ENERGY ACROSS THE COASTAL ZONE

PROCEEDINGS of
THIRD ANNUAL CONFERENCE

Published by

THE COASTAL SOCIETY
3426 North Washington Boulevard
Arlington, Virginia 22201

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Seattle, Washington

Nov. 3–5, 1977

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Society conference could not have been successfully organized and implemented by the two of us alone. Aside, of course, from the fine invited speakers who participated, we are indebted to many people, only some of whom can be mentioned here, for their kind assistance. Our thanks go first, to Saskia Schott, Robert Goodwin and their coworkers for conducting an excellent Seattle waterfront field trip on the last afternoon of the conference. Then too, for handling a tremendous amount of secretarial work we are indebted to Patricia Hamilton, Joan Roley, Patricia Combs, Irene Kwasney and the W.W.U. Bureau of Faculty Research staff. Most of all though, we thank our own graduate students, Greg Behrens, Scott Morrison, Ralph Keuler, John Spasari and Bob Siegfried, who were on hand throughout the conference, helping in every way. We could not have done it without them.

Maurice L. Schwartz

Thomas Terich

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*Paper not available for publication.

*Paper not available for publication.
***Oral presentation only.

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*Paper not available for publication.

ENERGY ACROSS THE COASTAL ZONE
THE PETROLEUM POINT OF VIEW

J. R. JACKSON, JR.
EXXON COMPANY, U.S.A.
HOUSTON, TEXAS

It's a real pleasure to participate in The Coastal Society's annual meeting and to be on this panel discussing "Energy Across the Coastal Zone" from the viewpoint of the industrial community. I am a charter member of The Coastal Society and will be speaking as a representative of the Western Oil and Gas Association with the petroleum viewpoint. I hope this and the other sessions will turn out to be a "dialogue toward understanding". Dialogue can be defined as a "series of conversations between people toward a mutual comprehension of each others' meanings". I hope this particular conference will work in that direction and the end result will be better understanding and communication between representatives with differing viewpoints.

The petroleum industry has participated in numerous such programs over the last few years. It has come to realize the ever enlarging interest in petroleum activities by members of citizen groups and the general public and the need for more knowledge and enlightment concerning our extremely complex technical, engineering and scientific operations.

First, I would like to discuss the energy situation because this seems to be where interest is concentrated today. Since my business and that of my company and associations is energy, I will try to put the current situation into perspective in very basic terms.

The United States and indeed the world is now consuming oil and natural gas faster than new reserves are being discovered. Thus we are faced with the inescapable conclusion that petroleum will not be able to maintain its share of the rapidly growing demand for energy. This means that much of the future demand growth will have to be met by other fuels.

Everyone concedes that petroleum is a finite resource, however there is a wide range of disagreement as to how much remains in the world, how long it will last, and what the rates of consumption will be over the next few decades. I am a geologist by training and have been engaged in oil and gas exploration and production all of my life. I certainly realize that the oil and natural gas resource is finite. The difficulty is determining when our oil and gas resources will run out or become extremely depleted. In the past we have heard many doomsday predictions usually from federal agencies. Such predictions were made in 1920, 1926, 1939, 1949, and again in 1977. There is still a great deal of oil and gas to be discovered and produced in the USA, and it will be unless governmental legislation, regulation, red tape and overall interference make it impossible for the private sector to carry out its functions.

The resource base in our country's onshore and particularly offshore areas is sufficient to fuel our economy for the transition period during which time the nation must convert from a petroleum based economy to an economy based on renewable energy sources. The period will be similar to our conversion from wood to coal and from coal to petroleum.

This future economy may be based on fusion, solar power, or other renewable resources. For this nation to maintain its economy, to feed its growing number of people, to provide jobs for the disadvantaged, and indeed to elevate the quality of life for those who are currently not as advantaged as most in this room, it will be necessary to have sufficient energy. This has to be provided by oil and gas over the next several decades, while other resources are being developed, technology is being perfected, and these new sources brought on stream to replace oil and natural gas in many sectors of use.

In this same context I would remind you that we have vast resources of domestic energy in coal, oil shale, tar sands, and the multitude of small energy sources that individually provide very small amounts but collectively can add to the energy supply. Among these in addition to hydropower, one of the most important is conventional nuclear power.

To reiterate there is simply no feasible way to avoid the transition to new forms and sources of energy. But this transition is going to take long periods of time and huge investments. In the meantime we must develop our conventional resources and use them wisely to maintain a

viable economy for this nation during this transition period. Offshore oil and gas are a vital part of this transition.

A considerable body of opinion now indicates the American people are achieving some kind of a concensus of basic principles and objectives which is the first and the fundamental phase of solving the energy problem. We believe

- There is widespread recognition of the need for energy conservation although putting this into practice has not yet become a national ethic.

- There is solid support for efforts to expedite development of new energy technologies. But these are extremely costly, have long lead times, and will take many years to phase in to where they supply a substantial percentage of our energy needs.

- There is agreement we should make greater use of the country's abundant reserves of coal. However, conflicting policies mitigate against this happening at the rate most people and studies indicate to be desirable.

- And I think most people agree it is important to accelerate the discovery and development of new domestic onshore and offshore resources of oil, gas and uranium. With this type of agreement and general understanding, the nation can progress toward a solution of our energy problems.

With that backdrop let's look at the importance of energy in the Coastal Zone. The Coastal Zone is an area where many problems are encountered, where emotions become heated, and where often there appears to be more heat than light. This usually results in a great deal of misunderstanding.

Obviously the Coastal Zone is where energy is produced, transported, refined and generated. While I cannot give you a percentage of the energy that crosses the Coastal Zone, it must be a very high number. Today we are importing about 48 percent of our petroleum liquids. This crosses the Coastal Zone. A large percentage of the crude oil and natural gas produced in this country comes from or crosses the Coastal Zone. Most refineries are in the Coastal Zone as are many conventional and nuclear power plants. The Coastal Zone is extremely vital to the energy industry.

This interest along with many other competing interests such as transportation, recreation, fishing, agriculture, housing, wildlife, plus those of government and other private interests make emotions run high. This in turn excites people to legislate, regulate, control and prevent all activities in the Coastal Zone that are not their special interest. Energy is frequently a victim of these efforts. Some states are notably hostile to any energy development in the Coastal Zone. For some unknown reasons these states are for the most part states which produce little, if any, energy. Yet in most instances, these same states are massive consumers of energy produced in other areas.

We could discuss for hours the importance of energy in the Coastal Zone, but I only want to touch on three items that seem to bring forth the greatest emotional reaction and try to put these subjects in perspective.

The subject of oil spills probably generates the greatest emotional reaction. Of all the people that are most interested in preventing oil spills, the energy industry is number one. If we spill a barrel of oil that could have been sold for $12, or $15, it generally costs somewhere in the range of $100 a barrel to clean up. This does not give consideration to the problems of public reaction, adverse public relations, new potential legislation, regulations and controls that might result from such an accident. Therefore, we have a strong incentive not to have oil spills. This was recently pointed out by Dr. Peter Pritchard of the Florida Audubon Society when he stated, "I am encouraged by an important aspect of oil spills that is not mentioned enough. That neither of us, environmentalists or industry, wants it to happen". He also stated that blanket opposition to OCS development would result not only in greater oil pollution of the oceans (because of increased imports), but also a very negative impact on our balance of payments problem.

I couldn't agree more with Dr. Pritchard and I would like to add a couple of statistical items. The National Academy of Sciences has found that only 1.3 percent of oil spilled into the marine environment comes from offshore oil and gas production, the smallest of identified sources of oil entering the marine environment. The United States Geological Survey has pointed out that worldwide there has never been an offshore exploratory well that has spilled over 50 barrels of oil. And last, our offshore industry has drilled over 21,000 wells in the offshore areas of the United States, produced 7.5 billion barrels of oil, over

41 TCF of natural gas, and only one accident, Santa Barbara, put any substantial amount of oil on the beaches. This was cleaned up, the cost was $27 million and many studies have indicated that Santa Barbara was not the disaster indicated by the media.

The second subject is pipelines. Today we have in the United States over 200,000 miles of pipeline. There are over 7,100 miles of pipeline offshore and many landfalls where pipelines enter the coastal zone. Most people are unaware these pipelines exist, because advanced technology is available and used to cross beaches, to monitor and control pipeline operations throughout their lifetime. There are very few problems with pipelines. Yet this has become a highly emotional issue in parts of the country where people do not understand the facts, or commonplace usage of pipelines or the state of development of the technology.

The third subject concerns onshore effects of offshore oil and gas production. Again many people are highly emotional about anticipated impacts that might occur from offshore operations. Their concerns are creating massive amounts of new unnecessary and costly bureaucratic red tape. Many studies have been made of the impacts of offshore production on onshore areas and to summarize briefly, they are generally minor. They differ little from normal industrial activities and facilities and are generally located in a similar type of environment. However, the economic benefits are important. Admittedly, there are areas where some concern is justified; for example some of the remote areas of Alaska. In those areas industry is extremely careful and cautious to ensure that the impacts are minor and that communities and individuals involved do not suffer.

I will summarize my remarks by saying that there is really no need for conflicts between people interested in development and people interested in environment. Basically, we are all interested in both. Our differences generally occur when information is based on emotion, not on fact. We are most willing to work with those interested in acquiring factual information.

There is a great national debate raging today on energy. The subject is being discussed very widely from small cities in coastal towns to the halls of Congress. We believe that better understanding and better agreement will result from this debate. The people of the United States will suffer or gain from the decisions that are finally made. We hope that full recognition will occur as to the importance of energy

and the need for much of its development in the coastal zone. Also, we hope people will understand that excessive rules, regulations and legislation will harm the nation and increase costs to individuals. As the old saying goes, "There is no free lunch". Every new regulation costs money to implement and those that do not have a favorable cost/benefit ratio will have to be paid for by someone. That someone is you and me -- the consumer.

In conclusion, the nation has made significant gains in the area of better understanding. There is now a substantial national concensus on most of the basic principles and broad objectives of a sound energy policy. There is considerable evidence that the nation is becoming more efficient in the use of energy. Steady progress is being made in the use of coal. Attention is being paid to developing new energy technologies for the future that will eventually replace current energy sources. But we must develop our domestic resources for the transition. This does not mean that we do not have problems, that everyone is in complete accord and there won't continue to be a great deal of debate over the subject of energy. However, we have every confidence that we will eventually solve these problems with a sound policy and one of the results will be to keep Energy Moving Across the Coastal Zone.

Thank you.

WHAT DEGREE AND TYPE OF REGULATION IS NEEDED?*

Donald M. Taylor
Ocean Industry Magazine
Houston, TX

*Paper not available for publication.

IMPORTANCE OF COASTAL ZONE PLANNING TO THE PETROLEUM INDUSTRY*

Cynthia R. Stoertz
American Petroleum Institute
Washington, D.C.

*Paper not available for publication.

POWER PLANT SITING AND THE COASTAL ZONE IN CALIFORNIA*

James E. Schumann
Pacific Gas & Electric Co., CA

San Francisco, CA

* Paper not available for publication.

PART II

Thursday, November 3, 1977
Afternoon Session

THE CONSERVATION POINT OF VIEW

Thomas Terich, Session Chairman

1. *A Proposed Method for Assessing Impacts of Energy Development on Living Resources and Habitat in the Coastal Zone,*
   Jeffrey A. Zinn and John R. Clark

2. *Local Initiative as an Imperative in Estuarine Planning,*
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3. *Washington's Inland Waters: Public Domain v. Corporate Rights--A Grass Roots Response,*
   Phyllis Graham

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   Charles Keenan*

5. *The Science Market in Coastal Planning,*
   John R. Clark and Jeffrey A. Zinn

* Paper not available for publication.

THE TRANS-SHIPMENT DEBATE

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The public debate over oil in Puget Sound began in the period between 1972 and 1974 as the culmination of the following series of events:

1. passage of the Trans-Alaska Pipeline Act and the realization that a marine terminal for Alaskan crude oil would be needed.

2. the increased dependence of the U.S. on oil imports. Prior to 1967, the U.S. was a plentiful supplier of crude oil; by 1980, it is expected that the U.S. will have to import about 35% of its oil.[1]

3. the decision to terminate the supply of Canadian crude oil to the U.S. The supply of Canadian crude has now, in fact, ceased completely.

4. the 1974 SOHIO proposal to transport oil through Washington to refineries in the Midwest (this proposal is no longer active).

5. the proposal to expand facilities at Cherry Point, Washington, and transport oil through these facilities to the Northern Tier States.

6. the realization that a tanker terminal has severe environmental drawbacks in addition to the oil spill threat.

Figure 1 shows world tanker routes, and is presented to give an overview of where the major tanker terminals are.

Washington State has been forced to consider two unpleasant realities: that the deep water ports of Puget Sound might be used to unload much more oil than the region needed, and that the oil refineries now operating in Puget Sound would have to be supplied from some source

other than Canada. These are separate realities: a trans-shipment decision need have no effect at all on the means of supply for existing Washington refineries.

Should the State of Washington become an "energy supplier" via trans-shipment to inland refineries? What are the dimensions of the trans-shipment argument? First, let us consider the quantities of crude oil involved. Washington is part of Petroleum Administration for Defense District V (PAD V)(see Figure 2), which also includes Oregon, California, Nevada, Arizona, Alaska, and Hawaii. PAD V uses 12% of the U.S. supply of petroleum, and uses almost two-thirds of this for transportation. Sixty-four percent of the PAD V use is in California. By contrast, the Midwest States (PAD II) use 25% of the U.S. supply.[2]

The Pacific Northwest States (Washington, Oregon and Idaho) consumed 440,000 bbl/day in 1972. This is about a third again as much as the Puget Sound refineries currently treat (280,000 bbl/day) and only about one-quarter more than these refineries are capable of handling (360,000 bbl/day).[3] Refined petroleum products are shipped out of Puget Sound right now, have been for many years, and will continue to be shipped for some time to come. One commonly hears the word "export" associated with the delivery of petroleum products from the Puget Sound refineries. However, "export" implies movement of goods across international boundaries, and is really the wrong word to use. One can say more precisely that crude oil is refined at Cherry Point and Marsh Point, in Northern Puget Sound, and is then transported, by tanker and pipeline, to other parts of the United States. Fifteen percent of the PAD V supply comes from these refineries.

Figure 3 shows the international pipeline system in the U.S. and Canada, with both the Kitimat, B.C., and Trans-Mountain pipeline proposals included. The Trans-Mountain system is the existing system which brought Canadian crude to the U.S.[4] The ARCO proposal for expansion of their facilities at Cherry Point requires a parallel system forming a loop at the western end of the pipeline, which may then carry reversed flow.[5] The Northern Tier proposal is also shown in this figure.

Figures 4 and 5 show some throughput figures projected over the next 21 years. One need no longer assume that the Midwest refineries will be served - that is to be done through California. However, if oil is trans-shipped through Washington to the Northern Tier refineries, the numbers are very comparable to those for the Midwest refineries. The ultimate current Northern Tier refinery capacity is 800,000 bbl/day. Combined with Puget Sound refinery capacity, this would mean marine throughput of 1.1 to 1.2 million bbl/day. The Federal Energy Administration estimates that this could go as high as 1.3 million bbl/day. If this oil is all brought in by tanker, tanker traffic will increase by a factor of at least three.

The trans-shipment question can be considered from two points of view: should we trans-ship (or, as some prefer to word it: should we allow trans-shipment), and what would be the justification for not permitting trans-shipment? Figure 6 is a map showing the four Washington sites which have come under realistic consideration: Cherry Point (Ferndale), Marsh Point (Anacortes), Burrows Bay and Port Angeles. All are possible sites; all have severe environmental disadvantages. Because of the need for dredging, Marsh Point is no longer under serious consideration. Burrows Bay has no heavy industry and was the least likely site. Cherry Point is, in many respects, a logical site, since it is already heavily industrialized. If it were not for the risks to tanker traffic in inner Puget Sound, Cherry Point would be the site of choice. The risk of a bad spill, and the consequences of such a spill in the inner Sound, make Cherry Point out of the question. Port Angeles is a much better site from the point of view of casualty risk, but there is strong local opposition to the terminal; the shoreline west of Port Angeles is sufficiently unspoiled that the damage done by locating a sizable tanker terminal there would be severe and irreparable.

There are also air quality problems associated with these locations.[6] There are three sources of air pollutants associated with an off-loading terminal: the tanker engines, the off-loading operations, and the storage area ("tank farm"). Table I summarizes the sources, the pollutants, and possible mitigating measures which would protect the air quality.

Table I

Source	Pollutant	Mitigating Action
tanker engine	SO_2 (sulfur dioxide) particulates CO (carbon monoxide) hydrocarbons NO_x (oxides of nitrogen)	shut off engines in port and pump out oil electrically; burn 0.5% sulfur fuel (SO_2 only), burn lower residue fuel (particulates only)
venting	hydrocarbons	use of inert gas to blanket vented gas
ballasting	hydrocarbons	use of segregated ballast
purging	hydrocarbons	purge downwind, offshore, out of port air basin
tank farm	hydrocarbons	use of vapor recovery system on all tanks

At the present time, Federal ambient standards for SO_2 are occasionally violated at Cherry Point and Port Angeles, and Federal ambient

standards for particulates are violated occasionally at Port Angeles. Siting of a terminal either at Cherry Point or in Port Angeles Harbor would mandate use of low sulfur, low residue fuel in the tanker engines, and a source of energy for oil pumping other than the tanker engines. A dispersion model of Burrows Bay shows that fumigation in residential areas would be severe.[7]

Ambient hydrocarbons and CO are not monitored at Cherry Point,[8] but the quantities of these pollutants emitted into the Cherry Point air basin (4500 tons of hydrocarbons per year; 91,000 tons of CO per year) makes it very likely that ambient standards are currently being violated. Purging emissions in particular, since purging is done for safety reasons, would aggravate this problem severely. Under the Clean Air Act, no large throughput terminal could now be built at either Cherry Point or Port Angeles. Current emissions, especially at the mill at Port Angeles, must be reduced for compliance. Moreover, a thorough dispersion model needs to be done.

These considerations have led to a response, by some environmentalists, that can best be characterized as reactionary: the "no trans-shipment under any circumstances" response. In detail, it sounds something like the following:

"We will not allow trans-shipment through Washington because we will not pay the environmental price for gas-hungry, overpopulated Chicago, Minneapolis, or whatever. The Los Angeles area is a mess anyway. Let Long Beach bear the burden; it won't make any difference to their already polluted environment. Build the LOOP facility off the Gulf Coast of Louisiana, down there with all those offshore oil rigs. Trade Alaskan oil to Japan, and bring foreign oil into Galveston or Boston or New York, where the marine waters are already disaster areas. In short, put a terminal anywhere, but not here, not 'next door,' not where we can see it."

This would indeed be a defensible position under the proper circumstances. Let us, however, examine the circumstances. First, since the major concern here is the protection of the marine life and fisheries of the Northwest, can one honestly say that they are more valuable and unique than any other fishery in the U.S.? In particular, how do they compare with the Gulf Coast fisheries and shellfish - what sort of a bargain is being made? Second, if the residents of Washington are unwilling to bear the environmental burden of an oil terminal, how can they ask the residents of Gary, Indiana to live in blast furnace fallout, or the residents of Tyler, Texas to breathe asbestos fibers, or the chemical workers of Wilmington, Delaware to expose themselves to the toxic fumes of vinyl chloride monomer? We in the Northwest use steel, insulate with asbestos, own polyvinyl chloride ski boots. Someone, somewhere, is paying the environmental price. A final irony is that economic support for opposing industrialization is found in promotion of tourism. How do most tourists get to the Olympics or Cascades?

In cars which burn gasoline, of course.

There is a case to be made for preservation of an unspoiled coastline, and there is a much stronger case to be made for protection of the Puget Sound fisheries resource. We cannot afford destruction of wilderness and any more wild areas, and our food sources must be protected and enhanced. Rather than simply denial or acceptance of trans-shipment, there must be an honest effort to locate such facilities with the least environmental damage possible, and maximum pollution control must be assured. The cost, which is considerable, will be passed on to the consumer of petroleum products, and he must then pay it. Wherever a terminal is located, damage to the natural environment must be minimized.

The West Coast sites under consideration for trans-shipment now are Long Beach (see Fig. 7), Port Angeles, Cherry Point, and Kitimat, B.C. (see Fig. 8). Large tankers now enter the ports at Long Beach and Cherry Point and will continue to do so. What are the options?

The sea must not be killed, and this could happen all too easily. We have seen over and over what a marine oil spill can do: the bottom sediments at Falmouth still ooze oil; the beach in the Straits of Magellan, where the METULA ran aground, are still covered with a thick, asphalt-like layer;[9] the waterfowl population at Santa Barbara has not recovered. Protection against spills from tanker casualties cannot be assured because there is no control over human error. Tankers must remain in waters that are as safe as possible: large tankers should not enter the Straits of Rosario, and tanker traffic there now should be cut back sharply. Not only should the traffic to Cherry Point not increase, it should be diminished from its present level by at least two-thirds.

Should oil be trans-shipped anywhere through Washington? Not if there is another place where the environmental damage would be less. Should there be support for a terminal at Kitimat, B.C.? We could jump on the bandwagon for Kitimat, but very little is known about Kitimat. It would be unconscionable to suggest a site because little is known about it.

Should we favor increase of the proposed capacity at Long Beach because it is already polluted? Is it better to concentrate environmental damage in a place that one then writes off as a disaster area, or to disperse it and diminish everyone's environment by a lesser amount? Should we site a facility at Port Angeles, or west of Port Angeles on the Strait of Juan de Fuca? To do the latter runs counter to the American philosophy of wilderness preservation, embodied in the Wilderness Act, the Wild and Scenic Rivers Act, and the Coastal Zone Management Act. There are so few wild and natural areas left; is it right to ruin another one? There is no easy answer, only an answer in terms of priorities. We must aim at preventing the worst possible environmental damage - an oil spill in the inner Sound, eliminate all unnecessary damage,

and sharply minimize what must occur. It would be preferable if U.S. oil consumption could be drastically reduced before 1980, and if the Alaska oil could stay in the ground, but that is not going to happen.

Even optimistic estimates of the reduction of oil consumption put a date for significant cutback far into the future. As long as ERDA puts less than 5% of its budget into solar energy and other alternative sources,[10] significant development will be slow. Energy use in the U.S., including home heating, has, since the 1930's, favored methods which have low installation costs and high operating costs, and for which consumers have not paid the marginal price. Oil will remain one of the fuels of choice for producing electric power. Moreover, every thermal power generation scheme has a high environmental cost. It can be argued that the cost for oil is not as high as that for coal-generated or nuclear-generated power.

Most of the refined product consumed in the U.S. is used in transportation. Until adequate inter-city and intra-city mass transit becomes a reality, the high consumption for transportation will continue. Even with good mass transit, those vehicles will have to burn a refined oil product. Fishing boats, trucks, buses, and most other vehicles burn liquid fuel as well.

Crude oil is, of course, the base of the petrochemical resource. Not only are all plastics, synthetic fabrics, and so on petrochemicals, but most pharmaceuticals as well. Suppose that we could phase out of the current heavy dependence on oil, except for pharmaceuticals and some oil for mass transport and power generation. Even if this could be done, it would take at least a generation. Oil is going to be with us for a while.

A trans-continental pipeline from Prudhoe Bay would, in retrospect, have been a far better alternative, but it is a bit late for that now. There will probably be a trans-shipment terminal either at Kitimat, B.C. or Port Angeles, Washington, and it must be made as compatible with maintenance of environmental quality as it is within our power to do so. In sum, if we do not have trans-shipment through Washington, it is likely that someone else will.

Is this, however, a final solution? Let us suppose, not unreasonably, that there will <u>not</u> be trans-shipment through Washington State. The real immediate problem is not trans-shipment at all, but current continued and increasing tanker traffic to the Cherry Point and Anacortes terminals. This traffic will continue whether oil is transshipped to the Northern Tier States or not. What is more, if the tanker weight limit law now before the U.S. Supreme Court is overturned, there will be Very Large Crude Carriers (VLCC's) going through the Straits of Rosario to Cherry Point. It would be relatively easy, within current zoning and land use patterns, to expand the refinery capacity at Cherry Point, and to introduce a petrochemical facility there.

Ultimately, Vancouver, B.C. refineries must also be supplied, and may be supplied by tanker. One cannot ignore existing tanker traffic with its inherent spill risk; it is only a matter of time before there is a major spill in inner Puget Sound. The U.S. Coast Guard is of the opinion that, like death and taxes, tanker collisions are inevitable.[11] It is a matter of when the spill will occur and how large it will be. Are we so crisis-oriented that we are going to wait until it happens?

Cutting back on existing tanker traffic carries considerable cost with it; we are certainly doing the cheapest thing now. The cost of environmental protection must be paid, and someone will pay it. It has been argued that pipelines should not cross the Hood Canal watershed or the Spokane aquifer. Those pipelines are going to cross some aquifer; in fact, oil is carried across the Skagit River by pipeline now.

The question is not whether or not to have trans-shipment of oil through Washington; it is finding alternatives for the heavy consumption of oil. There must also be a recognition that we are not paying the real cost of resources, which includes environmental reparations, and that everything we do carries with it some burden of irreparable damage to the environment. We do not dispose of this burden by pushing it out of sight, or onto someone else.

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5. Atlantic Richfield Co. (ARCO), Application to the Washington Energy Siting and Evaluation Council, 1977.

6. U.S. Environmental Protection Agency, The Alaska Oil Disposition Study, 1977, 122 pp.

7. Rossano, August T., private communication.

8. Washington Department of Ecology, Testimony before the Energy and Utilities Committee, Washington House of Representatives, Sept. 19, 1977.

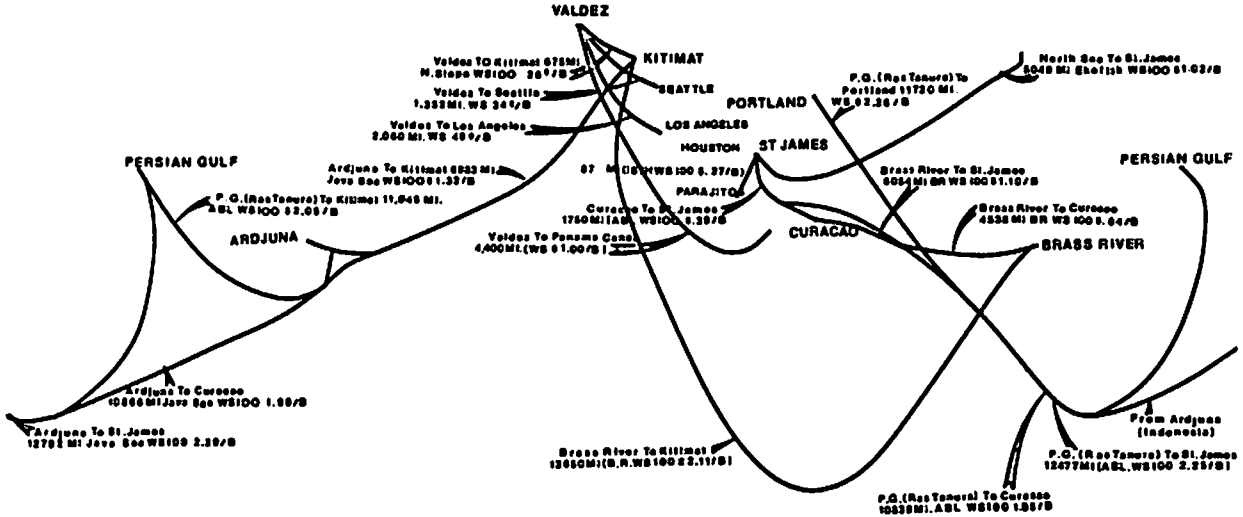
9. National Oceanic and Atmospheric Administration, MESA Study Report No. 3, 1977, p. 10.

10. See, for example, the 1975 and 1976 budget authorizations for the Energy Research and Development Administration.

11. Capt. Richard Malm, U.S. Coast Guard, presentation to the Cousteau Society, Seattle, Washington, October 29, 1977.

Figure 1.

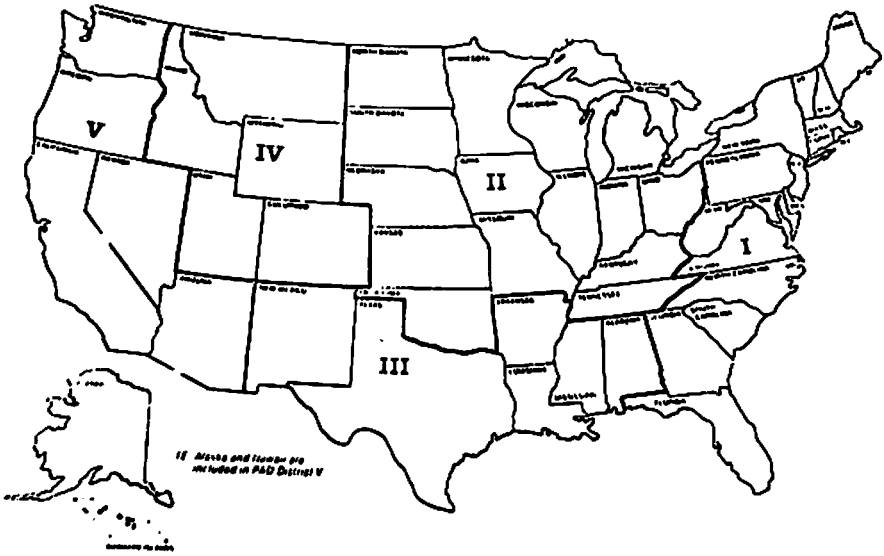
WORLD TANKER ROUTES



See Reference 4.

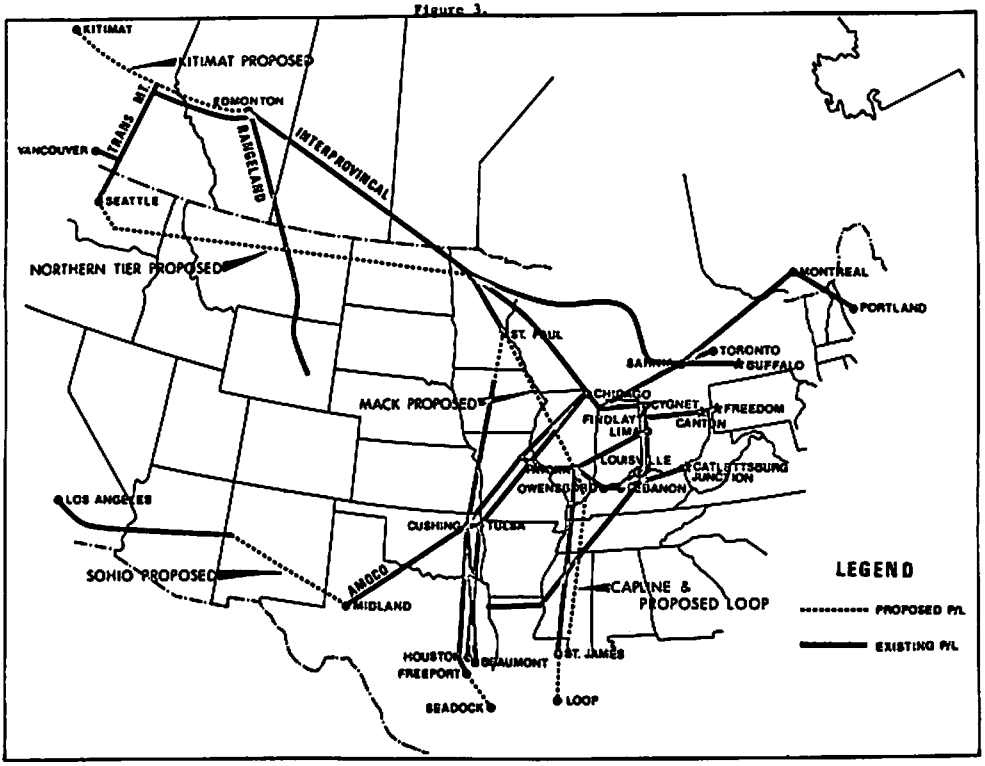
Figure 2.

Petroleum Administration for Defense Districts



See Reference 2.

Figure 3.


KITIMAT
KITIMAT PROPOSED
EDMONTON
TRANS MT.
RANGELAND
INTERPROVINCIAL
VANCOUVER
SEATTLE
NORTHERN TIER PROPOSED
MACK PROPOSED
ST. PAUL
CHICAGO
TOLEDO
FINDLAY
LIMA
LOUISVILLE
OWENSBORO
CATLETTSBURG JUNCTION
CANTON
FREEDOM
SAINIA
TORONTO
BUFFALO
MONTREAL
PORTLAND
LOS ANGELES
CUSHING
TULSA
SOHIO PROPOSED
AMOCO
MIDLAND
CAPLINE &
PROPOSED LOOP
HOUSTON
BEAUMONT
FREEPORT
ST. JAMES
SEADOCK
LOOP
LEGEND
PROPOSED P/L
EXISTING P/L

WASHINGTON MARINE THROUGHPUT REQUIREMENTS, WITH NO CANADIAN SUPPLY
(thousands of barrels/day)*

Year	Midwest Pipeline		No Midwest Pipeline	
	$7/bbl	$11/bbl	$7/bbl	$11/bbl
1980	1463-1476	1400-1466	463-476	400-466
1985	1496-1527	1395-1506	496-527	395-506
1990	1529-1579	1389-1545	529-579	389-545
2000	1662-1707	1480-1655	662-707	480-655

*1972 Washington marine throughput was 130,000 bbl/day.

From: OCW: Offshore Petroleum Transfer Systems, 1974, pp. I-27, I-28.

Figure 4.

QUANTITIES OF CRUDE PETROLEUM DELIVERED AT WASHINGTON PORTS
(in millions of barrels/day)

Markets	NW, MW, CAL		NW, MW		NW, CAL		NW	
Canadian Crude	w	w/o	w	w/o	w	w/o	w	w/o
1980	1.2	1.3	1.2	1.3	0.2	0.3	0.2	0.3
1990	1.4	1.7	1.1	1.4	0.4	0.7	0.1	0.4
2000	1.4	1.9	1.0	1.5	0.4	0.9	0.0	0.5

From: Oceanographic Commission of Washington: Offshore Petroleum Transfer Systems, 1974, p. I-3.

Figure 5.

Figure 6.

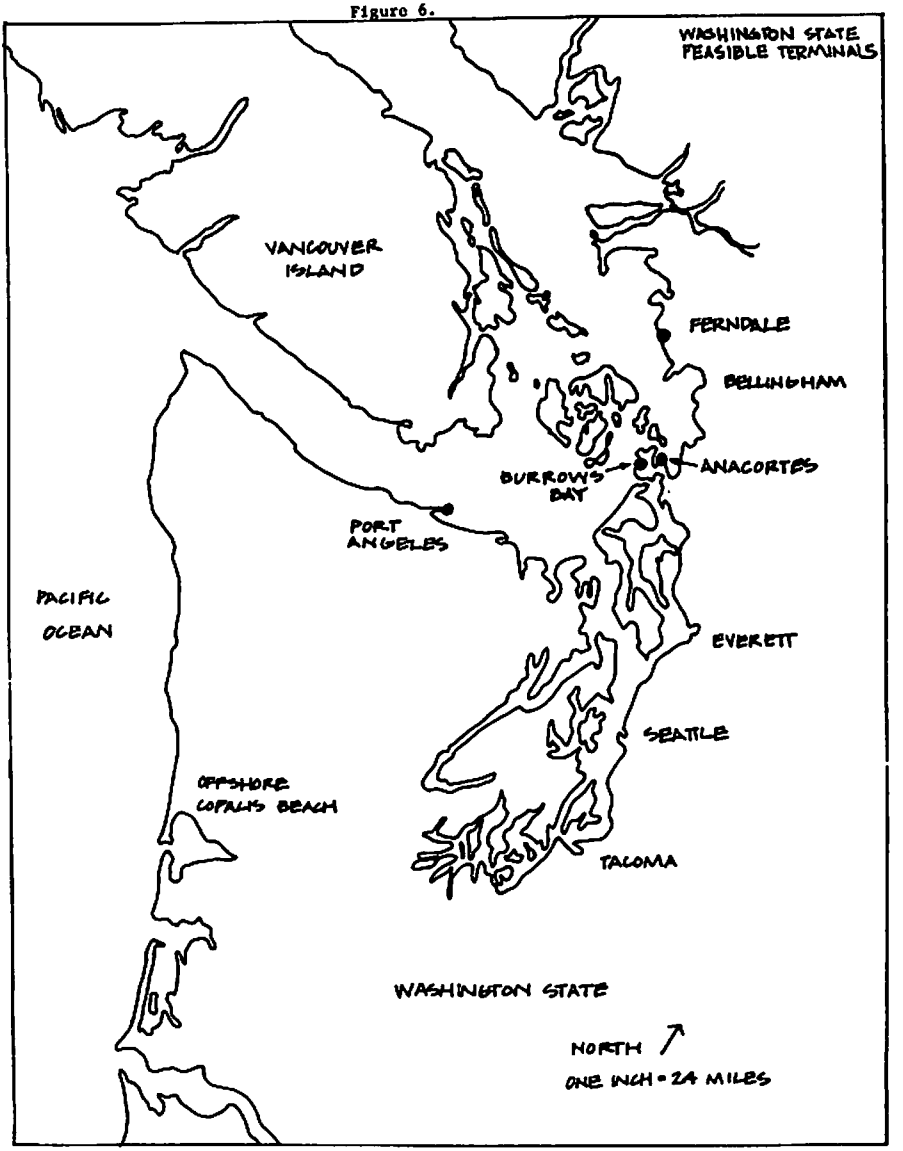

WASHINGTON STATE
FEASIBLE TERMINALS
VANCOUVER
ISLAND
FERNDALE
BELLINGHAM
BURROWS
BAY
ANACORTES
PORT
ANGELES
PACIFIC
OCEAN
EVERETT
SEATTLE
OFFSHORE
COPALIS BEACH
TACOMA
WASHINGTON STATE
NORTH
ONE INCH = 24 MILES

Figure 7.

