1974

Penobscot Policy Choices: a Summary of the Findings of the Penobscot River Study Team

Penobscot River Study Team

PENOBSCOT POLICY CHOICES

OCCASIONAL PAPER No. 74-3

"Looking ahead to the next decades, one sees that the desire for greater participation in the decision-making of organizations that control individual lives...and the increasing technical requirements of knowledge form the axes of social conflict..." *(Daniel Bell,* The Coming of Post-Industrial Society; *New York: Basic Books; 1973.)*

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THE PENOBSCOT RIVER STUDY TEAM
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This summary is based on research results as reported in *Penobscot River Study, Volume 1.* This research was supported in large part by the Ford Foundation and the University of Maine at Orono.

Environmental Studies Center
University of Maine at Orono
1974

PENOBSCOT POLICY CHOICES

A SUMMARY OF THE FINDINGS OF THE PENOBSCOT RIVER STUDY

preface

The Penobscot River is one of the most extensively researched rivers in Maine. Some skeptics have noted a negative relationship between the amount of such research and constructive action. In an effort to synchronize the two a bit more closely we offer what we hope is a fairly non-technical primer on the River's water pollution problems, condensed from the results of a two-year multidisciplinary research project. We also offer a brief review of public pollution policy issues and suggestions for future action.

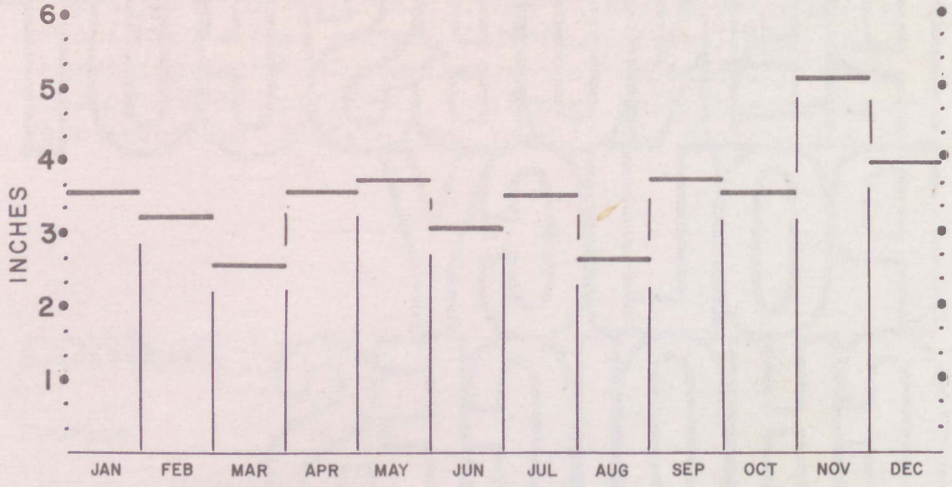
the background

water flow in the penobscot basin

When the Penobscot Valley was in its heyday as the lumber capital of the world, around the middle of the last century, one used to be able to walk from Bangor to Brewer across the Penobscot River on the decks of the ships at anchor. This waterborn commerce is largely gone now, but sometimes it still seems as if one could walk across the River on its thick covering of foam. These images convey the region's spirit at different times, the first of vitality and expanding opportunity, the second of stagnation - both environmental and economic.

But if this outer layer, the one superimposed by man, has gone through a degenerative cycle, the heart of this great body of water still pulses with the same spirit witnessed many years before when there were fewer barriers between man and nature. This is the pulse of the basic water cycle. The climate of the Penobscot Basin is cold and subhumid with precipitation - 44 inches on the average - rather evenly distributed throughout the year. This makes the Valley a comparatively water-rich area.

MONTHLY PRECIPITATION AT BANGOR, ME.
1944–62

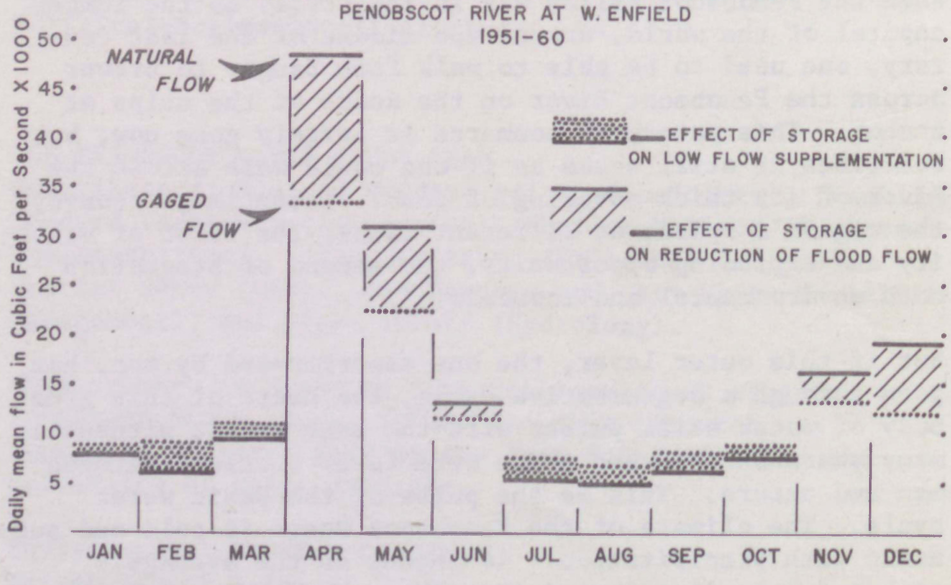


SOURCE: U.S. Weather Bureau

In contrast, the water runoff is uneven. In the spring the River floods due to snowmelt; while winter and summer runoff is low, the latter being greatly reduced by plant transpiration and by evaporation.

Two companies regulate river flow for the generation of electric power and in so doing smooth it. Great Northern Paper Company maintains 57 billion cubic feet of storage on the West Branch. This stored capacity is used to produce 40% of Great Northern's steady power needs, to control flooding, to maintain a legally established minimum flow at Millinocket of 2000 cubic feet per second (cfs), and to provide process water and water for waste assimilation and transport. Bangor Hydro-Electric Company maintains 6 billion cubic feet of storage on basin tributaries with six generating stations which provide 20% of its power

COMPARISON OF NATURAL FLOW AND GAGED FLOW
PENOBSCOT RIVER AT W. ENFIELD
1951–60



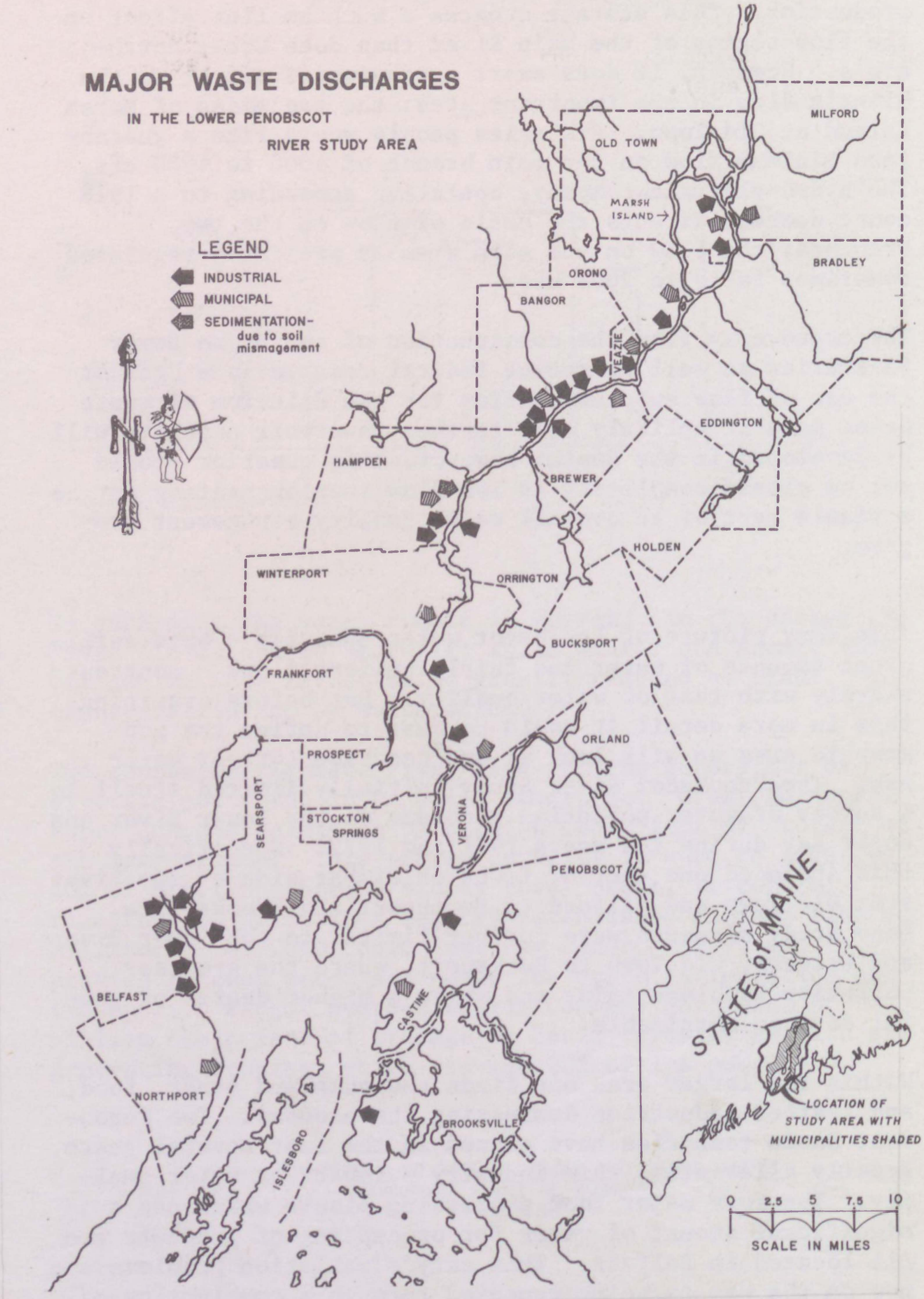
SOURCE: Water Supply Paper No. 1721, Part 1-A production. This storage creates a much smaller effect on the flow regime of the main River than does Great Northern's. However, it does exert a pronounced effect on the River's flow in one important area: the two sides of Marsh Island at Old Town. Fisheries people would like a guaranteed minimum flow on the main branch of 4000 to 4500 cfs. The hydro-electric company, operating according to a 1918 court decree, directs the ratio of flow on the two branches; the flow on the main stem as presently regulated sometimes falls to 2000 cfs.

The trend away from the construction of new hydro power facilities as well as recent federal restrictions against the use of flow supplementation for the dilution of waste water make it unlikely that further reservoir capacity will be developed in the Basin; however, this question should not be closed completely as low flow supplementation may be a viable part of an overall water quality management program.

water use on the lower river

This rosy picture of Penobscot water quantity - both sufficient amounts of water and fairly uniform flows - contrasts sharply with that of water quality. But before examining this in more detail it would be best to define the geographic area we will look at and describe current water use. The Penobscot River Study initially limited itself to a survey of water pollution problems on the lower River and upper Bay during the years 1971 and 1972. Specifically this included one tier of towns on either side of the River from Old Town and Milford to Northport and Brooksville. Many Study elements were further limited to the lower River and Estuary, Old Town to Bucksport, where the greatest pollution problems exist and where a higher degree of useful data is obtainable.

