Casco Bay Estuary Project

PRELIMINARY

COMPREHENSIVE

CONSERVATION AND MANAGEMENT PLAN

October 1992

Casco Bay Estuary Project

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I. INTRODUCTION

The preliminary Comprehensive Conservation and Management Plan sets the agenda for the next three years and begins the discussion on how to address the issues facing Casco Bay.

The Management Committee is pleased to offer the preliminary Comprehensive Conservation and Management Plan (CCMP) for the Casco Bay Estuary Project. The preliminary plan has two purposes. First, it sets the agenda for the Casco Bay Estuary Project (CBEP) for its next three years of participation in the National Estuary Program. Equally important, it is the vehicle around which to begin dialogue on how to address the priority issues facing Casco Bay. It is a preliminary plan because these discussions will further develop the CCMP.

Looking ahead to 1995

Part of the agreement between the State of Maine and EPA to include Casco Bay in the National Estuary Program was a commitment to develop a final CCMP by 1995. The final CCMP must contain specific actions to address the priority issues facing Casco Bay and identify agencies responsible for implementing the actions. The final CCMP is envisioned as having several parts:

A summary of the State of Casco Bay;

Identification of priority issues and the goals and objectives developed through the activities of the Management Conference;

Specific actions to be taken and identification of organizations responsible for taking them;

A strategy for funding implementation activities;

A program for monitoring the health of the Bay and the success of the action plans; and

A mechanism to ensure that federal grant programs fund projects that are consistent with the final CCMP.

In contrast to the final CCMP, this preliminary CCMP describes the steps to be taken before the final CCMP can be developed. This preliminary CCMP begins to lay out the structure and substance of the final CCMP.

The preliminary CCMP

As a preliminary document this CCMP does not include final recommendations for the management actions. Rather, it details the work to be done before decisions about final management actions can be made. The actions in this document call for a variety of activities -- feasibility studies, scientific research, development of guidance documents, the setting of priorities and taking of action to demonstrate the feasibility of management actions.

The preliminary CCMP also points to the "future directions" that are likely to be part of the final management strategy. The future directions focus the action plan by describing the approaches to be investigated and demonstrated.

The future directions also provide the focus for the broader discussions to be held during the next three years. These discussions will develop the most appropriate management approaches and build support for their implementation. The results of both the groundwork and the discussions will be the basis for the final action plans.

Format of the Preliminary CCMP

This document is presented in four sections, including this introduction (Section I). Section II describes the process by which the CBEP set priorities and developed the action plans which make up this preliminary CCMP. Section III sets the context for the action plans by describing the physical and biological characteristics of Casco Bay and the human uses of the Bay and its watershed. Section IV contains the action plans. Each action plan explains the issue being addressed including the goal, objective, actions and future directions.

Overarching Themes

There are several themes which the project hopes emerge from these action plans. The first is that the CBEP is committed to involving a broad range of participants. The project is structured so that it is directed through an open, consensus-building process that brings together federal, state and local agencies, business, industry, academic institutions and the public. In undertaking these action plans, the Management Committee is committed to involving a broad group of interests in the data collection and decision making.

The CBEP will work towards fostering cooperation between the regulated community and the regulators. The action plans in this preliminary CCMP work toward a cooperative approach based on providing technical assistance on protecting the environment and the regulatory process.

The CBEP recognizes the importance of public education, and the education of children, about environmental issues and has made it one of its priority issues. One of the following action plans describes the efforts the CBEP will take regarding public education.

Finally, the CBEP recognizes the role of economic issues on environmental protection. It will work toward demonstrating the value of the environment and the cost effectiveness of environmental protection. The CBEP will also work to demonstrate how the protection measures included in the final CCMP will achieve the desired objectives.

Developing a "living" document

To be effective, the management plan must be reviewed and revised on a regular basis.

It is difficult for a document like a CCMP to remain up-to-date. Actions in the plan will be implemented, but these implementation activities will reveal other needs, and economic and environmental conditions will charge. In addition, as the current priorities are addressed there the opportunity to add new priorities and develop new action plans will arise.

To be effective over time, the CCMP must become a "living" document -- one that is reviewed and revised on a regular basis. It is hoped that by preparing a preliminary CCMP and then a final CCMP, the CBEP is setting the precedent for the development of a living document.

II. SETTING THE PRIORITIES AND DEVELOPING THE CCMP

The CBEP has focused its efforts to address five issues.

This preliminary CCMP focuses on five priority issues. A limited number of issues are included because the Management Committee recognized that for the CBEP to be effective, it must concentrate its efforts in a few areas.

These may not be the only issues the CBEP addresses but they are the issues it will address first. Once action plans are developed and implementation is underway, the Project may identify and address other issues. This approach of identifying problems and addressing them in succession will mean the CCMP must become a "living" document, one that is updated, added to, and revised.

Assuring public input

Though the Management Committee represents a diverse group -- state and federal agencies, industry, citizen groups, local government officials, and scientific and education institutions -- the members realized that public participation was vital to the success of the Project and the development of the preliminary CCMP. This section outlines the process used to identify priority issues and develop the preliminary CCMP.

Joining the National Estuary Program

Casco Bay was accepted into the National Estuary Program in April, 1990. That summer the organizational structure was developed and committees were formed.

In November, 1990, a public forum was held in Brunswick. The forum had three goals: 1) educate participants about issues facing Casco Bay; 2) allow participants to hear what other citizens think the important issues are; and 3) develop a list of priority issues.

Over 120 people attended the forum. The day began with talks by experts on issues affecting the Bay. Participants then broke into small groups to brainstorm about these issues. The issues were sorted into three categories: 1) problems that should be addressed; 2) actions that need to be taken; and 3) questions that need answering. Over 75 different items were listed.

People attending a public forum in November, 1990 identified 75 issues affecting Casco Bay.

After reviewing the lists from all groups, each small group reconvened to discuss which of these 75 issues were most important. The day ended with an informal "vote," with each participant voting for the two issues they felt were most important. The issues most widely viewed as important were:

Problems:
Toxic waste, such as PCBs and oil pollution
Balancing economic development with environmental protection
Lack of enforcement

Nutrients
Bacteria
Combined sewer overflows (CSOs)

Actions:
Educate the public
Include the Kennebec River in project
Develop baseline data
Step up enforcement

Questions:
What is the extent of contamination by heavy metals and PCBs?
What are the flows and currents in the Bay?
What is the nutrient carrying capacity of the Bay?
Who has existing data?

First year workplan

The first year workplan addressed the issues of concern identified by the public and included research projects, public awareness activities and demonstration projects.

Early in 1991, the workplan for the first year was developed with the help of the three advisory committees. Many of the issues raised at the forum were addressed in the projects in the workplan. For example, one project was designed to determine the contaminant levels in sediments of Casco Bay. A second study sought to determine the currents and flushing rates in Casco Bay, including determining the influence of the Kennebec River on the Bay. Existing data was not only to be collected, but put on a computer mapping data base that presents the data in a visual format that can be used by a wide variety of people. Finally, a significant portion of the workplan was devoted to developing a public outreach strategy to raise awareness about the Project and the issues facing Casco Bay.

As part of this workplan the Management Committee identified three broad priorities for the first year of the project. These were:

> A need for more information so that specific issues and problems can be prioritized. This includes gathering and analyzing existing information and gathering some new data.
>
> A need to involve a broad spectrum of people and interests in the Project. This involvement is necessary in order for credible and effective actions to be developed.
>
> A need to focus on activities and needs at the local level. This reflects the realization that many of the efforts that are likely to be undertaken will depend on efforts undertaken at the local level.

Priority Issue Identification

The Management Committee developed a mission statement and then undertook a process to identify priority issues.

The Management Committee recognized that to be effective, the Project had to limit the number of issues to work on at one time. After completing the first year workplan, the Management Committee attempted to identify a set

of priority issues for the CBEP. However, a problem emerged about how to define issues -- should the priorities be set based on the sources of pollution, the impacts of the pollution, or the types of pollution. Each approach had limitations and none was adequate to handle the numerous interrelations that exist among issues.

With the approach of 1992, the need to set priorities became acute. The Management Committee was scheduled to develop the preliminary CCMP, by that September. In addition, the Committee wanted to identify priority issues in time to use them to develop the second year workplan.

A more structured priority-setting approach was undertaken. The first step was the preparation of six issue papers. They ensured that all members of the Management Committee had an understanding of the issues and their interrelationships. The topics of the issue papers were: toxics; pathogens; nutrients; depletion of marine resources; habitat loss and alterations; and aesthetics.

The papers defined each issue; discussed the known impacts of the issue in Casco Bay; explained its effect on the ecology and human uses of the Bay; identified typical sources of the pollution or problem and mitigation strategies available to address them; and described the existing efforts in place to address the issue.

After receiving and discussing the issue papers, the next step was the development of a formal mission statement (see page 1). The mission was designed to set the broad mandate for the program. Once the mission was set, the Management Committee developed a list of potential threats to Casco Bay and the criteria by which to judge them. The list contained 21 potential threats (hereafter referred to as issues) that included a mix of categories of pollution sources and activities that threaten the Bay.

A list of 21 threats or potential threats to Casco Bay were identified and ranked using 12 criteria.

The Committee ranked each issue as high, medium or low on 12 criteria. The criteria were:

1) Existing or potential impact on the ecosystem of Casco Bay.
2) Existing or potential impact on the economic resources of the Bay.
3) Existing or potential impact on public use of the Bay.
4) Whether existing efforts addressing the issue are inadequate.
5) Whether the CBEP could make a positive contribution to the issue.
6) Whether there could be immediate action taken to address the issue.
7) Whether addressing the issue would lead to a greater understanding of the Bay.
8) Whether the efforts to address the issue could be replicated in other areas.
9) Whether the efforts to address the issue could be precedent setting.
10) Whether the issue fit within the CBEP mission.
11) Whether the issue was of strong public concern.
12) Whether public involvement was required to address the issue.

The ranking of issues by these criteria resulted in the emergence of a set of priority issues. The results were reviewed and adjusted by combining similar issues and by making sure no major omissions had occurred. The result was the selection of five priority issues.

This narrowing of issues to five priorities was a difficult process. The Management Committee recognized that all 21 issues were important to maintaining the health of the Bay. However, the Committee realized only a few issues could be adequately addressed at one time.

Five priority issues were identified. A goal statement was developed for each issue.

The five priority issues were turned into goal statements. They are:

> To promote environmentally appropriate use and development of land and marine resources.
>
> To minimize environmental impacts from stormwater runoff and combined sewer overflows.
>
> To minimize adverse environmental impacts of individual wastewater systems.
>
> To determine the effect of existing sediment contamination on the health of Casco Bay.
>
> To promote responsible stewardship of Casco Bay and its watershed through increased public involvement.

Second Year Workplan

After the priorities were set, the second year workplan was developed. The workplan addressed both the new priorities and many of the issues raised at the first public forum.

The second year workplan included a study of nutrients and pathogen loadings to a small embayment in Casco Bay in order to identify the most important sources of each pollutant (including stormwater, septic systems and overboard discharges) and determine the nutrient carrying capacity of the embayment. Another study follows-up on the first year sediment work, studying historical trends of sediment contamination.

The workplan also continued the public awareness program and funded a volunteer monitoring program to involve citizens in measuring the health of the Bay. Since many of the issues involved in the priorities are under the jurisdiction of local governments, a major effort to provide information and technical assistance to local governments was included. Another study in the second year will examine the economic value of Casco Bay to local municipalities.

Public feedback on the priorities

The priority issues were taken to a public forum in April, 1992 to get additional feedback.

On April 11, 1992 the CBEP held a second public forum in Brunswick to get feedback on the five priority issues. Despite a spring snow storm, 30 - 40 people met to discuss the issues. Those present heard a summary of the priority setting process and attended small group discussions on the issues. Management Committee members were present to discuss how and why the priorities were selected and an expert in each field answered technical questions about the issue.

Developing Objectives

After the priorities had been set, the next step was to focus the goals into more specific objectives. The Committee agreed that each objective should contain the impact that was of most concern (the priority issues often had more than one impact) and one or two approaches that should be used to address the impact. This process resulted in the objectives that are included in the action plans in this preliminary CCMP.

Developing Action Plans

Technical experts met to brainstorm lists of possible actions to address each priority issue.

Having developed goals and objectives, the Committee then began developing action plans. The first step was to give each goal and objective to an "expert roundtable" composed of people from federal, state and local governments and research institutions who deal with the issues on a regular basis. Each goal and objective had its own roundtable. Participants of the roundtables brainstormed lists of possible actions and identified those that they felt were most important.

The Management Committee reviewed the results of the roundtables, reduced the number of actions, focused the actions more narrowly, and adjusted the priority of the actions. The action plans were structured to include a brief discussion of existing efforts underway, a series of short term actions, and discussion of future directions. The future directions point to where the Committee thinks the actions should end up. The final recommendations, however, will depend on the outcome of the existing efforts and short-term actions.

Focus Groups

Groups of people representing eight different interest groups provided feedback on the draft action plans.

The draft action plans were taken to a series of focus groups. Each focus group was composed of people representing a particular interest that has a stake in the issues addressed in the action plans. The people asked to participate in the focus groups were identified by the Citizens Advisory Committee. The eight stakeholder groups were:

Waterfront organizations and industry
Homeowners, septage haulers and plumbers
Fishing community, clam diggers, and marina owners and operators
Real estate and land use, including brokers and contractors
Local elected officials and planning board members
Municipal government staff
Environmental advocates
Farmers and foresters

The participants in each focus group reviewed the two action plans of most interest to their group. Each group responded to three questions: 1) Are the future directions outlined in the action plans appropriate; 2) will the actions achieve the stated goals and objectives; and 3) what opportunities and barriers exist for the implementation of the action plans.

