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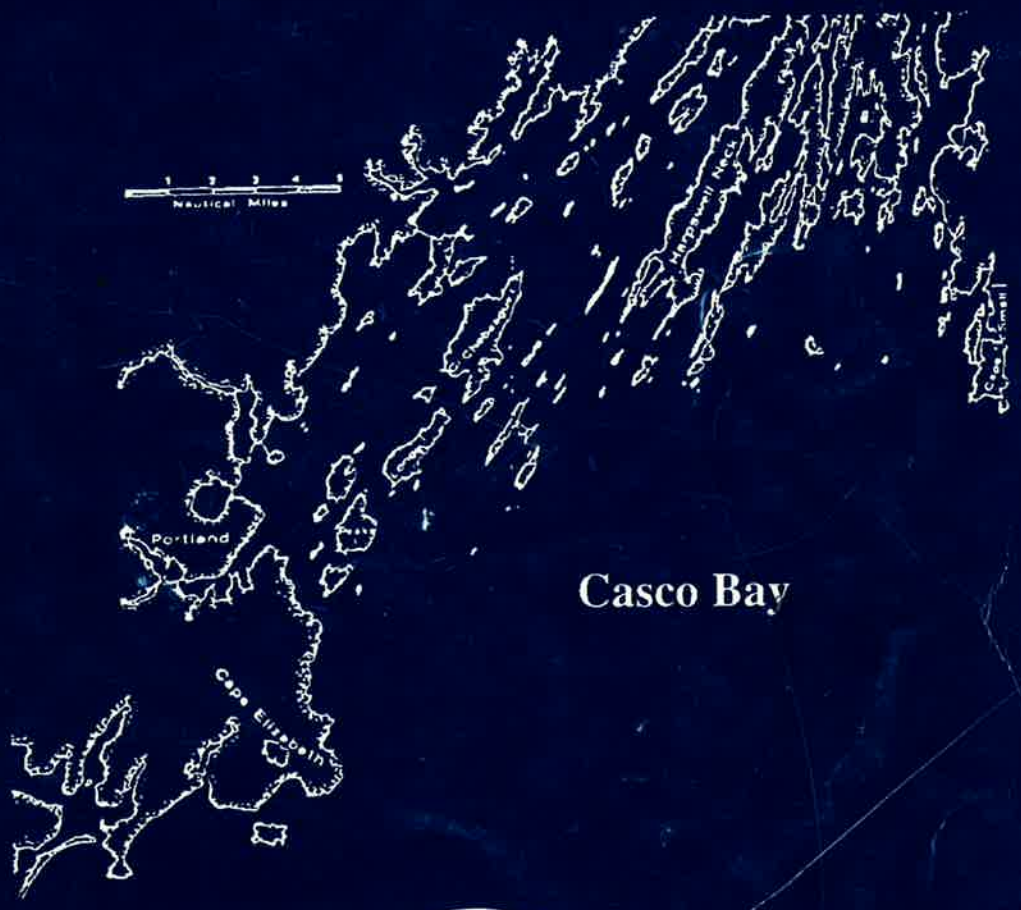
Agenda For Action - Casco Bay

Department of Environmental Protection

AGENDA FOR ACTION



Casco Bay

Department
of
Environmental
Protection

Augusta, Maine
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INTRODUCTION

Casco Bay contains a rich assortment of natural resources and physical features which make this body of water one of the most widely used areas north of Boston. Spanning a distance of about 20 miles, from Cape Elizabeth on the west to Small Point on the east, Casco Bay covers an area of about 150 square miles. Around the bay's immediate perimeter live almost 150,000 of Maine's year round population and almost 240,000 people live in its watershed. This portion of Maine's coast is one of the more rapidly growing areas in the State. Casco Bay, with its deep water, many islands, rich fishery, apparently clean water, and ample space for its many water oriented activities, continues to draw people to its shores to locate their residences, business, and industry.