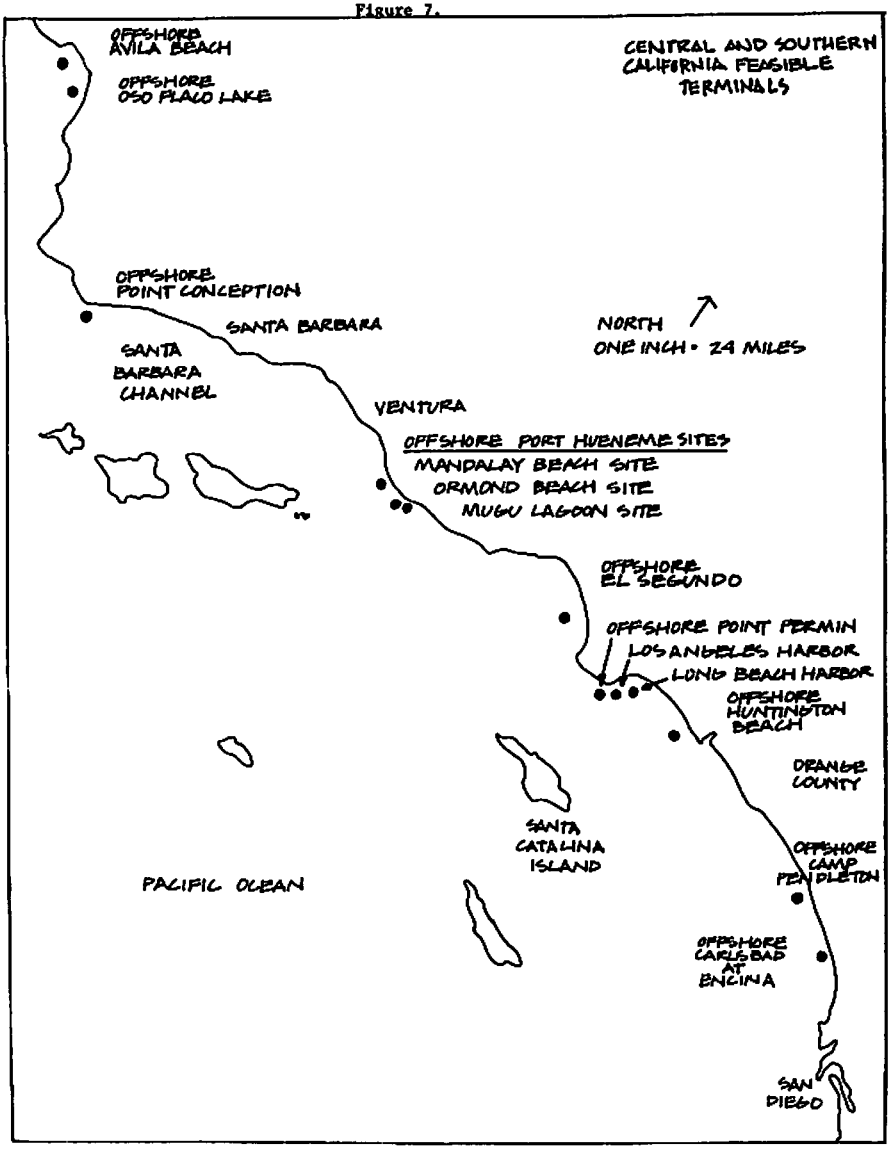
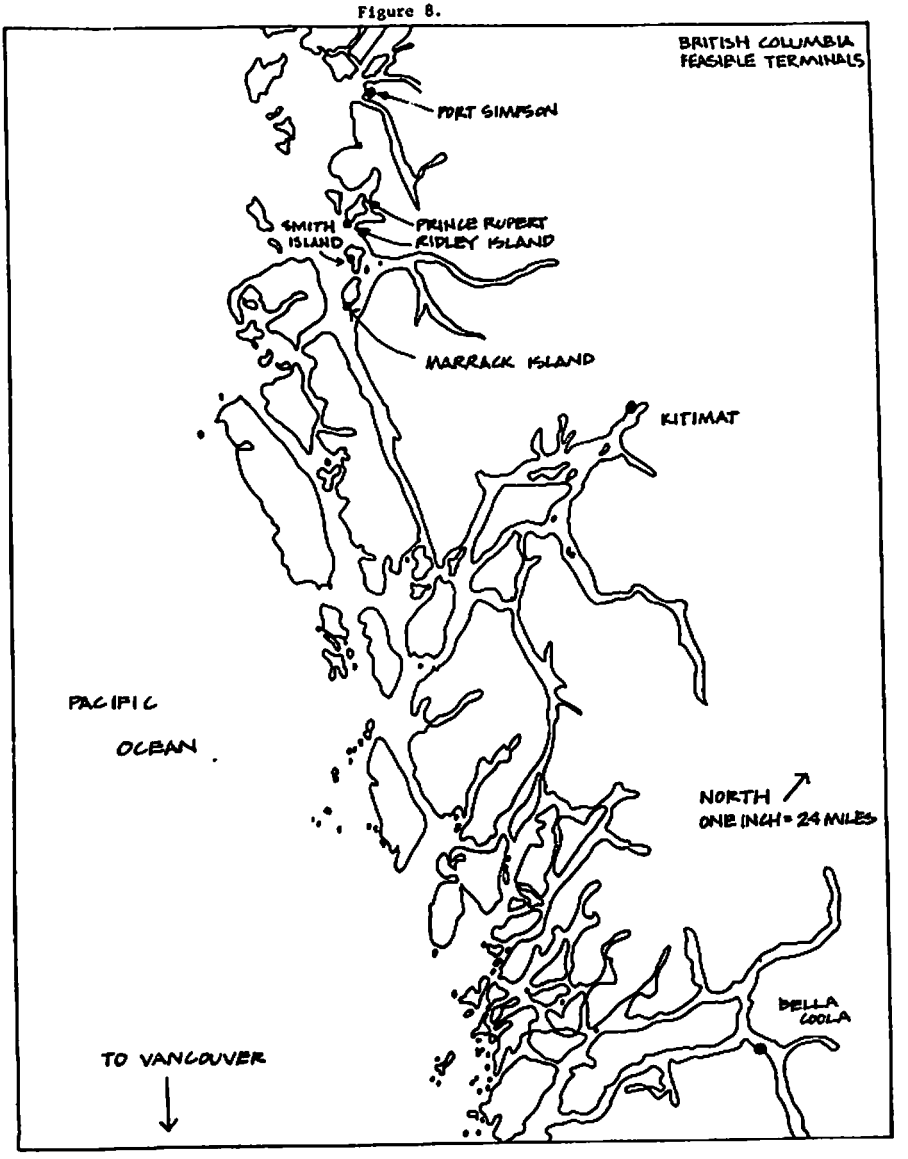

OFFSHORE AVILA BEACH
OFFSHORE OSO FLACO LAKE
CENTRAL AND SOUTHERN CALIFORNIA FEASIBLE TERMINALS
OFFSHORE POINT CONCEPTION
SANTA BARBARA
SANTA BARBARA CHANNEL
NORTH
ONE INCH • 24 MILES
VENTURA
OFFSHORE PORT HUENEME SITES
MANDALAY BEACH SITE
ORMOND BEACH SITE
MUGU LAGOON SITE
OFFSHORE EL SEGUNDO
OFFSHORE POINT FERMIN
LOS ANGELES HARBOR
LONG BEACH HARBOR
OFFSHORE HUNTINGTON BEACH
ORANGE COUNTY
SANTA CATALINA ISLAND
OFFSHORE CAMP PENDLETON
PACIFIC OCEAN
OFFSHORE CARLSBAD AT ENCINA
SAN DIEGO

Figure 8.


BRITISH COLUMBIA
FEASIBLE TERMINALS
PORT SIMPSON
SMITH ISLAND
PRINCE RUPERT
RIDLEY ISLAND
HARRACK ISLAND
KITIMAT
PACIFIC
OCEAN
NORTH
ONE INCH = 24 MILES
BELLA COOLA
TO VANCOUVER

A PROPOSED METHOD FOR ASSESSING IMPACTS OF ENERGY DEVELOPMENT ON LIVING RESOURCES AND HABITAT IN THE COASTAL ZONE

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ABSTRACT

The lack of clear criteria for impact assessment has contributed to the large size and limited utility of environmental impact statements. A replicating format for assessment, using a limited array of predetermined criteria, offers a solution to this problem. Assessment of OCS petroleum development impacts on coastal living resources and habitat has been examined using this solution.

Development of an offshore petroleum field requires a variety of offshore and onshore facilities, or projects. The proposed methodology examines the physical components of projects by subproject and the activities required to construct and operate them. Our research of OCS petroleum development identified 15 projects which included 20 "standard" subprojects. Forty-two distinct activities required to implement and operate these subprojects are known to damage the natural environment.

* * * * * * * * * * *

What was most remarkable about these hearings [June 1977 hearings on NEPA] to me was the extent of agreement about NEPA. . . . virtually every witness volunteered that NEPA had created a good process. Perhaps the height of agreement was reached when an oil company attorney representing the petroleum industry opened his presentation by endorsing

in its entirety the statement of the president of the Sierra Club.

At the same time, all the speakers believed that the EIS process might be improved. They criticized statements for being extremely bulky, for often being burdened with masses of detail that obscure rather than facilitate analysis. A fat volume or series of them serve nobody's interests. Top-level personnel in agencies rarely read them; the business man or woman compalins that they take too long to prepare; and the environmentalist asserts that agencies use bulk to hide the critical issues.

Gus Speth, Councilmember, Council on Environmental Quality. Presentation to the National Association of Environmental Professionals, June 30, 1977.

INTRODUCTION

Impact assessment methodology has developed over seven years to meet the requirements of the National Environmental Policy Act (NEPA). Since this law became effective, environmental impact statements (EIS) analyzing about 8,400 proposed programs and projects have been submitted to the Council on Environmental Quality by 47 federal agencies. [1]

At forums about NEPA, such as the June hearings held by the Council on Environmental Quality, participants generally agree that the impact statement has been a positive force in the Federal decision process, although major problems have hindered its full effectiveness. One of the greatest problems is how to simplify the impact statement to make it relevant. The sheer length of documents assessing proposed coastal and offshore energy activities has often made it impossible to discern the key environmental issues. For example, the final EIS for lease sale #40 in the Mid-Atlantic contained about 2,000 pages in four volumes. The final environmental statement describing the Alaska Pipeline proposal, an extreme case, makes an excellent barstool when volumes are stacked on top of each other. Describing this problem, one critic stated: [2]

> The Department of Interior's Bureau of Land Management has [used] obfuscation--manifested by 4 and 5 volume EIS tomes approaching 10 pounds in weight which are written as if the authors are preparing for a game of trivia on the subject at hand. Characteristically, DOI's draft and final EIS's fail to integrate the information contained in any logical manner which will draw it to a conclusion. Thus, DOI's

EIS's are themselves useless to the decisionmaker.

The Council on Environmental Quality invited each state to submit testimony in response to several questions to obtain background information for the June hearings. More respondents cited the size of statements than any other characteristic as the greatest constraint to using the environmental statements in a decision-making process. [3]

The Conservation Foundation recently completed an anlysis examining the effect of OCS offshore and onshore activities on coastal living resources and natural habitat. Based on this analysis we propose a potential alternative form of impact assessment that would help diminish the size of environmental impact statements. [4]

STATUS OF IMPACT ASSESSMENT

The purpose of impact assessment, as used in environmental impact statements, is to ensure thorough review of effects of alternative courses of action. An inadvertent result arises, in certain cases, when the assessment becomes a strategic mechanism to delay a decision on a proposed action.

The requirements of thorough review create a necessary burden on the design and application of any assessment methodology. Existing regulations generally require four aspects of impacts to be addressed in an EIS: identification, measurement, interpretation and communication to information users. Each factor can be broken down into more specific subsets, but in all cases, the assessment must analyze all "important" aspects and be complete and clear enough to demonstrate the interrelated nature of analyzed elements.

To some project protaganists, the assessment process can be used to delay project implementation rather than to attempt to determine the best course of action. While less than 10 percent of all EIS's submitted to CEQ between 1970 and 1975 have ended up in litigation, the litigation process is long and delays final action on projects. Between 1970 and 1975, 654 cases were filed. Approximately 60% of the 333 cases completed by June 30, 1975 resulted in temporary injunctions, ranging from a few weeks to the time required to prepare an adequate impact statement. It may surprise some to learn that only four cases resulted in permanent injunctions. [5]

How can the intended purposes of assessment be fulfilled in a more expeditious and useful manner? Two possibilities worth considering are: first, the concept of a thematic approach to assessment and, second, a consistent or replicating method of analysis. These possibilities are discussed in detail below, but for now it is useful to relate them to the broad purposes of impact assessment. The thematic approach simply means assessing similar proposals in the same way.

Agencies that are preparing or reviewing environmental assessments for permit approval, for example, should require a consistent framework of analysis. The level of consistency should center on impacts and their causes. Consistency allows the reviewer to compare current alternatives with past proposals and decisions. If those who prepare these documents give more attention to these two approaches, the documentation will often be shorter, the factors considered clearer, and the rationale for the decision more apparent.

Briefly consider the reverse situation: If the impact assessment procedure is used as leverage to delay a project, an impact statement that contains all available data and analysis, regardless of relevancy, will rarely be accepted. No matter how much information is catalogued and analyzed, a searching critic can almost always find technical omissions and inaccurate or inappropriate analysis. Less than 10 percent of all proposed actions for which an impact statement was prepared have gone to court based on some alleged deficiency of that document, and the percentage is declining. It seems inappropriate to make all environmental statements cumbersome and unwieldy to try to save projects from litigation.

What then are the desirable goals in creating the context for impact assessment? A thematic approach could: first, have predetermined criteria available to set the general format for analysis of each proposed action; second, simplify the document so important analysis can be emphasized and irrelevant lists and other "fillers" deleted; and third, have a replicating assessment system that can be applied to a number of similar proposals. Of these goals, predetermined criteria is the most important because if these criteria are generally acceptable, then the other two goals will also be met; the length is limited by the range of information required to address the criteria and the criteria become the basis of the replicating system.

This approach will help impact assessors who may be either analysts or reviewers. Criteria will give analysts specified work elements within defined topics. Reviewers will know if important topics have been analyzed and how the analysis is supposed to be structured for each review.

The main value of this system would be for those actions that are often repeated. Assessment is commonly done either to gain approval of federal permit applications, such as dredge and fill, or to examine a proposed action, such as an offshore lease sale. If a method for reaching those goals can be delineated by each preparing and reviewing agency, then the applicant will, in advance, know the criteria that must be addressed. If an EIS contains a known assessment process with criteria or tests approved in advance, the reviewing agency (and public) can concentrate on examining the meaning of test results, not on whether the correct tests were performed and methods of analysis were acceptable.

The coastal area serves as an appropriate testing ground for the process. Concentrated attention on this area in the recent past has given agencies and the public a lot of experience and fostered development of a substantial data base. Many actions which require an environmental assessment are concentrated in coastal areas. These programs include the broad topics of water quality, dredge and fill, coastal zone plans, and wetlands alteration, as well as a myriad of specific energy-related issues.

PROPOSED METHOD OF IMPACT ASSESSMENT

The method is based on applying predetermined criteria, available in advance to all interested parties, to all important aspects of a development proposal. This method requires a precise definition of terminology. These terms describe the cycle of events which lead to adverse impacts.

Recognition of a need results in programs which may be initiated through specific development projects. A project is a completed unit of development which is self-sufficient and functions alone. Projects are made up of component subprojects which are implemented by construction and operation activities. Any activity which leads to an environmental disturbance sets off a series of ecological effects. Environmental disturbances are adverse perturbations to the ecosystem caused by a disruptive activity. The ecological effect of such disturbances is measured by the reaction of an ecosystem. Finally, environmental impacts are the result of ecological effects that alter the ability of the ecosystem to the fulfillment of human needs. It is important to view these relationships as a cycle; the ecological effects and impacts caused by one project becomes an altered environmental base condition when proposed projects are assessed for environmental impact in the future. Examples of each term in this cycle are presented in Table 1.

Table 1

Examples of Impact Assessment Terms

Term	Examples
Program	Offshore Lease Sale
Project	Refinery, Crew Base, Pipe Coating Yard
Subproject	Navigational Improvements, Bulkheads

cont.

Table 1, cont.

Term	Examples
Activity (Construction)	Dredging, Paving, Excavating, Pile Driving
Activity (Operation)	Wastewater Disposal, Oil & Gas Processing
Environmental Disturbance	Toxic Discharge, Elimination of Wetlands
Ecological Effect	Oxygen Reduction, Turbidity, Siltation
Environmental Impact	Depleting Oysters

Each term was examined with specific reference to OCS activities and their effects on living resources and natural habitat. If an OCS lease sale is the program in a frontier area and the normal group of projects that accompany exploration and production are anticipated, then a set of 15 standard projects and 20 standard subprojects can be ascertained. The lists could be subdivided in a variety of ways, so the key word is standard: lists accepted by all potential analysts and reviewers. Table 2 presents these standard projects and subprojects.

Table 2

Standard Projects and Subprojects

Standard Projects	Standard Subprojects
Geophysical Survey	Overland Transmission Systems
Exploratory Drilling	Stormwater Systems
Production Drilling	Solid Waste Disposal
Pipelines	Industrial Wastewater Systems
Offshore Mooring and Tanker Operations	Industrial Cooling Water Systems
Service Bases	Pest Control
Marine Repair and Maintenance	Dikes and Levees
General Shore Support	Offshore Platforms and Structures
Platform Fabrication Yards	Marine Transport of Oil
Pipecoating Yards	Submerged Transmission Systems
Oil Storage Terminals	Navigational Improvement
Refineries	Piers
Petrochemical Industries	Bulkheads
	Beach Stabilization

cont.

Table 2, cont.

Standard Projects	Standard Subprojects
Gas Processing	Site Preparation
Liquified Natural Gas Processing	Site Development
	Artificial Watercourses and Water Bodies
	Roadways and Bridges
	Groundwater Supply
	Sewage Systems

An activity has been defined as a work action required to construct or operate a subproject. Activities of concern here are those known to affect living resources and habitat. Twenty-four construction activities and eighteen operations activities were determined as associated with one or more OCS subprojects and known to disturb the natural environment.

Table 3

Construction Activities

Aggregate Removing	Land Surface Grading
Canal Excavating	Line Constructing
Concrete Pouring	Oil and Gas Drilling
Dredging	Paving
Dune Stabilizing	Pile Driving
Earthwork Building	Pile Jetting
Excavating	Pile Placing
Facility Installing	Spoil Depositing
Fill Depositing	Structure Erecting
Fill Removing	Submerged Line Laying
Land Draining	Trenching
Land Surface Clearing	Water Well Drilling

Table 4

Operation Activities

Chemical Broadcast	Pipe Coating
Circulation of Cooling Water	Piped Gas Transmission
Circulation of Process Water	Piped Oil Transmission
Gas Liquification and Regasification	Road Traffic
Groundwater Withdrawal	Solid Waste Disposal
Maintenance Dredging	Steel Processing
Marine Oil Transport	Stormwater Conveyance
Marine Traffic	Wastewater Disposal
Oil and Gas Processing	Welding

One often encounters a list of items called "impacts" in assessment. In many cases, the items are a mixed list of effects and impacts, as well as activities, subprojects and disturbances. Use of the proposed structure clarifies the relationships of items on such a list.

Almost all systems of impact assessment concentrate on the project level. One study has divided assessment methodologies into five groupings; ad hoc, overlays, checklists, matrices and networks. [6] Application of each method centers on a project or projects, rather than the level at which the effect of a specific disturbance can be assessed. Assessment at the project level detracts from any effort to simplify and focus EIS contents and assists successful litigation. We believe that activities are the key level because it is the point of control for ecological protection measures and the point of opportunity for any approval conditions and for mitigation recommendations.

An important characteristic of activities is that they consist of disturbances that have well-known ecologic effects. This is not always true for projects and subprojects, which require more complex analysis. If proposals are assessed at the activity level, the assessor can concentrate his attention on the scale of disturbances and interrelationships among elements of disturbance.

Analysis of ecological effects may be complex or simple. Effects may be simple and isolated, interact with other effects, or feedback to cause secondary effects. The pattern of effects is often portrayed as a web. The complexity of such relationships can be extreme. A profusion of effects leads directly from a single disturbance, or, conversely, a number of separate disturbances may multiply a single effect. Comprehensive analysis of all elements of the more complex patterns may even be difficult for a knowledgeable scientist. Although such expert understanding occasionally is required in the assessment

of large and controversial projects, a small percentage of all assessments, more routine work normally proceeds at a simpler level.

THE PROCESS OF IMPACT ASSESSMENT

How can impacts be assessed to meet the goals stated earlier? The process described below has five steps; steps that staff in many agencies may already follow in part. These steps can be used by the analyst, preparing the assessment or by a reviewer. In practice, the sequence may be simplified because of familiarity with the type of work proposed and its typical disturbances, or because of the ordinary nature of the proposal. Nevertheless, these steps, explicitly or implicitly, should be part of each impact assessment.

Step 1. Analyze Proposed Work Plan

An impact assessment must contain sufficient information so that the analyst or reviewer can determine the exact nature of the proposal, the stages by which it would be accomplished, and the specific activities that would be conducted. Predetermined criteria can be used to limit analysis to those activities that are known to affect habitat and natural resources when they are undertaken. After this first step, projects and subprojects are not considered; all analysis is of activities and resultant disturbances.

Step 2. Select Activities with Potential for Significant Disturbance

In this step, the analyst or reviewer identifies potential disturbances and screens them against personal knowledge and experience. This step is a preliminary assessment to winnow down the list of potential disturbances to those that have a reasonable probability of having significant impact. By using predetermined criteria, the content of the assessment can be limited to specific and important issues.

Step 3. Evaluate Disturbances and Effects

The activities selected in Step 2 are subjected to detailed examination to determine probable effects and impacts. The assessor or reviewer uses available knowledge of the severity of effects that typically result from particular disturbances. Many disturbances to the natural environment have predictable effects based on past or repetitive experience. An experienced individual can therefore often make reliable judgments of final impact simply by knowing the extent of the anticipated disturbance from identified characteristics of activities.

Once each anticipated disturbance has been evaluated and the full range of effects is outlined, additive effects must also be considered.

This is easy enough if disturbances in two cases have the same effect. For example, the effects of turbidity from hydraulic dredging of a channel may be added to those of dragline dredging of a boat basin, because the disturbance, release of suspended solids, is the same in both cases. But it is not so simple if the disturbances are different. For example, the eutrophication effects of channel dredging are difficult to add to those of sewage discharge during facility operation. This additive process must be resolved based on experience.

A second type of additive problem is cumulative impacts. While the problem is widely recognized, solutions are not abundant. The typical reaction is to specify those alterations which will add to the known accumulated alterations of the past. Information and ground rules for determining "how much is too much" for an ecosystem is usually unavailable. No solution is offered here because the acceptable limits of cumulative impacts is often more a policy matter than a technical one.

This is the stage for dispelling doubts about marginal cases. If an activity being analyzed in this review proves not to have significant potential for impact, it is tentatively dismissed. Activities identified as having a potential for significant adverse impact are carried to step 4.

Step 4. Identify Modifications to Work Plan

Both the assessor and the reviewer should have the opportunity to suggest modifications to the proposal based on the assessment. Often, suggesting modifications requires a higher degree of informed judgment than forecasting adverse effects. Suggestions for modification must be tailored to the specific circumstances of the project and may range from a small setback (to preserve a fringing marsh) to a major rescheduling of dredging (to avoid the spawning season). Feasibility of project modification depends upon many factors, such as the planned sequence of events of projects, the degree of commitment of the sponsor to the present configuration, and the cost that could be incurred.

Step 5. Make Preliminary Recommendation

In this step, the question of scale becomes critical. In the case of living resources and habitat, how much ecologic alteration of any kind is acceptable and how much is not? The answer must ordinarily come from judgement, not rule. Therefore experience and precedent is important in formulating recommendations. The judgement is based on available scientific evidence and knowledge of public needs, requirements, and desires as set forth in agency policy. Public interest balancing is usually beyond the scope of this effort.

Suggested conditions can take either of two forms; (1) design specifications, in which a specific engineering solution is recommended; or (2) performance specifications.

SUMMARY

We have described an impact assessment method that would appear to work well in coastal areas, specifically for assessing the effects of OCS-related activities on living resources and habitat. The key to simplicity and focus is predetermined criteria. If all who are responsible for EIS analysis could agree on a standard list of criteria, then the assessor and the reviewer could concentrate on important elements, rather than mixing all possible (and impossible) concerns together.

The Council on Environmental Quality is presently formulating new guidelines for the preparation of environmental statements. Many of the comments made at the June, 1977 hearing that are a proposed part of the Council's effort touched on elements of our proposed framework. This proposal is one of many possible solutions, but it is our hope that the basic goals discussed in the introduction will be addressed in guidelines revisions to be released in the spring of 1978.

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LOCAL INITIATIVE AS AN IMPERATIVE IN ESTUARINE PLANNING

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ABSTRACT

The tentacles and threads, real or imagined, of mandated federal and state coastal zone management planning goals and policies, objectives and tasks can lead to a latter day version of the Boston Tea Party. But this doesn't have to be. An alternative is education which leads to local initiative for planning. Locally stimulated planning must utilize the generally excellent state and federal technical and management resources to develop action plans for both conservation and development of America's critical coastal resources. In this paper, some examples of successful local planning efforts on the Oregon coast will be discussed.

"Why do we have to hire consulting biologists for thousands of dollars to fight environmentalists who work for free? Sea Grant should provide biologists to the ports to counter those working for the government who are trying to put us out of business." I didn't make up that quotation. It actually was spoken very recently and points up the extent of the estuarine planning problem for those of us who search for the elusive middle ground between conservation and development. The obvious answer is that government biologists, engineers, and planners (in whatever agency) -- local, regional, state and federal -- are working for all of us. The perception, however, is otherwise. It seems always to be us (locals) versus them (who don't live here).

Why this perception exists is not the subject of this discussion. How to turn the situation around is.

Most of the world's larger cities were built on estuaries. Early city development on estuaries was usually totally unplanned. Of modern cities, perhaps Melbourne is an exception. The specific site was usually upstream far enough to build a state-of-the-art bridge or ferry to the other side. A few miles inland and upriver also provided a kinder

climate than the open seacoast. The advantages of readily available food from the bay and ocean, and access to the ocean transportation freeway were only slightly lessened by the tendency of the Vikings to come in every couple of years and steal all the women. Thus, for thousands of years, the estuaries have been considered important human use areas. Most of the Oregon ports were developed to supply the gold camps of the mid-to-late-1800's. Since then, however, marine trade in fisheries, lumber, wheat, vegetables, and petroleum have become mainstays.

At the same time, the coast in general and particularly the estuaries were becoming more attractive as home sites. Aquaculture and recreational fishing, cruising and even water skiing became valid uses of estuarine waters. Timbered watersheds were denuded. Intensive agriculture provided wastes to the streams which meandered to the estuaries and out to sea. The ocean was downhill from everything. Personal transportation from inland helped to turn "our" estuary into "everyone's" estuary.

At an early stage, the existing pattern of local government, the counties, was established, based largely on watersheds and transportation. The result today is an almost inviolate group of small fiefdoms, separated now by hours rather than days, from the next venue.

About a dozen years ago, few in Oregon had heard the word estuary. Almost too late came the awakening of environmental concern and understanding of estuaries. This concern about estuaries rode the tide of environmentalism which swept America in the late 1960's and early 1970's. Several factors contributed to forming a crisis in estuarine management. Cities on estuaries, local government structure, multiple use pressures and environmental consciousness all played a part.

There are always pioneers. The Oregon Chapter, American Fisheries Society, lead the charge toward public understanding of estuaries. Sea Grant helped by publishing the Society's bulletin "Crisis in Oregon Estuaries". About 20,000 copies later, the bulletin is still in demand. Withdrawn from publication, because some positive changes have occurred, a new version, "Oregon's Fragile Few" should soon be available.

Crisis is a good word. Everyone reacts. Stir up the people. Create an emotional confrontation. Stop everything. Stop reclaiming and polluting the estuaries. Stop shipping. Stop docks. Stop eating. Starve.

A classic situation with no middle ground. Choose--you're for estuaries or against them. Choose--you're an industrialist or a conservationist--or worse yet, an environmentalist. Pass some laws. Create some cocoons.

The bulletin "Crisis in Oregon Estuaries", for those who made it

past the title, pointed out that the solution was largely in local hands --with your port commission, your county court, your neighbors and you. Ten years later this situation has not changed. Local initiative is an imperative in estuarine planning. There are some good examples. They'll be discussed later. First, let's consider two bill of rights for those organisms (human and otherwise) who value the estuaries. We'll call the first the Fishery Bill of Rights. --Why? Because estuaries are perhaps the most fertile spots on earth, biologically.

In simplified form, the living creatures which live in, migrate through, or visit an estuary need these assurances:

1. Good water quality. Can all the life states of the organisms which use the estuary for birth, a nursery, life, shelter, or a transportation corridor thrive in the temperature-nutrient-salinity-chemical mix of the waters?

2. The water flow pattern must not be materially altered. Channels, fills and other changes should be shaped to complement the natural flow system.

3. An estuary should not be filled. I said "should" rather than "must". There are times when fills are a priority use.

4. Primary food production areas must be protected--usually the shallow tidelands which traditionally have been most vulnerable to alteration.

5. Freedom from harassment. Estuarine organisms can be used intensively but must have periods of rest. The alternating tides provide rest for clams, for instance, from the "rapacious" shovels of recreationists.

A second Bill of Rights relates to Human-Associated uses: After all, we can ill afford to deny that humans exist. Yet, this seems to be happening.

In the economic sense, estuaries are productive in the creation of capital.

1. Maritime shipping requires docks, back-up storage, stabilized channels, turning basins, and a safe all-weather bar.

2. Commercial fisheries require unloading docks, adjacency to processing facilities, drydocks and other ship repair, fuel, ice and other supplies, staging areas for gear storage and repair, docks for boat parking, and a safe bar.

3. Recreational hunting, fishing and boating uses of the estuary

require boat docks, launching areas, fuel, parking for automobiles, and other amenities.

Many other commercial-industrial-recreational human uses of estuaries could be listed. Each use may develop into a point of conflict over environmental versus economic-industrial uses. A key to successful planning is to find points of mutually compatible compromise on both sides. These compromises can include an agreement to restrict development on shallow tideflats, shape the fills to harmonize with water flow, and seek creative uses for dredge spoils.

And time is wasting. A port manager told me last week that this is the year. "A dirty knockdown battle is going on as to who will control Oregon's estuaries," he said.

The most effective solution to estuarine use conflicts is a broad-based, local initiative plan which can lead to zoning of the estuary and watershed. Although state and federal governmental planning agencies promote local impetus in land use planning and zoning, few citizens seem to believe it.

Let me discuss some of these efforts with you. The Yaquina Bay Task Force was appointed by the Lincoln County, Oregon, Commission in 1969. This group was charged with developing a comprehensive use plan for the Yaquina estuary based on existing knowledge which would lead to zoning of the water surface and adjacent uplands. Further, the Task Force was asked to take the lead in implementation of the plan for industrial development and conservation. The Yaquina Bay Task Force included representatives from the county, ports, cities, major user groups of the estuaries, and citizens. Agency biologists, engineers, and planners participated in the development of the plan. Thus, the agencies were a party to the plan, rather than a reviewer of the plan, after the fact. The comprehensive use plan was completed in 1971. The water and adjacent areas were zoned in 1971. Implementation followed closely thereafter. New docks, marinas, and other water-related facilities have been constructed since then and more are in progress. The natural resource base is being protected. The "Fisheries Bill of Rights" and the "Human Use Bill of Rights" are effective.

In Tillamook Bay, Oregon, a similar local initiative led toward a comprehensive plan for the estuary. The Task Force was organized in 1973 to study the Tillamook Bay area and to recommend guidelines for its future development. Representatives from ports, city councils, the county and industry served on the task force--elbow to elbow with a technical advisory group from local, state, and federal agencies. The group examined natural, governmental, land use, and economic resource characteristics. The shoreline and associated water uses were divided into 15 units. A community attitudes survey published in the Tillamook Headlight Herald newspaper drew heavy response. As in the Yaquina Bay example, agencies planned with the citizens. The result was our plan.

Noting the success of efforts at Yaquina and Tillamook Bays, the Oregon Coastal Conservation and Development Commission published, in 1973, a bulletin "Estuarine Planning Guidelines". This remains as an excellent step-by-step guide to locally stimulated estuarine planning.

Based on these two examples plus planning in Alsea Bay and CREST (Columbia River Estuary Study Team), I believe that the local initiative is essential to successful estuarine planning. If results are measured in hours spent in planning, arguing, compromising, and haggling, local planning must be successful. On the basis of efficiency from commencement to completion of a plan, locally initiated planning is a loser. Education takes time. Compromises must be hammered out.

Unfortunately, this is rational thinking. Rationality seems to have little to do with planning efforts in the 1970's.

But take a visit to any local governmental authority. I suggest that most counties, cities, port districts, etc. have a number of plans on file for nearly any contingency. The plans, in many cases, were prepared in good faith by talented consultants. Professional documents all the way. SOMEBODY ELSES PLAN. Not ours. Why were they prepared? Perhaps as a requirement to establish a district's eligibility for funds under some Federal or State Act. After suitable fanfare and presentation of copies to local politicians and others who might have a professional or personal interest, the dust-gathering process begins. The plan becomes an artifact--a monument. Something to be pointed to and cited as -- Yes, we have completed our plan and thus are eligible, etc.

A locally initiated estuary plan has the best chance to be a living, moving, changing process document. There are educational resources available to help develop this living estuary plan. The Community and Resource Development section of the Land Grant University Extension Service in each state has faculty who are educational specialists in land use planning methodology. If a Sea Grant University is available, the Marine Advisory Program may have faculty with assignments in coastal zone management. In New England and the Pacific Northwest, fledgling Regional Coastal Information Centers are in operation. These units are a cooperative effort of the Office of Coastal Zone Management, Environmental Data Service, and the Sea Grant university. The plan itself must be constructed by the people which it affects. Laws are made in the capitols of the world. Life is lived where the people are--in this case, among the coastal estuaries.

The people of Tillamook Bay completed their written estuary plan on the following note: "The condition of the estuary can never be as it was before the area was settled. The future reality will always be less than the ideal. But human impact on natural productivity can be managed, in the Tillamook Bay estuary and elsewhere, if concerned residents will act."

WASHINGTON'S INLAND WATERS: PUBLIC DOMAIN V. CORPORATE RIGHTS - A GRASS ROOTS RESPONSE

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The president of Protect Our Waters, Betty Jones, is unable to be here today. I am assuming the title of her talk, but not her proposed content.

I am Phyllis Graham, vice president of POW, Protect Our Waters, and a resident of Birch Bay, which is just north of Cherry Point and the ARCO refinery - proposed site of the ARCO-Transmountain oil transshipment center, the catalyst for the formation of P-O-W, POW.

What is POW? It is a public interest group concerned with the social, economic and environmental costs to the coastal environment. It was formed to oppose the transshipment of oil from the Cherry Point site to the midwest. The risks are too high and there are alternatives.

Who is POW? POW is composed of environmentalists, conservationists, sailboaters, pleasure boaters - and boat builders, fishermen - both sport and commercial, boat fitters, gear manufacturers, crab fishermen, students, grandparents, Lummi Indians, resort owners, real estate people, second home developers, groups and individuals concerned that this multi use estuary known as Puget Sound not become a single purpose highway for the oil interests.

Questions immediately arose: who pays for the fishing nets fouled by oil - or cut loose from a boat because a large tanker is approaching? who pays for cleaning up beaches fouled by oil? for marinas, docks and boats which become dirtied?

And so the grass roots became organized - and vocal. Fortunately, there was a nucleus of informed citizens. Several years ago, as a result of a KING tv series on the environment, a group known as Eco-Action was formed in Bellingham. It included women from other parts of Whatcom County as well. This group became very involved in land use planning (as a

matter of fact, its members were appointed to boards and commissions in the cities of Bellingham and Blaine as well as Whatcom County). As a result of Eco-Action's reputation for education and hard work, some of its members were appointed to the newly formed citizens shorelines committees to draft shoreline management programs for the county and cities. These programs formed the base of the State's Coastal Zone Management Program. I served as chairman of the Whatcom County Citizens Shorelines Committee. Eco-Action testified at the Army Corps of Engineers West Coast Deepwater Port Facilities hearing in 1973 in Seattle, as well as at the State Oceanographic Commission hearings concerning deepwater ports. Eventually, in connection with the Whatcom County League of Women Voters, Eco-Action published a booklet entitled "Deepwater Ports, Supertankers & Puget Sound". This was in 1974-1975. Many from Whatcom County participated in the "Oil on Puget Sound Conference" held at Skagit County Community College in the spring of 1974. We toured the two local refineries plus the other industry at Cherry Point, Intalco, to research the idea of a multi purpose port in the Cherry Point area. We attended the programs of Wolf Bauer, Seattle engineer hired by Whatcom County to assess the marine shore processes of the county. The information he amassed was studied.

Thus, long before the ARCO-Transmountain proposal, the groundwork had been done on information and research concerning oil and other development at this site. This proved to be invaluable when the oil transshipment plans were announced and Governor Ray threw her weight behind the Cherry Point proposal. Her insistence on the suitability of this site BEFORE STUDIES WERE DONE, BEFORE THE APPLICATION WAS REVIEWED IN THE MANNER PRESCRIBED BY LAW, BEFORE AND DURING THE TIME HEARINGS WERE BEING HELD, actually aroused the citizenry to form organized resistance to the plan. And the ride the governor took on the ARCO FAIRBANKS and her remarks about how easy the ship was to steer and how there was plenty of room to maneuver through

Rosario Straits, only served to arouse more people against the manner in which she was endorsing the proposal. It seemed as though she was selling out all the 'little people' making their livings from a clean Puget Sound to the large corporate interests.

So, Protect Our Waters formed. It is a strictly volunteer group. As in most volunteer groups, some are activists, some not. Some donated money, but didn't wish it known. Others donate time and talent along with their dues. The one point all who joined could agree on was that we opposed an oil transshipment center at Cherry Point. The members were at all different levels of education and information concerning this complex question of oil/energy/need, and since we were in a crisis situation, efforts had to be narrowed down to this one point: NO to Cherry Point. Exploring other facets such as alternatives, Port Angeles, etc., had to be pushed aside. We contacted Bob Lynette of the Coalition Against Oil Pollution and Norma Turner of No Oil Port in Port Angeles. Both were very helpful in sharing information and passing on how-to hints.

At this time the State legislature was in session. Our own Whatcom County representatives and senator, especially Mary Kay Becker and Barney Goltz, were solidly opposed to oil transshipment at Cherry Point. Protect Our Waters testified before committees and the Energy/Site Facilities Evaluation Council, wrote letters, sent telegrams, met with key people in both House and Senate. This often meant getting up at 3 and 4 AM in order to be in Olympia by 9 AM,and perhaps not getting home until 10 or 11 at night.

