLLUTION AT MARINAS

To guide marinas through the process of implementing nonpoint source pollution control measures, a project was designed and funded to develop BMPs for the Rhode Island marina industry. This project began in 1992 through a grant from the EPA Region I,

using funding from section 319 of the Clean Water Act. The grant was downlinked to the RI DEM, which then allocated the funding to the Coastal Resources Center (CRC) at the University of Rhode Island. The project was developed to reduce nonpoint sources of pollution at marinas and, in doing so, gain experience that can be used during the development of Rhode Island's CNPCP. The project applies and evaluates best management practices for marinas that meet the management measures detailed in §6217(g) of CZARA. The project's two primary objectives are: (1) prepare a Marina Operations and Maintenance Plan guidance document that identifies appropriate best management practices to mitigate nonpoint sources of pollution for a wide range of operations and marina sizes. Marinas will need to apply these BMPs once the CRMC and RI DEM complete the CNPCP in response to section 6217 of CZARA; and, (2) to reduce nonpoint pollution sources by conducting a demonstration project in cooperation with two model marinas. Best management practices, once implemented, were evaluated for effectiveness for abatement of nonpoint source pollution, ease of implementation, and cost effectiveness.

A project advisory committee consisting of federal and state regulators, marina industry representatives, and university researchers guided the implementation process. This committee was invaluable during the development of this document for providing important input, insights, and expertise.

PROJECT COMPONENTS

The project consists of four major components: demonstration, evaluation, education, and development of the best management practice document. Each component is a building block for the next. The process provides a means for interacting directly with the marina industry at each stage of the project to ensure that accurate and acceptable products are produced.

1. Demonstrations

The demonstration segment of the project occurred at two different types of boating facilities. The primary model facility is a small, privately owned and operated marina capable of wet-storing approximately 70 vessels up to 50 feet in length. This facility provides light repair work and general vessel maintenance service. The second modeling site is a large, corporate-owned facility capable of wet storing up to 220 vessels. Full-service facilities operate on the six acres of upland area, including painting and fiberglassing sheds, an engine repair shop, and a ship's store. BMPs were implemented at the primary site using some cost share funds that were made available through the federal grant. Once implemented, BMPs were evaluated for their appropriateness in regards to the nonpoint source pollution problem the practice was designed to address. BMPs were also evaluated in terms of their acceptability by the marina manager and the tenants. The best management practice chapter of this document is based primarily on the experience gained from the demonstration segment of the project.

2. BMP Evaluation -Water Quality Testing

To measure the effectiveness of the best management practices at the model marina, a limited water quality study is part of the project. The water quality testing component was initiated by the Project Advisory Committee, which expressed concern about the lack of scientific evidence that clearly identified the nonpoint source problem and its relationship

to recreational boating facilities. This sentiment is echoed in a report issued by the International Marina Institute in response to Chapter 5 of the proposed *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* issued under the authority of section 6217(g) of CZARA. The report indicates that there is insufficient scientific knowledge about the extent of pollutant loading and the effects of BMPs on mitigating nonpoint sources of pollution in marinas. (Ross and Amaral, 1991)

The sampling component of the project measured levels of: total petroleum hydrocarbons (TPH); bacteria; metals, including lead, copper, and zinc; and total suspended solids (TSS). The target pollutants were selected according to those pollutants that are traditionally found in marinas according to Chapter 5 of the *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Appendix E further explains the water quality study component of this project and provides the collected data.

3. Education

Education is the third project component. Nonpoint source pollution fact sheets for boaters were created by the Project Advisory Committee and distributed at boat shows in the state. A poster was also created depicting the location of pumpout stations within the state and providing information about the pumpout facilities, such as time of operation and fee for use. Tours of the model facilities were conducted to provide an opportunity for marina operators, marine trade representatives, and federal, state, and local regulators to discuss nonpoint source pollution problems. This method has proven to be effective in developing positive personal relationships between the regulators and the regulated. Appendix D includes some educational information that can be used by marina operators.

BEST MANAGEMENT PRACTICE DOCUMENT

The final output from this project is this guidance document, which includes descriptions of practices and technologies for spill prevention and mitigation, disposal of toxic products, proper maintenance practices, and the collection of boat sewage based on the experience gained in the demonstrations. In developing these best management practices (BMP), the Coastal Resources Center coordinated closely with the Rhode Island DEM Division of Water Resources and Office of Environmental Coordination, Coastal Resource Management Council, Rhode Island Marine Trade Association, and other appropriate agencies and organizations to evaluate traditional practices and consider alternate methods. This was primarily achieved through the demonstration component of the overall project. However, information and experiences from other sources were also included. A baseline list of traditional BMPs was compiled by completing an extensive literature search of existing BMP documents. Additional experiential information was collected by completing multiple site visits of marinas not participating in the demonstration project. Site visits documented the types of activities on-site and what BMPs were being applied. Although the BMPs included in this document are based on a wide range of informational sources and experiences they are not all-inclusive and do not preclude marina operators from applying additional, alternate BMPs to reduce nonpoint sources of pollution. Marina activities vary greatly, as do the solutions to reduce pollution produced by the activities. Therefore, marina managers are encouraged to apply their expertise and skill to developing technically sound management practices that are as capable of minimizing or eliminating nonpoint sources of pollution as the BMPs provided in this document.

For organizational purposes this guidance document divides Best Management Practice into four major sections:

- (1) Solid waste and storm water runoff
- (2) Fuel, oil, and other hydrocarbons
- (3) Hazardous material and liquid waste
- (4) Vessel discharge of sewage

These sections were selected by the project advisory committee because they encompass the range of pollutants that are considered when implementing nonpoint source pollution controls. These major sections also relate to activities that traditionally occur within marinas. Activities include winterizing, fueling, storing, cleaning, maintaining and servicing boats. To improve the organization, each section is divided into subsections that contain pertinent best management practices. Subsections were based on broad management practices that contain multiple, independent best management practices. The subsections generally include BMPs for:

- (1) storage and containment
- (2) spill protection
- (3) disposal
- (4) source control/delivery reduction
- (5) education
- (6) signs
- (7) contracts

Each subsection contains multiple best management practices that have been designed based on the experience gained in the demonstration component of the project and the other informational sources used. Provided with a range of BMPs, the marina manager can select what practices are most appropriate for the particular activities that exist on site.

In addition to the best management practices, the document also discusses pollution impacts and fates in the marine environment; provides a framework to create an individual operations and maintenance program (OMP); and, provides an example of a completed program for a model marina. The section on pollutant impacts and fates provides a broad overview of the types of pollutants that generally exist within marina facilities, the general characteristics of those pollutants, and what happens to them once they are released into the marine environment.

The chapter on developing an individual operation and maintenance program provides a framework for selecting appropriate BMPs. The purpose of this program is to identify what operation and maintenance activities a marina needs to consider in terms of nonpoint source pollution, and to outline what steps are being implemented to address those activities. This chapter provides a basic framework that a marina operator may choose to use in developing an operation and maintenance program.

The final chapter focuses on developing an OMP. We provide a general overview of a model marina and what activities are prevalent. This information is then applied to developing an operations and maintenance program, using the framework developed in the previous chapter.

Besides the complete reference section, selected publications divided by topic are presented. Topics include: environment and pollution assessment; marina design; marina

economics; hazardous material; fueling, oil, and other hydrocarbons; liquid and solid waste; vessel discharge of sewage; general information pertaining to marinas.

This manual also provides five appendices, each designed to supplement information provided in one of the chapters. The first appendix is a model oil spill response plan. Appendix B is a summary of the Rhode Island storm water pollution program. This is provided because of the overlap between the storm water and nonpoint source program. Although this manual is designed primarily for the nonpoint source program, it provides a framework that accounts for both programs. Appendix C is a list of known pumpout manufacturers. Appendix D contains information sheets developed for boaters. These can be used by the marina operators for educational material. The final appendix presents the data collected in the water quality component of the project.

Overall, our experience has been that the interaction of these stakeholders throughout the project bolstered relationships between the government agents and the marina representatives. This was especially apparent during the marina tours, when regulators and marina operators had the opportunity to discuss multiple issues throughout the day. This process also created a constituency for implementation. The model marinas, by participating in the project, have already begun implementation of best management practices. Other marinas not directly involved in the modeling can apply the model marina's experience by using this guidance document. This proactive stance has allowed the marina industry in Rhode Island to work with, and influence, state regulatory agencies in the early stages of policy development. The result is an accepted body of regulation that adheres to the goals set forth by Congress, does not substantially burden the marina industry, and, ultimately, results in a cleaner environment.

Pollution Impacts and Fates in the Marina Environment

POLLUTANT CHARACTERISTICS AND FATE¹

A broad range of pollutants (sediments, heavy metals, hydrocarbons, solvents, antifreeze, acids/alkalis, nutrients, and bacteria) are regularly contributed to the surrounding coastal waters. These pollutants may be transported to the marine environment via surface runoff, groundwater, air, or direct discharge to the receiving water. Modes of transport for a specific pollutant depend on its source and characteristics.

The following discussion focuses on the general characteristics of these pollutants, and their modes of transport and ultimate fate in marine environments. This information is important to understanding the potential for negative impacts, as well as identifying potential control mechanisms. Table 1 presents an overview of the general physical and chemical characteristics, fates, modes of transport, and potential environmental consequences of various pollutants.

Sediments

Sediments, both inorganic and organic, may enter marine waters from numerous marina activities. These activities include erosion during construction, vessel scraping and sanding, and storm water runoff. Other contaminants, such as heavy metals, hydrocarbons, and nutrients, may be associated with these sediments.

Sediments discharged to coastal waters in storm water, rinse water runoff, or via other sources, ultimately accumulate in depressions. Movement of accumulated sediments may occur, resulting in resuspension and tidal circulation. Sediments may be inorganic or organic in nature, ranging in size from fine silts and clays to coarse sands and gravels.

Regardless of their source, sediments may present the following direct environmental impacts: 1) burial of food organisms and habitat; 2) increases in turbidity, which may reduce primary productivity (EPA, 1993) as well as affect feeding efficiencies of visual feeders; 3) clogging of the gills of fish; and 4) increases in sediment oxygen demand, resulting in dissolved oxygen depletion. In addition, numerous other contaminants, such as heavy metals, hydrocarbons, and nutrients, may be associated with sediments. These contaminants may find their way into the water column from the sediments through resuspension or dissolution. The impacts of these associated contaminants are discussed below.

Heavy Metals

Heavy metals (such as aluminum, iron, lead, nickel, zinc, cadmium, copper, tin, and chromium) are contained in paint particles from sandblasting and boat washings, metal shavings from engine oils, bilge water, and runoff from maintenance and repair areas. Metals are also contained in some wood preservatives commonly used in marina construction, such as chromated copper arsenate (CCA). Metal contaminants are also

¹This text was adapted from:

Connecticut Department of Environmental Management. 1992. *Best Management Practices for Coastal Marinas*. Report completed by Fugro and McClelland for Connecticut Department of Environmental Protection, Office of Long Island Sound Programs, and Bureau of Water Management, financed by an EPA 319 Nonpoint Source Implementation Grant.

commonly found in urban runoff and some sewage treatment plant and industrial discharge effluents. The accumulation of heavy metals, such as lead, copper, zinc, and mercury, has been documented in studies of marina impacts (McMahon, 1989). However, the McMahon (1989) study also concluded that the levels of accumulation were similar to those in other areas affected by human activity. Testing of sediment prior to dredging shows that cadmium, chromium, and nickel frequently accumulate in dredged areas associated with marinas, at elevated concentrations that can result in adverse biological effects.

Antifouling paints are designed to be toxic to marine organisms and are the primary source of zinc at marinas. Other investigators (CT DEP, 1992) found higher levels of zinc in waters and sediments associated with increasing density of boats. Zinc may also be derived from motor oil and tires and is a common constituent in urban runoff (Athayde et al., 1983). Land-based sources of nickel include brake linings and pavement material. Various marina maintenance and repair activities, as well as engines, may contribute nickel to the coastal environs. Potential sources of cadmium include batteries, street runoff, sewage treatment plant effluent, and industrial effluent.

The solubility of heavy metals is controlled by numerous factors, but particularly by salinity and pH in marine environments (Balls, 1989). Many heavy metals are known to absorb into particulate matter and accumulate in bottom sediments. Balls (1989) suggests that the affinity of metals to form complexes with particulate matter in coastal waters decreases as follows: Pb, Hg > Cr, Zn, Ni > Cd. That is, lead (Pb) and mercury (Hg) are strongly associated with particulates while cadmium (Cd) has a greater tendency to remain in dissolved form. These pollutants pose an environmental concern because of the potential for bioaccumulation, bioconcentration and, in the case of mercury, biomagnification in aquatic organisms (Connell and Miller, 1984)². In addition, mobilization of these pollutants into the water column may result in acute or chronic toxicity to aquatic life. The lethal toxicity to marine fish (i.e., the concentration which results in 50 percent mortality of individuals exposed for a 96-hour period; 96-hour LC₅₀) varies depending upon the metal and, in some cases, its speciation or chemical form. Lethal toxicity levels vary in order of increasing concentration as follows: Hg < Cu < Cd < Zn < Pb < Ni. That is, mercury (Hg) produces 50 percent mortality at concentrations lower than copper (Cu), and so on (Connell and Miller, 1984).

Hydrocarbons

There are numerous potential sources of hydrocarbons within marinas, including fueling docks, engine repair or maintenance activities, dredging, urban storm water runoff, and boat operation. Elevated levels of hydrocarbons in the water column and the accumulation of hydrocarbons in sediments have been documented in studies of marinas (McMahon, 1989).

² Connell and Miller define these terms as follows:

Bioaccumulation is the uptake and retention of pollutants from the environment by organisms via any mechanism or pathway.

Bioconcentration is uptake and retention of pollutants directly from the water mass by organisms through such tissues as the gills or epithelial tissues.

Biomagnification is the process whereby pollutants are passed from one trophic level to another and exhibit increasing concentrations in organisms related to their trophic status.

During fueling operations at fueling docks, hydrocarbons (in the form of dripping gasoline or diesel fuel) may be discharged into the water, onto the dock, or onto adjacent land areas. Accidental spills or releases during fuel delivery may result in the discharge of hydrocarbons directly to the receiving water or via surface runoff or ground water transport. Leaking storage tanks may also result in such discharges.

The drippings and drainings from marine engine repair and maintenance may contain fuels, oil, or other oil-based lubricants. If not properly contained, these drippings and drainings may enter the receiving water via surface runoff or ground water transport from work areas.

Urban storm water runoff also contains petroleum hydrocarbons (Athayde, et al., 1983). Depending on land use, median concentrations of hydrocarbons in urban runoff of 2.5 - 5.0 mg/l have been documented (Hoffman, 1985). Therefore, runoff from parking areas, boat ramps, and other impervious areas may contribute hydrocarbons to the marine environment.

Hydrocarbons vary considerably in their physical properties and chemical composition (Connell and Miller, 1984). However, in general they have a low solubility in water and readily adsorb to particulate matter in aquatic environments. Low molecular weight components of hydrocarbons may be lost from aquatic environments due to volatilization. However, heavier constituents may accumulate in bottom sediments. Microbial degradation is the primary degradation pathway for accumulated hydrocarbons. Some constituents (i.e., polynuclear aromatic hydrocarbons - PAHs) may be toxic to aquatic organisms at concentrations as low as 0.1 to 0.5 ppm. Further, many PAHs may bioaccumulate and are carcinogenic, mutagenic, and teratogenic (Connell and Miller, 1984).

Solvents

Various vessel maintenance and repair activities involve the use of solvents, such as methylene chloride, tetrachloroethane, trichloroethene, and trichloroethylene. These activities include engine repair and maintenance, as well as vessel painting and cleaning. Most solvents are mobile in groundwater and may enter the receiving water via ground water transport, or in surface runoff from work areas.

Solvents such as tetrachloroethylene, tetrachloroethane, trichloroethylene, trichloroethene, and methylene chloride are used as degreasing agents and in varnishes, paint removers, and lacquers. These generally stable compounds are insoluble in water and may accumulate in deep aquifers due to their high density. These solvents may be entrained in lateral ground-water flow, but will generally sink in water until an impermeable layer (e.g., bedrock) is reached. Many solvents are known carcinogens.

Antifreeze

Antifreeze that contains ethylene glycol or propylene glycol is toxic to aquatic organisms. Such antifreezes are used as engine coolants and to prevent freezing during winter storage. Both dry storage and engine maintenance involve the use, storage, and disposal of these materials. Improper use, storage, or disposal may result in the release of these compounds to the marine environment via surface runoff or ground-water transport. Antifreeze is also released to the surface water by direct discharge, particularly in the spring when boats are launched after winter storage.

Propylene glycol is reportedly significantly less toxic than ethylene glycol to aquatic life and is generally preferred over ethylene glycol for use in boats (CT DEP, undated).

Tributyltin

Tributyltin (TBT), an antifouling additive in paints, came into considerable popularity because of its ability to keep boat hulls clean (CT DEP, undated), and because it does not react chemically with aluminum hulls. Nichols (1988) documented high concentrations of tributyltin in harbors. Microbial degradation is the primary process accounting for the degradation of TBT in seawater (Seligman et al., 1988). TBT inhibits the growth of organisms by slowly releasing from the paint. However, TBT is generally nonspecific in the organisms it affects. Therefore, while it effectively controls the growth of algae and barnacles on boat hulls, it may adversely affect other nontarget organisms.

The EPA has restricted the use of antifouling paints with release rates greater than 4.0 micrograms per square centimeter per day. TBT, with a release rate of 4 micrograms or less, may only be used on vessels larger than 82 ft (25 meters), or aluminum hulled vessels regardless of size. Additionally, TBT (4 micrograms or less) may be used in a spray can to paint outboard or lower drive units.

Acids/Alkalis

The primary potential sources of acids and alkalis from marinas are batteries and compounds used for cleaning vessels. Battery acid is extremely corrosive and often contains high concentrations of heavy metals (i.e., lead). Spilled battery acid may be transported to the marine environment via surface runoff or ground-water transport. Cleaning compounds and detergents often contain strong acids or lye. These acids and alkalis may enter marine waters via direct discharge if cleaning takes place over the water, or via surface runoff or ground-water transport from upland work areas. Acids may solubilize other contaminants, such as heavy metals, resulting in indirect toxicity to aquatic organisms. Acids may also lower the pH of the receiving water, particularly on a localized basis, resulting in the loss of aquatic life.

Surfactants

Surfactants, which act to reduce surface tension, are present in most detergents and other cleaning agents. Surfactants occur in a wide variety of chemical formulations of both natural and synthetic origin (Connell and Miller, 1984). According to Connell and Miller (1984), surfactants may accumulate in sediments and undergo microbial degradation in soils. Some surfactants, such as alkyl benzene sulfonate (ABS), may exhibit acute and chronic toxicity to aquatic organisms. In aquatic environments, surfactants that accumulate may form a surface film and reduce oxygen transfer at the air-water interface (Connell and Miller, 1984). In addition, surfactants have been documented to exhibit synergistic effects with other substances. Indirectly, surfactants may alter the hydraulic characteristics of soils, thus affecting the movement of contaminants through soils and into groundwater (Connell and Miller, 1984). Surfactants and detergents may also cause foam on the receiving waters, which is aesthetically unacceptable.

Nutrients

Nutrients, particularly nitrogen and phosphorus, are essential to aquatic plant and algae growth. However, in excessive concentrations they may stimulate nuisance growths of these plants. Excessive plankton growth and decay can lower dissolved oxygen concentrations and reduce light penetration, which in turn can cause declines in aquatic vegetation, such as eelgrass, and aquatic animals. Marina activities that may result in the discharge of nutrients to receiving waters include urban storm water runoff, sanitary wastewater disposal, dredging, and vessel cleaning. Also, fertilizers applied to lawns at marinas can be transported to the water resource by air and storm water.

Phosphates and nitrogen compounds contained in cleaning agents may enter surrounding waters via surface runoff or ground-water transport from work areas. Dredging activities may result in the release or resuspension of sediment-bound nutrients within the marina itself. Storm water runoff from impervious surfaces (e.g., parking areas, roof tops, etc.) also contains elevated nutrient concentrations (Athayde et al., 1983). Soils eroded from construction sites or other nonstabilized pervious areas may transport soil-bound nutrients into the marine environment via surface runoff. Phosphates that find their way into groundwater are generally absorbed within the soil matrix. However, nitrates typically travel indefinitely in the ground-water regime.

Sanitary wastewater contains high concentrations of both phosphorus and nitrogen. Nutrients in sanitary wastewater may be discharged to marina waters via ground-water transport from onshore septic systems, as well as in surface runoff, where surface break-outs occur from failing onshore septic systems. Mobile and fixed pumpout facilities may also discharge nutrients to the receiving water due to spillage and cleaning of hoses in the marina. Direct discharge of untreated sanitary wastes from boats is prohibited in the state of Rhode Island. However, illegal discharges by boaters may represent a direct source of nutrients within marinas.

Bacteria

The principal source of bacteria discharged to marina waters is sanitary wastewater disposal. However, urban storm water runoff has also been found to contain elevated bacteria concentrations from domesticated animals as well as natural sources (Heufelder, 1987 and Koppleman & Tannenbaum, 1982). Onshore septic systems, spillage from sanitary pumpout facilities, and illegal discharges may contribute bacteria to the marine environment via ground-water transport, surface runoff, and direct discharge to the receiving water. Whatever the source, elevated bacteria concentrations above state or local standards result in the mandatory closure of shellfish harvesting and swimming areas.

Floatables/Plastics

In marinas, the primary sources of floatable and plastic materials discharged to the marine environment are the degradation of certain marine construction materials and solid wastes generated by marinas or marina users. The principal mode of entry is direct discharge to the receiving water, although some solid wastes may be conveyed by surface runoff. Combined sewer overflows (CSOs) and storm drainage from upland areas are likely the major contributors of floatables and plastics to coastal waters.

Table 1. Pollutant Characteristics, Fates, and Environmental Consequences (Adapted from Connecticut Department of Environmental Protection, 1992)

Pollution Type	General Characteristics	Ultimate Fate	Potential Environmental Impact
Sediments	<ul style="list-style-type: none"> Inorganic or organic in nature May have adsorbed contaminants (e.g., nutrients, heavy metals, hydrocarbons, etc.) 	<ul style="list-style-type: none"> Accumulation in bottom depressions 	<ul style="list-style-type: none"> May decrease dissolved oxygen Interfere with food uptake by shellfish, causing reduction in reproductive success Toxicity due to clogging of gills Burial of habitat/organisms
Heavy Metals	<ul style="list-style-type: none"> Bind to sediments by adsorption exchange, or complexation Chemical complexes Solubility affected by environmental conditions (salinity, pH, etc.) Persistent in the environment 	<ul style="list-style-type: none"> Sediment Accumulation Bioaccumulation Microbial degradation Bioconcentration 	<ul style="list-style-type: none"> Acute or chronic toxicity to marine plants and animals
Hydrocarbons	<ul style="list-style-type: none"> Vary widely in physical properties and chemical composition Aliphatic and aromatic hydrocarbons Low solubility in water Readily adsorb to particulate matter in aquatic environments. 	<ul style="list-style-type: none"> Volatilization to atmosphere Sediment accumulation Microbial degradation Bioaccumulation Bioconcentration 	<ul style="list-style-type: none"> Some constituents toxic to marine plants and animals at low concentrations Some constituents carcinogenic
Other Organic Compounds (e.g. PCBs).	<ul style="list-style-type: none"> Vary widely in physical properties and chemical composition 	<ul style="list-style-type: none"> Volatilization to atmosphere Sediment accumulation Microbial degradation Bioaccumulation Bioconcentration 	<ul style="list-style-type: none"> Acute or chronic toxicity to marine plants and animals Some compounds carcinogenic
Acids/Alkalis	<ul style="list-style-type: none"> Soluble in water Alter pH of receiving water Affect solubility of other contaminants 	<ul style="list-style-type: none"> Dilute in water Chemical transformation 	<ul style="list-style-type: none"> Direct toxicity Solubilize other toxic substances (e.g., metals)

Table 1. (continued)

Pollution Type	General Characteristics	Ultimate Fate	Potential Environmental Impact
Surfactants	<ul style="list-style-type: none"> • Used in detergents and cleaning agents • Wide variety of chemical structures 	<ul style="list-style-type: none"> • Accumulate in sediments • Microbial degradation 	<ul style="list-style-type: none"> • Acute and chronic toxicity to aquatic organisms • May have synergistic effects with other substances on aquatic life • Result in foam formation
Nutrients	<ul style="list-style-type: none"> • Phosphorus has high affinity to bind with particles • Nitrate removed by denitrification under anaerobic conditions • May occur in inorganic or organic forms 	<ul style="list-style-type: none"> • Biological uptake • Sediment accumulation 	<ul style="list-style-type: none"> • Eutrophication • Ammonia toxicity • May alter hydraulic characteristics of soils
Bacteria/Pathogens	<ul style="list-style-type: none"> • Serve as indicators for other pathogenic organisms • May travel through soils • May survive in marine environments for up to 2 weeks 	<ul style="list-style-type: none"> • Biological uptake 	<ul style="list-style-type: none"> • Tainting of fish and shellfish • Human pathogens • Degradation of water quality resulting in reduction in allowable uses
Floatables/Plastics/Styrofoam	<ul style="list-style-type: none"> • Often nondegradable • Typically of human origin 	<ul style="list-style-type: none"> • Fragments may accumulate in depressions • May collect in backwater areas 	<ul style="list-style-type: none"> • Physical impairment or mortality of animals • Aesthetic degradation
Antifreeze	<ul style="list-style-type: none"> • (See solvents and organic compounds) 		
Fouling Organisms	<ul style="list-style-type: none"> • Marine organisms that attach to marine structures and vessel hulls 	<ul style="list-style-type: none"> • Organic material accumulates in sediment or water column as organisms die off or are dislodged by cleaning 	<ul style="list-style-type: none"> • Eutrophication • Ammonia toxicity

Table 1. (continued)

Pollution Type	General Characteristics	Ultimate Fate	Potential Environmental Impact
Wood Preservatives	<ul style="list-style-type: none"> • Vary in physical properties and chemical composition • Some are insoluble in water (eg. creosote). <p>Some are water soluble (eg. chromated copper arsenate - CCA)</p> <ul style="list-style-type: none"> • May contain heavy metals 	<ul style="list-style-type: none"> • May leach into water column • Sediment accumulation • Microbial degradation 	<ul style="list-style-type: none"> • May be toxic to aquatic organisms • May be carcinogenic
Other Hazardous and Toxic Materials (e.g. TBT).	<ul style="list-style-type: none"> • Vary widely in physical properties and chemical composition • May contain heavy metals 	<ul style="list-style-type: none"> • Biological uptake • Sediment accumulation • Various other mechanisms 	<ul style="list-style-type: none"> • Acute and chronic toxicity to aquatic and terrestrial organisms • Carcinogenic (some)

Best Management Practices for Marinas

This chapter provides suggested management practices that are appropriate for application at recreational boating facilities to abate nonpoint sources of pollution. Best management practices (BMP) are suggested methods, tools and techniques for achieving pollution control objectives. The BMPs have been designed based on information and experience gained by completing a demonstration project at model marinas in Rhode Island. At the model marinas, BMPs were implemented and then evaluated. Measurements were taken to see how effective the BMPs were at mitigating the target nonpoint source of pollution. Other observations were also made that included: how easily the BMPs were implemented; how well received they were by the marina managers and tenants; and how they were integrated into the maintenance and operation of the marina.

Other research techniques were also used to gather information about the BMPs. The baseline list of BMPs was generated from a literature review of all marina nonpoint source manuals that could be identified. The results of that search showed that many of the BMPs listed in independent manuals were similar to one another. BMPs appropriate for implementation at the model marina were selected from this baseline list.

Field research techniques were also used to collect data about BMPs. Other Rhode Island marinas not included in the demonstration project were visited. The observer collected information about the facilities' activities, BMPs that were already in place, and what additional BMPs could be implemented. The field research found that many of the BMPs identified in the literature search were already implemented at marina sites throughout Rhode Island.

The BMPs are organized in this chapter by four major sections; each is divided into seven subsections. A list of the practices can be found at the beginning of each section, providing a summary of BMPs. Following this summary are the section's objectives, which are equivalent to the management measures discussed in the federal and state nonpoint source program. The BMPs listed in each section provide options that can be implemented by a recreational boating facility to meet the section's objectives.

To control nonpoint pollution, site-specific solutions are needed. The BMPs presented here are only proposed recommendations. Marina operators may already be using BMPs that are not listed, that are more effective at abating nonpoint pollution. To select appropriate BMPs, marina operators need consider their facility site-specific activities and the potential pollution sources. Because each facility is unique and the potential pollution problems are different, the selection of BMPs will vary among marinas. This is addressed by providing marina operators with recommended BMPs and the flexibility to select practices appropriate for the site-specific activities. The Operations and Maintenance Program chapter of this manual provides a framework to help marina operators select appropriate BMPs based on the nonpoint source pollution abatement objectives.

SUMMARY Section 100.0 Solid Waste and Storm Water Runoff

100.1 Containment

- Perform abrasive blasting within spray booths or plastic tarp enclosures to prevent residue from being carried into surface waters. If tarps are used, blasting should be closely monitored on windy days to prevent drifting dust.
- Provide and clearly mark designated work areas for outside boat repairs and maintenance. Do not permit work outside designated areas.
- Perform maintenance work inside buildings whenever possible.
- Perform maintenance over tarps to ease the cleanup process and prevent material from being carried into surface waters. Dispose of collected material properly.
- Clean trash, sandings, paint chips, etc., immediately after any maintenance activity. Dispose of collected material properly.
- Use vacuum sanders to remove paint from hulls and collect paint dust.
- Provide covered containers for solid waste that is generated within the facility.

100.2 Collection facilities and recycling

- Provide proper trash disposal facilities to marina patrons.
- Provide facilities for the eventual recycling of appropriate materials, such as glass, aluminum, plastic, trash, newspapers, and batteries.
- Establish fish-cleaning areas.

100.3 Source control/delivery reduction

- Install and maintain adequate buffer areas between the coastal zone and upland facilities.
- Implement effective runoff control strategies, such as surfacing areas with crushed gravel, decreasing the slope of facility towards surface waters, or installing filters and wet ponds that remove 80 percent of the total suspended solids from hull maintenance areas.
- Wash the boat hull above the waterline by hand. Where necessary, remove the boat from the water and perform cleaning where debris can be captured and disposed of properly.
- Support the use of environmentally compatible products.
- Minimize the impacts of wastewater created during pressure washing.

SUMMARY Section 100.0, continued

100.4 Education

- Use pamphlets, flyers, newsletters, inserts, and meetings to convey the importance of any environmental precautions that have been instituted in the marina.

100.5 Signs

- Have adequate signs throughout facility identifying BMPs.

100.6 Contracts

- Issue rules governing the conduct and location of fish-cleaning operations.
- Insert language into facility contract that requires tenants to use certain areas and techniques when conducting boat maintenance.
- Have a clearly written outside contractors agreement.

Section 100.0 Solid Waste and Storm Water Runoff

Objectives: Implement effective runoff control strategies that include the use of pollution prevention activities and the proper design of hull maintenance areas¹.

Reduce the average annual loading of total suspended solids in runoff from hull maintenance areas by 80 percent.

Properly dispose of solid wastes produced by the operation, cleaning, maintenance, and repair of boats to limit the entry of solid waste into surface waters.

Promote sound fish-waste management practices.

For boats that are in the water, perform cleaning operations to minimize, to the extent practicable, the release to surface waters paint from in-water hull cleaning.

Institute a public education/outreach/training program for boaters to prevent improper disposal of polluting material.

Purpose: Provide the boating facility several options for the collection, containment, and reduction of solid waste that is generated within marine recreational facilities and reduce exposure of waste to storm water. Solid waste in this section includes: trash and recyclables (paper, bottles, cans, plastics); hull-cleaning debris (paint); fish waste; and waste generated from general boat maintenance (fiberglass, wood, grit).

Discussion:

Recreational boating facilities, during daily operations, generate some solid waste. Solid waste encompasses many pollutant types, such as plastics and heavy metals generated from many different activities such as fishing and boat bottom washing. If this waste is collected and disposed of properly, its impact on the environment is minimized. Therefore, this chapter focuses on capturing contaminants before they enter the surface waters.