The comments of the focus groups included suggested changes to the action plans and more general comments about environmental protection issues. However, six overarching themes emerged from the comments that cut across all the groups and issues discussed. These six themes are:

Regulatory overload - People are overwhelmed by the maze of environmental regulations. The regulations are often unfairly applied and the people who try to comply have more trouble than those who ignore the rules.

Cooperative approach - Government should be less adversarial and more supportive of people who are trying to protect the environment and play by the rules. There needs to be technical help on environmental and regulatory issues.

Bottom-up approach - It is important to involve a broad range of people in the information gathering, priority setting and decision making which accompanies environmental protection. These efforts should not be restricted to only local, state and federal governments.

Economic and taxes - There is a need to demonstrate the cost effectiveness of protective measures, the economic value of protection and the true costs of development. Current tax policies often drive unwise development and should be changed to provide the correct incentives.

Logical Approach - Government should mandate goals and provide a list of options of how to achieve the goal rather than mandating the use of a specific option. This would allow the most practical approach to be used in a given situation. Resources for environmental protection should be targeted to address the most important concerns and achieve the biggest impacts.

Public education - There was almost universal agreement that education is one of the most important ways to protect the environment. In particular, working with schools to teach children was seen as the best long-term protection measure.

The comments from all the groups, and the overarching themes, were taken to the Management Committee for review. The Committee revised the action plans based on the comments, including some major revisions, such as reworking the objectives of two of the action plans to clear up inconsistencies. These revised action plans were then taken to a public forum for additional input.

Public Forum

People attending a public forum in October, 1992 provided feedback before the preliminary CCMP was released.

A public forum was held on October 10, 1992 in Portland to allow a broader public discussion of the action plans. Over 60 people attended and participated in small group discussions about two action plans of their choice. The comments from these small groups were brought back to the Management Committee for review, revision, and approval of the preliminary CCMP for release.

III. BACKGROUND

This section describes the physical setting and living resources of Casco Bay. To the extent possible, the living resources are described in the habitat type that they characteristically inhabit. Many animals, however, use different habitats to meet the critical life needs such as breeding and winter feeding. Habitats that provide these critical functions are described also.

PHYSICAL CHARACTERISTICS

Casco Bay is 229 square miles in size, has 578 miles of coastline and 758 islands and ledges. Its watershed covers 985 square miles and goes as far inland as Bethel.

Casco Bay extends from Two Lights at Cape Elizabeth on the west to Cape Small in Phippsburg on the east, a distance of 20.43 miles. The Fore and Stroudwater Rivers, the Presumpscot River and the Royal River are the principal rivers flowing into Casco Bay. There are numerous lakes, rivers and streams in the Casco Bay watershed. The watershed covers 985 square miles and extends 60 miles inland to Bethel. The second largest lake in Maine, Sebago Lake, is in the Casco Bay watershed. There are 39 cities and towns and one unorganized township (hereafter referred to as towns) in the watershed.

Casco Bay is 229 square miles in size and has 578 miles of shoreline. There are 758 islands and ledges above the high tide line. A number of the islands have year round residents and a larger number have seasonal residents. Many islands and ledges are uninhabited by humans and serve as home for a variety of waterbirds and seals.

The coastal landscape in Casco Bay reflects its geological history. Over the past 400 to 500 million years, volcanic eruptions, the collision of continents, erosion, glaciers followed by sea level rises and dislocation of river drainages have resulted in the geologic features now present in the Bay (for a brief geologic history and a description of a self guided field trip refer to Dr. Joseph Kelley's article in the Maine Audubon's Habitat journal, June, 1992).

LIVING RESOURCES NEEDING PROTECTION

The nomination to the U.S. Environmental Protection Agency's National Estuary Program stated that Casco Bay is nationally significant because:

1) it has a highly productive invertebrate (animals without backbones) population that supports large numbers of fish, seals and birds,

2) it supports a diverse assemblage of invertebrates and birds,

3) it provides nesting areas for the endangered least and roseate terns, and

4) it provides nesting areas for two species of special concern, the common and Arctic terns.

Casco Bay provides critical food, cover, migratory corridors and breeding and nursery areas for a diverse group of living resources. The wide variety of habitats available in Casco Bay, both on land and underwater, results in a large number of animals and a high species diversity for both birds and marine invertebrates.

One reason Casco Bay is an estuary of national significance is that it is at the northern edge of the breeding range for many southern species and the southern edge of the breeding range for many northern species.

Casco Bay is at the northern edge of the breeding range for many southern marine invertebrates and birds and at the southern edge of the breeding range for many northern or boreal birds and some invertebrates. Therefore, high numbers of species are present at this zoogeographic transition zone.

Casco Bay provides certain habitat requirements that are suitable for such a diverse population of animals. These habitat requirements include sufficiently high water quality to support marine life. This clean water supports a healthy marine invertebrate population that provides essential food for birds and many fish. Birds also rely on the availability of fish for sustenance. Seals require large amounts of fish to sustain their populations. An important aspect of preserving the ecological integrity of Casco Bay is providing an environment that allows for the continued existence of these diverse living resources through protection of habitat and water quality.

Clams, lobsters, marine worms, crabs, sea urchins, mussels, scallops, fish and seaweed are the commercially and recreationally important resources in the Bay. Seals and visiting whales add to the diversity of animals in the Bay.

The significant habitats in Casco Bay and use by important animals or groups of animals are described on the following pages. Sections include subtidal waters, flats, eelgrass beds, mussel bars, salt marshes, freshwater wetlands, edge zones and rivers and streams. The integrity of these habitats is critically important to the well being of Casco Bay.

The specific information on invertebrates described below is from Verrill (1874), Kingsley (1901), Fefer and Shettig (1980) and Larsen et al. (1983). Information for marine birds and mammals is from Casco Bay Coastal Resources Inventory (Hutchinson and Ferrero, 1981), the Ecological Characterization of Coastal Maine (Fefer and Shettig, 1980) and the Maine Audubon Society (personal communication).

SUBTIDAL WATERS

Subtidal waters are areas that are always covered by the ocean. The habitat provided by subtidal waters includes the ocean floor, the surface of the ocean and the water itself.

Marine Invertebrates

Subtidal waters are the primary habitat for a broad range of marine invertebrates. In Casco Bay, there are two basic types of bottom habitat: rock and sediment. Kelp, lobsters, Jonah crabs, sponges and sea urchins principally live on rocky habitats; while rock crabs, European oysters, scallops and a variety of marine worms prefer a sedimentary habitat. Shrimp migrate inshore from the Gulf of Maine in the winter to breed. They prefer a sedimentary habitat when they are on the bottom.

Casco Bay's two primary subtidal habitats, rock and sediment, are ideal for marine invertebrates such as lobsters, Jonah crabs, sponges and sea urchins.

Casco Bay has ideal habitat for lobsters, Maine's most important commercially fished species. During the summer months, lobsters prefer ledge and rocky bottoms near rocky shores and islands. They also prefer high salinity waters. Casco Bay, with its hundreds of islands, rocky bottoms and shores, and high salinity waters, provides all the preferred habitat requirements for lobsters.

In the mid 1800's, Casco Bay was a popular place to collect marine invertebrates for museum collections. The famous marine biologist, A.E. Verrill, collected marine invertebrates in numerous locations in North America. In 1873, he and his colleagues used Peaks Island in Casco Bay as a base for collecting marine invertebrates throughout the Bay. The following are excerpts from Verrill's description of marine invertebrates in Casco Bay:

> "There is great diversity in the character of the bottom and here a large amount of profitable dredging has been done" (i.e., these collectors found a large variety of species).
>
> "Most of the species are decidedly boreal and arctic forms, which we had previously dredged in the Bay of Fundy and further north."
>
> "There is considerable diversity in the character of the fauna in different parts" (of the Bay).
>
> "The deeper localities have a very northern fauna, similar in many respects to that of the deeper outer water; while the shallow localities, especially in the inner harbor of Portland and in Back Cove, have less northern fauna and even yield a few decidedly southern forms."

Marine biologists in the late 19th and early 20th century noted that Casco Bay was extremely rich in the number of different species and the total number of organisms.

In the early 1900's, marine biologist, J. S. Kingsley, established a biological field station in South Harpswell and collected marine invertebrates throughout Casco Bay. Kingsley noted that conditions in Casco Bay "are favorable for the development of marine life" and that "Casco Bay is nearly as rich in species as is the southern coast (i.e. Vineyard Sound, Massachusetts) while in individuals it is vastly richer, as has been noticed by everyone who collected in the two regions."

The diversity and richness of marine invertebrates in the outer parts of the present-day Casco Bay appear to be similar to observations made in the late

1800's and early 1900's. A 1980 survey of marine invertebrates living in the sediments of Casco Bay by Larsen and colleagues yielded 264 species compared to 173 species found by Verrill in the same type to habitat. In fact in a single one foot square grab sample in outer Casco Bay, there were 86 species. The total number of different species of marine invertebrates found in Casco Bay is at least 850. When densities reported in the 1980 survey are compared to other studies in the world, it appears that much of Casco Bay is highly productive.

One of the localities where Verrill collected in Casco Bay was Quahog Bay in Harpswell. He found the area to be interesting zoologically because of the number of southern species present in this shallow sheltered cove. He considered these species to have a remarkable distribution because they are completely isolated from their co-species on the southern coast of New England and surrounded on both sides by more northern forms. Some of these southern species still occur in the upper reaches of shallow bays in the Brunswick and Harpswell area.

Other areas in Casco Bay may have isolated pockets of Virginian oysters. There is evidence that one of these pockets of oysters used to be in the Fore River. These isolated populations are particularly sensitive because they cannot draw on the larger population for replenishment when their populations become reduced because of natural cycles caused by pollution or disturbance.

Fish

The numerous shallow protected coves in Casco Bay provide perfect spawning habitat for fish that deposit eggs on the bottom.

Thirty-six species of finfish are common residents in Casco Bay. The most common species found year round in the Bay is winter flounder. Bottom feeders are the most abundant fish in the Bay and include winter flounder, pollock, sculpin, skate and cod. These fish feed on the diverse and plentiful supply of marine invertebrates including small bottom-dwelling clams, marine worms and shrimp-like animals. The numerous shallow protected coves in Casco Bay provide perfect spawning habitat for fish that deposit eggs on the bottom. These fish include sculpins, winter flounder, rock gunnel, tomcod and skate.

The Atlantic herring, alewife, Atlantic menhaden (pogy), American sand lance and Atlantic shad live in the water column and feed on microscopic plants and animals. Bluefin tuna, the hakes, spiny dogfish, bluefish, Atlantic mackerel and striped bass are important summer visitors to Casco Bay. Alewife, rainbow smelt, shad and possibly salmon pass through Casco Bay on their way to rivers to spawn.

Waterbirds

Waterbirds include seabirds, shorebirds, wading birds and waterfowl. Cape Elizabeth in Casco Bay is the boundary for two zoogeographic regions for waterbirds: the boreal zone and the northern temperate zone. The result is that a wide variety and unusual aggregation of marine birds occur in Casco

Bay. Approximately 150 species of waterbirds inhabit Casco Bay, 100 of which are regularly occurring. The number of waterbirds in Casco Bay varies seasonally from approximately 4,600 to over 32,000. There are three peaks: in October during fall migration, during January when approximately 32,000 birds are wintering in Casco Bay and in February and March during spring migration.

Water birds use open water for feeding, molting, migrating and wintering. The endangered least tern nests on beaches north and south of Casco Bay and uses the Bay for feeding.

The number of waterbirds in Casco Bay varies between 4,600 to over 32,000, depending on the season. The peak months are: October, January, and February-March.

Casco Bay supports one of the most important winter waterfowl populations on the Maine coast. American eiders, king eiders, black ducks, mallards, common goldeneyes, Barrow's goldeneyes, buffleheads, great scaups, white-wing, surf scoters, black scoters, old squaws, red-breasted mergansers, common mergansers, harlequin ducks, brant, green-winged teal, blue-winged teal, Canada geese and snow geese are common in the Bay. American eiders (referred to hereafter as eiders) are the most common waterfowl in the bay. Larger numbers of eiders, goldeneyes, black ducks and buffleheads winter in Casco Bay than in other regions of coastal Maine because of the abundance of waterfowl food present. Back Cove in Portland is an important winter feeding area for black ducks.

Two species of loon and three species of grebe are winter residents in Casco Bay, and a few non-breeding loons remain in the Bay year round. The horned grebe and the common loon are the most common of the five species wintering in the Bay. The maximum number of wintering loons is approximately 200 individuals, and the maximum number of grebes is approximately 400 individuals. Loons and grebes live singly and in small groups throughout Casco Bay.

Bonaparte's gull and the ringbilled gull are the principal migratory seabirds found in Casco Bay. Flocks of a few hundred ringbilled gulls use the Fore River and Back Cove year round. Bonaparte's gulls also use the Bay year round, although their numbers are lower than the ringbilled gulls. Laughing gulls occasionally use in Casco Bay in the summer.

Several raptors, including osprey and the endangered bald eagle, use open water areas of the Bay for feeding.

Marine Mammals

Approximately 600 - 650 seals live in Casco Bay year round. Humpback, killer, beluga and sperm whales migrate through the waters off Casco Bay.

The harbor seal is the principal seal found in the open waters of Casco Bay. There have been sightings of gray seals in the Bay. Approximately 600-650 seals live year round in Casco Bay.

Whales principally migrate through the waters off Casco Bay. Sightings in the Casco Bay area include the endangered humpbacked whale, the killer whale, the beluga and the sperm whale. Harbor porpoises migrate into Casco Bay in the summer. The common dolphin and the striped dolphin

occasionally use Casco Bay.

