Water Pollution and Water Quality in Massachusetts' Coastal Zone

A Municipal Official's Primer

by Madeleine Hall-Arber, Ph.D.
MIT Sea Grant College Program

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$17.00 plus $1.00 S+H
2.50 foreign

recycled paper

MITSG 91-22

ISBN: 1-56172-005-4

The Water Pollution and Water Quality in Massachusetts' Coastal Zone is a project of the MIT Sea Grant College Program. The work was funded by the MIT Sea Grant College Program under federal grant # NA90AA-D-SG424, from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

Sponsored by the Massachusetts Bays Program, a joint project of the Environmental Protection Agency and Massachusetts Executive Office of Environmental Affairs.

Acknowledgments

I wish to thank all who have helped in this endeavor. Many people contributed ideas and suggested references as well as offering enthusiasm and encouragement over the lengthy development period. Though not everyone can be named, I am grateful to all.

This primer was originally suggested by Edward Brainard of Endeco, Inc., a member of MIT Sea Grant College Program's State-Industry Advisory Council. Norm Doelling, assistant director of Sea Grant, encouraged me to take up the writing challenge. Other Sea Grant staff members, including John Moore and Karen Hartley, read early drafts and pushed me on.

Later drafts were thoroughly read, and very helpful comments made, by Marc MacQueen, Pilgrim Resource Conservation and Development Area Council; Commander D. B. Parsons and Lt. Bob Hazelton, U.S. Coast Guard; and by Myles Brown, Department of Environmental Protection.

Comments on portions of the primer were made by Lee Ann Campbell and Graham Giese of Woods Hole Oceanographic Institution; Mimi McConnell, Coalition for Buzzards Bay; Alan MacIntosh, Merrimack Valley Planning Commission; Dan Curll, Boston Voyages and Learning; Jay Kaufman, Jay R. Kaufman Associates; Fara Courtney, Massachusetts Coastal Zone Management Program; and unnamed staff members of DEP.

Thanks also to Carolyn Levi who expertly edited the manuscript and to Tekla McInerney whose design talents made the format attractive and therefore more easily comprehensible.

Finally, I wish to thank Carol Kilbride and Diane Gould of EPA and the Massachusetts Bays Program, respectively, for bringing the primer to the attention of the Management Council of the Mass Bays Program. I am grateful to the Council for agreeing to distribute it as a companion document to the Massachusetts Bays' Comprehensive Conservation and Management Plan.

Naturally, I am solely responsible for errors.

Madeleine Hall-Arber

Acronyms

ACEC	Area of Critical Environmental Concern
BOD	Biological oxygen demand
CBRS	Coastal Barrier Resources System
CCMP	Comprehensive Conservation and Management Plan
CMR	Code of Massachusetts Regulations
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DCS	Division of Conservation Services
DEM	Department of Environmental Management
DEP	Department of Environmental Protection
DEQE	Department of Environmental Quality Engineering (Changed to DEP in 1989)
DFA	Department of Food and Agriculture
DLI	Department of Labor and Industries
DMF	Division of Marine Fisheries
DPH	Department of Public Health
EIR	Environmental Impact Report
ENF	Environmental Notification Form
EOEA	Executive Office of Environmental Affairs (Massachusetts)
EPA	U.S. Environmental Protection Agency
FCZ	Fishery Conservation Zone
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FOSC	Federal On-Scene Coordinator
FWPCA	Federal Water Pollution Control Act
HWFSSC	Hazardous Waste Facilities Site Safety Council
LEPC	Local Emergency Planning Council
LOSC	Local On-Scene Coordinator
MACC	Massachusetts Association of Conservation Commissions
MCZM	Massachusetts Coastal Zone Management
MDC	Metropolitan District Commission
MEPA	Massachusetts Environmental Policy Act
MGD	Million gallons per day
MGL	Massachusetts General Laws
MIDA	Massachusetts Inshore Draggermen's Association
MOHML	Massachusetts Oil and Hazardous Material List
MSD	Marine Sanitation Device
MSDS	Material Safety Data Sheets
MWRA	Massachusetts Water Resources Authority
NCP	National Contingency Plan
NEP	National Estuary Program

NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOPPA	National Ocean Pollution Planning Act
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
OCRM	Ocean and Coastal Resource Management (NOAA office)
OSC	On-Scene Coordinator (see also FOSC and LOSC)
OSHA	Occupational Safety and Health Administration
OTA	Office of Technical Assessment
PAH	Polynuclear aromatic hydrocarbon
PBC	Polychlorinated biphenyl
P.L.	Public Law
POTW	Publicly Owned Treatment Works
RC & D	Resource Conservation and Development District
RCRA	Resource Conservation and Recovery Act
RFD	Request for Determination
RPA	Regional Planning Agency
RRC	Regional Response Center
RRT	Regional Response Team
SCS	Soil Conservation Service, USDA
SDWA	Safe Drinking Water Act
SRPEED	Southeastern Regional Planning and Economic Development District
TSCA	Toxic Substances Control Act
U.S.C.	United States Code (Federal Statutes)
USDA	United States Department of Agriculture
USGS	United States Geological Society
WPA	Wetlands Protection Act
WWTP	Wastewater Treatment Plant

Contents

Figures

Purpose

Conservation commissions, boards of selectmen and other municipal agencies are the first line of defense against a multitude of assaults on water quality in the rapidly developing Commonwealth of Massachusetts. Maintaining a community's water quality is a daunting task, faced, in many cases, by volunteers whose primary qualification is a devotion to their town or city and a willingness to spend a large part of their "leisure" time working to improve and protect their community.

This manual is a reference guide to problems, causes, solutions, experts and bibliographic references in the field of water pollution and water quality. With overviews of the main issues and suggestions for coping mechanisms, as well as listings of pertinent legislation and responsible government agencies, the manual should be a time saver for both experienced and novice decision-makers. It will not answer every question in detail, but will serve as a starting point for the seeker.

Comments on the manual's format and organization

The manual has been left unbound, in loose-leaf form, to allow the user to add updates or pertinent information in each section. In addition, the user may want to shift sections around for quicker access to issues of relevance to his or her location or interest. Margins are extra wide to permit user notations.

Notice that within each topic there is reference to legislation and to concerned agencies. For more information, including addresses and telephone numbers, the user should consult Chapters 8 and 9, "Government Agencies" and "Legislation and Programs," respectively. Chapter 3, "Immediate/Emergency Response" should be read immediately and kept current with names of local harbormasters, oil or hazardous materials spill coordinators, boards of health officials, conservation commissioners, etc.

Chapters 5 and 6 discuss water quality problems, probable causes and some solutions. The reader will note that not all problems are discussed to the same degree of detail. This is partially by choice and partially by chance, reflecting in part the accessiblity of information and in part the complexity of the individual problem. However, a few problems are especially likely to occur and for these the reader is provided with extra background. The quantity of detail is <u>not</u> correlated with the significance of the problem.

This variation in detail is also characteristic of the discussion of legislation and programs in chapter nine. Again, the quantity does not reflect a judgment about the significance of the legislation or program. Here too, the user has an opportunity to add information appropriate to his or her interests and needs. For example, a number of coastal communities have bylaws that address specific problems and could be appended.

Background

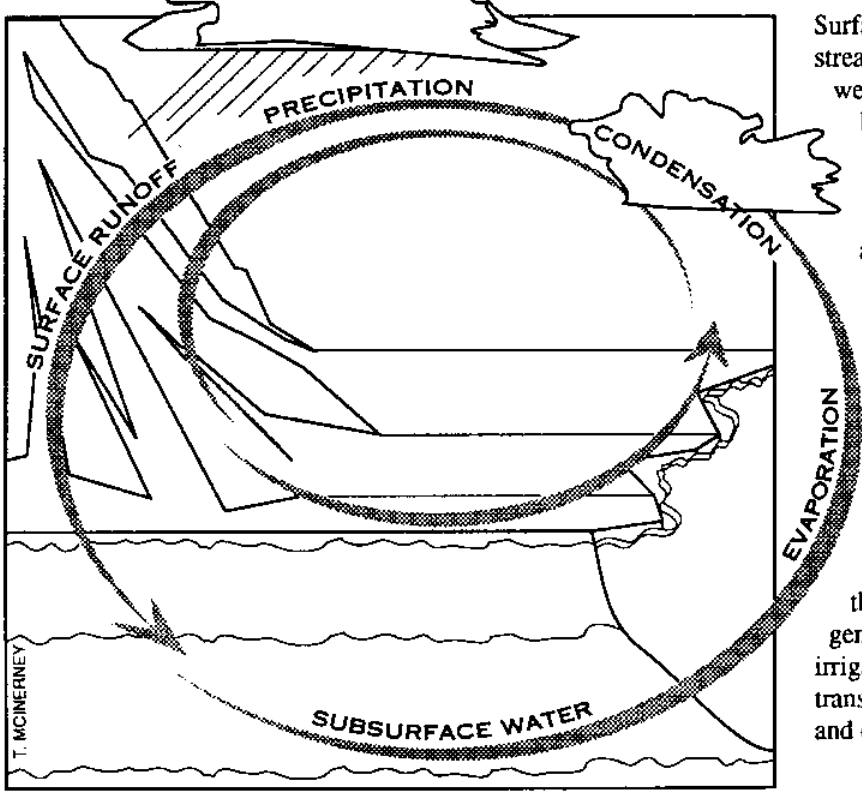
In the hectic pace of daily life, early science education is easily forgotten. But, many of the principles taught in grade school could, and indeed should, be applied in everyday activities. For example, the basic scientific law stating that matter can neither be created nor destroyed is important in understanding the water cycle and why water quality problems are so widespread.

It is not intuitively obvious that all water is related and that what happens on the land affects water near and far. Inland residents tend to think of local water as important only to their own community. Coastal residents tend to think of the ocean as infinite. Almost everyone in the Common-

wealth takes for granted the easy access to piped-in water. In the face of ever-increasing water quality problems, however, it is clear that we must improve our stewardship of all water.

Whether your drinking water comes to you from a reservoir or from groundwater is insignificant from a broad historical perspective. Water cycles through air, ground and surface. Over time, some of the same water we drink today has irrigated fields in ancient Egypt, quenched the thirst of dinosaurs and floated the Spanish Armada.

As Massachusetts' population increases and people crowd together in urban areas, the sheer quantity of demands on its water resources questions the ability of nature's water cycle to cope in the short term. Though we cannot entirely destroy water in the long run, the quality of the Commonwealth's water resources are at risk.



Surface waters such as streams, rivers, wetlands, ponds, lakes, bays, harbors and the ocean are used for recreation and commercial enterprise. People swim, fish, boat and ice skate on surface waters. They enjoy viewing, bird-watching, and living near these waters. People also use the water to generate their power, irrigate their fields, transport their goods and dock their vessels.

▲ **Hydrologic Cycle**

The same water eventually reaches reservoirs and aquifers and is piped to farms, homes, restaurants, office buildings and universities where it is used for drinking, cooking, washing, cleaning, carrying wastes and irrigating. At the same time, water evaporates, precipitates and runs off, carrying solubles downstream.

At every point in its cycle, the quality of water is at risk because it easily dissolves and/or transports multiple undesirables–including chemicals, pesticides, oil, salt, untreated sewage and metals. However, we have the knowledge and legislative means to better protect our water resources. This manual outlines those basic means.

Checklists of Symptoms and Probable Causes

Tables 2-1 and 2-2 offer a quick overview of some of the major symptoms and the likely causes of water quality problems considered in this primer. See chapters 5 and 6 for discussion of these issues.

Note that in a few cases the cause of the symptom is a natural process that is not considered a "problem to be resolved." These are mentioned to remind the reader that a wide range or variety of conditions are part of healthy ecosystems. Examples include the decay of organic matter in wetlands that may cause an oil slick, dark water in swamps and marshes and low dissolved oxygen levels due to high water temperatures in the summer.

Following the tables is a more descriptive overview of both acute and chronic problems. The next chapter offers information on the appropriate responses to acute water quality problems.

Table **2-1**
Symptoms of Water Pollution: Acute Water Quality Problems

Symptoms	Likely Causes
Oil slick	Accidental spill or leak (transportation accidents most frequently) Dumping (waste oil, for example) Industrial discharge Storm drainage–drains over capacity, illegal discharges to system Road runoff Failing septic system Boat traffic; problems with marina operation, bilge pumps Creosote from piers and other structures Stirred-up sediments Jet exhaust Decay of organic matter in wetlands
Foul odor	Chemical or microbial contamination (see Table 1-2) Same causes as oil slick, plus: Pesticide use Landfill leachate Marine head discharges Combined sewer overflows Municipal wastewater treatment plants (WWTPs) Eutrophication (also see Table 1-2) Anoxic sediments Dead fish (see Table 1-2) Anoxic water (under ice, in first melt) Illegal dumping
Water discoloration or turbidity	Same causes as oil slick and chemical/microbial contamination, plus: Erosion Urban runoff Dredging Fill Algal blooms (see under Foul odor: Eutrophication) Storms Saltwater intrusion

Table **2-2**
Symptoms of Water Pollution: Chronic Water Quality Problems

Symptoms	Likely Causes
Algal growth	Nutrient loading from human, animal and bird wastes Sewage system overcapacity Illegal hookups to sewer system Failing septic systems Stormwater runoff Agricultural runoff (fertilizers) Marine head discharges Temperature increases
Low dissolved oxygen concentrations	Algal decomposition High water temperatures in summer Poor mixing
High coliform counts (Shellfish bed and beach closures)	Human, animal and bird wastes (see algae growth)
Loss of eel grass beds	Same causes as loss of wetlands, trace metals and chemical contamination, plus turbidity (see Table 2-2) Natural "wasting disease" Pollution Other
Loss of freshwater inflow into estuaries	Developments (housing and industrial)
Loss of wetlands	Same causes as algae growth, loss of freshwater inflow and chemical contamination, plus all causes cited in Table 2-1 Fill Boat traffic (wakes)
Lower catches of fish	All causes cited in Table 2-1 as causes of acute water quality problems Habitat loss (esp. wetlands and eel grass beds loss) Overfishing Other
Trace metals (in fish, water or sediments)	Industry Homes and small business Landfill leachate (mercury and copper, esp.) Vessel bottom paints Vehicle emissions and tire erosion (transported by stormwater) Contaminated sediments Atmospheric deposition Same sources or causes as chemical contamination ▶

Chemical contamination	Polychlorinated biphenyls (PCBs) from: Sewage sludge Disturbed sediments Dredging and disposal Polynuclear aromatic hydrocarbon (PAH) concentrations from: Atmospheric deposition Combined Sewer Overflows (CSOs) Same causes as oil slick (see Table 2-1)
Erosion	Groins, jetties, other structures Dredging Recreational vehicle and foot traffic Boat wakes Uncontrolled stormwater runoff Sea-level rise Currents over geologic time periods (i.e., long term)
Marine debris	Ships, fishing vessels and offshore structures Litter and dumping Balloon launches Dilapidated shorefront structures

Overview of Symptoms of Acute Water Quality Problems

Foul odors, discoloration of water and oil slicks are the most easily recognized symptoms of water pollution. The causes of these may be isolated incidents requiring little more than cleanup, but reoccurrences of the same symptom suggest that a comprehensive analysis of the problem, its likely causes and long-term solutions or controls may be necessary.

In this primer, the most common problems of water quality will be addressed, beginning with acute symptoms (those which appear suddenly and demand an immediate or emergency response) and moving on to chronic symptoms (those which become noticeable over a longer time period). The division between the two groups is rather arbitrary, based on degree rather than inherent differences. The negative impacts of the rare dramatic spills of oil may be negligible compared to the cumulative impacts of frequent small dumpings of motor oil, for example. Nevertheless, the striking symptoms cited for the acute cases do indicate a need for immediate attention, thus the division.

All the problems cited have a multiplicity of interrelated causes. Tables 2-1 and 2-2 above serve as checklists for problems and their sources. The solutions are, of course, complicated by the interrelatedness of the problems and their causes, but just as the negative impacts of a few sources of pollution are widespread, so too may a few solutions solve a diverse group of problems.

Overview of the Symptoms of Chronic Water Quality Problems

While symptoms of acute incidents of water pollution grab headlines, there is a growing recognition of the negative impacts on water quality of continuous or frequent, low-level incidents of water pollution. In most cases, this is referred to as "non-point source pollution" or sometimes simply "non-point pollution."

Stormwater runoff, for example, can lead to non-point source pollution. The runoff picks up residues of oil, tire rubber and pet wastes and carries them to the nearest water body. Although the individual portions of chemicals and wastes may be very small, the cumulative impact over time may be great.

Most of the symptoms of chronic water quality problems are traceable in part to non-point sources of pollution. The leading probable causes of algal growth, low dissolved oxygen concentrations, high coliform counts, loss of eelgrass beds, loss of freshwater inflow, erosion, loss of wetlands, lower catches of fish, trace metal and chemical contamination, and marine debris in coastal waters may all be linked to non-point sources.

The diffuse character of such sources of pollution make chronic problems more difficult to solve than acute problems. The problems tend to arise over long periods of time, slowing recognition of the existence of a problem and disguising the contributing factors or responsible parties.

Public education may heighten awareness of the problems and their probable causes, leading to more sensitive development and subsequent use of the environment. It is also important for local community leaders to encourage *long-range planning*, so that growth and development may enhance their communities without ruining their water resources.

Emergency/Immediate Response 3 to Acute Symptoms[1]

Who is officially "in charge"?

The Federal Water Pollution Control Act of 1972, amended by the Oil Pollution Act of 1990, mandated a National Contingency Plan and a network of Regional Contingency Plans for handling major spills of oil and other hazardous substances. The country has 10 predesignated **Regional Response Teams** (RRT) that operate from **Regional Response Centers** (RRC).

The RRT responsible for spills in Massachusetts is co-chaired by the Coast Guard and EPA. Currently, the chairs are :

Capt. Eric Williams
First Coast Guard District
Captain John Foster Williams Coast Guard Building
408 Atlantic Avenue
Boston, MA 02210-3331
Telephone (617) 223-8444

and

Edward J. Conley
U.S. EPA
Lexington Laboratory
60 Westview Street
Lexington, MA 02173
Telephone (617) 860-4320

The **National Response Team** chair is Jim Mackeras, of EPA (OS-120), U.S. EPA, Washington, D.C. 20460. Vice-chair is at U.S. Coast Guard Headquarters, 2100 Second Street S.W., Washington, D.C. 02593. The National Response Team has members from the Department of Transportation, Department of Defense, Department of Commerce, Department of Interior, and the Environmental Protection Agency.

The **Regional Response Team** has representatives from these federal agencies and from the Massachusetts Department of Environmental Protection.

The RRT designates a **Federal On-Scene Coordinator** (FOSC) who takes advice from the RRT and is responsible to it. For spills under the Coast Guard's jurisdiction, the FOSC is the Captain of the Port. For spills under EPA's jurisdiction, that is, on land and in non-navigable waters (in Massachusetts, roughly inland of Route 1 on the north shore, Route 3A on the south shore), the FOSC is an employee in the EPA's Emergency Response Office–designated at the time of the spill.

In smaller spills the RRT may not be activated and the FOSC may designate an on-scene representative to oversee the cleanup crews. The FOSC supervises field workers, including any provided by the spiller, commercial pollution contractors, environmental groups and volunteers, and specialized teams from the Coast Guard, EPA and state agencies; coordinates the information flow; and handles the finances involved in containing and removing the oil or other hazardous material.

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[1] Much of the general information in this section was derived from *Oil Spills: A Public Official's Handbook* by John T. Omohundro, New York Sea Grant Institute, Cornell University, Ithaca, NY. Information Bulletin 166, Social Sciences, Sea Grant 3, 1980, and from *Oil Spills: A Coastal Resident's Handbook* by John T. Omohundro, New York Sea Grant Institute, Cornell University, Ithaca, NY. Information Bulletin 164, Physical Sciences, Sea Grant 2, 1980.

In the case of large spills, the FOSC receives help from EPA's Emergency Response Team, the Public Information Assistance Team, NOAA's Scientific Support Coordinator and the Coast Guard's National Strike Force.

What is hazardous waste?

Common hazardous wastes include:

- waste oil
- solvents and thinners
- acids and bases/alkalis
- toxic or flammable paint wastes
- nitrates, percholorates and peroxides
- pesticides
- some wastewater treatment sludges

Hazardous materials may be listed as such in regulations or may be defined by hazardous characteristics such as: toxic, ignitable, flammable, corrosive, and/or reactive. EPA specifically lists 450 wastes and waste streams as hazardous.

Whom to tell?

Notification of a problem may come from responsible parties, observant citizens or directly from members of the Coast Guard.

To report spills of oil and other hazardous materials, telephone:

Federal authorities:

- National Response Center Hotline 800-424-8802 (24 hours/day) **and**
- Boston Coast Guard office 617-223-3000 (24 hours/day)(Plymouth and north) **or**
- Providence Coast Guard office 401-528-5335 (24 hours/day)(south of Plymouth)

State authorities:

- DEP's Emergency Response Section, Boston 617-292-5887

- Notify regional offices of DEP on weekdays (Monday-Friday) 8:45 a.m. 5 p.m. On weekends, holidays and weekdays after 5 p.m., contact DEP via the State Police (617-566-4500).

  DEP Regional offices:

Northeast Region–Woburn	617-935-2160
Southeast Region–Lakeville	508-946-2850
Central Region–Worcester	508-792-7653
Western Region–Springfield	413-784-1100

- Executive Office of Environmental Affairs, Boston 617-727-9800

To report small spills:

■ Notify the local oil spill coordinator, as well as the Coast Guard. In Massachusetts, the local oil spill coordinator may be known as a hazardous waste coordinator and is typically the fire chief, but may be the harbormaster, police chief or director of the town's department of civil defense. In addition, each community designates a local emergency planning council (LEPC).

Telephone: _____

Useful information to report:

■ Your name and phone number
■ Source and/or cause of the spill
■ Location of the spill
■ Time spill was discovered
■ Type of product spilled
■ Quantity of product spilled
■ Size, color, movement of the slick
■ On-scene weather (wind, seas, current)
■ Any actions taken so far

In addition:

■ Samples:
If **certain** that the pollutant will not dissolve or permeate your **rubber gloves**:
1. take three samples in clean glass jars, a minimum of one teaspoon per sample, of:
–unaffected water nearby,
–water, at the site of the spill, during the incident and
–water, at the site of the spill, after the spill.
2. Record time, date, place and sampler's name.

■ If **not sure** what the pollutant is, stay away from it
■ Photographs
1. Polaroid or 35 mm is acceptable, video is not.
2. Record time, date, place and photographer's name.
3. Long-range shots to identify area should include landmarks, vessel name in relation to the spill, people in vicinity.
4. Short range shots need to show precise point of discharge, path of the discharge into the water, and pollutant in the water.

■ Take written or oral statements, preferably signed, and list names of other witnesses
■ Later, request follow-up information from the Coast Guard on the disposition of the case. This will tell you whether your procedures enabled the Coast Guard to take action (e.g., issue a citation) against the responsible party.

What should the responsible parties do?

Spiller must:

- Notify the Coast Guard and/or EPA. All spills or dumping must be reported if a sheen is visible.
- Notify Massachusetts Department of Environmental Protection as soon as possible, but no longer than two hours following incident, if the spill exceeds the reportable quantity threshold, if a release is imminent, or if a release constitutes an imminent hazard.
- Reportable quantity thresholds vary: spills of petroleum products exceeding 10 gallons must be reported, thresholds for other substances are listed on the Massachusetts Oil and Hazardous Material List (MOHML) 310 CMR §40.30. When in doubt, spill should be reported to DEP (Brown, 1991).
- Some towns have reporting requirements

Spiller may:

- Retain a cleanup contractor for cleanup and removal of waste. However, "regulations promulgated by the federal Occupational Safety and Health Administration (OSHA) require that persons engaged in cleanup activities must have received training commensurate with their role in the cleanup" (Parsons, 1991). See list of Hazardous Waste Transporters Authorized to Perform Emergency Response Cleanup in Massachusetts, available from DEP.

Who does what in an emergency?

▼ Coast Guard

The Coast Guard is concerned with all navigable waters and most frequently faces spills in ocean, bays or sounds.

Seaward of the first major roadway (Route 1 in northeast region of Massachusetts, Route 3A on the south shore) to 200 miles offshore, the Coast Guard is the lead agency investigating and responding to oil and chemical spills. All spills or dumping must be reported if a sheen is visible on navigable waters. The sole exception is discharge permitted by EPA under National Pollutant Discharge Elimination System (NPDES) permits issued by the Commonwealth.

The Coast Guard Response Team:

1. assesses situation,
2. secures source,
3. contains or cleans up spill, and
4. disposes of spill material

If spills cannot be handled locally, the federal strike team for the East Coast is called in from Fort Dix, N.J.

However, the Coast Guard may not actually physically participate in the cleanup if the responsible party (i.e., the vessel owner/operator) takes appropriate action immediately. Also, the Coast Guard has standing contracts with private firms for containment and cleanup. (The spiller is responsible for paying, however.) The Federal On-Scene Coordinator (FOSC) remains respon-

sible for overseeing the cleanup, however, and monitors the progress. When the responsible party is unable or unwilling to clean up or pay for the cleanup, the spill is "federalized" and the FOSC directs the team's work.

▼ Department of Environmental Protection–Emergency Response Section

While the FOSC is in charge of all reported spills into or on navigable waters and/or adjoining shoreline and has responsibility for directing the cleanup, Massachusetts law also requires that DEP be notified when spill quantities exceed stipulated thresholds. DEP's Emergency Response Team oversees investigation and cleanup of spills in conjunction with the Coast Guard .

For spills occurring during the week, (Monday-Friday) 8:45 a.m.–5 p.m., regional offices of DEP must be notified. On weekends, holidays and weekdays after 5 p.m., contact DEP through the State Police (617-566-4500). Regional offices of DEP are the enforcement branches.

Northeast Region–Woburn	617-935-2160
Southeast Region–Lakeville	508-946-2850
Central Region–Worcester	508-792-7653
Western Region–Springfield	413-784-1100

DEP also assesses damages based primarily on inhalation and ingestion hazards. Spillers may have to pay for remediation, lost use and/or restoration of other natural resources (e.g., repairing fish ladders) as compensation.

Towns can help DEP to properly protect resources and assess damages by evaluating the town's natural resources **before** spills and ranking those that the town believes should have highest priority for protection in an emergency.

▼ Fire or Police Department

Primarily concerned with land spills, though departments in coastal towns may respond to spills in waterways. It is important for towns to know whether their fire or police department is equipped to respond to spills in waterways or wetlands.

Large fire departments generally have a hazardous material officer (known as the HazMat Officer) who is trained to respond to spills. The department will determine the likely source and cleanup small quantities.

For spills of petroleum products over 10 gallons (considered a "reportable quantity" in accordance with the Massachusetts Contingency Plan for oil and hazardous materials spills), the fire department will generally call the Emergency Response Team of DEP; however, the spiller remains responsible for notifying DEP.

Note: Massachusetts Executive Office of Environmental Affair's (EOEA) Strike Force is principally an investigative branch, seeking sources of pollution and scofflaws operating without permits.

▼ **Harbormaster**

Harbormasters are principally concerned with spills in coastal embayments

Notifies the Coast Guard and state officials of spills, including the name of the boat owner or others involved or responsible. If trained in oil containment (through Coast Guard workshops) may use a town-owned boom or absorbent pads to help contain the spill. Should take pictures and collect statements from witnesses to turn over to the Coast Guard.

In the event of major spills, harbormasters may act as liaisons between the On-Scene Coordinator and the impacted community. His or her knowledge of the resources available in the area, names of streets, neighborhoods and bays can be useful to the OSC, and the harbormaster's observation of the team's work can provide the community with a reliable source of information.

▼ **Waterways Committee**

In some communities, the Waterways Committee has funds dedicated for use in case of an oil spill.

▼ **Local Associations**

Useful for creating contingency plans and for mobilizing for protection and restoration in the event of a spill. Well-organized associations enable a community to hold together and work efficiently with outside help (Omohundro, 1980).

Yachting or sailing clubs, sport clubs, beach associations, citizen monitoring groups, homeowners associations, garden clubs and local chapters of environmental groups are often well-established associations that can be encouraged to participate in contingency planning.

▼ **Other Volunteers**

The National Contingency Plan encourages the use of trained or prepared volunteers for "beach surveillance, logistical support, bird and other wildlife treatment, and scientific investigations" in the event of a major spill. Those with special skills, equipment or other resources should contact their LOSC to offer services, preferably before a spill occurs. It might also be advisable to alert the RRT or DEP. Any of these agencies could contact the OSC to refer such services. "The OSC has the authority to place all resources in the field" (Omohundro, 1980).

Pilots or sport guides, wildlife experts, owners of steam hoses, etc. are among those who should be encouraged to participate in planning for oil spill emergencies.

coming soon...