In developing a plan to address this issue, identify what activities within the facility generate solid waste that could potentially degrade the marine environment. Obvious activities include vessel maintenance and repair. Seasonal maintenance generates solid waste, such as paint chips and dust, from sanding hulls. Toxic forms of heavy metals, such as copper, are inherent to bottom paint (METRO, 1992). Some facilities provide sandblasting services that create particles of both paint and metal from the hull. Pressure washing creates wastewater laden with suspended solids containing metals (METRO, 1992). Daily operational activities of the facility generate such items as paper, bottles, cans, and plastics. Tenants also generate waste similar to what the facility generates during its daily operation, such as paper, bottles, and plastic. Tenants also may generate

¹ Section 6217 (g) of CZARA defines hull maintenance areas as those areas whose primary function is to provide a place for boats during the scraping, sanding and painting of their bottoms.

other waste types, such as fish discards and fishing line. Once the waste types and sources are inventoried, practical best management practices can be selected that collect and properly dispose of them.

This chapter provides suggested best management practices that are designed to collect, contain, and reduce the amount of solid wastes that exist at recreational boating facilities. This component of nonpoint sources is expansive and includes a broad range of activities and pollutants. The level of attention you will need to provide to this topic is highly dependent on the type of facility. The more diverse the activities, the more intensive the management practices may need to be. For facilities that only provide an in-water berthing area, perhaps only signs, education, and trash and recycling receptacles will be necessary. If the facility provides hull maintenance areas, then additional management practices will be needed. Marina operators have the flexibility to select the best management practices that are most appropriate for your activities.

BEST MANAGEMENT PRACTICES

100.1 Containment

- Perform abrasive blasting within spray booths or plastic tarp enclosures to prevent residue from being carried into surface waters. If tarps are used, blasting should be closely monitored on windy days to prevent drifting dust.

This management practice focuses on preventing the abrasive material used in sandblasting from entering adjacent waterways. It is applicable to facilities that have abrasive (sand) blasting capabilities. Quantities of the used abrasive material, such as “black beauty”, can collect toxic levels of metals from bottom paint and steel hulls that are stripped during the blasting process. Ideally, this process should occur within a rigid walled booth that ensures the containment of the blasting material and the residue. If a permanent structure is inappropriate because of space, cost or other limitations, then the area around the vessel to be blasted should be enclosed. The tarps should extend high enough above the blasting surface to contain the blasting material and residue. Because tarps do not constitute a rigid structure, they do not eliminate wind flow through the blasting area, allowing wind to carry the blasting material and residue into surface waters. Therefore, if tarps are used, blasting should be closely regulated when wind can carry the blasting material and residue out of the tarped-in area and into sensitive areas. Containment is made easier if the blasting is consistently performed in the same area of the facility. This area should be in a location away from the land-water interface and cleaned regularly. For instance, a facility may choose to locate the blasting area at the farthest corner from the water’s edge. Records that include the volume of blasting material on-site and level of toxins contained in the material should be regularly kept. Used blasting material should be tested and disposed of regularly.

- Provide and clearly mark designated work areas for outside boat repairs and maintenance. Do not permit work outside designated areas.

If a facility is large enough, one section of the yard should be dedicated for outside boat repairs and maintenance. Boats should be moved to this location before any maintenance activity (such as sanding, painting, fiberglassing, and woodworking) is undertaken. The work area should be well marked with signs. A list of boat owner responsibilities and limitations, while using the work area, should also be clearly posted. Limitations may include the prohibition of hazardous materials and a maximum time a boat may be left in the area. The work area should allow for easy removal of waste and debris that is

generated from maintenance activities. An operational system that is capable of managing requests to access the work area, move boats to and from the maintenance area, and enforce the practice will need to be implemented.

Work areas are often synonymous with hull maintenance areas that are defined by the federal nonpoint source program as areas whose primary function is to provide a place for boats during the scraping, sanding, and painting of their bottoms. Hull maintenance areas are also addressed in the Storm Water Program. See Appendix B for details.

- Perform maintenance work inside buildings whenever possible.

When possible, completing boat maintenance work inside an enclosed area is recommended to keep contaminants where rain can't wash them into water and where they can be easily collected and disposed of. This is especially true for activities such as fiberglassing or pressurized painting, where outside material can easily escape during the process and enter the environment.

Having dedicated work areas may not be feasible in many marinas because of various constraints (size of facility, cost). In these cases, locations within the facility where boats are stored can be used as work areas if additional BMPs are implemented. If this option is selected, all the areas where maintenance is performed must be managed for NPS. This may increase the marina's responsibility to install or implement BMPs that are designed to minimize the abundance of solid waste resulting from maintenance activities that can potentially enter adjacent surface waters. Because the maintenance area is not within a contained area, more intense application of BMPs may be necessary. For instance, if bottom scraping is done in a designated, properly designed work area, the need for performing this activity over tarps may be eliminated. If the same activity is not done in a work area, then the use of tarps to collect scrapings will probably be more widespread.

Additional BMPs should include preventive measures to decrease the potential amount of material resulting from the maintenance activity from entering adjoining surface waters. The following BMPs should be considered for implementation whether or not the marina has a dedicated work area. These practices prevent hazardous material (metals, toxins) from being released into an open environment, thereby decreasing the potential for the material's entering the surface water.

- Perform outdoor maintenance over tarps or hard surfaces to ease the cleanup process and prevent material from being carried into surface waters. Dispose of collected material properly.

Similar to the BMP on abrasive blasting, this practice prevents paint dust and other waste materials from washing throughout the facility when it rains. This practice should be applied when maintenance is being performed over a surface that is not easily cleaned, such as crushed gravel. Once the maintenance activity is completed, the material on the tarp should be captured and disposed of properly.

- Clean (trash, sandings, paint chips, etc.) immediately after any maintenance activity. Dispose of collected material properly.

Require boat owners to spend a few minutes cleaning up their work area after they have performed a maintenance activity that generates waste. Immediate attention to sweeping or vacuuming the work area and collecting and disposing of the waste properly greatly decreases the amount of waste that is available to enter the surface water. To ease in the

cleanup, cover nearby storm drains to inhibit waste from being washed into pipes that directly discharge into surface waters.

- Use vacuum sanders both to remove paint from hulls and collect paint dust.

This new technology is effective at capturing paint dust during sanding. Immediate capture prevents paint dust from entering the surface water, makes cleaning up the work area easier, and increases the speed at which a boat bottom can be completely sanded. Rentals of these units could also evolve into another profit center for the marina.

Marina operators may consider prohibiting any hull maintenance (sanding, painting, wood or fiberglass work) in locations within the facility that directly abut the land-water interface unless the BMPs that have been implemented can ensure that the material does not enter the surface water. This is often difficult to achieve, and the potential for the material's entering the water increases with proximity of the maintenance activity to the water's edge.

- Provide covered containers for solid waste generated within the facility.

Once material that has been generated during maintenance activities is properly collected, it must then be disposed of properly. Containers to collect frequently generated waste should be located near maintenance areas, or locations within the facility that are accessible. The number and type of containers are dependent on the type and volume of waste collected. If containers are outdoors, they should be properly covered to prevent rainwater from collecting in them. A proper cover also ensures that the collected material will not be washed out during a rain event.

100.2 Collection facilities and recycling

- Provide proper trash disposal facilities to marina patrons.

Provide trash receptacles in convenient locations and in adequate numbers to handle the amount of trash generated. The receptacles should be emptied on a regular basis, depending on their usage and before they overflow. Usually, facilities have a centralized location for collecting trash. This collection facility may be regulated by local ordinance for location, height, and aesthetics. Some marinas have decided to regulate the accessibility of the collection facility by fencing it in to avoid problems with improper disposal of items such as oil in the container.

- Provide facilities for the eventual recycling of appropriate materials, such as glass, aluminum, plastic, trash, newspapers, and batteries.

Materials such as aluminum, glass, plastic, newspapers, office paper, and cardboard are generally recyclable. Inventory recyclable material in your facility and identify what outlets exist for removing recycled material once it is collected. Design your program around those materials. Do not neglect items that are not commonly recycled but could be, such as monofilament and shrink-wrap. In some cases, the manufacturer may collect the material after it has been used. Once the program is created, start slowly and build on success. Also, check with your local ordinance to see what materials are required to be recycled.

In selecting recycling containers, first decide how containers will be collected and sorted. Consider the weight of a full container and judge whether it can be dumped by one person. Can some recyclables be collected in one container (i.e., glass and aluminum)?

Should containers have lids to protect the contents from spilling out and prevent rain water from getting in? Appreciate the value of a distinct, commonly known, recognized recycling bin like the green igloo or gumdrop.

The easier and more convenient recycling is for the boaters, the more cooperative they will be. The definition of adequate and convenient reception facilities is elusive and best defined by the marina management. When considering convenient facilities, consider frequency and type of use in certain portions of the marina, distance between end of finger piers and dumpster in parking lot, number of customers, etc. Some suggested locations include: next to or near trash containers, landside foot of the dock, close to bathrooms and showers, next to vending machines, fuel docks, and transient docks, in the marina office, and ship's store. Consider, where possible, the potential of keeping trash and recycling bins near each other. Be aware, however, some customers may accidentally confuse the two bins and contaminate them.

- Establish fish-cleaning areas.

If the facility is home port to people who partake in recreational fishing, consider providing special areas within the facility for them to clean their catch and dispose of fish waste properly. The objective is to minimize the possibility of fish waste's being disposed of directly into the marina confines. Fish waste can be especially problematic in "dead end" coves and harbors where flushing rates are low. As fish waste degrades within the marina confines, it uses dissolved oxygen that may lead to foul odors as well as water quality problems. Other methods to mitigate this potential problem include:

- (1) Implementing fish composting or fish disposal containers where appropriate.
- (2) Encouraging boaters to clean their catch on their way back into port.

100.3 Source control/delivery reduction

- Maintain adequate buffer areas between the coastal zone and upland facilities.

Vegetated buffers can provide a natural filter to remove pollutants and sediments contained in surface water runoff. The effectiveness of any given vegetated buffer for removing pollutants and sediments is dependent upon a variety of site-specific conditions, such as slope, soil type, type of vegetation, and permeability. A vegetated buffer is typically found between an inland area (pollutant source) and an adjacent waterway. As runoff moves through the vegetated buffer, sediment and pollutants attached to sediment are filtered out as the buffer slows flow velocity, allowing sediment and pollutants to settle out. In general, the greater the width of vegetated buffer the surface runoff must travel through, the more sediment and pollutants it can remove.

Even relatively narrow vegetated buffers can remove large percentages of sediment and attached pollutants. For instance, a 15-foot vegetated buffer is able to remove, on average, 50 percent or more of the sediment and attached pollutants moving through the vegetated area (Desbonnet et al., 1994). To achieve an approximate 80 percent removal of sediment and attached pollutants, a vegetated buffer of 225 feet would be required (Desbonnet et al., 1994). These buffer widths apply to coarse-grained sediments and sand, while wider vegetated buffers may be required to effectively remove silt, clay, and other fine-grained sediments contained in runoff water. The following table summarizes pollutant removal effectiveness and wildlife habitat value of vegetated buffers according to buffer width, adapted from Desbonnet, A. et al.

Table 2. Pollutant Removal and Wildlife Habitat of Vegetated Buffers

Buffer Width (m)	Pollutant Removal Effectiveness	Wildlife Habitat Value
5	Approximately 50% or greater sediment and pollutant removal	Poor habitat value; useful for temporary activities of wildlife
10	Approximately 60% or greater sediment and pollutant removal	Minimally protects stream habitat; poor habitat value; useful for temporary activities of wildlife
15	Greater than 60% sediment and pollutant removal	Minimal general wildlife and avian habitat value
20	Approximately 70% or greater sediment and pollutant removal	Minimal wildlife habitat value; some value as avian habitat
30	Approximately 70% or greater sediment and pollutant removal	May have use as a wildlife travel corridor as well as general avian habitat
50	Approximately 75% or greater sediment and pollutant removal	Minimal general wildlife habitat value
75	Approximately 80% sediment and pollutant removal value	Fair-to-good general wildlife and avian habitat value
100	Approximately 80% sediment and pollutant removal value	Good general wildlife habitat value; may protect significant wildlife habitat
200	Approximately 90% sediment and pollutant removal value	Excellent general wildlife value; likely to support a diverse community
600	Approximately 99% sediment and pollutant removal value	Excellent general wildlife value; supports a diverse community; protection of significant species

Vegetated buffers that are implemented with a primary purpose of removing sediments and attached pollutants will require maintenance on a regular basis. The frequency of maintenance procedures will depend upon the amount of sediment being removed by the vegetated buffer. The majority of sediments and coarse-grained materials is removed at the leading edge of the vegetated buffer. Over time, the vegetated buffer may become “clogged” with sediment removed from runoff water, oftentimes forming a berm at its leading edge. Once a berm forms, water may be channeled around the vegetated buffer instead of through it, rendering the buffer ineffective for the treatment of surface runoff. If runoff continues to move through the vegetated buffer, the clogging action will continue to move into the buffer, reducing its effective width for treatment of runoff, and eventually rendering the vegetated buffer useless. Maintenance procedures to remove sediments will occasionally need to be conducted to keep the vegetated buffer in proper working order.

Pollutants that exist in a dissolved form in runoff water—nitrate, for instance—often require wide vegetated buffers for effective removal. Dissolved pollutants are removed by uptake in plants and through both chemical and biological interactions with soils. Wider vegetated buffers are required to allow the long retention times needed for plants to utilize the pollutants, as well as to allow chemical and biological interactions to occur. Wide vegetated buffers can have multiple-use value. Although they will function to remove sediment and pollutants contained in runoff water, they can also provide habitat for wildlife, reduce erosion, and increase the aesthetic and scenic value of the area. Multiple-use value of a vegetated buffer increases as width of the buffer increases.

In order for the vegetated buffer to be effective in the removal of sediment and pollutants, it should be of shallow slope, thickly vegetated, and should be relatively level throughout its length and width. Any vegetated buffer that promotes channelized flow through its vegetated area—through gullying, for instance—will be generally ineffective for pollutant and sediment removal, will promote erosion, and will simply funnel runoff into an adjacent water body as if it were a point source of pollution.

Vegetation in the buffer will vary according to the primary purpose of its use. Thickly growing grasses that are maintained at a height of four inches or more are very effective at removing sediments and attached pollutants. Thickly growing grasses also work well to slow the velocity of runoff flow and to promote a shallow, even flow of runoff through the buffer area. Grassed buffers are also easily maintained. Interspersed shrubs, bushes, and trees in a grassed buffer area will enhance scenic and aesthetic qualities, and also promote its use by wildlife by increasing vegetative diversity.

As marinas generally rely upon direct access to the water, vegetated buffers could be implemented between inland work areas and the water's edge, leaving an access way along the actual edge of the water. The buffer could be grassed and interspersed with low-growing shrubs and bushes. This would provide sediment and attached pollutant removal from runoff water, allow for easy access and maintenance of the vegetated buffer, and provide some scenic and visual diversity within the marina. Some buffers can be used for light recreation, such as picnic areas. Areas with direct access to the water, such as boat ramps, could be engineered so that the majority of runoff they produce can be diverted into the nearby vegetated buffers rather than run down the boat ramp and directly into the water.

- Implement effective rain runoff control strategies, such as surfacing areas with crushed gravel, decreasing the slope of the facility towards surface waters, or installing filters and wet ponds that remove 80 percent of total suspended solids from hull maintenance areas.

Reducing rain runoff also decreases the amount of pollution entering the water. Many techniques for achieving this exist. A less expensive approach is to cover or replace hard-packed areas that would normally allow for high runoff with a pervious material such as gravel or shell. This works especially well to slow down flow, allowing material to fall out of the moving water. Most types of marina machinery can be operated on the pervious material. Placing gravel or shell down over packed sand or dirt also helps to keep dust down and can improve the marina's aesthetics.

Another technique for reducing flow is to create a slope within the facility that does not generate a storm flow directly into the water. This could be considered at the time when other construction or infrastructure improvements are under way. Slope modification can also be achieved in conjunction with pervious material. Slope can be raised by using gravel as the filling material.

Other more complicated techniques also exist. Catch basins, either on the surface or sub-surface, can be designed and constructed to collect runoff. Once the water is collected, numerous processes can be applied to purge the water of contaminants. One method is simply to allow the material to settle out of the captured water. Other systems exist that will filtrate the water to remove contaminants. Once the pollutants are removed, the water can be released. Under current standards, the release of this water is regulated under storm water provisions of the state's environmental protection program.

- Wash the boat hull above the waterline by hand. Where necessary, remove the boat from the water and perform cleaning where debris can be captured and disposed of properly.

Instead of washing the topsides of boats with a pressure washer, consider cleaning boat hulls above the waterline by hand. This practice will decrease the amount of water necessary to complete the job and will reduce the amount of potential contaminants that can enter the water. While hand washing the boats, do so in a way that minimizes the

amount of debris that falls into the water. Boats should be removed from the water before cleaning or maintenance activities if the impacts of the activities cannot be contained or mitigated. For instance, if toxic chemicals are being applied during a maintenance activity and those chemicals are apt to enter the surface water, move the boat to a designated maintenance area ashore. However, if a vessel is being cleaned with nontoxic detergents, then removing the boat from the water may not be necessary.

- Support the use of environmentally compatible cleaning products.

Encourage boaters to use only cleaning products that will not degrade the environment. Use low-phosphate detergents for cleaning boats and other equipment within the facility. Promote the use of biodegradable chemical counterparts to traditional chemicals commonly found on board vessels. Ensure that your ship's store has "green" products available, and help sales people understand and be able to explain the differences between traditional and environmentally compatible products.

- Minimize the impacts of wastewater created during pressure washing.

During this activity, bottom growth consisting of marine organisms is washed off the hull along with particles of the bottom paint and fragments of hull material. The particles and fragments contain metals and other chemicals that retard marine growth. In concentration, such as that occurring in wastewater from pressure washing, it can have negative impact on the marine environment.

Options are available to minimize water quality degradation from pressure washing. Removal of contaminants from wastewater can be implemented in a step process, depending on the amount of pollutant removal desired or required.

- (1) **Settling**-This process allows the contaminants to drop out of the wastewater once it is collected and allowed to stand, undisturbed. It requires a platform that will collect the water during the washing process and a containment facility. This method is the least expensive and easiest to design and construct. However, it is only moderately effective at removing contaminants because it will only remove particles that drop out during settling.
- (2) **Filtration**-Filtration is completed by allowing the water to flow through one or more filters that screen out different sized particles. Filtration can start at the washing platform with the installation of hay bales or filtration cloth over the wash water intake drain. This method is effective for straining visible particles. Additional filtration can be achieved by directing the water through a filter or series of filters with decreasing mesh sizes.
- (3) **Treatment**-This method uses existing technologies from other industries to pretreat the wastewater and remove contaminants. This method operates under the same premise as a mini-treatment plant. The treatment can include the removal of oil and grease, metals, or other contaminants, depending on the technology applied. For instance, agents can be introduced into the wastewater that encapsulate metals and force them to settle out of solution. This method is the most sophisticated level of wastewater treatment.

Once the wastewater has moved through the purification process, the marina operator must then decide to:

- (a) discharge back into the water body;
- (b) discharge into a sanitary system; or
- (c) reuse for pressure washing or other applications that require water, such as irrigation.

These three options are dependent on the level of purification the water received. If option (a) or (b) is chosen, the discharge effluent will be required to meet discharge standards set for the receiving water body or sewage treatment facility. Either option will require discharge permits and water quality monitoring. The final option, reuse, may be the most appropriate practice. Reuse not only bypasses the need for discharge permits; it also achieves the goal of water conservation.

100.4 Education

- Use pamphlets, flyers, newsletters, inserts, and meetings to convey the importance of any environmental precautions that have been instituted in the marina.

Provide information to your tenants about the BMPs in this section. Topics that particularly affect them may include recycling, fish cleaning, boat maintenance, and boat washing. When new practices are implemented, be sure that the tenants are aware of the changes and are ready to comply. Distribute to your customers fact sheets and flyers on the topics, many of which have already been prepared and are available free for distribution. Circulate the material in special environmental mailings or include them in current mailings.

Invite lecturers from local academic institutions and state regulatory agencies to speak about nonpoint source pollution to your customers. This is an effective method for both the audience and the guest to discuss potential problems and attempt to identify solutions. Inviting outside experts to speak shifts some of the pressure for explaining change from the marina manager to the visiting expert.

Education must not stop with the tenants, but must also be applied to the facility's staff. Every member of the staff (administrative, grounds keepers, maintenance, painters, mechanics, etc.) must understand and comply with any new initiatives.

- Educate boaters regarding the importance of proper fish-cleaning practices.

Let boaters know that disposing of fish waste within the facility's waters is not appropriate. Appendix D provides some handouts that can be duplicated and distributed among boaters informing them why it is important to properly dispose of fish wastes.

100.5 Signs

- Have adequate signs throughout facility identifying BMPs.

Use signs to inform your tenants about equipment, disposal containers, cleaning practices, etc. Special instructions should be marked clearly. Recycling containers and trash containers should be marked accordingly, and if necessary, a sign used to list what each container is capable of accepting. Try using nonverbal signs around the facility.

400.6 Contracts

- Issue rules governing the conduct and location of fish-cleaning operations.

If improper disposal of fish waste is an issue, then deter boaters from continuing harmful practices by adding language to the contract that prohibits improper disposal of fish waste within the marina confines.

- Insert language into facility contract that requires tenants to use certain areas and techniques when conducting boat maintenance.

If boat maintenance activities occur within the marina, clearly state the proper procedures for this activity in the contract. For instance, if boat maintenance is only allowed in designated areas, state that in the contract. An outside contractor doing work in the marina also needs a contract. If other practices have been implemented, such as using tarps or sweeping the work area immediately after the maintenance activity is complete, then state those conditions in the contract.

- Have a clearly written outside contractors agreement.

The facility is often responsible for pollution problems that negligent outside contractors can create. Because this threat exists, arrange for any outside contractors to sign into the facility. While they are signing in, provide them with information about the facility's pollution prevention policies. If it is necessary, have the contractors sign an agreement that clearly identifies their responsibilities.

SUMMARY Section 200.0

Fueling, Oil, and Other Petroleum Hydrocarbons

200.1 Spill protection and recovery

- Each facility should have adequate oil spill response equipment that is easily accessible and clearly marked.
- Each facility should develop and maintain an oil spill plan.
- Inform your local harbormaster and fire department about your oil spill recovery plan and equipment.

200.2 Disposal

- A separate container for the disposal of used petroleum products should be accessible to your tenants.
- Properly dispose of used oil spill response equipment.
- Institute a recycling program for used oil filters.

200.3 Source control/delivery reduction

- Promote the use of oil-absorbing materials in the bilge areas of all boats with inboard engines. Encourage your tenants to examine these materials at least once a year and replace them as necessary.
- Use automatic shut-off nozzles and promote the use of fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel oil spilled into surface waters during fueling of boats.
- Place containment berms around fixed pieces of machinery that use oil and gas within the facility.
- Properly maintain engine repair areas.

200.4 Education

- Provide information to marina tenants on collection and recycling programs for oil, oil-absorbing pads, and oil filters.
- Direct marina patrons to the proper disposal of all used hydrocarbon products through the use of signs, mailings, and other means.
- Insert language into facility contract that recommends tenants use fuel/air separators and oil absorption materials.

Section 200.0 Fueling, Oil, and Other Petroleum Hydrocarbons

Objectives: Allow for ease in cleanup of spills.

Provide and maintain appropriate storage, transfer, containment, and disposal facilities for fuel, oil, and other petroleum hydrocarbons and encourage recycling of this material

Reduce the amount of fuel and oil from boat bilges and fuel tank air vents entering marina and surface waters.

Institute public education/outreach/training programs for boaters to prevent improper disposal of polluting material.

Purpose: Provide recreational boating facility managers with suggested practices that can be easily applied to abate pollution from hydrocarbons.

Discussion:

Small amounts of fuel, oil, and other petroleum hydrocarbons introduced into the marine environment are a chronic problem. This incremental pollution, a little here, some there, adds up to hundreds of thousands of gallons every year (Olsson et al, 1994). In Rhode Island alone, over 1,000 minor spills have been reported to the captain of port in the last five years (Coast Guard, 1994). This figure may only reflect a small percentage of the total number of spills, because only a fraction of all the small spills ever get reported (Jewell, 1994). This problem is not limited only to boating activities. Storm drains often carry oil that is washed off impervious surfaces or is illegally dumped into them. Rain flow and snow melt can lift oils up and carry them across paved parking lots directly into surface waters. Once these materials enter coastal waters, they can accumulate in sediments or bioaccumulate in some aquatic species.

Some marina activities can increase the amount of fuel accidentally introduced to the environment. Generally, fueling operations have the greatest potential of contributing to this problem. Another activity is the repair and maintenance of engines where oil is removed from the crankcase and not disposed of properly. One common, but often overlooked, threat is the possibility of sinking of a vessel stored in marina. A moderately sized power boat can carry hundreds of gallons of fuel and at least some oil which, if not contained, will be freed into the environment. In many cases, particularly small gasoline spills from fueling operations, spills will dissipate in the environment rapidly. Often the greatest danger from gasoline spills is the threat of an explosion and fire. Persistent hydrocarbons like residual crankcase oil will not dissipate as rapidly but are generally easier to contain and collect.

Some marina infrastructure may also contribute to hydrocarbons in the coastal environment. Parking areas, boat ramps and other impervious surfaces are subjected to small oil spills and leaks from automobiles and other mechanized equipment. Once on the surface, oils can move into the marina environment when a carrying agent, such as water, is introduced. Other structures often found on marina sites also pose potential concerns, particularly containment facilities for fuel and oil. These should all be considered, in addition to the more obvious concerns, when evaluating marina activities that contribute to incremental oil pollution.

Federal regulation has tighten in recent years in regards to oil spill response and recovery. Currently, any sheen upon the navigable waters of the United States must be reported to the Coast Guard. New regulations prohibit the use of dispersants on oil spills without the permission of a Coast Guard on-scene coordinator. The policies and procedures for recovering expenses incurred for removal costs and damages have been clarified. In certain cases, removal costs incurred by any person for acts taken during an oil spill response may be recovered.

In this changing climate, any facility that handles or stores fuel should act to minimize potential dangers. This chapter suggests practices that can be implemented at marina facilities to prevent oil spills and put mechanisms in place that will improve the recovery process from an accident. In addition to the management practices, a model oil spill response plan is provided in Appendix A. This model can be used to develop the facility's own response plan. When augmented with additional best management practices, marinas will ensure they have taken the proper steps to minimize this nonpoint source pollution concern.

BEST MANAGEMENT PRACTICES

200.1 Spill protection and recovery

- Each facility should have adequate oil spill response equipment that is easily accessible and clearly marked.

The key to spill protection is early response and action. By having adequate spill response equipment on site and accessible, larger, more expensive spills can be prevented. The spill response equipment should be stored in an area were it can be deployed quickly. Consider storing the equipment where the greatest threat of an oil spill exists. In most marinas, this is the fueling station. The primary response equipment should be stored together in an enclosed container or bin. Oil response kits, containing the basic equipment and designed to fit on a dock, are commercially available. You can also build or buy a waterproof storage container and stock it with the equipment you feel is necessary. Whatever storage method you use, it should be accessible by your staff, especially those who handle the fueling operation. Some marinas have opted not to lock the storage container and leave it accessible for all patrons to use at their discretion. This may encourage quicker response to smaller spills away from the fueling dock.

Having adequate spill response equipment depends on the type of recreational boating facility and the type of vessels stored there. At a minimum, oil booms and absorbent pads should be available. The amount (linear footage) of boom will depend on the size of the largest fuel tank on board a vessel in your facility. As a standard rule, for every foot of boat, expect to use three feet of boom. Therefore, to adequately encircle a forty foot boat would require 120 feet of boom. Generally, two types of booms exist: one type, the oil containment floating boom, prevents oil from spreading on the surface by presenting a floating barrier; and the second type, the oil-absorbing floating boom, not only prevents the oil from spreading but also absorbs the oil. Both types can be strung together to encircle the affected area, but become less effective as surface currents increase.

Absorbent pads are now available in a multitude of shapes, sizes, and prices. These products are designed to absorb and trap hydrocarbons for easy disposal. They are primarily used for the quick cleanup of light fuel spills by deploying them into the oil slick and retrieving them once they are saturated. Some marinas have adopted the

practice of securing oil-absorbent material at the waterline of floating fuel docks to quickly capture small spills.

Traditionally, other equipment includes dispersants and surface skimmers. Dispersants, although effective for removing light oil from the surface, should not be used. The chemicals do not remove the oils from the environment but simply move them from the surface to subsurface areas. When oil is dispersed to subsurface areas, it usually becomes entrapped in bottom sediments, potentially causing long-term impacts. Surface skimmers should not be required. The primary purpose of your response equipment is to minimize the amount of oil free in the environment. Resources for removing the oil from the environment can be called upon once the spill is contained.

- Each facility should develop and maintain an oil spill recovery plan.

The plan should be short, with clear directions that can be understood by each employee. Components of a spill recovery plan should address the following:

- (1) **Who**-Clearly identify who is responsible for taking what action. Action items will include deploying the equipment and contacting the emergency agencies and additional resources. The plan should contain a list, updated periodically, of emergency phone numbers that would be used during a spill event. One person on the marina staff should be designated the official spokesperson for the facility.
- (2) **What**-What action should be taken during an oil spill event and, based on likely threats, what equipment should be deployed. Include information on what type of spill equipment is available on site and what its characteristics and capabilities are.
- (3) **When**-When additional resources should be called for assistance. When the equipment will be inspected and replaced, if necessary. A maintenance and practice schedule for the equipment should be established.
- (4) **Where**-Where the material is located in the facility. Identify sources where additional oil response equipment can be quickly attained, if it is necessary. Sources may include commercial response companies or neighboring marinas that have oil spill response equipment. If a commercial oil spill response firm is going to be used, consider establishing a pre-arranged agreement with them.
- (5) **How**-Explain how the equipment should be used and disposed of. To be sure that the crew understands the response plan, conduct drills that simulate an oil spill. Evaluate the drill and share observations with all your employees.

Appendix A provides a model oil spill response plan that addresses each of these five components.

- Inform your local harbormaster and fire department about your spill recovery plan and equipment.

Because the fire department and the harbormasters may be included in any first response action, it may be appropriate for them to have a copy of the oil spill plan on file. This will improve the marina's efficiency when working with the municipality in response to a major oil spill. In some cases, the marina operator has granted permission for the city or town to use the response equipment, if necessary. Marina operators may also consider

inviting the harbormaster or fire department to participate in drills as they are held at the facility.

200.2 Disposal

- A separate container for the disposal of used petroleum products should be accessible to your tenants.

If tenants do not have a convenient means for properly disposing of items like waste oil and fuel, it will undoubtedly end up in the environment. The most popular disposal site, after the storm drain, has been the dumpster. Waste oil in the dumpster can lead to fines if the material finds its way into the water body, or additional removal fees if the hauler considers the material hazardous. The best way to combat the situation is to provide containers that can store this type of material and then be easily disposed of. Designing storage facilities for this material requires three key components: (1) substance control, (2) secondary spill protection, and, (3) special hazards, such as fire and flooding.

Substance Control

One recurring problem with providing a waste oil receptacle is controlling what is put into the containers. If a container becomes contaminated, then the cost to remove that container escalates. Therefore, installation of collection facilities should not simply be containers placed within the facility and left without management. The marina must carefully regulate what is being placed in the container. To achieve this, the holding facility is usually monitored by a person or is locked. If it is locked, then the tenants leave their waste oil in a closed, sturdy container at a collection site. A member of the marina staff is then responsible for moving the waste from the collection facility and dumping it into the storage facility. This allows the marina to monitor what is being poured into the storage container and limits the amount of open access, decreasing the possibility of contamination.

Holding facilities need to be covered, primarily to keep rainwater from filling up the secondary containment. Also, the area is usually fenced to provide the marina with greater ability to regulate what is being disposed of. It is also important to keep the storage area clean. Keeping the deck clean allows you easily and quickly to identify leaks in the storage containers.