Seals and whales use the subtidal waters for feeding. Large amounts of fish are consumed by seals and most whales. Each seal consumes approximately 2500-3000 pounds of fish per year. The basic diet for most of the year for seals is flounder and hake; two common fish found in Casco Bay.

ISLANDS

Casco Bay contains 758 islands or ledges that are exposed at high tide. Islands are important habitats because they provide large intertidal areas for feeding as well as upland areas for nesting for waterbirds. Seals use rocky ledge islands (known as "haulouts") for breeding, resting and sunbathing.

Waterbirds

Islands are important to sustaining seabird populations because they provide protection from predatory animals and human disturbance.

The uninhabited islands of Casco Bay and other uninhabited islands along the coast of Maine support the largest breeding populations of double-crested cormorants, eiders and black guillemots on the east coast of the United States. Islands are important to the continued viability of seabird populations in Casco Bay because islands provide protection from predatory animals and human disturbance and are closer to feeding areas.

Seabirds which live and breed in the Casco Bay area include: double-crested cormorants, great black-backed gulls, herring gulls, eiders, least terns, roseate terns, arctic terns, common terns and black guillemots that are on the southern extent of their breeding range. The endangered roseate tern recently nested on Clapboard and Nubbin Island in Casco Bay. The Bay has 50 seabird nesting islands of which 17 support significant populations of nesting birds (defined by wildlife biologists as greater than 1% of a species population). The 17 major nesting colonies are inhabited by approximately 15,000 nesting pairs of eiders, herring gulls, great black-backed gulls and black guillemots. These birds are year-round residents of Casco Bay.

The numbers of common terns are reduced today in Casco Bay because they are outcompeted by great black-backed and herring gulls. A recently enacted tern restoration program at Jenny Island in Casco Bay has resulted in the restored colony of common terns. The number of birds tripled between 1991 and 1992. Seven endangered roseate terns were also seen on Jenny Island in July, 1992.

Other types of birds use islands for habitat also. Breeding colonies of wading birds including the great blue heron, the snowy egret and the black-crowned night heron use three islands in Casco Bay. One of these, Upper Goose Island, recently contained the largest number of nesting great blue herons in Maine.

Approximately 300 pairs of snowy egrets, glossy ibises and black-crowned night herons use one island just south of Casco Bay. Southern Maine, south

of Casco Bay, is the northern limit for the little blue heron, Louisiana heron and the glossy ibis; however, their limit of breeding is extending northward. Maine is also the northern limit for breeding by snowy egrets.

Ledges and bars associated with the outer islands provide important ice-free wintering areas for eiders, scoters and old squaws. Migratory brant use these areas in the spring. Landbirds, shorebirds and geese also use islands during the migration season.

Until the 1960's, the endangered bald eagle nested in Casco Bay. No nesting has been observed in the Bay since that time. In the winter, bald eagles use Casco Bay for feeding. An estimated 50 pairs of osprey nest in Casco Bay, principally in the northern part of the Bay. The endangered peregrine falcon uses Casco Bay during migration occasionally.

Marine Mammals

The 45 seal haulouts in Casco Bay are used for resting, sunning, feeding, breeding their young and socializing.

There are 45 seal haulouts in Casco Bay. Areas used by seals as haulouts are either small islands without terrestrial vegetation that have some areas exposed at high tide or half-tide ledges that are under water at high tide. Other factors that make sites suitable for haulouts include ledges with gentle slopes, dense seaweed cover and deep water around the sites for quick escape, even at low tide. Haulouts are critical to the lives of seals. These sites are used for resting, sunning, feeding, breeding their young and socializing. Seals tend to use haulouts exposed to wind and wave action for feeding and socializing and more sheltered haulouts during molting, mating and bearing their young. The numerous ledges in Casco Bay provide both types of haulouts. The group size at the haulouts varies from one to greater than 100, with a mean of 31 seals.

FLATS

Flats are the most characteristic intertidal habitat in Casco Bay. The flats form in relatively sheltered bays and are principally mud or sand. Flats are especially important environments because they support a rich animal community including the commercially harvested clams, sandworms and bloodworms. Flats are also home for the Baltic clam, green crabs, numerous tiny worms and shrimp-like animals (amphipods). The flats in the Brunswick and Harpswell area also have southern species such as quahogs that are completely isolated from their counterparts in southern New England.

Shorebirds, waterfowl and wading birds feed on flats and the creeks and shallow subtidal areas near flats. The great blue heron, the snowy egret, the black-crowned night heron and the glossy ibis are the common wading birds found feeding on flats and in wetlands in the summer. The extensive tidal flats and associated mussel bars and eelgrass beds in Casco Bay help provide the winter food supply for waterfowl. Flats are essential for shorebird feeding (discussed below).

Shorebirds

There are five locations where large numbers of migrating shorebirds congregate: two in the Fore River, one in Back Cove, and one each in Maquoit and Middle Bays.

The Maine coast is an important resting and feeding area for migrating shorebirds including sandpipers, plovers, turnstones, godwits, curlews, dowitchers and phalaropes. Thirty-three species of shorebirds are common along the Maine coast. As many as 500,000 semipalmated sandpipers, which is approximately 10% of the total population of semipalmated sandpipers, migrate along the coast of Maine. Tens of thousands of migrating semipalmated plovers, short-billed dowitchers, black-bellied plovers and ruddy turnstones also use the Maine coast.

Intertidal mudflats are critical for feeding while nearshore ledges and sand and gravel beaches or spits are important roosting areas. Casco Bay has numerous locations that are appropriate for both feeding and roosting. The shorebirds feed on marine invertebrates and favor the shrimp-like amphipods.

There are five locations in Casco Bay where large numbers of migrating shorebirds congregate to feed. Three locations are near downtown Portland, two in the Fore River Estuary and one in Back Cove. The two other feeding locations are in the upper reaches of Casco Bay, Maquoit and Middle Bays in Brunswick. The most popular feeding area is Back Cove where up to 5,000 semipalmated plovers, black-bellied plovers, ruddy turnstones, yellowlegs, least sandpipers, dunlins, short-billed dowitchers and semipalmated sandpipers congregate to feed. The other four locations attract fewer birds (500-2,500) and represent fewer species than are found in Back Cove.

EELGRASS BEDS

If conditions are favorable, eelgrass grows on intertidal and shallow subtidal flats. Once the eelgrass becomes sufficiently dense, it provides protection for fish, shellfish and other animals. In addition, eelgrass beds are very important substrates for attachment of plants and animals which in turn are food for ducks and geese. These beds are also important in reducing current velocities thus trapping sediments leaving and entering flats. Eelgrass beds provide an important three dimensional habitat for animals living in the sediments, plants and animals living attached to the eelgrass plants and for fish living between the grasses.

MUSSEL BARS

Mussel bars form in association with mudflats. The formation begins with a dense set of mussels on stones, shells or other debris. Once the first mussels become established other mussels attach to them. The mussel bar becomes a habitat itself and is home to a wide variety of animals. Eiders and black ducks use mussel bars for feeding. Mussel bars tend to be ephemeral and are subject to damage or destruction by storm waves and floating ice.

Mussels are abundant throughout Casco Bay in the intertidal and shallow subtidal areas. They are particularly abundant and grow to marketable size quickly in areas that have good circulation of water.

SALT MARSHES

Salt marshes are productive elements of coastal areas worldwide. Casco Bay, unlike areas south along the Atlantic Coast, does not have numerous expansive salt marshes. However, significant areas of salt marsh exist around sheltered flats and these marshes are extremely productive areas.

The wide variety of organisms found in and around salt marshes provides evidence of their high productivity. Ribbed mussels protrude from the small fringe marshes. Small fish feed in the marsh during high tide. Wading birds and larger fish prey on these small fish. Muskrats feed on marshgrass and use the grass blades to construct their mounded homes. Red-winged blackbirds and sharp-tailed sparrows consume marsh grass seeds. The intertidal flats along the edge of the creeks harbor animals similar to those in the flat habitat. The creeks provide cover and food for black ducks and mallards.

Salt marshes act as a filter for stormwater flow from upland developments and help to regulate nutrient flow to adjoining waters. Marshes also act as giant sponges during storms that help to reduce damage from flooding.

FRESHWATER WETLANDS

Freshwater wetlands aid in controlling floods, recharging groundwater supplies, regulating nutrients and maintaining streamflows.

Freshwater wetlands include marshes, bogs and wooded swamps. They are valuable because they aid in controlling floods, recharging groundwater supplies, regulating nutrients and maintaining minimum stream flows. Many species of reptiles, amphibians and wildlife depend on freshwater wetlands during certain phases of their life cycle. Approximately 100 species of birds breed in freshwater wetlands and some breed only in wetlands. Forested wetlands are especially important for the hole-nesting wood ducks and mergansers. All the habitat requirements for muskrats are found in freshwater wetlands. Forested wetlands provide important winter habitat for deer. Other wetland users include red fox, moose, raccoon, mink, otter, black bear and beaver.

EDGE ZONES

The riparian (streambank) zone and the 578 miles of edge habitat next to the shoreline of Casco Bay are important links between the terrestrial (land) ecosystem and the wetlands or water. Many species of birds and mammals use these areas for shelter, feeding and nesting or raising young. This

riparian or edge habitat protects the abundant and diverse species that use the adjacent open water. These habitats also act as filters for stormwater and groundwater flow from upland development.

RIVERS AND STREAMS

The numerous rivers and streams in the Casco Bay watershed serve as important habitat for resident and anadromous fishes as well as waterbirds, muskrats, beavers and otters. Anadromous fish such as alewife, smelt, shad and possibly salmon travel from Casco Bay upstream to freshwater to spawn. Important resident recreational fish in the rivers and streams include several species of trout, perch, pickerel and bass. The landlocked salmon, a prized recreational fish, lives in Sebago Lake and spawns in the upper Casco Bay watershed.

USES

Casco Bay is used for a variety of purposes including commercial fishing, commerce, tourism and recreation and waste disposal. In the past, the bird colonies in the Bay were almost eliminated by overharvest and disturbance. The area surrounding Casco Bay is used for residential living. The following section describes the many uses of the Bay.

COMMERCIAL FISHERIES

The commercial and recreational harvest includes many species that inhabit Casco Bay. The value of total fish and shellfish landings for Cumberland and Sagadahoc County was $47 million in 1990 (Department of Marine Resources); however, actual landings may be 10-33% higher because direct sales to restaurants and the public are not part of the landings value.

In 1990, the value of total fish and shellfish landings for Cumberland and Sagadahoc counties was $47 million. The actual landings may be 10-33% higher because of direct sales that are not part of landing values.

The Portland Fish Exchange, located on the Portland waterfront, is the only fish auction north of Massachusetts. The catch landed is principally from the Gulf of Maine; although some is from Casco Bay. The specific information on commercial and recreational marine resources described below is from Card (1980), Fefer and Shettig (1980) and the Department of Marine Resources.

Lobsters

Nationally, people associate lobsters with Maine. Thousands of lobster traps are present throughout Casco Bay. The landings of lobsters in Cumberland County is approximately 20% of Maine's landings. The lobster season is from April to November, with peak fishing from August to October.

Clams

There are approximately 200 shellfish harvesters in Casco Bay. The reported harvest each year over the past decade ranged from 27,000 to 61,000 bushels. To keep a sustained harvest, it is necessary to transport seed or juvenile clams from flats where they are over-abundant to flats where the clam densities are low.

Marine Worms

Commercially harvested marine worms include sandworms and bloodworms. Sandworms are the principal marine worm found in Casco Bay. Bait for the recreational fishery along the east coast of the United States relies, in part, on marine worms from Maine.

Crabs

One-quarter of Maine's crab landings is from the Casco Bay area. The fishing season for crabs is from mid-April through October, with a peak in May and a secondary but smaller peak from September through October. Most of the crab catch is incidental to the lobster catch; however, there are a few full time crabbers.

Mussels

The mussel harvest is principally in the winter, from October through April, when the threat of contamination by red tide is low. Harvest methods for mussels include dragging with a modified scallop drag or pitching them into skiffs by hand. Dragging is the principal method used in Casco Bay.

Scallops

There is a limited scallop fishery in Casco Bay. Scallops live in beds or groups and their populations vary dramatically from year to year. Four percent of Maine's landings come from the Casco Bay area. Lobstermen do the majority of scalloping by converting to scallop dragging in winter during the slack time for lobster fishing. The state regulates the scalloping season. The season extends from November 1 to April 15. Recreational scallopers also harvest scallops by diving for them in Casco Bay.

Sea Urchins

Sea urchins, which live on the rocky subtidal bottoms of Casco Bay, are a relatively new commercial species.

Sea urchin harvesting is a relatively new commercial activity in Maine. In Casco Bay, there are indications that there may be limits to the sustained productivity of the resource at present. The market for sea urchins is almost completely for export to Japan. Sea urchins live subtidally on rocky bottoms and graze on seaweed.

Fish

A commercial fishery exists for herring and menhaden (pogies) in Casco Bay periodically. Herring catches in the Bay have varied annually from none to over 100,000 bushels. Menhaden catches also have been variable; however, the catch has increased in recent years. Both herring and menhaden are schooling fish. Seals and whales follow and prey upon schools of herring. Bluefish prey upon schools of menhaden. The bluefish is an important recreational sportfish.

In Casco Bay, recreational fishing is important aspect of the value of the Bay. Recreational sportfish in Casco Bay include mackerel, pollock, flounder, haddock, cod, bluefish, striped bass, and bluefin tuna. Fishing from piers, bridges and boats is a popular summertime recreational activity in Casco Bay.