▼ **Marine Spill Response Corporation**

Offshore oil industry's not-for-profit oil spill response organization

Constructing sixteen 210-foot offshore response vessels to deploy full range of response equipment. The vessels will be stationed around the country's coastline.

Agencies with ultimate or long-term responsibility

▼ **The Federal Trustees**

- Department of Interior is the trustee for land, mammals and birds.
- National Oceanic and Atmospheric Administration (NOAA)'s National Ocean Services is the trustee for all things marine.
- Some Indian tribes are trustees of reservation lands.
- States are trustees of state parklands.

The Federal Trustees are the "landlords" for all the land and natural resources of the country that is not privately owned (Lehmann, 1991).

Responding to average spills: Left up to local communities

Although the Coast Guard and DEP must be notified of oil and hazardous waste spills, the truth is that if the spill is smallscale, the local community is often given the responsibility for overseeing the response and cleanup. Communities that have contingency plans and some public knowledge about who should be called and what should be done are certainly in a better position to safeguard their own resources than those that expect the national or state agencies to take care of them.

Modeling the optimal response to oil spills in the New England region, Sea Grant-supported researchers at MIT found that it is more cost-effective to invest in "small-spill" response capability than to acquire expensive large-scale equipment that would be used only rarely (Psaraftis *et al*, 1986). Furthermore, the equipment to combat small spills should be geographically dispersed across many small local-response sites, whereas capability to respond to large spills should be consolidated at one or a few large-scale strike centers.

The authors point out that though the public, governments and industry are most concerned about planning for emergency response to catastrophic major spills, in fact, the damage potential (i.e., damage costs per unit volume) of small spills is higher than that of large spills. The explanation suggested is that small spills almost always occur closer to shore and consequently have greater impacts on valued resources (ruining fish nurseries, oiling beaches, etc.).

Being Prepared

At a minimum, towns should designate a local on-scene coordinator (or even two, one for land spills (fire chief) and one for water spills (harbormaster or shellfish officer)). Contingency plans should be updated and numerous copies distributed. Periodic drills are highly recommended.

It is a good idea for communities to work with their neighboring towns in planning spill response. Equipment bought in bulk is much less expensive; and furthermore, is more likely to work well together. The Marine Safety office of the Coast Guard offers information about the pros and cons of equipment such as containment and absorbant booms, as well as offering training workshops.[2] The Coast Guard will also go to towns to assess equipment needs.

Regional offices of Massachusetts Coastal Zone Management are interested and willing to help coastal communities develop oil spill contingency plans. See Chapter 8 for agency addresses and telephone numbers. See Chapter 9 for relevant legislation.

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[2] For a useful survey of oil spill response technologies and policy issues, see the Office of Technology Assessment's 1990 report, *Coping With an Oiled Sea*.

What is considered a "violation" and who issues citations?

The Coast Guard lists five elements that constitute violations: (1) There is a discharge (2) of oil or hazardous material, (3) a harmful quantity (i.e., characterized by a sheen, sludge, emulsion or discoloration), (4) into a navigable waterway with (5) an identifiable source of discharge. The Coast Guard will investigate all reported spills. If there is sufficient evidence of a violation under its jurisdiction, the Coast Guard will issue citations.

The Commonwealth's Environmental Police have the authority to issue citations.

Some communities have passed bylaws that give their police the power to issue citations for spills and dumping of oil or hazardous wastes in storm drains, on the ground, etc. Salem and Marblehead, for example, have such local ordinances. These are particularly useful in cases of small spills that are likely to dissipate quickly, or in cases where the responsible party may disappear. Somerville also has a model program to stop environmental crime, particularly illegal dumping.

What about restoration and compensation?

▼ **Assessment of Damages**

NOAA's Office of Oceanography and Marine Assessment

Responsible for determining damages to marine resources, estimating dollar value, identifying and evaluating alternative actions for restoring resources, seeking compensation from those responsible; and implementing restoration plans. On occasion, NOAA has negotiated with foreign vessel owners to arrange payment for immediate assessment of damages due to major spills and reimbursement to the Coast Guard for cleanup costs. NOAA works with the U.S. Justice Department when the situation warrants it.

Damage assessment is complicated and often the subject of intense debate. When a natural resource is not traded in a market setting based on explicit prices, the evaluation of loss is problematic. (E.g., how does one quantify the value lost when oil fouls a beach?) Table 1-4 lists parties and values affected by marine and coastal oil spills, taken from *Oil Spill Clean-up: An Economic and Regulatory Model* (1981).

▼ **Massachusetts Department of Environmental Protection**

DEP can assess penalties (fines) or order restoration based on the impact of the violation (Brown, 1991).

Small spills=large bills for local communities

The costs of cleanup and compensation for losses must be paid by the responsible parties, that is, by the owner or operator of the vessel or facility or its insurance company. Although the Coast Guard will investigate spills and assemble evidence for civil and criminal action, it is up to the town to seek compensation from the responsible party, if known.

Once the implementing regulations are in place, it will be possible, under the Oil Pollution Act of 1990, for towns to file claims with the $1 billion Oil Spill Liability Trust Fund for claims that have

not been settled within 90 days, if for example, the responsible party is unknown, denies liability or damages exceed their liability.

After the guidelines are implemented, funds will be available for,"... assessing natural resource damages and for developing and implementing plans for the restoration, rehabilitation, replacement, or acquisition of the equivalent of damaged resources...." Also, "the fund will be available to state officials for reimbursement for removal costs consistent with the National Contingency Plan, which will greatly reduce the financial burden on local communities resulting from their involvement in spill responses" (Parsons, 1991).

Table **3-1**

Parties and Resources Affected by Marine and Coastal Oil Spills[3]

Party Affected	Resources Affected
Coastal residents	Residential enjoyment Health quality of residential environment
Commercial resource harvesters	Fish Shellfish and other invertebrates Algae Research organisms Other harvested organisms
Marine and coastal tourists	Quality of the natural environment Non-commercial recreational opportunities
Marine and coastal recreation and tourism industry	Commercial recreational opportunity Tourism opportunities
Marine and coastal workers	Employment opportunities in resource harvesting, recreation and spill cleanup Health quality of working environment
Marine and coastal property owners	Private property–real estate Private property–other Public property
Cleanup industry	Cleanup opportunities
Oil industry	Oil availability Company time and expenses related to oil spill responses
Consumers of marine products	Food quality Food availability Other marine products quality and availability Research materials quality and availability
Government agencies–spill respondents	Time and funds
Citizen groups	Time and funds
Potential tourists	Quality of the natural environment
Taxpayers	Tax revenues
Secondary consumers	Energy source availability Oil products Other economic indicators
Suppliers and workers–secondary industries	Opportunities for revenue Opportunities for employment

[3] From *Oil Spill Clean-up: An Economic and Regulatory Model*, The MIT/Marine Industry Collegium, Opportunity Brief #25, July 1981.

Chronic, low-level pollution slowly but surely damages our coastal and marine resources and is associated with enormous financial losses.

- Commercial and recreational fishing and shellfishing suffer from diminishing and/or damaged stocks.
- Other recreational uses are unattractive or not allowed where pollution is obvious and when human health may be affected.
- Drinking water is all too easily tainted by accumulations of small quantities of pollutants.

Impacts on the Fisheries

Although overfishing is a major cause of diminishing fisheries stocks, research on cumulative impacts indicate that the blame must be shared with chronic coastal pollution responsible for ruined coastal fish habitat. Among other things, chronic pollution:

- Causes eelgrass and other aquatic vegetation to die off;
- Lowers the amount of oxygen dissolved in water, suffocating some species; or
- Poisons fish larvae.

Pollution also breaks some of the first links in the food chain, killing off organisms upon which small fish feed, thus reducing the quantity of prey upon which commercial fish and shellfish species feed.

Deprived of food and hiding places,the population and species diversity of fish and crustaceans decline. And, as toxic chemicals accumulate, diseases and abnormalities increase. The negative consequences move up the food chain with more fish, shellfish, birds and mammals dying or failing to reproduce.

The chain of consequences spreads well beyond the coastal areas since many important commercial and recreational fish species caught offshore either spend some part of their lifetime in the nearshore environment, or depend for food upon species produced by coastal systems.

Losses of commercial and recreational shellfish catches because of shellfish bed closures due to high coliform counts are directly correlated with human-generated pollution. Poorly flushed embayments are particularly susceptible to pollution of shellfish beds. Areas with Combined Sewer Overflows (CSOs) or a high level of recreational boating are also likely to be closed to shellfishing, at least conditionally (following rains or in boating season, respectively).

Impacts on Other Recreational Uses

- Visible water quality problems, such as floating debris and sewage, and media reports about poor water quality diminish the appeal of recreational uses–leading to a fall in tourism.
- Human health can be affected by contact with polluted waters. For example, water-contact sports or activities, such as swimming, wind-surfing and jet-skiing, in sewage contaminated water can lead to diseases such as swimmer's ear and swimmer's itch.
- Opportunities for fishing, shellfishing, waterfowling and nature appreciation activities are disrupted, diminished, or disappear entirely when wildlife habitat is disturbed or ruined.

Impacts When Drinking Water is Affected

Human health is obviously affected by water quality problems in drinking water. For example, water tainted with untreated sewage "contains disease-causing (pathogenic) bacteria, viruses and protozoans from human wastes. If ingested, pathogens can cause a multitude of diseases including infectious hepatitis, gastroenteritis (stomach aches, nausea and diarrhea), and amoebic dysentery" (Narragansett Bay Project, 1990).

Rises in cancer rates have been documented when drinking water is tainted with certain chemicals.

The impacts of water quality problems are costly and the symptoms often serious. The next section describes some of the natural habitats and areas critical to maintaining high water quality.

Introduction

Water quality affects and is affected by natural forces and terrain. The following paragraphs provide an overview of the natural habitats and terrain that are most at risk from the negative impacts of man's activities. This section will provide readers with the rationale for a concern with water quality problems and a sense of how impacts differ not only according to the type of problem but also to habitat or terrain affected.

The cutting and clearing of the world's rainforests has been widely criticized as a terrible environmental catastrophe because the loss of rainforests diminishes the planet's biodiversity and contributes to global warming. On a smaller scale, Massachusetts, too, boasts diverse habitat with wide ranges of plant and wildlife species that should be protected. Variety of habitats and inhabitants allows the environment to cope with catastrophic events and limits the spread of disease. This flexibility is embedded in the separate, but interrelated, networks of fresh water, coastal or marine, and upland systems.

Maintenance of the diversity of wildlife and protection of critical habitats has been difficult in the Commonwealth because of a lack of information about the location of different habitats and/or the effects of the cumulative impacts of human activity in or nearby these areas. Analysis of cumulative impacts remains elusive, but mapping projects in various parts of the Commonwealth have identified many areas of critical concern. *(On Cape Cod, see maps published by the Association for the Preservation of Cape Cod. Telephone: 508-255-4142.)*

Estuaries

Where fresh water flows meet and mix with salt water, estuaries form. Differences in temperature and chemical characteristics are involved in this mixture. Three types of river estuaries are described by differences in the way the fresh water mixes with the salt. "Salt water wedge" is where strong river flows push the fresh water on top of the heavier salt water; another type of estuary occurs when tidal currents are strong and the resulting turbulence creates partial mixing of the salt and fresh waters; the third type is when the waters are completely mixed, not a type that usually occurs in Massachusetts (Carlozzi, et. al., 1975).

Estuaries are characterized as nutrient traps, concentrating marine and fresh water productivity and resultant detritus. As the detritus settles, it forms the basis for the development of salt marshes and tidal flat communities and becomes a rich source of food for a wide variety of marine organisms. Estuaries are critical habitats for most commercial and recreational fish and shellfish, providing food and nursery or spawning areas for two-thirds of the important commercial species. Many of the nesting areas of rare and endangered shorebirds are found at the edges of estuaries.

Estuaries are vulnerable, however, to river-borne pollution and the vast array of development attracted to the shoreline. Dredging, dams, bridges and other structures can all affect the habitat and the circulation patterns of the water with some negative consequences for the marine organisms inhabiting the estuaries.

Legislation and agencies: Buzzards Bay, the Massachusetts Bays (Massachusetts Bay and Cape Cod Bay) and Mount Hope Bay (as part of Narragansett Bay NEP) on the Taunton River have been designated as "estuaries of national significance" and been incorporated into the National

[1] NOAA's Hazardous Materials Response Branch uses a ranking system based on geological formations and habitat to predict oil reaction and recommend cleanup activities. Towns would be well advised to obtain copies of at least that portion covering geology and habitat characteristic of their area. (Telephone 617-223-8016)

Estuary Program under EPA. Massachusetts Coastal Zone Management Program is an active participant in the program. Activities in other estuaries may be covered by Massachusetts public trust (Chapter 91), the Wetlands Act, the Clean Water Act, etc.

Wetlands

Wetlands are lowland areas that are covered with water during much of the year and have distinctive soils and vegetation. For many years wetlands were considered dispensable and even undesirable, blamed for breeding fevers and pests. Wetlands were drained and filled whenever a property owner wanted dry land for construction or agriculture. Although research has determined the immeasurable value of wetlands and legislation now formally protects them, construction projects, dredging and filling, and pollution from specific and non-specific sources still threaten existing wetlands.

The primary source of inventory information on wetlands are the National Wetland Inventory (NWI) maps prepared in 1977 by the U.S. Fish and Wildlife Service. The NWI maps were based on aerial photographs and use 1:25,000 scale U.S.G.S. quadrangle maps. No detailed summaries of wetlands acreages based on these maps has yet been compiled (Lickus, et al., 1989).

Perhaps the most appealing known function of freshwater wetlands is their role in the purification of groundwater through the breakdown and removal of nitrates, for example, and the absorption of toxic heavy metals, phosphates and some pesticides (APCC, 1985). These wetlands also are important in holding and preserving excessive rainfall, in shoreline protection, as nursery and feeding areas for fish, in providing habitat for much wildlife, including many rare or threatened species and for their aesthetic values.

"No net loss of wetlands" has become a national goal–even articulated by President George Bush in 1989. However, policies permit "mitigation." This means that natural wetlands may be degraded or destroyed for approved projects, if other wetlands are "enhanced or constructed" in their stead. If for example, a builder wants to construct a building on a specific site that happens to be a salt marsh, he or she must agree to build an artificial salt marsh somewhere else to make up for filling the natural marsh.

The problem is that there are clear indications that science has not yet figured out truly effective techniques for enhancing or constructing wetlands. The natural diversity of plant and animal species is not supported in an artificially constructed wooded swamp, for example. The difficulty does vary; for example, replication of a fresh-water marsh has been successful.
Payment into a fund for purchasing wetlands or restoration of another damaged habitat to its original condition are offered by some communities as alternatives to replication.

Legislation and agencies: The Wetlands Protection Act is implemented by Massachusetts Department of Environmental Protection (DEP) and local conservation commissions. DEP's Wetlands Conservancy Program administers the Coastal and Inland Wetlands Restrictions Acts. The Wetlands Protection Act also protects rare or endangered species so if projects are apt to affect resource areas identified on "Estimated Habitat Maps," the Division of Fisheries and Wildlife's Massachusetts Natural Heritage and Endangered Species Program must be notified.

Coastal Systems

▼ Salt Marshes

Salt marshes are coastal **wetlands** extending from the mid-tide line to the highest spring tide line. "Low marshes," areas submerged by daily tides, are commonly dominated by saltwater cord-grass (*Spartina alterniflora*). "High marshes," inundated during spring tides, are dominated by salt meadow-grass (*Spartina patens*). Salt marsh vegetation is extremely productive and forms the basis for complex marine and estuarine food chains. Salt marshes are one of the most productive natural ecosystems on earth (VanLuven, 1990), producing more biomass on a per acre basis than a Kansas wheat field.

The importance of salt marshes and estuaries as nurseries for many of our commercially important seafoods cannot be overstated. In fact, two-thirds of the commercial catch of fish and shellfish of the nation's east coast spends part of its life cycle in marshes. These wetlands provide food and protection for larval and juvenile marine organisms. Even those species that do not themselves utilize wetlands for spawning or as nurseries for their young depend indirectly on wetlands by consuming species that do. Other functions of these areas include protection of coastal areas from storm surges, winds and high tides; retardation of seaward flow of freshwater; and (like the freshwater wetlands) purification of water. Furthermore, many shorebirds nest in the high marsh (Buzzards Bay Project, 1990).

Legislation and agencies: See above–salt marshes are wetlands.

▼ Shellfish Habitat

Softshelled clams (*Mya arenaria*), surf clams (*Spisula solidissima*), blue mussels (*Mytilus edulis*), oysters (*Crassostrea virginica*), quahogs (*Mercenaria mercenaria*) and bay scallops (*Argopecten irradians*) are culturally and economically the most important species in Massachusetts. The most prolific beds tend to be established in coves, bays and similar areas where fresh water flows dilute the seawater and lower salinity. Major aquatic predators such as starfish and moon snails are unable to survive in the lower salinity. However, these beds may be subject to greater risk of bacterial or chemical degradation, transported from the watersheds of the fresh water streams.

Measurement of fecal coliform levels in shellfish beds is part of routine testing performed to determine if harvesting of shellfish is to be permitted. High levels of fecal coliform indicate that shellfish is likely to be unsafe for human consumption, so the beds are closed to harvesting. (See Chapter 6, Nutrient Loading.)

Legislation and agencies: Shellfish beds are inevitably found in wetlands, so see above. In addition, National Marine Fisheries Service's Habitat Division is concerned about shellfish habitat and will offer technical advice and assistance. Massachusetts Division of Marine Fisheries has jurisdiction over harvesting and closures of beds and the Interstate Shellfish Sanitation Conference sets standards for closures to commercial harvesting.

▼ Eelgrass Beds

Subtidal eelgrass (*Zostera marina*) beds are "found in waters of varying salinity, growing in sand or mud, in depths ranging from just under low-tide level to twenty feet below sea level where sunlight penetrates to the ocean floor and current or wave action is not too severe" (Buzzards Bay Project, 1990).

Eelgrass beds serve as a base for other plant and animal life, are consumed directly as food by some animals, offer protection and habitat to other marine animals and cycle nutrients. Winter flounder and bay scallops, for example, both depend on eelgrass for habitat and nursery areas.

Legislation and agencies: Eelgrass beds often occur in wetlands. In other areas they grow in waters under the protection of the Clean Water Act, administered by EPA and the Coast Guard.

▼ Tidal Flats

These are shallow, sloping flats composed of materials ranging from very fine silt and clay to coarse sands. Prevalent microscopic algae provide nourishment for tidal-flat life, clams, quahogs and marine worms. "It is the combination of salinity, substrate quality, and the character of water movement over the flat that determines the species composition of the plant and animal community" (Carlozzi, et. al., 1975).

▼ Coastal Salt Ponds

Coastal salt ponds are shallow marine embayments whose inlets are periodically closed by shifting barrier beaches (VanLuven, 1990). When open, the tidal flows mix with groundwater and create moderate salinity conditions, when closed the pond waters freshen and become brackish.

Salt ponds are among the most productive ecosystems on the coast and are commonly associated with salt marshes, tidal flats, eelgrass beds and occasionally, rocky shores (Carlozzi, 1975).

The transition to brackish conditions usually results in large scale die-offs of saline-dependent organisms. These die-offs may generate unpleasant odors prompting human neighbors to lobby for dredging and other efforts to permanently open the ponds' outlets to the sea.

Legislation and agencies: Coastal salt ponds are wetlands.

▼ Major Dune Systems

In addition to the primary dunes commonly found along the coast, major dune systems have secondary dune systems, wet meadows ("dune bogs") and sometimes dune migration. These dune systems provide nesting places for various birds, including on Cape Cod, the short-eared owl (*Asio flammeus*)–the only ground-nesting owl in New England (VanLuven, 1990). A variety of unusual plants also grow in the dune systems. The Eastern spadefoot toads *(Scaphiopus holbrookii)* and diamond-backed terrapins (*Malaclemys terrapin*) both use portions of the system, the former for breeding areas and the latter for laying eggs.

Legislation and agencies: Dunes bordering lakes, creeks, streams, rivers ponds, estuaries or the ocean are covered by the Wetlands Protection Act. See above.

▼ Barrier Beaches

Barrier beaches are low-lying, unstable strips of coastal dune and beach that protect inland areas by absorbing the brunt of storm waves and tides. They are extremely dynamic systems, moving and changing with waves, currents and wind (VanLuven, 1990). Occasionally, storm waves can open an inlet through the beach, but normally such a breach closes within a few weeks. In some areas, however, the cycle of opening and closing is much longer, radically altering tidal flow in the meantime. For example, the breach of Chatham's North Beach in 1987 is part of a predicted 150-year cycle (Humphries, 1988).

Barrier beaches have three zones: frontal beach, dune and inland beach. The frontal beach faces the ocean waves, the dune zone varies in size from single foredunes to major systems, and the inland beach borders an estuary or marsh system (VanLuven, 1990). Barrier beaches are critical nesting areas for piping plovers (*Charadrius melodus*), least terns (*Sterna albifrons*), common terns (*Sterna hirundo*), arctic terns (*Sterna paradisaea*) and roseate terns (*Sterna dougallii*).

Recreational vehicles and foot traffic risk crushing vegetation that stabilizes the beach and unintentionally disrupting nesting birds. Efforts to stabilize barrier beaches with retainment structures are generally unsuccessful. Given their slow but inevitable movement, it is inadvisable to attempt to build permanent structures on barrier beaches. Dredge and fill operations, housing development, roads, and degradation from pollution all threaten barrier beaches.

Legislation and agencies: Covered by Wetlands Protection Act and the Coastal Wetlands Restriction Act. See above. Location and extent of the approximately 300 barrier beaches along Massachusetts coast can be identified from maps held by the Massachusetts Coastal Zone Management Office. The federal Coastal Barrier Resources System does not allow developers of specific barrier beaches to obtain federally subsidized flood insurance or federal aid for bridges and road building.

▼ Rocky Headlands

During phases of Continental glaciation, Cape Ann was periodically covered with ice (Robbins and Yentsch, 1973:13), as were Cape Cod and the Islands. Erratic and perched boulders, glacial scratches and hard granite bedrock scraped smooth by the ice offer evidence of these periods of glaciation. Where the bedrock extends below the sea surface many tide pools have formed. In other areas, boulder beaches of large rocks, small stones or pebbles create gradually sloping shorelines.

The rocky shore provides habitat for a wide range of plant and animal life including blue-green algae, periwinkles and barnacles, brown seaweeds, Irish moss, kelp, sponges, hydroids, anemones, mollusks (e.g., snails, clams, mussels, squid and octopi), echinoderms (sea urchins and sand dollars), arthropods (insects, spiders and crustaceans including crabs, hermit crabs, lobsters, shrimp and water fleas), tunicates and fish.

"The edge of the tide is a fragile environment which in its delicate natural balance can easily be destroyed by interference. The building of piers, jetties, and sewage outfalls, and the dumping of trash or industrial wastes into the ocean can be devastating" (Robbins and Yentsch, 2973:16).

Legislation and agencies: Covered by the Wetlands Protection Act, see above.

▼ Atlantic White Cedar Swamps

In the whole world, Atlantic white cedar (*Chamaecyparis thyoides*) swamps are found only in a 100 mile-wide strip along the United States' Atlantic and Gulf coasts (VanLuven, 1990). Once abundant, intensive logging and conversion to cranberry bogs have reduced Barnstable County's 6,000 acres (early 1600's) to 140-240 acres. This rare and significant habitat supports Heartleaf Twayblade (*Listera cordata*), spotted turtles (*Clemmys guttata*), sharp-shinned hawks (*Accipiter striatus*) and the parula warbler. In addition to supporting rare species, cedar swamps buffer surrounding areas from sudden flooding by absorbing great quantities of rainwater and spring runoff.

Legislation and agencies: Covered by the Wetlands Protection Act, see above.

Freshwater Systems

▼ Sphagnum Bogs and Quaking Bogs

Sphagnum bogs are perpetually saturated wetlands carpeted by thick layers of *Sphagnum* mosses and low growing shrubs (VanLuven, 1990). Like marshes, these bogs have herbaceous plants and low shrubs, but are distinguished by unusually thick sphagnum mats and deep layers of peat. Stagnant acidic water permeates the peat, blocking the penetration of oxygen below the bog surface. These conditions retard decay processes, so only plants tolerant of low nutrient conditions survive.

Quaking bogs form across the surface of shallow ponds when the movement of ground water through a pond is so slow that acidity increases and dissolved oxygen levels are not replenished. As wetland plants invade the stagnant water, floating mats of tangled roots and rhizomes form (*Ibid*).

These bogs support a number of rare plant species including the dragon's mouth orchid (*Arethusa bulbosa*) and few-fruited sedge (*Carex oligosperma*). Provincetown boasts one of Massachusetts' finest examples of the sphagnum/quaking bog habitat and the world's largest known quaking bog on a barrier beach system.

Legislation and agencies: Covered by the Wetlands Protection Act, see above.

▼ Vernal Pools

Vernal pools form in shallow depressions during wet seasons. Periodic drying out of the pools precludes fish habitation, allowing a variety of organisms to breed free from fish predation. Wood frogs (*Rana sylvatica*), marbled salamanders (*Ambystoma opacum*) and spotted salamanders (*Ambystoma maculatum*) breed exclusively in vernal pools, and adults return to spawn in the same pools in which they hatched (VanLuven, 1990). Fairy shrimp spend their entire lives in vernal pools. Other species breed in vernal pools, but are not limited to them.

Besides supporting a wide variety of species, vernal pools serve as temporary habitats for a variety of wildlife fleeing disturbed areas. Unfortunately, their small size, seasonal nature, and location in many cases away from other wetlands, mitigates against their being mapped and protected.

Legislation and agencies: Massachusetts Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program certifies vernal pools. The Westport River Watershed Alliance has a vernal pool certification project committee, telephone (508) 636-3016 and Massachusetts Audubon Society has a vernal pool program, telephone (617) 259-9500.

▼ Coastal Plain Pond Shores

Most coastal plain ponds in Massachusetts are "kettle ponds" formed when chunks of ice left behind by retreating glaciers melted. The water level of these ponds rises and falls seasonally with the water table, leading to a specialized niche for plants tolerant of major changes in water levels and low nutrient conditions.

Though locally plentiful, there are a number of globally rare species who survive along the shores of the coastal plain ponds of Cape Cod. Plymouth gentian (*Sabatia kennedyana*), slender arrowhead (*Sagittaria teres*), the barrens bluet damselfly (*Enallagma recurvatum*), and long-legged green darners (*Anaz longipes*) are a few examples (VanLuven, 1990).

Legislation and agencies: Covered by the Wetlands Protection Act, see above.

Linking Coastal and Freshwater Systems

▼ Anadromous-Fish Runs

Anadromous-fish runs are streams linking marine and fresh water bodies used by anadromous fish, who live in salt water systems but spawn in fresh water. Alewives (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*) and white perch (*Morone americana*) are three important anadromous fish species in Massachusetts that provide recreational, aesthetic and [occasionally] commercial benefits (VanLuven, 1990). These species also are significant food sources for other fish and wildlife.

Legislation and agencies: U.S. Fish and Wildlife is a lead agency. Massachusetts Division of Fisheries and Wildlife and The American Littoral Society (P.O. Box 301, Woods Hole, MA 02543 or telephone (508) 457-1499) work on restoration of anadromous herring runs and provide information.

▼ Upland Systems

The habitats described below are all found in Massachusetts' coastal zone, particularly on Cape Cod and the islands. Although their role in preserving water quality is perhaps not as obvious as that of wetlands or barrier beaches and the other habitats described above, anthropogenic impact on upland habitat ultimately has consequences for water quality.

Water runs from upland systems down to the sea, picking up sediments and pollutants where these are not anchored by trees and grasslands. This is of particular concern in river watershed areas, since rainwater carries pollutants directly into the river, which then transports these pollutants to the coastal waters and ocean. In fact, according to Michael Connor of the Massachusetts Water Resources Authority, recent research associated with the effort to clean Boston Harbor indicates that river-borne pollution has much greater negative impact on water quality than previously imagined.

In addition, the importance of maintaining biodiversity has already been noted.

▼ Woodland Communities

In the early years of Massachusetts history, clearing for agriculture and pastureland and overharvesting of woods for fuel and construction destroyed many of the forests in coastal areas. Hardwood species like beech (*Fagus grandifolia*), American holly (*Ilex opaca*), coastal basswood (*Tilia neglecta*) and post oak (*Quercus stellata*) are critical seed reservoirs for forest succession on Cape Cod.

▼ Pitch-pine/scrub-oak barrens

Pitch-pine barrens are dry, open pitch pine (*Pinus rigida*) forests, which usually have almost impenetrable understories of scrub oak (*Quercus spp.*). Bearberry (*Arctostaphylos uva-ursi*), sedges (*Carex spp.*), lichens (*Caladonia spp.*) and broom crowberry (*Corema conradii*) fill open areas. Interspersed through pitch-pine barrens are kettle holes, which support a variety of plant and wildlife populations not found in denser forests (VanLuven, 1990).