Within the larger area one finds the pulp and paper, food, and leather industries dominating the economy. Two Penobscot Basin tanneries have closed in the last several years, greatly alleviating this industry's impact on water quality. The four major food processing plants which use a significant amount of water for processing of products are all located in Belfast. This city's pollution problems are now on the way to being remedied through a combination of privately built waste water treatment facilities for the poultry processors and the use of the municipal system by the others. Thus pulp and paper is the major industry in the lower Valley with a continuing effect on water quality. Of four major mills, two use the River for process water; all use it for waste assimilation. In addition there are three related chemical operations which have caused problems in the past: one discharging high levels of mercury, the two others improperly storing chemical products on the shore. Other industries using the River as a waste receptacle include five mining and construction companies, a textile mill, two railroads (oil runoff from railyards and improper use of herbicides to clear tracks), and a utility (thermal pollution). With the exception of the railroads each of these dischargers either has taken remedial



measures or pollution impact is insignificant. Shipping on today's Penobscot is largely natural gas and oil transport. Over twelve companies operate oil terminals. In spite of their generally progressive attitude toward equipment maintenance and oil spill controls there are exceptions. One terminal in particular has had a chronic oil seepage problem.

Another important use of the River has been the assimilation of municipal wastes. Two municipalities in the Study Area (Belfast and Orono) already have primary and secondary waste water treatment facilities. Bangor has primary treatment. Castine and Brewer have facilities under construction. Other communities which should be constructing treatment facilities but are currently waiting for federal funds are Old Town, Veazie, Hampden, Winterport, Bucksport, Searsport, Northport, Indian Island, and Bangor (secondary treatment plant).

The last group of dischargers comes under the catch-all title of "non-point sources". The list for one type of non-point source alone is seemingly endless. Oil, for example, is discharged into the River through leaks associated with oil storage and transport operations, disposal of petroleum products by filling stations, pumping of bilges on oil tankers, cleaning of oil transport vehicles, accidents involving these vehicles, and so on. There is some debate about the effects of extensive sawdust deposits on the River bottom still left from the lumbering days. Do these deposits continue to decay and exert a demand on the dissolved oxygen in the River or is the basic problem with their mobility and consequent smothering of bottom fauna? When one adds other types of non-point pollution such as biocides, fertilizer, animal wastes, and faulty septic tanks, and multiplies each by the long list of possible sources, the complexity of the problem becomes apparent.

This list of pre-emptive uses deserves some counterbalance. One can think of the River in terms of fishlife, recreation and water contact sports, municipal water supply, scenic values, and pleasure boating. Yes, there is fishlife, for example, eels being caught for an export market and the promise of future success in stocking Atlantic salmon. There is at least one town above Old Town which still uses the River for drinking water. The shores of the Penobscot are largely undeveloped and beautiful thanks in large part to the lack of interest in using a dirty river. Some progressive businessmen see a marina in Bangor - tomorrow; while many longtime Valley residents talk about the times they swam in the River - yesterday. To sum up, the positive uses are largely potential, while the pre-emptive ones are real and immediate.

water pollution characteristics

Therefore let us look at the state of the water in the River. To make the job manageable means concentrating on the major problems mentioned above (municipal and paper industry pollution), and some understanding of the nature of these wastes is in order. There are four waste water elements of special importance on the Penobscot.

(1) Biochemical oxygen demand (BOD) results from the discharge of biodegradable organic wastes into the water. As they decompose, these wastes use up the available dissolved oxygen (DO), making it increasingly difficult for organisms which need this oxygen. The amount of dissolved oxygen found in the River runs from 0 to 14 milligrams per liter (mg/l) depending on the wastes it is receiving, the temperature, and the rate of flow: the colder the water and the faster it moves, generally the more DO it will contain. At least 5 mg/l DO are necessary for cold-water fishes like trout and salmon. The maintenance of this concentration of dissolved oxygen or higher is a major task in the restoration of Atlantic salmon to the Penobscot. BOD is often the

chief concern of the water quality engineer: its effects are better known, technology is available for removal, it is a characteristic common to most wastes, and it can readily be quantified and used in the setting of legal standards.

(2) On the other hand, toxic substances, a chief concern of biologists, are hardly definable, let alone quantifiable. And while BOD is a non-conservative pollutant, these substances are often conservative, that is, their concentration in the stream may not be changed appreciably other than by dilution, evaporation, or other physical transport mechanisms. Although some have come to be well known - among them the heavy metals such as lead and mercury and the biocides such as DDT and Aldrin - it is usually only after many persons have already suffered their ill effects. Many toxic materials may not yet have been identified. Even those that have may still occasion a great deal of debate among the experts about the extent and nature of their effects. Mercury is one which is as yet little understood. Another difficulty lies in discriminating between lethal and sub-lethal effects. If determining the cause of a fish kill can be difficult, the discovery of less dramatic effects is even more so. Because of all these difficulties and because increasing the River's dissolved oxygen is the most pressing problem we will pay most attention to BOD while paying relatively little attention to toxic or poisonous substances.

(3) Bacteria from human and other animal wastes are also important, particularly because of their deleterious effects on shellfish in the Bay area. Coliform is one group of bacteria present. Total coliform bacteria are contained in large numbers in fecal wastes but also may come from sources other than sewage. Fecal coliform bacteria are that part of the coliform population having a distinctly high order of positive correlation with warm-blooded animals such as man. The coliform bacteria themselves cause no problems for man, but their presence *may* indicate the presence of disease causing bacteria - that clams, for example, *may* be a disease risk should one eat them.

(4) Undissolved solids are another major problem on the Penobscot. Their impact is largely unknown.

waste water treatment techniques

There is also a counterlist: it gives various levels of waste water treatment. Primary treatment is basically designed to remove undissolved solids through the use of screening and settling. The major purpose of secondary treatment* is to reduce the waste water's BOD - which would otherwise exert an oxygen demand on the River. This treatment may be physical or chemical but is most often biological - using either a trickling filter or activated sludge.

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*Secondary treatment is defined by the U.S. Environmental Protection Agency: 87% removal of BOD for industries; activated sludge process for municipalities.

POLLUTION AND THE BOTTOM DWELLING FAUNA

The biological data collected from the fresh-water portion of the Study Area provided the foundation for an effective pollution assessment and monitoring program. Sampling in the relatively clean water above the major sources of pollution at Socks Island (just above Old Town) established the state of the River prior to reaching the Old Town area. If there were no pollution, samples taken at two other stations below Old Town (at the Orono-Old Town line and at the tip of Marsh Island just above the confluence of the Stillwater Branch) should be similar to those at Socks Island. Overlap and diversity indices, biological tools which allow evaluation of species diversity and thus of numbers of pollution intolerant species, indicated this was not the case and reflected the cumulative effect of pollution emanating from the Old Town area.

There is a unique situation presented by lateral differences between the east and west channels of the two lower stations with the west channel showing low species diversity (only pollution tolerant bottom dwelling animals remain) and the east channel much higher diversity. If most of the pollution is stopped, benthic (bottom dwelling) fauna similar to the east channel will also occupy the west channel. If, however, the pollution is increased, the east and middle channel faunas will become similar to the present west channel fauna.

The strong longitudinal similarity between the two lower (polluted) sampling stations in all channels is indicative of the channeling of pollutants along the west bank of the River. Because of this strong channeling of pollutants, a small increase in pollution might not be readily noticed laterally across the River. Such small increases should be reflected by changes in species composition at sampling stations further downstream. The relatively higher diversity indices in the area just above the northern boundary of Veazie indicate that the effect of pollution on the benthos is decreasing at this point on the River. Of course one should be careful to discriminate between these geographically immediate effects on bottom fauna and the pollution effects on fishlife which tend to occur much further downstream.

Tertiary treatment is actually a melange of waste removal methods which go beyond the secondary stage. They are used to reduce certain special elements such as color, heavy metals, phosphate, nitrate, or to achieve very high reductions of BOD. A product of recent technology is physical-chemical treatment; it can accomplish within a single system the equivalent of primary, secondary, and tertiary treatment combined. This has special significance for municipalities, because once a town has decided to treat its waste water to the fullest extent it is usually much cheaper to build the single system than to proceed incrementally through the three stages, as is often the case.

Combining pollutants with treatment we arrive at the table on the next page. This table bears out the effectiveness of primary treatment for solids removal, secondary for BOD removal, and the need for special treatment of toxic materials. What is not readily apparent is that the 45% gain in coliform removal afforded by secondary treatment can be accomplished in other ways. Perhaps the simplest is disinfection of wastes after primary treatment. Should the case arise where coliform removal is the only significant gain in using secondary treatment, the relatively lower cost for disinfection would make such secondary facilities

pollutant effects and treatment removals

POLLUTANT MATERIAL OR CHARACTERISTIC	EFFECTS ON WATER QUALITY	PRIMARY REMOVAL	SECONDARY REMOVAL	SECONDARY GAIN ON PRIMARY
Biochemical Oxygen Demand	Creates oxygen demand on the body of water thereby reducing its dissolved oxygen content. When DO falls below a critical level higher aquatic life (fish) dies; with zero DO water becomes septic and odor problem created. Substances comprising BOD may cause foam, discoloration, or turbidity.	30%	87%	57%
Coliform Bacteria	An indicator organism which gives a quantitative estimate of the water's bacterial contamination. Indicates when it may be dangerous to eat clams, swim in or drink water.	50%	95%	45%
Undissolved Solids	Inhibit waste reduction by bacteria; create an unaesthetic stream; increase turbidity.	70%	90%	20%
Toxic Substances	At certain levels kill aquatic life; serious sub-lethal effects. Includes pesticides, heavy metals, other poisonous substances.	0%	0%	0%
Oil and Grease	May exert an oxygen demand; coat surface of water and inhibit transfer of oxygen; coat wildlife, river banks, or any other surface with which water body comes in contact.	50%	80%	30%
Detergents	If non-biodegradable may cause foaming; also, may add phosphorus to the water.	0%	20%	20%
Phosphorus	Stimulates the growth of aquatic plants, especially algae; as quantity increases this growth may reach an undesirable level.	10%	30%	20%
Nitrogen	Promotes undesirable aquatic growth.	0%	30%	30%
Color	Aesthetically displeasing.	0%	0%	0%
Lignin	A by-product of pulp manufacturing; creates color problem: gives water a dark brown hue.	0%	0%	0%
Turbidity	Caused by solid and colloidal materials; aesthetically displeasing; may make disinfection more difficult.	30%	90%	60%
Reduced Sulfur Compounds	Leads to creation of odor problems.	0%	0%	0%
Chlorine Residual	May be harmful to aquatic life.	added during treatment		
Acidity/ Alkalinity	Water tends to be corrosive/caustic; destruction of stream life; formation of undesirable chemicals.	0%	0%	0%
Heat	Reduces the capacity of the stream to absorb oxygen; speeds up the use of oxygen by life forms within the water; upsets delicate ecosystems.	60%	90%	30%

economically unsound.