We did not neglect our federal delegation either. In the end, the fact that the people of Washington State had already made their wishes known in the Coastal Zone Management Program under Governor Dan Evans specifying no oil transshipment center east of Port Angeles; the fact that they spoke again through their State legislators and the passing of a bill reiterating that stand; the fact that public testimony at public hearings was overwhelmingly opposed to such a project at Cherry Point;

and the fact the present governor vetoed the bill of the legislature and continued to put her personal preference first before that of the people, - all these facts convinced our federal delegation, led by Senator Warren Magnuson, to step in and settle the question . . . for which Protect Our Waters is grateful. The cost of continuing contested case hearings before the Energy Facilities Site Evaluation Council for a project that would likely end up in the courts is certainly not justified. ARCO-Transmountain might feel the longrange value of their project to them personally justifies the money that would be spent, but the cost to the State for holding contested case hearings, the cost to the local public for hiring attorneys to represent them, the cost to the nation in terms of indecision and delay in answering the question, "How do we get oil to the Midwest" cannot be justified. Magnuson and the federal delegation recognized this and did the only thing possible. The Governor has been quoted as saying she doesn't feel the people of the State have spoken - I wonder if she didn't hear the people because they were not saying what she wanted to hear.

Are grass roots movements simply obstructionist tactics? Is Protect Our Waters made up of kooks? or little old ladies in tennis shoes??? Don't you believe it. A lobbying effort - an educational campaign - takes dedication, hard work, intelligence, research, writing skills, organization and money. A legislator or official is too busy to have his time wasted. You must be succinct, sure of the facts, and detail concrete reasons for your stand in order to be listened to. POW did all these things - and we knew we were effective when we received calls from staff people, legislators, and their aides asking us for information, or requesting we contact individuals, or suggesting what we might do next.

What were some of our telling arguments - ones that helped sway those necessary votes for the state legislature to pass the bill opposing Cherry Point as a transshipment center for oil?

First: Economic. The 16 to 30 jobs such a facility might generate do not begin to compare with the 74,000 plus jobs in the fishing industry alone that would be jeopardized by such a facility. Over $8 million worth of new construction was planned for the resort area of Birch Bay this past summer. Boatbuilding, sales of pleasure craft, and tourism are all big industries in Whatcom County - and all dependent on clean beaches and waters. It doesn't make sense to risk existing, operating businesses because the government and/or oil companies did not keep pace with Alaskan oil coming on stream, Canadian oil being cut back, and failure to solve oil spill cleanup.

The second argument was that of Food Producer. Besides commercial salmon & bottom fishing, this rich estuary of Puget Sound contains aquaculture projects. The Lummi Indian Aquaculture project is just south of Cherry Point. Millions of federal dollars have gone into developing this fish and oyster rearing habitat and aquaculture school. Just to the north of Cherry Point is a valuable herring spawning area and prolific crab producing area; further north are commercial oyster beds. Plus the clams and crabs taken by individuals at Birch Bay. There is a vast potential to produce protein for world markets on a sustained yield basis - surely more important than an oil port whose life expectancy is ??? how long?

The third argument is that of Multi Use. Freighters, ferries, sail boats, fishing boats, pleasure boats, water skiers, houseboats, swimmers, beachcombers, resorts, second home industry, sewage treatment plants and industrial outfalls all use the waters of Puget Sound. Tanker lanes have been established - although the gillnetter drifting at night has a hard time knowing exactly where those boundaries are. So does the pleasure boater in the fog and rain. The more ships and the larger those ships, the less room there is for other users of the water surface. One user should not be allowed to harm, eliminate or preclude other legitimate users.

The fourth major argument is the Lack of Oil Spill Cleanup Capability. All agree there will be oil leaked on the Sound, whether through chronic spills or a catastrophic spill; whether caused by human error or mechanical failure. The only question is how much.

At the April and May, 1977, "Oil In Washington Waters: Boon or Bane" conferences, John Weichert, head of Clean Sound Oil Co-operative, gave detailed presentations on the current "state of the art" of oil spill cleanup. In sum, the Co-operative has booms and equipment that are most effective in enclosed areas, such as harbors. Note that Cherry Point in no way resembles a "harbor". Mr. Weichert pointed out the three necessary factors to effectively contain an oil spill: 1) prompt notification, 2) reasonable weather conditions, and 3) reasonable communications. He further stated that the five miles of boom currently at the disposal of the Co-operative, if properly deployed, is sufficient to protect the 2600 miles of Puget Sound shoreline. I question this.

My very real concern is what happens when the boom is not effectively deployed? when there is rough weather (a not unusual state for Puget Sound in the winter)? when too much time elapses between the spill and the notification?

And what happens when the oil reaches the intertidal zone - the vast expanses of mud flats exposed at low tide just north of Cherry Point at Birch Bay, Drayton Harbor, Boundary Bay in Canada and Lummi Bay just south of Cherry Point? What happens to the rivers with deltas, the salt marshes, estuaries and grass beds in Puget Sound which catch and hold spilled oil with the consequent serious results on all types of marine life and the danger to the marine food chain?

Under very restrictive conditions, dispersants may be used in deep water. This does not help the mud flats, estuaries or salt marshes. When it comes to oil spill cleanup capability, the "best technology available" is simply not good enough.

I was living in my present home in June of 1972 when the ARCO spill occurred (and as of this spring, the fines assessed

for the spill had not yet been paid). The weather conditions that Sunday were extremely favorable - the water in Birch Bay was like glass (an unusual occurrence), no wind or rain. Watching the oil skimmers trying to clean up the spill was like my taking my vacuum cleaner to clean the streets of Seattle. Eventually individuals were hired to walk the shoreline and pick up all oil covered debris - rocks - seaweed - driftwood. Although there are larger and more efficient skimmers in use today, the method is still the same - insufficient and unreliable if less than ideal weather conditions exist.

Tied in with recreation and economics is aesthetics. Why do people choose to live here? to come here for vacations? Sometimes we need to feast our eyes on beauty for beauty's sake. Our souls need food. We need to look at nature to put man in perspective, to realize that man, the biological, needs to adapt to the physical environment. The waves on Puget Sound will continue to roll, whether covered with oil or not; the tide will ebb and flow, giving no thought to the oil slick it leaves on the mud flats.

Is the fight over? Has the 'grass roots response' beaten the big corporation? Possibly - but POW has not disbanded. Protect Our Waters incorporated to do just that: protect our waters. Cherry Point offers deep water without dredging. It is located on an exposed coastline of the Georgia Straits. The weather we've had in the past few days exposes its vulnerability to the elements. The land at Cherry Point is classified Industrial mainly because existing industry is already there and large tracts are owned by industrial interests.

Another project being proposed for the area is a dredge and fill operation to create flat land and deep drydock for a staging and assembly area for things like offshore oil drilling rigs. Besides being located right on the herring spawning area , this proposal might interfere with the littoral drift

of materials to Sandy Point, a fragile hook or point containing homes and located immediately south of Cherry Point. Sandy Point has already experienced erosion from the interruption of the natural flow of materials due to the piers and bulkhead now located at Cherry Point. Any further development in the Cherry Point area would have to address this question of littoral drift to insure that "Peter isn't robbed to pay Paul."

And basically that is what the questions should come down to. Do the benefits to society as a whole - county, state, region, country - outweigh the risks? How much does the public give up and how much does the public gain? Too often the question posed is "How much saving/profit for the company proposing the project?" And brought into the argument are such statements as "But we already own the land," "We've invested X amount of dollars already," "Our longrange plans have always included such a project at this location." Too often in the past industry has made the land use and coastal use decisions simply by announcing their plans.

Puget Sound is indeed unique and valuable and necessary to protect; to use - but use carefully and wisely. In a democracy, the citizenry must be ever vigilant. The fight is never over.

THE COASTAL ZONE AS AN ECONOMIC HIGHWAY*

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*Paper not available for publication.

THE SCIENCE MARKET IN COASTAL PLANNING

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ABSTRACT

The problem of recruiting scientific expertise to assist with coastal resource management and comprehensive planning programs is considered. Much of the problem stems from communication failure among the various participants in the science market. The misunderstandings, at times sufficient to seriously block the progress of planning and management programs, have been the subject of analysis by The Conservation Foundation. We have found that many of these problems are susceptible of solution through: 1) anticipation of and rigorous preparation for sources of conflict, 2) comprehension of the idiosyncracies of science, 3) due regard for the uniqueness of the scientific method and 4) improvements in the way applied science deals with its planning customers. In this paper some solutions are discussed and a set of working principles presented that have been devised and field tested by The Conservation Foundation in developing its Coordinate Planning System for use by coastal communities.

INTRODUCTION

There is an active market for science in coastal planning. Scientists collect information, develop principles, and predict consequences that are extremely valuable to planners and politicians, particularly in the still mystic field of ecology. However, the market is not so strong for basic research which scientists relish, as for information transfer, including interpretation and consultative services, which scientists often disdain. Thus the needs and aspirations of sciencists often conflict with those of planners and administrators whose job it is to translate scientific knowledge

into an action format. There are serious communication problems at this interface.

In coastal planning, scientists must face the fact that the market for original research is weak. More research is not what is needed. What is needed is to get more of our present knowledge applied in planning and in management. The problem is with implementation. The resolution lies in improved information transfer, a process which has many cheerleaders but no rules, no system, and no identified roles. The purpose of this paper is to stimulate some improvement in the transfer process by delineating some of the problems, by identifying the major actors and their roles, and by suggesting some solutions from past experience.

In the three case studies to follow, I try to illustrate the current state of information transfer and how the science market in planning is working. Further, that there is a strong and immediate need for science to provide specially experienced coordinators to work at the interface with planners and implementers and thereby to create an improved market place for science in the planning arena.

EXAMPLES

California

Case I is the California Coastal Zone Planning Program which resulted from a statewide public referendum in 1972, the well-known Proposition 20. The mandate included a regulatory, or permit, program for the coast and a planning program--the first to terminate when the second was completed. The planning was to include three tasks: first, determine the state interest in the coastal zone; second, develop ecological principles for planning; and third, develop a specific coastal plan built on nine elements.

Science saw a market for research here but the Commission wasn't interested because its policy was: "Decisions, not research." Moreover, the Commission thought its coast was already the most studied in the world. This was somewhat shocking to many of the scientists who tried to get into the program. By polling the science group in California during a Conservation Foundation study [1] we found that approximately 100 natural scientists were recruited to review the individual plan elements. The scientists averaged 150 hours each on plan element review, and about 50 percent of them gave advice on permit issues. About 70 percent said their influence on the Commission was acceptable and only 30 percent were unhappy. However, the majority griped about the Commission and their way of handling potential science input. These scientists were puzzled. They felt isolated and under-utilized. They thought they could have helped strengthen the program.

Our analysis showed that the scientists' complaints were real from their point of view--they were under-utilized. The planners were unimpressed with the potential of science for many reasons and did not urge natural scientists to participate beyond reading staff written drafts of the plan elements. One result is that there were unnecessary gaps and ambiguities in the technical substance of the California coastal act as it passed the Legislature in August of 1976. Apparently the nexus joining science to implementation did not materialize in California.

The moral of this case: Science should define an active role for itself as an interpreter of existing knowledge and sell this role to planners; it should make its potential role attractive to those in planning and management.

Sanibel

Case II is the City of Sanibel, Florida, a semi-suburbanized, sub-tropical island on the west coast of Florida. Now, 12,000 people live there, but there were many less in 1975, when The Conservation Foundation joined forces with Bill Roberts and John Sutton (of Wallace, McHarg, Roberts and Todd; Philadelphia planners) and Fred Bosselman and Charles Siemon (of Ross, Hardies, O'Keefe, Babcock and Parsons; a Chicago law firm). The object was to design an innovative total management plan to control speculative and development excesses. Sanibel had just separated itself from Lee County in December 1974, incorporated to get land use controls away from the County, seated its own government and then established a general development and construction moratorium. In March of 1975 The Conservation Foundation was asked to participate. We started in May with a comprehensive ecosystem analysis and continued through to finish our job in September. Along with the planners and lawyers, we succeeded in formulating a plan that was incorporated into law in toto [2].

At Sanibel we had all the breaks, so we can't recommend that this model be applied nationally, but we did learn some things from it of wide application, particularly, on how to make the science market work. In April, we established a multidisciplinary science team, each member receiving a specific assignment and some money (a small amount). By the end of June each of the team members (15 in all) had surveyed the island from his own discipline perspective. In July the team completed their basic reports. In early August we had a consensus session, where we formulated a set of environmental requirements which we passed on to the planning board that month. In mid-September we presented our comprehensive program for environmental protection to the City of Sanibel.

These environmental requirements involved permitted uses, density of uses, performance standards, and restoration of ecosystems. By

December, the draft plan was completed by Roberts/Sutton and Bosselman/Siemon. Following lengthy hearings and many tune-ups, the ordinance was put into law in July, 1976. It has passed several court tests, none of which has involved the science team. Because of the representativeness of the team and the way we conducted ourselves, no one on either side has been interesting in bring us (the science team) into court.

There are several items of interest arising from Sanibel. One thing was that we used a "bellweather" advisory group of citizens, an informal group (they were not appointed by the planning commission) that could keep us on track and let us know informally what they thought of the policy assumptions we were making. We used our Coordinate Planning System (as opposed to a conjunctive system) with a coordinator to deal with the planners and administrators. That is, we formed a balanced team of scientists and kept them isolated from the rest. We took the science questions through the coordinator to the scientists and sent the answers back to the community through the coordinator. Everybody seemed to be happy with that. We used the rewards and the processes typical of science: seminars, reference papers, and so on. With this approach the scientists felt comfortable. Our method of coming up with requirements for the plan was a consensus method. We did not lean on regression analyses or computer results. We "black-boxed" it through using a team with a wide representation of disciplines, of advocacies, and alliances among the technical people--they ranged from developers consultants to committed environmentalists.

The moral of this case: Fifteen scientists, properly prepared, sitting around a table operating at a high level of interaction are able to accomplish results impossible for a collection of uncoordinated scientists or for any computer. With such a compatible system, technicians can have a strong influence on management. And they can do this without becoming policy makers themselves which is very dangerous.

Carrying Capacity Analysis

Case III involves the subject of carrying capacity on a national scale. This is not the ecologically defined carrying capacity--the number of animals that can occupy a spatial unit. Carrying capacity, when used by planners, has to do with a search for rational limits to growth in three areas: public services, human conditions, and natural systems. Services means water, sewage and transportation. The human condition implies health, the general ambience of the community, prosperity, jobs, and so forth. Natural systems includes soil, water, air, fauna, flora, and so forth.

For this case I had 26 published carrying capacity studies to

review that had been examined and reported by a colleague, David Godschalk. The work was done for the U.S. Department of Housing and Urban Development [3]. Godschalk looked at three techniques for analysis of carrying capacity--inventory of resources; calculations, including simple arithmetic; and computer modeling. Five out of the 26 studies that I reviewed succeeded in getting an appropriate administrative or legislative response and 21 failed to get the response [4]. The question is why? Of the five cases that did get a response, all had used both inventory and calculations methods. These were Sparta (N.J.), Medford (N.J.), Sanibel (Fla.), Bucks County (Pa.), and Lake Tahoe (Ca.). Only one of these used a model (Tahoe). Of the 21 that failed, only one noted an absence of power, of local authority, to implement the carrying capacity results into law. Six out of 21 cited a lack of data, a common complaint of scientists. But 13 out of 21 cited inadequate methods--state-of-the-art problems.

In reflection, one needs to take the problem of inadequate method with a grain of salt. The reason--and this is my opinion only--that the technical approach to the carrying capacity studies failed was that it couldn't push through the policy vacuum. Policy wasn't set, the scientists came up with their own assumptions, politicians didn't understand it, planners couldn't defend it, and the momentum failed.

The salient point about these cases is that the nexus materialized for only 5 of the 26 technical studies of carrying capacity. The middlemen failed to marry science to implementation in 21 cases. Science did not succeed in its mission. For 5 of them, science succeeded because appropriate policy was set and because this nexus was provided.

The moral of this case: Science cannot be effective in the absence of appropriate policy upon which to base its assumptions. Until science learns the process of getting and using policy grounding under its assumptions, its promise in the planning arena will not be realized.

PARTICIPANTS

It is useful to recognize the different participants in the science market in coastal planning and to understand their roles. We have identified three major actors. They may be described as follows: 1) Technicians who are the scientists, engineers and other technical specialists; 2) Implementers who are the policy makers, planning boards, elected officials and so forth; and 3) Brokers, who are the middlemen, the planners, administrators, and so forth that work at the interface between technicians and implementers to make it all work. There is a fourth and very important go-between role to be

played by either the Technician or Broker, but usually by a Technician. This is the role of science interpreter, or coordinator, an individual who knows the business of planning and is intimately familiar with the way in which scientists and other technicians work and who therefore can provide the pathway for effective communication between the Brokers and the Technicians. There are few people who are specifically trained or experienced to fit the role of Coordinator. It is a gap that exists and a role that has never been accorded professional recognition in applied science. It is a responsibility of science to recognize this gap and to prepare people to fill it.

As it is now, attempts to effect a working partnership between the scientists and other technical experts and the Implementers and Brokers are often frustrated by differences of philosophy and problems of communication between the disciplines. On one side, scientists may appear to the Brokers as incapable of grasping relevance, tedious, unable to deal with issues simply, incompatible with compromise, or irreconcilably divided in their interpretations and advice. On the other side, the Brokers may appear to scientists as uncomprehending, over-expectant, unable to express their needs, overly concerned with politics, or unappreciative of the rigors of the scientific method.

People outside science are often quite puzzled by scientists and by their eccentricities. Science has always had special methods for conducting its affairs and for assuring the credibility of its products. The different way in which science does its business results in a different mindset with scientists; so different in fact, that scientists are often uncomfortable in trying to work conjunctively with the Implementers or the Brokers. The exceptional few that can work comfortably in this context, the Coordinators, provide a crucial bridge between science and the Brokers.

Science is motivated by a system of rewards that its customers must recognize. They are scientists first and servants of society second. It is often difficult for the Brokers working with scientists to recognize the pervasiveness of their system and the effect it has on the willingness of scientists to engage in directed, or applied, work.

WORKING WITH IMPLEMENTERS AND BROKERS

We have found that the dilemma of conflict between the Technicians and the Brokers or Implementers is often amenable to solution through: 1) improved comprehension of the idiosyncracies of science and regard for the uniqueness of the scientific method on the part of the Brokers, and 2) an improved sense of responsibility to the public and an

understanding of the special requirements of interpretative, or applied, science and guideline formulation on the part of the scientists [4].

The Conservation Foundation has gained experience in the science market to work with the Broker--professional planners and administrators [2] [5]. In our system, the scientists review appropriate information and write summary reports in their discipline areas. They meet together for discussions and for decision sessions. They maintain close contact with a team Coordinator (supplied by the Foundation) who makes the formal contact with the planners, handles administrative details, interprets goals, makes assignments, reviews and refines the individual and group work products, and attempts to remove value oriented bias by appropriately framing the questions.

Our experience is that natural scientists can work most effectively and objectively on their own, under scientific leadership, rather than in conjunction with the Brokers and other professionals (e.g., engineers, lawyers, planners). Accordingly The Conservation Foundation science teams have been most successful when working coordinately, i.e., when comprised of natural scientists with the Brokers serving in guidance roles where appropriate but communication principally through the Coordinator.

In a further refinement of approach it is most important that the Broker work with the science team <u>through the Coordinator</u> to refine the statement of the task until it is clearly amenable to a technical solution. For example, an inappropriate statement would be "Where should septic tanks be put?" An appropriate question might be "In the context of prevailing groundwater and soil conditions, how far back from a watercourse should leach fields be set in order not to degrade water quality below existing state standards?" That kind of a question has a scientific answer. Scientists can give you a number, or perhaps a yes-or-no answer. Thus, the Coordinator may have to educate the Broker in advance to condition him to phrase tasks in an unambiguous and objective fashion. This skill can be learned with practice or instruction.

Among the tasks that Technicians should not be expected to address are the following:

- Population limits
- Density of structures
- Mix of uses
- Optimal rate of development

The tasks that Technicians can assist with, given the right context, are:

- Ecological impacts from human actions
- The identification of critical areas
- Prediction of the effects of alternative approaches
- Restoration of ecosystems and renewable resources
- Allocation of predetermined amounts of growth
- Performance standards for development
- The consequences of various levels of resource utilization

Even with tasks clearly defined, it is not always easy for scientists to make precise cause-and-effect calculations--much still remains a type of black art.

We disagree with people who think science should labor to educate politicians about ecosystem function, impacts of pollution, other such detail, because politicians normally don't want to absorb a lot of facts, they want to make a decision. Therefore, they want the advice of credible Technicians without hearing the ins and outs of it. They usually don't care how an ecosystem works. They just want to know how to vote on the next issue. We think that the educational process should be focused in the middle, on the Brokers and the Coordinators--on the people that have to be educated thoroughly about politics, policy making, and planning as well as hydrology, geology, biology, and so on.

WORKING WITH SCIENTISTS

Some principles that have evolved from the coastal resource conservation and planning studies of The Conservation Foundation are presented in the following discussion along with working procedures that appear to have general application. Properly integrated and executed, they can serve as the framework for incorporating scientific information and expertise into many comprehensive planning/resource management activities and environmental protection programs. Furthermore, assisting with such public tasks should be a satisfying experience for the scientist.

Benefits of Isolation

In our planning work with the scientific community we have found it better to adapt to their system rather than to try to make the scientists adapt the planner's system. An important part of this is to ensure that necessary communications with the Implementers and the Brokers are handled through a Coordinator, a group leader especially qualified for this role. This principle of working with academic and practicing scientists as a separate team and through specially qualified leadership coordinating their work with other aspects of planning is fundamental to the Foundation's Coordinate Planning System.

Scientists may assist planners most effectively when working separately; that is, not organized in multi-profession task groups. Broad task force operations, by their nature, are antithetical to the deliberate pace of "the scientific method," the generally accepted sequential process by which scientists proceed through a series of steps--observation, hypothesis, experiment, theory, and proof. Caution and doubt are the handmaidens of success in scientific pursuit. As stated by Ritchie Calder [6], the scientist is conditioned to "practice three things: he must observe and choose his facts; he must form a hypothesis which links them together and provides a plausible explanation of them; he must carry out numerous and repeated experiments to prove, or disprove, his hypothesis." Further, science is "an exacting discipline which demands that a scientist lay aside all his prejudices (of which he just as many as the rest of us); marshal his facts without fear or favor and frame his hypothesis on those facts, and then be prepared to labor for months or for years--just to prove himself wrong, perhaps, in the end." Finally, Calder states the essential principles of modern science as "rejecting the deductive or thinking-off-the-top-of-the-head principle and stating clearly the inductive or take-your-coat-off principle."

It is just exactly when scientists take off their coats and settle into extended dialogue that directors of multi-profession task forces become impatient. Too often to suit them, the dialogue turns on ignorance and caution rather than knowledge and action. But, whatever the task force's burden of time restraints may be or the urgency of its need for decisions, the scientist must follow his norm: "True science teaches to doubt, and, in ignorance, to refrain." (Claude Bernard)

The rigors of scientific methodology condition scientists not only to "refrain" but also to approach issues differently than laymen and to use a special jargon that makes others uncomfortable. Also, the professional circumstances of advanced scientists condition them to be quite unresponsive to pressures to conform to the expediencies of the multi-profession task force. Because the institutions of academic science join unanimously in protecting scientists from the coercive forces of society, most scientists will remain remarkably unaffected by pressures to shorten their usual approach.

Motivation

Scientists best perform public tasks when motivated through their own reward system. Classical science is motivated by a unique system of rewards that must be accommodated by its customers. It is often difficult for administrators and planners working with scientists to recognize the pervasiveness of this system and the effect it has on the willingness of scientists to volunteer for public tasks.

The Conservation Foundation has established the following four major policies: 1) ensure that scientists are not asked to do anything that would interfere with peer approval or with the basic ethics and controls of science; 2) make suitable provisions for publication, however simple, of the work of each scientist; 3) provide for suitable recognition of their efforts; and 4) budget funds for payment of expenses and for honoraria of principal contributors.

Peer Approval: Academic scientists serving as volunteers simply will not cooperate if they are not able to maintain peer approval, the strongest factor governing the practice of science. Their work must be consonant with the procedures, controls and approvals which science uses for its own governance. The scientist should not be asked to perform any task whereby he might suffer major disapproval of the science community by the appearance of unprofessional conduct.

Publication Opportunity: Success and advancement in the sciences is measured in terms of the quantity and the quality of research publications that the scientist produces. Publication, then, is the major tangible result of the efforts of the scientist. It follows that the opportunity to publish a credible scientific paper provides strong motivation and one that should be afforded scientists performing public tasks whenever possible. Publication can be arranged through a special scientific document offered in support of the coastal plan or resource management program or through appropriate professional journals.

Recognition: Many, but not all, science volunteers appreciate public recognition of their efforts. A news article or media interview may be enough to satisfy the individual scientist and this may be small reward for his labors. However done, it is desirable to incorporate the recognition element into the operational plan.

Support: The scientist will incur some expenses and may also need the help of a student or paid assistant in analyzing or doing field verifications of his data. These expenses should be anticipated. It must be understood that the successful scientist may have numerous opportunities for paid consulting within his field of expertise at rates which the public agency cannot match. Therefore, the agency must compete by providing other rewards.

Context

Scientists joining a coastal planning effort will want a clear expression of working policies, operating procedures, and scheduling of the program. They will have to be enlightened on planning goals and on the practical and political limitations of the planning process. More importantly, scientists will want the problems presented to them in a context that does not force them to make social value judgements.

For example, we have previously stated [7]:

> While scientists can often state the conditions that are optimum for best ecosystem function, they are not specially equipped to offer advice on what constitutes socially acceptable or unacceptable levels of carrying capacity. In effect, ecological scientists can establish the criteria upon which to judge ecosystem conditions and upon which public decision-making shall proceed, but are not themselves qualified to make the decisions by virtue of their knowledge.

Bentley Glass makes the point that scientists are aware that they operate in a wider arena of goal setting [8]:

> Man must choose goals, and a choice of goals involves us in weighing values--even whole systems of values. The scientist cannot make the choice of goals for his people, and neither can he measure and weigh values with accuracy and objectivity. There is nonetheless an important duty he must perform, because he and he alone may see clearly enough the nature of the alternative choices, including laissez faire, which is no less a choice than any other.

Considerable care must be given to the preparation of assignments for natural scientists. For example, one should not ask a team of scientists "Should this hillside be built upon?" or "Is that wetland worth saving?" Scientists are thus asked to make judgements of value that they are not equipped to do. They must have clear policy grounding on each aspect of their work. For example, on the wetlands question, the scientists would have to know existing federal and state wetlands policies and regulations in detail and, if applicable, exactly what local goals and policies had been developed for wetlands.

A National Academy of Sciences study group has cautioned, however, that this must be done in such a way as not to substitute the scientists' judgement for that of the administrator [9]:

> We are aware that outside scientific boards can become counterproductive, especially if there is not a clear definition of where review of technical analysis ends and application of sociopolitical judgments leading to a decision begins. However, if such a board can perform its task well, avoiding attempts to make decisions or preempt the administrator's role in decision making while maintaining independence in exercising its technical judgement, it can serve a vital role in the decision-making process.

To ensure that they are working in the appropriate context it is most important that the science team, through its leader, work with the

administrator or planner to refine the statement of the task until it is unambiguous, objective, and clearly amenable of a technical solution.

This is to say that scientists may have to provide advice to administrators on the context and consequences of their decisions if these are not immediately obvious to laymen.

Science has accepted mores about the judgements it gives, as expressed by Bentley Glass [8]:

> ...although they may agree upon the basic scientific facts which are relevant to the issue, there are rarely enough established facts to clinch the argument and there is always room for differences of opinion in interpreting the facts. In these matters the ethic of the matter requires the scientist to state his opinion on matters of social concern, but at the same time to distinguish clearly between what he states to be fact and what opinion he holds. Moreover, his opinion about matters within his technical sphere of competence is an "informed" opinion; his opinion about other matters, even other scientific matters, is that of a layman. He must in all honesty make clear to the public in what capacity he speaks.

As a natural scientist who has worked on several carrying capacity analyses around the coasts of the country, I am left with a strong conviction that the problems with application of science to planning are actually problems with communication and particularly with policy clarification, in disguise. Too often community officials are unable to provide a clear set of social goals, policies, and decisions, by which technicians can formulate the basic assumptions they require as underpinnings to their analyses. In the absence of these, technicians on their own must try to simulate policy to get on with the job. For example, they might conclude that wetlands should be saved regardless of social or economic consequences when, politically, the community would be willing to sacrifice hundreds of acres under certain futures options. Therefore, such simulation is politically dangerous and often leads to failure because the community officials will find that the social assumptions underlying the technical analysis are unacceptable and therefore it cannot be used.

Scientists begin to assume the role of policy maker when they make assumptions. For example, to run through a computer program the Technician may need to assume a growth of 5,000 homes or a need for 500,000 megawatts of electricity. He may give the Broker or Implementer three different answers based on three assumptions--none of which seem reasonable or make sense politically to the people that need to use the information for implementation. Each time a scientist makes a simplifying assumption he is making a value judgement, a policy

decision. But policy makers are most reluctant to accept policy made by scientists and put it into implementation. While it's true that causes and effects can be defined, often quantitatively, the issues at conflict are not usually resolved technically. They are resolved politically because even when science can confidently predict, it cannot make the value judgements for society. As Lee Loevinger has stated it [10]:

> It is the part of wisdom and maturity to recognize social problems as conflicts of interests and values to which science can contribute data and methodology, but which science cannot claim special authority to resolve. Scientists can show the public the means of defining the parameters of problems, the methods of investigating possible solutions, and the data that are relevant to the choice of solutions. Beyond this, scientists can offer interpretations, inferences, and implications from their data for the enlightenment of the public. However, their data and arguments will be accepted as scientific only if it is apparent that they were sought and offered in a truly scientific manner--that is, in a spirit of objective inquiry and not of advocacy. To put the matter most simply, scientists can best influence law and government by working as scientists.

While that simple advice sounds good, it offers no solution. The reality is that the Technicians have a difficult time staying out of social policy issues when they are involved with planning. Because the Brokers are limited in technical knowledge and how to deal with science, they have a hard time even asking the right questions, much less properly interpreting the answers. Therefore, scientists must often define the terms of their own work and interpret their own results. In so doing they often unconsciously move into the policy arena. This is bad for science and for the public cause. The notion of scientists as policy advocates was popularized during the recent environmental era in which science has played a strangely dominant role in environmental policy formulation. It is a peculiarity of the environmental reform movement that scientists were often both its leaders and its heroes--Barry Commoner, Paul Erhlich, Rachel Carson and dozens more. These scientists not only brought on public awareness, but also provided the basic ideology and helped to pattern the programs of change. This extent of scientific influence is nearly unparalleled in the history of reform movements in the United States. Its legacy is a high respect by the public for the ability of scientists as environmental policy makers. This regard does not necessarily extend to the outlook of the administrator or policy maker who needs the help of science, but who wishes to reserve policy judgement to himself. To accomplish this the Brokers and Implementers have to learn how to communicate with science.

Finding Consensus

In the Coordinate Planning System framework, only the team leader, the Coordinator, needs to be in regular communication with the Broker. This framework insulates scientists from the effects of value orientation and prejudgment of outcome by the Brokers and the Implementers. These are great advantages when opposition is generated by persons aggrieved by the planning or management decisions, who may hire their own scientists to contest the plan or program leading to a lengthy and expensive "battle of experts." Selecting individual experts in expectation that they will reinforce political judgements already made is risky. This situation has caused numerous enervating and wasteful confrontations in the United States over environmental issues in the past ten years. Don K. Price counsels [11]: "Any policy decision, either in the administrative or the political world, has its opponents, and nobody wants to give his opponents a chance to say the decision is unsound from the professional or scientific point of view."

Our solution to this dilemma is to engage experts of undoubted credibility who, as a team, can speak for the natural science community in the relevant field. This requires that the individuals are not only well versed in the principal sciences dealt with in the project but also have a varied range of personal and professional advocacies. The combination should greatly reduce the possibility for technical conflict over the team's data and recommendations.

By the nature of their proclivities and training, natural scientists are well prepared to work in the format of an all-science team and to reach joint conclusions by consensus. The science forum process may bewilder laymen but it is everyday stuff for academic researchers.

In a recent example using the coordinate approach in coastal zone planning, we were able to provide a comprehensive natural systems analysis and a workable set of recommendations for the innovative comprehensive plan of the city of Sanibel, Florida, (approved in July, 1976) in less than five months, with preliminary results in 3 1/2 months. The natural science team was required to meet only twice during the five months because continuing communication and integration was conducted by the team leader. The first meeting was for orientation and organization of the work; the second was for reaching a consensus on conclusions and giving recommendations [2].

Our team included specialists in a wide variety of disciplines, including: hydrology, botany, aquatic ecology, energetics, zoology, ornithology, ichthyology, geology, and wildlife management. Joined together by their science backgrounds, high interest in the subject, and a resulting spirit of comraderie, the team was able to function smoothly and effectively. Communication and transfer of information

to the planning consultants (Wallace, McHarg, Roberts, and Todd, Inc.) and to city administrator proceeded on schedule. It is clear that successful completion in so short a time could not have been accomplished in a large multi-profession conjunctive task force.

The same approach can be applied to planning tasks performed by much smaller groups of scientists. The work of any group of three or more scientists could be organized into a separate team and successfully managed following the Coordinate Planning System.

The consensus system as The Conservation Foundation uses it draws on the above general philosophies and specifies several particulars. In the Sanibel test of the Coordinate Planning System we proceeded as follows [2]:

> In conducting the natural systems study our consulting experts not only performed the surveys and determined the condition of the systems, they also identified management requirements and formulated recommendations. In order to reach a consensus on requirements and recommendations, the following procedure was devised: 1) Survey team members were consulted by CF staff members during the course of their work; 2) working conclusions were transmitted to the team by CF; 3) a draft of conclusions based upon the comments was prepared; 4) a final workshop was held to refine and consolidate the requirements and recommendations--based upon comments on the revised workshop draft and 5) a final draft report was prepared for presentation to the City Council....

The system succeeded partly because we did not frustrate ourselves trying to build recommendations on mathematical proofs of causes and effects. We did no multi-variate analyses requiring computers or regression analysis. We simply sat as a scientific panel, in the academic style. We presented data and opinions to our colleagues and reached consensus on all recommendations. To the world outside, we black-boxed it through. The approach was sound because the team members represented a wide variety of disciplines and a balance of advocacies and alliances. They were experts of undoubted credibility who, as a team, could speak for the natural science community. A consensus of this group left little room for dispute over the recommendations.

As stated by Don K. Price [11]:

> Politicians and administrators [Implementers and Brokers] who work in a field of such uncertainty that their decisions are always open to question, are eager to base them on as large an element of certainty, as possible. For them, truth must be defined in practice as what the experts agree on. To go against accepted

consensus of either a scientific discipline or a profession--as long as that consensus appears to be based on scientific evidence rather than mere corporate self-interest--is extremely hazardous.

Our experience, then, is that recommendations developed through a consensus of representative teams of scientists appears to provide the best advice to the public on issues that may be strongly contested. By their nature scientists are best prepared to work in the format of all-science teams and to reach joint conclusions by consensus. If the team is properly selected and its terms of reference properly clarified, it should represent the views of science at large and therefore can be considered the final best opinion of science. Conversely, recommendations that are the result of individual opinions of experts, regardless of the number, may be challenged aggressively by experts representing opposing interests and therefore may remain tentative and continually open to dispute. Unfortunately, there are special interests that often stand to gain at least in the short term, from such controversy and divisiveness. The team should not only be well versed in the principal sciences dealt with in the project but also have a varied range of personal advocacies and alliances. Such a balance should greatly reduce the possibility for technical conflict over the team's data and recommendations.

Accountability

In order to get the best results from scientists on public tasks they should work within a clear framework of responsibility. Once their work is put into an acceptable context they should then be left free to perform their task. They will work most effectively and accountably if they originate the work product according to their methods rather than start by reviewing products already prepared. The natural scientist generally feels rather diffident about reviewing products on technical subjects prepared by others and often will not be motivated to make the effort of criticism and revision necessary to transfer responsibility and accountability to himself. We believe that this is particularly true where the scientist has not been consulted in advance on the "ground rules" for preparation of the product. Our experience has shown that scientists will be most accountable if they are brought in at the beginning, permitted time to collect verification data, required to report results in publishable form, consulted frequently, and encouraged to communicate with their colleagues. A scientist's accountability to the public client is second to and stems from his accountability to the profession of science. Therefore he must be allowed to work in a way that is harmonious with the methods and ethics of science.

A scientist's accountability to the public client stems from his accountability to the profession of science instilled in him as a student. Scientists are indoctrinated with lofty goals. These are

summarized by Bentley Glass as follows [8]:

> ...to cherish complete truthfulness; to avoid self-aggrandizement at the expense of one's fellowscientists; fearlessly to defend the freedom of scientific inquiry and opinion; and fully to communicate one's findings through primary publication, synthesis, and instruction. Out of these grow the social and ethical responsibilities of scientists that in the past twenty years have begun to loom ever larger in our ken.

Uncoerced by conflicting social pressures, science normally lives up to these goals handily and wrestles with knotty problems effectively.

Coordination

The Coordinate Planning System presupposes specially qualified leadership. The scientific team leader, or Coordinator, must understand the processes of policy formulation, planning and administration in order to provide the proper context for the tasks given to the team. He must understand the limitations of knowledge and of interest in science on the part of administrators and planners and also assist them to ask questions that can be answered by scientists. He is the intercommunications link between the Technicians and the Brokers. While we believe that the Coordinator's role is best handled by the science team leader, we also believe that a specially qualified Broker can play this role. This is especially relevant where relatively little science input is required in a large-scale planning effort.

The Coordinator has other responsibilities. For example, setting the pace and maintaining the momentum of the team is critical. The rate of progress of the natural science team must closely match that of the planning team and others involved so that profitable interactions can take place. The science team should neither finish too soon nor too late. In the first case, the planning team may have further questions or refinements which come too late. In the second case, the planners may have had to push on ahead of the scientists. Either situation leads to reduced benefit from the work of the science team. Consequently, the Coordinator has to be wise in the way by which both groups work in the real world.

The leadership skills for management in the type of planning tasks under discussion are not taught formally: they must be learned by experience. This is not to say they could not be taught. Conversely, we think they could, in the framework of developed principles, practices, and case histories. We hope that this essay will provide encouragement in that direction, particularly toward a system of mid-career training for those who find themselves in the position of managing natural science input in natural resources conservation or comprehensive community planning.

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PART III

Friday, November 4, 1977
Morning Session

STATE POLICIES AND PROGRAMS

Thomas Terich, Session Chairman

1. *Federal-State Conflicts in the Coastal Zone,*
   Ralph W. Johnson and Eileen Cooney

2. *Policy Implications for Alaska Resulting from Energy Development,*
   Glenn Akins*

3. *Oil Transportation and the West Coast of Canada,*
   John Millen

4. *Energy Considerations in the Washington Coastal Zone Management Program,*
   Marvin L. Vialle and Michael Hambrock

5. *Energy Facility Planning and the Coastal Energy Impact Program in the Great Lakes Coastal Zone,*
   Charles A. Job

6. *Why Planning for Supertanker Terminals is Uncertain,*
   Gary Catron

*Paper not available for publication.