A means for disposing of the oil, once collected, needs to be devised. This usually has to happen in conjunction with a state-certified waste hauler. These operators are available to collect and dispose of waste for a fee. There may be some economies of scale by working with other collection sites in your area to coordinate pickups of waste material.

Secondary Spill Protection

All containers used to store this material should have a form of secondary containment. In most cases, this secondary containment must equal 110 percent of the capacity of the primary container. Generally, this backup is provided by constructing a nonleaching berm with an impervious bottom around the containers. Other methods may include a fully enclosed containment facility that provides internal secondary revetment.

Special Hazards

When considering the placement of a waste oil reception facility, consider the hazard of flooding. Locate the containment facility in an area that is least prone to flooding. You may also consider keeping the entire facility mobile so that its movement can be part of your hurricane preparedness plan.

Fire is a special hazard that is best planned for in cooperation with your local fire marshal. If you are storing the material in an enclosed area, the fire marshal may request that the outside of the container be marked to reflect the flammability of its contents. Fire-fighting equipment, such as fire extinguishers, may be required to be mounted near the storage facility. In some instances, automated fire-fighting systems may be used. The contents of the storage facility should be kept on record and accessible to fire-fighting personnel, if needed.

A storage facility that has worked well and addresses substance control, secondary spill protection, and special hazards is a retrofitted shipping container. A twenty-foot standardized shipping container can hold multiple 55-gallon drums, provide secondary containment, has only a single access point that is easily controllable, and is wholly moveable.

- Properly dispose of used oil spill response equipment.

Much of the currently available oil spill recovery material can be disposed of easily. Nonabsorbing booms can be cleaned and reused. Oil-absorption materials, such as pads, have a low seawater retention rate when fully saturated and can presently be disposed of the same way as other oil-soaked material. An ideal storage technique would be to reserve a container in your storage facility for all oil-saturated material. Once filled, the container can be removed by a certified waste hauler. Some oil-absorbent material can be recycled by pressing the oil out of the boom or pad. Recycling is dependent on the characteristics of the product information that can be provided by the manufacturer. Some facilities have implemented the practice of on-site burning of the oil-laden material as a heat source for indoor workspaces.

- Institute a recycling program for used oil filters.

How do tenants who change the oil on their boats in your facility dispose of the old filters? Ideally, old filters should be drained and crushed before disposal. The objective of this process is to purge as much oil from the filter as possible. Machinery designed to do this exists commercially. It may be more cost-effective for a group of marinas to purchase the machinery for shared use. Perhaps it would be possible to work with an existing operation that has the machinery, such as an automotive oil and lube station. Waste oil filters, if not destined for recycling, must be managed as a hazardous waste under the Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage, and Disposal promulgated pursuant to the Rhode Island Hazardous Waste Management Act of 1978. Waste oil filters may not be disposed of by discarding them in the trash. For additional information contact RI DEM at (401) 277-2797.

200.3 Source control/delivery reduction

- Promote the use of oil-absorbing materials in the bilge areas of all boats with inboard engines. Encourage your tenants to examine these materials at least once a year and replace them as necessary.

Oil-absorption pads and pillows are now readily available from numerous manufacturers. Have these materials available in your ship's store for your customers. Encourage boaters to use absorption pads to reduce the overboard discharge of oily bilge water, which has been a problem for boats with automatic bilge pumps and engines that leak. A solution is to keep oil-absorption pads or pillows in the bilge, allowing them to absorb oil and fuel before the bilge water is discharged overboard. The pads can also be used to clean engine spaces, absorbing oils, grit, and water. Instruct boaters at the time of purchase about proper disposal of the pads. To reduce the problems even further, boaters should keep engine spaces clean. This allows easier detection of oil spills and leaks, permitting a quicker response and remedial action. Consider applying these same practices to any mechanized equipment at your facility.

- Use automatic shut-off nozzles and promote the use of fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel oil spilled into surface waters during fueling of boats.

Automatic shut-off nozzles should be installed, if they are not already, on fueling pump discharge hoses. These devices automatically stop the flow of fuel from the pump into the boat's fuel tank when enough reverse pressure is created. This guards against the continuous pumping of fuel when a boat's fuel tank is full. Installation of these devices should be considered anytime the facility is upgrading fuel pumps.

Fuel/air separators are in-line devices for boats that prevent fuel from exiting vents during fueling operations. The inexpensive devices can easily be installed by the boater or the marina staff. They are fitted in the fuel line between the vent and the fuel tank, generally in a void area. Once installed, they should only require minimal maintenance and do not need to be annually replaced or cleaned. Fuel/air separators, when properly installed, will only allow air to flow through them, thus preventing fuel from being spilled into the water. Information about these devices can be obtained from major manufacturers of oils and fuel filters.

Both these devices can significantly reduce the small incremental amount of fuel being discharged into waters surrounding a marina.

- Place containment berms around fixed pieces of machinery that use oil and gas.

Generators and other mechanized equipment that may have a tendency to leak oil or gas should have berms around them. In some cases a leak-proof container could be affixed below the machine to catch dripping fluid. Drain plugs in the container should be used to remove collected material on a regular schedule. This practice can also be augmented by placing oil-absorbent pads under the machinery. This will help capture leaking material and prevent it from entering the environment. Attempt to secure the source of the leaking to reduce the amount of pollutant entering the environment.

- Properly maintain engine repair areas.

Keep areas clean that are routinely used for engine repairs. Clean up spills immediately; don't dispose of waste in sinks or drains. Block waste from inadvertently entering drains by using a plug.

200.4 Education

- Provide information to marina tenants on collection and recycling programs for oil, oil-absorbing pads, and oil filters.

Use your existing network with your customers to inform them of new procedures and services that are offered. Existing networks may include your billing program or the marina's newsletter.

- Direct marina patrons to the proper disposal of all used hydrocarbon products through the use of signs, mailings, and other means.

All disposal facilities for oil and fuel should be clearly marked. Instructions for using the facility should be posted on a sign in or near the collection and storage site. Warn those using the facility not to add any material that may be contaminated, and provide instructions on the procedure for disposing of containment waste. In places where waste oil is likely to be generated, place signs explaining where it can be disposed of properly. When oil is sold to tenants, pass along a flyer outlining disposal techniques and tips on how to keep the oil out of the environment.

- Insert language into facility contract or newsletters that recommends tenants use fuel/air separators and oil-absorption materials.

Use newsletters and your contract with your tenants as an educational method to inform them about environmental rules and regulations. They should be informed that, as a condition of being customers of the facility, they need to conform to these rules—including those involving illegal discharge of oil and fuel.

SUMMARY Section 300.0 Hazardous Material and Liquid Waste

300.1 Storage and containment facilities

- Separate containers for the disposal of used antifreeze, paint cans, mineral spirits, and other solvents should be available and clearly labeled.
- Build curbs, berms, or other barriers around areas used for the storage of liquid material to contain spills. Store materials in areas impervious to the type of materials stored.

300.2 Spill protection

- Each facility should maintain a spill prevention and recovery plan for hazardous material.
- Each facility should have adequate spill response equipment.

300.3 Disposal

- Recycle where possible; adhere to existing state regulations pertaining to disposal of hazardous material.

300.4 Source control/delivery reduction

- Enforce the prohibition on the use of TBT-based paint.
- Detergents and cleaning compounds used for washing boats should be phosphate-free and biodegradable. Discourage the use of detergents containing ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, or lye.
- Use antifreeze that is less toxic to the environment.
- Amounts of hazardous material stored and used should be kept to a minimum.

300.5 Education

- Provide to marine tenants information on collection and recycling programs and source reduction.

300.6 Signs

- Direct marina patrons as to the proper disposal of all liquid materials through the use of signs.

300.7 Contract

- Insert language into facility contract that recommends tenants dispose of hazardous material in the proper containment facilities.

Section 300.0 Hazardous Material and Liquid Waste

Objectives: Provide and maintain appropriate storage, transfer, containment, and disposal facilities for liquid material, such as harmful solvents, antifreeze, and paints.

Encourage recycling of hazardous material, such as harmful solvents, antifreeze, and paints.

For boats that are in the water, perform cleaning operations to minimize, to the extent practicable, the release to surface waters of harmful cleaners and solvents.

Institute public education/outreach/training programs for boaters to prevent improper disposal of polluting materials.

Purpose: Provide boating facilities with options for storing, containing, and disposing of hazardous material and liquid waste. This section also discusses methods for reducing levels and responding to spills of hazardous material that could potentially enter surface waters. In this section hazardous material and liquid waste include harmful cleaners, solvents, detergents (i.e. ammonia, sodium hypochlorite, chlorinate solvents, petroleum distillates or lye), antifreeze, and paints.

Discussion:

Materials that are dangerous in the environment are routinely used in marina facilities because they are often a necessary part of marina activities. If they are handled properly, the dangers may never become apparent. When handled improperly or carelessly, hazardous materials can be introduced into nearby coastal waters causing acute or chronic toxicity to marine plants and animals. This threat not only applies to aquatic creatures, but to terrestrial ones as well. Some cleaners, solvents, and paints can pose health hazards to your tenants and staff if not used properly and with caution. Animals, such as your tenants' pets, can also be susceptible to materials such as spilled antifreeze, often with deadly effects. A nonpoint pollution prevention program can address these threats because they occur during a range of activities and exist throughout the marina property instead of emanating from one single source. As with most nonpoint sources of pollution, integrating appropriate practices into the operation of the facility will minimize the threats from hazardous material.

An inventory of the activities at your facility will identify where hazardous materials exist or are used and how to manage them. Consider the materials and processes used in activities such as boat scraping, painting or cleaning. Do you or your customers use solvents and cleaners during these processes? If so, how are they applied, stored and disposed of when their useful life is over? If engine repairs and maintenance are completed on site, assess what types of materials are used. During the boat winterization and commissioning, are materials such as antifreeze and acid part of the procedures? These are some of the activities that require the use of materials that may be hazardous. For minimizing the potential impact of these materials, appropriate practices, such as a reducing the amount of materials that are used on site or keeping the material from entering the open environment, should be considered.

This chapter provides recommended practices for reducing or eliminating the threat of hazardous material and liquid waste as a nonpoint source of pollution to coastal waters. Generally, best management practices attempt to reduce the source or provide mechanisms that prevent the material from entering surface waters. In addition to the practices documented here, other regulatory agencies have suggested, and in some cases required, measures that also mitigate hazardous material threats. The level of attention this issue requires and the extent you will need to go beyond this guidance will depend on the type and extent of activities at your facility. If activities on site use the materials discussed in this chapter more intensively than would be expected at a traditional recreational boating facility, it is advisable that you check with the department within the state that regulates hazardous waste. In Rhode Island, that is the Division of Hazardous Waste in the Department of Environmental Management. This chapter will provide the marina operator with a starting point and, in most cases, enough information to minimize the threats of hazardous material and liquid waste as a source of nonpoint pollution.

BEST MANAGEMENT PRACTICES

300.1 Storage and Containment Facilities

- Separate containers for the disposal of used antifreeze, paint cans, mineral spirits, and other solvents should be available and clearly labeled.

Design a collection scheme that provides adequate facilities capable of storing the types and volumes of material that are commonly disposed of at the facility. The first step in the design process is completing an inventory of materials that are used by the marina. List in the inventory all materials that are available for use, regardless of quantity. Consider dividing the list into broad categories such as: detergents, solvents, paint, and lubricants. Once a comprehensive list is completed, identify what materials require collection facilities. Commonly, collection facilities are required for materials that have a limited life span, such as antifreeze, or materials that are not fully dispensed during application, such as paint. Based on this evaluation, identify what types of collection facilities are needed and place them in the marina. Like all collection facilities, the containers should be easily accessible and clearly marked. When dealing with liquid collection facilities, be sure to consider issues such as: how the marina will control what is put into the containers; secondary spill protection; and special hazards. For information on these issues, see Section 200.2.

It is also important to compare the inventory to the state's list of regulated wastes. If the marina is storing material that is considered hazardous, design the collection and disposal scheme so that it conforms to the specific state requirements. A listing of materials regulated by the state as hazardous and associated regulations are contained in a document titled *Rules and Regulations for Hazardous Waste Management*, which can be obtained from the Division of Hazardous Waste in the Department of Environmental Management, located at 291 Promenade Street, Providence, RI 02908 (401-277-2797). These controls are based on federal regulations codified in the Code of Federal Regulations (40 CFR 261).

- Build curbs, berms, or other barriers around areas used for the storage of liquid material to contain spills. Store materials in areas impervious to the type of materials stored.

All collection containers used to store liquid material should have a form of secondary containment. In most cases, this secondary containment must equal 110 percent of the capacity of the primary container. Generally, this backup is provided by constructing a nonleaching berm with an impervious bottom around the containers. If the volume of liquid being stored is relatively small, one secondary spill revetment may be adequate to contain the material stored in several containers. Consider storing this material in the same revetment area with other hazardous material, such as waste oil. Other secondary spill protection methods may include a fully enclosed containment facility that provides internal secondary revetment. This method is explained in Section 200.2.

300.2 Spill protection

- Each facility should maintain a spill recovery plan for hazardous material.

A spill prevention and recovery plan for significant amounts of hazardous materials stored on site should be adopted. The plan should list the types and volumes of materials that could potentially be spilled. This information is important because spill response action is dependent on the type of material. For hazardous materials, specific remedial action is required by state law. For state regulated substances, required actions are outlined in the document titled *Rules and Regulations for Site Remediation*. This document can be acquired from the Division of Hazardous Waste in the Department of Environmental Management. For materials that are not regulated by the state, devise a plan that, when implemented, prevents the material from entering adjacent surface waters.

The spill response plan for hazardous material could be integrated into an oil spill response plan and should include the same components:

- (1) **Who**-Clearly identify who is responsible for taking what action.
- (2) **What**-What action should be taken during a spill event and, based on multiple scenarios, what equipment should be deployed.
- (3) **When**-When additional resources should be called for assistance.
- (4) **Where**- Where is the material located in the facility.
- (5) **How**- Explain how the equipment should be used and disposed of.

Section 200.1 contains additional details.

- Each facility should have adequate spill response equipment.

Unlike hydrocarbons, many solvents, detergents, and other hazardous materials do not remain on the surface of a water body if they are spilled, making them difficult to contain and capture. Therefore, equipment that can contain the material and prohibit it from entering surface waters should be available. The type of equipment that is necessary will vary depending on the type of material being used and stored and should be identified in the facility's spill response plan. In most situations, absorbent materials that are easily dispersed will be acceptable. Once response equipment is used, either recycle or dispose of it properly. Check with the product manufacturer and RI DEM on recycling and disposal specifications.

300.3 Disposal

- Recycle where possible; adhere to existing state regulations pertaining to disposal of hazardous material.

Once the material is collected, ensure that it is disposed of properly. If the material is regulated as hazardous waste by the state, ensure that the pertinent requirements in the state hazardous waste disposal regulations are satisfied. This information is contained in the document titled *Rules and Regulations for Hazardous Waste Management*, which can be obtained from the Division of Hazardous Waste in the Department of Environmental Management.

When evaluating disposal methods, select recycling when it is available. This decision will be based primarily on the type of material and the availability of recycling facilities. In some cases it may be possible to shift from a product that is nonrecyclable to a similar product that is recyclable without sacrificing effectiveness. By selecting recycling as a disposal mode, the facility will lower its overall waste stream and decrease the burden on land-based waste disposal sites. Choosing recycling also exemplifies the marina's dedication to improving the environment, and may encourage tenants to do the same.

Regardless of whether the material is eventually recycled or disposed of, carefully document how much material was collected, how it was removed from the facility and the material's final destination. These records will be invaluable if there is ever any question about the facility's hazardous waste collection and disposal practices.

300.4 Source control/delivery reduction

- Enforce the prohibition on the use of TBT-based paint.

The use of TBT-based paints in the marine environment has been found to be harmful because of its toxicity. This finding led to the passing of a federal statute that prohibits the use of TBT in the marine environment. The state has created a law, based on the federal legislation, that phases out the use of TBT-based paint. Rhode Island General Law 23-25.3 prohibits the use of TBT-based paint in commercial boatyards except when its measured release rate does not exceed four (4.0) micrograms per square centimeter per day and it is applied only to vessels in excess of 65 feet in length or having aluminum hulls. However, federal law—which preempts the state law because it is more stringent—prohibits use of all TBT products on vessels that are less than 82 feet (25 meters), unless the vessels are made of aluminum (Federal Register, 1988). Both laws allow TBT-based paint to be applied to outboards or lower drive unit of vessels. Adhere to the stricter federal law by not using TBT-based paints in your facility, unless you meet the specific criteria. Ensure that tenants and subcontractors are operating in accordance with these standards.

- Detergents and cleaning compounds used for washing boats should be phosphate-free and biodegradable. Discourage the use of detergents containing ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, or lye.

Use products throughout the facility that are environmentally compatible. Generally, these include products that are not toxic in the marine environment and are often biodegradable. For vessel cleaning use detergents that are phosphate-free and do not contain such toxins as ammonia and sodium hypochlorite. If the facility has a store where detergents and solvents are sold, consider stocking products that are also environmentally

compatible. Encourage your customers to use products that will not degrade the environment.

There is a growing number of services that grade a product's environmental compatibility. Discover if one of these services is available to the marina and consider using the information it can provide.

- Use antifreeze that is less toxic to the environment.

Currently there are two types of antifreeze on the market. Ethylene glycol is standard or traditional antifreeze and is usually discernible by its green or blue coloring. This antifreeze is toxic in the environment and should be collected and recycled. If recycling is not an option, the ethylene glycol should be collected and disposed of according to appropriate state regulations. Propylene glycol antifreeze is less toxic in the environment and is often identified by its pinkish color (Gannon, 1990). Consider using propylene glycol instead of standard antifreeze, especially if there are no means for recycling antifreeze. Encourage your tenants to use propylene glycol because of its greater compatibility with the environment.

- Amounts of hazardous material stored and used should be kept to a minimum.

Review the facility's hazardous material inventory and identify any materials that can be stored in smaller amounts. The benefits of maintaining only minimal amounts include: secondary spill revetments can be smaller; the amount of potential contamination is limited if there is a spill; and, the conservation of the product may be encouraged. Also, in some instances, regulatory requirements are based on the volume of material being stored. If these amounts do not exceed regulated levels, the facility may be subject to less stringent storage and disposal rules.

Keep amounts to a minimum when toxic material is used during maintenance activities. Use only enough detergent, solvent, or other compounds to get the job done. Encourage your tenants to use only a minimum amount of cleaning material when they are washing their boats. Minimizing the amount of material being applied also reduces the amount of material that eventually enters surface waters.

300.5 Education

- Provide to marine tenants information on collection and recycling programs and source reduction.

If a hazardous waste collection and recycling program is new at the facility, be sure that tenants understand the new procedures. As necessary, update your customers about changes in operating practices at the facility. Outline why the new procedures have been implemented and link this change with improving the boating environment using existing mechanisms, such as newsletters or mailings. Reinforce, through special newsletters or workshops, the fact that these changes in maintenance practices will help to improve the environment. Consider having the facility name added to the mailing lists of government and nongovernment agencies that provide information about environmental protection. Provide information that is obtained from these agencies to your customers as free handouts in the front office or store. Allow customers to provide suggestions on how the facility could improve further.

Because employees are key to the implementation of new practices, it is important that they are well informed. Employees should have enough knowledge about the

improvements to provide reasonable answers to customers when questioned. In many instances your employees, through their daily contacts, provide the best opportunity to inform customers about new practices and why they are important. This reinforces the importance of having employees who understand new practices and how these changes will help to improve the environment.

300.6 Signs

- Direct marina patrons as to the proper disposal of all liquid materials through the use of signs.

Use signs to mark where collection facilities are located, the type of material each is designed to collect, and any special requirements. In the designated cleaning areas, post descriptive signs that explain why environmentally compatible materials are preferred and that any hazardous material should be used in a way that minimizes impact on the environment.

Use signs to mark special hazards, such as flammability or toxicity on collection containers. These markings will be especially useful to emergency crews, such as the local fire department, during an emergency response.

300.7 Contract

- Insert language into facility contract that recommends tenants dispose of hazardous material in the proper containment facilities.

Use your contract to inform tenants about operating and maintenance policies when they are using hazardous material. Perhaps policy statements can be added to the legal requirements, telling customers about special responsibilities regarding hazardous material. Restrictions on the use of certain materials, such as TBT, that are already law, could be reinforced in the contract. Restrictions that apply to outside contractors should also be included in the contract.

SUMMARY Section 400 Vessel Discharge of Sewage

400.1 Pumpout installation

- If you have vessels within your facility that have on-board sanitation devices, consider installing a pumpout facility.

400.2 Pumpout operation

- Provide the service at convenient times and at a reasonable cost.
- Make the pumpout station user friendly.
- Develop and adhere to a regular inspection and maintenance schedule for the pumpout equipment.

400.3 No-discharge area designation

- Work with local and state governments to declare your harbor a no-discharge area once adequate pumpout facilities are installed.

400.4 Education

- Provide education information about the pumpout service to customers.

400.5 Enforcement

- Formally advise your municipality that you have a pumpout facility available and provide pertinent information, such as time of operations and fee.
- Encourage the local harbormaster to enforce existing state and federal regulations pertaining to Marine Sanitation Devices and the illegal discharge of boat sewage.

400.6 Signs

- If you operate a pumpout facility, install adequate signs to identify the pumpout station, location, and hours of operation.

Section 400.0 Vessel Discharge of Sewage

Objectives: Install pumpout, dump station, and rest room facilities where necessary to reduce the release of sewage to surface waters.

Design pumpout facility to allow ease of access and post signage to promote use by boating public.

Ensure that sewage pumpout facilities are maintained in operational condition and are used.

Institute public education/outreach/training programs for boaters to prevent improper disposal of polluting material.

Purpose: Provide boating facility operators several options that they can apply within their facilities to eliminate the discharge of untreated sewage from their tenants' vessels.

Discussion:

The discharge of untreated sanitary waste has commonly been addressed as a concern in marine environments. Studies have documented a correlation between boating activity and elevated levels of fecal coliform, especially in areas of poor flushing. (Milliken and Lee, 1990; JRB Associates, 1980). A study in Martha's Vineyard, Massachusetts, identified significant increases in fecal coliform bacteria during high boat use times (Gaines, 1990). This was also documented in studies conducted in Rhode Island's Block Island Great Salt Pond between 1986 and 1991. Although accurate measurements for the volume of boater discharge are difficult to make, the Narragansett Bay Project estimates that 3.9 million gallons of sanitary waste could be discharged in Narragansett Bay in a single boating season (NBP, 1991). Even if only a fraction of this potential occurs, the illegal discharge of untreated waste is an existing problem.

The predominant concern is the impact that sewage, from urban sources and boats, has on shellfish that are harvested and sold for human consumption. Because of this potential health problem, water quality is closely monitored through measurements of levels of fecal coliform, which are used to indicate the levels of potential pathogens in the water column resulting from waste from warm-blooded animals. These bacteria can cause acute gastroenteritis, hepatitis, typhoid, and cholera (Milliken and Lee, 1990). Areas where fecal coliform reaches unsafe levels are closed to shellfishing. Other health concerns also exist. One boat discharging illegally as it transits the bay may not have significant impact, as the effluent is rapidly diluted. However, in harbors where boats congregate, total input of untreated sewage is increasing, having significant impact. This problem is compounded by the fact that boaters are drawn to closed harbors, which inherently do not provide adequate flushing. Problems can exist for swimmers and others who come in direct contact with water in these congested areas.

Since the adoption of the Clean Water Act in 1972, it has been illegal to discharge untreated waste into coastal waters. Legally, waste has to travel through a Marine Sanitation Device (MSD), before discharge or be held in a holding tank, until such a time that it can be pumped out or discharged offshore. However, it was difficult to enforce

this regulation when there were few or no vessel MSD pumpout stations available to boaters. Consequently, it was not uncommon to find improperly equipped boats or incorrectly used MSDs. This situation improved as pumpouts began to be installed in marinas and town-operated facilities as boating populations increased and impacts on water quality became an issue.

Pumpout installation was further spurred on by the advent of harbor management plans, which require each community to address the location and installation timetable for pumpout facilities. Each approved harbor management plan discusses how the community is going to reduce the amount of untreated waste being discharged in its harbor areas from boats. For most communities, two options exist: reduce the number of boats in the water, or install pumpout facilities for the boaters to use. The result has been a dramatic increase in the number of pumpout stations in Rhode Island. In 1990, the Rhode Island Marine Trade Association reported that only five marinas operated pumpout stations (NBP, 1991). Today, there are 14 operating pumpout stations and numerous more sites planned for construction (RI DEM, 1993). The current trend, in Rhode Island and across the country, is to move towards federally approved no-discharge areas where it is illegal to allow sanitary waste, treated or untreated, to be discharged into the water. This will become more likely as the number of pumpouts serving the boating population rises.

BEST MANAGEMENT PRACTICES

400.1 Pumpout Installation

- If you have vessels within your facility that have on-board marine sanitation devices, consider installing a pumpout facility. EPA Region I assumes that vessels over 25 feet have an on-board marine sanitation device (EPA, 1991).

Although not every marina facility is required to have a pumpout station, each facility that stores boats greater than 25 feet in length is encouraged to install one because pumpout stations, when used, are the most efficient means for removing sanitary waste from boats. Pumpout stations can also attract customers who want to keep their boats moored or docked in areas where they can easily pump out their holding tanks.

The location of pumpout stations in Rhode Island is based on the size of the boating fleet in a particular harbor. EPA Region I has identified two types of harbors, transient (destination) and nontransient. For harbors that are deemed transient, one pumpout is required for every 300 boats over 25 feet or with an installed MSD. If information about boat size is unavailable, the state counts all boats in the harbor. Nontransient harbors that serve as boat parking lots require one pumpout per 600 boats. In order for a pumpout to be included in the count, it must be a fixed unit, tied directly to a sewer line or holding tank. A mobile pumpout station (vessel or cart) can be used in the count, if it is working in coordination with an approved fixed system in the particular cove or harbor. The purpose of this requirement is to ensure that there is a continuous means of holding and disposing of the waste once it is collected. Without this requirement, it is more difficult to monitor the final fate of the boat sewage once it is collected. This also guards transfer of waste from the harbor where it was collected to an unsuspecting sewage treatment plant in another geographic region.

The permit process for installing a pumpout is managed by the Coastal Resources Management Council (CRMC) and the state Department of Environmental Management (RI DEM). General requirements of the permit usually include:

- (1) Assent from CRMC to permit construction in a coastal zone
- (2) Order of approval from the local sewer treatment plant if you are tying directly into a sewer line
- (3) Order of approval from the Division of Water Resources at RI DEM for a sewer connection if a holding tank needs to be installed

Pumpout stations are manufactured by numerous companies. Each type of pump has individual characteristics that need to be considered in evaluation of the specific site. The basic criteria used in pump selection are the pump's capacity and the distance, both in height and length, it can move waste through a pipe. Other considerations may include durability and ease of operation and maintenance. A pumpout system includes four functional parts: flexible hose and nozzle; pump machinery; pipe lines; and sewage disposal system (Ross and Amaral, 1992). Pump types include centrifugal, diaphragm and vacuum designs.

Centrifugal-Moves sewage by using an impeller that pushes the waste to the outside of the impeller by using centrifugal force. This forces the sewage to flow through the impeller as it rotates.

Diaphragm-Moves sewage by lifting up and pushing down a diaphragm in a pump casing. The upward motion sucks sewage into the pump casing through a check valve. During the downward motion, sewage is pushed out of the pump casing through the outlet check valve.

Both of these systems have parts that are in direct contact with the sewage, and the centrifugal pump requires priming.

Vacuum-Moves sewage by creating a vacuum between the hose nozzle and an accumulator tank. When the accumulator pump is full, the vacuum is reversed, sending pressurized air into the tank and pushing the sewage out to the disposal system.

In addition to the type of pump utilized, consider where to locate the pumpout station and how to dispose of the waste once it is collected. Pumpout stations can either be fixed, mobile, or remote-operated. Mobile pumpouts can be attached to a pumpout vessel and used in the harbor area or attached to a cart and used within the marina. Both methods allow the pumpout to get to the customer easily. Mobile pumpout boats have worked particularly well in areas with a high number of boats on moorings, such as Great Salt Pond on Block Island, Rhode Island. Fixed stations are permanently mounted in a location within the marina that is accessible to boaters, generally on an existing gas dock. Remote stations provide a direct hookup to multiple locations or each slip within a facility. These systems are expensive but provide the most convenient means for customers to pump out their holding tanks. Fixed and remote stations must be directly attached to either a sewer line or a holding tank.

The cost to install a pumpout system ranges greatly, depending on the type and location within the facility. According to a 1992 EPA report, the average cost to install a pumpout facility is \$5,323 and can range in cost from zero to \$50,000 (Ross and Amaral, 1992). Total costs include engineering and permit fees, pumpout machinery and pipes, excavation and installation charges. A helpful guide on the installation and operation of pumpout stations has been completed by the Maryland Department of Natural Resources, Boating Administration. The guidebook provides a partial list of portable, stationary, and remote pumpout units available according to manufacturer's model. A copy of *A Guidebook for Marina Owners and Operators On the Installation and Operation of*

Sewage Pumpout Stations can be obtained by writing the Maryland Department of Natural Resources, Boating Administration, 902 Commerce Road, Annapolis, MD, 21401. An abridged listing of pumpout manufacturers is located in Appendix C of this manual.

400.2 Pumpout Operation

- Provide the service at convenient times and at a reasonable cost.

Pumpout stations should be available to customers at times that encourage their use. Traditionally, a fixed station is open during the same time that the fuel dock is open and is generally busiest on weekend mornings and evenings. Mobile pumpout vessels can operate on an as-needed basis or during fixed hours, depending on the needs of your customers.

In many cases, charging a fee is justified and appropriate. Pumpout fees should be kept at the lowest level possible to encourage their use. In New England, pumpout prices range from free to \$50 (Ross and Amaral, 1992). EPA's report on pumpouts finds that boaters are willing to pay between \$3 and \$7 for the service (Ross and Amaral, 1992). In 1992 the highest number of pumpouts was at facilities that did not charge a fee, and the lowest number of pumpouts charged an average of \$12 (Ross and Amaral, 1992). Some facilities offer the pumpout free to their customers and make up the revenue through slip fees or an environmental surcharge, which helps pay for all new environmental improvements. When pumpouts began to appear regularly on the coast, incentive offers, such as free pumpout to anyone who bought fuel, were used extensively to encourage use. Studies show that boaters are willing to pay for the service. In fact, when the cost is built into the slip fee or environmental surcharge, boaters often feel obligated to use the service. Marinas are encouraged to charge an appropriate fee that encourages use and helps offset the capital and operational costs of the pumpout system. If the marina is participating in the Clean Vessel Act Grant program, which provides a 75 percent to 25 percent matching grant for the installation of marine pumpout stations, then a maximum fee of \$5 may be charged. A higher fee must be justified in the written proposal (Clean Vessel Act Technical Guidance, 1994).

- Make the pumpout station user friendly.

Keeping the pumpout boat or area neat and tidy will encourage use and improve safety. If the pumpout is self-service, be sure the directions are clearly posted and all the necessary equipment for using the pumpout is in close proximity. If an employee is operating the pumpout, make sure that he or she is knowledgeable about the procedure as well as rules pertaining to MSDs and no-discharge areas.

- Develop and adhere to a regular inspection and maintenance schedule for the pumpout station.

Once a pumpout is installed and operating properly, only minimal maintenance should be required. The pumpout manufacturer should be able to provide you with information on servicing the pump and pipes. In the past, some pumpout stations have been rendered unusable by lack of proper maintenance. It is important to have a pumpout station that is dependable. A standard maintenance schedule can ensure that the system continues to operate properly for the boater and helps protect your investment.

400.3 No-discharge area designation

- Work with local and state governments to declare your harbor a no-discharge area once adequate pumpout facilities are installed.