other abatement alternatives

In addition to treatment, which seems to be the most popular method of waste water handling, there are other approaches to pollution control. There are various ways of reducing waste discharges: changes in raw materials being used in a production process, changes in the process itself, changes in the products produced, recirculation of water, and recovery of materials from wastes for reuse or production of new products. There are also ways of increasing the assimilative or waste handling capacity of the receiving waters (certainly not very feasible considering today's environmental outcry): addition of extra dilution water or low flow augmentation, introducing extra air into the stream with mechanical devices, and distributing the effluent in small, scattered doses rather than massive jolts at major outfalls. Of course all of these methods can be used in various combinations to achieve an effective pollution abatement program.

pollution economics

waste water control alternatives

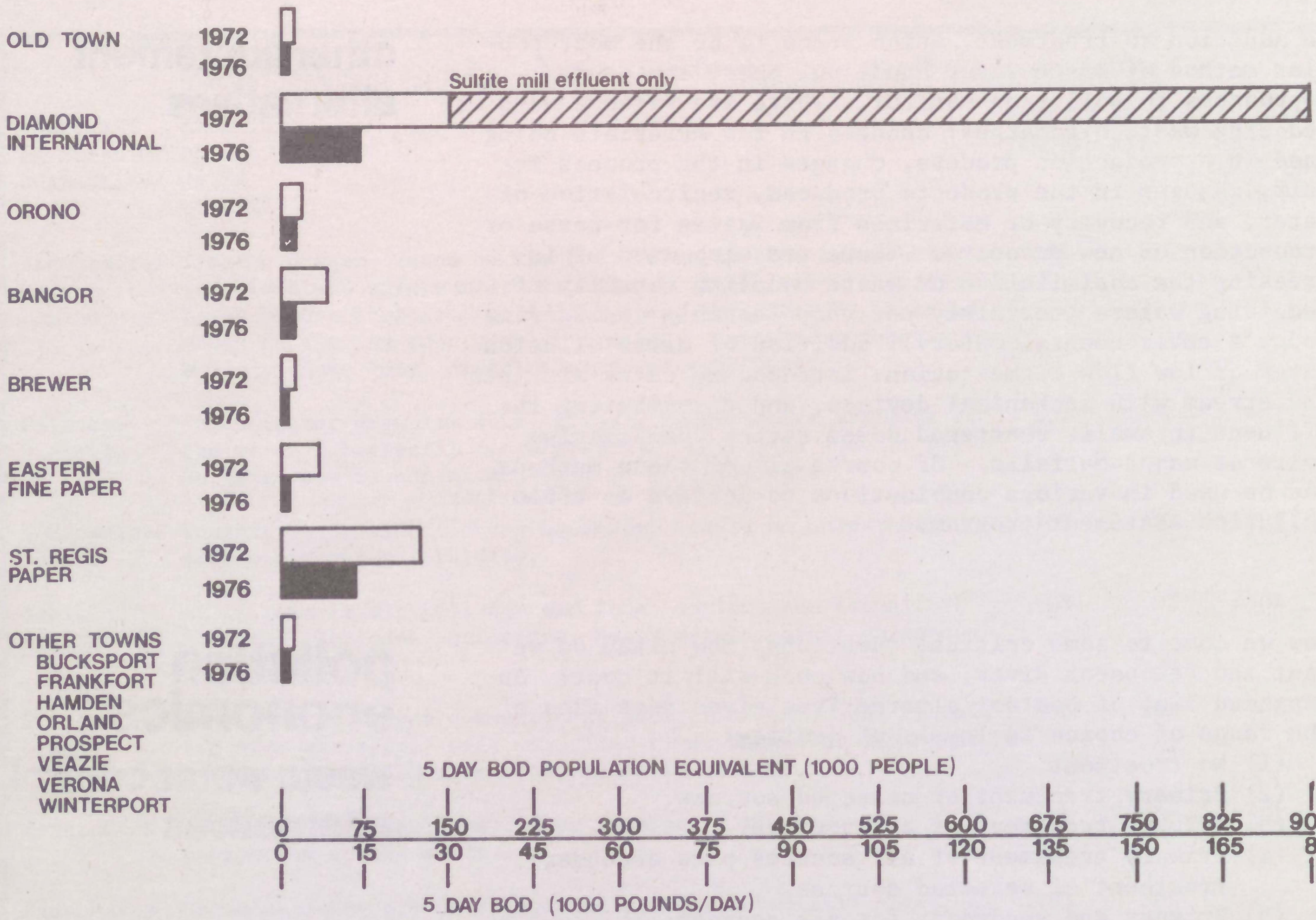
Now we come to some critical questions: how clean do we want the Penobscot River, and how much will it cost? An expanded list of control alternatives gives some idea of the range of choice in levels of quality:

(1) No treatment.
(2) Primary treatment of selected sources.
(3) Primary treatment of all sources.
(4) Primary treatment of all sources plus secondary treatment of selected sources.
(5) Primary and secondary for all sources.
(6) Primary and secondary for all sources plus tertiary treatment of selected sources.
(7) Primary, secondary, and tertiary treatment of all sources.
(8) Complete recycling: zero discharge.

These possibilities run from the dirty river to the clean river, from no direct cost to a huge monetary outlay. It establishes the range but does not discriminate between the various points on the scale: cost and cleanliness do not necessarily move in steady, closely related steps. To gain a deeper understanding of these alternatives let us look at each one and measure it against a basic minimum goal, the restoration of Atlantic salmon.

The best approach is to deal with that pollution problem which has been identified as the single greatest hindrance to fishlife, the lack of dissolved oxygen. The figure on the next page presents the amount of BOD discharged in 1972 and the amount proposed in 1976 at major point sources on the lower Penobscot. It is quite clear that the two major pulp and paper mills are the largest contributors and that they will continue to be. Bangor, the largest city in the Valley, does not even compare in the area of total BOD discharge.

LOWER PENOBSCOT RIVER WASTE WATER DISCHARGE PROFILE · 1972 AND 1976



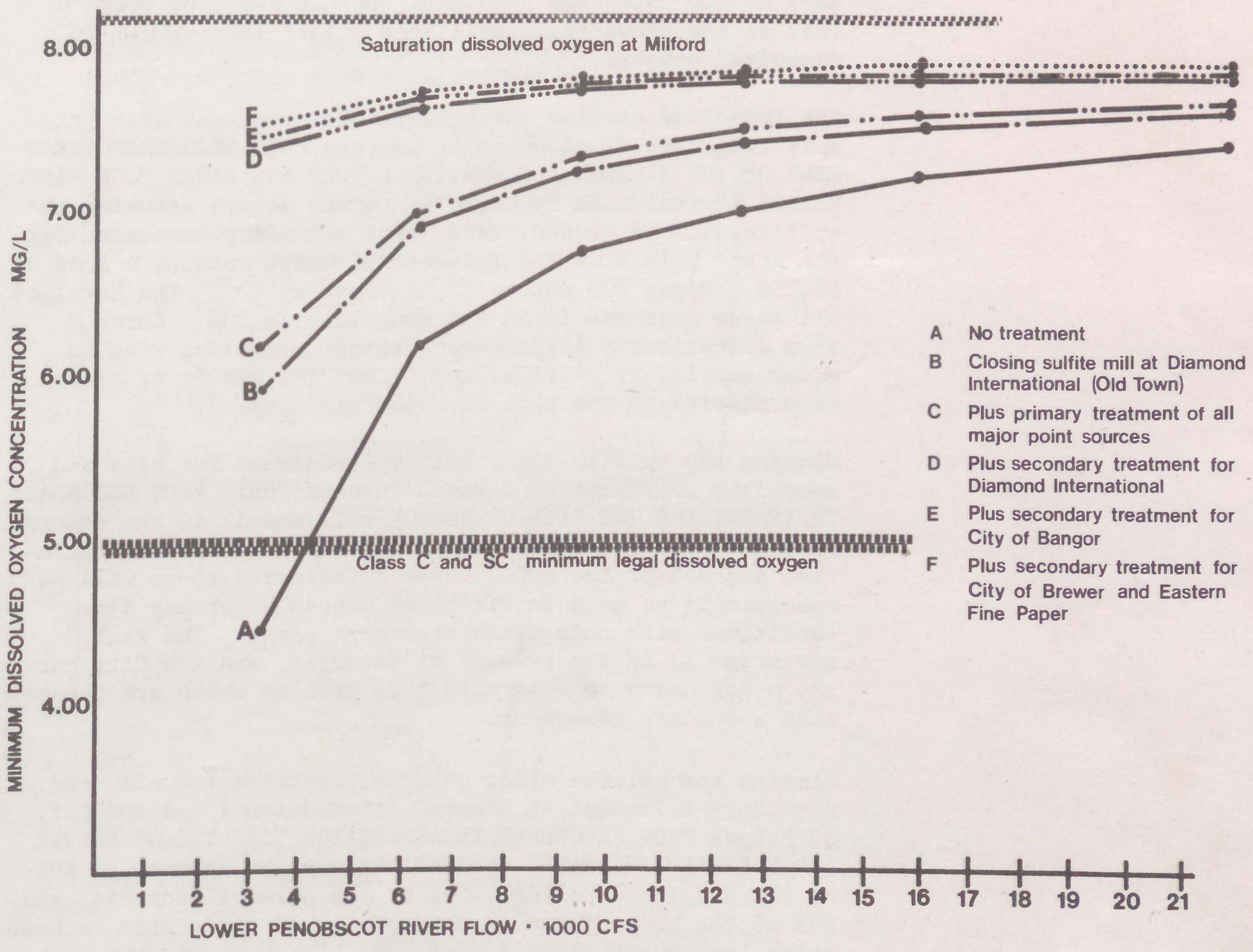
Source: Refuse Act Permit Program Applications

With no treatment of 1972 waste water 224,000 pounds of BOD enter the lower River each day. This equals a waste load produced by 1,120,000 people. Ninety-two percent of this total is discharged by the pulp and paper industry. Two factors largely determine the impact of this waste load: the amount of water in the River and the water temperature. With larger amounts of water for dilution of the wastes and a low water temperature permitting greater saturation of dissolved oxygen it is possible to dump more BOD without having an effect on the oxygen available for fishlife. Summer becomes the critical period with its higher temperatures and lower flows. For example, water as it enters the lower Penobscot River just above Old Town varies from a low temperature of 32°F in November through April to a high of 68°F in July. This means that the amount of dissolved oxygen can vary from a saturation of 14 mg/l in winter to approximately 8 mg/l in summer. The actual amount of water in the River has gone as low as approximately 3200 cubic feet per second during the summer months (measured at West Enfield). This convergence of low flows and low oxygen carrying capacity means that the River's ability to harmlessly assimilate BOD is drastically reduced during the summer.