COMMERCE

Portland is Maine's largest shipping port, handling petroleum, bulk cargo and passenger travel.

The port of Portland in Casco Bay is Maine's largest shipping port. The Greater Portland area surrounding the port is the largest center of business and industry in the state. The port of Portland handles a variety of goods including petroleum, bulk cargo (coal, salt, etc.), bagged cargo and packaged bulk cargo. Petroleum shipments are by far the largest percentage of cargo being off loaded in the port. From the 1960's into the 1970's, Portland was the second largest oil handling port on the East Coast. The reduction in oil handling since that time has resulted from Canada's reduced need for oil piped from Portland to Canada by Portland Pipeline Company. This company pipes oil from Portland to refineries in Montreal, Quebec. Recently, Portland Pipeline announced plans to increase their cargo handling in the future.

Bath Iron Works is another user of the port of Portland. The large dry dock facility on the Portland waterfront refurbishes large military vessels.

Eleven private cruise lines plus the ferries of Casco Bay Lines take numerous passengers on trips across and around Casco Bay. In recent years, approximately 15 cruise ships carrying 7,000 - 12,000 passengers have stopped in Portland each summer. The cruise ship, Scotia Prince, provides an important link between the port of Portland and Yarmouth, Nova Scotia. The Scotia Prince operates from May to October and at peak season arrives and leaves the port of Portland every night.

The port of Portland is important to the many island residents who principally rely on the services of Casco Bay Lines to provide their link to the mainland.

TOURISM AND RECREATION

The economy of the Casco Bay region is more service based than industry based. Tourism and recreation are a major part of the service sector economy and in the most recent estimate (1986-88), they contributed a total of over $250 million to the Greater Portland and Bath-Brunswick region.

Casco Bay is an excellent area for recreational boating; both sail and power. There are approximately 1,900 slips in 19 marinas and 3,400 moorings controlled by the towns. Residents and tourists use Casco Bay for bird watching, sightseeing, windsurfing, sea kayaking, recreational fishing and hunting.

The increased use of Casco Bay for recreation has resulted in increased concerns about water quality in the Bay.

RESIDENTIAL LIVING

The Department of Economic and Community Development examined population and housing trends in the lower Casco Bay watershed (Risser et al., 1992). The following observations were made:

Population growth in the 1970s and 1980s was concentrated in rural and suburban communities.

The population in the 24 towns in the lower Casco Bay watershed increased by 11.2% in the 1970s and by 11.4% in the 1980s.

The distribution of population growth that took place during the 1970s and 1980s was not even throughout the watershed, but concentrated in the rural, suburban communities. Windham had the highest growth rate followed by Brunswick, Scarborough, Standish, Gorham, Buxton, Yarmouth, Gray, Harpswell, Poland and Freeport in descending order. Growth in these eleven towns accounted for 80% of the total growth in the 24 lower watershed communities. Portland and South Portland lost population during the same time.

Small communities had the most significant percentage increase in housing unit growth. The highest increase was in Durham (164%) followed by Buxton, North Yarmouth, Standish, New Gloucester, Yarmouth, Scarborough, Windham, Poland and Gorham (83%) in descending order.

Due to a drop in the number of persons per housing unit, the percentage of housing unit growth usually outpaced the percentage of population growth. In most communities, the percentage of housing growth was greater that the percentage of population growth on an average of two to one. However, in Gray, Harpswell, Poland, Standish and Windham percent population growth outpaced percent housing growth.

THE WATERSHED OF CASCO BAY - 40 TOWNS

TOWNS IN THE LOWER WATERSHED (24):

Coastal (12):
PHIPPSBURG
WEST BATH
HARPSWELL
BRUNSWICK
FREEPORT
YARMOUTH
CUMBERLAND
FALMOUTH
PORTLAND
SOUTH PORTLAND
CAPE ELIZABETH
SCARBOROUGH

Inland (12):
GORHAM
WESTBROOK
BUXTON
WINDHAM
STANDISH
POLAND
NEW GLOUCESTER
GRAY
AUBURN
DURHAM
POWNAL
NORTH YARMOUTH

TOWNS IN THE UPPER WATERSHED (16):

BETHEL
STONEHAM
ALBANY TOWNSHIP
GREENWOOD
NORWAY
WATERFORD
SWEDEN
DENMARK
HARRISON
BRIDGTON
NAPLES
RAYMOND
OTISFIELD
CASCO
SEBAGO
BALDWIN

WASTE DISPOSAL

In the last twenty years much has been done to eliminate point sources of pollution (licensed discharges). It is now estimated that over half of the remaining water pollution comes from nonpoint sources such as stormwater.

In the last twenty years, treatment plants were built to treat sewage and pulp and paper wastes. Overboard discharge units were installed in an attempt to treat wastes from shorefront properties. Before that time untreated wastes entered the Bay from sewers, industry and shorefront homes and cottages. Raw sewage still enters the Bay from some municipal sewage systems during storms, from malfunctioning overboard discharge units and at Peaks Island where a sewage treatment plant is being built. Much has been done to eliminate point sources (discharges that are licensed) of pollution from our waters, but further work needs to be completed to clean up and protect Casco Bay from further degradation.

Knowledge about the nature of pollution has changed in the last decade. It is now estimated that over half of the pollution comes from nonpoint sources such as stormwater runoff from parking lots, roads, fields and lawns. Increased scientific knowledge about pollutants combined with a greater public awareness about the environment has resulted in concerns about the ecological health of Casco Bay in recent years. Enhanced chemical analytical ability has allowed scientists to measure pollutants with greater precision and at lower levels than in the past. Our ability to understand the effects of pollutants on organisms and the ecosystem is improving. Exact cause and effect information is not available but the evidence is mounting that steps should be taken to protect Casco Bay before it is subjected to the severe problems being experienced in other bays and estuaries in the country.

There are signs of human impact on Casco Bay. The inner Fore River (upstream from Million Dollar Bridge) and an area off the mouth of the Presumpscot have greatly reduced numbers of species and individuals. Toxic pollution may be responsible for the altered community in the inner Fore River, although there is no proven source. Some of the worms and shrimp-like animals (amphipods) in the inner Fore River appear to have oil on their appendages. The area off the Presumpscot has deposits of sawdust that may not be a preferred habitat for animals.

HABITAT DISTURBANCE

Seabirds were not always as abundant in Casco Bay as they are today. In the late 1800's human exploitation and disturbance of nesting colonies resulted in dramatic declines in seabird colonies in the Bay. Birds nesting on islands were disturbed by grazing by sheep, introduction of pets, lumbering and construction. In addition, seabirds were hunted and their eggs were collected. These activities caused the elimination of breeding populations of double-crested cormorants, eiders, great black-backed gulls and black guillemots in Casco Bay and the rest of the Maine coast. The few remaining herring gull colonies that were not eliminated inhabited off-shore islands. Common terns declined in numbers but not to the extent of the other seabirds. Protection efforts in the early 1900's resulted in the recovery of most species. Habitat disturbance continues to be a concern to wildlife biologists as the human use of the Bay increases.

PRIMARY POLLUTANTS

Pathogens, toxics, nutrients and sediments have been identified as the primary pollutants of concern in Casco Bay. The following sections describe the pollutants and how they impact Casco Bay.

Pathogens

Public health officials rely on "indicator" organisms to assess the presence of disease-causing bacteria, fungi and viruses.

A pathogen is an agent that causes disease, especially a microorganism such as a bacterium, fungus or virus. In Casco Bay, the concern is disease-causing bacteria and viruses that infect humans who eat contaminated seafood and who come in contact with contaminated waters, usually while swimming. The pathogens are transmitted from infected humans, by their fecal and other waste, to other individuals who may come in contact with contamination.

Public health officials are not able to measure the entire range of human pathogens directly. Instead they rely on "indicator" organisms to assess the probability of the presence of pathogens. The indicator organisms in Maine for estuarine and marine waters are enterococcus bacteria of human origin and a group of bacteria called fecal coliform bacteria. Large numbers of enterococcus bacteria and coliform bacteria are present in the fecal material of warm-blooded animals, including humans. For the most part, indicator

organisms are not themselves pathogenic, but are often found associated with other rarer organisms that do cause disease in humans. For fresh water, the indicator organisms are Escherichia coli bacteria.

A number of problems are associated with the use of coliforms as indicators of public health risk. While this method may protect human health from bacterial pathogens, the same may not be true for viral pathogens. Under certain circumstances, the presently used indicator organisms bear little, if any, quantifiable association with pathogens of concern. In addition, the coliform indicator does not differentiate between human and animal wastes. The health risks and implication of the presence of coliforms from non-human sources have not been determined. The validity of the use of coliform and the search for another indicator is an important on-going discussion.

Pathogen Problems in Casco Bay

Over 43% of the clam flats in Casco Bay were closed in 1990 because of suspected pathogen contamination.

Closed and warning signs have been posted in the summer at East End Beach in Portland and at swimming areas on Peaks Island because of high levels of pathogens.

Over 43% of the 11,112 acres of clam flats in Casco Bay were closed in the summer of 1990, which is up from a 38% closure calculated for 1989.

Toxic Pollution

What makes a substance a toxic pollutant is determined by its chemical form, quantity and availability to organisms.

Since the mid 1980's reports of toxic pollution in mussels, fish and sediments in Casco Bay have resulted in public concern. What makes a substance a toxic pollutant is a matter of its chemical form, quantity and availability to organisms. The presence of a toxic pollutant in sediments or animal tissues is not necessarily an impending human health hazard.

Toxic pollutants of concern in Casco Bay include metals, polychlorinated biphenyls (PCBs), polynuclear (or polycyclic) aromatic hydrocarbons (PAHs) and other hydrocarbons, pesticides and dioxin.

Metals are inorganic compounds that are naturally occurring elements in bedrock and minerals along the Maine coast. Over time, rocks erode and metals leach into the environment. Antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, iron, silver, tin and zinc are all metals whose naturally occurring concentrations can be elevated to harmful levels by human activities. All developed and industrialized regions of the world have experienced an elevation of some metals in coastal waters, especially in the sediments. However, the toxicity of metals depends on both the form and the concentration. Some forms of metals are harmless to humans.

PCBs are organic chemicals that were manufactured from the early 1930s until 1979, when their production was banned because of their suspected cancer-causing capabilities. PCBs are contained in some electrical

equipment that is still in use. Spills from this equipment and illegal disposal of it result in ongoing PCB contamination in the environment. The U.S. Environmental Protection Agency regulates disposal of any equipment containing PCBs, but illegal dumping continues to occur because of the high cost of disposal and the lack of understanding about the toxicity of the chemical.

PAHs are organic compounds that occur naturally in coal and crude oil. PAHs are released to the atmosphere during the incomplete combustion of wood, coal, gasoline and other petroleum products. Atmospheric PAHs can be deposited in the sea through rain and other meteorological phenomena. Oil and gasoline spills also contribute to the presence of PAHs in the environment. Some PAHs are carcinogenic and are persistent in the environment.

Pesticides are chemical compounds that kill fungi, rodents, vegetation and insects. Although some pesticides are of plant or animal origin, most pesticides are manufactured by humans and do not occur naturally in the environment. Pesticides that are extremely toxic and/or degrade slowly cause environmental problems. DDT, now banned from use in the United States, is a well-known example of a pesticide with a slow rate of degradation that has caused reproductive problems for eagles and ospreys in Maine and elsewhere.

Dioxin and related chemicals (organochlorines) are produced in the papermaking process. Controversy exists about the levels at which these chemicals are toxic to humans who may ingest fish containing these compounds.

Where do toxic pollutants concentrate?

Toxic pollutants tend to accumulate in the tissues of animals. Because animals feed upon each other, toxics can be passed from one organism to the next.

The ocean is not a giant body of water that simply dilutes toxic pollutants. Many toxic pollutants tend to be associated with particles suspended in the water and settle to the bottom. This phenomenon is especially pronounced in estuaries and bays where freshwater from rivers and streams mixes with saltwater and particles stick together (flocculate) to make larger particles that settle to the bottom. Spring runoff delivers a load of contaminated sediments down the estuaries and into bays where they may become available to marine animals.

Toxic pollutants are of concern because they tend to accumulate in the tissues of animals. The process by which birds, seals or whales eat fish that in turn feed on worms and clams that in turn feed on microscopic plants is the way in which toxic pollutants are passed from one organism to the next. Animals with longer lives are able to eat many contaminated meals and therefore, over time, may concentrate contaminants in their bodies. This process is called bioaccumulation. Some animals are more susceptible to accumulating toxic pollutants than others.

Seals eat massive amounts of fish; approximately 18 million pounds annually for the seal population in Maine. However, seals and many other animals have adaptations to protect them from toxic pollutants. The hepatopancreas or tomalley in lobsters and the liver in fish, seals, birds and humans are the organs that filter and concentrate toxic pollutants to protect the animal from toxic effects. As the concentration of toxic pollutants increases, the demand on the liver increases. This demand may result in effects on the animal such as liver cancer.

Toxic Pollution in Casco Bay

Toxic pollution in the sediments of Casco Bay is principally concentrated around the Fore River, Back Cove and near the mouth of the Presumpscot River.

Toxic pollution in the sediments is principally concentrated in the Inner Bay region around Greater Portland in the Fore River, Back Bay and in and off the mouth of the Presumpscot River. Localized contaminated sites were present in other parts of the Bay; however, the contamination was generally far below levels suspected of evoking a biological response. Details of the sediment contamination study are available in a separate document (Texas A&M, 1992).

There is evidence that some toxic pollutants are being taken up by mussels in the Fore River and the Presumpscot River. Flounder off Casco Bay have been found to have toxic pollutants in their livers. The bottom dwelling animal community appears to be altered in the inner Fore River, although there is no proven cause.