Installation of pumpouts has been based on the anticipated no-discharge designation that the state will apply for as soon as there are adequate pumpouts in specific areas. Once each harbor has the required number of pumpouts, no-discharge areas can be defined and declared. No-discharge areas are zones of water that require greater environmental protection, where even the discharge of treated sewage could be harmful (Coast Guard, 1986). In these areas it is illegal to allow sanitary waste, treated or untreated, to be discharged into the water. In no-discharge areas the only marine sanitation device that can legally be used is an approved Type III MSD (holding tank). Type I and II MSDs (on-board treatment systems using macerator/chlorinators) can be installed but cannot be used. Regardless of what type of MSD is on board in no-discharge areas, overboard Y valves must be secured. When declared and enforced, no-discharge areas can significantly reduce the amount of bacterial contamination being introduced by the illegal discharge of MSDs. Rhode Island's first no-discharge area is Great Salt Pond on Block Island, where water quality studies in the pond indicate that levels of fecal coliform have declined during the boating season since the declaration of no discharge. (Constantine, 1993)

Table 3. Pumpouts In Rhode Island

Note: Because of the variability of boating populations, these boat counts may not be fully accurate.

NonTransient Harbors
 NonTransient Harbors = 1 Pumpout/600 Boats

Location	Total Moorings/Slips	Existing Pumpouts	Pumpouts Pending Construction	Additional Pumpouts Needed
Seekonk River East Providence	86	1	-	-
Bullock Cove East Providence & Barrington	494	0	-	1
Warren River Barrington & Warren	480	1	-	-
Kickemuit Warren & Bristol	147	0	-	1
Bristol Harbor Bristol Highlands	716 45	0	1	1
Sakonnet River Portsmouth & Tiverton	457	1	-	-
East Passage Portsmouth	360	1	-	-
Sakonnet Harbor Little Compton	138	0	-	1
Providence River Cranston & Pawtuxet	5,490	0	-	1
Warwick Cove	1,639	0	-	3
Apponaug Cove	984	0	-	2
Greenwich Cove Warwick & E. Greenwich	781	0	-	2
Allen Harbor N. Kingstown	139	0	-	1
Wickford Harbor Bissel Cove & W. Passage	720	0	-	2
Narragansett Pier Area	82	0	-	1
Pt. Judith Pond Narragansett & S. Kingstown	1,320	1	1	2
Little Narragansett Bay Pawcatuck River Westerly	969	1	-	1
Total	9,597	6	2	19

Transient Harbors
 Transient Harbors=1 Pumpout/300 Boats

Location	Total Moorings	Existing Pumpouts	Pumpouts Pending Construction	Additional Pumpouts Needed
Jamestown	463	2	-	-
Block Island	1,501	4	-	-
Newport and Coasters Harbor	1,312 170	2	1	2
Total	3,446	8	1	2

Combined Transient and NonTransient Harbors

Harbor Type	Total Moorings	Existing Pumpouts	Pumpouts Pending Construction	Additional Pumpouts Needed
Transient	3,446	8	1	2
Non Transient	9597	6	2	19
Total	13,043	14	3	21

*The information provided in this table was provided by:
 Department of Environmental Management
 Division of Water Resources*

*Original data sources include:
 Marina Pump-Out Management Plan, Division of Water Resources/Narragansett Bay Project.
 May 1993.*

Harbor Management Plan Technical Report, CRMC. 1988.

400.4 Education

- Provide educational information about the pumpout service to customers.

Many boaters are unaware of current state and federal regulations that require the use of properly operating marine sanitation devices, or how their on-board system works. Marinas can act as the most efficient source of accurate information to boaters. Even if you do not currently have a pumpout station, let boaters know where the nearest facility is located. Methods for sharing information about pumpouts and MSD regulations are numerous and can include:

- (1) ***Pamphlets and Flyers***-There is a great deal of information being produced by the government and many nonprofit organizations that can be handed out at your facility, perhaps in the ship's store or at the fuel/pumpout dock. Most of the information is free and carries no copyright. Some sources for pumpout information include:
 - Coastal Resource Management Council: Stedman Government Center, Tower Hill Road, Wakefield, RI 02879 (401-277-2476)
 - State Department of Environmental Management, Division of Water Resources, or Narragansett Bay Project: 291 Promenade Street, Providence, RI 02908. (Water Resources, 401-277-3961; Narragansett Bay Project, 401- 277-3165)
 - RI Sea Grant, University of Rhode Island Bay Campus, Narragansett, RI 02882-1197 (401-792-6842)
 - US Coast Guard, Marine Safety Office, 20 Risho Avenue, East Providence, RI 02914 (401-435-2300)
 - US EPA Region I, Waters Program: J. F. K Federal Building, Boston, MA 02203-2211 (617-565-3420)
 - Save the Bay: 434 Smith Street, Providence, RI 02908 (401-272-3540)
 - International Marina Institute: 35 Steamboat Avenue, Wickford, RI 02852 (401-294-9558)
 - RI Marine Trade Association: (401-885-5044)
 - Local Harbormaster
- (2) ***Newsletter***-If you provide a newsletter to your customers, perhaps you could consider a section highlighting different steps you are taking to improve the environment. This is also a great way to advertise the pumpout service and could be distributed to boaters who are not customers.
- (3) ***Inserts***-Billing statements provide an opportunity to let your customers know about your pumpout service.
- (4) ***Meetings***-Once a pumpout station is installed, consider hosting a meeting for your tenants and other boaters to explain the services and rules relating to the MSDs and pumpout stations. A demonstration of how cleanly and efficiently a pumpout

operates may make people more likely to use it. Your local harbormaster or Coast Guard Auxiliary/Power Squadron unit should be able to assist you in conducting meetings.

- (5) **Inspections**-Consider offering an additional service to your customers by inspecting their existing MSDs and correcting any problems that may lead to improper operations. This could become another step in the winterization or spring commissioning process. Providing holding tank installation services will also help boaters easily comply with new no-discharge laws.

The Coast Guard Auxiliary is also available to conduct free boating safety inspections, which include a check of the MSD and overboard discharge valve.

- (6) **Slip leasing agreement**-You can use your tenant contracts to inform boaters about the use of the pumpout station. Although having no legal authority to enforce state laws, marinas can declare themselves no-discharge marinas and require tenants to use pumpout stations and ensure that Y valves are sealed to prevent incidental overboard discharge. In most facilities with these requirements, the penalty for discharging within the facility is expulsion.

There are other ways to help the boater understand the value in using a pumpout station and having a properly operating MSD. It is also important to have any member of the staff who will be operating the pumpout understand state and federal laws pertaining to MSDs and pumpout stations. This will enable them to answer questions that boaters may have.

400.5 Enforcement

- Formally advise your municipality that you have a pumpout facility available and provide pertinent information, such as times of operation and fees.
- Encourage the local harbormaster to enforce existing state and federal regulations pertaining to Marine Sanitation Devices and the illegal discharge of boat sewage.

Marina operators do not have the legal authority to enforce MSD and no-discharge area regulations. This is the responsibility of the local, state, and federal governments. Section 312 of the Clean Water Act sets the standards for MSD operations and provides enforcement power to some federal and state entities. In Rhode Island a state law exists that grants local harbormasters the power to enforce MSD requirements and fine violators, where necessary. To enforce MSD requirements, several methods can be employed:

- (1) Place in holding tanks a dye tablet that will disperse and be discharged from the vessel if overboard discharge occurs
- (2) Inspect Y valves to ensure they are sealed
- (3) Inspect MSDs and ensure they are properly operating

Work with your harbormasters so that they understand the importance of enforcing existing rules and regulations. If you know of any violations, report them immediately to the proper authority.

400.6 Signs

- If you operate a pumpout facility, install adequate signs to identify the pumpout station, its location, and hours of operation.

Standard pumpout signs that mark the location of pumpout stations are available through EPA's Near Coastal Waters Program. You should obtain these signs and post them near each pumpout station. This sign has been designed by marina operators to provide a standard method for marking the location of pumpout facilities and is being used throughout the New England region. In addition to the EPA sign, other pertinent information should be posted, such as hours of operation and fee. If the pumpout is self-service, be sure that the operating instructions are clearly posted. Informational signs and displays should also be posted in the ship's store or wherever your tenants congregate. If your pumpout station serves the harbor area, consider posting signs or posters in neighboring marinas and mooring areas directing boaters to the pumpout station and providing pertinent information.

Developing an Operations and Maintenance Plan

OPERATIONS AND MAINTENANCE PROGRAM

Why an Operations and Maintenance Program?

The purpose of an operations and maintenance program (OMP) is to outline what steps the marina facility is taking to reduce nonpoint sources of pollution. The program should be written in a form that identifies on-site activities and applicable best management practices (BMP). In many cases, this means documenting practices that are already in use or providing a schedule for expected implementation. This chapter provides a framework to help marinas create an OMP to minimize or eliminate nonpoint sources of pollution that result from the operations and maintenance of the marina.

This OMP chapter is also designed to address each of the applicable marina management measures as described in chapter five of the *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. As described in the introduction, management measures are pollution control objectives, implemented by applying best management practices. States must implement the management measures prior to January 1995 to receive approval of their Coastal Nonpoint Pollution Control Program (CNPCP). Rhode Island's CNPCP will address these management measures by requiring each marina to submit an OMP, outlining how the facility is controlling nonpoint pollution, by 1999. Using the framework provided in this chapter, the marina can create an OMP that addresses the requirements that appear in CRMC's regulations for Recreational Boating Facilities, Section 300.4 of the Rhode Island Coastal Resource Management Program (RICRMP) relating to nonpoint source pollution. When the marina operator has finished this chapter, he/she should have a list of applicable BMPs that will be implemented and included in an OMP.

Benefits of an OMP

Once the CNPCP is in place by 1995, marinas may begin submitting OMPs to CRMC for approval. Each marina is expected to have an OMP approved by 1999. If a submitted OMP demonstrates that the applicable BMPs are fully implemented, then CRMC will allow the facility to perform minor modifications on site, both in-water and upland, without having to receive additional permits from CRMC. The specific modifications allowed by CRMC can be found in section 300.4 of the RICRMP. An OMP would likely receive an approval with stipulations from CRMC if the program identifies the applicable BMPs that are already in place and a planning schedule for those applicable BMPs that are not. This will allow the facility to undertake minor modifications, as prescribed by the stipulations in the approval, without having to apply for a CRMC permit. For either option, certain BMPs will require a CRMC permit before installation. Generally these will include, but are not limited to: increase in impervious surface; filling, removing or grading activities; addition or expansion of hull maintenance areas; or, an increase in the footprint of any building, or additional floors or structures.

The OMP can also be a foundation for the facility to build a comprehensive document that includes everything the facility is doing to comply with environmental regulations. For instance, the framework presented in the following pages and throughout the document, has been designed in coordination with the Storm Water Permitting Program at RI DEM, known as Rhode Island Pollution Discharge Elimination System (RIPDES). An OMP that uses this framework will also meet many of the requirements of RIPDES. To clarify the overlap, Appendix B identifies BMPs suggested by RIPDES that are not included in the CNPCP. When the operator completes the following eight worksheets and the additional one located in Appendix B, he/she should have enough information to complete a Pollution Prevention Plan required by RIPDES for certain facilities, in

addition to an approval OMP. By incorporating other plans, the final OMP will describe all the operational procedures, required by regulation, in place at the facility, providing one document for the marina and government agencies to reference as necessary.

Operations and Maintenance Program Requirements

A typical operations and maintenance program will identify:

- (1) Activities that occur at the facility detailed on a site plan; and
- (2) BMPs that are existing, planned, and not applicable in mitigating nonpoint source issues at the specific facility.

The first step in devising a program to abate nonpoint pollution is to summarize the facility operations and maintenance activities. This component will include a site plan that shows a graphic representation of the facilities' operations, the location of maintenance activities, and applicable BMPs. Site plans should include:

- Title block, with date and name of person who prepared the plan
- North arrow
- A complete set of property bounds
- Marina perimeter limit as defined by CRMC and the location of all in-water facilities
- Boat capacity of the existing slip layout
- Parking areas with striping plan and the surface treatment (e.g., paved, crushed stone, etc.)
- Location of any pumpout facilities, dump-stations, rest rooms, launch ramps, travel lifts, gas docks, etc.
- Location of dry rack storage, with the number of boats accommodated
- Location of seawalls, bulkheads, breakwaters, revetments, etc.
- Location and footprint of all upland structures
- Location of all pertinent underground utilities including, but not limited to, septic tanks and drainage fields, sewer line, pumpout holding tanks, water and electric lines, and fuel tanks and lines
- Location of federal channel or anchorage areas and municipal mooring fields relative to the in-water facilities
- Location of established riparian lines designated by either the Army Corps of Engineers or the CRMC
- General location of docks, piers, etc. on abutting properties

However, before preparing a site plan, an applicant should first consult with the CRMC to ensure that these site requirements are accurate. The marina operator may also

consider reviewing the site plan requirements of the Storm Water Program listed in Appendix B. At this stage of OMP development, it may be easy and cost-effective also to incorporate the storm water site plan requirements if the facility is subjected to the storm water program. Appendix B provides the necessary details.

Site plans are an effective way of showing what activities exist within a marina facility. In some cases, implementation of structural BMPs, such as oil waste receptacles or hull maintenance areas, will be documented on site plans. This reduces the amount of narrative necessary to complete the OMP. The site plan will also include notes that explain the types of vessel storage areas (docks, moorings, dry rack); vessel cleaning, maintenance and repair activities; and, information about other activities that occur on site, including, but not limited to, fueling, pumpout services, and fish cleaning.

The second part of the operations and maintenance program is an explanation of selected BMPs to control nonpoint sources from the on-site activities. Applicable BMPs, when implemented, should minimize or eliminate nonpoint source pollution. In the previous chapter, BMPs are listed by major topics (hazardous material, liquid and solid waste, fuel, oil and hydrocarbons, and vessel discharges of sewage). This chapter lists the BMPs by corresponding management measures presented in the CNPCP. These management measures are equivalent to the objectives stated at the opening of each BMP section. The best management practices listed in this chapter are recommendations that can be used to reduce nonpoint pollution and are not inclusive of all potential BMPs. Alternate practices may be applied if they can meet or exceed the effectiveness of the recommended BMPs. Some facilities may require alternate BMPs because of site specific conditions (e.g. geographical location, unique operations, or other individualized situations.)

The BMP section of an OMP will list:

- **Existing BMPs**-Explain how applicable BMPs are implemented. Often, implementation can be documented by including applicable BMPs on the site plan when possible (e. g., identifying oil containment areas). Applicable BMPs are those that address a nonpoint pollution issue resulting from an activity at the facility.
- **Planned BMPs**-Identify what BMPs are applicable but not yet implemented. Explain when they will be implemented.
- **Not applicable BMPs**-Explain why BMPs are not applicable to the facility. Generally, not applicable BMPs are those that do not address a nonpoint pollution issue resulting from an activity at the facility or cannot be implemented because of a constraint and conditions such as limited land, geographical location, unique operations, or other individual situations. Because each facility is unique, applicability will be decided by CRMC on a site-by-site basis.

If necessary the program will also include:

- What alternative BMPs were applied in lieu of the listed BMPs and a brief explanation why. This provides the flexibility to marina operators to select BMPs that were not listed.
- What management measures are not addressed and a brief explanation why (e.g., fish disposal is not addressed because fish waste has not been shown to be a water quality problem).

Because the final state regulations will not be in place before 1995, it is important that, before preparing an OMP, the marina operator is sure to check with the CRMC to identify the most recent coastal nonpoint regulations and the required components of an OMP. Final instructions can be obtained from CRMC, located at Stedman Government Center, Tower Hill Road, Wakefield, RI 02879 (401-277-2476).

Selecting BMPs

The following pages contain worksheets designed to help select applicable BMPs. Each worksheet is a list of the BMPs that address specific management measures presented in federal and state nonpoint source programs. There are eight management measures that concern marina operations; therefore, there are eight worksheets. The section number listed with each BMP represents the section within this document where the BMP is explained. To facilitate the decision-making process, a question is posed on each worksheet about a nonpoint source pollution issue. For instance, the question on the solid waste worksheet asks if solid waste is produced by the operation, cleaning, maintenance and repair of boats that are stored on site? If the answer is yes, evaluate each BMPs and, by marking the appropriate box, identify if the practice is either:

- (1) *Existing*-Explain, in the space provided, how it is being implemented.
- (2) *Planned*-Explain, in the space provided, when it will be implemented.
- (3) *Not applicable*-Explain, in the space provided, why it is not applicable.

Refer to the BMP chapters for a complete explanation of the BMPs by using the section reference. If the answer to the framing question is no, explain why it is not an issue on site, then move to the next worksheet.

When you have completed the eight worksheets, you will have completed the BMP component of the OMP that identifies what practices are existing, planned, and not applicable in mitigating nonpoint source issues at the facility. Augment this with a summary of activities that occur at the facility using the site plan and notes, add a cover sheet, and you will have completed an OMP. The following chapter shows what an example of an OMP, completed using this framework, will look like.

This worksheet provides only a suggested framework to develop an OMP. Other methods may exist that better suit a particular marina's needs. Regardless of what methodology is used, the key elements of an OMP are:

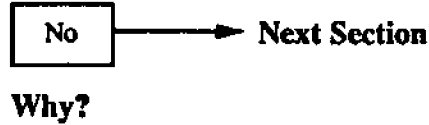
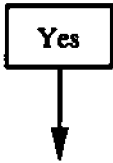
- (1) Activities that occur at the facility; and,
- (2) BMPs that are applicable to mitigate nonpoint source issues.

A marina may opt to use a different format that still includes these two elements if it is more applicable for your facility or provides a clearer program that meets the CRMC requirements.

Please note: An approved OMP does not conclude a marina's responsibility to adhere to other regulatory programs that extend beyond nonpoint source pollution.

1. Storm Water Runoff

Are hull maintenance areas* present on-site?

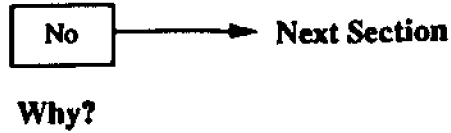
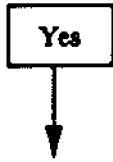


These practices are:

	Existing	Planned	Not Applicable
Install and maintain adequate buffer areas between the coastal zone and upland facilities (section 100.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Implement effective runoff control strategies such as surfacing area with crushed gravel, decreasing slope of facility towards coastal zone, or installing filters and wet ponds (section 100.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perform maintenance work inside buildings whenever possible (section 100.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perform maintenance over tarps to ease the cleanup process and prevent material from being carried into surface waters. Dispose of collected material properly (section 100.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use vacuum sanders to remove paint from hulls and collect paint dust (section 100.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Hull maintenance areas are areas whose primary function is to provide a place for boats during the scraping, sanding, and painting of their bottoms. If boat bottom scraping, sanding, and/or painting is done in areas other than those designated as hull maintenance areas, this checklist applies to those areas as well. A hull maintenance area may indicate a need for a storm water permit. See Appendix B for additional details.

2. Fueling Stations




These practices are:

	Existing	Planned	Not Applicable
Have adequate spill response equipment (section 200.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintain a spill prevention and recovery plan (section 200.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inform your local harbormaster and fire department about your spill protection and recovery plan and equipment (section 200.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Properly dispose of used oil spill response equipment (section 200.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Solid Waste

Are solid wastes (including trash, recyclables, hull-cleaning debris, waste generated from boat maintenance) produced by the operation, cleaning, maintenance and repair of boats that are stored on site?

Yes



No

 **Next Section**

Why?

These practices are:

	Existing	Planned	Not Applicable
Provide covered containers for solid waste that is generated within the facility (section 100.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide proper disposal facilities to marina patrons (section 100.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide facilities for the eventual recycling of appropriate materials, such as glass, aluminum and plastic (section 100.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Support the use of environmentally compatible products (section 100.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use pamphlets, flyers, newsletters, inserts and meetings to convey the importance of any environmental precautions that have been instituted in the marina (section 100.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Continued next page

Have adequate signs throughout facility identifying BMPs (section 100.5).

Explain:

Perform abrasive blasting within spray booths or plastic tarp enclosures to prevent residue from being carried into surface waters. If tarps are used, blasting should be closely monitored on windy days (section 100.1).

Explain:

Provide and clearly mark designated work areas for boat repairs and maintenance. Do not permit work outside designated areas (section 100.1).

Explain:

Clean trash, sandings, paint chips, etc., immediately after any maintenance activity (section 100.1).

Explain:

Insert language into facility contract that requires tenants to use certain areas and techniques when conducting boat maintenance (section 100.6).

Explain:

Have a clearly written outside contractors agreement (section 100.6).

Explain:

Other.

Explain:

4. Fish Waste

Is fish waste, as determined by CRMC and DEM, a potential source of water pollution within the facility?

Yes
↓

No → Next Section
Why?

These practices are:

	Existing	Planned	Not Applicable
Establish fish-cleaning areas (section 100.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Educate boaters regarding the importance of proper fish-cleaning practice (section 100.4). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Issue rules governing the conduct and location of fish-cleaning operations (section 100.6). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Liquid Material

Are liquid materials (including oil, harmful solvents, antifreeze, and paints) used in the maintenance, repair, or operation of boats stored on site?

Yes
↓

No → Next Section
Why?

These practices are:

	Existing	Planned	Not Applicable
Have separate containers for the disposal of liquid materials such as waste oil, waste gasoline, used antifreeze, waste diesel, kerosene, and mineral spirits available and clearly labeled (section 200.2 and 300.1).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Institute a recycling program for oil filters (section 200.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Build curbs, berms or other barriers around areas used for the storage of liquid material to contain spills. Store materials in areas impervious to the type of material stored (section 300.1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintain a spill prevention and recovery plan for hazardous material (section 300.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have adequate spill response equipment for hazardous material (section 300.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Place containment berms around fixed pieces of machinery within the facility that use oil and gas (section 200.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recycle where possible, adhere to existing state regulations pertaining to disposal of hazardous material (section 300.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Continued next page

**Enforce the prohibition on the use of TBT-based paint (section 300.4).
Explain:**

**Use environmentally compatible antifreeze (section 300.4).
Explain:**

**Keep to a minimum amounts of hazardous material stored and used (section 300.4).
Explain:**

**Provide to marina tenants information on collection and recycling programs and
source reduction (section 300.4).
Explain:**

**Direct marina patrons as to the proper disposal of all liquid materials through the use
of signs (section 300.4).
Explain:**


**Insert language into facility contract that requires tenants to dispose of hazardous
material in the proper containment facilities (section 300.4).
Explain:**

**Other.
Explain:**


6. Petroleum Control

Do fuel and oil from boat bilges and tank air vents enter the marina and surface waters?

Yes



No

 **Next Section**
Why?

These practices are:

Promote the use of oil-absorbing materials in the bilge areas of all boats with inboard engines (section 200.3).

Explain:

Existing	Planned	Not Applicable
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Use automatic shut-off nozzles and promote the use of fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel spilled into surface waters during fueling of boats (section 200.3).

Explain:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

Provide to marina tenants information on collection and recycling programs for oil and oil absorbing pads (section 200.4).

Explain:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

Direct marina patrons to the proper disposal of all used hydrocarbon products through the use of signs, mailings and other means (section 200.4).

Explain:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

Insert language into facility contract that recommends tenants use fuel/air separators and oil absorption materials (section 200.4).

Explain:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

Other.

Explain:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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7. In-Water Boat Cleaning

Do the cleaning of boat topsides and hull scrubbing in the water occur on site?

Yes
↓

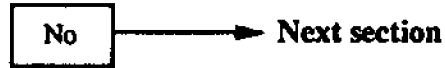
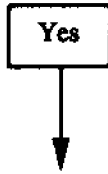
No → Next Section
Why?

These practices are:

	Existing	Planned	Not Applicable
Wash the boat hull above the waterline by hand (section 300.4). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Where feasible, remove the boat from the water and perform cleaning where debris can be captured and properly disposed of (section 100.3). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Recommend and use phosphate-free and biodegradable detergents and cleaning compounds for washing boats (section 300.4). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discourage the use of detergents containing ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, or lye (section 300.4). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Sewage Facility

Are sewage pumpout facilities or dump stations present on site?



Why?

These practices are:

Provide the service at convenient times and at a reasonable cost (section 400.2).

Explain:

Existing

Planned

Not
Applicable

Make the pumpout station user friendly (section 400.2).

Explain:

Develop and adhere to a regular inspection and maintenance schedule for the pumpout station (section 400.2).

Explain:

Work with local and state governments to declare your harbor a no-discharge area once adequate pumpout facilities are installed (section 400.3).

Explain:

Provide educational information about the pumpout service to customers (section 400.4).

Explain:

Formally advise your municipality that you have a pumpout facility available and provide pertinent information, such as time of operation and fee (section 400.5).

Explain:

Encourage the local harbormaster to enforce existing state and federal regulations pertaining to MSDs (section 400.5).

Explain:

Install adequate signs to identify the pumpout station (section 400.6).

Explain:

Other.

Explain:

Operations and Maintenance Plan - An Example

OPERATIONS AND MAINTENANCE PROGRAM - AN EXAMPLE

This chapter shows, using a model marina as a guide, how an operations and maintenance program (OMP) can be developed. Along with providing a sample of an OMP, this chapter presents a description of the model marina used in the example and some notes on the how the OMP was written. The output of this chapter, a sample of an OMP, was developed using the framework and suggestions presented in the previous chapters. Because the final regulations that require an OMP will not be in place until 1995, this sample plan has not been submitted for an official regulatory review. However, it was created in close consultation with the Coastal Resource Management Council, which will be responsible for approving plans once the coastal nonpoint control program is in place.

An OMP was developed for two reasons. First, developing an OMP created the opportunity to implement best management practices and evaluate their effectiveness. Second, it provided a true test of the worksheets and OMP format presented in the last chapter. By applying a marina's experience and expertise to the recommended OMP planning process, the format and procedures could be evaluated and revised as necessary. This chapter's product, a sample OMP, can provide marina operators with additional insights on how a plan can be developed, what needs to be included, and how it can be presented. Again, this is only one of what may be numerous methods that can be employed to complete an approval plan. Remember, the key components of a plan include:

- (1) Activities that occur at the facility detailed on a site plan; and
- (2) BMPs that are appropriate and not appropriate to mitigate nonpoint source issues at the specific facility.

The Facility

The model marina is a small-to-medium owner-operated facility located in a Riverine/Estuarine area of Rhode Island. The model marina has the capacity to wet-store 96 boats on three dock systems, one fixed, two floating, and seven single point moorings. There are no dry racks. The largest vessel the facility wet-stores is approximately 50 feet, and the average size boat is 28 to 32 feet. Smaller boats, under 25 feet in length, are also stored and make up about 10 percent of the population. There is an almost even mix of sailboats and power boats. Many of the tenants use their boats for day trips. On occasion, during the boating season, transients do visit the boatyard, but the primary focus is on seasonal tenants.

The upland area is less than one acre (40,000 sq. ft) and contains two small structures that house the ship's store, the business office, and rest rooms. The other, smaller, building is used as a storage shed and work area. Boat storage in the winter and auto parking during the boating season occupy the rest of the upland area. This area is surfaced with a mix of gravel and hard-packed sand. Pavement is not used on site. Parking is on a first come-first serve basis, with adequate spaces for over 71 automobiles. Below the parking area is an underground storage tank for fuel and a septic system.

The facility, like many in Rhode Island, is in a residential neighborhood. A small paved road separates the marina facility from the residential homes to the east and the other two sides are also abutted by residential homes. On the water side, a federal navigational channel is approximately 70 feet westward of the docks.

The boatyard hauls boats from the water by one of two methods. First, a crane and sling raises boats from the water onto a trailer where they can be moved around the facility. The second method is a marine railway system in which boats are floated onto a cart and winched up the rails.

When fully operational, the facility employs three people who are responsible for maintaining the facility, operating the fuel dock, running the ship's store, and managing the business. The boatyard provides some general services to customers, such as winterization and commissioning. Some minor maintenance activities occur on site, which usually include engine repairs, hull painting and scraping, woodworking and some fiberglass repairs.

Developing an Operations and Maintenance Plan - An Example

The following is an example of a OMP developed for the model marina. It was created by using fictional and real information from the model marina, to complete the worksheets presented in the last chapter. Each BMP listed in the last chapter's worksheets was considered, and the practices were selected as either existing, planned, or not applicable, followed by an explanation. In addition to the worksheets, a site plan appropriate for the model site was completed. Drawing the site plan was the last step in the preparation of the OMP because this allowed the BMPs selected for use to be shown on the drawing. Of course not all BMPs can be shown graphically (i.e. using environmentally compatible cleaners), but they should be whenever possible. The OMP begins with a basic cover sheet that identifies the applicant and submission date.

Operations and Maintenance Program

The Model Marina

Submitted to:

**Coastal Resource Management Council
Stedman Government Center
Tower Hill Road
Wakefield, RI 02879**

Submitted by:

**The Model Marina
12 Water Street
Smalltown, RI 00000
401-555-0000**

Submitted on:

July 1, 1994

This operations and maintenance program (OMP) accurately identifies (1) activities that occur at the facility and (2) BMPs that are applicable to mitigate nonpoint source issues for the model marina. This OMP is submitted to the Coastal Resource Management Council pursuant to section 300.4 of the RI Coastal Resource Management Program. The following section identifies the activities that exist on site. This is achieved by first describing the site and also displaying the appropriate information on an attached site plan.

IDENTIFIED ACTIVITIES

Notes

- (1) *Location*-Marina is the on the Smalltown River, 80 feet southeast of the federal channel marker number nine. The facility is 40,000 sq. ft situated on plat 149 lot 42 and 42A in Smalltown, RI. See site plan for property bounds.
- (2) *Marina perimeter*-CRMC marina permit number A93-1-53. See site plan for location of in-water facilities and marina perimeter delineation.
- (3) *Boat capacity of the existing slip layout*-In-water capacity is 96 vessels, ranging from under 25 feet to approximately 50 feet.
- (4) *Parking areas*-There is parking for a minimum of 71 automobiles. The parking area is surfaced with a mix of gravel and hard-packed sand.
- (5) *Services and activities*-Services available at the facility include pumpout station and fuel pump located on the south pier; rest rooms in main building; marine railways and crane for boat hauling; and boat supplies sold in ship's store. See site plan for locations. The property is used primarily for storing recreational boats. In addition to boat storage, other activities include: winterization and commissioning; minor engine repairs, wood and fiberglass repairs; hull scraping and painting.
- (6) *Dry rack storage*-There is no dry rack storage. During the winter, the upland facility stores boats.
- (7) *Structures*-Two nonpermanent buildings are on the property. One is the main building that houses the business office, ship's store, and rest rooms. The other, smaller, building stores equipment and materials used in the operation of the marina. Bulkheads and revetments create the land-water interface. See site plan for locations.
- (8) *Underground utilities*-Underground utilities are shown on site plan.
- (9) *Miscellaneous*-Location of the federal channel and municipal mooring fields; location of established riparian lines; and general location of docks, piers, etc., on abutting properties can be found on the site plan.