Also, the amount of BOD already in the water is a factor in how much more may be added without significantly affecting the level of dissolved oxygen downstream. The Penobscot River has recovered from upstream BOD loads by the time it reaches Old Town, but at this point a new cycle is started. That is, new biochemical oxygen demanding waste is dumped into the River in large amounts. It starts to decompose as it moves downstream; the dissolved oxygen is lowered as this decomposition process picks up speed until at some distance from the original source the lowest point is reached, the bulk of the waste has been assimilated, and the River finally starts to regain dissolved oxygen. This process may be described graphically by a dissolved oxygen "sag curve". On the lower Penobscot the bottom of this sag falls in the Winterport-Orrington area.

With these variables in mind one can see in the figure below the impact on dissolved oxygen of various pollution control alternatives (with the amount of DO in the River as it enters Old Town held constant at 8 mg/l).

LOWER PENOBSCOT RIVER DISSOLVED OXYGEN IMPACT PROFILE



Source: Penobscot Study River Model

With NO WASTE WATER TREATMENT it is apparent from CURVE A that during summertime low flows the amount of dissolved oxygen downstream will dip below the critical 5 mg/l necessary for salmon. If the flow could be maintained at or above 4200 cfs the lower River could assimilate the 1972 BOD load without violating the legal standard set for salmon; however, approximately 4% of the time this is not the case.

CURVE B represents the CLOSING OF DIAMOND INTERNATIONAL'S SULFITE PULP MILL at Old Town coupled with an increase in kraft pulp mill production to compensate for this loss. This alternative is in line with the Company's finding's that it is better economics to shut the sulfite mill down rather than try to treat its wastes. Diamond's BOD load would thus drop from 180,000 lbs/day to 88,750 lbs/day and would make a noticeable improvement in water quality - still with no waste water treatment of any kind!

Closing the sulfite mill PLUS PRIMARY TREATMENT OF ALL MAJOR POINT SOURCES of waste water on the lower Penobscot would remove 70% of the suspended solids, 50% of the harmful bacteria, and 30% of the BOD. With 70% (or 93,000 lbs/day) of the total BOD remaining one can see from CURVE C that at low flows there will be a slight improvement in dissolved oxygen.

The impact of closing the sulfite mill together with primary treatment at major point sources PLUS SECONDARY TREATMENT OF THE DIAMOND INTERNATIONAL PULP AND PAPER MILL WASTE WATERS is indicated by CURVE D. Since we are assuming the sulfite mill is closed, this means secondary treatment for the kraft pulp mill and tissue mill waste waters, a load of 88,750 lbs/day BOD cut to 13,313 lbs/day BOD. The total of all these measures is an 85% reduction in BOD. Curve D thus dramatically illustrates another startling rise in water quality at critical low flows: the result of reasonable efforts on the part of major dischargers.

Closing the sulfite mill, primary treatment for all, and secondary treatment at Diamond International PLUS SECONDARY TREATMENT FOR THE CITY OF BANGOR will result in the removal of 80% of the suspended solids, 80+% of the harmful bacteria, and 85% of the BOD. CURVE E indicates there will be essentially no gain in dissolved oxygen under any flow conditions with this extra treatment plant. The real advantage is in the removal of bacteria, and the City can use other means to deal with this problem which are cheaper than secondary treatment.

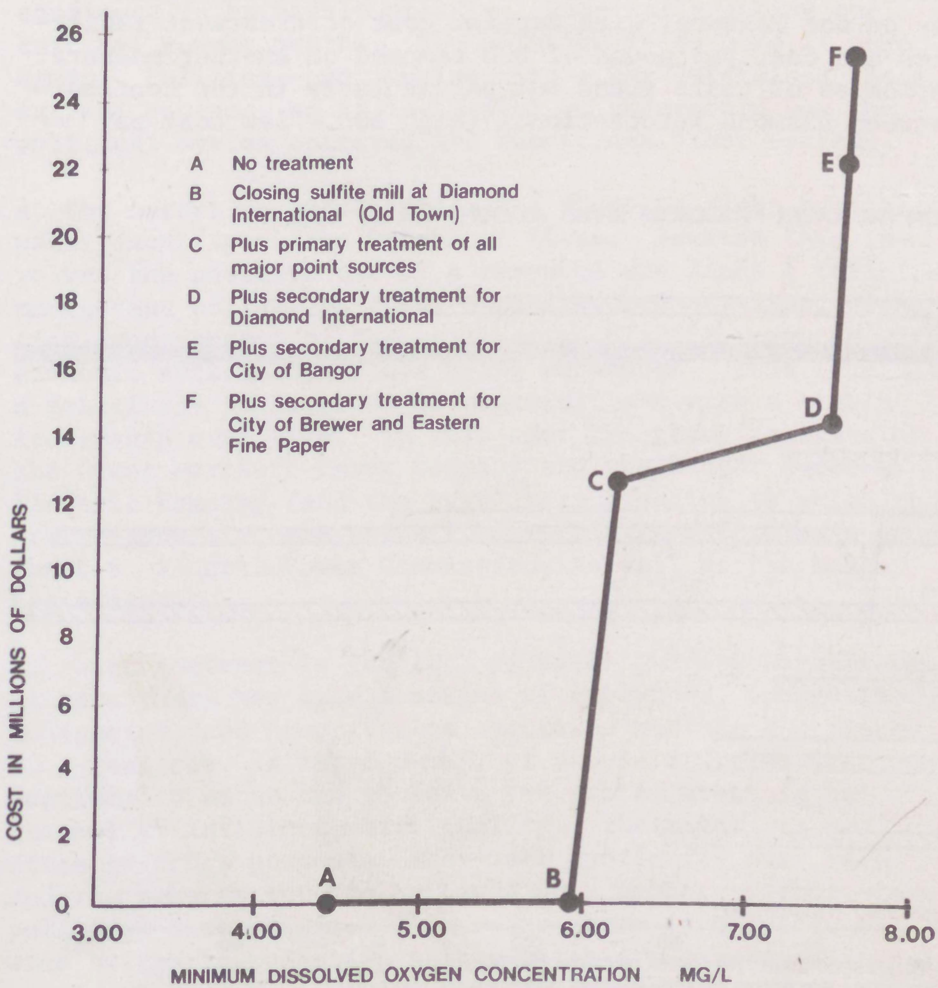
Closing the sulfite mill, primary treatment for all, and secondary treatment at Diamond International and the City of Bangor PLUS SECONDARY TREATMENT FOR THE CITY OF BREWER AND EASTERN FINE PAPER (BREWER) brings the removal to 80% of the suspended solids, 80+% of the harmful bacteria, and 86% of the BOD. There is no appreciable difference between these last three alternatives and CURVE F illustrates this fact.

cost of the alternatives

The above shows water quality impact. What about the costs involved? Obviously, with no treatment there is no additional cost. Primary treatment involves capital and operating costs for sewage collection systems and treatment plants. For simplification only capital costs of treatment plants are used for the six major waste water sources on the lower River: the Cities of Bangor, Brewer, and Old Town and Diamond International (Old Town), Eastern Fine Paper (Brewer), and St. Regis (Bucksport). The cost: $19 million (all cost figures are in 1972 dollars). Secondary treatment at Diamond International would add about $3,660,000 to this figure; secondary at Bangor another $7,800,000; and Brewer and Eastern Fine Paper's secondary facility still another $4,000,000 (secondary treatment costs for St. Regis are not included). A comparison between these costs and treatment effectiveness shows that where the most money is called for the least benefit is derived in terms of the River's dissolved oxygen - which is what secondary waste water treatment plants are designed to improve.

The figure below illustrates the marginal cost of lower Penobscot River dissolved oxygen - with incoming DO held

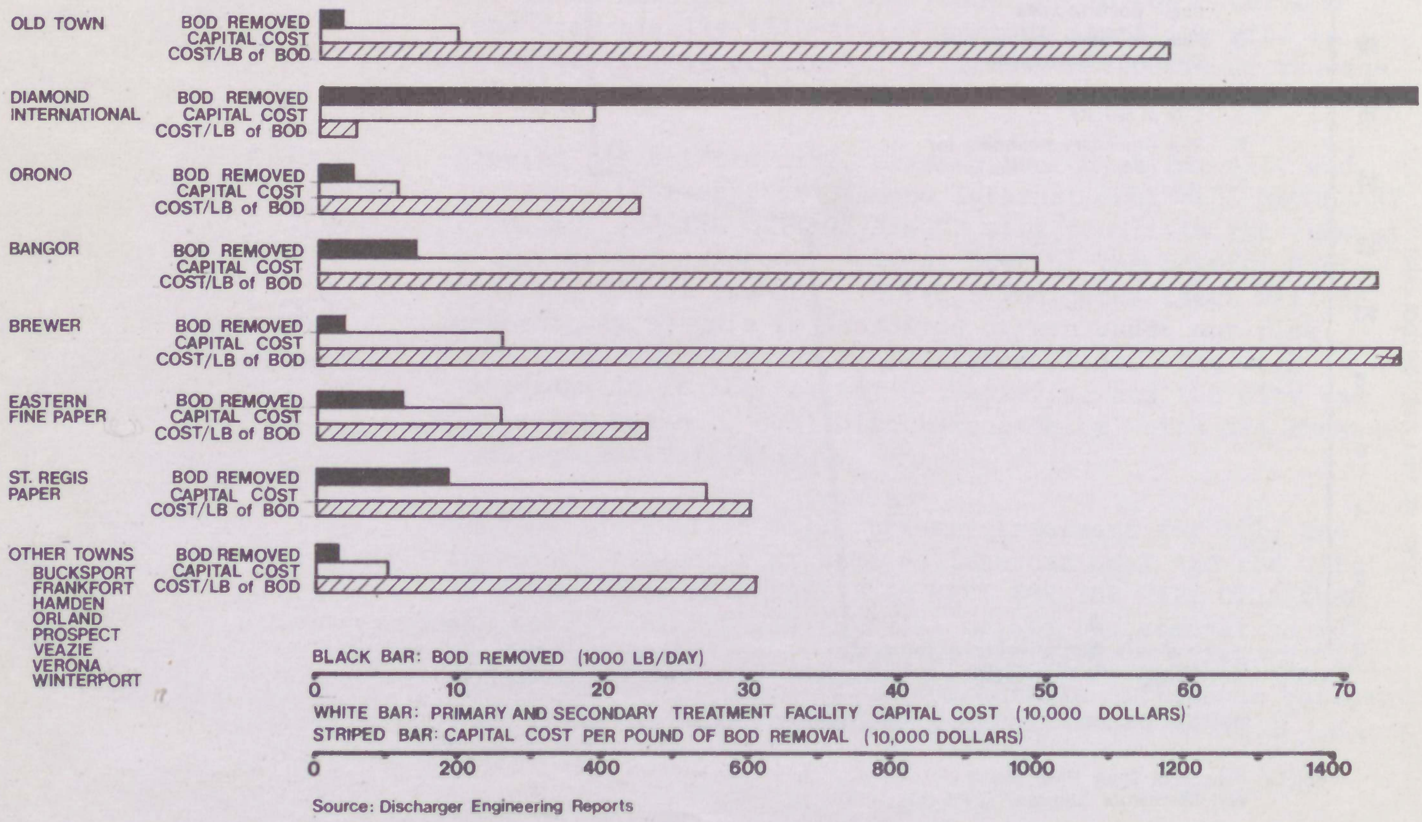
MARGINAL COST OF DISSOLVED OXYGEN ON THE LOWER PENOBSCOT RIVER (with a 3100 cfs flow)