While it appears that toxic pollution levels have remained stable over the last decade (Texas A&M, 1992), there are no data to determine over the long term if the pollution is getting better, worse or staying the same. It is also unknown if toxic pollutants are being concentrated at unhealthy levels in fish, seals and birds that feed in Casco Bay. Research has shown that adult and juvenile winter flounder, common inhabitants in the Bay, are susceptible to developing tumors or abnormalities when exposed to toxic pollutants. The health of winter flounder in Casco Bay is unknown.

Nutrients

Nutrients are essential for the growth of plants and animals, but when supplied in excessive amounts can harm aquatic ecosystems.

Nutrients such as nitrogen, phosphorus, and carbon are essential for the growth of plants and animals, but when supplied in excessive amounts they can harm aquatic ecosystems. In marine and estuarine waters, nutrients stimulate the growth both of microscopic plants (phytoplankton) and larger plants (seaweeds and eelgrass). If a key nutrient is missing, growth will stop. The missing nutrient is said to be limiting the growth of algae. In marine waters, nitrogen usually limits plant growth (as opposed to phosphorus in fresh waters). That is, in "pristine" coastal areas, plant growth usually is limited by the supply of nitrogen. In populated coastal areas, however, human activities can provide a continuous supply of nitrogen, disrupting the natural cycle of algal (plant) growth. Waters highly enriched with nutrients often are characterized by massive blooms of phytoplankton (algae). In addition, nitrogen loading can cause other impacts such as oxygen depletion.

This pattern of nitrogen load enrichment and the resultant algal productivity is called "nutrient enrichment" or "cultural eutrophication." Adverse effects of nutrient load enrichment run the gamut from mildly altered ecosystem processes (e.g., shifts to phytoplankton species that are less important in marine food webs) to severe oxygen depletion that kills fish and shellfish. The severity of the adverse effect depends on how much nitrogen reaches the waterbody, and how well flushed it is with water of lower nitrogen concentration. A certain amount of nitrogen loading to coastal waters is natural; what is of concern is when natural loading levels are exceeded as a result of human activity.

Although oxygen depletion caused by nutrient enrichment may not yet be a widespread problem in Maine, other New England estuaries already are experiencing serious problems. Examples can be found in Waquoit Bay (Cape Cod), in upper Narragansett Bay, in western Long Island Sound, and further south in Chesapeake Bay. Stringent management actions are either underway or under consideration in all of these waterbodies. There is a need to consider whether actions should be taken now to ensure that Casco Bay does not experience problems in the future from nutrient enrichment.

Nutrient Pollution in Casco Bay

There have been numerous algal blooms reported in Casco Bay in recent years. It is not known whether local nutrient enrichment is contributing to these blooms.

Residents living around Casco Bay have reported numerous algal blooms in recent years. Since no records have been kept and no scientific monitoring has been conducted, it is difficult to tell if there is a current problem in Casco Bay or if a problem is developing.

In the fall of 1988, massive numbers of shellfish and other animals died in Maquoit Bay in Brunswick when a large phytoplankton bloom entered the Bay. It is unknown whether localized nutrient enrichment contributed to the problem but the "kill" in Maquoit Bay could be an example of problems that might someday occur there and elsewhere in Casco Bay if preventative measures are not taken.

Sediments

Erosion from human activities can increase sediment loads which smother plants and animals.

Sediments entering Casco Bay from erosion can smother plants and animals. Sediments also carry associated toxic pollutants to the Bay. Brown plumes of sediments enter Casco Bay from rivers and streams after thunderstorms and large rainstorms. Intermittent streams, that only contain water during large storms, also carry a sediment load that impacts the Bay. Sediments also affect vegetation, fish and other animals in the streams and rivers that carry the sediment load.

Erosion from human activities have increased the sediment load to Casco Bay. Road building and ditching, site preparation for the construction of houses and businesses, farming and forestry cause erosion if Best Management Practices are not followed.

IV. ACTION PLANS

INTRODUCTION TO THE ACTION PLANS

The action plans are the central piece of the preliminary CCMP and lay out the steps that need to be taken before the final CCMP can be developed.

The action plans are the central piece of the preliminary Comprehensive Conservation and Management Plan (CCMP) for the Casco Bay Estuary Project (CBEP). The action plans lay out the steps that need to be taken before the final CCMP can be developed in 1995. The action plans do not include final recommendations for management strategy. Rather, they detail the work to be done before decisions about final management actions can be made.

The action plans do point to the "future directions" that are likely to be part of the final management strategy. The future actions describe the approaches to be investigated and demonstrated. The future directions also provide the focus for the broader discussions to be held during the next three years. These discussions will develop the most appropriate management approaches and build support for their implementation.

Overarching Themes

There are several themes which the project hopes emerge from these action plans. The first is that the CBEP is committed to involving a broad range of participants. The project is structured so that it is directed through an open, consensus-building process that brings together federal, state and local agencies, business, industry, academic institutions and the public. In undertaking these action plans, the CBEP is committed to involving a broad group of interests in the data collection and decision making.

The CBEP will work towards fostering cooperation between the regulated community and the regulators. The action plans in this preliminary CCMP work toward a cooperative approach based on providing technical assistance on protecting the environment and the regulatory process.

The CBEP recognizes the importance of public education, and the education of children, about environmental issues and has made it one of its priority issues. One of the following action plans describes the efforts the CBEP will take regarding public education.

Finally, the CBEP recognizes the role of economic issues on environmental protection. It will work toward demonstrating the value of the environment and the cost effectiveness of environmental protection. The CBEP will also work to demonstrate how the protection measures included in the final CCMP will achieve the desired objectives.

Continuing the dialogue

The CBEP hopes the preliminary CCMP and these action plans are the vehicle that will begin the dialogue on how to address the priority issues facing Casco Bay. The CBEP recognizes that these discussions may change the CCMP. However, if the CBEP is able to build a sustained dialogue, it will have taken important steps in developing a comprehensive management framework for protecting Casco Bay.

Format of the Action Plans:

The action plans have four sections:

1) Goal statement - the broad statement of intent in each of the priority issues.

2) Objective - the more specific impact to be addressed and the approaches to be used to address the impact.

3) Actions - lists the actions to develop information or try management techniques in preparation of developing the final action plans by 1995.

4) Future directions - describes the suggested management approach to be included in the final CCMP. It serves as the focal point of the short term actions and of the broader discussion that will be held as part of the development of the final CCMP.

MINIMIZE ADVERSE ENVIRONMENTAL IMPACTS FROM THE USE AND DEVELOPMENT OF LAND AND MARINE RESOURCES

BACKGROUND

Development, land use and marine use refer to situations where construction or changes take place in both natural, undisturbed areas and in developed areas.

The terms "development," "land use" and "marine use" encompass a broad range of activities. They refer to situations where new construction and changes in land and marine resource use take place in undisturbed, natural areas, as well as in developed areas. Activities associated with development or land and marine resource use include such actions as building a new home, converting a seasonal camp to a year-round home, paving an unpaved parking lot, rebuilding a seawall, placing a mooring, or expanding a pier or marina. In the broadest sense, the terms include any activities resulting in a change in the natural environment such as farming, forestry and aquaculture.

There are some particularly sensitive and important environments that are of primary concern when changes in land and marine uses are being considered. These include: critical wildlife habitats, coastal and freshwater wetlands, lakes, ponds, rivers, streams, riparian zones (streambank), estuaries, and bays.

From an overview of comprehensive plans that were completed under Maine's Growth Management Law, conversion of land to residential use accounted for the greatest amount of land use change that occurred over the past 20 years within the Casco Bay watershed. The word used in many comprehensive plans to describe post - 1950's residential development is "sprawl." During this time, lot sizes for homes increased dramatically. To lessen the negative impact that larger lot sizes can have on rural character and increased stormwater runoff, many plans express the desire to encourage clustered subdivisions, where open space can be preserved as an environmental and visual buffer.

In addition to clustering residential development, several communities in the watershed employ land use tools to ensure that land use changes work with ecosystems and have a limited impact on natural resources. Land use tools include: subdivision regulations, shoreland zoning, and land use ordinances that incorporate performance standards, buffer standards, and contain erosion and sedimentation control practices; lake and aquifer protection districts, and "best management practices" -- regulatory and non-regulatory tools that can be used to lessen the environmental impacts of development, agricultural, and forestry activities.

There are also non-regulatory approaches which can be used to protect ecosystems. These include: technical assistance programs, public education,

acquisition of land, and acquisition of conservation easements. A variety of organizations are involved in such activities, including municipalities, land trusts, environmental organizations, educational institutions and government agencies, such as the Soil Conservation Service.

In addition to concern over land use, there are concerns about marine resources. These concerns arise over the following types of activities: dragging, dredging, recreational and commercial boating, shellfish digging, and seaweed gathering. To best address the negative aspects associated with these marine resource uses, coastal municipalities within the Casco Bay watershed, and throughout Maine have adopted shellfish management plans and ordinances, and harbor plans and ordinances.

The connection between land use activities and marine resource protection cannot be overlooked. By adopting proper regulatory and non-regulatory tools, critical marine resource habitats can be protected. Not only is it important that development in the shoreland zone is compatible with marine resources, but the impacts from development occurring within the watershed that drains into the adjacent bay or estuary need to be adequately managed.

Several of the techniques to protect land and marine resources involve an analysis of the cumulative impact that individual developments will have over time. Assessing cumulative impacts is critical to protecting environmental resources.

Protecting the environment can have economic benefits by reducing the likelihood of losing valuable resources like shellfish beds and needing to undertake costly clean-ups.

The techniques that are listed protect environmental resources, but they have economic benefits as well. When development, and land and marine uses occur in an appropriate manner, costly side effects such as groundwater contamination, closed shellfish flats, and road washouts are avoided.

ISSUES

Some of the environmental concerns associated with development include:

Habitat loss - Development results in direct long-term and short-term habitat loss. Though the impact of one change may seem minor, the cumulative impact of many changes are major.

Fragmentation of habitat - Many animals and plants need large tracts of open space for their territory or as a buffer from human activities. Development can fragment these tracts, making them unsuitable habitat.

Distributing sediments - Dredging for marine projects destroys habitat both when the material is removed and when it is disposed. Dredging also releases toxic chemicals that are associated with the sediments into the water. Dragging for scallops also disturbs sediments, releasing any toxic chemicals that are associated with the sediments.

Erosion - Development can cause increased erosion both during and after construction. Increased sediment in the water can make the estuary, lake, stream or river uninhabitable for some species. Further, since toxic chemicals often are bound to sediments, erosion may carry contaminants to coastal waters.

Disturbing wildlife - Many species cannot tolerate human disturbance. In particular, intrusion on islands during nesting season may cause loss or abandonment of nests.

Changing waterbody conditions - Development can increase water temperatures, change stream flows, increase turbidity, change salinity, and increase levels of pollutants. For example, dams impound water, changing the habitat from moving water to a still waterbody.

Changing of drainage patterns - Development can drastically alter the way water flows. Buildings and pavement prevent water from seeping into the ground, instead channelling it to storm drains, gullies or streams. Such changes cause flooding, reduce the recharge of groundwater, change stream flows, increase water temperatures, and increase erosion.

Blocking natural processes - Structures often create barriers to species. Culverts can be too narrow to allow the proper exchange of water beneath roads and prevent the passage of fish and other aquatic species. Culverts also can restrict the flow of saltwater to upstream marshes, causing them to change into freshwater systems. Dams create barriers to the migration of fish.

Nonpoint source pollution - Development adds pollutants to the environment. Rain washes oils and other pollutants from land. Other non-point sources include the effluent from septic systems and other pollutants that travel through groundwater.

Point source pollution - If the development includes new commercial or industrial facilities, new outfalls for process or cooling water may be part of the facility. These point sources can destroy habitat areas not only by contributing pollutants but also by increasing water temperatures.

To address the issues on appropriate use and development of land and marine resources, the Casco Bay Estuary Project has developed the following goal, objective and steps to be taken to protect critical habitats in the Casco Bay watershed.

CASCO BAY ESTUARY PROJECT

GOAL: To minimize adverse environmental impacts from the use and development of land and marine resources.

OBJECTIVE: Preserve the sustainability of ecological communities by protecting critical habitat[1] through actions such as the development of performance standards and provision of technical assistance.

ACTIONS

1) **Identify and map critical regional habitats on GIS.**
Critical regional habitats will be identified and mapped on GIS with the help of relevant state and federal agencies, local governments and other interested individuals and groups. Other issues that will be explored cooperatively with the groups and individuals include:

- define and use indicator species, both terrestrial and marine
- define a baseline year
- identify appropriate buffer sizes
- develop methods to keep critical habitat information up-to-date
- develop a method to get more detailed local information into the federal and state databases
- develop criteria that towns can use for local habitat protection

2) **Collect and develop protection measures.**
Protection measures will be collected to minimize the adverse environmental impacts from the use and development of land and marine resources. Regulatory and nonregulatory measures to protect habitat and living resources will be collected or developed with the help of appropriate state and federal agencies, local governments and other interested individuals and groups. Nonregulatory measures that allow for a cooperative approach will stressed. The feasibility of providing incentives to protect identified critical habitats will be examined. Strategies to encourage people that are out of compliance to begin to cooperate and seek the help they need will be explored.

The protection measures will be based on the type of development, type of habitat or species to be protected, buffer requirements and the reason for protection. Protection measures will include standards for marine activities (such as dock building and dredging) and land based activities.

3) **Identify gaps in habitat protection.**
Gaps in habitat protection will be identified with the help of the appropriate state and federal agencies, local governments and other interested individuals and groups. Information about gaps in habitat protection and actions that could be taken to fill these gaps will be disseminated.

