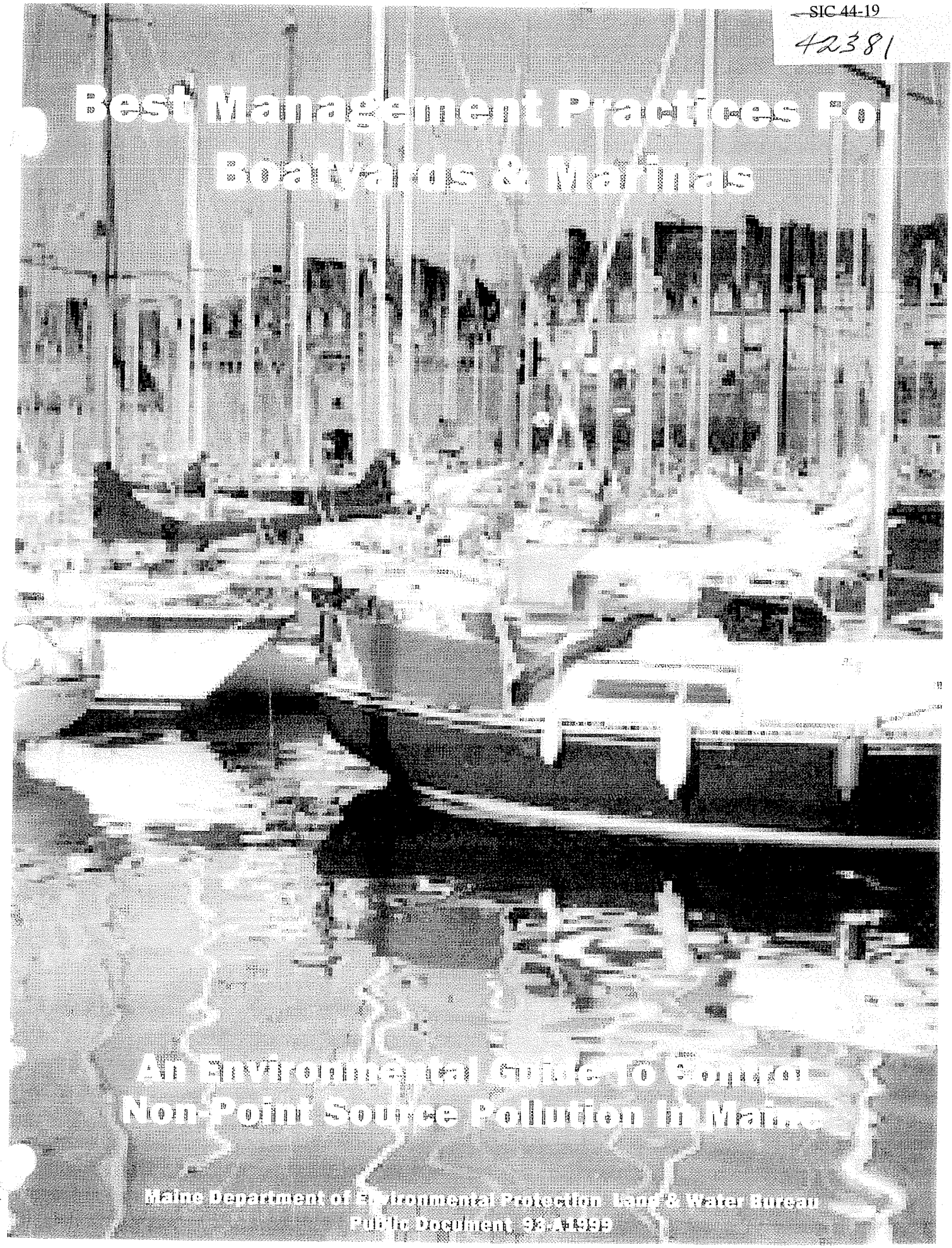
SIC 44-19

42381

Best Management Practices For Boatyards & Marinas



An Environmental Guide to Control Non-Point Source Pollution in Maine

Maine Department of Environmental Protection, Land & Water Bureau
Public Document #93-4999

Best Management Practices for Marinas and Boatyards

An Environmental Guide to Controlling Nonpoint Pollution in Maine

March, 1999

FORWARD

The BMPs described in this manual derive largely from efforts undertaken in Rhode Island. The Rhode Island project began in 1992 with a grant from the New England office of the Environmental Protection Agency, using funding from the Clean Water Act. A project advisory committee consisting of federal and state regulators, marina industry representatives, and university researchers provided important input, insights, and expertise during the project. This manual reflects the best results of their work.

This manual was originally produced in December, 1995. It has been extensively supplemented in this new version. The additional information presented here should be more complete and of greater value to boatyard and marina owners.

This edition of the manual includes:

- a new section about all applicable regulations;
- much more on stormwater management and erosion control;
- new sections on fuel, hazardous materials and wastes management, spill prevention, and all applicable operations for boat maintenance and repairs;
- a description of a pilot project to collect and treat boat bottom washwater;
- the state's water classification of Maine coastal waters; and
- much more.

Acknowledgments

Principle Author: Marianne Hubert, Senior Environmental Engineer, Maine Department of Environmental Protection
Principle Editor: Alison Truesdale; LandForms, Brunswick, Maine
Assistant Editor: Brooke Wilkerson; Alna, Maine
Graphics: Brian Kent, Kent Associates, Gardiner, Maine

The best management practices presented in this manual are meant to guide the marina or boatyard operator in meeting or exceeding their regulatory responsibilities, but are not a substitute for existing regulations. Any questions about specific regulations and compliance responsibilities should be directed to the Department of Environmental Protection, 17 State House Station, Augusta, ME 04333 (207-287-2651).

DEP is continually gathering information on new BMPs, so this manual is a "work in progress". Your input is welcome. If you have information that you think should be included in this document, if you can suggest corrections, or if you need additional information, please contact Marianne Hubert at the Maine Department of Environmental Protection at 287-4140.

TABLE OF CONTENTS

1. INTRODUCTION

NONPOINT SOURCE POLLUTION IN MAINE

This manual is intended to help people who work in marinas and boatyards to reduce water pollution resulting from their activities. The practices and tips described in this manual are designed to protect Maine surface water and to sustain the natural ecology of lake and coastal waters ecosystems.

"Nonpoint source pollution" (NPS), is caused by rainfall or snow melt moving over and through the ground and carrying natural and man-made pollutants into lakes, rivers, streams, wetlands, estuaries, other coastal waters and ground waters.

Pollution from surface runoff and other diffuse sources, known as "nonpoint source pollution" (NPS), is caused by rainfall or snow melt moving over and through the ground and carrying natural and man-made pollutants into lakes, rivers, streams, wetlands, estuaries, other coastal waters and ground waters. Pollution from discrete sources such as oil, hazardous materials, or detergents from faulty septic systems or boat toilets can also be considered nonpoint source pollution. Many contaminants, such as bacteria and viruses, nutrients, suspended solids, petroleum products, and other toxins are introduced into the aquatic environment from either polluted runoff or accidents. Studies show that these contaminants have significant effects on water quality and can affect seafood harvests and recreational activities, such as boating and swimming. Pollution can also depress the local economy if tourism, recreational boating, and fishing industries decline.

POLLUTION MANAGEMENT AT MARINAS AND BOATYARDS

Marinas and boatyards are usually located on or adjacent to coastal waters, lakes, and rivers, and their activities can contribute significant pollution to waterbodies. For example, marina construction may alter the type of aquatic and upland habitat on and adjacent to the site. Fueling, maintenance operations, scraping and painting, the improper discharge of boat toilet contents, and other common activities can discharge pollutants that affect water quality.

The most effective way to reduce polluted runoff is by pollution management practices and controls (called Best Management Practices or BMPs). This manual describes many of these techniques and is intended to help marina and boatyard operators identify which pollution control practices work best for their site. When applied correctly and appropriately, these BMPs should also help the boating facility conform with state and federal laws protecting water quality. Although the BMPs included in this document are based on a wide range of 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. Therefore, marina and boatyards managers are encouraged to apply their expertise and skill to develop technically sound management practices that are as capable of minimizing or eliminating nonpoint sources of pollution as do the Best Management Practices (BMPs) presented in this document.

Throughout this document, the term boating facilities or "marinas" will be used to refer to marinas, yacht clubs, and boatyards. A boating facility includes any dock, pier, wharf, float, floating business, or combination of such facilities that serve five or more recreational boats as a commercial enterprise or in

association with a club. The types of marina and boat yard operations that this manual applies to include:

- Recreational boat docking facilities;
- Commercial boat docking facilities;
- Boat storage facilities; and
- Boat building and maintenance facilities.

Any questions about specific regulations, compliance responsibilities, or the implementation of BMPs should be directed to the nearest DEP office.

2. POLLUTION IMPACTS FROM MARINAS AND BOATYARDS

Pollution impacts from marinas and boatyards depend on the types of activities that occur at the site and the way those activities are performed. Hull and engine maintenance and repair, fueling, and handling of sewage and solid waste can all harm the aquatic environment if mismanaged. Persistent toxic pollutants can create significant long-term environmental problems. Other less persistent pollutants can have immediate and severe impacts, but the damage to the environment can be eliminated once the pollutant is no longer discharged.

PERSISTENT TOXIC POLLUTANTS

The two groups of toxic pollutants that accumulate in the sediments near marinas and boatyards are organic chemicals and heavy metals. Some organic chemicals occur naturally, but several hundred thousand have been developed for use in oils, paints, pesticides, cleaners, solvents, and other products. The organic compounds most commonly associated with activities at marinas and boatyards are hydrocarbons, solvents, and tributyltin (TBT). Hydrocarbons include persistent polynuclear (cyclic) aromatic hydrocarbons (PAHs) and are primarily found in oil, gasoline and exhaust from burning fuel. Components of gasoline, diesel fuel and kerosene, andsolvents can be less persistent and acutely toxic. TBT is a persistent chemical that was commonly used in antifouling paints on boats prior 1987 when it became regulated because of its toxicity to aquatic organisms. TBT is still in the sediments near many marinas and boatyards. Persistent organic chemicals eventually become harmless, but this process takes years or decades; during the interim, they can remain toxic.

Heavy metals are persistent elements such as lead, mercury, copper, nickel, cadmium, zinc, chromium, and arsenic. These metals are in paint particles, metal shavings, engine oils, bilge water, and runoff from maintenance and repair areas. Metals, such as chromated copper arsenate (CCA), are in wood preservatives commonly used in dock and pier construction. Metals generally do not break down into less harmful chemicals and tend to accumulate where they are released into the environment.

A number of studies have documented elevated levels of toxic contaminants in Maine's marine sediments. These accumulation levels are primarily attributed to human activity, including the operation of boatyards and marinas. Tests of sediment near wharves and docks show that PAHs and heavy metals frequently accumulate at elevated concentrations. TBT is elevated in the sediments of Casco Bay in areas around docks, anchorages, and boatyards.

Toxicity

The toxicity of chemicals depends on how they are structured, how much is present, and how readily they can be absorbed and accumulated in the tissues of living organisms. Mercury, for example, is relatively nontoxic in some forms, but highly toxic in other forms. While essential for a healthy diet in low concentrations, copper, nickel, and zinc can be lethal to humans and other animals in high doses.

In water, some toxic contaminants, such as gasoline, float to the surface where the young of many animals live during their most sensitive life stages. Others adhere to sediments and settle to the bottom where they can impact the aquatic environment. The highest levels of toxic pollutants usually accumulate in areas where sediments are deposited.

Hydrocarbons can be either harmful or benign. Some are not known to cause problems, while others may be toxic to aquatic organisms at very low concentrations. Many PAHs accumulate in tissues and can cause cancer, mutations and birth defects.

The use of TBT, an additive in paint, became popular because it keeps boat hulls relatively free of fouling organisms and does not harm aluminum hulls. Even in very low concentrations, TBT can accumulate in tissues or be lethal to plants and animals. Some molluscs are particularly sensitive. Federal and Maine laws prohibit the use or sale of antifouling paint containing TBT in most situations.

Impacts from Persistent Toxic Pollutants

Persistent toxic pollutants have the potential to have a negative long-term impact on the aquatic environment. Toxic chemicals can also combine to produce a synergistic or "cocktail effect" that is more harmful than exposure to a single substance. Organisms vary widely in their uptake and retention of toxic contaminants. Some species exhibit reproductive, birth and developmental problems, organ damage or harmful impacts on the nervous, immune and endocrine systems, while other species seem to have no response.

Toxic contaminants are of particular concern because of the potential for bioaccumulation, bioconcentration and biomagnification in aquatic organisms.

- Bioaccumulation is the uptake and retention of pollutants from the environment by organisms.

- Bioconcentration is the uptake and retention of pollutants directly from the water through tissues such as the gills, gut, or organ walls.

- Biomagnification is the process whereby pollutants are passed from one animal to another resulting in higher levels of pollutants in organisms further up the food chain (e.g., birds, whales, and humans).

Bottom-Dwelling Animals

Contaminants collect in sediments, so bottom-dwelling animals that live in mud habitats tend to accumulate pollutants. These bottom-dwelling (or benthic) animals play an important role as a source of food for larger animals such as fish, birds, and lobsters and crayfish. Many benthic animals feed by passing mud through their guts and extracting food. The toxic chemicals in the mud may accumulate in their tissues. When larger animals feed on them, the chemicals may then accumulate in their tissues, and the pattern is repeated all the way up the food chain.

While thorough studies of toxic impacts on benthic life in Maine waters have not been undertaken, there is some evidence of damage in the polluted areas of Casco Bay. Animals that would be expected to live in this area are missing or impaired, potentially due to oil-related contaminants, heavy metals, combined sewer overflow discharges, sedimentary disturbances, or a combination of factors. In bottom samples taken in 1989, some hardy worms were present in much smaller numbers than expected, and mollusks, crustaceans, and other species were absent. Some of the worms collected had oil on their "feet" (parapodia), probably due to petroleum-related contaminants.

Fisheries and Recreational Fishing

Elevated levels of toxic contaminants in fish and crustaceans can inhibit growth and reproduction, disrupt the life processes of the young, change sex ratios, cause cancer or problems with the endocrine system, or even result in death. Toxic contaminants can inhibit natural immunities, making animals more susceptible to disease and attack by microorganisms. Fin rot in fish and shell degradation in lobsters are examples of this type of disease.

The livers of flounder caught near the Kennebec River in 1984 were found to have elevated levels of lead, copper, zinc, and PCBs. Experiments have shown that flounder are prone to develop tumors after eating worms contaminated by PAHs, and the presence of contaminants in their bodies causes them to generate additional toxic byproducts which further stimulate tumor growth.

Wildlife

Mammals and birds that feed on bottom-dwelling organisms or fish may absorb concentrated amounts of contaminants. Many of the tidal mudflats along Maine's coast are important feeding areas for shorebirds, waterfowl, and wading birds. If the animals that they feed on in these flats are contaminated, the bird population may become impacted.

Human Health

When toxic contaminants pose an unacceptable health risk, the state toxicologist issues a consumption advisory. However, because testing has been limited, the absence of an advisory does not mean there is no problem. There are now health advisories which suggest people limit their consumption of lobster tomalley, striped bass, bluefish and freshwater fish because unhealthy levels of toxic pollutants have been documented in these animals.

Economic Effects

Testing of sediment near wharves and docks prior to dredging has shown that PAHs, lead, mercury, nickel, copper and other heavy metals frequently accumulate at elevated levels. The economic consequences of allowing these sediments to become contaminated are great. If the sediments have to be dredged and do not pass the toxicity tests required by state and federal agencies, they cannot be disposed of at sea, and disposing of them on land costs about ten times as much.

Another economic cost of toxic contamination is the potential impact on the viability of fishery stocks and the marketability of seafood. Maine fisheries depend on quality products and healthy populations of fish, lobsters and

shellfish. If toxic pollutants impact growth and reproductive success, the productivity of the already struggling fisheries may be harmed. Also, seafood dealers stop buying fish or shellfish if they become aware of any potential health problems. In lakes and ponds, toxic contamination can impact fish stocks and the food quality of the recreational fishery.

Sources

Toxic pollutants wash into harbors and bays from marinas or boatyards when it rains, during snowmelt, or during boat cleaning activities. Pollutants also are introduced directly into the water from activities such as fueling and running boat engines.

Heavy metals in Maine's aquatic environment are the result of contemporary or historical discharges from vehicles and industry, leaching from rocks and minerals, deposition from polluted air, as well as from activities at marinas and boatyards. Antifouling paints are designed to be toxic to aquatic organisms and are a source of heavy metals. Various maintenance and repair activities may also add these contaminants to the aquatic environment.

PAHs and other hydrocarbons in Maine's waters come from drippings and debris from vehicles and their exhausts; smoke from industries and residences; stormwater discharges; old industrial sites and dumps; air pollutants from the eastern seaboard and the midwest; and businesses that use and handle oil, including marinas and boatyards. During fueling, hydrocarbons in dripping gasoline or diesel fuel may be discharged into the water, onto the dock, or onto adjacent land areas. Accidental spills result in the discharge of hydrocarbons directly to the water or indirectly through surface runoff or from groundwater. Roughly 70 spills, averaging 20 gallons each, are reported each year in Maine. Drippings and drainage from boat engine maintenance and repair activities, or simply from running boat engines, may contain fuels, oil, or other oil-based lubricants. If not properly contained, these substances may enter the water directly or be transported by surface runoff or groundwater seepage. Finally, runoff from parking areas, boat ramps, and other impervious areas may contribute hydrocarbons to the aquatic environment.

OTHER POLLUTANTS ASSOCIATED WITH MARINAS AND BOATYARDS

Less persistent pollutants may have immediate and potentially severe impacts on the aquatic environment, but the damage to the environment can be eliminated once the pollutant discharge has ceased. These pollutants include:

Solvents: Solvents are used in engine maintenance and repair, boat painting, and cleaning. Solvents such as tetrachloroethylene, tetrachloroethane, trichloroethylene, trichloroethane, and methylene chloride are used as degreasing agents and in varnishes, paint removers, and lacquers. 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 aquatic environment via surface runoff or groundwater transport. Antifreeze is occasionally dumped directly into lakes and coastal waters, particularly in the spring when boats are launched after winter storage.

Acids/Alkalis: The primary sources of acids and alkalis from marinas are batteries and compounds used for cleaning boats. Battery acid is extremely corrosive and often contains high concentrations of heavy metals (e.g., lead). Spilled battery acid may be transported to the aquatic environment via surface runoff or groundwater transport. Cleaning compounds and detergents often contain strong acids or lye. These acids and alkalis may enter surface waters via direct discharge if cleaning takes place over the water, or via surface runoff or groundwater transport from upland work areas. Acids may make heavy metals and other toxics soluble, impacting aquatic organisms. In a localized area, acids may also lower the pH of water, particularly fresh water, harming or killing aquatic life.

Sediments: Sediments may enter the aquatic environment during construction, boat scraping and sanding, and by stormwater runoff. Operating boats in shallow waters can scour the bottom and resuspend bottom sediment, as well as cut off or uproot aquatic plants. Sediments are also stirred up during dredging operations. Sediments may affect the aquatic environment by: 1) smothering bottom-dwelling plants and animals; 2) increasing turbidity, which may reduce the amount of available light that plants and phytoplankton need to grow, as well as affect the ability of animals to find food; 3) clogging fish gills; 4) increasing sediment oxygen demand, resulting in the depletion of dissolved oxygen and 5) attaching to contaminants, such as heavy metals and hydrocarbons.

Chlorine and formaldehyde: Chlorine and formaldehyde are used to sanitize human wastes from boats. These chemicals can be very toxic to aquatic organisms and can greatly impact plants and animals that are directly exposed. Chlorine and formaldehyde are relatively non-persistent in the environment and do not accumulate in sediments. Some species of spawning fish, such as salmon, trout, shad, and alewives, can detect toxic pollutants such as chlorine and avoid contaminated rivers, but this rerouting can disrupt their migration.

Surfactants: Surfactants are present in most detergents and other cleaning agents and occur in a wide variety of chemical formulations of both natural and synthetic origin. Some surfactants, such as alkyl benzene sulfonate (ABS), may be acutely toxic to aquatic organisms. In aquatic environments, surfactants may form a surface film and reduce oxygen transfer at the water surface. 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. Surfactants and detergents may also cause foam on the waters, which is aesthetically displeasing.

Nutrients: Nutrients, particularly nitrogen and phosphorus, are essential to aquatic plant growth. However, in elevated concentrations, they stimulate nuisance plant growth either in the form of algae blooms, or excessive growth of weed-like aquatic plants. When this excessive plant growth dies and decays,

dissolved oxygen concentrations may become depleted and kill fish and other aquatic animals. Algae blooms can reduce light penetration and harm beneficial aquatic plants such as eelgrass. Also, excessive growth of tiny plants attached to the blades of aquatic plants can harm the growth of the larger plant. Weed-like plants tend to out-compete the normal aquatic plants and may smother animals. In marine waters, excess nitrogen tends to stimulate nuisance plant growth; in freshwater, phosphorus tends to be the nutrient that stimulates growth.

Marina and boatyard activities that may add excessive nutrients to the aquatic environment include sanitary wastewater disposal, dredging, fertilizing lawns, soil disturbance, and boat cleaning with compounds that contain nutrients.

Pathogens: The principal source of pathogens, such as bacteria and viruses, is sanitary wastewater disposal. Discharge of untreated sanitary wastes from boats is prohibited in Maine's inland waters and in marine waters within three miles of the coast. However, illegal discharges by boaters do occur. Malfunctioning onshore septic or overboard treatment systems, spills from sanitary pumpout facilities, partially treated sanitary discharges, pet waste, and stormwater runoff are all sources of pathogens. Whatever the source, these pollutants can cause clamflat and swimming area closures and disease or infection in people who come in contact with water.

Floatables/Plastics: The primary sources of floatable and plastic materials in the water are from marina or boatyard construction and solid wastes generated at the site. Most waste found in aquatic environments has been discarded directly into the water, although some is blown in or washed in during storms. Besides making waters and beaches unattractive, animals may become entangled in the debris or mistake bits of plastic for food.

Reducing Toxic Pollution

Steps that have already been taken to reduce the amount of contamination entering Maine's waters include:

- stricter requirements for industrial and municipal discharge permits and pre-treatment programs;
- the reduction of combined sewer overflows;
- better oil-spill prevention and response;
- the cleanup of many hazardous waste sites;
- the discontinued use of shore-side dumps;
- the elimination of leaded gasoline;
- increased awareness among citizens and boaters regarding safe disposal of toxic materials;
- collection programs for household hazardous wastes; and
- the use of best management practices in road construction, development, farming, forestry, and marinas, and boatyards.

To continue reducing levels of pollution in Maine waters, more attention must now be focused on nonpoint sources of pollution such as marinas and boatyards. The following chapters describe the things that marina and boatyard operators can do to protect the resource they depend on. Once these measures are taken, pollution levels will be reduced and the ecosystem will eventually cleanse itself:

persistent pollutants will be diluted when covered and mixed with new, cleaner sediments and some will break down chemically. But the ecosystem cannot recover without a concerted effort on the part of all who enjoy and use Maine's waters to stop the small but numerous discharges of pollution.

3. EROSION AND SEDIMENTATION CONTROL BMPS

We are all familiar with at least some chronic erosion problems that are made worse by a high spring water table or a swift moving summer thunder shower. Usually considered little more than an inconvenience, these type of problems have a cumulative effect that, over the years, can have significant environmental impacts, such as loss of aquatic habitat and the accumulation of sediments, resulting in the loss of water depth. Of course, the cost of correcting these problems is more than inconvenient.

In years past, the main concern was getting surface runoff off a site safely. But with our increasing knowledge of the effects of nonpoint source pollution, the problem has become more complicated. Sediment in runoff contains high concentrations of phosphorous, which in lake systems can result in obnoxious algae blooms and loss of cold water fisheries habitat. In estuaries and ocean environments, other pollutants that can be associated with sediment — like bacteria, nitrogen and heavy metals — can close shellfish areas and harm delicate aquatic habitat.

This chapter covers many Best Management Practices (BMPs) that will help control the release of sediment to the aquatic environment and prevent pollution associated with erosion and sedimentation. ***Erosion*** is the loss of soil particles from the ground surface through a force working on the soil's surface, such as wind, water or heavy use. ***Sedimentation*** is the deposition of soil particles onto the soil surface. Erosion control BMPs help to hold the soil particles in place, whereas sedimentation control BMPs are used to filter or settle out soil particles that are already suspended in the water.

There are many erosion and sedimentation control BMPs, and they are covered in full detail in *Maine Erosion Control Handbook for Construction: Best Management Practices*, available from the DEP. Many of the basic erosion control BMPs, the ones that you should expect to encounter frequently, are covered in lesser detail in this manual. To select the appropriate BMPs, marina operators need to consider their site-specific activities, site layout, and the potential pollution sources.

MULCHING BMPS

Mulch holds down soil particles and prevents them from being washed away by rainfall. There are two types of mulch: temporary and permanent.

Temporary mulch, like hay or straw, is used to help in the establishment of vegetation or to cover bare soil during construction when it is expected that the area will be re-disturbed. ***Permanent mulch*** is used in place of vegetation on bare soil. Examples of permanent mulch include wood chip landscaping around bushes and shrubs where grass will be heavily shaded, or crushed stone on areas that are heavily traveled so that grasses cannot grow.

Temporary Mulch

Areas which have been temporarily or permanently seeded should be mulched immediately following seeding. Areas which cannot be seeded within the

growing season should be mulched to provide temporary protection to the soil surface. Mulches are applied to the soil surface to protect the soil and to promote plant growth. A surface mulch is the most effective and quickest means of controlling runoff and erosion on disturbed land. Mulches can regulate the infiltration rate of the soil, conserve soil moisture, prevent soil compaction, modify soil temperatures, and provide a suitable micro-climate for seed germination. **Always mulch new seeding.**

If mulch isn't anchored properly, the soil and seed will wash away. To hold the mulch down, stake biodegradable netting or twine over it, or work the mulch into the soil with a shovel or roller.

Mulch anchoring should be used on slopes greater than 5%, on concentrated flow areas such as diversions and waterway channels, in late fall (past September 15), and over-winter (September 15 - April 15). In sensitive areas (within l00 feet of water resources), temporary mulch must be applied within 7 days or prior to any storm event.

KINDS OF MULCH

Organic Mulches: Organic mulches include hay, straw, shredded corn stalks, wood chips, bark or shavings, sawdust, wood, erosion control mats and wood fiber. The most common mulching material used is hay or straw. Apply mulch hay or straw at a rate of 2 bales per 1,000 square feet. Wet the mulch down with water to hold it in place in flat areas.

Chemical Mulches and Soil Binders: A wide range of synthetic spray-on materials are marketed to protect the soil surface. These are emulsions which are mixed with water and applied to the soil. They may be used alone, but most often are used to hold wood fiber, hydromulches or straw to the soil surface. Apply according to the manufacturer's instructions.

Mats: Mats are manufactured combinations of mulch and netting designed to retain soil moisture, modify soil temperature, and act as a mulch anchor. The most critical aspect of installing mats is obtaining firm continuous contact between the mat and the soil. Install mats in accordance with the manufacturer's recommendations.

Maintenance: All mulches must be inspected periodically, particularly after rainstorms, to check for erosion. If less than 90% of the soil surface is covered by mulch, additional mulch should be applied immediately. Nets must be inspected after rainstorms for dislocation or failure. If the netting is washed out or broken, re-install the net as necessary after repairing any damage to the slope.

Permanent Mulch

Permanent mulch is used in areas where the soil is exposed and vegetation is difficult to establish. This includes high traffic areas around landscaping, paths and walkways that are not paved, and areas that are covered by decking. Permanent mulch reduces runoff and erosion, prevents soil compaction, conserves moisture, helps to establish plant cover, and controls weeds on any area prone to erosion.

Apply plant residues or other suitable materials that resist decomposition (such as wood chips or crushed stone) to the soil surface where it is either impractical or difficult to grow and stabilize vegetation. Wood chips or aggregates should be used on slopes no steeper than 3 to 1 (3 feet horizontally to 1 vertical foot). Regardless of the type of permanent mulch used, it should be applied three or more inches deep in order to adequately control weeds.

KINDS OF MULCH

Wood Chips – Wood chips should be applied at a rate of 500-900 pounds per 1,000 square feet or 10-20 tons per acre. Wood chips should be green or air-dried and free of objectionable coarse materials.

Gravel and Stone – Aggregate cover gravel, crushed stone, or slag should be washed. A ¼ inch to 2½ inch size aggregate should be used at a rate of 9 cubic yards per 1,000 square feet. A plastic filter cloth may be placed between the ground and the stone to prevent the germination of weed seeds or other undesirable vegetation.

Industrial By-Products (Residuals) – Due to the recycling efforts of the state of Maine, an assortment of low cost, environmentally safe industrial by-products are now available. Many of these recycled materials are made from bark and wood waste from the paper making process. This material has performed well in high traffic areas, on steep slopes, and even in areas where runoff flows are expected.

VEGETATIVE COVER

Vegetation holds soil in place and will maintain itself once established. Seeding is used to permanently stabilize the soil, to reduce damage from sediment and runoff, and to enhance the environment. Wherever possible, replanting with native woody species is the best measure. In some cases, where an open area is desirable, lawn or "meadow" grasses may be appropriate.

When seeding a permanent ground cover, use nutrients and pesticides sparingly in order to protect surface and ground water quality. You should also be aware that late fall seeding may fail.

Woody Vegetative Covers

An area can be allowed to revert to or be planted in woody vegetation. Whether as landscaping or as a vegetated buffer, woody vegetative covers confer definite benefits to water quality. Trees, shrubs and brush intercept rainfall before it hits the ground, significantly reducing the chance of erosion. They also absorb more rainfall than lawns, which results in less runoff. In addition, once the trees are established a duff/organic layer is formed from leaf litter, which absorbs and traps many kinds of pollutants associated with stormwater runoff.

The soil between trees and shrubs must be planted with cover vegetation or must be mulched. When establishing ground covers, it is not desirable to plant species that will compete with the ground cover or will make maintenance difficult. A thick durable mulch such as shredded bark or wood chips is recommended to prevent erosion and reduce weed problems.

On slopes where erosion may be a problem, jute netting or erosion control mats may be installed prior to planting, and plants may be tucked into the soil through slits in the netting. Such plants should be put in a staggered pattern to minimize erosion.

SEDIMENT BARRIERS

Sediment barriers are filter fabric fences or lines of hay bales installed to intercept runoff from areas of bare soil. The barrier allows runoff to pass through while trapping the sediment carried by the runoff. They are properly used only for trapping sediment from small disturbed areas having no obvious swales or channels. They must not be installed across ditches, swales, brooks, or streams where concentrated flows will erode the soil around them or collapse them. Do not attempt to use sediment barriers to trap sediment from a large, disturbed area. They work only if you use them within the following limits:

the drainage area behind the barrier is no more than ¼ acre per 100 feet of barrier,
the maximum length of slope behind the barrier is no more than 100 feet, and
the maximum grade behind the barrier is no more than 50% (one 1 foot vertical rise for every 2 horizontal feet).

How to Construct a Sediment Barrier

Construct sediment barriers with either hay bales or synthetic filter fabric (silt fencing). Hay-bale barriers are generally cheaper and easier to install than silt fences. Silt fences, however, generally last longer and trap more sediment than hay-bale barriers.

No matter which type of barrier you use, install it along a slope contour (i.e., straight across the slope so that the barrier is at the same elevation from one end to the other). Otherwise, water will run against the uphill side of the barrier and discharge at its lower end. It is also useful to flair the ends of the barriers slightly uphill to help prevent this problem.

SILT FENCES

Construct a silt fence of standard-strength or extra-strength synthetic fabric following the procedure shown in Figure 1. The fabric rnust be stapled or wired to the uphill side of the posts and entrenched into the ground. You can avoid having to use a wire backing fence if you use extra-strength fabric and the spacing between support posts is six feet or less. In no case should the post spacing exceed 10 feet or the fence height exceed 3 feet.