Pitch pine barrens primarily occur on easily buildable, dry, flat sandy areas, so are tempting targets for development. Interestingly, fire suppression also threatens the pitch pine barrens, because without fire, there is no check on the invasion of hardwood species.

▼ Sandplain grasslands

Sandplain grasslands are globally rare, grassy areas dominated by two bunch grasses, little bluestem (*Schizachyrum scoparium*) and poverty grass (*Danthoria spicata*). Between the tussocks thrives a diverse and unusual plant community (VanLuven, 1990). One plant community, the sandplain gerardia (*Agalinis acuta*), has only 10 known locations worldwide. The only known location in southeast Massachusetts is on Martha's Vineyard (MacQueen, 1991).

Bunch grasses easily colonize areas disturbed by fire and clear cutting, but all too quickly disappear under invasions by brushy shrubs. With the lack of open spaces, the only remaining sandplain grasslands survive in or along periodically-mowed powerline corridors, fields and roadways.

▼ Heathlands

Dense mats of prostrate and hummock shrubs characterize the Atlantic coast heathlands that grow only between Maine and northern New Jersey. Coastal-edge sites have stable communities that endure despite frequent blasting by sand and salt spray (VanLuven, 1990). Bearberry (*Arctostaphylos uva-ursi*), beach heather (*Hudsonia tomentosa*) and black huckleberry (*Gaylussacia baccata*) cover the coastal heathland. Bushy rockrose (*Helianthemum dumosum*) and broom crowberry (*C. conradii*), both "Special Concern" species are found in heathlands. Inland sites are transitional, developing in areas opened by clear cutting, grazing and fire.

▼ Grassy Heaths

Grassy heaths are very rare assemblages of sandplain grassland and heathland species in which neither association is dominant. "Their total range is restricted to Nantucket and North Truro, so each site is globally rare and very significant," (VanLuven 1990). Some of the rare ("threatened" or "special concern") species that live in the grassy heaths include: purple needle grass (*Aristida purpurascens*), Commons' panic-grass (*Dichanthelium ovale*), the Eastern spadefoot toad (*Schaphiopus holbrookii*), and the chain dot geometer moth (*Cingila catenaria*).

Acute Symptoms: Oil and Hazardous Waste 5.1

Introduction

Oil spills are the most serious acute problems. Large spills due to collisions or groundings of shipping vessels threaten the quality of water with a suddenness and to a degree rarely matched by other problems. Once a major spill occurs, the cleanup is complicated by questions of responsibility and liability. Legal, technical and economic issues abound. Who should clean up, who should pay, how much should be spent and who should assess the damages are all pertinent questions.

Oil spill contingency plans exist in Massachusetts, though most are not up to date. Recent major spills and "close-calls" however have renewed interest in these plans and efforts to update them have begun. (Contact the regional coordinators of Massachusetts Coastal Zone Management to participate. See Chapter 8 for phone numbers.) Since speed of response correlates with the success of containment and cleanup efforts, familiarity with contingency plans and annual drills is advisable.

However, of the 3.5 million tons of oil that end up in the sea every year world wide, according to the National Research Council's 1985 report, *Oil in the Sea*, only 12.5 percent is a consequence of tanker spills. The vast majority (about 70 percent) comes almost equally from municipal and industrial wastes or runoff and from other-than-tanker transportation. Apart from spills, tanker transportation is thought to be responsible for smaller, but chronic contributions of oil and hazardous chemicals through discharges of oily bilge water, tank cleaning, etc.

The cumulative impacts of the smaller, but more frequent occurrences of little spills and constant drips of non-point sources of pollution may be more devastating to water quality in the long run than the attention-grabbing major spills. Contingency plans for large spills are important, but planning for the individually small, but common contributions to water quality problems is equally imperative. Removal of oil and many other hazardous wastes by treatment systems is difficult, consequently, prevention of their entering the waste stream is a key to protecting our water's quality.

Small oil slicks may be clues to daily dribs and drabs of pollution that eventually accumulate in water and cause major problems if a solution is not identified. Oil slicks on water or in street gutters may indicate waste oil disposal, for example. In fact, some experts say that 40 percent of the pollution in America's waterways is from used crankcase oil (Earthworks Group, 1989: 52). One pint of motor oil can create a slick one acre in diameter or can contaminate 125,000 gallons of drinking water. The Earthworks Group points out that "just one part oil per million parts water will make drinking water smell and taste funny." In addition, waste oil dumped in sewers can damage sewage treatment plants.

In the First District (West Quoddy Head, Maine to Tom's River, New Jersey) alone, the Coast Guard investigates 200-250 incidents per year of Clean Water Act violations in marine waters. Other cases of Clean Water Act violations are handled by EPA because they occur inland, though the negative impacts may eventually be felt in marine waters. In Massachusetts, the numbers of incidents investigated by the Department of Environmental Protection, Waterways Committees and firemen have not been totaled.

Legislation and agencies: The Coast Guard and EPA share responsibilities under the Clean Water Act, The Oil Pollution Act of 1990 and CERCLA. The Coast Guard has responsibility for spills from foreign flag ships under the Intervention on the High Seas Act. DEP's Emergency Response Section represents the Commonwealth in cases of marine oil spills.

Spills and Dumping:
The Most Common Sources of Oil Slicks

▼ **Accidental spills or leaks**

Transportation accidents are frequently the source of accidental spills or leaks. An American owner-operator of a vehicle or vessel is financially responsible for paying for cleanup costs. In the case of shipping, however, there is no legislation currently in place that requires foreign vessel owners to pay for cleanups. As of July 1990, the U.S. has not yet signed the protocols to the 1969 International convention on Civil Liability for Oil Pollution Damage and the 1971 International Convention on the Establishment of an International Fund for Compensation of Oil Pollution Damage. The U.S. Senate wants to allow states to impose unlimited liability on owners and operators of tankers spilling oil off their coasts. The U.S. House of Representatives wants the U.S. to sign the protocols, then to work within the convention to raise the liability limits.

Regulations for pilotage are being reviewed in Massachusetts as a consequence of recent spills related to groundings.

Responding to spills: See Chapter 3

▼ **Effects of spills on natural resources**

Large oil spills that wash ashore can immediately kill marsh grass, shellfish, lobsters, worms, snails and other creatures that live in marsh mud. It also coats the feathers of sea and shore birds, leading to their deaths. During the first three months of 1990, an estimated 25,000 birds were killed in Newfoundland alone by oil illegally dumped from ships passing off Newfoundland's coast.

Oil and other hydrocarbon compounds may disappear relatively quickly from the water column due to their immiscibility, volatility, biodegradability or because of the effects of weathering, (Milliken and Lee, 1990) but the portion of oil reaching the sediment may still affect mud-burrowing creatures years later. Storms that disturb the sediments may resuspend the oil, causing further damage to resources. Oil degrades slowly in mud flats, marshes and muddy bottom sediments. Residues are found in algae, marsh grass, mussels, birds, crabs, fish, worms and other invertebrates years after a spill.

Follow-up studies by EPA and Woods Hole Oceanographic Institution of a beach and marsh off West Falmouth, Cape Cod, subjected to an oil spill in 1969 of 17,000 gallons of light, refined No. 2 fuel oil record the devastating, long-term effects of such spills. The original impact of a spill that kills off large numbers of the benthic population may lead to a permanent imbalance or diminishment of the diversity of species. In addition, the sub-lethal effects may disrupt normal feeding, breeding and locomotion of various species; interfere with the control of body temperature in birds and mammals; trigger changes in biological processes and reproductive rates, changes in growth rates, changes in the competitive balance, alterations in predator-prey interactions and changes in the population-age structure.

The small spills and leaks that contribute to chronic problems may slow the growth of fish larvae, affect migratory patterns of some species and may also damage the organisms that serve as food for fish and whales. Odors and an off-taste in fish may also result from oil pollution.

The loss of marsh grass stemming from acute or chronic spills changes the amount of habitat available for fish nursery areas, changes the natural water purification system and alters the way land is usually stabilized.

▼ Dumping of waste oil

Commercial fishing vessels: How much oil in coastal waters is contributed by fishing vessels is difficult to judge because of the widely varying quantities of oil used and the even more widely varying habits of disposal. Massachusetts' Division of Marine Fisheries roughly estimates that there are 3,700 commercial fishing vessels berthed in the Commonwealth.

Depending on the design of the engine, fishermen use from 35 to 150 gallons per oil change. Different engines may require changes of oil every 500 hours (that is, two 10-day fishing trips), every 750 hours or even every 1500 hours of running time. The frequency with which oil is changed also depends on the conscientiousness of the captain, engineer and/or owner.

One owner-operator of two offshore fishing boats generates 1500-1700 gallons of used oil a year, some of which is pumped directly into the boats' tanks for reuse as fuel, and the rest is disposed of in a municipal bulk waste oil collection container. Another fisherman whose boats' engines have a different design, slower turning with larger sumps, probably generates 5,000 gallons annually that he also disposes of in the municipal container.

Much of the oil from other fishing vessels, however, reportedly just goes overboard. One fisherman said that most wait until they are offshore to dump the oil, but commented that that doesn't really solve the problem, just spreads it around. He joked that the "only saving grace" is that the lazy ones who dump their oil overboard are also probably less conscientious about following the engine oil change schedule and do so less often [than proper care would require].

By state law in Massachusetts, companies selling the oil must take back used oil from their customers, though there is a limit of two gallons per customer in the regulation. Nevertheless, some sellers of oil offer to accept the waste oil used by fishermen or other large-quantity users. However, a majority of users do not take advantage of this service. For example, in spite of active promotion of their disposal service, less than a third of the 175,000 gallons of oil sold by the New Bedford Seafood Cooperative each year is returned, reports manager, Jerry Wheeler. The company makes an effort to make the disposal as convenient as possible and the service is incorporated into the price of the oil, so there is no extra charge, but most customers do not take advantage of the service.

Some portion of the unreturned oil is being filtered and reused as fuel by the vessels. Some may be carried to other oil outlets that collect used oil for recycling. Some is probably collected and stored indefinitely in basements or back yards, where it may eventually be accidently spilled. An unknown quantity, however, is dumped into sewers, left unattended on a dock someplace, or pumped into bilges and then washed directly into the ocean.

Recreational vessels: The National Research Council did not analyze the amount of oil being contributed by "pleasure boaters" in their 1985 study, *Oil in the Sea*, as they believed that the quantities were relatively small and presumably, therefore, without serious consequences worldwide. However, for any coastal community with marinas and moorings, shellfish beds, beachgoers and other recreational users, the cumulative impacts of small spills and leaks associated with recreational boating may indeed have serious consequences.

For vessels using two-cycle outboard motors, fuel intake and exhaust occur in the same cycle, so unburned fuel is released along with the exhaust gases. Engines manufactured before 1972 drain excess fuel directly into the water while newer engines recycle this lost fuel. Since most two-cycle engines also have lubricant oil mixed in the fuel, this is also released into the water. Release of oily bilge water is another source of oil spillage/leakage due to recreational boating.

Home automobile mechanics: About half of all American drivers change their own oil. Although some is recycled, many people still pour the oil on the ground where it eventually seeps into the groundwater or into the sewer system and eventually the waterways. Others people put it their trash which has the same effect as pouring it on the ground or in the sewers, since trash is dumped in landfills where the oil will seep into the groundwater.

How to Stop the Dumping of Waste Oil

The solution in the long run is to make collection and recycling as easy and inexpensive to fishermen and other consumers as is dumping. It is up to consumers of oil, however, to recognize that it is in their own best interest to reuse oil whenever possible, to dispose of the remainder properly and to convince their fellow consumers to do the same. Educational outreach, to inform consumers of the damages their waste oil can effect and offer alternatives to dumping is extremely important.

Massachusetts stepped in the right direction in 1974[1] by requiring retail sellers of oil to accept up to two gallons of used oil per day from customers with receipts or other proof of purchase. DEP conducted "sting" operations in 1989 that revealed 12 of 17 major retail and oil company chains with hundreds of outlets in Massachusetts were not accepting customers' used oil. The chains were given 30 days to comply which all but one did without harsher enforcement action being threatened. In addition, a dozen other chains came forward voluntarily to set up used oil recycling programs. A handful of supermarket and drug store chains chose to discontinue motor oil sales (Brown, 1991).

The City of **Cambridge** adopted an Ordinance in 1990 requiring retailers to provide the city with annual reports of the amount of oil sold and the amount of used oil accepted and recycled. Fines may be levied for non-compliance. Some communities are considering requiring deposits on quarts of oil to encourage returns (similar to the "returnable bottles" program for cans and glass).

For those who use significant quantities, such as fishermen, collection must be made easier by setting up accessible bulk containers on docks. Such facilities must be overseen to ensure that the oil is not contaminated by additions of antifreeze and other solvents. **Provincetown** is the first community in Massachusetts to install a municipal harbor waste oil facility (Thayer, 1990). The town has leased two 300-gallon containers with double walls, vents and portholes for $240/month, including pumpout and disposal services by a licensed hauler. The containers are lockable and there are designated hours for authorized personnel to accept waste oil.

One way to pay for such a facility is by reusing the oil. Massachusetts Department of Environmental Protection has developed a new set of guidelines for the handling of waste oil to enable municipalities to do just that. It is hoped that municipalities' heating costs will be eased through the use of space heaters that meet department's standards for burning used motor oil, thus adding economic incentives to the environmental concern. Boxford is using waste oil to heat a couple of buildings, including a school.

[1] Waste Oil Retention Law (GL Ch. 21, §52A)

For information on forced hot air furnaces on the market that burn waste oil contact: Fornax (800) 639-2077 or Robert Sun Co. (800) 356-9424. Before purchasing, however, be sure to contact DEP to check that these companies' products remain on the "approved" list.

Other Sources, Effects, and Prevention of Oil Slicks

▼ **Industrial discharge**

U.S. industries are generating hazardous waste at the rate of 600 billion pounds per year. The EPA says that chemical manufacturers alone are discharging 68 billion pounds per year of toxic chemicals directly into the nation's rivers, lakes and streams. Some of these chemicals are petrochemicals that leave oil slick traces.

Effects: What doesn't directly kill marine organisms may be taken up by the organism through its food and is consequently incorporated into the food chain. What may not be toxic to a lower organism may kill or damage a higher organism. Clams, for example, may concentrate these toxins and thus endanger the otters or other mammals that eat them.

Prevention: A source reduction and **pretreatment** program is being actively pursued by the Commonwealth to try to halt the discharge of hazardous wastes. Nevertheless, oil slicks are sometimes traceable to illegal industrial discharge.

▼ **Small Companies**

Companies with operations by the water, regardless of whether or not they are water-dependent users, often have impacts on water quality through accidental spills or other human errors. Catch basins, placement of tanks as far upland as possible, and stocking of at least a minimum of cleanup materials are advised.

▼ **Stormwater drainage, combined sewer overflows, illegal hookups and road runoff** (see also "Nutrient Loading" under Chronic: Algal Growth)

When the sewer system was built, combined sewer overflows (CSOs) were the norm. As the term implies, when the influx of water to the sewer system is greater than its design capacity due to stormwater runoff, the sewage and fresh water combine and overflow into pipes that bypass the treatment plants and empty directly into rivers or the ocean. Because stormwater washes the roads, gas stations, driveways and parking lots, it picks up oil and other wastes that have dribbled from vehicles, transporting them into groundwater, rivers and other water bodies, and finally into the ocean.

Effects: According to the *Buzzards Bay Project Fact Sheet, Stormwater Run-off* (11/89), "Heavy metals, engine oil, gasoline, radiator fluid, and insecticides end up in stormwater flow." The fact sheet further points out that the effects of these depends on the degree of urbanization, types of land use and the level of automobile traffic. In some areas, stormwater runoff is thought to be the most serious contributor to bacterial contamination of shellfish beds and beaches. It is also a major carrier of nutrients from fertilizers and failing septic systems.

Prevention: To remedy the negative impacts of stormwater drainage, towns first need maps of storm drain systems as well as the critical areas needing protection, such as productive shellfish beds. The Division of Marine Fisheries' sanitation survey is an excellent source of this information. (Barnstable mobilized volunteers to help map these systems.) Sizes and quality of discharges should also be analyzed. (Massachusetts Department of Public Works will grant funds to

prepare road drainage-system maps.) Bylaws or regulations may be adopted to control drainage. New developments may be required to minimize the size of paved areas, that is, parking lots, patios, etc. They may be required to include catch basins to filter the runoff from their parking lots. Developers might also be required to have an operation and maintenance fund for storm drain maintenance in new developments. Alternatively, a portion of property taxes could be earmarked for this purpose. In general, storm drains need to be cleaned more often than they usually are, especially in winter (MacQueen, 1991).

Run-off from roofs, patios and parking areas may also be directed into vegetation, which helps to naturally filter out petroleum products and other pollutants while recharging the groundwater. Infiltration devices that maximize percolation of stormwater into soil include: porous pavement, soak-away pits or dry wells, seepage or infiltration trenches, recharge or percolation basins and grass swales (Buzzards Bay Project, 1990).

Catch basins placed to catch road runoff allow pollutants to settle and biological processes reduce nutrients. A maintenance schedule is necessary however to keep the basins working properly. Buffer zones of grassy areas, forests and artificial wetlands may help control stormwater run-off, but their effectiveness may be limited by climate and biology. (See report on Stormwater Management Workshop by Kimara Pollock and Barbara Sego in *The Buzzards Bay Newsletter*, 5:2 (Summer 1990).)

Unintended infiltration into sewer systems and CSOs from leaky pipes and seeps compound the capacity problems associated with stormwater and must be repaired. Communities must also eliminate illegal hookups ("inflow") to the sewers and illegal outfalls along the coast. (Infiltration and inflow problems are sometimes referred to as "I and I.")

Better maintenance of sewers and overflows, detection of illegal sewer hookups and installation of new chlorination facilities at major sewer overflow sites, as well as increased pumping capacity at Boston's sewage treatment facility reportedly have been responsible for a significant improvement in the condition of Boston Harbor's water quality.

Legislation and agencies: EPA may soon issue national regulations governing permitting of stormwater drain discharges (Buzzards Bay Project, 1990). Otherwise, subdivision bylaws and road-drainage regulations provide the only guidelines for new drains and nothing yet regulates existing drains. The Division of Marine Fisheries sanitation surveys provide information on existing drains' location, size and probable fecal coliform contributions, which threaten shellfish beds.

The U.S. Soil Conservation Service (SCS) offers technical assistance to communities developing subdivision laws incorporating best management practices for handling stormwater drainage. Massachusetts Water Resources Authority's Harbor Studies Department is monitoring CSOs around the Boston Harbor.

▼ Failing septic systems

Septic systems that are old or not properly sited or maintained (not pumped out regularly, for example) may leak, leading to visible slicks and foul odors.

Effects: In addition to visible slicks and foul odors, nutrient loading and subsequent eutrophication is frequently associated with septic systems (see "Chronic: Algal Growth, Nutrient Loading").

Prevention: Placement considerations must include elevation above groundwater, distance between leaching component and point of water use (e.g., well), and suitability of the soil to receive the liquid effluent. Proper siting should also be based on percolation tests during the time of highest groundwater (i.e., during the spring and high tides near the coast or on barrier beaches), sufficiently large leach fields, etc. Proper maintenance is necessary for continued use.

Legislation and agencies: The Commonwealth's Title V regulations can, and in many cases, should be strengthened by local bylaws and Boards of Health regulations to assure proper siting and operation. Setback distances between systems and resource areas and/or groundwater may need to be increased, especially in flood-prone areas and velocity zones. (Velocity or "V" zone is the area within the 100-year flood plain subject to high-velocity waters, also known as the high-hazard area.)

▼ Boat Traffic

Areas around fuel pumping facilities are vulnerable to spills from overfilling tanks. Some oil inevitably leaks into the bilge tanks of boats and is pumped out along with the water that seeps into the tanks. Very oily bilge water indicates either leaks that need attention or dumping of crankcase oil. Because of the number of motorized vessels gathered in a small area, and the repairs, refueling, and other services required, marina operations are particularly prone to spills and leaks.

Effects: "The most obvious effects of pollutants from marine engines include odor, off taste in fish and toxic effects on marine organisms" (Milliken and Lee, 1990). Organisms in urban estuaries are particularly vulnerable since hydrocarbons from other sources contribute to a sustained level of concentration that, even if low, can be toxic over long periods.

Prevention: Buffer zones around marinas and limits on numbers of moorings and slips permitted are the primary controls currently in place. Education of recreational boaters is a high priority to inform them of the importance of taking care in filling tanks, attending quickly to signs of leaks, and disposing properly of waste oil.[2] Alternatively, trained marina employees should fill the tanks. Fuel intake devices to prevent overflows are available.

Some advisors recommend that booms be placed around vessels during fuel loading. Certainly all boatyards and marinas should have some response equipment on site. Edwards Boat Yard in Falmouth has placed oil tanks as high upland as possible, has installed catch basins and has taken numerous other steps to protect the water quality.

▼ Creosote

Creosote is a brownish, oily liquid used to protect wooden piers and other structures from the deteriorating effects of salt and water. It consists of aromatic hydrocarbons obtained by distilling coal tar. Newly-treated wood is especially prone to creating oil slicks.

Effects: In recent years, creosote has been implicated in toxic effects on marine organisms, possibly from phenols leached from creosote-treated wood. Also, studies found that polycyclic aromatic hydrocarbons (PAHs) from creosote pilings were released into the environment and found in shellfish, molluscs and sediments. Some PAHs are carcinogenic, mutagenic and/or

[2] Two useful, free booklets for boaters are *Handbook for Mariners of Buzzards Bay* and *Environmental Guide for New England Mariners*, both by Mimi McConnell of the Coalition for Buzzards Bay. Besides providing tips and phone numbers, the former lists and maps pump-out stations/services around Buzzards Bay, the latter lists pump-out facilities throughout New England.

teratogenic (Pederson, 1987). In other words, some PAHs are known to cause cancer, to change hereditary material and/or produce developmental malformations in laboratory animals.

Prevention: Chromated-cupric-arsenated (CCA) treatment of wood pilings is the preferred alternative to creosote. (Pentachlorophenol and selected salt-treated woods, such as tributyltin (TBT), are not recommended.) There is some indication that the plastic lumber made from recycled plastics may be a good substitute for wood pilings for small scale projects.

▼ **Stirred-up sediments**

Sediments in water are able to temporarily remove oil, metals, chemicals and other undesirable constituents from the water column. Clean sediments may cover or cap settled areas of such particles on the water body's floor, but if the area is dredged, stirred up by storms or otherwise disturbed, these undesirable elements may be resuspended in the water column and oil slicks noticed.

▼ **Jet exhaust**

Waterways under jet pathways may exhibit slicks from the exhaust. However, most of the slicks visible in water near airports is likely to be from stormwater runoff that picks up fuel spills, deicing chemicals, maintenance wastes and equipment -washing runoff.

Prevention: Logan Airport has a large "end of the pipe" pollution-control facility that separates oil and water from the runoff caught by their storm sewers. Nevertheless, Massport admits that despite their efforts, overflow does occur, especially because they do not have tight control over the actions of their tenants. Massport is actively pursuing education and enforcement efforts with the aid and cooperation of the MWRA, to improve prevention of oil and chemicals from reaching the water.

Introduction

Foul odors are generated by chemical or microbial contamination caused by the same factors as those cited for oil slicks, plus a number of others. In addition, the growth of algae, lack of oxygen in the sediments and decaying of dead fish can all contribute to foul odors.

Chemical or Microbial Contamination: Common Sources of Foul Odor (See also section on chronic problems)

▼ Pesticide use

More than two billion pounds of pesticides are used in the United States each year, according to a report in the *Pollution Prevention Action Plan*. Large agricultural operations can be a major source of pollution from their use of pesticides and herbicides (as well as fertilizer). Agricultural runoff has been cited as contributing pollutants to Puget Sound, San Francisco Bay, the Gulf of Mexico and Chesapeake Bay (OTA, 1987:19-22).

Even home gardeners are culpable, due to the cumulative impact of their actions. In fact, Paul Gosselin of the Massachusetts Department of Food and Agriculture said, "We consider homeowners to be at the top of the list of those who misuse and overuse pesticides." In the past, lawn care companies were considered a major contributor to nonpoint sources of pollution, though most now pursue alternatives to chemical controls.

Prevention: Consumer demands for organic foods and ecologically sounder methods of agricultural production have led to an increasing number of farms using integrated pest management and other less chemically-dependent methods of controlling pests. Lawn care companies and golf course owners should be strongly urged to pursue such alternatives as well. Home gardeners should be cautioned to read the fine print on the chemicals and pesticides they buy and also use alternative methods, such as pest traps, beneficial predators, companion planting, etc. (See fact sheets prepared by the Coalition for Buzzards Bay).

▼ Landfill leachate

Six million tons of trash are "thrown out" in Massachusetts annually. Two-thirds of it is dumped in 193 landfills, many of which are believed to be polluting groundwater.

Water percolating through landfills picks up a wide variety of bacteria, contaminants, toxins, etc. that cause foul odors. Carefully planned, constructed and maintained landfills limit the amount of leachate released. However, reduction of the quantity of waste generated, i.e., waste minimization and recycling, is becoming a high priority, and a search for alternatives is mandated by such legislation as the **Massachusetts Toxics Use Reduction Act** (G.L. Ch. 211, §§ 1-23). Encouragement of separate collection and disposal of households' hazardous wastes on a regular basis is strongly recommended. DEP may need additional funding to adequately address this.

Martha's Vineyard Waste Disposal District has regular collections of household and small quantity generators' waste. Waste paint and paint solvents comprises eighty percent of what is collected.

▼ Marine-head discharges[3]

Just as home car mechanics are often unaware of the negative impacts of pouring a few pints of motor oil on the ground, so too are many boaters unaware of their personal contributions to the cumulative impacts of marine-head discharges. Although the volume of wastewater discharged from recreational boats is small, the organics in this water are concentrated, so the biological oxygen demand (BOD), i.e., the dissolved oxygen needed to decompose the organic matter is much higher than that of municipal sewage (Milliken & Lee, 1990). This means that there is less dissolved oxygen available to aquatic organisms.

Another serious problem is the introduction of disease-carrying microorganisms from fecal matter into the coastal environment, putting swimmers and shellfish-consumers at risk.

Foul odors can stem from insufficiently mixed wastes (too much waste in unflushed basins, particularly problematic near marinas on busy weekends). The unsightliness and odors can have negative impacts on tourism. Furthermore, accumulation of the disinfectants, especially chlorine compounds, used in marine sanitation devices can have a negative impact on biota and flora in the area, leading to foul odors from decay.

Prevention: The Federal Water Pollution Control Act Amendments of 1972 (FWPCA) regulate vessels with installed heads, requiring marine sanitation devices (MSDs). **EPA** established the standards for MSDs (prohibiting discharge of boat wastes exceeding 200 fecal coliform per 100 ml and suspended solid concentrations of 150 mg/l); the **Coast Guard** promulgated the regulations and currently holds the enforcement responsibilities. Fines range as high as $2,000 per flush.

Massachusetts' Title V sewage discharge prohibition may be applied only to vessels without installed heads. In fact, however, the **Massachusetts Department of Environmental Protection (DEP)**, which enforces Title V, does not apply this to recreational vessels. A memorandum of understanding with the Division of Environmental Law Enforcement could transfer authority to the DEP to allow them to enforce Title V when boaters are involved.

Type III MSDs are holding tanks from which discharges are prohibited within the 3-mile territorial waters. The macerated and treated wastes from Types I and II, though, may be discharged except in EPA-designated "no-discharge-zones." States may request -EPA to designate specific areas as no-discharge-zones. In no-discharge-zones and within the 3-mile limit, Y-valves that bypass the MSD to directly discharge wastes overboard must be closed and secured with a padlock, heavy tape or by removing the handle.

There are no areas in Massachusetts designated as no-discharge-zones, though DEP is discussing the requirements for such designations. EPA requires the area to be a critical use area; adequate pumpout facilities must exist; boat facilities must meet standards for adequate operations schedules; boat facilities must have an approved maintenance plan; and it must be certified that the area requires greater protection than that afforded under the federal discharge limits (Thayer, 1990).

Cities and towns may also regulate boats in municipal waterways (Chapter 90B, section 15B). Fairhaven, for example, requires marine heads to be sealed while vessels are berthed. Enforcement of municipal regulations must rely on harbormasters, police, health officers and shellfish wardens.

Chapter 91, section 59B requires marinas to maintain marine head disposal facilities (pumpout stations), but no guidelines for their design were established, so this regulation was rarely en-

[3] See footnote on page 35.

forced. As of 1988 there were only four pumpout stations on Cape Cod (Cape Cod Water Quality Task Force, 1988:20). Currently **DEP's Water Pollution Control Division** considers this a high priority concern and is developing the requisite guidelines. It is unlikely that every marina will be required to maintain pumpout stations or waste treatment facilities, but there will have to be some organizational framework to ensure that there are sufficient facilities in any area.