Site Plan

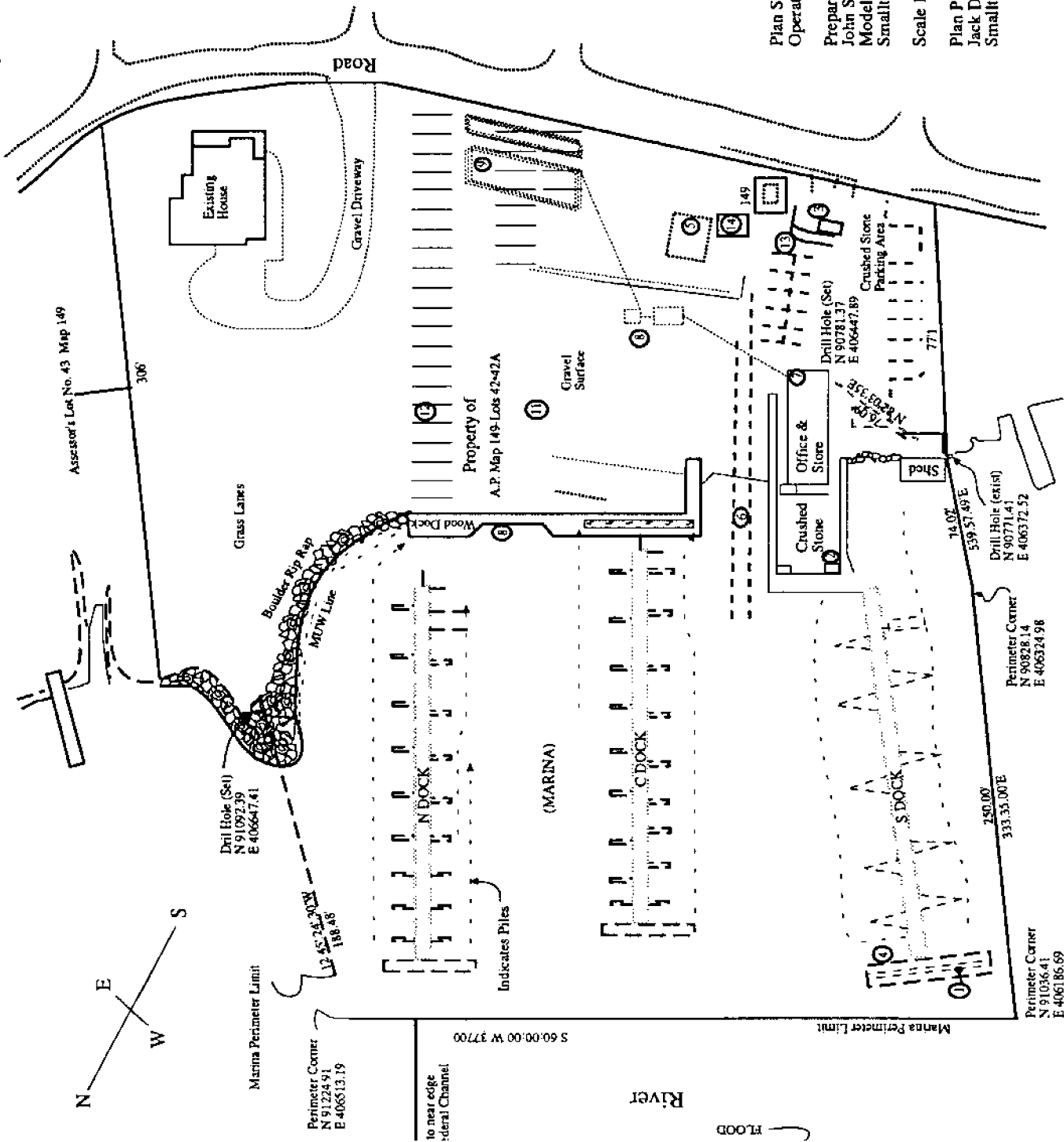
- (1) *See attached*

Legend and Notes

- 1 Sewage Pump-out Facility (boater's access)
- 2 Sewage Pump-out Unit (vacuum and pump)
- 3 Sewage Holding Tank (watertight)
- 4 Gasoline and Diesel Dock Pumps
- 5 Underground Gas & Diesel Fuel Tanks
- 6 Railway Boat Launch (winch operated)
- 7 Restroom & Shower Facilities (in building)
- 8 Septic Tank and Pump Chamber
- 9 Leaching Field (RIDEM 8536-104)
- 10 Boat Launching Area by Crane
- 11 Boat and Hull Repair Area
- 12 Typical Parking Space (gravel lot, no lines)
- 13 Water Service Line (town water supply)
- 14 Liquid Waste Receptacle

Notes:

1. This plan is a composite plan based upon other plans prepared for this marina. (See RICRMC Assent No. A95-1-55, modified 2/23/94.) Further detail showing underground piping and electrical utilities are shown on larger scale plans.
2. "A dock" and "C dock" are floating docks, "B dock" is fixed pile and timber.
3. Boat capacity is 96 boats.



Plan Showing
Operations and Maintenance Program Perimeter

Prepared for:
John Smith
Model Marina
Smalltown, RI

Scale 1"=40' July 1994

Plan Prepared by:
Jack Doe, Jr. PLS
Smalltown, RI

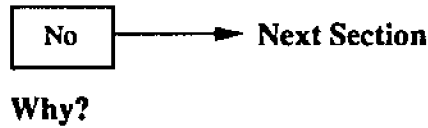
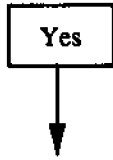


BMP SELECTION AND IMPLEMENTATION SCHEDULE

The following is a list of BMPs for the model marina, divided by major nonpoint source issue, that are existing, planned, or not appropriate for the model marina. An explanation about how each practice is or will be implemented, or why it is not being implemented, is provided.

1. Storm Water Runoff

Are hull maintenance areas* present on site?



These practices are:

Install and maintain adequate buffer areas between the coastal zone and upland facilities (section 100.3).
Explain: Because of the facility's limited size, the installation of buffer areas is impractical. Instead of buffer areas, the facility is implementing BMPs that focus on source reduction and limiting the amount of material allowed to enter the open environment.

Implement effective runoff control strategies, such as surfacing area with crushed gravel, decreasing slope of facility towards coastal zone, or installing filters and wet ponds (section 100.3).
Explain: Steepest portion of the facility has been regraded and topped with crushed gravel. These changes, along with the implementation of BMPs that reduce the amount of material entering the open environment, reduce the risk of pollutant-laden runoff.

Perform maintenance work inside buildings whenever possible (section 100.1).
Explain: Because of space limitations and the expenses associated with providing inside facilities, all maintenance activities on vessels are performed outside.

Perform maintenance over tarps to ease the cleanup process and prevent material from being carried into surface waters. Dispose of collected materials properly (section 100.1).
Explain: Because the entire area is a maintenance area, when feasible, maintenance is done over tarps to ease the cleanup process and prevent material from being carried into surface waters. Tenants are advised to use this procedure before they sand or paint boat bottoms. Collected material is disposed of by sealing it and placing it in the central trash receptacle.

Use vacuum sanders to remove paint from hulls and collect paint dust (section 100.1).
Explain: The facility is considering the purchase of a vacuum sander to remove paint from hulls and collect paint dust. Decisions will be made based on this season's experience.

Other.
Explain:

Existing Planned Not Applicable

* Hull maintenance areas are areas whose primary function is to provide a place for boats during the scraping, sanding, and painting of their bottoms. If boat bottom scraping, sanding, and/or painting is done in areas other than those designated as hull maintenance areas, this checklist applies to those areas as well. A hull maintenance area may indicate a need for a storm water permit. See Appendix B for additional details.

2. Fueling Stations

Are fueling stations present on-site?

Yes
↓

No → Next Section
Why?

These practices are:

	Existing	Planned	Not Applicable
Have adequate spill response equipment. (section 200.1) Explain: <i>Facility has adequate spill response equipment (see oil spill recovery plan).</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintain a spill prevention and recovery plan. (section 200.1) Explain: <i>Facility maintains a spill prevention and recovery plan (attached).</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inform your local harbormaster and fire department about your spill protection and recovery plan and equipment. (section 200.1) Explain: <i>Harbormaster and fire department have been notified that equipment is on-site in a letter dated March 1994.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Properly dispose of used oil spill response equipment. (section 200.2) Explain: <i>Proper disposal equipment (55 gallon drum) for used oil spill response equipment and oil absorbing material will be made available by May 1995.</i>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Other. Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Solid Waste

Are solid wastes (including trash, recyclables, hull-cleaning debris, waste generated from boat maintenance) produced by the operation, cleaning, maintenance, and repair of boats that are stored on site?

Yes

No

→ Next Section

Why?

These practices are:

	Existing	Planned	Not Applicable
Provide covered containers for solid waste that is generated within the facility (section 100.1). <i>Explain: Covered containers are available for staff and customers to dispose of waste.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide proper disposal facilities to marina patrons (section 100.2). <i>Explain: Proper disposal facilities are provided to marina patrons for trash. A central dumpster is located near main building. Individual trash receptacles are located on the beginning of each dock.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide facilities for the eventual recycling of appropriate materials, such as glass, aluminum, and plastic (section 100.2). <i>Explain: Facilities for the recycling of glass, aluminum, and plastics are provided on site, near the main building.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Support the use of environmentally compatible products (section 100.3). <i>Explain: The facility supports the use of environmentally compatible products by providing appropriate materials for sale in the ship's store. Examples include environmentally compatible antifreeze, head chemicals, and cleaning compounds.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use pamphlets, flyers, newsletters, inserts, and meetings to convey the importance of any environmental precautions that have been instituted in the marina (section 100.3). <i>Explain: The facility distributes a monthly newsletter to all its customers. As part of that newsletter, information about the importance of properly using the instituted BMPs is stated. Also, through the use of a bulletin board located near the restrooms, marina tenants are notified about new practices or procedures. The facility has also hosted several events that feature their environmentally compatible practices.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have adequate signs throughout facility identifying BMPs (section 100.5). <i>Explain: Signs mark all trash and recycling containers and what they are designed to accept.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perform abrasive blasting within spray booths or plastic tarp enclosures to prevent residue from being carried into surface waters. If tarps are used, blasting should be closely monitored on windy days (section 100.1). <i>Explain: No abrasive blasting is performed.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Continued next page

Provide and clearly mark designated work areas for boat repairs and maintenance.
Do not permit work outside designated areas (section 100.1).

Explain: Because of space constraints, it is impossible to provide a single designated work area for boat repairs and maintenance. Because the extent of the repair and maintenance work is limited and primarily focused on painting and sanding, the entire upland area where boats are stored is designated as a work area.

Clean trash, sandings, paint chips, etc., immediately after any maintenance activity (section 100.1).

Explain: To minimize the impacts from the activities that occur in the designated work area, trash, sandings, paint chips, etc., are cleaned immediately after any maintenance activity.

Insert language into facility contract that requires tenants to use certain areas and techniques when conducting boat maintenance (section 100.6).

Explain: Inserting language into facility contract that requires tenants to use certain areas and techniques when conducting boat maintenance is unnecessary at this time. If practices are not adequately used by tenants, then this will be reconsidered.

Have a clearly written outside contractors agreement (section 100.6).

Explain: All outside contractors and tenants are required to check in with the office before they can begin work. They must provide the marina manager with information about the nature of their work. They are instructed accordingly.

Other.

Explain:

4. Fish Waste

Is fish waste, as determined by CRMC and DEM, a potential source of water pollution within the facility?

Yes
↓

No → Next Section

Why? *Neither CRMC nor DEM has found fish waste to be a source, or potential source, of water pollution within the facility.*

These practices are:

	Existing	Planned	Not Applicable
Establish fish-cleaning areas (section 100.2). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Educate boaters regarding the importance of proper fish-cleaning practice (section 100.4). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Issue rules governing the conduct and location of fish-cleaning operations (section 100.6). Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Liquid Material

Are liquid materials (including oil, harmful solvents, antifreeze, and paints) used in the maintenance, repair, or operation of boats stored on site?

Yes
↓

No → Next Section
Why?

These practices are:

	Existing	Planned	Not Applicable
<p>Have separate containers for the disposal of liquid materials such as waste oil, waste gasoline, used antifreeze, waste diesel, kerosene, and mineral spirits should be available and clearly labeled (section 200.2 and 300.1). Explain: <i>A container is available and clearly marked for the disposal of waste oil, gasoline, and diesel. A used antifreeze container will be added by May 1995. Containers are emptied by a state-certified waste hauler.</i></p>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<p>Institute a recycling program for oil filters (section 200.2). Explain: <i>Recycling oil filters at this time is not practical because the number of filters to be recycled is low. However, before filters are disposed of in waste receptacle, they are fully drained into waste oil receptacle and stored in a covered 55 gallon drum. Filters are disposed of by a state-certified waste hauler.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Build curbs, berms or other barriers around areas used for the storage of liquid material to contain spills. Store materials in areas impervious to the type of material stored (section 300.1). Explain: <i>A berm surrounding the container for waste oil, gasoline, and diesel, and capable of collecting 110% of the material will be installed by May 1995. Berm will be made of steel plating welded at the seams. The area will be covered by a roof, surrounded by a fence that provides limited access.</i></p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<p>Maintain a spill recovery plan for hazardous material (section 300.2). Explain: <i>Primary upland threat of spill is waste oil. This contingency is covered in the oil spill recovery plan (attached).</i></p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p>Have adequate spill response equipment for hazardous material (section 300.2). Explain: <i>(See oil spill recovery plan).</i></p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p>Place containment berms around fixed pieces of machinery within the facility that use oil and gas (section 200.3). Explain: <i>There are no fixed pieces of machinery that use oil and gas within the facility.</i></p>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<p>Recycle where possible, adhere to existing state regulations pertaining to disposal of hazardous material (section 300.3). Explain: <i>Waste oil, gasoline, and diesel are recycled, using a certified waste hauler.</i></p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Continued next page

Enforce the prohibition on the use of TBT-based paint (section 300.4).

Explain: *Facility is not licensed to apply TBT-based paint.*

Use environmentally compatible antifreeze (section 300.4).

Explain: *Environmentally compatible antifreeze is available, in small amounts, in the ship's store.*

Keep to a minimum the amounts of hazardous material stored and used (section 300.4).

Explain: *Minimal amounts of hazardous materials are used and are stored in small quantities in the shed.*

Provide to marina tenants information on collection and recycling programs and source reduction (section 300.4).

Explain: *The facility distributes a monthly newsletter to all of its customers. As part of that newsletter, information about the importance of properly using the instituted BMPs is stated. Also, through the use of a bulletin board located near the restrooms, marina tenants are notified about new practices or procedures.*

Direct marina patrons as to the proper disposal of all liquid materials through the use of signs (section 300.4).

Explain: *All liquid disposal containers are clearly marked.*

Insert language into facility contract that requires tenants to dispose of hazardous material in the proper containment facilities (section 300.4).

Explain: *Inserting language into facility contract that requires tenants to dispose of hazardous material in the proper containment facilities is not appropriate at this time.*

Other.

Explain:

6. Petroleum Control

Do fuel and oil from boat bilges and tank air vents enter the marina and surface waters?

Yes
↓

No → Next Section
Why?

These practices are:

Promote the use of oil-absorbing materials in the bilge areas of all boats with inboard engines (section 200.3).

Explain: Oil-absorbing materials are sold in the ship's store and are suggested for use in the bilge areas of all boats with engines.

Existing Planned Not Applicable

Use automatic shut-off nozzles and promote the use of fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel spilled into surface waters during fueling of boats (section 200.3).

Explain: Automatic shut-off nozzles are used on the two fuel pumps. Fuel/air separators for air vents or tank stems of inboard fuel tanks are available in the ship's store.

Provide to marina tenants information on collection and recycling programs for oil and oil-absorbing pads (section 200.4).

Explain: Use of these products and recycling of oil and oil-absorbing pads is promoted in the monthly newsletter and by the dock attendant.

Direct marina patrons to the proper disposal of all used hydrocarbon products through the use of signs, mailings and other means (section 200.4).

Explain: Waste oil receptacle is properly marked.

Insert language into facility contract that recommends tenants to use fuel/air separators and oil absorption materials (section 200.4).

Explain: Inserting language into facility contract that recommends tenants use fuel/air separators and oil absorption materials is unnecessary at this time. If practices are not adequately used by tenants, then this will be reconsidered.

Other.

Explain:

7. In-Water Boat Cleaning

Do the cleaning of boat topsides and hull scrubbing in the water occur on site?

Yes
↓

No → Next Section
Why?

These practices are:

	Existing	Planned	Not Applicable
Wash the boat hull above the waterline by hand (section 300.4). Explain: <i>No pressure washer or other mechanical means to clean boat topsides are used on docks.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Where feasible, remove the boat from the water and perform cleaning where debris can be captured and properly disposed of (section 100.3). Explain: <i>Because of limited operational capacity to lift each boat prior to cleaning, this practice is not appropriate at this time.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Recommend and use phosphate-free and biodegradable detergents and cleaning compounds for washing boats (section 300.4). Explain: <i>Phosphate-free and biodegradable detergents are available for sale in ship's store.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discourage the use of detergents containing ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, or lye. (section 300.4) Explain: <i>Through the monthly newsletter and other postings, the use of certain detergents is discouraged. Sales clerks in the ship's store recommend using detergents that are phosphate-free and biodegradable.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other: Explain:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Sewage Facility

If you have vessels within your facility that have on-board sanitation devices, consider installing a pumpout facility.

Are sewage pumpout facilities or dump stations present on site?

Yes



These practices are:

No

Next section

Why?

	Existing	Planned	Not Applicable
Provide the service at convenient times and at a reasonable cost (section 400.2). Explain: <i>Pumpout service is available every day from 7 a.m. to 5 p.m. On Saturday mornings, tenants are invited to use the pumpout for free. The normal cost is \$5 per holding tank less than 25 gallons.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Make the pumpout station user friendly (section 400.2). Explain: <i>The pumpout area is clean and easily accessible. It is operated by one of the marina staff.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Develop and adhere to a regular inspection and maintenance schedule for the pumpout station (section 400.2). Explain: <i>The pumpout is inspected once a month during the boating season according to the manufacturer's specification. At the end of the boating season, the sewer lines are cleared for winterization.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work with local and state governments to declare your harbor a no-discharge area once adequate pumpout facilities are installed (section 400.3). Explain: <i>The facility distributes a monthly newsletter to all of its customers. As part of that newsletter, information about the importance of properly using the instituted BMPs is stated. Also, through the use of a bulletin board located near the restrooms, marina tenants are notified about new practices or procedures.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide educational information about the pumpout service to customers (section 400.4). Explain: <i>A letter dated May 1993 was directed to the harbormaster, advising him that the pumpout facility is available, and providing him with the pertinent information, such as time of operation and fee.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Formally advise your municipality that you have a pumpout facility available and provide pertinent information, such as time of operation and fee (section 400.5). Explain: <i>Representatives from the marina have been active in the town's harbor planning process, encouraging the local harbormaster to enforce existing state and federal regulations pertaining to MSDs.</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encourage the local harbormaster to enforce existing state and federal regulations pertaining to MSDs (section 400.5). Explain: <i>See Above</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Continued next page

Install adequate signs to identify the pumpout station (section 400.6).

Explain: *Official EPA Pumpout sign installed on pumpout dock.*

Other.

Explain: *The marina provides four upland restroom facilities for its customers and encourages their use. Restrooms are cleaned daily.*

Final notes on developing an OMP

The information presented in the BMP section of this document provides ideas and explanations about how to choose and implement BMPs. By going through the process of developing an OMP in cooperation with a model marina, it was found that many of the practices were already in place and only some housecleaning and implementation of some selected BMPs were necessary. The new BMPs implemented at the model marina include a pumpout station, oil waste receptacle, oil spill response plan, and use of improved practices during painting and sanding.

The decision to designate the entire facility a maintenance area was made out of sheer necessity and therefore required the installation of additional practices on a wider scale. For instance, the marina operator will now have to carefully watch tenants to be sure they are using tarps below the areas they are cleaning. If this proves to be inadequate, then the facility will, in all likelihood, purchase a vacuum sander and make it available for its customers for a small fee. The final step, if the tenants do not embrace the practices, is to include some language in the contract requiring proper procedures. The best solution to this problem would have been to offer a specific area within the facility where boats can be moved for work, an area specially designed to collect waste easily. However, because of the facility's space constraints, this is impossible.

The facility did not want to add language to the contracts, forcing boaters to use the practices. Instead, use will be encouraged by making BMPs openly available and providing enough good information about them to customers. The reluctance to insert language into the contract stems from the desire to minimize the need for the marina operator to act as an enforcement official. It is better to foster an atmosphere where other boaters ensure that the practices are being properly applied by policing one another.

Overall, the OMP planning process was easily completed. The BMPs were extracted from the worksheets, evaluated, and selected as existing, planned, or not applicable. For those that were not applicable, the reasons were stated. For those that were applicable, a brief summary explained how the BMPs were implemented, or will be. In some instances, the facility was exempted from a whole worksheet because the problem or issue did not exist at the facility. The site plan is based on the plan that was submitted to the CRMC for the marina perimeter program, only modified to show upland facilities and the structural BMPs that were implemented as a result of this process.

The BMPs that were selected for implementation were chosen because they worked within the constraints of the facility and met the requirements of the management measures. If the facility had provided different services or had more space, the BMPs may have been different. Regardless of the BMPs, the OMP contained the two key elements. First, it identified, both in writing and by drawing, the facility activities. Second, it detailed the practices that were implemented or being implemented to address each of the management measures. These two components, presented in this format, provide a sample of an OMP that addresses nonpoint pollution at the model marina site.

Reference Sources and Selected Publications

REFERENCES:

- Athayde, D. N. et al. 1983. Results of the nationwide urban runoff program, Volume I - Final Report. U. S. Environmental Protection Agency, Office of Water Regulations and Standards, Monitoring and Data Support Division., Washington, D. C.
- Balls, P. W. 1989. The partition of trace metals between dissolved and particulate phases in European coastal waters: A compilation of field data and comparison with laboratory studies. *Netherlands J. of Sea Research* 23(1).
- Coast Guard. 1994. Oil spill summary report. Providence, RI, Marine Safety Office, East Providence, RI.
- Coast Guard, 1986. Boat Sewage. Consumer Fact Sheet # 13, Washington, DC.
- Connell, D. W. and G. J. Miller. 1984. *Chemistry and Ecotoxicology of Pollution*. John Wiley & Sons: New York.
- Constantine, Lawrence. 1993. Personal communication. 19 October 1993.
- CT DEP. Boat Marinas. Undated memorandum issued by Department of Environmental Protection. Hartford, CT.
- CT DEP. 1992. Best management practices for coastal marinas. Final Report for Connecticut Department of Environmental Protection, Office of Long Island Sound Programs and Bureau of Water Management. Hartford, CT.
- Desbonnet, A., P. Pogue, V. Lee and N. Wolff. 1994. *Vegetated Buffers: A Summary Review and Bibliography for Their Use in the Coastal Zone*. University of Rhode Island, Narragansett, RI.
- Federal Register. October 4, 1988. Tributyltin antifoulants. Environmental Protection Agency, Washington, DC.
- EPA. 1990. *Draft Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Office of Water, Washington, D. C.
- EPA. 1991. Draft EPA Region I no-discharge area policy. U.S. Environmental Protection Agency, Region I, Boston, MA.
- EPA. 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Government Printing Office, Washington, D.C.
- Gaines, A. G. and A.R. Solow. 1990. *The Distribution of Fecal Coliform Bacteria in Surface Waters of the Edgartown Harbor Coastal Complex and Management Implications*. Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA.
- Gannon, T. 1990. Ethylene or propylene? *Practical Sailor* 16 (19):15.
- Jewell, Paul. 1994. Personal communication. 3 January 1994.
- Heufelder, G. 1987. Bacteriological monitoring on Buttermilk Bay. Barnstable County Health and Environmental Department, Barnstable, MA.

- JRB Associates, Inc. 1981. Analysis of wastewater discharge from marine sanitation devices. Final Report prepared for the U.S. Environmental Protection Agency. JRB Associates, Inc., McLean, VA.
- McMahon. 1989. The impact of marinas on water quality. *Wat. Sci. Tech.* 21(2).
- Metro. 1992. Boatyard wastewater treatment guidelines. Municipality of Metropolitan Seattle, Water Pollution Control Department, Industrial Waste Section. Seattle, WA.
- Milliken, A.S., and V. Lee. 1990. *Pollution Impacts From Recreational Boating: A Bibliography and Summary Review*. Rhode Island Sea Grant Publications, University of Rhode Island Bay Campus, Narragansett, RI.
- NBP. 1991. Comprehensive conservation and management plan for Narragansett Bay. The Narragansett Project, Rhode Island.
- NOAA and EPA. 1993. Coastal nonpoint pollution coastal program. Program Development and Approval Guidance. U.S. Government Printing Office, Washington, D.C.
- RI DEM, 1989. Rhode Island's nonpoint source management plan. Division of Environmental Coordination, Providence, RI.
- RI DEM. 1993. Boat count for Rhode Island waters. Unpublished data. Department of Environmental Management, Division of Water Resources.
- Ross, N. and M. Amaral, 1991. Comments on U.S. Environmental Protection Agency proposed guidance specifying management measures for sources of nonpoint pollution in coastal waters. International Marina Institute, Wickford, RI.
- Olsen, Stephen and George Seavey. 1983. The State of Rhode Island coastal resource management program as amended. Coastal Resource Management Council, Wakefield, RI.
- Ollson, E. and M. Lynch. 1993. Small oil spills in Washington state's coastal waters. Unpublished report. Washington Sea Grant, Seattle, WA.

SELECTED PUBLICATIONS BY TOPIC

Environmental and Pollution Assessment

- Barada, W. and W.M. Partington. 1972. Report of investigation of the environmental effects of private water front canals. Board of Trustees of the Internal Improvement Fund, State of Florida.
- Bell, Frederick W. and V.R. Leeworthy. 1987. Economic demand for marinas and projected impact on wetlands. *Land Economics* 63:1.
- Bourdon, E. 1990. Marina Del Rey: First 30 years of environmental impact. Los Angeles County Department of Beaches and Harbors, International Marina Institute, Wickford, RI.
- Bourdon, E. 1990. Marina Del Rey: First 30 years of environmental impact. International Conference on Environmental Management for Marinas. International Marina Institute, Wickford, RI.
- British Waterways Board. 1983. Waterway ecology and the design of recreational craft. Inland Waterways Amenity Advisory Council, London, England.
- Brown, C. W. 1977. Monitoring hydrocarbons on and in seawater. Marine Technical Report. The University of Rhode Island Sea Grant, Narragansett, RI.
- Cardwell, R.D., M.I. Car, and E.W. Sanborn. 1978. Water quality and biotic characteristics of Birch Bay Village Marina in 1977 (October 1, 1976 to December 31, 1977). Report No. 69, Washington Department of Fisheries Protection.
- Cardwell, R.D. 1982. Water quality biological implications in Pacific Northwest marinas. *Boating and Moorage in the '80s*. A Washington Sea Grant Publication, University of Washington, Seattle, WA.
- CBC. 1989. Chesapeake Bay Commission. Issues and Actions. Annapolis, MD.
- Charness, L. N. 1990. Swimbeach remediation at Marina Del Rey Harbor. Los Angeles County Department of Beaches and Harbors, International Marina Institute, Wickford, RI.
- CTDEP. 1992. Best management practices for coastal marinas. Final Report for Connecticut Department of Environmental Protection, Office of Long Island Sound Programs and Bureau of Water Management, Hartford, CT.
- Chmura, G.L. and N.W. Ross. 1978. The environmental impacts of marinas and their Boats. A literature review with management considerations. Marine Advisory Service, University of Rhode Island, Narragansett, RI.
- Cubit Engineering. 1982. Wexford Marina water quality analysis. Prepared for Willard Byrd and Associates.
- Desanto, R.S. 1987. Quantitative growth & chemical analysis of eastern oysters in Clinton Harbor. DeLauw, Cather & Co., East Hartford, CT.

- FDA. 1989. Evaluation of marinas by state shellfish sanitation control officials. FDA Guideline 1.0, Shellfish Sanitation Branch, Food and Drug Administration, Washington, D.C.
- Fisher, J.S., R.R. Perdue, M.F. Overton, M.D. Sobsey, and B.L. Sill. 1987. Comparison of water quality at two recreational marinas during a peak-use period. University of North Carolina Sea Grant College program, Raleigh, NC.
- Forestry Suppliers. 1992. Environmental 1992 catalog. Forestry Suppliers, Inc., Jackson, MS.
- Geldreich, E., 1962. The distribution of coliform bacteria in the feces of warm-blooded animals. *JWPCF* (March) 34(3).
- Hamrick J.M. and B.J. Neilson, 1989. Determination of marina buffer gyres using simple mixing and transport models. Virginia Institute of Marine Science, School of Marine Science, College of William and Mary, Gloucester Point, VA.
- Hunt, C.D., P.A. Sampson, S.R. Jackson, W.M. Warren, J.D. Cullen, J. Coyne, and M.E.Q. Pilson. 1987a. Narragansett Bay water quality monitoring and source strength measurements. Cruise and Data Report, SINBADD 1, October 21-24, 1985. Marine Ecosystems Laboratory, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI.
- Hunt, C.D., W.M. Warren, P.A. Sampson, S.R. Jackson, and M. E. Q. Pilson. 1987b. Narragansett Bay water quality monitoring and source strength measurements. Cruise and Data Report, SINBADD 2, November 18-21, 1985. Marine Ecosystems Laboratory, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI.
- Hunt, C.D., M.F. Fox, W.M. Warren, S.R. Jackson, and M.E. Q. Pilson. 1987c. Narragansett Bay water quality monitoring and source strength measurements. Cruise and Data Report, SINBADD 3, April 7-10, 1986. Marine Ecosystems Laboratory, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI.
- Hunt, C.D., M.F. Fox, S.R. Jackson, and M.E.Q. Pilson. 1987d. Narragansett Bay water quality monitoring and source strength measurements. Cruise and Data Report, SINBADD 4, May 19-22, 1986. Marine Ecosystems Laboratory, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI.
- Huffman, W. J. 1990. Beneficial environmental aspects of lock harbor marinas. Thomas & Hutton Engineering Co., International Marina Institute, Wickford, RI.
- ISSC, 1986. Marina Policy. Interstate Shellfish Sanitation Conference.
- Klein, R.D. 1992. The effects of boating activity and related facilities upon small tidal waterways in Maryland. Community and Environmental Defense Services, Maryland Line, MD.
- Kopecky, A. L. 1991. Microbiological treatment of marine sanitation devices (MSD). Merrick-Racicot, Inc. International Marina Institute, Wickford, RI.

- McMahon, P.J.T. 1989. The impact of marinas on water quality. *Water Science Technology*, 21 (2). Great Britain.
- Mills, W.B., D.B. Porcella, M.J. Unga, S.A. Gherini, K.V. Summers, M. Lingfung, G.L. Rupp, G.L. Bowie, and D.A. Haith. 1985. Water quality assessment: A screening procedure for toxic and conventional pollutants. U.S. Environmental Protection Agency, Athens, GA, EPA/600/685/002a,b.
- Natchez, D.S. 1991. Are marinas really polluting? International Marina Institute, Wickford, RI.
- Natchez, D. S. 1990. Marina structures as sources of environmental habitats. Daniel S. Natchez and Associates, Inc., International Marina Institute, Wickford, RI.
- NCDEM. 1990. North Carolina coastal marinas: water quality assessment. Report No. 90-01. North Carolina Division of Environmental Management, Raleigh, NC.
- NCDEM. 1991. Coastal marinas: field survey of contaminants and literature review. Report No. 91-03. North Carolina Division of Environmental Management. Raleigh, NC.
- Nielsen, T.A. 1991. Case study: A San Diego boatyard's approach to environmental compliance. Nielsen Beaumont Marine, Inc. In: Ross, N. ed. *Proceedings of the 1991 National Applied Marina Research Conference*, International Marina Institute, Wickford, RI.
- Nixon, S.W., C.A. Oviatt, and S.L. Northby. 1973. Ecology of small boat marinas. Marine Technical Report Series No. 5, University of Rhode Island, Kingston, RI.
- Officer, C.B. 1980. Box models revisited In: Hamilton, P. and McDonald, R.B., eds. *Estuaries and Wetland Processes*. Marine Science Series Volume 11. Plenum Press, New York.
- Paulson, B.K. and S.L. DaCosta. 1991. A case study of propeller-induced currents and sediments transport in a small harbor. In *Proceedings of World Marina '91*, American Society of Civil Engineers, New York, NY.
- PSWQA. 1990. 1991 Puget Sound water quality management plan. Puget Sound Water Quality Authority, Seattle, WA.
- Rheault, R. B. and M. A. Rice. 1989. Nursery culture of shellfish seed in marinas. Spatco, Ltd., and The University of Rhode Island, Department of Fisheries, Aquaculture & Veterinary Science, International Marina Institute, Wickford, RI.
- RIDEM. 1984. Water quality regulations for water pollution control. State of Rhode Island. Division of Water Resources, Department of Environmental Management, Providence, RI.
- Rogers, G.L. and C. D. Cohen. 1990. Artificial circulation and aeration improve marina water quality. Aeration Industries International, Inc., International Marina Institute, Wickford, RI.