Source: Penobscot Study River Model and Discharger Engineering Reports constant at 8 mg/l and flow held constant at 3100 cfs (a particularly low flow is used to show costs associated with quality at critical times when treatment is most needed). Point A indicates no treatment: no cost and a low amount of DO (4.45 mg/l). Point B shows what happens with the closing of Diamond International's sulfite pulp mill: also no additional cost but dissolved oxygen soars to 5.91 mg/l. For primary treatment of all major lower River effluents, Point C, the cost soars: $12,560,000 for an increase of only 0.28 mg/l DO. The curve takes another jag when secondary treatment of Diamond International's kraft and tissue mill wastes is added in: $3,660,000 for 1.22 mg/l DO - at Point D. And finally the addition of secondary treatment facilities at other major discharges carries a tremendous price tag but little measurable improvement in dissolved oxygen: Bangor's $7,800,000 increasing the DO by 0.05 mg/l (Point E); an additional $3,380,000 for other dischargers increasing the DO by another 0.07 mg/l (Point F). One can envision the law of diminishing returns as a curve which rises skyward at the end; greater additional resources are required for increasingly smaller returns. With a goal of maximum treatment one is operating at the high end of the curve.

Another way of looking at this is presented in the figure below. This shows the amount of BOD removed in pounds per day on one measure, with capital cost of treatment facilities and cost per pound of BOD removed on another measure. Economies of scale stand out particularly in the contrast between Diamond International (high BOD - low cost per

BOD REMOVAL ON THE LOWER PENOBSCOT RIVER: AMOUNT VERSUS COST



Source: Discharger Engineering Reports

pound for removal) and Bangor (low BOD - high cost per pound for removal).

the economic optimum

In more highly industrialized river basins it might be difficult to strip away the complex interrelationships between pollutant loads and instream water quality, but here the facts stand out clearly. The engineering-economic optimum for handling lower Penobscot River waste water is primary treatment at all major point sources plus neutralization of pathogenic organisms if necessary, shutdown of the Diamond International sulfite pulp mill, and at least secondary treatment for its kraft pulp and tissue mills. Anything below this level of treatment and the River will suffer during critical periods of high temperature and low flow; anything above this will entail tremendous costs for very little return.

pollution politics

the political optimum

This is the "golden mean" in Penobscot water quality management, a path neither so low that it will prevent other uses of the River nor so high that we will over-extend our resources and so vitiate further environmental aspirations. At present it is only an ideal. In reality we have travelled at one extreme or the other. The River has been and continues to be highly polluted, especially during the critical summer months. The solution is to make it pure again. Politics - not engineering - has determined these extreme courses, so it is helpful to understand how the political system operates and supercedes other systems.

At the outset we established that there is tight control of water *quantity* on the Penobscot River. Because this involves the positive use of a resource one finds a definite management policy, that is: planning, organization, direction, and control of the utilization of this resource with economic efficiency values being paramount. This involves a relatively small group of organizations with a stable leadership over time. In this case the group consists of the Great Northern Paper Company and the Bangor Hydro-Electric Company (and the regulatory agencies to which they are responsible, the Maine Public Utilities Commission and the U.S. Federal Power Commission, as well as the Maine Legislature).

In sharp contrast is the lack of water *quality* management. Rather, there has been a series of unplanned, unorganized, undirected, and uncontrolled reactions against the misuse of a resource. A large number of people and organizations continue to enter and to leave the public arena in an attempt to influence water quality. Their efforts are often at cross purposes, they lack continuity over time, and the results tend to be based on a number of short-term political compromises. This means there is a series of wide swings in pollution policy which are generated in a crisis atmosphere. With industrialization of a river basin, pollution reaches a threshold point where public
(continued on page 18)

WHO OWNS THE RIVER

Sovereignty Ownership of the River is initially determined by sovereignty. After more than a century and a half of intense French-English rivalry, the British finally gained military ascendency, their sovereignty recognized by the Treaty of Paris in 1763. This also assured the ascendency of English common law for the area.

Legal Title At English common law, private ownership along navigable waters stopped at high water mark. English law was modified by the Colony Ordinance of 1641-47, promulgated by the Massachusetts Bay Colony. This ordinance made Great Ponds public and allowed private ownership on tidal waters to low water mark or 100 rods, whichever was less. Private ownership in the intertidal zone, however, was impressed with the public servitude of navigation and fishing. Private ownership on non-tidal streams was left intact. Riparian owners on tidal waters have the right to access along the length of their shore, in addition to certain prerogatives on placing permanent structures on their flats and shores. But neither these riparian nor littoral owners along the shores of Great Ponds have any particular right to the use of the water itself or special privileges in or on the water which are not shared with the general public.

State ownership of the flowage rights from Great Ponds and the State's right to divert water from Great Ponds without compensation derive from ownership of the soil underlying Great Ponds. Unfortunately, most flowage rights from Great Ponds have either been sold or given away. The State is, therefore, deprived of this management mechanism to control rate of flow and the level of the River.

On non-tidal streams, riparian owners possess valuable rights to the flow of the stream, to erect mill dams, to the consumption of diversion of the stream, and to the quality and quantity of the stream as it flows past their land. The demarcation between a tidal and a non-tidal stream is determined by the effect of tidal action rather than degree of salinity.

To qualify as a riparian owner along a non-tidal stream one must hold a portion of the river bed beyond the edge of the water. If a land owner's interest stops at water's edge, he does not share in these special rights to the stream. There is a presumption at law that a conveyance of real estate along a fresh water stream conveys title to the thread (middle) of the stream. This same legal principle relating to private ownership of riparian land was used by the Maine Supreme Judicial Court in ruling on municipal boundaries in the absence of specific provisions in the municipal charter as to the extent of municipal jurisdiction. A parcel of land along a river may be granted, however, in such a manner as to include or exclude all of the soil between opposite banks. The title to a river bed or some portion of it may also be obtained by adverse possession.

A riparian owner is entitled to the natural flow of the stream "substantially undiminished in quantity and unimpaired in quality" as it passes his land. He is, however, also entitled to unlimited amounts of water for domestic purposes and reasonable amounts in the service of riparian lands. The test of reasonableness provides a modification of the strict "natural flow" doctrine but what is reasonable is not measurable by objective standards. Reasonableness must be measured vis-a-vis other riparian owners and thus cannot be determined in advance with any degree of legal precision. What constitutes "riparian land" has not been adjudicated in Maine, but there have been some suggestions that it must be within the same watershed.

A use that is not in service of riparian land is unreasonable as a matter of law. Thus it has been held that taking water from a fresh water stream for a municipal water supply is not a riparian use and hence unreasonable per se. Water companies, however, have been given statutory authority to buy or take such water rights by eminent domain. Rights to use water may also be obtained by prescription.

It has also been held in Maine that no effluent, despite licensing by the Maine Department of Environmental Protection, may be dumped into a non-navigable stream if such effluent did not originate in the service of riparian land. In the aforementioned fact situation, the effluent would have been subjected to tertiary sewage treatment and would have equalled if not excelled the natural quality of the water. This same discharge, however, would have materially altered the volume of the stream and was thus disallowed. This ruling poses real problems for municipalities or land developments not located on rivers in the disposal of their treated sewage. An attempt to modify the effects of this decision with its strict adherence to the natural flow theory was made by the 105th Legislature in providing that no cause of action shall be allowed against such discharge by a riparian owner in the absence of a lowering of water quality of the receiving stream or actual damage.

Riparian owners have been allowed a form of eminent domain under the Milldam Act. This act allows a riparian owner to harness the power of the River by erecting a dam on his own river bed in a nontidal stream. He may build the dam as high as he likes and overflow the lands of upstream riparian owners subject to payment of compensation. The only limitation under this statute is that the water level must not encroach on the tail water of the next power dam upstream. A legal right to impede the natural flow of the water may be obtained against lower riparian owners by adverse possession.

This general statutory authority applies only to power dams. Dams for water storage or any other purpose must be specifically authorized by the Legislature. While contained in some charters, specifications as to water levels or rate of flow have not been universally incorporated into the granted authority. Some earlier specifications may no longer be appropriate for the present conditions of the River.

Prior to enactment of water quality standards, disposal of waste in or pollution of a stream was governed only by the laws of nuisance and the common law test of reasonableness among riparian owners. Rights to pollute a stream to an extent greater than was permissable at common law was obtained by upstream riparian owners against downstream owners by adverse possession.

Social-Economic Trends The development and evolution of common law and the statutory enactments which have modified this law reflect social and economic trends. In response to the needs for transportation and commerce in colonial America common law was modified so that any body of water that was navigable in fact became navigable at law for purposes of interstate and foreign commerce. In the 19th Century power became the overriding consideration. Not only did the Legislature make outright gifts of land and natural resources to encourage industrial growth, but it also extended preferential treatment to prospective industrial enterprises. By the early 20th Century questions were raised about public water power development; however, an opinion of the Justices of the Maine Supreme Judicial Court held in 1919 that State development and improvement of its water power resources for commercial gain would not meet the constitutional requirements of a public use or public purpose. Present day water law reflects the problems of over use of resources with legal safeguards enacted to counteract the impact of modern earth moving equipment and a series of actions to abate water pollution.

Exercise of Sovereign Powers Incidents of ownership in the River are also determined by the exercise of sovereign powers. The federal government has always exercised power over navigation but federal supremacy over obstructions in navigable waters was not asserted until the end of the 19th Century. Since that time State regulation of the same activity must conform or give way to federal regulations. The term "navigable waters" has been broadened to include tributaries or storage areas on non-navigable streams if they relate to installations on navigable streams under the jurisdiction of the Federal Power Commission. This power to control navigation has been used to build dams, locks, or other installations, to fill or dredge or give permission to others to carry on this activity, to license obstacles or obstructions in waterways, and to prescribe for the regulation of traffic in the navigable waters of the United States. Federal interest in the River is also manifest in a number of executive agencies which do everything from gaging flow to financing waste water treatment facilities.

The State of Maine, even though subordinate to federal supremacy, is the protector of the public right of navigation.