FEDERAL-STATE CONFLICTS

IN THE

COASTAL ZONE

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This paper will cover three main topics. First, the origin and development of the state coastal zone management concept in the United States. Second, the different approaches to coastal zone management by states on the west coast, and states on the east and gulf coasts. (These two regions have quite different approaches, both of which are conceptually interesting, although they are hard to perceive unless one becomes quite familiar with several state programs.) Third are the main conflicts that exist between the state and federal governments in the area of the management of the coastal zone.

First I will deal with the origin and development of the coastal zone management concept. There is no doubt that 20 years ago the public consciousness had not yet grappled with the question of coastal zone management, with the destructibility of the coastal zone, with the idea that this is an area deserving of special legal protection and special management consideration.

Then in the mid-60s the people in the San Francisco Bay area, whose environment is dominated by that bay, became aware that something very bad was happening to this body of water and to their beautiful environment. Preliminary studies showed that the surface of the bay had been reduced from about 680 square miles in the mid-1850s to about 430 square miles in 1965. The marshes had been reduced from about 304 square miles to 78 square miles. The bay, was being filled at the rate of between two and three square miles per year. The result was that bay area residents were losing a very valuable amenity, one that impacted water quality, recreational opportunities, visual beauty, and even local weather patterns: there was some evidence that the continued filling of the bay was causing a difference in the weather pattern of the area and reducing the fog that comes in and cools the area and provides moisture.

After an extensive preliminary study in 1964 the state legislature enacted a law creating a study commission. That commission was made more permanent in 1965 and called the San Francisco Bay Conservation and Development Commission. It made an extensive four-year study and ultimately produced the San Francisco Bay Plan in 1969.

The Conservation and Development Commission operated essentially in a fish bowl. It was composed not only of environmentalists, but also of developers, business people and industrialists. It was subject to a great deal of public pushing, tugging and hauling. However the result was that the Commission came up with a consensus report for the area. Very summarily, what they recommended was a new plan, a new approach to the management of the coastal zone. Their basic policy was to stop the filling of San Francisco Bay, and in future to allow only those fills that were water related. There are a few other exceptions that we don't have time to discuss, but they also tended to cluster around the water-relatedness concept. The Commission adopted a zoning program for the shoreline of San Francisco Bay (not the general zoning for the city of San Francisco and other communities). The Commission also adopted a permit program requiring the acquisition of a permit to

do any kind of development in the area. The jurisdiction of the Commission (and the permit program) extends 100 feet inland from the high-tide line. In a sense this is artificial, but no one has been able to figure out a better approach so far.

In 1966 the Stratton Commission Report "Our Nation and the Sea", appeared. It constituted a national recognition of the problems of the destruction of the wetlands and the coastal areas. Among other things the country began to realize that some two-thirds of the wetlands of the United States have been filled over the past 150 or 200 years, and that the loss of these areas was not simply something that offended our sense of beauty and aesthetics, it also had a significant impact on our economic and social wellbeing.

With this brief background, I am now going to turn to the Washington Shoreline Management Act, R.C.W. 90.58.010 (1971), because this act is one of the most comprehensive and advanced acts in the country. The Washington Coastal Zone Management Program, which is based largely on this Act, was the first one to be approved under the Coastal Zone Management Act. The Washington SMA was enacted in 1971. It is not a piecemeal program, but a comprehensive, state-wide program that affects not only the coastal zone, but also freshwater lakes and streams.

It provides for two levels of management. There are "shorelines of statewide significance", which are those that have a regional or statewide impact, and there are "other shorelines", which include almost all the other water and shoreline areas in the state. The Washington State Department of Ecology, has substantial authority over shorelines of statewide significance, not only to provide standards and guidelines, but also to veto actions of local governments in their planning and permit process. For other shorelines, the DOE provides a set of standards and essentially leaves the management to local government.

One of the important policies expressed in the SMA is to suppress filling of water areas; in this respect the policy is similar to the California program or San Francisco Bay Program. The general approach is to discourage filling that is not water related. The Washington Coastal Zone program depends on zoning and permits for implementation. Jurisdiction is 200 feet inland, instead of 100 feet as in San Francisco Bay. As mentioned earlier, the Washington Coastal Zone Management Program, was the first one approved by NOAA (in June 1976) under the Federal Coastal Zone Management Act of 1972 (16 U.S.C. §1451).

Notice that the policy of the federal government under this federal Act is one of guiding the management of the coastal zone by way of the carrot rather than the stick. Congress could have enacted a law that would have pre-empted the field, taking over the complete management of the coastal zone. However Congress chose not to take this approach, and to leave the management power at the state and local levels; the federal

government would only provide standards and guidelines. The feds then dangled a "carrot" in front of the state governments, saying that "if you do what we think is right and adopt a comprehensive coastal zone management program that meets our standards, then you will get the carrot, you will get money, and we'll keep pumping in that money if you keep doing what we think is good for you." This approach has worked quite effectively in that the states have generally lined up at the trough to feed on the federal money.

On the West Coast we also have the Oregon statewide land-use planning program. It started out as a statewide coastal zone program. now it is statewide land-use planning, and the coastal zone is part of that plan.

In 1976 California adopted a statewide comprehensive coastal zone management program after much debate and turmoil. The program was developed along lines similar to the others in that it included planning, suppression of fills, preservation of beach areas, and classification of areas as areas of statewide significance.

The second major point of this paper concerns the comparison between the programs on the east and west coasts. The East Coast has generally approached coastal zone management on a piecemeal basis. An eastern state may have an estuary management law, or a law that prohibits certain kinds of industries in special areas. In Florida and some other states, there is a statewide coastal zone plan which the state urges (but does not require) the local government to comply with.

This approach is obviously quite different than the West Coast programs which generally require local government compliance with the state plan.

The approach of the western states is essentially to adopt statewide comprehensive programs. On the east coast, the approach tends to be piecemeal, trying to pull together a lot of different pieces, and to bring about coordination through state urgings.

Florida has quite an interesting process. It uses the carrot approach somewhat like the feds do with the states. The state government says to the local governments, "look, we have state plans and policies, and if you will comply with those plans and policies we'll provide you money for planning in the coastal zone".

Now we come to the area of federal/state conflicts in the coastal zone. There is increasing involvement by the federal government in state and local coastal zone management, in other respects than the "carrot approach" mentioned earlier. However there still is no single overall federal coastal zone management law that provides mandatory controls for state action in the coastal zone. There is not even a mandatory federal major facility siting law. One such law has been proposed, but was not enacted, and probably won't be enacted in the foreseeable future.

Nonetheless, as illustrated below, the federal government is very much involved in a variety of special programs that have a direct impact on the management of the coastal zone.

The Corps of Engineers has control over fill and dredge activities in the coastal zone under an 1899 act (Rivers and Harbors Act §10, 33 U.S.C. §403) and the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. §1344 (Supp. V 1975). The Corps has powers over the navigable waters of the United States, however navigable waters are defined so broadly as to cover nearly all the waters of the United States.

The Environmental Protection Agency has substantial powers over activities in the coastal zone. These powers are often not readily apparent and they arise from the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. §1251 (Supp. V 1975), and through the Clean Air Act of 1970, 42 U.S.C. §1857. Let me give you an example. Recently in the state of Washington there was a controversy over whether an oil port could be located at Cherry Point, in the northern part of Puget Sound. The proposal was going through the state permit process. (This was before the Magnuson Bill (S. 1522, 95th Cong., 1st Sess.) was passed, which ruled out Cherry Point as a major oil port site.) One problem that I don't think was realized even at the highest levels of state government, was that before that project could go forward, before a port could be established at Cherry Point, a state water pollution permit and a state air pollution permit would have to be issued. But these state permits also had to go through EPA, which is a federal agency, and EPA could say no. It could veto the project.

Now when the Magnuson bill was enacted in October 1977, it didn't tell the state what to do. It simply provided that no federal agency could thereafter issue a permit for an oil port in Puget Sound east of Port Angeles. Thus when these permits would come up through the state permit process and would get to the EPA, or to the Corps of Engineers, those agencies would have to veto them. So the federal government is very much involved in the management of the coastal zone.

The U. S. Coast Guard is also very much involved in ship movements, under the Ports and Waterways Safety Act of 1972, 33 U.S.C. §§1221-1227 (Supp. V 1975); 46 U.S.C. §391a (Supp. V 1975). The controversy over federal/state control of ship movements in Puget Sound is a very "live" one at the present time. The case of ARCO v. Ray has just been argued in the United States Supreme Court. This case concerns the Washington Tanker Act, R.C.W. 88.16.170-190 (Supp. 1976) and its constitutionality. The question is whether the federal government has pre-empted the field through the Ports and Waterway Safety Act of 1972, and whether there is any room for the state to control tanker activity in navigable waters in light of the federal act.

Lastly on federal activity, the Bureau of Land Management is engaged in a massive leasing program for Outer Continental Shelf oil

reserves. Even though these leases cover lands on the outer continental shelf, well beyond the coastal zone, and beyond the territorial sea, they will nonetheless have a significant impact on the coastal zone. They are a major impact producing activity for the coastal zone because the oil is going to come ashore someplace. And those impacts are not very far down the road.

I see three major areas of federal/state conflict in Coastal Zone Management. One is the scope of the federal/state "consistency" provision. Let me explain that a bit. As I mentioned earlier, there are two incentives for a state to obtain a federally approved coastal zone management program. Number one, a state with an approved program is entitled to receive federal funds. Number two, once the federal government approves a state program, federal agencies must conduct themselves consistent with the program to the maximum extent practicable. This gives the states broader planning power and better leverage and authority over federal agencies, and licensees of federal agencies. There is, however, still a large question over the scope of this "consistency" provision, over the extent to which federal agencies must comply with state programs.

The second big area of federal-state conflict is major facility siting. In the immediate future we must plan for some new and very large oil ports; we have things like the Trident submarine base; at the present time we have no adequate way for the states to have substantial input to the siting of these major facilities. I suggest to you that even though Washington's Coastal Zone Management Program is one of the most comprehensive and most advanced in the country, that it had minimal impact on the development, the shape and the impact of the Trident base. The planning was done in areas and at levels that simply were not affected by the state coastal zone management program. This still remains an important issue.

The third federal-state conflict involves the outer continental shelf oil development and its impact on the coastal zone. We can be assured that the leases are going to be issued and the oil will be developed. The question is, can state A, that has the optimal inshore area for the oil to be brought ashore, refuse to allow pipelines to be built there so that the oil has to brought ashore at State B or State C? Who is going to decide where that oil is to be brought ashore, and where the facilities will be located? At the present time it is the states that will decide these questions. However, the country may wish to change this. Scotland, Denmark, and a number of other countries have national siting controls. We should look very carefully at their experience, and at the advantages and disadvantages of such a national program.

In conclusion, these examples indicate that the main problem over the next few years will be how to develop energy and transportation facilities, and at the same time to rationalize local, state and national interests in social, economic and political impacts of development.

POLICY IMPLICATIONS FOR ALASKA RESULTING FROM ENERGY DEVELOPMENT*

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*Paper not available for publication.

OIL TRANSPORTATION AND THE WEST COAST OF CANADA

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ABSTRACT

In Canada as in the United States the need for new West Coast Oil Transportation facilities arise more from questions that are national in scope than local. The objections to oil terminal facilities are mostly local in their origins.

The West Coast Oil Ports Inquiry was established by the Government of Canada to advise that government on the marine implications including environmental, social, economic and navigational aspects of proposed oil ports. The issues before the Inquiry include whether the risks to the valuable marine resource are justified by the expected benefits of an oil port, and indeed whether Canada itself has need of a West Coast oil port.

Recent energy facility decisions in Canada suggest divergences in the aims of different segments of the population, in their expections for the future and in the trade-offs they are prepared to make. These divergences are surfacing in our Inquiry and contribute to the difficulties of the government in making decisions on oil terminal facilities.

INTRODUCTION

The decade of the 1970's appear to be a watershed era in transportation of oil. The Pacific North West Region has latterly been supplied with crude oil, by pipeline from the interior of the continent. The supply patterns are changing and structural changes are required in the facilities which handle oil. The proposal to build an oil terminal on the British Columbia Coast resulted in the creation by the Federal Government of Canada of the West Coast Oil Ports Inquiry.

THE NEED

The refineries of British Columbia have been supplied with crude oil from Alberta since 1953 by the Trans Mountain Pipeline System. The same pipeline, until last year provided the bulk of crude oil supplies for the Washington State Refineries. British Columbia would prefer to continue to use Alberta crude because of its desirable quality and its reliability of supply. The extent of reserves in Alberta suggest that this source of supply will be available to British Columbia at least through the 1980's. Consequently there is no provincial requirement for a port to import oil. There are, however, some in the Province of B.C. in favour of the establishment of an oil port because of the industrial benefits. Those in favour include the Mayor and Council of the municipality of the District of Kitimat. Kitimat is the site of the marine terminal proposed by the Kitimat Pipeline Company Ltd.

There are two factors on the national scene in Canada in favour of new facilities for oil transhipment on the West Coast. One is the consideration being given to accommodate those United States refiners who have been dependent on Canadian crude and are scheduled to be cut off from Canadian supplies. The other is to create an alternative supply route into central Canada to meet a growing need for the importation to Canada of foreign crude oil. Our Canadian Dept. of Energy Mines and Resources estimates that additional facilities will be required to supply Ontario from 1983. Both of these needs can be satisfied by the provision of an oil pipeline from the B.C. coast to Edmonton, Alberta, the origin of a major pipeline network serving the Northern United States and Eastern Canada.

Consequently, we see any Canadian support for an oil port on the West Coast of Canada arising from broad national considerations rather than from an immediate local need or even from any specific Canadian commercial interest. In contrast the burden of environmental costs and possibly of social dislocation would fall mainly on residents of British Columbia.

THE INQUIRY

The West Coast Oil Ports Inquiry is an inquiry created by the Federal Government of Canada under the Canadian

Inquiries Act. The Inquiry is to report directly to the Federal Cabinet and to the Canadian public. It is important to remember that under the Canadian constitutional system, it is the Federal level of government that has most, though not all, of the legislative authority over tanker and oil port operations. The Inquiry is not part of the existing regulatory process and to that extent is an ad hoc process created to deal with a specified situation outlined in the Inquiry terms of reference.

The role of the Inquiry is to examine the marine implications - environmental, social, economic, navigation, fisheries and others - of proposals to build oil ports in or near British Columbia and the implications to Canada of the resultant oil tanker traffic. The National Energy Board has responsibility to examine the terrestrial aspects, basically the pipeline.

The Inquiry was established on March 10, 1977, to examine essentially the Kitimat proposal. Subsequently, on June 30, 1977, the scope of the Inquiry was broadened to specifically examine "the broader Canadian concerns and issues related to oil tanker movements on the west coast as might be affected by the Kitimat Pipe Line Ltd., Trans Mountain Pipe Line Company Ltd. and other proposals".

The Inquiry is chaired by a sole Commissioner, Dr. Andrew Thompson, a former Chairman of the B.C. Energy Commission.

The original Order-in-Council of March, 1977, suggested that the Inquiry report by the end of 1977. This is clearly impossible given the list of issues to be examined. While no report date can be predicted it is expected that the Inquiry will carry on through the Spring of 1978.

The Inquiry has now been holding formal hearings since September 26, and has heard evidence on the legislative and regulatory aspects of tanker traffic and port development. The Commission is now hearing evidence on the supply and demand for crude oil which gives rise to the need for an oil port and what tanker traffic could be expected to result from its establishment. In addition the Inquiry has held community hearings at a number of small communities whose interest in the marine environment would be affected by one or other of the port proposals. These include Namu, Mt. Currie, Lillooet, and Steveston. The Inquiry plans to visit more communities. The formal hearings will eventually cover marine, environmental and socio-economic issues.

B.C. ALTERNATIVE PORTS

The B.C. coastline presents a distinct contrast with all the coast of the contiguous United States in the matter of port site selection. In British Columbia there is no lack of sites where deep draft ships can be brought alongside the land in sheltered waters. The limitation on our coast is the restricted access to the centres of demand for oil. In fact there are only five locations on the mainland coast where the continental land transportation networks extend to the shoreline. These are at Vancouver, Bella Coola, Kitimat, Prince Rupert and Stewart. To the north of Prince Rupert, in the latitude of the southern end of the Alaskan Panhandle the road and rail network of B.C. is still developing. In this region there are some potential port sites that as yet have no highway or rail connections, although the terrain itself is not a limiting factor.

For my purpose there are two main categories of alternative oil ports for B.C.:

1. Lower Mainland ports in or near the Port of Vancouver; and

2. North coast ports.

A third lessor category which merits brief mention is southern Vancouver Island, necessitating a submarine pipeline to the mainland.

The Lower Mainland sites are all extremely unattractive environmentally. From Canada's point of view they all compare unfavourably with Cherry Point, the ARCO docksite in Washington State some nine miles south of the Canada/U.S. border. That proposal has been ruled out by the United States.

No feasible port proposal in the third category has been brought forward. This may be due to the difficulty of laying a submarine pipeline from Vancouver Island to the continental shore. The depth of Georgia Strait is excessive and the more feasible alternatives involve island hopping through the San Juan Islands, or crossing Juan de Fuca Strait direct to Port Angeles! Clearly these are not attractive concepts.

The north coast alternatives as a group have several features in common. They are all subject to boistrous

weather and frequent poor visibility in the approaches. The north coast is not well provided with navigation aids. The approaches to these port sites tend to be long and intricate. Several sites are at the head of fiords. The largest municipalities on the north coast are Prince Rupert, population 18,000 and Kitimat population 13,500. The Inquiry is charged specifically with examining the Kitimat port proposal.

THE ISSUES

The issues in their broad outline are familiar to all. There are similar issues for any oil port. Perhaps we in Canada may be excused for thinking that the North coast of B.C. is a rather special area. Certainly the inhabitants think so. The wealth of the salmon and herring resources is familiar to them, as is the little exploited shrimp, crab and abalone. Many of these people have come forward to identify their concerns to the Inquiry. They are represented at the Formal Hearings by legal counsel for the United Fishermen & Allied Workers Union, for the Kitimat Oil Coalition, for the Union of B.C. Indian Chiefs, for the Nishga Tribal Council, and others such as the Labour Advisory Committee of Northwestern British Columbia, the B.C. Wildlife Federation, the Municipality of Kitimat and the Government of British Columbia. As may be expected there is a wide range of view points among these participants.

The Union of B.C. Indian Chiefs represented to the Inquiry in Phase I that the establishment of an oil port at Kitimat would not only put at hazard the life style of native people resident on the coast but would prejudice the land and resource claims they are now formulating. The representative of the Labour Advisory Council of N.W.B.C. said in his opening statement to the Inquiry that the oil port and pipeline is a type of development

> "incapable of generating well rounded, relatively self-sufficient regions. For people living in the region these of course are not abstract questions but relate to practical matters like job security, raising families and having access to desired cultrual facilities".

Similar issues have been raised in other parts of Canada

where decisions have been required on energy facilities. James Bay and the McKenzie Valley are prominent examples. The common feature in each of these cases seems to be that the primary benefit of the facility acrues to one segment of the population and the primary environmental and social burden falls on another segment.

In conclusion, I should like to bring to your attention a remark made by the Commissioner, Dr. Andrew Thompson in his opening statement before the Inquiry in July of this year. He said:

> "Should someone ask me what I consider to be of utmost importance in this Inquiry, I would say the process itself!"

ENERGY CONSIDERATIONS IN THE WASHINGTON COASTAL ZONE MANAGEMENT PROGRAM

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and

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INTRODUCTION

The following attempts to describe the present energy facility planning process for the Washington State Coastal Zone. Essentially, this process is embodied in three state laws, and supplemented by a Federal Act. The three state laws are: (1) the Shoreline Management Act of 1971 (SMA), RCW 90.58; (2) the State Environmental Policy Act (SEPA), RCW 43.21; and (3) the Energy Facilities Site Evaluation Council Law (EFSEC), RCW 80.50.

Taken together, the policies and procedures established by these laws, provide for the recognition of national and state interests in energy development and the preservation and conservation of the state's valuable coastal resources in the siting of energy facilities in the coastal zone.

ENERGY FACILITY SITE EVALUATION COUNCIL (EFSEC) RCW 80.50

The EFSEC procedures provide the primary mechanisms for anticipating and managing the impacts of energy facility development in Washington's Coastal Zone. The EFSEC procedures are founded upon the policy declarations in its enabling legislation:

> "It is the policy of the State of Washington to recognize the pressing need for increased energy facilities, and to ensure through available and reasonable methods, that the location and operation of such facilities will produce minimal adverse effects on the environment, ecology of the land and its wildlife, and the ecology of state waters and their aquatic life."

Fourteen state agencies are represented on EFSEC to provide coordination among the diverse state interests affected by the siting of energy facilities and to provide technical input to the decision making process. EFSEC receives applications for the siting of energy facilities and provides substantial technical review and public involvement throughout the process. The Council may override local land use plans and zoning ordinances, thereby providing for the required recognition of greater than local interest in the siting of energy facilities in the coastal zone.

The Council must, within 12 months or at such later time as is mutually agreed to, of receiving an application, submit its recommendation to the Governor. Past applications have taken well beyond 12 months to process. The Governor has 60 days after receipt of the Council's recommendation in which to accept or reject it. Once approved, the site certification specifies in contractual form all the environmental regulations and safeguards by which the applicant must abide in constructing and operating the proposed energy facility.

There are two important aspects of the legislation which relate to the EFSEC. First, after the Council has received a site application, the Attorney General is required to appoint a lawyer to act, in effect, as a "people's advocate" in terms of ensuring that the public interest as it relates to environmental protection is represented. This counsel is to serve in this capacity through the term of the EFSEC process. Second, the certification which is ultimately issued is in lieu of any permit or similar document required by any arm of the state.

EFSEC anticipates energy facility impacts through its assessment of siting applications, and it imposes criteria, through its site certification agreement, for the amelioration of those impacts. As a committee of state agencies and affected local parties, EFSEC coordinates state and local interests through its review procedure.

SHORELINE MANAGEMENT ACT OF 1971

The Shoreline Management Act (SMA) provides policy for the management of freshwater as well as saltwater shorelines within 200 feet of the water's edge and their associated wetlands and floodplains. It requires that local governments inventory local shorelines, establish a permit system to control shoreline development, and develop a Master Program to guide future development of the shorelines.

If a person proposes a substantial development on the shoreline, the developer must obtain a permit from the local government. This ensures that the development is compatible with the Master Program.

The significance of the SMA for energy facilities planning is that most of those coastal dependent facilities that will not be in EFSEC's jurisdiction will follow the permit process established by the SMA. This process allows the state to review and appeal, if necessary, any

substantial development permits granted by local governments.

Because of technical requirements that result in some energy facilities being sited at the water's edge, permits will be required for platform construction yards, for example, which would not be processed through EFSEC even though the impacts will be significant.

THE STATE ENVIRONMENTAL POLICY ACT

The State Environmental Policy Act (SEPA) is parallel to the National Environmental Policy Act and is the state's strongest statement of a comprehensive environmental policy. It requires that an applicant for a state or local government permit fill out an Environmental Checklist from which a determination is made whether or not the proposed action will significantly affect the environment. If the action is declared significant, then the state or local government agency must prepare an Environmental Impact Statement (EIS).

For the purpose of energy facilities planning, it is important that SEPA applies to the whole state, not just to the coastal zone or the shoreline. Thus, an energy facility not in the coastal zone but significantly affecting the coastal zone would have to be planned in the sense that impacts are anticipated through the EIS, assuming a local building permit, rezone, or other governmental action is required. Thus, it is possible that some energy facility, using CZMA definition, which does not go through the EFSEC site certification process or the SMA substantial development permit process, would still be channeled through the SEPA EIS process.

Given this admittedly simplified discussion of EFSEC, SMA and SEPA, there remains a question of how they all fit together to form Washington's energy facility planning process.

THE PLANNING PROCESS

EFSEC and SEPA are relatively straightforward. All EFSEC certification proceedings include the preparation of a SEPA EIS, with EFSEC as the lead agency. It is possible that if a federal permit, such as for dredging, is required, and a NEPA EIS is written, that NEPA EIS can be used in lieu of the SEPA EIS. However, it is unlikely that the federal EIS would cover the entire project.

SMA and SEPA combine in the following manner. Local governments issue substantial development permits under SMA in accordance with their Master Programs. If the development will have a significant effect on the environment, the local government is the lead agency for a SEPA EIS. However, if the project also requires a state permit or a federal permit administered by the state, then the state rather than local government may take the lead role. The SEPA guidelines provide for arbitration if the issue of lead role cannot be decided among the agencies.

The interplay of EFSEC and SMA is more complicated. It may often happen that a development being brought before EFSEC is located within 200 feet of a shoreline. Site certification by EFSEC overrides all other state permits.

Neither EFSEC nor local government issues a shoreline management substantial development permit during the EFSEC process. The site certification agreement, as is the case with all other state permits, is considered in lieu of the substantial development permit.

However, the substance of the SMA guidelines, as well as the local shoreline master programs, are considered and incorporated at various points throughout the EFSEC process. These are discussed below.

EFSEC must hold a public hearing to determine whether or not the proposed energy facility is consistent with local plans and zoning ordinances. If a shoreline master program is considered as a part of a local comprehensive plan or zoning ordinance it can nevertheless be preempted by EFSEC, but this provides a vehicle to analyze relationships and impacts. Moreover, there are explicit requirements in the SMA that local master programs be consistent with one another as well as with regional and statewide land use plans.

EFSEC relates to CZM/SMA in several other ways. During the application review phase, and subsequent steps in the process, the DOE representative to EFSEC has the opportunity to provide detailed technical input relative to not only SMA considerations but other environmental laws and guidelines administered by the Department of Ecology. Within the Department, the Office of External Affairs serves as the Department's office representative on EFSEC. Applications and other pertinent information regarding the siting of energy facilities in the coastal zone would be forwarded to the Office of Land Programs, Shorelands Division for review.

Additional opportunities for CZM/SMA input are afforded the Department at the contested case hearing stage of the proceedings. The Department is granted by statute the opportunity to participate as a party to the contested case hearing proceeding. Since the Department's representative to the Council must act as a member of the Council, and not as a representative of the agency at the hearings, the Department's case would be presented by other expert individuals (Land, Air and/or Water).

Another means by which CZM/SMA concerns are addressed in the EFSEC process is through the State Environmental Policy Act guidelines and procedures which are adopted by the Council pursuant to WAC 463-46. Generally, as a matter of operating policy, EFSEC orders the DRAFT EIS prior to the contested case hearing, the final EIS is prepared subsequent to this hearing. Thus, there is ample opportunity for the environmental ramifications of the proposed project (including CZM/SMA matters) to be thoroughly assessed by the Council, and the public, prior to, during and after the contested case hearing.

Once the application review and hearings are completed and if the Council recommends approval of an application for certification, the Council must attach conditions to protect state or local interests and conditions designed to recognize the purpose of laws, ordinances, rules or regulations which are preempted or superceded by EFSEC. This is an extremely significant stipulation of the Act as it relates to the meeting of the objectives of the CZM/SMA program. In essence, this requirement ensures that the objectives of the Coastal Zone Management Program will be met, although by means which may vary from normal procedures. It is conceivable that the Council could require the applicant to provide compensation for potentially damaged or lost coastal resources, for example purchase of public access or public beach areas damaged or eliminated by the proposed facility. Other CZM/SMA objectives could conceivably be met by the imposition of other conditions. It should be noted that this provision is mandatory, not discretionary, i.e., the Council must impose conditions which provide for the recognition of the purpose of laws preempted (including the SMA).

Another significant mechanism for inserting CZM/SMA concerns into the EFSEC process is provided by temporary local government representation on EFSEC (as voting members). Local CZM/SMA interests can be formally introduced through the city, county or port district representative sitting with the Council.

Individual citizen concerns relative to CZM/SMA matters can be formally inserted in the EFSEC process in several ways. First, individuals or representatives of special interest groups may make their concerns known at the public information meeting or at the initial public hearing held for the purpose of determining consistency with local land use plans and zoning ordinances.

Secondly, individual citizens or representatives of special interest groups may be granted "intervenor" status by the Council. This procedure in essence makes the individual a formal party to the proceedings, and allows cross-examination of witnesses for the applicant as well as introduction of their own experts to testify.

Thirdly, public interests, including any possible CZM/SMA concerns are represented before the Council by the Counsel for the Environment. Established by statute, the Counsel for the Environment is appointed by the Attorney General. The Counsel for the Environment represents the public and its interests in protecting the quality of the environment. He or she is afforded all of the rights, privileges and responsibilities of an attorney representing any official party to the proceedings. Thus, through the Counsel for the Environment the public at large becomes an official party to the EFSEC decision making process.

The Federal Consistency procedures established under section 307 of the CZM Act also provide an extremely important means for ensuring that coastal energy development is compatible with the state's CZM

program. The federal consistency mechanism established in the Act requires that the applicant for a federal permit associated with an energy facility certify to the state that the proposed action is consistent with the state CZM program. The state then provides a detailed review of the action and either concurs or rejects the certification. If the certification is rejected the proposer must revise the proposal to provide for the required consistency.

The federal consistency procedures are probably carried out in addition to the EFSEC procedures. However, the relationship of federal consistency and EFSEC is currently the subject of litigation and further comment at this time would be inappropriate.

ENERGY FACILITY PLANNING AND THE COASTAL ENERGY IMPACT PROGRAM IN THE GREAT LAKES COASTAL ZONE

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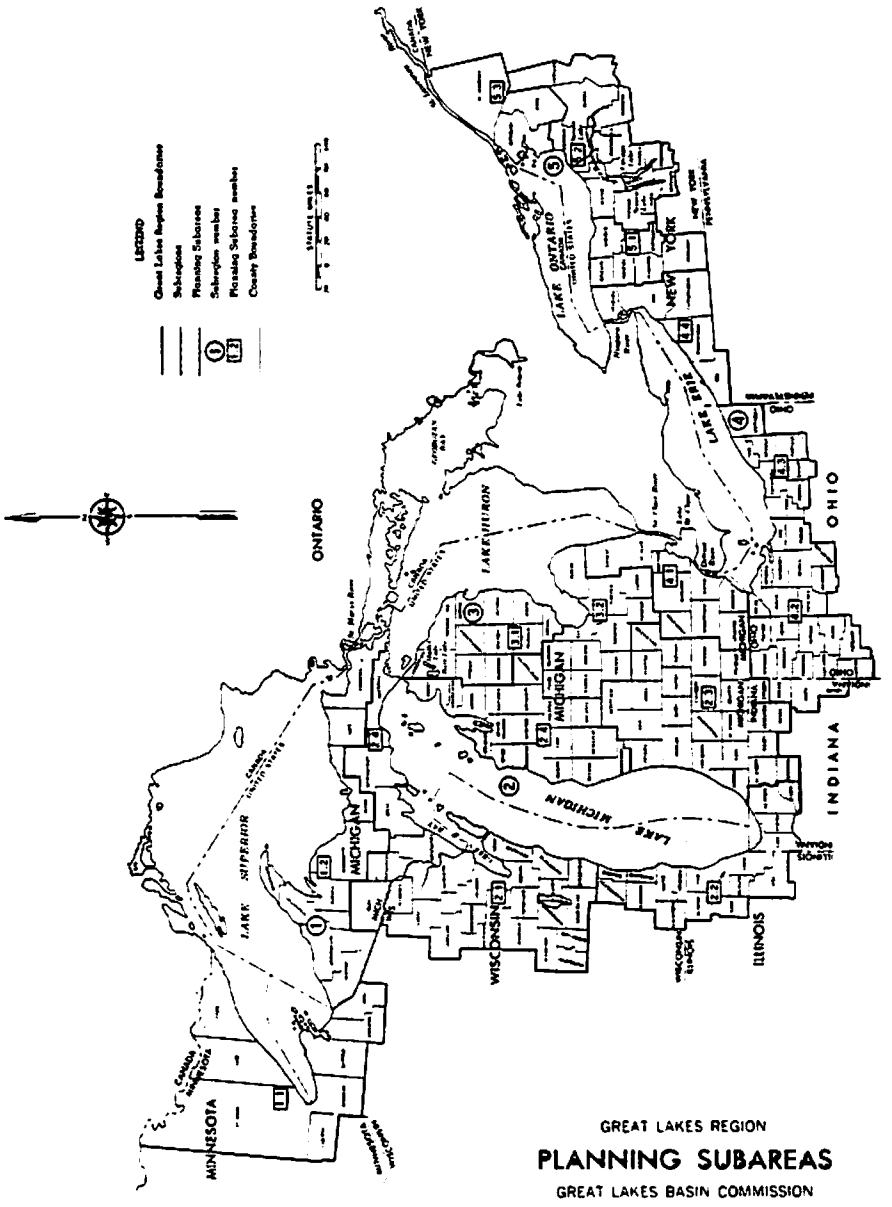
ABSTRACT

The US Great Lakes coastal zone provides significantly for electric generation and transportation of coal, the products of which are used throughout the region and the eastern United States. Four Great Lakes States (New York, Ohio, Wisconsin, and Minnesota) have energy facility siting programs to deal with the effects of some, but not all, types of energy facilities. The coastal energy impact program (CEIP) provides the basis for addressing energy facility planning comprehensively, at least in the coastal zone. However, due to the emphasis in the CEIP on outer continental shelf oil development and the narrow definition of "coastal energy activity" in the amended Coastal Zone Management Act, the potential major energy development in the Great Lakes Region of nuclear and coal-fired electric generating plants and coal transportation were not emphasized in the coastal energy impact program.

INTRODUCTION

Does the coastal zone of the Great Lakes contribute significantly in meeting the energy needs of the United States? To what extent would the Great Lakes be called on in the future to address energy problems? What will be the impacts of future energy scenarios on the Great Lakes Coastal Zone? These questions were addressed in a study by the Great Lakes Basin Commission staff of Energy Facility Siting in the Great Lakes Coastal Zone: Analysis and Policy Options, completed in January 1977. This study was conducted at the request of the eight Great Lakes States' Coastal Zone Management Programs out of their concern that the entire regional energy situation be examined in light of the energy-related Coastal Zone Management Act Amendments of 1976 then before congress.

FIGURE 1


LEGEND
STATUTE MILES
ONTARIO
LAKE ONTARIO
LAKE ERIE
NEW YORK
OHIO
LAKE HURON
MICHIGAN
LAKE MICHIGAN
INDIANA
WISCONSIN
ILLINOIS
LAKE SUPERIOR
MINNESOTA
GREAT LAKES REGION
PLANNING SUBAREAS
GREAT LAKES BASIN COMMISSION

BACKGROUND

The significance of the Great Lakes, whether measured by the location of energy facilities on or near their shorelines or by other coastal or water-related uses, is at times not recognized in national or federal programs. The Great Lakes system is the largest open flowing system of fresh water in the world. (See Figure 1.) The Great Lakes cover over 61,000 square miles. If the bays, inlets, river mouths and other wetlands are included, the Great Lakes cover approximately 95,000 square miles. The system includes Lakes Superior, Huron, Michigan, Erie, and Ontario and the connecting channels of the St. Marys River, St. Clair River, Detroit River, Niagara River and St. Lawrence River, as well as Lake St. Clair. Table 1 shows the shoreline of the Great Lakes and the other coasts of the contiguous United States.

TABLE 1

SHORELINE OF THE CONTIGUOUS UNITED STATES
BY COAST

Atlantic[a]	28,673 miles
Gulf[a]	17,141 miles
Pacific[a]	7,863 miles
(California)[a]	(3,427 miles)
Great Lakes (US portion only)[b]	5,270 miles
(Michigan)[b]	(3,282 miles)

a. Includes shoreline of outer coast, offshore islands, sounds, bays rivers and creeks to the head of tide water or to a point where tidal waters narrow to a width of 100 feet.

b. Includes outer coast offshore islands, bays, and river mouths. (There are no tides on the Great Lakes.)

Sources: The World Almanac and Book of Facts (1976); and International Joint Commission, International Great Lakes Levels Boards (1973). Regulation of Great Lakes Water Levels, Appendix C: Shore Property, page C-15.

Nestled in the east northcentral portion of the United States, the length of the US Great Lakes shoreline, is two-thirds that of the Pacific shoreline. The state of Michigan, alone, has over 60 percent of this shoreline.

The Great Lakes States are also significant from social and economic standpoints. In July, 1976, the population of the eight Great Lakes States was estimated to be approximately 75 million. This comprised 35% of the population of the United States. The coastal county population of the US Great Lakes was approximately 26% of this, or 19.5 million, nearly one-tenth of the entire US population. Additionally, there are 77 federally-maintained and private harbors. The Great Lakes Region (the county political boundaries that incorporate the drainage area of the Great Lakes Basin--see Figure 1) provides 50% of the steel production of the nation and 35% of the value added in manufacturing.

STUDY OBJECTIVES

The energy facility siting study, conducted from July to November of 1976, had as its main objectives: (1) a review of state and federal laws and policies affecting energy facility siting in the Great Lakes coastal zone, (2) an examination of the coastal dependence of energy facilities and a review of their impacts, (3) a projection of resources required in the Great Lakes coastal zone for energy facilities, and (4) the development of policy options for energy facilities that the study examined, including electrical energy generation (fossil fuel and nuclear), fuel transshipment and storage, refining, and coal gasification and liquefaction. With regard to this last type of facility, only a cursory review could be done with the limited time. Figure 2 gives an overview of the principal work elements of the study and their relationship to each other.

FIGURE 2

PRINCIPAL STUDY ELEMENTS

INSTITUTIONAL ANALYSIS	COASTAL DEPENDENCE AND IMPACT ANALYSIS	PROJECTIONS AND TRENDS
Federal	Social, Economic, and Environmental Effects	Existing Energy Use
State	Resource Requirements by Facility Type	Projections of Electrical Energy Consumption
Comparative Analysis	Coastal Dependence Case Study	Projected Resource Requirements
	Coastal Dependence Conclusions	Implications for Fuel Transport
		Coastal Resource Demands
	POLICY OPTIONS	
	Institutional	
	Technical	

STATE ENERGY FACILITY SITING PROGRAMS

The Great Lakes States were examined for the extent to which they had statewide energy facility siting processes. Additionally, other coastal states of the US were examined for comparison and also to determine whether they would provide options which could be utilized by the Great Lakes states. The other coastal states examined included California, Maine, Maryland, Massachussetts, Oregon, and Washington. With respect to the Great Lakes, four states have existing statewide energy faciility siting processes: Minnesota, New York, Ohio, and Wisconsin. The other four states, Illinois, Indiana, Michigan, and Pennsylvania, do not have statewide energy facility siting processes.