The National Marine Manufacturers Association says that most vessels over 26 feet have some on-board toilet facilities. Considering that about 1/4 of all vessels registered in Massachusetts are 26 feet or longer according to the Division of Environmental Law Enforcement, then 60,000 Massachusetts-registered vessels have toilet facilities. Unfortunately, many of the vessel owner/operators do not believe their wastes have negative effects on the marine environment, nor do they know where pump-out facilities are available.

Through their boards of health and/or through enactment of bylaws, **local communities** can enact stricter regulations, as well as inform boaters of the alternatives and sanctions for disregarding the regulations. Furthermore, communities can promote the use of less chemically-hazardous boat waste treatments, designations of "No Discharge Zones," and pass regulations requiring sewage treatment plants to accept holding tank wastes (Thayer, 1990). Communities may obtain funding from **EPA** for public education on this topic.

[See also: *Marine Head Discharges from Recreational Vessels: Analysis and Policy Response.* Unpublished paper written by Christopher E. Putala for Jan Smith, Massachusetts Coastal Zone Management, 1988.]

▼ Combined Sewer Overflows

Discussed above in the section on oil and hazardous waste spills, the CSOs are an obvious source of foul odor since raw sewage and unscreened, untreated stormwater runoff are combined and released directly into the open waters of the Commonwealth. (See Chapter 5.1 for more detail.)

Prevention: Proper maintenance of sewers and overflows can improve capacity and diminish the untreated quantities released through overflows. Chlorination facilities at major overflow sites help stem some water quality problems, though there are indications that chlorine sufficient to kill pathogenic viruses in wastes releases free chlorine, which is lethal to aquatic life at very low concentrations.

▼ Municipal Wastewater Treatment Plants

Insufficiently or improperly treated sewage is a direct source of foul odor. It may also contribute to nutrient overloading in the outfall area, leading to secondary causes of foul odor such as algal growth and fish kills (see "Eutrophication" below).

Early in 1990 there were 32 municipal treatment plants with discharges to coastal and near-coastal waters, including groundwater (Smith,1990). These are regulated by **DEP's Division of Water Pollution Control** and must have NPDES permits. It is difficult to generalize about the treatment plants because they vary so greatly in size, population served, conditions of the equipment, level of treatment, existence of combined sewer overflows, etc. One of the smallest plants provides secondary treatment, serves a population of 1,000 and has no CSOs, but the actual flow is exceeding the design flow of 0.972 million gallons per day (MGD). The largest system, serving Boston and surrounding communities provides only primary treatment, has problematic CSOs, and serves a population of 2.1 million people, 900,000 of whom live in the coastal zone. The plants are notoriously ill-equipped to handle the flows and new facilities are under construction.

Problems common to several of the municipalities include: "I/I," or infiltration (of groundwater through breaks or holes in the sewer system's pipes) and inflow (through illegal connections of roof or storm sewers), which burden the treatment plants with too much fresh water. Lack of funds for construction and maintenance compounds these difficulties. In addition, insufficient industrial pretreatment contaminates the effluent and sludge sufficiently to threaten shellfish beds and other resources in the outfall vicinity and/or the effluent's chlorine level may be at toxic levels.

All these factors contribute to the release of poorly treated, smelly effluent, whose impact on receiving water can increase the odor by killing vegetation, etc. In addition, at least one treatment plant, in Gloucester, has itself been criticized for emitting foul odors, probably due to the difficulties in handling the wastes from fish-processing industries.

Prevention: Strict enforcement of industrial pretreatment programs is a low-cost, highly-effective means to begin countering the problems leading to foul odors. Repairs to the system to prevent inflow and infiltration, proper maintenance and sufficient new construction to handle the necessary flow are more expensive, but necessary techniques for long term control of odor.

Eutrophication, Another Source of Foul Odor

Water lilies, duckweed, sedges, rushes, milfoil, elodea and a host of algae all proliferate in nutrient rich waters. Eutrophication occurs when a body of water becomes overly rich in dissolved nutrients, stimulating excessive plant and algal growth.

Organic matter, released when these organisms die and decay, is naturally broken down by bacteria, but the biodegradation processes consume dissolved oxygen in the process. (The amount of dissolved oxygen needed by the bacteria to break down the organic content is referred to as biological oxygen demand or BOD). Overloading of nutrients also promotes the growth and survival of fecal coliform.

Well-flushed water bodies are less apt to experience eutrophication, but embayments, where currents and flushing are slowed, are at risk.

The over-enrichment of a body of water has been associated with neighboring development, which leads to increased runoff and higher levels of waste discharged (Bliven, 1990). Specifically, increased numbers of septic systems increase quantities of nutrients discharged to groundwater. Furthermore, clearing of land means that rainwater can sweep nutrients, previously captured by trees and other foliage, directly into the water body.

Because nitrates can travel long distances in groundwater and drainage basins may be large, septic systems and other factors far from the shores of a water body may also contribute to eutrophication.

Other factors contributing to over-enrichment include waterfowl and pet fouling of shorelines and marine vessel discharges. Aquaculture may contribute to eutrophication if farms are not carefully sited. Settling organic matter, reduced dissolved oxygen levels and nutrient enrichment may smother bottom dwelling organisms in the vicinity of aquaculture pens (Van Dusen and Hayden, 1989).

Once an algal problem develops, there may be no quick solutions. For example, MIT Sea Grant researchers have concluded that a ball-forming brown algae, *Pilayella littoralis*, which is causing

Massachusetts' Revere Beach and Nahant Bay to smell like rotten eggs or sewage, may only be gotten rid of by using special vacuums and/or nets to scoop up the algae and then by carrying it away (Levi, 1990).

Prevention: Planning to control growth and development in sensitive areas may be the best way to prevent eutrophication over the long term. Strict enforcement of "pooper-scooper" laws, bans on feeding wild waterfowl, proper siting of septic systems, and use of foliaged buffer zones near water bodies may offer immediate benefits. In addition, a denitrifying septic system removes 60 to 80 percent of incoming nitrogen, compared to the usual 30 to 35 percent of currently approved systems. Falmouth is presently studying a denitrifying system.

Legislation: Massachusetts' recently revised Surface Water Quality Discharge Standards (314 CMR § 4.01 et seq.) include regulations to control eutrophication. These prohibit "new or increased point source discharge of nutrients, primarily phosphorous and nitrogen, directly to lakes and ponds ... or to tributaries of lakes and ponds." Nonpoint sources must be treated with the best available management practices.

(The revised standards define surface waters as: "All waters other than groundwaters within the jurisdiction of the Commonwealth, including without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters and vernal pools.")

▼ Anoxic Sediments: An Indirect Source of Foul Odor

When the depletion of oxygen is so extreme that a "dead zone" occurs throughout the water column and into the sediments, foul odors can arise from the death and decay of marine animals and plants. Healthy sediments provide a home and nourishment to a myriad of creatures, ranging from those too small to see, to worms and shellfish–lowly but essential links in the food chain. Without oxygen, these creatures cannot survive. Though there is usually an anoxic layer in sediments in healthy areas this occurs below the layer utilized by the worms and shellfish (Moore, 1991).

▼ Dead Fish

The decay of fish that die because they cannot survive without oxygen is another factor contributing to foul odor. In the summer of 1988 a million fluke and flounder died when they were trapped in the oxygen depleted water of New Jersey's Raritan Bay.

Eutrophication is not the only cause of oxygen depletion, high water temperatures in the summer can also affect dissolved oxygen levels, leading to hypoxia, resultant fish kills and subsequent odor.

Water discoloration or turbidity

Introduction

Discoloration of some waters is natural and was noted long before human impacts became critical. Thoreau called the dark water in swamps and marshes "meadow tea" (MacQueen, 1991). However, water may become discolored or turbid through the same causes as described under oil slick and chemical/microbial contamination associated with foul odors. In addition, erosion, dredging, fill, storms and saltwater intrusion can affect the water's clarity. A major source of turbidity, however, is from the overgrowth of microalgae (e.g., phytoplankton) and macroalgae (e.g., seaweeds) stimulated by excessive nitrogen or phosphorous inputs from human sources (see "**Eutrophication**" above).

Erosion

Topsoil washes into neighboring water bodies when the flow of water is too fast to be absorbed by the land. This occurs most frequently when land has been cleared for development, so there is no grass, few trees, or other plants to slow down the water long enough for the ground to absorb it.

Erosion is also a natural process along the coast, where currents and tides wash the beaches and redistribute the sand to other beaches, marshes and estuaries. Efforts to stop this natural erosion by construction of jetties and seawalls are generally ill-advised since they are successful only for a relatively short period of time and in fact may often hasten erosion.

Prevention: The solutions to topsoil erosion during construction are generally relatively simple and straightforward. Silt fences and hay bales are usually sufficient and they may be combined with sandbag diversion dikes or temporary sediment basins for further control. Monitoring of the control systems is necessary, however, to ensure their continued efficacy.

Once construction is complete, a natural groundcover, trees and bushes help control erosion. Untrimmed vegetation bordering waterways or waterbodies increase the protection.

Stormwater runoff

"Water draining off streets, rooftops, parking areas and lawns contributes sediments and nutrients such as nitrogen and phosphorous, as well as petrochemicals, salt and heavy metals to water bodies" (Pelto, 1989). Fecal coliform bacteria from pets and wildlife are also present in urban runoff. Agricultural runoff may also contribute bacteria from manure and chemicals from fertilizing and pest management. (See Chapter 5.1 for more detail.) Runoff is a chronic problem complicated by the difficulty inherent in assessing its cumulative impacts or determining how to halt or abate this non-point source of pollution.

Dredging

Dredging is the removal of bottom sediments from rivers and harbors for disposal in another location (OTA, 1987). Maintenance dredging is necessary to clear shipping channels, harbors and berths of river-borne or naturally eroding sediments. The Boston Harbor dredging project anticipates the removal of 2.9 million cubic yards of sediment now obstructing navigation.

Dredging temporarily stirs-up settled sediments, disrupts benthic communities and creates turbidity. Though it does not add pollutants to the environment, it does redistribute sediments that may be contaminated (OTA, 1987:242). In addition, it can increase erosion of coastal land

because it disrupts natural sedimentary processes (Van Dusen and Hayden, 1989:37). Historically, many coastal habitats have been dredged to create harbors, open shipping lanes or otherwise open marshes and other wetlands to development.

In some cases, dredging is considered beneficial to shellfishing. Edgartown and other communities on Martha's Vineyard try to dredge about every ten years, finding that the shellfish harvest jumps dramatically after they do so (MacQueen, 1991).

The **disposal** of uncontaminated dredged material may contribute to degradation by covering shellfish and other wildlife habitat, for example. These negative impacts, however, are generally temporary, with recolonization taking place from several months to a few years after disposal ends (OTA, 1987:237).

Sometimes fill can be beneficial, as when contaminated sediments are capped with clean dredged spoils, when beaches are replenished or strip mines reclaimed (OTA, 1987). However, when the dredged material is itself contaminated with PCBs, metal or PAHs, disposal becomes particularly problematic.

In addition, the potentially negative, cumulative impacts of all state and federally permitted dredging and/or spoils disposal has rarely been addressed. The Coastal Society's Statement of Policy (1990) suggests that to minimize impacts of dredging and disposal of dredge materials, it is important to:

- Pay attention to impact on submerged aquatic vegetation, fish, water column (For example, scheduling projects to avoid spawning seasons)
- Sequester toxins from the food chain
- Designate regional sites, manage conservatively, monitor rigorously

Long-term management plans for dredged material disposal should be incorporated into broader management plans for estuaries and coastal waters. Further research is needed on assessment of sediment contamination, long-term effects of bioaccumulation on organisms, minimization of adverse impacts of dredging and disposal of dredge spoils (OTA, 1987).

Legislation and agencies: The Army Corps of Engineers is involved in permitting; EPA has veto power. The River and Harbor Act; the Marine Protection, Research and Sanctuaries Act; and the Clean Water Act help regulate dredging. Massachusetts Coastal Zone Management and the Department of Environmental Protection are involved in reviews and permitting.

Fill

Dumping of dredged material in coastal areas may damage fish and wildlife habitat. Fill has often been used to diminish wetlands. Furthermore, because it is loose, fill easily erodes in rainstorms, creating turbidity in streams, ponds and coastal waters.

Fill has transformed huge areas around Boston, creating buildable land where there were once marshes and mudflats. This development continues, leading to high density related pressures on coastal resources. Demand for water, sewage, oil, paved areas, etc. naturally increases with the population that accompanies development, leading to increases in non-point source pollution and thence to turbidity, etc.

Legislation and agencies: NPDES permits and Clean Water Act permits under §404 or §10 must be consistent with state water quality standards. NPDES permits are issued jointly by U.S. EPA and the Commonwealth. MGL Ch. 21A §14 allows DEP to issue permits for disposal of dredged material. Both §404 permits and §10 permits, issued by the Army Corps of Engineers, control placement of fill in wetlands and waterways. DEP's Water Quality Certification Program reviews these activities for consistency with the state's standards (Buzzards Bay Project, 1990). The Wetlands Protection Act offers some protection.

Storms

Storms naturally stir up sediments, increase erosion, and lead to overflows from the storm drains and combined sewer overflows.

Saltwater intrusion

When salty estuary or lagoon water leaks past tide gates, at dikes for example, fresh water vegetation dies, releasing tannin and causing both fresh and salt water bodies to become strikingly brown in color (Giese, 1991).

Chronic Symptoms of Water Quality Problems 6

Introduction

By their nature, the causes of chronic symptoms are closely related and intertwined. The table of symptoms and causes is reproduced here for easy reference as a checklist. In many cases, the causes of chronic problems are the same as those of acute problems, but extended in time. An effort has been made to refer the reader to the other sections which bear on each problem.

Chronic: Algal Growth

Some forms of algae are considered nuisances such as *Pilayella*, a weed form of brown algae found primarily in Lynn and Nahant that makes swimming unappealing and smells foul as it dries along the high tide line of the shore. Unfortunately researchers have not yet identified the cause of this particular algae's overabundance. Most algal growth, however, has been linked with the causes listed below.

▼ **Nutrient loading** (see also "Eutrophication" under Acute: Foul Odor)

Marine flora and fauna require nutrients for growth and reproduction, but an overabundance of nutrients such as nitrogen and phosphorus leads to an imbalance in natural processes, with increased growth of algae; water turbidity; changes in the distribution, abundance and diversity of species; changes in food chain relationships; and depletion of oxygen levels when algae die and decompose, leading to fish kills (OTA, 1987).

A scientist with the National Marine Fisheries Service referred to the nutrient over-enriched, nearshore environment as the "old age home of sick fish," (Patanjo, 1991). In the period before oxygen is depleted and fish kills result, algal blooms provide easily accessible fish food. This abundance allows diseased fish, which couldn't otherwise survive, to reproduce. In such cases, natural selection of the fittest is undermined by the unusual abundance of food, potentially giving rise to a less robust population.

Nutrient loading, especially nitrogen contribution, involves whole drainage basins of water bodies through both surface and groundwater discharges. To preserve the water quality of embayments and other areas of coastal waters, an analysis of the carrying capacity of the area is needed and a long-term management plan for land-use in the drainage basin should be developed.

Managing nutrient loading is difficult, however. Even Falmouth, which has a nutrient-loading bylaw, has trouble enforcing lawn care and lawn size guidelines (MacQueen, 1991).

Table **2-2**

Symptoms of Water Pollution: Chronic Water Quality Problems

Symptoms	Likely Causes
Algae growth	Nutrient loading from human, animal and bird wastes Sewage-system overcapacity Illegal hookups to sewer system Failing septic systems Stormwater runoff Agricultural runoff (fertilizers) Marine head discharges Temperature increases
Low dissolved oxygen concentrations	Algal decomposition High water temperatures in summer Poor mixing
High coliform counts (Shellfish bed and beach closures)	Human, animal and bird wastes (see algal growth)
Loss of eelgrass beds	Same causes as loss of wetlands, trace metals and chemical contamination, plus turbidity (see Table 2-1) Natural "wasting disease" Pollution Other
Loss of freshwater inflow into estuaries	Developments (housing and industrial)
Loss of wetlands	Same causes as algal growth, loss of freshwater inflow and chemical contamination, plus all causes cited in Table 2-1 Fill Boat traffic (wakes)
Lower catches of fish	All causes cited in Table 2-1 as causes of acute water quality problems Habitat loss (esp. wetlands and eelgrass bed loss) Overfishing Other
Trace metals (in fish, water or sediments)	Industry Homes and small business Landfill leachate (mercury and copper, esp.) Vessel bottom paints Vehicle emissions and tire erosion (transported by stormwater) Contaminated sediments Atmospheric deposition Same sources or causes as chemical contamination ▶

Chemical contamination	Polychlorinated biphenyls (PCBs) from: Sewage sludge Disturbed sediments Dredging and disposal Polynuclear aromatic hydrocarbon (PAH) concentrations from: Atmospheric deposition Combined Sewer Overflows Same causes as oil slick (see Table 2-1)
Erosion	Groins, jetties, other structures Dredging Recreational vehicle and foot traffic Boat wakes Uncontrolled stormwater runoff Sea level rise Currents over geologic time periods (i.e., long-term)
Marine debris	Ships, fishing vessels and offshore structures Litter and dumping Balloon launches Dilapidated shorefront structures

Sewage

System overcapacity:

■ If the sewerage system is receiving a greater flow than it can process because land development has outstripped the anticipated growth rates and, therefore, the planned capacity of the treatment plant is insufficient; and/or
■ illegal hookups have increased the flow beyond the anticipated upper limits, the overflows of untreated sewage into adjacent water bodies may significantly increase nutrient loading.

Ailing septic systems:

■ Siting, capacity or maintenance problems associated with septic systems;
■ increases in growth (i.e., increases in numbers of septic systems) so higher volume of nutrients are reaching groundwater;
■ land clearing, so that there is less vegetation to take up nutrients, can all contribute to increases in nutrient loading.
■ Once common, but no longer allowed, are overflow pipes connected to the leaching section of septic systems that divert overflow directly into water bodies. Such pipes can mask system failure and contribute to water quality degradation.

Remedies: For sewer overcapacity:

- Growth limits;
- New-technology retrofits that improve capacity and add a denitrification process to sewage treatment; and
- Inspections to identify illegal hookups.

For septic system problems:

- Upgrades and inspections of septic systems upon sale or transfer.
- Better public information about proper maintenance, including regular pumpouts.
- Construction standards that include stronger pipes for tank to house connections (e.g., 40 grade PVC) and construction oversight.
- Increased vertical separation from groundwater
- Mandatory wet weather site evaluation
- Limits on the rate water percolates through the soil (neither too fast, nor too slow should be allowed).
- Limits on allowable amount of nitrates entering the soil from a subdivision.
- State sanitary codes should allow installation of denitrifying septic systems.

Legislation and agencies: Massachusetts Department of Environmental Protection regulates setback distances from wetlands for septic systems under Title 5, the State's sanitary code. Boards of Health often have (or should have) stronger regulations addressing inspections, construction standards, nitrates, water table setbacks, percolation rate, septic system upgrades and pump-outs. Virus transport, cumulative impacts of nitrogen, considerations of sea-level rise and special resource areas might also need to be addressed. Since DEP is unlikely to have the resources to address all of these issues, Boards of Health should be aware of the cumulative impacts of their decisions on individual permits, etc.

The Clean Water Act gives EPA and the Coast Guard jurisdiction over all discharges into navigable waters of the United States.

Stormwater runoff (see also under "Acute symptoms: Oil and Hazardous Wastes")

Stormwater runoff has been identified as a source of nutrient overloads and bacterial contamination of water in studies of Buzzards Bay, Long Island and Cape Cod (Cape Cod Marine Water Quality Task Force, 1988:10).

Remedies: A general strategy for stormwater management recommended by the Buzzards Bay Project (1990) includes five steps:

- Inventory and identify the location of drains and their drainage areas.
- Check for dry-weather discharges or illegal connections.
- Sample the discharge 15 minutes after first runoff flush and at least 3 days after the previous rainfall to identify major sources of coliform.
- Implement best management practices to control the first flush.
- Insist upon proper land-use measures in developing areas.

Criteria for evaluating need to repair, replace or eliminate specific drains include:

- Rate and volume of stormwater discharge
- Impervious area drained
- Best management practices available
- Installation problems
- Relative cost to implement
- Expected treatment effectiveness
- Maintenance requirements.

Remedial efforts handling existing drains have included diverting stormwater into leaching basins, use of vegetated swales, use of porous pipes to reduce the quantity of flow into rivers or bays, and redesigning drainage systems to accommodate sediment and pollutant removal.
To be practical, (i.e., affordable) solutions to stormwater runoff must take into account the drainage area. Catch basins or infiltration trenches should control no more than two or three acres of drainage, for example.

Legislation and agencies: EPA may soon issue national regulations governing permitting of stormwater drain discharges (Buzzards Bay Project, 1990).

Local and state permits for constructing new storm drains or installing tank and leaching chambers or detention-recharge basins for old storm drains are usually required. In Bourne, wetlands and floodplain permits are required, as is a state underground injection permit from DEP. Other reviewers included: MEPA, Massachusetts Historical Commission and the Bourne Board of Health. A sludge disposal site was needed, placement had to avoid underground utilities and Town meeting approval was needed for the use of public land (Ibid). (In other cases, easement rights must be obtained from private landowners.)

Agricultural runoff

Fertilizers are a major nutrient source in some areas. Irrigated or rain-fed fields drain into rivers and thence to other water bodies, eventually transporting fertilizers and pesticides to the coast. The cumulative impact of home gardeners' use of fertilizers may equal or even surpass that of larger-scale users such as farmers and departments of public works. In the Buzzards Bay drainage basin, agriculture is estimated to contribute 6 percent of the nitrogen reaching the bay, while septic systems, lawn fertilizer and atmospheric deposition are all higher (MacQueen, 1991).

Remedies: Reduction in use of fertilizers.

▼ **Marine head discharges** (see also under "Acute symptoms: Foul Odor)

Nutrient loading from marine heads is most problematic when discharges occur in embayments or other poorly flushed areas. Summer holiday weekends when the sheer volume of discharge is increased because of the larger number of active boaters, can create nutrient overloads sparking algal growth, growth that is enhanced in summer anyway by increased temperatures and sunlight.

Legislation and agencies: The Clean Water Act gives EPA and the Coast Guard jurisdiction over all discharges into navigable waters of the United States.

▼ **Temperature increases**

Temperature increases due to increased runoff from paved roadways and parking lots or discharge from industries using water cooling systems (e.g., power plants) can also encourage chronic overgrowth of algae. Warmer waters in summer naturally encourage algal growth as well.

Chronic: Low Dissolved Oxygen Concentrations

When algae die, their decomposition uses dissolved oxygen. Overabundance of algae naturally leads to low levels of dissolved oxygen. Lack of dissolved oxygen kills fish and other fauna dependent on the oxygen. See above for discussion of algal-growth causes. Naturally, well-flushed areas are less likely to develop this problem.

Chronic: High Coliform Counts (Closed Shellfish Beds and Beaches)

Many of the factors that promote algal growth due to nutrient overloading are associated with high coliform counts. However, most coliform bacteria enter coastal waters through direct surface flow, rather than through the broader drainage basin contributions associated with nutrient overloading. Sewage-reatment plants, failed septic systems, CSOs, stormwater runoff and boat wastes all contribute to high coliform counts (see above for more information).

▼ **Human, animal and bird wastes**

Pets and waterfowl may be a large source of fecal-coliform contamination in coastal waters. Current testing procedures and criteria for closing shellfish beds do not differentiate among the sources of coliform bacteria. (Eventually, this should change: on-going research at Massachusetts Institute of Technology is developing a DNA probe that will be able to differentiate among the sources of coliform bacteria.)

"Watercraft clustering in marinas or in coves or bays for several days have been shown to have noticeable short-term effects on the number of enteric bacteria in the aquatic environment" (JRB Associates, :25); however, oxygen depletion, nutrient levels and disease incidence have not been analyzed. Fecal-coliform counts in shellfish beds under major boating routes increase after summer holiday weekends (Rhode Island Water Quality Plan, 1978).

Survival and growth of fecal coliform bacteria may be enhanced by the increased turbidity and release of dissolved organic matter from algae associated with nutrient overloading (Buzzards Bay Project, 1990).

Effects: Fecal coliform are used as indicators of the possible presence of disease-causing bacteria and viruses. For example, gastroenteritis, hepatitis and polio are associated with human waste-borne viruses. Shellfishing is prohibited when concentrations reach 14 fecal coliforms per 100 milliliters (ml); swimming is not allowed at levels of 200 fecal coliforms per 100 ml (Buzzards Bay Project, 1990).

Thousands of acres of productive shellfish beds, representing millions of dollars of value, have been closed to harvesting in recent years because of potential pathogen contamination.

Remedies: Conduct a sanitary survey to identify the sources of fecal contamination. Sanitary surveys include: an evaluation of pollution sources that may impact an area; an evaluation of meteorological factors; a review of hydrogeographical factors that may affect the distribution of pollutants; and an assessment of water quality (testing for bacterial presence) under adverse pollution conditions (Buzzards Bay Project, 1990). Research indicates that algal growth associated with nitrogen-loading may promote the growth of fecal coliforms through the algae's release of sugars and nutrients.

Towns may enact seasonal restrictions on allowing dogs on public beaches and salt marshes, have pooper-scooper laws and prohibit or limit the feeding of waterfowl (Cape Cod Marine Water Quality Task Force, 1988:20). Pump-out stations for boats are receiving more attention and their use may soon be required.

Legislation and Agencies: Boards of Health and shellfish departments, commissions and/or officers may take local responsibility.

Chronic: Loss of Eelgrass Beds

Effects: Without eelgrass beds to trap soil particles and anchor the estuarine substrate, shellfish beds can be buried by shifting sediments and the organisms that form the lowest link in the food chain may decline resulting in a less diverse and productive estuarine ecosystem (Van Dusen and Hayden, 1989).

▼ Natural "Wasting Disease"

During the 1930s, large areas of eelgrass disappeared along the Atlantic coast because of a "wasting disease." Though this major loss of beds is not yet fully understood, later declines in the 1970s and 1980s have been attributed to human disturbance and pollution, particularly increases in nitrogen to coastal waters (Buzzards Bay Project, 1990). In some cases, the direct cause of the loss of eelgrass beds may be parasitic infection.

▼ Pollution

Research suggests that coastal pollution may reduce the capacity of eelgrass to resist infection. Loss of eel grass beds is due to the same factors as: algal growth, trace metals and chemical contamination, plus turbidity (see Table 1-1). For example, excessive nutrient loading increases phytoplankton growth that in turn increases turbidity, preventing sunlight from reaching the eelgrass, so the eelgrass die off.

▼ Other

Many of the same causes as those of wetland loss, trace metal and chemical contamination and turbidity are associated with loss of eelgrass beds. (See relevant sections). Furthermore, eelgrass is sensitive to changes in water temperature–increases in the temperature could reduce flowering

and seed development (Carlozzi, et. al., 1975). Dredging, silting, oil spills, etc. all affect eelgrass survival. Moorings in eelgrass can cause significant spot damage. Even storms can wreck havoc on eelgrass beds (Moore, 1991).

Chronic: Loss of Freshwater Inflow Into Estuaries

▼ **Developments** (Housing and Industrial)

Households use a tremendous amount of water, for example, a family of four taking five-minute showers daily use more than 700 gallons of water per week, equivalent to a three year drinking supply for one person; another 950 gallons are flushed down the toilet. If the households are connected to a sewer, this water is generally transported to a treatment plant that, if situated along the coast, uses outfall pipes to discharge the treated wastes at sea. Consequently, groundwater is not recharged and freshwater flows may lessen.

Industry also commonly uses water in processing and cooling. Water used for processing is usually discharged to sewers, added to the household wastes and lost to groundwater and estuaries.

Chronic: Loss of Wetlands

Wetlands are perhaps most frequently victims of development–filled in and paved over. Problems with boundary delineations, exemptions for public works, lack of buffer zones and use of tide gates have contributed to losses. Additionally, the same factors that cause algal growth, foul odor, turbidity, oil slicks, loss of freshwater inflow, chemical contamination, indeed all water quality problems, lead to loss of wetlands and/or diminish their productivity. (See Chapter 4.2, Natural Habitats, for discussion of the importance of wetlands.)

Legislation and agencies: The Wetlands Protection Act identifies inland and coastal wetland resource areas to be protected. Conservation commissions implement the Act; DEP provides technical assistance and serves as an appeal board. The Coastal and Inland Wetlands Restriction Acts require protective ordersto be issued and registered on landowner's deeds, but only 42 communities have had wetlands registered. Because the Wetlands Protection Act provides minimal protection, communities can and should enact non-zoning wetlands bylaws that provide more protection.