With the exception of structures on non-tidal streams encompassed by the Milldam Act, all impediments in Maine's navigable waters must be specifically authorized by the Legislature. All new storage and power dams must be approved by the Maine Public Utilities Commission, but this approval relates more to fiscal fitness than physical soundness. Any specific requirements as to type of construction or requisite water levels or rate of flow must be incorporated in the special legislature authorization in the absence of any statutory standards. Many previously constructed dams are obsolete; however, there is no state procedure or requirement for the orderly liquidation of these potential safety hazards. In addition to new land management tools, the Site Selection Law and the Mandatory Shoreland Zoning Law, the State could use its power of taxation to manage land in and around the River. A certain degree of land use control has been given the Department of Inland Fisheries and Game and the Department of Parks and Recreation in allowing these agencies the power of eminent domain to acquire land necessary to carry out their statutory duties. In addition to land use controls the State has a significant commitment to environmental protection as evidenced by statutes pertaining to air and water quality standards, the coastal conveyance of petroleum, pesticides, wetlands protection, maintenance of fishways, and regulation of the construction and usage of sanitary sewers.

Municipalities have control of River frontage through the mechanism of zoning; they may also acquire conservation easements. Municipalities on tidal waters have the authority to manage their own shellfish resources if they care to exercise the option.

awareness is aroused; this triggers an outcry which peaks rather rapidly and declines. Following in its wake are remedial measures which over-compensate but which do return the water to a quality condition below the public's threshold of awareness. Continued growth precipitates another crisis and further extreme remedial measures. This is not positive resource management but merely an attempt to influence the course of resource misuse. Therefore one cannot call those involved "managers"; in many cases even calling them "influencers" is putting the case too strongly.

Among the competing influencer groups, those having the most political clout at any given time will usually get their way - at least until the pendulum of power swings in the other direction. If industry is in favor they ask for a river so dirty it tends to preclude other uses. If environmentalists gain the upper hand they ask for a goal of zero waste water discharge. Earth Day, April 22, 1970, signalled a surge of public interest in environmental problems. The industrial point of view was countered with loud demands for public responsibility. Up to that point the State policy called for meeting stream quality standards allowing discharges of pollutants under certain conditions. Federal policy pleaded for secondary treatment for all major waste water dischargers. As the environmental point of view became dominant, greater bargaining power came into the hands of clean water advocates. The Federal Water Pollution Control Act Amendments of 1972 testifies to this fact. Carefully guided through Congress by Maine's Senator Edmund S. Muskie and passed over a presidential veto, this law states:

"...it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985." An interim goal of best practicable treatment by 1977 is also provided. Maine law has been tightened up and brought into line with this new federal law, general stream standards have in effect been superceded by more specific effluent standards, and secondary treatment is now not just a hope but a federal requirement for all point source dischargers. The political optimum has thus changed with a shift in the locus of power and public persuasion, but this political optimum is still as much out of synchronization with the economic optimum as it ever has been.

reasons for the political optimum

Because of this mismatch it may seem as easy today to criticize the extreme environmentalist as it once was to excoriate the industrialist; however, there may be some very good reasons why this political optimum now prevails. Before either rejecting or accepting it perhaps one should explore these reasons. To do so means looking at the major water quality influencers and their motivations.

The *U.S. Environmental Protection Agency* (EPA), the latest evolutionary form of the federal water quality regulatory agency, historically has not been a regulatory agency at all but rather a bargaining agency, and its bargaining has not been directly with polluters but with an intermediary, the state pollution control agencies. The rediscovery of the 1899 Refuse Act gave this agency more muscle, particularly in the control of toxic substances; and the recent transfer of the water quality aspects of the Refuse Act Permit Program to EPA under the new federal law has further strengthened its hand. As its powers have grown, its essential approach has remained the same: all dischargers must clean up to a certain specified level, first secondary treatment, now maximum practicable treatment, eventually maximum feasible treatment. EPA officials tend to rationalize this with the idea that no one can own the assimilative capacity of receiving waters; thus it is not only fair but desirable to protect our waters to the maximum extent possible from those who would use them in this way. In a more pragmatic vein the Agency finds it easier to bargain if all are treated equally. (How can one ask a downstream pulp mill to install secondary treatment without imposing a similar requirement on the upstream mills?) But the strongest reason of all lies in the very structure of the Agency. Centralization of control at the top is at odds with flexible administration down on the ground. Even though EPA has established regional offices, it has failed to give these offices the authority to develop the more flexible policies needed to deal with specific regional problems.

The *Maine Department of Environmental Protection* (DEP) is caught between a combination of forces that have been shaping it for years: the United States Congress, EPA, the Maine Legislature, other State agencies, municipalities, conservationists, industries, and the People of Maine. The three most outstanding forces are EPA, conservationists, and large industry, most notably the pulp and paper industry. They have catapulted the DEP into a bargaining position:

> "Due to the fact that regulatory agencies are directly trying to balance a large number of competing and often conflicting interests, the regulators attempt to bargain with each regulatee individually to achieve maximum feasible (politically) compliance. This means that the end product of all of these individual negotiations precludes any overall sub-optimizing by the regulator relative to broad policy goals." (David C. Ranney, *Water Quality Management: An Analysis of Institutional Patterns;* Madison, Wisconsin: The University of Wisconsin Press; 1972.)

In other words, this sort of political bargaining may attain some degree of equity but not of economic efficiency. The DEP also finds it easier to centralize control in Augusta and apply administrative standards equally and inflexibly rather than operating with a flexible river basin program: the paperwork is simpler, dischargers can be dealt with on a case by case basis rather than with a priority system, and there is little need to examine the interrelationship of the dischargers.

State and national lawmakers are concerned with equality under the law if with nothing else. The idea of a fair balance underlies the whole American legal system. In this context it hardly seems fair to enforce stringent requirements on one party and not on another who is similarly liable.

Maine *industry* with an influence on water quality would hardly seem committed to rigorous and inflexible standards of waste water treatment, and yet most industrialists will publicly declare their support for uniform nationwide standards. The reason, of course, is to provide competitive equality. Certain industries will not be able to get an edge by operating in dirty and unregulated regions.

And *conservationists* would like to see everyone reducing harmful environmental impacts as much as possible. If secondary treatment means cleaner water then it is desirable. Tertiary treatment and beyond that complete recycling are even more so. As advocates the conservationists will try to achieve the most comprehensive measures. Giving variances to individual polluters because of special situations would hardly be in line with this approach.

A poll of *municipal officials* in the lower Penobscot Valley taken as part of the Penobscot River Study found an overwhelming choice for the political over the economic approach to pollution management. This is interesting in light of the fact that towns have the most to save (or lose) on waste treatment facilities.* One reason for this

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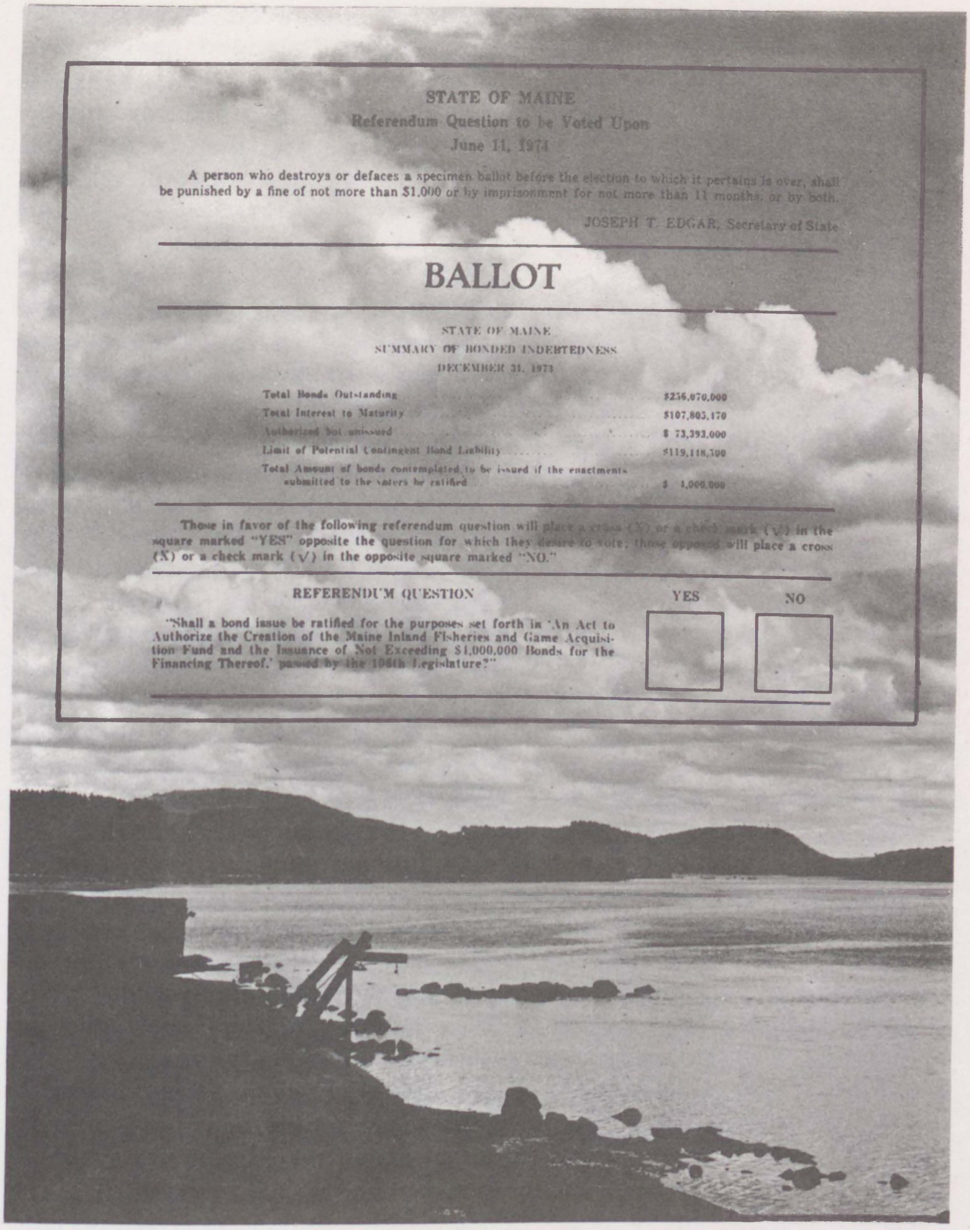
*Towns in comparison to industries usually have to make the heaviest investment in terms of cost per unit of waste removed because they do not often have the same economies of scale, because they demand many cosmetic features which in



choice is that towns may feel the need to clean up their own wastes before being able to demand better waste water treatment by upstream dischargers. And should there be state or federal funding available what town would want to forgo the opportunity of seeing them applied where they will do the most good, right at home? Another factor has to do with local autonomy: towns which can achieve cost savings through participation in a regional treatment system may not desire this because it would erode their control over the operation.

In addition to these special reasons that are characteristic of each type of water quality influencer, there are others which may be held in common - for example, simple ignorance of the economic alternative - or which may be

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no way contribute to plant operation, and because they are required to meet higher standards of construction procedure.

very particularized - for example, a belief that anything which reflects badly on the current Muskie approach would also reflect badly on Maine. "Equity" sums up the major thrust of many of these reasons: the need for fairness between towns, between industries, between the regulated, and justice in the demands made by citizens, environmentalists and lawmakers.

the dilemma posed by conflicting values

The two approaches to a polluted river, those of economic efficiency and political equity, present interesting contrasts. The engineer-economist deals with hard quantitative data: he can develop a theoretically convincing case, and he can save money and preserve natural resources. The politician works with qualitative information: he lives on a stage, not in a laboratory. His arguments all have a very practical ring, especially when it comes to avoiding social strife and preserving properly balanced human resources. Each approach has a great deal to recommend it. If we could weigh the many positive and negative features of each, compute a total, and make a definite decision, there would be few problems left.