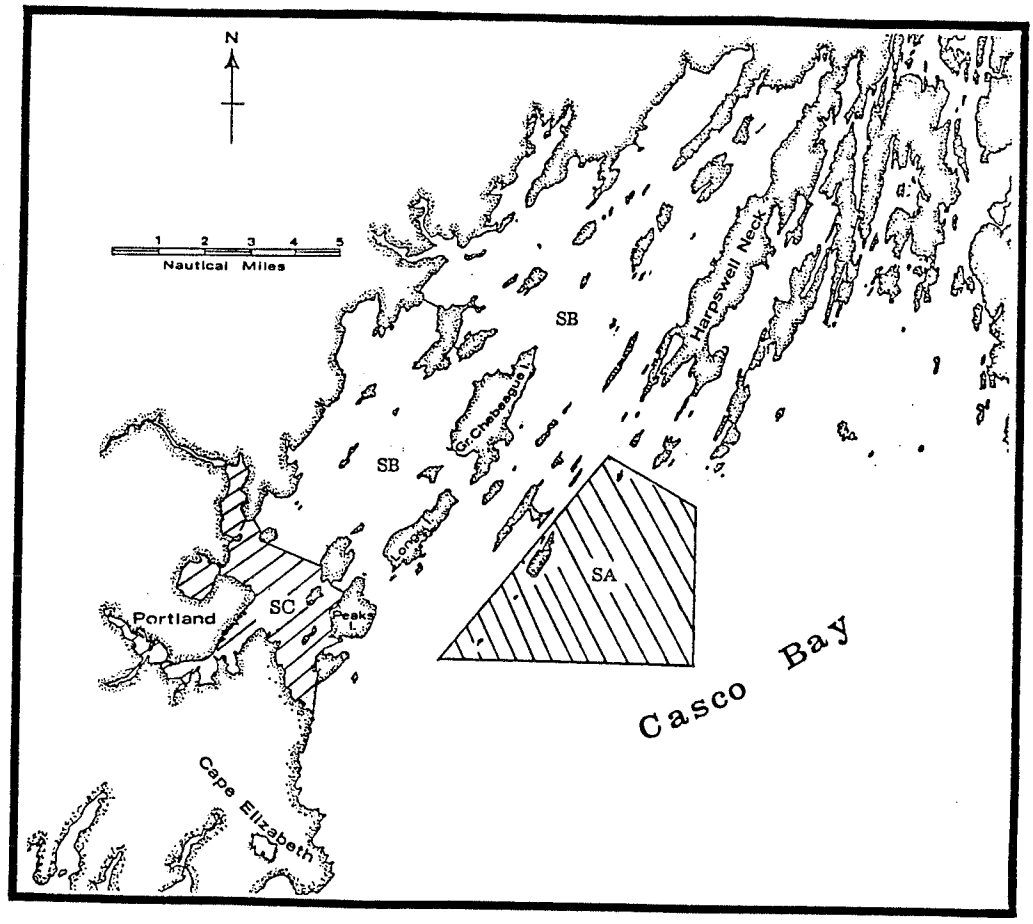
As Maine moves into the 1990's, demands on the bay from an increased population threaten the very qualities of Casco Bay which drew people there in the first place. Impacts associated with growth must be managed if that quality of life and its environment are to be preserved. Already, there are several indications that the environmental quality of Casco Bay has suffered. Data from a wide array of sources point to the conclusion that pollution has affected Casco Bay to the degree that some of its uses are impaired. This paper is intended to draw together information on the present status of Casco Bay; its uses, environmental condition, documented problems and potential threats. Finally it will identify steps which may be taken to remedy those problems and prevent new ones.

USES AND CLASSIFICATION OF CASCO BAY

The State of Maine manages its surface water through the Water Classification Program (MRSA Title 38 Article 4-A). Marine waters are divided into three classes; SA, SB, and SC (Figure 1). SA waters are those outstanding marine waters which should be preserved in their natural condition. In Casco Bay, the water around State public lands such as Jewell and Eagle Islands are SA. SB waters are marine waters of truly general multiple use and comprise 95% of Casco Bay. The third class of water, SC, is considered to be more oriented toward commercial and industrial activities such as are found in Portland Harbor. SC waters nevertheless must meet the minimum criteria of "fishable/swimmable" according to State law and the federal Clean Water Act. Attainment of classification is largely achieved through the regulation of waste discharges and land use activities. For example, all waste discharge licenses and Board Orders permitting land use changes are written to protect or restore the legislated classification of downstream receiving waters. How well the permittee complies with conditions of the license largely determines how well a receiving water's classification is maintained. Even then, however, attainment may not

Figure 1

SURFACE WATER CLASSIFICATION OF CASCO BAY, MAINE



exist due to a number of uncontrolled problems such as atmospheric deposition, non-point source pollution, accidents and illegal dumping.

COMPARISON OF CASCO BAY TO OTHER POLLUTED COASTAL WATERS

Recent news articles and independent reports have compared the problems in Casco Bay to those of infamous areas such as Boston Harbor, Long Island Sound, and Narragansett Bay. While such comparisons generate significant attention, no real perspective of Casco Bay is gained. Physically, chemically, and biologically, Casco Bay is not comparable to these aforementioned waters. More importantly, impacts and potential threats to Casco Bay are significantly less. Population density in Casco Bay's watershed is 10% that of Boston's and the body of water itself is 250% larger in area and 400% larger in volume (Table 1).

Table 1

PHYSICAL AND DEMOGRAPHIC COMPARISON OF CASCO BAY WITH OTHER BAYS IN THE NORTHEAST U.S.

	AREA	DRAINAGE AREA	TIDAL VOLUME	TOTAL VOLUME
	(areas in sq. mi.)		(volumes in millions of cu. ft.)	
CASCO BAY	152	979	41	191
BOSTON HARBOR	65	682	18	50
NARRAGANSETT BAY	157	1151	17	139
LONG ISLAND SOUND	1268	5693	133	2190

	POPULATION (1985)	DENSITY (per square mile)	URBAN AREA (square miles)
CASCO BAY	251000	256	141
BOSTON HARBOR	1913000	2805	362
NARRAGANSETT BAY	1232000	1070	294
LONG ISLAND SOUND	5485000	963	1418

Unlike Boston, New York, and Providence, the economy around Casco Bay and Portland in particular is service oriented as opposed to traditional "heavy" industry which is generally viewed as having more deleterious environmental effects. Not only is the total volume of wastes less in relation to the waterbody, but the mix of wastes is less industrial.

THE PROBLEMS

Pollution in Casco Bay is for the most part invisible. Unlike our rivers and lakes, today's coastal pollution does not attract attention. With few exceptions, locally produced noxious scums, odors, and solids are less of a problem in Casco Bay than 15 years ago. The obvious problems have been addressed leaving the general impression that all is well. Recent discoveries and reports indicate otherwise. Casco Bay is not pristine.

Information on the status of Casco Bay pollution has been summarized by the Conservation Law Foundation Report on Casco Bay (1988). There is no need to repeat its contents in great detail. The information was collected primarily from two sources; NOAA (1988) and Larsen (1984). The NOAA data set is too limited to allow a full characterization of Casco Bay since there were only three sediment, two mussel, and one fish tissue sample station.