▼ **Fill**

Before the function of wetlands as water filters, nursery and spawning grounds for fish and shellfish, and haven for other wildlife was understood, marshes and other wetlands were drained or filled with soil, creating land for development. Though loss of wetlands is now generally deplored, the development appeal of coastal property is so great that filling of wetlands still occurs. Regulations require replication, but the science of creating new wetlands is not yet successful, particularly with wooded swamps.

Regulations permit filling under some circumstances that seriously weaken the protection intended by the Wetlands Protection Act. For example, permitted filling of bordering vegetated wetlands allows discretionary destruction of up to 5,000 square feet if the area is replaced in accordance with seven general conditions (Buzzards Bay Project, 1990). In addition, conservation commissions may issue permits for unlimited alteration without replication for such activities as agriculture, silviculture, construction and maintenance of roadways and driveways, inland docks and piers (*Ibid*). However, the commissions can deny permits under certain circumstances or can and should require certain conditions to afford the protection intended by the Act.

▼ **Boat traffic**

Boat traffic cause problems for wetlands when wakes increase the turbidity (see "Acute symptoms: turbidity"). Marine-head discharges may also negatively impact wetlands (See "Acute symptoms: Oil" and see above, "Chronic: High coliform counts.")

▼ **Sea-level rise**

As sea level rises (see below under "Chronic: Erosion" for more information), salt marshes retreat inland. However, much of the coastline is so developed that there is nowhere for marshes and other wetlands to retreat. EPA predicts a loss of 600 square miles of coastal wetlands for the Northeast with a one-meter rise in sea level, which could occur by the year 2100 (Van Patten, 1989).

Chronic: Lower Catches of Fish and Shellfish

▼ **Habitat loss**

Habitat loss is a major factor in lower catches. In Massachusetts alone, the loss of wetlands and eelgrass beds has diminished by at least one-third these valuable spawning and nursery grounds used by a majority of commercial and recreational finfish species. Shellfish beds are also lost as their habitat is diminished or destroyed.

▼ **Overfishing**

Too many boats with efficient equipment have led to too many fish being caught before they have had sufficient opportunity to spawn a new generation.

▼ **Other**

Chemical and trace-metal contamination, oil and hazardous wastes, marine debris, and turbidity may all diminish fish stocks, either by directly killing or injuring the fish or by diminishing fish capacity to spawn and survive to maturity. Shellfish beds are usually closed because of high coliform counts (see above). Metal contamination (e.g., from TBT anti-fouling paints) also kills shellfish.

Chronic: Trace Metals

Trace metals are chemical elements that cannot be destroyed or broken down through treatment or environmental degradation (Buzzards Bay Project, 1990). Metals of concern are copper, arsenic, lead, cadmium, mercury, silver, chromium, nickel and zinc.

Effects: Metals can accumulate in marine food webs, affecting the survival and reproduction of marine organisms and potentially having human health impacts (e.g., among consumers of seafood).

▼ **Industry**

Metal-plating industries, jewelry-making, textile mills and leather manufacturing all contribute metals to the waste stream. Federal and state laws now require pretreatment of the waste stream. Nevertheless, some metals do contaminate the discharges.

▼ **Homes and small businesses**

Copper leached from plumbing and silver from photography-processing laboratories or studios enter the waste stream and pass through treatment plants.

Remedies: Silver can be reclaimed and recycled.

▼ **Landfill leachate**

As rainwater percolates through landfills, it often picks up trace metals, especially mercury and copper, and transports them to water bodies where they may contaminate fish, sediments and the water itself.

Remedies: Proper siting, construction and maintenance can eliminate leachate problems. Testing should be conducted regularly.

▼ **Vessel bottom anti-fouling paints**

Antifouling paints are used on ship and boat hulls to prevent the attachment of marine organisms (e.g., barnacles). The problem is that active ingredients in these paints may also have toxic effects on nontarget organisms, such as mussels and clams (Milliken and Lee, 1990). Copper and organotin compounds are the most common active ingredients currently used in antifouling paints. Tributyltin (TBT) antifouling paints are now restricted in the United States.

Legislation and agencies: The Organotin Antifouling Paint Control Act of 1988 bans the use of organotin paints on all boats of less than 25 meters, except for those with aluminium hulls, and limits the use of antifouling paints on other vessels to those paints that are certified by EPA as releasing less than four micrograms per square centimeter per day into the water (Milliken and Lee, 1990).

▼ **Vehicle emissions and tire erosion**

Among all the nonpoint sources of water pollution, stormwater runoff may have the most serious effects on water quality because it transports the residue from vehicle emissions and tire erosion into surrounding water bodies. Chromium and cadmium are associated with vehicles.

▼ **Contaminated sediments**

Some metals adsorb to particulates in water and sink into the sediment, where they are likely to concentrate. Deep in the sediments, these metals pose the least risk since they affect few organisms. However, resuspension in the water column may occur if sediments are stirred up either naturally, by the action of worms and other benthic organisms, by wave actions, or by human activities such as dredging.

Bacteria and phytoplankton–low on the food chain–and filter feeders such as bivalve shellfish, tend to accumulate cadmium and mercury (OTA, 1987). Some metals (TBTs, for example) are reported to cause acute and chronic toxicity to marine organisms (Milliken and Lee, 1990).

▼ **Atmospheric deposition**

Metals from car emissions that don't end up on the road–and transported by stormwater–often are suspended for a time in the air before being washed out by rain to be deposited on land and waterways.

▼ **Other**

Metals may also be deposited by the same factors which cause chemical contamination (see below).

Chronic: Toxic Chemical Contamination

▼ **Polychlorinated biphenyls** (PCBs)

These are chemicals used in manufacturing electrical equipment; they are long-lived and accumulate in sediments and organisms. The toxic effects of PCBs in sediments threaten both aquatic organisms and humans who consume fish and shellfish. Fish and birds' mortality, small birth size, slow growth and tumor development have been correlated with high levels of PCBs.

▼ **Sewage sludge**

PCBs were discharged with the wastestream from industries manufacturing electrical equipment. Although no longer made or used in manufacturing, some continue to find their way into sewage perhaps through disposal of fluorescent light transformers.

Remedies: Interestingly, chitin, a compound found in the shells of crabs, lobsters and numerous other organisms, is being used by the Japanese for sludge treatment. Chitin derivatives are extremely useful in cleaning up toxic organic compounds such as PCBs (Hartley, 1989).

▼ **Disturbed sediments**

Because PCBs are long-lived and accumulate in sediments, disturbance of contaminated sediments (e.g., by dredging) resuspends PCBs in the water column and makes them available for uptake by organisms.

▼ **Dredging and disposal** (see Acute: Water Discoloration)

Periodic dredging is usually necessary for harbor and ship-channel maintenance because of natural sediment movement. When sediments have been contaminated with PCBs, however, disposal of dredge spoils becomes problematic. In fact, a major issue in the disposal of dredge materials is due to the difficulties in predicting chemical impacts on marine organisms. Bulk sediment composition analyses, elutriate tests, bioassays and bioaccumulation tests can require months to a year for completion and cost from $1,000 to $30,000 per sample (OTA, 1987). Furthermore, these tests are indicators, but not certain predictors, of potential impacts. For example, the potentially negative, cumulative impacts of all state and federally permitted dredging and/or spoils disposal is not addressed by such tests. In addition, assessment of the degree of contamination of dredged material is hampered by the lack of standardized, quantitative "sediment quality criteria" that could indicate when pollutant levels in dredged material would be likely to affect marine organisms (*Ibid*).

Legislation and agencies: The Army Corps of Engineers involved in permitting; EPA has veto power. The River and Harbor Act; the Marine Protection, Research and Sanctuaries Act; and the Clean Water Act help regulate dredging. Massachusetts Coastal Zone Management and the Department of Environmental Management are involved in reviews and permitting. Massachusetts Water Resources Authority's Harbor Studies Department is conducting contaminated-sediment research in Boston Harbor.

▼ **Polynuclear aromatic hydrocarbons** (PAHs)

From combusted and noncombusted fossil fuels, some PAHs cause cancer, birth defects and other physiological damage when they accumulate in tissue. They threaten human health and health of ecosystems.

Legislation and agencies: CZM is developing a policy defining acceptable levels of PAHs in sediments, including methods for analyses.

▼ **Atmospheric deposition**

Vehicle emissions and combustion of fossil fuels for heating and industrial use all contribute to air-borne PAHs.

▼ **Stormwater runoff** (see also Chronic: Algal Growth)

Carbon black from worn tire rubber contributes to PAHs in runoff.

▼ **Other** (see Acute: Oil and Hazardous Waste)

Prevention: Industrial pretreatment of wastewater is a major key to preventing chemical contamination.

Legislation and agencies: Where chemical contamination or accumulations have been highest, in New Bedford Harbor, for example, a **Superfund** site has been designated and cleanup begun. EPA and DEP are the lead agencies.

Chronic: Erosion

Erosion is a natural process along the coast, where currents and tides wash the beaches and redistribute the sand to other beaches, marshes and estuaries. Erosion is likely to increase with global warming, not only because of sea level rise, but also because higher ocean temperatures are likely to increase the frequency and intensity of hurricanes. Monitoring programs are needed for scientists and planners to better understand erosion processes.

Prevention: Efforts to stop natural erosion by construction of groins, jetties and seawalls are generally ill-advised, since they are rarely successful and, in fact, often hasten erosion. It is best to avoid building close to the shoreline even in relatively sheltered areas because of natural erosion processes. The "safe" proximity to the shoreline depends on historic rates of erosion, how sheltered the area is, and soil properties.

Where the erosion rate is slow, beach-nourishment projects may be worthwhile. In addition, the Army Corps of Engineers does offer some advice to property owners trying to protect existing structures (U.S. Army Corps of Engineers, 1981).

▼ **Groins, jetties and similar structures**

Such structures may trap sand in one location, but in so doing prevent the transport of sand to downdrift shore areas, and consequently increase erosion there (Carlozzi, et al., 1975). Combined with beach-nourishment projects and careful management, however, these structures can be effective in maintaining shorelines (Klauber, 1989).

▼ **Dredging**

Dredging, especially for sand and gravel for construction, can remove what were natural buffers of wave action, leaving the shoreline less protected and subject to greater erosion.

▼ **Recreational-vehicle and foot traffic**

Dunes are particularly susceptible to erosion due to recreational vehicle traffic and even foot traffic. The abrasive action of such traffic, and the soil compaction, destroys beach grass that stabilizes the dunes, making the wind and water erosion more severe.

▼ **Boat wakes**

Fast moving boats can create waves that increase erosion even in sheltered waters.

Prevention: Local communities can establish speed limits, enforced by the harbormaster.

▼ **Stormwater runoff**

Topsoil washes into neighboring water bodies when the flow of water is too fast or heavy to be absorbed by the land. This occurs most frequently when land has been cleared for development, so there is no grass, few trees, or other plants to slow down the water long enough for the ground to absorb it.
Prevention: The solutions to topsoil erosion during construction are generally relatively simple and straightforward. Construction should be planned to limit the size of open areas. Topsoil should be stockpiled and seeded with annual rye for quick cover. Silt fences and hay bales are often sufficient, and they may be combined with sandbag diversion dikes or temporary sediment basins for further control. Monitoring of the control systems is necessary, however, to ensure their continued efficacy. The **Soil Conservation Service** has guidelines for designing and installing developments (See Chapter 8 for address and telephone number).

Once construction is complete, a natural groundcover, trees and bushes help control erosion. Untrimmed vegetation bordering waterways or bodies increases the protection.

▼ **Sea-level rise**

For the last century, sea level has been rising about a foot per century, inundating about 65 acres of coastal upland per year. Some studies suggest that this rate of sea level rise is now accelerating due to global warming from the "greenhouse effect." If the earth warms, the ocean waters will expand as they warm and the polar ice caps partially melt. The resulting average global sea level rise predicted by EPA is between 4.5 to 7 feet by the year 2100 (Milleman, 1989:17).

Carbon dioxide, a by-product of fossil fuel burning (coal, oil and natural gas), is the major greenhouse gas blanketing the earth. Forests and the oceans are the main "sinks" of carbon dioxide, absorbing and/or converting it to other useful forms. Rain forests, however, are being cut down incredibly fast and no one knows how much carbon dioxide the oceans can absorb.

Rising sea level increases erosion, leads to increased floods, elevated groundwater levels and saltwater intrusion. Coastal property, especially developed barrier beaches, is likely to become submerged. Even one foot of vertical rise could mean hundreds of yards of inundated land (Buzzards Bay Project, 1990).

Global warming could also result in drastically increased hurricane and other storm intensity.

Remedies: Communities need to establish coastal construction setbacks that take into account erosion potential due to sea-level rise. Communities should also establish higher flood elevations than required by the Federal Emergency Management Agency. Development should be guided out of areas prone to flooding, erosion and sea-level rise. Flood insurance should not be offered or renewed for new or substantially improved development in high-hazard areas. Premiums should be increased for repeat damage claims.

Chronic: Marine Debris

Two of the qualities that make plastic appealing, its light weight and durability, also make it a marine pollution problem. Plastic discarded into water bodies tends to float, persist and accumulate. Plastic pollution is found in every sea and ocean and on every beach or coastline (Milliken and Lee, 1990).

Effects: Currents concentrate the debris along coastlines, and beaches are closed or avoided due to pollution and lack of aesthetic appeal; damage to boats occurs, and marine life is damaged through entanglement and starvation due to blockage of the intestines.

Remedies: Enforcement of regulations, recycling and high-profile public education. Requests to party and charter boat captains to inform clients that tossing trash overboard is forbidden; signage on beaches to request the public to "carry in and carry out;" or assessment of small user fees for cleanups and trash disposal (with explanations to beach goers) are just a few easily accomplished steps. Some tackle shops provide barrels for old monofilament line. Marblehead banned the use of plastics at shoreline concession stands.

Legislation and agencies: The Marine Plastic Pollution Research and Control Act of 1987 implemented Annex V of the International Convention for the Prevention of Pollution from Ships (known as the MARPOL agreement). The dumping of plastics at sea is prohibited and other ship-generated garbage is restricted in both U.S. navigable waters and the ocean. All ports and marinas must have adequate facilities for the disposal of garbage. The Coast Guard enforces these regulations. Fines of up to $50,000 may be assessed.

The state's anti-littering law (M.G.L. Ch. 270 §16) penalizes dumping of materials in coastal waters or within 20 yards of the shore with fines of $2,500 to $10,000. Local ordinances may also restrict littering. Enforcement, however, is generally lax. Perhaps the "bounty" offered to watchdogs whose information leads to successful prosecution of an offender should be advertised more widely.

▼ Ships, fishing vessels and offshore platforms

Most marine debris comes from ships, offshore platforms, commercial and recreational fishing vessels. Trash bags and old fishing gear such as nets are particularly dangerous to marine organisms. Waste products must now be returned to port for disposal. Portland, Oregon, has an active recycling program adapted to the marine community that has met with great success.

According to a 1988 report by the Center for Environmental Education, the world's fleet of merchant vessels was then dumping at least 450,000 plastic containers, as well as 4,800,000 metal and 300,000 glass containers, into the sea every day (O'Hara, 1988:27). "The world's commercial fishing fleets were discarding more than 50 million pounds of plastic packaging and 100,000 tons of plastic fishing gear including nets, rope, traps, and buoys every year" (*Ibid*).

The report also noted that the nine million registered recreational boats in the U.S. dumped more than a 100 million pounds of garbage into U.S. coastal waters every year, including thousands of miles of monofilament fishing line (O'Hara, 1988:28). The U.S. Navy, passenger cruise ships and the petroleum were all guilty of dumping huge quantities. Since the National Academy of Sciences estimated that the U.S. is responsible for one-third of the ocean's trash, the recent implementation of the MARPOL agreement (see "legislation" below) could significantly alter these statistics.

▼ Litter and dumping

In Massachusetts, analysis of data from *Coastweeks* cleanups indicates that much of the Commonwealth's shore is littered with debris from land sources. Plastic tampon applicators and oil and lube bottles are all too common, cigarette butts, most with filters made from a form of plastic, are ubiquitous.

In addition, recreational users of shorelines and rivers leave behind cups and straws, balloons, and enormous numbers of plastic bags, all of which can end up in the water, damaging fish and fowl.

Dumping of shopping carts, trash, other items is not only unsightly, but damages sensitive coastal habitat.

▼ Balloon launches

Beautiful helium balloons released by the hundreds for dramatic displays at celebrations are pushed by wind currents over the sea, where they lose their colors and float partially submerged, mimicking jellyfish. Turtles and other creatures that feed on jellyfish are strangled or starved by ingesting balloons.

▼ Dilapidated shorefront structures

Debris from deteriorating structures may simply be a nuisance. Old tanks for heating oil, old septic systems, etc. should be checked for residues or leaks, however. Furthermore, if the debris creates boating or shipping hazards, resulting accidents could add to oil spills.

Growth Management

- **Land-Use Planning**
- **Techniques for Controlling Land Use**

Zoning Bylaws	Subdivision Control	Board of Health Regulations	Wetlands Bylaws
Overlay Ground/Surface Water Protection Districts	Drainage requirements		
Performance Standards	Performance standards		
Surface-Water Buffer	Board of health review		
Cluster Design			

- **Nutrient loading bylaws**

Education, Training and Consensus Building

- **Conservation-Commission Training**

Source-Reduction Planning

State and Federal Regulations Use

Growth Management

Growth management is a fairly new way to protect water quality. Increasing, scientists and other concerned citizens recognize that the environment's ability to absorb the impact of uncontrolled, multiple uses is finite. However, long-term planning and management can mitigate potential problems, so that water quality can be maintained along with controlled and appropriate development.

▼ Land-Use Planning

Because not all land is suitable for all uses, it is important for communities to develop growth management plans that state what uses they consider appropriate for their lands. State and locally-approved plans that identify sensitive areas and justify their protection establish a legitimate basis for permitting decisions, land acquisition strategies, incentive programs and other techniques for protecting local resources. Federal and state regulations help, but resource protection ultimately relies on local-level attention and concern.

Comprehensive land use master plans, plans for open space, watershed management, water quality, harbor, waterfront or embayment management, and management for Areas of Critical Environmental Concern (ACEC) may all be undertaken at the community level (Buzzards Bay Project, 1990). Such plans specify jurisdiction-and enforcement-capabilities of town agencies, such as conservation commissions, making it possible for boards to review permit applications for consistency with town plans.

Comprehensive land-use plans should include:

- Special-areas inventory
- Land-acquisition plans
- Links with regional programs to identify pollution sources and implement management and controls
- Plans for public-access development
- Elimination of tax subsidies and benefits for development in sensitive or high hazard areas (subject to hurricanes, storms, erosion), but increased benefits for conservation of undeveloped coastal barriers
- Attention to global warming, sea-level rise and more severe storms.

Data Needs
The information needed for land-use plans includes:

- maps of habitats
- maps and analysis of drainage systems (including groundwater, stormwater, sewage and septic)
- soil surveys
- land-use survey and capacity analyses[2] (e.g., dwelling units constrained by land available)
- recreational capacity (constrained by numbers of moorings, potable water supply)
- identification and ranking of sources of water pollution (i.e., which watersheds contribute which proportion of a given problem)

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[1] Most of this chapter is derived from *Buzzards Bay Comprehensive Management Plan*, Buzzards Bay Project, 1990.
[2] Formation of plans can benefit from a full build-out analysis. Assessors' maps and tax data report existing development; potential development can be determined through zoning and subdivision rules and regulations. This analysis can predict potential for future problems, especially with regard to nitrogen-loading.

Plans should include priority listing of special areas or other particular concerns or interests for decision-making under budgetary constraints, but include fuller listing for for ideal database collections.

▼ **Techniques for controlling land use**

Zoning Bylaws (M.G.L. Ch. 40A)
Towns can regulate land use and drainage in subdivisions, requiring open space and vegetation. Special districts may be designated for environmental protection and special permits for particular uses may be required (Cape Cod Marine Water Quality Task Force, 1988:14). Contact the Buzzards Bay Project for a copy of their *Sample Bylaws and Regulations* (Tirrell et. al, 1989) addressing various water protection issues.

Unfortunately, many communities are discovering that their zoning and subdivision programs allow development in excess of the carrying capacity of their resources, to the detriment of the quality of their water. A lengthy "grandfathering" clause prevents the benefit of more restrictive zoning from having immediate impact since subdivision plans submitted under less restrictive zoning are not affected for eight years. Regional land-use agencies, however, have the authority to supersede certain troubling clauses in the Zoning Act. (The Martha's Vineyard Commission and Cape Cod Commission are the two existing regional land-use agencies in Massachusetts with regulatory authority.)

Overlay Ground/Surface Water Protection Districts
Imposes regulatory restrictions on activities within specified boundaries of a drainage basin or other important area.

For example:
According to the Cape Cod Marine Water Quality Task Force (1988:15), *Watershed protection districts* should require larger lot sizes, retention of natural vegetation in open space areas, on-site recharge of runoff from impervious surfaces, reduction of runoff by restricting the lot area covered by impervious surfaces to less than 10 percent, and retaining at least 30 percent of the entire lot in natural vegetation. Other land-use planning groups recommend cluster development and/or use of package treatment plants. The Water Quality Management Plan for Cape Cod (1978) also lists uses to be prohibited in watershed protection areas.

Great Pond protection areas should extend 300 feet from the pond edge and an additional zone of 1,000 feet upgradient of each pond.

Coastal embayment protection areas should extend 1,000 feet from mean high water. Natural vegetation buffer zones, prohibition of septic systems within 100 feet of the water and the lowest point of a leaching facility must be at least four feet above mean-high groundwater level.

Performance Standards
Allows uses that will not overload natural or man-made resources. Depends on carrying capacity analysis.

Surface-Water Buffer
Requires undisturbed vegetative buffers be left adjacent to and within a defined buffer area of surface waters to promote natural stormwater treatment.

Cluster Design
An alternative to grid-style subdivisioning, cluster development allows smaller building lots, with the left over land set aside as contiguous open space.

Subdivision Control
Subdivision control focuses on street construction, utility placement, traffic patterns, other engineering concerns rather than land use, but nevertheless is useful for water-quality protection.

Drainage requirements
Criteria for type of catch basin to be used, maintenance requirements and limitations on lawn fertilizer applications may be set.

Performance standards
Water-quality impacts of subdivision, especially nitrogen contribution, can be determined. Planning boards may use this information to limit development for water-quality protection.

Board of health review
Boards of health review all subdivision plans to ensure that they do not impose public health concerns. Water-quality concerns are pertinent.

Boards of Health Regulations
Boards of health regulations may be adopted quickly with a majority vote of the board. The speed and authority with which boards of health may act provides a powerful tool for water-quality management. In fact, many communities have found that health regulations are far more effective than zoning or subdivision controls.

Regulations may include supplements to Title V, such as more stringent subsurface disposal sewage standards; regulations of waste streams and regulation of activities that generate waste. For example, the Dennis Board of Health defines "environmentally sensitive area" more stringently and specifically than does Title V; Brewster requires that a water quality report be submitted to the board for wastewater discharges over 2,000 gallons per day; and the Bourne Board of Health prohibits septic-system construction in areas of shifting sand (Buzzards Bay Project, 1990).

Using the sanitary survey reports prepared by the Division of Marine Fisheries, communities should prioritize major sources of pathogen inputs and have their boards of health take action to correct these.

Wetlands Bylaws
Towns may establish set-back from wetlands requirements for construction. Implemented by conservation commissions, strict standards within buffer zones can be important in water quality protection.

Wetland replication is not recommended as a general or best-management practice. Replication has an extremely high failure rate due to inadequate design or maintenance. It is also believed that many of the complex ecological functions performed by natural wetlands may not be performed by artificial or replicated wetlands (Buzzards Bay Project, 1990).

The Buzzards Bay Project (1990) recommends that

- Alternative strategies and options be analyzed before wetlands are destroyed or altered, and only those projects with overriding public purpose or other extreme circumstances be allowed
- Restoration and/or replication be at a ratio of at least 2:1
- Limits be set on the total area of wetlands that may be destroyed by limited projects
- Discretionary destruction of bordering vegetated wetlands not be allowed

- Add isolated vegetated wetlands, and intermittent streams as resource areas requiring protection
- Define performance standards for land subject to coastal storm flowage or tidal action, as well as for the 100 foot buffer zone around wetlands

▼ **Nutrient loading bylaws**

Shallow, poorly flushed embayments that receive water from large land areas are most susceptible to impacts of nitrogen loading (Buzzards Bay Project, 1990). The Buzzards Bay Project has developed criteria to identify nitrogen-sensitive embayments based on: embayment volume, flushing time, depth, and the ratio of land drainage area to water volume. Depth, volume and flushing time determine the "carrying capacity" of the water.

Protection of embayments from nitrogen loading requires:

- Managing growth
- Reducing fertilizer use
- Treatment technologies that use a denitrification process
- Setting of nitrogen-loading limits based on "carrying capacity" of the embayment. (Buzzards Bay Project recommends prevention of nitrogen loading exceeding 250 mg nitrogen per cubic meter of receiving water during the flushing period. This can be expressed in pounds of nitrogen per year that cannot be exceeded.)

Technical assistance
The Buzzards Bay Project and the Southeastern Regional Planning and Economic Development District (SRPEDD) will assist communities in developing bylaws and health regulations for nitrogen management. The Soil Conservation Service will advise communities and farmers on best-management practices to reduce nitrogen from agricultural practices (Buzzards Bay Project, 1990).

Land Acquisition and Conservation Easements
Land acquired through donations, purchase or property-tax deferments and restrictions on land use through conservation easements are all useful for water quality protection.

Education, Training and Consensus Building

Although the ideal solution to the maintenance of water quality is comprehensive planning, the fact is that finances and other political realities often work against strict adherence to an orderly, goal-directed, comprehensive plan administered by a centralized authority. What is more likely to be effective is "consensus building, with particular attention given to the informed public, other governmental or agency technical experts and decisionmakers and environmental professionals." (Leschine, 1990:307).

▼ **Conservation-Commission Training**

Conservation commission members should be required to attend training courses on the Wetlands Protection Act, with an emphasis on writing effective orders of conditions.

Source-Reduction Planning

Overall reduction of the quantity of hazardous substances fabricated or used; plus reduction of the quantity that reaches water would contribute to protection of water quality. Goals of Massachusetts industrial source-reduction planning include:

- Substituting non-hazardous for hazardous products
- Modifying process
- Segregating hazardous wastestream from non-hazardous wastes
- Recycling wastes

Source control at the community level should include basic, low-cost controls, not only of hazardous waste, but also of nitrates.

- Substituting non-hazardous for hazardous products

  - home gardeners list of alternatives to pesticides available from the Coalition for Buzzards Bay

- Reducing quantity of nutrients reaching water bodies

  - use fertilizers sparingly
  - plant compact shrubs, grasses bordering wetlands and ocean; trees along streams (prevents excess nutrients from reaching waterways); three inch lawns
  - low-flow toilets
  - control feeding of waterfowl
  - clean-up dog and other animal waste
  - regular pumping of septic systems (every two years)
  - pump-out facilities for boats

- Recycling

  - provide information about where to discard used oil (and who is recycling)

Funding

Filing and review fees can be included in local wetlands bylaws.

Failsafe Opportunities at the State Level

The Commonwealth can use the "antidegradation" provisions of the state water-quality standards and the review process required by the Massachusetts Environmental Policy Act (MEPA) to address land-use management on behalf of water quality protection (Buzzards Bay Project, 1990).

The antidegradation provisions do not allow water quality to be degraded so that existing uses would be eliminated. "High quality" or "outstanding" resource waters have additional protection.

MEPA requires the Executive Office of Environmental Affairs to review the potential environmental impacts of all activities conducted, funded or permitted by the state (*Ibid*). Potential cumulative impacts of a proposed project and a special level of state review for "Areas of Critical Environmental Concern" (ACECs) are also required.