A review of the Great Lakes states not having energy facility siting programs indicates the following points:

1. They rely on traditionally utility regulation by a commerce commission or a public service commission in the areas of cost, safety, and reliability.

2. They have a variety of permits that are required of energy facilities related to environmental controls and that affect to some degree location/operation of the facility. These permits are administered through such agencies as State EPAs, Pollution Control Boards, Resource Recovery Commissions, and the National Pollutant Discharge Elimination System (NPDES) Permit Program.

3. Control of location and zoning is in the hands of local government although the power of eminent domain can be exercised by the utility through the state public service commission.

4. Many local authorities can exercise control over some aspect of water use (for example, in Illinois, 20 local authorities can affect the use of water).

5. No long-range plans are required to be submitted with respect to future energy facilities, although the state of Michigan has asked for voluntary submission.

6. Site selection is exercised by the utility within the constraints of regulatory bodies.

In summary, the approach of these states is disjointed, not comprehensive, and public input is required through each permit process. The emphasis is on facility certification, rather than site evaluation and selection.

Of the states not having energy facility siting programs, however, the state of Michigan has taken interesting approaches to some related problems, but not necessarily as a result of energy facility siting problems. Michigan has a permit program for structures in navigable waters, such as those for water intake from the Lakes. In the Great Lakes Region, each state holds in trust its respective portion of the bottom lands of the Great Lakes to the International boundary or state boundary, as appropriate. This provides them the power to regulate structures in navigable waters. Additionally, a Michigan executive order requires state environmental impact statements on major state actions, although they are not routinely applied to energy facilities.

The states having energy facility siting programs on a state-wide basis conduct these programs through various means: in Minnesota, the energy facility siting program is conducted through an Environmental Quality Council; in Ohio and New York, energy facility siting is regulated through a power siting commission; in Wisconsin, the legislature augmented the authorities of the Public Service Commission and the Department of Natural Resources. The major elements of these programs are summarized below:

1. In these states, the State can preempt local zoning, which indicates the states' concerns that greater than local needs be met.

2. In most of these state programs, an inventory of sites is required to be filed with the states and site selection criteria are applied.

3. Ohio and New York have combined all necessary permits--siting, construction, and operation--into one process. The other states require separate permit processes for each. The single-process approach allows for more organized and comprehensive public input.

4. Each of these states requires something similar to an environmental report or impact statement from the utility companies on the site or sites to be selected for energy facilities.

5. The application of the processes ranges from only oil, coal and nuclear power plants and their transmission lines to natural gas transmission lines.

POLICY OPTIONS FOR THE SITING FOR ENERGY FACILITIES

While the states of the Great Lakes having energy facility siting programs offer options to the states that do not, the states outside the Great Lakes having programs offer additional options. Table 3 provides an overview of these programs and their major elements. Notably, in

TABLE 3

FEATURES OF STATE ENERGY FACILITY SITING PROGRAMS

	General					Plans and Forecasts			
	Principal Agency	Types of Facilities	Local Preempt.	Relation to CZM	Conserv. Program	Public Discl.	Time Frame	Approval Process	Document. of Method.
Illinois	Commerce Commission	—	No	—	—	No	—	—	—
Indiana	PUC	—	By Env. Domain	—	—	No	—	—	—
Michigan	DNR/PSC	—	No.	Unspec.	None	No	—	—	—
Minnesota	Environmental Quality Council	PP (50 MW) TL (200 kv)	Yes	Regional Zoning Preempted	Energy Agency	Yes	P=5 Biennial P=15	None	Utility
New York	Board on Electric Generation and Siting	PP (50 MW)	Yes	Unspec.	Utilities must describe	Yes	P=10	Public Hrngs.	Assumptions and data
Ohio	Power Siting Commission	PP (50 MW) Gas & Elec. Trans.	Yes	Unspec.	Utilities must show impact	Yes	P=10	Public Hrngs.	Method, Assumpt. and data
Pennsylvania	Dept. of Envr. Resources/ PUC	—	Conditional	—	None	No	—	—	—
Wisconsin	DNR/PUC	PP (300 MW) TL (100 kv)	Yes	Unspec.	Utilities must describe	Yes	Biennial P=10	Public Hrngs. Agency Review	No
California	Energy Resource Conservation & Dev. Comm.	PP (50 MW) TL	Yes	—	Cons. Div. within ERCDC	Yes	Biennial P=5,10 20	Public Hrngs. State Approval	State Specifies
Maine	Dept. of Envr. Protect.	All EF over 20 ac.	Yes	Unspec.	—	No	—	—	—
Maryland	PSC/DNR	All PP TL (69 kv)	Yes	Unspec.	—	Yes	P=10	Eval. of Sites in Plan	No
Massachusetts	Energy Facilities Siting Council	PP (100 MW) TL (69 kv) ST (500 kbbl) Others	Yes	Unspec.	—	Yes	P=10	Public Hrngs. Council Votes	No
Oregon	Energy Facility Siting Council	PP (25 MW) TL (230 kv) geotherm. PL, Solar	Yes	None	Dept. of Energy	Yes	P=5,10 20 F=1-5, 10,20	Public Hrngs. State Compiles	No
Washington	Energy. Fac. Site Eval. Council	All EF	No	Shoreline Permits Preempted	State Energy Office	No	As Necess.	Energy Office Prepares	No

KEY: PP = Power Plants; TL = Transmission Lines; EF = Energy Facilities; ST = Storage Tanks; PL = Pipelines; OR = Oil Refineries; P = Plans; f = Forecasts

FEATURES OF STATE ENERGY FACILITY SITING PROGRAMS (cont'd)

Public Participation			Site Certification				Site Selection		Financing	
Agency Members	Access to Info	Public Hrngs.	One Stop	Time[1] Limits	Envr. Assess.	Alternate Sites	Site Select.	Site Acquis.	Applic. Fee	Annual Fee
—	—	Facility Certific.	No	—	—	—	Private Sector	Cond. Em. Domain	—	—
—	—	No	No	—	—	—	Private Sector	Em. Domain	—	—
—	Notice of Envr. Permit Applic.	Air Water Permits Etc.	No	—	By Exec. Order	—	Private Sector	Em. Domain	—	—
7S 1G 4PM	Yes	Criteria, Inventory, Site Certific.	Yes	PP (1 yr) TL (180)	EQC Staff	One Alt.	State Site Inventory	Em. Domain	$500/ 5 million ($3000 min.)	Based on kwh + $ sales
4S 1A	Plans, Applic. for Cert.	LR Plan Pre-applic. Application	Yes	Hrng. 6-7 mos after applic.	DER as part of applic.	One Alt.	Site Suitability Criteria	Private Sector	$25,000	—
4S 1G	Plans, Applic., for Cert.	LR Plan Pre-applic. Application	Yes	2-5 yrs.	PSC/ DER/ EPA	Four Total	Site Suitability Criteria	Private Sector	Formula for PF	—
—	Notice of Envr. Pre Applic.	Hrngs. on Envr. Permits	No	—	No Formal Requirement	—	Private Sector	Conditional Em. Domain	—	—
—	LR Plan	Plan, Site Certif.	2-Stop DER/PUC	ea. PP + TL (150) lg. PP (480)	DER	No	Private Sector	Conditional Em. Domain	—	—
5PM	Office of Public Advisor	Plans & Forecasts, Site Certific.	Yes Except CZ	18 mo.	Siting Agency (ERCDC)	Three Total, One Inland	Private Sector	Em. Domain	10 mills/ kw capac. ($1000 to $25,000)	.1 mill/ kwh
1GPM 1S	Notice of Permit Applic.	Pre-applic. hrng. siting hrng.	Yes	Hrng. 30 da. after applic.	Part of Permit Applic.	No	Private Sector	Em. Domain	—	—
PSC Members	LR Plans EIS Sites Applic.	Applic. Conference	Yes	2 yrs. minimum	DER	Yes	Site Inventory & Utility	By State and Utility	—	.1 - .3 mills/ kwh
4S 2PM 3G	LR Plan Notice of Intent Applic.	LR Plan Notice of Intent Applic.	Yes	PP (6 mo.) CZ(1-2 yr)	Dept. of Envir. Affairs	No	Site Suitability Criteria	Em. Domain	$25,000 for PP, Complex for EF	Complex Fee on Plans & Forecasts
7PM	LR Plans	P+F Suitable Areas, Site Cert.	Yes w/ Governor	PP(24 mo) Other EF (6-12 mo)	Indep. Study Possible	No	State Desig. Suitable Regions	Condit. Em. Domain	50 mills/ kw 1% of invest.	25 mills/ kw $300/6-million
14S	Not Specif.	Site Cert.	No Local & Governor	12 mo. + 60 da. + 30 da.	Indep. Private Consult.	No	Private Sector	No Em. Domain	$10,000	—

S = State Agency Heads
PM = Public Member (Appointed by Governor)
G = Other Governor Appointee
A = Ad Hoc Member

[1] Days, unless indicated otherwise.

states outside the Great Lakes, California requires prior approval of a Coastal Conservation Commission before energy facilities can be located in the Coastal Zone. Maine and Washington regulate the siting of all types of energy facilities. Maryland has set up a state energy facility "site bank" or "reserve". Massachussetts requires extensive hearings and long-range plans, and Oregon designates areas for energy facility development. Table 4 presents an overview of the major options described in the Great Lakes Basin Commission Study (Job, et al, 1977).

Major areas for policy option development include: (1) siting policy, (2) organizational structure and arrangements, (3) functional responsibilities, (4) siting procedures, (5) siting criteria and standards, (6) financial mechanisms, and (7) intergovernmental relations. From a technical standpoint, other policy options for the coastal zone include: (1) exclusion of all new energy facility development from the Coastal Zone Management area, including access to coastal waters and related fuel transshipment, (2) exclusion of all new energy facility development from Coastal Zone Management area, but allowing coastal water access, related fuel transportation and product transmission through the coastal zone, and (3) inclusion of all new energy facility development in the Coastal Zone Management area, except in designated sensitive areas in which additional development would be precluded.

RELATION TO THE COASTAL ZONE

How does this all relate to the coastal zone? Coastal Zone Management is a comprehensive resource management approach. The Coastal Zone Management Act Amendments require an "energy facility planning process", which will hopefully assist the states in developing an energy facility siting program comprehensively at least in the coastal zone. To date, the Great Lake States, as a whole, have been relatively slow in applying their existing energy facility siting processes to a CZM energy facility planning process. Furthermore, none of the programs briefly described above are comprehensive. For example, not included in these programs are oil pipelines and tank farms, coal transshipment facilities, coal gasificiation and liquefaction facilities, natural gas transmission and storage (except in Ohio), and other types of related facilities. These facilities could be located in the coastal zone and should be addressed by the states if they are to have comprehensive programs. Assuming the need for the energy facilities has been established, the purpose of exercising some measure of control by the states in the location of all types of energy facilities (if a siting program is comprehensive) is not to diminish the responsibility and function of the energy corporations. The purpose is to serve the public through attempting to optimize the collective beneficial and adverse effects of energy facilities, while striving with the corporations to maximize the benefits to the public of energy production, distribution, and use. The Commission's study suggests that electrical generating facilities and coal transshipment facilities will be the principal types of facilities located in the coastal zone of the Great Lakes over the next twenty years.

TABLE 4

INSTITUTIONAL

POLICY OPTIONS FOR ENERGY FACILITY SITING PROGRAMS[1]

- Siting Policy
  - Traditional Utility Regulation
  - Energy Policy
  - Land Use Policy
  - Pollution Control/Environmental Protection
  - Scope of Facility Siting Regulation
  - State Power Authority
- Organization Structure and Arrangements
  - Multi-Stop Process
  - Consolidation of Authority
  - Siting Agency Composed of State Agency Heads
  - Public Members
  - Hearings Examiners
  - Independent Staff
  - AD HOC Members
- Functional Responsibilities
  - Long Range Planning (By State & Private Sector)
  - Environmental Impact Assessment
  - Final Site Approval
  - Monitoring
  - Conservation
- Siting Procedures
  - Application Process
  - Site Selection
  - Treatment of Generic Issues
  - Funding
- Siting Criteria and Standards
  - State Designation of Site Suitability Criteria
  - Separate Site Suitability Criteria for Different Types of Energy Facilities
  - Detailed Siting Criteria for the Coastal Zone
  - Point of Application of Suitability Criteria
  - Designation of Environmental Impact Assessment Criteria for Site Evaluation
- Financial Mechanisms
  - Methods of Generating Financial Resources
  - Direct Public Involvement
  - Incentives for Energy Development by the Private Sector
- Intergovernmental Relations
  - State-Federal Relations
  - Options for Interstate Relations

[1]Further details concerning these options are provided in: Great Lakes Basin Commission, Energy Facility Siting in the Great Lakes Coastal Zone: Analysis and Policy Options, January 14, 1976, pp. 391-444.

TABLE 4 (cont'd)

TECHNICAL

EXCLUSION OF ALL NEW FACILITY DEVELOPMENT FROM THE COASTAL ZONE MANAGEMENT AREA INCLUDING ACCESS TO COASTAL WATERS AND RELATED FUEL TRANSSHIPMENT

EXCLUSION OF ALL NEW FACILITY DEVELOPMENT FROM THE COASTAL ZONE MANAGEMENT AREA BUT ALLOWING COASTAL WATER ACCESS, RELATED FUEL TRANSPORTATION, AND PRODUCT TRANSMISSION THROUGH THE COASTAL ZONE

- Limit expansion and construction of conveyance systems to existing corridors and rights-of-way
- Avoid areas of particular concern in determining access routes and rights-of-way
- Disperse new access routes and corridors
- Concentrate access routes and corridors
- Specify development areas
- Develop buffer control areas
- Develop multiple-use corridors and rights-of-way
- Establish limit on resource utilization
- Provide financial Assistance to affected areas for impact assessment and amelioration
- Use technologies requiring least land area for access rights-of-way

INCLUSION OF NEW FACILITY DEVELOPMENT IN THE COASTAL ZONE MANAGEMENT AREA, EXCEPT IN DESIGNATED SENSITIVE AREAS IN WHICH ADDITIONAL DEVELOPMENT WOULD BE PRECLUDED

- Limit expansion or reconstruction to existing industrial or utility areas
- Avoid areas of particular concern, including sensitive areas
- Encourage development of dispersed siting
- Encourage multiple unit/single site development
- Specify development areas
- Specify facility type and size in the coastal zone
- No restrictions on facility type and size in the coastal zone
- Give coastal development priorities to energy facilities
- Site close to existing transshipment facilities
- Locate in proximity to existing electric power grid
- Assign priorities for facility development to those facilities employing by-product utilization
- Develop buffer zones
- Maintain or increase public access to the shoreline in the event that a facility's property has shoreline frontage
- Establish restrictions on cooling systems
- Provide financial assistance to local areas for impact assessment and amelioration
- Permit shoreline site location of energy facilities
- Specify shoreline setback distance for energy facilities
- Permit only those facilities absolutely requiring shoreline location to be located on or near the shoreline

TABLE 5

ASSUMPTIONS FOR PROJECTIONS

	Scenarios	Coal	Nuclear	Oil, Gas Hydro	New Technologies
I.	Recent Trends	50%	35%	15%	
II.	High Coal	70%	15%	15%	
III.	High Nuclear	45%	45%	10%	
IV.	New Technologies	40-50%	20-35%		15-20%

RANGE OF ANNUAL GROWTH RATE IN ELECTRICAL ENERGY CONSUMPTION

3% - 5.5% - 8%

ASSUMED MIX OF GENERATING FACILITIES

75% - Base Load
20% - Intermediate Load
5% - Peak Load

ASSUMED CAPACITY LOAD FACTOR

65%

NEED FOR AN ENERGY FACILITY PLANNING PROCESS IN THE GREAT LAKES REGION

The study primarily focused on electrical generation and coal transshipment and storage facilities. Table 5 provides an overview of the assumptions made in projecting future Great Lakes coastal zone resource requirements for electrical energy generating facilities.

The study assumed a range of annual growth rate in electrical energy consumption from 3% to 8%, based upon the latest series of projections made by a number of analysts. The assumed mix of generating facilities was 75% base load, 20% intermediate load, and 5% peak load and the assumed capacity load factor of all plants was 65%. Also, the study suggested possibilities for alternative fuel mixes. The scenarios included "recent trends" (the projection of the existing situation), a "high coal" scenario (emphasizing coal production), a "high nuclear" scenario (emphasizing nuclear production), and a "new technologies" scenario (which included allowance for such technologies as solar, wind, and fluidized beds). Table 6 provides an overview of the additional resource requirements in the eight Great Lake states from 1975 to 1995 assuming a 3% growth rate in electrical energy consumption (a base case).

TABLE 6

ADDITIONAL RESOURCE REQUIREMENTS OF THE GREAT LAKES STATES, 1975-1995
SCENARIOS AT 3%/YEAR GROWTH RATE IN
ELECTRICAL ENERGY CONSUMPTION

Additional Requirements (1975-1995)	Scenarios		
	I	II	III
Nuclear (units)	70	24	104
land (acres)	46,725	16,020	69,420
water (gpd)			
once-through	$1,008 \times 10^8$	346×10^8	$1,498 \times 10^8$
closed-cycle	$1,512 \times 10^6$	518×10^6	$2,246 \times 10^6$
Coal (units)	40	96	12
land (acres)	16,000	38,400	4,800
fuel (millions of tons per year)	80	192	24
water (gpd)			
once-through	403×10^8	968×10^8	121×10^8
closed-cycle	576×10^6	$1,382 \times 10^6$	173×10^6

The requirements in Scenario IV, New Technologies, are assumed to be about 80% of those in Scenario I, Recent Trends, due to a postulated reduced dependence on more conventional generation technologies.

TABLE 7

ADDITIONAL RESOURCE REQUIREMENTS OF THE GREAT LAKES
COASTAL COUNTIES, 1975-1995,
ASSUMING A 3% GROWTH RATE IN ELECTRICAL ENERGY CONSUMPTION*

State	Additional Requirements					
	Generating Units*	Generating Capacity (MWe)	Land (Acres)	Water Withdrawals (gpm) Once-Through	Water Withdrawals (gpm) Closed Cycle	Coal (Millions of Tons per year)
Illinois	---	---	---	---	---	---
Indiana**	---	---	---	---	---	---
Michigan	11	11,000	5,870	9.35×10^6	137,500	11.0
Minnesota	1-2	1-2,000	1-2,000	$0.9-1.7 \times 10^6$	12-25,000	2-4.0
New York	7	7,000	3,740	5.95×10^6	87,500	7.0
Ohio	4	4,000	2,135	3.4×10^6	50,000	4.0
Pennsylvania	---	---	---	---	---	---
Wisconsin	8	8,000	4,270	6.8×10^6	100,000	8.0

*Coal and nuclear units, assuming a 50% coal/50% nuclear mix, as noted above.
**Does not include Bailly nuclear unit, Porter County, on site already containing two coal-fired units.
If an 8% growth rate is assumed, the figures in the table above would increase by a factor ranging from 2.0 to 4.8, depending on the state being examined.

TABLE 8

PROJECTIONS OF US GREAT LAKES SHIPMENTS OF COAL

(Millions of Short Tons)

		1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020
Corps of Engineers (1961)	(1)	83.5	93.4	106.7	114.6	124.9	130.3	135.0	139.6	143.2	148.5	---
Bureau of Mines (1970)	(2)	53.0	58.0	62.0	66.0	69.0	73.0	---	---	---	---	---
IGLLB - High (1973)	(3)	61.0	---	83.0	---	---	134.0	134.0	---	---	---	134.0
- Medium	(4)	53.0	---	62.0	---	---	74.0	74.0	---	---	---	74.0
- Low	(5)	44.0	---	43.0	---	---	43.0	43.0	---	---	---	43.0
Kearney (1976)*	(6)			81.0	---	104.5	---	105.1	---	149.2	---	170.5

*NOTE: The Kearney projections are for domestic traffic only.

SOURCES: Wisconsin University Sea Grant Program (1976). The Great Lakes Transportation System. Technical Report 230.
US Army Corps of Engineers, North Central Division (1976). Great Lakes/St. Lawrence Seaway Traffic Forecast Study. Summary Report.

Notably, all scenarios described require substantially larger land area for nuclear plants.

In reviewing the projected planned and scheduled electric generating capacity for the eight Great Lake States, information from the Federal Power Commission and the Federal Energy Administration indicated that through the mid-1980's, an additional 74,067 MWe would be under construction or put into service. Of this, 19,433 MWe, or 23 new plants or plant additions, would be located in the coastal counties of New York, Ohio, Michigan, Indiana and Wisconsin. Of these facilities to be located in the coastal counties, 28% were projected to be coal-fired, 12% oil-fired, and 60% nuclear. These figures highlight the projected emphasis on nuclear plants in the Great Lakes Region. It should be noted that in projecting from 1975 to 1995, assuming no existing facilities are decommissioned, the entire Great Lake state area would require one hundred twenty-six 1,000-megawatt units at a 3% growth rate in energy consumption. At an 8% growth rate, five hundred seventy-five 1,000-megawatt units would be required.

Table 7 describes the additional resource requirements of the Great Lakes coastal counties from 1975 to 1995 assuming a 3% growth rate in electrical energy consumption per year. These projected resource requirements further assume a 50% coal-fired/50% nuclear mix of plants, which is consistent with the scenarios if an approximate average is taken for all four scenarios. At a 3% growth rate, projected land area required totals about 17,000 additional acres by 1995. At an 8% growth rate, the projected requirement would be approximately 65,500 acres of land in the coastal counties of the Great Lakes. This latter figure is equivalent to an area one-half mile wide and 205 miles long (a distance approximated by the straight line distance from Gary, Indiana, to Green Bay, Wisconsin). These figures do not include transmission lines if long distance transmission lines are required to connect to the present transmission line network. Notably, the state of Michigan has the highest percentage (73%) of its generating capacity (18,926 MWe) already located in its coastal counties, and would continue to have the greatest demands on those counties because of its long shoreline with access to Great Lakes water.

The use and transportation of coal adds a further dimension to the Great Lakes energy picture. In 1974, over 35 million tons of coal and lignite were moved to or through Great Lakes coastal ports. During the same year approximately 9 million tons were moved to or through ports or waterways of the Atlantic, Gulf, and Pacific coasts. (Department of the Army, Corps of Engineers, 1974.) These figures highlight the importance of coal movement in the Great Lakes coastal zone as compared to the other coasts. Since 1974, a major new coal transshipment facility has been constructed at Superior, Wisconsin with the capability of transshipping 20 million tons of coal annually. Other facilities are likely to be located in the Great Lakes coastal zone in the near future. Additional facilities have been discussed for New York, Ohio, Michigan, Wisconsin and Minnesota. A further breakdown for 1974 indicates that eight US

Great Lakes receiving ports received nearly 21 million tons of coal, and seven major shipping ports shipped nearly 35 million tons that same year. There are major movements of coal from ports at one end of the Great Lakes to the other, as well as between ports in the mid-portion of the system. A substantial volume is shipped to Canada. With increased movement of western coal to the midwest and east, and increased movement of Appalachian coal to Canada, existing and future coal transshipment facilities on the Great Lakes shoreline will continue to increase their volume substantially in the future. By the year 2000, a projected 105 million tons of coal could move through US Great Lakes coastal ports. Table 8 provides an overview of projections of coal movement on the Great Lakes.

THE COASTAL ENERGY IMPACT PROGRAM IN THE GREAT LAKES REGION

As described in the law and regulations, is the Coastal Zone Management Act comprehensive as it applies to energy facilities and their impacts in the Great Lakes coastal zone? The emphasis of the Coastal Zone Management Act Amendments of 1976 on "coastal energy activity" stresses outer continental shelf oil development. It also emphasizes national interests in energy activity. Oil and gas in the submerged lands of the Great Lakes are held by the states, and royalties from or taxes on this oil and gas could be used for addressing any environmental effects resulting from producing it. At this time, there is no production on the US side, although exploratory wells have been drilled in the past. Additionally, estimated reserves are not nearly as extensive as those on the outer continental shelf.

So where does this leave the Great Lakes coastal zone with respect to energy facilities planning and the coastal energy impact program? The Great Lakes Coastal Zone Management Programs are eligible to receive grants for planning for the effects of energy facilities, to receive loans to provide additional public facilities and services as a result of these energy facilities, and to receive funds to mitigate environmental or recreational resource loss. This generally constitutes the coastal energy impact program for the Great Lakes coastal zone.

In Fiscal Year 1977, for example, the state of Michigan, which has over half of the US Great Lakes shoreline, will receive $246,305 for planning for economic, social or environmental effects of energy facilities in or significantly affecting the coastal zone; $259,380 for loans to state or local governments to assist in providing for improved public facilities or public services resulting from coastal energy activity; and $3,537 to help prevent, reduce or repair damage to or loss of valuable environmental or recreational resources. These figures point out the problems in undertaking a federal program to mitigate the effects of energy facilities that does not account for the particular energy developments specific to the Great Lakes. Substantial impacts cannot be mitigated for $3,537. Thorough planning cannot be done with these limited funds in a state with more than half the Great Lakes shoreline

and a large number of coal and nuclear plants to be constructed in the future. Clearly, some effects will not be addressed.

The term "energy activity" is too narrowly defined for the Great Lakes. The Great Lakes coastal zone provides electric power to states other than the eight Great Lakes states. Furthermore, there are no funds for mitigating effects from nuclear power plants, of which a substantial number are planned for the Great Lakes coastal counties. Nuclear power plants are not defined as a "coastal energy activity". Nuclear facilities will require substantial federal review and licensing, thus indicating the federal and national interest in this development. This is not to mention the capability of nuclear plants to generate large amounts of power that might be available for transmission outside the Region. Furthermore, readily available water has prompted suggestions for and studies of large energy parks that might be located on the Great Lakes with the electricity being sent to areas within as well as outside of the Great Lakes Region.

As mentioned before, coal movement on the Great Lakes is increasing tremendously and already accounts for a substantial volume of the coal moved to or through coastal areas of the entire United States. Coal transshipment from vessels is clearly coastal dependent. If coal transshipment facilities are placed in or near wetlands, substantial effects could result. Petroleum and related products are also shipped on the Great Lakes. If coal is as important to the national energy policy as oil development from the outer continental shelf, then emphasis should be placed on the coal movement of the Great Lakes Region in energy amendments to the Coastal Zone Management Act.

The Great Lakes coastal zone is, and will continue to be, important in addressing the region's, as well as the nation's, energy requirements. It will also receive a substantial share of the effects of this development. If increased energy production of all types is a major national objective, then more foresight should be given to the energy situation of the Great Lakes and their coastal zone in such an important program.

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WHY PLANNING FOR SUPERTANKER TERMINALS IS UNCERTAIN

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Some people believe that the State of Texas is in bed with the oil industry. In discussing the issue of supertanker terminals in Texas, I would like to persuade you that on some issues there is no such thing as "the state," even in Texas, or "the industry," even in oil. State government is often characterized by shifting coalitions of legislators, elected or appointed officials, and career bureaucrats, along with contributions and mischief from the press, lobbyists, and others. Of course, we all know this complexity exists at the federal level, but it can be just as confusing at the state level. Also, it should not be too surprising that diversity occurs within an industry or even within a single firm, especially when the industry is composed of dozens of firms of varying size, or when a firm has many separate operations and measures its business in billions of dollars and its employees in tens of thousands.

Regulation and Market Problems

Until recently, everyone considered two privately owned offshore oil terminals in the Gulf as certainties. Both Seadock, planned for the Texas coast, and Loop, located off Louisiana, were in the final stages of design and permit application. Now Seadock is very sick if not dead. Three major shareholders have withdrawn (Exxon 22%, Mobil 15%, Gulf 15%), and the time to find new shareholders is running out because the period for accepting the federal license is running out.

What happened? Seadock's troubles are generally attributed to stringent anti-trust license provisions arising from Department of Justice and Federal Trade Commission concerns communicated to the Department of Transportation. The companies felt that these conditions were too strict to justify the investment of $100-200 million per company. The principal objections were to a requirement that ownership of Seadock be kept open to outside companies for a specified period; a requirement that individual companies be liable for spills regardless of responsibility or fault; a prohibition against joint operation by member companies of pipelines leading from the tank farm; the requirement that use of the facility be open to anyone shipping oil; and a requirement that the project be completed by a given date. In addition, the companies were concerned about an Interstate Commerce Commission decision not to allow the trans-Alaska pipeline consortium to raise its charges to the point the consortium considered necessary to recover costs and receive a sufficient return on its investment.

Some observers speculate that the license conditions were only an excuse for some companies to withdraw and that the major reasons were economic. The cost of the facility has doubled from $350 million to more than $700 million in four years, and there have been changes in world oil movement patterns, including a prohibition against an exchange of Alaskan oil to Japan in return for Middle-Eastern oil to the Gulf.

The Complexity of the Players

Regardless of the weight assigned to external economic and regulatory factors, some of the uncertainites involved in planning for supertanker terminals are derived from the complexity of the players. On the Seadock side, some of the partners have existing docking facilities to accommodate smaller tankers. The oil from supertankers can be transferred to the smaller tankers either by lightering at sea or by transshipment at other ports. This existing capacity, although not as convenient or economical as a superport, makes the need for Seadock facilities less than critical. By contrast, the partners in Louisiana's Loop have had less choice. Many are firms with Midwestern refineries and no docking facilities of their own. Consequently, Loop has accepted the same conditions rejected by the three largest Seadock partners.

The variety of interests among the Seadock partners also helps to explain the importance of the restriction on joint pipeline operation outside the tank farm. Some of the partners had planned joint pipelines which would have provided a substantial profit if not considered as part of the facility. The decision that pipelines beyond the tank farms would be closely regulated as to rates took away an important incentive for some of the partners.

Not only do partners have differing interests, Seadock as a corporate entity has taken on some life of its own apart from the interests of its parent companies. The managers of Seadock, both those on assignment from partner companies and those hired especially for the project, would naturally much prefer to see the project a success, and their perspectives and motivations have tended to make Seadock an actor in its own right.

On the side of the state, the division of interests—if not a fragmentation—was reflected in the split within the Texas Offshore Terminal Commission, a state study commission which recommended a publicly owned port in 1974. That recommendation was rejected by the Texas Legislature in a sharp political battle in 1975, but supporters of the public port concept remain within the agencies and within the legislature. Surely the Federal Trade Commission was aware of the forces favoring a public port, and the FTC knew that tight restrictions placed on a private facility would not necessarily mean the end of the supertanker terminal possibility for Texas.

In summary, the uncertainty in planning for a supertanker terminal in Texas is based on several factors, including the complexity of the players and the complexity of larger economic, regulatory, and politicial forces. It is interesting to note that environmental issues were not directly involved. Almost everyone agreed that the

facility was needed, and that the site selected both by the public Offshore Terminal Commission and by Seadock was the safest location environmentally. The question was not whether oil was going to be imported in large quantities but how it was going to be imported.

It seems to me that there is also a lesson verging on a moral. In the Texas Coastal Management Program we have stressed the importance of process—that players should regard the planning process as legitimate and fair no matter how they view some of the results, and that both sides should see their opponents as something other than the hounds of hell.

The offshore terminal episode in Texas provides a dramatic example of the need for something besides total war. The adversaries of 1975—the parent companies of Seadock and the elements of state government favoring the public facility—are going to have to work closely together if Texas is to have any deep-water port at all. The Texas Deep Water Port Authority Act passed by the special session of the legislature in 1977 provides for public ownership but private (i.e., user) management and private construction if the Seadock project does not proceed. Texas cannot afford blanket denunciations of the oil industry on one hand or attempts to nullify legitimate government regulation (and regulators) on the other. I suspect no other state can either.

PART IV

Friday, November 4, 1977
Afternoon Session

FEDERAL POLICIES AND PROGRAMS

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*Paper not available for publication.

U.S. ATLANTIC OCS: PETROLEUM DEVELOPMENT AND MARINE ENVIRONMENTAL RISK*

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ABSTRACT

In proposing to leave the Atlantic Outer Continental Shelf (OCS) for petroleum development, the U.S. Interior Department was apparently satisfied that the risk of damage to the marine ecosystem was small. However, even in the case that risks were projected to be substantial they ought to be compared to oil spills hazards from tankers because oil produced on the OCS would probably be brought ashore by pipeline replacing, in part, oil carried in foreign-flag vessels. In this paper, the environmental hazards of offshore drilling and production are compared to oil spills from tankers. These hazards include oil spills from blowouts during drilling due to the surprise encounter with abnormally high pressure subsurface fluids, the accidental discharge of drill cuttings and drilling mud from platforms, and ruption of seabottom pipelines uncovered by shifting sands.

The worst oil spill from a platform was the 1969 Santa Barbara accident which occurred while drilling through overpressured strata. A study of the Atlantic OCS compared to offshore California and the U.S. Gulf Coast region reveals that the U.S. Atlantic OCS lacks the geologic conditions necessary to produce overpressured strata.

An analysis of the characteristics of drill cuttings and drilling mud shows that accidental spillage of these materials would have a nearly zero environmental impact because the maximum volumes of material that could be spilled is very small and because these are essentially natural rock and mud similar to rocks and mud of the seafloor.

*Paper not available for publication.

IMPLICATIONS OF THE 1977 CLEAN AIR ACT AMENDMENTS FOR COASTAL MANAGEMENT PROGRAMS

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ABSTRACT

The requirements of the Clean Air Act (CAA) must be incorporated in state coastal management programs developed under the Coastal Zone Management Act (CZMA). Implementation of the provisions of the CAA and the CZMA will have significant effects on development of energy resources and facilities in coastal areas. Environmental Protection Agency (EPA) guidelines categorize CAA requirements as either (1) uniform nationwide requirements or (2) nonuniform requirements applicable to a specific state or local area. Requirements in both categories change as a result of the 1977 amendments to the CAA.

Changes in the nonuniform requirements will generally affect state coastal programs to a greater degree. An initial task required of states by the amended CAA is the identification of areas where any national ambient air quality standard (NAAQS) has not been attained. The status of the air quality of an area determines whether the provisions of the amended CAA for attainment of NAAQSs or for prevention of significant deterioration of air quality apply. States must revise air quality plans now in effect to take into account both types of provisions. Implementation of the amended CAA offers new opportunities for coordinating state air quality and coastal management programs.

INTRODUCTION

The 1977 amendments to the CAA, signed into law by President Carter on August 7, 1977, represent the first comprehensive revision

to the Act since 1970. The basic framework of the CAA remains the same. The Administrator of the EPA has the responsibility to establish nationwide standards for the concentrations of pollutants allowable in the air and for the amounts of pollutants that certain categories of sources may emit. States, in cooperation with local governments, are primarily responsible for the development, implementation, and enforcement of plans to achieve and maintain the air quality standards established by the EPA. However, in responding to problems that arose in implementing the 1970 amendments to the CAA, the Congress did make changes that will significantly affect federal, state, and local air quality programs.

The changes that the amended CAA will cause in air quality programs will affect, directly and indirectly, state coastal management programs developed pursuant to the CZMA. Both air quality and coastal management programs include plans, policies, regulations, and administrative procedures dealing with facilities for the extraction and transportation of energy resources and for the production of energy. The manner in which the two programs are developed and administered and the extent to which they are coordinated will influence, to an important degree, decisions on the nature, location, and timing of energy facilities in coastal areas.

Requirements established in or pursuant to the CAA must, according to section 307(f) of the CZMA, be incorporated in state coastal management programs. CAA requirements have been categorized in interim EPA guidance for coordinating air quality and coastal management programs as either uniform requirements that are applicable nationwide or nonuniform requirements that are applicable to a specific state or local area (EPA 1977a). The uniform nationwide requirements are established in the CAA or by the Administrator of the EPA in accordance with the provisions of the Act. The nonuniform requirements are established by state and local governments to implement NAAQSs established by the EPA and to prevent significant deterioration of air quality. The variations in the requirements established by state and local governments result from differences in the nature and extent of air quality problems from area to area and in methods adopted to deal with the problems. Some of the more important requirements included in the two categories are summarized in Table 1.

In the following sections of this paper changes in the uniform and nonuniform requirements resulting from the 1977 amendments to the CAA are described together with some of the implications of the changes for the siting and operation of coastal energy facilities. New opportunties for coordinating the development and implemention of air quality and coastal management programs are then discussed.

Table 1. Clean Air Act "Requirements"

A. Uniform Nationwide Requirements

1. National ambient air quality standards
2. Motor vehicle emission standards[1]
3. New source performance standards
4. National emission standards for hazardous air pollants[2]

B. Nonuniform Requirements (State Implementation Plans)

1. Review of new or modified stationary sources[2]
2. Review of indirect sources
3. Emissions or air quality standards equal to or more stringent than federal standards
4. Prevention of significant deterioration[2]
5. Other measures, such as transportation controls, for attainment and maintenance of NAAQSs

[1]States may, under the 1977 amendments, establish standards more stringent than federal standards.

[2]May be federal permit process subject to section 307(c) of the CZMA.

Source: EPA, 1977a

UNIFORM NATIONWIDE REQUIREMENTS

Of the four types of standards included in the uniform nationwide requirements listed in the EPA guidance, three are set by the Administrator of the EPA. These include NAAQSs, new source performance standards, and national emission standards for hazardous air pollutants. The fourth type of requirement, motor vehicle emission standards, includes some vehicle emission limitations set by the Congress and others set by the EPA.

National Ambient Air Quality Standards

The requirement for NAAQSs was established in the 1970 amendments to the CAA. The Administrator of the EPA must establish national primary standards at levels sufficient, with a margin of safety, to protect public health and national secondary standards at levels to protect public welfare. The secondary standards are

designed to protect against adverse air pollution effects such as damage to vegetation and materials.

At the time the 1977 amendments were signed into law, standards had been set for six pollutants: photochemical oxidants, carbon monoxide, nitrogen dioxide, sulfur dioxide, total supended particulates, and hydrocarbons. Standards for a seventh pollutant, lead, have been proposed (EPA 1977b). Each of the standards is specified in terms of an allowable concentration over a particular time period.

The 1977 amendments to the CAA provide for a procedure for review and revision of existing standards and for development of new standards. An independent scientific review committee has been established to advise the Administrator in developing and reviewing standards. The amendments also require the EPA to investigate the need for a national primary standard for nitrogen dioxide concentrations occurring for time periods of three hours or shorter. The existing nitrogen dioxide standard is specified in terms of an annual arithmetic mean concentration. A shorter-term standard may mean increased emission controls for energy facilities and other emission sources. The standard must be promulgated by the Administrator within a year from the enactment of the 1977 amendments.

New Source Performance Standards

The 1970 amendments to the CAA require the Administrator of the EPA to list categories of sources that "may contribute to air pollution which causes or contributes to the endangerment of public health and welfare" and then to set standards of performance for such sources. The performance standards must reflect the emission reductions achievable when, taking costs into account, the best system of emission controls is applied. At the time of enactment of the 1977 amendments performance standards had been set or proposed for about 23 categories of emission sources including some, such as fossil-fuel steam electric plants, petroleum refineries, and petroleum storage vessels, that are energy-related.