Larsen's data, on the other hand, was from a set of 30 stations and does a fairly good job at characterizing Casco Bay's sediments as a whole and identifying specific problem areas. Table 2 shows the constituents discovered by NOAA and Larsen as sufficiently elevated in Casco Bay to be of concern. Of those, several have potential serious ecological and/or human implications. The problems will be discussed separately below, but due to the intertwined nature of sources, the solutions will be looked at separately. One should note that toxic materials are not reported from the water column. In contrast to freshwater systems, salt water reacts with many chemicals causing them to precipitate to the bottom; hence the illusion that pollution is absent.

Table 2

POLLUTANTS IDENTIFIED BY CONSERVATION LAW FOUNDATION IN DIFFERENT MATRICES OF CASCO BAY

WATER COLUMN	SEDIMENTS	MUSSELS	WINTER FLOUNDER LIVERS
BACTERIA	CHROMIUM	LEAD	COPPER
	COPPER	PAHs	LEAD
	LEAD		SILVER
	NICKEL		ZINC
	ZINC		PCBs
	PAHs		
	PCBs		
	PESTICIDES		

Pollutants are many and emanate from both point and non-point sources. It is equally important to understand that **sources are natural as well as man-made.** The Gulf of Maine in which Casco Bay sits, contains one of the most productive areas of ocean in the world. Nutrients from the open Gulf are exchanged with Casco Bay twice a day along with naturally derived metals from offshore sediments. To disregard these natural inputs makes it impossible to place man generated sources into perspective.

BACTERIA

THE SIGNIFICANCE

Bacterial pollution is probably the form of pollution in Casco Bay evoking most public response yet ironically has one of the least significant ecological impacts. Presence of human bacterial pollution is important, however, in that it is an indication that human pathogens, including viruses, could be present. Contact with pathogens through ingestion of water, food, or swimming may result in illness. Detecting pathogens in water is far less likely than detecting other more abundant bacteria associated with those pathogens. For this reason, the Food and Drug Administration and the State of Maine have water quality standards based on indicator organisms which are not generally considered pathogenic. When the standards are exceeded, uses such as shellfish harvesting or swimming, are either banned completely or greatly restricted. In either case, the result is an impairment of that water body and loss of use to the population.

Frequently associated with that impairment is the cost to former users as well as a loss of revenues by the fishing and tourism related industries. Although Maine law expressly prohibits discharges which results in closure of shellfish areas or cause unacceptable risks to swimmers, closures and violations of standards are in fact common. For example, the Maine Department of Marine Resources estimates that state wide 27% of the area of shellfish flats is closed due to pollution. In Casco Bay, that figure is probably somewhat higher. During the summer of 1988, the Maine Department of Environmental Protection monitored 8 areas around Greater Portland for enterococci, the swimming standard indicator organism, and found that 7 of the 8 areas exceeded swimming standards for SC waters at least once during the summer. Included in this sampling was East End Beach, Portland's single public beach.

SOURCES

Assessment of bacterial pollution is extremely complicated since it derives from many sources, both man made and natural, and the indicator organisms are less than ideal. For example, Klebsiella sp. is a bacterium which digests cellulose. It is abundant in pulp and paper wastewater treatment plants and considered part of the treatment process. Klebsiella sp.is also one of the organisms included in the total and fecal coliform test used for shellfish testing yet closures do not take this into account. The policy is one of erring on the side of safety which is appropriate but at

the same time somewhat misleading in terms of environmental quality.

1-Sewage Treatment Plants

Within Casco Bay are 7 municipal sewage treatment plants licensed to discharge a cumulative volume of 35 million gallons/day. To date, about $100 million has been spent for treatment plant construction and another $6 million is projected to be spent in the near future. Performance of these, and for that matter any treatment plant, is less than perfect. For example, the City of Portland's treatment plant exceeded its license limit about 50% of the time it was sampled during 1987 and 1988. In some areas, such as Boston, this is a result of the user population outgrowing the plant's capacity. In Casco Bay, this is not the case. All sewage treatment plants have been recently built or rebuilt to meet the demands of the population served. While the normal daily discharge quality can be greatly improved through enforcement of license conditions, improvements in Casco Bay will probably not be noticed until the many other sources of bacteria are controlled. Several of these sources follow.