The difficulty is that none of us is either a pure economist or a pure politician. We all share a number of competing value systems from these and other areas as well. For example, EPA is staffed with both political and technical people, and it has shown some interest in considering economic cost factors as well as equitable political balances. Maine's DEP has a very neat formula for combining both sets of values: all major dischargers will be required to install secondary waste water treatment or its equivalent (thus establishing a basic minimum, equal for all); if further treatment is required, then engineering-economic factors will be considered. Industry favors fair competition (equal pollution abatement requirements for all), but in a survey of lower Penobscot Valley water related industries the majority also favored the opposite, a least cost approach to pollution management. Conservationists embody this basic value split in two different groups within the movement: the environmental entrepreneurs who crusade for cleanup at any cost and the environmental professionals who strive first for a better understanding of the situation. Town officials often feel caught in the same kind of dilemma. Here it is symbolized by the differences between the consultant-planners and the townspeople. Legislators are increasingly caught in the dual roles of codifier of agreed standards and agent of social change - the former demanding reliable political pulse taking, the latter requiring the application of new technology.

Even more significant than the internal conflicts of each water quality influencer are their relationships with one another. Each influencer defines other influencers to whom he is directly related. Let us take the relation between the DEP and Maine industry as an example. The DEP defines industry, giving it an identity as a polluter. In turn, industry (and other interest groups) aid in the identification process of the government agency, providing it with functions and bargaining power. Thus industry and the agency are both part of the bargaining process, and in this process they define each other. This definition through clashing interests is complemented by two other aspects of the relationship. First are the direct exchanges involved: information (guidelines in exchange for effluent data), service (research or direct engineering assistance), and money (taxes to government, subsidization to industry) - exchanges which keep the clashing interests manageable. Second, each group serves as an excuse for the other's unresolved inner conflict. That is, they each see the reflection of their own ambivalence in the other and it allows them to point a finger at the reflection rather than at themselves. The obvious ambivalence encouraged by the nature of the relationship, one of aid and regulation, is amplified by this more subtle variety and in the amplification the love-hate relationship between regulator and regulated grows stronger.

This indicates how difficult it is to draw up a balance sheet, measure the alternatives against each other, and make a final decision. If this discussion has sounded somewhat theoretical it is easy enough to recast it in terms of blunt, immediate reality. Tens of millions of dollars will be required in the lower Penobscot Valley to comply with the political optimum of secondary treatment across the board. Where will the money come from? Or better put, how much is the taxpayer willing to pay for treatment systems which achieve human resources balances rather than natural resources balances? In light of fuel shortages, inflation, and early signs of a backlash against various environmental regulations it is quite likely earlier spending estimates will skyrocket upward while public enthusiasm begins to plummet downward.

policy choices

results of the project

The Penobscot River Study examined many scientific aspects of the current pollution problem from geohydrology to public opinion, but the basic thrust of its policy implications can be summed up in two ideas: (1) there is an engineering-economic waste water treatment optimum for the lower Penobscot River, (2) but for various and equally good reasons the political optimum prevails. With these statements made, the purely research part of the project ended and action began. When we say "action" however one should understand that as scientists and academicians we are pledged to the free dissemination of knowledge and ideas. The aim of our action is to communicate our various findings, point out alternatives in abating water pollution, and develop the pros and cons of each of these alternatives. We neither have the desire nor are we in a position to dictate public policy.

Since the least explored alternative has been that of economic efficiency, this is the one we chose to pursue. First we circulated our final report to a number of people, organizations, and agencies with an interest in the

(continued on page 25)

POLITICAL-ENVIRONMENTAL ATTITUDES

A 1971 survey of Maine Legislators and of voters and town officials in the Study Area undertaken as part of the Penobscot River Study documented the following attitudes:

General Perceptions of Environmental Problems

Voters and local officials agreed that pollution was the major issue facing Maine and that existing (1971) pollution laws were inadequate.

Legislators were divided on the importance of pollution as an issue, with those considering it "most important" feeling strongly about it; a large majority of legislators expressed the opinion that present (1971) pollution laws were inadequate.

Specific Awareness of Penobscot Pollution: Causes

Seventy percent of the voters and local officials were convinced that the Penobscot River was "very polluted".

Most state legislators agreed that the Penobscot River was "very polluted", but one out of four would not make a judgment.

All groups mentioned sewage most frequently as a cause of pollution of the Penobscot.

Overall, however, chemical-industrial sources were mentioned far more frequently than biological-nonindustrial sources among all groups.

Pulp and paper mills as a cause of pollution were mentioned more frequently by voters than by state and local officials.

Chicken wastes were mentioned far more frequently by voters (16%) than by local officials (2%).

When given a list of suggestions voters tended to mention person-related sources (dumping, detergents, boats, swimmers) while state legislators tended to mention more general chemical (mercury, phosphates) and industrial (logs, sawdust) sources.

Manifestations of Pollution

What happens *to* the water was more frequently mentioned than specific elements found *in* the water.

Overwhelmingly, respondents relied on sensory cues (smell, scum, and coloration - in that order) rather than restrictions on usage (recreation, consumption) to tell when a river is polluted.

A large proportion of the manifestations of Penobscot pollution will remain in the 1976 River thus implying a "beyond '76" orientation of voters and, to a greater degree, local and state officials.

In terms of restrictions on use, the absence of fish was the dominant characteristic of concern.

Personal restrictions on outdoor recreational activities such as swimming, fishing, boating, and clamming received substantial attention from voters but virtually no attention from either set of officials.

General Perceptions of Current Attempts at Environmental Control

Pollution control was not seen as a partisan issue in Maine.

All groups were optimistic about the chances of restoring the Penobscot "to a good condition in about 20 years" with state legislators more optimistic than local officials and the latter more optimistic than area voters.

As a general public issue, the fear of job loss as a result of pollution control programs was not widespread with large majorities rejecting job loss as a bar to abatement programs.

Fear of job loss was inversely related to income level; however, even the lowest 20% by income did not include a majority fearing job loss.

There was a slight tendency for coastal residents to fear that industry will not locate in the area because of too much emphasis on environmental protection. This may have been a reflection of the 1971 oil refinery controversy at Searsport.

A large proportion of all respondents felt government pollution programs cost the taxpayer too much money but also agreed that a sacrifice is necessary for pollution control.

Approximately half of both voters and local officials said they would be willing to pay at least 50¢ per month over the next year to help clean up the River.

Among those who took a position, local officials were willing to pay more than area voters. One out of four of the latter would pay nothing at all.

Officials, both local and state, were more likely to remain uncommitted to contributing to an unknown cleanup plan; while voters tended to make a specific payment choice.

The willingness to pay was directly related to income level.

Environmentalism

There was a generally pro-environmentalist feeling among all three target groups.

Voters and local officials tended to be significantly more "environmentalist" than state legislators.

While all socio-economic status groups among voters tended to be environmentalists, the higher ones were more environmentalist than the lower.

Democratic voters tended to be highly environmentalist more frequently than Republican voters.

Public or Private Management: Specific Program Orientation

All groups agreed that polluters and government should share the cost of pollution control, with most advocating an equal sharing and the rest placing a greater burden on the polluters.

While overwhelming majorities of local officials and voters supported the concept of an effluent charge, legislators were evenly divided on the subject.

Over two-thirds of each group would accept strong government controls to meet the public need for a clean River.

While there was a strong feeling among voters and local officials that the complex problem of pollution control should be left to the experts, they also wanted some form of local control or veto over the plans developed by such experts. State legislators tended to oppose such local veto powers.

State agencies, such as the DEP, regional planning commissions, and the State Planning Office, were given strong endorsement to strengthen their powers of environmental regulation, with the DEP most highly regarded.

Large majorities in all three groups supported program-by-program intervention to help solve environmental problems, legislators being least enthusiastic.

The "environmentalist" tended to support such intervention significantly more than those less committed to environmentalism.

Voters of lower socio-economic status tended to favor program-by-program intervention more than those who are higher.

Public or Private Management: General Political Orientation

Majorities of all groups disagreed, rather intensely, that government pollution programs have gone too far in regulating business.

All groups were somewhat less willing to concede government intervention to solve environmental problems when considered in the abstract, as compared to specific programs.

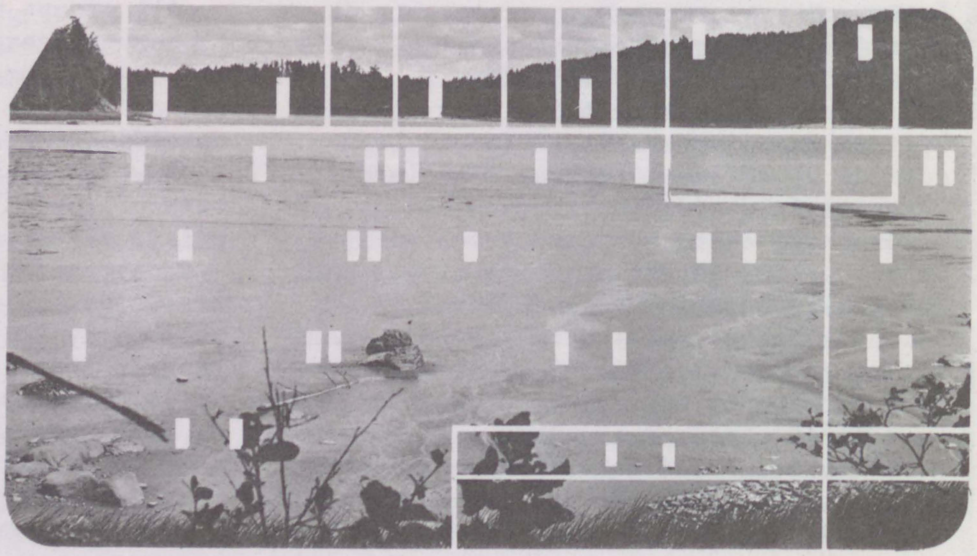
However, about half of each group were rated "liberal" in terms of general political orientation.

Interestingly, high socio-economic status voters tended as a political philosophy to favor government intervention in solving environmental problems, while lower socio-economic status voters opposed this philosophy. This presents a direct contrast to the attitudes about specific governmental programs.

Penobscot River. This fulfilled a minimum obligation on our part to all those people we had talked to during the study. But in order to do more than meet minimum requirements we saw it was necessary to go beyond the final report. This meant taking basic information already collected and reassembling it for its immediate relevance to the least cost question.