The 1977 amendments to the CAA require the Administrator to publish within one year a list of categories of major emission sources that meet the criteria established by the 1970 amendments, but for which no performance standards have yet been set. Performance standards must be set for all sources on the list within four years from the time the list is finalized. The governor of any

state may request that performance standards be established for additional source categories and that already established standards be made more stringent.

National Emission Standards For Hazardous Air Pollutants

Hazardous air pollutants are those to which no NAAQS applies and which the Administrator determines may cause or contribute to an increase in mortality or cause serious irreversible illness. The EPA has issued regulations for four such pollutants: asbestos, mercury, beryllium, and vinyl chloride, and proposed regulations for a fifth, benzene. Under the 1977 amendments to the CAA a governor may request that regulations be promulgated for additional pollutants.

Motor Vehicle Emission Standards

The 1970 amendments to the CAA give the Administrator of the EPA authority to establish standards for the levels of emissions from new motor vehicles except for light duty vehicles (primarily automobiles). Standards for carbon monoxide, nitrogen oxide, and hydrocarbon emissions from light duty vehicles are included in the 1970 amendments with provision for the Administrator to delay the date by which the standards are applicable and to establish interim standards. The 1977 amendments delay the effective date or revise the standards for light duty vehicles.

In addition to changing emission standards for light duty vehicles, the 1977 amendments establish emission reductions that will be required from heavy duty vehicles (trucks and buses) and motorcycles. The amendments also allow states to establish vehicle emission standards more stringent than federal standards. Under the 1970 amendments, only California was eligible to receive a waiver allowing the establishment of more stringent standards.

NONUNIFORM REQUIREMENTS

The 1970 amendments to the CAA require that, within nine months after the establishment of any NAAQS by the EPA, states must develop a plan to implement that standard and submit the plan to the EPA for approval. The plan must provide for attainment of a national primary standard within three years after the plan is approved. The Administrator of the EPA may, under certain circumstances, ex-

tend the attainment deadline for up two years. A national secondary standard must be attained within a "reasonable time" after plan approval.

Although the plans for implementing standards must meet certain general requirements, states do have flexibility in the manner in which they choose to meet the standards. This flexibility and the differences in the nature of the air pollution problem from area to area may result in relatively wide variations among states in the contents of plans.

Designation Of Nonattainment Areas

The initial NAAQSs for the six pollutants listed earlier were promulgated by the EPA in April 1971 (EPA 1971). To meet the requirements of the 1970 amendments state plans had to provide for the attainment of the national primary standards for the pollutants by May 1975 or, if an extension was granted, by May 1977.

National primary standards for the six pollutants were not attained in a substantial number of areas by the deadlines established by the 1970 amendments. The 1977 amendments provide new deadlines for meeting the standards and a timetable according to which state plans must be revised, submitted to the EPA, and approved.

An initial task required of the states under the 1977 amendments is an inventory of those air quality control regions or portions of regions where standards had not been attained at the time the amendments were enacted. By December 5, 1977, states must inform the EPA whether areas should be designated as attainment or nonattainment, or are unclassifiable because of insufficient information. The Administrator of the EPA must then publish the lists of the areas in each category, with any modification he deems necessary, by February 3, 1978.

The designation that an area receives is important because it determines the provisions of the 1977 amendments that apply to the area and the subsequent actions that a state must take. The EPA has recommended that states be as precise as possible in delineating the areas (Hawkins 1977). In general, the designations for total suspended particulates, sulfur dioxide, carbon monoxide, and nitrogen dioxide should be made on a basis not larger than an AQCR, which is typically a multicounty area. Where possible, the designations for these four pollutants should be on a county or subcounty basis.

Figures 1 and 2 illustrate the potential pattern of designations for two pollutants in three coastal states: Washington, Oregon, and California. Figure 1 shows, based on the air quality measurements available to the EPA, the counties where standards for total suspended particulates have or have not been attained and the counties where measurements are not available (Bauman 1977). Figure 2 shows the same information for sulfur dioxide. The actual designations made by the states may differ somewhat from those presented here. States may have additional air quality information available to them and may use mathematical modeling to supplement the air quality information.

The nature of the recommendations of the EPA for designating areas with respect to the photochemical oxidant standard differs from the recommendations for the four pollutants discussed above. States located east of the Mississippi River are encouraged to designate the entire area within their boundaries as nonattainment for oxidants even though measurements of oxidant concentrations may not have been made in all portions of the area, particularly in rural locations. In addition, the EPA recommends that all urbanized areas with populations in excess of 200,000 should be presumed to be nonattainment areas even if no measurements exist. The EPA recommendations are based on the extent of measured violations of the oxidant standard found in rural areas east of the Mississippi (see Figure 3) and in urbanized areas with populations over 200,000. The pervasive nonattainment of the oxidant standards found in the eastern half of the United States has not been sufficiently documented in the western half to make the same sort of recommendations.

Plan Requirements for Nonattainment Areas

The 1977 amendments to the CAA require that for all nonattainment areas included in the list published by the EPA in February 1978, states must revise the plans developed in response to the 1970 amendments. The revised plans must provide for attainment of all primary NAAQSs by December 31, 1982. If states demonstrate that attainment of the national primary standards for photochemical oxidants and carbon monoxide is not possible by 1982, despite the implementation of all reasonably available control measures, an extension in the attainment deadline of up to five years through December 31, 1987, may be granted by the Administrator of the EPA. No extension beyond the 1982 attainment date is provided for pollutants other than photochemical oxidants and carbon monoxide.

States must submit revised plans to the EPA not later than January 1, 1979. For any area where the revised plan demonstrates

the impossibility of meeting the national primary standards for photochemical oxidants or carbon monoxide by the December 1982 deadline, a state must prepare by July 1, 1982, a second submittal to the EPA that provides for attainment by the December 1987 deadline. All plan revisions must provide for annual reductions in emissions sufficient to constitute "reasonable further progress" towards attainment in the years between the submittal of the revisions in January 1979 and the attainment deadline. Plan revisions that do not provide for attainment of the photochemical oxidant and carbon monoxide standards until after 1982 must meet additional requirements. These requirements include the establishment of an expanded new source review program and a motor vehicle inspection and maintenance program. The expanded new source review program must require, prior to issuance of a permit to any major pollution source, an analysis of alternative sites, sizes, production processes, and control techniques. The analysis must demonstrate that the benefits of the proposed source significantly outweigh the environmental and social costs.

The 1977 amendments provide sanctions for failure to adequately revise and implement a state plan. No major air pollution source may be constructed or modified in any nonattainment area after July 1, 1979, if the applicable state plan does not provide for attainment and maintenance of the NAAQS being violated. Lack of an adequate plan may also result in loss to states of federal funding for highways and waste treatment facilities.

The Emission Offset Ruling

The 1977 amendments provide that in all nonattainment areas the EPA interpretative ruling on emission offsets (EPA 1976) applies until July 1, 1979, unless a state develops an equivalent procedure and is granted a waiver by the Administrator. Briefly, the offset ruling requires the following:

1. Any major new emission source proposed in a nonattainment area must meet the lowest achievable emission rate for such type of source.

2. Emission reductions that more than offset the emissions from the new source must be obtained from existing sources.

3. Any other source owned or controlled by the owner or operator of the new source and in the same AQCR must be in compliance with state plan requirements.

4. Progress towards attainment of the applicable NAAQS must be maintained.

The marine terminal and pipeline proposed by SOHIO to distribute Alaskan crude oil from the Port of Long Beach to the midwest and east is a well-publicised example of the application of the offset ruling to a coastal energy facility. The site of the proposed terminal is in the Los Angeles basin, an area where NAAQSs for photochemical oxidants, nitrogen dioxide, and total suspended particulates are being violated. The activities associated with the operation of the SOHIO terminal will increase the overall emissions for the area unless offsetting reductions are made. SOHIO has proposed a variety of measures to obtain the reductions including paving of roads and parking lots and modification of some dry cleaning plants. At the present time SOHIO's application to construct the terminal is still being considered by the state of California. The state has opposed the project not only because of the associated air pollution issues, but also because part of the pipeline proposed to be used to transport the crude oil from the terminal to the midwest and east may be needed to transport natural gas into California. The state is concerned that loss of the pipeline for transporting natural gas could result in future shortages in the state.

Prevention of Significant Deterioration

In May 1972 the EPA was ordered by the courts, as the result of a suit successfully brought by the Sierra Club, to disapprove all state plans developed in response to the requirements of the 1970 amendments, if those plans did not prevent the deterioration of air quality in areas where the air is cleaner than the NAAQSs. The EPA had contended that the 1970 amendments did not require such provisions in state plans. The courts also ordered the EPA to promulgate regulations to prevent such deterioration. The resultant EPA regulations (EPA 1976) allowed states to categorize land areas within their boundaries into one of three classes:

1. Class I where almost no worsening of air quality would be considered acceptable.

2. Class II where the deterioration normally accompanying "moderate well-controlled growth" would be acceptable.

3. Class III where deterioration in air quality to levels no worse than the NAAQSs would be considered acceptable.

Under the EPA regulations all areas of the country were designated Class II with provision for reclassification to either of the other two classes.

Each of the three classes had associated with it an allowable emissions increment for two pollutants, sulfur dioxide and particulates. The mechanism for preventing significant deterioration was the review, prior to construction or modification, of 19 categories of major pollution sources to assure that emissions from these sources did not violate the allowable increments.

The 1977 amendments to the CAA contain provisions that correspond relatively closely in concept to the EPA regulations for prevention of significant deterioration of air quality. There are, however, some differences. The increments of additional pollution allowed for each of three classes of areas established by the amendments are slightly different than the increments in the EPA regulations. The amendments also list pollution sources in addition to those included in the EPA regulations that must be reviewed for conformance to the increments. Included in the list in the amendments are energy related sources such as fossil-fueled steam electric power plants, coal cleaning plants, petroleum refineries, and petroleum storage and transfer facilities.

The 1977 amendments automatically classify as Class I areas all international parks, national wilderness areas and national memorial parks which exceed 5000 acres, and national parks which exceed 6000 acres. The location of the mandatory Class I areas in three coastal states: Washington, Oregon, and California are shown in Figure 4.

OPPORTUNITIES FOR PROGRAM COORDINATION

The 1977 amendments provide increased opportunities and additional requirements for coordinating air quality and coastal managment programs. First, development of coastal management programs and revised air quality implementation plans will occur at approximately the same time. This means, among other things, that use of common data (e.g., land use inventories and population projections) is possible. Common or compatible regulations and administrative procedures for implementing the two programs may also be possible. For example, the energy facilities siting process required by the 1976 amendments to the CZMA can be consolidated with the preconstruction review programs required by the CAA.

Second, the 1977 amendments encourage local governments and organizations of local elected officials to assume additional responsibilities in the development, implementation, and enforcement of revised air quality plans. In areas where NAAQSs for photochemical oxidants and carbon monoxide have not been attained, organizations of local elected officials are provided an opportunity by the amendments to take the lead in developing revised air quality plans. In addition, states must develop consultation processes to involve local governments and organizations of local elected officials in carrying out various provisions of the CAA, including those related to transportation controls, new source review, and certain enforcement orders. Where local governments are involved in the development or administration of coastal management programs, the 1977 CAA amendments facilitate the ability of these governments to approach their responsibilities under the CZMA and the CAA in a more coordinated manner.

Third, the amendments prohibit federal support or approval of any activity that does not conform to a revised air quality implementation plan. To the extent that elements of a revised plan coincide with or support a state coastal management program, the requirement for conformity will aid in the implementation of the program.

In summary, the 1977 amendments to the Clean Air Act provide a number of new considerations for those developing or administering coastal management programs. The changes in federal, state, and local air pollution control programs resulting from the amendments may conflict with or support coastal management programs. The nature of the affects will depend on the extent to which the programs are coordinated.

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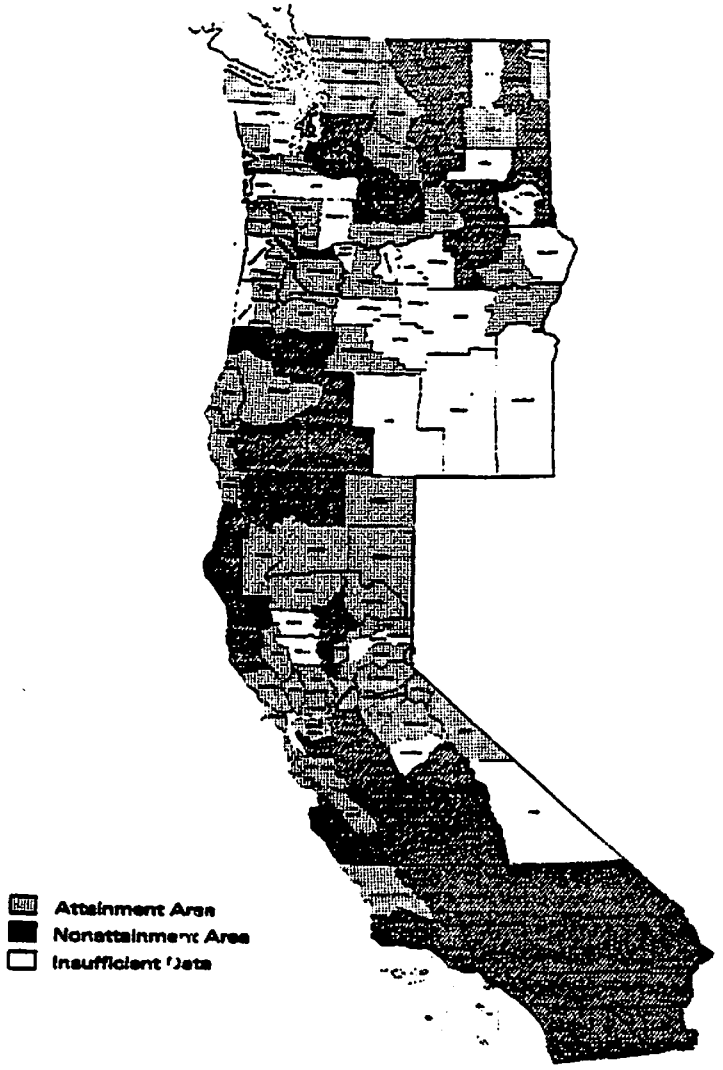

Figure 1. Attainment Status of NAAQS for Particulates in Washington, Oregon, and California (Bauman 1977)

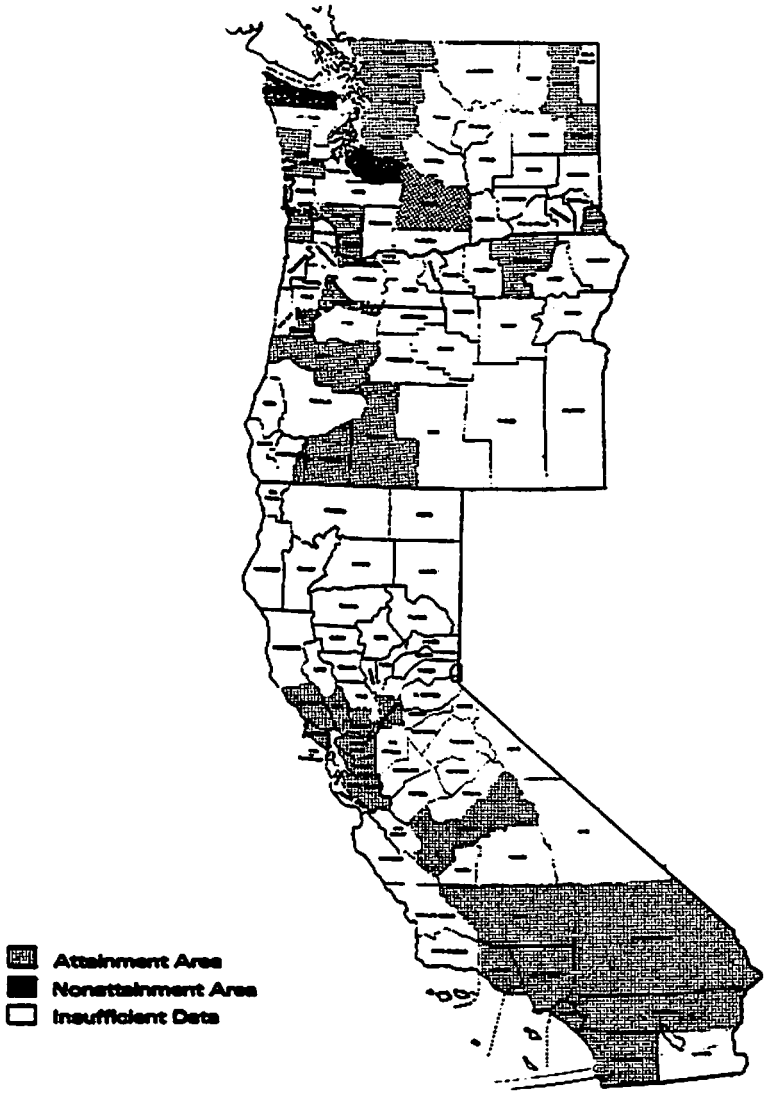

Figure 2. Attainment Status of NAAQS for Sulfer Dioxide in Washington, Oregon, and California (Bauman 1977)

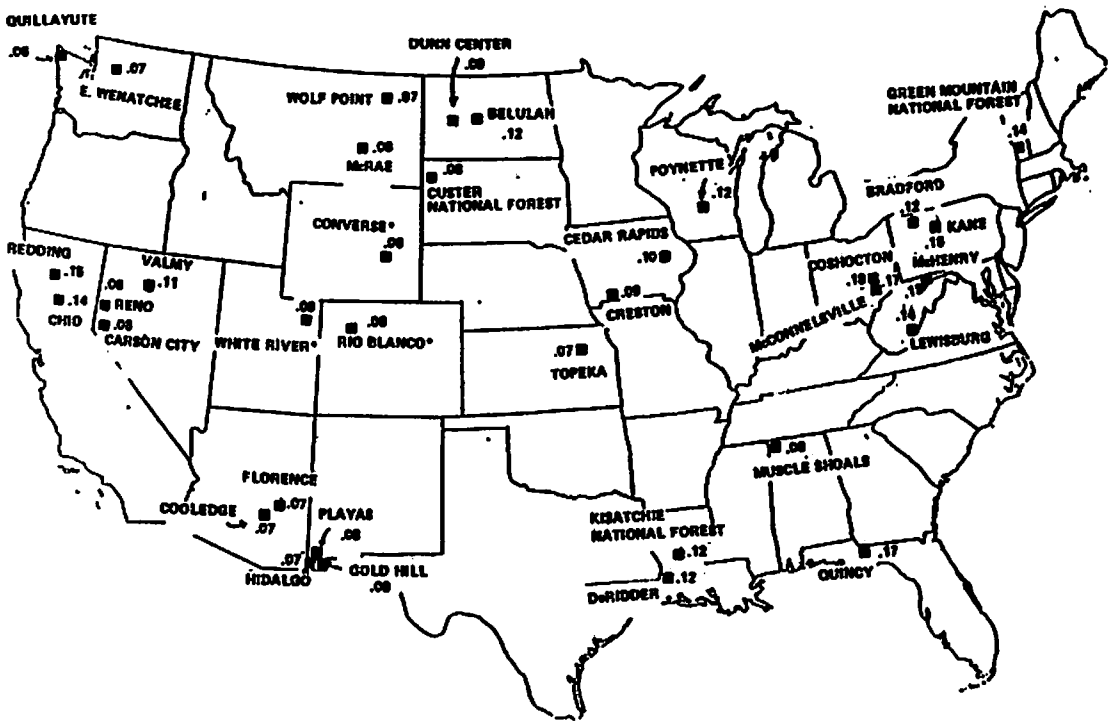

Figure 3. Summary of Yearly Second Highest Hourly Ozone Concentrations (ppm) at Rural and Semi-Rural Sites, 1973-1976 (EPA, 1977c)

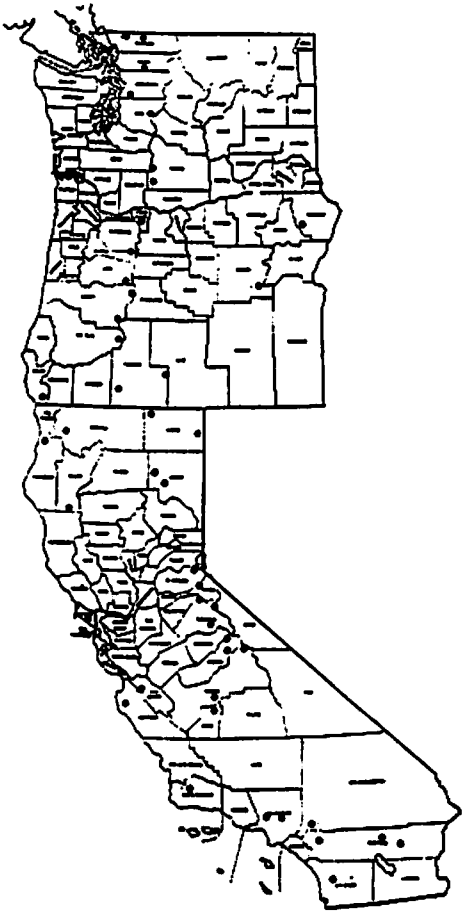

Figure 4. Location of Mandatory Class I Areas in Washington, Oregon, and California

OIL ON THE PUGET SOUND

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Perhaps no other issue in recent time has occupied the attention of people in the Pacific Northwest, environmental organizations, industry and government than has the siting of an oil terminal in Puget Sound.

Phase I, the initial flow phase, of the Trans-Alaska pipeline system was recently completed. Alaskan crude oil is now being transported by ship to West Coast refineries in Washington and California. However, not all of the anticipated Alaskan crude oil available can be marketed on the West Coast. Currently, the "surplus" is initially being shipped through the Panama Canal to Gulf ports for shipment by pipeline to both gulf states and mid U.S. refineries. This is an expensive route which adds a significant cost for the ultimate consumer.

The existence of a "surplus," which we believe may build up to about 500,000 barrels per day in one year; the need to supply existing U.S. Northern Tier, U.S. refineries and markets which face imminent cutoffs from Canadian crude oil supplies; and President Carter's decision not to swap "surplus" oil with Japan all have put great pressure on Washington state and local governments to site an oil terminal facility somewhere in Washington's coastal zone, and on California to permit an oil terminal on the coast in southern California.

Two proposals for locating a major marine terminal facility in Puget Sound or the Straits of Juan de Fuca are seeking federal and state permits. One, the Transmountain proposal would place an oil terminal and transshipment facility at Cherry Point, Washington within the Puget Sound. Cherry Point would connect with an existing Canadian pipeline system and would eventually deliver Alaskan crude to Northern Tier states at an estimated 320 - 400 million barrels per day. The second proposal, that of the Northern Tier

Pipeline Company would locate a terminal facility at Port Angles, Washington on the Straits of Juan de Fuca. Crude oil would be piped via an all-American, interstate 1500 mile pipeline route to Clearbrook, Minnesota. Like its Trans-mountain counterpart, this proposal would service Northern Tier refineries and markets, but at an estimated 600,000 to 1.2 million barrel per day delivery of crude oil. The Northern Tier proposed pipeline would cross five states, numerous local jurisdictions, and must meet regulatory requirements and considerations of thirteen (13) federal agencies. Ten (10) state agencies will have potential regulatory jurisdiction over its siting and operation.

Political disputes and institutional requirements at the federal, state and local level, present hurdles to both proposals, and have raised serious questions about the feasibility of implementing either proposal. Simply put, can a domestic west to east oil pipeline be built on a time scale which makes sense to investors and the public's need for the oil?

At the federal level, the Alaska Natural Gas Transportation Act mandates that federal agencies expedite to the fullest extent practicable all applications for an oil delivery system to serve Northern Tier States. At the same time, federal agencies are required to insure that their actions are consistent with state coastal zone management programs approved under the federal Coastal Zone Management Act. In this regard, the Transmountain proposal has been challenged on the basis that the Washington State Coastal Zone Management Program asserts as state policy that major oil terminal facilities may only be located "at or west of Port Angeles," Washington. The legality of the manner of adoption of this policy contained within the state's coastal zone management program and the consistency requirements of the Coastal Zone Management Act as they affect the Transmountain permit application pending before the Corps of Engineers, are now being litigated in the U.S. District Court in a suit brought by the Coalition Against Oil Pollution.

At the state level, a dispute exists between Governor Ray and the state legislature over the oil transport and siting issue, and the State is being sued in two instances.

Governor Ray has begun the process to delete the "at or west of Port Angeles" policy contained within the state's coastal management program, and in turn have this issue resolved by the Washington State Energy Site Evaluation Council (EFSEC). This attempt to amend the state's management program would appear to be made moot by Senator Magnuson's recent amendment to the Marine Mammals Protection Act.

In the first law suit, the State of Washington is a defendent in a suit brought by ARCO involving the Washington State Tanker Law. The tanker law would restrict crude oil carriers exceeding 125,000 dead weight tons from entering the Puget Sound. This suit is now before the U.S. Supreme Court and a decision is anticipated by June of 1978.

Separate and independent state legislative action dealing with the movement, storage, and transshipment of oil within the Puget Sound has affected siting authority at the state and local level. In 1975, the Washington State Legislature created the state Energy Site Evaluation Council (EFSEC) to evaluate and exercise authority over the location of energy facilities in Washington State.

A persisting issue has been whether the state in creating EFSEC intended to preempt local government control over the siting of energy facilities. The preemption issue has been central to the Northern Tier proposal to site an oil terminal facility at Port Angeles. Clallam County has argued that the 1975 law creating EFSEC does not preempt the County from denying permits needed to construct a tank farm, which the County argues, is in violation of its zoning law.

To resolve this issue, the Washington State legislature recently enacted amendments to the law creating EFSEC. The amendments preempt local siting authority over applications submitted after July 15, 1977. Since the Northern Tier application was submitted to EFSEC and Clallam County before July 15, 1977, it is not certain whether EFSEC may still exercise siting control over the Northern Tier Proposal. This issue may be resolved in another law suit against the State by Clallam County who have challenged EFSEC action on the Northern Tier proposal. The suit is currently pending in Thurston County.

Overshadowing all recent developments is the passage of the previously mentioned bill sponsored by Senator Magnuson and the Washington State congressional delegation which prohibits the issuance of any federal permit to construct an oil terminal facility in, on, or immediately adjacent to or affecting navigable waters of the State of Washington east of Port Angeles, Washington. Recent enactment of S. 1868 would appear to have effectively eliminated the Transmountain proposal as an oil transshipment facility for Alaskan crude oil. It is not clear what, if any, impact the provision banning oil ports on "navigable waters east of Port Angeles" will have upon the Northern Tier proposal, which would cross the Columbia River, a navigable waterway. The legislative intent of this provision appears to support the notion that Congress intended the prohibition to apply only to coastal marine waters (i.e. salt water areas) of the Puget Sound and associated areas. The oil ports prohibition apparently applies only in those cases where a federal license or permit is necessary to construct, renovate, modify or alter an oil terminal, dock or other facility. Its proscription should not affect a recent proposal by GATX Terminals Incorporated to receive and transship Alaskan crude oil from a terminal located on the Columbia River at St. Helens, Oregon to Montana Refineries by unit train tank cars.

Until recently, the Carter Administration has been working informally with appropriate federal and state officials to coordinate and expedite the permit issuance process. These informal efforts have been successful in eliminating some unnecessary delays. But despite the Administration's success in this regard, the successful experience in applying the procedures of the Alaskan Natural Gas Transportation Act to arrive at a decision on an Alaskan gas transportation system, have led increasingly to the view that a legislative framework for a decision on west-to-east oil pipeline routes would be in the public interest. Carefully drafted federal legislation could provide certain efficiencies over the present informal coordinating efforts and is therefore deserving of serious consideration.

At a minimum, a federal route designation could expedite state decisions, by eliminating potential alternatives and allowing the states to focus all of their attention on federally-designated routes.

Federal designation of a route or routes would also assure a more rational and orderly decision process than might not otherwise occur. Special legislation could provide criteria which would (1) designate a lead federal agency to coordinate issuance of all federal permits, licenses, and EIS preparation; (2) expedite the construction of a pipeline by precluding unnecessarily protracted litigation; and (3) mandate better coordination between federal and state decision-making processes.

For example, the Administration recognizes the possibility that, without some form of federal endorsement of a particular project, the chances are increased that none of the current proposals would receive all of the necessary state approvals. As things stand now, each state faces the major responsibility to decide whether its citizens should bear the environmental costs of an oil terminal and pipeline. While state officials recognize their responsibilities to the rest of the country, they may in the end find it politically impossible to approve a particular oil terminal facility in the absence of a federal determination that the facility best serves the national interest.

Senator John Melcher recently attached an amended version of an earlier bill to the Public Utility Rate Policy bill (S. 2114), which passed the Senate on October 6, 1977, and is now in the House-Senate conference committee which is considering national energy policy legislation. The Melcher bill sets up an expedited procedure for the approval of oil pipelines to move surplus Alaskan crude oil from the West Coast to the crude oil starved markets in the central United States.

The legislation would require that the final environmental statement for the Northern Tier Pipeline Company proposal to be completed by March 1, 1978.

The SOHIO Transportation Company applied some three years ago to the Federal Power Commission for a permit to incorporate an unused high pressure gas line in Arizona and New Mexico in a system to move Alaskan Crude oil from Long Beach, California, to Midland, Texas. The environmental statement has already been completed. The Melcher legislation would require the Interior and Energy secretaries to

make a decision on whether to approve the SOHIO project by December 15, 1977, and for the Northern Tier project by April 1, 1978. Similar legislation is working its way through the House. We understand that a Subcommittee of the House Committee on Interior and Insular Affairs will hold hearings on this matter in Seattle (Federal Office Building) November 14-15, 1977.

At the request of Senator Jackson the Melcher bill was amended to permit the consideration of other alternatives such as the Trans Provincial Pipeline proposal which would move Alaskan crude oil from the West Coast at Kitimat, British Columbia, and move it over the mountains to meet the existing North-South pipeline system near Edmonton, Alberta.

The Administration firmly believes that the construction of at least one, and perhaps two, of the proposed west-to-east pipeline systems is urgently needed in order to assure an efficient and economic means of delivering Alaskan crude oil to those areas of the country which need it. While transshipment of North Slope crude oil through the Panama Canal is an acceptable short-term alternative, from the standpoint of both producers and consumers, it is neither as economic nor as efficient, as an overland pipeline system from the West Coast. In addition, delay in building a west-to-east pipeline may delay any expansion in the rate of flow of the Trans-Alaska pipeline, because the capacity of our U.S. tanker (Jones Act) fleet is limited. This in turn could prolong our current level of dependence on foreign sources of crude oil, and exacerbate a persistent balance-of-payments deficit.

In summary, the Carter Administration does support the concept of legislation expediting a west-to-east pipeline especially if the present decision-making process should become hopelessly stalled. The Administration stresses, however, that such legislation must allow for a coordinated state and federal decision-making process. There is no apparent need at present to in any way preempt existing state authority to review and approve west-to-east projects.

ENERGY DEVELOPMENT IN THE COASTAL ZONE*

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*Paper not available for publication.

**Paper presented by Suzanne Wellborn.

THE COASTAL ENERGY IMPACT PROGRAM--A NEW APPROACH*

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ABSTRACT

In July of 1976, the Congress amended the Coastal Zone Management Act of 1972 to include an important new energy impact assistance program. The program is aimed at assisting states in ameliorating and reducing the adverse impacts on their coastal zones of national important energy development. The program has been constructed to provide several kinds of financial assistance in a carefully tailored manner to ensure that the impact aid is targeted to real need, that the program does not subsidize energy development or stimulate unnecessary growth, and to ensure that the funds are used in a manner consistent with the state's basic coastal management objectives. The presentation will include a discussion of the first year's experience under the new program and the outlook for the future.

*Paper not available for publication.
**Paper presented by Joellin Murphy.

ENERGY SYSTEMS PLANNING AND THE COASTAL ZONE

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ABSTRACT

The overlapping of high levels of natural and human activity has created severe conflicts among the multiple uses of the coastal zone. Recognition of the impacts of these uses led to the passage of the Coastal Zone Management Act of 1972, in which a state management program must provide ". . . for adequate consideration of the national interest . . . in the siting of facilities necessary to meet requirements which are other than local in nature." The 1976 Amendments to the Act mandated increased attention to management of coastal and coastal-impacting activities of energy supply systems.

Review of the administration of the CZMA and the development of state coastal management programs reveals less than a full consideration of the national interest and the necessity for a systems planning approach to coastal planning. In response to this void we are suggesting ways of solving environmental/coastal conflict issues related to energy supply system development. Viewed from the perspective of controlling land and water uses in the coastal zone, the national interest demands that we answer which of many alternative uses (including energy facility sites), will lead to the highest national, regional, state, and local benefit.

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* The views expressed herein are those of the author and do not necessarily represent the views of the Federal Energy Regulatory Commission.

** The Federal Energy Regulatory Commission (FERC) is an independent agency within the new U.S. Department of Energy, which was activated on October 1, 1977. It assumed many of the functions of the former Federal Power Commission.

INTRODUCTION

Ever since initial meetings in 1973 between staff from the Office of Coastal Zone Management (OCZM) and the Federal Energy Regulatory Commission (formerly Federal Power Commission) there has been a continuing dialogue on the extent to which energy systems planning should be defined and described in state coastal management programs. This dialogue and contacts with state coastal zone agencies have led us to the conviction that states must be sufficiently organized to deal with energy systems planning on several levels: local, state-wide, regional, and national. We believe that this approach is obligatory to avoid the state level of resource allocation in the coastal zone from hindering or precluding wider-based (regional and national) energy systems planning. In this paper we present an overview of one interpretation of the interrelationship between energy systems planning and the constraints and opportunities placed upon this planning by the CZMA, 1972 and its subsequent energy amendments in 1976.

My comments are presented in four sections: 1) the genesis of the national concern about the environment, 2 & 3) the FERC approach to the national interest question and Federal consistency, and 4) energy systems planning in relation to coastal zone management.

RETROSPECT AND GENESIS

Emergence of the environment impact and the coastal zone management concepts began largely as grass root developments among scientists. In the United States it was essentially a post-World War II phenomenon. Indeed, events associated with that war undoubtedly hastened its development, although these were clearly concepts whose time had arrived. All of the ingredients were there, bolstered by an ever increasing number of advocates. These ingredients existed in the same sense that the modern philosophy of evolution emerged in the 19th Century because the intellectual and cultural "climate" was appropriate. Some of the key ingredients existing in the 1940's were:

- The widespread application of basic science to wartime problems followed by a rapid post-war ascendancy of an awareness of the values that would accrue from national sponsorship of research programs. This led to the emergence of large scale Federal funding programs, such as the Office of Naval

Research and then the National Science Foundation, for the support of basic science.

- There was a cadre of well-informed professors, who were looking critically at ecological systems and at environmental problems. These had roots that must be traced further back to gain a fuller appreciation of the richness and extent of the experience and knowledge held by the established scientists at the time of World War II. One of my professors, Thurlow C. Nelson, is selected for illustration. In the 1940's, Professor Nelson was a prominent figure in science and in state affairs. He was an eminent teacher, chairman of the zoology department of Rutgers University, charter member (1929) and later chairman of New Jersey State Water Policy Commission, and had been selected by his peers as one of the leaders in zoology, starred in American Men of Science. His roots went back to his graduate training under the famous limnologists at the University of Wisconsin -- Edward A. Birge and Chancey Juday, and in estuarine studies through his father, Dr. Julius Nelson, also an eminent biologist, who was a student of Professor William Keith Brooks of the Johns Hopkins University who studied under Professor Louis Agassiz of Harvard University and Woods Hole. In addition to his research speciality, the biology of the oyster, Dr. Nelson had a broad interest in and a concern about the condition of the environment. Among these many interests -- which culminated in several awards in later years, as one of New Jersey's pioneer conservationists who had inspired many to a greater appreciation of natural resources -- were: environmental impacts from diversion of water from Delaware River Basin and dumping of industrial wastes into coastal waters; exposure of freshwater aquifers to saltwater intrusion by overpumping of groundwater and by excessive dredging; impact of shifts in salinity regimes upon ecosystems; shellfish culture; contributions of the soil to estuarine productivity, and biological relationships (predation, commensalism, parasitism, and competition) among estuarine organisms.

- The socioeconomic boom during and after the war -- of babies, industry, and the gross national product -- greatly increased the already perceived multiple use pressures upon the coastal zone.

- Then there was a mechanism for greatly expanding the scientific and technological background. There was a rapid expansion of student enrollments, many via the G.I. Bill, into the marine sciences, where the multidisciplinary approach to training was a key factor in producing many of the subsequent leaders in aquatic ecology and environmental studies.

- The encouragement of basic science led also to a proliferation of essential facilities, of laboratories and vessels equipped with sophisticated instruments.

Publication of noteworthy symposia, compendia, and reports also served to highlight the growing awareness and concern about the carrying capacity of the coastal zone. These included: "Man's Role in Changing the Face of the Earth" (Thomas et al., 1956); "Treatise on Marine Ecology and Paleoecology" (Ladd, Hedgpeth et al., 1957); "Proceedings, Salt Marsh Conference" (Marine Institute, University of Georgia, 1959); "Intrastate Water Resources Study" (State of Delaware, 1959); "Our Nation and the Sea: A Plan for National Action" (Report of the Commission on Marine Sciences, Engineering and Resources, 1969); "Estuaries" (AAAS, 1964); "Tools for Coastal Zone Management" (Conference Proceedings, Marine Technology Society, 1972), and "Coastal Ecological Systems of the United States" (Odum et al., 1974).

The ferment of this coastal awareness was evident at many scientific meetings, sessions, and workshops associated with groups like the AAAS, the Ecological Society of America, the American Society for Limnology and Oceanography, the Northeast Wildlife Federation, the National Shellfisheries Association, and the Atlantic States Marine Fisheries Commission. Over the years it spawned the Atlantic Estuarine Research Association (ca. 1951), the Marine Technology Society (1963), and the Coastal Society (1975) to name a few of the newer societies. By the 1960s this ferment was bubbling and ready for specific action. Sparked by Athelstan Spilhaus' remarks and stalwart adherents such as Bennie Schaeffer and Wib Chapman, the Sea Grant College concept gained impetus after meetings at the University of Rhode Island and sponsorship by Senator Clairborne Pell in Congress. This same kind of environmental enthusiasm by scientists was in part responsible for the National Environmental Policy Act of 1969 and the Federal Water Quality Act of 1972. A bill to establish a

national land use policy and program was not passed but the attention focused upon the coastal area resulted in land use management opportunities for coastal states via the Coastal Zone Management Act of 1972 (CZMA, 1972). Increasing concern over the impact of energy facilities lead to amendments of the CZMA in 1976.