Federal

- National Oceanic and Atmospheric Administration
  - National Marine Fisheries Service
  - Sea Grant College Program
  - Office of Ocean and Coastal Resource Management
  - Coastal Ocean Program
- U.S. Army Corps of Engineers
- U.S. Coast Guard
  - U.S. Coast Guard Auxiliary
- U.S. Environmental Protection Agency
  - Bays Program
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Soil Conservation and Development Districts

Regional

- Bays Program
- Conservation Districts
- New England Fishery Management Council
- Regional Planning Agencies
  - Regulatory Authorities
  - Planning Authorities
- Resource Conservation and Development Districts

State

- Massachusetts Department of Public Health
  - Division of Food and Drugs
- Massachusetts Department of Public Works
- Massachusetts Department of Transportation
- Massachusetts Executive Office of Environmental Affairs
  - Department of Food and Agriculture
  - Division of Conservation Services
    - Conservation Districts
  - Hazardous Waste Facilities Site Safety Council
  - Massachusetts Coastal Zone Management Office
  - Massachusetts Department of Environmental Management
    - Division of Forests and Parks
    - Division of Planning and Development
    - Division of Water Resources
    - Division of Waterways-Hingham
    - Office of Safe Waste Management
  - Massachusetts Department of Environmental Protection
    - Division of Air Quality Control
    - Division of Hazardous Waste Management
    - Division of Solid Waste Site Management
    - Division of Water Pollution Control
    - Division of Water Supply
    - Division of Wetlands and Waterways
  - Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement
    - Division of Fisheries and Wildlife
    - Division of Marine Fisheries
    - Division of Law Enforcement
  - Massachusetts Environmental Policy Act Unit
  - Metropolitan District Commission
  - Public Access Board
- Massachusetts Water Resources Authority

Interstate

- Interstate Shellfish Sanitation Conference

Municipal Departments or Boards

- Civil Defense and Emergency Planning Departments
- Conservation Commissions
- Fire Departments
- Harbormasters
- Health Department or Board
- Planning Boards
- Police Departments
- Public Works Departments
- Selectmen
- Zoning Boards of Appeals
- Waterways Commission or Committees

Other

Community or Citizens's Groups
Selected Non-Profit Organizations
- Conservation Law Foundation of New England, Inc.
- Essex County Regional Environmental Coalition
- MassRecycle

Private Companies

Professional Associations

Massachusetts Aquaculture Association
Massachusetts Association of Conservation Commissions
Massachusetts Environmental Education Society
Massachusetts Health Officers Association
Massachusetts Association of Health Boards, Inc.
Massachusetts Environmental Health Association
Massachusetts Inshore Draggermen's Association
Masachusets Lobstermen's Association
Massachusetts Shellfish Officers Association
Massachusetts Watershed Coalition
New England Fisheries Development Assoication
Women's Fisheries Network, Northeast Chapter

Agencies and their Responsibilities: A Cross-Reference[1] 8

Government agencies are not neatly organized into a hierarchy, instead their responsibilities intertwine and overlap complicating assignments of roles and descriptions of tasks. This list is essentially a checklist of relevant agencies, with addresses, phone numbers and stated objectives and services as well as some of the enabling legislation.

Federal

For telephone numbers and addresses of other federal agencies, call (800) 347-1997.

▼ National Oceanic and Atmospheric Administration (NOAA)

11400 Rockville Pike
Rockwall Building, Room 105
Rockville, MD 20852
(301) 443-8031

Objectives: To survey and chart coastal regions of the United States, to maintain tidal current observations, to work with the nation's coastal states to manage the resources of the coastal zone, to administer the Coastal Zone Management and Coastal Energy Programs, to manage the nation's fisheries, to predict and monitor the nation's weather, and to provide for the collection of oceanic and atmospheric data. The Status and Trends Monitoring Program assesses environmental degradation.

Services: Provides technical services and information; and educational information, materials and services. Involved in research, data collection and assessment, and management of marine and coastal resources.

National Marine Fisheries Service (NMFS)

Northeast Regional Office
One Blackburn Drive
Gloucester, MA 01930-2298
(508) 281-9300

Objectives: To achieve optimum utilization of the Northeast's living marine resources for the benefit of the nation.

Services: Issues permits for specific marine fishes in offshore (federal) waters, enforces laws and regulations for the taking of marine fishes and mammals, comments on proposed marine environmental-alterations projects, publishes harvest statistics and analyzes habitat and fish stocks. Issues news releases, holds public hearings and provides financial assistance to the fishing industry.

Northeast Fisheries Center
Water Street
Woods Hole, MA 02543
(508) 548-5123

[1] Much of the information in this chapter was obtained from the *Citizen's Guide to Sources for Marine and Coastal Information in Massachusetts*, compiled and edited by Madeleine Hall-Arber and Karen Hartley, Cambridge, MIT Sea Grant College Program, 1990.

Objectives: Monitors and regulates marine ecosystems of the New England continental shelf region.

Services: Conducts research and stock assessments; runs observer program. Offers library services; maintains a fisheries aquarium open to the public, with special tours for school groups.

Office of Ocean and Coastal Resource Management (OCRM)

National Ocean Service
NOAA
1825 Connecticut Avenue, NW, Suite 724
Washington, DC 20235
(202) 673-5158

Services: This is the National Coastal Zone Management headquarters. Administers National Estuarine Research Reserve System (see entry in Chapter 9).

Sea Grant College Program

Massachusetts Institute of Technology
292 Main Street, E38-300
Cambridge, MA 02139
(617) 253-7041

Woods Hole Oceanographic Institution
Woods Hole, MA 02543
(508) 548-1400 x2398

Objectives: Sea Grant is the nation's coastal ocean science and education program dedicated to research and technology transfer for marine science.

Services: Strengths include research, education and advisory services. Publications, libraries and technical assistance are offered by the various programs.

Coastal Ocean Program

Objectives: Determination of coastal and estuarine habitats that support marine resources, mapping resource areas for the analysis of present values and historical losses, and synthesis of the resulting information for use in resource management policy decisions (Crawford and Van Patten, 1991).

▼ U.S. Army Corps of Engineers

424 Trapelo Road
Waltham, MA 02254-9149
(617) 647-8237 and 647-8118

Objectives: To plan, design, construct, operate and maintain projects for navigation, beach erosion control, hurricane protection, flood control, stream bank protection, urban developments, irrigation and emergency response measures.

Services: Provides technical and analytic services, legal information, regulatory enforcement, human health and environmental information. Permitting: for marinas, dredging, fill (EPA has veto power).

Relevant legislation: Clean Water Act, §404; River and Harbor Act of 1899 §10

▼ U.S. Coast Guard

First Coast Guard District
Captain John Foster Williams Coast Guard Building
408 Atlantic Avenue
Boston, MA 02210-2209
(617) 223-8515

Objectives: To enforce fishery laws and other federal statutes, prevent pollution, promote safety and prepare for military duties.

Services: Boards vessels to inspect or investigate compliance with pollution prevention, safety and sanitation equipment regulations as well as fishing and customs regulations (including drug smuggling interdiction). Investigates and responds to oil and chemical spills that occur seaward of the first major roadway to 200 miles offshore. Promotes safety for commercial and recreational boaters through search and rescue, navigation aids and information.

Relevant legislation: Marine Plastic Pollution Research and Control Act of 1987, the Federal Water Pollution Control Act, Oil Pollution Act of 1990, and CERCLA. Also informs appropriate state and local officials of violations of other regulations.

To report spills of oil and other hazardous materials:
National Response Center Hotline (800) 424-8802 (24 hours/day)
Boston USCG office (617) 223-3000 (24 hours/day) (Plymouth and north)
Providence USCG office (401) 528-5335 (24 hours/day) (south of Plymouth)

U.S. Coast Guard Auxiliary

(617) 223-8310

Objectives: To assist with prevention of boating problems.

Services: Volunteers, working under Coast Guard supervision, provide public education on marine safety, courtesy checks of vessels' equipment to advise on compliance with federal standards; and report problems associated with on-water operations observed during patrols of coastal waters.

▼ U.S. Environmental Protection Agency (EPA)

John F. Kennedy Federal Building
Room 2203
Boston, MA 02203
(617) 565-3715

Region 1: Connecticut, Massachusetts, Maine, Vermont, New Hampshire, Rhode Island

Objectives: To take responsibility for federal government's major programs in water pollution, waste disposal and treatment, and coastal management and planning.

Services: Promulgates and enforces regulations. Provides technical information, educational information, film library, materials and other services. Shares jurisdiction with U.S. Coast Guard

with regard to handling spills of oil and hazardous waste. In Massachusetts, EPA is responsible for spills inland of Route 1 on the north shore, Route 3A on the south shore (roughly).
Relevant legislation: Clean Water Act.
Unleaded Fuel Hotline (800) 631-2700 in MA
Hazardous Waste Ombudsman (617) 223-1461
Assists citizens and community in voicing a complaint or resolving problems *vis a vis* hazardous-waste issues.
Small Business Ombudsman (617) 860-4300
Assists small businesses in complying with environmental laws and EPA regulations. Monday-Friday, 8 a.m. to 4:30 p.m.
Water Management Division (617) 565-3518
Develops evaluation criteria for disposal of dredge and fill material; ultimate authority to veto dredge and fill permits. **National Pollutant Discharge Elimination System (NPDES)** permitting authority–set water quality standards and permit the discharge of pollutants
National Small Flows Clearinghouse (800) 624-8301
Provides information on wastewater treatment technologies for small communities

National Estuary Program /Bays Program

U.S. Environmental Protection Agency
Water Management Division
John F. Kennedy Federal Bldg.
Boston, MA 02203
Section chief: Gwen Ruta (617) 565-4420

Objectives: Estuaries designated as being of "national significance" become a part of the National Estuary Program. The goals of the NEP are to protect and improve water quality and to enhance living resources. Federal, state and local governments work together to promote basinwide management and planning based on scientific research and management expertise.

Services: Comprehensive conservation and management plans are produced by each estuary program with technical advice and help from EPA and the Massachusetts Executive Office of Environmental Affairs. Public outreach, providing information and educational materials, is an important part of each of the estuary programs.

Buzzards Bay Project
Massachusetts EOEA
2 Spring Street
Marion, MA 02738

Project Manager: Dr. Joseph E. Costa (508) 748-3600
Program Coordinator: Bruce Rosinoff (508) 748-3600

Massachusetts Bays Program
Massachusetts EOEA
Coastal Zone Management
100 Cambridge Street, Room 2006
Boston, MA 02202

EPA Project Manager: Carol J. Kilbride (617) 565-3514
State Program Coordinator: Diane M. Gould (617) 727-9530

▼ **U.S. Fish and Wildlife Service**

Region 5 Office
One Gateway Center, Suite 700
Newton Corner, MA 02158
(617) 965-5100

Objectives: To conserve, protect and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the wildlife and the American people.

Services: Enforces federal laws protecting migratory birds and endangered species; 404 permit evaluations; provides advisory services, evaluates development projects on fish/wildlife resources, and provides scientific data needed to conserve and manage fish/wildlife resources. Prepared the **National Wetland Inventory** (NWI) maps in 1977.

▼ **U.S. Geological Survey (USGS)**

Water Resources Division
10 Causeway Street, Room 926
Boston, MA 02222-1040
(617) 565-6860

Objectives: To appraise and describe the quantity and quality of the nation's water resources.

Services: Provides information and educational materials, maps and reports on water resources, ground water, surface water, water quality and hydrologic research.

▼ **U.S. Soil Conservation Service** (part of the U.S. Department of Agriculture (USDA))

440 Nagog Park
Acton, MA 01720
(508) 264-4553

477 Main Street
Yarmouth, MA 02675
(508) 362-9332

21 Spring Street
Taunton, MA 0278
(508) 824-6668

Soil Survey Office:
40-48 No. Main Street
Middleboro, MA 02346
(508) 946-0272

Services: Advises communities and farmers on best management practices to reduce nitrogen from agricultural practices and stormwater runoff. Provides education and technical assistance to communities on groundwater and surface water quality issues. Carries out flood-plain management studies and construction projects. Maps soils and interprets their suitability for various uses.

Resource Conservation and Development Districts (RC&D)

Services: Supported and administered by the U.S. Department of Agriculture's Soil Conservation Service (SCS), these districts provide management and conservation advice, environmental impact studies, and help develop the areas' cultural, recreational and economic opportunities. Local programs are directed by **local councils**, which help local governments, associations and non-profit groups to find funds, equipment, technical experts and volunteers for their projects. The council also administers grants and has a public education outreach effort.

Pilgrim Resource Conservation and Development Area Council
40-48 North Main Street
Middleborough, MA 02346
(508) 946-1558

Interstate

The **Interstate Shellfish Sanitation Conference**, composed of federal, state and industry representatives of states that produce or receive shellfish, administers the **National Shellfish Sanitation Program** (NSSP). The Division of Marine Fisheries and Division of Food and Drugs are the responsible agencies in Massachusetts.

The NSSP requires growing-area surveys prior to state approval of harvesting, to protect the public from contaminated shellfish. These sanitary surveys evaluate potential pollution sources; evaluate weather factors affecting transport of contaminants; evaluate hydrological conditions affecting dispersal of pollutants; and assess water quality. Periodic review and evaluation is mandated. Water quality must be tested five times a year; each growing area classification is reevaluated every three years and a complete shoreline survey is required every 12 years (Buzzards Bay Project, 1990).

In updating their classification standards to protect public health, the Conference adopted regulations that close waters in marinas to shellfishing if fecal coliform measures greater than 14 per 100 ml and closes a buffer zone around marinas that could extend three to four miles depending upon occupancy rates.

State

▼ Massachusetts Department of Public Health

Division of Food and Drugs

305 South Street
Jamaica Plain, MA 02130
(617) 727-2670

Objectives: Public health regulations of food, drugs and pesticides. Includes fish and shellfish regulation, advisories on good manufacturing practices, chemical and microbiological contaminants, and red tide. Regulates handling of radioactive and infectious wastes. Works with EOEA on human health impact of fish kills in Massachusetts waters and environmental health problems associated with chemical spill sites.

Services: Provides regulation, advisories and investigation of illness outbreaks.

▼ Massachusetts Department of Public Works (DPW)

10 Park Plaza
Boston, MA
(617) 973-7500–General information
(617) 973-4700–Emergency or nights

Services: Will grant funds to prepare road drainage system maps.

▼ Massachusetts Department of Transportation (DOT)

Transportation Building
10 Park Plaza
Boston, MA
(617) 494-2000

Services: Publishes Emergency Response Guidebook for Hazardous Materials. Reviews insurance policies to cover liability including environmental restoration in cases of hazardous waste spills.

▼ Massachusetts Executive Office of Environmental Affairs (EOEA)[2]

100 Cambridge Street
Boston, MA 02202
(617)727-9800

Oversees the Commonwealth's environmental concerns, directing and coordinating state policies for preserving protecting and regulating natural resources and environmental integrity.

[2] Some of the information about the agencies and programs of the Executive Office of Environmental Affairs was drawn from the agency's bulletin *Massachusetts Environmental Programs*, January 1989.

One program housed at EOEA to which all the environmental agencies contribute information is **Massachusetts Geographic Information System** (Mass GIS). This data base includes information on aquifers; river basins; political boundaries; census data; habitat such as streams, bogs and ponds; state and federally protected open space; transportation routes and centers including airports and train lines; pipelines; some waste sites; some public water supplies; digital elevations; land use data; endangered species and underwater archaeological sites (Pelczarski, 1991).

Department of Food and Agriculture (DFA)

Saltonstall State Office Building
100 Cambridge Street
Boston, MA 02202
(617) 727-6632

Objectives: To maintain and strengthen the Commonwealth's agricultural economy.

Services: Regulates the agricultural industry; implements standards for handling of animals; promotes products through fairs and expositions; provides marketing news; promotes and develops breeding of horses and greyhound dogs. The Bureau of Land Use develops programs to preserve and improve land for agricultural use. The **Agricultural Preservation Restriction Program (APR)** allows the state to purchase development rights to farmland to protect it from development. Educational programs pertinent to water quality include: Homeowner Education Program on Pesticides and the Integrated Pest Management Program.

Division of Conservation Services (DCS)

Saltonstall State Office Building
100 Cambridge Street
Boston, MA 02202
(617) 727-1552

Objectives: Links state and local natural resource programs, assisting regional conservation districts, municipal park, recreation, and conservation commissions to preserve and acquire open space and recreation lands and to manage and develop their natural resources.
Services: Provides technical and financial assistance to the 16 **conservation districts** and through them to municipal park, recreation and conservation commissions as well as to private landowners. Also administers the federal **Land and Water Conservation Fund** for outdoor recreation facility acquisition or development .

Conservation Districts
There are 16 Conservation Districts in Massachusetts, one in each county except Worcester County where there are three, administered by the Division of Conservation Services (in EOEA).

Services: The Conservation Districts conduct surveys, investigations and research related to the conservation and development of natural resources, control and prevention of erosion, sedimentation, and the conservation, development, use and disposal of water. Support (financially as well as technically) the development of comprehensive plans for natural resources of their districts.

Hazardous Waste Facilities Site Safety Council (HWFSSC)

Saltonstall State Office Building
100 Cambridge Street
Boston, MA 02202
(617) 727-6629

Objectives: Reviews proposals for toxic waste disposal facilities and assists communities in evaluating proposed storage and treatment facilities.

Massachusetts Coastal Zone Management Office (MCZM)

Saltonstall State Office Building Room 2006
100 Cambridge Street
Boston, MA 02202
(617) 727-9530

Regional offices:
Northshore–Gloucester (508) 281-3972 (Fara Courtney)
Southshore–Marion (508) 748-3600 (Kristie Kapp)
Cape & Islands–Barnstable (508) 362-3828 (Pam Rubinoff)
Board of Underwater Archaeological Resources (617) 727-9800

Objectives: To implement the approved Massachusetts Coastal Zone Management Program, which consists of 27 policies concerned with coastal land and water management, port and harbor development, water quality, recreation, public access, coastal development, etc.

Services: Provides information and technical assistance on biology, geology and planning; reviews federal projects to insure consistency with the state's coastal policy; provides permit advisory service; offers other regulatory information, publications, conferences, and speaker's bureau. Leases audiovisual material, manages Coastal Facilities Improvement Program grants and Areas of Critical Environmental Concern (coastal) program, and jointly administers (with EPA) Buzzards Bay Project and Mass Bay/Cape Cod Bay Program.

Massachusetts Department of Environmental Management (DEM)

100 Cambridge Street
Boston, MA 02202
(617) 727-3159

Objectives: Preserving and protecting the natural resources and cultural treasures of the Commonwealth; managing state lands and waters; providing for public recreational needs; and contributing to the solution of global environmental problems.

Services: In addition to the programs noted below, the department offers other environmental educational programs including: Heritage State Park Programs, Rural State Forest and Park Programs, Boston Harbor Islands State Park Program, Forest Fire Prevention Program, Programs for Safe Waste Management, the schooner *Ernestina* and a speakers' bureau.

Division of Forests and Parks

Objectives: Management of 270,000 acres of land to protect natural resources and provide recreation for the public. Includes forests, urban parks, farmland, ocean beaches, inland ponds and

mountains, offering opportunities for hiking, bicycling, skiing, snowmobiling, swimming, boating, camping, picnicking, hunting and fishing.

Services: Administers **Mass ReLeaf**, a privately funded program, distributing thousands of tree seedlings to communities and citizens for planting. Protection of inland areas of critical environmental concern (ACECs).

Division of Planning and Development

Services: Prepares long-term management plans for state parks and forests. When funding allows, DEM acquires land to preserve special areas or natural resources and provide recreation. Also acquires development rights, leaving land privately owned, but undeveloped.

Division of Water Resources (617) 727-3267

Objectives: Collect, refine and update basic water resources data for dissemination to state, federal and local agencies and to the general public; prevent loss of life and damage to property through flood control; and to facilitate the development of a comprehensive water resources management plan for Massachusetts (Buzzards Bay Project, 1990).

Services: State coordinator for the **National Flood Insurance Program** administered by the Federal Emergency Management Agency. Manages the Commonwealth's **Ocean Sanctuaries Program. Scenic Rivers Program** provides technical assistance to regional planning agencies and local groups to protect riverfront land.

Division of Waterways–Hingham (617) 740-1600

Objectives: Improves, develops, maintains, and protects the Commonwealth's inland and coastal waterways.

Services: **Rivers and Harbors Program**; waterways projects such as dredging, beach nourishment, rehabilitation of coastal facilities; state piers; recreational facilities construction or improvements; public access projects. The **Connecticut Valley Action Program** is a model of integrated resource protection efforts.

Office of Safe Waste Management (617) 727-3260

Objectives: Planning and facilitating safe and efficient management of hazardous waste in Massachusetts.

Services: **Household Hazardous Waste Program** that provides technical assistance, educational programs and funds community collections. Industrial source reduction program and audit service helps industries reduce the amount of toxic waste generated. Recycling hazardous by-products and adopting water-saving technology and practices has yielded economic benefits to many of these companies.

Massachusetts Department of Environmental Protection (DEP)

One Winter Street
Boston, MA 02108
(617) 292-5500

Objectives: Enforcing environmental law, especially regarding water supply, water pollution control, wetlands and waterways, air quality, hazardous waste site cleanup and solid waste management.

Services: Provides emissions permits (air quality), construction grants (water pollution control), hazardous waste permits (for non-households generating over five gallons (20 kg) or more per month and for storage/transportation) and publications. In addition, the department has numerous environmental education programs including: Clean Air Programs, Clean Water Programs, Hazardous Waste Programs, Solid Waste Programs and Wetlands Programs.

Regional offices:
Lakeville (508) 946-2800
Springfield (413) 784-1100
Woburn (617) 935-2160
Worcester (508) 792-7650

Division of Air Quality Control

Objectives: Protection of air quality through reduction of pollution

Services: Inspects power plants, industrial sites, incinerators; reviews construction plans and specifications of new facilities that might be pollution sources; enforces odor and noise regulations.

Division of Hazardous Waste Management

Objectives: Regulates transportation, storage, and disposal of waste materials within the Commonwealth, monitoring their environmental impact.

Services:
■ *Site Assessment Team* oversees cleanup operations, using a team approach as follow-up to emergency response. Currently, there are 2,742 hazardous waste sites confirmed; 1,398 identified but not yet investigated.
■ *Emergency Response Team*–available 24 hours per day.
Responds to 2,000 to 4,000 spills a year in the 95 towns and cities in the northeast region alone. (The northeast region has the heaviest concentration of population and industry in the Commonwealth). The team oversees investigation and clean-up of spills, e.g., subsurface tank leaks.

Division of Solid Waste Site Management

Objectives: Regulates solid waste generated by municipalities, industry, commercial sources, and consumers.

Services: Oversees 140 active municipal landfills; 202 inactive. Develops programs for recycling, composting, other waste minimization and source reduction efforts.

Division of Water Pollution Control

Objectives: Technical Services evaluates and reports on water quality; determines treatment requirements and whether or not dischargers are meeting their permit requirements. Routine and periodic testing; enforcement powers. Priorities include waste prevention, water-resource protection, communications, municipal-state cooperation, and emergency response.

Services: Municipal treatment plants inspected if discharge at least 2,000 gallons per day. (Smaller facilities are regulated by the local DPW or Board of Health.) Any industrial wastes require a state permit–discharger and community may be issued a citation for violations. If unsewered, discharges of 15,000 gallons per day must be permitted. Groundwater status is most important consideration.

Respond to citizen's complaints, Boards of Health inquiries; check developers and industry permits; research and monitoring of sediments and fish for metals and organic-chemical pollution (PCBs and PAHs). Water-quality assessments of tributaries and estuaries and analysis of freshwater benthos (bottom dwelling organisms) is conducted. Public meetings are held. The Non-point Source Management Plan (1988) gives this division responsibility for non-point source control that includes: urban runoff, oil spills, dredging, atmospheric deposition, ship and boat bilges and other vessel wastes.

Legislation: Coastal Wetlands Restrictions Act (MGL Ch. 130 §105); Scenic Rivers Act (MGL Ch. 21, §17B); Citizens Right of Action Law (MGL Ch. 124 § 7A & §15.20); Environmental Penalties Act

Division of Water Supply

Services: Monitors surface and groundwater sources to ensure safe and adequate public drinking water. Guidance to communities on long-term water planning and land use. Administers a state construction grants program to fund water related projects.

Division of Wetlands and Waterways (617) 292-5695

Objectives: To regulate activities in or near wetlands and floodplains; to enforce environmental regulations; and to educate municipal decision makers and develop public policy on land development.

Services: Develops the regulations and policies guiding the Orders of Conditions issued by conservation commissions for work proposed in or near wetlands. Serves as trustee of public submerged lands (reviews Chapter 91 (Waterways) licensing); and provides technical assistance in the form of publications, education programs and regulatory advisory services. The division's **Wetlands Conservancy Program** administers the Coastal and Inland Wetlands Restriction Acts.

Other operational groups include:

■ *Office of Research and Standards* studies effects on water quality of atmospheric input such as acid rain. Also assesses risks associated with exposures to spills or hazardous waste sites.
■ *Bureau of Municipal Facility Grants and Loans* is a loan program under a state revolving fund. A construction grants program is available for wastewater projects that are either not eligible for federal grants, or low on the federal list of priorities. This program, however, is funded by "Local Aid" in the state's budget that has been severely trimmed.

Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement

Division of Law Enforcement

100 Nashua Street, Ninth Floor
Boston, MA 02114
(617) 727-3190

Objectives: To protect public health and safety, to ensure public compliance of management regulations designed to protect the environment, and to register and maintain records of all boats and recreational vehicles.

Services: Provides boating safety education, hunter safety education, recreational vehicle safety education and educational lectures on Divisional responsibilities. Maintains **Environmental Police** force, reports boating accidents to Coast Guard, reviews and approves boating-oriented town bylaws or city ordinances.

Relevant legislation: MGL Ch. 90B (boating laws); ch. 130 (fisheries laws); ch. 131 (fish and game laws)

Division of Fisheries and Wildlife

Field Headquarters
Route 135
Westboro, MA 01581
(508) 366-4470

Objectives: Research and management of the more than 500 wildlife species native to Massachusetts. Also to provide information and educational programs to the public regarding fisheries and wildlife management and to generally keep the public and sportsmen appraised of what is going on within the agency.

Services: Responds to inquiries; provides information on coastal birds, sports fisheries, wildlife research and management, including coastal species, restoration of endangered species, and Inland Fish and Wildlife Fund; conducts workshops for teachers on wildlife, and runs Project Wild and Aquatic Wild. Other environmental education programs include: the Aquatic Resource Education Program, Massachusetts Junior Conservation Camp, the Hunter Safety Program and the Recreational Vehicle and Boater Safety courses. The Division's **Natural Heritage and Endangered Species Program** certifies vernal pools as well as inventorying and monitoring rare species of the Commonwealth. See **Riverways Programs** in Chapter 9 under State Legislation and Programs.

Division of Marine Fisheries (DMF)
(Central Office)

Saltonstall State Office Building
100 Cambridge Street, 19th Floor
Boston, MA 02202
(617) 727-3193

Objectives: To manage and conserve the living marine resources of Massachusetts and promote the commercial and recreational industries that they support. Includes regulation and management of commercial and recreational marine fisheries, shellfisheries, and aquaculture; promotion and advocacy of the Massachusetts seafood industry; and protection of living marine resources; monitoring of contamination.

Services: Licenses fishermen and dealers; administers regulatory enforcement; conducts applied marine research; provides technical education, legal and environmental information and analytic services.

Relevant legislation: National Shellfish Sanitation Program standards.

Division of Marine Fisheries Cat Cove Marine Laboratory

92 Fort Avenue
Salem, MA 01970
(508) 745-3113

Objectives: To research and manage commercial and recreational fisheries, to establish baseline data on marine environmental contaminants, and to collect and disseminate commercial and recreational fisheries statistics.

Services: Provides selected fishery statistics, use of library, and information and technical assistance on wide variety of marine fisheries and marine environmental matters.

Massachusetts Environmental Policy Act Unit (MEPA)

Saltonstall State Office Building
100 Cambridge Street
Boston, MA 02202
(617) 727-5830

Objectives: Oversees MEPA reviews. Under MEPA, when permitting and licensing development, state agencies must review, evaluate and determine the impact on the environment of the proposed development and use all practicable measures to mitigate impacts and minimize environmental damage.

Legislation: Title 301 of CMR, ch. 11. defines projects subject to MEPA review.

Metropolitan District Commission (MDC)

20 Somerset St.
Boston, MA 02108
(617) 727-5216

Objectives: This multifaceted state agency is responsible for thousands of acres of parkland, hundreds of recreational facilities, numerous flood control systems, a system of parkways and bridges, MetroPolice, and the water supply for 2.5 million people.

Services: Provides land planning for recreational and cultural facilities; manages coastal and island beaches; offers programs at parks and recreational facilities; maintains a police force and flood control.

Public Access Board

100 Nashua
Boston, MA 02114
(617) 727-1843

Services: Acquires, develops, maintains and improves public access water and land areas such as boat launching ramps, access roads, trails and shelters used for recreational purposes by citizens.

▼ Massachusetts Water Resources Authority (MWRA)

Charlestown Navy Yard
100 First Avenue
Charlestown, MA 02129
(617) 241-6058 or 241-6057

Objectives: To supply water and sewage disposal services for 2.5 million people in 60 communities in the Greater Boston Area, to plan and implement the cleanup of Boston Harbor, and to encourage water conservation.

Services: In addition to upgrading treatment facilities and constructing new facilities, MWRA is creating a sludge disposal program and combined sewer overflow facilities management program. In addition, MWRA provides advisory services, publications, literature and educational material for teachers. The authority also runs a pretreatment program regulating industries discharging to sewers connected to Deer and Nut Islands.

Regional

▼ **Bays Programs (Estuaries of National Significance)**
see under U.S. Environmental Protection Agency

▼ **Conservation Districts** see under (State) Executive Office of Environmental Affairs, Division of Conservation Services

▼ **New England Fishery Management Council**

Suntaug Office Park
5 Broadway (Route 1)
Saugus, MA 01906
(617) 231-0422

Objectives: To prepare, monitor and amend, as necessary, fishery management plans for the fishery resources of the U.S. Exclusive Economic Zone in the New England region.
Services: Provides information; holds public hearings.