2-Combined Sewer Overflows

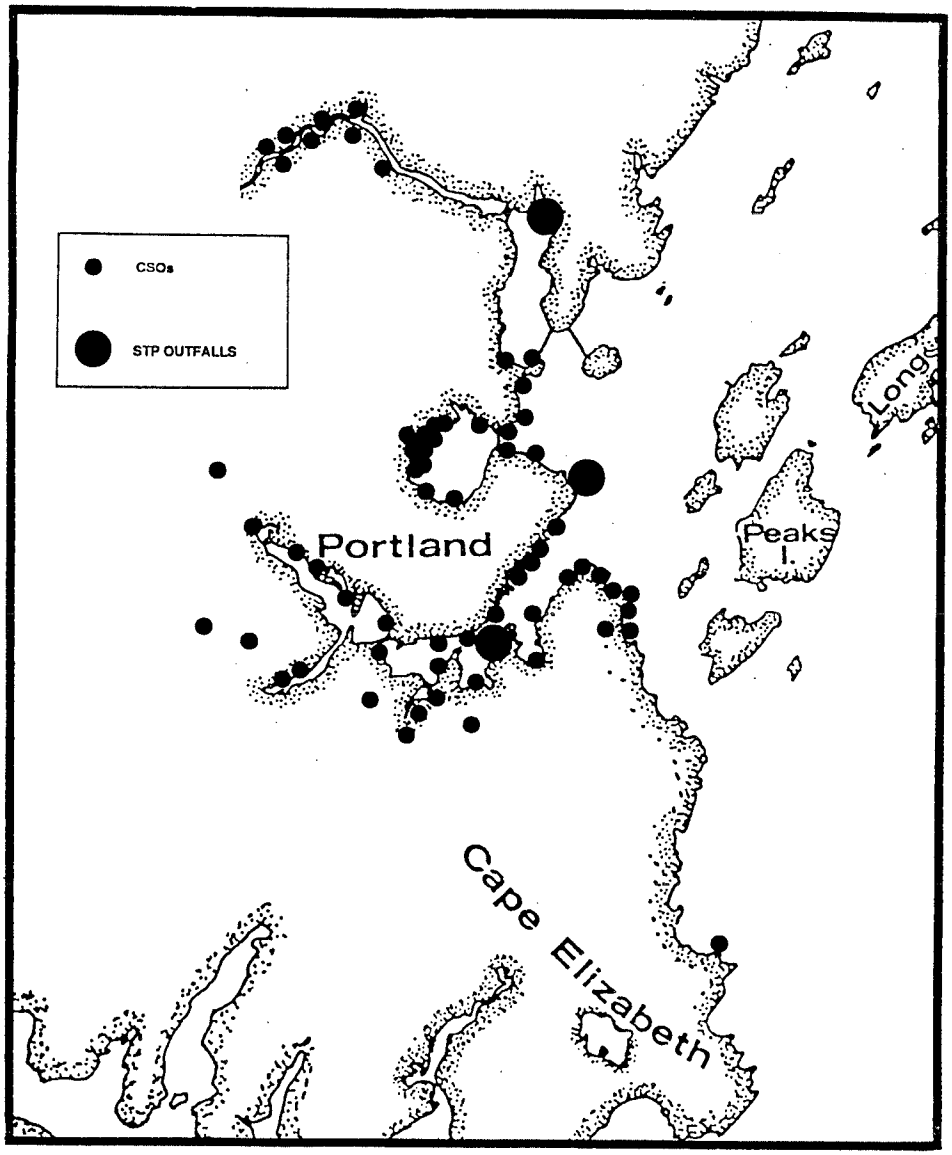
Before sewage treatment plants, Greater Portland's waste stream ran directly into storm sewers and then directly into Casco Bay. To reduce construction costs, those sewers were intercepted and directed to the new treatment facilities. Since sewage treatment plants are "sized" to efficiently treat waste flows from a certain size population, an increase in flow beyond design capacity results in an overloading or flushing out of the plant. To avoid this, combined sewer and storm water systems are engineered to bypass excess water around the treatment plant to preserve design flows. The result is a release of untreated wastewater into downstream waters, in this case Casco Bay. Each time it rains and when snow is melting, an unknown quantity of street runoff and raw sewage flows into Casco Bay through some or all of the 75 combined sewer overflows located around the bay (Figure 2). With the overflow water is the domestic waste of a large part of Greater Portland. Combined sewer overflows are very likely the largest source of bacteria to Casco Bay since untreated sewage contains many orders of magnitude greater numbers of bacteria than those found in routine discharge violations. Combined sewer overflows probably explain the violations of bacteria standards in most of the 7 areas tested in 1988, including East End Beach which is immediately adjacent to a combined sewer overflow discharge point.

3-Single Family Overboard Discharges

Around Casco Bay are about 350 single family sewage systems each licensed to discharge about 300 gallons of sewage per day. Single family overboard discharges were allowed in the past due to the impracticality of connecting to a distant sewer and with the understanding that the discharge would be adequately disinfected. Maine Department of Environmental Protection data indicate that most private systems are not properly maintained and result in a discharge of human

Figure 2

COMBINED SEWER OVERFLOW AND MUNICIPAL SEWAGE TREATMENT PLANT OUTFALLS IN INNER CASCO BAY



bacteria to state waters resulting in the closure of shellfish beds and localized violations of swimming standards. In 1987, the Maine Legislature prohibited the construction and use of new overboard discharge systems and required the gradual phaseout of existing systems. The exact contribution of overboard discharges to the overall problem is not known, however, it is likely that they result in an expansion of the zone of impact due to their wide spread distribution.

4-Boating

Casco Bay is home to about 5000 boats (Table 3). Only three pumpout facilities exist to serve them. The impact of these boats has never been quantified, however, the potential for localized contamination and ecosystem effect is real. While federal law requires that holding tanks be used, it is generally accepted that few boaters actually use them. In areas where boats are concentrated near shellfish areas such as in the Harraseekett and Royal River, boating may well be the source of sufficient bacteria to at least partially explain closure of those shellfish harvest areas.

Table 3

RECREATIONAL BOAT USE OF WESTERN CASCO BAY

	NO. MOORINGS	NO. SLIPS	LAUNCH USE (weekly)	PUMPOUTS
SOUTH PORTLAND and PORTLAND	1000	1500	≈220	≈1
FALMOUTH	1000	No Data	≈100	0
YARMOUTH	160	334	≈200	1
FREEPORT	485	95	No Data	2

5-Stormwater Runoff

Storm and melt water runoff contain bacteria from many different sources. Malfunctioning and illegal domestic waste systems, spills of sanitary wastes, animal feces, and sewer backups all contribute to bacterial contamination. Portland Harbor is particularly susceptible to runoff pollution because of the concentration of human activities within the watershed and great abundance of pavement that prevents runoff from soaking into soils where the bacteria are held. Some studies (Field, R. and A. Tafuri, 1973) suggest that the bacteria concentration in storm water runoff is equivalent to that found in raw sewage.