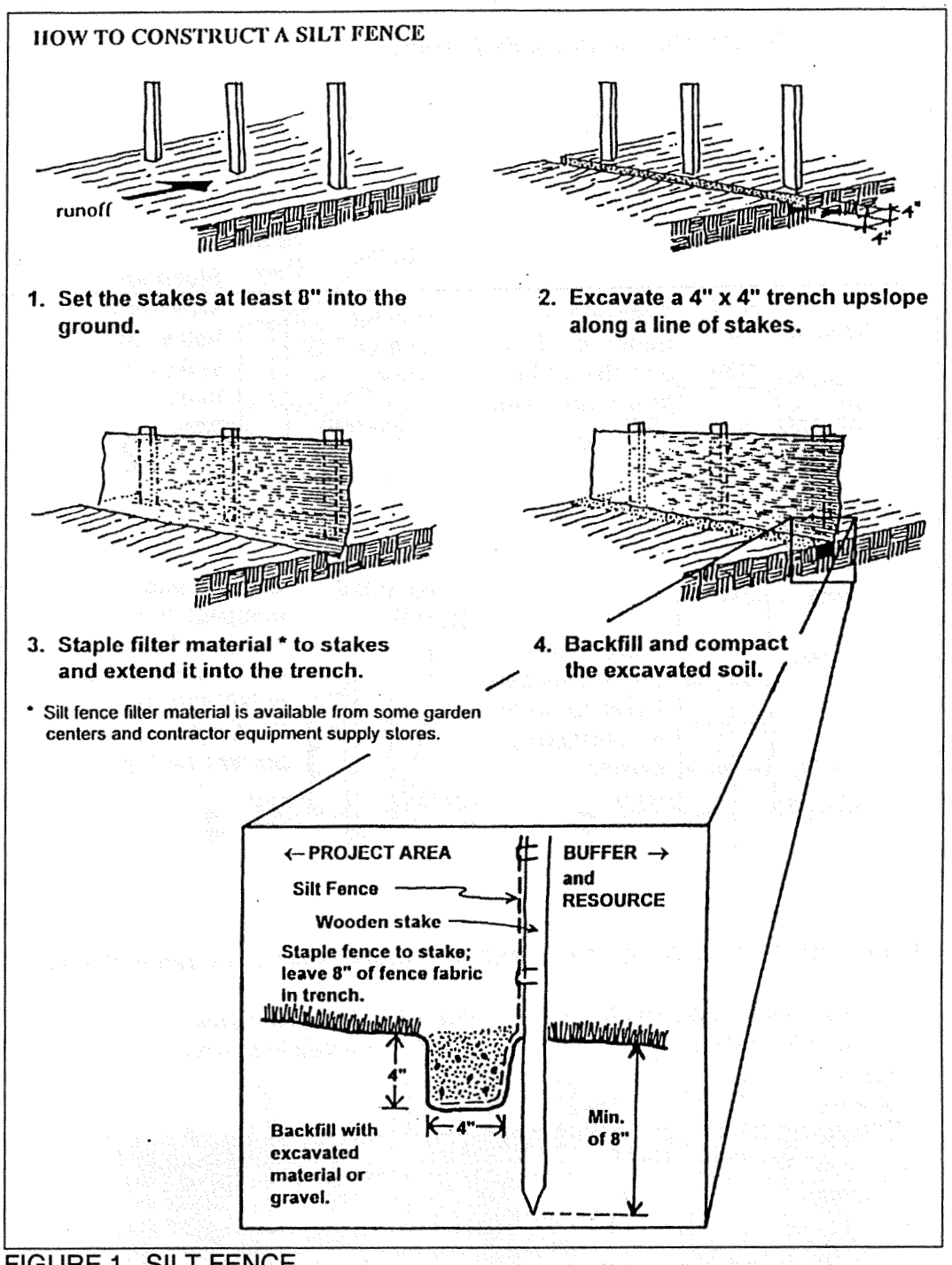


FIGURE 1. SILT FENCE

HAY BALES

Construct a hay-bale sediment barrier with wire-bound or twine-bound bales of hay following the procedure shown in Figure 2. The bales must be entrenched in the ground. Anchor each bale with at least two stakes driven through the bale. Drive the first stake in each bale toward the previously anchored bale so that the two bales are forced together. Loose hay can be used to fill any gaps between the bales.

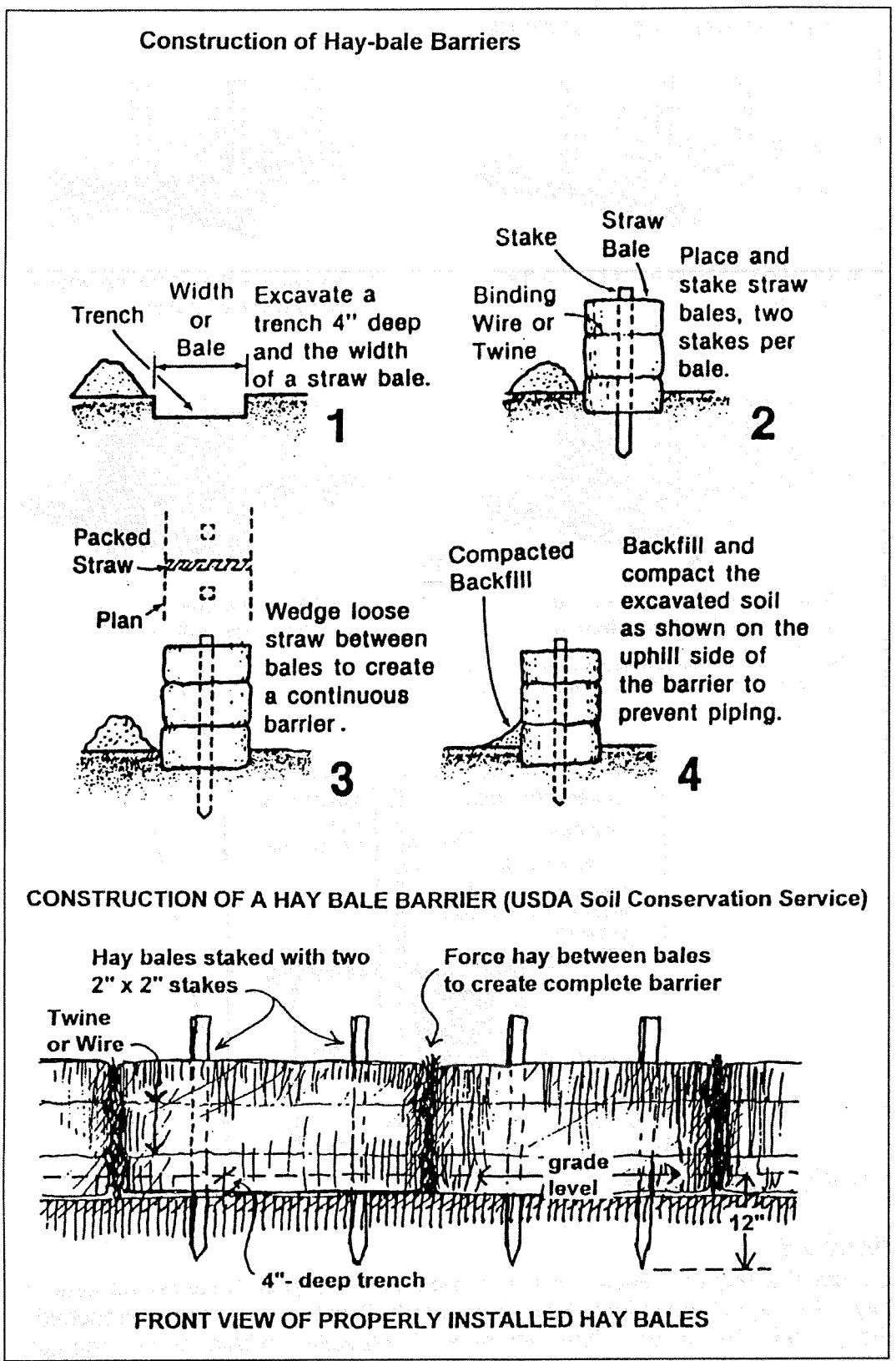


FIGURE 2. HAY-BALE BARRIER

Maintaining Sediment Barriers

Inspect the sediment barriers after each rainfall to ensure that water is not undermining the barrier or running around it. Make any needed repairs immediately.

If possible, remove accumulated sediment behind the barriers after each storm.

Remove the sediment barrier when the drainage area behind it has been stabilized. Grade, seed, and mulch any sediment deposits remaining in place after the sediment barrier is removed.

CHECK DAMS

Check dams are small dams constructed across a ditch or swale. They reduce the velocity of flowing water and so reduce soil erosion. Check dams also trap small amounts of sediment behind them; however, they are not a good sediment trapping device and should not be relied on to trap sediment from a severely eroding ditch. They are appropriately used in small ditches or swales which drain 10 acres or less. They must not be used in a natural stream or brook. Specific places in which to install them include the following locations:

temporary ditches or swales which cannot receive a mesh lining but still need protection;

permanent ditches or swales which need protection during the establishment of grass linings; and/or

permanent ditches or swales which cannot be permanently stabilized for an extended period of time.

Constructing Check Dams

Construct check dams from 2- to 3-inch stone. The height of the dam should not exceed 2 feet. The maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center of each check dam must be at least 6 inches lower than its outer edges to deter erosion.

Maintaining Check Dams

Inspect the dams frequently to ensure that the center of the dam is lower than its edges. Erosion caused by high flows around the edges of the dam should be repaired immediately. While check dams are not intended to be used for trapping sediment, some sediment will accumulate behind them. Remove the accumulated sediment before it reaches half the original height of the dam.

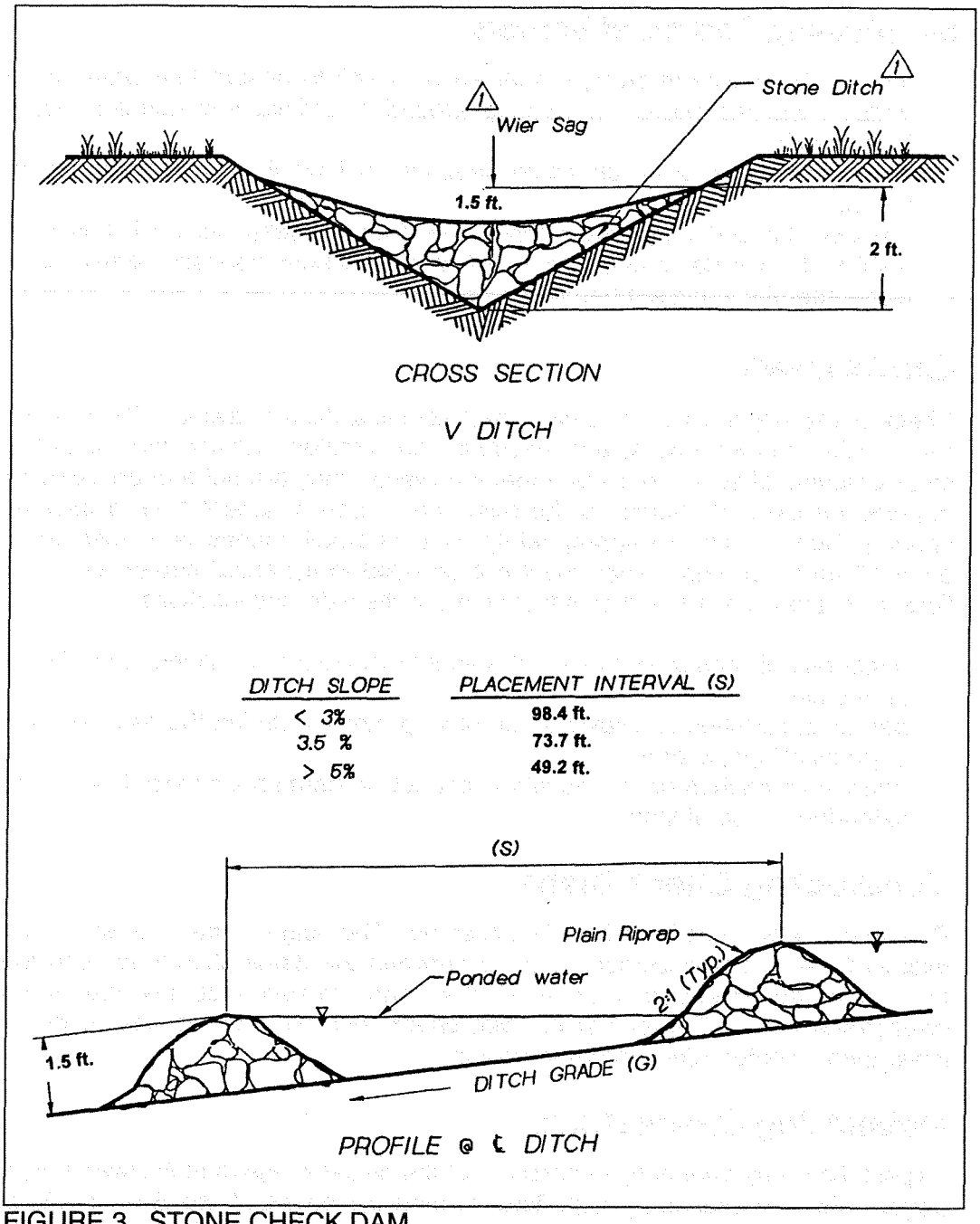


FIGURE 3. STONE CHECK DAM

Removing Check Dams

Check dams are a temporary measure for controlling erosion and must be removed when no longer needed. Remove the check dams once the ditch is stabilized with vegetation or riprap. In the case of a grass-lined ditch, check dams should be removed when the grass has matured sufficiently to protect the ditch. The areas beneath the check dams should be seeded and mulched immediately after the check dams are removed.

DITCH LININGS

Permanent ditch linings are rock or vegetative ground covers used to keep ditches from eroding. The linings protect the soil by binding the soil together and providing an erosion-resistant surface against which the water can flow. Lining a natural stream or brook will require a permit from the Maine Department of Environmental Protection and Army Corps of Engineers.

Should the Lining be Stone or Vegetation?
All linings should be designed or approved by a professional engineer or resource protection agency prior to installation. Large flows, groundwater seepage, and soil conditions can make selection and design of a permanent lining difficult. In general, use a riprap lining instead of a vegetative lining when the following conditions exist:

the water velocity in the ditch is so great that vegetated linings would fail;
steep grades, wetness, prolonged base flow, seepage, or piping would cause erosion of vegetated soils;
people, animals, or vehicles traveling through or across the ditch prevent the establishment of vegetation;
soils are so highly erodable that vegetation cannot become established; or
the lining must be installed after the growing season.

Stone Lining

Stone linings are stone ground covers (riprap) used to line the bottom and side slopes of constructed ditches. Keep the following facts in mind when planning the installation of a riprap lining:

Use a well-graded mix of durable stone for the lining.

The stone must be underlain by a filter fabric or a gravel bed to prevent soil loss.

Remove all trees, stumps, brush, stones, and other debris that will interfere with the placement of riprap in the ditch.

If possible, compact the surface soils on the ditch bottom and side slopes.

Place the stone in the ditch using a tractor loader or wheelbarrow. Dumping the stone from a truck will only puncture the filter fabric or tear it away from the side slopes. Major grading of the stone can usually be done with a backhoe. Final grading, however, usually requires hand placement of stones to fill in voids, completely cover any filter fabric, and create a uniform surface.

Maintaining Ditch Linings

VEGETATIVE LININGS

A maintenance program should be established to maintain the ditch's capacity and vegetative cover. The need for periodic liming and fertilizing should be based on soil tests or visual observation. Mow the waterway at least once

annually. When practical, delay mowing until after July 15 to accommodate ground nesting wildlife. Mow to a height of 4 to 6 inches to help maintain good surface protection. Do not mow later than 30 days prior to the first anticipated killing frost.

STONE LINING

A maintenance program should be established to maintain ditch capacity and lining integrity. Check the ditch in late spring and fall for slumps and fallen stones. Repair any slumps immediately. Replace stones on areas where the filter fabric is showing through the rocks. Remove any woody vegetation that attempts to grow up through the stones.

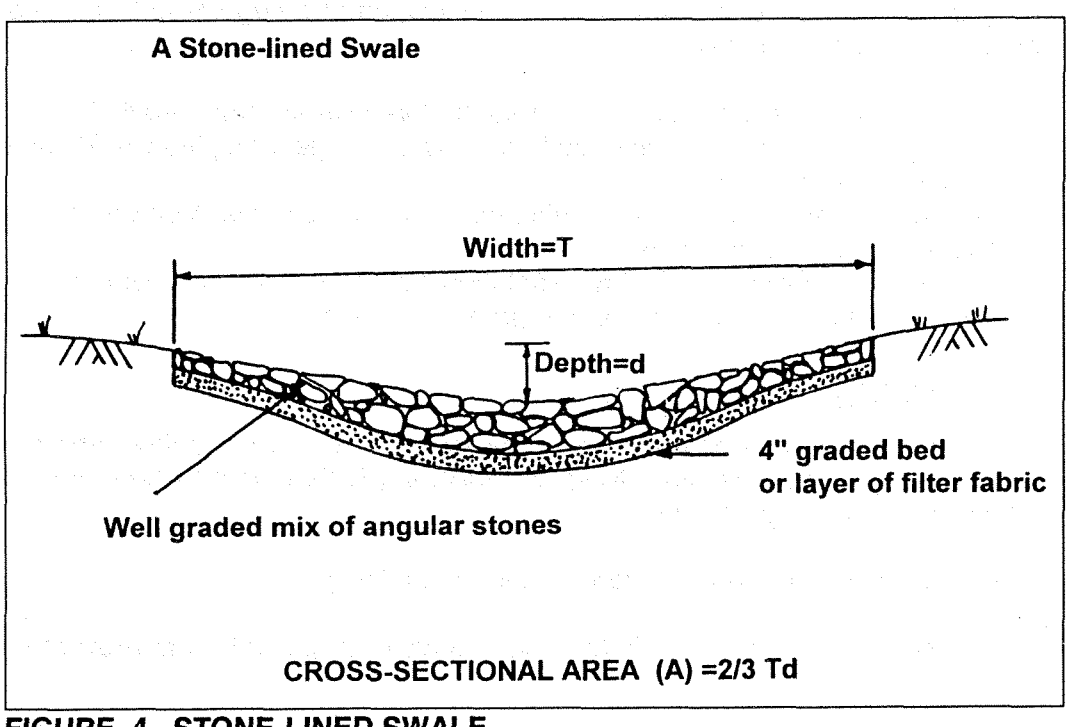


FIGURE 4. STONE-LINED SWALE

SHORELINE STABILIZATION

Shorelines are under constant attack from wave action, fluctuating water levels, tidal currents and boat traffic. Examine your property to determine what forces are at work. Slowly eroding shorelines may be able to be stabilized with vegetation. Otherwise, riprap will be needed.

Stabilizing with Vegetation

Following is a list of some of the variables that will determine if plants will be successful at stabilizing sand dunes or tidal areas. Before deciding to invest your time and money, evaluate your property in terms of the factors below and contact a natural resource agency or plant vendor for guidance on which species to plant.

Fetch: How many miles of open water can wind blow across before reaching your property? This will determine the size of the waves generated. If there are

over 5 miles of open water, it is unlikely that vegetation will successfully stabilize your land. Vegetation is most successful where the fetch is less than half a mile.

Shape of Shoreline: Vegetation can hold best in coves. It is most vulnerable on headlands or on straight shoreline areas.

Boat Traffic: The number of boats that travel along the shore and their distance from the shore will influence how well vegetation can grow. The odds of plant survival decrease when more than 10 boats per week travel within half a mile of the shore.

Width of the Beach above Mean High Tide: Beaches greater than 10 feet wide above the mean high tide have the best chances of successful vegetative growth.

Potential Width of Planting Area: The planting area must be greater than 10 feet wide for there to be any reasonable chance of success with vegetation.

Existing Beach Vegetation: The presence of vegetation below the toe of a slope is a favorable indication that planting will be successful.

Stabilizing with Riprap

Riprap is generally only used to stabilize areas eroding due to wave scouring and wave impact. It cannot be relied on alone to stabilize slopes failing due to seepage or soil instability. In these cases, shoreline stabilization may require the installation of groundwater drains, soil reinforcements, or retaining walls. Hire a professional if you have any doubts.

Riprap is composed of three sections: the armor layer, the filter layer, and the toe protection. The typical armor layer is composed of rough, angular rock. The underlying filter layer supports the stone against settlement, allows groundwater to drain through the structure, and prevents the soil beneath from being washed through the armor layer by waves or groundwater seepage. The toe protection prevents movement of the riprap layer into the water. It is usually constructed by trenching in the riprap at the toe of the slope.

Avoid using riprap if vegetation can solve your erosion problem. Vegetation provides habitat for wildlife species and a buffer capable of taking up pollutants and nutrients from runoff. If riprap is unavoidable, then use a combination of riprap and plantings to provide the vegetative cover needed. No riprap can be installed or repaired along the rivers, ponds, lakes, or the ocean without permission from the DEP and Army Corps of Engineers. Contact these agencies if you plan to do any riprap work along any of these locations.

Installing Riprap

Selecting a Filter Layer: Filter layers of either special filter cloth or a 6-inch layer of well-graded stone should be provided to prevent the loss of slope material through voids in the armor. If using a filter fabric, hire an engineer to choose an appropriate fabric for your soil conditions. Once the fabric is in place, put a layer of ¾-inch washed stone about 3 inches deep on top of the fabric to help distribute the riprap load and prevent rupture of the filter cloth. If using a

stone filter layer, get a clean, well-graded mix containing stone sizes ranging from ¾ of an inch to 3 inches.

Selecting a Stone Size for the Armor Layer: To assure that a riprap shoreline will remain stable, you must specify the size of the stone to be used for the armor layer. Stone size is commonly expressed in terms of a D50 value. D50 values are generally expressed in inches, and can be thought of as the average stone size in a rock mix. For example, if the D50 of a rock mix is 12 inches in diameter, half of the stones will be smaller than 12-inches and half will be larger than 12-inches. The largest stone in the mix should be no larger than 1.5 times the D50. The thickness of the riprap layer should be at least 2 times the D50. Be sure that you get a mixture which includes smaller stone sizes so that small voids in the rock mix can be filled. To find the stone size needed, determine the largest wave height your property is subjected to and use the wave size chart below to find the average stone size for your riprap.

Table 1
RIPRAP SIZING CHART*

Wave Height (ft)	Rock D50 (inches)	Rock Weight (lbs. ea.)
0.5	4	4
1.0	7	13
1.5	8	26
2.0	11	61
2.5	13	105
3.0	16	205
3.5	20	355
4.0	22	490
4.5	26	845
5.0	27	975
5.5	30	1203
6.0	33	1648
6.5	36	2145
7.0	38	2616

* Table is based on a 2:1 slope. Consult an engineer if your slope is steeper.
Assumed stone weight is 155 lbs./cubic foot

Plan to install your riprap when the water level is the lowest. The way in which the riprap is installed makes a big difference. Ideally, machinery should be parked on a flat area at the top of the slope and construction should be done by reaching out over the slope. Unstable slopes, however, may have to be worked from the side or toe to avoid possible slope failure due to the weight of the machinery. Follow the procedure below to install riprap.

Prior to placing the riprap, the existing ground should be graded to an appropriate slope, preferably no steeper than 1.5 horizontal feet to 1 vertical foot (1.5:1). Clean, well-graded fill material should be added as needed to achieve a uniform grade. The fill should be free of large stones (larger than 6 inches) and firmly compacted before construction proceeds.

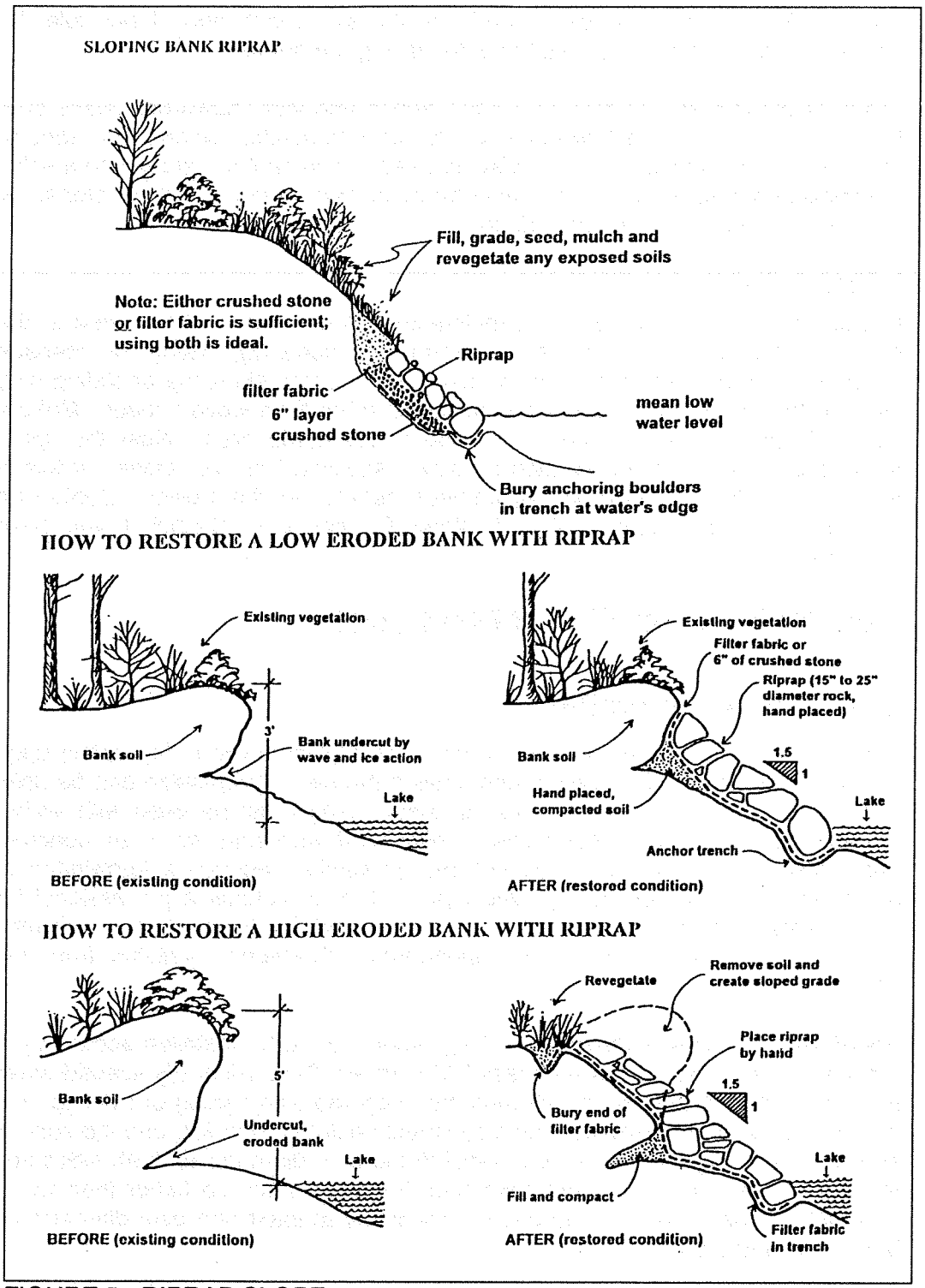


FIGURE 5. RIPRAP SLOPE

Dig a trench at the toe of the slope to key in the riprap. The key should be at least three feet deep.

Install the filter layer using proper construction methods for the material. Key-in the filter fabric at the top of the riprap edge and extend the fabric into the toe

trench. A stone filter should extend into the toe trench and, if possible, be compacted against the native soil prior to placing the riprap.

Stone placement should start at the toe trench and work upwards. Make sure the armor layer is at least two stones thick and completely covers the fabric or stone filter. An excavator bucket may be used to compact the stone into a solid, interlocking mass. In addition, it may be necessary to place smaller stones by hand in order to get a uniform surface.

MAINTENANCE

Despite its strength, riprap is not maintenance free. Inspect the slope in the spring, in the fall, and after severe storms for slumping, sliding, or seepage problems. Correct any problems immediately. Severe slumping or sliding may indicate that the slope is failing due to forces other than wave impact. Make a careful inspection of the land to the side of the riprap area. Near the riprap edge, erosion may be accelerated by wave reflection from the stone. If this is the case, additional measures may be necessary to halt the erosion. Contact an engineer or your county Soil and Water Conservation District if you have concerns.

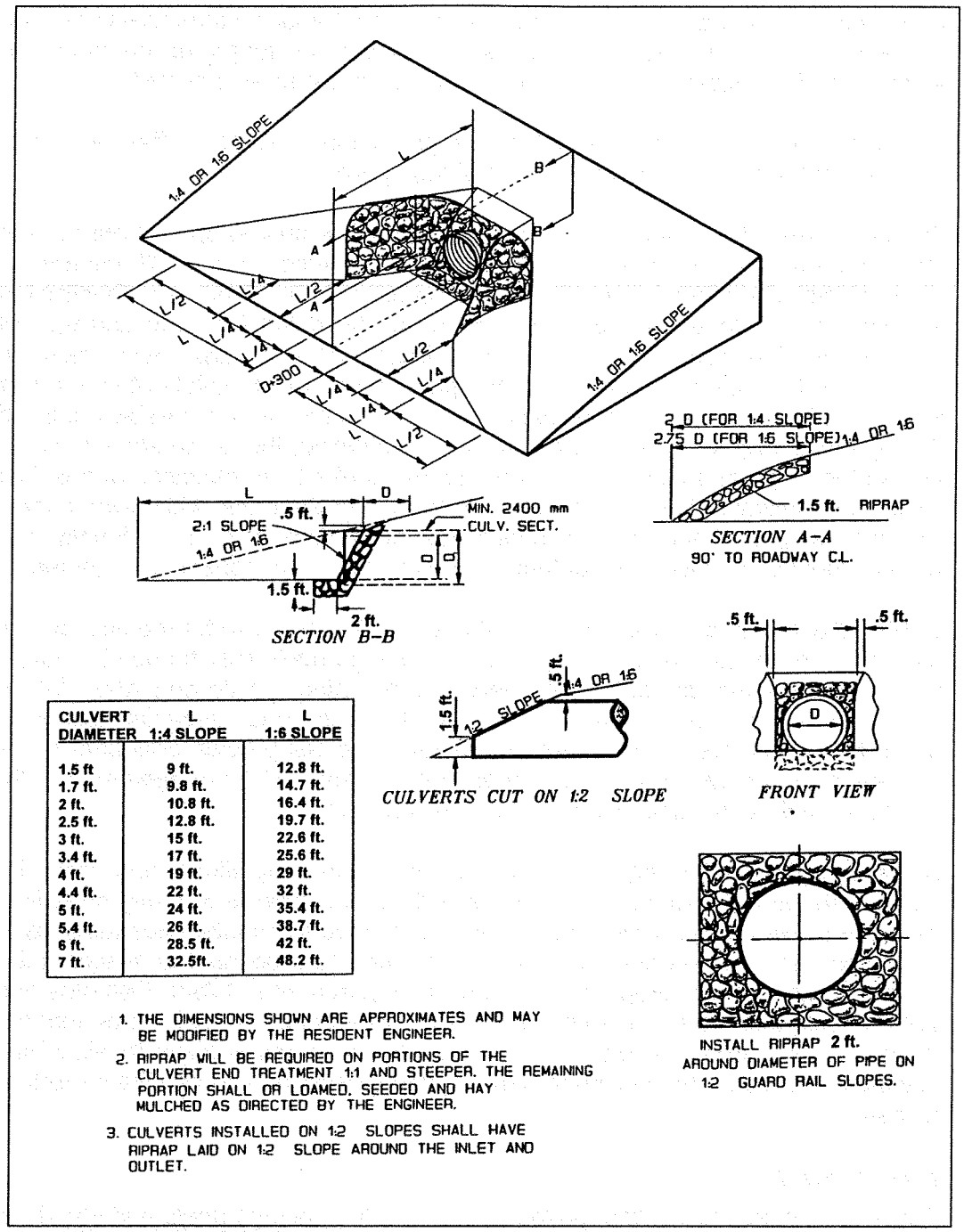
CULVERT INLET AND OUTLET PROTECTION

Culvert Inlet Protection

Different types of material should be used for inlet protection, depending upon the velocity of the water entering and leaving the pipe. Vegetation can be used where velocities are slow. A riprap or stone lining must be used with swifter moving water. The fastest waters need solid armoring such as concrete headwalls. Proper design of culvert inlet protection requires a knowledge of hydraulics and other design specific topics. Please consult a professional for help. More details on this topic can be found in *Maine Erosion Control Handbook for Construction: Best Management Practices*, available from the DEP.

Vegetative Protective Measures: Vegetation should be installed according to the standards of the permanent grass BMPs (see p.3-2). All newly seeded areas must be mulched, and the mulch must be anchored with netting or matting. On gravel and clay embankments, the slope must be flatter than 2:1, and the conduit should extend beyond the fill by at least ½ the pipe diameter on both sides and the top. On sand and silt embankments, the slope must be flatter than 2½:1, and the conduit should extend beyond the fill by at least one pipe diameter on both sides and the top.

Flexible Protective Measures: Riprap should be installed that has the ability to withstand the maximum velocity of flow that the approach channel is designed for. Flexible liners such as rock riprap and gabions should be underlain by a gravel filter and appropriate geotextile material to protect from piping. Light weight liners should be attached to the embankment with durable pins spaced closely enough to withstand the expected flow turbulence.



CULVERT DIAMETER	L 1:4 SLOPE	L 1:6 SLOPE
1.5 ft	9 ft.	12.8 ft.
1.7 ft.	9.8 ft.	14.7 ft.
2 ft.	10.8 ft.	16.4 ft.
2.5 ft.	12.8 ft.	19.7 ft.
3 ft.	15 ft.	22.6 ft.
3.4 ft.	17 ft.	25.6 ft.
4 ft.	19 ft.	29 ft.
4.4 ft.	22 ft.	32 ft.
5 ft.	24 ft.	35.4 ft.
5.4 ft.	26 ft.	38.7 ft.
6 ft.	28.5 ft.	42 ft.
7 ft.	32.5ft.	48.2 ft.