THE NATIONAL INTEREST

We believe the CZMA, 1972 and the amendments of 1976 clearly placed the responsibility directly upon a state to consider the national interest based on the well-being of all the people of the Nation. Our primary concern is that the potential exists for a particular State to implement coastal zone control measures inhibiting or preventing energy production and transmission within the States which could provide vital sources of supply to other States. We believe the goal should be to determine and strive for that combination of resource use which leads to the greatest net benefit to the public from the standpoint of the nation as a whole. Viewed from the perspective of controlling land and water use in the coastal zone, the national interest asks which of many alternative land and water uses (including energy facility sites) will lead to the highest net national benefit. The full array of positive and negative effects from each alternative use must be considered. Impacts of each alternative on national income, public health and safety, and many other factors must be included. The national interest views the coastal zone as being used for the benefit of the entire public rather than for local and State benefits alone. The States' determination of its share of energy transfers out-of-State should be based on national interest considerations.

FEDERAL CONSISTENCY

On September 23, 1976 the FPC issued a notice of proposed rulemaking to amend the areas of FPC regulatory responsibilities in relation to the Federal consistency condition (Section 307(c)) of the CZMA.

The major thrust of the proposed rulemaking was the requirement that, before an applicant makes a filing before the FPC (FERC), the applicant must obtain consistency clearance or approval from the state. Thus, the states would have an early consistency review of a proposed energy system facility which would be proposed in time to the FERC. This

would occur at a time much earlier than possible under present precedures. Currently, the Section 307(c) Federal consistency regulation of CZMA is pertinent only after an application has been filed with the FERC and FERC takes action upon that application.

Action on the proposed rulemaking was deferred by FERC until OCZM published its revised Federal consistency regulations in final form.* This was done so that the rulemaking would be consistent with the CZMA consistency regulations.

ENERGY SYSTEMS PLANNING CONCEPTS

Just before I transferred from the Environmental Protection Agency to the Federal Power Commission, Dr. Richard F. Hill (personal communication, November 13, 1972), then FPC Advisor on Environmental Quality, outlined several points to be kept in mind when dealing with energy and environment considerations. These are worth repeating here:

- The electricity-producing industry cannot afford the luxury of justifying single plants; individual plants are justifiable because they are a part of a larger system.
- A similar viewpoint should hold in evaluating the environmental impact of power facilities -- the entire affected ecosystem should be considered.
- To get at environmental consequences of energy supply systems, the approach should be via systems analysis.
- The aerospace approach, heavy on systems optimization, may be the way to go.
- Long-range environmental and energy systems planning is based more on faith in the future and in evaluation techniques than is generally acknowledged; more research and development is needed on the subject.

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* See Federal Register 42 (167): 43586-43610 for the most recently proposed OCZM policies and procedures on Federal consistency with approved coastal management programs.

These points have provided a background philosophy for several papers, reports, and activities of FPC staff: on accommodating national energy needs in coastal zone management planning (Holmes and Heinemann, 1974), in comments on food and energy resources in the coastal zone (Shuster, 1975), and the application of regional energy systems planning to coastal zone management planning (Hill, 1976). Ever since initial meetings in 1973 with the Office of Coastal Zone Management (OCZM),* Federal Power Commission staff and the OCZM have debated the extent to which energy systems planning should be defined and described in coastal management programs. This dialogue and those with states have led us to the conviction that states should be sufficiently organized to deal with energy systems planning on state-wide, regional, and national levels. In conjunction with this, FERC staff developed a energy systems planning guide which would permit incorporating a proper mix of energy-related uses with the many other vital uses of the coastal zone. Even though discussed in terms of energy here, the concepts outlined in the guide apply equally well to the consideration of other important uses of coastal zone resources.

Our first concern addresses the adequacy of a State coastal management plan. We believe two basic considerations should be fully described in any proposed Coastal Management Program (CMP):

- The scope and capability with which the program can deal with energy matters, and
- the degree to which the program proposes to resolve energy problems.

Our second area of concern deals with the scope of energy needs analysis. State and regional management programs should reflect the types of quantitative energy need projections required for a rational energy planning process. It is recommended that this process include, at a

* Of the National Oceanic and Atmospheric Administration. U.S. Department of Commerce.

minimum, the review of information and the making of analyses comparable to the following:*

1) a consideration of expected growth of the State, regional, and national economies by detailed energy using sector;

2) a consideration of current and future energy needs by energy source associated with the expected economic growth;

3) a process which will allow for adequate consideration of State, regional, and national energy requirements, including an analysis of what the State's share of energy transfers throughout the region and the rest of the nation should be; and

4) a discussion of how the State plans to meet its share of regional and national energy needs, including an identification of the type, location, and capacity of current and future bulk energy facilities that would be used in meeting these needs.

To say that a State should consider energy demand projections and the role that coastal energy facilities can play in meeting these demands should not be construed to mean we expect that the State coastal zone management office must make a detailed energy projection. Rather, the State CMP should demonstrate that the national interest in the siting of energy facilities has been adequately considered and that the CMP incorporates points 1 through 4 above. Much of the needed information and data should be available from State or Federal agencies and other sources including private companies. If the information is not available, it should be the responsibility of the State to

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* Alternative evaluation methodologies are available, e.g.:

Anderson, B.B. and L.E. Hodges. 1977 Energy analysis: accounting without dollars. GAO Review (Spring '77): 37-44.

Seidel, M.R. State Projections of Industrial Fuel Needs. Office of Energy Systems, FPC: 34 pp + 61 tables.

solicit the generation of that information by some appropriate State or Federal agency. The important thing is that the State summary coastal management office should adequately consider such information; it is not required to develop all of the information.

Regardless of which State agency is ultimately responsible for anticipating and managing energy supply systems development, the State would give full consideration to its energy future and to the energy plans of other States which depend on facilities within it. We have no interest in defining the energy future (including energy conservation) of any State, but we consider it necessary and realistic that State officials and the public demonstrate an understanding of the energy supply consequences of their coastal management program.

It follows, therefore, that the Office of Coastal Zone Management, NOAA-USDOC, should be encouraging States to provide a planning mechanism for energy facilities likely to be located in the coastal zone. The OCZM regulations concerning management program development grants in Section 305(b)(8) are an encouraging start in this direction; it should be further developed.

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PART V

Saturday, November 5, 1977
Morning Session

ENERGY SOURCES

Maurice L. Schwartz, Session Chairman

1. *Industrial Waste Heat Treated as an Energy Source,*
   Lincoln Katter***

2. *Energy Regimes Around the Australian Coast,*
   Eric C.F. Bird

3. *The United Kingdom's Research Programme on Wave Energy,*
   Alex Eadie

4. *State Provincialism and the Nation's Energy Needs,*
   Lawrence B. Bradley

5. *The "Cost" of Oil on Puget Sound,*
   Lloyd Meeds

***Oral presentation only.

INDUSTRIAL WASTE HEAT TREATED AS AN ENERGY SOURCE***

Lincoln Katter
Rocket Research Co.
Redmond, Washington

***Oral presentation only.

ENERGY REGIMES AROUND THE AUSTRALIAN COAST

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The Australian coast receives energy generated partly by tidal movements in the surrounding seas, partly by wind-formed waves (including ocean swells of distant derivation and occasional storm surges, notably in the zone subject to tropical cyclones), and partly by the direct effects of wind action, particularly onshore winds.

In addition, there are subsidiary energy inputs, generally localised, minor, and episodic: for example, outflowing currents at the mouths of rivers and estuarine lagoons, and the waves produced by tsunamis, the outcome mainly of Pacific-margin seismic events, transmitted into Australian waters. Tsunamis reaching the Australian coastline have been on a small scale: the Chilean earthquake of May 1960, which produced waves 40 metres high on the coast of Japan, was recorded as perturbations of only ± 0.7 metres on the tide gauge at Cronulla, south of Sydney. On the other hand, occasional storm surges resulting from meteorological effects have temporarily raised sea level by up to 2 metres on parts of the coast of southern Australia, notably in the South Australian gulfs; by 3 to 7 metres on the shores of the Gulf of Carpentaria, and by as much as 13 metres during the 1889 cyclone north of Cooktown, in north Queensland (Noye 1972).

The prevailing energy regimes in Australian coastal waters take the form of interacting tides, waves and currents, with sector variations around the 20,000 kilometre Australian coastline determined partly by zonal climatic and oceanic factors, and partly by sea floor and coastal configuration. There are also temporal variations, seasonal, cyclic, and irregular.

Consideration of energy regimes around the Australian coast has been largely in terms of geomorphological consequences and ecological effects in the coastal environment (e.g. Jennings and Bird 1967), with only incidental attention to the possibilities of economic utilisation of energy derived from tides, waves and currents. This paper will deal first with the geomorphological and related ecological aspects of these

energy regimes, and then with prospects of utilisation.

TIDAL ENERGY

Tidal oscillations of sea level around the Australian coastline and tidal currents in coastal waters result from the approach of tide waves (as distinct from 'tidal waves', i.e. tsunamis), diurnal and semi-diurnal, generated by solar and lunar gravitational forces in the Pacific and Indian oceans (Easton 1970). Fig. 1 shows the typical pattern of tide wave transmission to the Australian coastline. One such wave moves in from the south-east, through the Tasman Sea, its crest arriving on the New South Wales and east Tasmanian coastlines as an almost simultaneous high tide, then swinging round south of Tasmania to move in towards the southern shores of the Australian continent. There is a convergence of high tide within Bass Strait, usually north of Tasmania, although at spring tides the meeting is north-west or west of that island. Another tide wave arrives from the Coral Sea, filtering in through gaps in the Great Barrier Reef, and a third moves in from the Indian Ocean, swinging towards the north coastline and entering the Arafura Sea, where it mixes with an independent tidal circulation generated around a node within the Gulf of Carpentaria.

Tide ranges recorded at coastal stations are influenced by the varying width of the continental shelf, and by coastal configuration. Around the southern half of the continent, from North West Cape to Fraser Island, mean maximum tide ranges on open coasts are less than 1.5 metres. At the heads of the South Australian gulfs, within Western-port Bay, and around the shores of Bass Strait, tide ranges increase to between 2.0 and 2.5 metres, but the narrow entrance to Port Phillip Bay impedes tidal inflow and outflow, reducing mean maximum tide ranges from 1.8 metres outside to less than 0.9 metres within the bay. On the northern coasts of Australia, mean maximum tide ranges exceed 1.5 metres, except on parts of the shoreline of the Gulf of Carpentaria. Between North West Cape and Melville Island the tide wave arriving from the Indian Ocean is refracted and retarded in such a way as to increase tide ranges to between 3.0 and 8.0 metres, and within King Sound and the Kimberley gulfs they are still higher, attaining 10.5 metres in Collier Bay. Between Fraser Island and Cape York the coastline inshore from the Great Barrier Reefs has mean maximum tide ranges of 1.5 to 3.0 metres, with slightly higher ranges in the vicinity of Mackay, increasing to more than 6.0 metres within Broad Sound.

Tidal currents are generally weak off coasts where the tide range is less than 1.5 metres, but they become much stronger where tidal flow is confined, as at the entrances to estuaries and lagoons, or landlocked embayments such as Port Phillip Bay, or the passages between Bass Strait islands. Such localities are marked by sea floor topographies shaped by strong currents, with interdigitating shoal and channel features, and scoured hollows known as tidal colks. On the northern coast of

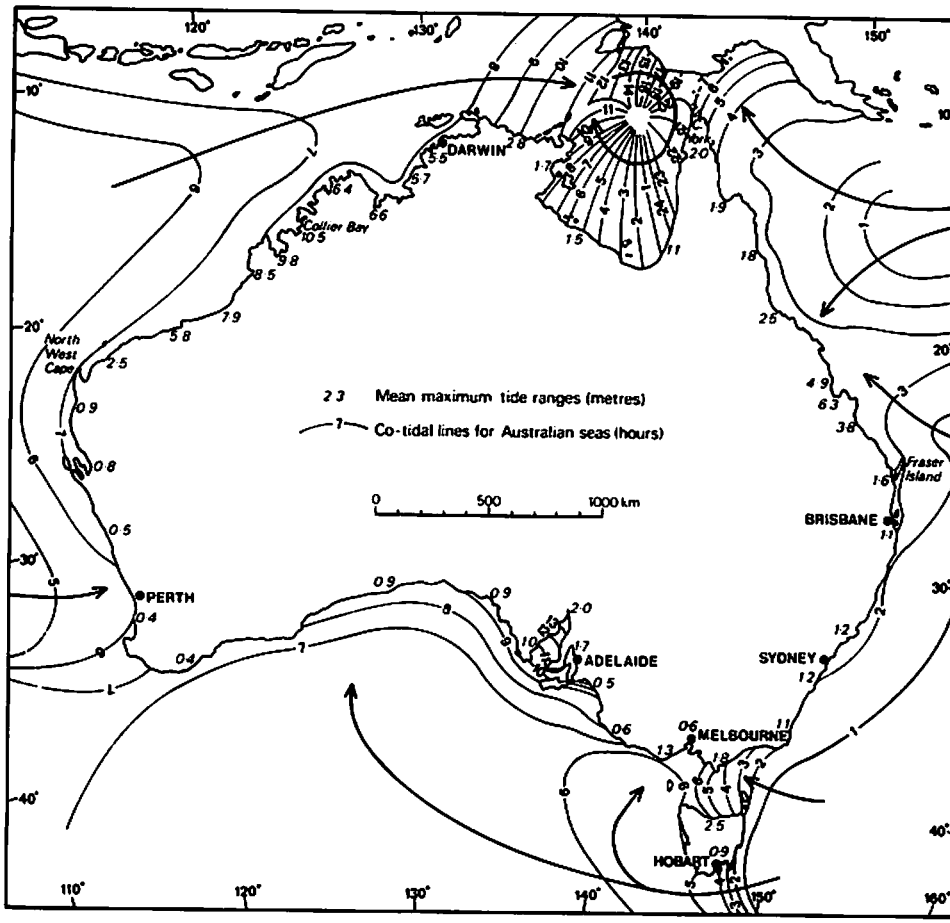

Fig. 1 Australia: tide waves and tide ranges

Australia, much stronger tidal currents are generated, particularly in gulfs such as King Sound, in the estuaries of such rivers as the Ord, the Victoria, and the Daly, and in narrow straits between islands: for example Apsley Strait, between Melville and Bathurst Island, where currents of up to 10 knots have been reported. Tidal scour is also strong in passages between the Torres Strait islands and in Clarence Strait, north-east of Darwin, where currents have shaped the growth of coral reefs, and maintained elongated deeps, and in bays and inlets on the east Queensland coast, particularly in Broad Sound, where tidal currents have shaped an intricate shoal and channel topography.

In geomorphological terms, tide range determines the width of the inter-tidal zone and the vertical distribution of wave energy reaching the shore. Typically, sectors with large tide ranges have broad inter-tidal zones with sandflats or mudflats, or ridge and runnel topography, and often salt marshes or mangroves around high tide level, reached only briefly by wave action at the peak of the tide. The heads of the South Australian gulfs and the inner shores of Westernport Bay show such features, as do the shores of King Sound in the north-west, and several of the bays and inlets of the east Queensland coast. On the other hand, the Kimberley gulfs have sectors of steep coast where the inter-tidal zone is narrow and rocky, despite tide ranges of up to 10.5 metres. Where the tide range is small, wave energy is more concentrated in vertical distribution, and coastlines are typically cliffed and rocky or beach-fringed; but shore sectors where wave attack is impeded by the protection of headlands, islands or reefs may show more varied patterns of deposition, with muddy as well as sandy sediment, and some development of salt marsh or mangrove swamp. Thus on the South Australian coast near Ceduna, where mean maximum tide range is less than a metre, sectors of bay and island shores protected from oceanic wave action are mangrove-fringed.

WAVE ENERGY

Much of the southern and western coastline of Australia receives ocean swell generated by strong westerly winds in the Southern Ocean, notably south of latitude 40°S and between longitudes 80° and 140°E. Orthogonals of waves thus generated follow great circle courses as they fan out eastwards, so that the predominant swell in sea areas off the southern and western coasts of Australia approaches from the south-west (Fig. 2). Coastal waters between North West Cape and the southern shores of Tasmania are rarely calm: even on windless days there is usually a south-westerly swell moving in to the shore, typically with a wave period of 12 to 16 seconds. The energy actually received as such waves break on the shore depends partly on aspect and partly on the width and configuration of the continental shelf, across which the ocean swell is refracted and gradually diminished. Where the bordering shelf is of uniform width, coastal sectors that face south-west, directly into the approaching swell, receive higher wave energy than sectors facing in

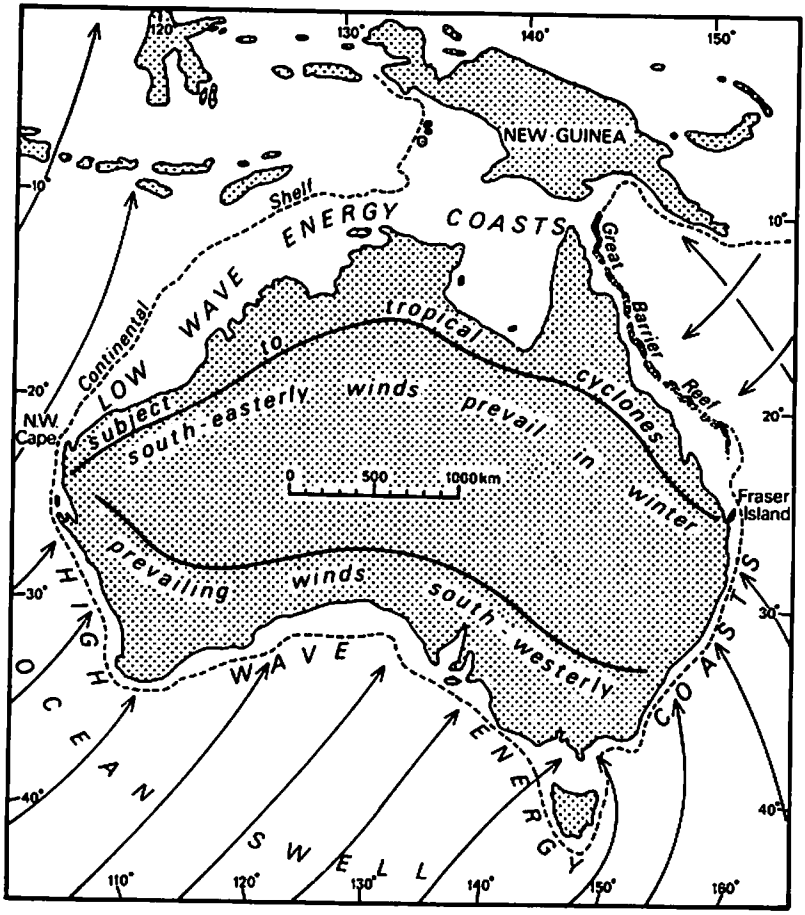

Fig. 2 Australia: wave energy regimes

other directions. The south-west facing coast between Discovery Bay and Port Campbell in Victoria is notable for the strength and consistency of ocean swell arriving across a relatively narrow shelf, whereas the coast near Ceduna in South Australia, of similar aspect, receives attenuated swell that has traversed a broader and shallower shelf.

Davies (1977) suggested distance offshore to the 20 metre isobath as a convenient index of sea floor profile influencing depletion of energy as waves reach the coastline. This distance is in fact so variable that attempts to portray it on a small scale map are of little value, but there is certainly a broad contrast between the southern half of the continent, from North-West Cape around to Fraser Island, where the 20 metre isobath is generally within a kilometre of major headlands and up to 5 kilometres off sandy bay shorelines, and the northern coast, where the 20 metre isobath ranges from 5 to 25 kilometres offshore. There are also variations related to the route taken by the incoming swell. Thus the south-westerly swell which is transmitted on either side of King Island into Bass Strait to reach the western shores of Wilson's Promontory and Flinders Island also extends around the eastern side of Tasmania, becoming southerly and south-easterly as it moves in towards the Ninety Mile Beach and the New South Wales coast, in somewhat weakened form as a result of dispersal and refraction.

In addition to these oceanic waves of remote origin there are waves generated locally by wind action over coastal waters. On the southern and western coast coastlines of Australia these are also predominantly south-westerly, accompanying and reinforcing the ocean swell arriving from this direction, and on the eastern coastline the onshore south-easterly winds have a similar augmenting effect, producing relatively strong wave action as far north as Fraser Island, beyond which a broadening shelf and intercepting reef structures diminish the energy of waves reaching the coastline. South-easterly waves can also be important in coastal waters in and around Bass Strait, generated by winds ahead of summer anticyclones.

The southern half of the Australian continent is thus subject to ocean swell and locally-generated waves, producing relatively high wave energy conditions. In geomorphological terms, these result in bold cliffing, abrasion platforms cut into coastal rock outcrops, and extensive sandy 'surf beaches'. River mouths and lagoon outlets are typically constricted by wave-built spits and bars, and in dry periods when outflow weakens some of them are sealed off altogether by sand deposition. There are variations related to aspect and sea floor topography off headlands and embayments. Where the waves arrive at an angle to the shoreline they become refracted in such a way as to anticipate, and eventually fit, asymmetrically curved sandy shorelines trailing away from rocky headlands. Thus the predominant south-easterly waves on the New South Wales coast have generated a succession of such embayments, sharply curved at their southern ends where the waves are much refracted and weakened, and straightening northwards as the shore-

line approaches a south-easterly orientation, subject to less refracted, stronger wave action. Other variations are related to the sheltering effects of reefs and islands, in the lee of which cliffs give place to gentler bluffs, inlets are less sand-encumbered, and salt marsh or mangrove shores may be present. Landlocked embayments, such as Port Phillip and Westernport Bays, subject to little oceanic wave action, show such features, related to low to moderate locally-generated wave energy.

In northern Australia, from North-West Cape to Cape York, wave energy is generally much lower than around the southern half of the continent. Cliffs are rare, and the long curving 'surf beaches' of southern Australia give place to irregular and intermittent sandy shorelines, complicated by the presence of spits and bars, interrupted by mangrove-fringed tidal inlets, and by river mouths: the De Grey, for example, has built a protruding lobate delta, a landform otherwise rare in Australia. As has been noted, large tide ranges diminish the effectiveness of waves approaching the shore, but wave action is in any case much weaker in these tropical sea areas, where strong winds occur much less frequently than in southern waters. Ocean swell fades out across the widening north-west shelf and the steadiest winds, easterly and south-easterly, head offshore. However, in the western part of the Gulf of Carpentaria these are onshore winds, and Groote Eylandt and the Arnhem Land coast receive south-easterly wave action, particularly in the winter months. South-easterly trade winds also generate moderate wave action in coastal waters inshore from the Great Barrier Reef on the east Queensland coast, notably between May and November. In the summer months winds are more variable, and sometimes north-easterly waves augment an ocean swell moving in from the Coral Sea to reach the coastline behind gaps in the Great Barrier Reef such as Trinity Opening, north of Cairns.

The prevalence of low to moderate wave energy regimes in tropical Australia is interrupted by occasional tropical cyclones, bringing strong wind action to generate large waves and storm surges which can achieve dramatic short changes in a few hours. Such cyclones develop sporadically off the northern coastline in the summer months, and each year a few of them move into coastal waters and become devastating, the intensified wave action having severe impact on sectors of up to 200 kilometres of coastline in any one event. Brief episodes of large waves and storm surge are responsible for such features as the hurling of blocks of dune limestone up on to a rocky platform 3 metres above ordinary high tide level on the coast near Cape Cuvier in north-western Australia, and the disruption and piling up of slabs of calcareous beach rock on the shore near Port Hedland. Cyclone Althea, which moved in across the Queensland coast just north of Townsville on Christmas Eve 1971, raised high tide 2.85 metres above predicted level, cut back sandy beaches by up to 15 metres, and smashed harbour structures (Hopley 1974).

Wave energy regimes around the Australian coast have generally been

considered in relative terms: the high, moderate and low wave energy categories described by Davies (1972) and others. On the local scale, use has been made of refraction coefficients calculated from the relative spacing of wave orthogonals in deep water and at the shoreline to express relative energy variations due to wave refraction. Attempts to define wave energy categories quantitatively have run into problems: one suggestion has been to take mean annual significant wave height (i.e. the mean heights of the highest one-third of waves recorded) as an indication, high wave energy conditions being those where this figure exceeds 1.0 metres, moderate wave energy 0.3 to 1.0 metres, and low wave energy less than 0.3 metres (Bird 1976a). However, it is difficult to obtain long-term data on wave heights for the calculation of such an index, and an assessment of wave energy should really take account of wave length (or period) as well as wave height. The well-known empirical relationship $E \propto H^2T^2$ (quoted, for instance, by King 1972) expresses the energy accompanying ideal waves in deep water, but is of little relevance to the effects of wave energy approaching the coast. More direct measurements, such as wave impact pressures recorded on dynamometers, have been used to analyse nearshore process effects (see for example Kirk 1973) but it is difficult to establish a quantitative assessment of wave energy in relation to large scale coastal features because of the complex and episodic nature of wave processes. Calculations of wave energy in terms of horse-power, watts, ergs, or joules have not proved helpful in geomorphological process-response studies, but such calculations may be of more relevance to the question of possible utilisation of wave energy as a source of power.

ENERGY RESOURCES

Though difficult to measure, it is evident that the energy of tides, currents and waves around Australia is enormous, but widely dispersed. At present, over 90 per cent of Australia's energy requirements are obtained from the burning of fossil fuels, about 2 per cent coming from hydroelectric power (Kirov 1971). Uranium is available, but there are no nuclear power stations. The 'energy crisis' in recent years has stimulated enquiry into actual and potential resources in terms of Australia's present and future energy demands. It appears that coal reserves will last for at least a century, and natural gas for some decades, but that an oil shortage is likely to develop before the turn of the century. It would be economically feasible to double exisiting production of hydroelectricity, and there is some optimism over the potential use of solar energy, it being estimated that Australia's present energy demands could be supplied from a 1000 square mile 'sun farm' in the dry interior. Other possible sources of energy considered include tidal and wave energy, bearing in mind that about 70 per cent of Australia's 14 million population lives within 20 kilometres of the coastline.

The best prospect for tidal power generation is in the macrotidal

coastal environment of the Kimberleys, in north-west Australia, where Lewis (1963) identified 25 sites suitable for tidal hydroelectric stations similar to that built by the French at La Rance in Brittany. He calculated a potential annual output from these 25 stations of 843,180 million kWh, noting that Australia's total power production in 1960 was only 25,000 million kWh. In 1974, D.W. Saunders of the Western Australian Fuel and Power Commission outlined a scheme for tidal power generation at one of Lewis' sites at Secure Bay, a branch of Collier Bay, where there is a spectacular rushing current through a narrow steep-sided entrance (The Funnel) as the tide rises and falls over a range of up to 10 metres. A dam here could enclose a tidal basin of 180 square kilometres and confine the ebb and flow through 30 turbines to generate power up to a peak of 570 megawatts. If some of this power were used to pump water into a high level storage to drive a second power station during slack water phases, a steady output of 170 megawatts could be assured (Fig. 3).

In a more recent review, Saunders (1976) has a much less optimistic assessment of Kimberley tidal power prospects. Only four of Lewis' 25 localities (Secure Bay, Walcott Inlet, George Water and St George's Basin) are now considered favourable in terms of basin size, dam length, and power production costs, and the remoteness of energy markets rules out any early development of these. The introduction of mineral processing and industry in the Kimberley region is the most likely way of utilising these tidal energy resources, but there are no plans for such developments at this stage.

The South Australian gulfs, near Adelaide, have augmented tides that could be harnessed for power supplies to that city, and to industrial centres at Whyalla and Port Pirie, but it is unlikely that the strong currents at the entrance to Port Phillip Bay will be so used, because the installation of a dam here would halt navigation and close the major ports at Melbourne and Geelong.

Energy could be derived from ocean waves moving in towards Australia by such devices as rotating vanes of the kind proposed by Stephen Salter in Britain, either anchored or drifting, the generated electricity being used to produce electrolytic hydrogen as a fuel. Other suggestions for power production include the installation of giant windmills along sectors of the coastline of southern Australia where onshore winds are relatively strong and consistent. Dr Harris Stewart of the Atlantic Oceanographic and Meteorological Laboratories in Florida has suggested that electricity could be generated by large-diameter turbines suspended in the path of relatively slow-moving ocean currents such as the Gulf Stream. Similar possibilities exist around Australia, where ocean currents flow north along the west coast, east along the south coast, south along the east coast, and west along the north coast (Weber 1977).

It is recognised that there are many problems. Apart from the expense and the engineering difficulties presented by the construction

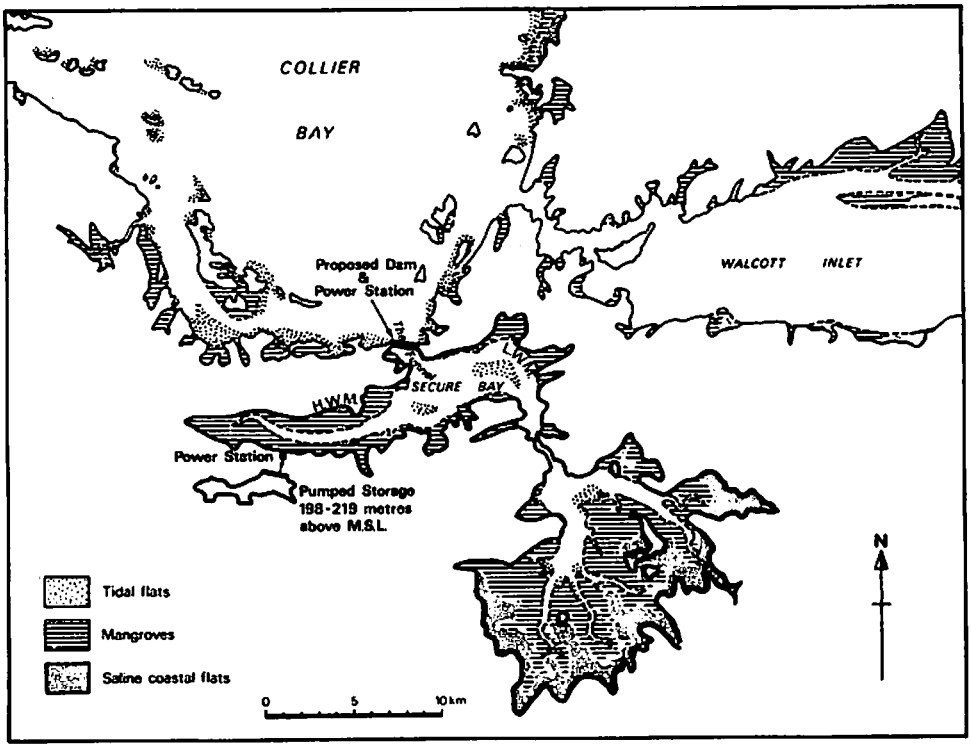

Fig. 3 Proposed tidal hydroelectric power generation system at Collier Bay, north-western Australia.

of tidal power stations and devices to tap wave and wind energy on a large scale, the structures required would have major environmental impacts. Any scheme designed to utilise tidal or wave energy involves a hazard or impedance to navigation, and would have direct and indirect geomorphological and ecological consequences: for example an estuary dammed for tidal power generation becomes a lagoon with a modified tidal regime, and probably accelerated siltation, as well as changing ecologically. Structures anchored in coastal waters and built along the coastline would intrude sharply upon existing scenery (Fig. 4), and undoubtedly there would be strong opposition to them from environmentalists, particularly as there is a prospect of generating more than enough power from solar energy installations sited inland.

In Australia, as elsewhere, there has recently been widespread beach erosion. The reasons for this have been discussed by Bird (1976b). Wave energy has lately been expended destructively, rather than constructively, eroding sandy material from beaches and removing much of it offshore to the sea floor. Increasingly aware that conventional anti-erosion works such as sea walls tend to accentuate this problem, coastal engineers have introduced artificial beach nourishment schemes, whereby sand brought from the sea floor (or from inland quarries) is piped on to the shore to restore depleted beaches. In such schemes the power used in ships, dredges, pumps and bulldozers is based on oil. The beach deficit generated by natural wave energy is thus being made good, but at the expense of burning non-renewable fossil fuels. It would be preferable to utilise energy drawn from renewable resources for such purposes as this, and perhaps particularly appropriate to use a fuel supply generated by the waves themselves: for example, electrolytic hydrogen could be produced from drifting rotatory vanes in offshore waters, and processed as a fuel supply for such coastal engineering projects. In Australia, as elsewhere, such rationalisations of power demand and energy supply may be expected to emerge as conventional non-renewable energy resources become depleted, but at this stage it is difficult to forecast which of the energy regimes around the Australian coast will prove most useful in terms of engineering, economics, and environmentalism.

I would like to acknowledge the help of Frank Fisher, Department of Geography, University of Melbourne, for advice on tidal power production, and Robert Bartlett of the same department, who drew the diagrams.

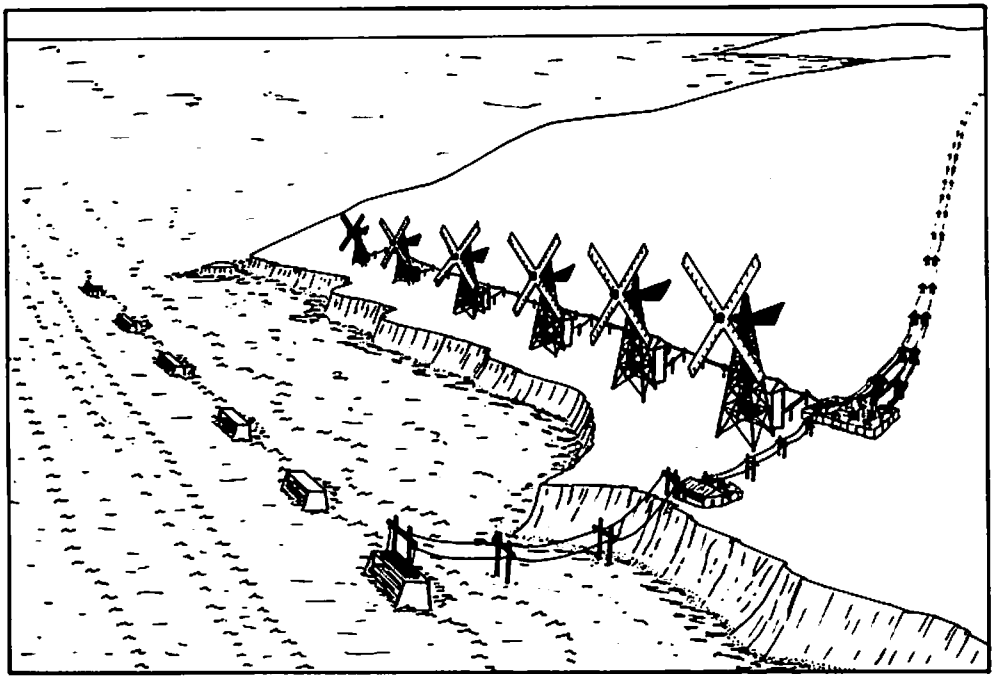

Fig. 4 Impression of the environmental impact of wave and wind energy utilisation systems on a sector of the Australian coast

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THE UNITED KINGDOM'S RESEARCH PROGRAMME ON WAVE ENERGY

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INTRODUCTION

The geography and size of the United Kingdom have always rendered our particular coastal zone of vital importance, and the next few decades will be no exception - especially in energy matters. We begun taking natural gas from under the North Sea 10 years ago, and increasing amounts of oil are now coming on strem from our recently-developed off-shore oil-fields. These energy sources are exhaustible, however, and it seems likely that the rate of production may no longer be able to keep pace with demand at current price relativities by the end of the century. But by then we may be able to tap a renewable source of energy from our coastal zone - that which is carried by ocean waves. The British Government place considerable importance on a full evaluation of this possibility and we are currently half way through a feasibility study of substantial scale. Whilst I cannot foretell what the outcome of the study will be, I am very pleased to have this opportunity of talking to you about the progress of the programme so far. Ensuring a stable and sufficient supply of energy for the future is the concern of us all, and I know that international exchanges of views and information can help significantly in achieving this goal.

THE ROLE OF WAVE ENERGY IN THE U.K.

Since the dawn of the industrial revolution, the material standard of living which we have achieved - in your country and in mine - has depended, amongst other factors, on ready access to cheap energy supplies. In the 19th century the industrialisation was achieved through exploitation of our coal reserves, but during this century coal's place has been superceded steadily by oil and natural gas. But now an increasing number of forecasting groups are telling us that the situation must change again. What is to replace the oil and natural gas?

In talking about energy futures it is becoming trite to say that the future is unknowable - but that doesn't alter the fact that it exists. However, for planning purposes we have to make the best guesses that we can, and I would like to set the general scene against which we view the role of wave energy.

It is not an absolute energy shortage which is forecast for the end of the century and beyond, but firstly an oil shortage. So let me show you some figures for the United Kingdom couched in oil equivalent terms.

They are taken from the energy policy review which we published a few months ago.

TABLE 1

United Kingdom Energy Demand and Indigenous Production
(million tonnes oil equivalent/year)

	1975	Possible ranges, 2000
Demand (including non-energy uses)	205	300-390
Indigenous Production		
Coal	76	60-99
Natural Gas	33	24-45
Nuclear (Magnox+existing AGR stations)	6	15
Hydro	1	1
Oil	1	30-90
TOTAL	117	130-250
Shortfall	88	50-260

The figures are rather complex. But the message I want to extract from it is simple:

- by the end of the century, the UK is likely to be once more in the oil-importing situation

- if our efforts to discover and exploit the fossil fuel resources follow the more optimistic of these predictions, our needs for oil might be less than in 1975, but nevertheless we will be having to import at a time when the world prices could be rising rapidly.

- at the other extreme, we might be some three times worse off than in 1975 in terms of oil imports.

There are various ways in which we can attempt to improve this situation:

- use our energy more efficiently

- explore ways in which even higher rates of production of coal may be achieved and sustained

- instal additional nuclear capacity

- develop as fast as possible the alternative renewable energy sources.

This talk is concerned with the last of these options.

Through the exploitation of oil and gas from our coastal zone we have a breathing space which we can use to make a thorough assessment of the alternative technologies, and to develop and commercialize those which can be shown to offer the lowest costs in national resources, taking account of constraints which may be imposed by social, environmental and industrial policies.

During the past 18 months I have announced the setting up of a new research and development programme on solar and geothermal energy and an expansion of our programme on wave energy. Tidal and wind power are still the subject of small exploratory studies to determine whether or not they warrant substantial development.

The relative importance of each of the alternative energy sources is specific to each individual country. We have given special attention to wave energy because, provided that the engineering problems can be solved at acceptable cost, it offers a high potential contributor to our future supply. The northwestern approaches from the Atlantic Ocean to the British Isles have some of the world's most energetic waves, and a qualitative advantage is that the energy is available most in the winter months when it is needed most. Our peak demand for energy, especially for electricity, comes in the winter, which is the opposite of your own situation where the need for air conditioning moves the peak demand to the summer.