TOXICS

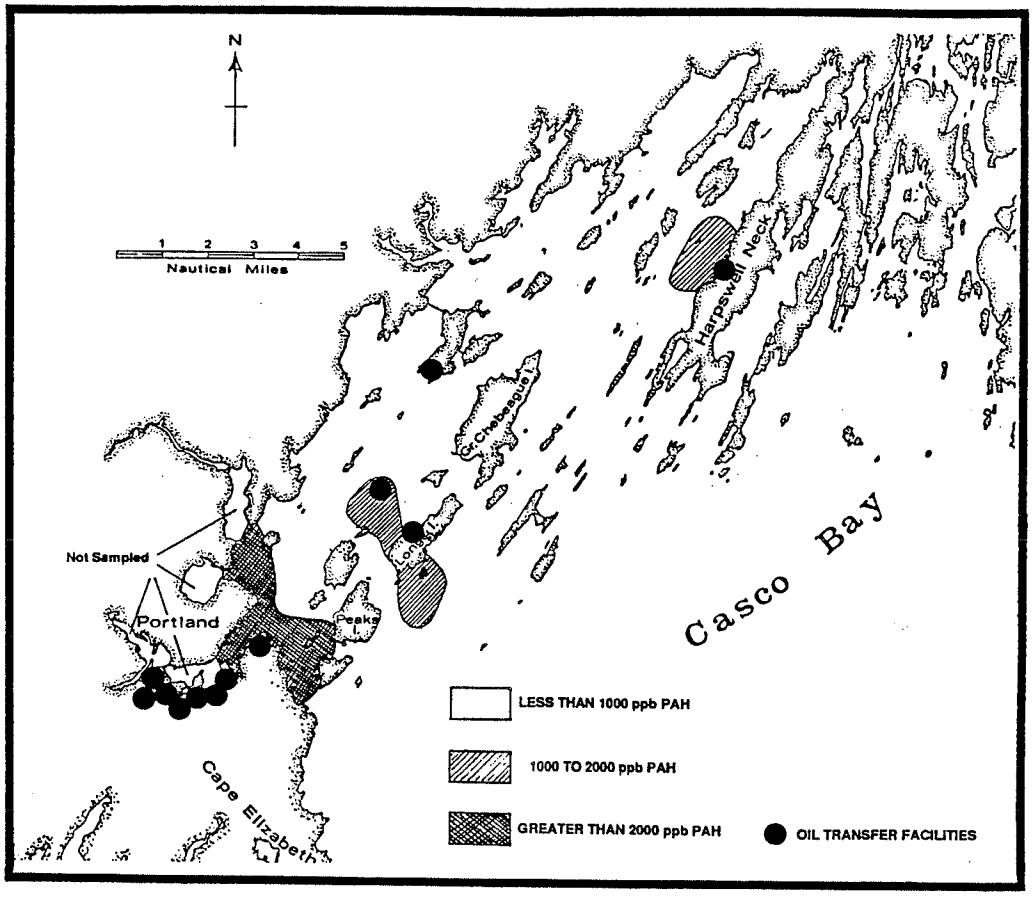
THE SIGNIFICANCE

Of a more serious ecological nature than bacteria is the threat of pollution by toxic materials such as heavy metals, chlorine, PCBs, PAHs, pesticides, dioxin and other organic compounds. **Lead** is now known to be far more dangerous to human health than formerly thought. In the human, for example, it causes brain damage and nervous disorders. EPA recently lowered the lead standard in drinking water from 50 to 20 µg/l in recognition of its toxicity. While Casco Bay's water is not used for drinking, lead has been found in the food chain. In fact, flounder livers collected from Casco Bay contained the highest level of lead of any in a national survey (NOAA,1988). **PAHs** (polynuclear aromatic hydrocarbons) are a group of fossil fuel compounds which include the known carcinogen benzo-a-pyrene. Larsen's work showed that levels in Casco Bay sediments were high, primarily around oil handling facilities (Figure 3). **PCBs** (polychlorinated biphenyls), known to be carcinogenic, were also found by Larsen and NOAA in Portland Harbor sediments and NOAA found that flounder livers collected in outer Casco Bay were also contaminated with PCBs. **Copper, zinc, and silver** also were found in relatively high concentrations in NOAA's flounder liver survey. While at levels below those of human health concern, these materials can nevertheless be extremely toxic to marine life causing ecological stress in the form of community structure disturbance and reduction in growth and reproduction at the species level.

The presence of toxic materials in fish tissues is of concern because it means that the material is biologically available. While the direct threat to human health through the food chain may be obvious to most people, the ecological consequences are less clear. Assessment of the seriousness of the problem is difficult, however. Few toxic materials have had "maximum safe levels" established for matrices (ie. sediments and tissues) other than water. The mere presence of lead in sediments, for example, means very little unless it can be related to biological activity. In order to place the information in any meaningful perspective, knowledge of sediment type, chemistry of overlying water, chemical form, and metabolic breakdown processes and products of the pollutant must be known. Without this understanding, one knows very little of a material's toxicity. To be safe, however, it is the policy of the Department of Environmental Protection to prevent the further accumulation of any pollutants in the environment unless, or until, factual information is available to support a change in that policy. To prevent accumulation of pollutants, identification of sources is mandatory.