1. THE DIMENSIONS SHOWN ARE APPROXIMATES AND MAY BE MODIFIED BY THE RESIDENT ENGINEER.
2. RIPRAP WILL BE REQUIRED ON PORTIONS OF THE CULVERT END TREATMENT 1:1 AND STEEPER. THE REMAINING PORTION SHALL OR LOAMED, SEEDED AND HAY MULCHED AS DIRECTED BY THE ENGINEER.
3. CULVERTS INSTALLED ON 1:2 SLOPES SHALL HAVE RIPRAP LAID ON 1:2 SLOPE AROUND THE INLET AND OUTLET.

FIGURE 7. CULVERT INLET

Structural or Rigid Protection: Structural or rigid inlet works should extend at least one pipe diameter beyond the culvert. Rigid inlet retaining walls should be reinforced enough to withstand settling, frost heaving, and other associated loadings without cracking or failing.

Culvert Outlet Protection

The outlets of pipes and structurally lined channels are areas where there's a high potential for erosion. Stormwater transported through man-made conveyance systems at design capacity often reaches a velocity which causes

erosion in the ditch area. To prevent scour, a flow transition structure is needed to absorb the initial impact of the flow and to slow it. Outlet protection should be installed and stabilized prior to directing runoff from the pipe or culvert.

There are a number of different outlet protection designs. The two most common of these are outlet aprons and plunge pools.

Outlet Apron: An outlet apron is designed to allow flow to spread out so that the flow off the apron is slow enough so as to not cause erosion. These aprons are generally lined with riprap, grouted riprap or concrete. They are constructed so that they are level for a distance related to the outlet flow rate and the tail water level. The depth of tail water immediately below the pipe outlet must be determined for the design capacity of the pipe. Pipes which outlet onto the areas with no defined channel may be assumed to have a minimum tail water depth. If the pipe discharges directly into a well-defined channel, the apron should extend across the channel bottom and up the channel banks to an elevation of one foot above the maximum tail water depth or to the top of the bank, whichever is less. The side slopes of the channel should not be steeper than 2:1. Finally, the apron should be situated so that there are no bends in the horizontal alignment.

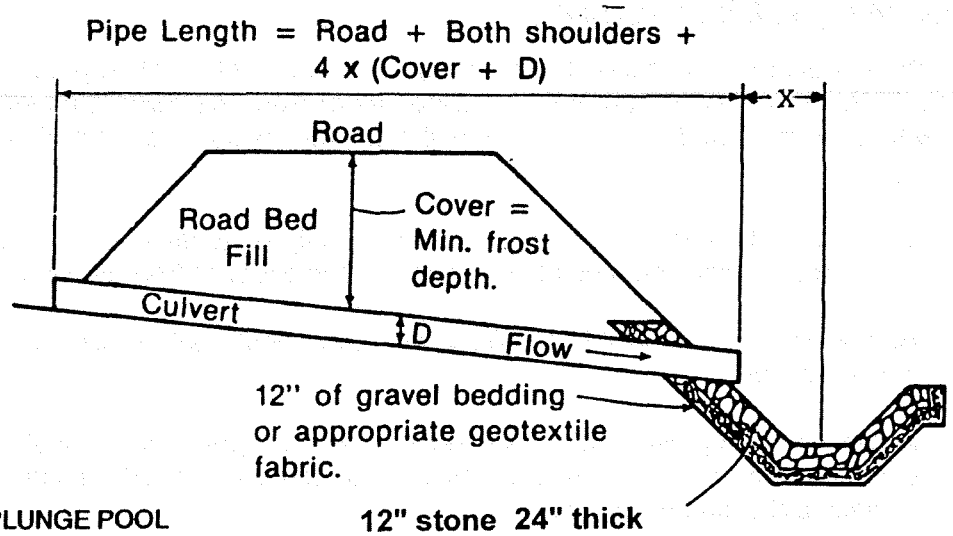
Stilling Basins and Plunge Pools: Where flow is excessive for the economical use of an apron, excavated stilling basins or plunge pools may be used. Plunge pools allow for the dissipation of energy by dropping the flowing water into a pool. An outlet pool lined with 6- to 12-inch stone constructed one diameter deep, two diameters wide and four diameters long will provide adequate outlet protection for a culvert with a 36 inch diameter or less. Culverts greater than 36 inches should be designed by a professional engineer.

Hanging culverts: 'Hanging' culverts (culverts with a significant drop from the outlet to the stream) with plunge pools are illegal on streams with migrating fish, as these prevent fish passage altogether. The need to maintain adequate base flow in streams to allow fish passage must be incorporated into the design of the culvert outlet where appropriate. The Maine Department of Inland Fisheries and Wildlife is concerned about some streams where aprons can be so wide that the depth of water from the base flow of the stream is too shallow to allow fish passage. Consult with the Department of Inland Fisheries and Wildlife for further guidance.

MAINTENANCE

Periodically check all aprons, paved channel outlets, plunge pools and structural outlets for damage, and repair them as needed. If any evidence of erosion or scouring is apparent, modify the design to provide long term protection (keeping in mind fish passage requirements, if applicable).

DETAIL OF CULVERT OUTLET PROTECTION (full flow non-pressure)



PLUNGE POOL
1 D deep
2 D side
4 D long

PIPE SIZE (inches)	X (feet)
12"	2 ft
18"	3 ft
24"	5 ft
36	7 ft

FIGURE 8. CULVERT OUTLET

DITCH TURNOUTS

A ditch turnout consists of a stable ditch, a turnout berm, and a trench outlet used to store and release road runoff into an existing, stable, vegetated buffer area. The outlet is constructed across the slope and is lined with a combination of stone and existing natural vegetation which disperses, filters and spreads the concentrated flow thinly over a receiving area. An additional benefit of a ditch turnout is to remove, to some degree, sediment and other pollutants from runoff by filtration, infiltration, absorption, adsorption, decomposition, and volatilization.

Mostly seen when treating short segments of roads, ditch turnouts can also be used below developed sites where it is desirable or necessary to disperse concentrated water into buffers adjacent to coastal areas. This BMP is restricted to drainage areas no larger than 2 acres.

Ditch turnouts should be installed at the same time the ditch is constructed. Once soil is exposed, the turnouts should be constructed immediately and stabilized. Plan the construction of the ditch and turnout so that the vegetation in the receiving and filter areas remains undisturbed. Small disturbed areas should be stabilized with vegetation.

Locating a Ditch Turnout

Ditch turnouts must be carefully located to divert water into well-vegetated woods or a buffer strip. When properly installed, water from the turnout should sheet flow through the woods or buffer (a thin film of water about ½ an inch deep at the most).

Ditch turnouts that treat road runoff should only be located within a buffer if they handle small volumes of less than 1.0 cubic foot of flow per second.

Runoff from the uphill side slopes of the road should not be allowed to drain into a turnout.

Before diverting water onto someone else's property, you must get the owner's permission. Sometimes ditch turnouts can be readily located along lot lines between properties.

Remember! Water should never be directed toward a septic system or leach field.

Design

Ditch turnouts should blend smoothly into the downstream receiving area without any sharp drops or irregularities, to avoid channeling the water. In the receiving area, evaluate the existing slopes and soil material, vegetative species and their condition, and the time of year available for proper establishment of vegetation prior to construction of the ditch and turnout berm. If grass cover needs to be installed in the ditch and/or the receiving area, the timing of the construction will be limited by the growing season. Final seeding should be completed by September 1.

The receiving area should be flat enough to prevent the flow from channeling before it enters a stable watercourse. If the receiving area is not stable before construction begins, stabilize it before the ditch turnout is built (this will limit construction to the growing season).

The ditch and turnout berm must be stabilized with either vegetation or a suitable structural lining such as riprap. The side slopes of the berm should be a maximum of 2:1. The minimum height should be 2 feet. Trenches should be constructed along the existing contour and should be 15-20 feet long, at least 7 feet wide across the top, and at least 2 feet deep. The trench should be filled with 4-6 inches of clean stone. The spacing between ditch turnouts is based on the road grade, as shown below, or through calculations.

Road Grade	Spacing between Turnouts
1-2%	200 feet
3-10%	150 feet
10%+	100 feet

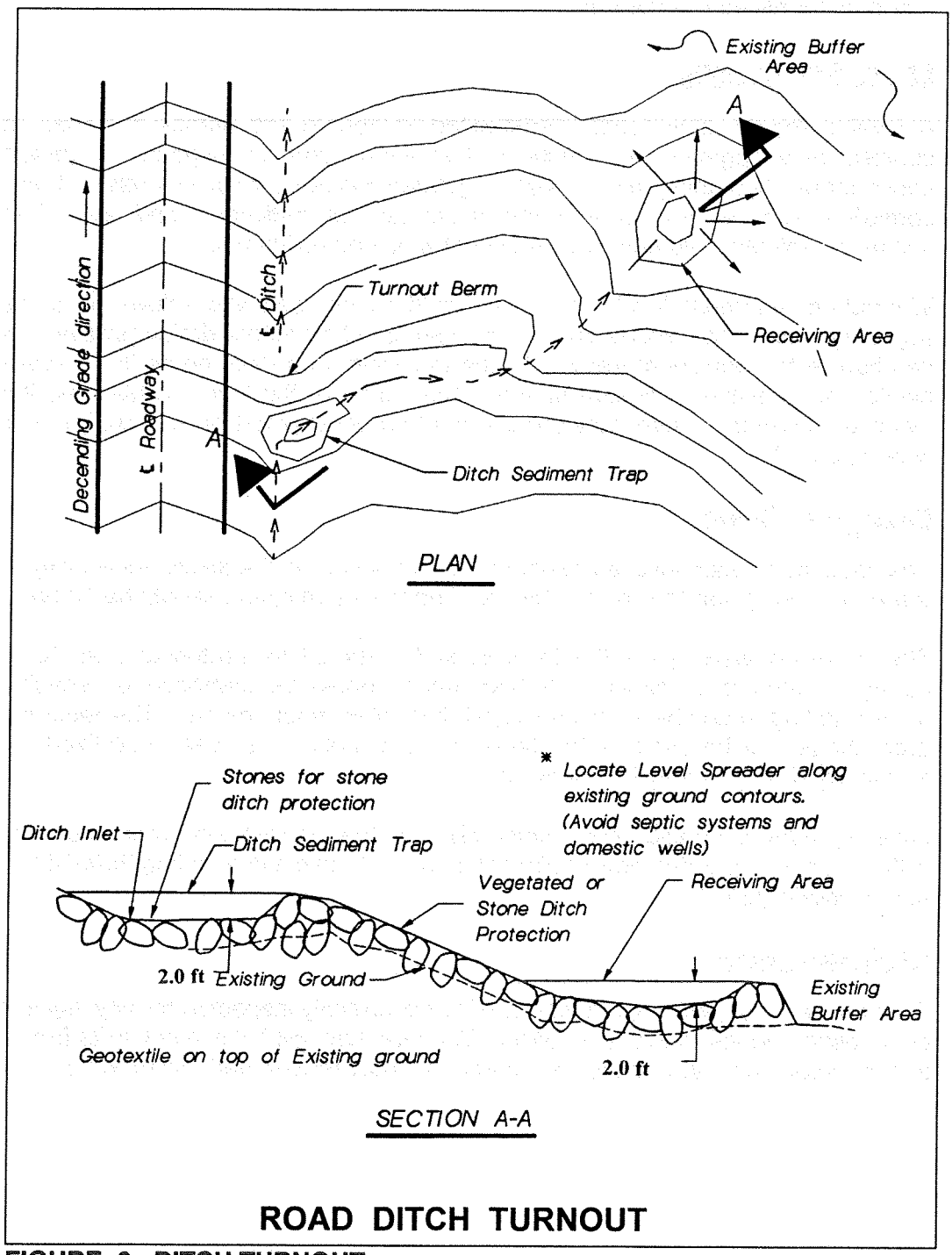


FIGURE. 9. DITCH TURNOUT

Maintenance

After construction, ditch turnouts need to be carefully inspected for any signs of channeling and immediately repaired. It will be necessary to remove sediment from the ditch turnout trench when the structure is no longer distributing the runoff uniformly across the trench.

LEVEL SPREADERS

A level spreader is an outlet constructed at zero grade across a slope. It consists of a vegetated or mechanical structure used to disperse or spread concentrated flow thinly over a well vegetated receiving area or buffer. Level spreaders reduce erosion and the movement of sediment, and also filter sediment, soluble pollutants, and sediment-attached pollutants.

Without an easement, level spreaders should not be used where flows will cross adjoining properties. Flows should be intercepted by stable drainageways that can handle the additional water, and the receiving area must be as flat in cross section as possible to ensure uniform distribution of the flow. Otherwise, the water will channel. Level spreaders should be constructed on undisturbed soil where possible.

Design Criteria

The capacity of each level spreader should be based on the allowable velocity of the water flow, given the soil conditions. The minimum length should be 12 feet.

The receiving area below the level spreader should be protected from harm during construction. Small disturbed areas should be stabilized by sodding and/or netting in combination with vegetation BMP requirements. The receiving area should not be used by the level spreader until it has been stabilized. A temporary diversion may be necessary.

Level spreaders should blend smoothly into the downstream receiving area without any sharp drops or irregularities in order to avoid channeling, turbulence, and hydraulic jumps.

Maintenance

After construction, level spreaders need to be carefully inspected for any signs of channeling and immediately repaired. The structure will fail if water exits from it in channeled flow. Vegetated level spreaders may require periodic mowing.

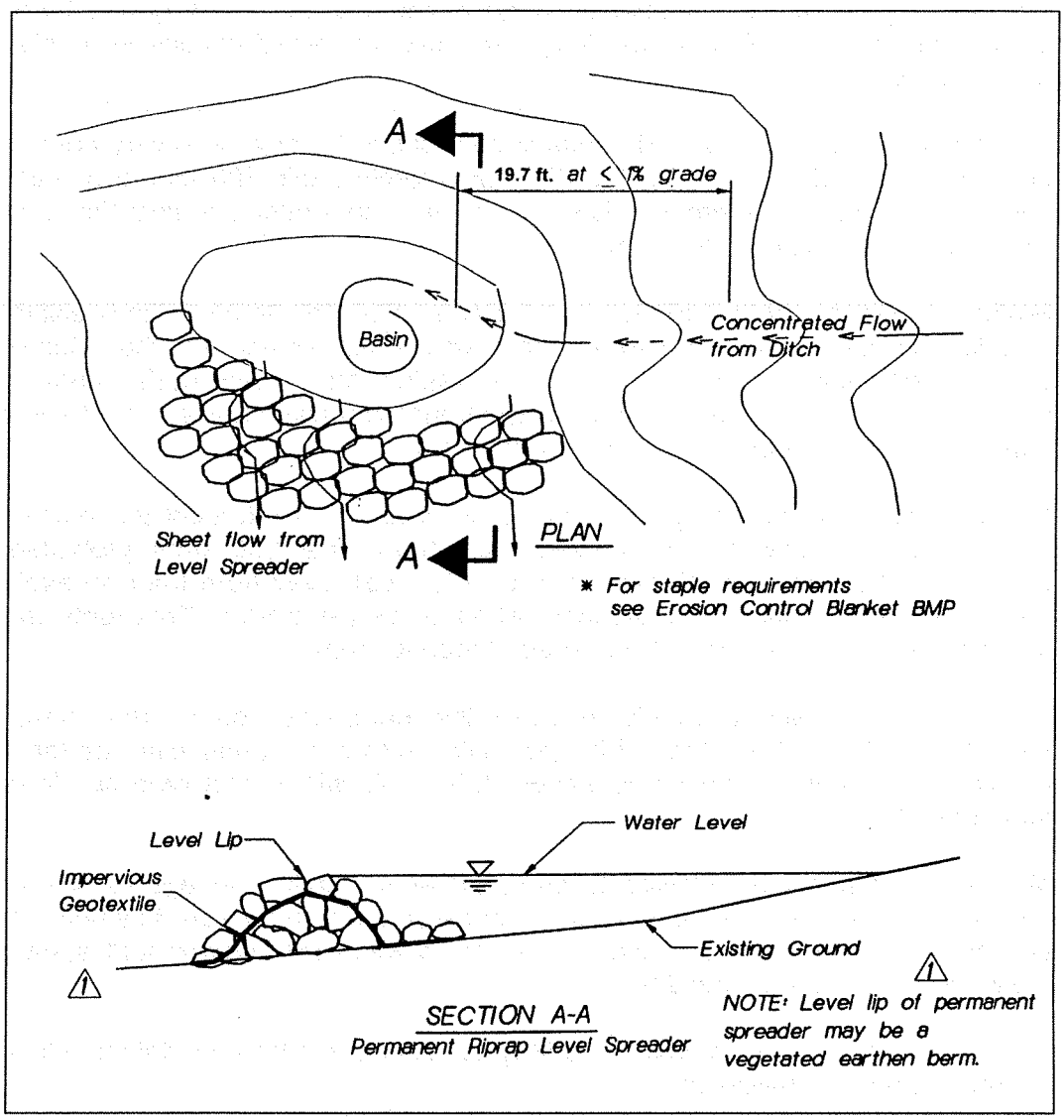


FIGURE 10. LEVEL SPREADER

CONSTRUCTION BMPS

Erosion and sedimentation are more likely to occur during construction projects because of the soil disturbance the construction causes. When construction occurs at a marina or boatyard – close to the water's edge – it is even more important to use Best Management Practices that will prevent or lessen polluted runoff.

Before Construction of any New Facility

Determine if the soils on your site are really suited for the proposed use. Avoid disturbing wet areas, steep slopes, drainageways, unstable soils, areas subject to flooding, stream banks or edges, and lake shores.

Become familiar with the natural drainage patterns of the property and try to avoid altering them. Proper site design will help you avoid expensive erosion control measures.

Contact your town office or code enforcement officer for any necessary permits or applications. Contact the Maine DEP for projects within 100 feet of a water body or wetland. If your property is in an unorganized territory, contact the Land Use Regulation Commission (LURC).

Minimize clearing and plan to preserve existing vegetation as much as possible. Vegetation will naturally curb erosion, improve the appearance and the value of your property, and reduce the cost of landscaping later. Wide buffer strips of undisturbed vegetation are required along stream and lake shores. Don't allow heavy machinery to operate in these buffer areas.

Discuss clearing limits with your contractor in advance. Field mark these limits with ribbons or flagging. Flag trees and shrubs that you want protected. Remember that heavy machinery must be kept well away from trees to avoid compacting their roots; otherwise, they will die a few years later. Tree roots can also be smothered if excess fill is re-graded around them.

Plan earth moving activities early enough in the year so that you can re-vegetate the site by September 15th. Plan to mulch disturbed areas over winter if construction is delayed past September 15th. This will protect bare soil from spring runoff.

Machinery must not be allowed to cross streams. Major damage to stream banks occurs when heavy equipment is carelessly run in stream channels. If access across a stream is needed, plan for a temporary culvert and stream crossing that can be removed later.

Winter construction (November 15 to May 15) should not be undertaken unless supervised by a professional.

During any Construction

Before doing anything else, install a filter barrier on the downslope side of the construction area. This barrier can be either a silt fence, an embedded hay bale barrier, or a combination of the two. A silt fence is better at filtering out soil from water, but is easily pushed over by construction equipment. Hay bales don't filter dirty water as well, but are more rugged in the field. When working in a critical area (next to water bodies) use them both. REMEMBER! Hay bales and silt fencing don't work unless they are installed and maintained properly.

If possible, when earth moving, stockpile the topsoil separately so it can be spread back on top of the site. You'll have greater success in establishing a new lawn or buffer strip area as a result. Ring the downslope edge of topsoil stockpiles with silt fencing or embedded hay bales.

Use mulch hay liberally on disturbed soil during the construction period to avoid having an erosion problem. Mulch hay is the cheapest and most effective way of protecting the soil. Don't let a week pass without mulching!

Culverts should be used where a driveway enters a main road. The minimum size should be 12 inches in diameter. A "rule of thumb" for estimating culvert size for watersheds smaller than 7 acres is to add 8 to the number of acres in the watershed to determine the culvert diameter. For example, a 7-acre watershed + 8 = a 15" diameter culvert. Larger culverts should be designed by a professional engineer. Generally, the entrance and exit areas of a culvert should be reinforced by stone (riprap).

Grassed ditches or waterways can be used to channel moderate water flows. Be sure to line the base of new channels with erosion control mats or use a combination of mulch and biodegradable netting to hold the soil until grass is established. Contact an engineer for ditches on steep slopes (greater than 5%) or ditches that will carry a steady flow of water.
Use diversions to take water across a slope and away from a critical area. A ridge or berm should be constructed on the low side to carry the water.

Structures such as stone (riprap) channels, catch basins, or pipe systems are used to carry large, concentrated flows down a steep slope. These should be designed by an engineer.

Cut and fill slopes should be no steeper than 2:1 (2 feet of horizontal run for every foot of vertical rise) if vegetation will be used to stabilize them. Steeper slopes generally will need riprap or other structural modifications. If a lot of water comes down the slope you may also need riprap. Consult an engineer in these cases.

After Construction

When the earthmoving is completed, replant the area. Don't automatically plant the area to grass – consider replacing the native trees and shrubs. These species are generally better at taking up the pollutants and nutrients in runoff.

Be extremely careful when using fertilizers near streams, lakes and ponds. Don't apply them before a storm. Use mixes that are very low in phosphorus in these areas.

Check to see that your silt fencing and hay bales are in good condition before a storm. Check and repair them again after storms. Remove sediment that has accumulated. Replace silt fencing that no longer allows water to filter through it. If the barriers are being undercut at the edges, they should be replaced by a stone checkdam.

4. INFILTRATION BMPS

VEGETATED SWALES

Vegetated swales are broad, shallow earthen channels, lined with dense vegetation. They promote infiltration through the soil and trap pollutants by filtration through the vegetation. The combination of low velocities and vegetative cover promotes the settling of particulates and some degree of treatment by infiltration.

Planning Considerations

Applicability: Vegetated swales are most appropriate when the impervious area which drains into them is small. Swales can be used along roadways in place of curbs and gutters.

Flow Volume/Velocity: Vegetated swales are most effective when the flow depth is shallow and the velocities are low. Also, the soils should be suitable to establish a vigorous stand of vegetation. If dense vegetation cannot be maintained in the swale, its effectiveness as a BMP will be severely reduced.

Slopes: Areas with steep slopes may limit the use of swales. In such areas, swales should follow the contour of the land.

Flow Duration: To be effective in removing stormwater pollutants, swales must not be subjected to low flows of long duration, and must not be kept wet for long periods. This will saturate the soil and may kill the vegetation, reducing the amount of pollutants removed.

Wildlife Habitat: In order to increase the potential for wildlife habitat in and around a swale, it is recommended that an additional, minimum 10-12 foot wide, no-mow buffer strip be incorporated into its design. This buffer strip should be located between the swale and developed areas, and could be planted with a variety of food-producing grasses, small shrubs and/or native wildflowers.

Design Criteria

Long-term performance research suggests the following design criteria will optimize the success of a swale:

Soils: Underlying soils should have a high infiltration rate (at least 1.0 inch/hour). The soils should be tilled before the grass cover crop is established to restore any infiltration capacity lost during the construction process.

Channel design: The channel should be designed for low velocity flow. Higher velocities might be permissible for channel stability, but could result in re-suspension of settled particulates. Flow depths in the swales should be minimized to increase the amount of vegetative filtering and settling. A

maximum design flow depth of 1 foot is suggested. The grade of the channel should be as flat as possible, preferably less than 2 percent.

Infiltration and sedimentation enhancement: The hydrologic performance of vegetated swales can be improved if check dams are used to temporarily pond runoff (see "**Check Dams**", p 3-7).

Vegetation: Vegetation for swale linings should be selected based on soils and hydrologic conditions at the site, in accordance with the guidelines for vegetative cover, p. 3-3.

Maintenance

Routine maintenance is important to keep a swale in good working condition. Mowing should be done frequently to maintain a growth of vigorous, dense vegetation. Grass should not be trimmed extremely short, as this will reduce the filtering effect of the swale. The cut vegetation should be removed to prevent the decaying organic litter from adding pollutants to the discharge from the swale.

Routine maintenance should include the immediate repair of newly formed channels or gullies; re-seeding bare spots; removing trash, leaves and/or accumulated sediments; and the control of woody or other undesirable vegetation. Routine fertilization and/or use of pesticides is strongly discouraged. Be sure to eliminate the gradual buildup of soil and grass adjacent to pavement which would prevent the entry of runoff into the swale. The mowed height of the grass should be 2-4 inches taller than the maximum flow depth, but a minimum of 6 inches.

Vehicles should not be allowed in the swale. The area should be inspected for failures following heavy rainfall and repaired as necessary. If complete re-seeding is necessary, half the original recommended amount of fertilizer should be applied with a full amount of seed.

Swales with Check Dams

A vegetated swale with check dams is used to retard and temporarily confine runoff in order to induce infiltration, and to provide an opportunity for nutrients and other pollutants to be filtered and settle out. The check dams create small infiltration pools along the length of the swale. A swale with check dams is more effective than a grassed swale because of the greater infiltration and settling they cause.

Check Dam Design

The check dam should be constructed of durable rock or rock-lined material to avoid erosion. The area just downstream of the check dam should be protected from scour with properly designed rock riprap or protective channel lining. The check dam may have a solid level surface integrated into it for added durability as shown in Figure 6.4. The heights of check dams are generally 6 to 12 inches, depending on the channel slope and the desired storage capacity. The check dams should be notched to allow the flows which exceed the dams' infiltrative

capacity to escape. Check dams should be designed so that the water ponded behind them will infiltrate in 12 hours or less.

Maintenance

The level of deposited sediment in the channel should be monitored regularly, and sediment should be removed from grassed channels before permanent damage is done to the grassed vegetation, especially if infiltration times are longer than 12 hours. Sediment should be removed from riprap channels when it reduces the capacity of the channel.

5. SEPARATOR BMPS

WATER QUALITY INLET

The water quality inlet is a conventional stormwater drainage structure (catch basin) with a sump and a hood. The sump is intended to trap coarse sediment and non-floating debris. The hood is intended to prevent floating debris and floating hydrocarbons from flowing out of the catch basin. Modified catch basins are intended to intercept coarse sediments, floating debris, and floating oil***(how are modified catch basins different from a sump and hood?)***.

While the modified catch basin can be used in-line in a storm drain system, it is most effective as the initial structure at the uppermost end of the drainage network. The area that drains toward the basin should be kept relatively small, since high flows can cause the mixing and re-suspension of accumulated sediment within the basin. Also, size limits on commercially available hood castings limit the size of the outlet pipe from the catch basin.

Properly maintained and cleaned, water quality inlets can help intercept the coarse sand and grit from winter deicing and the floating debris that accumulates on parking areas and streets. They can also serve as a relatively low-cost form of pretreatment for small site infiltration systems, where it is determined that fine sediment and organic debris loading is minor.

Planning Considerations

The modified catch basin should be considered as a component of an overall piped drainage system. It is a relatively low cost device for intercepting coarse sediment and debris that would otherwise consume available capacity or clog the pipe network. In some instances, existing catch basins may be readily modified with sump and hood.

Maintenance

Water quality inlets should be inspected three to four times annually, depending on their performance. Sediment should be removed when it accumulates within 6 inches of the bottom of the hood or at least twice a year.

OIL/GRIT AND OIL/WATER SEPARATORS

Planning Considerations

Oil/grit separators have several advantages:

- They are usually located underground so that they minimize use of valuable space.
- They are compatible with storm sewer systems.
- They can pretreat runoff before it is delivered to other BMPs.
- They are easily accessed for maintenance.

Disadvantages of the structures are:

- They have limited pollutant removal capability.
- They require frequent cleanings.
- They have high initial installation costs.

Oil/grit separators are installed as part of an engineered design. Water disposal can be an issue if a city stormwater sewer is not available. A typical design for an oil/grit or oil/water separator uses three chambers for treatment, and manhole access should be provided to each chamber to allow for cleaning. There are other simplified designs, but these are not recommended when fine grit or oil is a significant problem. Any oily material removed from an oil/grit separator must be disposed of as hazardous waste.

Maintenance

In order to have any effectiveness for pollutant removal, oil/grit separators must have trapped sediments cleaned out regularly and frequently: at least twice a year in order to maintain their pollutant removal capabilities. Failure to clean them out on a regular basis can result in floating hydrocarbons mixing in the water column and re-suspension and loss of previously trapped material.

6. ROADSIDE BMPS

Roads and driveways are big contributors of water runoff and surface water pollution. Phosphorus, which readily attaches to soil particles such as the gravel and dirt used for roads, can harm water quality when these soil particles are washed into a waterbody.

Phosphorus is not the only pollutant that can come from a roadway. All of the gas, greases, oils, road salt, and heavy metals (such as lead from regular gasoline) that drip from cars onto the road or driveway can also be transported in surface waters. Also, much of the gravel from regularly maintained access roads is washed into waterways with every major storm. Generally, the less road surface in a lake watershed, the better the water quality will be. In some situations, it may be possible for property owners to reduce the width of their road or driveway. A narrow roadway with several pull-out areas for passing cars may be a good option on seasonal roads with light traffic.

VEGETATED PHOSPHORUS BUFFER STRIPS

One of the first orders of business is to establish vegetation between the road or driveway and the waterbody. If road runoff can be filtered through a natural or planted vegetated buffer, it will percolate into the ground, depositing sediments, oils and phosphorus before it reaches surface waters.

WATER BARS

If the road gravel is continually eroding, consider installing a speed bump-type structure called a water bar. Water bars are small earth dams formed in the road to force water off the road, out of ditches, and into the woods (or buffer strip area). Refer to water bar figure for instructions on how to install a water bar. This measure will pose a challenge if the road must be plowed in the winter.

If the gravel or dirt road surface gets severely damaged with heavy rainstorms or spring runoff, or it needs year round maintenance, it may be time to consider a more permanent asphalt surface. If an asphalt surface is required, a modified water bar can be installed. A small asphalt "speed bump" 2 to 3 inches high can be built to divert water into the buffer areas. This will be low enough to be plowed, but will still divert rainwater during average storms.

How to Install a Water Bar

- Install bars with a skid blade, a dozer blade, or by hand.
- If recreational vehicles will use the road, use a log as a core for the bar.
- Install the bar so it is at a 30 degree angle downslope.
- Extend the bar into the side ditch or cut slope, so that it intercepts water there.
- Extend the outlet end of the bar beyond the road and place rocks, bushes or sod to filter the water.
- Construct the bar so that it extends at least 12 inches above the road surface and 12 inches below the road surface.
- Space the bars according to the following table:

Road Grade	Space Between Water Bars
1-2%	250 ft
3-5%	135-200 ft
6-10%	80-100 ft
11-15%	60-80 ft
16-20%	45-60 ft
21+%	40 ft

Owners of seasonal facilities can try seeding bare dirt driveways in the fall when they close down operations. Rake the dirt and scatter inexpensive annual rye grass seed over the surface. Don't bother to fertilize or lime. If hay mulch is available, mulch the area as well. This simple, inexpensive practice will protect the gravel surface from fall rainfall and spring runoff - two high impact seasons.

DITCH EROSION

Eroding ditches pose a chronic pollution problem to waterbodies. The best solution is to line them with sod, vegetation or stone. To determine the appropriate lining for the ditch, refer to the section on permanent ditch linings, p. 3-9.

STREAM CROSSINGS

Don't underestimate the importance of streams that flow through your property! These are the source of your lake's water, and they must be protected. If pollutants are reaching these streams, sooner or later the water quality at your waterfront property will be impacted.

- Correct erosion from road surfaces and road ditches.
- Don't let road runoff flow directly into the stream. Divert it into the woods or to a vegetated buffer strip.
- Install stone headwalls at culvert inlets and stone aprons or plunge pools at culvert outflows.

Maintenance

Improper methods and timing of maintenance procedures on gravel roads and driveways can cause serious environmental damage.

- Don't dig out road ditches in the late fall or early spring when vegetation in the ditch can't be grown quickly to stabilize the gravel and dirt.
- Grading operations should not leave earth berms at the edge of the road. They tend to channel water in the roadway instead of allowing free drainage to the woods or buffer areas.
- Do repair work on streams during periods of low flow (generally late summer). Obtain permits from the DEP for this work.
- Don't ignore chronic road erosion problems! Work with your local road association or the public works department of your municipality about correcting these problems.

7. BOAT WASHING BMPS

TARGET POLLUTANTS

This section addresses pollutants associated with antifouling paint; cleaning agents such as detergents, solvents, and degreasing agents; residues resulting from paint and varnish removal; and sediments resulting from washing boats.

Boat bottom paints contain metal compounds that are toxic to marine life, and the removal of these paints from the bottom of a boat produces a waste product which can harm the environment. It is illegal to discharge these substances to surface waters or land.

Contain and Properly Dispose of Pressure and Steam Cleaning Residues. Removing bottom point or cleaning hulls with a high pressure water or with a low pressure hose and a scrubber or scraper produces "industrial wastewater." To contain and control this wastewater, provide clearly marked designated work areas for land-side vessel maintenance, including cleaning. These activities should be conducted over an impermeable surface such as sealed asphalt or cement (not over open ground). The asphalt or cement should have a retaining berm and be pitched to contain the water.

The wastewater may be recycled or disposed of, but prior to disposal, it should be treated to reduce the concentration levels of heavy metals (principally copper) and meet the standards for disposal. This water may not be discharged to the ground, surface waters, septic systems, or storm sewers. Storm drain catch basins should be marked to warn marina users against such dumping. Do not discharge liquid wastes, including (but not limited to) solvents, detergents, and rinsewater onto the ground, or allow them to enter storm drains. Do not dispose of liquid wastes in dumpsters.