4) **Work with nongovernmental groups seeking to protect critical habitats identified by the Casco Bay Estuary Project.**

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[1] including riparian zones and nearshore habitat, defined as intertidal, subtidal and upland areas.

FUTURE DIRECTIONS

1) **Develop, adopt and implement appropriate regulatory and nonregulatory measures to assure protection of critical regional habitats.**
Regulatory methods may include performance standards that are designed to mitigate negative impacts. Nonregulatory methods may include technical assistance, public education, etc..

2) **Provide coordinated technical assistance on meeting environmental goals.**
The approach would be "one-stop shopping" -- providing a resource center and a single point of contact for tapping existing technical assistance available in the state. The assistance would focus on both technical environmental protection issues, such as identification of pollution sources, implementation of best management practices, and changing local ordinances; and on how to comply with the regulatory process, such as providing fact sheets explaining the various permitting procedures. The exact functions of the technical assistance program will be developed with input from the potential customers of such assistance.

MINIMIZE ADVERSE ENVIRONMENTAL IMPACTS FROM STORMWATER RUNOFF AND COMBINED SEWER OVERFLOWS

BACKGROUND

Stormwater

It is estimated that 60% of water pollution nationwide comes from nonpoint source pollution.

Stormwater runoff is the overland flow of rainwater and snowmelt. As stormwater washes across the landscape, it transports solids and dissolved matter in its path into lakes, streams, rivers and the ocean. Stormwater may include nutrients, pathogens, floatable material, sediments, and the metals and organic chemicals found attached to sediments, including polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), pesticides and dioxins. The specific elements in stormwater are dependent upon existing land uses and development, and the effectiveness of existing stormwater management practices. Stormwater may enter Casco Bay through natural channels (gullies, ditches and streams) or may be transported to the Bay by a stormwater collection system, comprised of catchbasins and pipes.

Vegetation slows the flow of stormwater enabling it to soak into the ground. As land is developed, the amount of vegetation is reduced. With development of more impervious surfaces, the volume of stormwater discharged will increase and the quality of the stormwater will likely decrease, unless specific stormwater management practices are employed.

It is estimated that approximately sixty percent of water pollution nationwide comes from nonpoint discharges contained in stormwater. Stormwater control measures have historically emphasized flood control and not water quality.

Combined Sewer Overflows

Combined sewer overflows act like release valves, diverting excess stormwater and sewage directly into Casco Bay.

A combined sewer system is a collection system that transports both sanitary water (sewage) and stormwater in the same pipe to a treatment plant facility. Combined sewer overflows (CSOs) are discharges from points along that combined sanitary and stormwater collection system precipitated by rainstorms. During rainstorms the volume of stormwater entering the combined system often exceeds the capacity of the pipe to deliver the flow to the treatment plant. CSOs act like release valves in the collection system diverting excess stormwater and sewage into Casco Bay. There are approximately 75 points of potential CSO discharge into Casco Bay or its tributaries.

Prior to construction of the treatment plant facilities in Greater Portland in the late 1970s, raw sewage from residential, industrial and commercial uses flowed directly into Casco Bay. With significant federal funding and design oversight, sewer interceptors (large force mains) and pump stations were

constructed to deliver sanitary waste to secondary treatment plants for treatment. Since sewage treatment plants were designed to efficiently treat waste flows from certain size populations, an increase in the flow created by a rainfall event, beyond design capacity results in overloading the collection system at points along the system known as CSOs.

CSOs discharge untreated sewage that contains fecal coliform and enterococcus bacteria and pathogenic bacteria and viruses. The cities of Portland, South Portland and Westbrook are currently developing comprehensive CSO facility plans for the control or abatement of combined sewer overflows.

Because the discharge from combined sewer overflows contains stormwater, the same contaminants found in stormwater are also present. The Casco Bay Estuary Project is primarily concerned with stormwater and the stormwater component of combined sewer overflows.

Impacts on water quality

Stormwater contributes toxics, nutrients, pathogens, floatable trash and sediments to Casco Bay.

Three major rivers drain into Casco Bay; the Presumpscot, Royal and Fore. The largest river is the Presumpscot with a drainage area of 674 square miles, or 69% of the Casco Bay watershed. The Presumpscot receives the licensed discharges from the Westbrook sewage treatment facility (population 16,121), and the S.D. Warren Paper Company, a kraft process pulp and paper mill (21.6 million gallons/day). The Royal, draining 143 square miles, has a watershed comprised primarily of agricultural and forested lands. Recently, however, development pressures along the shores of the Royal River have significantly increased the volume of stormwater runoff to the Bay. The Fore River, with a drainage area of 54 square miles, is actually a short river formed by the confluence of the Stroudwater River and several smaller streams draining in the urban portion of Portland and South Portland, including Capisic Brook in Portland and Long Creek, Jackson Brook and Red Brook in South Portland.

Both stormwater and combined sewer overflows contribute toxic pollutants to Casco Bay. What makes a substance toxic is a function of its form, its quantity and its availability to organisms. Some elements are a dietary necessity at low concentrations, but may be deadly at higher concentrations. Furthermore, some forms of pollutants accumulate in the tissues of marine animals. Longer lived marine animals concentrate toxics in their bodies over time, known as bioaccumulation. There has been no comprehensive risk assessment of potential health hazards to humans from consumption of seafood from existing and current pollutants in Casco Bay.

Elevated levels of toxic pollutants also have the capacity to affect ecosystems in a number of ways. They inhibit growth and reproduction of organisms, disrupt settlement of young, cause changes in shape and color, cause cancer and in high enough concentrations can be lethal.

Fish and other mobile animals may avoid areas that have elevated levels of toxic pollutants. The health of the bottom dwelling community, however is crucial because it plays an important role in the food chain of the Bay.

Other pollutants in stormwater are pathogens (bacteria and viruses that cause human diseases). The primary impact of pathogen contamination for humans is the risk of illness from either eating contaminated seafood or swimming in contaminated water. Another impact is the closure of shellfish beds and swimming areas which reduces the use and economic benefits of the Bay.

Another impact of stormwater is nutrient enrichment of surface waters. Nutrients are necessary for growth of both microscopic plants and larger plants (seaweeds and eelgrass). However, human activities can overly enrich water. Impacts of enriched water range from mildly altered ecosystem processes, such as subtle shifts in phytoplankton populations to severe oxygen depletion that kills fish and shellfish.

However, stormwater is not the only source of nitrogen. Nitrogen is introduced in a number of ways, including atmospheric deposition, septic systems, overboard discharge systems, sewage treatment plants and upwelling of nutrient rich deep waters.

Heavy sediment loads from erosion carried by stormwater can have a negative impact. Influxes of sediment can smother bottom dwelling plants and animals and disrupt migrating fish. In addition, because many toxic pollutants become associated with the sediment, the sediments are the main vehicle for transporting toxics to the Bay.

Finally, floatable debris in stormwater presents a danger to wildlife. Fish, birds and marine mammals confuse debris with food, causing internal injuries, intestinal blockage or starvation. Such species also become entangled and are unable to escape.

To minimize the impact from stormwater and CSOs, the Casco Bay Estuary Project has developed the following goal, objective and actions.

CASCO BAY ESTUARY PROJECT

GOAL: To minimize adverse environmental impacts from stormwater runoff and combined sewer overflows.

OBJECTIVE: Preserve and enhance water quality in marine habitat areas by minimizing the loading of pathogens, toxics, nutrients and eroding sediments from stormwater through technical assistance, training and implementation of best management practices and other measures.

ACTIONS

1) **Identify and map pollutants of concern.**
A Geographic Information System (GIS) map that identifies the pollutants of concern in the various geographic regions of Casco Bay and its watershed will be produced by the Casco Bay Estuary Project. The information will be generic, not site specific. The GIS maps will identify the pollutants of concern by taking into account the resources to be protected, the types of pollutants in stormwater and likely sources of pollution. The purpose of the map is to focus stormwater control efforts on the pollutants of concern.

Pollutants of concern include toxic pollutants (metals, oils), nutrients (nitrogen), pathogens (bacteria) and sediments associated with erosion. The GIS map will be distributed to relevant state and local agencies, the various committees of the Casco Bay Estuary Project and other interested individuals or groups for review and comment. The final GIS maps will be distributed and updated as necessary.

2) **Provide Best Management Practices Technical Assistance.**
A technical assistance program will be developed as a follow up to the Best Management Practices (BMPs)[2] demonstration project funded by the Casco Bay Estuary Project. The BMPs have been or are being developed by the Nonpoint Source Program of the DEP.

This technical assistance program will include a training program for environmental managers and local officials. The training will include selection, use of Best Management Practices for controlling pollutants of concern, methods to conduct local inventories of pollutant sources, implementation of source control programs, creative land use practices, review of demonstration projects and the incorporation of BMPs into town ordinances. Part of the technical assistance will be to help interested towns apply for the permits that may be necessary to implement BMPs and/or adapt model ordinances to local needs.

It is envisioned that a pilot project will be developed to work with interested towns to implement a technical assistance program. The Casco Bay Estuary Project will determine which towns are interested in receiving BMP technical assistance by reviewing the Council of Government reports on technical assistance to towns (funded by the Casco Bay

[2] BMPs are methods, activities, maintenance procedures or other management practices designed to reduce the amount of pollution entering a waterbody.

Estuary Project) to determine local interest. By starting with cooperative towns, it is hoped that other towns in the region may develop an interest in the program and participate.

3) **Determine the effectiveness of using BMPs.**
Cost effectiveness and what is gained or lost by using BMPs will be evaluated.

4) **Develop Retrofit Best Management Practices.**
The Casco Bay Estuary Project will work with the Nonpoint Source Program at the Maine Department of Environmental Protection to develop Best Management Practices (BMPs) for retrofitting stormwater controls. The BMPs will include determining costs of retrofitting and regulatory hurdles.

5) **Develop a hierarchical approach to stormwater management.**
An approach to control stormwater at a local and regional level will be developed. The hierarchy would begin with stormwater prevention (minimizing the quantity of stormwater from development), followed by on-site treatment, trading stormwater rights and treatment (in descending order).

6) **Investigate the feasibility of establishing a stormwater utility.**
The extent of the problem and the scope of infrastructure needs will be determined.

FUTURE DIRECTIONS

1) **Provide coordinated technical assistance on meeting environmental goals.**
The approach would be "one-stop shopping" -- providing a resource center and a single point of contact for tapping existing technical assistance available in the state. The assistance would focus on both technical environmental protection issues, such as identification of pollution sources, implementation of best management practices, and changing local ordinances; and on how to comply with the regulatory process, such as providing fact sheets explaining the various permitting procedures. The exact functions of the technical assistance program will be developed with input from the potential customers of such assistance.

2) **Develop an intermunicipal coordination process to facilitate the control of stormwater throughout the watershed based on the hierarchical approach developed by the Casco Bay Estuary Project.**

MINIMIZE ADVERSE ENVIRONMENTAL IMPACTS OF INDIVIDUAL WASTEWATER DISPOSAL SYSTEMS

BACKGROUND

Septic systems and overboard discharges are used to dispose of sewage and other wastewater from residences and commercial buildings.

Individual wastewater disposal systems include single and cluster septic systems and overboard discharge systems. These systems are used to dispose of sewage and other wastewater from residences and commercial buildings. The issue of concern to the health of Casco Bay is that the overboard discharges, malfunctioning and properly functioning septic systems and septage sludge disposal all contribute to pollution in the Bay. A related issue is the disposal of materials from the holding tanks of individual wastewater systems that are pumped as part of regular maintenance.

Septic systems are designed to take advantage of soil micro-organisms to decompose conventional household wastes, including fecal wastes. Septic systems consist of a buried concrete tank that catches solids and a leaching field through which liquids are dispersed. Cluster systems are larger septic systems designed to serve multiple users. Maine DEP estimates that there are at least 230,000 septic systems in the State of Maine, with many of these systems located within the Casco Bay watershed. In addition to the impacts from properly functioning systems are the impacts of subsurface disposal systems that fail to operate as designed. Failing systems often discharge untreated waste to surface waters.

Overboard discharge units consist of a mechanical or sand filter and a chlorination system. Overboard discharge systems were used to replace straight pipes that discharged raw waste directly into the Bay. They usually exist in areas where poor soils and/or impermeable rock ledge make underground septic systems impossible. Because these systems have proven ineffective, the Maine Legislature in 1987 prohibited the issuance of new overboard discharge permits and the state is now working with homeowners to remove or improve existing systems where possible.

Maine DEP reports that there are 355 licensed overboard discharges in Casco Bay that are licensed to discharge 300 gallons of sewage each day, and an undetermined amount of unlicensed overboard discharges. These overboard discharges are directly responsible for shellfish bed closures. Shellfish beds are closed around overboard discharge outfalls as a safeguard against system malfunction.

Part of the maintenance of individual wastewater systems is the regular pumping of septic holding tanks. Failure to pump septic tanks can lead to

system failure. The material pumped from these tanks, called septage, must be disposed of properly at a sewage treatment plant or septage receiving facility. In certain circumstances it can also be spread as a fertilizer. Improper disposal includes dumping material directly into the Bay or spreading it in areas where it degrades water quality or habitats.

Impacts on water quality

The primary pollutants from septic systems and overboard discharges are pathogens and nutrients. Toxic pollutants can also be a concern.

The primary pollutants from septic systems are pathogens (bacteria and viruses that cause human diseases) and nutrients. In addition, if hazardous waste is disposed in the system, toxic pollution becomes a concern. Overboard discharge pollutants are the same as septic systems, with the additional concern of toxic pollution from the chlorine used to disinfect the waste.