Figure 3

POLYCYCLIC AROMATIC HYDROCARBON CONCENTRATIONS IN CASCO BAY SEDIMENTS AND OIL TRANSFER FACILITIES



SOURCES

1-Industrial Discharges

Around Casco Bay and within its watershed are several industrial discharges. The largest, S.D. Warren Company of Westbrook discharges 21.6 million gallons per day of treated pulp and paper process waste. The primary pollutant found in this discharge is carbonaceous organic matter which by itself is non-toxic. Toxic materials such as heavy metals, however, are found in the effluent. Although the concentration of toxic materials is low enough to avoid problems in the river water, because of the large volume of wastewater, the actual load delivered to Casco Bay may be significant.

Similarly, Central Maine Power Company's electric power generating facility on Cousins Island discharges approximately 35 million gallons of cooling water each day. The concentrations of heavy metals such as copper is relatively low, however, the load may again be significant. Chlorine, a material generally accepted as beneficial because of its disinfectant qualities, is extremely toxic to aquatic and marine life. The Central Maine Power Company plant in Yarmouth routinely exceeds (2.0-3.8 milligrams per liter) its license limit (1.0 milligrams per liter) for this parameter.

In addition to the large industries which discharge directly to State waters, there are about 130 others which discharge indirectly through a municipal sewage treatment plant. Seven of these have wastes of sufficient quality to require pre-treatment before they are passed on to the sewage treatment plant.

Sewage treatment plants in the Casco Bay watershed are designed to remove solids, bio-chemical oxygen demand and bacteria. They are not designed to eliminate toxic materials. While much of the metals and some of the organic pollutants are removed coincidentally in the sewage treatment process, an unknown quantity passes through the facilities to Casco Bay. Monitoring of these materials is not normally part of a license condition.

2-Boating

Of the 5,000 boats berthed in Casco Bay and the 500 large transient vessels per year passing through Casco Bay, virtually all use toxic materials. Bottom paints to prevent the growth of fouling organisms, sacrificial zinc anodes and red lead paints to prevent corrosion, disinfectants for holding tanks and bilges, and motor oil and gasoline or diesel fuel for motors are commonly associated with boating. Tri-butyl tin (TBT), an effective anti-fouling ingredient of bottom paints, has been found to have severely toxic effects. In France, TBT based bottom paints were found to be directly linked to the decline of the lucrative oyster industry. France subsequently banned the use of TBT. Although TBT has recently been restricted in Maine, the effectiveness of the law is uncertain. Monitoring and enforcement is virtually non-existent.

Bilge water is often contaminated with fuel, oils, and chemical cargoes and cleansers spilled on and washed off the deck are regularly pumped into the water. No information is available on the quantity of such materials introduced into Casco Bay.

3-Petroleum Conveyance

About 80% of all petroleum products handled in Maine are handled through Casco Bay . Twelve facilities exist in the bay (Figure 3), most of which are adjacent to the Fore River. Larsen et al. (1983b) showed that PAH contaminated sediments corresponded closely with oil terminals and shipping lanes. While spill prevention and recovery procedures have improved greatly since the 1970s, spills continue to occur and oil continues to visibly seep from ground adjacent to terminal facilities. While it is probably not likely that levels of unburned petroleum products in Casco Bay's environment are increasing (oil transport has declined and spill prevention and containment improved since the 1970s) it is not known whether the levels of combusted petroleum products like PAHs are declining or remaining stable with the increased population.

4-Stormwater Runoff

Bacteria is not the only pollutant in stormwater runoff. Pesticides, heavy metals, motor oil, solvents, and other toxic compounds are abundant, especially in stormwater off urban areas such as Greater Portland. Lead from automotive burned and unburned fuels and crankcase oil, and zinc from galvanized culverts and rubber tire wear washes off highways, roads, and parking lots into storm drains and ditches leading to Casco Bay. Insecticides, herbicides, and fungicides wash off residential lawns, golf courses, and parks. Household chemicals improperly disposed of in streets or yards include a variety of toxic materials such as old paints, thinners, disinfectants, cleansers, and degreasers to name but a few. Little information exists, however, to permit environmental managers to know the relative importance of each of these non-point sources although data from other areas of the country suggest that the contribution of pollutants through such sources equals or exceeds that from point sources.

Analysis of dredge spoils collected adjacent to activities such as boat yards, shipping terminals, and industry located on the water indicates accumulation of lead, chromium, cadmium, zinc, hydrocarbons, and other organic pollutants. Sanded and sandblasted paints, composites, and metals such as zinc, chromium, copper, and lead are presumed to contribute to local sediment pollution.

Snow dumps, such as the one on Portland's Back Bay are in effect concentrating winter stormwater in one small area. Preliminary sampling of the pile during 1988 indicates that as much as 1500 pounds of lead may be included in the pile, virtually all of which washes into Back Bay in melt water. Further investigation is needed to determine the environmental impacts of this

method of snow disposal, not only in Casco Bay but state wide.