Some washing wastewater may be disposed of in a sanitary sewer. If detergents or solvents are not used, a properly sized grease trap/oil and water separator connected to a sanitary sewer should provide adequate treatment if properly maintained to allow the effluent to meet sewer standards. Tanks used to collect wastewater and remove solids are considered process tanks, and paint solids classified as hazardous must be separated and removed from these tanks by a licensed hauler.

Wash Boat Hulls Above the Waterline. 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. When washing boats by hand, do so in a way that minimizes the amount of debris that falls into the water.

Boats should be removed from the water before being cleaned or maintained if the impacts of these activities cannot be contained or mitigated. For instance, if toxic chemicals are being applied during maintenance 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. At a minimum, avoid and discourage the use of solvents and other toxic cleaning agents such as ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, acids, and lye, and bleach Soaps containing phosphates are illegal in Maine, and alternatives should be used for cleaning boats and equipment. Solutions of vinegar and water and citric acid compounds are effective cleaning agents. 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 employees understand and be able to explain the differences between traditional and environmentally friendly products.

Minimize the impacts of wastewater created during pressure washing. During pressure-washing, bottom growth consisting of marine organisms is washed off the hull along with particles of the bottom paint and fragments of hull material. Following is a list of ways to minimize water quality degradation from pressure washing.

- Pressure washing wastewater should be contained by directing it to a holding tank or silt trap to prevent paint chips and oil from being discharged to natural waters and storm drains. If the wastewater does not contain chemical additives, it may be diverted into wetpond detention basins or another stormwater BMP.

- Cleaning processes that use chemical additives such as solvents or degreasers must be conducted in self-contained systems that prevent discharge to storm drains or sanitary sewers.

- Wastewater from washing operations can be collected and reused.

- Permission may be required to discharge these wastes to the local municipal sanitary sewer system. Pretreatment may be required.

Removing contaminants from wastewater can be achieved by several processes, depending on the amount of pollutant removal desired or required.

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 the 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.

Filtration: Filter washwater by allowing the water to flow through one or more filters that screen out different size 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 accomplished by forcing the water through a filter. Such

treatment systems can remove more than 90% of the suspended solids and 80% of most toxic metals associated with hull pressure-washing.

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 the water. This method is the most sophisticated level of wastewater treatment.

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

a. discharge the wastewater into the water body;
b. discharge to a sanitary sewer system; or
c. collect the water for recycling in the pressure washing loop or for other applications, such as irrigation.

If option (a) or (b) is chosen, the discharged effluent will be required to meet discharge standards set for the receiving waterbody or sewage treatment facility. Either option will require discharge permits and water quality monitoring. The final option, reuse, may be the most appropriate practice. It would reduce the volume of water ultimately discharged and conserve water.

Appendix B is a design for a boat washing treatment system. This system should meet the requirements for a NPDES permit. It consists of a collection sump and filtration units for treating washwater. Clean water can then be discharged to either an infiltration bed or to a stormwater runoff ditch.

8. SANDING AND PAINTING BMPS

The sanding dust generated when sanding boat bottoms contains metal compounds (principally copper) that are toxic to marine life and the removal of paint from the bottom of a boat produces a waste product which can harm the environment. Discharge of these materials to surface waters or land is prohibited. Dust should not be allowed to become wind-borne or otherwise leave the containment area.

RECOMMENDED PRACTICES

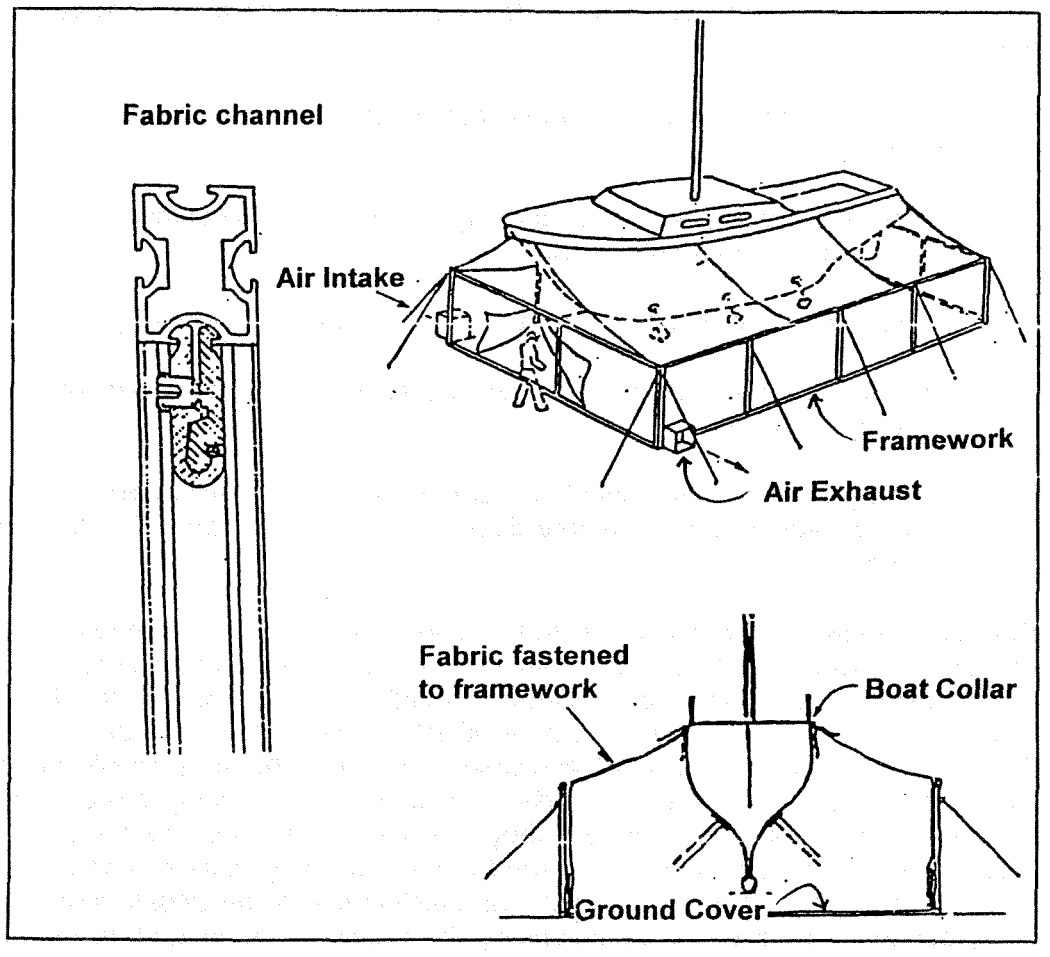
Wastes related to spray painting are also a major source of environmental pollution. Several steps can be taken to reduce waste emissions from painting operations.

- Carefully control inventory so that waste paint and solvents are kept to a minimum.
- Store waste paint, solvents, and rags in covered containers to prevent evaporation to the atmosphere.
- Whenever possible, use solvents and coatings with low volatility.
- Use techniques such as brushing and rolling to reduce overspray and solvent emissions.
- Spray painting on land should occur over an impermeable surface and in such a manner that overspray does not fall on open ground or surface waters.

Perform abrasive blasting within spray booths or plastic tarp enclosures. Ideally, sandblasting 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 with tarps. The tarps should extend high enough above the blasting surface to contain the blasting material and residue. Because tarps are not rigid, they do not eliminate wind flow through the blasting area, and so they allow the wind to carry blasting material and residue into surface waters. If tarps are used, the blasting should be closely monitored and planned to prevent wind from carrying the blasting material and residue out of the tarped 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 shore and it should be cleaned regularly. A facility owner may choose to locate the blasting area at the farthest corner from the water's edge. Records should be kept that document the volume of blasting material on site and the level of toxins contained in the material. Used blasting material should be tested and disposed of properly, following the procedures described in "Hazardous Materials and Wastes BMPs", p. 11-1.

Perform outdoor maintenance over tarps or hard surfaces. This practice prevents paint dust and other waste materials from washing throughout the facility when it rains. Hull maintenance activities should be done under a roof (where practical) and over hard, impervious surfaces such as cement. The use of hard impervious surfaces in hull maintenance areas facilitates the collection of paint chips and sandings. Once the maintenance activity is completed, the material on the tarp should be collected and disposed of properly. If scraping or blasting is done outdoors (with protective sheeting), avoid working on windy days when control of the protective covering is difficult. The bottom edges of tarps and plastic sheeting should be weighted to keep them in place during light breezes.



Example of sandblasting/ spray painting shield system.
Source: Pier Pressure Marine Systems, Inc.

FIGURE 11. SANDBLASTING/PAINTING SHEILD SYSTEM

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

Clearly post a list of boat owner responsibilities and any restrictions when boat owners are using the work area. Such rules may include the prohibition of hazardous materials, the maximum time a boat may be left in the area, and directives that the boat owner clean up each day and when the work is done.

The work area should allow for easy removal of waste and debris that is generated from maintenance activities. Develop a system to manage requests to use the work area, to move boats to and from the maintenance areas, and to enforce the use of best management practices.

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 with which a boat bottom can be completely sanded. Vacuum sander rentals could be provided by the facility.

Clean (trash, sanding, paint chips, etc.) immediately after any maintenance activity. 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 pollutants that are available to enter the surface water. For added ease in cleanup, cover nearby storm drains to prevent waste from being washed into pipes that directly discharge into surface waters. Dispose of collected material properly.

Provide covered containers for solid waste generated within the facility. Once material 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 within accessible areas of the facility. 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 when it rains.

Spent sandblasting grit, scrapings, and debris should be stored under cover in a manner that minimizes contact with process water or stormwater. Spent sandblasting grit and scrapings may be classified as a problem solid waste or as a hazardous waste if soluble metals are present in large amounts. For disposal of this waste material see p. 11-1.

Provide a Spray Booth. A spray booth should be used whenever possible to capture overspray. However, spray booths concentrate paints and, as a result, represent a hazard to both employees and the environment. Booths must meet the local building and fire code requirements and must ensure adequate ventilation for people working in them. Paint guns used in spray booths should be either High Velocity Low Pressure (HVLP) or High Efficiency Low Pressure (HELP) types, which are rated at 65% efficient paint transfer. Otherwise, painters should use electrostatic paint spraying methods. When replacing existing spray guns, convert to HVLP or HELP types.

Cleaning paint guns can also be hazardous since the spent solvent must be treated as hazardous waste and not discharged directly into drains. Cleaning should be done in an enclosed gun cleaner/recycler machine.

Outdoor Painting Paint and solvent mixing, brush cleaning, and similar activities should not be conducted on open floats or on structures over the water, but should be done in an on-shore work area. Drip pans or other protective devices should be used for all paint mixing, solvent transfer, or equipment clean up operations unless the operations are conducted in controlled areas away from storm drains, surface waters, shorelines, piers, docks, and floats. When painting from open floats, paints should be kept in cans of one gallon or less. Paint cans should be kept in drop pans with drop cloths or tarps underneath the drip pans. Painting and varnishing of vessels in water should generally be limited to interior surfaces or "brightwork", where paint materials and spills can be contained and prevented from entering the water.

Use and Manage Paints and Wastes Properly. Encourage the use of non-toxic, high bonding, easily cleaned hull coatings. More alternative coatings are anticipated to become available as technology advances. An example is the non-toxic, Teflon filled, vinyl ester system such as "Max-Pro-Coat" marketed by Pier Pressure Marine Systems, Inc.

The use of anti-fouling TBT (tributyltin) containing paints with a release rate greater than 4.0 micrograms per square centimeter is prohibited in the State of Maine. Older cans of paint with release rates greater than 4.0 micrograms per square centimeter should be disposed at a hazardous materials collection site (Call the Bureau of Remediation and Waste Management at the Maine DEP).

Paint and solvent spills present a threat to the waters of the state and, therefore, must be prevented from reaching storm or deck drains and subsequently discharging into the water. Cleanup solvents should be disposed of as described in "Hazardous Materials and Wastes BMPs", page 11-1. Adopt and implement the spill contingency measures identified under "Spill Prevention BMPs", p. 12-1.

9. ENGINE AND BOAT MAINTENANCE AND REPAIR BMPS

This section addresses general boat maintenance, engine maintenance, and repair. These activities may occur onboard vessels while in the water or in shore-side facilities, and can contribute significant amounts of petroleum-based hydrocarbons and heavy metals to the water. Following are some steps that marina operators can take to minimize the release of these pollutants into the water.

Perform maintenance work inside buildings whenever possible.
Conducting boat maintenance work inside an enclosed area keeps contaminants where rain cannot wash them into water and where they can be easily collected and disposed of. The following activities should be conducted with the vessel out of the water, and as appropriate, within an area specifically designed for this purpose:

- repairs requiring the disassembly of the outboard or lower drive unit;
- bilge repairs requiring opening or penetrating the hull;
- scraping, sandblasting, or painting the hull exterior or drive units; and
- any other activities which may cause an uncontained discharge of oil, chemicals, nutrients, or other contaminants to the water resource.

For some marinas, having dedicated work areas may not be feasible because of various constraints (site design, cost). In these cases, all the areas where maintenance is performed must be managed to prevent polluted runoff.

On-board Engine Repair and Maintenance
Activities which may be conducted on-board vessels while in the water are routine engine tune-ups, oil changes, and other minor services and repairs such as bilge pump repair. Removing and replacing an engine can be performed on board if one is careful to prevent a discharge of engine fluids or other hazardous waste into the water. The bilge should be inspected and cleaned before starting work that opens or penetrates the hull. All water, oil, or foreign materials found in the bilge should be cleaned using approved absorbent materials to remove contaminated bilge water.

ENGINE FLUIDS

Engine fluids should not be allowed to discharge to floor drains or other outlets unless the outlet conveys these fluids to an approved treatment device or to a secure storage container where it can be properly treated and disposed of. Drip pans or other protective devices should be used when working with oil, solvents, paints and paint mixing to catch accidental spills or leaks from drains, nozzles, or other storage or transfer systems.

ENGINE PARTS

Engines and engine parts should be stored on an impervious surface such as sealed asphalt or cement, and covered to avoid contact with stormwater. Care

should be taken to prevent oil and other petroleum fluids from leaking onto the open ground.

Do not wash engine parts with solvent over open ground. Parts should be washed in a container or parts washer with a lid that prevents evaporation. The parts should be rinsed or air-dried over the parts cleaning container. Used washing fluid should be recycled or disposed of by a licensed waste hauler. Water soluble engine washing fluids should be treated in the same manner as other industrial wastewaters.

Rinsewater, washwater, and other drainage from maintenance work areas should be directed to an oil/grit separator or a filtration system prior to discharge to sanitary sewers or to a holding tank for proper disposal off-site.

Vertical lift and marine railway devices should be kept clean. Prior to lowering a lift or railway, the device should be swept clean of debris, and any oil or hazardous substance should be cleaned from the device to prevent contamination of the water resource.

ANTIFREEZE

Use and encourage the use of propylene glycol based antifreeze rather than ethylene glycol based antifreeze. One simple way for marinas to encourage such use is to only offer the propylene glycol product for sale. Collect and reuse or recycle waste antifreeze in containers clearly marked "Antifreeze Only." See "Hazardous Materials and Wastes BMPs", p. 11-1.

SPILL CONTINGENCY PLAN

A spill contingency plan should be developed for each area where oil and hazardous materials are used or stored. Such plans should specify potential spill sources, oil and hazardous materials used or stored in the area, prevention measures (e.g., security, inspection, containment, training, equipment), and spill emergency procedures, including health and safety, notification, and spill containment and control measures. A drainage plan should be included as part of the plan. Emergency telephone numbers should also be included in the plan and posted at critical locations.

Appropriate containment and control materials should be stored in a clearly marked location, readily accessible to work and storage areas. These materials should include absorbent pads and booms, empty sand bags, sewer pipe plugs, speedi-dri absorbent, square end shovels, a pry bar, curtain boom, drain covers, fire extinguishers, and a copy of the spill contingency plan.

Do not discharge waste oils, anti-freeze or other liquid waste (e.g., paints, solvents, detergents, rinsewater) onto ground, or allow them to enter storm drains. Waste oil and solvents should be collected in separate, clearly labeled drums. Do not dispose of liquid waste in dumpsters. See "Hazardous Materials and Wastes BMPs", p. 11-1..

10. WINTERIZATION AND STORAGE BMPS

This section outlines management practices recommended for two types of boat storage areas. Both types of storage may contribute to nonpoint sources of pollution through the use of heavy equipment (fork lifts and cranes), as well as through various storage procedures (e.g., use of anti-freeze, battery storage). One type is the traditional storage of boats within the upland area of the marina, either within closed structures or outdoors, under a shrink-wrap cover. This practice is typically used for winter storage.

The other type of storage is "dry rack storage," in which boats are routinely removed from the water between uses, cleaned, and placed in racks until the next use. These types of facilities may reduce the need for in-water structures. Also, because vessels are not constantly sitting in the water, the accumulation of fouling organisms on the hulls is minimized, reducing the need for washing, scraping, and painting. Thus, dry-rack storage can help reduce nonpoint-source pollution.

The following practices will minimize pollution from all winterization-related activities:

- Provide storage facilities to minimize the need for more intensive hull maintenance.

- Avoid installing floor drains in storage structures. Connect any existing floor drains to the sanitary sewer, if available, or to a holding tank (with appropriate permits).

- Do not perform vessel maintenance and repair activities in dry storage areas unless accepted management measures are fully implemented (these are described in "Boat Washing BMPs", "Sanding and Painting BMPs", "Engine and Boat Maintenance and Repair BMPs", and "Hazardous Materials and Wastes BMPs", pages 7-1 through 9-3, and page 11-1).

- Bilges should be inspected and cleaned prior to extended vessel storage. All water, oil, or foreign materials found in the bilge should be cleaned using approved absorbent materials to remove contaminated bilge water. Used absorbents should be disposed in accordance with the chapter on solid waste recycling and disposal, p. 13-1. Contaminated bilge water must not be allowed to enter the waters.

- Provide secondary containment for all liquid waste and hazardous material storage areas.

- Fuel tanks should be topped off or emptied and purged as required by the method of storage, and in accordance with applicable codes. The procedures should be performed by qualified personnel.

- In the spring, collect and recycle shrink-wrap used to cover boats during the winter months.

- Prior to lowering a vertical lift or marine railway, the device should be swept clean of all debris. Any oil or hazardous substance should be cleaned up to prevent contamination of the receiving waters.

  A Spill Contingency Plan should be developed for each area where hazardous materials are used or stored. This plan should specify potential spill sources, hazardous materials used or stored in the area, prevention measures (e.g. security, inspection, training, equipment), and spill emergency procedures, including health and safety, notification, and spill containment and control measures. A drainage plan should be included as part of the plan.

11. HAZARDOUS MATERIALS AND WASTES BMPS

A number of substances used in marinas may be considered "hazardous materials" or "hazardous wastes and are subject to "cradle to grave" management measures specified under federal and state statutes and regulations. Marina owners and operators are responsible for determining whether materials handled at their facilities are subject to regulated management and for complying with applicable regulations for the handling, storing, transporting, and ultimate disposal of these materials, including any manifesting and reporting requirements.

Hazardous materials are routinely used in activities such as boat scraping, painting or cleaning, and engine maintenance. These materials and wastes include harmful cleaners, solvents, detergents (i.e. ammonia, sodium hypochlorite, chlorinate solvents, petroleum distillates, or lye), antifreeze, and paints. This section provides boating facility owners options for storing, containing, and disposing of hazardous material and liquid waste. It also provides enough information, in most cases, to minimize the threats of hazardous material and liquid waste as a source of nonpoint pollution. If your facility uses the materials discussed in this section more intensively than would be expected at a traditional recreational boating facility, check with the Bureau of Remediation and Waste Management in the Department of Environmental Protection, (207) 287-2651, for recommended management practices.

STORAGE AND CONTAINMENT

- The first step in the design process is to complete an inventory of materials that are used by the marina. The inventory should identify the location of hazardous materials, where they are used, and how to manage them. List all materials that are available for use, regardless of quantity.

- Divide the list into broad categories such as petroleum products, detergents, solvents, paints, and lubricants. 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. For a copy, contact the Bureau of Remediation and Waste Management in the Department of Environmental Protection, 17 State House Station, Augusta, ME 04333 (207-287-2651), and ask for a document titled Hazardous Waste Management Rules.

- Where feasible, minimize the use and storage of hazardous materials on-site or replace hazardous materials with non-toxic ones.

- Separate containers should be available and clearly labeled for the disposal of used antifreeze, paint cans, mineral spirits, and other solvents. Liquid material should be stored carefully to prevent spills due to overfilling, tipping, or rupture.

- Design a waste collection scheme that can handle the types and volumes of material that are commonly disposed of at the facility. The containers

should be easily accessible and clearly marked. With regard to liquid collection facilities, be sure to consider issues such as: how the marina will control what is put into the containers; how the marina will protect itself against secondary spill protection; and how the marina will handle special hazards.

- All hazardous liquid products should be stored in containers on durable, impervious surfaces and within berms or impoundments. Impoundments should have a capacity equal to 110% of the volume of the largest storage tank or container. If the volume of liquid being stored is relatively small, one secondary spill impoundment may be adequate to contain the material stored in several containers.

- Incompatible or reactive materials should be segregated and securely stored in separate areas in closed containers that prevent the mixing of chemicals.

- Concentrated hazardous wastes or spilled chemicals must be transported off-site, in accordance with state law, for disposal at a facility approved by the DEP. These materials must not be discharged to any sewer or state waters.

HANDLING PETROLEUM PRODUCTS

A separate container for the disposal of used petroleum products should be accessible to your facility patrons. Otherwise, the most popular disposal site, after the storm drain, is the dumpster. However, it is often difficult to control what is put into an oil collection container. If a container becomes contaminated with water or other substances, then the cost to empty the waste oil may be very high, so locate and supervise the containers carefully. Consider keeping the containers in a locked storage area, and the tenants can 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 appropriate containers in the storage facility.

Once filled, the container can be removed by a certified waste hauler. Some facilities use waste oil burners to dispose of oily materials and provide heat for work areas. Most oil spill recovery material can be disposed of easily. Nonabsorbent booms can be cleaned and reused. Oil absorption materials, such as pads, retain little water when fully saturated and can be disposed of the same way as other oil-soaked material.

Oil collection containment areas need to be covered, primarily to keep rainwater from filling up the secondary containment. If the area is fenced, the marina may be able to better regulate oil disposal. It is important to keep the storage area clean.

Waste gasoline should be stored in a non-leaking container, on an impermeable surface and cover eot prevent stormwater form contacting the container. The container should be clearly labeled "waste gasoline", and the storage location should conform to local fire codes. Whenever possible, waste gasoline should be filtered and used as a fuel. Gasoline can be stored successfully for future

use by adding a stabilizing compound to the fuel. Waste gasoline should not be poured on the ground; disposed of in storm sewers, septic systems, or POTW's; discharged to surface waters; or be allowed to evaporate. It should be removed from the site by a licensed waste transporter.

Used Oil Collection Center

In 1996, the Maine Legislature passed a law to encourage used oil recycling. It provides incentives for establishing centers where used oil can be collected from the public. If you wish to establish a used oil collection center, you may be eligible to obtain low interest loans or grants for purchasing above ground used oil storage tanks. The loan program is administered by the Finance Authority of Maine (FAME). In addition, the new law allows marina operators to dispose of oil contaminated with hazardous waste (i.e. "hot loads") at reduced costs, if the collection center is designed and operated as the law proscribes and if it is registered with DEP. Any questions about this program and compliance responsibilities should be directed to the Department of Environmental Protection, 17 State House Station, Augusta, ME 04333 (207-287-2651).

HANDLING HAZARDOUS MATERIALS

Used lead-acid batteries should be stored on an impervious surface, stored under cover, protected from freezing, and picked up by an approved recycling facility.

Fuel filters should be crushed or punctured and hot-drained by placing a filter in a funnel over the appropriate waste collection container to allow the excess petroleum product to drain into the container. Drained filters should be collected and recycled when possible. Only filters that have been crushed or hot-drained to remove all excess oil can be disposed of as solid waste.

Mercury lamps and switches Spent fluorescent bulbs, other mercury lamps, and mercury switches are hazardous waste. Spent lamps should be collected and stored safely to prevent them from breaking. When a sufficient quantity has accumulated, they can be recycled.

Fiber reinforced plastic Use of epoxy and polyester resins for repair or construction of boat hulls can generate significant amounts of waste. Common solvents such as acetone or methylene chloride evaporate easily and should be kept in covered containers. Small amounts of unused resins may be catalyzed prior to disposal as solid waste. However, catalyzation is not an acceptable method of disposing of outdated or unneeded resin stores. This material must be treated as hazardous waste and disposed of by a licensed waste hauler.

Glue and adhesives Residual amounts of glues and adhesives remaining in empty caulking tubes may be disposed of as solid waste. All other glue- and adhesive-related wastes must be considered potential hazardous waste. Non-hazardous glues and adhesives in liquid form cannot be disposed of as solid waste and should be used for their originally intended purpose.

Paints, waste diesel, kerosene and mineral spirits should be stored in non-leaking containers on an impermeable surface and covered to prevent

stormwater from contacting the container. Each container should be labeled with its contents, and storage locations should conform to local fire codes. A licensed waste transporter should dispose of any waste products from these materials. The wastes should not be disposed of in storm sewers, septic systems or POTW's; poured on the ground; discharged to surface waters; or be allowed to evaporate.

SOURCE CONTROL AND REDUCTION

Enact a public education, outreach, and training program for boaters to prevent improper disposal of polluting material. A great deal of pollution can be prevented in the first place by simply educating the boating public about the problems and their solutions. Marina and boatyard operators are in a unique position to provide boaters with this information. Some of the fact sheets in Appendix C of this manual can help. Copy them and distribute them to customers, or post them in frequently used areas.

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. Both federal and Maine laws prohibit the possession, sale or use of TBT-based paint except in commercial boatyards. This paint must be applied only to vessels more than 25 meters in length or having aluminum hulls, and once applied, the paint's measured release rate must not exceed four (4.0) micrograms per square centimeter per day. TBT-based paint can be applied from a spray can of 16 ounces or less to outboards or the lower drive unit of vessels. Make sure that patrons 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, chlorine, chlorinated solvents, petroleum distillates, or lye. Use products throughout the facility that are environmentally benign where possible. Generally, these include products that are nontoxic and biodegradable. Maine law bans cleaning agents that contain phosphate. For vessel cleaning, use detergents that are phosphate free and do not contain such toxins as ammonia and sodium hypochlorite.

Use antifreeze that is less toxic to the environment. Currently, there are two types of antifreeze on the market. Ethylene glycol is the standard antifreeze and is usually identified by its green or blue coloring. This antifreeze is toxic 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. Use propylene glycol instead of standard antifreeze, and encourage your tenants to do the same.

Keep the quantity of toxic material to a minimum during maintenance activities. Encourage your tenants to use only a small amount of cleaning material when they are washing their boats. Minimizing the amount of material applied reduces the amount of material that eventually enters surface waters, and saves money, too.

If the facility has a store where detergents and solvents are sold, consider stocking products that are environmentally compatible. Encourage your customers to use products that will not degrade the environment.

Paints and solvents should be prevented from entering waterways by using drip pans, drop cloths or tarps. Whenever possible, paints and solvents should be mixed in bermed areas away from storm drains, surface waters, shorelines, and piers. Only one gallon (or less) of paint should be opened at a time when working on floats. Paint should be contained within drip pans or tarpaulins. Paint and solvent spills should be prevented from reaching storm or deck drains, and cleaned up and disposed of properly. Clean-up materials soaked with solvent must be handled as hazardous waste.

For boats in the water, perform cleaning operations to minimize the release of harmful cleaners and solvents to surface waters. Institute public education, outreach, and training programs for boaters to prevent improper disposal of polluting materials.

RECYCLING AND DISPOSAL

Always recycle, if possible. Whether or not a material can be recycled will depend primarily on the type of material and the availability of recycling facilities. In some cases, it may be possible to switch from a product that is non-recyclable to a similar product that is recyclable without sacrificing effectiveness.

By recycling, 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 protecting the environment, and may encourage patrons to do the same.

Once waste 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 are satisfied.

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.

12. SPILL PREVENTION BMPS

Small amounts of fuel, oil, and other petroleum hydrocarbons regularly introduced into the marine environment are a serious problem. This incremental pollution – a little here, some there – adds up to hundreds of thousands of gallons every year. In Maine alone, many minor spills have been reported in the last five years. Moreover, these spills may only reflect a small percentage of the total number, because only a fraction of all the small spills ever get reported.

Generally, fueling operations have the greatest potential of contributing to nonpoint pollution from spills. Another problematic activity is the repair and maintenance of engines when oil is removed from the crankcase and not disposed of properly. Storm drains also carry oil that is washed off impervious surfaces or illegally dumped into them. Rain flow and snow melt can lift up oils and carry them across paved parking lots directly into surface waters.

One common, but often overlooked, hazard is a vessel sinking at a mooring or slip. A moderately sized power boat can carry several gallons of fuel and at least some oil which, if not contained, will spill into the water as the boat sinks. Although the environmental impact may not seem significant from any individual minor spill, the cumulative impact of many spills over time may be considerable.

In recent years, federal regulation of oil spill response and recovery has tightened. Any sheen seen 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 regulations clarify the policies and procedures for recovering expenses incurred for removal and damages. In certain cases, the person responsible for the spill may be responsible for the clean-up.

Any facility that handles or stores fuel should act to minimize potential dangers. This chapter suggests practices to prevent spills and improve the process of recovery from an accident. In addition to implementing best management practices, marinas and boatyards should develop an oil spill response plan. The following model can be used to develop a facility's own response plan.

SPILL CONTINGENCY PLAN

A spill contingency plan is required for each area where oil and hazardous material are used or stored. Such plans should specify potential spill sources, oil and hazardous material used or stored in the area, prevention measures (e.g. security, inspection, containment, training, equipment), and spill emergency procedures, including health and safety, notification, and spill containment and control measures. A drainage plan should be included as part of the plan. Emergency telephone numbers should also be included in the plan and posted at critical locations.

If spill occurs or any oil or hazardous material is accidentally discharged into the water of the state or onto land with any potential for entry into state surface or ground waters, the Maine DEP Bureau of Remediation and Waste Management should be notified immediately by calling (207) 287-2651 or 1-800-432-0777.

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:

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.

What: Plan 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.

When: Decide when additional resources should be called for assistance and when the equipment will be inspected and replaced, if necessary. Establish a schedule for maintaining and practicing with the equipment.

Where: Know where the material is located in the facility. Identify sources where additional oil response equipment can be quickly obtained, 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.

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.

Inform your local harbormaster and fire department about your spill recovery plan and equipment. Because the fire department and the harbormaster 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 of 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.

In the event of an actual spill, cleanup efforts should begin immediately and be completed as soon as possible, taking precedence over normal work. The cleanup should include properly disposing of any spilled material and used cleanup material. The following steps should be performed as quickly as possible:

1. Stop the source of the spill.
2. Contain the liquid.
3. Cover the spill with absorbent material such as kitty litter, sawdust, or oil absorbent pads. Do not use straw.

4. For small spills of flammable liquids, the absorber can be aired out – check with the local fire department. When the absorber is dry, put it in a dumpster. Keep the area well ventilated.
5. Deploy containment booms if any spill may reach the water.
6. Comply with state and federal regulations to contain and clean up the spill, and dispose of materials at an approved facility.

GENERAL PRACTICES

Prevent spills from occurring by using appropriate fueling procedures.
As always, prevention is cheaper than clean-up. Employees and boaters should be reminded not to "top off" the gas tank, but to fill it three-quarters full to avoid splash-back and to account for expansion. Nozzles should be placed in a container rather than left on the dock. Where possible, locate and design fueling stations so that spills can be easily contained with booms.

The key to spill protection is early response and action. The spill response equipment should be stored in an area where it can be deployed quickly. Consider storing the equipment near where the greatest threat of an oil spill exists. In most marinas, this is the fueling station.

Make spill response equipment readily available.
However the spill response equipment is stored, it should be readily accessible to your staff, especially those who handle the fueling operation. Some marinas have opted to not lock the storage container and leave it accessible for all patrons to use at their discretion. This may encourage quicker response to smaller spills that are away from the fueling dock or which occur when staff are not on duty.

SPILL RESPONSE EQUIPMENT

The type of spill response equipment needed depends on the type of boating facility and the type of vessels stored there. At a minimum, the response kit should include absorbent pads and booms, fire extinguishers, a copy of the Spill Contingency Plan, and other appropriate equipment.

Booms absorb up to 25 times their weight in petroleum products while still floating. Booms are available at a cost of approximately $160 for four 10 foot booms, 8 inches in diameter. 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. For example, 120 feet of boom would be needed to adequately encircle a 40 foot boat.

Generally, there are two types of booms. One type, the oil containment floating boom, prevents oil from spreading on the surface by acting as a floating barrier. The second type, the oil-absorbing floating boom, prevents the oil from spreading and also absorbs the oil. Both types can be strung together to encircle the affected area, but become less effective as wave action increases.