Legislation: Public Law 94-265

▼ **Regional Planning Agencies (RPAs)**

Regional agencies are important for establishing guidelines for developments with potential regional impact, that is, those that could affect resources that cross municipal boundaries. In general, RPAs encourage development of regional management plans for the area's physical, social and economic development. RPAs also help review federal funding applications and federal development proposals. Two RPAs in Massachusetts have regulatory authority, the Cape Cod Commission and Martha's Vineyard Commission. The other agencies are advisory only.

Regulatory Authorities:

Cape Cod Commission
First District Courthouse
Barnstable, MA 02630
(508) 362-3828

Objectives: This 19-member regional land-use planning and regulatory agency for Cape Cod has the power to review projects affecting the region and/or proposed for Districts of Critical Planning concern.

Services: Reviews Cape development for consistency with a regional policy plan and local plans. Provides educational materials and services on land-use planning, water quality and waste management, market and economic information, legal and environmental information and regulatory enforcement services. The **Cape Cod Marine Water Quality Task Force** is housed by the Commission. The task force draws together municipal officials to identify pollution problems and recommend remedial actions.

Martha's Vineyard Commission
P.O. Box 1447
Oak Bluffs, MA 02557
(508) 693-3453

Objectives: To preserve and protect the unique natural, scientific and cultural values of Martha's Vineyard; and to promote sound economies of local towns.

Services: Provides technical assistance to member towns, advice and guidance, graphic presentation and cartography.

Planning Authority Only:

Merrimack Valley Planning Commission
350 Main Street
Haverhill, MA 01830
(508) 374-0519

Objectives: To support the orderly growth of the region as a desirable place to live and work.

Services: Supports and prepares comprehensive planning programs for the 15 member communities. Includes technical assistance, advocacy, and information exchange on issues related to transportation, environmental and economic development planning.

Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
(617) 451-2770

Objectives: To promote regional planning and to offer technical assistance to local governments in planning and resource management on such topics as water supply, water quality, aquifer protection, land use/growth management, open space, solid waste management and household hazardous waste.

Services: Provides publications, use of library and referrals.

Nantucket Planning and Economic Commission
1 East Chestnut Street
Nantucket, MA 02554
(508) 228-7237

Objectives: To promote long range planning for balanced growth on the island of Nantucket.

Old Colony Planning Council
47 West Elm Street
Brockton, MA 02401
(508) 583-1833

Objectives: Prepares plans for the physical, social and economic development of the 15 communities in the district.

Services: Professional planners are employed by the council and technical assistance offered on request.

Southeastern Regional Planning and Economic
Development District (SRPEDD)
88 Broadway
Taunton, MA 02780
(508) 824-1367

Objectives: Comprehensive regional planning, including land use, transportation, economic development, water quality and coastal zone management.

Services: Provides environmental information, including model bylaws and regulations for local communities to protect their natural resources; technical assistance, for example, on hazardous waste management for municipalities; cartography and a planning library.

▼ Resource Conservation and Development Districts (RC& D)
see under U.S. Soil Conservation Service

Municipal Departments or Boards

▼ Civil Defense and Emergency Planning Departments

An organization of volunteers trained and prepared to help in case of disasters or other emergencies. Many of the volunteers are trained emergency medical technicians while others are amateur radio operators. Some departments have ambulances, rescue trucks, mobile communications equipment, and computer systems that contain data bases of hazardous material as well as emergency management data. Most municipal civil defense departments are associated with regional civil defense councils.

▼ Conservation Commissions (ConCom)

Services: Wetlands permitting and enforcement. "ConComs" have the authority to regulate activities within 100 feet of wetlands, within the 100 year floodplain and within land under water bodies and waterways. In communities with setback requirements (local bylaws), conservation commissions can protect sensitive wetlands by requiring strict standards within the buffer zones. Conservation commissions can accept and hold conservation restrictions and can acquire conservation lands.

Relevant legislation: Massachusetts Wetlands Protection Act (MGL Ch. 131 §§40 and 40A) and local bylaws.

Background: Conservation Commissions are composed of three to seven appointed members. Members have three-year terms, are volunteers, subject to political pressure and late nights (leading to high turnover). Relatively few towns provide a budget to support staff or site visits. Local bylaws can strengthen commissions ability to carry out responsibilities by giving the commissions authority to enforce filing requirements and compliance with determinations, and by providing funds to allow commissions to employ hydrologists and other experts when needed. Massachusetts Association of Conservation Commissions provides literature, outreach and legal assistance.

▼ Fire Departments

Services: Large fire departments generally have a hazardous material officer (known as the HazMat Officer) who is trained to respond to spills. The department will determine likely source and cleanup small quantities. If the spill is considered a "reportable quantity" in accordance with the Massachusetts Contingency Plan for oil and hazardous materials spills (e.g., over 10 gallons of petroleum products), the fire department will generally call the Emergency Response Team of DEP; however, the spiller is responsible for notifying DEP. (See Chapter 3 for details.)

▼ Harbormasters

Objectives: Effective coastal harbor management, including maritime law enforcement (e.g., the Federal Boat Safety Act), oil spill cleanup coordination (and other enforcement of the Clean Water Act), coastal planning and permitting, and attention to coastal and marine environments. Harbormasters are frequently designated as oil spill coordinators.

Services: Provides regulatory enforcement of boating safety laws, pollution and conservation laws; investigates larcenies and boating accidents. Boating accidents involving fatalities or property damage valued at $100 or more are reported to Environmental Enforcement. The harbormaster is responsible for mooring regulation–he or she designs mooring schemes, assigns moorings, oversees use of transit moorings and management of town marinas with their various facilities possibly including guest slips, showers and lodge facilities.

Relevant legislation: MGL Ch. 90B §12 and §15B grants harbormasters authority to enforce boating safety laws.

▼ Health Department or Board

Relevant legislation: MGL Ch. 111 and Title V of MCR.

Background: Towns either elect or the governing body of the city or town (selectmen or mayor) appoints the three-member board.

Services: Directed by law to examine and make regulations to protect the public health and safety from all nuisances and causes of sickness, and to destroy, remove, or prevent these nuisances as the case may require. Boards of Health have wide-ranging authority and precedent to protect public health and prohibit environmental degradation through their regulations.

Among some of their activities: Administer Title V regulations including approval of septic system installations and landfill regulation. Can help protect wetlands by adopting regulations that prohibit the use of filled wetlands for setbacks from septic systems. Usually become familiar with local industry and pay particular attention to hazardous waste facilities and their emergency contingency plans. Boards of health also have special authority over drainage and waste disposal in proposed subdivisions.

▼ Planning Boards

Relevant legislation: MGL Ch. 41

Background: Five to nine members, either elected or appointed by selectmen (or mayor).

Services: Responsible for implementing zoning regulations and subdivision bylaws. (Zoning regulates permissible land use, i.e., residential, commercial, industrial.) Developers must submit subdivision plans to the board for approval before construction begins. Boards can adopt subdivision filing rules that require wetland delineation prior to subdivision approval. Can require only the upland portion of property be applied to minimum lot size requirements (though may have to amend local zoning bylaw).

▼ Police Departments

Services: Maybe able to provide joint training and/or technical assistance to harbormasters in the areas of: CPR, the writing of court reports, addressing shellfishing violations, firearms training, prosecution of complaints, and computerization/statistical analysis.

Note: Marshfield has established the harbormaster's office as a division within the Police Department, thus encouraging cooperation.

▼ Public Works Departments

Services: Responsible for the infrastructure of towns, including roads, landfills, wastewater treatment plants and piping, and the water system (including holding tanks, pipes, valves, flow and pressure). Can contribute to the protection of water quality by constructing and maintaining catch basins and grease traps and utilizing other impact mitigation techniques for handling stormwater runoff of roads, etc.

▼ Selectmen

Principal officers of towns, boards of selectmen supervise all that is not designated by law or town meeting vote to some other officer or board (Buzzards Bay Project, 1990). In some towns, selectmen act as assessors, water commissioners, sewer commissioners and boards of health. In other towns they appoint conservation commissions, boards of health members, harbormasters and other board members.

▼ Zoning Boards of Appeals

Relevant legislation: MGL Ch. 40A

Services: If soil conditions, the shape of the lot and topography create a hardship for the owner of a property, variances from zoning and/or subdivision bylaws may be granted by this board. This board may also grant permits in special zoning areas, such as in overlay protection districts. Permits under affordable housing provisions of Chapter 40B may also be granted.

▼ Waterways Commission or Committees

Services: Tries to protect the public's interest in waterways, especially in the Commonwealth's tidelands. Comments on proposed development, suggests ways to reduce the potential for negative impacts.

Background: Commonly a seven-member board appointed by Selectmen.

Note: Waterways commissions generally have a budget and authority roughly equivalent to conservation commissions. Waterways committees, on the other hand, are generally interested citizen volunteers restricted to an advisory role not always accorded the same respect as Concoms. Committees, nevertheless can have significant water quality protection impacts by commenting on proposed developments directly to their planning boards, zoning boards and the appropriate state agencies.

Other

▼ Community or Citizens' groups

Services: Local monitoring programs or "watch" groups spot water quality problems as they begin, bringing in state or federal agencies before major problems develop. For example, groups can file Request for Determination of Applicability forms with conservation commissions when they suspect wetlands violations or they may appeal deficient orders.

Citizens groups can draw attention to problem areas by informing property owners that they can file tax abatement requests when their ponds, beaches, etc. are closed due to pollution. Advocacy groups can pressure selectmen to appoint environmentally concerned citizens to boards such as the conservation commissions. Education programs may also be developed.

For information about an "Adopt-a-Brook" program and curricula modules, contact Charles River Watershed Association, 2391 Commonwealth Avenue, Auburndale, MA 02166. Telephone 617-527-2799.

Note: Monitoring programs should be coordinated with agencies that might be able to use the results such as Division of Marine Fisheries or local Boards of Health. It is important to make sure the proper instrumentation is used and calibrated correctly for data use by others. (See *Directory of National Citizen Volunteer Environmental Monitoring Programs*, Rhode Island Sea Grant Program, The University of Rhode Island Bay Campus, Narragansett, RI 02882-1197).

▼ Non-Profit Organizations (selected)[3]

Conservation Law Foundation of New England, Inc. (CLF)

23 Joy Street
Boston, MA 02108
(617) 742-2540

Objectives: A non-profit environmental-law organization, the foundation works to preserve and enhance the natural resources and public health of New England through legal processes.

Services: Provides legal and environmental information, counseling, regulatory enforcement, administrative intervention and litigation.

Essex County Regional Environmental Coalition

c/o Massachusetts Audubon: Resources for the North Shore
159 Main Street
Gloucester, MA 01930
(508) 927-1122

[3] A wide variety of non-profit organizations are interested and actively involved in water quality issues. See *Citizen's Guide to Sources for Marine and Coastal Information in Massachusetts*, MIT Sea Grant Program (Publication no. 90-3) for a more complete listing. Call (617) 253-7041 for ordering information.

Objectives: A newly-formed association of organizations and agencies interested in cooperating to achieve better communication and planning for environmental efforts county-wide. Hope to exchange ideas, tools and solutions and will lobby collectively for funds targeting environmental problems.

MassRecycle

P.O. Box 311
Worcester, MA 01613

Objectives: An association of individuals, industry, environmental groups, state and local government, MassRecycle is a coalition promoting reduction, reuse and recycling to conserve resources and protect the environment.

Services: Technical assistance, education programs, generally an information clearinghouse.

▼ Private Companies

Services: Engineering firms perform a wide variety of tests for clients before development projects begin or permits are issued. Water supply and landfall leachate are particularly common. Massachusetts Association of Conservation Commissions has a useful directory.

Professional Associations

▼ Massachusetts Aquaculture Association

P.O. Box 154
West Yarmouth, MA 02673
(508) 362-2511 ext. 204

Objectives: To promote aquaculture and to improve the potential for aquaculture production in Massachusetts

Services: Provides educational, advisory and referral services, information exchange and technical assistance for growers. Lectures and exhibits upon request.

▼ Massachusetts Association of Conservation Commissions (MACC)

10 Juniper Road
Belmont, MA 02178
(617) 489-3930

Objectives: To help municipal conservation commissions and interested citizens preserve and protect community natural resources.

Services: Hotline; workshops and conferences; publications, videos; legal, procedural and technical assistance.

▼ Massachusetts Environmental Education Society

15 State Street
Boston, MA 02109

Objective: Dedicated to the promotion and improvement of environmental education in Massachusetts. Affiliated with New England Environmental Education Alliance.

Services: Conferences, meetings, publications.

▼ Massachusetts Harbormasters Association

c/o Elmer Pooler, Scituate Harbormaster
Town Marina
100 Cole Parkway
Scituate, MA 02066

Objectives: Effective coastal harbor management

▼ Massachusetts Health Officers Association

Executive Secretary Michael D. Saraco, C.H.O.
P.O. Box 321
Winchester, MA 01890
(617) 729-8721

Objectives: Sharing professional expertise to promote public health and provide support for local health officers and departments.

Services: Keeps members informed about improvements in public health practices, legislation, opportunities for continuing education. Helps establish closer links among local and state-wide health and environmental agencies.

▼ Massachusetts Association of Health Boards, Inc.

Marcia Elizabeth Benes, MS, Executive Director
56 Taunton Street
Plainville, MA 02762
(508) 643-0234

Objectives: A non-profit organization dedicated to the promotion of public and environmental health through the education and support of boards of health throughout the Commonwealth.

▼ Massachusetts Environmental Health Association

George Young, R.S. CHO, President
40 South Street
Fosborough, MA 02035
(508) 543-1207

Services: Founded in 1948, the association holds quarterly meetings providing training, seminars and other information on wide array of environmental health concerns including air and water quality, solid waste disposal, recycling, environmental crime. With Massachusetts Health Officers Association, has a newsletter. Members include directors of public health agencies, members of academia and consulting engineers.

▼ Massachusetts Inshore Draggermen's Association (MIDA)

P.O. Box 155
Marshfield Hills, MA 02051
(617) 834-6432

Objectives: To establish cooperation among various segments of the industry, to work for favored legislation, to encourage conservation measures and improve conditions of the fisheries.

Services: Educational and environmental information, regulatory enforcement.

▼ **Massachusetts Lobstermen's Association**

8 Otis Place Box 9101
Scituate, MA 02066
(617) 545-6984

Objectives: To protect the species through sensible harvesting and conservation methods; strengthen law enforcement; promote understanding and cooperation among lobstermen, provide forum for information exchange among members.

Services: Technical assistance, legal information, limited market and economic information, and boat/life insurance cooperative for members.

▼ **Massachusetts Public Health Association**

Lynne Karsten, Executive Director
305 South Street
Jamaica Plain, MA 02130
(617) 524-6696

Objectives: A membership organization, this association links members in a diversity of occupations who share an interest in public health issues.

Services: Educational programming, legislation, advocacy, networking among specialists

▼ **Massachusetts Shellfish Officers Association**

c/o Natural Resources Department
South Yarmouth, MA 02664
(508) 394-3508

Objectives: Forum for shellfish officers to exchange information about research, management, law enforcement, water quality, etc. Work with Division of Marine Fisheries and provides information to legislators.

Services: Reference or referral services, annual convention

▼ **Massachusetts Watershed Coalition**

c/o NRWA
348 Lunenberg Street
Fitchburg, MA 01420-4566

▼ **New England Fisheries Development Association**

280 Northern Avenue
Boston, MA 02210
(617) 542-8890

Objectives: To improve the handling of fish and shellfish in the Northeast so that quality is preserved and product safety assured.

Services: Education programs for industry, seafood contaminants electronic bulletin board, newsletter, research and development projects.

▼ Women's Fisheries Network, Northeast Chapter

Box 1432 GMF
Boston, MA 02205

Objectives: Exchange of information and expertise within fisheries-related industries; education on fishing-related issues; support of career development within fisheries related fields.

Services: Bimonthly dinner meetings with speakers. Newsletters.

This chapter will summarize a selection of significant laws and programs that attempt to control sources of pollution, protect public health and safeguard coastal resources. Lead enforcement agencies will also be noted.

Federal Programs/Legislation

Act to Prevent Pollution from Ships (33 U.S.C. 1901)

Regulates and prohibits specific discharges from ships. Also see below: Marine Plastic Pollution Research and Control Act of 1987.

Coastal Barrier Resources Act (P.L. 97-348; 16 U.S.C. §3501)

Established the Coastal Barrier Resources System that disqualifies developers of specific barrier beaches from federally subsidized flood insurance and from federal aid for bridges and road building. Responsibility for the system is with the Department of the Interior.

Coastal Zone Management Act of 1972 (P.L. 92-583 or 16 U.S.C. §.1451 et seq.)

Recognizing the importance of the nation's coastal zone resources and the threats to their continued viability, this Act instituted a program of financial assistance to states to manage their coasts. The program is administered by the Secretary of Commerce through NOAA's Office of Coastal Zone Management. The Act authorizes funding states to develop their own management program; then, upon approval of individual states' programs, it authorizes annual grants to the eligible states for administering these. In addition, the Act stipulates that federal activities affecting the coastal zone must be consistent with approved state management programs (to the maximum extent practicable), and provides for mediation by the Secretary of Commerce in cases of serious conflicts between federal agencies and a state (*Massachusetts Coastal Zone Management Program 1978*). The Act identifies the coastal zone management needs as including natural resource protection, management of coastal development, and comprehensive planning, conservation and management for living marine resources (Millemann, 1986).

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (42 U.S.C. §9601 et seq.) also known as **Superfund**

Provides emergency response and cleanup capabilities for chemical spills (including oil) and releases from hazardous waste treatment, storage, and disposal facilities. Large numbers of hazardous waste sites with potential leaking of pollutants into marine waters have been identified in the coastal zone. Some ocean disposal of waste generated by Superfund site clean-ups was suggested and includes provisions for liability of ocean incineration vessels (OTA, 1987).

Persons in charge of a vessel or facility must notify the National Response Center (800-424-8802) as soon as he or she learns of a release of a reportable quantity of oil or hazardous material.

Cleanup costs must be borne by spillers. The federal government and the states may claim damages for impacts on natural resources.

Emergency Planning and Community Right-to-Know Act of 1986 also known as **Title III of the Superfund Amendments and Reauthorization Act of 1986**

Includes sections on emergency planning, emergency release notification, community right-to-know reporting requirements and toxic chemical release reporting emissions inventory. In most

cases, 500 pounds of extremely hazardous substances and/or 10,000 pounds of all other hazardous chemicals are the threshold quantities above which a facility must prepare material safety data sheets (MSDSs). These must be submitted to state and local emergency planning or response commissions and to local fire departments.

Endangered Species Act (16 U.S.C. 1531 et seq.)

Prevents physical harm to endangered or threatened species and regulates federal actions that impact critical habitats.

Executive Orders

Special written justification is required of any federal agency authorizing work on floodplains (EO #11988) and wetlands (EO #11990).

Federal Emergency Management Agency (FEMA)

FEMA administers the **National Flood Insurance Program**. This program provides subsidized flood insurance to qualified land owners in participating communities. Regulates development in flood-prone areas for public safety. Communities are supposed to adopt floodplain management standards, enforced and implemented through local zoning ordinances and bylaws (DEQE, 1984). However, the land-use component of the program has been largely neglected and ignored (Milleman, 1989). Instead of restricting development and guiding it away from flood zones, construction has boomed. "The number of households located in flood hazard areas has grown by 40 percent since 1966"(*Ibid*).

Federal Water Pollution Control Act

Loans for the construction of sewage treatment plants and research on pollution or pollution control technologies were authorized (Dolin, 1990). In 1956 amendments authorized grants to states for sewage treatment plants. The 1965 amendment (**Water Quality Act of 1965**) created the Federal Water Pollution Control Administration. It also required states to develop water quality standards for all interstate, navigable waters (*Ibid*).

The 1972 amendment known as the **Clean Water Act** (33 U.S.C. 1251 et seq.) regulates all discharges into navigable waters of the United States, including the territorial sea, with the goal of maintaining or improving the physical, chemical and biological integrity of all of the nation's estuaries and coastal waters. CWA coverage generally extends to pipeline discharges and the dumping of waste from vessels in estuaries and some coastal waters. CWA also covers discharges from point sources other than vessels in waters beyond the territorial sea (e.g., long outfalls from landbased facilities and from stationary drilling platforms) (OTA, 1987).

A central feature of the Clean Water Act is the **National Pollutant Discharge Elimination System (NPDES,** 40 CFR 122). Point sources discharging pollutants to navigable waters must obtain permits authorizing the discharge from EPA or states delegated responsibility for the permit program (Massachusetts is <u>not</u> a delegated state). Permits limit suspended solids, biochemical oxygen demand (BOD), fecal coliform and chlorine in the effluent. Without a permit, dumping or other discharge of any non-dredged material is illegal within three miles of the coast and inland, and point source discharges are illegal beyond three miles.

The **Water Quality Act of 1987** expands ongoing programs and adds new programs to control toxic materials in surface water and pollution from nonpoint sources and to further protect and

restore lakes and estuaries. These programs include: the **National Estuary Program**, the **Great Lakes Program** and the **Chesapeake Bay Program**.

Responsible: EPA and the states have developed standards for point sources of pollution, have awarded grants for sewage treatment facility construction, and have engaged in compliance monitoring and enforcement (U.S. EPA, Office of Water, 1989). **Section 404** of the Act controls the discharge of dredged materials. This is regulated by the Army Corps of Engineers, using criteria developed with EPA. EPA is directly responsible for carrying out the National Estuary Program. Under the Clean Water Act, NOAA acts on behalf of the Secretary of Commerce as a "federal trustee for living and non-living natural resources in coastal and marine areas" (Botzum, 1990).

Fishery Conservation and Management Act (16 U.S.C. 1801)

Also known as the **Magnuson Act**, this established eight regional councils nationwide as part of the National Fishery Management Program to prevent overfishing, rebuild stocks, conserve and manage the stocks in order to obtain their optimal yield. This law gives the United States the exclusive right to manage fish and shellfish in the 200-mile Fishery Conservation Zone (FCZ)– except for tuna, a highly migratory species.

The councils must work closely with the National Oceanic and Atmospheric Administration and the National Marine Fisheries Service (NMFS). The Secretary of Commerce approves the plans, NMFS and the Coast Guard enforce the management.

Low-Level Radioactive Waste Policy Amendments Act of 1986 (42 U.S.C. 2021(b))

Makes states responsible for managing commercial, low-level radioactive waste generated within their borders. Marine disposal is barred, but there are only three operational land-based disposal sites in the country (OTA, 1987).

Marine Mammal Protection Act (16 U.S.C. 1361)

Prohibits killing or taking marine mammals. (Negligent or intentional dumping might lead to a killing or be considered a "take" if, for example, discarded fishing nets entangle a mammal. The problem could be proving the connection or in the case of nets, identifying the source .)

Marine Plastic Pollution Research and Control Act of 1987 (Title II of P.L. 100-220)

Implements the prohibitions contained in the **International Convention for the Prevention of Pollution from Ships** (referred to as **MARPOL Annex 5**) for the United States. MPPRCA prohibits the disposal of plastics at sea by U.S. vessels and prohibits the disposal of plastics by any vessel within U.S. waters, including inland waterways, out to 200 miles (O'Hara, et al. 1988). Each port must provide for collection and proper disposal of plastic. In addition, the MARPOL agreement mandates that within 3 miles of shore only dishwater, drainage from laundry and bath, etc. and fresh fish parts may be dumped. Between three and 12 miles, only food waste, paper, rags, glass, metal, bottles, crockery, incinerator ash and similar refuse ground to smaller than one inch is allowed. Between 12 and 25 miles sinkable garbage is allowed, beyond 25 miles dumping of dunnage, lining and packing materials is allowed. **Enforcement:** The Coast Guard may enforce MARPOL by fining violators up to $50.000 and/or up to 5 years imprisonment. Ports and terminals may be closed for violations, as well.

Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1401 et seq.)

Known as the **Ocean Dumping Act.** Regulates the transportation and dumping of wastes in waters seaward of the baseline (inner boundary) of the territorial sea. The waters subject to MPRSA can be either open ocean or coastal waters; estuarine waters are excluded because they lie landward of the baseline (OTA, 1987). The Clean Water Act governs dumping in estuaries.

- Monitoring of discharges–EPA monitors for compliance with permits and for environmental conditions.
- Issuing permits for dumping–EPA chooses sites for dredged material dumping, but the Army Corps of Engineers issues the permits.
- Working on solutions to non-point source pollution.

National marine sanctuaries may be established under Title III of this Act. These sanctuaries are marine areas of special national significance designated to promote comprehensive and coordinated management of their conservation, recreational, ecological, historical, research, educational or esthetic values. Stellwagen Bank has been nominated for designation as a national marine sanctuary.

Responsible: EPA and the Army Corps of Engineers are responsible for administering the Act, the National Oceanic and Atmospheric Administration (NOAA) is responsible for monitoring the effects of ocean dumping and managing sanctuaries, and the Coast Guard is responsible for enforcing the Act. The Secretary of Commerce has the authority to establish marine sanctuaries.

National Environmental Policy Act (NEPA) of 1970 (42 U.S.C. § 4321 et seq.)

Environmental impact statements (EIS) are required for all proposed legislation and major federal actions that could significantly affect the quality of the human environment. EPA is exempt, but has voluntarily prepared EISs for proposed revisions in regulations or site designations (OTA, 1987).

National Estuarine Research Reserve System

Under CZMA §315, OCRM (Office of Ocean and Coastal Resource Management) may make grants to coastal states for the purpose of acquiring, developing or operating estuarine reserves (Milleman, 1986). These protected areas are also intended to serve as long-term field laboratories and outdoor classrooms.

National Flood Insurance, Mitigation and Erosion Management Act
(1991 Proposed legislation)

Limits flood insurance in erosion hazard areas and promotes protection of the natural and beneficial functions of floodplains. (See above under Federal Emergency Management Agency for existing National Flood Insurance Program information.)

National Ocean Pollution Planning Act (NOPPA) of 1978 (33 U.S.C. 1701)

Requires that ocean pollution research and monitoring conducted by various Federal agencies be coordinated by the National Oceanic and Atmospheric Administration (NOAA). NOAA is also supposed to establish Federal priorities in marine research (OTA, 1987).

National Oil and Hazardous Substances Contingency Plan

NOAA is the scientific support coordinator for the Coast Guard.

National Sea Grant College and Program Act of 1966 (P.L. 89-688)

Directed the National Science Foundation to design and conduct a national program to make the oceans more productive in the service of people, the nation and the environment (Goodwin and Abel, 1988). The network of twenty-nine programs emphasizes research, advisory services and education linking government, industry and academia in an effort to use wisely and protect the oceans' resources.

Massachusetts has two Sea Grant programs, one at Massachusetts Institute of Technology and the other at Woods Hole Oceanographic Institution.

National Shellfish Sanitation Program

Overseen by the Interstate Shellfish State Conference.
Mandates that a growing area should be classified as prohibited unless it can be proven otherwise. Open areas should meet the approved area criteria at all times. (55,000 acres were closed to shellfish in January 1989).

Oil Pollution Act of 1990 (P.L. 101-380)

Establishment of liability and compensation for damages to natural resources; federal resources trustees required to issue new damage assessment regulations and change the National Contingency Plan to protect ecologically sensitive areas; new oil spill research program. Double-hull tanker bottoms required. Right of state to establish higher standards for clean-up and liability is retained.

Pollution Prevention Act of 1990

This act encourages pollution prevention through changes in technology, material, design and composition of products so that waste and pollution is minimized in production, i.e., source reduction. Makes grants available to states for source reduction programs and requires a biennial report to Congress. Creates an office of pollution prevention in the EPA and requires EPA to focus on source reduction.

Port and Tanker Safety Act of 1978 (33 U.S.C. 1221 et seq.)

Regulates the operation of ships within U.S. ports and waterways to promote navigational and vessel safety and protect the marine environment. Handling, storage, loading and movement of dangerous materials are covered in the regulations (OTA, 1987:146).

Resource Conservation and Recovery Act (RCRA) of 1976 (42 U.S.C. 6901)

Focusing on land-based solid waste, this is designed to control the generation, transport, treatment, storage and disposal of hazardous waste. The regulations mandate a tracking system that records the movement of hazardous waste from its point of generation to its treatment and disposal. The goal is to prevent random dumping of these wastes on land or in waterways. However, some legal disposal sites are near estuaries or coastal waters and wastes sometimes leak into the marine waters. EPA is now encouraging waste minimization efforts as well as treatment prior to disposal

to reduce quantities and toxicity. (See the Federal **Pollution Prevention Act of 1990** that emphasizes reducing or eliminating pollution before it reaches the waste stream.)

The **1984 Hazardous and Solid Waste Amendments** discourages most land-based disposal methods, prohibiting such disposal of diozin-containing and spent-solvent wastes among others. Physical and chemical treatment are encouraged. The absence of legal disposal sites could lead to increased illegal discharges to municipal sewers, however.