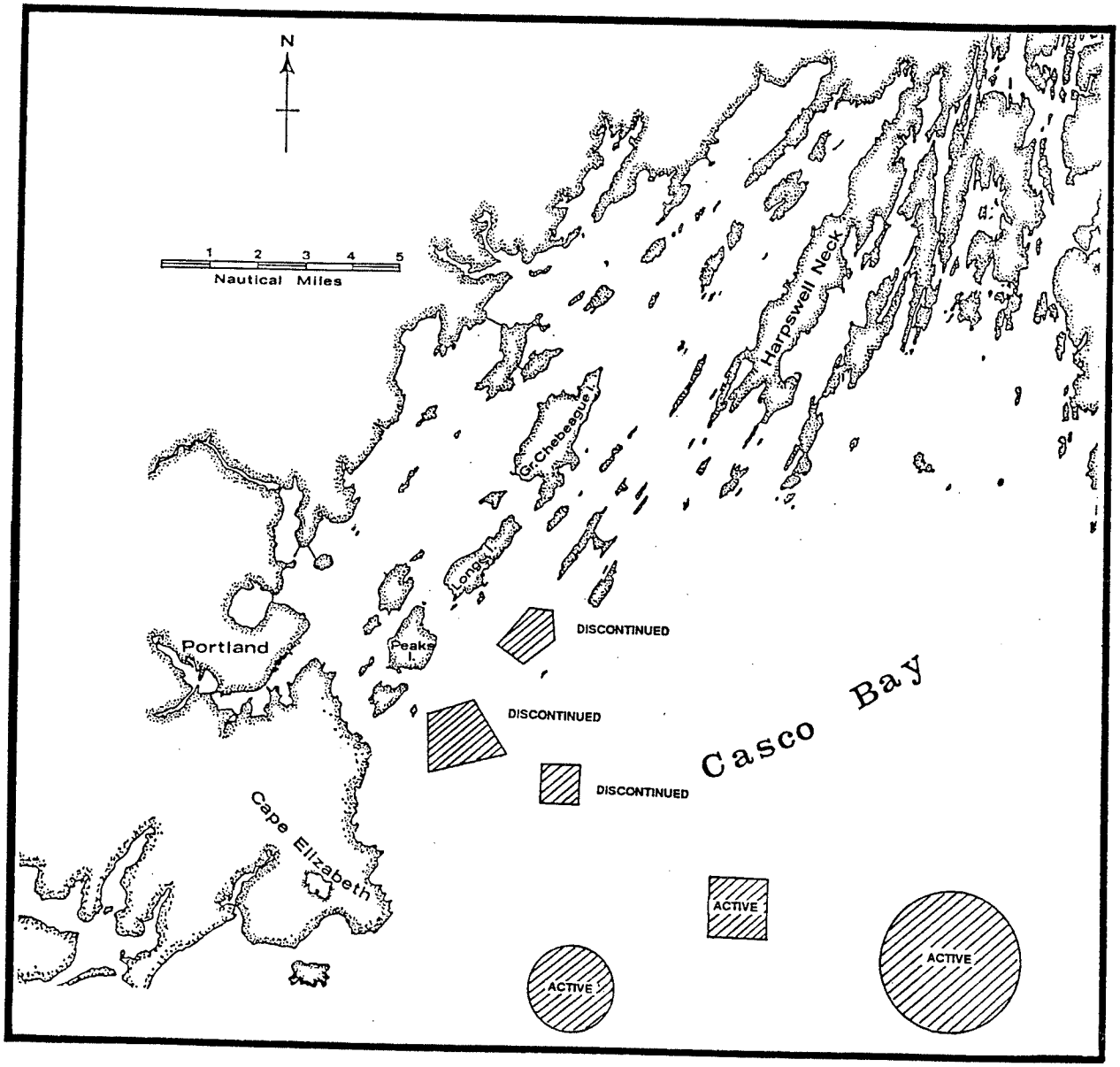
Atmospheric deposition is included in this category although some of it falls directly into Casco Bay. Very little local data exists to assess the contribution of pollutants to Casco Bay from the atmosphere, although for some parameters, such as lead, it appears that improvements are in hand. For example, Maine Department of Environmental Protection (1987) data show a reduction in the annual arithmetic mean concentrations of atmospheric lead in Portland from 0.29 µg per cubic meter in 1982 to 0.07 µg per cubic meter in 1987. Total suspended particulates over that period remained unchanged, however, indicating that lead may be an exception.

5-Ocean Disposal of Dredge Materials

Six ocean disposal areas exist within Casco Bay relatively close to shore. Three sites located in shallow water have been discontinued while three in deeper water (100 ft.) are active (Figure 4). No information exists on the contribution of these disposal areas to Casco Bay's pollution problem although it is known that polluted sediments can be a significant source to surrounding areas through resuspension and transport and biological uptake and transfer through the food chain. Problems can therefore extend beyond the limits of the disposal areas. In fact, NOAA's outer Casco Bay "control" station is very close to the Bigelow Bight Industrial Disposal Area which contains dredge spoils from at least Portland Harbor. The elevated PAH and metal levels encountered may likely be "echos" of Portland Harbor.

Figure 4

OCEAN DISPOSAL AREAS IN CASCO BAY



NUTRIENTS

THE SIGNIFICANCE

Not heretofore addressed by NOAA, the CLF, or the media, the issue of nutrient enrichment is of concern. In other estuaries such as Narragansett Bay, Chesapeake Bay, and Long Island Sound, eutrophication has resulted in several serious problems including shifts of phytoplankton species to toxin producing forms causing "red tides", oxygen depletions resulting in fishkills, and esthetic impairment similar to that produced by algae blooms on several Maine lakes. There exists some opinion that the recent shellfish dieoff in Maquoit Bay at the western end of Casco Bay may have been related to localized nutrient enrichment leading to blooms of a phytoplankton species known elsewhere to be associated with pollution. In marine systems, availability of nitrogen is generally the factor limiting plant growth. NOAA (1988) estimates that about 1400 tons of nitrogen are discharged each year to 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.

SOURCES

1-Domestic wastewater from sewage treatment plants, faulty septic systems, and overboard discharges are a major contributor of nutrients in general and nitrogen in particular. While some treatment plants are designed to remove nitrogen it is extremely expensive and no plant in Maine does so. The NOAA Northeast Case Study (1988) estimates that about 408 tons of nitrogen per year is discharged to Casco Bay from sewage treatment plants.