The primary impact of pathogen contamination is the risk of illness from either eating contaminated seafood or swimming in contaminated water. Another impact is the closure of shellfish beds and swimming areas that reduces the use and economic benefits of the Bay. If a system is functioning properly and located away from surface or groundwater, it should not be a source of contamination. Malfunctioning systems are often sources of pathogen contamination and shellfish bed closures.

Another impact of septic systems or overboard discharges is nutrient enrichment of surface waters. Even a properly functioning septic system is not designed to remove nitrogen, which is the primary nutrient of concern in marine waters.

Septic systems are not the only source of nitrogen. Nitrogen is introduced in a number of ways, including atmospheric deposition, stormwater runoff and upwelling of nutrient rich deep waters. The National Oceanic and Atmospheric Administration (NOAA) in 1988 estimated that about 1400 tons of nitrogen are discharged each year into Casco Bay's watershed. The quantity actually delivered to the Bay is uncertain, however, since natural denitrification processes occur between the points of discharge and the bay itself. As the population of the Casco Bay watershed grows and forest cover declines, it becomes important to know more about the effects of nutrient enrichment on Casco Bay. The NOAA Northeast Case Study (1988) estimates that about 408 tons of nitrogen per year is discharged to Casco Bay from sewage treatment plants, with an unknown amount from overboard discharges, septic systems, stormwater and atmospheric deposition.

Nutrients are necessary for the growth of both microscopic plants and larger plants (eelgrass and seaweed). However, human activities can overly enrich waters with nutrients. The impact of overly enriched water ranges from mildly altered ecosystem processes, such as subtle shifts in phytoplankton populations to severe oxygen depletion that kills fish and shellfish.

Overboard discharges create additional impacts. Where overboard discharges exist, shellfish beds must, by regulation, be kept closed because

of potential threat of a malfunction and the release of inadequately treated waste into the Bay. In addition, the chlorine used for decontamination can impact the environment immediately surrounding the outfall pipe.

The improper disposal of septage, or the material pumped from the holding tanks of septic systems and overboard discharge units will have the same adverse impacts as improperly functioning overboard discharges or septic systems, because septage contains both pathogens and nutrients.

To minimize the impact from individual wastewater systems, the Casco Bay Estuary Project has developed the following goal, objective and actions.

CASCO BAY ESTUARY PROJECT

GOAL: To minimize adverse environmental impacts of individual wastewater disposal systems.

OBJECTIVE: Lower pathogen[3] and nutrient loadings to Casco Bay so that coastal waters closed to shellfish and other public uses can be re-opened or protected from closure by identifying pathogen and nutrient sources and providing technical assistance with respect to failing septic systems and the removal of overboard discharges.

ACTIONS

1) **Prioritize closed shellfish beds for restoration.**
Shellfish beds will be prioritized based on the value of the resource. Sources of pollution (Action 2) will be identified for priority shellfish beds.

2) **Identify sources of pollution with the help of volunteers.**
Trained local volunteers will identify sources of pollution such as old, failing septic systems and overboard discharges. Stormwater sources will be mitigated by the actions outlined in the Stormwater Action Plan. Sources from individual wastewater disposal systems will be covered by the actions in this plan. The potential for success will depend on such factors as the nature and number of sources of pollution and the degree of difficulty in controlling them.

3) **Study feasibility of a wastewater management district.**
A feasibility study on setting up a wastewater management district will be conducted that will include:

Administrative issues:
- adequacy of state sanitary district enabling legislation
- evaluation of the effectiveness of the state plumbing code in coastal areas
- recordkeeping/logistics
- policies for failing systems and performance standards for new systems
- enforcement policies
- relationship to existing wastewater facilities
- Probable collection volumes and septage disposal alternatives

Financing options for pumpouts, replacing failing systems, system upgrades and low flow devices
- applicability of using state revolving loan funds
- fee structure
- evaluate financing options for municipalities that finance sewage treatment through user fees, as well as those that finance through property taxes.

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[3] As measured by the current "indicators" for shellfish harvesting and swimming: numbers of fecal coliform bacteria and enterococcus bacteria, respectively.

How overboard discharge units can be addressed in a wastewater management district

4) **Determine the criteria that need to be addressed to enable regional cooperation on intermunicipal wastewater districts including:**

- consideration of geographic extent (e.g. districts centered around shared resources)
- cost effectiveness
- political obstacles - education/outreach
- septage collection (volume) and disposal
- determine regional capacity
- acceptance of non-local septage

5) **Facilitate the development of a wastewater management district in an interested town(s).**

FUTURE DIRECTIONS

1) **Provide coordinated technical assistance on meeting environmental goals.**
The approach would be "one-stop shopping" -- providing a resource center and a single point of contact for tapping existing technical assistance available in the state. The assistance would focus on both technical environmental protection issues, such as identification of pollution sources, implementation of best management practices, and changing local ordinances; and on how to comply with the regulatory process, such as providing fact sheets explaining the various permitting procedures. The exact functions of the technical assistance program will be developed with input from the potential customers of such assistance.

2) **Form an intermunicipal wastewater management district.**

EFFECT OF EXISTING SEDIMENT CONTAMINATION

BACKGROUND

Casco Bay serves as the catch basin for pollutants. Pollutants are associated with soil and other particles that collect on the sea-floor.

Pollutants from past activities are present in the sediments of Casco Bay and the soils of the Casco Bay watershed. To understand the health of the Bay, it is necessary to understand the effect these pollutants have on the Bay today.

Casco Bay serves as the catch basin for pollutants derived from local rivers or municipal sources. Pollutants are associated with soil and other particles suspended in the water. These particles settle to the bottom of Casco Bay and collect in annual layers on the seafloor. Because of manufacturing and industrial activities undertaken before environmental controls were in place, there could be more heavily contaminated sediments below the surface sediments. Shipbuilding and convoy organization during World War II also contributed to sediment contamination.

Contaminants in the sediments affect the Bay in several ways. Worms and other burrowing animals mix sediments, bringing deeper particles and their associated pollutants up to the surface. Erosion of sediments by currents, tides, and dredging also expose older sediments. Thus, despite new regulations controlling the release of pollutants, it is possible for older sediment to be exhumed and released today.

Long-term pollutants in Casco Bay include metals and organic chemicals. Metals are naturally occurring but in high concentrations, often the result of industrial processes, some metals are toxic. Organic chemicals come from a wide range of sources: industries, farms and homes. They include pesticides to control weeds, insects and rodents, PCBs (polychlorinated biphenyls) used until recently in electrical transformers, and PAHs (polycyclic aromatic hydrocarbons), a part of fossil fuels released through spills and incomplete combustion of fuels.

Impacts of sediment contamination

Elevated levels of toxic pollutants can inhibit growth and reproduction of organisms, disrupt settlement of young, cause changes in shape and color, cause cancer, and in high enough concentrations, kill.

The toxicity of a substance is determined by its form, its quantity and its availability to organisms. Some metals are a dietary necessity at low concentrations but are deadly at higher concentrations.

Some pollutants are in chemical forms less available to organisms. Others are more available and accumulate in the tissues of organisms. In the food chain, pollutants are passed from one organism to another. Over time, longer lived animals concentrate toxins in their bodies, a process known as bioaccumulation. Humans, the recipients of the highest concentrations of toxins, are at the top of the food chain.

Elevated levels of toxic pollutants have the capacity to affect ecosystems in a number of ways. They inhibit growth and reproduction of organisms, disrupt settlement of young, cause changes in shape and color, cause cancer, and in high enough concentrations, kill.

Bottom dwelling communities are impoverished in areas which have elevated levels of toxic pollutants. For example, only hardy worms dwell at the bottom of the Fore River in some areas between Million Dollar and Veterans Memorial Bridges. More sensitive animals may no longer exist there as a result of toxic contaminants. The health of the bottom dwelling community is crucial because it plays an important role in the food chain of the Bay.

To address the issues about the effect of existing sediment contamination on Casco Bay, the Casco Bay Estuary Project has developed following goal, objective and actions.

CASCO BAY ESTUARY PROJECT

GOAL: To determine the effect of existing sediment contamination on the health of Casco Bay.

OBJECTIVE: Collect data to help determine the biological impact of existing contaminants in Casco Bay and ensure that appropriate actions are taken.

ACTIONS

1) **Collect and analyze dated sediment cores.**
Trends in contamination over time as revealed through sediment cores will be determined. The Technical Advisory Committee (TAC) working group will review the sediment contamination study conducted by the Casco Bay Estuary Project and will select locations to conduct core sampling.

2) **Complete the analysis of sediment contamination.**
To complete the analysis of sediment contamination, the TAC will develop a sampling plan for dioxin and other contaminants not measured in the initial study. Also, existing sediment contamination data will be reviewed and evaluated.

3) **Decide on future work or actions.**
The Management Committee, with input from the TAC, will decide on the research needed to answer remaining questions about sediment contamination in the Bay. This will likely include biological effects sampling. Other future work may range from issues arising from on-going sampling programs to policy issues related to dredging and dredged materials.

4) **Develop a long-term monitoring plan.**
A long-term monitoring plan for determining trends in sediment contamination that goes beyond the Casco Bay Estuary Project will be developed. The long-term plan will include the identification of potential funding sources.

FUTURE DIRECTIONS

1) **Implement scientific review of new data and monitoring goals and procedures by a "permanent" technical review group composed of representatives from the academic and research communities and state agencies.**

2) **Establish a response mechanism to address significant contamination problems that are identified.** The response mechanism needs to address the fact that action may have to be taken without all the desired scientific data.

3) **Implement a long-term monitoring program.**

PROMOTE RESPONSIBLE STEWARDSHIP

BACKGROUND

A primary objective of the Casco Bay Estuary Project is to develop ownership for the care and maintenance of the Bay among people who live in the coastal and watershed communities.

Stewardship of Casco Bay by the residents of the watershed is the key to ensuring the long-term health of the Bay. A primary objective of the Casco Bay Estuary Project is to develop ownership for the care and maintenance of the bay among the people who live in the shorefront and watershed towns. The Casco Bay Estuary Project was initiated by the federal and state environmental agencies. The involvement of those agencies is concentrated in the first five years of the project with financial and resource assistance to develop a management plan for the Bay. The federal and state initiatives are important and both agencies believe that Casco Bay is one of the State's most significant resources. However, the agencies involved feel strongly that a local resource such as Casco Bay is managed best by local people. State and federal agencies involved in the program can offer expertise and guidance, but should not drive the program.

The best long-term care for Casco Bay will be achieved if the citizens of the Bay area understand the Bay, appreciate its resources and functions and if they have developed a plan for caring for the resource.

Stewardship actions

Stewardship of Casco Bay involves everyday decisions, such as how we maintain our cars and fertilize our lawns, and political decisions, such as participating in town meeting and voting in elections.

There are many levels of actions that impact the Bay.

At the individual level those actions may include how we fertilize our lawns, maintain our cars, dispose of household chemicals, recycle our trash, apply pesticides, or pave our driveways. As individuals we need to be aware of how everyday actions affect the environment and we need accurate information about how to act in a responsible manner. Most of us want to do the right thing; we just do not always have the information we need. We also do not always have alternatives that are convenient and safe.

At the community level, protecting the Bay means we must make responsible decisions as political entities and we must know the ramifications of our actions. To do this we again need information. We need to know what is the best way to regulate land and marine uses, how to reduce waste, how to deal with overboard discharges and combined sewer overflows, what uses rely on a shoreline location, what are good ratios of open space to paved area (both on a per lot basis and a town wide basis), what are the best road maintenance practices. We also need to make provisions at the local level and the regional level for public facilities (e.g., sewage treatment facilities) to accommodate growth and protect the Bay.

Regional decisions are equally significant to sustaining the Bay. Water, habitat, stormwater, and runoff do not know political boundaries. We need to expand our relationships with our neighboring towns to work more cooperatively, and probably more effectively, together.

There are two critical steps needed to attain stewardship: public awareness, which must come first, and public involvement. To develop public awareness and involvement, the Casco Bay Estuary Project has developed the following goal, objective and actions.

CASCO BAY ESTUARY PROJECT

GOALS: To promote responsible stewardship of Casco Bay and its watershed through increased public involvement.

OBJECTIVE: Provide opportunities for education and involvement in the Casco Bay Estuary Project activities among stakeholders, opinion leaders and the general public by producing materials, coordinating activities and enhancing existing educational efforts.

ACTIONS

1) **Educate constituency groups.**
Groups in Casco Bay watershed will be educated about why they need a healthy bay. These groups will be asked to help gain local support and attend crucial local meetings. The education program should target both stakeholder groups (those with some interest in the Bay or the issues affecting the Bay) and non-related groups. Some activities which should be taken include:

Develop materials that explain what individuals can do to help protect Casco Bay.

Deliver technical scientific information to the public. Develop a fact sheet on each study that explains its objective and a brief summary of the findings.

Find a mechanism for publicizing positive actions taken by municipalities, private groups and individuals.

Demonstrate and publicize the economic value of the Bay.

Develop a public service campaign.

Develop a speakers bureau.

Expand CBEP newsletter distribution.

2) **Coordinate and support outreach activities with other groups.**
Individuals in the groups that have outreach programs will be identified and contacted. A communications network will be built with these groups. Support activities sponsored by other groups (e.g., storm drain stenciling). Develop a display for participation in fairs, festivals and shows sponsored by other groups.

3) **Develop facts sheets in support of each of action plans.**
Fact sheets explaining the priority issues and how to address these issues will be developed. In addition to general fact sheets, more specific educational facts sheets will be targeted to specific audiences.