- Ross, N. 1985. Towards a balanced perspective...boat sewage. Presented at Thirteenth National Docks and Marinas Technical Conference. University of Wisconsin, Madison, WI.
- Ross, N.W. 1990. *Marinas and Boatyards...It's Time to Become Environmentally Aggressive*. International Marina Institute ecology tips. International Marina Institute, Wickford, RI.
- Ross, N. W. 1990. *It's Time for Marina Environmental Compatibility*. International Marina Institute International Conference on Environmental Management for Marinas. International Marina Institute, Wickford, RI.
- Smith, W. R. 1990. *Environmental Management for Marinas—Compensation and Enhancement Strategies*. Robinson & Cole. International Marina Institute, Wickford, RI.
- Sawyer, C.M. and A.F. Golding. 1990. Marina pollution abatement. International Marina Institute, Wickford, RI.
- SCDHEC. 1987. Heavy metals and extractable organic chemicals from the coastal toxics monitoring network 1984-1986. Technical Report No. 007-87, South Carolina Department of Health and Environmental Control.
- Sherk, J.A. 1971. Effects of suspended and deposited sediments on estuarine organisms. Contribution No. 443, Chesapeake Biological Laboratory, University of Maryland.
- Smith, G.F. and H.H. Webber. 1978. A biological sampling program of intertidal habitats of northern Puget Sound. Appendix K. W.W.U. Intertidal Study. Baseline Study Program North Puget Sound, Washington Department of Ecology, Olympia, WA.
- Smith H.T., J. Phelps, R. Nathan, and D. Cannon. 1991. Avalon Harbor: example of a successful destination harbor. In *Proceedings of World Marina '91*. American Society of Civil Engineers, New York, NY.
- Smith, J.E. 1977. A baseline study of invertebrates and of the environmental impacts of intertidal log rafting on the Snohomish River Delta. Final Report. Fisheries Research Institute, University of Washington, Seattle, WA.
- Soule, D.F., M. Oguri, and B.H. Jones. 1991. The marine environment of Marina Del Rey: October 1989 to September 1990. Marine Studies of San Pedro Bay, California, Part 20F. University of Southern California, Los Angeles, CA.
- Souza, S.J., R.L. Conner, B.I. Krin, and J.A. Tiedemann. 1990. *Compatibility of Coastal Development and Coastal Resources, Port Liberte': A Case Study*.
- Stephenson, M.D., D.R. Smith, J. Goetzl, G. Ichikawa, and M. Martin. 1986. Growth abnormalities in mussels and oysters from areas with high levels of tributyltin in San Diego Bay. In *Proceedings Oceans 86, Volume 4 Organotin Symposium*. Institute of Electrical and Electronics Engineers Inc. New York, NY.
- Swanson, J.C. and K. Jayko. 1988. *A Simplified Estuarine Box Model of Narragansett Bay*. Final Report prepared for Narragansett Bay Project. Environmental Protection Agency, Region I.

- Swanson, J.C., C. Turner, and K. Jayko. 1987. Marina environmental characterization of Weaver Cove, Narragansett Bay, Rhode Island. ASA Report 87-23. Applied Science Associates, Inc., Narragansett, RI.
- Tetra Tech. 1988. Rive St. Johns Phase II canal system water quality. Model Study. Tetra Tech Report TC-3668-04. Prepared for Dostie Builders, Inc., Jacksonville, FL.
- Tetra Tech. 1991a. Draft final report on marina water quality. Models. Submitted to EPA Region IV, Atlanta, GA.
- Tetra Tech. 1991b. Coastal marina water quality assessment using tidal prism analysis user's manual. Tetra Tech, Inc., Fairfax, VA.
- Thomann, R.V. and J.A. Mueller. 1987. *Principles of Surface Water Quality Modeling and Control*. Harper & Row, NY.
- Tsinker, G.P. 1992. Small craft marinas. In: Herbich, J.B., ed. *Handbook of Coastal and Ocean Engineering: Vol. 3, Harbors, Navigational Channels, Estuaries, Environmental Effects*. Gulf Publishing, Houston, TX.
- USEPA. 1974. Assessing effects on water quality by boating activity. U.S. Environmental Protection Agency, National Environmental Research Center, Cincinnati, OH.
- USEPA. 1976. Impacts of construction activities in wetland of the United States. U.S. Environmental Protection Agency. EPA/600/3-76-045.
- USEPA. 1985. *Coastal Marina Assessment Handbook*. U.S. Environmental Protection Agency, Region IV, Atlanta, Georgia.
- USEPA. 1985. *Coastal Marinas Assessment Handbook*. (April) U.S. Environmental Protection Agency, Region IV, Atlanta, GA.
- USEPA. 1985. Water quality assessment: a screening procedure for toxic and conventional pollutants. EPA/600/6-85/002a,b., U.S. Environmental Protection Agency, Athens, GA.
- USEPA. 1986. Wexford Locked Harbor, April 1986 and September 1986. U.S. Environmental Protection Agency, Region IV, Environmental Services Division, Marine and Wetlands Unit, Athens, GA.
- USEPA. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. EPA/444/4-89-001, U.S. Environmental Protection Agency, Office of Water (WH-553), Washington, DC.
- USEPA. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- USEPA. 1991. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- USEPA. 1992. Development of estuarine community bioassessment protocols. Issue paper for work group meeting January 8 and 9, 1992. U.S. Environmental Protection Agency, Washington, D.C.

- USEPA. 1990. National water quality inventory, 1988 report to Congress. US EPA, Washington, DC.
- USFWS. Mitigation and enhancement techniques for the upper Mississippi river system and other large river systems. Resource Publication 149. U.S. Department of the Interior, U.S. Fish and Wildlife Service.
- WDF. 1974. Bulkhead criteria for surf smelt (*Hypomesus pretiosus*) spawning beaches in Puget Sound, Hood Canal, and Strait of Juan de Fuca, San Juan Islands, and the Strait of Georgia. Washington State Department of Fisheries, Seattle, WA.
- Wendt, P.H., R.F. Van Dolah, M.Y. Bobo and J.J. Manzi. 1990. The effects of a marina on certain aspects of the biology of oysters and other benthic macrofauna in a South Carolina estuary. Unpublished, draft manuscript. South Carolina Department of Health and Environmental Control, Columbia, SC.
- Young, D.R., T.C. Heesen, D.J. McDermott, and P.E. Smokler. 1974. Marine inputs of polychlorinated biphenyls and copper from vessel antifouling paints. Southern California Coastal Water Research Project, El Segundo, CA.

Design

- Askren, D.R. 1979. Numerical simulation of sedimentation and circulation in rectangular marina basins. NOAA Technical Report NOS 77. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Rockville, MD.
- Braam, G.A. and W.A. Jansen. 1991. North Point Marina—a case study. In: *World Marina '91: Proceedings of the First International Conference Long Beach, CA, 4-8 September, 1991*. American Society of Civil Engineers.
- Cahill Associates. 1991. Limiting NPS pollution from new development in the New Jersey coastal zone. New Jersey Department of Environmental Protection.
- Cardwell, R.D., R.E. Nece, and E.P. Richey. 1980. Fish, flushing, and water quality: Their roles in marina design. In *Coastal Zone '80: Proceedings of the Second Symposium on Coastal and Ocean Management*. ASCE, Hollywood, FL.
- Cardwell, R.D. and R.R. Koons. 1981. Biological consideration for the siting and design of marinas and affiliated structures in Puget Sound. Technical Report No. 60. Washington Department of Fisheries.
- Chamberlain, W. Clinton J. 1983. *Marinas: Recommendations for Design, Construction, and Management Vol. I*. National Marine Manufacturers Association, Chicago, IL.
- Corrough, J.C. 1990. Some definitions and questions for planning/designing environmentally compatible marinas. The Corrough Consulting Group, published by International Marina Institute, Wickford, RI.
- CTDEP. 1992. See Environmental, Pollution Assessment
- Christensen, B.A. 1986. Marina design and environmental concern. In: *Ports 86: Proceedings of a Specialty Conference on Innovations in Port Engineering and*

- Development in the 1990's , 19-21 May 1986, Oakland, CA. American Society of Civil Engineers.*
- City of Austin. 1990. The first flush of runoff and its effects on control structure design.
- Dunham, J.W. and A.A. Finn. 1974. Small-craft harbor: Design, construction, and operation. (December) Special Report No. 2.U.S. Coastal Engineering Research Center, Fort Belvoir, VA.
- Holland, R.C. 1986. Designing marinas to mitigate impacts. In: *Ports 86, Proceedings of a Specialty Conference on Innovations in Port Engineering and Development in the 1990's, 19-21 May 1986, Oakland, CA. American Society of Civil Engineers.*
- Layton, J.A. 1991. Case history of the Point Roberts Marina. In: *World Marina '91, Proceedings of the First International Conference, 4-8 September 1991, Long Beach, CA. American Society of Civil Engineers.*
- Layton, J.A. 1980. Hydraulic circulation performance of a curvilinear marina. In *Proceedings of the 17th International Conference on Coastal Engineering, 23-28 March 1980, Sydney, Australia. American Society of Civil Engineers.*
- Moffatt and Nichol. 1986. Modification to the North Point Marina Breakwater Structures Based on the Physical Model Study.
- Natchez, D. S. 1990. Marina structures as sources of environmental habitats. Daniel S. Natchez and Associates, Inc., published by International Marina Institute, Wickford, RI.
- Nece, R.E. 1981. Platform effects on tidal flushing of marinas. *Journal of Waterway, Port, Coastal and Ocean Engineering*, 110(2).
- Rogers, G.L.and C. D. Cohen. 1990. Artificial circulation and aeration improve marina water quality. Aeration Industries International, Inc., International Marina Institute, Wickford, RI.
- Schluchter, S.S. and L. Slotta. 1978. Flushing studies of marinas. In *Coastal Zone '78-- Proceedings Symposium on Technical, Socioeconomic and Regulatory Aspects of Coastal Zone Management, March 1978 San Francisco, CA. American Society of Civil Engineering.*
- Tetra Tech. 1992. Environmental assessment for siting and design of marinas. Draft Interim Report, submitted to EPA Nonpoint Source Control Branch, Washington, DC, by Tetra Tech, Inc.
- Tobiasson, Bruce O. and Ronald C. Kollmeyer. 1991. *Marinas and Small Craft Harbors.* Van Nostrand Reinhold, NY.
- USACOE. 1984. U.S. Army Corps of Engineers. Shore Protection Manual. 4th Edition. Waterways Experiment Station, Coastal Engineering Research Center.
- USEPA. 1976. Impacts of construction activities in wetland of the United States. EPA/600/3-76-045. U.S. Environmental Protection Agency.

-
- USEPA. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- USEPA. 1991. Draft EPA Region I. no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- Walton, R. 1983. Computer modeling of hydrodynamics and solute transport in canals and marinas: A literature review and guidelines for future development. Miscellaneous paper EL-83-5. Prepared for the U.S Army Engineer Waterways Experiment Station, Vicksburg, MS, by Camp Dresser and McKee, Annandale, VA.
- WDF. 1971. Criteria governing the design of bulkheads in Puget Sound, Hood Canal, and Strait of Juan de Fuca for protection of fish and shellfish resources. Washington State Department of Fisheries, Seattle, WA.

Economics

- 1992 Economic Report of the President. (February). U.S. Government Printing Office. Washington, D.C.
- Behrens, R.H. 1985. *Commercial Loan Officer's Handbook*. Banker's Publishing Company, Boston, MA.
- Bell, F.W. 1990. Economic impact of bluebelting incentives on the marina industry in Florida. Florida Sea Grant College Program, Florida State University, Tallahassee, FL.
- Bell, F.W. and W. R. Leeworthy. 1987. Economic demand for marinas and projected impact on wetlands. *Land Economics* 63:1.
- Bowlin, O.D., J.D. Martin, and D. Scott. 1990. *Guide to Financial Analysis*. McGraw-Hill, New York.
- Dornbusch, D.M. and Company, Inc. 1988. Economic impact of the boating industry in California. Prepared for California Department of Boating and Waterways.
- Dun and Bradstreet. 1991. Industry norms and key business ratios. Dun's Analytical Services.
- Goodwin, R.F. 1991. Moorage markets in western Washington: county synopses 1989/90. Washington Sea Grant Marine Advisory Services, University of Washington, Seattle, WA.
- Hastopoulos, G.N. 1991. Cost of capital: reflections of a CEO. *Business Economics* 26(2).
- Jellicorse, B.L. and J. Duffin. 1992. Economic analysis of coastal nonpoint source pollution controls: Marinas. U.S. Environmental Protection Agency, NPS Control Branch, Washington, D.C.

- National Marine Manufacturers Association (NMMA). 1982-1992. Boating: A statistical report on America's top family sport. Eleven brochures published yearly by the Marketing Services Department of the National Marine Manufacturers Association. Chicago, IL.
- Norvell, D.G. 1987. Prototype feasibility studies of two marinas. Western Illinois University, Center for Business and Economic Research, Macomb, IL.
- Norvell, D.G. and D.G. Egler. 1987. Financial profiles of ten marinas. National Marine Manufacturers Association.
- Stone, R. 1989. Boating and the economy. Boating and moorage in the 90s. A Washington Sea Grant Marine Advisory Services Publication, University of Washington, Seattle, WA.
- U.S. Coast Guard. 1990. *American Red Cross National Boating Survey: A Study of Recreational Boats, Boaters, and Accidents in the United States*. U.S. Department of Transportation, United States Coast Guard, Washington, D.C.

Hazardous Material

- Brown, C.W. 1977. Monitoring hydrocarbons on and in seawater. Marine Technical Report. The University of Rhode Island Sea Grant, Narragansett, RI.
- CTDEP. 1992. Best management practices for coastal marinas. Final report for Connecticut Department of Environmental Protection Office of Long Island Sound Programs and Bureau of Water Management, Hartford, CT.
- DNREC. 1990. *State of Delaware Marina Guidebook*. Delaware Department of Natural Resources and Environmental Control, Dover, DE.
- Gannon, T. 1990. Ethylene or propylene? *Practical Sailor* 16(19).
- Industrial Products Co. 1991. Safety equipment and supplies. Industrial Products Co., Langhorne, PA.
- Johnson, B.R. and S.A. Rice. 1989. Protection of wood from marine borers. USDA Forest Service, University of Tampa. International Marina Institute, Wickford, RI.
- LSS. 1991. Lab Safety Supply. 1992 Safety Essentials Catalog (Spring Edition). Lab Safety Supply, Inc., Janesville, WI.
- Marcus, J.M., G.R. Swearingen, A.D. Williams, and D.D. Heizer. 1988. Polynuclear aromatic hydrocarbons and heavy metals concentrations in sediments at coastal South Carolina marinas. *Archives of Environmental Contamination and Toxicology* 17.
- Marcus, J.M. and T.P. Stokes. 1985. Polynuclear aromatic hydrocarbons in oyster tissue and around three coastal marinas. *Bulletin of Environmental Contamination and Toxicology* 35.
- Milliken, A.S. and V. Lee. 1990. *Pollution Impacts from Recreational Boating: A Bibliography and Summary Review*. Rhode Island Sea Grant Publications, University of Rhode Island Bay Campus, Narragansett, RI.

- Romano, F. 1990. Oil and water don't mix: The Application of oil-water separation technologies in stormwater quality. Office of Water Quality, Municipality of Metropolitan Seattle, Seattle, WA.
- USEPA. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
- USEPA. 1991. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- Young, D.R., T.C. Heesen, D.J. McDermott, and P.E. Smokler. 1974. *Marine inputs of polychlorinated biphenyls and copper from vessel antifouling paints*. Southern California Coastal Water Research Project, El Segundo, CA.

Fueling, Oil and Other Petroleum Hydrocarbons

- CTDEP. 1992. Best management practices for coastal marinas. Final report for Connecticut Department of Environmental Protection. Office of Long Island Sound Programs and Bureau of Water Management. Hartford, CT.
- DNREC. 1990. *State of Delaware Marina Guidebook*. Delaware Department of Natural Resources and Environmental Control, Dover, DE.
- Silverman, G.S., M.K. Stenstrom, and S. Fam. 1986. Best management practices for controlling oil and grease in urban stormwater runoff. *Environmental Professional*, 8.
- USEPA. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
- USEPA. 1991. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- Voudrias, E.A., and C.L. Smith. 1986. Hydrocarbon pollution from marinas in estuarine sediments. In: *Estuarine, Coastal and Shelf Science*, Vol. 22, Academic Press, Inc., London, England.

Liquid and Solid Waste

- CTDEP. 1992. Best management practices for coastal marinas. Final Report for Connecticut Department of Environmental Protection. Office of Long Island Sound Programs and Bureau of Water Management. Hartford, CT.
- DNREC. 1990. *State of Delaware Marina Guidebook*. Delaware Department of Natural Resources and Environmental Control, Dover, DE.
- Doyle, B and R. Barnaby. 1990. *Reducing Marine Debris: A Model Program for Marinas*. University of New Hampshire Sea Grant College Program, International Marina Institute, Wickford, RI.

- Milliken, A.S. and V. Lee. 1990. *Pollution Impacts from Recreational Boating: A Bibliography and Summary Review*. Rhode Island Sea Grant Publications, University of Rhode Island Bay Campus, Narragansett, RI.
- NOAA. 1988. *Dealing with Annex V—Reference Guide for Ports*. NOAA Technical Memorandum NMFS F/NWR-23. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, WA.
- Penttila, D. and M. Aguero. 1978. Fish usage of Birch Bay Village Marina. Washington Department of Fisheries Pro. Report No. 39. Whatcom County, Washington.
- Pisano, W.C. 1989. Swirl concentrators revisited. In: Roesner, L.A., Urbonas, B., and Sonnen, M.B., eds. *Design of Urban Runoff Quality Controls*. American Society of Civil Engineers, New York, NY.
- Shaver, E. 1991. Sand filter design for water quality treatment. Presented at 1991 ASCE Stormwater Conference. Crested Butte, CO.
- Schueler, T.R., P.A. Kumble and M.A. Heraty. 1991. A current assessment of urban best management practices. Review Draft. Metropolitan Washington Council of Governments, Washington, D.C.
- Schueler, T.R., P.A. Kumble, and M.A. Heraty. 1992. *A Current Assessment of Urban Best Management Practices: Techniques for Reducing Non-point Source Pollution in the Coastal Zone*. (March) Report prepared by the Anacostia Restoration Team, Department of Environmental Programs, Metropolitan Washington Council of Governments for the U.S. Environmental Protection Agency.
- Silverman, G.S. and M.K. Stenstrom. 1989. Source control of oil and grease in an urban area. In: Roesner, L.A. Urbonas, B., and Sonnen, M.B., eds. *Design of Urban Runoff Quality Controls*. American Society of Civil Engineers, New York, NY.
- Tull, L. 1990. Cost of Sedimentation/Filtration Basins. City of Austin, TX.
- USEPA. 1982. *Design Manual: Swirl and Helical Bend Pollution Control Devices*. EPA-600/8-82-013. U.S. Environmental Protection Agency, Washington, D.C.
- USEPA. 1990. National pollutant discharge elimination system permit application regulations for storm water discharges; Final Rule. U.S. Environmental Protection Agency, Office of Water Enforcement and Permits. Federal Register, November 16, 1990.
- USEPA. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
- USEPA. 1991. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- WADOE. 1991. Stormwater management manual for the Puget Sound basin. Publication No. 90-73 Washington State Department of Ecology, Olympia, WA.
- Wanielista, M.P., and Y.A. Yousef. 1986. Best management practices overview. In: *Urban Runoff Quality—Impact and Quality Enhancement Technology, Proceedings of*

an Engineering Foundation Conference. American Society of Civil Engineers, New York, NY.

White, D. G. 1989. Composting: A waste disposal alternative for marina based fish cleaning facilities. New York Sea Grant Extension Program, International Marina Institute, Wickford, RI.

Woodward-Clyde Federal Services. 1991. Urban BMP cost and effectiveness: Summary data for 6217 (G) guidance. Government Printing Office, Washington, DC.

Vessel Discharge of Sewage

Bleier, A. 1991. Waste management / marine sanitation. In: Ross, N., ed. *Proceedings of the 1991 National Applied Marina Research Conference*. International Marina Institute, Wickford, RI.

Bleier, A. 1991. Waste management/marine sanitation. Keco Pump-A-Head, Inc., International Marina Institute, Wickford, RI.

Brown, C. A. 1982. Treatability of recreational vehicle wastewater at highway rest areas. Unpublished Master's thesis.

Charness, L. N. 1990. Swimbeach remediation at Marina Del Rey Harbor. Los Angeles County Department of Beaches and Harbors, International Marina Institute, Wickford, RI.

Cox, T. February 14, 1992. Marina pays boaters to use pump-outs. *Dock Lines Newsletter*. International Marina Institute, Wickford, RI.

CTDEP. 1992. Best management practices for coastal marinas. Final Report for Connecticut Department of Environmental Protection. Office of Long Island Sound Programs and Bureau of Water Management. Hartford, CT.

DNREC. 1990. *State of Delaware Marina Guidebook*. Delaware Department of Natural Resources and Environmental Control, Dover, DE.

Eldridge, M.E. 1989. The Contribution of Recreational Boats to Bacterial Water Pollution: A Model for Determining Sewage Loading Rates. 1989 National Marina Research Conference. International Marina Institute, Wickford, RI.

FDA. 1989. Evaluation of marinas by state shellfish sanitation control officials. FDA Guideline 1.0, Shellfish Sanitation Branch, Food and Drug Administration, Washington, D.C.

Federal Register. July 10, 1978. Marine sanitation devices. Department of Transportation, US Coast Guard, (78-059), Washington, DC.

Federal Register. March 10, 1994. Clean Vessel Act: Pumpout grant program. Fish and Wildlife Service, (59-47), Washington, DC.

Federal Register. March 10, 1994. Clean Vessel Act: Pumpout station and dump station technical guidelines. Fish and Wildlife Service, (59-47), Washington, DC.

- Gaines, A. G. and A.R. Solow. 1990. *The Distribution of Fecal Coliform Bacteria in Surface Waters of the Edgartown Harbor Coastal Complex and Management Implications*. Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA.
- Geldreich, E., 1962. The distribution of coliform bacteria in the feces of warm-blooded animals. *JWPCF* (March). 34(3).
- ISSC, 1986. Marina Policy. Interstate Shellfish Sanitation Conference.
- JRB Associates, Inc. 1981. Analysis of wastewater discharge from marine sanitation devices. Final Report prepared for the US Environmental Protection Agency. JRB Associates, Inc., McLean, VA.
- Karp, C.A. and C.A. Penniman. 1991. *Boater Waste Disposal Briefing Paper and Proceedings from Narragansett Bay Project Management Committee*. The Narragansett Bay Project, Rhode Island.
- Kenton, W. 1992. Personal Communication. Keco, Inc., San Diego, CA.
- Kinney, E. T. and E. E. Constant. 1971. Naval shipboard wastes: Their treatment and disposal. (March) *Naval Ship Systems Command*.
- Kopecky, A. L. 1991. Microbiological treatment of marine sanitation devices (MSD). Merrick-Racicot, Inc., International Marina Institute, Wickford, RI.
- Larime, M. W. April 1982. Holding tank deodorants compatible with camp-ground waste treatment systems. *Recreational Vehicle News*. Thetford Corporation.
- Leonard, D.L., M.A. Broutman, and K.E. Harkness. 1989. The quality of shellfish growing water on the East Coast of the United States. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Rockville, MD.
- Manheim, P., 1988. Rhode Island marina and boat occupancy in Narragansett Bay. Social Forum, Peace Dale, Rhode Island.
- Maryland Department of Natural Resources. 1991. A guidebook for marina owners and operators on the installation and operation of sewage pumpout stations. Maryland DNR Boating Administration, Annapolis, MD.
- MDDNR. 1991. A guidebook for marina owners and operators on the installation and operation of sewage pumpout stations. Maryland Department of Natural Resources, Boating Administration, Annapolis, MD.
- Milliken, A.S. and V. Lee. 1990. *Pollution Impacts from Recreational Boating: A Bibliography and Summary Review*. Rhode Island Sea Grant Publications, University of Rhode Island Bay Campus, Narragansett, RI.
- Novak, J.T., C.R. McDaniel, and S.C. Howard. 1990. The effect of boat holding tank chemicals on treatment plant performance. *Research Journal Water Pollution Control Federation* 62(3).
- Pearson, F., D. Jenkins, H. McLean, and S. Klein. 1980. Recreation vehicle waste disposal in roadside rest septic tank systems. A study done for the Federal Highway

- Administration, CA. Department of Transportation, and CA State Water Resources Control Board. Sanitary Engineering Research Laboratory, University of California, Berkeley.
- Pollutech Limited. 1974. An assessment of odour control chemicals for use in marine holding tanks and toilets. Department of the Environment, Ottawa, Ontario.
- Rheault, R.B. and M.A. Rice 1989. Nursery culture of shellfish seed in marinas. 1989 National Marina Research Conference. International Marina Institute, Wickford, RI.
- Robins, J.G. and A.C. Green. 1974. Development of on-shore treatment systems for sewage from watercraft waste retention systems. EPA-670/2-74-056. National Environmental Research Center, Office of Research & Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.
- Rogers, S.M., Jr. and L.E. Abbas. 1982. Availability and use of pumpout facilities in North Carolina. A survey of marinas. UNC-SG-WP-82-1. North Carolina State University, Sea Grant College Publication, Raleigh, North Carolina.
- Ross, N. and M. Amaral, International Marina Institute. 1992. New England coastal marina pumpout survey. Report prepared for the U.S. Environmental Protection Agency, EPA Region I, Boston, MA.
- Ross, N.W. 1989. Towards A balanced perspective on boat sewage. Editorial Position Paper, International Marina Institute, Wickford, RI.
- Seabloom, R.A., G. Plews, F. Cox, and F. Kramer. 1989. The effect of sewage discharges from pleasure craft on Puget Sound waters and shellfish quality. Washington State Department of Health Shellfish Section, Olympia, WA.
- Tanski, J. 1989. Boater use of pumpout facilities in Suffolk County, Long Island, New York. In: *Proceedings of the 1989 National Marina Research Conference*. International Marina Institute, Wickford, RI.
- Tiedemann, J.A. 1989. Pump it or dump it? An analysis of the sewage pumpout situation in the New Jersey coastal zone. 1989 National Marina Research Conference. International Marina Institute, Wickford, RI.
- US Department of Health and Human Services, FDA. 1990. *NSSP Shellfish Sanitation Program, Manual of Operations, Part I, Sanitation of Shellfish Growing Areas*. US Food and Drug Administration, Washington, DC.
- USEPA. 1991a. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
- USEPA. 1991b. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- USEPA 1992. Guidance for states and municipalities seeking no-discharge area designation for New England coastal waters. (January 22) US EPA Region I, Boston, MA.

WPCF. 1989. Combined sewer overflow pollution abatement. Manual of Practice No. FD-17. Water Pollution Control Federation, Alexandria, VA.

Dredging

CTDEP. 1992. See Environmental, Pollution Assessment.

Johnston, S.A., Jr. 1981. Estuarine dredge and fill activities: A review of impacts. *Journal of Environmental Management* 5(5).

Millot, P. S. 1990. *Dredging for the 1990's and Beyond—Needs, Alternatives And Attitudes*. Daniel S. Natchez and Associates, Inc., International Marina Institute, Wickford, RI.

Murawski, W.S. 1969. A study of submerged dredge holes in New Jersey estuaries with respect to their fitness as finfish habitat. Miscellaneous Report No. 2M (August) Prepared for New Jersey Department of Conservation and Economic Development, Division of Fish and Game, Bureau of Fisheries, Nacote Creek Research Station.

Patin, T. R. 1990. Dredged material: A recognized resource. US Army Engineers, International Marina Institute, Wickford, RI.

Polis, D.D. 1974. The environmental effects of dredged holes. (May) Present State of Knowledge. Report to Water Resources Administration.

General

Brillat, T.H. 1989. Marinas and harbor management planning in Rhode Island. The University of Rhode Island Sea Grant Marine Advisory Service, International Marina Institute, Wickford, RI.

Cheyne, M. and N. Carter. 1989. The 1988 Puget Sound recreational boaters survey. Washington Public Ports Association and Parks and Recreation Commission, State of Washington.

Donoghue, C.M. and E.D. Sethness. 1991. Recurrence intervals and decision-making for marinas. Technical Report Series Vol. I, No. 5, International Marina Institute, Wickford, RI.

Goodwin, F.R. 1988. *Urban Ports and Harbor Management: Responding to Change Along U.S. Waterfront*.

Goodwin, R.F. 1989. Innovations in marina management. *Boating and Moorage in the 90s*. A Washington Sea Grant Marine Advisory Services Publication, Washington State University.

Koelbel, W. H. 1990. Permits: Consider the possibilities. Waterfront Consultants, Inc., International Marina Institute, Wickford, RI.

Natchez, D.S. 1990. Mitigation approaches—do they work? Are they accepted? Are the trade-offs reasonable? Daniel S. Natchez and Associates, Inc. Published by International Marina Institute, Wickford, RI.

- Nielson, T.A. 1991. Case study: A San Diego boatyard's approach to environmental compliance. Nielson Beaumont Marine, Inc., International Marina Institute, Wickford, RI.
- NOAA. 1976. Coastal facility guidelines. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, Washington, DC.
- NYBA. 1990. Progress report: The New Moon Project. Northwest Yacht Brokers Association, Seattle, Washington.
- PSWQA. 1989. *Managing Nonpoint Pollution: An Action Plan Handbook for Puget Sound Watersheds*. Puget Sound Water Quality Authority, Seattle, WA.
- Richards, W.R., J.E. Shwop, and R. Romano. 1981. Evaluation of urban stormwater quality and non-structural best management practices. In: Flynn, K.C. ed. *Nonpoint Pollution Control: Tools and Techniques for the Future*. Interstate Commission on the Potomac River Basin, Rockville, MD.
- RIDEM 1984. Water quality regulations for water pollution control. State of Rhode Island. Division of Water Resources, Department of Environmental Management, Providence, Rhode Island.
- Ross, N.W. 1989. Auto parking in marinas. International Marina Institute, Wickford, RI.
- Ross, N.W. 1989. Marina dictionary. International Marina Institute, Wickford, RI.
- Ross, N.W. 1990. It's time for marina environmental compatibility. International Conference on Environmental Management for Marinas. Keynote, September 5-7, 1990. International Marina Institute, Wickford, RI.
- SCCC. 1984. Guidelines for preparation of coastal marina report. South Carolina Coastal Council, Charleston, SC.
- Souza, S. J. 1990. *Compatibility of Coastal Development and Coastal Resources, Port Liberté: A Case Study*. Coastal Environmental Services, Inc., published by International Marina Institute, Wickford, RI.
- U.S. Coast Guard. 1990. *American Red Cross National Boating Survey. A Study of Recreational Boats, Boaters, and Accidents in the United States*. U.S. Department of Transportation, United States Coast Guard, Washington, DC.
- USEPA. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- USEPA. 1991. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.
- Zabawa, C. and C. Ostrom. 1980. Final report on the role of boat wakes in shore erosion in Anne Arundel County, Maryland. Tidewater Administration, Maryland Department of Natural Resources, Annapolis, MD.

Rhode Island Department of Environmental Management
Nonpoint Source Program Publications List

- An Assessment of Nonpoint Sources of Pollution to Rhode Island's Waters, DEM. 1988.
- Recommendations of the Stormwater Management and Erosion Control Committee Regarding the Development and Implementation of Technical Guidelines for Stormwater Management, DEM. 1988.
- Soil Erosion And Sediment Control Handbook, DEM, USDA Soil Conservation Service, Rhode Island State Conservation Committee. 1989.
- Rhode Island's Nonpoint Source Management Plan, DEM. 1989.
- Artificial Wetlands for Stormwater-Treatment: Processes and Designs, DEM. 1989.
- A User's Guide to the Revised Phosphorous Loading Model Adopted by Rhode Island's Nonpoint Source Management Program, DEM. 1989.
- Protecting Wetlands Water Quality: A Review of Current Knowledge and an Analysis of Regulatory Needs for the State of Rhode Island, DEM. 1991.
- Stormwater Runoff: Problems and Recommendations for Rhode Island, DEM. 1991.
- Rhode Island Site-Suitability Assessment Manual for Large Flow On-Site Sewage Disposal Systems, DEM. 1991.
- Stormwater Design and Installation Standards Manual, DEM. 1991.
- Hydric Soil Overlay Districts, DOP. 1992.
- Site Evaluation for Community Development, DEM. 1992.
- Inventory of Nonpoint Pollution Sources in Water Supply Watersheds, DEM. Pending Publication 1992.
- Draft Policy of Implementation NPDES Regulations.
6.100.