Absorbent pads are 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 quickly cleaning up light fuel spills by throwing 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.

Traditional dispersants (soaps) should not be used. These 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 damage. Substances using enzymes or other innovative approaches that actually remove the hydrocarbons from the environment are acceptable, if they are available.

SECONDARY SPILL PROTECTION

All containers used to store secondary spill response equipment should have a form of secondary containment. In most cases, this secondary containment must equal 110% of the capacity of the primary container. Generally, this backup is provided by constructing a non-leaching berm with an impervious bottom around the containers. Other methods include a fully enclosed containment facility outside the primary containment vessel.

SPECIAL HAZARDS

Consider the possibility of storm or flood when planning the placement of a waste oil reception facility. Locate the containment facility in an area that is least prone to flooding or storm damage. If the facility is mobile, it can be moved in the event of a nor' easter or hurricane. Shipping containers can be retrofitted to serve as storage facilities competent in substance control, secondary spill protection, and special hazards. 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.

Consult with your local fire chief to reduce the possibility of fire. If your are storing oil or other flammable substances in an enclosed area, the fire marshal may request that the outside of the container be labeled with 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 be accessible to fire fighting personnel.

13. SOLID WASTE RECYCLING AND DISPOSAL

Several options for the collection, containment, and reduction of solid waste that is generated within marine recreational facilities are proposed in this section. Solid waste includes:

- trash and recyclables (paper, bottles, cans, plastics);
- hull-cleaning debris (paint); and
- waste generated from general boat maintenance (fiberglass, wood, grit).

If this waste is collected and disposed of properly, its impact on the environment can be minimized.

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 before they overflow. Usually facilities have a centralized location for trash collection. This collection facility may be regulated by a local ordinance for its location, height and appearance. Some marinas regulate the accessibility of the collection facility by fencing it in to avoid problems with improper disposal of items such as oil.

Put into place a public education, outreach, and training program for boaters to prevent improper disposal of polluting material. Posters and brochures are available from the Maine State Planning Office which encourage boaters not to dump their trash overboard.

The easier and more convenient recycling is for boaters, the more cooperative they will be. The marina management is best able to determine how to make recycling receptacles adequate and convenient, but following are some general recommendations:

- Provide facilities for the recycling of materials, such as glass, aluminum, plastic, newspapers, and batteries. 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. Call the Maine State Planning Office for information on markets for waste materials. Also check with your local municipality to see what materials are recycled in the local transfer station. Once the program is created, start slowly and build on success.

- In selecting recycling containers, first decide how the recycling 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 together in one container (i.e. plastic, glass and aluminum)? Should containers have lids to protect the contents from spilling out and prevent rain water from getting in?

- When locating recycling containers, consider the amount and type of use in certain portions of the marina, the distance between the end of piers and dumpsters in the parking lot, the number of customers, etc. Possible locations for receptacles include: next to trash containers; the land-side foot of the dock; close to bathrooms and showers; next to vending

machines, fuel docks, and transient docks; and in the marina office and ship's store.

- Institute a recycling program for used oil 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. Commercial machinery designed to do this is available. It may be cost effective for a group of marinas in a busy harbor area to purchase the machinery for shared use. It may also be possible to work with an operation that already has the machinery, such as an automotive oil and lube station.

  Waste oil filters, if not recycled, must be managed as hazardous waste under the Maine Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage, and Disposal. Waste oil filters should not be discarded in the trash. For additional information contact Maine DEP, Bureau of Remediations and Waste Management at (207) 287-2651.

RECOMMENDED OPERATIONS

- Waste disposal and/or collection bins, dumpsters, and containers should be clearly marked, and accessible to patrons.

- Solid waste disposal areas should have signs that clearly spelling out the rules and regulations for disposal, including information about which materials are not acceptable for disposal at the site.

- The area surrounding solid waste collection facilities should be inspected daily or more frequently by marina personnel, and any waste should be cleaned up from the surrounding grounds.

- Dumpsters containing solid wastes from repair areas should be covered.

- Waste disposal areas should be conveniently located with respect to repair and maintenance areas.

- Any waste receptacles placed on docks or near the water's edge should be secured to prevent them from tipping over.

- Provide for separate receptacles for recyclable solid and liquid waste. Furnish containers for glass, recyclable plastics, scrap metal, aluminum, wood pallets, papers, cardboard, and other recyclables in clearly marked, accessible locations.

- Appropriate receptacles for waste oil and antifreeze should be provided.
- Use tarps and vacuums to contain and collect paint chips, sandings, and other debris from boat maintenance areas. Dispose of non-hazardous solids in a covered dumpster or other covered solid waste receptacle. Dispose of hazardous wastes in accordance with this manual.

- Regularly clean areas that collect wastes to prevent debris from falling or getting blown into the water. Cleaning with a vacuum is the preferred

method for collecting sandings and trash. Sandblasting debris should be collected and stored with the spent grit and removed frequently. Do not hose down decks or docks when it might wash debris into the drains or directly into the receiving waters.

- Reuse or recycle empty drums rather than dispose them as solid waste. If this is not possible, empty drums should be flattened and made unusable.

Marina operators are responsible for the contents of their dumpsters, and hazardous waste should never be placed in them. Dumpsters should be locked to prevent "midnight dumping." Refer also to the *spill prevention practices* on page 12-1, and the BMPs for storing and handling hazardous waste, page 11-1.

14. BOAT PUMPOUT

The discharge of untreated sanitary waste from boats into marine waters is a known pollution problem. Studies have documented a correlation between boating activity and elevated levels of fecal coliform, especially in areas of poor water circulation. In harbors where boats congregate, the total amount of sewage pumped overboard illegally may be considerable. Protected harbors, which are favored refuges for boaters, often have poor tidal flushing, making them particularly vulnerable to pollution from overboard discharges.

Sewage from urban sources and boats can pollute shellfish that are harvested and sold for human consumption. Coastal water quality is closely monitored by measuring levels of fecal coliform, which are used to indicate the amount of potential pathogens in the water column. Areas where fecal coliform reaches unsafe levels are closed to shellfishing. Swimmers may be exposed to viruses in these areas as well.

Since the adoption of the Clean Water Act in 1972, it has been illegal to discharge untreated waste into coastal waters. Similarly, under Maine law, it is illegal to discharge sewage or any other pollutants from boats into the inland waters of the state or into the ocean within three miles of the mainland.

Legally, waste has to travel through a Marine Sanitation Device (MSD), before being discharged; or it must be stored in a holding tank until it can be pumped out or discharged three miles offshore. In 1989, the Maine legislature required that all marinas serving coastal waters provide, directly or through contractual agreements, facilities to remove sanitary waste from boat holding tanks. This applies to any commercial facility with slip or mooring capacity for 19 or more vessels exceeding 24 feet in length. As of 1996, there were 26 pumpout facilities available at marinas around the state.

The Maine DEP, with funding from U.S. Fish and Wildlife, is providing grants to marinas, municipalities and boat clubs for new dockside pumpout facilities, and has funded the purchase and operation of a mobile pumpout boat on Casco Bay. The 75% to 25% matching grants are available through the Clean Vessel Act grant program. For information on the grant program, write the Maine DEP, 17 State House Station, Augusta, ME 04333.

DUMP STATIONS

Vessels utilizing portable toilet facilities require dump stations to dispose of accumulated sewage. A dump station consists of a receiving facility for sewage from portable toilets used on vessels and includes associated equipment and a storage tank. The device is typically comprised of a receiving basin with a lid (to control odors and insects), with provisions for rinsing the basin after the portable toilets are emptied. The device may discharge directly to a municipal sewer, a storage tank, or to a vehicle for transport.

PUMPOUT FACILITIES

Pumpout Installation

Pumpout facilities, whether mobile or fixed, are used to remove sanitary wastes from vessels for appropriate collection and treatment. Fixed pumpout facilities, including a holding tank and pump, are usually located at the end of a pier or dock, often on or near the fueling pier. Vessels access the facility by approaching and securing to the dock or pier. Mobile facilities, rather than being centrally located, consist of a small vessel with a holding tank and pump, which serves boats at their moorings or slips. Pumps, which are typically electrically driven, pump wastes to a central storage tank through a flexible hose with a universal fitting attached to the boat deck. Wastes are then hauled off site for treatment at a wastewater treatment plant or may, in some cases, be treated on-site using properly designed septic systems. Note that the chemicals used in vessel holding tanks may adversely affect the function of typical septic systems.

Every marina facility that stores boats greater then 25 feet in length is encouraged to install a pumpout system because they may be more readily used if available. Customers may want to keep their boats moored or docked in areas where they can easily pump out their holding tanks or empty portable toilets.

Different types of manufactured pumps have individual characteristics that need to be considered when deciding which is best for a particular site. The basic criteria used in pump selection are the pump's capacity and the distance, both in height and length, that it can move waste through a pipe. Other considerations may include durability and ease of operation and maintenance.

Pumpout stations can either be fixed, mobile, or remotely 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. Portable systems include a pump and an small storage tank. Mobile pumpout boats work particularly well in areas with a large number of boats on moorings, such as Casco Bay. Aside from choosing the type of pumpout most suitable for your facility, two other considerations are important: the location of the pumpout and the disposal of the collected waste.

Fixed stations are permanently mounted in a location within the marina in an area that is accessible to boaters, generally near a fueling dock. Remote stations provide a direct hookup to multiple locations or each slip within a facility. These systems are expensive, but provide a convenient means for customers to pump out their holding tanks, particularly if they live aboard their boats. Fixed and remote stations must be directly attached to either a sewer line or a holding tank. Less common are slip-side systems which provide continuous wastewater collection; these are most often used for resident slips.

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. Total costs include engineering and permit fees; pumpout machinery and pipes; and excavation and installation charges.

A helpful guide on the installation and operation of pumpout stations has been completed by the Maine Coastal Program. The guidebook provides a partial list of portable, stationary, and remote pumpout units available, according to manufacture's model. A copy of Marine Sewage Pumpout Facilities: A Guidebook for Marinas and Municipalities on Maine Waters can be obtained by writing the Maine Coastal Program, Maine State Planning Office, 38 State House Station, Augusta, ME 04333.

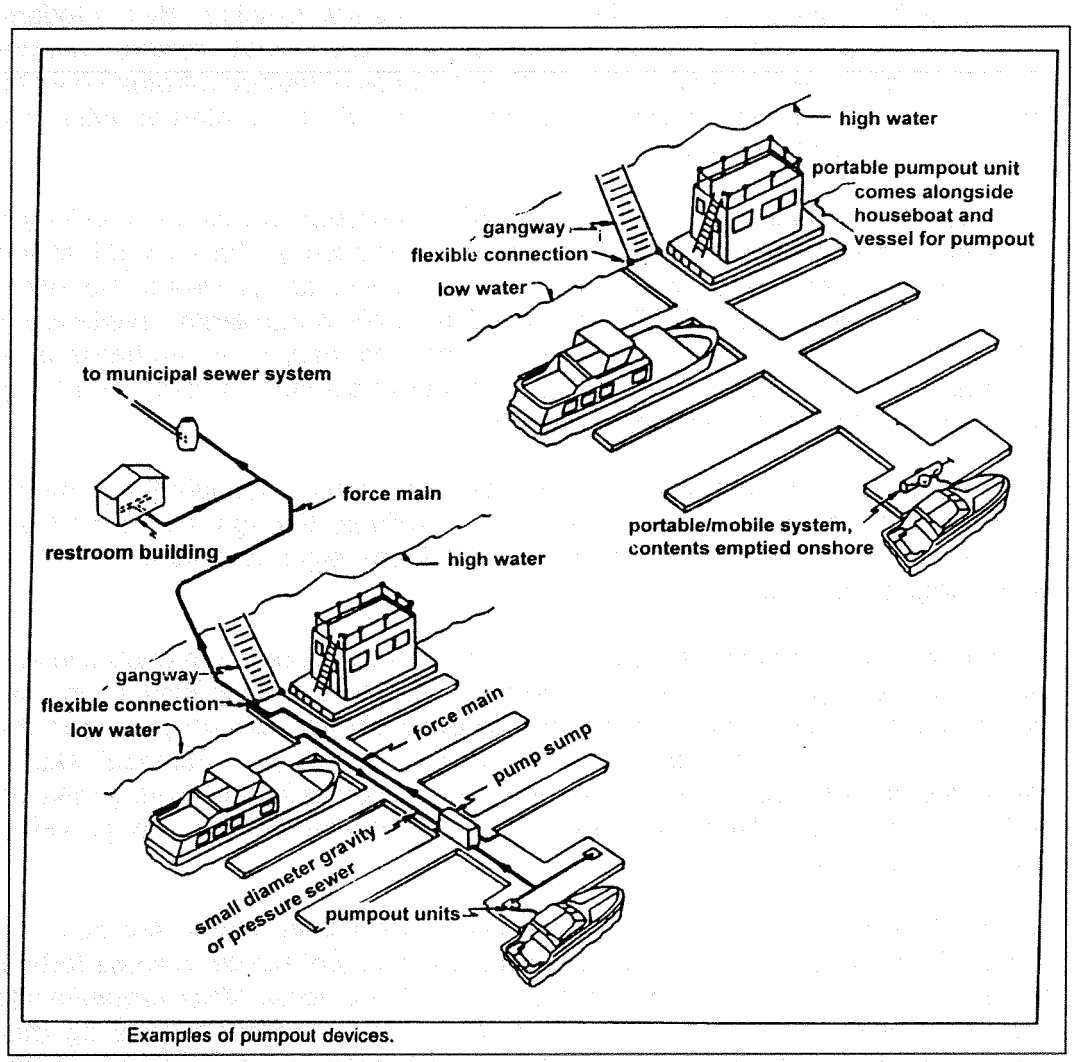


FIGURE 12. PUMPOUT FACILITIES

Pumpout Operation

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 operation procedures as well as the rules pertaining to marine sanitary devices (MSDs) and no-discharge areas.

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. Maintain a regular inspection and maintenance schedule for the pumpout station; failing to do so may make the pump station fail.

Work with local and state governments to declare your harbor a no-discharge area once the required number of pumpout facilities are installed. By the federal definition, no-discharge areas are zones of water that require greater environmental protection – where even the discharge of treated sewage could be harmful. 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 onboard marine sanitation device that can legally be used is an approved Type III MSD (with a holding tank). Type I and II MSDs (on board treatment systems using macerator/chlorinators) 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, a no-discharge area designation can significantly reduce the amount of bacterial contamination being introduced by the illegal discharge of MSDs.

If you operate a pumpout facility, install adequate signs to identify the pumpout station and its location. Standard signs are available through the EPA's Near Coastal Waters Program. You should obtain these signs and post them near each pumpout station.

Other pertinent information should be posted, such as hours the of operation and fees. 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.

Monitor boaters' use of pumpout services. The Clean Water Act sets the standards for MSD operations and provides enforcement power to some federal and state entities. Local harbormasters may also enforce MSD requirements and fine violators, when necessary. Work with your harbormasters so they understand the importance of enforcing existing rules and regulations. If you know of any violations, report them immediately to the proper authority. To enforce MSD requirements:

- Place a dye tablet in the holding tanks that will be released if an overboard discharge occurs;
- Inspect Y valves to ensure they are sealed; and
- Inspect MSDs and ensure they are properly operating

ONSHORE WASTEWATER DISPOSAL FACILITIES

Pumpout facilities and on-shore wastewater disposal facilities can contribute to nonpoint source pollution in coastal waters if they are not used and maintained properly. The following management practices should be employed for all pumpout facilities, including fixed, mobile or slip-side pumpouts:

- Hoses, fittings, pumps, and other accessory equipment should not be washed on the pier, dock or shore so that rinse water discharges directly into the marina basin or into surface or ground water.

- Sanitary waste from vessels should not be discharged to an on-site septic system unless the system has been specially designed to handle waste from vessels.

- Waste holding tanks, if they are above ground, should be secured and have a secondary containment area, including a concrete pad. This containment area should be inspected weekly to check the integrity of the tank and any connecting pipe and fittings.

- Pumpout facilities should only be operated by trained marina personnel.

- Pumpout facilities and regulations should be clearly posted at the marina. Fees charged should encourage rather than discourage the use of the facilities. Where these facilities are convenient to fueling facilities, the cost of maintaining pumpouts can be offset by fuel sales.

SEPTIC SYSTEMS

In cases where no municipal sewer system is available, or connection to existing sewer lines is too costly, on-site wastewater treatment using conventional septic systems is common. When properly sited, designed, and maintained, septic systems can provide adequate treatment of sanitary wastewater. Local and state health regulations should ensure the proper siting and design of on-site septic systems. However, these systems are often not properly maintained over the long term. Alternative on-site wastewater treatment systems (e.g. recirculating sand filters, RUCK system, etc.) may need to be considered to enhance phosphorus or nitrogen removal on sites adjacent to poorly flushing coves, embayments, or harbors where nutrients pose a significant problem. Following are recommended practices to ensure the proper long term functioning of septic systems:

- Unless specifically designed to handle sanitary waste from vessels with holding tanks, such waste should not be discharged to septic systems.

- Provide a system that serves the combined flows from on-shore bathroom facilities and the pump-out facilities, so that MSD wastes are diluted by ordinary domestic sanitary flows.

- Provide two septic tanks in series to help segregate solids in the first tank and increase retention time in the system, allowing for more complete waste decomposition.

- Do not pave, allow vehicular traffic, or dispose of dredge spoils over septic tank leachfields, unless the disposal systems are specifically designed for this loading.

- Stormwater runoff, including runoff from rooftops and pavement, should be directed away from the leachfield to prevent inundating the field.

- Tanks should be pumped out regularly to prevent overflows and clogging of the leachfield.

- Prohibit the disposal of fats, solvents, oils, disinfectants, paints, poisons and other hazardous materials, diapers and other similar products in drains or toilets.

- Promote water conservation to reduce the total waste flow to the system.

- Post signs notifying patrons of pertinent rules and regulations.

- Sanitary sewage facilities should be provided at all existing marinas, and marina expansions should not be permitted without adequate septic systems in order to avoid the necessity for on-site storage and disposal in coastal areas.

- Provide clean, conveniently located shore-side bathroom facilities to reduce marina patrons' reliance on vessel facilities while in port.

- Provide facilities for transferring sewage from vessels to shore-side storage and disposal, pumpout facilities to empty vessel holding tanks, and dump stations to dispose of sewage from portable toilets used on vessels.

- When on-site disposal is necessary, marinas should provide buffer areas between sewage disposal systems and waterbodies, and reserve suitable upland soils for leaching fields.

APPENDIX A : REGULATIONS

Like all other Maine businesses, marina and boatyards' operators must comply with environmental regulations. Unlike other businesses, marinas and boatyards have a unique relationship with the state's lakes, rivers bays and estuaries. The use of these waters carries with it a special responsibility: to protect these valuable resources.

FEDERAL LAWS

Congress attempted to address the problems associated with nonpoint source pollution by passing both the Clean Water Act and the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). Amendments to the Clean Water Act in 1987 also sought to address polluted runoff, but took a less regulatory approach. Under the Clean Water Act, states were to develop a report identifying the waters affected by polluted runoff, and carry out a plan to prevent and reduce the pollution. Some federal funds are available for demonstration mitigation projects.

Section 6217 of CZARA requires coastal states to develop a nonpoint source pollution control program that uses enforceable policies to prevent and reduce polluted runoff. According to federal law, the state program must incorporate management measures "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." CZARA requires states to coordinate their programs "closely with existing Clean Water Act programs and with approved coastal zone management plans."

The state of Maine brought together representatives from government, business, environmental advocacy groups, and engineers and consultants to form advisory groups on major nonpoint sources. The goal for each group was to evaluate and improve Maine's existing regulations and nonregulatory programs that seek to control polluted runoff. The Maine State Planning Office (SPO) and the Maine Department of Environmental Protection (DEP) convened groups from the forestry, agriculture, urban development, transportation and marina sectors. Thus, marina operators must also comply with federal laws and regulations which include Nonpoint Pollution Discharge Elimination System (NPDES), Clean Water Act (CWA 404), etc.

STATE LAWS

Principal state laws that address polluted runoff are: 1) the Natural Resources Protection Act, 2) the Stormwater Management law, and 3) the Water Pollution Control law. Marinas and boatyards are also regulated by municipalities through the shoreland zoning and growth management ordinances. Additionally, the Board of Pesticide Control of the Maine Department of Agriculture regulates anti-fouling paints containing tributyltin, the Department of Human Services administers subsurface wastewater disposal rules, the Land Use Regulation Commission (LURC) administers unorganized territories, and the Department of Conservation administers submerged land leases.

WHICH REGULATION?

A good rule of thumb is that if a business generates any waste, it is likely to be subject to an environmental regulation. The obvious wastes subject to regulation are hazardous wastes, air emissions, sewer discharges and solid wastes. For each or these wastes, there are a number of regulations at the local, state and federal levels. The more dangerous the material is to the environment or human health, the more complex the regulations. Hazardous materials resulting in hazardous wastes are regulated in terms of shipping or transport, storage and labeling, employee exposure, treatment and disposal, and long-term liability. These regulations involve many agencies such as the US. Environmental Protection Agency, Maine Department of Environmental Protection, Maine Department of Transportation and the Occupational Safety and Health Administration.

This appendix provides a short description of all regulations which may apply to the operations and siting of boatyards and marinas in order to comply with federal and state regulations while implementing pollution abatement practices. An address and contact is provided at the end of each section so that you may obtain applicable regulations, license applications, or instructions.

NRPA Requirements

The Natural Resources Protection Act (NRPA) regulates activities in, on, over, or adjacent to protected natural resources: coastal wetlands; sand dunes; freshwater wetlands; great ponds; rivers, streams and brooks; fragile mountain areas; and significant wildlife habitat. The NRPA recognizes the state significance of these natural resources in terms of their recreational, historical, and environmental value to present and future generations. The Act's intent is to prevent any unreasonable impact, degradation or destruction of the resources and to encourage their protection or enhancement.

WHAT ACTIVITIES REQUIRE AN NRPA PERMIT?

Permits are required for certain activities (1) in, on, or over a protected natural resource and (2) on land adjacent to any great pond, river, stream or brook, coastal wetland and freshwater wetlands that may cause material or soil to be washed into those resources.

Generally, a permit is required if work disturbs soil within 100 feet of a protected natural resource. The definitions of each of the protected natural resources are contained within the law. In most cases, determining whether or not your project is in the resource itself (a great pond, for instance) is not difficult. However, identifying the boundary of a resource can be more of a problem. In particular, determining wetland boundaries may require technical expertise. If you are unsure about whether or not an NRPA permit is required for your project, contact the appropriate DEP office and arrange for a staff visit.

Activities that may be regulated include:

- dredging, bulldozing, removing, or displacing soil, sand, vegetation, or other materials;
- draining or otherwise dewatering;
- filling; and

- constructing, repairing or altering any permanent structure (permanent structure is one placed or constructed in a fixed location for a period exceeding 7 months of the year).

To receive an NRPA permit, the applicant must demonstrate that the proposed activity will not:

- unreasonably interfere with existing scenic, aesthetic, recreational, or navigational resources;
- cause unreasonable erosion of soil or sediment, or prevent naturally occurring erosion;
- unreasonably harm any significant wildlife, fisheries or aquatic habitat;
- unreasonably interfere with the natural flow of any surface or subsurface waters;
- lower water quality;
- cause or increase flooding;
- unreasonably interfere with the supply or movement of sand to dune areas; or
- cross a river segment identified in the NRPA as "outstanding" unless no other alternative having less adverse impact on the river exists.

HOW DO NRPA PERMITS ISSUED BY THE DEP RELATE TO OTHER PERMITS?

DEP permits do not incorporate or supersede any other state, federal or local permits. Be sure to check with your own town and the DEP to find out what other permits are required for your proposed activity. The U.S. Army Corps of Engineers is the most common federal agency involved with projects located in waterways and wetlands. The Corps' Maine Field Office can be reached at (207) 623-8367. For some activities that only affect freshwater wetlands, a joint application for both the state and federal permits is available through the DEP.

For additional information, contact the DEP office closest to you, and ask specifically for a staff person in the NRPA program.

Maine Department of Environmental Protection:
Portland – 312 Canco Road, Portland, ME 04103 (207) 822-6300
Augusta – 17 State House Station, Augusta, ME 04333 (207) 287-2111
Bangor – 106 Hogan Road, Bangor, ME 04401 (207) 491-4570

NPDES Permit

In 1987, the United States Congress enacted a two phase stormwater permit program under section 402(p) of the Clean Water Act. Under phase I of the program – the National Pollutant Discharge Elimination System (NPDES) – permits are required for stormwater discharges associated with certain industrial activities performed at marinas and boatyards. The Environmental Protection Agency published a rule implementing Phase I on November, 1990.

Under the NPDES Stormwater Program, a discharge permit is required for point source discharges of stormwater from marina and boatyards. A point source discharge of stormwater is a flow of rainfall runoff in some kind of discrete conveyance (a pipe, a ditch, channel, swale, etc.).

A marina primarily in the business of renting boat slips, storing, cleaning, and repairing boats, and which generally performs a range of other marine services is classified under the the Standard Industrial Classification (SIC) system as a SIC 4493. A SIC 4493 marina is required to obtain an NPDES stormwater discharge permit if boat maintenance activities are conducted on the premises. The stormwater permit will apply only to the point source discharge of stormwater from the maintenance areas at the marina. Operators of these types of marinas should apply for a NPDES permit through the Environmental Protection Agency. The following list of activities are regulated under the NPDES stormwater permit:

Pressure washing: Washwater contains contaminants such as paint solids, heavy metals and suspended solids and must be treated before release into the environment.

Hull maintenance: Surface preparation, paint removal by mechanical sanding, abrasive blasting, grinding, paint spraying, and paint clean-up will generate regulated wastes and pollutants such as paint solids, heavy metals, spent solvents and dust.

Engine Maintenance and Repairs: Cleaning fluids, greasy rags, batteries and potential spills are petroleum- or solvent-based wastes and contain heavy metals, oil and detergents.

Material handling: The fueling area and the liquid storage area are where spills, leaks, overfills and piping system failures may occur. The pollutants may be fuel, oils, and solvents.

Shipboard processes: When inapropriately discharged to stormwater drainage or receiving water, process and cooling water, sanitary waste, bilge and ballast water may pollute surface water by biochemical oxygen demand, bacteria, suspended solids, oil and fuel.

For additional information, contact the DEP and ask specifically for a staff person in the NPDES program:

Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333
(207) 287-2111

The application for a NPDES stormwater pollution prevention permit must include the following:

- the identification of the pollution prevention team;
- the description, location and inventory of potential pollutants and a list of potential pollutant sources;
- a stormwater control plan that includes: 1) a "good housekeeping plan" for the pressure washing area, the blasting and painting area, the material storage and handling area, the engine maintenance area, the dry dock area, and the general

yard; 2) a preventive maintenance plan; 3) a spill prevention and response procedures plan; 4) an inspection log; 5) an employee training plan; 6) recordkeeping and internal procedures; 7) a list of all non-stormwater discharges and sources; and 8) a plan for control of sediment, erosion, and runoff; and

- a comprehensive site compliance evaluation plan for all the above.

Section 413

Here's another State law that affects boatyards and marinas' operations. Section 413 requires that no person may directly or indirectly discharge or cause to be discharged any pollutant into state waters without first obtaining a license from the Department of Environmental Protection. A discharge means any spilling, leaking, pumping, pouring, emptying, dumping, disposing or other addition of any pollutant to waters of the State. A pollutant is considered to be dredged spoil, solid waste, incinerator residue, sewage, refuse, effluent, sewage sludge, munitions, chemicals, biological or radiological materials, oils, petroleum products or by-products, heat, discarded equipment, rock, sand, dirt and industrial, municipal, domestic, commercial, or agricultural wastes of any kind.

The department may grant a permit to construct, maintain and operate any facility necessary to comply with the terms of that license in, on, above or under tidal waters or sub-tidal land of the State. However, the facility must not interfere with navigation, the development of conservation of marine resource, the scenic character of any coastal area and existing public use of such area or the health and safety of the public. Violators are subject to state and federal enforcement actions, which may include monetary penalties if the discharge is found to be willful.

For additional information, contact the DEP and ask specifically for a staff person in the Water Resource Regulation program:

Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333
(207) 287-2111

Shoreland Zoning

The Mandatory Shoreland Zoning Act requires all municipalities to establish zoning ordinances for land within 250 feet of great ponds, rivers, tidal areas, and freshwater and coastal wetlands. The law also requires those ordinances to apply to areas within 75 feet of streams defined as "an outlet of a great pond or the confluence of two perennial streams as shown on the most recent edition of a USGS topographic map." Within the shoreland zone, permits are required from the municipality (usually the planning board) for any new marina or expansion (including new structures).

Marinas are considered to be water-dependent uses and, therefore, in most cases are not subject to the same setback standards as those for non water-dependent uses. Most local ordinances have no minimum water setback standard for marina structures.

Most shoreland zoning ordinances also regulate structures and activities which extend into and over the water. This would include boat ramps, piers, docks, and floats. Again, most ordinances have limited construction standards for piers, docks and floats. For instance, the facility must be no larger in dimension than necessary to carry on the activity, and must be consistent with the existing conditions, use and character of the area. Also, the facility cannot interfere with existing developed or natural beach areas, and must be located so as to minimize adverse effects on fisheries. Furthermore, only structures which require direct access to the water as an operational necessity may be constructed on a pier, dock or float, and the height of that structure may be limited.

Other land use standards also apply to marinas in the shoreland zone. On tidal waters, a new marina must have at least two hundred feet of shore frontage and at least 40,000 square feet of lot area, unless the area is zoned as a Commercial Fishing/Maritime Activities District, in which case there may be no minimum frontage and lot size standards. Parking areas associated with marinas must meet the setback requirement for non water-dependent structures, except in the Commercial Fisheries/Maritime Activities District, where the setback is usually 25 feet.

Any person wishing to establish a new marina in an inland or coastal area should contact the local code enforcement officer for details of the local permitting requirements.

Stormwater Management Law

Under the State of Maine Site Location Law, 38 M.R.S.A. § 481-490, most boatyards and marinas are not regulated because of their small size; but a new state stormwater law (38 M.R.S.A. § 420D) went into effect in July, 1997. A new or expanded boating facility will now require a permit from the Department of Environmental Protection prior to construction if it is located in the watershed of a body of water most at risk and includes:

- 20,000 square feet or more of impervious area, or
- 5 acres or more of disturbed area.

In any other area, the new or expanding facility requires a permit if it will include:

- one acre or more of impervious area, or
- 5 acres or more of disturbed area.

Stormwater should be handled within the area of the facility in order to conduct surface runoff away from critical site features and to a suitable outlet. This is generally accomplished by site grading, vegetation and/or routing the water flow into a properly designed stormwater system. Traditionally, storm drainage systems consist of roadside gutters or ditches, catch basins or other inlets, storm drain pipes, culverts, and channels and "improved" natural waterways.

Stormwater runoff should not exceed the capacity nor diminish the quality of the receiving watercourse. Water quality can be protected through a number of measures, generally referred to as water quality Best Management Practices (BMPs), such as, swales, vegetated buffers, and sweeping the pavement. All BMPs aim to prevent the generation and release of pollutants, limit their transport, or remove them from the stormwater discharge.

Stormwater runoff should not cause erosion of surficial soils. Exposed soil should be stabilized immediately with vegetation. Runoff discharged into a receiving ditch should not erode the vicinity of the outlet, and finally, discharged runoff should not cause bank erosion or sedimentation of the receiving water body. Stormwater runoff management and erosion and sedimentation control BMPs are presented in Chapters 3 and 4 of this manual.

For additional information, contact the DEP office nearest you and ask for a staff person in the Stormwater Program.

Maine Department of Environmental Protection:
Portland – 312 Canco Road, Portland, ME 04103 (207) 822-6300
Augusta – 17 State House Station, Augusta, ME 04333 (207) 287-2111
Bangor – 106 Hogan Road, Bangor, ME 04401 (207) 491-4570

Hazardous Wastes Regulations

The United States Congress enacted the Resource Conservation and Recovery Act (RCRA) in 1976, to protect public health and the environment from the improper management of hazardous waste. This Act directs the US Environmental Protection Agency (EPA) to issue federal regulations pursuant to RCRA in the Code of Federal Regulation (CFR) Title 40, Parts 260 through 270. The state of Maine has authorization from Environmental Protection Agency to implement its own RCRA program. Maine's "Hazardous Waste Management Rules" are stricter than the federal regulations.

All facilities which generate wastes are required to identify their wastes and to determine if they are hazardous. Waste may be determined to be hazardous if it exhibits a hazardous characteristic, or if it is a listed waste. A generator must obtain a permit if the following criteria are met:

Small quantity generator (SQG) An SQG is a facility that generates less than 100 kilograms of hazardous waste per month (approximately 27 gallons or 1/2 drum of waste) AND accumulates no more than 55 gallons (1 drum) of hazardous waste on site at any one time.

The following management requirements must be met by each SQG:

1. Determine which of your wastes are hazardous.
2. Store hazardous wastes in containers of 55 gallons or less.
3. Label each container as "Hazardous Waste."
4. Label each container with the date it is first used to store waste and the date it is filled.
5. Ship each full container off site within 180 days of filling.
6. Use a hazardous waste manifest form.
7. Use a hazardous waste transporter, licensed by the state of Maine.
8. Send the waste to a licensed, authorized hazardous waste facility.
9. Report any discharge or spill of hazardous waste or matter to the DEP.
10. Do not treat hazardous waste unless licensed to do so.