2-Industrial Discharges are estimated to account for about 343 tons of nitrogen discharged per year (NOAA, 1988). In Casco Bay this is mostly from S.D. Warren Paper Company, about 6 river miles upstream or about one day's time of travel to head of tide in Casco Bay (Mitnik, 1980).

3-Non-Point Sources include agriculture and forestry operations that are estimated to contribute about 393 tons of nitrogen per year to Casco Bay's watershed. Not included in NOAA's estimate is the amount of nitrogen fertilizer applied to and lost from residential areas and golf courses.

4-Atmospheric Deposition has been implicated in the eutrophication of Chesapeake Bay. Fisher et al. (1988) estimate that one quarter of all nitrogen inputs into the Chesapeake and other Atlantic Ocean coastal waters is from atmospheric nitrate deposition.

THE SOLUTIONS

PRECAUTIONS

From the preceding discussion, it should be clear that pollution in Casco Bay is packaged in many forms and comes from many different and diffuse sources. Corrective actions will be costly. To separate stormwater from combined sewer overflows is estimated to cost from $100,000 in Cape Elizabeth to $174.5 million in Portland, but simple separation may not be the answer. The complex nature of the problem requires extreme care when planning correction of the problems to avoid trading one problem for another. For example, to single out bacteria as the priority and proceed to separate storm water from the combined sewer overflows may appear to solve the problem of bacterial pollution, but it would result in an increased loading of toxic materials and may still not remove sufficient bacteria because of the storm and meltwater runoff sources.

It is also necessary to be alert to the fact that the relatively easy steps have been taken to control pollution. Treatment plants have been built to process and cleanse concentrated wastes. Today's form of pollution is diffuse. It includes stormwater runoff from large areas of land and atmospheric deposition which may be a result of human activity thousands of miles away. This "non-point" pollution is estimated to at least equal and perhaps exceed that from all "point" sources combined. Innovation and forward thinking are the tools necessary to meet this new challenge.

MONITORING is critical to obtaining accurate information upon which decisions are made. Most information on Casco Bay's pollution load is based on models developed from other areas of the world. While models are useful in pointing out general areas of concern, they are not adequate for effective expenditure of millions of dollars to solve problems. Neither do models account for natural inputs of materials. Monitoring information should properly include both anthropogenic as well as natural sources.

Monitoring should not focus solely on chemistry but include physical and biological parameters. A physical understanding of Casco Bay's hydrodynamics is necessary for modelers to determine flushing rates, currents, pollutant trajectories. And a knowledge of biological communities existing in Casco Bay is necessary if we are to determine whether application of models, discharge requirements, and regulations are effective.

ENFORCEMENT of waste discharge licenses is necessary to predict and properly manage pollutants in Casco Bay. Licenses are written to avoid use impairment through consideration of the capacity of any downstream water to assimilate the wastes. Compliance with these license limits in large part determines how well water quality management goals are attained.

LICENSING waste discharges has changed dramatically over the past several years. So-called "conventional pollutants" like dissolved oxygen, pH, bacteria, and solids have been the focus of most discharge licenses. Today, other parameters are of equal or greater concern; especially those materials known to have toxic effects. New licenses and renewals should be written with more attention directed toward the ultimate receiving water; in this case Casco Bay.

REGULATION is the State's tool to manage resources belonging to its citizens. As has been shown in this case study of Casco Bay, there remain many uncontrolled sources of significant pollution. In some instances, no regulation exists at all and in other cases the regulations are ineffective. Dredge spoil disposal, stormwater management, and atmospheric deposition are but a few examples.

EDUCATION surely is the ultimate solution. The invisible nature of Casco Bay's pollution promotes the impression that no problems exist. While poisons are invisible, their effects are not. In Casco Bay there is still time to prevent impacts from becoming obvious. At present not only is the public uninformed, but many responsible for making the management decisions directly impacting Casco Bay are equally uninformed. A solid and continuing environmental education campaign must begin if Casco Bay is to be saved from a fate similar to waters to our south. Such a campaign clearly extends beyond the limits of Casco Bay and should be considered state wide.

RECOMMENDATIONS

Where do we start? Sufficient information exists now to warrant some immediate actions and enough questions remain to compel us to look beyond the present.

AGENDA FOR ACTION IN CASCO BAY

IMMEDIATE ACTIONS - 1989

1. **The Governor** shall **nominate the Gulf of Maine**, of which Casco Bay is a valuable part, to be designated **a Nationally Significant Estuary.**
2. Declare **Casco Bay a Priority Waterbody** for comprehensive **action by all State Agencies.**
3. Strictly **enforce of all waste discharge licenses** held in Casco Bay through use of **penalties and corrective action.**
4. **Review and revise municipal and industrial discharge license** monitoring requirements to reflect concerns of Casco Bay.
5. Require municipal **monitoring of stormwater and combined sewer overflows.**
6. **Report violations of water quality standards** immediately to municipalities.
7. **Assess present and potential economic value of uses** within Casco Bay.
8. Prepare legislation requiring all marinas to **provide for adequate pumpout facilities.**

CONTINUING ACTIONS FOR THE 1990s

1. **Identify, prioritize** and adequately **treat stormwater and combined sewer overflows.**
2. **Quantify** inputs of **toxics, nutrients, and bacteria** into Casco Bay.
3. **Remove discharges conflicting with designated uses.**
4. Prepare a **Comprehensive Casco Bay Watershed Plan.**
5. Develop a **public education program on Casco Bay's** environmental issues.
6. Review and **coordinate inter-agency management goals** for Casco Bay.
7. **Expand and improve** the State's environmental **data management** system.
8. **Review and revise** as necessary State **policy** on the location of **snow dumps** and the **ocean disposal** of dredge spoils.

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