Appendix A
Oil Spill Response Plan

MODEL OIL SPILL RESPONSE PLAN

This appendix contains a model oil spill response plan for marinas. It is only a recommended format and should be modified to meet a facility's individual needs. Note, however, that it contains all the components of an oil spill response plan as suggested in Section 200.1 of the BMP chapter of the best management practices. This model was developed with input from:

RI Department of Environmental Management
US Coast Guard, Providence, RI Marine Safety Office
RI Marine Trade Association
International Marina Institute
Harbour Towne Marina, FL
Ram Point Marina, RI
Cove Haven Marina, RI

Oil Spill Response Plan

Name of Marina

EMERGENCY RESPONSE ACTION:

Reaction

- Identify the source of the spill if possible.
- Attempt to secure the source of the spill.
- If spill is observed at fueling dock, immediately cease all fueling activities.
- Make a preliminary assessment as to what the spill material is and approximately how much has entered the waterway. This information will dictate what equipment needs to be deployed
- Advise facility manger or spill response manager if necessary

Reporting

- U.S . Coast Guard 1-800-424-8802
- RI DEM Business hours, 277-3872; 24 hours, 277-3070

All spills that result in a sheen on the water require that the Coast Guard and RI DEM be contacted and provided with pertinent information.

Response

Gasoline spill

If spill is small (five gallons or less):

- Allow natural weathering to reduce and eliminate spill.
- No smoking during any spill.
- Do not contain or collect gasoline because confined gasoline may create a risk of explosion and fire.

For larger spills (more then five gallons):

- Implement the previous steps.
- Secure all electricity.
- Make sure everyone is away from the affected area.
- Do not allow anyone to enter the affected area.
- Use water hoses to wash spill away to protect docks and boats.
- Contact the fire department and harbormaster

Other oil spills (crude and refined residual oils, diesel, and kerosene)

- Contain oil spill using curtain boom to prevent spreading. When possible, completely surround source.
- If oil was spilled in an upland area, use sorbant boom and pads to contain material and prevent it from entering water body.
- If more oil than can be contained by the boom has been spilled, contact: *name of primary contact for additional spill equipment.*
- Once spill is contained, use sorbant material to collect oil. Absorbent pads can be placed within boomed area, retrieved, wrung out, and placed back in boomed area.
- If spreading is occurring too rapidly or other conditions prevent the containment of the oil, employ the boom to deflect the oil from critical or sensitive areas (see note B).

PERSONNEL

Spill Manager

Name of person responsible for maintaining plan and equipment inventory.

Qualified Staff

List marina staff authorized to implement spill plan.

Marina spokesperson

Select one person who is responsible for communicating to enforcement officials, customers and the media. Using one person helps to ensure a consistent message.

Contact for additional assistance

In the event that this facility needs the services of a professional oil spill response company, contact: list the name of a professional oil spill response company with whom prior arrangements exist.

This service should only be requested by the facility manager or the spill response manager.

THREATS

Maximum threat(s)

Overfilling of gasoline during fueling, creating explosion hazard

The most common spill occurrence will result from overfilling of gasoline and diesel fuel tanks at the fueling dock. Gasoline, because of its volatility, is this greatest threat.

Vessel spill

Under a worst-case scenario, the largest on-board fuel tank is aboard a 50-foot power boat which carries approximately 200 gallons of diesel fuel and 20 gallons of crankcase oil. This poses a maximum threat if this vessel were to sink within the marina perimeter.

Spill from fuel storage tank or connections to pumping station

On site there is a ___ gallon in-ground storage tank which is connected to the fuel pumping station by a series of flexible and rigid hoses. A fuel spill could result from the failure of one of the connections. A spill could also result when the fuel tank is being filled.

Minimum threats

Spill from waste oil receptacle

On site there is a 200 gallon waste oil receptacle. It is located 100 yards from the coastal edge and is surrounded by an impervious berm designed to retain 110 percent receptacle's volume.

SPILL RESPONSE EQUIPMENT

Available on-site resources

150-foot harbor curtain boom (3 x length of vessel with largest fuel tank)

Operational characteristics: serves to deflect and contain oil in the water.

Curtain boom is susceptible to wind, waves, and current. These factors can cause oil to escape over the top and under the bottom of the boom.

Deployment: Can be attached to a fixed structure or to an anchor. Place downstream of oil spill. If surface current is moving greater than .7 knots, the boom will not contain oil acting at a right angle to it. Boom angle will need to be adjusted to decreasing angles as the speed of the current increases.

Disposal: Boom, if maintained properly, can be used multiple times. The average life span for the boom is approximately five to ten years, depending on the use it receives.

Maintenance: Rinse with fresh water thoroughly. Be sure to collect with sorbants any remaining oil on the boom. Store out of sunlight in a manner that allows quick deployment.

80 feet of 5-inch sorbant boom (37.5 cu ft; 84 lbs.)

200 individual sorbant pads (3/8 in. x 18 in. x 18 in.)

Operational characteristics: Boom has little inherent strength and many need extra floatation to keep from sinking when laden with oil. Use sorbants only in low current velocity situations.

Deployment: Place sorbants on spilled oil. Recovery efficiency decreases rapidly once outer layer is oil soaked.

Disposal: May be wrung out and reused (*See manufacturer's specifications*). At the end of the sorbant's useful life, wring out and store in a sealed container. The container will be disposed of by contracted waste hauler.

Maintenance: When possible, wring out and dry after use. *See manufacturer's specifications*. Otherwise, material will be disposed of properly.

Empty 55-gallon drum with lid for storage of collected oil

Gloves

Pitch fork

2, 15 lb. Danforth anchors

Mooring lines

Standard mop or laundry wringer

Located

The spill response equipment is stored in the spill response shed located adjacent to the maintenance shed. Key number 000, which the manager holds on the master ring, opens the spill response shed.

Additional equipment

If the rapid deployment of additional resources is necessary, we have secured permission to use equipment from:

List local sources of equipment and how they can be reached, i.e.

Neighboring marina, they can be reached on VHF CH 68 or by calling 555-0000.

Coast Guard oil spill response trailer is also available as a first-aid measure

NOTES

Do not use dispersants on oil/fuel spills. Dispersants include products manufactured specifically for that purpose and more common products such as detergent. This simply forces the oil into the water column where it may be more harmful. Dispersants may only be used with the approval of the Coast Guard federal on-scene coordinator.

On the downstream side of the marina exists a salt marsh which should be protected from a large oil spill. Floating oil boom should be used to deflect spilled oil away from this critical area.

This response plan will be tested twice a year, with at least one test occurring at the beginning of the boating season. All of the spill response equipment will be inspected at the time of the tests.

RECORDS

Drills

Date	Drill Simulation	Who participated	Supervisor
8/3/93	Sinking vessel	List of staff members who participated	signature

Inspection

Date	Inspected by:	Condition/Notes
8/3/93	name	all equipment in good condition

Emergency Phone List

- United States Coast Guard, Marine Safety Office
In Rhode Island:
435-2300
1-800-424-8802
- State Department of Environmental Management
In Rhode Island:
277-3872 Business hours
277-3070 24 hours
- Local Harbormaster Department:
- Local Police Department:
- Local Fire Department:

Plan last updated:
Updated by:

Appendix B
Storm Water Pollution Program Summary

STORM WATER POLLUTION PROGRAM

This appendix contains information regarding the State of Rhode Island's storm water permitting program under authority of the National Pollution Discharge Elimination System (NPDES). This appendix is divided into four sections:

- (1) A summary, provided by RI DEM, that explains when a marina needs a storm water permit.
- (2) A general fact sheet about the RI Storm Water Program.
- (3) A table, provided by EPA and revised by RI DEM, that compares nonpoint source program with the storm water program.
- (4) Guidance on completion of a storm water pollution prevention plan as part of the RI Storm Water Program.

This appendix has been included to clarify the differences between nonpoint source and point source pollution practices and provide marina operators with a mechanism to easily satisfy both the nonpoint source program and the storm water program.

When does a marina need a RIPDES storm water permit?

The Rhode Island Pollutant Discharge Elimination System (RIPDES) regulations require that facilities identified by certain Standard Industrial Classification (SIC) codes obtain permits for the discharge of storm water. The goal of the RIPDES storm water program is to eliminate pollutants by developing and implementing management practices (identified in the facility's Storm Water Pollution Prevention Plan, SWPPP) that reduce the contact between storm water and sources of pollutants. Selection of the proper SIC code is based upon the activities the facility is "primarily engaged in." The SIC code that most accurately describes most "marinas" is 4493. A complete description of facilities included in SIC code 4493 may be found in the *Standard Industrial Classification Manual*, published by the Office of the President, Office of Management and Budget. Other related facilities that require RIPDES storm water permits include, SIC codes 373 and 44. In general, a marina is defined as a facility that rents boat slips, stores boats and generally performs a range of other marine services, including boat cleaning and incidental boat repair. However, only marinas that meet the following conditions are required to obtain a RIPDES permit:

- (1) Vehicle (vessel) maintenance or equipment cleaning is conducted at the facility. *The term vehicle (vessel) maintenance includes vehicle (vessel) rehabilitation, mechanical repairs, painting, fueling, and lubrication.*
- (2) There is a point source discharge of storm water from vehicle (vessel) maintenance or equipment cleaning areas into State waters. *The term point source means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container or rolling stock. The discharge may flow directly into the water of the state or may be discharged into a storm sewer system.* However, if the fueling is the only type of vehicle (vessel) maintenance that occurs at the site, a permit is not required even if there is a point source discharge.

It should be noted that even if both of the conditions described above are met, a permit is only required for the discharge of storm water from areas where the vehicle (vessel) maintenance or equipment cleaning occur. In addition, a marina could also need a RIPDES permit if the director determines the discharge of storm water contributes to a water quality violation or is a significant contributor of pollutants to waters of the state.

Once it is determined that a RIPDES permit is required, a facility has two options. The first option is to apply for coverage under the General Permit for Storm Water Discharges Associated with Industrial Activity by filling out a Notice of Intent (NOI) form. This is the recommended option. The second option is to apply for coverage under an individual permit by filling out EPA Forms 1 and 2F. In the past, there was a third option available—coverage under the EPA group application process. The deadline for this process expired September 1, 1991. Regardless of the type of permit application selected, a SWPPP must be developed. Additional information concerning the application process, including the appropriate DEM contacts, is provided in the attached fact sheet.

FACT SHEET
RHODE ISLAND POLLUTANT DISCHARGE ELIMINATION SYSTEM
STORM WATER DISCHARGE ASSOCIATED WITH INDUSTRIAL ACTIVITY

BACKGROUND

In 1972, Congress passed amendments to the Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), to effectively prohibit the discharge of pollutants to the waters of the United States, unless authorized by a National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits specify the monitoring, reporting, and control requirements, including allowable levels of pollutants in discharges. Traditionally, the focus has been on implementing controls on industrial process wastewater and municipal wastewater. As these control measures were put in place, it became obvious that more diffuse sources of water pollution were becoming a major cause of water quality degradation.

Initially, urban and industrial runoff were considered clean. Now, it is recognized that this is indeed not the case. Storm water runoff picks up a multitude of pollutants from streets, parking lots, construction sites, and industrial sites. These pollutants are carried by runoff to either natural or manmade channels, which eventually lead to surface water bodies such as: creeks, rivers, lakes, estuaries, and bays. The National Urban Runoff Program (NURP) has shown that runoff may contain significant quantities of heavy metals, pesticides, herbicides, and organic compounds, such as fuels, solvents, lubricants, and grease. The presence of these pollutants can potentially cause problems for both human health and aquatic organisms.

In 1987, amendments to the CWA added Section 402(p), which set up the framework to regulate industrial storm water under the NPDES program. On November 16, 1990, EPA issued final regulations that established application requirements for storm water permits. These regulations required owners or operators of specific categories of industrial facilities, which discharge storm water directly to the waters of the United States or indirectly through a separate storm sewer system via a point source conveyance, to obtain a NPDES storm water permit. As defined in the Code of Federal Regulations (40 CFR 122.2), a point source means "any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel, or other floating craft, from which pollutants are or may be discharged..."

As a delegated state by EPA, Rhode Island is authorized to issue individual or general permits under the Rhode Island Pollutant Discharge Elimination System (RIPDES) to cover discharges of industrial storm water. In order to maintain delegation of this program, Rhode Island Department of Environmental Management (RIDEM) is required to update the RIPDES regulations when changes are made to the NPDES regulations. RIDEM, Division of Water Resources, has developed a statewide general permit to cover all storm water discharges associated with industrial activity, excluding discharges from construction sites. A separate general permit has been issued to cover storm water discharges associated with construction activity. The Division of Water Resources has decided to stress the use of the general permit for two basic reasons. It would alleviate the immense administrative burden that is associated with the start-up of a new program to regulate industrial storm water discharges; and it would be the least costly way for facilities to comply with these regulations. Information gathered from this general permit will be used to determine if more stringent controls are needed to control pollutants in storm water discharge.

The general permit enclosed with this fact sheet has three conditions that must be met. These conditions were developed to be consistent with the minimum requirements of EPA's draft general permit and to meet the requirements of the RIPDES regulations. The first condition is that non-storm water discharge, including illicit connections, must be eliminated from all storm water systems. The second condition is that a storm water pollution prevention plan must be developed to minimize or even eliminate the potential for pollutants in industrial storm water discharge. The final condition is to conduct appropriate monitoring of discharges to storm water systems.

To apply for coverage under this permit, a facility must fill out a Notice of Intent (NOI). An NOI cannot be submitted until after the effective date of this permit. The NOI is a standardized form and must be submitted to

RI Department of Environmental Management
Division of Water Resources
Permits Section
291 Promenade Street
Providence, RI 02908

AUTHORIZATION

For industrial facilities in existence prior to October 1, 1992, authorization is granted immediately upon this department receiving a complete NOI. The NOI must be received by this department by April 19, 1993, for a facility to be in compliance with these regulations.

For discharges of storm water associated with industrial activity which commence after October 1, 1992, the NOI must be submitted ninety (90) days prior to the discharge of any industrial storm water. Authorization to discharge is automatic at the end of the ninety (90) day review period, unless notified to the contrary by this department. Regardless of whether the NOI was actually reviewed by this department, or it became approved because of this department's failure to act within ninety (90) days, the permittee is still responsible for upholding all permit conditions and any other applicable state or federal regulations.

STORM WATER POLLUTION PREVENTION PLAN

The general permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The goal of the SWPPP is to help identify the sources of pollutants in industrial storm water discharge and to ensure practices are being implemented to minimize pollutants from entering industrial storm water discharge. This plan emphasizes the use of Best Management Practices (BMPs) to provide the necessary flexibility to address different sources of pollutants at different facilities. The required elements of the SWPPP must be retained on-site for the duration of the authorization to discharge. This information must be made available to this department to monitor the effectiveness of the BMPs and to assure the permit conditions are being met.

Industrial facilities, existing prior to October 1, 1992, have until April 1, 1993, to develop a SWPPP and must comply with its conditions by October 1, 1993. For discharges of storm water associated with industrial activity which commence after October 1, 1992, the SWPPP must be developed and submitted as part of the NOI; compliance is required upon authorization to discharge.

MONITORING REQUIREMENTS

The monitoring requirements are based on a three-tiered, risk-assessment basis. Class I facilities are considered to have the highest potential for contributing to

surface water quality problems via storm water discharges. These facilities are required to sample semi-annually and report the results to this department semi-annually. Class II facilities are considered to have somewhat of a lower potential for contributing pollutants. These facilities are required to sample annually and report the results to this department annually. Class III facilities, considered to be the least hazardous of the three classes, are not presently required to conduct any sampling. All three classes, however, are required to conduct an annual Comprehensive Site Evaluation of all storm water control measures and submit this information to this department.

The objective of the above measures is (1) to assure the permit conditions are being met, (2) to aid in the development of the SWPPP, and (3) to measure the effectiveness of the BMPs in minimizing or removing pollutants in storm water discharge. The data collected will also provide this department with information to assess future development of the Storm Water Program. Table #1 summarizes the monitoring requirements for each of the three Classes.

There are additional monitoring requirements for facilities located in the Pawtuxet River Watershed. These facilities must sample by May 18, 1993 and submit the analysis to this department by June 17, 1993. These samples are to be analyzed for the following: lead, copper, silver, zinc, cadmium, chromium, nickel, and TSS. This is a one-time requirement, subsequent sampling, analysis, and reporting shall follow the requirements summarized in Table #1. It should be noted that this requirement is also for Class III facilities, located in the Pawtuxet River Watershed.

The Pawtuxet River has been identified as one of the most polluted rivers in the State. To improve the water quality of the Pawtuxet River, the Department has required the municipalities of West Warwick, Warwick, and Cranston to implement advanced wastewater treatment. To further ensure these efforts are successful, the Department is committed to evaluating the water quality impacts associated with non-point sources of pollution. The objective of this sampling requirement is to provide data to evaluate the impact of storm water discharges on the water quality of the Pawtuxet River and to determine the need for developing a watershed-specific general permit.

DEM CONTACTS

Additional information concerning the general permit may be obtained between the hours of 8:30 a.m. to 4:00 p.m., Monday through Friday, excluding holidays from:

Constance Carey
Senior Environmental Scientist
291 Promenade Street
Providence, RI 02908
Telephone: (401) 277 6519

Christopher S. Feeney
Sanitary Engineer
291 Promenade Street
Providence, RI 02908
Telephone: (401) 277 6519

Peter A. Duhamel
Environmental Scientist
291 Promenade Street
Providence, RI 02908
Telephone: (401) 277 6519

Table 4. Monitoring Requirements

Monitoring Category	Type of Facility	Parameters	Monitoring Frequency	Reporting Frequency
Class 1	SARA Title III, Section 313 Facilities; which release "Section 313 water priority chemicals" into the environment	Oil and grease; BOD ₅ ; TSS; TKN; total phosphorous; pH; any pollutants listed in Tables II and III of Appendix D of 40 CFR 122, if the discharger knows or has reason to believe are present at the facility; and any "Section 313 water priority chemical" for which the facility is subject to reporting requirements under the EPCRA of 1986	Semi-annual	Semi-annual
	Primary Metal Industries (SIC 33)	Oil and grease; BOD ₅ ; TSS; pH; total recoverable lead; total recoverable cadmium; total recoverable copper; total recoverable arsenic; total recoverable chromium; any pollutants listed in Tables II and III of Appendix D of 40 CFR 122, if the discharger knows or has reason to believe are present at the facility; and any pollutant limited in an effluent guideline to which a facility is subject	Semi-annual	Semi-annual
	Landfills, Land Application Sites, and Open Dumps	Total recoverable magnesium; dissolved magnesium; TKN; BOD ₅ ; TDS; TOC; oil and grease; pH; total recoverable arsenic; total recoverable barium; total recoverable cadmium; total recoverable chromium; total recoverable cyanide; total recoverable lead; total mercury; total recoverable selenium; total recoverable silver; and any pollutants listed in Tables II and III of Appendix D of 40 CFR 122, if the discharger knows or has reason to believe are present at the facility	Semi-annual	Semi-annual
	Hazardous Waste Treatment, Storage, or Disposal Facilities	Total recoverable magnesium; dissolved magnesium; TKN; BOD ₅ ; TDS; TOC; oil and grease; pH; total recoverable arsenic; total recoverable barium; total recoverable cadmium; total recoverable chromium; total recoverable cyanide; total recoverable lead; total mercury; total recoverable selenium; total recoverable silver; and any pollutants listed in Tables II and III of Appendix D of 40 CFR 122, if the discharger knows or has reason to believe are present at the facility	Semi-annual	Semi-annual

Table 4. Continued

Monitoring Category	Type of Facility	Parameters	Monitoring Frequency	Reporting Frequency
Class I	Wood Treatment Industry (SIC 2491)	Oil and grease, BOD ₅ , TSS, and pH	Semi-annual	Semi-annual
	using chlorophenolic formulations	Pentachlorophenol and any pollutants listed in Tables II and III of Appendix D of 40 CRF 122, if the discharger knows or has reason to believe are present at the facility		
	using creosote formulations	Any pollutants listed in Tables II and III of Appendix D of 40 CRF 122, if the discharger knows or has reason to believe are present at the facility		
	using chromium arsenic formulations	Total recoverable arsenic, total recoverable chromium, and total recoverable copper		
	Coal Pile Runoff	Oil and grease, pH, TSS, total recoverable copper, total recoverable nickel, and total recoverable zinc. Storm water runoff from coal piles have numeric effluent limitations as follows: pH of 6.0-9.0 and a TSS of 50 mg/l	Semi-annual	Semi-annual
	Battery Redemption Sites	Oil and grease, BOD ₅ , TSS, pH, total recoverable copper, and total recoverable lead	Semi-annual	Semi-annual
Class II	Airports with greater than 50,000 flights per year	Oil and grease, pH, BOD ₅ , TSS, and the primary ingredient in deicing	Annual	Annual
	Coal Fired Steam Electric Plants	Oil and grease, pH, TSS, total recoverable nickel, and total recoverable zinc	Annual	Annual
	Animal handling areas, manure management or storage areas, and production waste or storage areas in Meat Packing Plants (SIC 2011), Poultry Slaughtering and Processing (SIC 2015), and Animal and Marine Fats and Oils (SIC 2077); where there is exposure to precipitation	Oil and grease, BOD ₅ , TSS, TKN; total phosphorus; pH; and fecal coliform	Annual	Annual
	Chemicals and Allied Products (SIC 28) and Rubber and Miscellaneous Plastic Products (SIC 30); where solid chemicals, used as raw materials, are exposed to precipitation	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject	Annual	Annual
	Auto Salvage Yards	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject	Annual	Annual
	Oil handling areas at Oil Fired Steam Electric Plants	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject	Annual	Annual

Table 4. Continued

Monitoring Category	Type of Facility	Parameters	Monitoring Frequency	Reporting Frequency
Class II	Cement Manufacturers (SIC 3241)	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject	Annual	Annual
	Ready-Mix Plants (SIC 3273)	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject	Annual	Annual
	Ship Building and Repairing (SIC 3731)	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject	Annual	Annual
	Lime storage piles at Lime Manufacturing Facilities	Oil and grease, BOD ₅ , TSS, pH, and any pollutant limited in an effluent guideline to which a facility is subject		
Class III	All other applicable facilities not specifically mentioned as being part of Class I and Class II	No parameters are required to be analyzed	NA	NA
Pawtuxet River Watershed	All applicable facilities located in the Pawtuxet River Watershed	Lead, copper, silver, zinc, cadmium, chromium, nickel, TSS, and any other applicable parameter required by this permit	One-time Rqmt	June 17, 1993

Table 5. Marina & Boat Pollution Sources: Comparison of CZARA Management Measures and RIPDES Regulations.

Pollution Source	Covered by CZARA Management Measures	Covered by RIPDES Permitting
Siting considerations to minimize NPS impacts	Yes	No
Design considerations to minimize NPS impacts	Yes	No
Siting/design to minimize habitat impacts	Yes	No
Runoff from boat washing on shore	Yes*	Yes, storm water from SIC 4493***
Runoff from marina grounds (nonindustrial)	Yes	No
Runoff associated with hull maintenance/repair/painting	Yes	Yes, storm water from SIC 4493***
Nonpoint source impacts from shoreline erosion	Yes	No
Design for ease of fuel spill cleanup	Yes*	May be addressed in marina (SIC4495) storm water pollution prevention plan (SWPPP)
Improper disposal of sewage	Yes*	Yes, as boat**discharge if in water and as SIC4493 if in storm water on shore
Solid waste handling	Yes*	Yes, if storm water runoff is in contact with material from industrial activity***as a SIC4493 facility
Fish waste disposal	Yes	No (except commercial fish processing facility)
Liquid waste handling	Yes*	Yes, if the storm water runoff contains the material from industrial activity***as a SIC4493 facility
Petroleum from boats	Yes*	Yes, as storm water from SIC4493 facility for leaks from boats in maintenance yards
In-water cleaning	Yes*	Yes, may be addressed in marinas (SIC4493) SWPPP
Public education	Yes	Not directly, but could be required as part of marina's (SIC4493) SWPPP
Boat operation impacts on habitat	Yes	No

* Covered by CZARA until a permit is issued, then no longer covered by CZARA.

** Boat owner, not marina, would be the responsible party for point source (process) discharge to surface waters.

*** Industrial activity is defined as equipment cleaning or vehicle (e.g., boat) maintenance including vehicle rehabilitation, mechanical repairs, painting, and lubrication.

Storm Water Pollution Prevention Plan

This section provides some detail about the storm water pollution prevention plan (SWPPP) required by RIPDES. Specifically, this section identifies what a SWPPP must include and how it can be created. Like an operations and maintenance program (OMP), the SWPPP requires that the facility address:

- (1) Potential pollution sources, and
- (2) Management practices or controls.

After reviewing the specific requirements, the marina operator may find that many of the components of a SWPPP are already addressed in the operations and maintenance program (OMP) developed for the Coastal Nonpoint Source Pollution Control Program (CNPCP). To minimize duplication of effort, appropriate sections of the OMP can be included in the SWPPP. A final SWPPP may closely resemble a OMP—it will include a site plan and text to explain potential pollution sources and worksheets to identify and explain management controls being implemented.

To help marina operators develop a SWPPP, this section outlines what controls need to be addressed by the SWPPP. First, a textual explanation of the SWPPP requirements administered by RI DEM is presented. Second, the same worksheet format applied in chapter four to develop the nonpoint source program is provided to help select appropriate management practices. To complete these worksheets, identify whether each practice is existing or planned. Similar to the nonpoint source program, the marina operator identifies the sources of pollutants and implements the appropriate storm water management control for each source. However, the storm water program lists general requirements that all marinas must include in their SWPPP and requires a narrative consideration of others. Therefore, “not applicable” is no longer provided as an option to check off. In some instances, it may be adequate to reference specific worksheets from the OMP. If a control is planned for implementation, use the space provided to explain the schedule for implementation. Again, in some instances, it may be adequate to reference specific worksheets from the OMP. To help link nonpoint source practices and storm water controls, the worksheet presented in this appendix references:

- OMP worksheets from chapter four that apply to the storm water controls; and
- Specific BMPs from chapter three that apply to the storm water controls.

Storm Water Pollution Prevention Plan Requirements

- A. The SWPPP shall be prepared in accordance with good engineering practices and identify potential sources of pollutants, which may reasonably be expected to affect the quality of storm water discharges associated with industrial activity from the facility. In addition, the plan shall describe and ensure the implementation of best management practices (BMPs) that are to be used to reduce or eliminate the pollutants in storm water discharges associated with industrial activity at the facility and to assure compliance with the terms and conditions of this permit.
- B. The plan shall be signed by the owner and operator in accordance with Part V.G. of the RIPDES general permit and retained on site for at least five (5) years. Owners or operators of a facility with storm water discharges covered by this permit shall make plans available upon request to the director or in the case of a storm water discharge associated with industrial activity, which discharges through a municipal separate

storm sewer system with a RIPDES storm water permit, to the municipal operator of the system.

- (1) *Facilities that Discharge Storm Water Associated with Industrial Activity Prior to October 1, 1992 must:*
 - a. Develop the Storm Water Pollution Plan, as described in Part IV of this permit, by April 1, 1993.
 - b. Comply with the Storm Water Pollution Prevention Plan by October 1, 1993.
 - (2) *Facilities that Commence to Discharge Storm Water Associated with Industrial Activity After October 1, 1992 must:*
 - a. Submit the Storm Water Pollution Prevention Plan, as described in Part IV of this permit, as part of the NOI.
 - b. Comply with the Storm Water Pollution Prevention Plan upon the date of authorization to discharge.
- C. If the plan is reviewed by the director, he or she may notify the permittee at any time that the plan does not meet one or more of the minimum requirements of this part. After such notification from the director, the permittee shall make changes to the plan and shall submit to the director a written certification that the requested changes have been made. Unless otherwise provided by the director, the permittee shall have thirty (30) days after such notification to make the necessary changes.
- D. The permittee shall immediately amend the plan whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the potential for the discharge of pollutants to the waters of the state; a release of reportable quantities of hazardous substances and oil; or if the SWPPP proves to be ineffective in achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. Changes must be noted and then submitted to this department. Amendments to the plan may be reviewed by DEM in the same manner as Part III.C. of the RIPDES general permit.
- E. The SWPPP shall include, at a minimum, the following items:
1. ***Description of Potential Pollutant Sources.*** Each plan must provide a description of potential sources that may be reasonably expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan must identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include:
 - a. A site map indicating:
 - a delineation of the drainage area of each storm water outfall
 - each existing structural control measure to reduce pollutants in storm water runoff
 - locations where significant leaks or spills have occurred
 - a delineation of all impervious surfaces

- all surface water bodies
 - all separate storm sewers
 - allocations of the following activities where such areas are exposed to storm water: fueling stations, boat and equipment maintenance and/or cleaning areas, material handling areas, material storage areas, process areas, and waste disposal areas;
- b. A topographic map extending one-quarter of a mile beyond the property boundaries of the facility;
- c. An estimate of the overall runoff coefficient for the site, determined by an acceptable method, such as, but not limited to, area weighting;
- d. A narrative description of:
- significant materials that have been treated, stored, or disposed of in a manner to allow exposure to storm water between the time of three years prior to the issuance of this permit to the present
 - method of on-site storage or disposal
 - materials management practices employed to minimize contact of these materials with storm water runoff between the time of three years prior to the issuance of this permit and the present
 - materials loading and access area
 - the location and description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff
 - any treatment the storm water receives;
- e. A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at the facility three years prior to the effective date of this permit to the present;
- f. A list of any pollutants limited in effluent guidelines to which a facility is subject under 40 CFR Subchapter N, any pollutants listed on a RIPDES permit to discharge process water, and any information required under RIPDES Rule 11.02(a)(14)(iii)-(v) or 40 CFR 122.21(g)(iii)-(v);
- g. For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow and an estimate of the types of pollutants that are likely to be present in storm water associated with industrial activity;
- h. A summary of existing sampling data describing pollutants in storm water discharges from the facility; and

- i. A list of any allowable non-storm water discharges, as described in Part 1.B.2 of the RIPDES general permit, except discharges from fire fighting activities, that are known or are reasonably expected to be present at the site.
- (2) **Storm Water Management Controls.** Each facility covered by this permit must develop a description of storm water management controls appropriate for the facility and implement such controls. The appropriateness for implementing controls listed in the plan must reflect identified potential sources of pollutants at the facility. The description of storm water management controls must address the following minimum components, including a schedule for implementing such controls:
 - a. **Pollution Prevention Team-**Each plan must identify a specific individual(s) within the facility organization as members of a team that are responsible for developing the plan and assisting the plant management in its implementation, maintenance, and revision. The plan must clearly identify the responsibilities of each team member. The activities and responsibilities of the team must address all aspects of the facility's plan.
 - b. **Risk Identification and Assessment/Material Inventory-**The SWPPP must assess the potential of various sources at the plant to contribute pollutants to storm water discharge associated with the industrial activity. The plan must include an inventory of the types of materials handled. Facilities subject to SARA Title III, Section 313, shall include in the plan a description of the releases to land or water of SARA Title III, Section 313 "water priority chemicals" that have occurred at any time after the date of three years prior to the date of the issuance of this permit. Each of the following must be evaluated for the reasonable potential for contributing pollutants to runoff: loading and unloading operations, outdoor manufacturing or processing activities, significant dust-or particulate-generating processes, and on-site waste disposal practices. Factors to consider include the toxicity of chemicals; quantity of storm water, and the history of significant leaks or spills of toxic or hazardous pollutants.
 - c. **Preventive Maintenance-**A preventative maintenance program must involve inspection and maintenance of storm water management devices (ie, oil/water separators, catch basins), as well as inspection and testing of paint equipment and systems to uncover conditions that could cause breakdown or failures resulting in discharges of pollutants to surface waters.
 - d. **Good Housekeeping-**Good housekeeping requires the maintenance of a clean, orderly facility.
 - e. **Spill Prevention and Response Procedure-**Areas where potential spills can occur and their accompanying drainage points must be identified clearly in the SWPPP. The potential for spills to enter the storm water drainage system must be eliminated wherever feasible. Where appropriate, specific material handling procedures, storage requirements, and procedures for cleaning up spills must be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a cleanup must also be made available to personnel. In accordance with Part

V.I of RIPDES, the permittee shall immediately notify the division of releases in excess of reportable quantities.