Concurrently with this work - which took the form of a paper included as part of the technical appendix to the final report - the public awareness of our findings began to grow. The *Bangor Daily News* carried a news item, and the City of Bangor decided to carry the message directly to Washington. Representatives from the City, the Maine DEP, and the Penobscot River Study Team first visited the legislative branch. This consisted of discussions with the staff of Senator Muskie's Subcommittee on Air and Water Pollution. A second trip brought confirmation of the basic validity of the Study from the Environmental Protection Agency. In spite of this the U.S. Economic Development Administration held back funds on Bangor's waste water collector system because EPA approval was lacking. EPA approval was still based on completion of the design of a secondary treatment plant, one which was both expensive and unnecessary according to our findings. In other words, no one had disagreed with our engineering findings, but they did disagree with the policy implications. Another trip to Washington loosened up some federal funds for the City's sewerage program. The collection system now has a high priority for funding while the secondary facility does not.

Political questions - how clean do we want our River and how much do we want to pay? - will continue to be judged in the political arena. This is as it should be. One can only wonder if the citizens of Bangor and of the Penobscot Valley, knowing the full implications of all the alternatives for a clean River, would vote for the least cost approach and if they would be prepared to back up their decision with active commitment.



the future: alternatives in river management

Beyond this specific decision there is a much larger one for Valley citizens to make: what kind of overall system should they design to fulfill water quality goals? A spectrum of alternatives is presented on pages 28 and 29. They range from the single use industrial river to the ecological utopia of a complete recycling system. Somewhere in the middle lie our two most immediately realistic choices. Should we continue to pursue a policy of requiring each discharger to treat his own waste water at the source or should we attempt to define a river basin authority, that is, a system which takes a more cost effective approach through large scale river basin management? The former choice with its tendency to optimize political values is the current federal and State answer. Its very simplicity leaves one with little need for further exploration. The River Basin Authority, on the other hand, with its tendency to optimize economic efficiency values and its rather complex machinery warrants some discussion.

The rationale for such an authority is fairly straightforward. Once waste is dumped into a river and begins its downstream journey the situation becomes a regional one with the regional area being defined by river basin boundaries. Waste load "localization" or confinement at the source (also known as zero discharge) is possible. It is in fact the current goal for 1986 and will thus preclude the need for any regional waste water handling. Yet however politically realistic this solution may appear it is in its own way as utopian as any other solution so far offered. We do not have unlimited resources. The difficulty in even obtaining funds for our interim water quality goals has been and continues to be but one small manifestation of this fact. Assuming we will not achieve zero discharge in the near future and assuming a continued interest in high water quality the need for regional management becomes more apparent.

To lay out a complete blueprint for a basin management system would be somewhat premature, but three basic elements are worth considering here. Most immediately obvious is the technical data monitoring and handling network. There is a need to know both the condition of the water in the River and the quantity and quality of waste loading at major points of discharge. Four instream monitors for the lower Penobscot River could be equipped with sensors for various measurements: dissolved oxygen, temperature, pH, turbidity, and salinity. At regular intervals this information could be telemetered to a central processing station where the data could then be logged and displayed for visual inspection. Effluent discharge data already being gathered from all point sources as part of the National Pollutant Discharge Elimination System could also be utilized in this centralized monitoring effort.

If any of the instream measurements were to approach a critical value an alarm system could signal the need to call on the management model in the computer. The water quality simulation model, developed during the Penobscot River Study, could then determine with sufficient exactness how much increase in River flow or decrease in waste discharge from each source would be necessary to maintain the River at desired quality.

The amount of control the River Basin Authority should then be able to exert (for example, requiring dischargers to cut back on waste loads or opening storage dams) forces us to confront the second and most important element, the political and administrative machinery. This is the great stumbling block: how can one design a politically feasible River Basin Authority? It must not erode municipal and industrial sovereignty, it must not create another level of
(continued on page 30)

some comparisons between river basin management alternatives

	THE INDUSTRIAL RIVER	INTERNALIZATION OF SPILLOVER EFFECTS AT THE SOURCE
DEFINITION	The single use industrial river is one on which there are no competing uses; it has been declared an open sewer, an extension of the industrial process wherein effluents are assimilated. This can happen either through a conscious decision-making process (the Emsher in Germany) or through slow, steady incrementalism as on the Penobscot prior to institution of pollution abatement measures.	Each major discharger is required to treat his waste water according to a certain standard of waste removal, for example, secondary treatment, best practical treatment, best feasible treatment, zero discharge.
POLLUTION LOAD	Heavy but short of anaerobic conditions.	Less than on the industrial river just how much depends on required minimum treatment, season of the year, stream's assimilative capacity, nature of the wastes.
DESIGN FEATURES	Range from none all the way to the highly sophisticated use of a river as an extension of the industrial process to assimilate wastes through use of instream aeration and other technical instruments.	Emphasizes separate complex treatment technologies at each major point source of pollution: this means either biological or physical-chemical systems.
WHO CONTROLS	Major dischargers on a river.	Each discharger builds and operates his own system according to government standards.
PLANNING ASPECTS	Range from none all the way to long range planning with considerations for load allocations and a highly technical payments formula.	Seemingly a static situation: each discharger builds to a certain treatment capacity and stops but instability built in with changing government standards and internal production changes.
GOOD POINTS	Maximizes use of river's assimilative capacity and thus cuts municipal and industrial overhead.	Improved water quality over industrial river; discharger has control over his operations; easy to administer; gives comprehendable sense of equity.
WEAKNESSES	New and competing river uses come to define waste water assimilation as an externality: pollution. Ecosystem is degraded. Minimum emphasis on broad based participation.	Not economically efficient: in some cases may do more to degrade the total environment than improve it; lack of flexibility especially with possible new dischargers; new standards confuse.
IMPLEMENTATION	Public outcry is bringing this approach to an end. There is no longer a willingness to trade clean for dirty rivers; however, cost considerations and environmental backlash may force partial return to this system.	This is basically the present program planned for 1976 and afterwards. New technologies and rising costs may cause some changes but unlikely.

THE RIVER BASIN AUTHORITY	MACHINE ECOLOGY	NATURAL ECOLOGY
The river basin is managed as a whole through a central authority with the capability to monitor, fully analyse the data, and control both the amount of water in the river and the effluent loading. The purpose is to maximize effectiveness while minimizing costs through use of a complex mix of technical and institutional tools.	Larger and larger technologies to solve technological problems eventually leading to the completely integrated technological supersystem wherein the waste products from one production process become the input to another production process. This requires highly sophisticated technical integration as well as an omniscient surveillance and information exchange system.	Involves humanizing present technology and developing new technology in line with both human and biospheric needs and aspirations. The complete integration aimed for is that of man with nature not of machines with one another. This will mean destructuring the present system: deprofessionalization and detechnologization to achieve human scale; use of more human and less non-renewable energy.
Actual effluent load will vary with a large number of variables used in operating the system, but instream water quality will not fall below designated minimum	None.	None.
Complex mix of technical tools (regional treatment, instream aeration, low flow augmentation) and institutional tools (user charges, direct regulation of discharges) to achieve a dynamic balance.	All production processes interlocking.	In process of definition.
Ideally all water interests can be represented in a Water Congress which sets policy.	Management team supervises production processes; high skill required; number of managers in line with size of operation.	Fullest participation of all members of community.
Long range policy goals set by Water Congress; short range day to day management carried out by staff of engineers who manage river as a dynamic system.	Long range planning required, perhaps the most highly sophisticated and most long range ever attempted by man.	Allows for day to day planning.
Flexibility, economic efficiency, participation; centralized control and thus greater effectiveness; emphasis on optimizing multiple use of river.	Eliminates waste: maximizes efficiency and strives for a perfect balance of resources. Positive utilization of all natural resources.	Fullest participation possible; all technologies built according to human scale; biospherically sound.
Seeming inequities in applying controls so hard to implement politically; dischargers lose sovereignty; no successful Authority to use as model; does not necessarily maximize ecological values	Does not allow for broad based participation; loss of human scale with creation of the mega-machine.	This approach fights the whole trend of the times. It is not efficient as economists currently define efficiency.
Historically impossible to implement especially in Maine where water is abundant. Only when resource pressures begin to mount will positive action appear desirable.	Depends on development of new technology for utilization of waste products. At present emphasis is on treatment rather than reuse.	A critical mass of committed members of the counterculture is necessary. Highly unlikely since this movement has so far been based on overabundance and decadence rather than on self-discipline and aware goal seeking.

bureaucracy, and it must not be expensive. This last problem is the easiest to solve, for the major intention of an Authority is to save money. If such an agency were created under the auspices of an existing agency such as the Penobscot Valley Regional Planning Commission or - better yet - if the Commission became a River Basin Authority, no new bureaucracy would arise. This makes sense as the Commission is the only organization specifically designed along river basin lines. In addition it would give a weak body some real power, an ability to implement its plans. And the mechanism to accomplish this is readily at hand in certain planning sections of the Federal Water Pollution Control Act Amendments of 1972.

The essence of the political problem is sovereignty. It is basically insolvable. The whole idea of a River Basin Authority revolves on the creation of a larger system in which the individual dischargers become component parts. However, this situation can be ameliorated with the institution of a Water Congress to encourage the full participation of all water interests in the Basin, with representatives from industries, municipalities, conservationists, recreationists, governmental agencies, riparian owners, as well as the public at large. It would establish water management goals and objectives, oversee the executive staff responsible for carrying out the technical handling of the management program, and raise funds for capital and operating costs through grants, taxation, and user charges.

It could also hope to develop its own powers as it grows and acquires stature, yet if it is to start with any authority at all certain basic jobs should come within its scope. Monitoring and control has been mentioned. It should also be able to build regional treatment facilities where called for and to set priorities for building these plants (for example, recent modelling for cost effectiveness has developed the idea that not only is it possible and desirable to minimize treatment plant construction costs in satisfying water quality standards, but it is also possible to maximize water quality for a given limited amount of money). And perhaps it should have some voice in establishing guidelines for the location of new water using industries and perform research on the effects of Valley land-use on water quality.

The third basic element in the River Basin Authority arises from the first two, the need to establish a dialog between the policy making body and the policy implementing staff. While the Water Congress may have a corner on the political pulse of the Valley, the staff water planners will have almost a monopoly on technical information. One difficulty with such a monopoly is that although facts may be neutral, the ordering of facts into some meaningful form never is. Values will always color an ordering scheme, so there has to be a way for those interest groups without the funds or the expertise to challenge the planners when they suspect biases are placing suggested programs in the hands of opposition interests. Advocacy planning should be built into the Water Congress. With this done the dialog can begin in earnest, the point being to establish a dynamic balance between political and technical values. Although it appears undesirable to fully optimize either one set of values or the other, nevertheless it seems worthwhile to seek some compromise between the two.

What actually happens in the Penobscot Valley will very likely not come close to fulfilling anyone's utopian plans. We will probably continue to plan on spending more money than is actually available; we will undoubtedly attain neither the most efficient system possible nor the cleanest one. However, it is equally certain that with sustained concern for a stable environment we must continue to seek an end to pollution in the most efficient and fairest way possible. Therefore after this journey through some of the better understood complexities of the situation there can be no conclusive final statement or *answer* - only a few questions and an assertion of faith in the ability of the people of the Penobscot Valley to make wise decisions given adequate information...