SQG Plus An SQG Plus generates less than 100 kilograms of hazardous waste per month. An SQG Plus license has additional regulatory requirements in addition to those that SQGs must comply with.

Generators A generator produces more than 100 kg per month, OR accumulates more than 600 kg of hazardous waste on site at any one time.

Additional informational material and the Maine Hazardous Waste Management Rules are available through:

Bureau of Remediation and Waste Management
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
(207) 287-2651

Underground Storage Tank Regulations

All underground fuel storage tanks (USTs), piping, and related equipment must be registered with the DEP (38 M.R.S.A., §564.2-A.H). Amended registrations must also be filed whenever there is a change in facility registration information, such as ownership or operational status. All repairs to UST facilities must be registered with DEP at least 5 business days prior to work being done and must be performed by a Maine Certified Tank Installer (CTIs).

Registration forms and lists of CTIs are available from:

Bureau of Remediation and Waste Management
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
(207) 287-2651

Tank Installation

All new and replacement USTs must:

- have secondary containment and continuous electronic monitoring of the interstitial space for all tanks, piping, and ancillary equipment;
- be constructed of fiberglass, cathodically protected steel, or other equally non corrosive materials approved by DEP; and
- be installed by a Certified Tank Installer.

Spill Management

Any evidence of a leak or discharge from a UST facility must be reported to the DEP as soon as possible, but no later than within 24 hours. Examples of evidence of a leak include: unexplained fluctuations in product inventories, accumulation of water in an

UST, failure of precision tests, actual discovery of leaks or discharges, and others included in, but not limited to Chapter 691.5.D. and 38 M.R.S.A., §564.2-A.H.

Financial Assistance for Clean-up

Owners/operators of UST facilities that are discharging petroleum may apply to the Groundwater Oil Cleanup (Insurance) Fund for financial assistance for site remediation. Up to $1 million is available toward reimbursement of eligible costs. Applicants must apply within 180 days of reporting the discovered discharge. Deductibles assessed under the Insurance Fund are based on the number of facilities owned and on compliance with applicable UST laws and regulations.

To obtain additional information, contact:

Bureau of Remediation and Waste Management
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
(207) 287-2651

Above-ground Storage Tank Regulations

Tank Installation

Above-ground petroleum storage tanks (ASTs) are fuel tanks with a capacity of less than 660 gallons located more than 90% above ground. ASTs are regulated by the State Fire Marshall's Office.

For more information on AST requirements call:

State Fire Marshall's Office: (207) 624-8744

Spill Management

Any evidence of a leak or discharge from a storage tank (as defined in Chapter 691.5.D. and 38 M.R.S.A., §564,2-A.H.) must be reported to the DEP within 24 hours. All surface discharges must be reported to DEP within 2 hours. Spills, leaks, or discharges are to be reported to the Department at 1-800-482-0777 statewide, 24 hours per day, 7 days per week.

Even though Maine DEP rules do not apply to the design and installation of above-ground heating oil tanks (typically 275 gallon tanks), DEP responds and supervises the clean up of several hundred spills each year from these tanks. Most result in soil and basement clean-ups, but several spills each year have contaminated drinking water wells.

To obtain additional information, contact:

Bureau of Remediation and Waste Management
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
(207) 287-2651

USED OIL COLLECTION CENTERS

The Maine Legislature passed a law (PL 1995 Ch. 573) in 1996 to encourage used oil recycling. It provides incentives for establishing centers where used oil can be collected from the public.

If you wish to establish a used oil collection center, you may be eligible to obtain low interest loans or grants for purchasing above-ground used oil storage tanks. The loan program is administered by the Finance Authority of Maine (FAME).

In addition, the new law encourages collecting used oil from the public by reducing the potential financial risks of used oil contaminated with hazardous waste. This law offers some relief under those circumstances is you design and operate your center as the law proscribes, and if you register your operation with DEP. Registration is strictly voluntary, but to qualify for the relief described above, it is necessary.

To obtain additional information, contact:

Bureau of Remediation and Waste Management
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
(207) 287-2651

SPILL PREVENTION , CONTROL AND COUNTERMEASURE (SPCC) PLAN

The Federal SPCC rules (40 CFR Part 112) were adopted in 1972 under the Clean Water Act to protect against surface water contamination from petroleum storage tanks greater than 660 gallons, and facilities storing an aggregate volume of more than 1,320 gallons above ground or 42,000 gallons underground. The SPCC rules are further limited to tanks and facilities that could produce a discharge into a navigable waterbody. The Clean Water Act definition of "navigable waters" has been broadly interpreted to include all facilities meeting the volume requirements that could impact such water bodies either directly or indirectly via tributaries, sewers and groundwater. The definition of "navigable waters" includes not only water courses used for transport, but also those used for public recreation.

An SPCC plan is a comprehensive "living document" that has full management approval. It is developed using good engineering practices and is required before a

facility design can receive professional engineering certification. The plan must be updated if any pertinent modifications or procedures are made to the facility. The plan must also be recertified every three years.

Even though the SPCC rules are strictly a federal program with no state authorization, the DEP uses them frequently as review guidelines for groundwater/surface protection plans in Site Location law and Land Use Regulation Commission permit reviews.

Additional information may be obtained from:

Bureau of Remediation and Waste Management
Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017
(207) 287-2651

Pesticide Application

Commercial facilities that construct, store, maintain, repair or refurbish vessels and independent marine maintenance contractors who use antifouling paints must be aware of the regulations concerning antifouling paint. Antifouling paint means a compound, coating, paint, or treatment used for the purpose of controlling freshwater or marine fouling organisms on vessels, wooden lobster traps, fishing gear for marine waters, floats, moorings or piers. This compound may contain tributyltin, considered a pesticide. The Board of Pesticides Control is the enforcement agency for all pesticide regulations.

Prohibition on the Use of Tributyltin

Under 38 M.R.S.A. §419-A, no person may distribute, possess, sell, offer for sale, apply or offer for application any substance that contains a tributyltin compound in a concentrated form or that is labeled for mixing with paint or solvents to produce an antifouling paint. An exception to this prohibition can be made for the owner or agent of a commercial boatyard who may purchase, possess and apply an antifouling paint containing tributyltin compounds if it is applied only within the boatyard and is applied to vessels exceeding 25 meters (82 feet) in length or have aluminum hulls. The paint's release rate must be measured at less than 4.0 micrograms per square centimeter per day at steady state conditions.

The sale, application or possession of antifouling paint containing tributyltin compound is not regulated if it is contained in a spray can of 16 ounces or less, and is used on outboards or lower drive units.

Pesticide Applicator's License

A commercial license is required for the application of any restricted or limited use pesticide (38 M.R.S.A. §258-A, Sec.1471-D). All antifouling paints for vessel hulls and other marine structures to inhibit the growth of aquatic organisms are included in this category. A license is needed if one for the following criteria is met when the pesticide is applied for :

a. the pesticide is being used for any purposes other than producing an agricultural commodity;
b. the pesticide application is a service for which compensation is received; or
c. the application is occuring on sites open to the public.

The commercial applicator/operator certification is the minimum license required for individuals employed as technicians under the supervision of a licensed master applicator. The operator's license is in effect only if the employing company or organization has at least one licensed master applicator. The commercial applicator/master certification is required for one individual within each company. This license is generally intended for the owner, supervisor or manager as long as it is the person responsible for major pest control decisions, for establishing policies related to proper pesticide application, and for employee training and overall work practices.

For additional information, please contact:

Gary Fish
Pesticide Control Board
Department of Agriculture
28 State House Station
Augusta, ME 04333-0028
phone # (207) 287-2731

Pumpout Regulations

Since the adoption of the Clean Water Act in 1972, it has been illegal to discharge untreated waste into coastal waters. Similarly, under Maine law, it is illegal to discharge sewage or any other pollutants from boats into the inland waters of the state (38 M.R.S.A. § 423-B). Legally, waste has to travel through a Marine Sanitation Device (MSD), before being discharged or held in a holding tank until it can be pumped out or discharged offshore.

No person, firm, corporation or other legal entity may discharge, spill or permit to be discharged sewage, garbage or other pollutants from watercraft (as defined in M.R.S.A., 38 § 423, Title 12, section 7791, subsection 14) into inland waters of the state, on the ice of these same lakes, or on their banks so that undesirable wastes may be washed into Maine surface water, or so that the discharge may flow into Maine surface water.

Watercraft Sewage Pumpout Facilities at Marinas

Marinas serving coastal waters must provide a facility to remove sanitary waste from the holding tanks of watercraft, or make such a facility available through contractual agreements (38 M.R.S.A. § 423-B). The term "marina" means any commercial facility that provides supplies and services, and has the capacity to provide slip space or mooring for 18 or more vessels that exceed 24 feet in length. As of 1996, there were 26 pumpout facilities available at marinas around the state.

Discharge of Waste from Watercraft

By the same token, any watercraft having a permanently installed sanitary waste disposal system is required to retain all sanitary wastes in the disposal system, holding tank or suitable container so as to prevent its discharge or drainage into the inland waters of the state.

The Maine State Planning Office, with funding from US Fish and Wildlife Services through the Clean Vessel Act grant program, is providing grants to marinas, municipalities, and boat clubs for dockside pumpout facilities. There is a 25% matching requirement.

For additional information contact the DEP and ask specifically for a staff person in the Pumpout Program.

Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333
(207) 287-2111

APPENDIX B : BOAT WASHING TREATMENT SYSTEM DESIGN

The submerged portion of the hull of marine vessels is coated with an anti-foulant-paint which is toxic to marine organisms. The paint contains copper and other pesticide ingredients to prevent shell fish and algae from growing on the underwater areas of boats or other marine structures. Designed to continuously deliver these toxic ingredients into the water, significant amount of the paint can also be released to the environment when the underside of boats are pressure washed if the wash water is freely infiltrating into the ground surface or running-off into natural buffers. This activity will concentrate particles of copper and other heavy metals in the ground in the vicinity of the washing area.

This appendix describes a small collection and treatment system for boat washwater to demonstrate that washwater treatment can be managed effectively, simply, and in a cost-effective manner. This technology would promote washwater treatment at boatyards and marinas in Maine without the need for regulations. The Department of Environmental Protection will oversee the demonstration project.

The treatment plant will contain the water, and settle the larger paint particles and marine sediments (i.e., seaweed, shells and sand) in a sump. The water will then be processed for the removal of finer particles by filtration through a manufactured filter system which will strip the water to meet ambient water quality criteria (AWQC), allowing it to be discharged in a stormwater drainage ditch or into an infiltration system. The washwater could also be discharged into the local stormwater system, if available.

Ideally, the treatment system will be fully passive (i.e., with no mixing of chemicals or pumping components), and if the site layout permits, with gravity water flow. This will have to be determined based on site elevations. The cost associated with a passive treatment system will be minimal. With a pumped system, costs will be only slightly more.

The alternative to this simple passive filtering device is a mechanical wastewater treatment system (e.g., Novachem "Flow Through Clarifier" or Alikota water recycling system). The concern with such systems is the cost – approximately $10,000 or more. When a marina or boatyard is operating only 4 to 5 months of the year, or washes only a dozen or so boats every year, this kind of investment is not justifiable.

PROPOSED CONSTRUCTION DESIGN

The installation of the demonstration project will involve the construction of a bermed and paved concrete pad with a collection trough and catch basin connected to a small filtering system placed in a sump. Because boatyards and marinas in Maine do not serve a large number of boats, the disposal of the water could be directed either directly into a buffer, stormwater drainage system, or into an infiltration trench.

The lay-out of the proposed design is shown in Figure B-1.

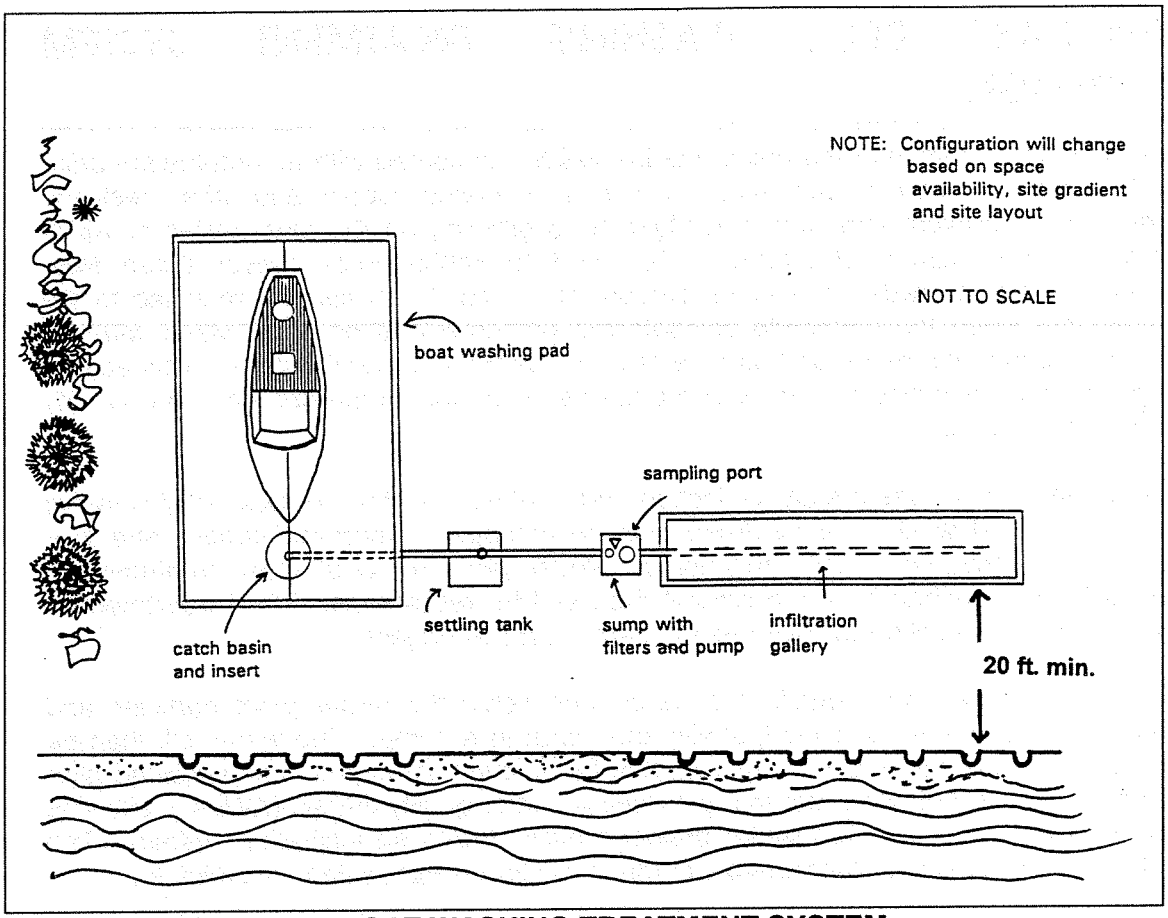


Figure B-1. DESIGN OF BOAT WASHING TREATMENT SYSTEM

1. **PAD** An impervious slab of either concrete or bituminous pavement will be built beneath the area designated for washing boat hulls. Its size will be adequate to collect all the dripping water from the largest boats. It should slope to the center a minimum of 5%, and toward a catch basin 5 to 7%. Curbing will be installed around the perimeter of the slab.

The site plan and pad design are shown in Figures B-1 and B-2.

2. **CATCH BASIN** A catch basin will be installed under a grate at the lowest point in the slab. It is designed to settle any sea shells, sand and gravel, and to filter floating marine debris. The bottom elevation of the catch basin will be a minimum of 3 feet above the highest tide for the site.

   If site gradient and elevation differential will not permit gravity water flow, a sump pump may be necessary to pressurize the water through the filtration devices. The catch basin will be cleaned, and the pump maintained, on a regular basis.

3. **SEDIMENT FILTRATION** To remove large debris and sediments from the water stream, a filter bag insert will be installed in the catch basin. An insert or bag filter can be cost effective, disposable, easily cleaned or replaced, and works passively to remove up to 96% of total suspended solids which are 15 microns or larger.

The filter should be cleaned and/or replaced as needed during the boat washing season when it is full, or if water flow through the filters is slowed by clogging The filter contents may be able to be disposed of in a public landfill. However, the contents of the first bag during the pilot test will be analyzed to confirm which disposal method is most appropriate.

Water exiting the catch basin will be sufficiently stripped of fine sediment and metal particulates to be processed in the proposed water treatment filters.

4. **FINAL FILTRATION DEVICE** All final filtration devices are located in a sump after the catch basin. If the water cannot flow through the filters by gravity, a pump will be needed.

   Water flows first through a particulate filter to reduce turbidity in the water which otherwise could cause clogging. The proposed particulate filter is a regular household cartridge filter rated at 6 gallons per minute and with a 5 microns filtering capability.

   Final treatment of the washwater occurs in a cation exchange resin filter. The canister has a 2 cubic foot capacity and is filled with a reactive resin. Water exiting the filter should be free of metals (copper in particular) and below AWQC. The resin filter may or may not need replacement at the end of the boat washing season. For the pilot test, the resin filter will be evaluated at that time and if it needs replacing, the resin pellets will be emptied and replaced. The material removed can be disposed of in a public landfill. As part of this project, the Department will test the water initially, at the end of the season, and the following year to confirm the system's effectiveness.

DESIGN VARIATIONS

Based on site constraints, the proposed design can be altered in some respects. The following discussion anticipates some possible implementation needs.

1. **SETTLING TANK** Depending upon the volume of water used for washing, the quantity of water needing treatment, the flow capacity of the filtering devices, and the permeability of the infiltration trench, a settling tank may be needed. The tank would permit additional settling time and control the rate of water flow out of the tank and through the final filtration device. Depending on the site gradient, a pump may be needed to pressurized the water outflow and through the filtration devices. Based on the water storage needs, the size of the tank could vary between 50 gallons and 300 gallons and could be either underground or above ground.

   At the end of each boat washing season, the tank should be pumped out and the settlements disposed of appropriately, either through a licensed hazardous waste handler or in a licensed landfill, depending upon laboratory results for heavy metals. If a tank is needed, the Department is proposing to test the residues once as part of this project. The sediments will then be handled from then on based on these results.

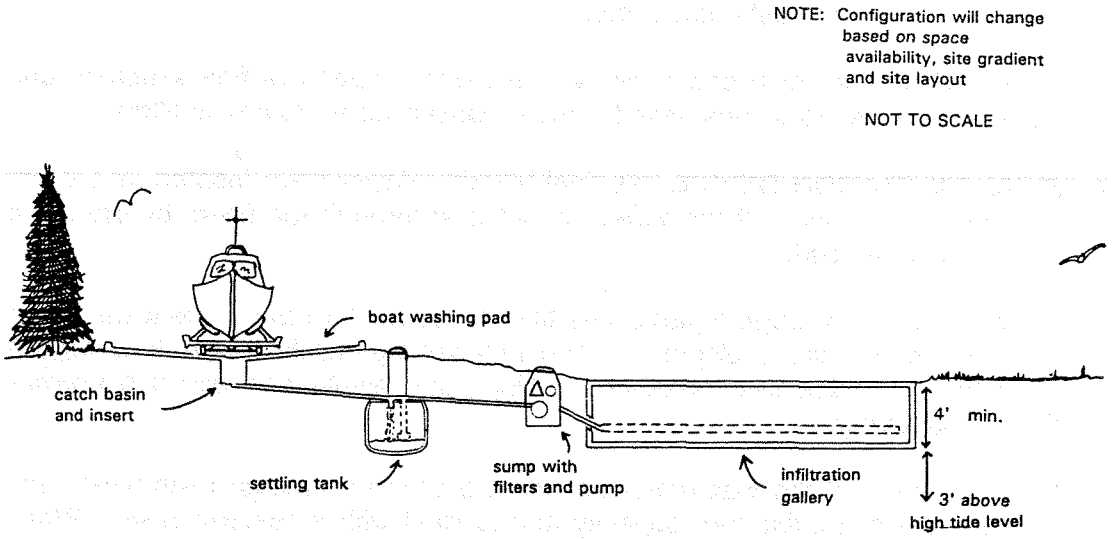


Figure B-2. CROSS SECTION OF BOAT WASHING SYSTEM

2. **WATER RECYCLING** As an alternative to discharging treated water into the environment, the settlement tank proposed above could also be used as a holding tank for boat-washing water. This option would be considered if the area has bedrock near the ground surface and excavation is not practical.

   In that case, the filtration devices would be placed before the tank, either located underground or above-ground. A sump pump would need to pressurize the water from the catch basin through the filters and into the storage tank. There, another pump would be needed to pressurize the stored treated water for washing the next boat. Additional tap water would be added as needed to maintain water flow. At the end of the season, the stored water would be disposed of appropriately through a hazardous waste handler, if needed, as the water may accumulate copper through multiple reuses. Again, the Department would test the water as part of this project.

3. **INFILTRATION TRENCH** If disposal of the treated water is not feasible because either the treatment is insufficient in meeting AWQC water quality levels or because of site constraints, a small infiltration trench would be built to percolate the treated water into the subsurface. For infiltration into the subsurface, water quality would only need to meet Drinking Water Standards which are much less stringent than Ambient Water Quality Criteria (AWQC).

   The proposed trench should be, at a minimum, 10 feet long and lined with a geotextile filter fabric to a 3 foot depth. A slotted PVC pipe, 4 inches in diameter, would be installed in granular sand and extended to a depth of 1½ feet below the ground surface. The bottom elevation of the pipe should be a minimum of 3 feet

above the highest tide recorded for the site. The excavated soil could be used to backfill the trench.

The trench should be placed within 10 to 20 feet of the high tide level. This distance will ensure sufficient filtration, but also make sure that the infiltrated water will never end up in a drinking water well. A good location for an infiltration bed is underneath the boat washing pad, if another emplacement is not feasible.

Final Design Selection

The final selection of the system's different component options is based on several factors:

- the level of treatment for the water discharged directly to surface waters;
- the availability of space for an infiltration trench;
- the site gradients and whether there is a sufficient change in elevation for gravity water flow;
- the soil type – if the site is on bedrock, then infiltration is not possible and the recycling approach must be considered, and the whole system will be installed above ground;
- the number of boat washings – in a small boatyard, where very few boats are washed in a year, the simpler the system, the most acceptable, implementable and cost effective it will be; and
- the availability of a water supply for washing boats and where conserving water is unnecessary.

Maintenance

Maintenance will be required to keep the treatment system fully operational and effective. The following maintenance schedule is anticipated:

Initially:

- Water samples will be obtained after the catch basin filtration device and after the resin filter. The samples will be analyzed for turbidity, pH, suspended particles size and amount, metals, and hydrocarbons.

At the end of the season:

- A water sample will be obtained after the resin filter to assess its current effectiveness. The sample will be analyzed for the same parameters as the initial testing round.

- When the resin pellets are replaced in the filter, it will be tested for metals to determine the appropriate disposal method.

- If a settling tank is used, the sediments will be sampled and tested for metals to determine the appropriate disposal method.

- If the water is recycled, it will be tested for metals to determine the appropriate disposal method.

COST ASSESSMENT

At this point, the proposed system's following costs are approximate:

Pad :	
site leveling, subbase, pavement and curb; size 20' by 50'	$3,000
Catch basin: basin	$200
piping	$100
filter inserts	$300
Settling tank:	
250 gallons plastic tank	$300
pump	$200
Excavation/installation	$500
Electrical	$1,000
Final filtration:	
sump	$200
particulate filter	$100
resin filter	$200
resin	$200
pump	$200
plumbing	$500
electrical	$1,000
infiltration trench:	
excavation/backfill	$2,000
piping/sand/filter fabric	$500

- TOTAL for basic system (pad, catchbasin and filtration): $6,000
- If an infiltration trench is needed, additional cost: $2,500.
- If a settling tank is necessary, the additional cost will be approximately $2,000.
- If a Novachem (off the shelf) system is used, the additional cost will be in excess of $10,000 to $13,000.
- Laboratory sampling will amount to approximately $500 to $1,000 the first year, none thereafter.
- Approximate maintenance cost is $100 to $200 per year for the catchbasin insert, cartridge filter and resin material.

APPENDIX C : EDUCATION FOR BOATERS

BOATER ENVIRONMENTAL AWARENESS FACT SHEETS

Many boaters are unaware of the current state and federal regulations regarding washing, sanding, or painting boats. Marina staff may also need to be educated about the law. Some boaters may need information about the facility's operation and procedures, or such things as how to properly operate marine sanitation devices. Ultimately, it is to the marina operator's advantage to see that staff and customers are fully informed about procedures that prevent nonpoint source pollution. When staff and customers are working together to minimize pollution impacts, the facility will have gone a long way toward compliance with state and federal regulations, and the waters near the marina will be cleaner and more attractive.

Methods for sharing this information are numerous and can include:

Newsletters: If you provide a newsletter to your customers, perhaps you could consider a section highlighting different steps that you are taking to protect the environment. This is also a great way to advertise your new services and operations and could be distributed to boaters who are not customers.

Inserts: Billing statements provide an opportunity to bring your customers up-to-date.

Meetings: Consider hosting a meeting for your tenants and other boaters to explain your facility's services and rules. Your local harbormaster or Coast Guard Auxiliary/Power Squardron unit should be able to assist you in conducting meetings. A one-on-one demonstration of how to operate different components of the available equipment would make people more likely to use it.

Inspections: Consider offering an additional service to your customers by inspecting their existing activities and correcting any problems that may lead to improper operations. This could become another step in the winterization or spring commissioning process. The Coast Guard Auxiliary is also available to conduct free boating safety inspections, which include a check of the MSD and overboard discharge valve.

Slip leasing agreement: You can use your tenant contracts to inform boaters new rules and operations. Although marinas do not have the legal authority to enforce state laws, they can declare themselves no-discharge marinas and require tenants to use pumpout stations and ensure that boaters activities prevent incidental spills, and discharge. In most facilities with these requirements, the penalty for discharging and careless operation within the facility is expulsion.

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 pamphlets and flyers include:

Maine State Planning Office
Maine Coastal Program
38 State House Station
Augusta, ME 04333
(207) 287-3261

U.S. Coast Guard
Marine Safety Office
312 Fore Street
Portland, ME 04101
(207) 780-3251

Department of Environmental Protection
Bureau of Land & Water Quality
17 State House Station
Augusta, ME 04333
(207) 287-3901

Friends of Casco Bay
2 Fort Road
South Portland, ME 04106
(207) 799-8574

U.S. EPA New England
Waters Program
J.F.K. Federal Bldg.
Boston, MA 02203-2211
(617) 565-3420

Maine Marine Trades Association
20 Beacon Avenue, Suite 7
Biddeford, ME 04005-2931
(207) 282-8814

International Marina Institute
35 Steamboat Avenue
Wickford, RI 02852
(401) 294-9558

Fact Sheets: The following pages contain fact sheets describing activities that cause nonpoint pollution and suggest ways to improve the health of our waterways while enjoying boating. These fact sheets are provided as a source of educational information for the boating public. Marina operators should feel free to copy and distribute them to their customers, or post them in an prominent location.

Fact Sheet #1

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 US. 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 sanding, detergents, fish waste, antifreeze, sewage, and litter.

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

While each boat's contribution is so small that it seems 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.

NONPOINT SOURCE POLLUTION

Stormwater runoff is the most common way pollutants get into rivers, lakes and bays. Rain and melting snow running over the 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 waterbody 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 the ground, oily bilge water, fuel tank overflows, and non-biodegradable hull cleaners.

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

- 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 pathogens can result in closed shellfish beds or swimming areas.

Nonpoint pollution, because it is spread out, can be hard to find, but often it is easy to prevent and control. 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, or 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 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.

Fact Sheet #2

Boating + Common Sense = Clean Water

Clean Water is Everyone's Goal

We all need to be concerned about protecting our coastal areas, the habitat and wildlife. We can have profound impacts on the ecosystem of which we are a part if we are careless or simply unaware. Every speck and drop of pollution from boats and marinas, when added to all the bits from thousands of other sources, can really spoil the pleasure we get from boating; ultimately, this pollution can hurt our own health and that of other creatures. Fortunately, we can all help by minimizing these impacts.

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 materials 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 your boat and take a careful look around. Invite boating friends, family, and marine facility personnel 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. Set an example.

Make sure all your boating 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 AND 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 you see someone 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 use cleaner operations and offer educational pollution control 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.

Remember:- EACH ONE OF US IS PART OF THE SOLUTION.

Fact Sheet #3

Boat Sanding and Painting

Problem:

When your boat is being sanded or painted – often a messy job – a great deal of dust and paint can fall onto the ground or water. If the paint contains toxic chemicals that can leach out, it can cause environmental harm.

Antifouling paint, for example, is made with toxic chemicals to minimize growth on the boat's bottom during the boating season. However, concentrated amounts of this type of paint, 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.

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 properly dispose of the dry paint sandings and wet paint drops.
- 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 designated sanding and painting areas in marinas and yacht clubs, which are designed to minimize pollution – 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 washwater 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.

Fact Sheet #4

Boat Sewage

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 pollution.

Sewage from marine heads can add extra nutrients to the water which use dissolved oxygen and can stimulate algae growth. In the worst cases, the algae can grow so fast that it uses up the oxygen that fish and other organisms need to live. Untreated wastes can contaminate swimmers and shellfish, potentially leading to serious health problems.

Boaters tend to concentrate in groups, around swimming and fishing areas, thus increasing the frequency and total number 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.

There are four basic types of toilets that can be used in US. waterways:

- marine sanitation devices (MSD) types I and II, which treat the waste before discharging overboard (legally, only Coast Guard approved MSDs can be discharged at sea);
- MSD type III is the common holding tank which cannot be discharged and needs to use pumpout equipment;
- Portable toilets, which must be carried ashore to be emptied or pumped out; and
- Incineration type toilets, which burn the waste and don't need to be pumped out.

Use Your "Head" (Properly)!

- Type I and II MSDs must be maintained regularly. Keep the disinfectant tank full to ensure the device operates properly.
- MSD type III holding tanks cannot be emptied into any navigable US. 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. When inshore, holding tanks must be emptied at 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. However, the number of pumpout stations is increasing rapidly – if charts or cruising guides do not show that the marina or boatyard you plan to use has a pumpout station, call the facility to see if one has been installed recently.
- Boats in no-discharge waters, including most lakes and many inland waterways, cannot use MSD type 1, 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.

Rule of Thumb

Use a pumpout station to empty out your boat head.

Fact Sheet #5

Fuel and Oil

Problems:

It is not unusual to see a small fuel sheen on the water surface near docked boats. Although it may only be a tiny amount of fuel from some boats, the cumulative impact on the environment of many small fuel spills can be 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 can pollute the marine environment when waste oil from oil changes is dumped on the ground, into storm drains or in dumpsters.

Small fuel and oil spills are easy to prevent.

Solutions:

- Take care during fueling to prevent drops of fuel 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 to make sure the tanks are not overfilled so that fuel spills out of the air vent. Stop pumping at the first sign of escaping fuel. 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 your engines properly tuned – you'll burn less fuel, save money, and have cleaner exhaust.
- 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 (also called 'bilge pillows') can be wrung out when they are full, then reused.
- Used oil filters and oil absorption pads should be placed in a proper leak-proof collection receptacle at the boating facility.
- Don't use dispersants (soap or surfactants) on small oil spills or in bilges. This doesn't eliminate the petroleum in the environment, but just moves it from the water surface to the subsurface areas. Follow the US 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.
- When 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 with the fuel.

Rule of Thumb

Any time you see an oil sheen on the water, something's wrong. Check the engine, tanks, and lines for leaks; tune up the motor; and use oil absorption pads. Use proper fueling procedures. These measures save money and keep boating waters clean.

Fact Sheet #6

Antifreeze and Engine Coolants

Problem:

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

Solutions:

- When a boat is to be stored for the winter, drain as much of the water as possible out of all waterlines, the hot water tank, and sewage holding tank in order 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 recommendations 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 out where the recycling facilities in the area are located and when they are open. If recycling facilities are not available, ask the marina operator how and where the substances should be disposed of.
- Don't mix different chemicals, such as antifreeze and oil, prior to disposal – especially if they are going to be recycled.

Fact Sheet #7

Washing and Cleaning Boats

Problem:

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

Many cleaners contain chlorine, ammonia, and phosphates which can harm tiny plankton and fish. Often their biggest impact occurs immediately after entering the water, and decreases rapidly as the chemicals are diluted. However, eventually some of these chemicals find their way into the food chain and can build up in fish flesh which may then be eaten by people. The second concern is that, in the boat cleaning process, antifouling paint may be scraped or chipped off and then enter the water in concentrated amounts which harm marine life.

Solutions:

- Wash the boat frequently with only plain water, a bucket and sponge. Use cleaners only on the dirty spots.
- Buy and use safe, nontoxic, phosphate-free, and biodegradable cleaners for use on the deck, teak, hull and bilge; use these only in small quantities, as needed.
- Substitute natural cleansers, such as vinegar, lemon juice, lime juice, borax, baking soda, and liquid soaps for chemical-based ones.
- Use all chemicals carefully, according to the manufacturers instructions.
- Clean boat bottoms ashore where the washwater and any bottom scrapings and antifouling paint particles cannot run into the waterway. Don't clean the hull in the launching ramp; take the boat inland away from the shoreline. Use a marina or boatyard which has a designated bottom cleaning area. Some areas ban in-water bottom scrubbing, so check with local authorities.
- Use low-volume hose 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 as well, and probably should not be used around the waterway.