- f. **Storm Water Management**-The plan must contain a narrative consideration of the appropriateness of traditional storm water management practices. Based on an assessment of the potential of various sources at the plant to contribute pollutants to storm water discharges associated with industrial activity, the Plan must provide that measures, determined to be reasonable and appropriate, must be implemented and maintained.
- g. **Sediment and Erosion Prevention**-The plan must identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify measures to limit erosion.
- h. **Employee Training**-Employee training programs must inform personnel responsible for implementing activities identified in the plan, or otherwise responsible for storm water management at all levels, of the components and goals of the plan. Training should address topics, such as spill response, good housekeeping, and material management practices. The plan must identify periodic dates for such training.
- i. **Visual Inspections**-Qualified plant personnel must be identified to inspect designated equipment and plant areas. Material handling areas must be inspected for evidence of, or the potential for, pollutants entering the drainage system. A tracking of follow-up procedure must be used to ensure that the appropriate action has been taken in response to the inspection. Records of inspections must be maintained on site for at least five (5) years.
- j. **Record Keeping and Internal Reporting Procedures**-Incidents, such as spills, or other discharges, along with other information describing the quality and quantity of storm water discharges, must be included in the records. All inspections and maintenance activities must be documented and maintained on site for at least five (5) years.
- k. **Non-storm Water Discharge**-A certification that the discharge has been tested for the presence of non-storm water discharges. The certification must include a description of the results of any test for the presence of non-storm water discharges, the method used, the date of any testing, and the on-site drainage points that were directly observed during the test. Such certification may not be feasible, if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the SWPPP must indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water discharges.

Note: Each of these controls is listed in the worksheet that follows this section.

- (3) **Site Inspection**-An annual inspection must be conducted by appropriate personnel named in the SWPPP to verify that the description of potential pollutant sources required under Part IV.E.1 of the RIPDES general permit is

accurate, that the drainage map has been updated or otherwise modified to reflect current conditions, and that controls to reduce pollutants in storm water discharges associated with industrial activity identified in the plan are being implemented and are adequate. A tracking or follow-up procedure must be used to ensure that the appropriate action has been taken in response to the inspection. Records documenting significant observations made during the site inspection must be retained as part of the SWPPP for a minimum of five (5) years.

- (4) ***Additional Requirements for Salt Storage Piles***-Storage piles of salt used for deicing or other commercial or industrial purposes, and that generate a storm water discharge associated with industrial activity, must be enclosed to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile.
- (5) ***Additional Requirements for SARA Title III Facilities***-Facilities that are subject to reporting requirements under the Emergency Planning and Community Right-to-Know Act (EPCRA) for "Section 313 water priority chemicals," must, in addition to all the requirements under this part, follow all the appropriate conditions under EPCRA and CERCLA requirements and regulations.
- (6) ***Consistency with Other Plans***-Storm water management controls may reflect requirements for Spill Prevention Control and Countermeasure (SPCC) plans under Section 311 of the CWA or Best Management Practices (BMP) Programs otherwise required by a RIPDES permit and may incorporate any part of such plans into the SWPPP by reference.

9. Storm Water Management Controls for a Pollution Prevention Plan

Address the following minimum components:

	Existing	Planned
These controls are:		
Establish a pollution prevention team. (No reference to OMP worksheet). Explain:	<input type="checkbox"/>	<input type="checkbox"/>
Complete a risk identification and assessment/material inventory. (No reference to OMP worksheet). Explain:	<input type="checkbox"/>	<input type="checkbox"/>
Institute a preventative maintenance program that inspects and maintains storm water management devices. (See OMP worksheet 1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>
Institute good housekeeping practices (See OMP worksheets 3 and 5). Explain:	<input type="checkbox"/>	<input type="checkbox"/>
Complete a spill prevention and response plan (See OMP worksheets 5 and 6). Explain:	<input type="checkbox"/>	<input type="checkbox"/>
Implement appropriate traditional storm water management practices (See OMP worksheets 1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>
Identify areas with high potential for significant soil erosion and implement measures to limit erosion (See OMP worksheet 1). Explain:	<input type="checkbox"/>	<input type="checkbox"/>

Continued next page

These controls are:

Existing Planned

Complete employee training schedule (No reference in OMP worksheets).
Explain:

Identify qualified personnel to inspect designated equipment and facility areas (No reference in OMP worksheets). **Explain:**

Maintain records of all inspections, storm water discharge, and incidents (No reference in OMP worksheets). **Explain:**

Certify that discharge has been tested for the presence of non-storm water discharges (No reference in OMP worksheets). **Explain:**

Complete an annual inspection by personnel named in SWPPP (No reference in OMP worksheet). **Explain:**

Minimize the impacts of wastewater created during pressure washing (See BMP section 100.3). **Explain:**

Properly maintain engine repair areas (See BMP section 200.3). **Explain:**

Appendix C
List of Pumpout Manufacturers

Pumpout Manufacturers

This is a list of known pumpout manufacturers. It is based on information from a guidebook titled "A Guidebook for Marina Owner and Operators On the Installation and Operation of Sewage Pumpout Stations," written by the Maryland Department of Natural Resources, and a list contained in the "Marina Environmental Workbook," distributed at a national workshop series conducted by the International Marina Institute. The information from these two sources was verified by contacting each manufacturer. The listing of a product in this appendix does not constitute an endorsement by any of the agencies involved in the project.

Keco, Inc.
Anne Bleier, President
PO Box 80308
San Diego, CA 92110
or
3235 Hancock Street
San Diego, CA 92110
(619) 298-3800-Phone
(619) 298-3300-fax

Exstar International Corporation
Charles Mattes, President
301-E1 North Green Meadows Drive
Wilmington, NC 28405
(910) 452 4737-Phone
(910) 452-4738-Fax

Far Products, Inc.
Joseph B. Stinson, President
PO Box 561
Fremont, OH 43420
(419) 332 8286-Phone and Fax

Waubauskene Machine and Welding
Alan King, President
111 Coldwater Road
Waubauskene, Ontario
CANADA L0K 2C0
(705) 538-1459-Phone
(705) 538-1776-Fax

AIRVAC
John Grooms, R&D Manager
A division of BMCI
PO Box 528
4217 North Old U.S. 31
Rochester, IN 46975
(219) 223-3980-Phone
(219) 223-5566-Fax

Envirovac, Inc.
Doug Uzar
1260 Turret Drive
Macasney Park, IL 61115
(815) 654-8300-Phone
(815) 654-8306-Fax
(800) 435-6951-Toll Free (except IL, HI, AK)

Edson International Industries
Peter Burlinson, Sales Manager
146 Duchaine Blvd.
New Bedford, MA 02745-1292
(508) 995-9711-Phone
(508) 995-5021-Fax

Sealand Technology, Inc.
Ed McKiernan, President
PO Box 38
Fourth Street
Big Prairie, OH 44611
(216) 496-3211-Phone
(216) 262-1727-Fax
1-800-321-9886

Appendix D
Information Sheets for Boaters

INFORMATION FOR BOATERS

This appendix contains two information sheets that have been designed to educate recreational boaters. The first is a Sea Grant Fact Sheet developed during this project and available through Rhode Island Sea Grant at the University of Rhode Island. The second is a public environmental flyer prepared by the International Marina Institute in Wickford, RI, with funding from the U.S. Environmental Protection Agency, Office of Water, and authored by Neil Ross and Mark Amaral.

The information sheets are intended for use by marina operators to inform boaters in their marina. The sheets can be copied out of this document, perhaps placed on the marina's letterhead, and distributed to the tenants.

Boater Environmental Awareness Fact Sheet

Nonpoint Pollution From Boats

Boating Needs Clean Water

Imagine a great day of boating with family and good friends—enjoying a warm sunny day with a gentle breeze, a cooling spray on the face, natural scenery passing by, fine food to eat, and lighthearted conversation. Picture fishing, sailing, water skiing, or just cruising to a quiet harbor. That's the fun image of an ideal boating trip.

Stop! Now visualize that same boat trip on dirty brown water, with drifting oil-soaked debris, and a foul odor. The shoreline is littered with semi-submerged junk and old tires.

That first clean fun picture has now probably changed to uncomfortable displeasure. Clearly a dirty image takes much of the recreational value out of boating. When most boat owners are asked where they like to go, they usually describe clean harbors, rivers, and bays nearby.

Recreational boating is increasingly popular. Its growth has led to a growing awareness of the need to protect our waterways.

According to the U.S. Environmental Protection Agency (EPA), some water pollution comes from boating. While the largest nationwide water pollution sources are still municipal sewage treatment plants, storm sewers/runoff from roads and parking lots, land disposal, agriculture, and industrial plants, boating does add small amounts of nonpoint pollution. It is called incremental pollution—a little here, a little there, scattered widely over space and time. Common pollutants include engine oil, fuel, antifouling paint, hull and bottom sandings, detergents, fish waste, antifreeze, sewage, and litter.

Some nonpoint pollutants are easily seen, such as trash and oil slicks. Other are hidden because they are dissolved in the water and/or absorbed into plants and animals, including heavy metals, toxic compounds, pesticides, bacteria, and viruses.

While each boat's contribution is so small as to seem almost irrelevant, when added to other boats and to the small amounts from many other sources in an area, it can add up.

All boats and marinas should reduce their pollution.

This fact sheet describes some boating sources of nonpoint pollutants and suggests ways to improve the health of our waterways while enjoying boating.

• This public environmental information flyer was prepared by the International Marina Institute, under a grant from the US Environmental Protection Agency, and authored by Neil Ross and Mark Amaral, Wickford, RI, 1993.

Nonpoint Source Pollution

Storm water runoff is the most common way pollutants get into rivers, lakes and bays. Rain and melting snow running over land wash away a variety of pollutants—some seen, some unseen. As water flows downhill it collects more and more contaminants, ultimately running into a boating water body where it can hurt animals and plants.

- **Nonpoint pollution** comes from widespread sources, including pets, lawn fertilizer, oil drops on parking lots, tossed trash, and boats.
- Some nonpoint pollutants don't need rain to get into the water, such as boat litter, dumped antifreeze spilled on ground, oily bilge water, fuel tank overflows, and non-biodegradable hull cleaners.
- Nonpoint pollution, because it is spread out, can be hard to find, but often easy to prevent and control.

Pollution poses a significant threat to our coastal bays, inland lakes, and river waterways, including:

- Increased metals and chemicals in the tissues of organisms, such as oysters, mussels, and fish, can get into humans when eaten.
- Toxic chemicals in the water column can kill or weaken fish.
- High levels of nutrients and organic material in the water can decrease dissolved oxygen, leading to foul odors, fish mortality, and/or algae blooms.
- Increased petrochemicals and antifouling paint chips, can kill organisms living in and above bottom sediments.
- High levels of sewage bacteria and pathogen indicators can result in closing shellfish beds or swimming areas.

The most effective way to control pollution is to stop it at the source.

National Boating Goal:

Cleaner Water With Nonpoint Pollution Control

All who boat, walk, work, live along the water have a responsibility to be aware of their potential harmful impacts, however slight, and need to act in ways that minimize those impacts.

What harm will this little bit from my boat do? Probably not much, by itself. But when added to the small incremental pollution from millions of people, every day, our combined impacts can be very large and can significantly degrade the environment. One boat's pollution added to hundreds of other boats crowded into the same small cove, can harm the boating environment.

Boaters can play an important role in controlling nonpoint pollution, by making simple, common sense changes to the way we go boating.

Remember:

- Every little bit does hurt.
- Every boater is part of the solution.

Boat Sanding and Painting

POTENTIAL PROBLEM:

When sanding and painting boats—often a messy job—a great deal of dust and paint can fall onto the ground or water. When the paint contains toxic chemicals that can leach out, there is potential environmental harm.

Antifouling paint, for example, is made with toxic chemicals to minimizing bottom growth during the boating season. However, concentrated amounts falling or washed into the water during and after hull bottom work can be harmful to the environment. Therefore, whenever applying or removing antifouling paint, the paint must be contained and not allowed to enter adjacent waterways.

POSSIBLE SOLUTIONS:

- Because bottom work is best done onshore, it is easy to always use a drop cloth on the ground beneath the hull to catch and then dispose of properly the dry paint sandings and wet paint drops, or
- When sanding or grinding hulls over a paved surface, vacuuming loose paint particles is the preferred way to clean up.
- Work indoors or under cover whenever wind can potentially blow paint and dust all over the ground (later to be carried off in the next rain) or directly into the water.
- Use environmentally friendly tools, like a vacuum sander and grinder, which automatically collect and store paint dust before it can get into the environment (or eyes and lungs). Some boatyards have them for rent.
- Use dedicated sanding and painting areas in marinas and yacht clubs, which are designed to minimize negative impacts—check with the facility manager.
- Remember, if it is necessary to wear a respirator to keep lungs free and clean from paint dust or sprays, then it is also important to protect the waterways from the same contamination.
- Use a marina/boatyard where the high-pressure power wash water is collected and contained, and/or filtered before entering the water.

Rule of Thumb - Keep paint particles from falling on the ground and washing into the water.

Boat Sewage

POTENTIAL PROBLEM:

Boat Sewage is a problem when dumped overboard without proper pretreatment. Although the volume of boat waste isn't as great as a typical sewage treatment plant outfall, it still contributes to the overall problem of fecal coliform loadings to the water body. Understand the problems.

- Sewage from marine heads impacts water by:
 - a. Adding extra nutrients that use dissolved oxygen and can stimulate algae growth, which in worst cases can grow so fast that it uses oxygen needed by fish and other organisms to live.
 - b. Contaminating swimmers and shellfish, if untreated waste goes overboard, potentially leading to serious health problems.
- Boaters tend to concentrate in groups, around swimming and fishing areas, thus increasing the possible number and frequency of toilet discharges.

Federal law prohibits dumping untreated sewage into all navigable waters of the US. Some states have designated 'no discharge areas' where even treated sewage cannot go into the water and only holding tanks can be used.

The only legal boat toilets for use on U.S. waters are Coast Guard-approved marine sanitation devices (MSD). There are four basic types of toilets that can be used in U.S. waterways:

- a. MSD type I and II, which treat the waste before discharging overboard,
- b. MSD type III is the common holding tank with no discharge possible and needs to use pumpout equipment,
- c. Portable toilets, which must be carried ashore to be emptied or pumped out,
- d. Incineration type toilets, which burn the waste and don't need pumping out.

The number of pumpout stations is increasing rapidly as many marina facilities are taking advantage of federal grants for that purpose made available by the Clean Vessel Act of 1990.

POSSIBLE SOLUTIONS:

- Type I and II MSDs must be maintained regularly to operate properly, including keeping the disinfectant tank full.
- MSD type III holding tanks cannot be emptied into any navigable U.S. waters. Holding tanks can only be dumped in the ocean more than three miles offshore, and the Y-valve must be sealed closed at all times when inshore. Holding tanks must be emptied into approved shoreside waste-handling facilities, called pumpout stations. Fortunately pumpouts can be fast, clean and inexpensive—use them. New NOAA navigation charts are adding pumpout sites; most states and cruising guides also list pumpout stations.
- Boats used in no-discharge waters, including most lakes and many inland waterways, cannot use MSD type I, type II or Y-valves at all.
- Boats with portable toilets must take them ashore to be emptied. Never dump them overboard. Many marinas now have special dump stations for portable toilets, which are easy to use with fast cleanup.
- Use pumpout facilities whenever possible.

Rule of Thumb - Zero discharge of all sewage into no-discharge waters; zero discharge of any untreated sewage into all other waters.

Fuel and Oil

POTENTIAL PROBLEM:

It is not infrequent to see a small fuel sheen on the water surface near docked boats. Although it may only be a tiny amount from some boats, the cumulative impacts can be damaging and quite significant. A cup of oil can produce a thin oil sheen over an acre of calm water.

Small gasoline spills, while they quickly evaporate before causing much environmental harm, can cause a safety problem.

Hydrocarbons are also a problem in the marine environment when oil changes result in improper disposal practices, such as dumping waste oil on the ground or into storm drains or dumpsters.

But small fuel and oil spills are easy to prevent.

POSSIBLE SOLUTIONS:

- Take care during fueling to prevent fuel drops from falling into the water when removing the fuel nozzle. Listen to the filler pipe to anticipate when the tank is filling to avoid splash back. Have a piece of oil absorption pad handy in case of splashes.
- When fueling have one of the crew watch that tanks are not overfilled so that fuel spills out of the air vent. Stop pumping at the first sign of fuel escape. To prevent any spill, install a fuel/air separator in the air vent line and/or an air vent whistle, but use care to prevent backsplash at the nozzle.
- Today most boating facilities have oil reception facilities for recycling; use them. If the facility or town doesn't recycle, encourage them to do so.
- Have engines properly tuned for efficient fuel consumption, clean exhaust and economy.
- Place an oil absorption pad into the bilge and below the engine to collect the drips. Keeping the engine clean makes it easy to spot and correct small leaks before they become a big problem. Some pads can be wrung out when full and reused. These may also be called 'bilge pillows'.
- Used oil filters and oil absorption pads also should be placed in a proper leak-proof collection receptacle at the boating facility.
- Don't use dispersants (soap and surfactant) on small oil spills or in bilges. This doesn't eliminate the petroleum in the environment, it just moves it from the water surface to the subsurface areas. Follow the U.S. Coast Guard rules in accordance with the local marina or town practices for responding to small oil spills.
- Remember, the law requires all boats 25 feet and more in length to have a sign posted in the engine compartment about the federal oil pollution control regulations.
- If buying a new outboard motor, consider a 4-stroke engine which will be much cleaner burning than the common 2-stroke motors, and doesn't need oil mixed into the fuel.

Rule of Thumb - Any time an oil sheen is seen coming from the boat or engine, something has gone wrong: Check the engine, tanks, and lines for leaks; tune up the motor; and use oil absorption pads—these save money and keep boating waters clean.

Antifreeze and Engine Coolants

POTENTIAL PROBLEM:

Small amounts of used antifreeze and engine coolants are toxic when entering the waterway, and can harm many marine and aquatic organisms, as well as pets and humans.

POSSIBLE SOLUTIONS:

- When a boat is to be stored during winter freezes, drain as much of the water as possible out of all waterlines, hot water tank, and sewage holding tank, to minimize or eliminate the use of antifreeze.
- Never let any coolant or antifreeze be dumped overboard or into storm drains.
- Read the container and follow the coolant and antifreeze manufacturer's recommendation for use and disposal.
- When preparing a boat or engine for freezing weather, the orange/pink colored propylene antifreeze—used to protect drinking water lines in boats and RVs—is the better environmental choice. The blue/green colored ethylene glycol is toxic and can kill any birds and animals that drink it.
- Find where recycling areas are in the area and when they can be used. If recycling facilities are not available, ask the marina operator how and where the substances should be disposed.
- Don't mix different chemicals, such as antifreeze and oil, prior to disposal, especially if they are going to be recycled,

Rule of Thumb - If coolant/antifreeze is blue or green, overboard it isn't 'clean'; if orange or pink, we're starting to think.

Washing and Cleaning Boats

PROBLEMS:

Washing the boat's topside deck and wetted hull surfaces is a common practice in marina slips. If done sensibly, harmful chemicals can be kept out of the environment. There are basically two concerns to think about.

Many cleaners contain chlorine, ammonia and phosphates, which can harm tiny plankton and fish. Often their biggest impact occurs immediately on entering the water, decreasing rapidly as dilution occurs. However eventually some of these chemicals find their way into the food chain and can build up in fish flesh which may be eaten by people.

Will the cleaning detergent kill marine and aquatic life?

Will the cleaning process mechanically scrape or chip off antifouling paint which will enter the water in concentrated amounts?

POSSIBLE SOLUTIONS:

- Wash the boat frequently with plain water only, bucket and sponge, using cleaners only on dirty spots.
- Buy and use safe, nontoxic, phosphate-free, and biodegradable cleaners for use on the deck, teak, hull and bilge; use only in small quantities as needed.
- Substitute natural cleansers for chemical-based ones, such as vinegar, lemon juice, lime juice, borax, baking soda, and liquid soaps.
- Use all chemicals carefully, according to the manufacturers instructions.
- Cleaning boat bottoms should be done ashore where the wash water and any bottom scrapings and antifouling paint particles cannot run into the waterway. Avoid hull cleaning in the launching ramp; take the boat inland away from the shoreline. Use a marina or boatyard which has a designated safe bottom cleaning area. Some areas ban in-water bottom scrubbing, so check with local authorities.
- Use hose low-volume nozzles, which shut off when released, to conserve water and reduce the runoff from boat washing.

Rule of Thumb - If the cleaner's label warns that the product is harmful to humans, then it is likely to harm marine and aquatic plants and animals, and probably should not be used around the waterway.

Plastic and Floatable Litter

POTENTIAL PROBLEM:

Floating six pack rings entangled around seabirds and plastic bags washed up on beaches are two photos common in antilitter brochures. Litter comes in all kinds, colors and sizes—bottles, plastic bags, drink cans, coffee cups, six-pack rings, disposable diapers, wrapping paper and fishing line. Cigarette butts with filters are often the most frequent type of litter found in boating waters.

Each piece of trash adds to a serious problem that can be easily prevented. Birds and fish often fatally mistake garbage for food and get tangled in plastic.

POSSIBLE SOLUTIONS:

- Don't throw any trash overboard; keep it on board until reaching port when it can be disposed of properly.
- Put cigarette butts in an ash tray, and bring them all back.
- Every waterfront facility has trash disposal areas. Many of them provide recycling bins for cans, plastics and glass—use them.
- If the marina facility doesn't recycle, bring all trash home for recycling and disposal.
- Remember, the law requires all boats 25 feet and more in length to have a sign posted and visible where garbage is stored—such as in the galley—about the federal trash disposal regulations, which are part of an international treaty called MARPOL Annex V.

Rule of Thumb - If the waste didn't come from nature, don't throw it overboard; bring it back for proper disposal.

Fish Cleaning

POTENTIAL PROBLEM:

Sport fishing is very popular, with most fish taken ashore to be cleaned, cooked, and eaten. Fish parts are absolutely biodegradable and can be eaten by other fish, birds and marine animals. But when many fish are gutted and cleaned, with the waste discarded into the same water area on the same day, especially during fishing tournaments, there can be a real disposal problem.

Too much fish waste in the same water can rot and result in lowered oxygen levels, which could lead to odor and fish kills.

No one likes to see floating fish heads drifting about for days.

POSSIBLE SOLUTIONS:

- Clean the fish as they are caught offshore, or near fishing grounds on the way back in, so the scraps are widely scattered as natural food.
- In some marina facilities, centralized fish-cleaning stations are available, with cutting tables, wash water, covered trash containers, and frequent disposal. Some even have large garbage disposals, which grind, then send the fish waste to the city sewage plant for treatment.
- Encourage marinas and clubs to create compost programs to recycle the fish parts with peat moss for gardens. This process is surprisingly fast, without odor, and makes excellent mulch.

Rule of Thumb - A few fish parts overboard make good food for fish and sea birds; a lot just floats around for days until it rots. Put fish scraps and waste in same area where the fish are caught.

Clean Water Is Everyone's Goal

We all need to be concerned about protecting our coastal areas, the habitat and wildlife. All of us are part of an ecosystem on which all of us can have profound impacts if we are careless or simply unaware. Nonpoint sources of pollution do exist, do have an impact, and can be minimized by all of us.

Clean water and clean environment are essential for good boating. Every speck and drop of pollution from boats and marinas, when added to all the bits from thousands of other sources, can really spoil boating's fun and ultimately hurt our health.

The best solution is to follow some common sense rules:

- When doing maintenance and working with chemicals, avoid spills and immediately clean up any remnants.
- Use substances that are environmentally safe, work with small amounts and dispose of waste material properly.
- Bring trash and waste, especially plastic and sewage, back to port and dispose of them using the proper containers and equipment.
- When handling fuel and other petroleum products, use care and planning to prevent any from spilling into the water.

Step One: Clean Water Starts With Each Boat

Go aboard the boat and take a careful look around. Invite boating friends, family, and marine facilities to help find ways to improve the environment. Decide what to change, and do it. Tell everyone what the boat's new clean boating rules are when they come aboard. Be a good environmental example.

Make sure all neighbors know about nonpoint source pollution and encourage them to also help keep the water clean. Remember, the problem comes from the cumulative impact of each source.

Step Two: Keep A Watchful Eye For Polluters & Speak Up

Each person doing his part to make boating more environmentally compatible must also be concerned about every other boater, marina, business, government, and individual who isn't doing their best. Speak up whenever someone is seen throwing trash overboard, or allowing bottom sandings to wash into the water, or not using their toilet correctly.

All marinas and yacht clubs should have the necessary facilities and operational practices to help control nonpoint source pollution. Encourage marina managers to implement cleaner operations and pollution control educational programs for all marina users. Help create a demand for cleaner water, recycling programs, and pumpouts. By being aware, responsible, and proactive, all boaters can help eliminate nonpoint sources of pollution.

EACH one of US is part of the SOLUTION.

• Prepared by International Marina Institute, Wickford, RI. 1993

Appendix E
Water Quality Testing Results at Demonstration Site

Water Sampling Results Avondale Boatyard Pawcatuck River Westerly, Rhode Island

This water sampling project was designed to collect data about the water quality conditions at the model marina and evaluate if the implementation of best management practices affected levels of pollution typically associated with marinas: bacteria, total suspended solids (TSS), petroleum hydrocarbons, and selected metals. However, the researchers concede that because of the limited scope of this study, it is unlikely that causal linkages between implementation of best management practices and improved water quality will be established. To collect enough adequate information on which concrete conclusions can be drawn between water quality and best management practice implementation would require a more rigorous study, extending beyond the limited frame of this sampling project.

These data, however, do increase the amount of baseline information about water quality levels within marina perimeters. To promote and facilitate future work, the analytical procedures and sampling design and strategy are described so they can be replicated. Building upon the data collected in this limited effort allows additional information and understanding to be gained about the influence marinas have on water quality.

TECHNICAL DESIGN AND STRATEGY

Target Pollutants

This sampling component of the project measured levels of: total petroleum hydrocarbons (TPH), bacteria; metals, including lead, copper, and zinc; and TSS. TPH includes: gasoline, coal tar, jet fuel, turpentine, mineral spirits, kerosene, #2 diesel fuel, #4-#6 fuel oil, bunker oil, mineral oil, compressor oil, hydraulic fluid, lubrication oil, transmission oil and creosote. The target pollutants were selected according to those pollutants that are traditionally found in marinas according to Chapter 5 of the *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*.¹

Sample Site

The selected model marina is on the Pawcatuck River Estuary, which forms the border between Rhode Island and Connecticut. This facility where the testing was done is representative of small-to-medium size marinas in Rhode Island. It stores approximately 70 vessels in the water, ranging from 20-foot ski boats to 45-foot recreational fishing boats. The facility, when fully operational, employs three people who are responsible for facility maintenance, operating the fuel dock, running the ship's store, and managing the business. The boatyard provides some general boat services to customers, such as winterization and commissioning. Some repairs are made on site, including minor engine repairs, woodworking and some fiberglass work, generally sanding and painting of boat bottoms. Sampling locations for metals, TSS, and TPH were selected based on runoff patterns of the upland portion of the marina. The field sampling supervisor has identified,

¹US EPA, 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. Government Printing Office. Washington, DC., p. 5.3.

TPH

Analysis done by GC/MS (ASTM methods D3328) using a Perkin Elmer 5971A/5890 II. Samples were extracted (particulate and soluble combined) into 3ml/l of methylene chloride to retard bacterial alteration/degradation.

Metals

Copper and zinc were analyzed in accordance with EPA method 200.7 (ICAP). Lead was analyzed in accordance with EPA method 239.2 (HGA).

Table B. Field Sampling

Analyte (Target Pollutants)	Desired Detection Limits	Sample Volume Collected	Sample Container	Method of Preservation
Fecal coliform bacteria	MPN A-1	100ml	Sterilized Poly Prop.	In darkened cooler on ice
TSS	0.1 mg/l	1 liter	Amber glass, teflon cap	In darkened cooler on ice
TPH	10.0 µl	4 liters	Amber glass, teflon cap	In darkened cooler on ice. 0.1% methylene chloride in bottle
Metals Copper Zinc Lead	2.0 µg/L 0.5 µg/L 2.0 µg/L	100 ml	Acid-cleaned polyethylene	In darkened cooler on ice. 0.1% methylene chloride in bottle

RESULTS

The samples were analyzed by independent labs that provided the results to the project manager. The data are presented in two separate tables.

Table C. Results of Fecal Coliform Determinations

Date	Site			Notes
	A	B	C	
6/25/93	95	95	70	Peak boating, pre-pumpout
7/1/93	22	49	13	Nonpeak boating, pre-pumpout
7/8/93	11	33	11	Nonpeak boating, pre-pumpout
7/18/93	33	23	33	Peak boating, pre-pumpout
9/4/93	49	49	79	Peak boating, post-pumpout
9/7/93	49	70	79	Nonpeak, post-pumpout
9/12/93	23	17	33	Peak boating, post-pumpout
9/22/93	17	46	33	Nonpeak, post-pumpout

Note: A-1 MPN procedure for fecal coliforms measured in parts/100ml

Table D shows the results from the bacteria testing within the marina perimeter. All samples were taken at the end of the flooding tide during both peak and nonpeak boating times. Peak times were assumed to be when the marina had the most activity, such as Saturday mornings as families prepared to depart from the dock. Nonpeak times were weekdays when there was little or no activity within the marina.

Table D. Results of Storm Water Runoff Measurements

Site-sample*		Unit				
		mg/L	µg/L	µg/L	µg/L	µg/L
		TSS	TPH	Copper	Lead	Zinc
9/17/93 Dry Weather	1-1	16.0	ND	ND	ND	ND
	1-2	13.0	ND	ND	ND	ND
	2-1	2.1	ND	16.2	ND	ND
	2-2	1.1	ND	7.9	ND	ND
	3-1	1.1	ND	2.3	ND	ND
	3-2	0.8	ND	2.2	ND	ND
9/22/93 Wet Weather	1-1	13.9	ND	3.0	ND	2.7
	1-2	19.2	ND	2.2	ND	2.4
	2-1	26.4	ND	19.6	1.2	6.8
	2-2	26.8	ND	26.1	0.8	6.2
	3-1	17.8	ND	2.8	ND	3.1
	3-2	9.7	ND	3.1	ND	3.2
10/26/93 Wet Weather Post BMP	1-1	24.0	ND	1.7	ND	1.7
	1-2	40.0	ND	2.1	ND	ND
	2-1	3.7	ND	55.0	0.7	6.6
	2-2	75.0	ND	49.7	0.8	7.4
	3-1	75.0	ND	1.8	ND	ND
	3-2	6.2	ND	2.7	ND	ND

ND=Not detected above reporting methods limit: for TPH ND=<2.0 µg/l; for metals ND=<2.0 µg/l.

** First number indicates the sample site, the second number indicates if it is the first or second sample taken at that site

Table E presents the information from testing results of metals, TSS, and TPH. Only three sample days were used to collect all the data. The first day was an attempt to assess background levels in dry weather. The last two days were measurements of runoff during rain events pre- and post-best management practices.

CONCLUSIONS

This study is too limited to draw broad conclusions about the impact of pollution abatement methods in marinas. Moreover, there is very little information in the literature for comparison or extrapolation. A thorough assessment of marina pollution would be a major contribution to the scientific literature and the regulatory community. Nevertheless, the data represented here give some interesting observations.

Bacteria

Background concentrations of fecal coliform bacteria are too variable, and there are too many other sources of bacteria from other marinas and sewer plant discharges to the estuary to make a clear pattern at this marina discernible. In future marina studies, it will also be difficult to separate out the impact of adopting BMPs at one facility from the cumulative impacts of all the other sources.

TSS

Total suspended solids showed higher levels during wet weather events, but generally were variable. Elevated levels of TSS may result because gravel and hard-packed sand provide the only buffer between upland areas and surface waters.

TPH

Total petroleum hydrocarbon samples were below detection limits of 2.0 µg/l throughout the study, even during wet weather. This may be due to the fact that the paving and boat storage area is topped with gravel instead of pavement.

Metals

Metals associated with wet weather conditions and surface flow across the marina into adjacent waters are clearly elevated over dry weather conditions for lead, zinc, and copper. It would appear that installation of appropriate BMPs does make a reasonable reduction in the concentration of metals flowing into adjacent coastal waters.