By a complex route, wave energy is actually a form of solar energy which nature has concentrated for us (though not to the extent of the fossil fuels). Some of the input of solar radiation is dissipated in the atmospheric winds, which in turn can transfer some of their energy to produce the waves.

In this process the solar energy, with an annual daytime average of about 200 watts per square metre is transformed over a distance of some hundred miles up to a flux of thousands of watts per square metre over the first few metres depth of water. On the good sites in the northwest approaches, the annual average power available is about 70 kW for each metre of wave front intercepted. Depending upon the efficiency with which we can extract this energy, a line of wave energy machines placed along a 400 km stretch of water to the west of the Outer Hebrides might contribute the equivalent of about 15 million tons of oil per year to our electricity supply system: more than twice the contribution in 1976 from our nuclear stations. If we include installations at other locations shown in the diagram, the contribution could be higher still. It is possible to conceive of systems for conversion of wave energy to other energy carriers than electricity, for instance hydrogen or ammonia, but on current thinking electricity seems to be the most attractive output and my remarks will be based on that assumption.

THE WAVE ENERGY PROGRAMME

The aim of our programme on wave energy is to develop the technology as quickly as is reasonably possible to the extent necessary to establish whether it is commercially viable, and to establish more firmly the resulting contribution it could make to the UK energy supply. The present phase is funded to the extent of £2.5M from the Department of Energy together with further contributions from the CEGB and several industrial firms. The Department expects to receive a major report on the technical and economic feasibility towards the end of 1978.

The concept of using energy from waves is not new: a study of the literature and patent applications over the past century reveals some 350 ideas. Four main types of device have been selected so far for examination in the feasibility study, chosen in part to represent substantially different engineering approaches to the overall conversion of the wave energy to electricity. At the end of 1978 we may be able to narrow the choice. The devices are:

1. The Salter 'duck'

2. The Cockerell raft

3. The Hydraulics Research Station (HRS) rectifier

4. The National Engineering Laboratory (NEL) oscillating water column.

The duck and the raft do have in common the feature that their primary output comes from the wave-induced motion of one component (a duck or a raft) relative to another 'fixed' component (a central spine or another raft). There is then a choice to be made between various methods - mechanical, hydraulic, electric, etc. - to convert this relative primary motion into the primary energy output from the device. The sea contains a mixture of waves of varying height, frequency and direction, and considerable engineering ingenuity is required to optimise the system parameters so as to achieve the highest efficiency at an acceptable cost. However, the results to date show that the efficiency of energy extraction is not likely to be a limiting problem.

The HRS rectifier and the N E I oscillating water column are at an earlier stage of research, but seem to offer the possibility of simplifying the energy conversion problems. Thus, the rectifier can produce a constant head of water of a few metres, and conventional turbines, albeit of low speed and very large, can be used to convert the head of water into electricity. An important engineering problem here is the design of the one-way gates which control the flow of water into and out of the system.

In the oscillating water column there is a direct flow of energy from the moving water column to the air trapped above it, and in turn the air can be used to drive a turbine. Like the rectifier, a wave energy station using this technique would be a massive structure, but the experience of building and floating out the North Sea oil production rigs is providing a valuable guide to constructional techniques and locations.

Another important difference is worth pointing out. The duck and the raft are envisaged as floating devices located some 10 kilometres offshore, whereas the rectifier and the oscillating water column offer the possibility of being fixed to the seabed in somewhat shallower water.

For a marginal loss of the available energy one can eliminate the problems of mooring and provide a stable working environment.

During the past year the work on the duck and the raft concepts has progressed from the early experiments of about 1/100 scale in the laboratory wave tanks to 1/10 scale machines to go into the Solent and into Loch Ness. These locations can provide scaled-down natural seas to represent the conditions in the North Atlantic.

Development work funded jointly by the Department of Energy and Sea Energy Associates Ltd has taken the original work of Stephen Salter at Edinburgh University through 1/50 scale experiments in an inland reservoir to the stage of the larger scale work in Loch Ness. The device being prepared for trials in the Solent is the raft pioneered by Sir Christopher Cockerell, the work being carried out by Wave Power Ltd. in collaboration with the British Hovercraft Corporation.

The rectifier and the oscillating water column concepts have also been tested on the 1/100 scale in laboratory wave tanks and larger scale trials are being considered. We cannot rule out the possibility of other good ideas coming forward, and the Department has recently begun to fund some proof-of-concept work at Vickers Ltd. on a device which may be designed to operate well below the surface of the sea.

All this work on the engineering devices is supported by generic work in several problem areas such as:

- the wave climate, involving studies by
  - the National Maritime Institute
  - the Institute of Oceanographic Sciences
  - the UK Offshore Operations Association (weather ships)
- the forces exerted by breaking waves, by
  - Cambridge University
  - the Institute of Oceanographic Sciences

- conversion of the mathematical models of the mechanical behaviour of ships to take account of the very different characteristics of wave power devices, by
    - the British Ship Research Association
    - The National Maritime Institute
    - the Naval Construction Research Establishment
- transmission of the power from the devices to the shore, by
    - manufacturers of energy conversion and transmission equipment in collaboration with the CEGB
- the environmental impact, by
    - the Hydraulics Research Station
    - the Highlands & Islands Development Board
    - a range of laboratories concerned with fisheries and wildlife

So you can seethat we are bringing a wide range of skills to bear on the key problem areas. The work of the teams associated with each device and on the generic areas is all coordinated for the Department by its Energy Technology Support Unit at the Harwell Laboratory.

CONCLUSION

I hope this necessarily brief review of our wave energy programme will have shown you that we are at a very exciting stage. The harnessing of wave energy - one of the world's untapped renewable sources - presents a substantial challenge to scientific and engineering ingenuity, and it is remarkable how much progress has been achieved by all the enthusiastic teams during the first year.

The current move to 1/10 scale will permit the first engineering assessment to be made of the problems and costs of designing, assembling, launching and servicing large-scale

wave energy converters, and is beginning to open up a new range of problems of reliability inherent in our expecting the devices to operate for long periods in the very hostile conditions of the eastern Atlantic Ocean.

We shall have some very difficult choices ahead of us at the end of next year, when we have to decide whether or not to move on to development at a still larger scale. At present, no really fundamental problem has arisen to indicate that nature is basically against a viable technological solution to the harnessing of wave energy on a large scale. However, we do not yet know what is the optimum solution or whether we can achieve it at acceptable cost. That will be the ultimate test of the creative inventiveness which is currently driving the programme along.

STATE PROVINCIALISM AND THE NATION'S ENERGY NEEDS

Lawrence B. Bradley, Acting Director
Washington State Energy Office
Olympia, Washington

I don't suppose the zeal shown by the people in Washington to protect their coastal environment can be excelled anywhere in the country, unless one lives in Oregon, California, or Florida -- or Maine or Georgia, or North or South Carolina, etc. If left to the devices of the few militant cause-oriented zealots in each of the Western, Gulf or Eastern Coastal states, they would have us believe that there are really two nations on mainland America. Simply described on a have or have not basis, one group has a coastline and all the other states are landlocked. In a sense, some 22 states control the economic welfare and destiny of 26 other states in today's world and while some might say that there is here a fair balance in the numbers, to believe that is to defy the very principles that have made this nation strong.

It is one thing to consider the coastal states as super important, if that is what they are, and quite another to think of them each as one out of the 48 contiguous mainland states and as such each possessing a shared dependency on its neighbor for economic and social survival.

Probably not in the past 13 years has the cliche "united we stand - divided we fall" become such a focal point of my understanding and attention, as the recent provincial actions of a few in precluding the location of an oil transshipment port on Puget Sound.

I say that with full awareness of my own and the Governor's often stated but seldom quoted position that we know there is little if any long-term state economic benefit consequence to the siting of an oil port on Puget Sound. But if there has to be one, and there's a choice between at least two bonafide proposals, let us find out which is best and let it be done on the terms or conditions established by the State. In consideration of comparing only the sheer logistics of the construction complexities of the two proposals an obvious preference can be made by even an elementary schoolboy.

Now I cite the foregoing circumstance only because it has now become representative of similar actions the citizens of this state and others can continue to expect from a well-meaning but tunnel-visioned few. Among these are those who regard the perpetuation of summer houses on Puget Sound and water skiing rights as being more important than the tractor fuel needed by an Eastern Washington farmer to plant or harvest

the food and fiber crops that support the basic economy of this state. I haven't touched on the alleged economic havoc or unemployment that, it is said, will occur in Montana as the refinery operations in that state winds down from a lack of crude oil product to refine. The uncertain alternative offered, even if it was begun today, will take a minimum of four years to complete; long past the time Canadians have indicated their crude oil supply will cease to flow across the border.

Now since the theme of today's conference has to do with discussions on "Energy Across the Coastal Zone," it seems necessary for me to begin with a recitation of some energy facts. Then perhaps we can get to the theoretical or hypothetical as the case may be of how a variety of energy sources can be moved across the coastal zone safely.

I must assume first that our state predominates with reasonable, patriotic people and that the residents of the Washington coastal zones don't really believe that they have a right to the exclusive use or have an exclusive interest in the protection of such zones, for that matter. You note that I used the word "protection" rather than "preservation." I don't believe that a Washingtonian from Benton County has any less interest in zonal protection than one from Skagit or even King. However, preservation of the coastal zone states can only be regarded as regressive and displays a notable lack of understanding that nature is the greatest pollutor of all time.

Now in terms of the need for petroleum supply in the Northwest, and the need to move at least some of it for now and all of it sometime across the coastal zone, we'll begin with some actual consumption figures. The 1974 Northwest petroleum use in the States of Washington, Oregon and Idaho amounted to 156,700,000 barrels. Considering a modest 8.7% increase in demand each five years, by the year 2000 there will be a need to import 318,000,000 barrels annually from any source since only a little will be available from the oil supply states who are our neighbors and suppliers.

At the present time, only 7% of the crude oil needed to feed the 361,500 barrels per day needs of our six existing Puget Sound refineries comes from Canada. That will cease altogether by 1980.

In the more immediate Washington State sense, the effect will be first and most felt in Eastern Washington because there are no refineries there. Eastern Washington receives all of its product from Montana and Utah via the Yellowstone and Chevron pipeline system. The latter serves both Idaho and Eastern Oregon.

About 40% of the Northern Tier refineries needs for "light" crude oil has been coming from Canada. Beginning next year, Montana will feel a shortage of 10,439,000 barrels for the year. This will rise to 17,739,000 barrels per year in 1980. Interestingly enough, that

equates to about 18 deliveries of a 125,000 dead weight ton tanker for the year, certainly not a horrendous traffic problem.

Without such deliveries, the Washington State economy will suffer a loss of 139 million dollars, or so the estimators have indicated. By 1980, the economy of our sisterstate of Montana will suffer a loss of more than 500 million dollars together with a reported estimate of more than 6,000 jobs lost.

I think I would be remiss in my duty to the people of this state if I failed to consider, on a tit for tat basis, the likelihood of some retaliatory action by the State of Montana for what has recently happened in Washington, D.C. I think the state could very well hold up the approval of two coal fired electricity generating plants from which Washington has been assured 70% of the generated output. As a matter of fact, since Wyoming is tied closest to Montana thinking, it wouldn't surprise me after the way we've treated them that they too will express a reluctance to pollute their sky and burn up their resource to produce electrical energy for the State of Washington as long as we have failed to respond in a timely and orderly fashion to their needs for crude oil to supply their refineries and thus their customers in Eastern Washington and Idaho and Oregon.

This is a frightening prospect when one considers the actual 1974 electrical energy use in Washington State with most of the energy conservation actions still in place from the 1973 shortage period was 70,400,000 kilowatt hours. The demand increase over that figure in 1977 has already outstripped the input to the grid system from coal strip 3 and 4.

What a Pandora's Box has possibly been opened as a direct or lack of circumspect evaluation of all the repercussive factors from such a unilateral action. One could probably wonder at the presumptiveness of establishing at least one little piece of a national energy policy, the lack of which has been described by the people for five years or more. Then again, one has also to wonder how much of the rest of the policy will be put together behind closed doors, and without benefit of public input or responsible argument.

I must in truth, as I think do most of you, regard petroleum energy coming across the coastal zone as the single most important energy delivery problem facing all Americans today. You will note I said "all Americans," not just coastal Americans. While I am a known and acknowledged champion of state's rights, I have always felt I was one in relation to resisting encroachment on our provincial interests by the federal government. Never have I believed a true state's righter had in mind a fight with a sisterstate or states. Rather, to pair up another old cliche with the one quoted in the beginning part of this paper, I'm reminded of the one that states, "in union, there is strength."

I think that the one thing that will invite a federal takeover of state constitution given perogatives, is for states to alienate themselves from one another by such provincial actions as the President approved on October 18th.

We need to be reminded time and again that the federal government is involved in the nation's energy business in a number of ways, both overt and in some instances, covert. However, in many respects, federal authority stops at state boundaries. Individual states primarily regulate the local monopolies operating within their area, for example, electrical and gas utilities. They may in some instances, as does the state of Washington, also have siting authority. More recently, there has emerged a regional concern on the part of sisterstates that are destined to become energy producers through the exploitation of virgin lands such as are in Montana, Wyoming, South Dakota, etc., with their coal resources.

Or, key energy pass-through states, through the use of their shorelines, harbors, and dock facilities and that is the state of Washington. Thus, land planning, a matter traditionally left to state and local authorities, have become intertwined with energy planning and energy planning has taken on national significance.

In that connection, I'd like to quote from a recent paper by Peter L. Auer of Cornell University, writing on a subject of Energy Self-Sufficiency.

"Concern over energy planning in a coordinated manner at the national level is a matter of relatively recent origin. As long as energy was abundant and cheap, there seemed little need for serious national interest. Isolated issues such as oil import restrictions, could be dealt with on a case-to-case basis, and no attempt was made to coordinate these discussions within the framework of coherent policy. Energy oversight to the extent that it exists, is exercised at various levels of government and by a multiplicity of agencies. Most imperative, perhaps is the fact not stressed until now that the production of energy and its delivery to the ultimate customer is largely in the hands of the private sector. This sector is organized into a variety of constituencies each of which has found through experience how to best achieve a working relationship with its government counterparts, whether they are regulatory agencies at the federal or state level, or appropriate committees of the Congress.

Orchestrating this diffuse and fragmented collection of institutional arrangements to a common purpose under the banner of "national energy policy" is difficult at best. To that difficulty, I must add there is a well organized, well-intentioned, often misguided and few in number when compared to the great number of us affected by their actions, of environmental-oriented groups who see their causes with greater clarity

than they see the reprecussive effects from their progress inhibiting strategies. I think with that I'll close.

Thank you for allowing me to participate in this very worthwhile program.

THE "COST" OF OIL ON PUGET SOUND

Hon. Lloyd Meeds, M.C.
2nd Congressional District of Washington
U.S. House of Representatives

In reviewing the program for this conference, I was impressed with the obvious effort you have made to examine the issues relating to management of our coastal areas from all major points of view. It indicates an earnest search for facts....for, if you will, the truth.

The approach is often different in the political arena. Democracy -- especially the legislative process -- generally functions more as an adversary system. Different groups with a variety of points of view and often conflicting goals use facts too. But more often than not, they use only those facts that buttress their arguments. Here, truth is not the goal. Winning your point is the goal.

And, in this pluralistic nation of ours, compromise is essential if eny thing is to get done. But in the process of compromising, objective analysis of facts often gives way to expediency.

It is, therefore, refreshing for a legislator such as me to step outside of my usual roles as advocate and seeker of honest compromise and take a somewhat more objective stance. I enjoy speaking in this other arena where objectivity, rather than advocacy, is the overriding mind set and where the scientific method, rather than the democratic process is the basic procedure. It gives me a welcome chance to set forth some ideas that I know will not be accepted on faith, nor rejected out of bias.

I hope to offer some insight about how our coastal zones relate to our economy and especially how economic growth can be disguised as something it is not.

Jobs, profits and economic growth are the banners of any proposed industrial development, as well they should be. But too often debate over specific proposals centers only on whether the economic benefit is worth the social and environmental costs.

That may have been fine a few years ago. But in today's world, I do not believe it is enough. We cannot accept carte blanche the

notion that all industrial development automatically means more jobs, profits and economic development.

It is all too easy for advocates of a proposed industrial project to develop facts which make an impressive case for more jobs, greater profits and economic growth.

But how frequently do we examine the other side of the "economic coin?" How much thought do we give to the impact projects might have on other sectors of the economy? Is there economic benefit when we permit a new industry that creates 100 jobs, for example, if it has the potential of damaging or wiping out other industries employing thousands of people?

One of the proposals crying out for this kind of economic evaluation is, I believe, the proposal for locating an oil transshipment port in Puget Sound.

Now as you all know already, the question of an oil superport in Puget Sound is somewhat moot today in light of the amendment Senator Magnuson made to the Marine Mammal Protection Act a few weeks ago. The amendment implemented, in federal law, the state's existing Coastal Zone Management Plan insofar as it prohibits the construction of an oil transshipment port east of Port Angeles.

The legislation, which has been signed into law by President Carter, clearly eliminates Cherry Point as a potential site for an oil transshipment facility.

While response to the action of the Washington State Congressional Delegation in obtaining passage of this amendment has been overwhelmingly favorable, there has been some criticism of the methods used.

In reviewing editorial comment of this whole matter, I was reminded of a comment made by the journalist Murray Kempton some years ago. He said that "editorial writers come down out of the hills after the battle and shoot the wounded." Those of us who were on the battle line, however, are proud of the decisive action we took.

So much for history. But the problem remains: how do you properly evaluate the economic implications of the proposed development? While the question of Cherry Point may be behind us, the question of economic benefits versus corresponding risks is not.

With that in mind, I think we should go back and look at the proposal for an oil transshipment port within Puget Sound, particularly the Cherry Point site.

I have a special interest in Cherry Point. It is located in Whatcom County, the northernmost county in the Second Congressional District which I represent. I want that area to be prosperous. I want to see a healthy economy. A healthy and prosperous economy means jobs. And that's important to me and the people who live there.

So, when ARCO proposed to make Cherry Point a transshipment port for Alaskan oil going to the Midwest, naturally, my initial reaction was favorable.

I knew my own district could become the center of this development. At the time we had three refineries operating and a forth nearing completion. It seemed to me that if we wanted the industry, it was ours for the taking.

And why shouldn't we want it? We'd have jobs by the score, I thought. Industry would increase the tax base for the towns and cities. Business would boom, housing would advance.

It was a very rosy picture indeed. It took some examination of less obvious implications of this type of industrial development before that picture began to fade.

Cherry Point is a growing area a few miles west of Ferndale, with a population nearing 10,000. Two of the oil refineries I referred to are located there, there is an aluminum plant, and just this year another manufacturer, employing several hundred people, moved his business into the area.

Just north of Cherry Point is Birch Bay, a very beautiful resort community. Development in the area has been slowed because there is a lack of adequate sewers and water supplies. But this problem is being corrected and this year alone new construction is going to top $50 million. The life-blood of Birch Bay is, of course, the water. The clean, clear waters of the bay.

Point Roberts, also north of Cherry Point, is a little peninsula extending south of British Columbia and is accessible by land only by crossing the international boundary and coming back across a few miles to the west. A five million dollar marina is under construction at Point Roberts, the first significant industry to locate there since the fish cannery closed more than 20 years ago. There is a waterfront park at Point Roberts, and this park is visited by thousands every day in the summer. Again, life revolves around the clear waters of the bay.

South of Cherry Point are other great recerational areas. Neptune Beach, Sandy Point and Lummi Island are very popular places for

vacation homes, picnickers and campers. And, if I may inject one of my own prejudices, some of the most beautiful islands in the whole world are not fifteen miles from Cherry Point--the San Juan chair--through which oil tankers must wind on their way to the offloading facilities at Cherry Point.

I noticed a report published last month indicating the population of Whatcom County is going to triple by the year 2000. Much of this growth was projected as a direct result of the tourist trade. Much of this trade, in Whatcom County, is the direct result of our attractive coastline.

I think now you can begin to see the scenario I am developing. There is a direct correlation between tourism and recreational industries, the water and other sectors of the economy.

Some of these relationships are well documented. Others, of course, are not. One well-documented report was done by the University of Washington Institute for Marine Studies. Puget Sound related tourism trade, the report concluded, means an estimated $149 million to our local economy. This translates into 7,920 jobs--that's seven thousand nine hundred and twenty.

Now, it's essential to understand that these figures account for only the trade generated directly and indirectly by Puget Sound waters and, on top of this, only by out-of-state visitors. Surely millions more are spent by recreation-minded Puget Sound residents. Surely thousands of individuals are employed in pleasure boat construction, marinas, scuba diving and recreational equipment, private and public parks. Seattle is known throughout the country as the boat building capital of the nation, with more boats per capita than any other American city.

Another important sector of the economy which is totally dependent on the quality of the waters in Puget Sound, an industry which has been a caldron of controversy over the past few years partly because of a court decision and partly because the resource is rapidly dwindling, is the commercial salmon industry.

As you know, I am particularly concerned with the situation commercial fishermen face trying to cope and stay in business under the strains of the decisions made by Judge Boldt regarding Indian fishing.

Fishing, particularly for salmon, is big business in Puget Sound. Again, from the Marine Studies report, the facts are: the Puget Sound commercial fishery alone contributes $169 million to the economy of our area every year. That means jobs for another 6,051 persons.

On top of this, the state and federal governments have spent millions trying to build up the salmon and steelhead runs. Hatcheries have been constructed, stream beds improved, aquaculture poojects st started and efforts made to keep the water clean.

Today, there is a Task Force appointed by President Carter working to find ways to solve some of the problems Puget Sound fishermen are facing. One of the solutions, I suspect, will be a proposal for more enhancement dollars, perhaps as much as $50 million. Added to that is $33 million the Washington State Legislature appropriated this year for enhancement programs. Obviously, these investments are not being made lightly. They are dependent on clean water.

Now those are facts. Almost 14,000 jobs in tourism and fishing and more than $300 million priming the local economy every year.

On the other side of the coin, of course, are the benefits to be derived from an oil transshipment port. By ARCO's own estimate the facility at Cherry Point would have created only 25 permanent jobs.

The Environmental Protection Agency has stated that air pollutants coming off the tank farm and from tanker exhaust at the transshipment port would increase air pollution to a level which would prevent any new industries from locating in the area. Ambient standards for industrial pollutants would be attained, and federal law would prohibit any further industrial expansion. In effect, no other industry, not even a labor intensive industry which pollutes just small amounts, would be able to locate in the area of Cherry Point.

Others have spoken about the dangers of an oil spill in Puget Sound. Whether we have one spill or a dozen, few people are denying that someday a spill will happen. The only questions are: when? where? and how much? With this in mind it is our responsibility to take into consideration the possible economic consequences.

The only oil spill which has ever occurred in an environment similar to the inland waters of Puget Sound happened in December of 1974 on the Inland Sea of Japan. A study of this spill was done by the Canadian government and released last year, though the damange reports were still coming in.

According to this study, the costs of clean-up and compensation, still mounting in mid-1976, were in the hundreds of millions of dollars. More than 200,000 people, 38 thousand vessels and 300 aircraft took part in the clean-up. 469 miles of coastline were seriously polluted, and much of the sludge sank to the botoom, only to be stirred up by storms at later dates, causing the clean-up work to start all over again. Beaches were covered, the oil flowed up rivers and, most importantly, the total damage to fisheries was over 31 million dollars, with claims still coming in. This was a spill

involving only 2 million gallons of oil. If Cherry Point became the site of a major oil port, then tankers carrying upwards of 40 million gallons would be weaving through Rosario Strait nearly every day.

It seems to me that when one weighs all facts in this case, even just all the economic facts, they demonstrate a strong case against an oil transshipment port being located in Puget Sound.

But ladies and gentlemen, this particular oil issue is a moot subject now and I chose to speak about it today only as an example. My real subject has been the need to bring some objectivity to the evaluation of major public policy issues. In this light I feel it is appropriate to compliment you all for your work in determining the best use of our coastal zones by using your talents and skills to delineate the facts from the sometimes murky bog of public debate. It helps us, your elected representatives, as we try to move through the oily arena of advocates and adversaries, confusion and compromise toward our goal of developing sound public policy.

PART VI

APPENDICES

THE COMMISSION ON THE COASTAL ENVIRONMENT AND ITS PROGRAM IN THE PACIFIC REGION

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The Commission on the Coastal Environment is one of 17 Commissions established by the International Geographical Union during its Congress in Moscow in August 1976. It developed from the Working Group on the Dynamics of Shoreline Erosion set up at the previous Congress in Montreal in 1972, a Working Group that had accumulated data on world-wide trends of shoreline change during the past century, presented to the Moscow Congress in the form of a preliminary report compiled by Bird (1976). The Commission is working on five projects, arising out of the experience gained by the preceding Working Group. The first of these deals with historical changes on the world's sandy shorelines, the second with historical changes on marshy shorelines, including those that are mangrove-fringed, the third examines the effects of artificial structures on shoreline features, the fourth is concerned with the listing of coastal sites of scientific interest, and the fifth deals with instability and management problems in coastal dune systems. The five projects are running concurrently, and reports on them will be prepared in time for the next International Geographical Congress, to be held in Japan in 1980.

The Commission is organised by a group of six, led by myself as Chairman and Professor H. J. Walker of Louisiana State University as Vice-Chairman and Secretary. The others are Professors A. Guilcher (University of Western Brittany), T. Machida (University of Tsukuba), J. Norrman (University of Uppsala), and V. Zenkovich (Academy of Sciences, Georgia, U.S.S.R). There are over 100 corresponding members representing coastal sectors, largely on a national and regional

basis; and 26 of these represent coastal sectors bordering the Pacific Ocean.

The program is developing partly on a regional and partly on a topical basis, by means of numerous symposia to take place between now and 1980. In many cases, these symposia are associated with the programs of conferences organised by national and international associations and societies. The present symposium, to deal with problems in the Pacific region, was conceived when we learned that the Coastal Society and the American Geological Society were to meet here in Seattle. We shall be holding symposia during the Association of American Geographers' meeting in New Orleans next April, and during the International Geographical Union's Regional Conference in Lagos next July, and we expect to have held about a dozen such meetings before the 1980 Congress meets in Japan. Some of these meetings will deal with one or other of our five projects in detail; others will consider the whole program in a regional context. Today's symposium seeks to illustrate work related to each of the five projects in selected Pacific coast and island environments, and to promote discussion on our developing program in this part of the world. In introducing the symposium, I shall describe briefly each of the five projects, and take some illustrations from the Pacific sector of the Australian coastline.

PROJECT 1 - CHANGES ON SANDY SHORELINES

This project continues part of the work initiated by the Working Group on the Dynamics of Shoreline Erosion in 1972-76. That Group compiled data which showed that most of the world's sandy shorelines have been in retreat during the past century. Some have shown alternations of advance and retreat, but as a rule there has been more retreat than advance over this period. The relatively restricted sectors that advanced (prograded) during the past century include portions of growing spits and cuspate forelands, parts of deltas and coasts near river mouths still receiving substantial amounts of fluvial sediment, areas where land uplift is in progress, leading to coastal emergence, and sites where sand is still being received from sea floor

sources, notably where wave action is reworking submerged glacial drift deposits. In addition, there are sectors that have prograded as a result of coastal engineering works, especially where jetties or breakwaters have been built on shorelines where longshore drifting has led to a build-up of sand adjacent to these artificial structures. Elsewhere, erosion has been dominant, even on the shorelines of Holocene barrier systems that are known to have prograded seaward in the period since the last major marine transgression brought the sea to approximately its present level, about 6000 years ago.

Some information has been obtained on rates of sandy shoreline recession. In many sectors it has averaged only a metre or so per year; more than 10 metres a year is exceptionally rapid on the world scale, the most rapid retreat being measured on such sectors as the sandy shoreline of the Nile delta, which has recently been retreating at up to 40 metres per year.

Within the Pacific region, the Commission hopes to obtain more detailed information on sandy shoreline changes, particularly in Central and South America, Southeast Asia, and the Soviet Union. So far, the most thorough studies are those from Japan (Koike 1974) and New Zealand (McLean 1976) and the summary of United States data by Shepard and Wanless (1971).

The east coast of Australia consists of a long succession of sandy beaches, separated by rocky headlands and limited cliffed sectors. South of Fraser Island these are subject to relatively high wave energy from ocean swell and storm waves generated in coastal waters; to the north the Great Barrier Reef largely excludes ocean swell, and beaches are subject to low to moderate wave energy from the effects of south-easterly trade winds in coastal waters, augmented occasionally by the more drastic effects of storm surges generated by tropical cyclones.

South from Sydney, the beach sands have been supplied mainly from the sea floor, with only small

contributions from cliff erosion, and fluvial yield restricted to the vicinity of four larger river mouths, those of the Shoalhaven, Moruya, Bega and Towamba Rivers. Other rivers drain into estuarine lagoons, at the mouths of which marine sand has been washed in from the sea to form sandy thresholds (Bird 1967). The larger rivers north of Sydney have made a more substantial contribution to sand deposition in coastal embayments, but the massive sand islands (Stradbroke, Moreton and Fraser) in south-east Queensland are remote from river mouths and consist laregly of sand derived from the sea floor through Quaternary times. Farther north, in the lee of the Great Barrier Reef, there are sectors of sandy shoreline directly nourished by sediment supplied by rivers, for example the Burdekin, which has built a large delta south of Townsville.

As Thom (1974) has demonstrated, erosion has lately been dominant on the sandy shorelines of the Pacific coast of Australia. It is difficult to find sectors that have prograded during the past century. There are local examples near the mouths of major rivers, as on Seven Mile Beach adjacent to the mouth of the Shoalhaven and on parts of the deltaic shorelines on the North Queensland coast; and in some places there has been accretion alongside harbour structures, as at Lakes Entrance in Victoria, Tweed Heads in New South Wales, and Mackay in Queensland. The most likely explanation is that sand supply from the sea floor, which prograded these sandy shorelines earlier in Holocene times, has now diminished to such an extent that losses from beach systems (to backshore dunes and into estuary thresholds) can no longer be made good, except in the vicinity of the mouths of sand-yielding rivers. However, there may also have been losses from beaches seaward to the nearshore zone and beyond, perhaps in response to a slight rise in sea level or an increase in storminess in recent decades.

On steep coasts, common around Japan (Koike 1974) and New Zealand (McLean 1976), fluvial sediment yields have been sufficient to maintain or prograde many beach sectors during the past century, but erosion is

a widespread phenomenon on beaches remote from such nourishment. Probably this conclusion is applicable to Pacific coasts generally, but much more detailed information is required to give a reliable picture of sandy shoreline changes around the Pacific Ocean, and the Commission on the Coastal Environment will be glad to receive further reports from people who have studied particular coastal sectors.

PROJECT 2 - CHANGES ON MARSHY SHORELINES

The distribution of salt marsh and mangrove coasts is much more scattered than that of sandy shorelines, but very few have been studied in detail. Reports to the Working Group on the Dynamics of Shoreline Erosion referred to the prevalence, notably in parts of Western Europe, of erosion at the seaward margins of salt marshes. It is acknowledged that within estuaries and embayments there is commonly an intricate pattern of erosion and deposition at the seaward margins of salt marshes, some sectors being cliffed while others show the seaward spread of halophytic vegetation, usually on to tidal mudflats. Estuaries or embayments that are in receipt of abundant fine-grained sediment would be expected to show a general advance of the seaward margins of salt marshes; those that are receiving little sediment might show a balance between erosion of some sectors and accretion on others; but a prevalence of erosion requires further explanation, since it implies a net loss of sediment from salt marsh systems.

In eastern Australia, such salt marshes occur in estuarine inlets in Tasmania, where reconnaissance studies suggest that seaward advance under present conditions is limited and localised. In the Tamar estuary, as in Anderson's Inlet in Victoria, the situation has been complicated by the introduction of vigorous hybrids of Spartina grass, which have promoted the building upward and outward of young depositional marshland terraces. On the Australian mainland, the seaward margins of salt marshes are generally occupied by mangroves, which increase in vigour of growth, size, and species variety northward along the east coast to the luxuriance of

mangrove swamps in North Queensland. There have been fluctuations in the extent of mangroves around Westernport Bay, in Victoria, during the past century, partly as a consequence of man's impact, both direct (clearing, burning) and indirect (freshwater and scour from hinterland drainage schemes), and partly as the result of environmental stress (frosts, storm damage), the mangroves being close to their ecological limits (Bird and Barson 1975). On the other hand, in the accreting environment of Cairns Bay, in north Queensland, mangroves have shown a marked seaward advance in recent decades (Bird 1972).

Studies on the dynamic physiography of salt marsh and mangrove coasts have been initiated in several places around the Pacific, but much more work is needed, especially from geomorphologists or coastal geologists co-operating with plant ecologists.

PROJECT 3 - EFFECTS OF ARTIFICIAL STRUCTURES

Reports to the Working Group on the Dynamics of Shoreline Erosion included many references to changes that had taken place at or near man-made structures such as sea walls, groynes, breakwaters and harbour jetties. Some of these have been documented by geomorphologists and engineers (Komar 1976), but many have received little attention, and the Commission on the Coastal Environment seeks to compile an up-to-date series of case histories.

In many cases, longshore drifting of beach material has been intercepted by a protruding structure to prograde the shoreline, and accelerated erosion has ensued down-drift. In eastern Australia the accretion of northward-drifting sand at Tweed Heads since stone jetties were built to stabilise and protect a river mouth has been followed by severe erosion of the resort beach at Coolangatta, to the north. On the other hand, protruding stone jetties at Lakes Entrance, in Victoria, have acquired depositional sandy forelands, representing local accretion on a sector of the Ninety Mile Beach, the rest of which is a receding shoreline.

Construction of sea walls as a means of halting

shoreline erosion is commonly followed by depletion of the adjacent beach as a result of reflection of storm waves. In Australia, techniques of artificial re-nourishment of depleted beaches have recently been introduced, based on engineering experience in the United States, Britain and elsewhere. In some cases sandy sediment has been dredged or pumped from the sea floor and piped in to the shore; in others the sand has been taken from estuarine environments; and in a few instances it has been trucked to the coast from inland quarries. Some of these projects have been successful; others have failed. Case studies, based on an awareness of geomorphological factors, could be of much value to coastal planners, and the Commission on the Coastal Environment is seeking documented information of this kind.

PROJECT 4 - COASTAL SITES OF SCIENTIFIC INTEREST

In some countries, coastal sites of geological, geomorphological, biological, or archaeological interest have been well documented, and many of them are now incorporated within reserves of various kinds, under management designed to maintain their scientific value. But on many sectors of coast this information is scanty, and it is necessary to locate and map such sites as a prelude to their detailed study and, where possible, conservation. A number of national and international organisations are interested in such work, and projects are active under the auspices of the International Union for the Conservation of Nature, of U.N.E.S.C.O's Man and Biosphere program, and of various national and local groups. The Commission on the Coastal Environment believes that its members can make an important contribution to the perception and delimitation of coastal sites of scientific interest.

In Australia, such an inventory has been made on the coast of the state of Victoria, where sites of geological, geomorphological, botanical, zoological, and archaeological interest have been listed and mapped on behalf of the state's Town and Country Planning Board. Some 160 sites were recorded on a 2000 kilometre coastline (Bird 1977), about half of them in existing reserves. Further reserves are

planned, and the Town and Country Planning Board has a policy of protecting scientific sites from development projects that would diminish or destroy their interest and significance.

Similar projects are in progress elsewhere in Australia, and it is hoped that they can be extended to sectors of Pacific coast and islands where such information is not yet available.

PROJECT 5 - COASTAL DUNE SYSTEMS

Reports to the Working Group on the Dynamics of Shoreline Erosion included several references to landform changes in progress in coastal dune areas, extending inland from shorelines. In some cases these accompanied shoreline changes; in others there was no direct relationship.

Major dune systems are associated with several sectors of the Pacific coastline, including Australia's eastern seaboard, where the long sandy beaches are commonly backed by extensive dune areas, in part stable beneath a vegetation mantle, but in some sectors active and mobile. Some of the dunes are arranged in successive ridges parallel to the present shoreline, and are the outcome of intermittent progradation of the sandy coast. Others have moved inland, often as transverse ridges of elongated parabolic form, their axes aligned with onshore wind resultants.

The Pacific coast of Australia is a region of relatively large and regular rainfall, reaching a maximum in the humid tropical sector of North Queensland between Townsville and Cooktown, and dunes are generally well vegetated, with a cover of scrub or woodland. Nevertheless, there are areas of active sand movement, including blowouts initiated behind receding sandy shorelines and patchy mobile dunes farther inland. Since the climate is suitable for vegetation growth on dunes, it is thought that much of the instability is due to man's interference, a prehistoric aboriginal impact (mainly by the agency of fire) producing the active dunes recorded by the explorers, Cook in 1770 and Flinders in 1802, and a

more substantial European impact (by grazing as well as fire) subsequently (Bird 1974). In recent decades this impact has been augmented by the effects of open-cast mining to extract heavy minerals, notably rutile, from the dune sands.

This 'sand mining' has proceeded extensively along the coast, particularly in the sector from Sydney north to Fraser Island. It requires the clearance of the vegetation and the migration of a floating dredge through the dune system, sluicing the sand and removing the heavy mineral fraction. It leaves in its wake a devastated landscape, within parts of which dunes have remained unvegetated, and have become mobile. In recent years there has been strong opposition from environmental groups to this procedure, resulting in restrictions on the activities of sand mining companies, and indeed the cessation of such mining on Fraser Island, which is a major wilderness area, with such features as rain forest growing on dune sand and a fine series of perched freshwater lakes amid the dune topography. Areas that have already been mined have been changed geomorphologically and ecologically: even where vegetation has revived, it is often quite unlike the natural communities that previously occupied the dune terrain. Areas where mining may still proceed carry requirements on the standards of topographic and ecological restoration to be achieved at the expense of the mining companies.

Elsewhere, coastal dune systems are being subjected to management procedures usually designed to achieve and maintain stability. This may not always be desirable: a migrating dune system can be a feature of geomorphological interest, with an associated dynamic ecology. The broad question of how coastal dune systems should be managed requires much more background on their geomorphology and ecology, and the effects of man's impact. The Commission on the Coastal Environment seeks to compile such background with reference to selected coastal dune systems, and will welcome contributions from people who have worked on coastal dunes around the Pacific.

CONCLUSION

It will be seen that the Commission on the Coastal Environment already has an ambitious program. Nevertheless, it also constitutes an international forum for the discussion of problems and the promotion of research projects, as well as the facilitating of contacts between research workers, particularly by way of its symposia. Suggestions for additional projects in the Pacific region will be welcomed by the Commission.

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