4) **Educate students about environmental protection.**
A program to educate children about environmental protection issues will be developed. This could include materials, school curriculum, teacher training and citizen

apprenticeship programs (e.g. Kids as Planners).

FUTURE DIRECTIONS

1) **Create a public outreach network that results in a mechanism for continued support for protecting Casco Bay and that makes the public aware of individual actions that can be taken to protect Casco Bay.** This mechanism should have adequate funding to fulfill its objectives.

2) **Establish an interactive outreach program with stakeholders and opinion leaders so that the final CCMP reflects consensus about goals, objectives and priorities necessary to protect Casco Bay.**

MANAGEMENT AND FUNDING OPTIONS

BACKGROUND

The actions in the preliminary CCMP seek to build an effective management framework for protecting Casco Bay. This will only occur if there is strong citizen and local support.

Each of the action plans in this preliminary CCMP is part of the effort to build an effective management framework for Casco Bay. Effective management can be achieved in one of three ways: maintain the status quo, if it is adequate; improve inadequacies in the current system through changes and increased coordination between existing programs; or create a new structure that enhances and supplements existing management efforts.

The Management Committee realizes that change can only be successful if there is strong citizen and local support for such changes. It sees the role of CBEP as one of encouraging and supporting the dialogue among stakeholders, providing the necessary information for an informed discussion, and serving as a catalyst when areas of consensus are reached.

To lay the groundwork for this discussion, the CBEP commissioned a study by the Marine Law Institute at the University of Maine titled The Existing Regulatory Framework and Long-term Management Options for Casco Bay. This study examined the existing framework in terms of fifteen different types of activities. The report also examined four regional organizations from around the country and examined their purposes, jurisdiction, organization and management, size and budget, authority and functions and discussed their applicability to Casco Bay.

The report outlined the steps that have to be included in developing an effective regional management framework. First, the key issues have to be identified. Second, the adequacy of the existing framework in relation to these key issues must be determined. The report then described a number of factors that should be included in the discussion of how to improve management efforts.

The action plans provide a starting point for identifying key issues:

- Establish a wastewater management district - the establishment of such a district offers a comprehensive approach to the inspection and maintenance of septic systems and elimination of overboard discharges.

- Comprehensive stormwater management - stormwater does not follow political boundaries. Its effective management could involve the establishment of regional planning and funding approaches.

- One-stop shopping for technical assistance - municipalities

and individuals need information and technical support to take actions to protect the resources and uses of Casco Bay. The assistance needs to be accessible.

- Long-term monitoring - Whether efforts to sustain Casco Bay's resources and benefits are effective depends on being able to measure changes over time.

- Long-term public awareness - Actively involving the public as stewards for protecting the Bay on an on-going basis is key to sustaining the Bay over time.

- Long-term funding mechanisms - Each of the above activities requires funding to implement and sustain the activity.

To build a management framework the key issues must be identified, the adequacy of the existing efforts assessed, and the functions of a structure outlined.

The Marine Law Institute Report identified other issues that could be part of the discussion of an improved management framework. These issues are not directly addressed in the action plans and are not specifically endorsed - other than that they should be part of the larger discussion. These issues include mechanisms to:

- promote regional consistency of local comprehensive plans,

- provide incentives to local governments to implement CCMP recommendations,

- provide special protection for critical areas of regional significance,

- review developments with potential regional impacts for consistency with regional management plans (e.g. CCMP),

- review state and federal programs for consistency with regional management plans (e.g. CCMP), and

- assist state and local enforcement activities.

The following action plan discusses the steps to develop an effective management framework and to secure financing for long-term management efforts.

CASCO BAY ESTUARY PROJECT

GOAL: Ensure effective management and funding in order to preserve the ecological integrity of Casco Bay and ensure the compatible human uses of the Bay's resources.

OBJECTIVE: Improve management and ensure continuing funding by identifying key issues, determining the adequacy of existing efforts, developing management and funding alternatives, and building consensus for the best practical alternative.

ACTIONS

1) **Secure local government commitment for protecting Casco Bay and implementing the final CCMP.**
A two step approach to develop agreement between towns to support protection of Casco Bay and the final CCMP will be used:

Develop a general compact between local governments which states their support for protecting Casco Bay (similar to one signed in Buzzards Bay).

Seek a series of limited agreements on specific issues between neighboring towns regarding shared resources. Gradually build agreements on small bodies of water into agreements among communities within watersheds with the goal that these interlocal agreements would lead to a regional mechanism.

2) **Secure state commitment for protecting Casco Bay and support for the final CCMP.**

A memorandum of agreement between EPA and state agencies to support protection of Casco Bay and the final CCMP will be developed.

3) **Determine key issues to be addressed.**
A structured and strategically planned process will be developed to identify key issues, using the issues in the action plans as a starting point.

4) **Determine adequacy of existing management efforts.**
Existing efforts which relate to the key issues will be reviewed to determine their ability to provide sound environmental management on a regional basis.

5) **Define the key management functions to be performed.**
New functions which need to be performed will be defined and options for carrying out these functions will be explored. Functions might include technical assistance, monitoring, education, information exchange, developing interlocal coordination and facilitating cooperation especially on issues that affect multiple municipalities. The communities should be thought of as customers and the basic management function would be to provide service, not regulation.

The feasibility of establishing an entity to provide regional coordination will be determined. The feasibility analysis should show economic benefits of regional coordination. For example, a regional approach to monitoring may be efficient and cost-effective.

6) **Establish management mechanisms and support efforts to implement changes to management framework.**

7) **Develop final CCMP.**
By the end of 1995, a final CCMP which meets the requirements of section 320 of the Clean Water Act will be developed. This plan should include a characterization report, monitoring plan, finance plan, plan for ensuring consistency of federal and state actions with CCMP, and action plans that identify the parties responsible for their implementation.

8) **Determine the level of funding needed, identify sources of funds and secure funding for:**

- implementation of CCMP.
- long-term monitoring.
- long-term public awareness.
- technical assistance.
- stormwater management infrastructure. The use of regional bond issues and establishment of stormwater management districts will be investigated.
- repair and replacement of septic systems and overboard discharges.
- regional bond issues and the use of the State Revolving Loan fund will be investigated.

FUTURE DIRECTIONS

1) Establish mechanism(s) to ensure the existence of regional coordination and ensure the implementation of the final CCMP and long-term preservation of the ecological and compatible human uses of Casco Bay.

PUBLIC INPUT FOR THE FINAL CCMP

The actions included in this preliminary CCMP outline the tasks which are to be undertaken in order to develop the final CCMP. An important element of developing the final management plan will be assuring adequate public input. This will involve creating a dialogue among the various groups and interests in the communities surrounding Casco Bay and its watershed that have a stake in the issues addressed. Through this dialogue the best approaches for addressing the issues can emerge and support for their implementation develop.

To ensure that adequate input on the final CCMP is received, the Casco Bay Estuary Project has developed the following goal, objective and actions.

CASCO BAY ESTUARY PROJECT

PUBLIC INPUT

GOAL: To assure adequate public input as the final CCMP is developed and implemented.

OBJECTIVE: Conduct a series of strategically planned meetings, forums and workshops to allow for comment by persons, groups and agencies and to provide feedback about proposed actions and recommendations.

ACTIONS

1) **To get public input on the preliminary CCMP, the Casco Bay Estuary Project will undertake a four part strategy.** The Casco Bay Estuary Project will:

- meet with groups of stakeholders to explain the preliminary CCMP, get comments, and seek opportunities for cooperation. The list of groups will be developed by the Citizens Advisory Committee.

- hold a public forum in October, 1992 to explain the preliminary CCMP and get feedback.

- present comments from the meetings and forum to the Management Committee. The Management Committee will review the comments and make any improvements to the preliminary CCMP that are needed.

- hold stakeholder roundtables to bring together those people who would be responsible for implementing CCMP actions and future directions. The roundtables will be used to plan implementation strategies.

- develop strategies, by September 1993, that outline the next steps in addressing

priority issues in the CCMP. These strategies will detail the next actions to be taken for input and implementation.

2) **To get local government input on the preliminary CCMP, the Casco Bay Estuary Project will undertake a four part strategy.** The Casco Bay Estuary Project will:

- meet with all the towns in the watershed to explain the preliminary CCMP, get comments and seek opportunities for cooperation.

- hold a municipal forum in the winter of 1993 to allow municipalities to talk with each other about the preliminary CCMP and get feedback.

- present the comments from the meetings and forum to the Management Committee. The Management Committee will review comments and make any improvements to the preliminary CCMP that are needed.

- hold expert roundtables. These will bring together those people who would be responsible for implementing CCMP actions and future directions. These roundtables would be used to plan implementation strategies.

- develop strategies, by September 1993, that outline the next steps to address the priority issues in the CCMP. These strategies will detail the next actions to be taken for input and implementation.

3) **The staff of the Casco Bay Estuary Project will be responsible for coordination between the public outreach and local government efforts.**

4) **Appropriate state and federal agencies will be canvassed to determine what activities are being undertaken or could be undertaken to support the preliminary CCMP.**

5) **Public input will be requested on work products developed as a follow-up to the preliminary CCMP.** These include: prioritization of closed shellfish beds, the feasibility of a wastewater management district study, critical regional habitat maps, proposed regulatory and nonregulatory approaches to habitat protection, pollutants of concern maps and the long-term monitoring plan. Input would be requested from groups or people that might be affected by the proposed delineations or actions.

6) **Conduct an assessment of the success of strategies used to get input on the preliminary CCMP in time to be used to develop a strategy for public input on the final CCMP.**

FUTURE DIRECTIONS

1) **Develop consensus on the actions proposed in the final CCMP.**

MEASURES OF SUCCESS

BACKGROUND

To successfully protect Casco Bay we must be able to measure the success of our actions to protect the Bay.

An important piece of attempting to protect Casco Bay over the long run is being able to measure the success of the actions taken to protect the Bay. There are three aspects to measuring success:

1) Measuring whether the actions have been taken;

2) Measuring whether taking the actions achieved the intended results;

3) Measuring the health of the Bay over time.

It is important to understand the limits of the ability to measure success. Measuring whether an action was taken is fairly easy. However, it is more difficult to measure to what extent it achieved its intended results, and more difficult still to measure how these results affect the health of the Bay.

The difficulty in measuring success is also related to the type of activity. If the activity is straightforward, measuring success can also be straightforward. For example, if the action is identifying critical habitat, one can count the number of habitats identified.

However, if the activity is process oriented, measuring success can be more difficult. For example, if the activity is to provide a model ordinance, one can measure whether the ordinance was provided, and measure how many municipalities adopted the ordinance. However, it is extremely difficult to measure how the adoption of the ordinance affects the health of the Bay.

Measures of success were identified for each action plan. These include the three types of measures mentioned above. These measures are outlined here by action plan.

Minimize impacts from development and land and marine use

1) Critical regional habitats have been identified, mapped on GIS and the resulting information disseminated.

2) Regulatory and nonregulatory measures have been developed and disseminated.

3) The number and effectiveness of regulatory and nonregulatory measures that are in place to protect the viability of critical habitats including closing gaps in protection.

4) The number of municipalities that are protecting the viability of critical habitats and the effectiveness of their programs.

5) The number of acres of critical regional habitats that have been protected including the number of land banks and the number of conservation easements.

6) The changes in the quantity and quality (viability) of critical regional habitats.

Minimize impacts from stormwater and combined sewer overflows

1) A coordinated technical assistance program exists.

2) The number of towns that have BMP provisions in their ordinances and the effectiveness of implementation of the ordinances.

3) The number of towns that are participating in an intermunicipal stormwater control program and the effectiveness of the program.

4) Water and/or sediment quality measurements are assessed as part of the long-term monitoring plan.

Minimize impacts from individual wastewater treatment systems

1) The existence of municipal or intermunicipal wastewater management district(s).

2) The existence of a coordinated technical assistance program.

3) The number of overboard discharges that are eliminated.

4) The number of failing septic systems that are repaired or replaced.

5) The number of acres of shellfish beds that are reopened.

6) The changes to and effectiveness of the state plumbing code as it relates to coastal areas.

Determine the effects of existing sediment contamination

1) A scientific review team exists with a mechanism for receiving new data, conducting peer reviews and disseminating comments.

2) A mechanism or entity is in place to respond to newly identified significant contamination problems.

3) A long-term scientific monitoring plan has been produced and is being implemented.

4) Trends in sediment quality over time are assessed as part of the long-term monitoring plan.

Promote public stewardship

1) Number of public outreach events and number of people attending.

2) The existence of a coordinated program with other outreach groups that keeps each group

up-to-date on activities and shares resources.

3) The existence of a package of public outreach materials (either developed by the Casco Bay Estuary Project or by others) that educates the public about issues of concern to the CBEP.

4) Public service announcements and cable television program(s) aired on television and radio.

Ensure public input

1) The number of groups and municipalities participating in and providing feedback to Casco Bay Estuary Project.

BUILDING THE FUTURE

The efforts of the Casco Bay Estuary Project to protect the ecological integrity of Casco Bay and the compatible human uses of the Bay begin by addressing the issues outlined in the action plans -- the five priority issues, developing regional management and funding options, ensuring there is adequate public input in developing final management recommendations, and developing ways to track what works and what doesn't. If the CBEP is effective in addressing these issues, it will be able to go forward and address other issues facing Casco Bay.

The success of the CBEP's efforts will depend on developing a broad based discussion of the issues facing Casco Bay. If the CBEP is able to build a sustained dialogue and use the dialogue to develop the best approaches to address these issues, it will have taken important steps toward developing a comprehensive management approach for Casco Bay. The dialogue should become the foundation for making the final CCMP a living document which can continue to address the important issues facing Casco Bay into the future.

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