Fact Sheet #8

Plastic and Floatable Litter

Problem:

Birds and fish often mistake garbage for food, with fatal results. They can also get tangled up in plastic. You have probably seen pictures of six pack rings tangeled tightly around seabirds. 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 usually the most common type of litter found in boating waters. Each piece of trash adds to a serious problem that can be easily prevented.

Solutions:

- Don't throw any trash overboard; keep it onboard until reaching port where 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 your trash home for recycling and disposal.
- Remember, the law requires all boats 25 feet and more in length to have a sign about the federal trash disposal regulations posted and visible where garbage is stored, such as in the galley.

Rule of Thumb

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

Fact Sheet #9

Cleaning Fish

Problem:

Sport fishing is very popular, and most of the time the fish are taken ashore to be cleaned, cooked, and eaten. However, there are times when large amounts of fish are gutted and cleaned on the water, such as during fishing tournaments. Fish parts are absolutely biodegradable and can be eaten by other fish, birds and marine animals. But when a lot of fish wastes are discarded into the same waters on the same day, the waste can rot and result in lowered oxygen levels, which can result in odor problems and fish kills. And of course, no one likes to see floating fish heads drifting about for days.

Solutions:

- Clean 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, washwater, covered trash containers, and frequent waste 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, odor-free, 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. ***Keep fish scraps and waste on board until they can be disposed of properly.***

Clearing Hair

Contents

Introduction

APPENDIX D : WATER CLASSIFICATION PROGRAM OF MAINE

The waters of the state are classified in accordance with MRSA 38 § 464:

1. *Findings; objectives; purpose. The Legislature finds that the proper management of the state's water resources is of great public interest and concern to the state in promoting the general welfare; in preventing disease; in promoting health; in providing habitat for fish, shellfish and wildlife; as a source of recreational opportunity; and as a resource for commerce and industry.*

   The Legislature declares that it is the state's objective to restore and maintain the chemical, physical and biological integrity of the state's waters and to preserve certain pristine state waters. The Legislature further declares that in order to achieve this objective the state's goals are:

   A. *That the discharge of pollutants into the waters of the state be eliminated where appropriate;*

   B. *That no pollutants be discharged into any waters of the state without first being given the degree of treatment necessary to allow those waters to attain their classification; and*

   C. *That water quality be sufficient to provide for the protection and propagation of fish, shellfish and wildlife and provide for recreation in and on the water.*

The Legislature intends by passage of this article to establish a water quality classification system which will allow the State to manage its surface waters so as to protect the quality of those waters and, where water quality standards are not being achieved, to enhance water quality. This classification system is based on water quality standards which designate the uses and related characteristics of those uses for each class of water and which also establish water quality criteria necessary to protect those uses and related characteristics. The Legislature also intends to assign to each of the state's surface water bodies the water quality classification which shall designate the minimum level of quality which the Legislature intends for the body of water. The state's management of that waterbody is intended to achieve at least that minimum level of water quality.

Per MRSA 38 § 465-B, Standards for classification of estuarine and marine waters, the Department of Environmental Protection has three standards for the classification of estuarine and marine waters.

1. **Class SA waters** Class SA is the highest classification and is applied to waters which are outstanding natural resources and which should be preserved because of their ecological, social, scenic, economic or recreational importance.

   A. Class SA waters shall be of such quality that they are suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and

harvesting of shellfish and navigation and as habitat for fish and other estuarine and marine life. The habitat shall be characterized as free-flowing and natural.

B. The estuarine and marine life, dissolved oxygen and bacteria content of Class SA waters shall be as naturally occurs.

C. There shall be no direct discharge of pollutants to Class SA waters.

2. **Class SB waters** Class SB shall be the 2nd highest classification.

A. Class SB waters shall be of such quality that they are suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation and navigation and as habitat for fish and other estuarine and marine life. The habitat shall be characterized as unimpaired.

B. The dissolved oxygen content of Class SB waters shall be not less than 85% of saturation. Between May 15th and September 30th, the numbers of enterococcus bacteria of human origin in these waters may not exceed a geometric mean of 8 per 100 milliliters or an instantaneous level of 54 per 100 milliliters. The numbers of total coliform bacteria or other specified indicator organisms in samples representative of the waters in shellfish harvesting areas may not exceed the criteria recommended under the National Shellfish Sanitation Program Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, United States Department of Food and Drug Administration.

C. Discharges to Class SB waters shall not cause adverse impact to estuarine and marine life in that the receiving waters shall be of sufficient quality to support all estuarine and marine species indigenous to the receiving water without detrimental changes in the resident biological community. There shall be no new discharge to Class SB waters which would cause closure of open shellfish areas by the Department of Marine Resources.

3. **Class SC waters** Class SC waters shall be the 3rd highest classification.

A. Class SC waters shall be of such quality that they are suitable for recreation in and on the water, fishing, aquaculture, propagation and restricted harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation and navigation and as a habitat for fish and other estuarine and marine life.

B. The dissolved oxygen content of Class SC waters shall be not less than 70% of saturation. Between May 15th and September 30th, the numbers of enterococcus bacteria of human origin in these waters may not exceed a geometric mean of 14 per 100 milliliters or an instantaneous level of 94 per 100 milliliters. The numbers of total coliform bacteria or other specified indicator organisms in samples representative of the waters in restricted shellfish harvesting areas may not exceed the criteria recommended under the National Shellfish Sanitation Program Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, United States Food and Drug Administration.

C. Discharges to Class SC waters may cause some changes to estuarine and marine life provided that the receiving waters are of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

4. **Classifiications of Estuarine and Marine Waters** Per MSRA 38 § 464, all estuarine and marine waters lying within the boundaries of the state and which are not otherwise classified are Class SB waters.

1. CUMBERLAND COUNTY

A. Cape Elizabeth
(1) Tidal waters of the Spurwink River system lying north of a line at latitude 43º-33'-44"N – Class SA.

B. Cumberland
(1) Tidal waters located within a line beginning at a point located on the Cumberland-Portland boundary at approximately latitude 43º-41'-18"N, longitude 70º-05'-48"W and running northeasterly to a point located on the Cumberland-Harpswell boundary at approximately latitude 43º-42'-57"N, longitude 70º-03'-50"W; thence running southwesterly along the Cumberland-Harpswell boundary to a point where the Cumberland, Harpswell and Portland boundaries meet; thence running northeasterly along the Cumberland-Portland boundary to point of beginning – Class SA.

C. Falmouth
(1) Tidal waters located within a line beginning at a point located on the shore at latitude 43º-42'-03"N longitude 70º-15'-22"W and running southwesterly along the Falmouth-Portland boundary to the shore of Mackworth Island; thence running northerly along the western shore of Mackworth Island and the Mackworth Island Causeway to a point located at latitude 43º-41'-42"N, longitude 70º-14'-25"W; thence running along the shore of the Presumpscot River Estuary to point of beginning – Class SC.

D. Harpswell
(1) Tidal waters located within a line beginning at a point located on the Cumberland-Harpswell boundary at approximately latitude 43º-42'-57"N, longitude 70º-03'-50"W and running northeasterly to a point located at latitude 43º-43'-08"N, longitude 70º-03'-36"W; thence running southeasterly to a point located at latitude 43º-42'-02"N, longitude 70º-00'-00"W; thence running due south to the Harpswell-Portland boundary; thence running northwesterly along the Harpswell-Portland boundary to a point where the Cumberland, Harpswell and Portland boundaries meet; thence running northwesterly along the Cumberland-Harpswell boundary to point of beginning – Class SA.

E. Portland
(1) Tidal waters located within a line beginning at a point located on the Cumberland-Portland boundary at approximately latitude 43º-41'-18"N, longitude 70º-05'-48"W and running southeasterly along the Cumberland-

Portland boundary to a point where the Cumberland, Harpswell and Portland boundaries meet; thence running southeasterly along the Harpswell-Portland boundary to longitude 70º-00'-00"W; thence running due south to a point located at latitude 43º-38'-21"N, longitude 70º-00'-00"W; thence running due west to a point located at latitude 43º-38'-21"N, longitude 70º-09'-06"W; thence running northeasterly to point of beginning – Class SA.

(2) Tidal waters lying northwesterly of a line beginning at Portland Head Light and running northerly to the southernmost point of land on Cushing Island; thence running northerly along the western shore of Cushing Island to the northernmost point of land on Cushing Island; thence running northerly to the southernmost point of land on Peaks Island; thence running northerly along the western shore of Peaks Island to a point located at latitude 43º-40'-10"N, longitude 70º-11'-34"W; thence running northwesterly to the southernmost point of land on Great Diamond Island; thence running northwesterly along the westerly shore of Great Diamond Island to a point located at latitude 43º-40'-36"W, longitude 70º-11'-34"W; thence running northwesterly for 0.7 mile to a point where the Falmouth-Portland boundary forms a right angle; thence running northwesterly along the Falmouth-Portland boundary to a point located at latitude 43º-42'-03"N, longitude 70º-15'-22"W – Class SC.

F. Scarborough

(1) Tidal waters of the Scarborough River system lying north of a line running easterly from a point where the old Boston and Maine Railroad line intersects the marsh at latitude 43º-33'-06"N, longitude 70º-20'-58"W to a point of land north of Black Rock at latitude 43º-33'-06"N, longitude 70º-19'-25"W, excluding those tidal waters of Phillips Brook lying upstream of a point 500 feet south of U.S. Route 1 – Class SA.

(2) Tidal waters of the Spurwink River system lying north of a line extending from Higgins Beach at latitude 43º-33'-44"N to the town line – Class SA.

G. South Portland

(1) All tidal waters – Class SC.

2. HANCOCK COUNTY

A. Bar Harbor

(1) Tidal waters, except those lying within 500 feet of privately owned shoreline, lying northerly of latitude 44º-16'-36"N, southerly of latitude 44º-20'-27"N, and westerly of longitude 68º-09'-28"W – Class SA.

B. Bucksport

(1) All tidal waters – Class SC.

C. Cranberry Isles

(1) Tidal waters, except those lying within 500 feet of privately owned shoreline, lying within 0.5 mile of the shore of Baker Island – Class SA.

D. Mount Desert
(1) Tidal waters, except those lying within 500 feet of privately owned shoreline, lying northerly of latitude 44º-16'-36"N and easterly of longitude 68º-13'-08"W – Class SA.

(2) Tidal waters of Somes Sound lying northerly of a line beginning at a point located at latitude 44º-18'-18", longitude 68º-18'-42"N and running northeasterly to a point located at latitude 44º-18'-54"N, longitude 68º-18'-22"W and lying southerly of a line beginning at a point located at latitude 44º-19'-37"N, longitude 68º- 18'-52"W and running northeasterly to a point located at latitude 44º-19'-45", longitude 68º-18'-23"W – Class SA.

E. Orland
(1) Tidal waters lying northerly of the southernmost point of land on Verona Island – Class SC.

F. Southwest Harbor
(1) Tidal waters lying northerly of latitude 44º-12'-44º -"N, southerly of latitude 44º-14'-13"N and westerly of longitude 68º-18'-27"W – Class SA.

(2) Tidal waters of Somes Sound lying northerly of a line beginning at a point located at latitude 44º-18'-18"N, longitude 68º-18'-42"W and running northeasterly to a point located at latitude 44º-18'-54"N, longitude 68º-18'-22"W – Class SA.

G. Tremont
(1) Tidal waters lying northerly of latitude 44º-12'-44º -"N, southerly of latitude 44º-14'-13"N and easterly of longitude 68º-20'-30"W – Class SA.

(2) Tidal waters lying northerly of the southernmost point of land on Verona Island – Class SC.

H. Winter Harbor
(1) Tidal waters lying south of a line running west from the northernmost tip of Frazer Point to longitude 68º-05'-00"W and east of longitude 68º-05'-00"W – Class SA.

3. KNOX COUNTY

A. Isle Au Haut
(1) Tidal waters, except those lying within 500 feet of privately owned shoreline, lying northerly of latitude 44º-00'-00"N, southerly of latitude 44º-03'-06"N, easterly of longitude 68º-41'-00"W and westerly of longitude 68º-35'-00"W – Class SA.

B. Owls Head
(1) Tidal waters lying westerly of a line running between the southernmost point of land on Jameson Point and the northernmost point of land on Battery Point – Class SC.

C. Rockland
(1) Tidal waters lying westerly of a line running between the southernmost point of land on Jameson Point and the northernmost point of land on Battery Point – Class SC.

4. LINCOLN COUNTY

A. Boothbay
(1) Tidal waters lying south of the northernmost point of Damariscove Island and west of longitude 69º-36'-00"W – Class SA.

5. PENOBSCOT COUNTY

A. Hampden
(1) Tidal waters lying southerly of a line extended in an east-west direction from the outlet of Reed Brook in the Village of Hampden Highlands – Class SC.

B. Orrington
(1) Tidal waters lying southerly of a line extended in an east-west direction from the outlet of Reed Brook in the Village of Hampden Highlands – Class SC.

6. SAGADAHOC COUNTY

A. Georgetown
(1) Tidal waters located within a line beginning at a point on the shore located at latitude 43º-47'-16"N, longitude 69º -43'-09"W and running due east to longitude 69º -42'-00"W; thence running due south to latitude 43º-42'-52"N; thence running due west to longitude 69º -44' -25"W; thence running due north to a point on the shore located at latitude 43º-46'-15"N, longitude 69º -44'-25"W; thence running northerly along the shore to point of beginning – Class SA.

B. Phippsburg
(1) Tidal waters east of longitude 69º-50'-05"W and west of longitude 69º-47'-00"W – Class SA.

7. WALDO COUNTY

A. Frankfort
(1) All tidal waters – Class SC.

B. Prospect
(1) All tidal waters – Class SC.

C. Searsport

(1) Tidal waters located within a line beginning at the southernmost point of land on Kidder Point and running southerly along the western shore of Sears Island to the southernmost point of Sears Island; thence running due south to latitude 44º-25'-25"N; thence running due west to latitude 44º-25'-25"N, longitude 68º-54'-30"W; thence running due north to the shore of Mack Point at longitude 68º-54'-30"W; thence running along the shore in an easterly direction to point of beginning – Class SC.

D. Stockton Springs
(1) Tidal waters lying northerly of the southernmost point of land on Verona Island – Class SC.

E. Winterport
(1) All tidal waters – Class SC.

8. WASHINGTON COUNTY

A. Beals
(1) Tidal waters lying east of the line extending from the westernmost point of Three Falls Point to the easternmost point of Crumple Island; thence south along longitude 67º-36'-47"W – Class SA.

(2) Tidal waters lying south of a line extending from the easternmost point of the southern shore of the Mud Hole; thence extending along latitude 44º-29'-00"N to the town line – Class SA.

B. Calais
(1) Tidal waters of the St. Croix River and its tidal tributaries lying westerly of longitude 67º-14'-28"W – Class SC.

C. Cutler
(1) All tidal waters except those waters in Machias Bay and Little Machias Bay north of a line running from the town line due east to the southernmost point of Cross Island; thence running northeast to the southeasternmost point of Cape Wash Island; thence running northeast to the westernmost point of Deer Island; thence running due north to the mainland; and those waters lying northwest of a line running from the easternmost point of Western Head to the easternmost point of Eastern Knubble – Class SA.

D. Eastport
(1) Tidal waters lying southerly of latitude 44º-54'-50"N, easterly of longitude 67º-02'-00"W and northerly of latitude 44º-53'-15"N – Class SC.

E. Edmunds
(1) All tidal waters – Class SA.

F. Lubec
(1) Tidal waters, except those lying within 500 feet of West Quoddy Head Light, south of a line beginning at a point located on the northern shore of West

Quoddy Head at latitude 44º-49'-22"N, longitude 66º-59'-17"W and running northeast to the international boundary at latitude 44º-49'-45"N, longitude 66º-57'-57"W – Class SA.

(2) Tidal waters west of a line running from the easternmost point of Youngs Point to the easternmost point of Leighton Neck in Pembroke – Class SA.

G. Milbridge

(1) Tidal waters south of a line running from the town line along latitude 44º-27'-39"N to the northernmost point of Currant Island; thence running southeasterly to a point 1,000 feet from mean high tide on the east shore of Bois Bubert Island; thence along a line running 1,000 feet from mean high tide along Bois Bubert Island to the southernmost point of the island; thence running due south – Class SA.

H. Pembroke

(1) Tidal waters west of a line running from the easternmost point of Leighton Neck to the easternmost point of Youngs Point in Lubec – Class SA.

I. Steuben

(1) Tidal waters southeast of a line beginning at Yellow Birch Head at latitude 44º-25'-05"N; thence running to longitude 67º-55'-00"W; thence running due south along longitude 67º-55'-00"W – Class SA.

(2) Tidal waters southwest of a line beginning at a point located south of Carrying Place Cove at latitude 44º-26'-18"N, longitude 67º-53'-14"W; thence running along latitude 44º-26'-18"N east to the town line – Class SA.

J. Trescott

(1) All tidal waters – Class SA.

K. Whiting

(1) Tidal waters of the Orange River – Class SA.

9. YORK COUNTY

A. Biddeford

(1) Tidal waters of the Saco River and its tidal tributaries lying westerly of longitude 70º-22'-54"W – Class SC.

B. Kennebunk

(1) Tidal waters of the Little River system lying north of latitude 43º-20'-10"N – Class SA.

C. Kittery

(1) Tidal waters of the Piscataqua River and its tidal tributaries lying westerly of longitude 70º-42'-52"W, southerly of Route 103 and easterly of Interstate Route 95 – Class SC.

(2) Tidal waters lying northeast of a line from Sisters Point; thence south along longitude 70º-40'-00"W to the Maine-New Hampshire border; thence running southeast along the Maine-New Hampshire border to Cedar Ledge beyond the Isles of Shoals, except waters within 500 feet of the Isles of Shoals Research Station – Class SA.

D. Old Orchard Beach
(1) Tidal waters of Goosefare Brook and its tidal tributaries lying westerly of longitude 70º-23'-08"W – Class SC.

E. Saco
(1) Tidal waters of Goosefare Brook and its tidal tributaries lying westerly of longitude 70º-23'-08"W – Class SC.

(2) Tidal waters of the Saco River and its tidal tributaries lying westerly of longitude 70º-22'-54"W – Class SC.

F. Wells
(1) Tidal waters of the Little River system lying north of latitude 43º-20'-10"N – Class SA.

G. York
(1) Tidal waters lying southwest of a line from Seal Head Point east along latitude 43º-07'-15"N – Class SA.

APPENDIX E : OPERATIONS AND MAINTENANCE PROGRAM

Using a model marina as a guide, this chapter shows how to develop an operations and maintenance program (OMP). This sample plan was developed using the suggested best management practices presented in the previous chapters. Developing an operations and maintenance plan creates the opportunity to evaluate the effectiveness of a facility's operations and practices. The key components to a plan include a description and map of the site layout, a detailed description of activities and procedures that occur at the facility, and a list of the BMPs that are either appropriate or inappropriate to mitigate nonpoint source issues at the facility.

SITE LAYOUT

The average marina is a small-to-medium owner-operated facility located in an estuary on the southern Maine coast. In this example, the 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% of the boat population. There is an almost even mix of sailboats and power boats. 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. Winter boat storage and parking occupy the rest of the upland area. This area is surfaced with a mix of gravel and hard-packed sand. There is no pavement on the 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. This area is surfaced with a mix of gravel and hard-packed sand.

The facility, like many in Maine, 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.

Structures

Two nonpermanent buildings are on the upland area of the property. The larger main building houses the business office, ship's store, and rest rooms. The 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.

Miscellaneous

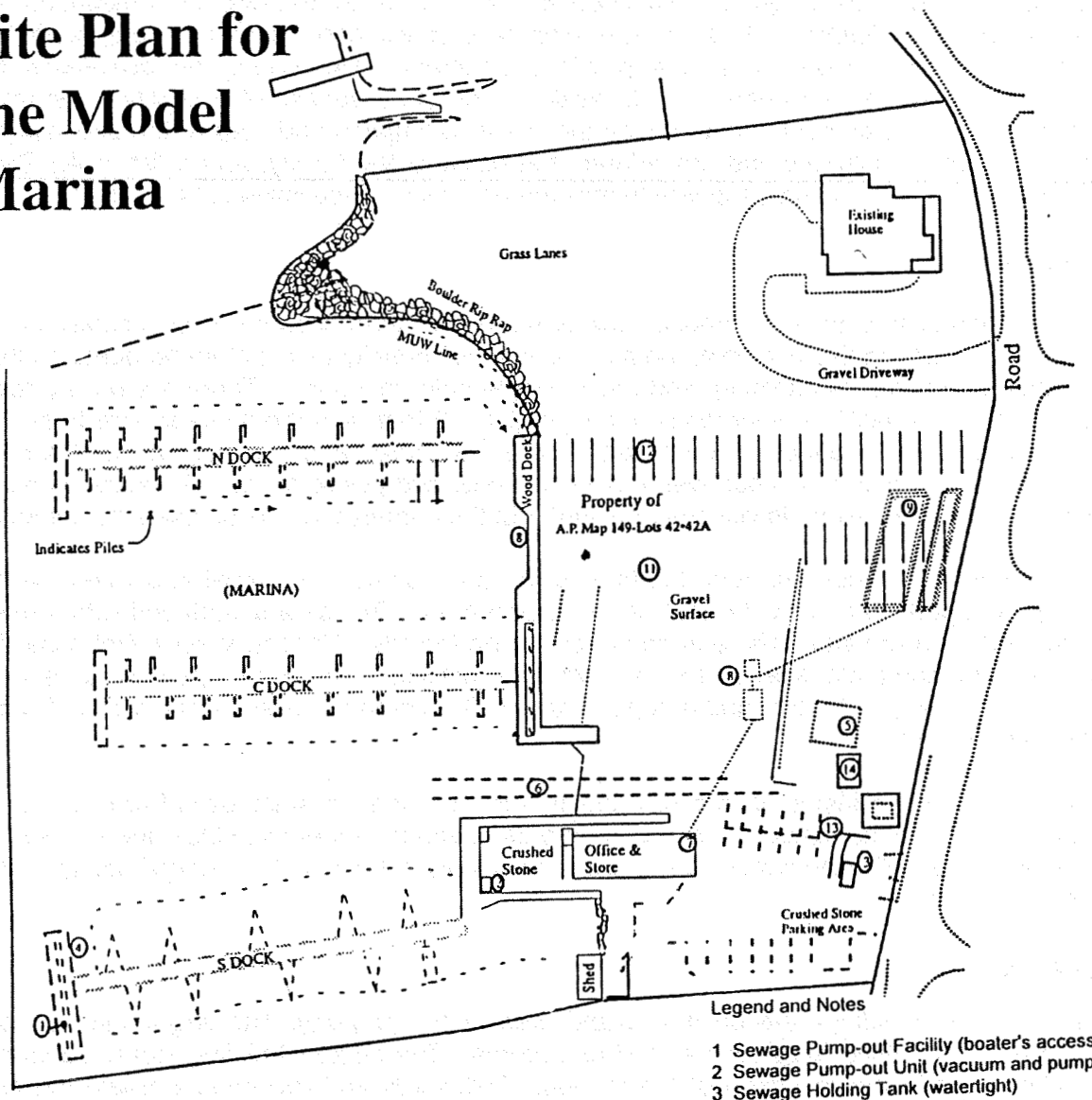
The location of the federal channel and municipal mooring fields, underground utilities, established riparian lines; and general location of docks, piers, etc. on abutting properties can be found on the site plan.

SERVICES AND ACTIVITIES

Service facilities available at the marina include: a pumpout station and a fuel pump located on the south pier; restrooms in the main building; marine railways and a crane for hauling boats; and a ship's store. See the site plan for these locations. The property is used primarily for storing

recreational boats. In addition to boat storage, other activities include: winterizing and commissioning; minor engine repair, wood and fiberglass repair; and hull scraping and painting.

Site Plan for the Model Marina



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 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.

Scale 1"=40' July 1994

Plan Prepared by:
Jack Doe, Jr. PLS

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 on which 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.

Dry Rack Storage

There is no dry rack storage. During the winter, the upland facility stores the boats.

Implementation of Best Management Practices

It may be that many of the practices necessary to minimize nonpoint source pollution at a marina are already in place and only some housecleaning and implementation of a few selected BMPs may be necessary. New BMPs to be implemented at the example marina include an oil waste receptacle, an oil spill response plan, and improved painting and sanding practices.

A more wide-scale practice that needs to be implemented is the close supervision of tenants to be sure that they are using tarps below where they are cleaning. If this proves to be inadequate, then the facility should, in all likelihood, purchase a vacuum sander and make it available to its customers for a small fee. If the tenants do not embrace the practices, the final step is to include some language in the contract requiring proper procedures. The best solution to this problem would be to offer a specific area within the facility where boats can be moved for work – an area specially designed to collect waste easily.

BMP Selection and Implementation Schedule

The worksheets included at the end of this section address all the BMPs, arranged by nonpoint source pollution category, that are appropriate for a model marina. The worksheets help the marina operator to evaluate which BMPs and changes are needed. In the example above, 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.

1. Storm Water Runoff

Are hull maintenance areas* present on-site?

Yes ↓ **No** →**Next Section**
Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Install and maintain adequate buffer areas between the coastal zone and upland facilities. Explain:	☐	☐	☐
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. Explain:	☐	☐	☐
Perform maintenance work inside buildings whenever possible. Explain:	☐	☐	☐
Perform maintenance over tarps to ease the cleanup process and prevent material from being carried into surface waters. Dispose of collected material properly. Explain:	☐	☐	☐
Use vacuum sanders to remove paint from hulls and collect paint dust. Explain:	☐	☐	☐
Other. Explain:	☐	☐	☐

*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 there fueling stations on site?

Yes ↓ **No** →**Next Section**

Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Have adequate spill response equipment. Explain:	☐	☐	☐
Maintain a spill prevention and recovery plan. Explain:	☐	☐	☐
Inform your local harbor master and fire department about your spill protection and recovery plan and equipment. Explain:	☐	☐	☐
Properly dispose of used oil spill response equipment. Explain:	☐	☐	☐
Other. Explain:	☐	☐	☐

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 stored on site?

Yes ↓ **No** →**Next Section**
Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Provide covered containers for solid waste that is generated within the facility. Explain:	☐	☐	☐
Provide proper disposal facilities for marina patrons. Explain:	☐	☐	☐
Provide facilities for the eventual recycling of appropriate materials, such as glass, aluminum and plastic. Explain:	☐	☐	☐
Support the use of environmentally compatible products. Explain:	☐	☐	☐
Use pamphlets, flyers, newsletters, inserts and meetings to convey the importance of any environmental precautions that have been instituted in the marina. Explain:	☐	☐	☐
Have adequate signs throughout facility identifying BMPs. 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. Explain:	☐	☐	☐
Provide and clearly mark designated work areas for boat repairs and maintenance. Do not permit work outside designated areas. Explain:	☐	☐	☐
Clean trash, sandings, paint chips, etc., immediately after any maintenance activity. Explain:	☐	☐	☐
Insert language into facility contract that requires tenants to use certain areas and techniques when conducting boat maintenance. Explain:	☐	☐	☐
Have a clearly written outside contractors agreement. Explain:	☐	☐	☐
Other. Explain:	☐	☐	☐

4. Fish Waste
Is fish waste a potential source of water pollution within the facility?

Yes **No →Next Section**
↓ Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Establish fish cleaning areas. Explain:	☐	☐	☐
Educate boaters regarding the importance of proper fish cleaning practice. Explain:	☐	☐	☐
Issue rules governing the conduct and location of fish cleaning operations. Explain	☐	☐	☐
Other. Explain:	☐	☐	☐

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?

Best Management Practices:	**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 sprits available and clearly labeled. Explain:	☐	☐	☐
Institute a recycling program for oil filters. Explain:	☐	☐	☐
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. Explain:	☐	☐	☐
Maintain a spill prevention and recovery plan for hazardous material. Explain:	☐	☐	☐

Have adequate spill response equipment for hazardous material. Explain:	☐	☐	☐
Place containment berms around fixed pieces of machinery within the facility that use oil and gas. Explain:	☐	☐	☐
Recycle where possible, adhere to existing state regulations pertaining to disposal of hazardous material. Explain:	☐	☐	☐
Enforce the prohibition on the use of TBT-based paint. Explain:	☐	☐	☐
Use environmentally compatible antifreeze. Explain:	☐	☐	☐

Keep to a minimum amounts of hazardous materials stored and used Explain:	☐	☐	☐
Provide to marina tenants information on collection and recycling program and source reduction Explain:	☐	☐	☐
Direct marina patrons as to the proper disposal of all liquid material through the use of signs. Explain:	☐	☐	☐
Insert language into facility contract that requires tenants to dispose of hazardous material in the proper containment facilities Explain:	☐	☐	☐
Other Explain:	☐	☐	☐

6. Petroleum Control
Do fuel and oil from boat bilges and tank air vents enter the ground and surface waters?

Yes **No →Next Section**
↓ Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Promote the use of oil-absorbing material in the bilge areas of all boats with inboard engines. Explain:	☐	☐	☐
Use automatic shut-off nozzles and promote the use of fuel/air vents or tank stems of inboard fuel tanks to reduce the amount of fuel spilled into surface waters during fueling of boats. Explain:	☐	☐	☐
Provide to marina tenants information on collection and recycling programs for oil and oil absorbing pads. Explain:	☐	☐	☐
Direct marina patrons to the proper disposal of all used hydrocarbon products through the use of signs, mailings, and other means. Explain:	☐	☐	☐
Insert language into facility contract that recommends tenants use fuel/air separators and oil absorption materials. Explain:	☐	☐	☐
Other. Explain:	☐	☐	☐

7. In-Water Boat Cleaning

Are the topsides and hulls of boats cleaned or scrubbed in the water?

Yes ↓ **No** →**Next Section**
Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Wash the boat hull above the waterline by hand. Explain:	☐	☐	☐
Where feasible remove the boat from the water and perform cleaning where debris can be captured and properly disposed of. Explain:	☐	☐	☐
Recommend and use phosphate-free and biodegradable detergents and cleaning compounds for washing boats. Explain:	☐	☐	☐
Discourage the use of detergents containing ammonia, sodium hypochlorite, chlorinated solvents, petroleum distillates, or lye. Explain:	☐	☐	☐
Other. Explain:	☐	☐	☐

8. Sewage Facility

Are sewage pumpout facilities or dump stations present on site?

Yes ↓ **No** →**Next Section**
Why?