EPA is the lead agency.

Rivers and Harbors Act of 1899 (33 U.S.C. 407)

This was enacted to prevent obstruction of, and impediments to, navigation. Currently also prohibits discharge of refuse into navigable waters. Regulates dam and dike construction and establishes harbor lines. (DEQE, 1984). Section 10 requires a federal permit for any proposed work seaward of the mean high water line, including permanent or temporary structures. Permits issued by the Army Corps of Engineers.

Safe Drinking Water Act (SDWA) of 1974 (42 U.S.C. 300(f) et seq.)

Mandates development of primary and secondary drinking water standards.

Toxic Substances Control Act (TSCA) of 1976 (15 U.S.C. 2601 et seq.)

Designed to regulate the manufacturing, processing, use, marketing and disposal of newly invented chemicals through control measures such as labelling, restrictions and bans. Also regulates the disposal of wastes contaminated with PCBs.

U.S. Army Corps of Engineers Fill Permits (under Federal Water Pollution Control Amendments of 1972 (P.L. 92-500, §.404 as amended by P.L. 95-217).

Regulations were published in the Federal Register July 19, 1977 and further proposed regulations in October, 1984.

A Corps permit is required for deposit of fill in all waters of the United States and their adjacent wetlands, excepting intermittent streams, headwaters with an average flow of less than five cubic feet per second, isolated wetlands and impoundments and natural lakes under 10 acres. Exemptions include routine agricultural fill, maintenance of dams and dikes, and all federal projects for which an Environmental Impact Statement is prepared. State and local officials must approve the project before the Corps will issue a permit. The Corps standards for review include balancing economic and environmental effects, wildlife and historical protection, flooding, recharge area, and small boat docks and property protection. This does not regulate excavation and drainage of wetlands, however.

The Corps is a good source of technical assistance. For more information, contact their office 424 Trapelo Road, Waltham, MA 02254-9149. Telephone (617) 647-8237.

Federal constitutional law permits a larger degree of protection of tidal marshes without paying the landowner than does the Commonwealth, so can be used to reinforce protection of wetlands. Furthermore, all Corps permits are reviewed by EPA.

Other Corps programs are based on the **Rivers and Harbors Act of 1899**. These require permits for construction of any dam or dike across navigable waters (section 9); for obstruction or alter-

ation of navigable waters, including filling, dredging or any other work affecting their course, location, condition or capacity (Section 10); and/or for discharge of refuse into navigable waters.

State Legislation/Programs[1]

Citations refer to Massachusetts General Laws, chapter and section (MGL Ch. §) and to the Code of Massachusetts Regulations (CMR).

Areas of Critical Environmental Concern (ACEC) (301 CMR §11.15)

Land areas with at least four of a number of environmental characteristics creating a "unique cluster of natural and human resource values ... worthy of a high level of concern and protection." Any 10 Massachusetts citizens, interested agency, regional planning board, board of selectmen, city council, mayor, planning board or conservation commission of the city or town in which the land is located, the governor, or a member of the general court may submit a nomination to the Secretary of the Executive Office for Environmental Affairs for designating an area an ACEC.

Forty-five days after receiving the nomination, or additionally requested information, the Secretary must decide to proceed with a full review or decline review. Public hearings must be held if a review is initiated. Within 60 days after the public hearing, a final decision must be made. Denials may be appealed for reevaluation within one year of the denial.

Chapter 91 see below **Massachusetts Public Waterfront Act**

Coastal Wetlands Restriction Act (MGL Ch. 130 § 105) See also **Massachusetts Wetlands Protection Act** and **Inland Wetlands Restriction Act**, below.

The Commissioner, Department of Environmental Protectiont, in order to promote public health, safety and welfare, protect public and private property, wildlife and marine fisheries, is directed to issue orders restricting or prohibiting dredging, filling, removing or otherwise altering or polluting coastal wetlands. The protective orders are registered on the deeds of landowners.

Coastal wetlands include "any bank, marsh, swamp, meadow, flat or other low land subject to tidal action or coastal storm flowage and such contiguous land as the Commissioner of Environmental Management reasonably deems necessary to affect by any such order" (MACC, 1985:39)

The goal is the protection of the states most significant wetlands, specifically, all barrier beaches, salt marshes, contiguous freshwater marshes, sea cliffs, dunes, salt ponds and tidal flats. The coastal wetlands are considered important for flood control, prevention of storm damage, protection of marine and shell fisheries, and protection of wildlife habitat. The same constraints and advantages as for the Inland Wetlands Restriction Act apply (see below).

Administered by the **Wetlands Conservancy Program**, Division of Wetlands and Waterways, Department of Environmental Protection, One Winter Street, Boston, MA 02108. Telephone: 617-292-5908.

Colonial Ordinances of 1641 and 1647

Massachusetts citizens have certain rights of access to privately owned tidal land between low and high water for fishing, fowling and navigation.

[1] Unless otherwise noted, the details about Massachusetts' legislation is primarily drawn from *Massachusetts Environmental Law for Environmental Consultants and Managers* by Wendy B. Levine and Jo Ann Shotwell, The Cambridge Institute, 1990.

Environmental Penalties Act (since September 1986)

Allows the Department of Environmental Protection (DEP) to penalize and fine polluters directly without having to refer to attorney general. For discharging without a permit, violators may be fined up to $25,000 per day . In assessing these "administrative penalties," DEP considers: number of days, whether violator tried to prevent, compliance steps, history (e.g. of non-compliance), control over events, reasonable prevention, impact on public, damage, cost avoided by violator, cost to state of enforcement action, and economic benefit. The major problem is that there is insufficient staff for enforcement.

Home Rule Amendment

This 1966 amendment to the state's constitution is a strong declaration of the right to local control. Municipalities are authorized to exercise through the "adoption, amendment, or repeal of local ordinances or bylaws ... any power or function ... not denied ..." by the state (Buzzards Bay Project, 1990). This amendment permits municipalities to adopt stricter bylaws and other controls addressing environmental concerns such as wetlands protection, erosion and sedimentation control, aquifer and well protection, aesthetics, wildlife and recreation (Tirrell, et. al., 1989).

Inland Wetlands Restriction Act (MGL Ch. 131, § 40A)

The Commissioner, Department of Environmental Protection, in order to preserve and promote public safety, private property, wildlife, fisheries, water resources, flood plain areas and agriculture, is directed to issue orders restricting or prohibiting development of inland wetlands, defined as "freshwater wetlands" and "that portion of any bank which touches any inland waters, or any freshwater wetland," and furthermore, prohibiting obstruction or encroachment along waterways of flood prone areas. Public hearings, with notice to conservation commission and affected landowners, and reviews by selectmen or city council are held before an order is issued. City officials may disapprove an order within 30 days, but the Commissioner may override local disapproval after six months. The final order is recorded in the Registry of Deeds and is binding on all present and future landowners. Landowners may appeal to Superior Court within 90 days.

Constraints on implementation: Data on the nature of the land and landownership is scattered. Extensive hearings and consultations with landowners are necessary but time-consuming. Advantages: Notice to prospective buyers through recorded maps; finality, because of the 90-day limitation period for landowner lawsuits, and inclusion of protection of wildlife (MACC, 1985:39).

Administered by the **Wetlands Conservancy Program**, Division of Wetlands and Waterways, Department of Environmental Protection, One Winter Street, Boston, MA 02108. Telephone: 617-292-5908.

Massachusetts Anti-littering Act (MGL Ch. 270 §16)

Prohibits disposal of trash, debris, etc. on or within 20 feet of public highways, public land and/or coastal or inland waters. Fines may be up to $3,000 for the first offense, up to $10,000 for subsequent offenses. Violators are liable for costs of identification, removal and disposal of material. This is enforceable by natural resource officers, division of motorboats, harbormasters (and assistants), state police, inspectors of registry of motor vehicles and by city, town and MDC police officers. Cities can also designate health officers as enforcers.

Massachusetts Clean Air Act (MGL Ch. 111 §§142A-142J)

DEP's Division of Air Quality Control has responsibility for Massachusetts air pollution control program. The program established Ambient Air Quality Standards, emission limitations and performance criteria for facilities and activities within the state which may cause air pollution and established a review and approval process for proposed activities which may cause or contribute to air pollution. There are six Air Pollution Control Districts in the state. DEP maintains a list of the types of facilities characterized as ones which may cause or contribute to air pollution and for which written approval must be obtained prior to construction or alteration.

Massachusetts Clean Waters Act (MGL Ch. 21, § 26-56)

Massachusetts Water Pollution Control Regulations found at 314 CMR. §1.00 et seq. §4.06 shows classification of the Commonwealth's surface waters with tables and maps.

DEP's Division of Water Pollution Control is responsible for implementing any actions necessary to comply with the federal Water Pollution Control Act; adopts minimum water quality standards for waters of the Commonwealth; prescribes effluent limitations; establishes rules for monitoring, sampling, record keeping and reporting by dischargers; regulates waste treatment facilities; and cooperates with federal and regional agencies on water pollution matters. The 1974 amendments requires Water Pollution Control to investigate and prosecute violations.

DEP issues several types of permits regulating the discharge of pollutants from point sources–e.g., pipes, containers, vessels. Regulations regarding surface water discharge permits; ground water discharge permits and sewer extension and connection permits are in 314 CMR §3.00, §5.00, and §7.00.

The **water quality standards** for groundwater (314 CMR §6.00 et seq.) and surface water (314 CMR §4.00 et seq.) designate uses of the ground and surface waters, prescribe the minimum standards for the designated uses and promulgate regulations to achieve those standards.

Surface waters are defined as: "All waters other than groundwaters within the jurisdiction of the Commonwealth, including without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters and vernal pools."

There are three specific classes and criteria for coastal and marine waters. Class SA are waters designated as excellent habitat for fish, aquatic life, wildlife and for primary and secondary contact recreation. In approved areas, they are suitable for shellfish harvesting without depuration.
Class SB are waters designated as habitat for fish, aquatic life, wildlife and for primary and secondary contact recreation. In approved areas, they are suitable for shellfish harvesting with depuration.
Class SC are waters designated as a habitat for fish, aquatic life, wildlife and for secondary contact recreation. They shall also be suitable for certain industrial uses.

In addition, there are minimum criteria for all coastal and marine surface waters, such as those that pertain to aesthetic considerations (prohibiting debris, scum, objectionable odor, etc.) as well as prohibiting pollutants that affect the bottom or effect accelerated eutrophication; radioactive substances, toxins, etc.
An antidegradation provision protects existing uses, high quality, significant and outstanding resource waters. This provision is particularly useful in regulating potential polluters (e.g., municipal treatment plants).
Dredging and dredged material disposal and fill projects in the Commonwealth all require water

quality certification. Regulations (314 CMR §9.00 et seq.) have set out procedures and criteria for uniform and coordinated administration.

Massachusetts Coastal Zone Management Program

Formally adopted by the Commonwealth in 1978 under the provisions of the federal Coastal Zone Management Act, a Coastal Zone Management Office was established as part of the Executive Office of Environmental Affairs with duties of overseeing the implementation of the program. The program is based on 27 policies concerned with coastal land and water management, port and harbor development, water quality, recreation, public access, development, etc. Some of the policies are regulatory, others are incorporated into existing regulations, implemented by other agencies.

Among some of the specific programs overseen by the MCZM office are: Areas of Critical Environmental Concern; Designated Port Areas (DPA); Dredged Material Disposal; Harbor Planning Program; and the Ocean Sanctuaries Program.

Massachusetts Environmental Policy Act (MEPA) (MGL Ch. 30 §61-62H)

Requires that state agencies "review, evaluate, and determine the impact on the natural environment of all works, projects or activities conducted by them." "Conducted by them" is defined broadly since projects undertaken by a person, but requesting financial assistance from an agency or even requiring permits from an agency may be reviewed. Minimizing and preventing damage to the environment is mandated by MEPA.

The Executive Office of Environmental Affairs regulations specify the criteria that determine whether a project must be reviewed. If the project does require review, the responsible party must submit an Environmental Notification Form (ENF) to the MEPA Unit of EOEA. If the MEPA Unit determines that it is necessary, the submission of an Environmental Impact Report (EIR) will be required. Upon receipt of the draft EIR, the Secretary announces its availability in the *Environmental Monitor* and opens a 30-day public comment period. The final EIR must incorporate the comments made on the draft and must also be circulated and commented on. If the EIR is determined to be adequate, the proponents must notify the Secretary when construction begins. The MEPA Unit must be notified if there are changes in the proposed project, or if more than three years have lapsed, between the time of filing the ENF and the filing of the final EIR; or if more that five years have passed between the filing of the final EIR and the substantial beginning of the project. If the MEPA Unit determines that environmental consequences are thereby increased, it may require the process to begin again.

There are specific categorical inclusions that lead to MEPA review, including the size of the project, effects on wetlands, use of water, and air emissions; and there are certain thresholds spelled out that determine the necessity for MEPA review. Projects sited in an Area of Critical Environmental Concern (ACEC) are also subject to MEPA review and may be subject to more stringent review thresholds. In addition, there is a "fail-safe" provision that allows the Secretary of Environmental Affairs to find that an ENF is required under certain conditions. These conditions include: the project has the potential to cause significant impact on the environment, and that it was not possible to have foreseen such potential when the review threshold was promulgated; or that the damage would be caused by a unique set of circumstances that individually would not be likely to cause such damage (e.g., cumulative impacts); or that the project requires a permit due to recent legislation or regulations. Furthermore, compliance with MEPA procedures is essential to minimize damage and would not constitute severe hardship to the project proponent.

Massachusetts Hazardous Waste Management Act (MGL Ch. 21C §4)
Regulations may be found at 310 CMR 30.000.

This Act was enacted to fulfill the mandates stipulated by the Federal Resource Conservation and Recovery Act (RCRA).

The Division of Hazardous Waste Management in the Department of Environmental Protection has promulgated regulations that list hazardous wastes; set criteria and standards for the identification of hazardous waste as well as its transporting; requirements for generators of such waste and operators of hazardous waste and/or treatment facilities. In addition the regulations set the financial responsibilities for treatment, storage and disposal facilities.

DEP has four lists of specific hazardous wastes with identification numbers assigned by EPA or DEP (310 CMR §30.100 et seq.). There is also a list of exempted wastes that includes household and agricultural waste as well as certain industrial wastes. Characteristics of hazardous waste are ignitability, corrosivity, reactivity, and toxicity. In all notification, records and other reporting requirements, the identification numbers must be used.

Other provisions of the regulations apply to the handling of recyclable materials (that would be hazardous if stored or disposed of instead of reused) and waste oil. Standards and requirements for permit applications and conditions, generation, transportation, manifests, storage, recycling, transfer stations and marketing are all specified in the regulations. Licensing is required for anyone transporting, using, collecting, storing, treating or disposing of hazardous waste or for anyone constructing, operating, maintaining a facility for the use, storage, treatment or disposal of hazardous waste. Exceptions are granted to those who hold the waste for fewer than 90 days and for emergency containment and treatment in the case of spills.

Notification requirements, etc. are part of a comprehensive tracking system that only exempts very small generators of hazardous waste or waste oil. *Generators* of hazardous waste must have identification numbers, notify DEP of changes in status and are required to transfer waste only to EPA licensed transporters with DEP registered vehicles. *Manifests* must accompany the material, identifying its origin, quantity, composition, routing and destination (including an alternate site in case of emergencies). Furthermore, the material must be packaged, labelled, marked and placarded according to regulations.

Generators must maintain records for three years after the waste was transferred. They must file annual reports and, if they have not received a signed copy of the manifest from designated facility within 45 days of the transfer to a transporter, they must file an *Exception Report*.

Accumulation of up to 55 gallons of hazardous material in one container and one quart of acutely hazardous waste in a single container is permitted under certain circumstances and following certain labeling and handling regulations, without a storage licence.

Transporters must maintain an Emergency Procedures Guide that includes notification requirements, procedures for containing a discharge and instructions on use of required equipment. Insurance policies must have an approved Department of Transportation or DEP endorsement.

In order to obtain a license to operate, Hazardous Waste Facilities must submit a waste analysis plan, a security plan, an inspection plan, a personnel training plan, contingency plan, emergency procedures, a closure plan and post-closure plan.

Penalties for violations include: Fines of up to 25,000 dollars, or two years in the House of Corrections or both for each violation; or a civil penalty of up to 25,000 dollars per violation; or for any who knowingly violates section five, a fine of 100,000 dollars, imprisonment in the state prison for no more than 20 years, or two and one-half years in the House of Corrections or both for each violation. Each day a violation occurs or continues is considered a separate violation.

Massachusetts Oil and Hazardous Material Release Prevention and Response Act (MGL Ch. 21E)

According this, the Massachusetts **Superfund** statute, any potentially responsible party, including site owners, former owners (at time of storage or disposal of hazardous material, not oil), operators, generators, transporters, and anyone who caused or is responsible for the release must notify DEP within two hours of the release or threat of release of oil or hazardous material. Failure to do so is a felony (Shotwell, 1990). This same group is liable for the costs relating to the release of or threats of release of oil and hazardous material. The regulations are part of the **Massachusetts Contingency Plan.**

Massachusetts Public Waterfront Act (MGL Ch. 91)

Regulations found at 310 CMR §9.03(2)

"Establish[es] a licensing program for the purposes of preserving and protecting the public 'rights of fishing, fowling, and navigation in the foreshore and all rights in the Commonwealth tidelands...'." (Levine and Shotwell, 1990). The goal of the program is to ensure that tidelands and other special waterways are used only for water dependent uses or serve a proper public purpose. Besides promoting and protecting water dependent use, the program preserves pedestrian access to the water's edge, protects ACECs and encourages the development of harbor plans so that local communities can adapt and use the state regulations to shape their waterfront in accordance to their interests and needs. The licensing program is administered by DEP's Wetlands and Waterways Division.

Massachusetts Self-Help Act (MGL Ch. 132A §11(§15.04))

This program offers municipal conservation commissions the opportunity to obtain up to 80 percent of the cost of acquiring land for conservation and passive outdoor recreation purposes from the Commonwealth.

Massachusetts Solid Waste Act (MGL Ch. 21H, §2)

This Act established new solid waste clean-up programs, changed the facility siting process and authorized new regulations for solid waste disposal and for facility siting, operation, and maintenance.

For approval of construction and operation or expansion of a facility, an application for site assignment must be submitted to the local board of health, Massachusetts Dept. of Public Health (DPH), and the Massachusetts Dept. of Environmental Protection (DEP). DEP prepares a "suitability report" and public hearings are held. Appeals may be made to Superior Court. Regulations covering operation and maintenance of solid waste transfer stations and disposal of solid wastes by sanitary landfills have been promulgated by DEP.

Massachusetts Toxics Use Reduction Act (MGL Ch. 211, §§ 1-23)

Goal is to promote industrial hygiene, worker safety, protection of environment and public health through a fifty percent reduction from 1987 levels of toxics and hazardous by-products produced in Massachusetts by industry.

Various boards and councils have a role in helping achieve this goal. The Administrative Council on Toxics Use Reduction promotes increased coordination of efforts; Massachusetts Advisory Board on Toxics Use Reduction provides a forum for discussion of issues; the Toxics Use Reduction Institute at the University of Lowell is to provide education and training, as well as research results on toxics use reduction; the Office of Toxics Use Assistance and Technology (in EOEA) provides technical assistance to toxics users. There are provisions for annual reporting, preparation of reduction plans and protection of trade secrets.

Funds are available to industries to implement their plans.

Massachusetts Wetlands Protection Act (MGL Ch. 131 § 40 and 40A)

Governs any development activity (including site preparation) that is in, near or affecting any marshes, meadows, swamps and/or bogs, plus banks, beaches and dunes that border lakes, creeks, streams, rivers, ponds, estuaries, or the ocean. The controls are intended to protect public or private water supply and groundwater supply, prevent pollution, aid flood control and storm damage prevention, protect fisheries, including land containing shellfish. Work on land subject to flooding as well as land subject to coastal storm flowage and tidal action is covered by the Act (MACC, 1985:35). Work in a 100 foot Buffer Zone around the wetlands which border water around banks, beaches and dunes may be covered and the developer has the option of filing a Notice of Intent (NOI) or a Request for Determination (RFD). If the commission decides work "will alter" a resource area, then a NOI is required and the commission can set conditions on the work. The NOI must include information about which resource areas will be affected, physical characteristics, proposed work and proposed mitigation. Before an NOI is filed, all other permits and approvals under local bylaws must have been applied for.

Regulations permit filling under some circumstances that seriously weaken the protection intended by the Wetlands Protection Act. For example, permitted filling of bordering vegetated wetlands allows discretionary destruction of up to 5,000 square feet if the area is replaced in accordance with seven general conditions (Buzzards Bay Project, 1990). In addition, conservation commissions may issue permits for unlimited alteration without replication for such activities as agriculture, silviculture, construction and maintenance of roadways and driveways, inland docks and piers (*Ibid*). However, the commissions can deny permits under certain circumstances or can and should require certain conditions to afford the protection intended by the Act.

Work outside the resource areas and Buffer Zone can be regulated only after alteration of a resource area occurs. There are statutory exemptions for mosquito control work, for cranberry farming, and for specific government projects (e.g., highways) (*Ibid*).

Conservation commissions (or selectmen/mayor) administer the WPA by reviewing applications (Notices of Intent) and holding public hearings before issuing permits (Orders of Conditions). Department of Environmental Protection (Division of Wetlands and Waterways) provides oversight, reviewing local decisions, provides additional enforcement and hears appeals from commission decisions. Both conservation commissions and the Department of Environmental Protection must follow DEP's "Wetlands Regulations" (cited in the Code of Massachusetts Regulations as 310 CMR 10.00 et seq.) in administering the law. These regulations clarify jurisdiction, create

presumptions for significance of certain wetlands and floodplain areas, and set performance standards for development to meet. All final Orders of Conditions issued by either the Department of Environmental Protection or a commission can be enforced by either body (*Ibid*:37).

Wetlands Protection regulations include provisions for protecting rare or endangered species. If projects will alter resource areas identified on "Estimated Habitat Maps," applicants must notify the Division of Fisheries and Wildlife's Massachusetts Natural Heritage and Endangered Species Program. Projects will not be permitted to have adverse effects on the habitat of state-listed species.

For details, see MACC's *Environmental Handbook for Massachusetts Conservation Commissioners* and contact Executive Director, Massachusetts Association of Conservation Commissions, 10 Juniper Road, Belmont, MA 02178. Also see *Massachusetts Wetlands and Waterways. A General Guide to the Massachusetts Regulatory Programs*, Dept. of Environmental Quality Engineering (DEQE, now Dept. of Environmental Protection), Nov. 1984.

Weaknesses: The exceptions for government projects, the driveway and road crossing exception, ability to fill 5,000 square feet. Other weakness is in its reliance on volunteer enforcement agents. (The rapid turnover among conservation commissions membership is indicative of the problems.)

National Pollutant Discharge Elimination System (NPDES) program

Permit system, with EPA funding, for industrial and municipal point source discharges into state waters–administered by DEP.

(For other discharges see: Title V of the State Environmental Code that regulates subsurface sewage disposal in unsewered areas (i.e., discharge to groundwater) and the federal Clean Water Act that regulates surface water disposal.)

Ocean Sanctuary Act (MGL Ch. 132A, §13-16 and §18; 302 CMR 5.00)

This act places designated sanctuaries under the care and control of the Department of Environmental Management (DEM) to be protected from exploitation, development or activity that would seriously alter or otherwise endanger the ecology or appearance of the ocean, seabed or subsoil thereof, or the Cape Cod National Seashore. The legislative intent was to ensure a continued supply of fish and shellfish as well as clean, enjoyable beaches attractive to tourists. Amended regulations provide policies and procedures for obtaining variances for discharges into an ocean sanctuary under limited conditions.

Private Suits

Parties suffering as a result of officially permitted actions (e.g., Wetlands Orders or other permits) may successful bring private action for damages against the party holding the permit.

Right to Know Law (MGL Ch. 111F, §1 et.seq.)

"An Act Further Regulating the Protection of the Public Health" requires that manufacturers and users of hazardous substances tell their workers and their community's residents about the presence of hazardous substances, potential risks and protective measures and to provide employee training for proper handling. The Dept. of Public Health, the Dept. of Labor and Industries and the Dept. of Environmental Protection each have associated responsibilities to enforce this law.

DPH maintains the "Massachusetts Substance List" identifying the materials subject to the Right to Know law; and must release information about the nature and risks associated with the hazardous materials. Certain exceptions to completion of "Material Safety Data Sheets" (MSDSs) may be requested on the basis of trade secret status or research laboratory status.

DLI enforces the regulations concerning container labeling in facilities; employers preparations of MSDSs and other aspects of employers' record-keeping. Employees may file complaints with DLI.

DEP has "suspended indefinitely" enforcement of the regulations requiring manufacturers and users of hazardous materials to file a copy of the MSDS for each substance with DEP (Brown, 1991). This could handicap investigations by other state and municipal agencies and by community residents trying to determine what toxic or hazardous materials are used or stored in local facilities.

Riverways Programs

Riverways Contracts Program, Adopt-a-Stream, the Assabet River Program and the Blackstone River Program all administered by the Department of Fisheries, Wildlife and Environmental Law Enforcement involve citizens in river protection. Staff members work with watershed associations, town officials and other citizens to improve water quality and protect the rivers and their corridor lands.

Scenic Rivers Act (MGL Ch. 21, §17B)

The Department of Environmental Management may restrict or prohibit dredging, filling, or otherwise altering or polluting "scenic and recreational" rivers (any rivers and streams so designated by DEM, plus contiguous land up to 100 yards on each side of the natural bank). Furthermore, DEM may also control use of these waters, including restrictions on the use of motorboats. Landowners may appeal to Superior Court.

Title 5 (Minimum Requirements for the Subsurface Disposal of Sanitary Sewage) (MGL Ch. 111, §31 and 310 CMR 15.00)

Title 5 of the State Environmental Code (310 CMR 15.01 et. seq.) regulates sewage disposal in Massachusetts–specifically, subsurface sewage disposal in unsewered areas, i.e., discharge to groundwater. Title 5 addresses the location of the septic system, operation, volume, inspection and maintenance. However, the lack of detailed specifications and regulations regarding inspections, construction standards, nitrates, watertable setbacks, percolation rate, upgrades and pumpouts limits Title 5's effectiveness and towns or local boards of health frequently must address these issues. MGL Ch. 111 §31 allows boards of health to strengthen minimum requirements. A useful source of information is an August 21, 1991 paper written by Louis J. Wagner of Massachusetts Audubon Society to DEP entitled, *Recommendations for Revisions to Title 5 and Regulations Governing the Use of Privately-owned Sewage Treatment Facilities.*

Underground Tanks and Containers

Installation, upgrading, maintenance and testing of underground storage tanks is regulated by the Board of Fire Prevention Regulations to ensure "the public safety."

In addition to licenses and permits associated with the site, underground storage tank facilities must be permitted by the local fire department. To obtain the permit, the owner must, among

other things, include a plot plan that notes proposed location of the tank and the location of wells and/or bodies of surface water.

Waste Oil Retention Law (GL Ch. 21, §52A)

A retailer of motor oil must install a waste oil retention facility and accept, without charge, up to two gallons of used oil per day from customers bearing receipts. (Compliance has improved since "sting operations" were conducted by DEP in 1989. Ten-thousand retailers have Division of Standards permits to sell motor oil, but not all comply with the regulations.) Management of the used oil is regulated by the Hazardous Waste Management Regulations 310 CMR 30.000.

County or Towns

Local rules may be enforced only to the extent they further the purposes of general law (Tirrell, et. al. 1989).

Boards of Health regulations

Strongest authority–can change zoning on the basis of health impacts without going through the town government.

- Regulations *vis a vis* disposal of sanitary wastes may be more restrictive than Department of Environmental Protection's environmental code.
- Monitoring the beaches for coliform bacteria (*Eschericha coli*) indicates the potential presence of harmful bacteria and viruses.

Zoning bylaws[2]

- Cluster zoning
- Conservancy and aquifer protection
- Large lot zoning
- Phased growth and moratoria
- Floodplain/wetlands protection zoning

Planning board's **subdivision regulations** can regulate land use and drainage, make provisions for open space and retention of vegetation.

Wetlands bylaws (for examples see, Tirrell et al., 1989 and Dawson, 1985).

Other: Earth removal ordinance or bylaw; scenic roads; public shade tree act; regulation of snowmobiles and motorboats on municipal lands or Great Ponds; historic districts; scenic mountains; billboard and sign control; insect control; herbicide spraying, defacing natural scenery are all potentially subject to regulation by communities.

Comprehensive planning with matched zoning regulations

Comprehensive plans identify:
- the resources to be protected
- areas of potential growth

[2] See Alexandra Dawson's *Environmental Handbook for Massachusetts Conservation Commissioners.*, 1985, for details.

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