Best Management Practices:	**Existing**	**Planned**	**Not Applicable**
Provide the service at convenient times and at a reasonable cost. Explain:	☐	☐	☐
Make the pumpout station user friendly. Explain:	☐	☐	☐
Develop and adhere to a regular inspection and maintenance schedule for the pumpout station. Explain:	☐	☐	☐
Work with local and state governments to declare your harbor a no-discharge area once adequate pumpout facilities are installed. Explain:	☐	☐	☐

Provide educational information about the pumpout service to customers. Explain:	☐	☐	☐
Formally advise your municipality that you have a pumpout facility available and provide pertinent information such as time of operation and fee. Explain:	☐	☐	☐
Encourage the local harbor master to enforce existing state and federal regulations pertaining to MSDs. Explain:	☐	☐	☐
Install adequate signs to identify the pumpout station. Explain:	☐	☐	☐
Other. Explain:	☐	☐	☐

APPENDIX F: OIL AND HAZARDOUS MATERIALS SPILLS

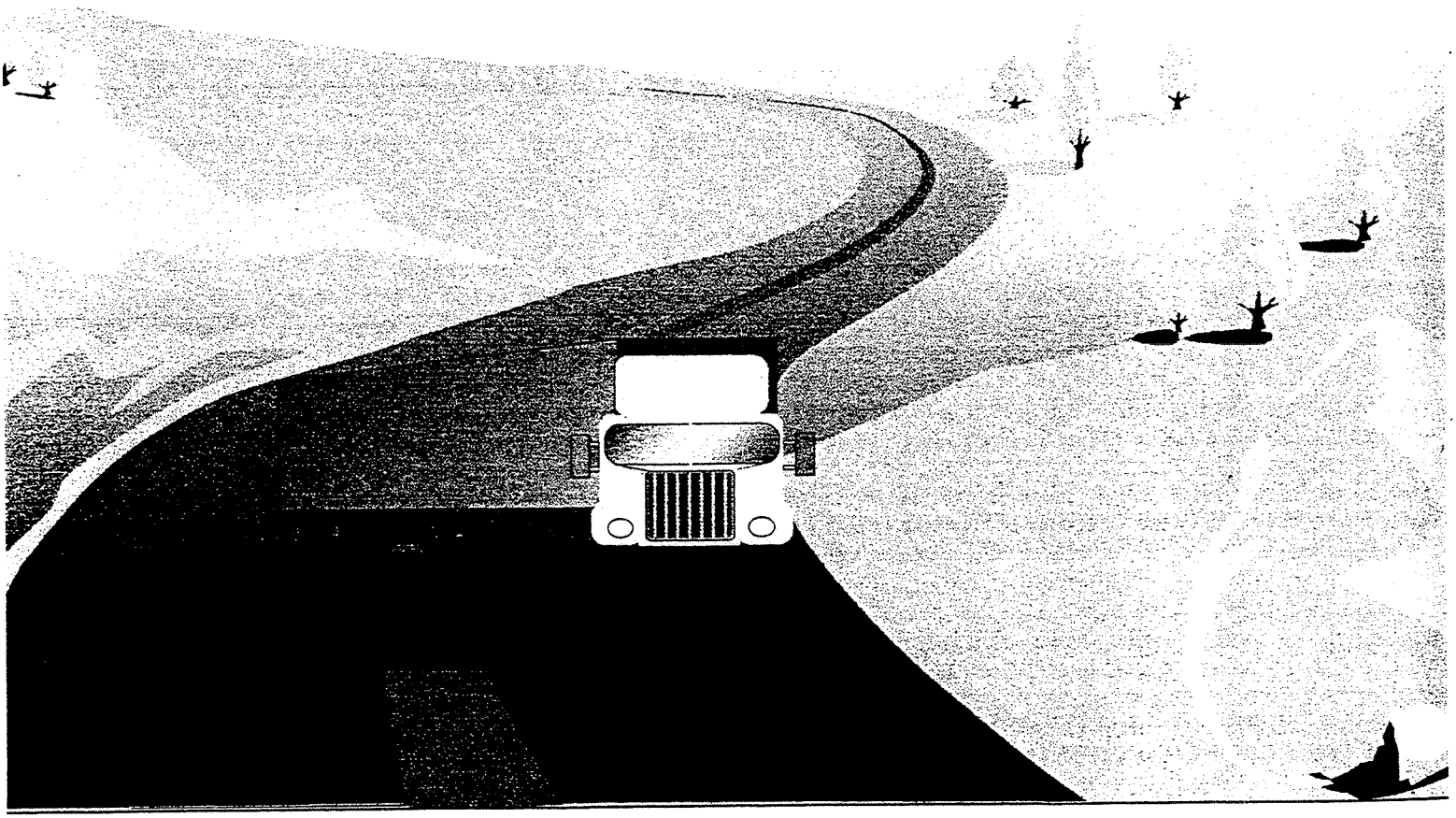
This Appendix contains a model oil and hazardous materials spills, including phone numbers to call to report a spill, what to do in the event of a spill, etc. This informational brochure was developed by the Department's Bureau of Remediation and Waste Management. Questions about oil and hazardous materials spills should be directed to DEP Response staff at the numbers listed under *FOR MORE INFORMATION.*

RESPONDING

TO

OIL & HAZARDOUS MATERIALS

SPILLS



EMERGENCY TELEPHONE NUMBERS

Company Numbers

Spill Coordinator _____

Backup Coordinator _____

Fire Department _____

Other Contact Numbers

Wrecker Service _____

Spill Cleanup Contractors _____

Spill Reporting

State of Maine

Oil Spills

Calls within Maine (24 hours)	800/482-0777
Calls from outside Maine (8 a.m. - 5 p.m.)	207/822-6300
Calls from outside Maine (nights, weekends, holidays)	207/657-3030

Hazardous Material Spills

Calls within Maine (24 hours)	800/452-4664
Calls from outside Maine (24 hours)	207/624-7000

State of New Hampshire

All calls (8 a.m. - 4 p.m.)	603/271-3440
Calls within New Hampshire (4 p.m. - 8 a.m.)	800/346-4009
Calls from outside New Hampshire (4 p.m. - 8 a.m.)	603/271-3636

Federal

National Response Center	800/424-8802

Canada

Canadian Coast Guard (will contact all other agencies)	902/426-6030
Spills in Quebec	
Federal (24 hour)	514/283-2333
Provincial (24 hour)	418/643-4595

For More Information

Department of Environmental Protection (8 a.m. - 5 p.m.)

Division of Response Services

Central Maine Regional Office (Augusta)	207/287-7800
Eastern Maine Regional Office (Bangor)	207/941-4570
Northern Maine Regional Office (Presque Isle)	207/764-0477
Southern Maine Regional Office (Portland)	207/822-6300
Maine Emergency Management Agency (8 a.m. - 5 p.m.)	
In-state	800/452-8735
Out-of-state	207/287-4080
CHEMTREC (for use only during a chemical emergency)	800/424-9300

Steps in Spill Response

Actions taken during spill response include:

I. Observation and Evaluation

II. Reporting and Seeking Assistance

Questions to ask:

a. What material spilled?
b. Where is the spill?
c. How much spilled? How much remains that could be spilled? Is it contained?
d. When did the spill occur?
e. Is help needed? Is help on the way?
f. Who is the owner? Has the owner been contacted?
g. Local conditions: What is the weather? Is there water or are there wells nearby?

III. Initial Containment

Guidelines to follow:

a. Do not endanger the health and safety of yourself or others.
b. Use measures that can be done without delay.

IV. Containment

Actions to take:

a. Plug holes when possible.
b. Shut valves.
c. Dike the area (ahead of the spill, if possible).
d. Contain any runoff water from fire suppression activities.
e. Install booms on streams.
f. Cover or dike threatened storm drains.

V. Spill Cleanup

Cleanup methods depend on the situation, product, and resource affected. Methods used include:

a. Sorbents
b. Pumps, vacuums
c. Controlled burns
d. Excavating contaminated soils
e. Ground water treatment
f. neutralization

VI. Restoration and Damage Compensation

How many spills of oil or hazardous materials occur in Maine annually?

In 1996, over 2,200 reports of spills were received and investigated by Department of Environmental Protection (DEP) spill response personnel. Most were small to moderate spills. However, damage from any spill can be minimized by acting promptly and using common sense.

What should you do in the event of a spill?

State law requires that all spills be reported. Procedures and requirements for reporting vary depending on the material spilled. (For phone numbers to report a spill, refer to the section titled "Emergency Telephone Numbers".) *Oil spills* must be reported to the DEP. All *hazardous materials spills* must be reported to the Department of Public Safety. (Public Safety will notify the DEP, the Maine Emergency Management Agency, and the public safety agency of the municipality in which the spill occurs.) For *hazardous materials spills above the reportable quantity* (as defined by the U.S. Environmental Protection Agency) contact: 1) the Department of Public Safety; 2) the closest local fire department; 3) the county sheriff; and 4) the National Response Center.

When reporting a spill, the following information is very helpful:

1. What spilled?
2. How much was spilled and is there a chance that more can be spilled?
3. What is the location of the spill?
4. Is help needed and how urgent is the situation?
5. What are the natural resources that might be impacted?
6. What has been done and what is planned to be done?
7. Who is the contact? Please include phone number.
8. Who is the responsible party (if known)?
9. Has a cleanup contractor been called?

A copy of the DEP's Initial Information Spill Report Form is included at the back of this booklet. You may wish to use this form to assist you in spill reporting.

When should a spill be reported?

All spills should be reported as soon as possible. If a surface oil spill is reported within 2 hours (and promptly removed) the responsible party is not subject to any fines or civil penalties. Evidence of a leak from an underground storage tank must be reported within 24 hours. (However, spills of less than 10 gallons from *underground storage tanks* do not need to be reported if the spill is removed within 24 hours, and other requirements are met.) Discharges of hazardous materials must be reported immediately. (Facilities with SPCC plans may have different reporting requirements.)

What happens after a spill is reported?

Your call to report a spill will alert a DEP responder in Augusta, Bangor, Portland, or Presque Isle. DEP response staff is on-call 24-hours a day. Depending upon the circumstances, DEP responders may assist by providing information over the phone, by bringing in a specially equipped response vehicle, or by hiring a private spill cleanup contractor.

Who is responsible for cleaning up a spill?

The spiller is legally responsible for cleanup and may choose to perform the cleanup under the direction of the DEP. Sometimes a spiller does not or cannot clean up a spill, so others, such as the

local fire department or the DEP, must act to protect public health, safety, and the environment. When and how this action takes place can make the difference between a temporary impact, and causing a resource to be destroyed for the foreseeable future.

Who can cleanup a spill?

Workers must be adequately trained before they can be involved in spill response. Both the state and federal governments have standards for health and safety for individuals involved in spill response. All persons who respond to spills in any capacity must receive training which is in compliance with federal standards. Hazardous waste operations and emergency response training is divided into two phases, an emergency phase and a post-emergency phase. Training requirements vary depending on the phase of clean-up.

All government agencies and private employers are directly responsible for the health and safety of their own employees. When response operations are undertaken, an occupational health and safety program, including a site health and safety plan, must be made available to the workers at the scene of operations. The site health and safety plan must be followed, in addition to meeting any applicable provisions of federal and state occupational safety and health regulations. All workers must be apprised of the site hazards, site safety practices, and other provisions of the site health and safety plan.

Can all spills be cleaned up?

Surface spills on land or water are the easiest to evaluate and mitigate as they can be seen and controlled. Vapor spills (e.g., chlorine or propane) usually cannot be cleaned up given their chemical properties. Corrective action for vapor spills is limited to stopping the discharge and protecting public health and safety by removing people from the affected area. Underground spills often go undetected, spreading contamination into water supplies and basements. Cleanup is possible, but often involves long periods of time and high cost. Prompt initial action is necessary in any spill since delay leads to prolonged, costly, and less effective cleanup.

Who determines what is needed to cleanup a spill?

Staff from the DEP will provide the responsible party with advice on proper spill mitigation measures. Depending on the nature and extent of the spill, oversight of cleanup may also be provided by the local fire department, the U.S. Environmental Protection Agency, or the U.S. Coast Guard.

What are the steps in spill cleanup?

Generally, the steps to mitigate a spill are the same, regardless of the source or product spilled:

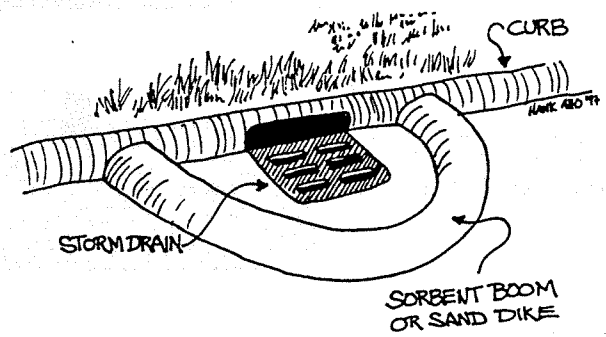
a. Evaluate the situation and identify hazards.
b. Stop the discharge.
c. Contain the spilled product.
d. Clean up the spilled product when possible.
e. Assist and/or compensate the people adversely affected by the contamination.
f. Restore any natural resources damaged by the spill.

The initial *evaluation* should be a quick look to determine what steps should be taken immediately, and if additional help is needed. Later, further evaluation of a spill may involve a long-term environmental monitoring program to determine the extent of the problem and the progress of remedial action.

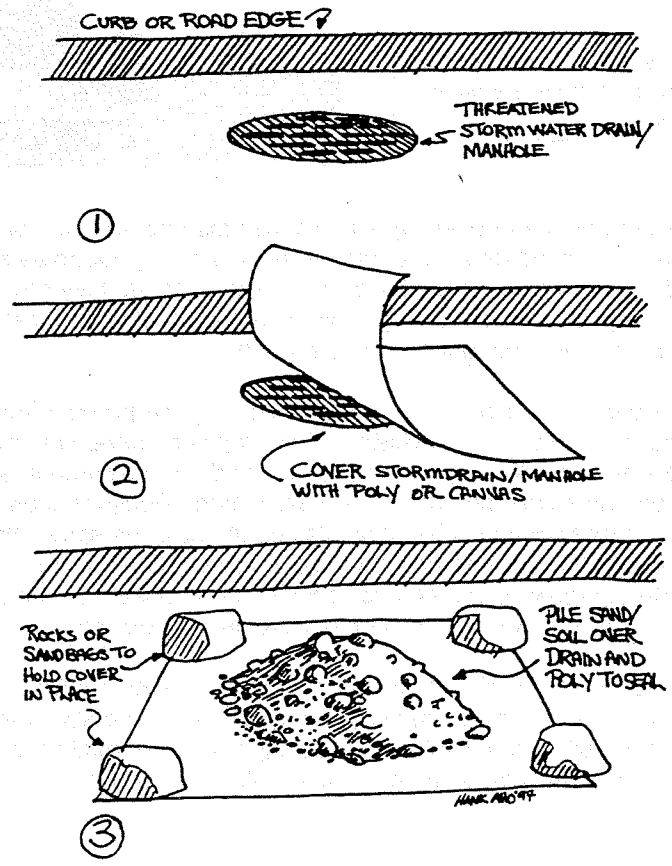
Stopping the discharge as soon as possible is the most important step. This is where local fire departments and local industry response teams, often first on-scene, are invaluable. As long as it is safe to do so, a trained person on the scene can close valves, plug or patch holes, or transfer the contents of a leaking container to a sound one. Using materials close at hand such as wooden plugs or rags to stop or slow a leak is often more effective than more elaborate methods which may take a while to obtain or install. No attempt should be made to stop a leak if undue risk is involved. Many chemicals require special handling, equipment, and procedures. If the equipment or knowledge is not at hand, you should wait until the necessary help arrives. Failure to do so could result in personnel casualties, fire, or explosions, and could also make the spill worse.

Containing the spill and stopping its spread should immediately follow or be concurrent with stopping the leak. Responders may employ several methods to contain the product spilled on the ground, such as building a dike around it, plugging or otherwise protecting all storm drains or sewers in the area, and diverting product into a ditch that can be dammed.

This figure shows how to protect a curb-type storm drain by diking or booming.



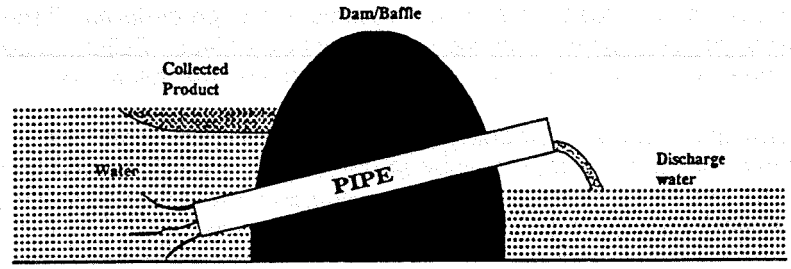
This figure shows how to protect an inroad storm drain or manhole.



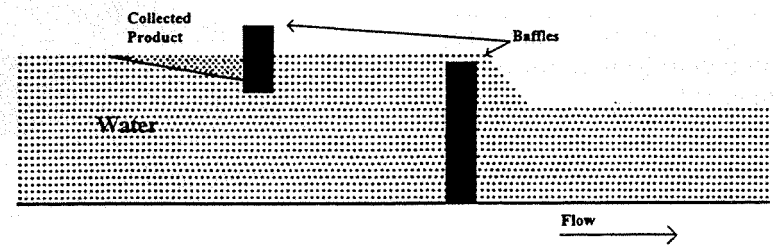
A product which floats on water can be contained by using booms, underflow dams, or weirs, which should be placed near access areas so that product can be recovered from the containment area. Underflow dams or weirs (shown below) are used to trap product as it floats downstream, without stopping water flow. Materials used to construct underflow dams (planks, sections of pipe, and earth) can usually be found locally.

THREE TYPES OF UNDERFLOW DAMS

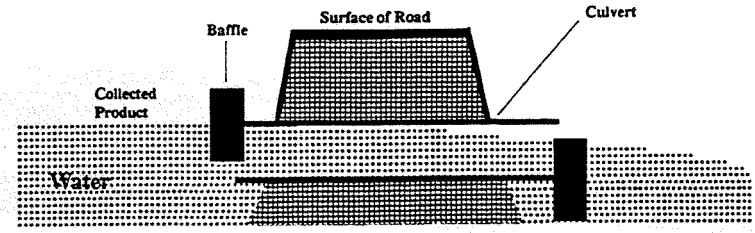
This figure shows the use of an earthen dam with a flow pipe.



This figure shows the use of wooden planks as baffles to trap product.



This figure shows the configuration for installing a weir in a road culvert.



Sorbent (a material that binds up a liquid) can also be used to contain a spilled product in the water and on land. If commercial sorbents are not available, materials such as sand, sawdust, hay, kitty litter, and "Speedy Dri" can be used. Disposal costs are lower for sorbents that are combustible. Containing a product moving in ground water may require the installation of a drawdown well, interceptor trenches and underground barriers.

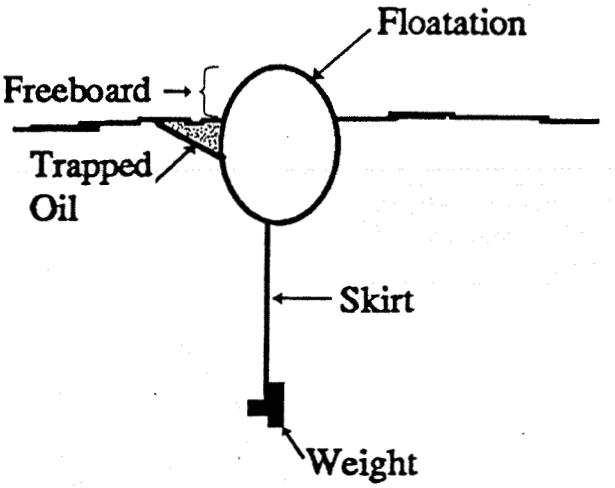
Cleaning up the spilled product involves removing the product from the environment and restoring the environment as much as practicable. This step is overseen by staff from the DEP. Once contained, liquids can be vacuumed up, pumped, skimmed, or picked up in sorbents. Liquids which have soaked into the soil and solids may have to be excavated. Equipment used in cleanup depends upon what is needed for safe handling, what is available, and how the spiller, the local authorities and the DEP determine the cleanup is to be done. For instance, supervised burning of the contaminated area with appropriate safeguards can be one of the better and least costly cleanup methods in certain circumstances; in other circumstances it can lead to disaster.

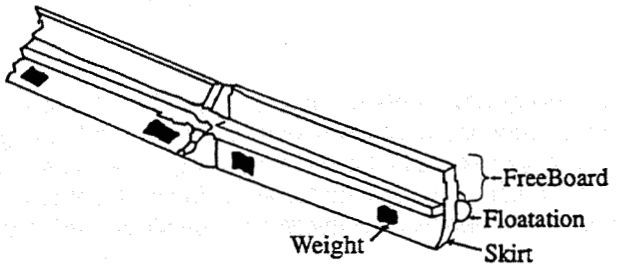
Determining compensation for persons affected by a spill is the hardest step, since it is difficult to put a dollar value on a resource damaged or destroyed. The spiller is responsible for damage directly related to the spill. For oil spills, spill damages can be reimbursed by the state or federal government through a third party claim process if the spiller will not or cannot pay.

What is a boom and how is it used?

The function of a boom is to stop floating product while allowing water to flow. A boom has several parts, which are shown in the two diagrams below.

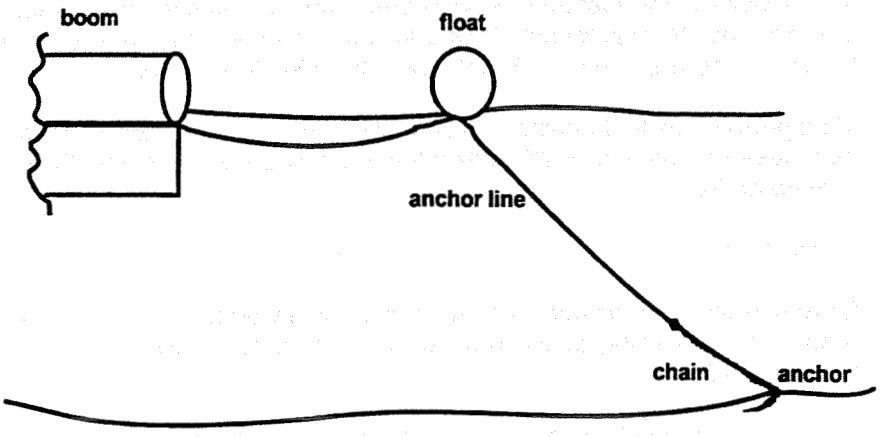
- *Floatation* can be logs, timbers, Styrofoam floats, air-inflated fire hose or almost anything that floats.
- *Freeboard* is the part of the boom that is exposed above the surface of the water. The amount of freeboard will depend on the buoyancy of the flotation. To be effective, boom must have enough freeboard to keep contained product from washing over the boom. Wind will act on the freeboard to move and stress the boom.
- The *skirt* of a boom is the amount the boom extends below the water. The skirt acts to prevent contained product from washing under the boom. The deeper the skirt, the more effective it is. Deeper skirts increase the water current loading on the boom.
- The *weight* is what keeps the boom vertical in the water. Lead weights, chain in the bottom of the boom, or the mass of the floatation can all act as weight.





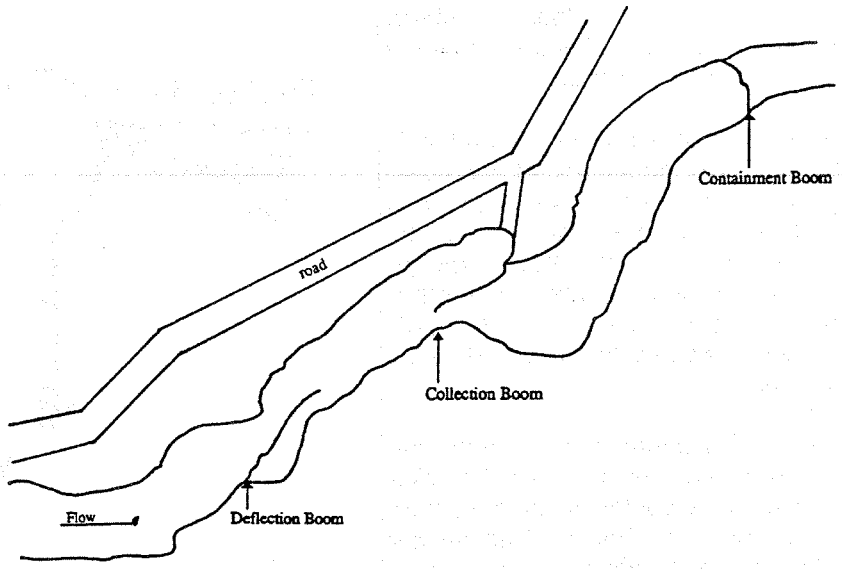
Boom performance is based on shape and angle of placement relative to the current. Cylindrical booms remain straighter in the water and can handle stronger currents, while flat booms are easier to transport and store. Boom must be set at a sharp enough angle to handle the present current and anticipated changes. Experimentation with boom angle may be necessary to prevent loss of oil beneath the boom.

Boom can be tied off to the shore or anchored to floating objects on the water. It is best not to tie boom directly to an anchor line, because the current will pull the boom under water. Anchor line must be of sufficient length to handle the current and tidal influence (usually 5 to 10 times the water depth). A sufficient number of anchors of an appropriate weight and type must be used.



Boom can be placed in many configurations depending on the situation. *Containment boom* extends across a waterbody such as a river or brook, and is limited to slow waters. *Collection boom* is used to divert product to a convenient collection point. Access to the collection point must be considered. *Deflection boom* is used to direct product around a critical area.

This figure shows several methods of booming.



In an emergency, containment boom can be fabricated from almost anything that floats at least partially submerged and is resistant to oil or the floating chemical being contained. For example, fire hose can be used as a boom by capping the ends and filling the hose with air. It is helpful if at least one of the caps has a fitting for an air hose. Containment booming is ineffective in currents over 1 knot; boom deployed in rivers must be staggered to divert oil to a recovery point.

How do you electrically ground a tanker or drum before pumping its contents?

Anything with mass has an electrical charge (or "potential"). When two items with potential are joined, a spark could be produced. The items most likely to have a stored static charge capable of producing a spark large enough to ignite the fuel are: 1) the full tanker; 2) the empty tanker; 3) the grounding rods; and 4) the pumping process. The objective of electrically bonding and grounding is to ensure that all parts of the system (the full tanker/drum, the empty tanker/drum, and the grounding rods) have the same electrical potential. This is achieved by bonding pieces of equipment together, and making the connections so any spark is far away from the fuel source.

Ideal procedures for bonding and grounding are described below. However, if the situation is such that these procedures could ignite a fire, the responder must alter the procedure to minimize the chance of fire.

Connecting:

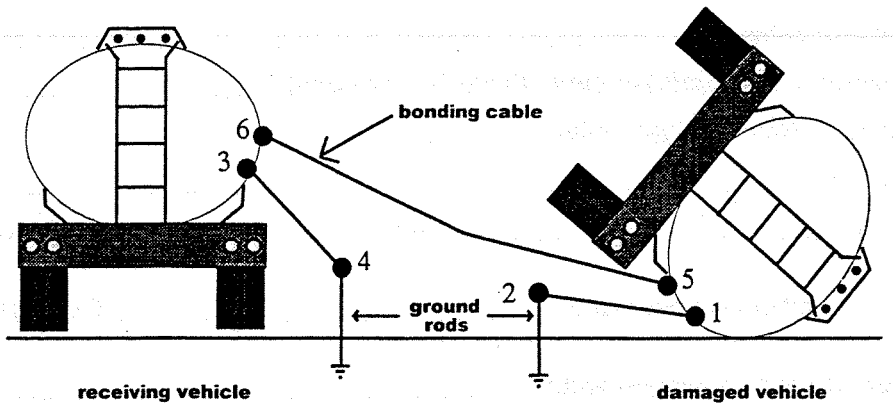
Drive two ground rods uphill and upwind of the incident. (The full tanker/drum will be bonded to one ground rod; the empty tanker/drum will be bonded to the other.) Then make connections in the following order:

1. Connect a bonding cable to the tanker/drum to be pumped out, then to the ground rod.
2. Connect a bonding cable to the tanker/drum to be filled, then to the other ground rod.
3. Connect a bonding cable between the two tankers/drums.

4. Ground the pump (connect to one of the ground rods) or bond it to the tanker/drum being emptied (since the tanker/drum is already grounded).
5. Bond any other equipment (hoses, air drills, etc.) to the tanker/drum being emptied. Connections should always be made to the tanker/drum first, then to the equipment.

Note: As connections are made, check them with an ohmmeter to ensure there is zero resistance.

This figure shows the order of connections to properly ground two tankers.



Disconnecting:

1. After the transfer is complete, break the bond between the two tankers/drums by disconnecting at the full tanker/drum first, then at the tanker/drum that is now empty (the empty tanker/drum is now the more dangerous).
2. Disconnect the pump ground or bond, then disconnect all extraneous equipment (make sure the connection at the equipment is disconnected first, then the connection at the tanker/drum).
3. If applicable, roll the damaged tanker onto its wheels.
4. Remove the ground rod connections last.

Off-loading of flammable liquids should be undertaken only by properly trained personnel with the ability to monitor for O_2 and LEL.

Who determines if a spill has been satisfactorily cleaned up?

Staff from the DEP will make a determination on the level of clean up required based on spill location, resources potentially impacted, and product spilled. Depending on the nature and extent of the spill, other agencies may be involved in the determination, such as the local fire department, the U.S. Environmental Protection Agency, or the U.S. Coast Guard.

DEP INITIAL SPILL INFORMATION REPORT FORM

Please fill in as much of the following as possible, using information provided by the caller/reporting official. **Bold fields are of primary importance.**

Date of Report _____ and Time ___:___ AM ___ PM ___

Date of Spill/Event _____ and Time ___:___ AM ___ PM ___

Name of caller _____

Telephone number(s) of caller (include area code) _____

Company Name (if applicable) _____

Address _____

Town _____ State _____ Zip Code _____

Name of other informed party _____ Phone Number _____

Type of product alleged spilled _____

Estimated amount of spill _____

Is more spillage possible? _____ (Yes or No) Amount? _____

Is the situation **URGENT**? _____ (Yes or No) Is **HELP** needed? _____ (Yes or No)

Nature of call or complaint _____

_____

_____

Actions taken so far: _____

_____

What resources are at risk? (check all that apply)

_____	Public Safety	_____	Surface Drainage
_____	Public Water or Well	_____	Storm Sewer
_____	Private Water or Well	_____	Sanitary Sewer
_____	Atmosphere	_____	Vapors in Building
_____	Land or Ground	_____	None (complaint only)
_____	Open Water		

Location of incident (Town name) _____

Specific directions to site _____

_____

_____

Emergency Response Kits

The following is a list of suggested items for a tool kit, patch kit, and air drill kit:

Tool Kit
Ax, bush hook
Ax, curved handle
Cable cutters
Drum de-header (can opener)
Grounding cables, 25' long (2)
Grounding rod
Hammer, ball peen
Hammer, claw
Hammer, short sledge, 3 lb.
Hammer, sledge, 15 lb.
Hatch dog clamps (4)
Ice chopper
Jumper cables
Knife, utility
Mag light
Multi-meter
Pick ax w/handle
Pinch bar
Pipe cutter
Pliers, diagonal cutting, 6"
Pliers, needle nose
Pliers, regular
Pliers, tongue & groove joint, 7" & 14"
Pliers, vice grips 5" & 10"
Quick-connect fittings, 2" & 1½"
Rake, floral, 7½" head
Rake, long handle
Saw, bow
Saw, hack
Screwdrivers, phillips & standard tips
Shovel, long handle spade
Shovel, short handle spade
Shovel, long handle square
Shovel, short handle square
Socket set, 3/8" drive, 32 piece, ¼" to 1"
Squeegee w/handle, 24"
Tank stick
Tape rules, 25' & 100'
Tarpaulin, 15' - 25'
Tool box, 2 or 3 drawer
Wrecking bar, 18"
Wrench, crescent (6" & 12")
Wrench, drum
Wrench, pipe (8", 10", & 18")
Wrench set, 13 piece, ¼" to 1"
Wrench set, hex, 15 piece

Patch Kit
Brush, wire
Clamps, hose, ¼" to 5"
Epoxy, PC7
Hammer, rubber
Knife, putty
Knife, utility
Liquid steel, 1 tube
Mega Stick (for steel patching)
Nut drivers, ¼" & 5/16"
Pliers
Plug 'n Dike
Plugs, rubber, 1½" to 5"
Plugs, wooden
Saw, hack, 6", w/extra blades
Screwdriver, phillips
Screwdriver, square tip
Screws, self-drilling
Seal All, 1 tube
Tape, duct
Tape, electrical
Tape, Teflon
Ties, wire
Tubing, rubber
Wire, steel, 1 roll
Wrench, crescent, 6"

Air Drill Kit
Air hose, 25'
Air regulator
Arbor for ½" chuck
Chuck key
C/P Drill w/½" chuck
Lubricant, 1 bottle
Pilot drill bits, 2
Saw, hole, 1", 3" or 4"
Screwdriver, phillips
Screwdriver, square tip
Wrench, crescent, 6"

Note: Hand tools should have large handles to facilitate working with them while wearing 2 pairs of gloves.

APPENDIX G : REFERENCE SOURCES & 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. January 3, 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.

National Oceanic and Atmospheric Administration and Environmental Protection Agency. 1993. Coastal nonpoint pollution coastal program. Program Development and Approval Guidance. U.S. Government Printing Office, Washington, D.C.

Rhode Island Department of Environmental Management, 1989. Rhode Island's nonpoint source management plan. Division of Environmental Coordination, Providence, RI.

Rhode Island Department of Environmental Management. 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. Ungs, 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. l991. 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.

South Carolina Department of Health and Environmental Control. 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. Applied Science Associates 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.

United States Environmental Protection Agency. 1974. Assessing effects on water quality by boating activity. U.S. Environmental Protection Agency, National Environmental Research Center, Cincinnati, OH.

United States Environmental Protection Agency. 1976. Impacts of construction activities in wetland of the United States. U.S. Environmental Protection Agency. EPA/600/3-76-045.

United States Environmental Protection Agency. 1985. *Coastal Marina Assessment Handbook.* U.S. Environmental Protection Agency, Region IV, Atlanta, Georgia.

United States Environmental Protection Agency. 1985. *Coastal Marinas Assessment Handbook.* (April) U.S. Environmental Protection Agency, Region IV, Atlanta, GA.

United States Environmental Protection Agency. 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.

United States Environmental Protection Agency. 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.

United States Environmental Protection Agency. 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.

United States Environmental Protection Agency. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

United States Environmental Protection Agency. 1991. Draft EPA Region I no-discharge area policy. United States Environmental Protection Agency, Region I, Boston, MA.

United States Environmental Protection Agency. 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.

United States Environmental Protection Agency. 1990. National water quality inventory, 1988 report to Congress. US EPA, Washington, DC.

United States Fish and Wildlife Service. 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.

Washington State Department of Fisheries. 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.

Connecticut Department of Environmental Protection. 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. I991. 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.

United States Environmental Protection Agency. 1976. Impacts of construction activities in wetland of the United States. EPA/600/3-76- 045. U.S. Environmental Protection Agency.

United States Environmental Protection Agency. 1991. *Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

United States Environmental Protection Agency. 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.

Washington State Department of Fisheries. 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.

Hastsopoulos, 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. 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.

United States 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., Langhome, 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. I991. 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 Recreatioal 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 Managment 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 Liberte': 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.